capaNCDT // Capacitive displacement sensors and systems

More Precision
In its sensor housing, the combiSENSOR combines an eddy current displacement sensor and a capacitive displacement sensor. This unique sensor concept enables one-sided thickness measurement of electrically non-conductive materials on metallic objects. Its field of application is the absolute thickness measurement of plastic film or of plastic coating on metal plates. Connected to the sensor via a cable, the controller processes and calculates the signals in order to put them out via interfaces. Calculation of the two sensor signals provides compensation of mechanical changes such as thermal expansion, deflections or eccentricity in the measurement device. Due to the redundancy of this combined sensor principle, the measured thickness value remains unaffected by any changes in the measurement setup. Due to the high temperature stability, the combiSENSOR provides high measurement accuracy even with fluctuating temperatures.

Fields of application
- Non-contact thickness measurement of plastic films
- Non-contact thickness measurement of coated metals
- Measurement of the applied adhesive
- Lateral profile due to a traversing axis

Measuring principle
The construction of the eddy current measurement coil and the capacitive measurement electrodes is concentric. Both sensors measure against the same spot. The signal of the capacitive displacement sensor is a function of the working distance, the thickness of the insulator (D) and the dielectric constant of the insulator material (\( \varepsilon_r \)). At the same time the eddy current displacement sensor measures the distance to the ground electrode (e.g. metal sheet or metal roller positioned behind the film). The controller outputs both single signals as well as the difference between capacitive sensor and eddy current sensor. Also the dielectric constant can be calculated with known thickness and working distance.

Thickness measurement:
If the dielectric constant \( \varepsilon_r \) and the working distance from the ground electrode are known, the controller calculates the insulator thickness D from the sensor signals.

Calculation of the dielectric constant:
If the thickness of the Insulator D and the working distance from the ground electrode are known, the controller calculates the dielectric constant of the insulator.
### Controller Specifications

<table>
<thead>
<tr>
<th>Controller type</th>
<th>KSS6420</th>
<th>KSS6430</th>
<th>KSS6420(01)</th>
<th>KSS6430(01)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor</td>
<td>KSH5(01)</td>
<td>KSH10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target thickness (insulator thickness)</td>
<td>40 µm...3 mm</td>
<td>40 µm...6 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working distance</td>
<td>2 mm...5 mm</td>
<td>4 mm...10 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. diameter measurement surface</td>
<td>45 mm</td>
<td>65 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>static, 100 Hz</td>
<td>0.0018 % FSO</td>
<td>0.0004 % FSO</td>
<td>0.0030 % FSO</td>
</tr>
<tr>
<td></td>
<td>dynamic, 3.9 kHz</td>
<td>0.0075 % FSO</td>
<td>0.0015 % FSO</td>
<td>0.0120 % FSO</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>analog: 1 kHz (3 dB)</td>
<td>≤ ±0.05 % FSO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linearity</td>
<td>≤ ±0.05 % FSO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature stability</td>
<td>Sensor (+10 ... +50 °C)</td>
<td>±50 ppm</td>
<td>±50 ppm</td>
<td>±50 ppm</td>
</tr>
<tr>
<td></td>
<td>Controller (+10 ... +50 °C)</td>
<td>±50 ppm</td>
<td>±50 ppm</td>
<td>±50 ppm</td>
</tr>
<tr>
<td>Temperature range</td>
<td>Operation</td>
<td>controller: +10 ... +60 °C; sensor: -10 ... +85 °C; sensor cable: -10 ... +125 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Storage</td>
<td>sensor, cable: -10 ... +100 °C; controller: 0 ... +75 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply</td>
<td>12 ... 36 VDC (5.5 W)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>Analog</td>
<td>capacitive, eddy current and differential signal: 0 ... 10 V (short circuit proof); internal sensor temperature signal (not scaled)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ethernet</td>
<td>capacitive, eddy current, differential and internal temperature signal: 24 Bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EtherCAT</td>
<td>capacitive, eddy current, differential and internal temperature signal: float</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trigger</td>
<td>TTL, 5 V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target geometry</td>
<td>straight surface or min. diameter 200 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection class</td>
<td>sensor: IP54, controller: IP40</td>
<td></td>
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<tr>
<td>Weight</td>
<td>sensor: 80 g; controller: 750 g</td>
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</tbody>
</table>

FSO = Full Scale Output

1) Insulator thickness below 40 µm on request; 2) RMS noise related to mid of measuring range

3) Difference signal of the digital output, measured with working distance = 50 % FSO

4) only valid when sampling rate = 3900 Sa/s

5) Reference material ground electrode: VA steel (1.4571) or aluminum. Changes of the ground electrode (material or geometry) require a recalibration of sensor and controller by the manufacturer.

