NOVOSTRICTIVE
Transducer
up to 4250 mm
touchless

Series TP1

Special features
- Non-contacting magnetostrictive measurement technology
- Touchless position detection
- Wear-free, unlimited mechanical life
- Resolution up to 1 µm, independently of length
- Low temperature coefficient <15 ppm/K
- Insensitive to shock and vibration
- Protection class IP67 / IP68
- Position-Teach-In
- Optionally galvanic isolated
- Interfaces: Analog, SSI, Impulse, Incremental, CANopen, IO-Link

Applications
- Manufacturing Engineering
  Plastic injection molding
  Textile
  Packaging
  Sheet metal working
  Woodwork
- Automation Technology

Transducer in profile design with magnetostrictive technology
for highly accurate and reproducible position measurement for
lengths up to 4250 mm. Mechanically decoupled and therefore
wear-free when the floating position marker is used.

The transducer TP1 is insensitive to dirt, dust or moisture and
thus proves itself in harsh industrial environments.
Depending on the interface, up to three positions and speed can
be measured.
## Contents

- Mechanical Data .......................................................... 3
- Analog Versions .......................................................... 4
  - Technical Data ......................................................... 4
  - Ordering Specifications .......................................... 5
- Digitale Versions ........................................................ 6
  - SSI ......................................................................... 6
  - Impulse .................................................................... 7
  - Incremental .............................................................. 8
  - Ordering Specifications .......................................... 9
- Fieldbus, IO-Link Versions .............................................. 10
  - CANopen ................................................................. 10
  - IO-Link ................................................................... 11
  - Ordering Specifications .......................................... 12
- Accessories ...................................................................... 13
  - Position Marker ....................................................... 13
  - M12 Connector System ........................................... 14
  - M16 Connector System ........................................... 17
Mechanical Data

Description

Materials
Housing: Anodized aluminum, AlMgSi0.5 F22, 3.3206.71
End flanges: Aluminum G AlSi12Cu1 (FE)

Mounting
Adjustable clamps (included in delivery)

Position marker
Floating position marker, plastic
Guided position marker, plastic, with ball coupling

Electrical connections
Connector M12x1, 4-pin / 5-pin / 8-pin, shielded
 Connector M16x0.75 (IEC 130-9), 6-pin / 8-pin, shielded
PUR-cable, 8 x 0.25 mm², shielded: 1 m, 3 m oder 5 m length

Electronic
SMD with ASIC, integrated
Connector casing (shield) is connected to the sensor housing.
Housing is capacitively decoupled to the electronics

Mechanical Data

Dimensions
see dimension drawing

Length of housing (dimension A)
Dimension B = 166 mm

Electrical measuring range
(dimension B)
0050 up to 0500 mm in 25 mm steps,
500 up to 1000 mm in 50 mm steps,
1000 up to 2000 mm in 100 mm steps,
2000 up to 4250 mm in 250 mm steps
other lengths on request

Max. operational speed
with valid output signal
10 ms⁻¹

Max. operational acceleration
with valid output signal
200 ms⁻²

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

Vibration (IEC 62068-2-6)
20 (5...2000 Hz, Amax = 0.75 mm)
g

Protection class (DIN EN 60529)
IP67 with fastened connector
IP68 with cable connection

Life
Mechanically unlimited
(with floating position marker)

Operating temperature range
-40 ... +85 °C

Storage temperature range
-40 ... +105 °C

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

CAD data see
www.novotechnik.de/en/download/cad-data/
Technical Data

**Analog Versions**

**Type designations**

| TP1- _ _ _ _-101 - 41 _ - _ _ _ | TP1- _ _ _ _-101 - 42 _ - _ _ _ |

**Voltage**  
0.1 ... 10 V (load ≥ 5 kΩ)
-10 ... 10 V (load ≥ 5 kΩ)

**Current**  
0.1 ... 20 mA (burden ≥ 500 Ω)
4 ... 20 mA (burden ≥ 500 Ω)

---

**Electrical Data**

**Electrical measuring range (dimension B)**
0.005 up to 4250 mm

**Output signal**

| TP1- _ _ _ _-101 - 41 _ - _ _ _ | TP1- _ _ _ _-101 - 42 _ - _ _ _ |

- 0.1 ... 10 V (load ≥ 5 kΩ)
- -10 ... 10 V (load ≥ 5 kΩ)
- 0.1 ... 20 mA (burden ≥ 500 Ω)
- 4 ... 20 mA (burden ≥ 500 Ω)

**Number of channels**

| 2 | 1 |

**Sampling rate / Update rate**

- < 750 mm: 2 kHz
- 750 ... < 2000 mm: 1 kHz
- > 2000 mm: 0.5 kHz

**Extrapolated to 16 kHz**

**Resolution**

16 bit

**Absolute linearity**

± 0.02 (min. ± 50 µm) % FS

**Tolerance of elec. zero point**

± 0.5 (min. 2 x reproducibility) mm

**Reproducibility**

± 0.03 % FS

**Hysteresis**

± 0.01 % FS

**Temperature error**

± 30 (min. 0.01 mm/K) ppm/K

**Supply voltage**

24 (19 ... 30) VDC

**Supply voltage with galvanic isolation**

24 (18 ... 36) VDC

**Supply voltage ripple**

< 10 % Ub

**Current consumption**

< 100 mA

**Overvoltage protection**

40 (temporary / 1 min.) VDC

**Polarity protection**

Yes, up to supply voltage max. VDC

**Short circuit protection**

Yes (outputs vs. GND and supply voltage max.)

