MICRO-EPSILON

More Precision.

capaNCDT 6500

High resolution capacitive multi channel system

Sub-nanometer-resolution

- **Multi-channel system**
- **Extreme high resolution**
- **True non contact measurement**
- **Unmatched temperature stability**
- **Any target, insulator measurement**
- **Tabletop or 19-inch-rack-mount**

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 opposing target. 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 analogue signal.

The high linearity is in the measuring principle

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

$$X_C = \frac{1}{j \cdot \omega \cdot C}$$

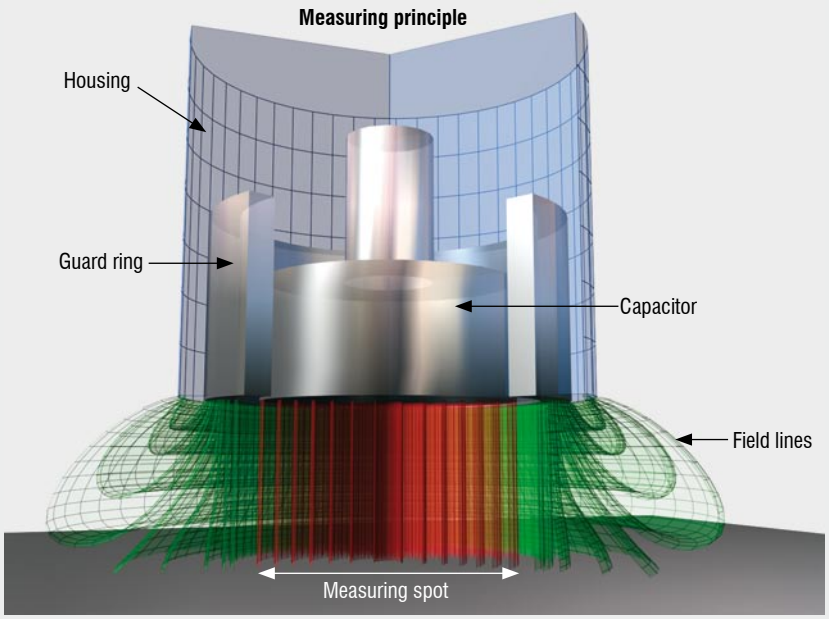
$$\text{capacitance } C = \varepsilon_r \cdot \varepsilon_0 \cdot \frac{\text{area}}{\text{distance}}$$

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

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

Active guard triaxial cable & three-electrode technology

The Micro-Epsilon capacitive system uses an unique active driven and hermetically sealed triaxial RF cable in conjunction with an active guarded three-electrode sensor. Therefore the system is electron leakage proof and creates a protected homogeneous measurement field enabling an absolute unmatched stable, interference free precision measurement.
Any parasitic capacitance which would compromise the accuracy is eliminated!



Application fields:

capaNCDT 6500 is designed for industrial use in production plants and for measuring and testing during in-process quality assurance. Illustrated here are just a few examples of many different potential applications for the sensors.

1 - vibration, amplitude, clearance, run-out

2 - displacement, distance, position, elongation

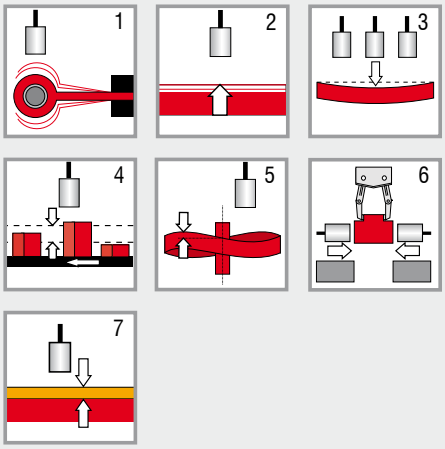
3 - deflection, deformation, waviness, tilt

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

5 - stroke, deformation, axial shaft oscillation

6 - in-process quality control, dimensional inspection

7 - thickness measurement on insulator material



System structure

The capaNCDT 6500 can be used for multi-channel operation and has been designed as a modular system. The sensors are connected to the signal conditioning electronics (Euro size cards) via a preamplifier module.

