More Precision

eddyNCDT // Inductive sensors based on eddy currents
For many years, Micro-Epsilon has been a pioneer in displacement measurement using high precision eddy current technology. The eddyNCDT displacement sensors are designed for non-contact measurement of displacement, distance, position, oscillation and vibrations. Considered as extremely precise and robust, they are preferably used in industrial environments.

Advantages
- Wear-free and non-contact measurement
- Highest precision and resolution
- High temperature stability
- Ferromagnetic and non-ferromagnetic materials
- For demanding, industrial environments: dirt, pressure, temperature
- Fast measurements up to 100 kHz
Overview

Eddy current sensor with integrated controller
eddyNCDT 3001
• Measuring ranges 2 - 8 mm
• Resolution ≥ 3 µm
• Frequency response 5 kHz

Compact eddy current measuring system
eddyNCDT 3005
• Measuring ranges 1 - 6 mm
• Resolution ≥ 0.5 µm
• Frequency response 5 kHz

High-performance inductive measuring system
eddyNCDT 3060
• Measuring ranges 1 - 4 mm
• Resolution ≥ 0.02 µm
• Frequency response up to 20 kHz

High precision eddy current displacement measurement
eddyNCDT 3300
• Measuring ranges 0.4 - 80 mm
• Resolution ≥ 0.02 µm
• Frequency response up to 100 kHz

Turbocharger speed measurement
turboSPEED DZ140
• Measuring ranges 0.5 - 1 mm
• Speed range from 200 to 400,000 rpm
• Sensor operating temperature up to 285 °C

Spindle growth measuring system
eddyNCDT SGS4701
• Measuring ranges 250 - 500 µm
• Resolution ≥ 0.5 µm
• Frequency response 2 kHz

Application examples

Accessories
page 38

Technical information
pages 39 - 43
Robust sensors with maximum precision
eddyNCDT eddy current sensors from Micro-Epsilon are often used in applications requiring maximum precision in harsh ambient conditions. Immunity to dirt, pressure and extreme temperature are their distinctive features.

Advantages over conventional inductive sensors
- High frequency response for dynamic measurements
- High resolution in the submicron range
- High linearity and temperature stability
- Measurement on ferromagnetic and non-ferromagnetic targets

Comprehensive product range
- More than 400 sensor models
- Miniature sensors smaller than 2 mm
- Customer-specific modifications and OEM

Measuring ranges 0.5 mm to 80 mm

Specific sensors for OEM applications
Application examples are often found where the standard versions of the sensors and the controllers are performing at their limits. For these special tasks, we modify your measuring system according to your individual requirements. Changes requested include, for example, modified designs, target calibration, mounting options, individual cable lengths, modified measuring ranges or sensors with integrated controller.
**Standard installation situation**
Each eddyNCDT sensor is factory-calibrated under standardized installation conditions. These installation conditions involve mounting, positioning of the nut and surrounding materials. Deviations installation situations may affect the linearity and accuracy. Field linearization or special tuning in the factory may counteract this effect.

**Standard target materials**
eddyNCDT sensors are factory-calibrated for the following materials:
- Ferromagnetic target: Steel (St37) DIN1.0037
- Non-ferromagnetic target: Aluminum AlCuMgPb3.1645
Customer-specific adjustment for other materials is also possible.

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**Unshielded sensors (e.g. EU1)**
Unshielded sensors are more compact than shielded sensors with the same measuring range. With unshielded sensors, the field lines emerge also at the side of the sensor which extends its measuring range. Nevertheless, the sensor design remains compact. The measurement spot is approximately three times the sensor diameter.

**Shielded sensors (e.g. ES1)**
Shielded sensors are larger than unshielded sensors with the same measuring range. A separate sheathing achieves a narrower distribution of the field lines, so they are insensitive to radially adjacent metals. The measurement spot is approximately one and a half times the sensor diameter.
Robust M12 miniature eddy current sensor

The two eddyNCDT 3001 U2 and U4 models are powerful eddy current sensors whose compact dimensions have to date only been reserved for inductive sensors and proximity sensors. These compact sensors come with integrated electronics including temperature compensation while offering an excellent price/performance ratio, as well as easy operation. Therefore, the sensors are ideally suited to OEM integration and machine building applications.

The temperature-compensated design provides high stability even in fluctuating ambient temperatures. The sensors are factory-calibrated for ferromagnetic and non-ferromagnetic materials, which eliminates the need for on-site linearization of the sensor. Its robust design combined with the eddy current measuring principle enables measurements in harsh industrial environments (oil, pressure, dirt). In addition, the eddyNCDT 3001 is suitable for offshore/marine applications (salt water).
### Pin Assignment of Integrated Supply and Signal Cable

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Cable Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply +24 V</td>
<td>Brown</td>
</tr>
<tr>
<td>Displacement signal</td>
<td>White</td>
</tr>
<tr>
<td>GND</td>
<td>White</td>
</tr>
<tr>
<td>Internal</td>
<td>Yellow</td>
</tr>
<tr>
<td>Internal</td>
<td>Gray</td>
</tr>
</tbody>
</table>

### Pin Assignment for Power Supply and Signal

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
<th>Color (cable: PCx5-M12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Supply +24 V</td>
<td>Brown</td>
</tr>
<tr>
<td>2</td>
<td>Displacement signal</td>
<td>White</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Blue</td>
</tr>
<tr>
<td>4</td>
<td>Internal</td>
<td>Black</td>
</tr>
<tr>
<td>5</td>
<td>Internal</td>
<td>Gray</td>
</tr>
</tbody>
</table>

### Measurement Details

<table>
<thead>
<tr>
<th>Model</th>
<th>DT3001-U2-A-SA</th>
<th>DT3001-U2-M-SA</th>
<th>DT3001-U4-A-SA</th>
<th>DT3001-U4-M-SA</th>
<th>DT3001-U4-A-Cx</th>
<th>DT3001-U4-M-Cx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>2 mm</td>
<td></td>
<td>2 mm</td>
<td>4 mm</td>
<td>2 mm</td>
<td>4 mm</td>
</tr>
<tr>
<td>Start of measuring range</td>
<td>0.4 mm</td>
<td></td>
<td>0 mm</td>
<td>0.4 mm</td>
<td>0 mm</td>
<td>0.4 mm</td>
</tr>
<tr>
<td>Resolution ^1</td>
<td>4 µm</td>
<td></td>
<td>4 µm</td>
<td>4 µm</td>
<td>4 µm</td>
<td>4 µm</td>
</tr>
<tr>
<td>Frequency response (-3dB)</td>
<td>5 kHz</td>
<td></td>
<td>5 kHz</td>
<td>5 kHz</td>
<td>5 kHz</td>
<td>5 kHz</td>
</tr>
<tr>
<td>Linearity</td>
<td>&lt; ± 28 µm</td>
<td></td>
<td>&lt; ± 28 µm</td>
<td>&lt; ± 28 µm</td>
<td>&lt; ± 28 µm</td>
<td>&lt; ± 28 µm</td>
</tr>
<tr>
<td>Temperature stability</td>
<td>&lt; 0.6 µm / K</td>
<td></td>
<td>&lt; 1.2 µm / K</td>
<td>&lt; 1.2 µm / K</td>
<td>&lt; 1.2 µm / K</td>
<td>&lt; 1.2 µm / K</td>
</tr>
<tr>
<td>Temperature compensation</td>
<td>0 ... +70 °C</td>
<td></td>
<td>0 ... +70 °C</td>
<td>0 ... +70 °C</td>
<td>0 ... +70 °C</td>
<td>0 ... +70 °C</td>
</tr>
<tr>
<td>Sensor type</td>
<td>unshielded</td>
<td></td>
<td>unshielded</td>
<td>unshielded</td>
<td>unshielded</td>
<td>unshielded</td>
</tr>
<tr>
<td>Min. target size (flat)</td>
<td>Ø 48 mm</td>
<td></td>
<td>Ø 48 mm</td>
<td>Ø 48 mm</td>
<td>Ø 48 mm</td>
<td>Ø 48 mm</td>
</tr>
<tr>
<td>Target material ^2</td>
<td>Aluminum</td>
<td>Steel</td>
<td>Aluminum</td>
<td>Steel</td>
<td>Aluminum</td>
<td>Steel</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>12 ... 32 VDC</td>
<td></td>
<td>12 ... 32 VDC</td>
<td>12 ... 32 VDC</td>
<td>12 ... 32 VDC</td>
<td>12 ... 32 VDC</td>
</tr>
<tr>
<td>Analog output</td>
<td>0.5 ... 9.5V</td>
<td></td>
<td>0.5 ... 4.5V</td>
<td>0.5 ... 4.5V</td>
<td>0.5 ... 4.5V</td>
<td>0.5 ... 4.5V</td>
</tr>
<tr>
<td>Synchronization</td>
<td>with LF &amp; HF variants</td>
<td></td>
<td>with LF &amp; HF variants</td>
<td></td>
<td>with LF &amp; HF variants</td>
<td></td>
</tr>
<tr>
<td>Connection</td>
<td>Supply/signal: 5-pole M12 connector (cable see accessories)</td>
<td></td>
<td>integrated cable, 5-pin, lengths: 3/6/9 m</td>
<td></td>
<td>integrated cable, 5-pin, lengths: 3/6/9 m</td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>Storage: -20 ... +80 °C</td>
<td></td>
<td>Operation: 0 ... +70 °C</td>
<td></td>
<td>Operation: 0 ... +70 °C</td>
<td></td>
</tr>
<tr>
<td>Shock (DIN-EN 60068-2-29)</td>
<td>15 g / 6 ms in 3 axes, 2 directions and 1000 shocks each</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration (DIN-EN 60068-2-6)</td>
<td>5 g / 10 ... 500 Hz in 3 axes, 2 directions and 10 cycles each</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection class (DIN-EN 60529)</td>
<td>IP67 (plugged)</td>
<td></td>
<td>IP67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>25 g</td>
<td></td>
<td>60 g (3 m)</td>
<td>100 g (6 m)</td>
<td>140 g (9 m)</td>
<td></td>
</tr>
</tbody>
</table>