**Insulation resistance (500 VDC)**

> 10 MΩ

---

**Environmental Data**

**MTTF (DIN EN ISO 13849-1**

23 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 discharges (ESD) 4 kV, 8 kV
EN 61000-4-3 Electromagnetic fields 10 V/m
EN 61000-4-4 Electrical fast transients (burst) 2 kV
EN 61000-4-6 Conducted disturbances, induced by RF-fields 10 V eff.
EN 55011 Radiated disturbances class B

---

**Connector assignment**

**Connector code 101, 102**

<table>
<thead>
<tr>
<th>Connector with cable (Accessories)</th>
<th>Analog voltage</th>
<th>Analog current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1 YE WH do not connect</td>
<td>0 ... 20 mA</td>
<td></td>
</tr>
<tr>
<td>Pin 2 GY BN Signal GND Signal GND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 3 PK GN +10 ... 0 (-10) V</td>
<td>do not connect</td>
<td></td>
</tr>
<tr>
<td>Pin 4 RD YE DIAG *** DIAG ***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 5 GN GY 0 (-10) ... +10 V</td>
<td>do not connect</td>
<td></td>
</tr>
<tr>
<td>Pin 6 BU PK GND GND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 7 SN BU Supply voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 8 WH RD ProG *** ProG ***</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Connector code 103**

<table>
<thead>
<tr>
<th>Connector with cable (Accessories)</th>
<th>Analog voltage</th>
<th>Analog current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1 WH</td>
<td>0 (-10) ... 10 V</td>
<td></td>
</tr>
<tr>
<td>Pin 2 BN Signal GND Signal GND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 3 BU +10 ... 0 (-10) V</td>
<td>do not connect</td>
<td></td>
</tr>
<tr>
<td>Pin 4 BR GND GND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 5 GY Supply voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 6 GN GND GND</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*) Valid for channel 1; channel 2 with additional offset and gradient tolerances (inverted signal from channel 1).

**Measured with position marker Z-TP1-P06.**

---

*) Valid for channel 1; channel 2 with additional offset and gradient tolerances (inverted signal from channel 1).

---

**Pin assignment**

**Connector code 101, 102**

<table>
<thead>
<tr>
<th>Connector with cable (Accessories)</th>
<th>Analog voltage</th>
<th>Analog current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1 YE WH do not connect</td>
<td>0 ... 20 mA</td>
<td></td>
</tr>
<tr>
<td>Pin 2 GY BN Signal GND Signal GND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 3 PK GN +10 ... 0 (-10) V</td>
<td>do not connect</td>
<td></td>
</tr>
<tr>
<td>Pin 4 RD YE DIAG *** DIAG ***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 5 GN GY 0 (-10) ... +10 V</td>
<td>do not connect</td>
<td></td>
</tr>
<tr>
<td>Pin 6 BU PK GND GND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 7 SN BU Supply voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 8 WH RD ProG *** ProG ***</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Connector code 103**

<table>
<thead>
<tr>
<th>Connector with cable (Accessories)</th>
<th>Analog voltage</th>
<th>Analog current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1 WH</td>
<td>0 (-10) ... 10 V</td>
<td></td>
</tr>
<tr>
<td>Pin 2 BN Signal GND Signal GND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 3 BU +10 ... 0 (-10) V</td>
<td>do not connect</td>
<td></td>
</tr>
<tr>
<td>Pin 4 BR GND GND</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 5 GY Supply voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pin 6 GN GND GND</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**)*** connect only for Teach-in-function (see manual).
### Ordering Specifications

#### Analog Versions

- **Voltage**
- **Current**

#### Electrical Interface

<table>
<thead>
<tr>
<th>Electrical connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>101: Connector M16x0.75 (IEC 130-9), 8-pin</td>
</tr>
<tr>
<td>102: Connector M12x1, 8-pin</td>
</tr>
<tr>
<td>103: Connector M16x0.75 (IEC 130-9), 6-pin</td>
</tr>
<tr>
<td>201: Cable, 8-pole, shielded, 1 m</td>
</tr>
<tr>
<td>203: Cable, 8-pole, shielded, 3 m</td>
</tr>
<tr>
<td>205: Cable, 8-pole, shielded, 5 m</td>
</tr>
</tbody>
</table>

#### Mechanical Version

- **Profile design**

#### Electrical Measuring Range

**Standard lengths**
- 0050 up to 4250 mm

Other lengths on request.