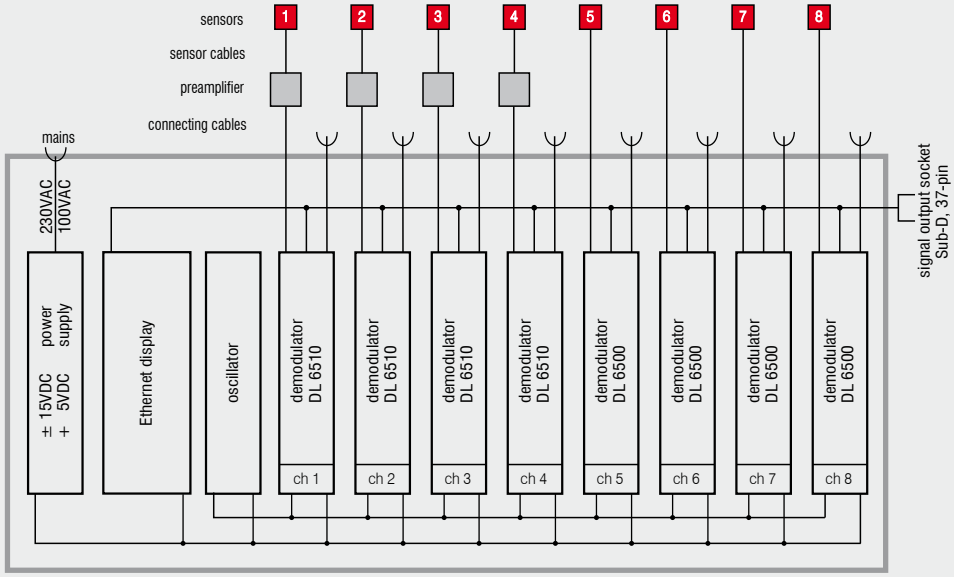
System Software

Digital values can be visualised and can be further calculated with the included software.

The system (n channels) consists of:

1. electronic cabinet with power supply, display, ethernet, oscillator and analog output RS6500
2. n x demodulator modules DL6510 (DL6500 with integral preamplifier)
3. n x preamplifier connecting cables (page 6)
4. n x preamplifier modules CP6001
5. n x sensor cables (page 6)
6. n x sensors (page 7)

DL6510: One item of position 2 to 6 is needed for each channel.
DL6500: One item of position 2, 5 and 6 is needed for each channel.
If the distance between the sensor and the rack is more than 3m the demodulator type DL6510 is needed.



Preamplifier CP6001

DL6510
with external preamplifier
for cable length >3m

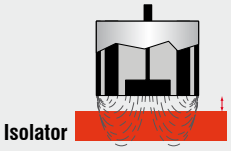
DL6500
with integral preamplifier
for cable length <3m

Standard distance measurement

The inherent linearity is based on the measuring principle for distance mode. The capaNCDT system evaluates the reactance X_C of the capacitor which changes strictly proportionally with the distance:
The linear characteristic of the measurement signal is achieved without extra electronic linearisation when measuring against flat targets made of electrically-conductive materials (metals), changes in the conductivity do not affect sensitivity or linearity. Any conductive or even semi-conductive targets are measured with the same measurement performance.

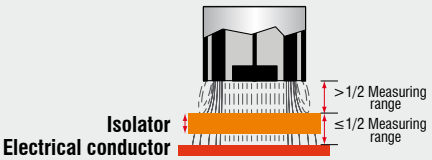
Insulator distance measurement

The capaNCDT system also measures against insulating materials. Linear performance for this type of target is achieved by using unique electronic circuitry. By measuring the length of the electrical field which is exciting the probe and returning through the target to the sensor shield, we can determine the distance. A consistent relative dielectric property of the material is necessary for accurate measurement.