^1 RMS noise relates to mid of measuring range at a frequency response of 5 kHz

^2 Steel: St37 steel DIN1.0037 / aluminum: AlCuMgPb3.1645

Dimensions in mm, not to scale.
Robust miniature sensors in M18 housing

The U6 and U8 models of the eddyNCDT 3001 series are powerful eddy current sensors with integrated controller in an M18 design. Calibrated for ferromagnetic or non-ferromagnetic materials, these compact sensors offer measuring ranges of 6 mm or 8 mm. As these sensors are temperature-compensated, they provide high signal stability even in fluctuating ambient temperatures. Due to their robust design, these sensors are used for measurement tasks in harsh, industrial environments.
### Pin Assignment Color (cable: PCx/5-M12)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Supply +24 V</td>
<td>Brown</td>
</tr>
<tr>
<td>2</td>
<td>Analog output</td>
<td>White</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Blue</td>
</tr>
<tr>
<td>4</td>
<td>RS485 (A+)</td>
<td>Black</td>
</tr>
<tr>
<td>5</td>
<td>RS485 (B-)</td>
<td>Gray</td>
</tr>
</tbody>
</table>

### Pin Assignment Color (cable: PCx/5-M12)

Dimensions in mm, not to scale.

### DT3001-U6-SA

**Model**: DT3001-U6-A-SA  DT3001-U6-M-SA  DT3001-U8-A-SA  DT3001-U8-M-SA

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>6 mm</td>
<td></td>
<td>8 mm</td>
<td></td>
</tr>
<tr>
<td>Start of measuring range</td>
<td>0.6 mm</td>
<td></td>
<td>0.8 mm</td>
<td></td>
</tr>
<tr>
<td>Resolution (1)</td>
<td>3 µm</td>
<td></td>
<td>4 µm</td>
<td></td>
</tr>
<tr>
<td>Frequency response (-3dB)</td>
<td></td>
<td></td>
<td>5 kHz</td>
<td></td>
</tr>
<tr>
<td>Linearity</td>
<td>&lt; ± 15 µm</td>
<td></td>
<td>&lt; ± 20 µm</td>
<td></td>
</tr>
<tr>
<td>Temperature stability</td>
<td>&lt; 1.5 µm / K</td>
<td></td>
<td>&lt; 2 µm / K</td>
<td></td>
</tr>
<tr>
<td>Temperature compensation</td>
<td>0 ... +70 °C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor type</td>
<td>Unshielded</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. target size (flat)</td>
<td>Ø 72 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target material (2)</td>
<td>Aluminum</td>
<td>Steel</td>
<td>Aluminum</td>
<td>Steel</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>12 ... 32 VDC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog output</td>
<td>0.5 ... 9.5 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital output</td>
<td>RS485</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synchronization</td>
<td>With LF &amp; HF variants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection</td>
<td>Supply/signal: 5-pole M12 connector (cable see accessories)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td></td>
<td>Storage</td>
<td></td>
<td>Operation</td>
</tr>
<tr>
<td></td>
<td>-20 ... +70 °C</td>
<td></td>
<td></td>
<td>-20 ... +70 °C</td>
</tr>
<tr>
<td>Shock (DIN-EN 60068-2-29)</td>
<td>15 g / 6 ms in 3 axes, 2 directions and 1000 shocks each</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration (DIN-EN 60068-2-6)</td>
<td>5 g / 10 ... 500 Hz in 3 axes, 2 directions and 10 cycles each</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection class (DIN-EN 60529)</td>
<td>IP67 (plugged)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>35 g (without nuts)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) RMS noise relates to mid of measuring range at a frequency response of 5 kHz

2) Steel: St37 steel DIN 1.0037 / aluminum: AlCuMgPb3.1645
Robust eddy current measuring system

The eddyNCDT 3005 is a powerful eddy current measuring system for fast, high precision displacement measurements. The system comprises a compact controller, a sensor and an integrated cable and is factory-calibrated for ferromagnetic or non-ferromagnetic materials.

As sensor and controller are temperature-compensated, high measurement accuracies can be achieved even in fluctuating temperatures. The sensors are designed for ambient temperatures up to max. +125 °C but can optionally be custom engineered for temperatures from -30 °C to 180 °C. The measuring system is pressure-resistant up to 10 bar and so is ideally suited to machine integration.

Integration into plant and machinery

The eddyNCDT 3005 provides ease of use and high measurement accuracy, offering an outstanding price/performance ratio. Therefore, the sensor is ideal for OEM integration and serial applications in machine building, particularly where pressure, dirt, oil and high temperatures are present. When large quantities are required, customer-specific designs can be tailored to suit individual requirements.

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Pin assignment for power supply and signal

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
<th>Color (cable: PCx/5-M12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Supply +24 V</td>
<td>Brown</td>
</tr>
<tr>
<td>2</td>
<td>Displacement signal</td>
<td>White</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Blue</td>
</tr>
<tr>
<td>4</td>
<td>internal</td>
<td>Black</td>
</tr>
<tr>
<td>5</td>
<td>internal</td>
<td>Gray</td>
</tr>
</tbody>
</table>

Its compact M12 design allows for the controller to be easily installed in restricted and difficult-to-access places.
### Table

<table>
<thead>
<tr>
<th>Model</th>
<th>DT3005-U1-A-C1</th>
<th>DT3005-U1-M-C1</th>
<th>DT3005-S2-A-C1</th>
<th>DT3005-S2-M-C1</th>
<th>DT3005-U3-A-C1</th>
<th>DT3005-U3-M-C1</th>
<th>DT3005-U6-A-C1</th>
<th>DT3005-U6-M-C1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>1 mm</td>
<td>2 mm</td>
<td>3 mm</td>
<td>6 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start of measuring range</td>
<td>0.1 mm</td>
<td>0.2 mm</td>
<td>0.3 mm</td>
<td>0.6 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution (^{a})</td>
<td>0.5 µm</td>
<td>1 µm</td>
<td>1.5 µm</td>
<td>3 µm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency response (-3dB)</td>
<td>5 kHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linearity</td>
<td>&lt; ± 2.5 µm</td>
<td>&lt; ± 5 µm</td>
<td>&lt; ± 7.5 µm</td>
<td>&lt; ± 15 µm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repeatability</td>
<td>&lt; 0.5 µm</td>
<td>&lt; 1 µm</td>
<td>&lt; 1.5 µm</td>
<td>&lt; 3 µm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature stability</td>
<td>&lt; 0.25 µm / K</td>
<td>&lt; 0.5 µm / K</td>
<td>&lt; 0.75 µm / K</td>
<td>&lt; 1.5 µm / K</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature compensation</td>
<td>Sensor: +10 ... +125 °C (optional -30 ... +180 °C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor type</td>
<td>unshielded</td>
<td>shielded</td>
<td>unshielded</td>
<td>unshielded</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. target size (flat)</td>
<td>ø 24 mm</td>
<td>ø 24 mm</td>
<td>ø 48 mm</td>
<td>ø 72 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target material (^{b})</td>
<td>Aluminum</td>
<td>Steel</td>
<td>Aluminum</td>
<td>Steel</td>
<td>Aluminum</td>
<td>Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply voltage</td>
<td>12 ... 32 VDC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog output</td>
<td>0.5 ... 9.5V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synchronization</td>
<td>with LF &amp; HF variants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection</td>
<td>Sensor: integrated cable, length 1 m, min. bending radius 18 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply/signal: 5-pole M12 connector (cable see accessories)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>Sensor: 0 ... +125 °C (optional 0 ... +180 °C), Controller: 0 ... +70 °C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure resistance</td>
<td>10 bar (sensor, cable and controller)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock (DIN-EN 60068-2-29)</td>
<td>15 g / 6 ms in 3 axes, 2 directions and 1000 shocks each</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration (DIN-EN 60068-2-6)</td>
<td>5 g / 10 ... 500 Hz in 3 axes, 2 directions and 10 cycles each</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection class (DIN-EN 60529)</td>
<td>IP67</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (^{c})</td>
<td>70 g</td>
<td>75 g</td>
<td>77 g</td>
<td>95 g</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{a}\) RMS noise relates to mid of measuring range at a frequency response of 5 kHz

\(^{b}\) Steel: St37 steel DIN1.0037 / aluminum: AlCuMgPb3.1645

\(^{c}\) Total weight for controller, cable and sensor

### Diagram

- **Controller**

Dimensions in mm, not to scale.
When connecting a PC via the Ethernet interface, a modern web interface can be accessed without any further installation and enables the parameterization of sensor and controller. The DT3061 controller provides enhanced features such as 5-point calibration, setting of switching and temperature outputs, as well as storage of multiple characteristic curves.

High performance for the industry
The eddyNCDT 3060 is a powerful, inductive sensor system based on eddy currents for fast, high precision displacement measurements. The system comprises a compact controller, a sensor and an integrated cable and is factory-calibrated either for ferromagnetic or non-ferromagnetic materials.

Integration into plant and machinery
As sensor and controller are temperature-compensated, a high measurement accuracy can be achieved even in fluctuating temperatures. The sensors are designed for ambient temperatures up to a maximum of +200 °C and an ambient pressure up to 20 bar. The compact controller design as well as the sensor robustness make the measuring system ideal for integration into plant and machinery.

New benchmark in controller technology
The industrial-grade M12 Ethernet interface offers a modern fieldbus connection. Configurable analog outputs enable to output the measured values as voltage or current. For operating several systems, a new frequency separation is provided, which enables to operate several sensors next to one another without requiring any synchronization.