---

**Important:** Avoid equalizing currents in the cable shield caused by potential differences.

---

**Series**

<table>
<thead>
<tr>
<th>T</th>
<th>P</th>
<th>1</th>
<th>0</th>
<th>8</th>
<th>0</th>
<th>0</th>
<th>1</th>
<th>0</th>
<th>1</th>
<th>4</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>0</th>
<th>2</th>
</tr>
</thead>
</table>

---

`*` With Teach-In-function
**Type designations**

TP1 - _ _ _ _ - 101 - 2_ _ - _ _ _

Synchronous-serial interface (SSI)

**Electrical Data**

- **Electrical measuring range (dimension B)**: 0050 up to 4250 mm
- **Protocol**: SSI 24 und 25 bit (26 bit on request)
- **Inputs**: RS422
- **Monoflop time (tm)**: 30 µs
- **Encoding**: Gray, Binary
- **Sampling rate / Update rate**: < 750 mm: 2 kHz, 750 ... < 2000 mm: 1 kHz, > 2000 mm: 0.5 kHz Extrapolated to 16 kHz
- **Resolution (SSI)**: 1, 5 or 10 (Other resolutions on request) µm
- **Absolute linearity ***: < 250 mm: ±25 µm, 750 mm ≤ ±30 µm, 1000 mm ≤ ±50 µm, 2500 mm ≤ ±80 µm, up to 4250 mm ≤ ±120 µm
- **Tolerance of electric zero point**: ± 0.5 mm
- **Reproducibility (rounded to LSB)**: 6 µm
- **Hysteresis (rounded to LSB)**: 4 µm
- **Temperature error**: 15 (min. 0.01 mm/K) ppm/K
- **Supply voltage**: 24 (13 ... 34) VDC
- **Supply voltage ripple**: < 10 % Ub
- **Overvoltage protection**: 40 (permanent) VDC
- **Current consumption**: ≤ 100 mA
- **Polarity protection**: Yes, up to supply voltage max.
- **Short circuit protection**: Yes (outputs vs. GND and supply voltage up to 7 V)
- **Chicmic load at outputs**: > 120 Ω
- **Max. clock rate**: 2 MHz
- **Insulation resistance (500 VDC)**: ≥ 10 MΩ

**Environmental Data**

- **MTTF** (DIN EN ISO 13849-1, parts count method, w/o load, wc): 27 Years
- **Functional safety**: If you need assistance in using our products in safety-related systems, please contact us

---

**Pin assignment**

### Connector code 101, 102

<table>
<thead>
<tr>
<th>Pin 1</th>
<th>YE</th>
<th>WH</th>
<th>Clk +</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 2</td>
<td>GY</td>
<td>BN</td>
<td>Data +</td>
</tr>
<tr>
<td>Pin 3</td>
<td>PK</td>
<td>GN</td>
<td>Clk</td>
</tr>
<tr>
<td>Pin 4</td>
<td>RD</td>
<td>YE</td>
<td>do not connect</td>
</tr>
<tr>
<td>Pin 5</td>
<td>GN</td>
<td>GY</td>
<td>Data +</td>
</tr>
<tr>
<td>Pin 6</td>
<td>BU</td>
<td>PK</td>
<td>GND</td>
</tr>
<tr>
<td>Pin 7</td>
<td>BN</td>
<td>BU</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>Pin 8</td>
<td>WH</td>
<td>RD</td>
<td>do not connect</td>
</tr>
</tbody>
</table>

### Connector code 20 _

- **Connector with cable (Accessories)**: Sensor
- **SSI Interface**: 24 (25) 1 2 3 + CLK + SSI

### Connector code 103

<table>
<thead>
<tr>
<th>Pin 1</th>
<th>WH</th>
<th>Pin 1</th>
<th>Data +</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 2</td>
<td>BN</td>
<td>Pin 2</td>
<td>Data +</td>
</tr>
<tr>
<td>Pin 3</td>
<td>BU</td>
<td>Pin 3</td>
<td>Clk +</td>
</tr>
<tr>
<td>Pin 4</td>
<td>BK</td>
<td>Pin 4</td>
<td>Clk -</td>
</tr>
<tr>
<td>Pin 5</td>
<td>GY</td>
<td>Pin 5</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>Pin 6</td>
<td>GN</td>
<td>Pin 6</td>
<td>GND</td>
</tr>
</tbody>
</table>

**Connector code 108**

- **SSI Interface**: do not connect

---

*) Measured with resolution 1 µm. At resolution > 1 µm the permissible linearity error is increased by the resolution.
**Type designations**

TP1- _ _ _ _ - 101 - 11 _ - _ _ _

Start-Stop-Impulse-Interface

**Electrical Data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical measuring range (dimension B)</td>
<td>0050 up to 4250 mm</td>
</tr>
<tr>
<td>Number of position markers</td>
<td>1 up to 3</td>
</tr>
<tr>
<td>Protocol</td>
<td>Impulse</td>
</tr>
<tr>
<td>Inputs</td>
<td>RS422</td>
</tr>
<tr>
<td>Sampling rate / Update rate</td>
<td>&lt; 500 mm: 1 kHz, 500 ... &lt; 2000 mm: 0.5 kHz, &gt; 2000 mm: 0.25 kHz kHz</td>
</tr>
<tr>
<td>Resolution</td>
<td>Depending on interpretation, normalized to 2800 ms⁻¹</td>
</tr>
<tr>
<td>Absolute linearity</td>
<td>&lt; 1000 mm ±50 μm µm</td>
</tr>
<tr>
<td>&lt; 2500 mm ±100 μm</td>
<td>up to 4250 mm ±120 μm</td>
</tr>
<tr>
<td>Tolerance of electr. zero point</td>
<td>±0.5 mm</td>
</tr>
<tr>
<td>Reproducibility</td>
<td>±6 µm</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>±4 µm</td>
</tr>
<tr>
<td>Temperature error</td>
<td>±15 (min. 0.01 mm/K) ppm/K</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>24 (13 ... 34) VDC</td>
</tr>
<tr>
<td>Supply voltage ripple</td>
<td>±10 % Ub</td>
</tr>
<tr>
<td>Overvoltage protection</td>
<td>40 (permanent) VDC</td>
</tr>
<tr>
<td>Current consumption</td>
<td>±100 mA</td>
</tr>
<tr>
<td>Polarization protection</td>
<td>Yes, up to supply voltage max.</td>
</tr>
<tr>
<td>Short circuit protection</td>
<td>Yes (outputs vs. GND and supply voltage up to 7 V)</td>
</tr>
<tr>
<td>Insulation resistance (500 VDC)</td>
<td>≥ 10 MΩ</td>
</tr>
</tbody>
</table>