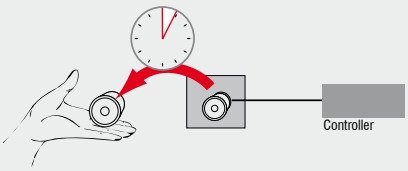
Thickness measurement

The system can also measure linear the thickness of insulator material. The capaNCDT system evaluates the reactance X_C change based on the dielectric volume of the material inside the constant sensor gap.



Instant sensor swap without recalibration

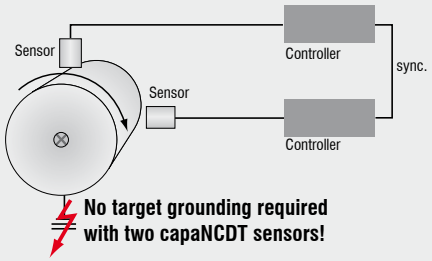
The unique Micro-Epsilon capacitive technology allows changing any capaNCDT sensor within seconds! Replacing sensors with different measuring ranges and any capaNCDT controller is possible without recalibration. A sensor swap with capaNCDT needs no more than 5 seconds, while other capacitive systems are not designed for replacing components without the need of individual calibration and linearization.



Instant sensor swap within 5 seconds!
Replace any capaNCDT controller and any capaNCDT sensor within seconds without recalibration!

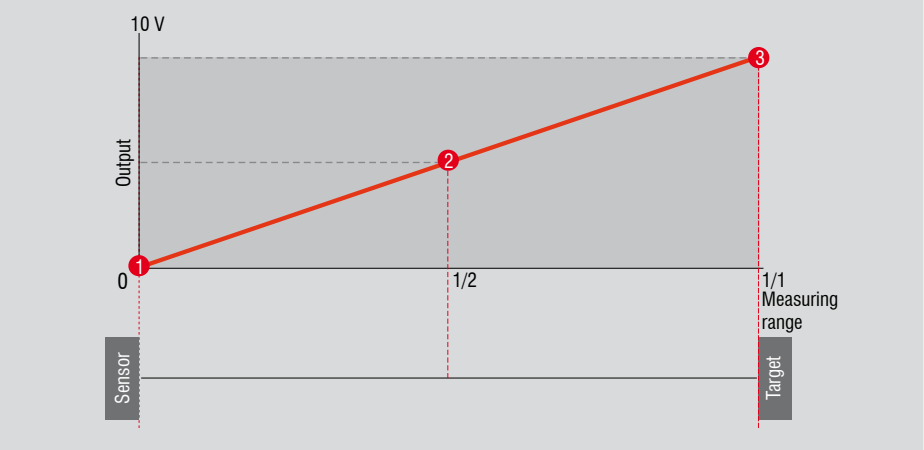
Non-contact target grounding

Target grounding sometimes can be very difficult or even impossible. Unlike conventional systems, due to the unique synchronisation of two capaNCDT systems, the target does not require any electrical grounding.
The principle on the right shows two synchronised capaNCDT sensors measuring roller run-out. The target does not need to be grounded because of the unique synchronised-non-contact-grounding technology.



Linearization and Calibration

capaNCDT 6500 systems are calibrated for metallic targets at factory (output 0-10 Volt). In special target materials or critical sensor mounting applications, the rated range of the output characteristic can be adjusted and optimized through the use of the “zero” potentiometer.
When insulators are used as target, a 3 point linearization is necessary. The adjustment is carried out at three distances (1= zero; 2= mid-range; 3= full-scale) which are measured by an independent reference.



