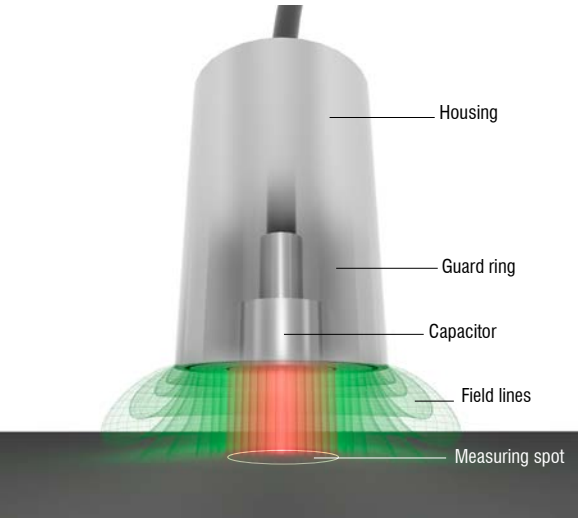
MICRO-EPSILON

More Precision

capaNCDT // Capacitive displacement sensors and systems

Measuring principle



Measuring principle

The principle of capacitive displacement measurement using the capaNCDT (capacitive Non-Contact Displacement Transducer) system is based on how an ideal plate-type capacitor operates. The two plate electrodes are represented by the sensor and the opposing measurement object. If a constant alternating current flows through the sensor capacitor, the amplitude of the alternating voltage on the sensor is proportional to the distance between the capacitor electrodes. The alternating current is demodulated and output as, for example, an analogue signal.

Benefits of the measuring principle

- Wear-free and non-contact measurement
- No interfering force on the target
- Robust against run out of electrically conductive measurement objects
- Unmatched accuracy and stability
- High bandwidth for fast measurements

Unmatched precision

Practice shows that capaNCDT measurement systems achieve excellent results in terms of linearity, reproducibility and resolution. While sub-micrometer precision is reached in typically industrial environments, high-precision sub-nanometre measurements are carried out in clean environments.

Use of capacitive sensors

The sensors measure against all electrically conductive materials, and with appropriate electronic circuitry even against insulators. Capacitive sensors are applied for displacement, position and thickness measurement.
The capacitive measuring principle is one of the most precise measurement methods for non-contact displacement measurement. The measurement principle requires a clean environment where a change of the dielectric ε_r affects the measurement result.

Modern and user-friendly controller technology

Modern capaNCDT controllers are the ideal basis for different fields of applications. Various interfaces and ease of use via web interface allow for a fast integration into the respective application environment.

Unique sensor design

The completely triaxial sensor design is unique for capaNCDT sensors, where the guard ring electrode and the grounding are also located on the front edge of the sensor as well as the measurement electrode. This means capaNCDT sensors can also be installed completely flush in conductive materials. The sensors can also come into contact with each other in the case of multi-channel measurements. Interference of the measuring field is reliably prevented by the triaxial design of the sensor.

Active guard triaxial cable

Capacitive measurement systems from Micro-Epsilon operate with a unique, active, low noise cable in combination with an active guard ring capacitor. A particularly high quality signal is achieved due to the double shielding of the field. The system has an almost perfect impermeable electrical shield, which ensures precise measurements. In addition, the guard ring electrode provides a protected, completely homogeneous measuring field for extremely high stability and interference-free, accurate measurements.

Sensor and controller exchange without calibration

The capacitive measuring principle specially developed by Micro-Epsilon enables the simple change of a sensor in just a few seconds. This simplified replacement of sensors with different measuring ranges and the interchange of different capaNCDT controllers can be easily carried out without any recalibration. A sensor replacement normally takes around 5 seconds, unlike conventional systems, which have to be subjected to time-consuming calibration and linearisation.

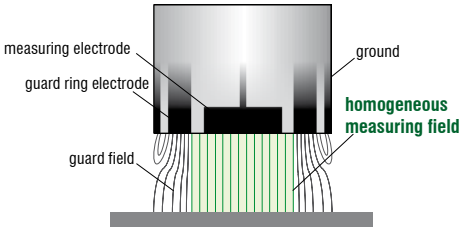
Non-contact target grounding

Unlike conventional systems, the target for synchronisation of two capaNCDT devices does not necessarily have to be grounded. However, maximum signal quality is only achieved when the measurement object is correctly grounded.

Sensors for customer-specific applications and OEM

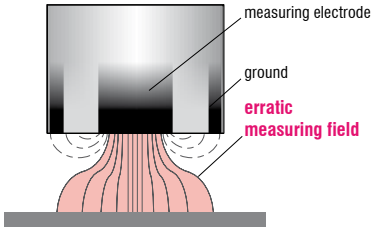
For special tasks, the measuring systems can be modified according to a customer's specific individual requirements. Changes requested include, for example, modified designs, target calibration, mounting options, individual cable lengths, modified measuring ranges or sensors with integrated controller.

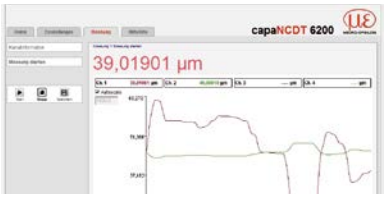
MICRO-EPSILON capaNCDT sensors



Active guard field for high precision measurement

Common capacitive sensors





Unmatched precision

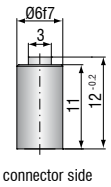
- Resolution from 0.0375nm
- Linearity from 0.1µm
- Reproducibility from 0.0003 % FSO

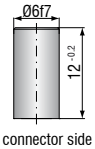
High stability

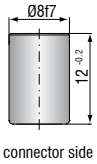
- Temperature stability 5 ppm (temperature range -270°C to +200°C, higher temperatures on request)
- Long-term stability ±0.002 % FSO / month

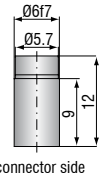
Comprehensive portfolio of sensors

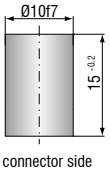
- 25 standard sensors with measuring ranges from 0.05mm to 10mm
- Controller operated via web browser, calculation functions, analogue interface, Ethernet and EtherCAT











Sensor Type		CS005	CS02	CS05	CSE05	CS08
Article number		6610083	6610051	6610053	6610102	6610080
Measuring range	reduced	0.025mm	0.1mm	0.25mm	0.25mm	0.4mm
	standard	0.05mm	0.2mm	0.5mm	0.5mm	0.8mm
	extended	0.1mm	0.4mm	1mm	1mm	1.6mm
Linearity [1]		0.15µm	0.4µm	0.15µm	0.15µm	0.4µm
		0.3% FSO	0.2% FSO	0.03% FSO	0.03% FSO	0.2% FSO
Resolution [1] (static, 2Hz)		0.0375nm	0.15nm	0.375nm	0.375nm	0.6nm
Resolution [1] (dynamic, 8.5kHz)		1nm	4nm	10nm	10nm	16nm
Temperature stability zero [4]		-60nm/°C	-60nm/°C	-60nm/°C	-60nm/°C	-60nm/°C
Temperature stability sensitivity		-0.5nm/°C	-2nm/°C	-5nm/°C	-5nm/°C	-8nm/°C
Temperature range (operation)		-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C
Temperature range (storage)		-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C
Air humidity [2]		0 … 95% r.H.	0 … 95% r.H.	0 … 95% r.H.	0 … 95% r.H.	0 … 95% r.H.
Sensor dimensions		Ø6 × 12 mm	Ø6 × 12 mm	Ø8 × 12mm	Ø6 × 12mm	Ø10 × 15mm
Active measuring area		Ø1.3 mm	Ø2.3 mm	Ø3.9mm	Ø3.9 mm	Ø4.9mm
Guard ring width		0.8mm	1mm	1.4mm	0.8mm	1.6mm
Minimum target diameter		Ø3mm	Ø5mm	Ø7mm	Ø6mm	Ø9mm
Weight		2g	2g	4g	2g	7g
Material (housing)		NiFe [3] (magn.)	NiFe (magn.)	NiFe (magn.)	NiFe (magn.)	NiFe (magn.)
Connector type		type C	type C	type C	type C	type C
Mounting		radial clamp	radial clamp	radial clamp	radial clamp	radial clamp

FSO = Full Scale Output
[1] With reference controller, relates to standard measuring range
[2] Non condensing
[3] Titanium version available
[4] Sensor mounted in the mid of clamping area

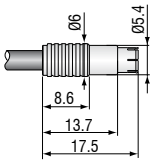
Sensors

The sensors are designed as guard ring capacitors. They are connected to the signal conditioning electronics with a triaxial cable. The sensor cable is connected to the sensor using a high quality connector. All standard sensors can be used within a maximum deviation of 0.3% without recalibration. Individually matched special sensors are produced on request.

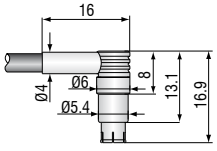
Measuring range expansion / reduction

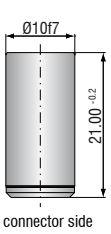
The capaNCDT controller can optionally be configured so that the standard measuring ranges of the sensors are reduced by half or expanded by the factor of 2. The reduction increases the accuracy while the measuring range expansion reduces the accuracy.

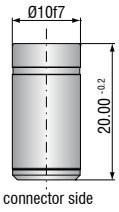
Connector type C

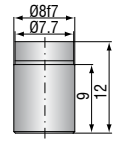


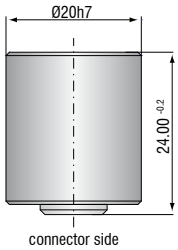
Connector type C/90

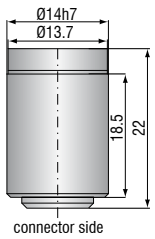












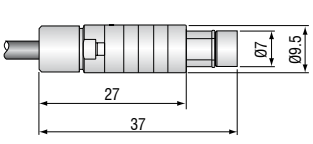
Sensor Type		CS1	CS1HP	CSE1	CS2	CSE2
Article number		6610054	6610074	6610103	6610052	6610104
Measuring range	reduced	0.5mm	0.5mm	0.5mm	1mm	1mm
	standard	1mm	1mm	1mm	2mm	2mm
	extended	2mm	2mm	2mm	4mm	4mm
Linearity [1]		1.5µm	1.5µm	2µm	1µm	2.6µm
		0.15% FSO	0.15% FSO	0.2% FSO	0.05% FSO	0.13% FSO
Resolution [1] (static, 2Hz)		0.75nm	0.75nm	0.75nm	1.5nm	1.5nm
Resolution [1] (dynamic, 8.5kHz)		20nm	20nm	20nm	40nm	40nm
Temperature stability zero [4]		-170nm/°C	-60nm/°C	-60nm/°C	-170nm/°C	-170nm/°C
Temperature stability sensitivity		-32nm/°C	-10nm/°C	-10nm/°C	-64nm/°C	-64nm/°C
Temperature range (operation)		-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C
Temperature range (storage)		-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200 C	-50 … +200°C
Air humidity [2]		0 … 95% r.H.	0 … 95% r.H.	0 … 95% r.H.	0 … 95% r.H.	0 … 95% r.H.
Sensor dimensions		Ø10 × 21mm	Ø10 × 20mm	Ø8 × 12mm	Ø20 × 24mm	Ø14 × 22mm
Active measuring area		Ø5.7mm	Ø5.7mm	Ø5.7mm	Ø7.9mm	Ø8.0mm
Guard ring width		1.5mm	1.5mm	0.9mm	4.4mm	2.7mm
Minimum target diameter		Ø9mm	Ø9mm	Ø8mm	Ø17mm	Ø14mm
Weight		8g	8g	3.5g	50g	20g
Material (housing)		1.4404 [3] (non-magn.)	NiFe (magn.)	NiFe (magn.)	1.4404 [3] (non-magn.)	1.4404 (non-magn.)
Connector type		type B	type B	type C	type B	type B
Mounting		radial clamp	radial clamp	radial clamp	radial clamp	radial clamp

FSO = Full Scale Output
[1] With reference controller, relates to standard measuring range
[2] Non condensing
[3] Titanium version available
[4] Sensor mounted in the mid of clamping area

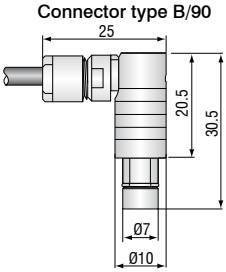
Mounting cylindrical sensors

All sensors can be installed as either freestanding or flush mounted. Fastening is carried out using a clamp or collet.