**Environmental Data**

MTTF (DIN EN ISO 13849-1, parts count method, w/o load, wc) 27 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 discharges (ESD) 4 kV, 8 kV
EN 61000-4-3 Electromagnetic fields 10 V/m
EN 61000-4-4 Electrical fast transients (burst) 2 kV
EN 61000-4-6 Conducted disturbances, induced by RF-fields 10 V eff.
EN 55011 Radiated disturbances class B

**Pin assignment**

<table>
<thead>
<tr>
<th>Connector code 101, 102</th>
<th>Cable code 20</th>
<th>Connector with cable (Accessories)</th>
<th>Start/Stop-Impulse-Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1</td>
<td>YE</td>
<td>WH</td>
<td>IN'T +</td>
</tr>
<tr>
<td>Pin 2</td>
<td>GY</td>
<td>BN</td>
<td>Start/Stop +</td>
</tr>
<tr>
<td>Pin 3</td>
<td>PK</td>
<td>GN</td>
<td>IN'T -</td>
</tr>
<tr>
<td>Pin 4</td>
<td>RD</td>
<td>YE</td>
<td>do not connect</td>
</tr>
<tr>
<td>Pin 5</td>
<td>GN</td>
<td>GY</td>
<td>Start/Stop -</td>
</tr>
<tr>
<td>Pin 6</td>
<td>BU</td>
<td>PK</td>
<td>GND</td>
</tr>
<tr>
<td>Pin 7</td>
<td>BN</td>
<td>BU</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>Pin 8</td>
<td>WH</td>
<td>RD</td>
<td>do not connect</td>
</tr>
</tbody>
</table>

**Connector code 103**

<table>
<thead>
<tr>
<th>Connector code 103</th>
<th>Connector with cable (Accessories)</th>
<th>Start/Stop-Impulse-Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1</td>
<td>WH</td>
<td>Start/Stop -</td>
</tr>
<tr>
<td>Pin 2</td>
<td>BN</td>
<td>Start/Stop +</td>
</tr>
<tr>
<td>Pin 3</td>
<td>BJ</td>
<td>IN'T +</td>
</tr>
<tr>
<td>Pin 4</td>
<td>BK</td>
<td>IN'T -</td>
</tr>
<tr>
<td>Pin 5</td>
<td>GY</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>Pin 6</td>
<td>GN</td>
<td>GND</td>
</tr>
</tbody>
</table>
Type designations  
TP1+_____-101-8+____

Incremental-Interface

Electrical Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical measuring range (dimension B)</td>
<td>0050 up to 4250 mm</td>
</tr>
<tr>
<td>Outputs</td>
<td>A+/A- / B+/B- / Z+/Z-</td>
</tr>
<tr>
<td>Level</td>
<td>RS422 differential</td>
</tr>
<tr>
<td>Sampling rate / Update rate</td>
<td>&lt; 750 mm: 2 kHz, 750 ... &lt; 2000 mm: 1 kHz, &gt; 2000 mm: 0.5 kHz Extrapolated to 16 kHz</td>
</tr>
<tr>
<td>Resolution (with 4-fold interpretation)</td>
<td>1 or 5 µm</td>
</tr>
<tr>
<td>Max. pulse frequency at power-on (initialising)</td>
<td>156 high speed mode</td>
</tr>
<tr>
<td></td>
<td>78 low speed mode</td>
</tr>
<tr>
<td>Frequency A/B-signal</td>
<td>Variable, depending on operational speed, max. 148 kHz</td>
</tr>
<tr>
<td>Missing increments when exceeding the max. operational speed</td>
<td>none</td>
</tr>
<tr>
<td>Length Z-pulse</td>
<td>Distance between 2 edges A / B</td>
</tr>
</tbody>
</table>

Absolute linearity *  

- < 250 mm ≤ ±25 µm
- < 750 mm ≤ ±50 µm
- < 1000 mm ≤ ±50 µm
- < 2500 mm ≤ ±80 µm
- up to 4250 mm ≤ ±120 µm

| Tolerance of electr. zero point               | ±0.5 mm                                           |
| Reproducibility                               | ±6 µm                                             |
| Hysteresis                                    | ±4 µm                                             |
| Temperature error                             | ≤ 15 (min. 0.01 mm/K)                             |
| Supply voltage                                | 24 (13 ... 34) VDC                                |
| Supply voltage ripple                         | ± 10 Vb                                           |
| Current consumption                           | ± 100 mA                                          |
| Overvoltage protection                        | 40 (permanent) VDC                                |
| Polarity protection                            | Yes, up to supply voltage max.                    |
| Short circuit protection                      | Yes (outputs vs. GND and supply voltage up to 7 V) |
| Chronic load at outputs                       | ≤ 120 Ω                                          |
| Insulation resistance (ISO 500 VDC)           | ≥ 10 MΩ                                           |