Sensor			S601 -0.05	CS02	CS05	CS1	CS1HP	CS2	CS3	CS5	CS10
Measuring range	el. cond. (metal)	mm	0.05	0.2	0.5	1	1	2	3	5	10
Linearity [1]	±0.2% FSO	µm	0.1	0.4	-	-	-	-	-	-	-
	±0.05% FSO	µm	-	-	0.25	0.5	0.5	1	1.5	2.5	5
Repeatability [2]	0.0003% FSO	nm	0.15	0.6	1.5	3	3	6	9	15	30
Resolution	2.6 Hz; 0.000075% FSO	nm	0.0375	0.15	0.375	0.75	0.75	1.5	2.25	3.75	7.5
	100 Hz; 0.0003% FSO	nm	0.15	0.6	1.5	3	3	6	9	15	30
	8.5 kHz; 0.002% FSO	nm	1	4	10	20	20	40	60	100	200
Sensor outer diameter		mm	6	6	8	10	10	20	30	40	60
Weight		g	2	2	3.5	7.1	7.1	61	95	120	230
Active measuring area (diameter)		ømm	1.3	2.3	3.9	5.5	5.5	7.9	9.8	12.6	17.8
Guard ring width		mm	0.8	1	1.4	1.5	1.5	4	8.1	11.8	18.1
Min. diameter of target	electr. cond. (metal)	mm	3	5	7	9	9	17	27	37	57
	insulator	mm	-	7	10	12	12	24	36	48	72
Temperature stability (sensor)	zero	µm/°C	0.06	0.06	0.06	0.17	0.06	0.17	0.17	0.17	0.17
	sensitivity	ppm/°C	11	11	11	30	11	30	30	30	30
Temperature stability (controller)			Digital: 5ppm/°C Analog:10ppm/°C								
Nominal sensitivity		V/mm	200	50	20	10	10	5	3.33	2	1
Output	voltage		0 - 10V (max. 10mA short circuit proof); Offset ≤10V to 0V								
	current		4…20mA (load max. 500Ohm)								
	digital		Ethernet 24 bit measurements								
Power supply			90 … 265VAC (50 … 60Hz)								
Bandwidth analog output			8.5kHz (-3dB) (adjustable hardware 8.5kHz; 1kHz and 20Hz)								
Bandwidth digital output	data rate			1kHz			2kHz			7.8kHz	
	max. channels			8			4			1	
Temperature range	sensors		-50 to +200 °C								
	sensor cable		-50 to +200 °C								
	electronics		+10 to +60 °C								
Air humidity	sensors		5 to 95% (non condensing)								
Electromagnetic compatibility (EMC)			DIN EN 61326 Spurious emission DIN EN 61000-6-2 Immunity to interference								
Protection class	controller & sensors		IP 40								

FSO = Full Scale Output
All data valid for standard sensor cable length 1m.
[1] only valid for originally delivered measuring channel with factory matched sensor and electronics
[2] at constant ambient temperature (including temperature and air humidity)

Sensor cables

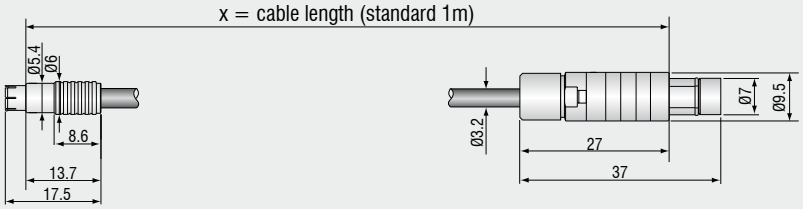
The sensors are designed as tri-electrode guard ring capacitors and are connected to the preamplifier electronics with a triaxial cable. The sensor cables are equipped with high quality triaxial RF connectors. All standard sensors can be used within any capaNCDT series electronic without recalibration (max. 0.5% deviation). Micro-Epsilon offers and designs customized probes for your specific application.

IMPORTANT!
All Micro-Epsilon sensors are short circuit proof. Unlike other systems the preamplifier will not get damaged, if the front face of the sensor gets shorted by touching the conductive target

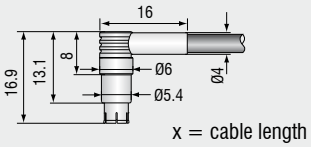
Sensor connecting cable

The sensor and preamplifier are connected by a special triaxial active guarded sensor cable. A special cable length of 2m and 3m is an option and requires special tuning of the preamplifier.