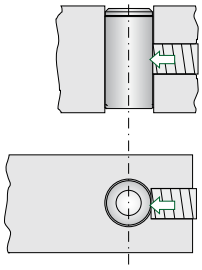
Connector type B



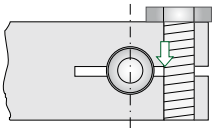
Connector type B/90

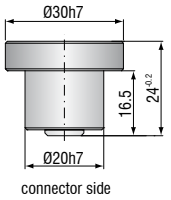


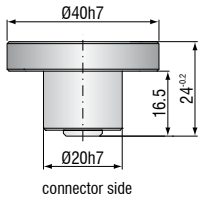
Mounting with grub screw (plastic)

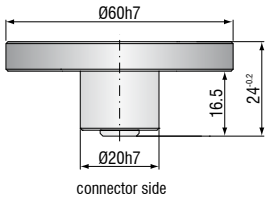


Mounting with collet



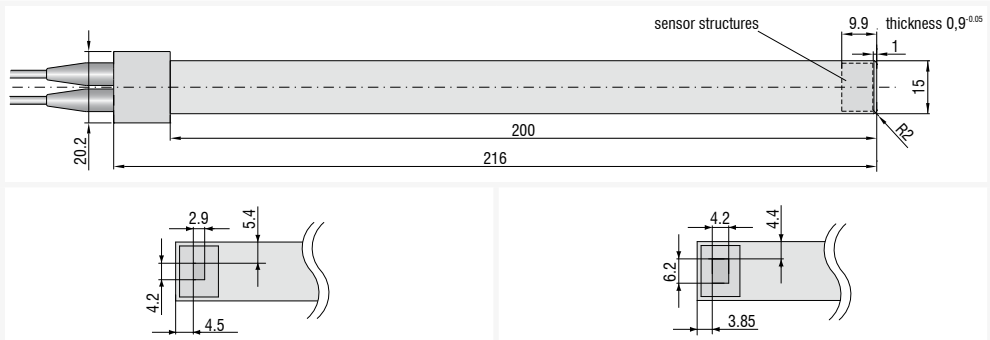






Sensor Type		CS3	CS5	CS10
Article number		6610055	6610056	6610057
Measuring range	reduced	1.5mm	2.5mm	5mm
	standard	3mm	5mm	10mm
	extended	6mm	10mm	20mm
Linearity [1]		0.9µm	2.5µm	15µm
		0.03% FSO	0.05% FSO	0.15% FSO
Resolution [1] (static, 2Hz)		2.25nm	3.75nm	7.5nm
Resolution [1] (dynamic, 8.5kHz)		60nm	100nm	200nm
Temperature stability zero [4]		-170nm/°C	-170nm/°C	-170nm/°C
Temperature stability sensitivity		-96nm/°C	-160nm/°C	-320nm/°C
Temperature range (operation)		-50 … +200°C	-50 … +200°C	-50 … +200°C
Temperature range (storage)		-50 … +200°C	-50 … +200°C	-50 … +200°C
Air humidity [2]		0 … 95% r.H.	0 … 95% r.H.	0 … 95% r.H.
Sensor dimensions		Ø30 × 24mm	Ø40 × 24mm	Ø60 × 24mm
Active measuring area		Ø9.8mm	Ø12.6mm	Ø17.8mm
Guard ring width		8mm	11.6mm	19mm
Minimum target diameter		Ø27mm	Ø37mm	Ø57mm
Weight		70g	95g	180g
Material (housing)		1.4404 (non-magn.)	1.4404 [3] (non-magn.)	1.4404 [3] (non-magn.)
Connector type		type B	type B	type B
Mounting		radial clamp	radial clamp	radial clamp

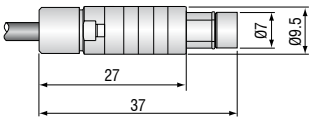
FSO = Full Scale Output
[1] With reference controller, relates to standard measuring range
[2] Non condensing
[3] Titanium version available
[4] Sensor mounted in the mid of clamping area

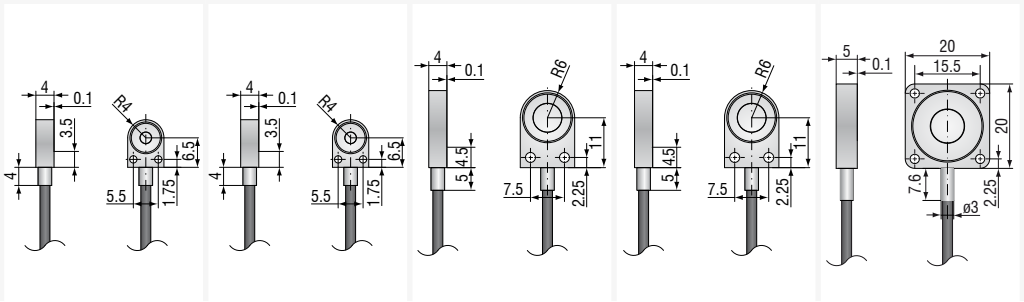


Sensor Type	CSG0,50-CAm2,0	CSG1,00-CAm2,0
Article number	6610112	6610111
Measuring range standard	0.5mm	1mm
Gap width [1]	0.9 - 1.9mm	0.9 - 2.9mm
Linearität [2]	0.5µm	1µm
Resolution [2] (static, 2Hz)	4nm	8nm
Resolution [2] (dynamic, 8,5kHz)	90nm	180nm
Temperature stability zero	-50nm/°C	-50nm/°C
Temperature stability sensitivity	-20nm/°C	-40nm/°C
Temperature range (operation)	-50…+100°C	-50…+100°C
Temperature range (storage)	-50…+100°C	-50…+100°C
Air humidity [3]	0…95%	0…95%
Sensor dimensions	200 x 15 x 0.9mm	200 x 15 x 0.9mm
Active measuring area	3 x 4.3mm	4.2 x 5.1mm
Guard ring width	2.7mm	2.2mm
Minimum target diameter	approx. 7 x 8mm	approx. 8 x 9mm
Weight	77g	77g
Material (housing)	1.4301	1.4301
Material (sensor)	FR4	FR4
Integrated cable	2m	2m

[1] Sensor width + measuring range on both sides
[2] With controller DT6530
[3] Non condensing

Connector type B





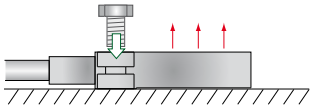
Sensor Type		CSH02FL-CRm1,4	CSH05FL-CRm1,4	CSH1FL-CRm1,4	CSH1,2FL-CRm1,4	CSH2FL-CRm1,4
Article number		6610075	6610085	6610072	6610077	6610094
Measuring range	reduced	0.1mm	0.25mm	0.5mm	0.6mm	1mm
	standard	0.2mm	0.5mm	1mm	1.2mm	2mm
	extended	0.4mm	1mm	2mm	2.4mm	4mm
Linearity [1]		0.05µm	0.09µm	0.2µm	0.84µm	0.32µm
		0.025% FSO	0.018% FSO	0.02% FSO	0.07% FSO	0.016% FSO
Resolution [1] (static, 2Hz)		0.15nm	0.38nm	0.75nm	0.9nm	1.5nm
Resolution [1] (dynamic. 8.5kHz)		4nm	10nm	20nm	24nm	40nm
Temperature stability zero [4]		-37.6 or 2.4nm/°C	-37.6 or 2.4nm/°C	-37.6 or 2.4nm/°C	-37.6 or 2.4nm/°C	-47 or 4nm/°C
Temperature stability sensitivity		-2.4nm/°C	-6nm/°C	-12nm/°C	-14.4nm/°C	-24nm/°C
Temperature range (operation)		-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C
Temperature range (storage)		-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C
Air humidity [2]		0 … 95% r.H.	0 … 95% r.H	0 … 95% r.H	0 … 95% r.H	0 … 95% r.H
Sensor dimensions [3]		10.5 × 8 × 4mm	10.5 × 8 × 4mm	17 × 12 × 4mm	17 × 12 × 4mm	20 × 20 × 5mm
Active measuring area		Ø2.6mm	Ø4.1mm	Ø5.7mm	Ø6.3mm	Ø8.1mm
Guard ring width		Ø1.9mm	Ø1.2mm	Ø2.4mm	Ø2.1mm	Ø4.4mm
Minimum target diameter		Ø7mm	Ø7mm	Ø11mm	Ø11mm	Ø17mm
Weight (incl. cable and connector)		28g	28g	30g	30g	36g
Material (housing)		1.4104 (magn.)	1.4104 (magn.)	1.4104 (magn.)	1.4104 (magn.)	1.4104 (magn.)
Integrated cable		Ø2.1mm×1.4m radial	Ø2.1mm×1.4m radial	Ø2.1mm×1.4m radial	Ø2.1mm×1.4m radial	Ø2.1mm×1.4m radial
Mounting		2x thread M2	2x thread M2	2x screw M2 DIN 84A	2x screw M2 DIN 84A	4x screw M2 DIN 84A

FSO = Full Scale Output CSH Sensors are matched to controller with standard cable length
[1] With reference controller, relates to standard measuring range
[2] Non condensing
[3] Without cable, bend protection and crimp
[4] In the case of a sensor mounting on the top or underside

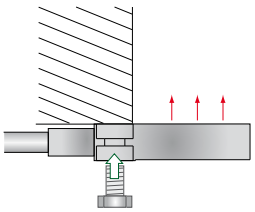
Mounting flat sensors

The flat sensors are attached using a threaded bore for M2 (for the sensors CSH02FL and CSH05FL) or using a through-hole for M2 bolts. The sensors can be bolted from above or below.