### Features

- **Controller type**
  - DT3060
  - DT3061

<table>
<thead>
<tr>
<th>Feature</th>
<th>DT3060</th>
<th>DT3061</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active temperature compensation for sensor and controller</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Frequency separation (LF &amp; HF)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Industrial Ethernet interface</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Intuitive web interface</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Multipoint calibration regardless of the distance (up to 3-point calibration)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Scalable measuring range via analog output (teach function)</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Scalable analog output</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Switching and temperature outputs</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>5-point calibration</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>Storage of multiple characteristic curves</td>
<td>-</td>
<td>✓</td>
</tr>
</tbody>
</table>

When connecting a PC via the Ethernet interface, a modern web interface can be accessed without any further installation and enables the parameterization of sensor and controller. The DT3061 controller provides enhanced features such as 5-point calibration, setting of switching and temperature outputs, as well as storage of multiple characteristic curves.
<table>
<thead>
<tr>
<th>Model</th>
<th>DT3060</th>
<th>DT3061</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>static (20 Hz)</td>
<td>0.002 % FSO</td>
</tr>
<tr>
<td></td>
<td>dynamic (20 kHz)</td>
<td>0.01 % FSO</td>
</tr>
<tr>
<td>Frequency response (-3dB)</td>
<td>selectable (20 kHz, 5 kHz, 20 Hz)</td>
<td></td>
</tr>
<tr>
<td>Measuring rate</td>
<td>50 kSa/s</td>
<td></td>
</tr>
<tr>
<td>Linearity</td>
<td>&lt; ± 0.2 % FSO</td>
<td></td>
</tr>
<tr>
<td>Temperature stability</td>
<td>&lt; 0.015 % FSO / K</td>
<td></td>
</tr>
<tr>
<td>Temperature compensation</td>
<td>+10 … +50 °C</td>
<td></td>
</tr>
<tr>
<td>Synchronization</td>
<td>with LF &amp; HF variants</td>
<td></td>
</tr>
<tr>
<td>Target material</td>
<td>Steel</td>
<td></td>
</tr>
<tr>
<td>No. of characteristic curves</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Supply voltage</td>
<td>12 … 32 VDC</td>
<td></td>
</tr>
<tr>
<td>Power consumption</td>
<td>2.5 W</td>
<td></td>
</tr>
<tr>
<td>Digital interface</td>
<td>Industrial Ethernet</td>
<td></td>
</tr>
<tr>
<td>Analog output</td>
<td>0 … 10 V; 4 … 20 mA (short circuit proof)</td>
<td></td>
</tr>
<tr>
<td>Connection</td>
<td>Sensor: pluggable cable via triaxial socket; supply/signal: 8-pole M12 connector; Industrial Ethernet: 5-pole M12 connector (cable see accessories)</td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td>through bores</td>
<td></td>
</tr>
<tr>
<td>Temperature range</td>
<td>Storage: -10 … +70 °C</td>
<td></td>
</tr>
<tr>
<td>Shock (DIN-EN 60068-2-29)</td>
<td>15 g / 6 ms in 3 axes, 2 directions and 1000 shocks each</td>
<td></td>
</tr>
<tr>
<td>Vibration (DIN-EN 60068-2-6)</td>
<td>5 g / 10 … 500 Hz in 3 axes, 2 directions and 10 cycles each</td>
<td></td>
</tr>
<tr>
<td>Protection class (DIN-EN 60529)</td>
<td>IP67 (plugged)</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>die-cast aluminum</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 230 g</td>
<td></td>
</tr>
</tbody>
</table>

FSO = Full Scale Output
1) RMS noise relates to mid of measuring range
2) Value with 3-/5-point linearization
3) Steel: St37 steel DIN1.0037 / aluminum: AlCuMgPb3.1645

---

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
<th>Color (cable: PCx/8-M12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analog output $U_{\text{replacement}}$</td>
<td>White</td>
</tr>
<tr>
<td>2</td>
<td>Supply +24 V</td>
<td>Brown</td>
</tr>
<tr>
<td>3</td>
<td>Limit value 1 / $U_{\text{limit_sensor}}$</td>
<td>Green</td>
</tr>
<tr>
<td>4</td>
<td>Limit value 2 / $U_{\text{Limit_Controller}}$</td>
<td>Yellow</td>
</tr>
<tr>
<td>5</td>
<td>GND Temperature, Limit value</td>
<td>Gray</td>
</tr>
<tr>
<td>6</td>
<td>GND analog output</td>
<td>Pink</td>
</tr>
<tr>
<td>7</td>
<td>GND supply</td>
<td>Blue</td>
</tr>
<tr>
<td>8</td>
<td>Analog output I $U_{\text{replacement}}$</td>
<td>Red</td>
</tr>
</tbody>
</table>

---

Dimensions in mm, not to scale.
<table>
<thead>
<tr>
<th>Model</th>
<th>ES-U1</th>
<th>ES-S2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>1 mm</td>
<td>2 mm</td>
</tr>
<tr>
<td>Start of measuring range</td>
<td>0.1 mm</td>
<td>0.2 mm</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.02 µm</td>
<td>0.04 µm</td>
</tr>
<tr>
<td>Linearity</td>
<td>&lt; ± 1 µm</td>
<td>&lt; ± 2 µm</td>
</tr>
<tr>
<td>Temperature stability</td>
<td>&lt; 0.15 µm / K</td>
<td>&lt; 0.3 µm / K</td>
</tr>
<tr>
<td>Min. target size (flat)</td>
<td>Ø 18 mm</td>
<td>Ø 18 mm</td>
</tr>
<tr>
<td>Sensor type</td>
<td>unshielded</td>
<td>shielded</td>
</tr>
<tr>
<td>Connection</td>
<td>integrated cable, axial, standard length 3 m; 1 m, 6 m, 9 m optional 5</td>
<td>integrated cable, axial, standard length 3 m; 1 m, 6 m, 9 m optional 5</td>
</tr>
<tr>
<td>Mounting</td>
<td>Cable gland (M6)</td>
<td>Cable gland (M12)</td>
</tr>
<tr>
<td>Temperature range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>-50 ... +180 °C</td>
<td>-50 ... +200 °C</td>
</tr>
<tr>
<td>Operation</td>
<td>-20 ... +180 °C</td>
<td>-20 ... +200 °C</td>
</tr>
<tr>
<td>Pressure resistance</td>
<td>20 bar (front); 5 bar (rear)</td>
<td>20 bar (front); 5 bar (rear)</td>
</tr>
<tr>
<td>Shock (DIN-EN 60068-2-29)</td>
<td>30 g</td>
<td>30 g</td>
</tr>
<tr>
<td>Vibration (DIN-EN 60068-2-6)</td>
<td>15 g</td>
<td>15 g</td>
</tr>
<tr>
<td>Protection class (DIN-EN 60529)</td>
<td>IP68 (plugged)</td>
<td>IP68 (plugged)</td>
</tr>
<tr>
<td>Material</td>
<td>stainless steel and plastic</td>
<td>stainless steel and plastic</td>
</tr>
<tr>
<td>Weight</td>
<td>2.4 g (without nuts)</td>
<td>11 g (without nuts)</td>
</tr>
</tbody>
</table>

5 Valid for operation with DT306x controller, referred to nominal measuring range
6 Relates to mid of measuring range
7 RMS value of the signal noise, static (20 Hz)
8 Only with DT3061 controller and 5-point linearization
9 Length tolerance cable: nominal value +30 %
<table>
<thead>
<tr>
<th>Model</th>
<th>ES-U3</th>
<th>ES-S4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>3 mm</td>
<td>4 mm</td>
</tr>
<tr>
<td>Start of measuring range</td>
<td>0.3 mm</td>
<td>0.4 mm</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.06 µm</td>
<td>0.08 µm</td>
</tr>
<tr>
<td>Linearity</td>
<td>&lt; ± 3 µm</td>
<td>&lt; ± 4 µm</td>
</tr>
<tr>
<td>Temperature stability</td>
<td>&lt; 0.45 µm / K</td>
<td>&lt; 0.6 µm / K</td>
</tr>
<tr>
<td>Temperature compensation</td>
<td>+10…+180 °C</td>
<td>+10…+180 °C</td>
</tr>
<tr>
<td>Min. target size (flat)</td>
<td>Ø 36 mm</td>
<td>Ø 27 mm</td>
</tr>
<tr>
<td>Sensor type</td>
<td>unshielded</td>
<td>shielded</td>
</tr>
<tr>
<td>Connection</td>
<td>integrated cable, axial, standard length 3 m; 1 m, 6 m, 9 m optional</td>
<td>integrated cable, axial, standard length 3 m; 1 m, 6 m, 9 m optional</td>
</tr>
<tr>
<td>Mounting</td>
<td>Cable gland (M12)</td>
<td>Cable gland (M18)</td>
</tr>
<tr>
<td>Temperature range</td>
<td>Storage: -50…+200 °C</td>
<td>Storage: -50…+200 °C</td>
</tr>
<tr>
<td></td>
<td>Operation: -20…+200 °C</td>
<td>Operation: -20…+200 °C</td>
</tr>
<tr>
<td>Pressure resistance</td>
<td>20 bar (front); 5 bar (rear)</td>
<td>20 bar (front); 5 bar (rear)</td>
</tr>
<tr>
<td>Shock (DIN-EN 60068-2-29)</td>
<td>30 g</td>
<td>30 g</td>
</tr>
<tr>
<td>Vibration (DIN-EN 60068-2-6)</td>
<td>15 g</td>
<td>15 g</td>
</tr>
<tr>
<td>Protection class (DIN-EN 60529)</td>
<td>IP68 (plugged)</td>
<td>IP68 (plugged)</td>
</tr>
<tr>
<td>Material</td>
<td>stainless steel and plastic</td>
<td>stainless steel and plastic</td>
</tr>
<tr>
<td>Weight</td>
<td>12 g (without nuts)</td>
<td>30 g (without nuts)</td>
</tr>
</tbody>
</table>