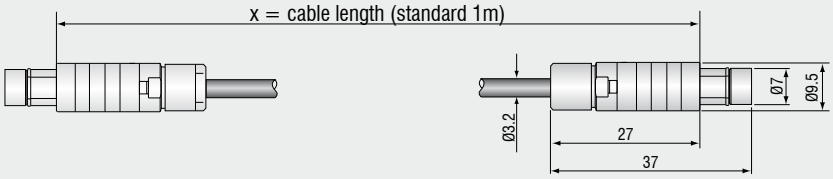
Sensor cable CCxC



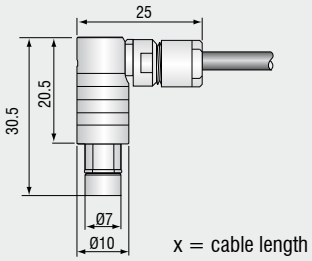
Sensor cable CCxC/90



Sensor cable CCxB

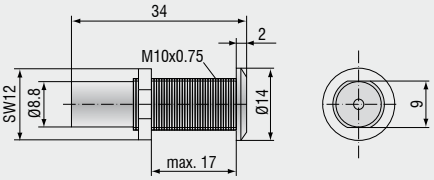


Sensor cable CCxB/90

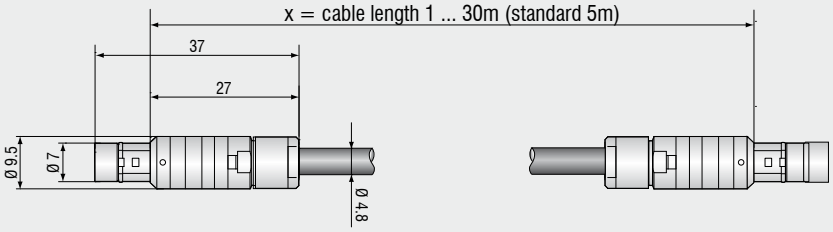


Model	for sensors	Cable length	2 straight connectors	1x straight + 1x 90°
CC1C	S601-0.05 CS02 CS05	1 m	x	
CC2C		2 m	x	
CC3C		3 m	x	
CC1C/90		1 m		x
CC2C/90		2 m		x
CC3C/90		3 m		x
CC1B	CS1 CS1HP CS2 CS3 CS5 CS10	1 m	x	
CC2B		2 m	x	
CC3B		3 m	x	
CC1B/90		1 m		x
CC2B/90		2 m		x
CC3B/90		3 m		x

Vacuum feed through SWH



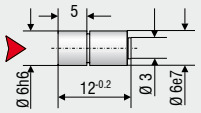
Preamplifier sensor cable CA5/CAx



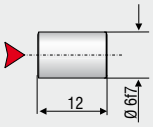
(Dimensions in mm, not to scale)

Sensor dimensions (Dimensions in mm, not to scale)