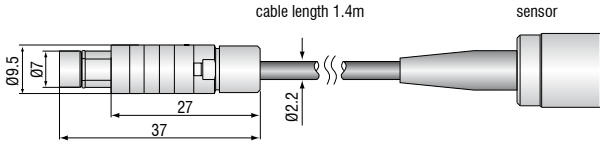
Screw connection from above on the underside

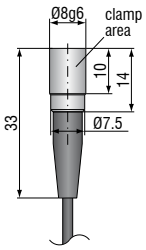


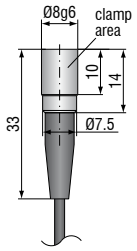
Screw connection from below on the sensor top side

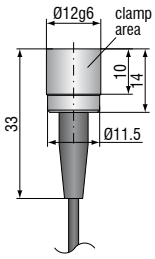


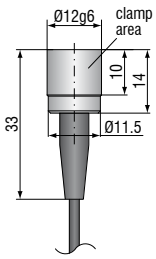
Connector for integrated cables

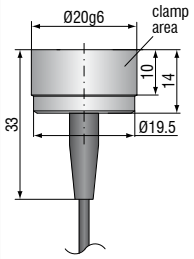












Sensor Type		CSH02-CAm1,4	CSH05-CAm1,4	CSH1-CAm1,4	CSH1,2-CAm1,4	CSH2-CAm1,4
Article number		6610086	6610087	6610088	6610089	6610107
Measuring range	reduced	0.1mm	0.25mm	0.5mm	0.6mm	1mm
	standard	0.2mm	0.5mm	1mm	1.2mm	2mm
	extended	0.4mm	1mm	2mm	2.4mm	4mm
Linearity [1]		0.054µm	0.13µm	0.13µm	0.84µm	0.5µm
		0.027% FSO	0.026% FSO	0.013% FSO	0.07% FSO	0.025% FSO
Resolution [1] (static, 2Hz)		0.15nm	0.38nm	0.75nm	0.9nm	1.5nm
Resolution [1] (dynamic. 8.5kHz)		4nm	10nm	20nm	24nm	40nm
Temperature stability zero [4]		-19nm/°C	-19nm/°C	-19nm/°C	-19nm/°C	-19 nm/°C
Temperature stability sensitivity		-2.4nm/°C	-6nm/°C	-12nm/°C	-14.4nm/°C	-24nm/°C
Temperature range (operation)		-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C
Temperature range (storage)		-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C	-50 … +200°C
Air humidity [2]		0 … 95%r.H.	0 … 95%r.H.	0 … 95%r.H.	0 … 95%r.H.	0 … 95%r.H.
Sensor dimensions [3]		Ø8 × 14mm	Ø8 × 14mm	Ø12 × 14mm	Ø12 × 14mm	Ø20 × 14mm
Active measuring area		Ø2.6mm	Ø4.1mm	Ø5.7mm	Ø6.3mm	Ø8.1mm
Guard ring width		1.9mm	1.2mm	2.4mm	2.1mm	4.4mm
Minimum target diameter		Ø7mm	Ø7mm	Ø11mm	Ø11mm	Ø17mm
Weight (incl. cable and connector)		30g	30g	33g	33g	38g
Material (housing)		1.4104 (magn.)	1.4104 (magn.)	1.4104 (magn.)	1.4104 (magn.)	1.4104 (magn.)
Integrated cable		Ø2.1mm×1.4m axial	Ø2.1mm×1.4m axial	Ø2.1mm×1.4m axial	Ø2.1mm×1.4m axial	Ø2.1mm×1.4m axial
Mounting		radial clamp	radial clamp	radial clamp	radial clamp	radial clamp

FSO = Full Scale Output CSH Sensors are matched to controller with standard cable length

[1] With reference controller, relates to standard measuring range

[2] Non condensing

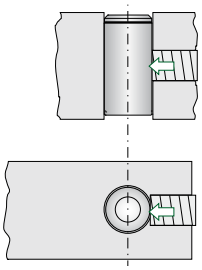
[3] Without cable, bend protection and crimp

[4] In the case of a sensor mounting 2mm behind front surface

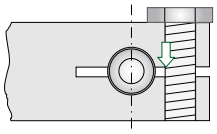
Mounting cylindrical sensors

All sensors can be installed as both freestanding and flush units. Fastening is carried out by using a clamp or collet.

Mounting with grub screw (plastic)



Mounting with collet



Important!

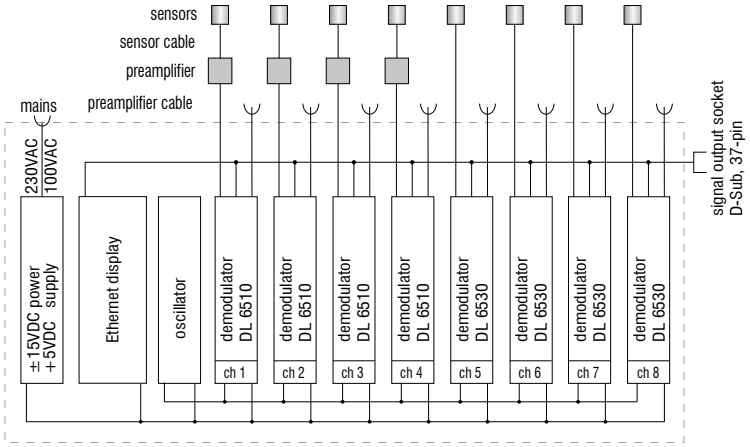
All Micro-Epsilon sensors are short circuit proof. Unlike other systems the pre-amplifier will not get damaged, if the front face of the sensor gets shorted by touching the conductive target.

- *Multi-channel system with sub-nanometre precision resolution*
- *Virtually independent of temperature*
- *Also measures against insulators*
- *As benchtop unit and as card carrier for a 19-inch format*
- *Integrated calculation function for thickness measurements*
- *Numerous filters, averaging, trigger functions, measured value storage, digital linearisation*

System structure

The capaNCDT 6500 can be used for multi-channel operation and is modular in its design. Up to eight sensors can be connected to the signal conditioning electronics (Euro-size cards) via a preamplifier module.

For the DL6530 version, the pre-amplifier is integrated in the housing and is used for cable lengths up to 4m (with CC cable) or 8m (with CCg cable). For longer cable lengths, the external preamplifiers CP6001 or CPM6011 are used.



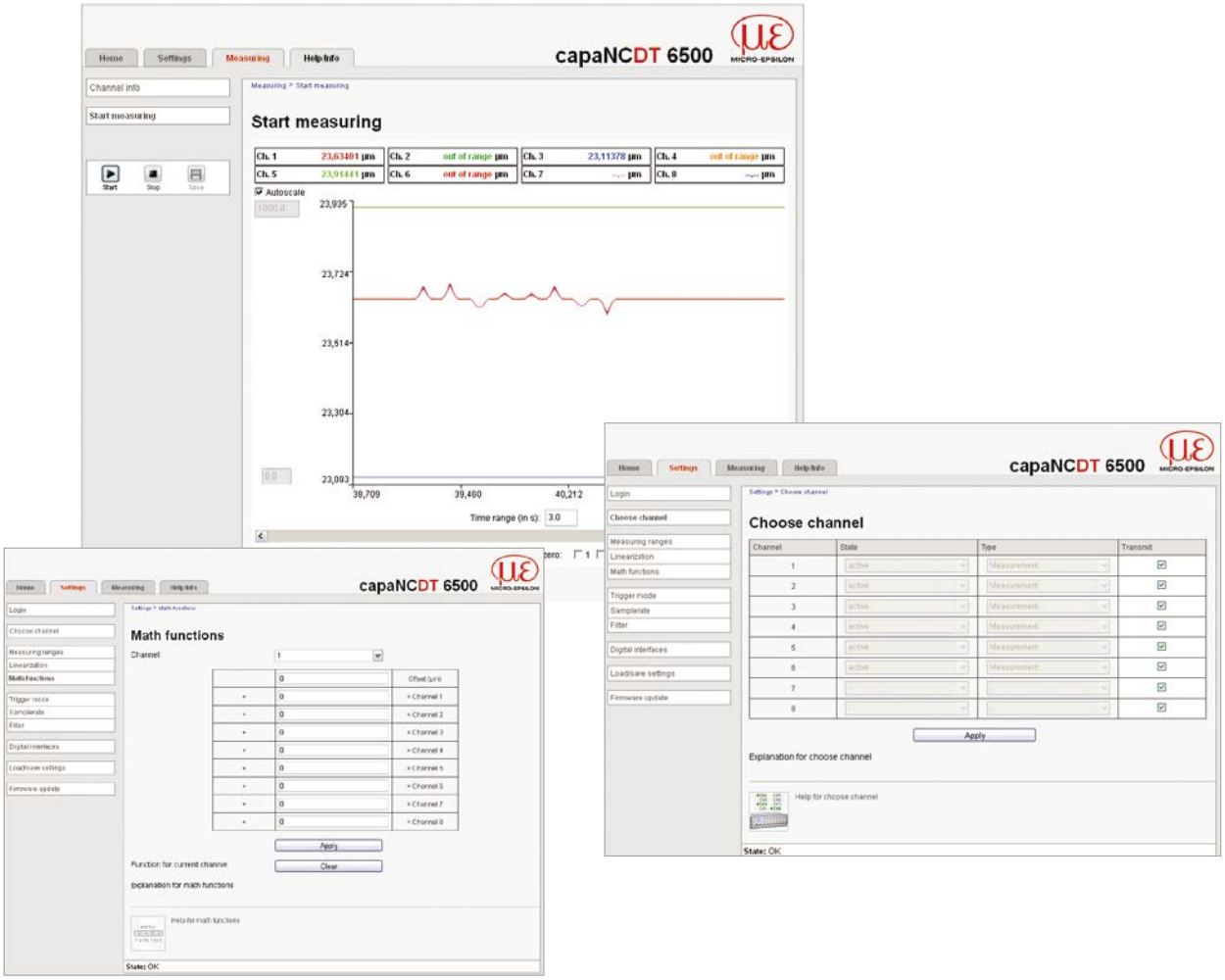
A measuring system with n measurement channels consists of:

1. controller DT6530 with power supply, display, Ethernet, oscillator and analogue output
2. n x demodulator modules DL6510 (DL6530 with integral pre-amplifier)
3. n x pre-amplifier connecting cables
4. n x pre-amplifier modules CP6001
5. n x sensor cables
6. n x sensors

DL6510: One item of position 2 to 6 is needed for each channel. DL6530: One item of position 2, 5 and 6 is needed for each channel.

Web interface

The controller is configured by the Ethernet which calls the web interface. Up to 8 channels can be visualised and combined arithmetically.