Environmental Data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. operating speed **</td>
<td>Resolution 1 µm</td>
</tr>
<tr>
<td>High speed mode</td>
<td>Resolution 5 µm</td>
</tr>
<tr>
<td>Low speed mode</td>
<td>0.45 ms¹</td>
</tr>
<tr>
<td>MTTTF (DIN EN ISO 13849-1, parts count method, w/o load, wc)</td>
<td>27 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>
</tr>
</tbody>
</table>

EMC compatibility

- EN 61000-4-2 Electrostatic discharges (ESD) 4 kV, 8 kV
- EN 61000-4-3 Electromagnetic fields 10 V/m
- EN 61000-4-4 Electrical fast transients (burst) 2 kV
- EN 61000-4-6 Conducted disturbances, induced by RF-fields 10 V eff.
- EN 55011 Radiated disturbances class B

Pin assignment

<table>
<thead>
<tr>
<th>Pin assignment</th>
<th>Connector code 102</th>
<th>Cable code 20_</th>
<th>Connector with cable (Accessories)</th>
<th>Incremental Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1</td>
<td>YE</td>
<td>WH</td>
<td>A+</td>
<td></td>
</tr>
<tr>
<td>Pin 2</td>
<td>GY</td>
<td>BN</td>
<td>B+</td>
<td></td>
</tr>
<tr>
<td>Pin 3</td>
<td>GN</td>
<td>GN</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>Pin 4</td>
<td>WH</td>
<td>YE</td>
<td>Z</td>
<td></td>
</tr>
<tr>
<td>Pin 5</td>
<td>RD</td>
<td>GY</td>
<td>Z</td>
<td></td>
</tr>
<tr>
<td>Pin 6</td>
<td>BU</td>
<td>PK</td>
<td>GND</td>
<td></td>
</tr>
<tr>
<td>Pin 7</td>
<td>BN</td>
<td>BU</td>
<td>Supply voltage</td>
<td></td>
</tr>
<tr>
<td>Pin 8</td>
<td>PK</td>
<td>RD</td>
<td>A-</td>
<td></td>
</tr>
</tbody>
</table>

*) Measured with resolution 1 µm. At resolution > 1 µm the permissible linearity error is increased by the resolution.

**) With valid output signal, when using a floating position marker.
### Ordering Specifications

#### Digital Versions
- **SSI**
- **Start-Stop-Impulse**
- **Incremental**

#### Ordering Specifications

<table>
<thead>
<tr>
<th>Preferred types printed in bold</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrical Interface</strong></td>
</tr>
<tr>
<td>1: Impulse-Interface</td>
</tr>
<tr>
<td>2: SSI-Interface</td>
</tr>
<tr>
<td>8: Incremental-Interface (A / B / Z)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Output signal Impulse-Interface</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Impulse-Interface Start-Stop Signal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Output signal SSI-Interface</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1: SSI 24 bit</td>
</tr>
<tr>
<td>2: SSI 25 bit</td>
</tr>
<tr>
<td>7: SSI 26 bit (25 = alarm, 26 = parity even) on request</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Output signal Incremental-Interface</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>4: Resolution 5 μm, high speed mode, power-on burst</td>
</tr>
<tr>
<td>6: Resolution 1 μm, high speed mode, power-on burst</td>
</tr>
<tr>
<td>7: Resolution 5 μm, low speed mode, power-on burst</td>
</tr>
<tr>
<td>9: Resolution 1 μm, low speed mode, power-on burst</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Impulse-Interface Start-Stop Signal</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1: For 1 position marker</td>
</tr>
<tr>
<td>2: For 2 position markers</td>
</tr>
<tr>
<td>3: For 3 position markers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Synchronous-Serial Interface</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Binary code; resolution 5 μm</td>
</tr>
<tr>
<td>2: Gray code; resolution 5 μm</td>
</tr>
<tr>
<td>4: Binary code; resolution 1 μm</td>
</tr>
<tr>
<td>5: Gray code; resolution 1 μm</td>
</tr>
<tr>
<td>7: Binary code; resolution 10 μm</td>
</tr>
<tr>
<td>8: Gray code; resolution 10 μm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Incremental-Interface</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1: RS422 differential (A / B / Z)</td>
</tr>
</tbody>
</table>