1) Valid for operation with DT306x controller, referred to nominal measuring range
2) Relates to mid of measuring range
3) RMS value of the signal noise, static (20 Hz)
4) Only with DT3061 controller and 5-point linearization
5) Length tolerance cable: nominal value + 30 %
6) Only with DT3061 controller and 5-point linearization
Connection cable for DT3060 portfolio sensors

**Sensors with integrated cable:** cable type ES-xx-C-CAx

Coaxial cable with Viton sheathing
- Cable diameter: Ø 3.6 mm
- Minimum bending radius: static approx. 18 mm / dynamic approx. 36 mm
- Temperature resistance: up to 200 °C (3000 hrs.)
- Available length: 1 m / 3 m / 6 m (9 m on request)

**Sensors with socket:** cable type EC-x/mB0/mB0

Coaxial cable with Viton sheathing
- Cable diameter: Ø 3.6 mm
- Minimum bending radius: static approx. 18 mm / dynamic approx. 36 mm
- Temperature resistance: up to 200 °C (3000 hrs.)
- Available length: 1 m / 3 m / 6 m (9 m on request)

**Extension cable:** cable type ECE-x/fB0/mB0

Coaxial cable with Viton sheathing
- Cable diameter: Ø 3.6 mm
- Minimum bending radius: static approx. 18 mm / dynamic approx. 36 mm
- Temperature resistance: up to 200 °C (3000 hrs.)
- Available length: 1 m / 3 m / 6 m (9 m on request)
Plug/Socket

1. **Connector Triax 0323118**: Type S 102 A014-120 D4,1
   - Triaxial connector:
     - Type: mB0
     - Connection: push-pull
     - Temperature resistance: 200 °C (3000 hrs.)

2. **Socket Triax 0323141**: Type KE102 A014-120 D4,1
   - Triaxial socket:
     - Type: fB0
     - Connection: push-pull
     - Temperature resistance: 200 °C (3000 hrs.)
Numerous sensor models even for customer-specific applications
High speed measurements: up to 100 kHz (-3dB) frequency response
High resolution & linearity
Sensors for ferromagnetic and non-ferromagnetic targets

The eddyNCDT 3300 eddy current system is a powerful displacement measuring system which offers numerous benefits in manufacturing automation, machine monitoring and quality control.

**Multifunctional controller**
The eddyNCDT 3300 controller is equipped with high performance processors for reliable signal processing and further processing. The three-point linearization feature enables almost fully automatic field linearization, which provides high accuracy for any metallic target and installation environment. The operation is supported by a dialog-aided graphical display.

**Highest frequency response**
Monitoring highly dynamic processes is possible with the eddyNCDT 3300 which offers a frequency response of 100 kHz. This enables to solve measurement tasks where high measurement speeds and high accuracy are required.
### Model DT3300 & DT3301

<table>
<thead>
<tr>
<th>Feature</th>
<th>DT3300</th>
<th>DT3301</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Resolution</strong></td>
<td>static (25 Hz)</td>
<td>0.005 % FSO (≤0.01 % FSO with ES04, ES05 and EU05)</td>
</tr>
<tr>
<td></td>
<td>dynamic (25 / 100 kHz)</td>
<td>0.2 % FSO</td>
</tr>
<tr>
<td><strong>Frequency response (-3dB)</strong></td>
<td>selectable 25 kHz, 2.5 kHz, 25 Hz, 100 kHz for measuring ranges ≤ 1 mm</td>
<td></td>
</tr>
<tr>
<td><strong>Linearity</strong></td>
<td>&lt; ± 0.2 % FSO</td>
<td></td>
</tr>
<tr>
<td><strong>Temperature compensation</strong></td>
<td>+10 ... 100 °C (option TCS: -40 ... +180 °C)</td>
<td></td>
</tr>
<tr>
<td><strong>Synchronization</strong></td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td><strong>Target material</strong></td>
<td>Steel, aluminum</td>
<td></td>
</tr>
<tr>
<td><strong>Supply voltage</strong></td>
<td>±12 VDC and 5.2 VDC 4</td>
<td>11 ... 32 VDC</td>
</tr>
<tr>
<td><strong>Max. current consumption</strong></td>
<td>approx. 420 mA</td>
<td>700 mA</td>
</tr>
<tr>
<td><strong>Analog output</strong></td>
<td>selectable 0 ... 5 V; 0 ... 10 V; ± 2.5 V; ± 5 V; ± 10 V (or inverted); / 4 ... 20 mA (short circuit proof)</td>
<td></td>
</tr>
<tr>
<td><strong>Connection</strong></td>
<td>Sensor: pluggable cable via 5-pole socket</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply/signal: 8-pole M16 x 0.75 connector (cable see accessories)</td>
<td></td>
</tr>
<tr>
<td><strong>Temperature range</strong></td>
<td>Storage: +25 ... +70 °C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operation: +5 ... +50 °C</td>
<td></td>
</tr>
<tr>
<td><strong>Protection class (DIN-EN 60529)</strong></td>
<td>IP64 (plugged)</td>
<td></td>
</tr>
<tr>
<td><strong>Control and display elements</strong></td>
<td>limit value monitoring, auto-zero, peak-to-peak, minimum, maximum, average, storage of 3 characteristics</td>
<td></td>
</tr>
</tbody>
</table>

**FSO** = Full Scale Output

1 Resolution data are based on noise peak-to-peak values

2 Temperature stability may differ with TCS option

3 Steel: S23 steel DIN1.0037 / aluminum: ACuMgPb3.1645

4 Additionally 24 VDC for external reset and limit switch

---

### Pin Assignment

**ANALOG - I/O**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
<th>Color (cable: SCA3/5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>n.c.</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>n.c.</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>Analog output U&lt;sub&gt;out&lt;/sub&gt;</td>
<td>Brown</td>
</tr>
<tr>
<td>4</td>
<td>n.c.</td>
<td>---</td>
</tr>
<tr>
<td>5</td>
<td>Temperature output U&lt;sub&gt;temp&lt;/sub&gt;</td>
<td>Green</td>
</tr>
<tr>
<td>6</td>
<td>n.c.</td>
<td>Gray</td>
</tr>
<tr>
<td>7</td>
<td>Agnd</td>
<td>White</td>
</tr>
<tr>
<td>8</td>
<td>Analog output I&lt;sub&gt;out&lt;/sub&gt;</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

1 Signal available only as option

**IN/OUT/24V IN**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
<th>Color (cable: SCD3/8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Zeroing In</td>
<td>Brown</td>
</tr>
<tr>
<td>2</td>
<td>Limit value A Out</td>
<td>Yellow</td>
</tr>
<tr>
<td>3</td>
<td>n.c.</td>
<td>Blue</td>
</tr>
<tr>
<td>4</td>
<td>Reset limit value In</td>
<td>Green</td>
</tr>
<tr>
<td>5</td>
<td>n.c.</td>
<td>Pink</td>
</tr>
<tr>
<td>6</td>
<td>24 VDC ground</td>
<td>White</td>
</tr>
<tr>
<td>7</td>
<td>+24 VDC In</td>
<td>Red</td>
</tr>
<tr>
<td>8</td>
<td>Limit value B Out</td>
<td>Gray</td>
</tr>
</tbody>
</table>

---

Dimensions in mm, not to scale.
### eddyNCDT 3300

<table>
<thead>
<tr>
<th>Model</th>
<th>ES04</th>
<th>EU05</th>
<th>ES08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>0.4 mm</td>
<td>0.4 mm</td>
<td>0.8 mm</td>
</tr>
<tr>
<td>Start of measuring range</td>
<td>0.04 mm</td>
<td>0.05 mm</td>
<td>0.08 mm</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.04 µm</td>
<td>0.05 µm</td>
<td>0.04 µm</td>
</tr>
<tr>
<td>Linearity</td>
<td>&lt; ± 0.8 µm</td>
<td>&lt; ± 1 µm</td>
<td>&lt; ± 1.6 µm</td>
</tr>
<tr>
<td>Temperature stability</td>
<td>&lt; 0.06 µm / K</td>
<td>&lt; 0.075 µm / K</td>
<td>&lt; 0.12 µm / K</td>
</tr>
<tr>
<td>Temperature compensation</td>
<td>0 ... +90 °C</td>
<td>0 ... +90 °C</td>
<td>0 ... +90 °C</td>
</tr>
<tr>
<td>Min. target size (flat)</td>
<td>Ø 6 mm</td>
<td>Ø 9 mm</td>
<td>Ø 7.5 mm</td>
</tr>
<tr>
<td>Sensor type</td>
<td>shielded</td>
<td>unshielded</td>
<td>shielded</td>
</tr>
<tr>
<td>Connection</td>
<td>integrated cable, axial, length approx. 0.25 m</td>
<td>integrated cable, axial, length approx. 0.25 m</td>
<td>integrated cable, axial, length approx. 0.25 m</td>
</tr>
<tr>
<td>Mounting</td>
<td>Cable gland (M4)</td>
<td>Cable gland (M3)</td>
<td>Cable gland (M5)</td>
</tr>
<tr>
<td>Temperature range</td>
<td>Storage</td>
<td>+20 ... +150 °C</td>
<td>+20 ... +150 °C</td>
</tr>
<tr>
<td>Pressure resistance</td>
<td>Operation</td>
<td>0 ... +150 °C</td>
<td>0 ... +150 °C</td>
</tr>
<tr>
<td>Protection class (DIN-EN 60529)</td>
<td>IP64 (plugged)</td>
<td>IP64 (plugged)</td>
<td>IP64 (plugged)</td>
</tr>
<tr>
<td>Material</td>
<td>stainless steel</td>
<td>stainless steel and ceramics</td>
<td>stainless steel and plastic</td>
</tr>
</tbody>
</table>