System configuration

System capaNCDT 6500 (with integral pre-amplifier):

- DT6530 / DT6530C Rack
- Demodulator DL6530
- Sensor cable
- Sensor

System capaNCDT 6510 (with external pre-amplifier):

- DT6530 / DT6530C Rack
- Demodulator DL6510
- Sensor cable
- Sensor
- Pre-amplifier CPM6011 / CP6001
- Pre-amplifier cable

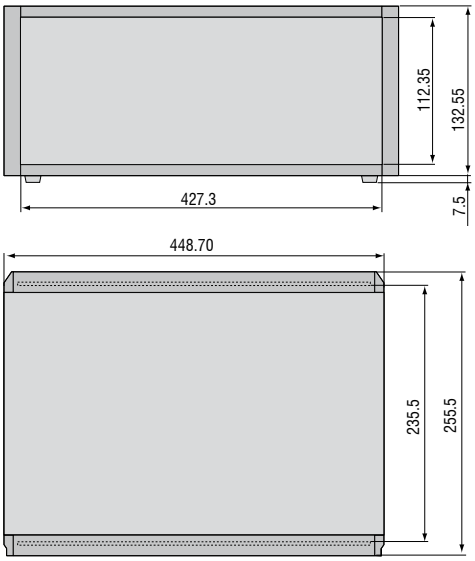
CPM6011
External pre-amplifier for standard measurements

CP6001
External pre-amplifier for high precision measurements

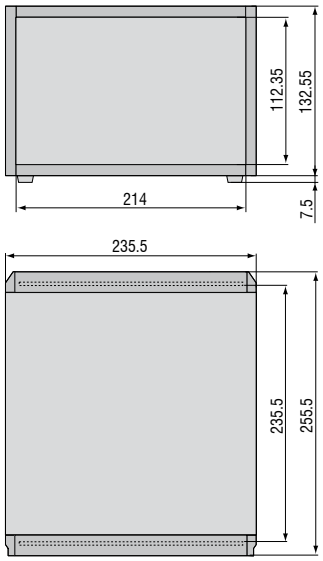
DT6530C 2 channel rack

DT6530 8 channel rack

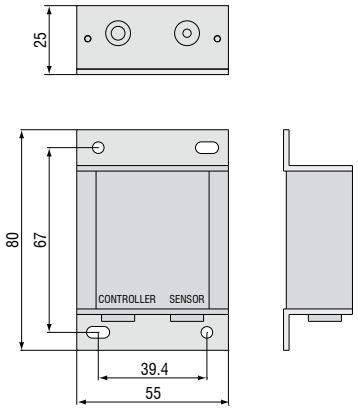
Controller DT6530 8-channel rack



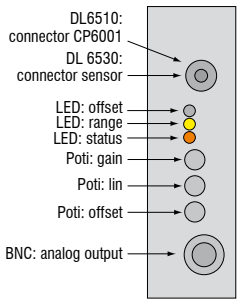
Controller DT6530C 2-channel rack



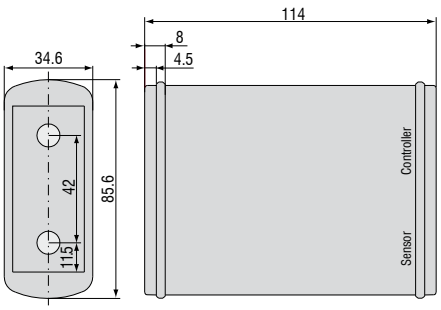
CPM6011 capacitive pre-amplifier



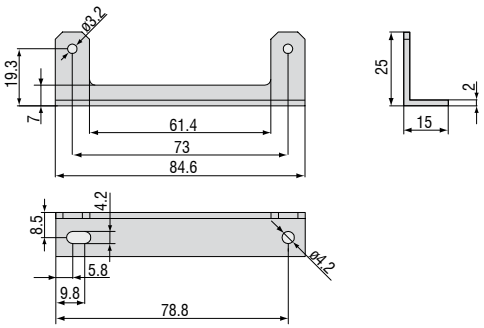
DL6530/6510 front cover



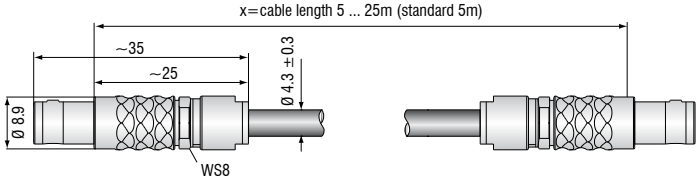
CP6001 capacitive pre-amplifier



Mounting adapter CP6001



Pre-amplifier cable CA5 / CAx



Controller type		DT6530	DT6530 with pre-amplifier CPM6011
Resolution static		0.000075% FSO	0.0006% FSO
Resolution dynamic		0.002% FSO (8.5kHz)	0.015% FSO (8.5kHz)
Data rate analogue ouput		8.5kHz (-3dB)	8.5kHz (-3dB)
Bandwidth adjustable		20Hz; 1kHz; 8.5kHz	20Hz; 1kHz; 8.5kHz
Bandwidth digital output		4 x 7.8kSa/s; 8 x 3.9kSa/s	4 x 7.8kSa/s; 8 x 3.9kSa/s
Linearity (typ.)		±0.025% FSO	±0.05% FSO
Max. sensitivity deviation		±0.05% FSO	±0.1% FSO
Repeatability		0.0003% FSO	0.001% FSO
Long term stability		±0.002% FSO / month	±0.02% FSO / month
Synchronous operation		yes	yes
Insulator measurement		yes	no
Temperature stability		± digital: 5ppm/°C analogue: 10ppm/°C	80ppm
Temperature range (operation)	Sensor	-50 ... + 200 °C	-50 ... + 200 °C
	Controller	+10 ... +60°C	+10 ... +60°C
Temperature range (storage)		-10 ... +75°C	-10 ... +75°C
Supply		230 VAC	230 VAC
Output		0…10V (max. 10mA short circuit proof); offset ≤10V ... 0V	0…10 V (max. 10mA short circuit proof); offset ≤10V ... 0V
		4…20 mA (load max. 500Ω)	4…20 mA (load max. 500Ω)
		optional: 0...20mA (load max. 500Ω)	optional: 0...20mA (load max. 500Ω)
		Ethernet 24 Bit; EtherCAT	Ethernet 24 Bit; EtherCAT
Sensors		suitable for all sensors	suitable for all sensors
Sensor cable standard		CC cable ≤ 1m CCm cable = 1.4m CCg cable = 2m	CC cable ≤ 1m CCm cable = 1.4m CCg cable = 2m
Sensor cable (matched)		double / triple / quadruple standard cable length	double / triple / quadruple standard cable length
Trigger		TTL, 5V	TTL, 5V
Number of channels		max. 8	max. 8

FSO = Full Scale Output

Options		
Article number	Description	Explanation
2982011	EMR2 CP6001	extended measuring range (factor: 2) in combination with DL6510
2982013	RMR 1/2 CP6001	reduced measuring range (factor: 1/2) in combination with DL6510
2982015	ECL2 CP6001	special tuning for double standard cable length in combination with DL6510
2982017	ECL3 CP6001	special tuning for triple standard cable length in combination with DL6510
2982026	ECL4 CP6001	special tuning for quadruple standard cable length in combination with DL6510
2982028	ECL2 CPM6011	special tuning for 2m sensor cable in combination with DL6510
2982019	EMR2 DL65x0	extended measuring range (factor: 2)
2982020	RMR 1/2 DL65x0	reduced measuring range (factor: 1/2)
2982021	ECL2 DL65x0	special tuning for double standard cable length
2982023	ECL3 DL65x0	special tuning for triple standard cable length
2982025	ECL4 DL65x0	special tuning for 4m sensor cable
2982033	EMR2 CPM6011	extended measuring range (factor: 2)

- *Modular, expandable for up to 4 channels*
- *Ethernet / EtherCAT interface*
- *Easy configuration using the web browser*
- *Resolution up to 0.0005% FSO*
- *Bandwidth: up to 20kHz*
- *Digital data rate: 4 x 3.9kSa/s*
- *Trigger feature*
- *Synchronous operation supported*

System structure

The new capaNCDT 6200 is an innovative measuring system that offers excellent performance at a very attractive price. Its modular design ensures that you can easily combine up to 4 channels. The measuring system includes a control unit and a demodulator for each sensor. Its Ethernet interface supports fast and easy configuration through a web browser. The modulator DL6230 is available for high resolution measurements. The capaNCDT 6222 is used for high speed measurements up to 20kHz.

The compact controller can be used as benchtop unit, it can be mounted to the wall or on a tophat rail. The capaNCDT 6200 is compatible with all Micro-Epsilon sensors.

Web interface

The controller is configured by the Ethernet which calls the web interface. Up to 8 channels can be visualised and combined arithmetically.

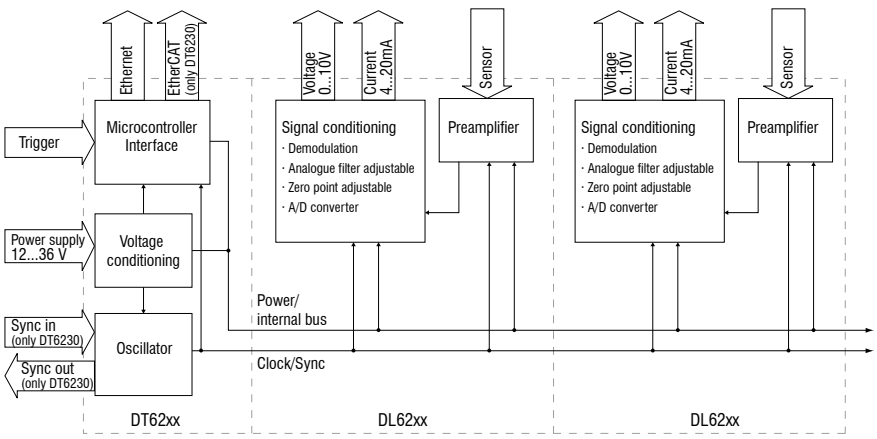
A measuring system consists of:

- control unit DT62xx
- demodulator DL62xx
- sensor
- sensor cable
- power supply cable
- Ethernet cable EtherCAT cable
- signal output cable

Accessories:

- signal output cable
- power supply cable
- DIN rail brackets
- mounting plates for wall mounting

