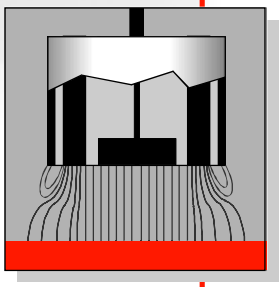
SENSORS & SYSTEMS

Authority in Displacement Measurement

MICRO-EPSILON

CAPACITIVE PRINCIPLE

capaNCDT

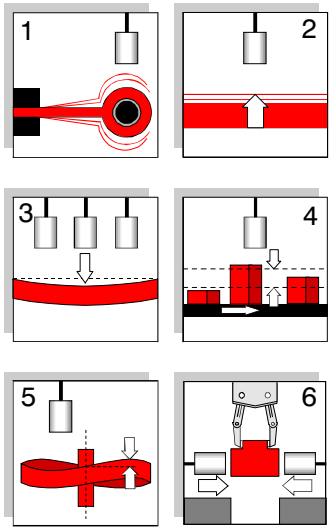
Non-Contact
Capacitive
Displacement
Measurement

Compact System
capaNCDT 610

## capaNCDT 610

## Non-contact displacement measuring

The operating principle of non-contact capacitive displacement measurement used by the capaNCDT system (capacitive Non-contact Displacement Transducer) is based on the ideal parallel plate capacitor. The two plate electrodes are formed by the sensor and the target opposite.
If an AC current with constant frequency flows through the sensor capacitor, the amplitude of the AC voltage on the sensor is proportional to the distance between the capacitor electrodes; an adjustable compensating voltage is simultaneously generated in the amplifier electronics. After demodulation of both AC voltages the difference is amplified and output as an analog signal.




- capaNCDT - sensors are wear-free and maintenance free
- Nearly temperature independent
- High zeropoint stability
- The sensors exert no interference force on the target
- Independent of variations in conductivity of electrically conductive target materials

*capaNCDT 610 features*

## Areas of use

The ***capaNCDT 610*** *is designed for industrial use in production plant and for measuring and testing during in-process quality assurance. Illustrated are examples showing only a small selection of the numerous possibilities.*

***1 -*** *vibration, amplitude, clearance, run-out*

***2 -*** *displacement, distance, position, elongation*

***3 -*** *deflection, deformation, waviness, tilt*

***4 -*** *dimensions, measuring of tolerances, sorting, part recognition*

***5 -*** *stroke, deformation, axial shaft oscillation*

***6 -*** *in-process quality-control, dimensions test*

## The high linearity is in the measuring principle

The capaNCDT system evaluates the reactance Xc of the capacitor which changes strictly in proportion to the distance:

$$Xc = \frac{1}{j\,\omega C} \quad \text{capacitance } C = \varepsilon_r \cdot \varepsilon_0 \cdot \frac{\text{area}}{\text{distance}}$$

$$Xc = \text{constant} \cdot \text{distance}$$

This theoretical relationship is put into practice by constructing the sensors as guard ring capacitors.

## System structure

The capaNCDT 610 is a compact, single-channel system consisting of a capacitive displacement sensor, a sensor- connecting cable and signal-conditioning electronics. The system is matched to reference target materials and is user-adjustable for other similar material by simple 2-point linearization.

*A complete measuring channel consits of:*

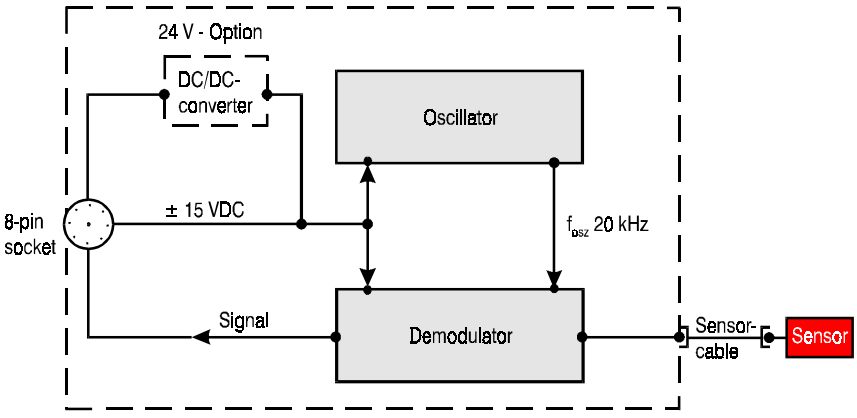
***1 -*** *a capacitive displacement sensor*
***2 -*** *a sensor cable*
***3 -*** *signal conditioning electronics*