1: Valid for operation with DT3300 controller, referred to nominal measuring range
2: Relates to mid of measuring range
3: RMS value of the signal noise, static (25 Hz)
4: Higher values possible with TCS option
5: Length tolerance of cable: ± 10 %
<table>
<thead>
<tr>
<th>Model</th>
<th>ES1</th>
<th>EU1</th>
<th>ES2</th>
<th>EU3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>1 mm</td>
<td>1 mm</td>
<td>2 mm</td>
<td>3 mm</td>
</tr>
<tr>
<td>Start of measuring range</td>
<td>0.1 mm</td>
<td>0.1 mm</td>
<td>0.2 mm</td>
<td>0.3 mm</td>
</tr>
<tr>
<td>Resolution 1,2,3</td>
<td>0.05 µm</td>
<td>0.05 µm</td>
<td>0.1 µm</td>
<td>0.15 µm</td>
</tr>
<tr>
<td>Linearity 1)</td>
<td>&lt; ± 2 µm</td>
<td>&lt; ± 2 µm</td>
<td>&lt; ± 4 µm</td>
<td>&lt; ± 6 µm</td>
</tr>
<tr>
<td>Temperature stability 5,6</td>
<td>&lt; 0.15 µm / K</td>
<td>&lt; 0.15 µm / K</td>
<td>&lt; 0.3 µm / K</td>
<td>&lt; 0.45 µm / K</td>
</tr>
<tr>
<td>Temperature compensation 4</td>
<td>0 … +90 °C</td>
<td>0 … +90 °C</td>
<td>0 … +90 °C</td>
<td>0 … +90 °C</td>
</tr>
<tr>
<td>Min. target size (flat)</td>
<td>Ø 12 mm</td>
<td>Ø 15 mm</td>
<td>Ø 18 mm</td>
<td>Ø 36 mm</td>
</tr>
<tr>
<td>Sensor type</td>
<td>shielded</td>
<td>unshielded</td>
<td>shielded</td>
<td>unshielded</td>
</tr>
<tr>
<td>Connection</td>
<td>integrated cable, axial, length approx. 0.25 m 5)</td>
<td>integrated cable, axial, length approx. 0.25 m 5)</td>
<td>Plug connection via triaxial socket</td>
<td>Plug connection via triaxial socket</td>
</tr>
<tr>
<td>Mounting</td>
<td>Cable gland (M8)</td>
<td>Cable gland (M5)</td>
<td>Cable gland (M12)</td>
<td>Cable gland (M12)</td>
</tr>
<tr>
<td>Temperature range</td>
<td>20 ... +150 °C</td>
<td>20 ... +150 °C</td>
<td>20 ... +150 °C</td>
<td>20 ... +150 °C</td>
</tr>
<tr>
<td>Pressure resistance</td>
<td>-</td>
<td>-</td>
<td>20 bar (front)</td>
<td>20 bar (front)</td>
</tr>
<tr>
<td>Protection class (DIN-EN 60529)</td>
<td>IP64 (plugged)</td>
<td>IP50 (plugged)</td>
<td>IP64 (plugged)</td>
<td>IP64 (plugged)</td>
</tr>
<tr>
<td>Material</td>
<td>stainless steel and plastic</td>
<td>stainless steel and plastic</td>
<td>stainless steel and plastic</td>
<td>stainless steel and plastic</td>
</tr>
</tbody>
</table>

1) Valid for operation with DT3300 controller, referred to nominal measuring range
2) Refers to mid of measuring range
3) RMS value of the signal noise, static (25 Hz)
4) Higher values possible with TCS option
5) Length tolerance of cable: ± 10 %

---

Diagram: Measurement direction and connector side.
## eddyNCDT 3300

### Model Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>ES4</th>
<th>EU6</th>
<th>EU8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>4 mm</td>
<td>6 mm</td>
<td>8 mm</td>
</tr>
<tr>
<td>Start of measuring range</td>
<td>0.4 mm</td>
<td>0.6 mm</td>
<td>0.8 mm</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.2 µm</td>
<td>0.3 µm</td>
<td>0.4 µm</td>
</tr>
<tr>
<td>Linearity</td>
<td>&lt; ± 8 µm</td>
<td>&lt; ± 12 µm</td>
<td>&lt; ± 16 µm</td>
</tr>
<tr>
<td>Temperature stability</td>
<td>&lt; 0.6 µm / K</td>
<td>&lt; 0.9 µm / K</td>
<td>&lt; 1.2 µm / K</td>
</tr>
<tr>
<td>Temperature compensation</td>
<td>0 ... +90 °C</td>
<td>0 ... +90 °C</td>
<td>0 ... +90 °C</td>
</tr>
<tr>
<td>Min. target size (flat)</td>
<td>Ø 27 mm</td>
<td>Ø 54 mm</td>
<td>Ø 72 mm</td>
</tr>
<tr>
<td>Sensor type</td>
<td>shielded</td>
<td>unshielded</td>
<td>unshielded</td>
</tr>
<tr>
<td>Connection</td>
<td>Plug connection via triaxial socket</td>
<td>Plug connection via triaxial socket</td>
<td>Plug connection via triaxial socket</td>
</tr>
<tr>
<td>Mounting</td>
<td>Cable gland (M18)</td>
<td>Cable gland (M18)</td>
<td>Cable gland (M24)</td>
</tr>
<tr>
<td>Temperature range</td>
<td>Storage</td>
<td>+20 ... +150 °C</td>
<td>+20 ... +150 °C</td>
</tr>
<tr>
<td>Pressure resistance</td>
<td>Operation</td>
<td>0 ... +150 °C</td>
<td>-20 ... +150 °C</td>
</tr>
<tr>
<td>Protection class (DIN-EN 60529)</td>
<td>IP50 (plugged)</td>
<td>IP64 (plugged)</td>
<td>IP64 (plugged)</td>
</tr>
<tr>
<td>Material</td>
<td>stainless steel and plastic</td>
<td>stainless steel and plastic</td>
<td>stainless steel and plastic</td>
</tr>
</tbody>
</table>

1. Valid for operation with DT3300 controller, referred to nominal measuring range
2. Relates to mid of measuring range
3. RMS value of the signal noise, static (25 Hz)
4. Higher values possible with TCS option

---

### Diagrams

[Diagram 1: Measurement direction and connector side]

[Diagram 2: Model configurations 1:1 and 1:2]

[Diagram 3: Component specifications]
<table>
<thead>
<tr>
<th>Model</th>
<th>EU15</th>
<th>EU22</th>
<th>EU40</th>
<th>EU80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>15 mm</td>
<td>22 mm</td>
<td>40 mm</td>
<td>80 mm</td>
</tr>
<tr>
<td>Start of measuring range</td>
<td>1.5 mm</td>
<td>2.2 mm</td>
<td>4 mm</td>
<td>8 mm</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.75 µm</td>
<td>1.1 µm</td>
<td>2 µm</td>
<td>4 µm</td>
</tr>
<tr>
<td>Linearity 1)</td>
<td>&lt; ± 30 µm</td>
<td>&lt; ± 44 µm</td>
<td>&lt; ± 80 µm</td>
<td>&lt; ± 160 µm</td>
</tr>
<tr>
<td>Temperature stability 2)</td>
<td>&lt; 2.25 µm / K</td>
<td>&lt; 3.3 µm / K</td>
<td>&lt; 6 µm / K</td>
<td>&lt; 12 µm / K</td>
</tr>
<tr>
<td>3)</td>
<td>0 … +90 °C</td>
<td>0 … +90 °C</td>
<td>0 … +90 °C</td>
<td>0 … +90 °C</td>
</tr>
<tr>
<td>4) Min. target size (flat)</td>
<td>Ø 111 mm</td>
<td>Ø 156 mm</td>
<td>Ø 210 mm</td>
<td>Ø 420 mm</td>
</tr>
<tr>
<td>Sensor type</td>
<td>unshielded</td>
<td>unshielded</td>
<td>unshielded</td>
<td>unshielded</td>
</tr>
<tr>
<td>Connection</td>
<td>Plug connection via triaxial socket</td>
<td>Plug connection via triaxial socket</td>
<td>Plug connection via triaxial socket</td>
<td>Plug connection via triaxial socket</td>
</tr>
<tr>
<td>Mounting</td>
<td>3 x through-holes</td>
<td>3 x through-holes</td>
<td>3 x through-holes</td>
<td>3 x through-holes</td>
</tr>
<tr>
<td>Temperature range</td>
<td>Storage</td>
<td>+20 … +150 °C</td>
<td>+20 … +150 °C</td>
<td>+20 … +150 °C</td>
</tr>
<tr>
<td>5) Operation</td>
<td>0 … +150 °C</td>
<td>0 … +150 °C</td>
<td>0 … +150 °C</td>
<td>0 … +150 °C</td>
</tr>
<tr>
<td>Protection class (DIN-EN 60529)</td>
<td>IP64 (plugged)</td>
<td>IP64 (plugged)</td>
<td>IP64 (plugged)</td>
<td>IP64 (plugged)</td>
</tr>
<tr>
<td>Material</td>
<td>epoxy</td>
<td>epoxy</td>
<td>epoxy</td>
<td>epoxy</td>
</tr>
</tbody>
</table>

1) Valid for operation with DT3300 controller, referred to nominal measuring range
2) Relates to mid of measuring range
3) RMS value of the signal noise, static (25 Hz)
4) Higher values possible with TCS option
Connection cables for DT3300 portfolio sensors

**Sensors with integrated cable:** cable types ECx + ESx or EUx

1. Cables eddyNCDT 3300

- Connection cables for DT3300 portfolio sensors
- Sensors with integrated cable: cable types ECx + ESx or EUx
- Sensor cable with open ends for solder connection: cable type ECx/1
- Extension cable for plug connection: cable type ECx/2

**Special coaxial cable**
- Coaxial cable with Viton sheathing
- Cable diameter: Ø 3.6 mm
- Minimum bending radius: static approx. 18 mm / dynamic approx. 36 mm
- Temperature resistance: up to 200 °C (3000 hrs.)
- Available length: 1 m / 3 m / 6 m (9 m on request)

**Miniature coaxial cable**

**Available length:** 1 m / 3 m / 6 m (9 m on request)
Plug/Socket

1. **5-pole socket 0323109**: series 712  
   - Type: 5 poles  
   - Connection: screwed connector  
   - Temperature resistance: 85 °C

2. **Triax plug 0323253**: Type SE102 A014-120 D4,9  
   - Triaxial plug: Type: mB0  
   - Connection: push-pull  
   - Temperature resistance: 200 °C (3000 hrs.)