Block diagram

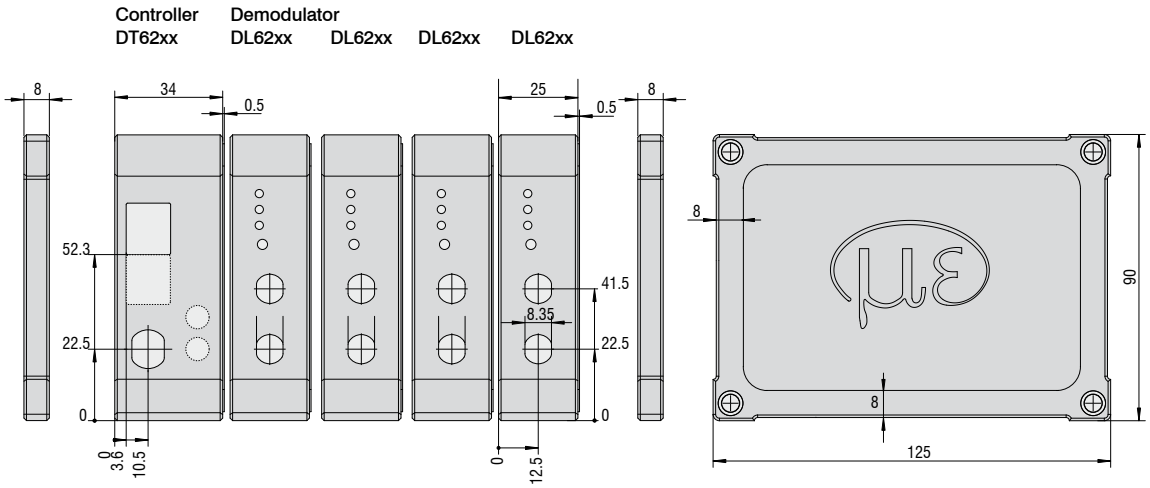


Controller type DT62x0		Demodulator DL6220	Demodulator DL6230
Resolution static		0.004% FSO	0.0005% FSO
Resolution dynamic		0.02% FSO (5kHz)	0.005% FSO (5kHz)
Bandwidth		5kHz (-3dB)	5kHz (-3dB)
Bandwidth adjustable		5kHz, 20Hz	5kHz, 20Hz
Bandwidth digital output		max. 3.906 kSa/s	max. 3.906 kSa/s
Linearity (typ.)		≤ ±0.05% FSO	≤ ±0.025% FSO
Max. sensitivity deviation		≤ ±0.1% FSO	≤ ±0.1% FSO
Long term stability		≤ 0.02% FSO/month	≤ 0.02% FSO/month
Synchronous operation supported	DT6220	yes (only internal)	yes (only internal)
	DT6230	yes	yes
Insulator measurement		no	no
Temperature stability		200ppm	200ppm
Temperature range (operation)	Sensor	-50 ... + 200°C	-50 ... + 200°C
	Controller	+10 … +60°C	+10 … +60°C
Temperature range (storage)		-10 … +75°C	-10 … +75°C
Supply	DT6220	24VDC (12…36VDC)	24VDC (15…36VDC)
	DT6230	24VDC (15…36VDC)	24VDC (15…36VDC)
Power consumption	per DL62x0	1.8W (typ.); 2.0W (max.)	1.9W (typ.); 2.2W (max.)
	DT6220	3.1W (typ.)	3.1W (typ.)
	DT6230	3.8W (typ.)	3.8W (typ.)
Analogue output		0 … 10V (short circuit proof)	0 … 10V (short circuit proof)
		4…20mA (load max. 500Ω)	4…20mA (load max. 500Ω)
Digital interface	DT6220	Ethernet	Ethernet
	DT6230	Ethernet + EtherCAT	Ethernet + EtherCAT
Sensors		all sensors	all sensors
Sensor cable standard		CC cable ≤ 1m CCm cable = 1.4m CCg cable = 2m	CC cable ≤ 1m CCm cable = 1.4m CCg cable = 2m
Sensor cable (matched)		double / triple standard cable length	double / triple standard cable length
Trigger		TTL, 5V	TTL, 5V
Number of channels		max. 4	max. 4

FSO = Full Scale Output

Controller type DT6222		Demodulator DL6222	Demodulator DL6222/ECL2
Resolution static		0.004% FSO	0.004% FSO
Resolution dynamic		0.05% FSO (20kHz)	0.1% FSO (20kHz)
Bandwidth		20kHz (-3dB)	20kHz (-3dB)
Bandwidth adjustable		20kHz, 20Hz	20kHz, 20Hz
Bandwidth digital output		max. 3.906kSa/s	max. 3.906kSa/s
Linearity (typ.)		≤ ±0.1% FSO	≤ ±0.2% FSO
Max. sensitivity deviation		≤ ±0.1% FSO	≤ ±0.1% FSO
Long term stability		≤ 0.02% FSO/month	≤ 0.02% FSO/month
Synchronous operation supported (multiple controllers)		no	no
Insulator measurement		no	no
Temperature stability		200ppm	200ppm
Temperature range (operation)	Sensor	-20 ... +200°C	-20 ... +200°C
	Controller	+10 ... +60°C	+10 ... +60°C
Temperature range (storage)		-10 … +75°C	-10 … +75°C
Supply		24VDC (12…36VDC)	24VDC (12…36VDC)
Power consumption	DT6222	2.8W (typ.)	2.8W (typ.)
	per DL6222	1.2W (typ.); 1.4W (max.)	1.2W (typ.); 1.4W (max.)
Analogue output		0 … 10V (short circuit proof)	0 … 10V (short circuit proof)
		4…20mA (load max. 500Ω)	4…20mA (load max. 500Ω)
Digital interface		Ethernet	Ethernet
Sensors		all sensors	all sensors
Sensor cable standard		CCm1,4x; CCg2,0x	CCm2,8x; CCg4,0x
Sensor cable (matched)		≤ 2.8m (with CCmxx) ≤ 4.0m (with CCgxx)	≤ 2.8m (with CCmxx) ≤ 4.0m (with CCgxx)
Trigger		TTL, 5V	TTL, 5V
Number of channels		max. 4	max. 4

FSO = Full Scale Output



Options

Article number	Description	Explanation	Suitable for articles			
			2303018 DL6220	2303022 DL6220/ECL2	2303023 DL6220/ECL3	2303029 DL6220/LC
2982044	LC DL62x0 digital	special calibration of linearity on digital output	○	○	○	•
2982045	LC DL62x0 analogue	special calibration of linearity on analogue output	○	○	○	•
2982046	ECL2 DL6220	special tuning for double standard cable length (CC =2m / CCm =2.8m / CCg =4m)	-	•	-	•
2982047	ECL3 DL6220	special tuning for triple standard cable length (CC =3 m / CCm =4,2 m / CCg =6 m)	-	-	•	•
2982048	EMR2 DL6220	extended measuring range (factor: 2) contains LC DL62x0 digital and LC DL62x0 analogue	○	○	○	•
2982049	RMR1/2 DL6220	reduced measuring range (factor: 1/2) contains LC DL62x0 digital and LC DL62x0 analogue	○	○	○	•

Article number	Description	Explanation	Suitable for articles			
			2303019 DL6230	2303024 DL6230/ECL2	2303025 DL6230/ECL3	2303030 DL6230/LC
2982044	LC DL62x0 digital	special calibration of linearity on digital output	○	○	○	•
2982045	LC DL62x0 analogue	special calibration of linearity on analogue output	○	○	○	•
2982054	ECL2 DL6230	special tuning for double standard cable length (CC =2m / CCm =2.8m / CCg =4m)	-	•	-	•
2982055	ECL3 DL6230	special tuning for triple standard cable length (CC =3m / CCm =4.2m / CCg =6m)	-	-	•	•
2982051	EMR2 DL6230	extended measuring range (factor: 2) contains LC DL62x0 digital and LC DL62x0 analogue	○	○	○	•
2982052	EMR3 DL6230	extended measuring range (factor: 3) contains LC DL62x0 digital and LC DL62x0 analogue	○	○	○	•
2982053	RMR1/2 DL6230	reduced measuring range (factor: 1/2) contains LC DL62x0 digital and LC DL62x0 analogue	○	○	○	•

Article number	Description	Explanation	Suitable for articles		
			2303035 DL6222	2303036 DL6222/ECL2	2303038 DL6222/LC
2982045	LC DL62x0 analogue	special calibration of linearity on analogue output	○	○	•
2982059	ECL2 DL6222	special tuning for double standard cable length	-	•	•
2982061	EMR2 DL6222	extended measuring range (factor: 2)	○	○	•
2982062	RMR1/2 DL6222	reduced measuring range (factor: 1/2)	○	○	•

• Articles already contain the option
○ Option available
- No option available

- *Compact and robust construction*
- *High temperature stability*
- *Nanometre repeatability*
- *Suitable for all conductive materials*
- *24V (9 – 36V) standard power supply for industrial applications*
- *Ideal for OEM applications*
- *Suitable for practically all sensors*

System construction

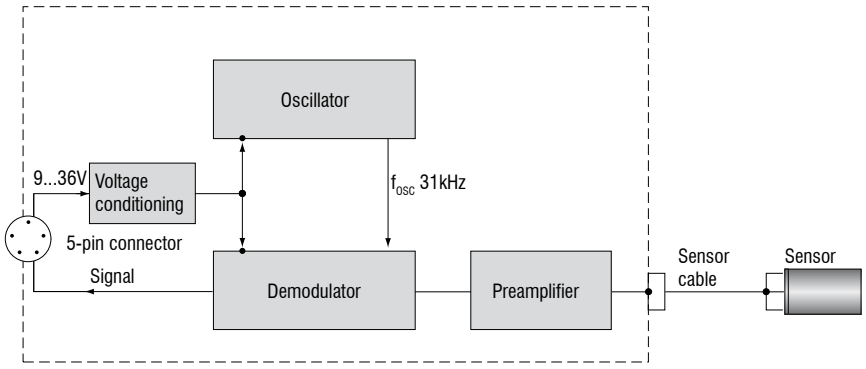
The capaNCDT 6110 single channel capacitive electronics is an extremely compact and low cost controller, compatible with all Micro Epsilon capacitive sensor ranges. Designed to be robust and simple to use, it is ideally suited to integration into OEM applications and simple single channel end user requirements. With all items available from stock, the user can quickly select the most suitable sensor range and cable length to be used with the capaNCDT 6110 electronics.
For higher volume applications, the capaNCDT 6110 can be used as a base specification for modification to user specific requirements.
The flexible 9-36V DC power supply, enables the capaNCDT 6110 series to also be used in mobile applications. Measurement output values are selectable 0-10V or +/-5V DC and high temperature stability and resolutions are achieved.

A measuring system consists of:

- Capacitive displacement sensor
- Sensor cable
- Controller
- Supply and signal output cable

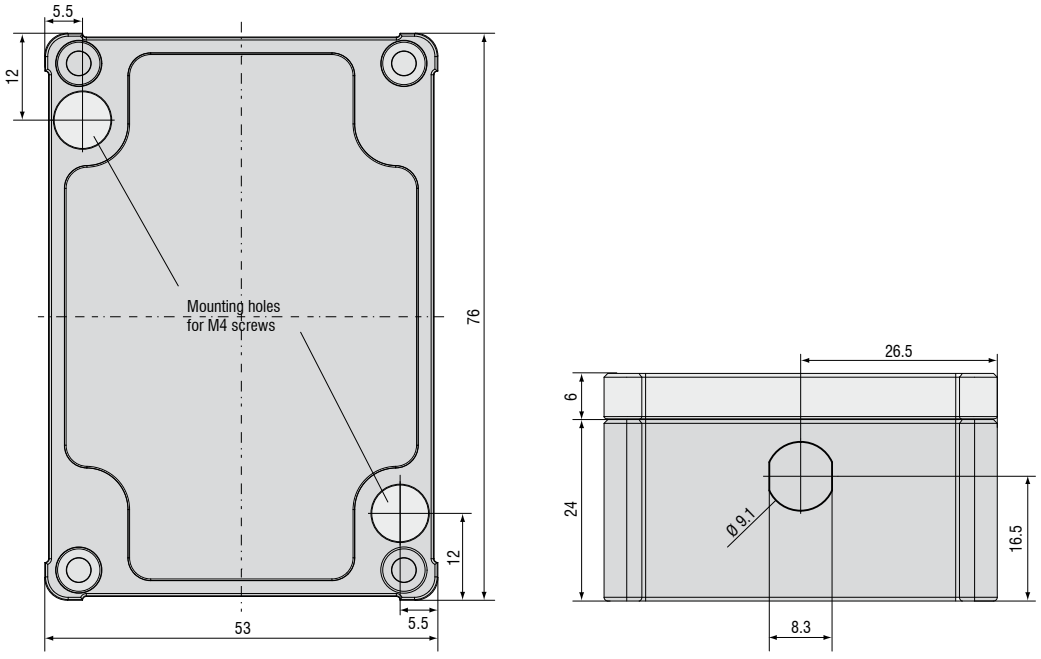
Accessory:

- Power supply



Controller type		DT6110	DT6110/ECL2
Resolution static		0.01 % FSO	0.01 % FSO
Resolution dynamic		0.015 % FSO (1kHz)	0.015 % FSO (1kHz)
Bandwidth		1 kHz (-3dB)	1 kHz (-3dB)
Linearity (typ.)		±0.05% FSO	±0.05% FSO
Max. sensitivity deviation		±0.1% FSO	±0.1% FSO
Long term stability		<0.05% FSO/month	<0.05% FSO/month
Synchronous operation		no	no
Insulator measurement		no	no
Temperature stability		200ppm	200ppm
Temperature range (operation)	Sensor	-50 ... + 200 °C	-50 ... + 200 °C
	Controller	+10 … +60°C	+10 … +60°C
Temperatur range (storage)		-10 … +75°C	-10 … +75°C
Supply		24VDC/55mA (9 ... 36V)	24VDC/55mA (9 ... 36V)
Output		0 … 10V (short-circuit-proof), optional: ±5V, 10 … 0V	0 … 10V (short-circuit-proof), optional: ±5V, 10 … 0V
Sensors		suitable for all sensors	suitable for all sensors
Sensor cable		CC cable ≤ 1m CCm cable = 1.4m CCg cable = 2m	CC cable ≤ 2m CCm cable = 2.8m CCg cable = 4m

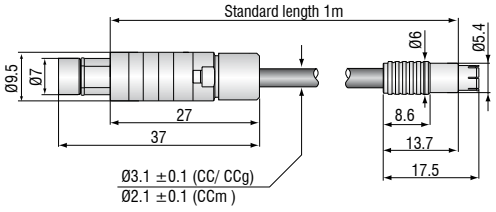
FSO = Full Scale Output



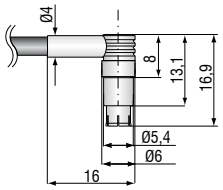
Sensor cable	**Cable CCx,x / CCx,x/90**	**Cable CCmx,x / CCmx,x/90**	**Cable CCgx,x / CCgx,x/90**
Description	Low-outgassing cable up to 4m length, for applications in clean rooms	Low-outgassing cable up to 4.2m length, for applications in clean rooms, UHV and EUV	Robust cable up to 8m length, for industrial applications
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	3.1mm ±0.1mm	2.1mm ±0.1mm	3.1mm ±0.1mm
Bending radius	3x cable diameter during installation; 7x cable diameter for movement; 12x cable diameter recommend at continous movement		

	Cable with connector type C for sensors CS005 / CS02 / CS05 / CSE05 / CS08 / CSE1						**Cable with connector type B for sensors CS1 / CS1HP / CS2 / CSE2 / CS3 / CS5 / CS10**					
Version	2 x straight connector			1 x straight / 1 x 90° connector			2 x straight connector			1 x straight / 1 x 90° connector		
Type	CCx,xC	CCmx,xC	CCgx,xC	CCx,xC/90	CCmx,xC/90	CCgx,xC/90	CCx,xB	CCmx,xB	CCgx,xB	CCx,xB/90	CCmx,xB/90	CCgx,xB/90
Standard 1m	•		•	•		•	•		•	•		•
1.4m		•			•			•			•	
2m	•		•	•		•	•		•	•		•
2.8m		•			•			•			•	
3m	•			•			•			•		
4m			•			•			•			•
4.2m		•			•			•			•	
6m			•			•			•			•
8m			•			•			•			•

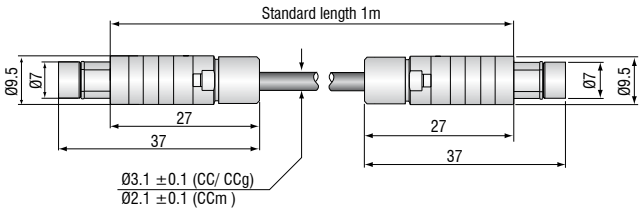
Sensor cable with connector type C



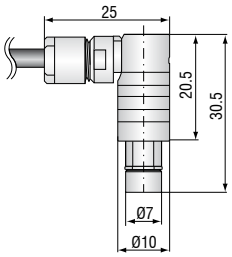
Connector type C/90



Sensor cable with connector type B

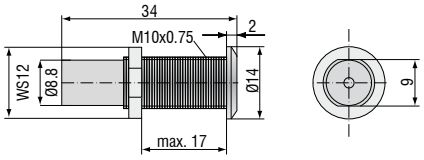


Connector type B/90



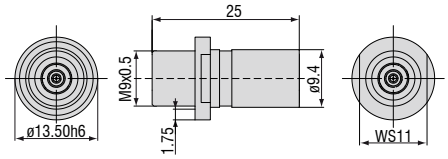
Accessories capaNCDT	6110	6200	6500
MC2.5 Micrometer for sensor calibration, range 0 - 2.5mm, Resolution 0.1µm. Suitable for sensors CS005 to CS2	•	•	•
MC25D Digital micrometer for sensor calibration, range 0 - 25mm, adjustable offset (zero). Suitable for all sensors.	•	•	•
HV/B Vacuum feed through triaxial	•	•	•
UHV/B Vacuum feed through triaxial for ultra-high vacuum	•	•	•
PC6200-3/4 Power-/trigger cable, 4 pin, 3m		•	
SCAC3/4 Signal output cable, (necessary for multi channel applications), 4 pin, 3m		•	
SCAC3/5 Signal output cable, analog, 5 pin, 3m	•		
SC6000-1,0 Synchronization cable, 5 pin, 1m		•	•
CA5 Preamplifier cable 5 pin, 5m			•
PS2020 Power supply for DIN rail mounting; Input 230VAC (115VAC); Output 24VDC / 2.5 A; L/W/H 120x120x40mm	•	•	

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



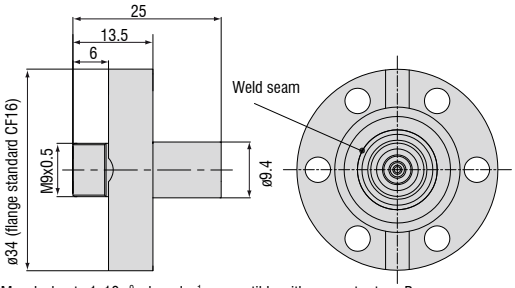
Max. leak rate 1x10e^{-7} mbar · l s^{-1}, compatible with connector type B

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



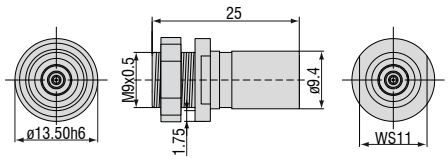
Max. leak rate 1x10e^{-9} mbar · l s^{-1}, compatible with connector type B

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



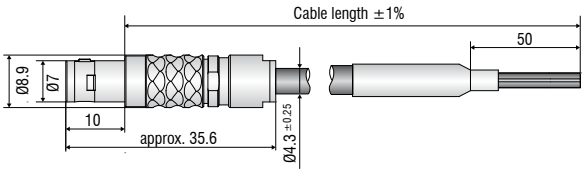
Max. leak rate 1x10e^{-9} mbar · l s^{-1}, compatible with connector type B

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

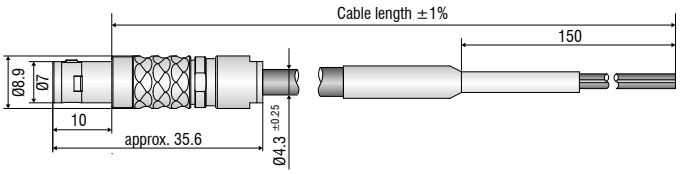


Max. leak rate 1x10e^{-9} mbar · l s^{-1}, compatible with connector type B

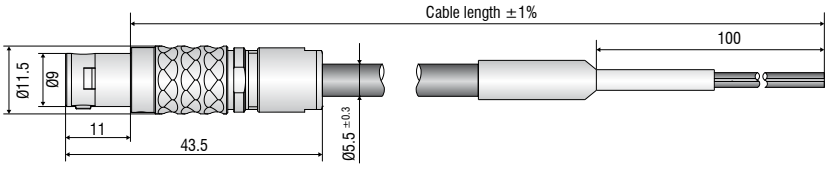
SCA3/4 Signal output cable (Art.-no. 2902104)



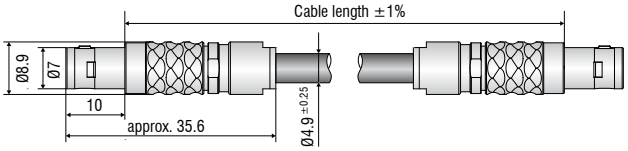
SCA3/5 Signal output cable (Art.-no. 2902112)



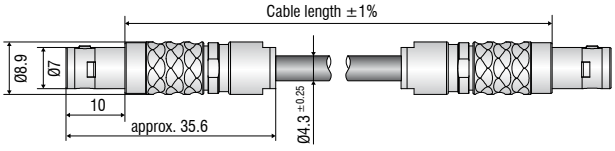
PC6200-3/4 Power-/trigger cable (Art.-no. 2901881)



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



CA5 Preamplifier cable (Art.-no. 2903180)



Influence of tilting the capacitive sensor

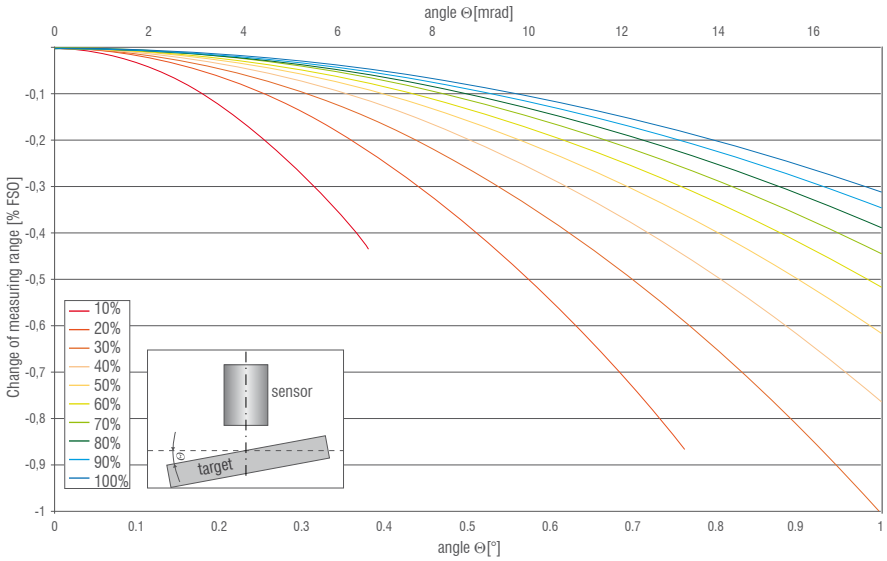
In the case of tilting of the capacitive sensor, a measurement error must be assumed as the geometric conditions of the field for the target change. In fact, the average distance of the sensor remains constant; however, the edge areas move closer or further away from the target. This results in field distortions, which affect the capacity C according to the following model:

$$C_d(\Theta) = C_d(0) * [1 + (\frac{1}{4}) * (\frac{R^2}{d^2}) * \tan^2\Theta]$$

$$\Delta_x = 100 * (\frac{d}{d_{MAX}}) * \{\frac{1}{[1 + (\frac{R^2}{4d^2}) * \tan^2\Theta]} - 1\}$$

C	*capacity*
Θ	*tilt angle*
R	*measurment area radius*
d	*working distance sensor-target*
d_{MAX}	*sensor measuring range*
Δx	*signal change*

Angle dependence with different offset distances (sensor CS02)



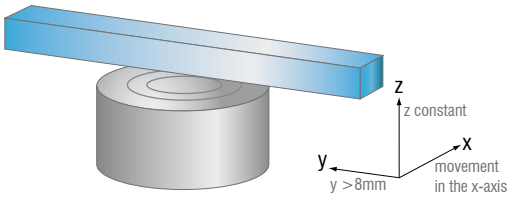
Example illustration of the influence using the CS02 sensor as an example, consideration of a tilt angle of max. 1° for different sensor distances.