*Optional:*

***4 -*** *power/signal cable*
***5 -*** *power supply*



## Block diagram




## Electronic models

**Amplifier-electronic DT 610**
Power supply: ± 15 VDC
Output: 0-10 V

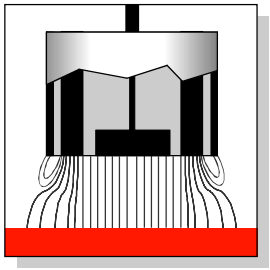
**Optional DC 24**
Power supply: 24 VDC
Output: 0-10 V

**Optional DC 9/36**
Power supply: 9-36 VDC
Output: 0-10 V

Technical specifications are valid for electrical conductors (metal) as reference material at 20 °C (70 °F) ambient temperature and for the standard length (1 m / 3.28 feet) of the sensor cable.

### Electrical conductors as targets

The linear characteristic of the measurement signal is achieved without extra electronic linearization when measuring against targets made of electrically-conductive materials (metals). Changes in the conductivity do not affect sensitivity or linearity.

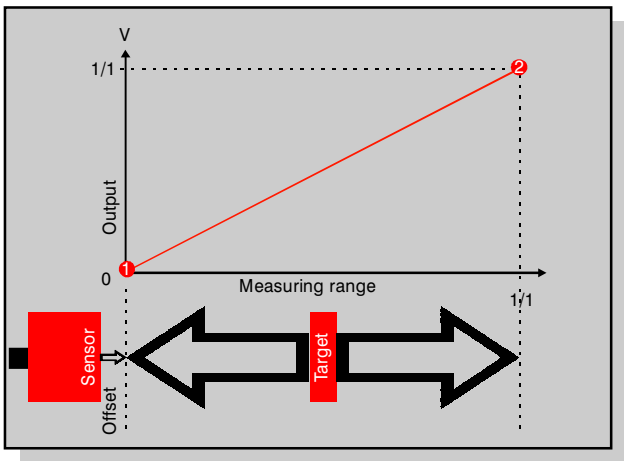


**Electrical conductor**

Certified acc. to

DIN EN ISO 9001: 1994

## Linearization and Calibration




capaNCDT 610 system is calibrated for metallic targets at the factory (output 0-10 Volt). In critical sensor mounting conditions, the rated range of the output characteristic can be adjusted and optimized, through the use of the zero and gain potentiometers. The adjustment is carried out at two distances (1= zero; 2= full-scale) that are measured by an independent reference.