#### Mechanical Version

<table>
<thead>
<tr>
<th><strong>101: Profile design</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Electrical connection</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>101: Connector M16x0.75 (IEC 130-9), 8-pin</td>
</tr>
<tr>
<td>102: Connector M12x1, 8-pin</td>
</tr>
<tr>
<td>103: Connector M16x0.75 (IEC 130-9), 6-pin</td>
</tr>
<tr>
<td>108: Connector M16x0.75 (IEC 130-9), 7 pin (only SSI interface)</td>
</tr>
<tr>
<td>201: Cable, 8-pole, shielded, 1 m</td>
</tr>
<tr>
<td>203: Cable, 8-pole, shielded, 3 m</td>
</tr>
<tr>
<td>205: Cable, 8-pole, shielded, 5 m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>T P 1</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 8 0 0 1 0 1 2 1 1 1 0 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Series</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Electrical measuring range</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard lengths 0050 up to 4250 mm</td>
</tr>
<tr>
<td>0050 up to 0500 mm in 25 mm-steps, 0500 up to 1000 mm in 50 mm-steps, 1000 up to 2000 mm in 100 mm-steps, 2000 up to 4250 mm in 250 mm-steps.</td>
</tr>
</tbody>
</table>

*Other lengths on request*

---

**Important:** Avoid equalizing currents in the cable shield caused by potential differences. Twisted pair cable (STP) is recommended.
Type designations
TP1 - _ _ _ _ -101- 6 _ _ - _ _ _
CANopen-Interface

Electrical Data

- Measured variables: Position and speed
- Electrical measuring range (dimension B): 0.0050 up to 4250 mm
- Measuring range speed: 0 ... 10 m/s
- Number of position markers: 1 / 2
- Output signal / protocol: 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

Programmable parameters:
- Position, speed, cams, working areas, temperature, node-ID, baud rate

- Node-ID: 1 ... 127 (default 127)
- Baud rate: 20 ... 1000 kBaud

- Resolution:
  - Position: 1 µm
  - Speed: 0.1 mm/s
- Update rate:
  - 1 kHz (Internal sampling rate < 750 mm: 2 kHz, 750 ... < 2000 mm: 1 kHz, > 2000 mm: 0.5 kHz)

- Absolute linearity *:
  - < 250 mm: ±25 µm
  - < 750 mm: ±30 µm
  - < 1000 mm: ±50 µm
  - < 2500 mm: ±80 µm
  - up to 4250 mm: ±120 µm

- Tolerance of electr. zero point: ±0.5 mm
- Reproducibility (rounded to resolution): ±6 µm
- Hysteresis (rounded to resolution): ±4 µm
- Temperature error:
  - ±10 ppm (min. 0.01 mm/K)
  - ±24 ppm (10 ... 34°C)
  - ±21 ppm (50 ... 60°C)
  - ±17 ppm (70 ... 80°C)
- Supply voltage:
  - ±10 V
- Current consumption:
  - ±10 mA
- Overvoltage protection:
  - ±40 VDC (permanent)
- Polarity protection:
  - Yes, up to supply voltage max.
- Short circuit protection:
  - Yes (outputs vs. GND and supply voltage max.)
- Insulation resistance (600 VDC):
  - ≥10 MΩ
- Bus termination internal:
- No

Environmental Data

- MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc):
  - ≥25 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 discharges (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 55016-2-3 Noise radiation class B

Pin assignment

<table>
<thead>
<tr>
<th>Connector code 106</th>
<th>Connector code 105</th>
<th>CANopen interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1</td>
<td>Pin 3</td>
<td>CAN_SHLD***</td>
</tr>
<tr>
<td>Pin 2</td>
<td>Pin 5</td>
<td>Supply Voltage</td>
</tr>
<tr>
<td>Pin 3</td>
<td>Pin 6</td>
<td>GND</td>
</tr>
<tr>
<td>Pin 4</td>
<td>Pin 2</td>
<td>CAN_H</td>
</tr>
<tr>
<td>Pin 5</td>
<td>Pin 1</td>
<td>CAN_L</td>
</tr>
<tr>
<td></td>
<td>Pin 4</td>
<td>n/a</td>
</tr>
</tbody>
</table>

***) CAN_SHLD: CAN-shield, internally connected to housing

*) Measured with resolution 1 µm. At resolution > 1 µm the permissible linearity error is increased by the resolution.
**Type designations**
TP1 _ _ _ _-101- A _ _ - _ _ _

**IO-Link**

**Electrical Data**

<table>
<thead>
<tr>
<th>Measured variables</th>
<th>Position, speed and temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical measuring range (dimension B)</td>
<td>0050 up to 4250 mm</td>
</tr>
<tr>
<td>Number of position markers</td>
<td>1 up to 3</td>
</tr>
<tr>
<td>Output signal / protocol</td>
<td>IO-Link Spec V1.1 to IEC 61131-9, Smart Sensor Profil (V1.0 compatible)</td>
</tr>
<tr>
<td>Programmable parameters</td>
<td>Zero point offset, resolution, averaging</td>
</tr>
<tr>
<td>Configurability</td>
<td>Number of position markers and measured variables (position, speed). All product versions listed in the ordering specifications (e.g. 1 x position) are also configurable by the customer (e.g. into 2 x position and 2 x speed)</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>Update rate</td>
<td>1 kHz (Internal sampling rate &lt; 750 mm: 2 kHz, 750 ... &lt; 2000 mm: 1 kHz, &gt; 2000 mm: 0.5 kHz)</td>
</tr>
</tbody>
</table>

**Resolution**

- Position: 1 µm, 5 µm, 10 µm, 25 µm
- Speed: 0.1 mms, 0.5 mms, 1 mms

**Hysteresis**

- Rounded to resolution: 4 µm

**Absolute linearity**

- < 250 mm: ±25 µm
- < 750 mm: ±30 µm
- < 1000 mm: ±50 µm
- < 2500 mm: ±80 µm
- up to 4250 mm: ±120 µm

**Zero point tolerance**

- 0.5 µmm

**Temperature error**

- ±15 mm (min. 0.01 mm/K)
- ±0.01 ppm/K

**Supply voltage**

- 24 (18 ... 30) VDC

**Supply voltage ripple**

- max. 10 % Ub

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

- ≤ 100 mA

**Reverse voltage**

- yes, up to supply voltage max.