3. **Triax socket 0323121**: Type KE102 A014-120 D2,1  
   - Triaxial socket: Type: fB0  
   - Connection: push-pull  
   - Temperature resistance: 200 °C (3000 hrs.)

4. **Triax plug 0323174**: Type S101 A005-120 D4,1  
   - Triaxial plug: Type: mC0  
   - Connection: push-pull  
   - Temperature resistance: 200 °C (3000 hrs.)

5. **Triax socket 0323173**  
   - Triaxial socket: Type: fC0  
   - Connection: push-pull  
   - Temperature resistance: 200 °C (3000 hrs.)
Subminiature sensors for restricted spaces

As well as standard sensors in conventional designs, miniature sensors with the smallest possible dimensions that achieve high precision measurement results are also available. Pressure-resistant versions, screened housings, ceramic types and other special features characterize these sensors, which achieve highly accurate measurement results despite their small dimensions. These miniature sensors are primarily used in high pressure applications, for example, in combustion engines.
**EU1FL Unshielded flat sensor**

- Measuring range: 1 mm
- Temperature stability: ≤±0.025% FSO/°C
- Connection: integrated coaxial cable 0.25 m (ø 2 mm) with sealed triaxial connector
- Max. operating temperature: 150 °C
- Housing material: stainless steel and epoxy
- Sensor cable: ECx

**EU05(93) Unshielded Sensor**

- Measuring range: 0.4 mm
- Temperature stability: ≤±0.025% FSO/°C
- Connection: integrated coaxial cable 0.25 m (ø 0.5 mm) with solder connection board
- Pressure resistance (static): front 2000 bar / rear side splash water
- Max. operating temperature: 150 °C
- Housing material: ceramic
- Sensor cable: ECx/1, length ≤ 6 m

**EU05(10) Unshielded Sensor**

- Measuring range: 0.5 mm
- Temperature stability: ≤±0.025% FSO/°C
- Connection: integrated coaxial cable 0.25 m (ø 0.5 mm) with solder connection board
- Max. operating temperature: 150 °C
- Housing material: stainless steel and ceramic
- Sensor cable: ECx/1, length ≤ 6 m

**EU05(65) Unshielded Sensor**

- Measuring range: 0.5 mm
- Temperature stability: ≤±0.025% FSO/°C
- Connection: integrated coaxial cable 0.25 m (ø 0.5 mm) with solder connection board
- Pressure resistance (static): front 700 bar / rear side splash water
- Max. operating temperature: 150 °C
- Housing material: ceramic
- Sensor cable: ECx/1, length ≤ 6 m

**EU05(66) Unshielded Sensor**

- Measuring range: 0.5 mm
- Temperature stability: ≤±0.025% FSO/°C
- Connection: integrated coaxial cable 0.25 m (ø 0.5 mm) with solder connection board
- Pressure resistance (static): front 400 bar / rear side splash water
- Max. operating temperature: 150 °C
- Housing material: ceramic
- Sensor cable: ECx/1, length ≤ 6 m

**EU05(72) Unshielded Sensor**

- Measuring range: 0.4 mm
- Temperature stability: ≤±0.025% FSO/°C
- Connection: integrated coaxial cable 0.25 m (ø 0.5 mm) with solder connection board
- Pressure resistance (static): front 2000 bar / rear side splash water
- Max. operating temperature: 150 °C
- Housing material: ceramic
- Sensor cable: ECx/1, length ≤ 6 m

**ES05(36) Shielded Sensor**

- Measuring range: 0.5 mm
- Temperature stability: ≤±0.025% FSO/°C
- Connection: integrated coaxial cable 0.5 m (ø 0.5 mm) with solder connection board
- Max. operating temperature: 150 °C
- Housing material: stainless steel and epoxy
- Sensor cable: ECx/1, length ≤ 6 m

**ES05/180(16) Shielded Sensor**

- Measuring range: 0.5 mm
- Temperature stability: ≤±0.025% FSO/°C
- Connection: integrated coaxial cable 0.25 m (ø 0.5 mm) with solder connection board
- Max. operating temperature: 180 °C
- Housing material: stainless steel and epoxy
- Sensor cable: ECx/1, length ≤ 6 m

**EU05(65) Unshielded Sensor**

- Measuring range: 0.5 mm
- Temperature stability: ≤±0.025% FSO/°C
- Connection: integrated coaxial cable 0.25 m (ø 0.5 mm) with solder connection board
- Pressure resistance (static): front 700 bar / rear side splash water
- Max. operating temperature: 150 °C
- Housing material: ceramic
- Sensor cable: ECx/1, length ≤ 6 m

**EU05(72) Unshielded Sensor**

- Measuring range: 0.4 mm
- Temperature stability: ≤±0.025% FSO/°C
- Connection: integrated coaxial cable 0.25 m (ø 0.5 mm) with solder connection board
- Pressure resistance (static): front 2000 bar / rear side splash water
- Max. operating temperature: 150 °C
- Housing material: ceramic
- Sensor cable: ECx/1, length ≤ 6 m

**EU1FL Unshielded flat sensor**

- Measuring range: 1 mm
- Temperature stability: ≤±0.025% FSO/°C
- Connection: integrated coaxial cable 0.25 m (ø 2 mm) with sealed triaxial connector
- Max. operating temperature: 150 °C
- Housing material: stainless steel and epoxy
- Sensor cable: ECx
Measuring principle
A coil integrated in the sensor housing is energized by a high-frequency alternating current. The emerging electromagnetic field changes when approaching a turbo charger blade. This is how every blade generates a pulse. The controller identifies the rotational speed (analog 0 - 5 V) by considering the number of blades.

Robust miniature controller
As the entire electronics is in a sealed miniature housing and designed for ambient temperatures up to 115 °C, the controller is easy to integrate into the engine compartment. The turboSPEED DZ140 offers excellent interference resistance for increased EMC requirements as well as in test cells and road tests.

Engine compartment application
The DZ140 eddy current measuring system is resistant to oil and dirt. This is a key advantage especially compared to optical speed measuring systems, as this immunity helps to achieve high precision measurements on a continuous basis.

Ease of use
A tri-color ‘status’ LED on the controller indicates when the sensor has reached the ideal distance from the turbocharger blades. This simple feature enables greatly reduced installation time.

As the sensor is connected with the electronics via a special BNC connector, it is therefore downward compatible with all previous sensor models. An industrial push-pull connector guarantees a reliable connection between the electronics and the power supply as well as the analog outputs.

Measuring aluminum and titanium blades
The DZ140 measures both aluminum and titanium blades. The sensors can be mounted at a relatively large distance from the blade. The maximum distance of 2.2 mm enables reliable operation.
Controller DZ140

Dimensions in mm, not to scale.

---

## Model DZ140

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>10 bits</td>
</tr>
<tr>
<td>Speed range (measuring range)</td>
<td>200 … 400,000 rpm</td>
</tr>
<tr>
<td>Linearity</td>
<td>&lt; ± 0.2 % FSO</td>
</tr>
<tr>
<td>Target material</td>
<td>aluminum or titanium</td>
</tr>
<tr>
<td>Supply voltage</td>
<td>9 … 30 VDC (short-term up to 36 VDC)</td>
</tr>
<tr>
<td>Max. current consumption</td>
<td>50 mA</td>
</tr>
<tr>
<td>Digital output</td>
<td>TTL level (1 pulse / blade with variable pulse duration or 1 pulse / rotation with 100 µs pulse duration)</td>
</tr>
<tr>
<td>Analog output</td>
<td>0 … 5 V (^1)</td>
</tr>
<tr>
<td>Connection</td>
<td>Sensor: triaxial connector; Supply/signal: 10-pole connector, raw signal: coaxial connector (cable see accessories)</td>
</tr>
<tr>
<td>Mounting</td>
<td>Screw connection with 4 through-holes</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-40 ... +125 °C</td>
</tr>
<tr>
<td>Protection class (DIN-EN 60529)</td>
<td>IP65 (plugged)</td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 85 g</td>
</tr>
<tr>
<td>Number of blades</td>
<td>adjustable via rotary switch accessible from outside for 1 to 16 blades</td>
</tr>
</tbody>
</table>

FSO = Full Scale Output (speed range)

\(^1\) Rotational speed adjustable via mode rotary switch

---

## Pin Assignment for Power Supply and Signal

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
<th>Color (cable: PC140-x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analog output for rotational speed 0 … +5 V</td>
<td>Blue</td>
</tr>
<tr>
<td>2</td>
<td>reserved, not connected</td>
<td>Yellow</td>
</tr>
<tr>
<td>3</td>
<td>TTL pulses, digital</td>
<td>Green</td>
</tr>
<tr>
<td>4</td>
<td>reserved, not connected</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Black</td>
</tr>
<tr>
<td>6</td>
<td>reserved, not connected</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Supply</td>
<td>White</td>
</tr>
<tr>
<td>8</td>
<td>Supply voltage +9 … 30 VDC</td>
<td>Brown</td>
</tr>
<tr>
<td>9</td>
<td>Not assigned</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>Not assigned</td>
<td>-</td>
</tr>
</tbody>
</table>