In the case of 10% distance in the sensor axis, there is already contact between sensor housing and target at 0.38°; in the case of 20% distance, the contact is at 0.76°. The simulation can be performed for all sensors and installation conditions; tilt angles around a decentralised tilt point can also be calculated.

Measurement on narrow targets

The influence of the target width on the measurement signal is shown using the example of a CS05 sensor. A target extended in the y-axis, narrowed in the x-axis has been varied in different parameters:

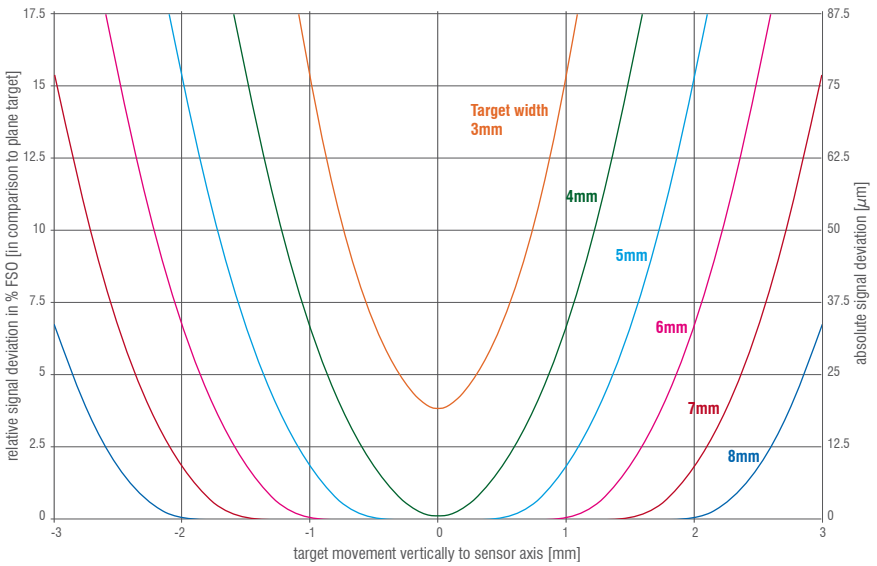
- target-sensor distance (z-axis): 0.25mm (measuring range centre)
- width of the target in the x-axis: 3 ... 8mm (21 values)
- displacement of the target in the x-axis (vertical to the sensor axis): 0 ... 3mm (13 values)



In each case, the capacity between electrode and target and its reciprocal (this is proportional to the sensor signal of the controller) were calculated. The diagram shows the deviations from the capacity values for a flat target (large opposite sensor in x and y axes) depending on the target width and displacement.

The smaller the distance between sensor and target, the narrower the target can be. In the example, a centrally placed target with a width of 5mm is sufficient to achieve a stable signal in the centre of the measuring range. This proves that the field does not spread beyond the sensor diameter.

Signal deviation at 50% FSO [0.25mm]



Force effects on the target

Alternating forces between the two electrodes are produced by the electrical field:

$$F = \frac{C * U^2}{(2 * d)} = constant$$

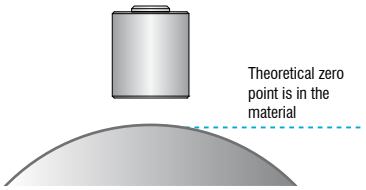
$$F = \frac{\epsilon_0 * \epsilon_R * A * E^2}{2} = constant$$

$$F = \frac{1}{2} * E * Q = constant$$

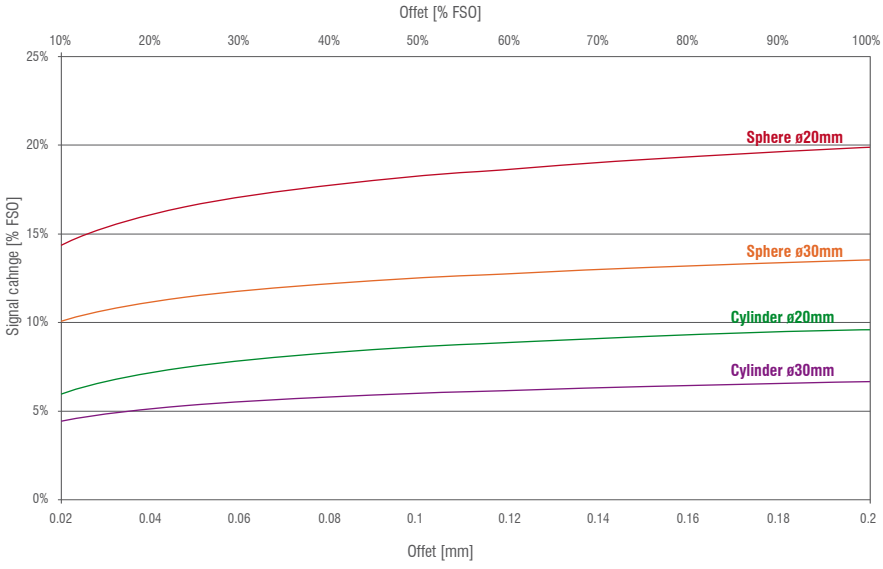
Using the example of a CS1 sensor, which is operated using the DT6230/DT6500 system, a force of approx. 0.23μN is produced. The force however is dependent on the selection of sensor and electronics, not on the sensor's position over the measuring range. The DT6110/6220 systems operate using lower measuring currents, whereby the electrical field and the electrical voltage are lower so that the force is only 0.01μN and so measurement without feedback is assumed.

Measurements on spheres and shafts

In practice, it is often necessary to measure curved surfaces. A classic example is shaft runout measurements, where a cylindrical target is measured. Compared to a flat target, there are either more or less significant measured value deviations depending on the bending radius in doing so. This is caused by various effects, e.g. concentration of the field lines at the highest point or a capacity increase due to a larger measuring spot.
In reality, it can be assumed that the bending radius results in a virtual zero point, i.e., the sensor value 0 can no longer be achieved. Due to the integrating function of the capacitive senor over the measurement surface, the virtual, average measuring plane lies behind the surface line. For example, this means that with a 200μm sensor and a roller with an external diameter of 30mm and a gap clearance of 20μm, almost 5% more is indicated, i.e. approx 30μm. As this effect can be calculated, corresponding characteristics can be calibrated in the evaluation electronics.



Signal change: various target geometries (sensor CS02)



Consideration of the conductivity requirements

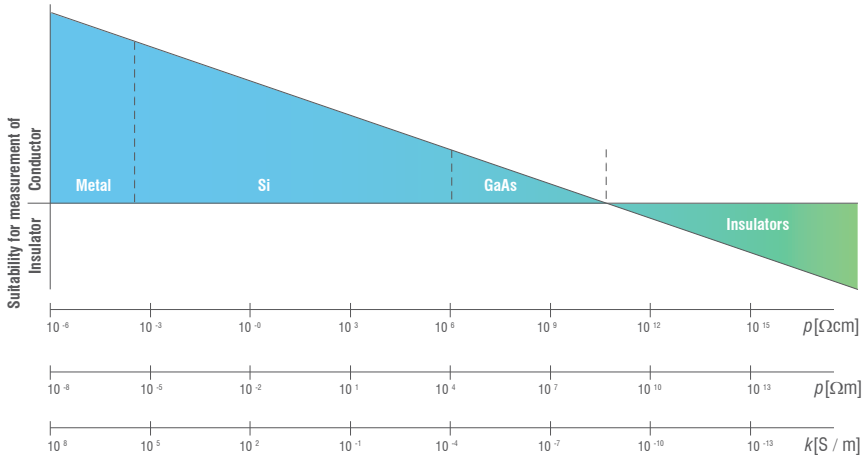
In order to achieve a linear output signal across the complete measuring range, certain requirements for the target or the counter electrode must be complied with.

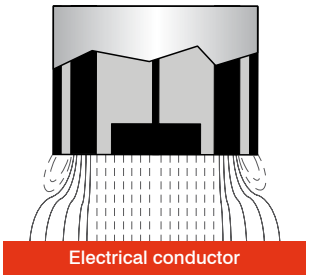
The impedance in the ideal plate capacitor can be shown in the equivalent circuit diagram by a capacitor and a resistor connected in parallel. For measurement against metals, the Ohm part can be disregarded; the impedance is only determined by the capacitive part.

Conversely, only the Ohm part is considered for measurements against insulators. In between, there is the large range of semiconductors. Most semiconductors can be measured very well as electrical conductors. The requirement is that the capacitive part of the total impedance is still significantly larger (>10x) than the ohmic part. This is almost always the case for silicon wafers irrespective of the endowment.

Nevertheless, semiconductors with poor conductivity (e.g. GaAs) can also be measured as conductors under certain circumstances. However, various adjustments are required for this, e.g. reduction of the operating frequency or a temporary, partial increase of the conductivity.

Relation between conductivity and suitability of materials





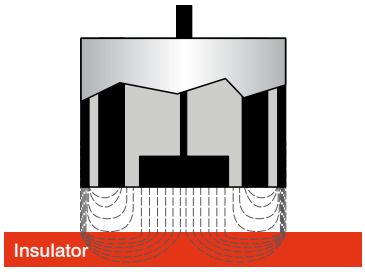
Electrical conductor as target

The capaNCDT system measures the reactance X_C of the capacitor, which changes proportionally with distance. The high linearity of the signal is achieved without further electronic circuitry. This particularly applies to measurements against electrically conductive materials (metals). Changes of the conductivity have no influence on linearity or sensitivity. All conductive or semi-conductive targets are measured without any loss in measurement performance.

No penetration of the fields for electric conductors

As the measurement principle operates without penetration of the fields in the target, even the thinnest targets, e.g. 10µm electrically conductive paint, can be measured.

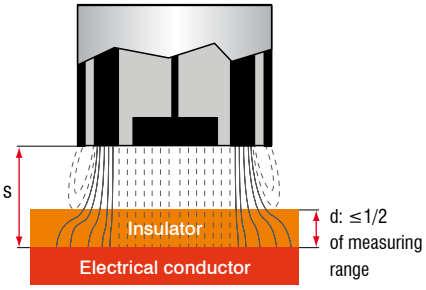
The capacitive measuring process operates with currents in the µA range. This means even the smallest electrical charges are sufficient to make measurements possible. Even very thin metallic objects can guarantee the charge carrier displacement. A target thickness of a few micrometres is sufficient here. The electrical field develops between sensor electrode and target surface; the distance determines the reactance.



Insulators as target

Some capaNCDT systems can also measure insulating materials. In this case resolution and accuracy are reduced.