**Short circuit protection**

- yes (C/Q vs. GND and supply voltage)

**Overvoltage protection**

- 36 (permanent) VDC
- 10 MΩ

**Environmental Data**

- MTTF (DIN EN ISO 13849-1 parts count method, w/o load, wc) > 28.6 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 discharges (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 55016-2-3 Noise radiation class B

**Connector M12 Code 107**

<table>
<thead>
<tr>
<th>Connector with cable (accessories)</th>
<th>IO-Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIN 1</td>
<td>BN</td>
</tr>
<tr>
<td>PIN 2</td>
<td>WH</td>
</tr>
<tr>
<td>PIN 3</td>
<td>BU</td>
</tr>
<tr>
<td>PIN 4</td>
<td>BK</td>
</tr>
</tbody>
</table>

**) alternatively on GND

*) Measured with resolution 1 µm. At resolution > 1 µm the permissible linearity error is increased by the resolution.
Ordering Specifications

Electrical Interfaces

6: CANopen-Interface
A: IO-Link

Interface parameters for CANopen

1: Resolution 5 μm, 1 x position and speed, 1 position marker fix
2: Resolution 1 μm, 1 x position and speed, 1 position marker fix
3: Resolution 1 μm, 2 x position and speed, 1 position marker fix
5: Resolution 5 μm, 2 x position and speed, 2 position markers fix
6: Resolution 1 μm, 2 x position and speed, 2 position markers fix

Interface parameters for IO-Link A

11: Resolution 5 μm, 1 x position, 1 position marker fix
12: Resolution 5 μm, 1 x position and speed, 1 position marker fix
13: Resolution 5 μm, 2 x position, 2 position markers fix
14: Resolution 5 μm, 2 x position and speed, 2 position markers fix
15: Resolution 5 μm, 3 x position, 3 position markers fix
31: Resolution 5 μm, 1 x position, 1 position marker fix
32: Resolution 5 μm, 1 x position and speed, 1 position marker fix
33: Resolution 5 μm, 2 x position, 2 position markers fix
34: Resolution 5 μm, 2 x position and speed, 2 position markers fix
35: Resolution 1 μm, 3 x position, 3 position markers fix

Electrical measuring range

0050 up to 2000 mm in 25 mm steps, 2000 up to 4250 mm in 250 mm steps.

Electrical Connection CANopen

105: Connector M16x0.75 (IEC130-9), 6-pin
106: Connector M12x1, 5-pin

Electrical Connection IO-Link

107: Connector M12x1, 4-pin

Series

TP 1 - 0 8 0 0 - 1 0 1 - 6 1 3 - 1 0 6

Important: Avoid equalizing currents in the cable shield caused by potential differences.
Only CANopen: Twisted pair cable (STP) is recommended.
Position Marker

Floating position marker
- Material: PA6 GF25
- Working distance: 0.5 ... 3 mm
- Weight: approx. 10 g
- P/N: 005693, Z-TP1-P06

Floating position marker for large distances
- Material: PA6 GB30
- Working distance: 3 ... 12 mm
- Weight: approx. 40 g
- P/N: 005694, Z-TP1-P07

Guided position marker
- Material: POM
- Weight: approx. 30 g
- P/N: 005695, Z-TP1-P08

Actuating rod for guided position marker Z-TP1-P08
- Material: Aluminum
- Weight: approx. 150 g
- Standard nominal lengths: 0075, 0100, 0125, 0150, 0200, 0250, 0300, 0350, 0400, 0450, 0500, 0600, 0800, 1000, 1500, 2000

Environmental conditions, length of actuating rod, acceleration etc. have a direct influence on life time and accuracy of the whole system; it must be qualified by the user in the real application.

Ordering example: Z-TP1-S01- _ _ _ _
- nominal lengths in mm
**Pin assignment**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>white</td>
</tr>
<tr>
<td>2</td>
<td>brown</td>
</tr>
<tr>
<td>3</td>
<td>green</td>
</tr>
<tr>
<td>4</td>
<td>yellow</td>
</tr>
<tr>
<td>5</td>
<td>grey</td>
</tr>
<tr>
<td>6</td>
<td>pink</td>
</tr>
<tr>
<td>7</td>
<td>blue</td>
</tr>
<tr>
<td>8</td>
<td>red</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
- **Wires**: PP; 0.25 mm²
- **Length**
  - 2 m: EEM 33-86 005629
  - 5 m: EEM 33-90 005635
  - 10 m: EEM 33-92 005637

**M12x1 Mating female connector, 8-pin, angled, A-coded, with molded cable, shielded, IP67, open ended**

- **Connector housing**: Plastic PA
- **Cable sheath**: PUR; Ø = max. 8 mm
- **Wires**: PP; 0.25 mm²
- **Length**
  - 2 m: EEM 33-87 005630
  - 5 m: EEM 33-91 005636
  - 10 m: EEM 33-93 005638