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### Controller Dimensions

- **Controller**
  - Dimensions: 75 x 125 x 1000
- **SCAC3/5 connector**
  - Signal output (5-pole plug)

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### Sensor Specifications

- **KSH5 sensor**
  - Dimensions: ø30 x 80 x 25
  - Connector: 14.5

- **KSH10 sensor**
  - Dimensions: ø45 x 80 x 25
  - Connector: 14.5

### Scope of Supply:
- KSH sensor
- Sensor cable 1m
- Controller
- PC6200 3/4 supply and trigger cable (3m)

### Accessories:
- SCAC3/5 signal output cable analog (3m)
## Accessories

### Sensor cable
- **Cable CCx.x / CCx,x/90**
  - Description: Low-outgassing cable up to 4 m length, for applications in clean rooms
- **Cable CCmx.x / CCmx,x/90**
  - Description: Low-outgassing cable up to 4.2 m length, for applications in clean rooms, UHV and EUV
- **Cable CCgx.x / CCgx,x/90**
  - Description: Robust cable up to 8 m length, for industrial applications

### Design
- **Std** 1 m
- **1.4 m** •
- **2 m** •
- **2.8 m** •
- **3 m** •
- **4 m** •
- **4.2 m** •
- **6 m** •
- **8 m** •

### Temperature stability
- **-100 °C to +200 °C**
- **-100 °C to +200 °C**
- **-20 °C to +80 °C (permanent)**
- **-20 °C to +100 °C (10,000 h)**

### Outer diameter
- **3.1 mm ±0.1 mm**
- **2.1 mm ±0.1 mm**
- **3.1 mm ±0.1 mm**

### Bending radius
- 3x cable diameter during installation; 7x cable diameter for movement; 12x cable diameter recommend at continuous movement

### Standard length
- **1 m**

### Accessories
- **MC2.5** Micrometer for sensor calibration, range 0 - 2.5 mm, Resolution 0.1 µm. Suitable for sensors CS005 to CS2
- **MC25D** Digital micrometer for sensor calibration, range 0 - 25 mm, adjustable offset (zero). Suitable for all sensors.
- **HV/B** Vacuum feed through triaxial
- **UHV/B** Vacuum feed through triaxial for ultra-high vacuum
- **PC6200-3/4** Power/trigger cable, 4 pin, 3 m
- **SCAC3/4** Signal output cable, (necessary for multi-channel applications), 4 pin, 3 m
- **SCAC3/5** Signal output cable, analog, 5 pin, 3 m
- **SC6000-1.0** Synchronization cable, 5 pin, 1 m
- **CA5** Preamplifier cable 5 pin, 5 m
- **PS2020** Power supply for DIN rail mounting; Input 230 VAC (115 VAC); Output 24 VDC / 2.5 A; L/W/H 120x120x40 mm
Max. leak rate $1 \times 10^{-7}$ mbar · l s$^{-1}$, compatible with connector type B

WS12
34
9
2
Ø8.8
Ø14
M10x0.75
max. 17

UHV/B Vacuum feed through (Art.-no. 0323050)

Max. leak rate $1 \times 10^{-9}$ mbar · l s$^{-1}$, compatible with connector type B

WS11ø13.50h6
ø9.4
M9x0.5
1.75

Max. leak rate $1 \times 10^{-9}$ mbar · l s$^{-1}$, compatible with connector type B

UHV/B Vacuum feed triax weldable (Art.-no. 0323346)

Max. leak rate $1 \times 10^{-9}$ mbar · l s$^{-1}$, compatible with connector type B

UHV/B Vacuum feed triax screwable (Art.-no. 0323370)

UHV/B Vacuum feed triax with flange CF16 (Art.-no. 0323349)

Cable length ±1%

approx. 35.6

10

Ø7

Ø4.9 ±0.25

SCAC3/4 Signal output cable (Art.-no. 2902104)

PC6200-3/4 Power-/trigger cable (Art.-no. 2901881)

SC6000-1,0 Synchronization cable (Art.-no. 2903473)

CAS Preamplifier cable (Art.-no. 2903180)
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