## Technical data

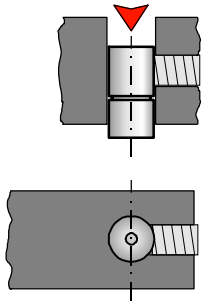
| Specification \ Sensor | | | S601-0,2 | S600-0,2 | S601-0,5 | S600-1 | S601-1 | S600-2 | S600-3 | S600-5 | S600-10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Measuring range | | mm | .2 | .2 | .5 | 1 | 1 | 2 | 3 | 5 | 10 |
| | | inch | .008 | .008 | .02 | .04 | .04 | .08 | .12 | .2 | .4 |
| Reference distance | | | .05 mm / .00197 inch | | | | | | | | |
| Linearity | ±1 % FSO | ±µm | 2 | 2 | 5 | 10 | 10 | 20 | 30 | 50 | 100 |
| Resolution | ±0.05 % FSO | ±µm | .1 | .1 | .25 | .5 | .5 | 1 | 1.5 | 2.5 | 5 |
| Sensor outer diameter | | mm | 6 | 6 | 8 | 10 | 10 | 20 | 30 | 40 | 60 |
| | | inch | .23 | .23 | .31 | .39 | .39 | .78 | 1.17 | 1.56 | 2.34 |
| Weight | | g | 2 | 2.5 | 12 | 7.1 | 7.1 | 61 | 95 | 120 | 230 |
| Active measuring area | Diameter | mm | 2.3 | 2.3 | 3.9 | 5.5 | 5.5 | 7.9 | 9.8 | 12.6 | 17.8 |
| | | inch | .09 | .09 | .15 | .21 | .21 | .31 | .38 | .49 | .69 |
| Guard ring width | | mm | 1 | 1 | 1.4 | 1.5 | 1.5 | 4 | 8.1 | 11.8 | 18.1 |
| | | inch | .04 | .04 | .05 | .06 | .06 | .16 | .32 | .46 | .71 |
| Min. diameter of target | | mm | 5 | 5 | 7 | 9 | 9 | 17 | 27 | 37 | 57 |
| | | inch | .2 | .2 | .3 | .35 | .35 | .7 | 1.1 | 1.5 | 2.3 |
| Temperature stability | Sensors | | ±0.02 % FSO / °C | | | | | | | | |
| | Electronics | | ±0.05 % FSO / °C | | | | | | | | |
| Long term stability[1] | | | 0.05 % FSO / month | | | | | | | | |
| Sensitivity | | V/mm | 50 | 50 | 20 | 10 | 10 | 5 | 3.33 | 2 | 1 |
| | | V/inch | 1270 | 1270 | 508 | 254 | 254 | 127 | 83.58 | 50.8 | 25.4 |
| Output | Standard | | 0 - 10 V<br>Resistance min. 1.2 k / Capacitance max. 1 nF | | | | | | | | |
| | Option I | | 4 - 20 mA / load max. 400 | | | | | | | | |
| Power supply | Standard | | ± 15 VDC / 50 mA (Option I 75 mA) | | | | | | | | |
| | Option DC 24 | | 24 VDC / 180 mA (Option I 205 mA) | | | | | | | | |
| | Option DC 9/36 | | 9 - 36 VDC / 200 mA (Option I 225 mA) | | | | | | | | |
| Band width | | | 0....500 Hz (-3 dB) | | | | | | | | |
| Temperature range | Sensors and cables | | -50 to +150 °C / -60 to +300 °F | | | | | | | | |
| | Electronics | | +10 to +50 °C / +50 to +125 °F | | | | | | | | |
| Sensor ambient air humidity | | | 5 to 95 % (non condensing) | | | | | | | | |
| Electromagnetic compatibility EMC | | | EN 50081-1 Spurious emission<br>EN 50082-2 Immunity to interference [2] | | | | | | | | |
| Protection class | Electronics and sensors | | IP 54 | | | | | | | | |

FSO = Full Scale Output 1 µm = 1 micron

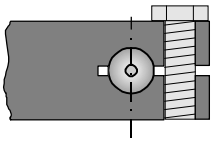
*1) At reference temperature 20 °C (68 °F) and steady state*

*2) Uncertainty of measurement: Immunity to interference / electromagnetic fields acc. to EN 50082-2 max. 1 %*

# Sensors and Sensor cables



Grub screw mounted (plastics)

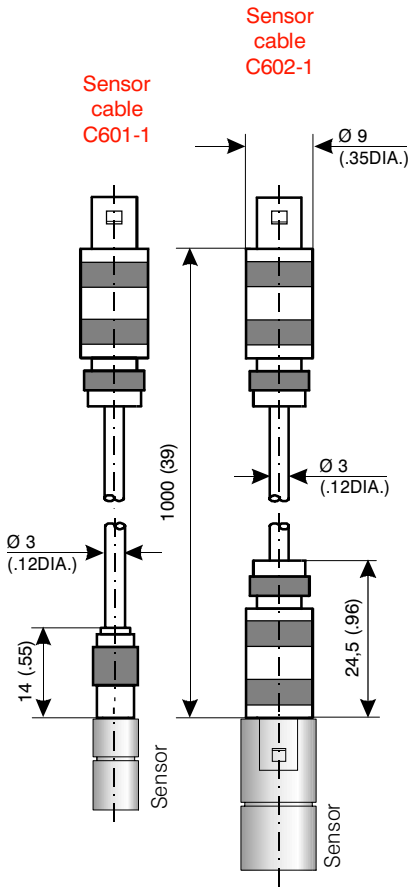


Clamping ring mounted

The sensors are designed as guard ring capacitors and are connected to the preamplifier electronics with a 1m (3.28 ft) long triaxial cable. The sensor cables are equiped with high quality plugs.
All standard sensors can be used within a sensitivity range from .5 to 1 % without recalibration.
Custom sensors are available.