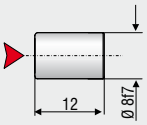
S 601-0.05



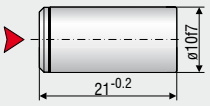
CS02



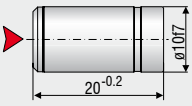
CS05



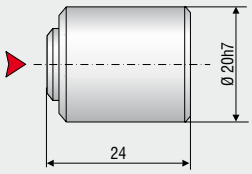
CS1



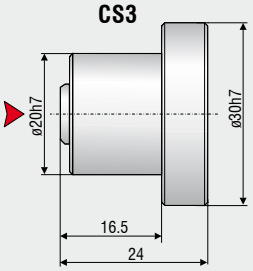
CS1HP



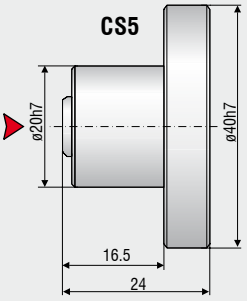
CS2



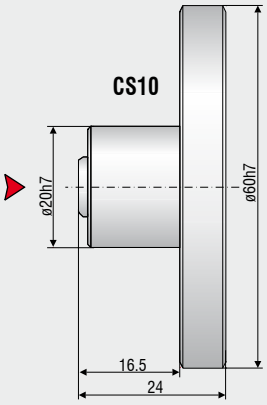
CS3



CS5



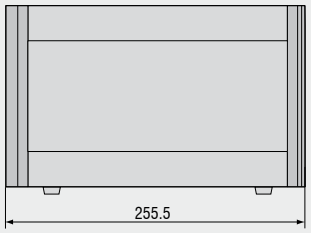
CS10

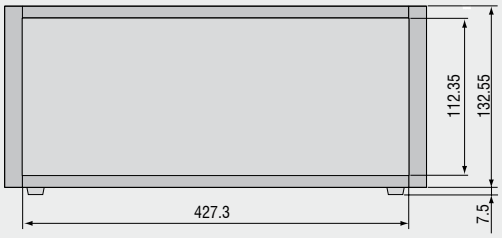


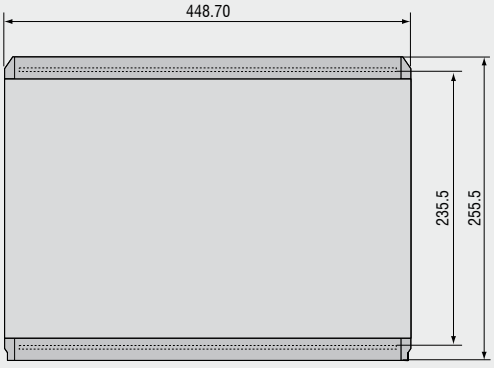
Dimension	Fit tolerance (µm)
6h6	0 - 8
6e7	-20 - 32
6f7	-10 - 22
8f7	- 13 - 28
10f7	- 13 - 28
20h7	0 - 21
30h7	0 - 21
40h7	0 - 25
60h7	0 - 30

▶ connector

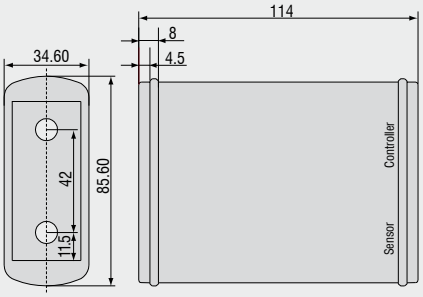
Controller DT6500



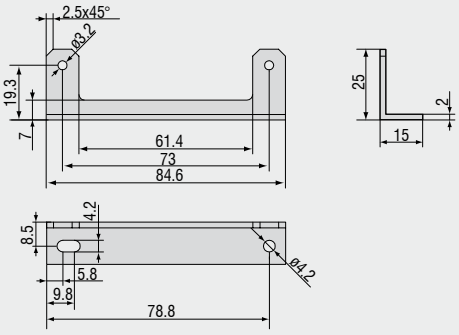




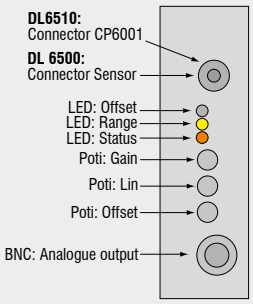
CP6001 preamplifier



Mounting adapter for CP6001



Front cover DL6500/6510



Accessories

MC2.5
Micrometer for sensor calibration
Range 0 - 2.5mm
Resolution 0.1µm
For sensors S 601-0.05 through to CS 2

MC25D
Micrometer for sensor calibration
with digital display
Range 0 - 25mm
Adjustable offset (zero), for all sensors

SWH.0S.650.CTMSV
Vacuum transition connector

System components:

System capaNCDT 6500 (with integral preamplifier):
- RS6500 Rack
- Demodulator
- Sensor cable
- Sensor

System capaNCDT 6510 (with external preamplifier):
- RS6500 Rack
- Demodulator
- Sensor cable
- Sensor
- Preamplifier
- Preamplifier cable

High performance sensors made by Micro-Epsilon

Sensors and systems for displacement, position and dimension
Eddy current sensors
Optical and laser sensors
Capacitive sensors
Inductive sensors
Draw-wire sensors
Optical micrometers
2D/3D profile sensors
Image processing

Sensors and measurement devices for non-contact temperature sensors
Online instruments
Handheld devices
Thermal imagers

Measuring systems for quality control
for plastic and film
for tire and rubber
for web material
for automotive components
for glass

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