The field lines penetrate the insulator and join with the electrical sensor housing. The reactance X_C depends on the distance between sensor and insulator. Therefore a constant thickness and permittivity of the insulator is necessary. Factory calibration/compensation is strongly recommended.



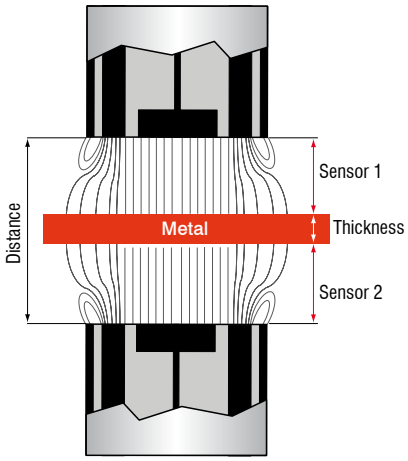
Thickness measurement of insulators

The capaNCDT system can also be used for the linear thickness measurement of insulators. The field lines penetrate the insulator and join with the electrical conductor. If the thickness of the insulator changes, this influences the reactance X_C of the sensor. The distance to the electrical conductor must therefore be constant.

$$\frac{C}{C_0} = \frac{1}{\left(1-\left(\frac{d}{s}\right)*\left(1-\frac{\epsilon_1}{\epsilon_2}\right)\right)}$$

$$\epsilon_1 = \epsilon_0 * \epsilon_{r1}, \epsilon_2 = \epsilon_0 * \epsilon_r$$

d *Target thickness*
s *Measuring gap*
ε_1 *Permittivity air*
ε_2 *Permittivity insulator*

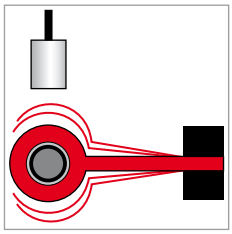


Thickness = Distance - (Sensor 1 + Sensor 2)

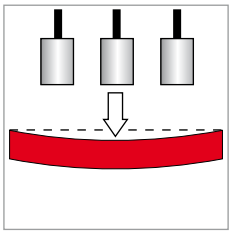
Thickness measurement of metals

Two-sided thickness measurement of metals is made possible by installing the sensors opposite each other. Strip thicknesses in the µm range can be measured using this method. Each sensor generates a linear output signal dependent on the distance between sensor surface and target surface. If the sensor distance is known, the thickness of the target can be determined easily.

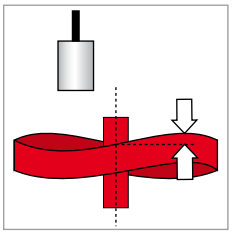
Due to the capacitive principle, the measurement is only performed against the surface without penetrating the target. If the measuring points are synchronised, measurement against non-grounded targets is possible.



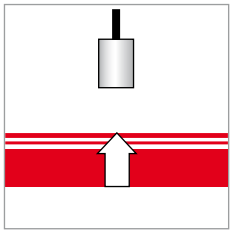
Vibration, amplitude, clearance, run-out



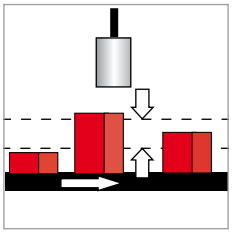
Deflection, deformation, waviness, tilt



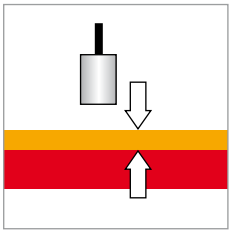
Stroke, deformation, axial shaft oscillation



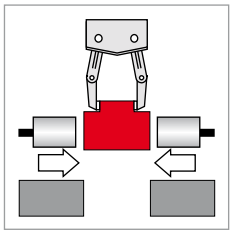
Displacement, distance, position, elongation



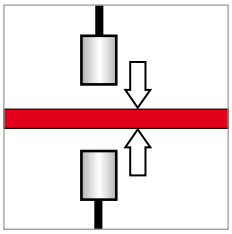
Dimensions, dimensional tolerances, sorting, parts recognition



Thickness measurement of insulating materials



In-process inspection, dimensional inspection



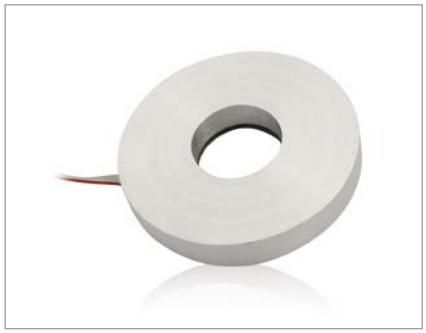
Two-sided thickness measurement

Specific sensors for OEM applications

Application examples occur again and again where the standard versions of the sensors and the controller are performing at their limits. For these special tasks, we modify the measuring systems exclusively according to your individual requirements. Changes often requested include for example modified designs, target coordination, mounting options, individual cable lengths, modified measuring ranges or sensors with integrated controller.

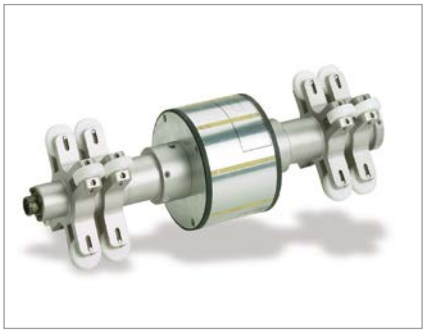
Customised sensor body

Customised modification for a specific environment



Special OEM design

Special OEM electronic design

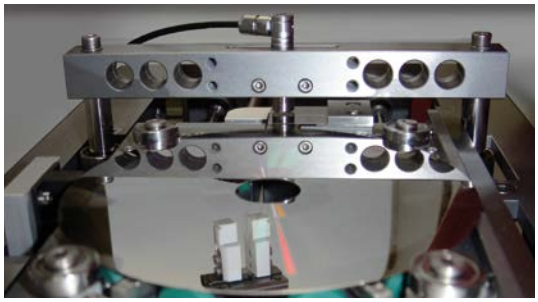


System for measuring the internal diameter of extruder bores

Dual sensor integration for ID check

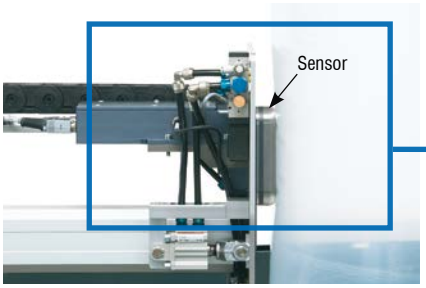
Thickness measurement of dies for optical data carriers

Previously, the data was transferred to a master system using a laser to reproduce CDs, DVDs, HD-DVDs or Blu-ray discs by pressing. A thin layer of nickel is applied using galvanisation to the silicon or glass carrier (substrate). The absolute thickness values of the nickel layer are required in order for the exact control of the galvanisation bath. Capacitive sensors from Micro-Epsilon are used to measure the thickness and profile. A sensor is positioned above and below the die, which is then moved between the sensors during measurements. Using the two units for distance information, the thickness is determined very precisely using the differential method.

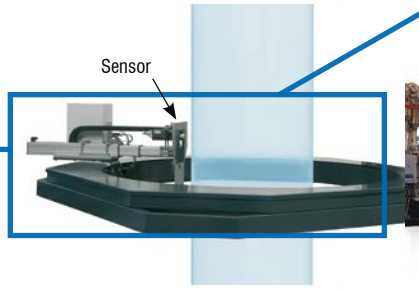


Modular measuring system for the profile measurement of blown films

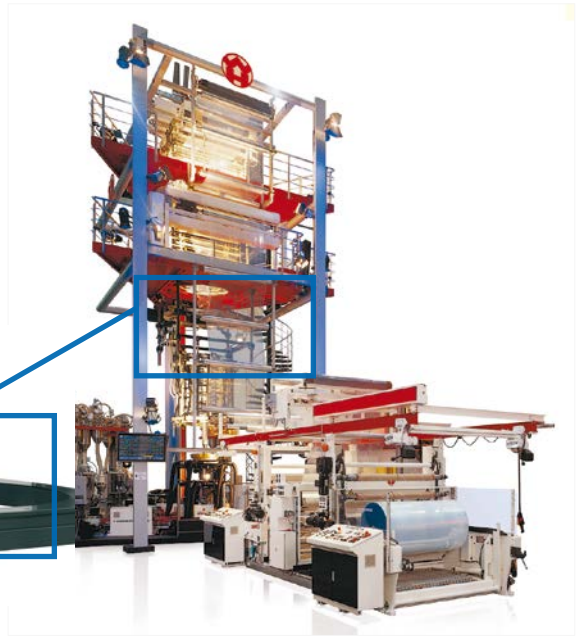
The measuring of the film profile already on the film bubble provides important data for extrusion control. In order to make the process as efficient as possible, a modular blown film measuring system was designed by Micro-Epsilon, which is installed immediately after the calibration cage. The system is available with contact and non-contact sensors. The sensor system used for profile measurement is based on the capacitive measuring principle, which reliably and accurately ascertains the profile of the film. The capacitive sensors used can be distinguished by their extreme precision and signal quality.



Contacting sensor



Non-contact sensor

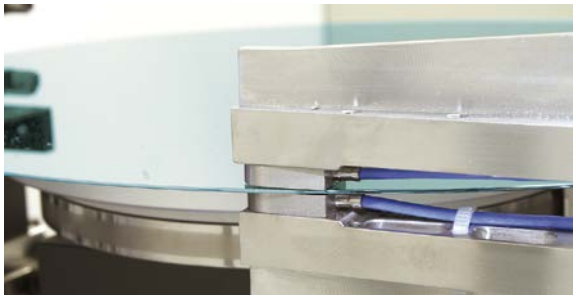


Measurements on wafers and semiconductors

Extreme accuracies are required in the semiconductor industry in order to design processes and products efficiently. Capacitive sensors from Micro-Epsilon are used, among other things, for the positioning, displacement measurement and thickness measurement in the semiconductors area.

Capacitive displacement sensors are used for adjustment with nanometre precision of lenses in optical systems for wafer exposure.

Wafer thickness measurement with 3 tracks

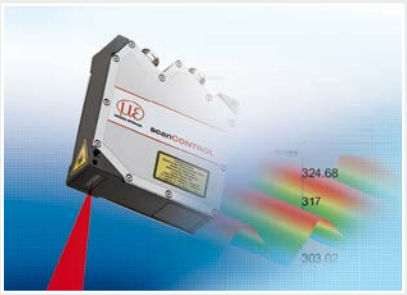


Wafer thickness measurement with two capacitive sensors

High performance sensors made by Micro-Epsilon

Sensors and systems for displacement and position

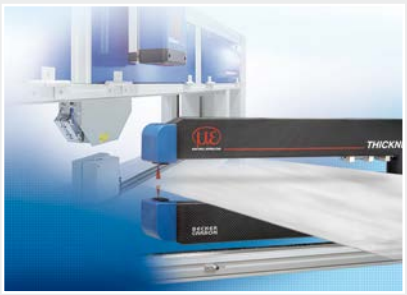
Sensors and measurement devices for non-contact temperature measurement



2D/3D profile sensors (laser scanner)

Optical micrometers, fibre optic sensors and fibre optics

Colour recognition sensors, LED analyzers and colour online spectrometer



Measurement and inspection systems

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