### Sensor installation

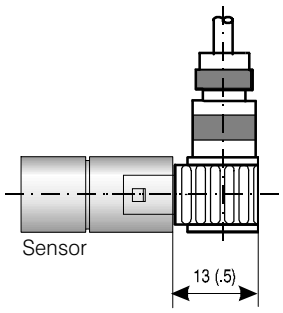
All sensors can be installed free-standing or flush and are secured by clamping or with a chuck.




## Sensor connecting cable

The sensor and electronics are connected by a double screened, 1 m (3.28 ft) long sensor cable.

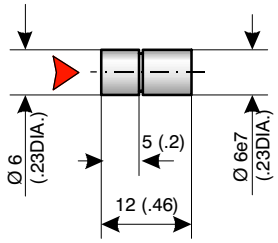
| Model | 2 straight connectors | 1 straight + 1 angled connector | suitable for sensors |
|---|---|---|---|
| C601-1 | ● | | S601-0,2 / S600-0,2 / S601-0,5 |
| C602-1 | ● | | S601-1 / S600-1 / S600-2 S600-3 / S600-5 / S600-10 |
| C602/90-1 | | ● | |



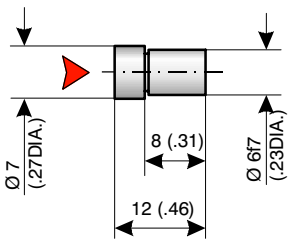

**Sensor cables dimensions in mm (inch)**

## Sensor dimensions in mm (inch)

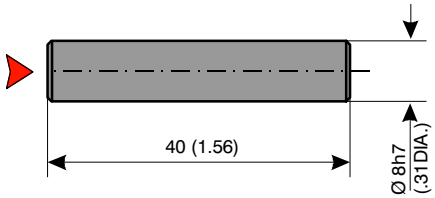
### S 601-0,2



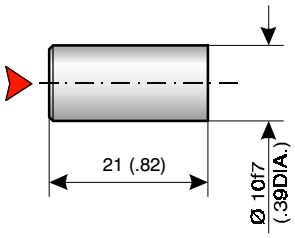

### S 600-0,2



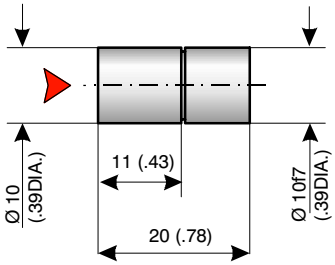

### S 601-0,5



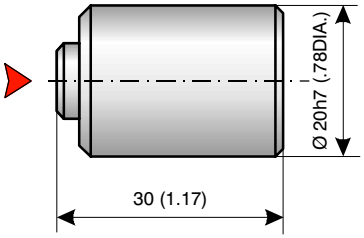

### S 600-1



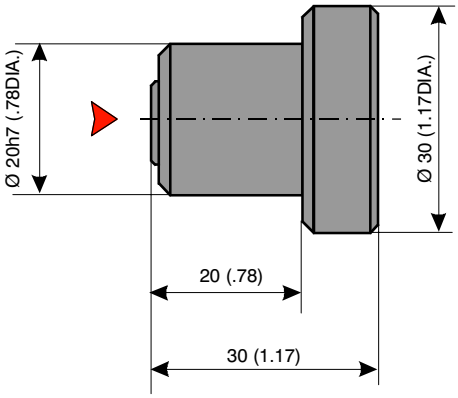

### S 601-1



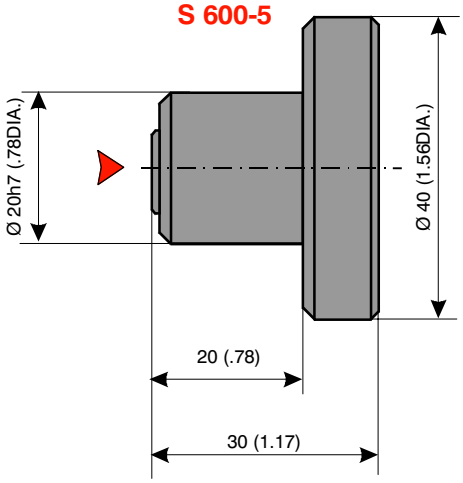