**M12x1 Mating female connector, 5-pin, straight, A-coded, with molded cable, IP67, shielded, open ended, CAN-bus**

- **Connector housing**: PUR
- **Cable sheath**: PUR
- **Wires**: PP 2x 0.25 mm² + 2 x 0.34 mm²
- **Length**
  - 2 m: EEM 33-41 056141
  - 5 m: EEM 33-42 056142
  - 10 m: EEM 33-43 056143

**M12x1 Mating female connector, 5-pin, straight, A-coded, with molded cable, IP68, shielded, CAN-bus**

- **Connector housing**: PUR
- **Cable sheath**: PUR; Ø 7.2 mm
- **Length**
  - 5 m: EEM 33-44 056144
Connector System M12

Terminating resistor M12x1, 5-pin, A-coded, IP67, 120 Ω resistance, CAN-bus

- Connector housing: PUR
- Temperature range: -25 °C...+85 °C
- Type: EEM 33-45, P/N 056145

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

T-connector M12x1, 5-pin, A-coded, IP68, 1:1 connection, female - male - female, CAN-bus

- Connector housing: PUR
- Temperature range: -25 °C...+85 °C
- Type: EEM 33-45, P/N 056145

It is possible to turn and fix the contact carrier in 90° positions.
**Connector System M12**

**Pin assignment**

- **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 (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 33-35</td>
<td>056135</td>
</tr>
<tr>
<td>5 m</td>
<td>EEM 33-36</td>
<td>056136</td>
</tr>
<tr>
<td>10 m</td>
<td>EEM 33-37</td>
<td>056137</td>
</tr>
</tbody>
</table>

**Length**

- **Type**
  - EEM 33-38
  - EEM 33-39
  - EEM 33-40
- **P/N**
  - 056138
  - 056139
  - 056140

**Connector housing**

- Plastic PA

**Cable sheath**

- PUR; Ø = max. 6 mm, -40 °C...+85 °C (fixed)

**Wires**

- PP, 0.34 mm²

**Length**

- **Type**
  - EEM 33-89
  - For wire gauge 6...8 mm, max. 0.75 mm²
- **P/N** 005634
**Connector System M16**

**M16x0.75 Mating female connector, 6-pin, straight, with coupling nut, solder terminal, IP67, shielded**
- Connector housing: CuZn (Brass, nickel plated)
- Cable sheath: PUR; Ø max. 6 mm, -40 °C...+70 °C (moved), -20...+70 °C (fixed)
- Wires: PVC, 6 x 0.25 mm²
- Type: EEM 33-82, P/N 005639

This coupling can be used in combination with 5-pin M16 connectors. Than “pin 6 / green” is open.

**M16x0.75 Mating female connector, 6-pin, angled, with coupling nut, solder terminal, IP67, shielded**
- Connector housing: CuZn (Brass, nickel plated)
- Cable sheath: PUR; Ø max. 6 mm, -40 °C...+70 °C (moved), -20...+70 °C (fixed)
- Wires: PVC, 6 x 0.25 mm²
- Type: EEM 33-83, P/N 005648

**Pin assignment**
1 = red
2 = black
3 = yellow
4 = blue
5 = white
6 = green

**M16x0.75 Mating female connector, 6-pin, straight, with molded cable, 2 m length, shielded, IP67, open ended**
- Connector housing: PUR
- Cable sheath: PUR; Ø max. 6 mm, -5...+70 °C (moved), -20...+70 °C (fixed)
- Wires: PVC, 6 x 0.25 mm²
- Type: EEM 33-26, P/N 0056126

**Pin assignment**
1 = red
2 = black
3 = yellow
4 = blue
5 = white
6 = green

**M16x0.75 Mating female connector, 6-pin, angled, with molded cable, 2 m length, shielded, IP67, open ended**
- Connector housing: PUR
- Cable sheath: PUR; Ø max. 6 mm, -5...+70 °C (moved), -20...+70 °C (fixed)
- Wires: PVC, 6 x 0.25 mm²
- Type: EEM 33-27, P/N 0056127

This coupling can be used in combination with 5-pin M16 connectors. Than “pin 6 / green” is open.

**Pin assignment**
1 = red
2 = black
3 = yellow
4 = blue
5 = white
6 = green

**M16x0.75 Mating female connector, 6-pin, straight, with coupling nut, solder terminal, IP68, shielded**
- Connector housing: CuZn (Brass, nickel plated)
- For wire gauge: 4...8 mm², max. 0.75 mm²
- Type: EEM 33-82, P/N 005639

**Pin assignment**
1 = red
2 = black
3 = yellow
4 = blue
5 = white
6 = green

**M16x0.75 Mating female connector, 6-pin, angled, with coupling nut, solder terminal, IP68, shielded**
- Connector housing: CuZn (Brass, nickel plated)
- For wire gauge: 6...8 mm², PG 9, max. 0.75 mm²
- Type: EEM 33-94, P/N 005648

**Pin assignment**
1 = red
2 = black
3 = yellow
4 = blue
5 = white
6 = green
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 to DIN EN 60529**
- **Protection class IP68 to 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

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.