10-pin cable connector View on solder side
**Sensors**

**turboSPEED DZ140**

---

- **Measurement direction**

---

<table>
<thead>
<tr>
<th>Model</th>
<th>DS 05(03)</th>
<th>DS 05(04)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor type</td>
<td>shielded</td>
<td>shielded</td>
</tr>
<tr>
<td>Connection(^1)</td>
<td>integrated cable, axial, length 0.5 m</td>
<td>integrated cable, axial, length 0.5 m</td>
</tr>
<tr>
<td>Mounting</td>
<td>Clamping/adapter</td>
<td>Clamping/adapter</td>
</tr>
<tr>
<td>Temperature range</td>
<td>Storage: -40 ... +200 °C</td>
<td>Operation: -40 ... +200 °C</td>
</tr>
<tr>
<td>Special feature</td>
<td>curved housing</td>
<td>-</td>
</tr>
</tbody>
</table>

\(^1\) Length tolerance ± 0.15 m

---

![Diagram of sensor connection](image)
<table>
<thead>
<tr>
<th>Model</th>
<th>DS 05(07)</th>
<th>DS 05(14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor type</td>
<td>shielded</td>
<td>shielded</td>
</tr>
<tr>
<td>Connection¹</td>
<td>integrated cable, axial, length 0.5 m</td>
<td>integrated cable, axial, length 0.5 m</td>
</tr>
<tr>
<td>Mounting</td>
<td>Cable gland (M5)</td>
<td>Cable gland (M5)</td>
</tr>
<tr>
<td>Temperature range</td>
<td>Storage: -40 ... +200 °C</td>
<td>Storage: -40 ... +200 °C</td>
</tr>
<tr>
<td></td>
<td>Operation: -40 ... +200 °C</td>
<td>Operation: -40 ... +200 °C</td>
</tr>
<tr>
<td>Special feature</td>
<td>-</td>
<td>Length of housing 42.5 mm</td>
</tr>
</tbody>
</table>

¹ Length tolerance ± 0.15 m

Measurement direction

![Diagram of sensor with specifications](image-url)
### turboSPEED DZ140

#### Model Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>DS 05(15)</th>
<th>DS 1</th>
<th>DS 1(04)</th>
<th>DS 1/T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor type</td>
<td>shielded</td>
<td>shielded</td>
<td>shielded</td>
<td>shielded</td>
</tr>
<tr>
<td>Connection</td>
<td>integrated cable, axial, length 0.5 m</td>
<td>integrated cable, axial, length 0.75 m</td>
<td>integrated cable, axial, length 0.8 m</td>
<td>integrated cable, axial, length 0.8 m</td>
</tr>
<tr>
<td>Mounting</td>
<td>Cable gland (M5)</td>
<td>Cable gland (M5)</td>
<td>Cable gland (M5)</td>
<td>Cable gland (M5)</td>
</tr>
<tr>
<td>Temperature range</td>
<td>Storage: -40 ... +200 °C</td>
<td>-40 ... +235 °C</td>
<td>-40 ... +235 °C</td>
<td>-40 ... +235 °C</td>
</tr>
<tr>
<td></td>
<td>Operation: -40 ... +200 °C</td>
<td>-40 ... +235 °C</td>
<td>-40 ... +235 °C</td>
<td>-40 ... +235 °C (short-term +285 °C)</td>
</tr>
<tr>
<td>Special feature</td>
<td>-</td>
<td>-</td>
<td>protective hose (stainless steel)</td>
<td>-</td>
</tr>
</tbody>
</table>

---

Supplementary details:

- Measurement direction
- **Sensor cable**: ø approx. 3.5 mm Length 0.5 m (± 0.15 m) with BNC connector
- **Sensor cable**: ø approx. 3.5 mm Length 0.75 m (± 0.15 m) with BNC connector
- **Sensor cable**: ø approx. 6.0 mm Stainless steel IP 40 Length 0.8 m (± 0.15 m) with BNC connector
- **Sensor cable**: ø approx. 4.5 mm Length 0.8 m (± 0.15 m) with triax BNC connector

---

1. Length tolerance ± 0.15 m
Connection cables for DZ140 portfolio sensors

<table>
<thead>
<tr>
<th>Miniature coaxial cable for DS05(x) and DS1 models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter: approx. 3.5 mm</td>
</tr>
<tr>
<td>Sheathing: thermal protection fabric hose (polyolefin shrink hose)</td>
</tr>
<tr>
<td>Temperature range: -50 °C to +200 °C (static)</td>
</tr>
<tr>
<td>Minimum bending radius: static approx. 18 mm / dynamic approx. 35 mm</td>
</tr>
<tr>
<td>Connection: BNC socket coaxial</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Miniature coaxial cable for DS1(04) models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter: approx. 6 mm</td>
</tr>
<tr>
<td>Sheathing: metallic protective hose (stainless steel)</td>
</tr>
<tr>
<td>Temperature range: -50 °C to +200 °C (static)</td>
</tr>
<tr>
<td>Minimum bending radius: static approx. 30 mm / dynamic approx. 60 mm</td>
</tr>
<tr>
<td>Connection: BNC socket coaxial</td>
</tr>
<tr>
<td>Protection class: IP 40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Triaxial cable for the DS1/T models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter: approx. 3.5 mm</td>
</tr>
<tr>
<td>Sheathing: thermal protection fabric hose (polyolefin shrink hose)</td>
</tr>
<tr>
<td>Temperature range: -50 °C to +200 °C</td>
</tr>
<tr>
<td>Minimum bending radius: static approx. 18 mm / dynamic approx. 35 mm</td>
</tr>
<tr>
<td>Connection: BNC socket triaxial</td>
</tr>
</tbody>
</table>
Measuring the thermal extension of spindles

The SGS4701 displacement measuring system (Spindle Growth System) is developed specifically for high speed milling machine applications. Due to high machining speeds and the heat generated, the linear thermal expansion of the spindle in precision machine tools needs to be compensated for in order to keep the tool in a defined position at all times. The SGS sensor measures the thermal and centrifugal force expansion of the spindle. These measurement values are fed into the CNC machine tool as correctional values, compensating for any positioning errors.

The SGS4701 operates on the eddy current measuring principle. This non-contact measurement method is wear-free. Furthermore, the measurement procedure is resistant to disturbances such as heat, dust and oil.

System design

The SGS 4701 consists of a sensor, a sensor cable and a controller, factory calibrated for ferromagnetic and non-ferromagnetic targets. Two miniature sensors enable it to be installed directly in the spindle, where the measurements take place, typically on the labyrinth-ring of the spindle. As well as measuring linear thermal expansion, the temperature of the sensor is also detected and output. The compact controller can be installed on the spindle housing via a flange or directly in the spindle.

The sensor cable must not be shortened as functionality loss may arise. Removing the connector is only permitted behind the plug-sided crimp when using the solder connections.

Customer-specific adjustment

For individual installation situations and measurement objects, sensor and controller can be adjusted in the factory. This enables to achieve the best possible measurement accuracy.

Pin assignment for power supply and signal

<table>
<thead>
<tr>
<th>Pin</th>
<th>Assignment</th>
<th>Color (cable: PC4701-x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>White</td>
</tr>
<tr>
<td>2</td>
<td>Supply 12 ... 32 VDC</td>
<td>Brown</td>
</tr>
<tr>
<td>3</td>
<td>Displacement signal</td>
<td>Green</td>
</tr>
<tr>
<td>4</td>
<td>Temperature signal</td>
<td>Yellow</td>
</tr>
<tr>
<td>5</td>
<td>n.c.</td>
<td>Gray</td>
</tr>
<tr>
<td>6</td>
<td>internal</td>
<td>Pink</td>
</tr>
<tr>
<td>7</td>
<td>internal</td>
<td>Blue</td>
</tr>
<tr>
<td>8</td>
<td>n.c.</td>
<td>Red</td>
</tr>
</tbody>
</table>

Pin assignment for power supply and signal

S = signal = inner conductor
M = ground = shield = outer conductor

View on pin side
Model | SGS4701
---|---
Measuring range | 500 µm (optional 250 µm 1))
Start of measuring range | 100 µm (optional 50 µm 1))
Resolution ² | 0.5 µm
Frequency response (-3dB) | 2000 Hz
Linearity | < ± 2 µm
Temperature stability Sensor | < 300 ppm FSO / K
Controller | < 1000 ppm FSO / K
Temperature compensation Sensor | +10 ... +80 °C
Controller | +10 ... +70 °C
Min. target size (flat) | 8 mm
Target material ³ | Steel, aluminum
Supply voltage | 12 ... 32 VDC
Analog output Displacement | 0.5 ... 9.5 V (100 ... 600 µm, optional 50 ... 300 µm)
Temperature | 0.5 ... 9.5 V (0 ... +90 °C)
Sensor: integrated cable ⁴, standard length 1 m (0.4 ... 1.5 m on request), min. bending radius 12 mm Supply/signal: 8-pole M12 connector (cable see accessories)

Shock (DIN-EN 60068-2-29) | 50 g / 6 ms in each direction, 1000 shocks each
Vibration (DIN-EN 60068-2-6) | 20 g / 10 ... 3000 Hz
Protection class (DIN-EN 60529) | IP67 (plugged)

Weight ⁵ | approx. 85 g

FSO = Full Scale Output
1) For OEM modifications: sensor with a measuring range of 250 µm and an offset of 50 µm are possible
² Static, relates to mid of measuring range
³ Steel: St37 steel DIN1.0037 / aluminum: AlCuMgPb3.1645
⁴ Detailed cable specifications can be found in the operating instructions
⁵ Total weight for controller, cable and sensor

EMU04(121) | EMU04(102) | Controller
---|---|---
Sealing Sensor coil | Cable diameter ø1.13 | SW 8
Connector (max. 20 mating cycles possible) | | SW 8
Dimensions in mm, not to scale.
Eddy current sensors from Micro-Epsilon have many possible fields of application. High measurement accuracy and increased frequency response together with an extremely robust design enable measurements where conventional sensors are not suitable.