### S 600-2



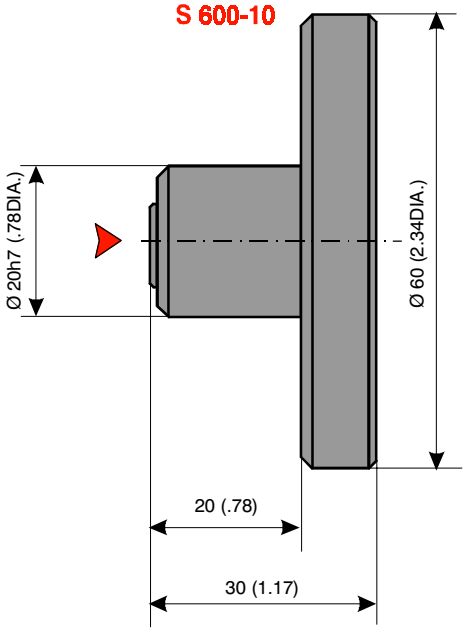

### S 600-3




### S 600-5



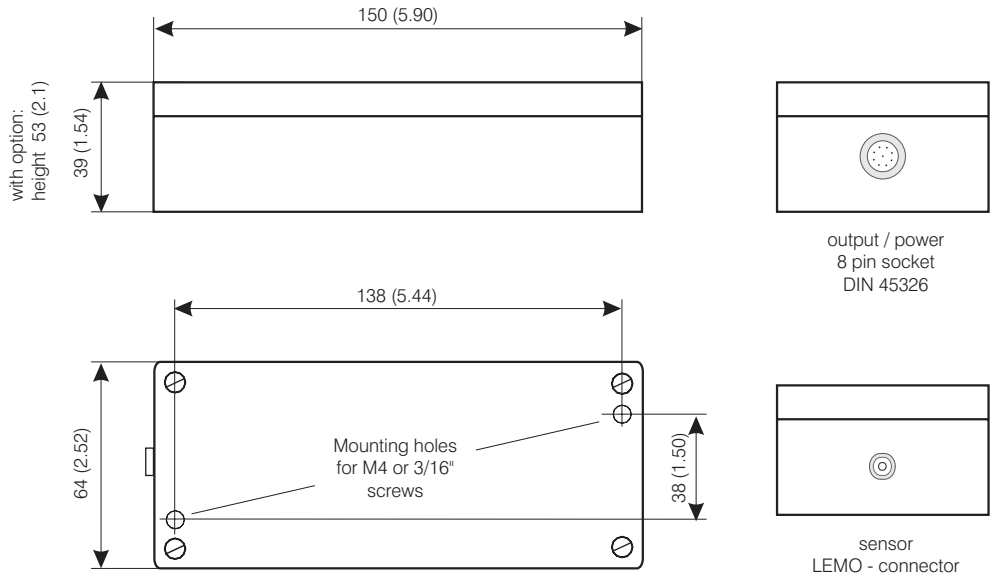

### S 600-10




| Dimension | Fit tolerance µm |
|---|---|
| 7 h7 | 0<br>-15 |
| 7 f7 | - 13<br>- 28 |
| 8 h7 | 0<br>- 15 |
| 20 h7 | 0<br>- 21 |
| 6 f7 | - 10<br>- 22 |
| 6 e7 | - 20<br>- 32 |
| 10 f7 | - 13<br>- 28 |

connector

## capaNCDT 610 Electronics-dimensions in mm (inch)




**Weight: 378 g**

## Accessories

**PC3/8**
Power- and output cable, 3 m (10 ft.) long, 8-pin

**PS100/15**
Power supply for mounting in cabinets
Output ± 15 VDC / 500 mA
Input 115 VAC / 230 VAC

**DD800**
Digital readout unit, programmable

**MC25**
Micrometer calibration fixture
Range 0 - 25 mm (0 - 1 inch)
Division 2 µm
Adjustable offset (zero), for all sensors

**MC2.5**
Micrometer calibration fixture
Range 0 - 2.5 mm (0 - 0.1 inch)
Division 1 µm
for sensors S 601-0,05 thru to S 600-2

**MC25D**
Digital micrometer calibration fixture
Range 0 - 25 mm (0 - 1 inch)
Adjustable offset (zero), for all sensors

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