- **Run-out monitoring of rolls**
- **Measuring the radial shaft expansion**
- **Monitoring of axial shaft displacement**
- **Oil gap measurement of drive shafts**

Applications
Environmental influences such as oil, temperature, pressure and moisture are largely compensated for and have a minimal effect on the signal. For this reason, the sensors are ideal in demanding application areas, such as industrial mechanical engineering and test bench construction.

- Monitoring the supporting moments in wind turbines
- Displacement measurement of the gear coupling
- Run-out monitoring of gear shafts
- Gap measurement in aluminum die-casting molds
<table>
<thead>
<tr>
<th>Article</th>
<th>Description</th>
<th>DT3001</th>
<th>DT3005</th>
<th>DT3060</th>
<th>DT3300</th>
<th>DZ140</th>
<th>SGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCx/8-M12</td>
<td>Supply and signal cable 8-pole with M12 connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Standard length: 3 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optionally available: 5 m / 10 m / 15 m / 10 m as drag-chain suitable variant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCx/5-M12</td>
<td>Supply and signal cable 5-pole with M12 connector</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standard length: 5 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optionally available: 20 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC4701-x</td>
<td>Supply and signal cable 8-pole with M12 connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Standard length: 10 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optionally available: 15 m / 10 m as drag-chain suitable variant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCD2/4/RJ45</td>
<td>Industrial Ethernet cable 4-pole with M12 connector on RJ45 connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Standard length: 2 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCx/5</td>
<td>Signal cable, analog 5-pole with M16x0.75 connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Standard length: 3 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optionally available: 6 m / 9 m</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCDx/8</td>
<td>Supply cable for switching inputs and outputs: 8-pole with M16x0.75 connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Standard length: 0.3 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optionally available: 1 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSCx</td>
<td>Supply and synchronization cable 5-pole with M19 connector</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Standard length: 0.3 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optionally available: 1 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESCx</td>
<td>Synchronization cable 5-pole with M19 connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Standard length: 0.3 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optionally available: 1 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC140-x</td>
<td>Supply and signal cable 8-pole connector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Standard length: 3 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optionally available: 6 m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PS2020</td>
<td>Power supply unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>Input 100-240 VAC output 24 VDC / 2.5 A; mounting onto symmetrical standard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>rail 35 mm x 7.5 mm, DIN 50022</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>
**Standard installation situation**

**Distance between the nut and the measuring area**

eddyNCDT sensors are mounted using the two mounting nuts included in the delivery. During the factory-calibration of the sensors, these were mounted in a defined distance A and included in the calibration. In order to achieve maximum linearity, the nut must be mounted in the defined distance indicated in the table.

Please note the respective distances recommended in the table below when mounting the sensors:

<table>
<thead>
<tr>
<th>Series</th>
<th>Model</th>
<th>Distance A</th>
</tr>
</thead>
<tbody>
<tr>
<td>DT3001-</td>
<td>U2-A-SA</td>
<td>22 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U2-M-SA</td>
<td>22 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U4-A-SA</td>
<td>22 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U4-M-SA</td>
<td>22 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U4-A-Cx</td>
<td>22 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U4-M-Cx</td>
<td>22 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U6-A-SA</td>
<td>22 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U6-M-SA</td>
<td>22 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U8-A-SA</td>
<td>22 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U8-M-SA</td>
<td>22 mm (± 0.2 mm)</td>
</tr>
<tr>
<td>DT3005-</td>
<td>U1-A-C1</td>
<td>8 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U1-M-C1</td>
<td>8 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>S2-A-C1</td>
<td>4 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>S2-M-C1</td>
<td>4 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U3-A-C1</td>
<td>10 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U3-M-C1</td>
<td>10 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U6-A-C1</td>
<td>13 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>U6-M-C1</td>
<td>13 mm (± 0.2 mm)</td>
</tr>
<tr>
<td>DT3060-</td>
<td>ES-U1</td>
<td>8 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>ES-S2</td>
<td>4 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>ES-U3</td>
<td>10 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>ES-S4</td>
<td>4 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>ES04</td>
<td>2.1 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>EU05</td>
<td>5.5 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>ES08</td>
<td>2.7 mm (± 0.2 mm)</td>
</tr>
<tr>
<td>DT3300-</td>
<td>ES1</td>
<td>4 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>EU1</td>
<td>6.7 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>ES2</td>
<td>4 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>EU3</td>
<td>10 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>ES4</td>
<td>4 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>EU6</td>
<td>10.125 mm (± 0.2 mm)</td>
</tr>
<tr>
<td></td>
<td>EU8</td>
<td>12.8 mm (± 0.2 mm)</td>
</tr>
</tbody>
</table>
Influences on the measurement signal

Sensor installation
The notes mentioned under “Standard installation situation” for correct sensor installation affect the measurement signal.

Minimum diameter of the target (flat)
The relative size of the target has effects on the linearity deviation. Ideally, the target size with shielded sensors is at least 2 times the sensor diameter, with unshielded sensors it is 4 times the sensor diameter. From this size on, almost all field lines run from the sensor to the target. Here, nearly any field line penetrates the target via the front surface and therefore contributing to the formation of eddy currents. With smaller target diameters, field linearization is recommended.

Minimum diameter of round targets
As well as the minimum size for flat geometries, a minimum diameter for round measurement objects is required.

Compensating the distance with curved measurement objects
When measuring on curved surfaces such as shafts, the sensors use the medium distance which results from the closest and the most distant field line range. However, this is not the distance between the vertex of the curved target and the sensor. For this reason, eddy current measuring systems from Micro-Epsilon enable the storage of the actual distance in the controller. This is how measurements can be performed on cylindrical objects such as rolls or shafts.
Material and thickness of the target

Stable measurement results require a certain target minimum thickness that depends on the target material used. For one-sided distance measurements, the following standard values are recommended:

<table>
<thead>
<tr>
<th>Target material</th>
<th>Recommended target thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>0.504 mm</td>
</tr>
<tr>
<td>Lead</td>
<td>1.377 mm</td>
</tr>
<tr>
<td>Gold</td>
<td>0.447 mm</td>
</tr>
<tr>
<td>Graphite</td>
<td>8.100 mm</td>
</tr>
<tr>
<td>Copper</td>
<td>0.402 mm</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.627 mm</td>
</tr>
<tr>
<td>Brass</td>
<td>0.747 mm</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.081 mm</td>
</tr>
<tr>
<td>Permalloy</td>
<td>0.012 mm</td>
</tr>
<tr>
<td>Phosphor Bronze</td>
<td>0.906 mm</td>
</tr>
<tr>
<td>Silver</td>
<td>0.390 mm</td>
</tr>
<tr>
<td>Steel DIN 1.1141</td>
<td>0.069 mm</td>
</tr>
<tr>
<td>Steel DIN 1.4005</td>
<td>0.165 mm</td>
</tr>
<tr>
<td>Steel DIN 1.4301</td>
<td>2.544 mm</td>
</tr>
</tbody>
</table>

Tilt angle

The high accuracy of the eddyNCDT sensors is only achieved with vertical sensor installation. When the sensor or the target are tilted, the measured results slightly deviate from those measured in the vertical position.

The extent of deviation differs from sensor to sensor. The tilt angle of ± 3° can be neglected for most of the measurement tasks. With a tilt angle of larger than 6°, factory calibration is recommended. With a 3-point calibration, the tilt angle can be stored in the controller. This compensates for all influences affecting the signal.
Frequency separation

For operating several eddyNCDT measuring systems, a new frequency separation (LF/HF) is provided. The frequency separation enables multi-channel operation without mutual influence. This function makes a synchronization cable superfluous.

Field calibration

If the installation situation does not correspond to the standard installation conditions, field linearization is recommended (available with eddyNCDT 3060 and eddyNCDT 3300). This on-site calibration compensates for influences which result from the installation scenario or the target materials and shapes. Therefore, optimum measurement accuracies will always be achieved even in the case of difficult installation conditions.

For machine integration, linearization with 2 fixed points (start and end point) is sufficient in most cases. Using 3 or 5 points for linearization enables to increase the accuracy again.

For a linearization with 2 or more points, this applies only within the selected edge points. Outside this range, there may be larger linearity deviations.
Thermal drift of a Micro-Epsilon eddy current system compared with the competitors

All eddyNCDT sensors and controllers are actively temperature-compensated (sensors up to max. 180 °C, controllers up to max. 50 °C). This means that the temperatures of the sensor and the controller are recorded during operation and considered in the measurement result. Consequently, you get an extremely stable measurement signal.

The temperature curve above compares a Micro-Epsilon sensor (green) with a competitive product (red). The maximum deviation over the entire temperature range is significantly below the 150 ppm/°C specified in the data sheet. Occasionally the deviation for the temperature increase of one degree amounts to a maximum of 150 ppm.
Sensors and Systems from Micro-Epsilon

Sensors and systems for displacement, distance and position

Sensors and measurement devices for non-contact temperature measurement

Measuring and inspection systems for metal strips, plastics and rubber

Optical micrometers and fiber optics, measuring and test amplifiers

Color recognition sensors, LED analyzers and inline color spectrometers

3D measurement technology for dimensional testing and surface inspection