MICRO-EPSILON

Operating Instructions
capaNCDT 6300/6310

CS005	CSH05FL	CSH1.2	CS5
CS02	CS08	CSH1.2FL	CS10
CSH02	CS1	CSH2FL	CSG0.50
CSH02FL	CSE1	CS2	CSG1.00
CS05	CSH1	CSH2	
CSE05	CSH1FL	CSE2	
CSH05	CS1HP	CS3	

Non-contact Capacitive Displacement Measuring

Contents

1. Safety

System operation assumes knowledge of the operating instructions.

1.1 Symbols Used

The following symbols are used in these operating instructions:

⚠ CAUTION	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
NOTICE	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
➡	Indicates a user action.
i	Indicates a tip for users.

1.2 Warnings

⚠ CAUTION

Disconnect the power supply before touching the sensor surface.
> Danger of injury

> Static discharge

Connect the power supply and the display/output device in accordance with the safety regulations for electrical equipment.
> Danger of injury

> Damage to or destruction of the sensor and/or controller

NOTICE

Avoid shock and vibration the sensor and controller.
> Damage to or destruction of the sensor and/or controller

The power supply may not exceed the specified limits.
> Damage to or destruction of the sensor and/or controller

Protect the sensor cable against damage
> Destruction of the sensor

> Failure of the measuring device

1.3   Notes on CE Marking

The following apply to the capaNCDT 6300/6310:
- EU Directive 2014/30/EU
- EU Directive 2011/65/EU

Products which carry the CE mark satisfy the requirements of the EU directives cited and the European harmonized standards (EN) listed therein. The EU Declaration of Conformity is available to the responsible authorities according to EU Directive, article 10, at:

MICRO-EPSILON Messtechnik GmbH & Co. KG
Königbacher Straße 15
94496 Ortenburg / Germany

The measuring system is designed for use in industrial environments and meets the requirements.

1.4   Intended Use

- The capaNCDT 6300/6310 measuring system is designed for use in industrial applications. It is used for
  - displacement, distance, thickness and movement measurement
  - position measuring of parts or machine components
- The system may only be operated within the limits specified in the technical data, see Chap. 2.3.
- The system must only be used in such a way that no persons are endangered or machines and other material goods are damaged in the event of malfunction or total failure of the controller.
- Take additional precautions for safety and damage prevention in case of safety-related applications.

1.5   Proper Environment

- Operating temperature:
  - Sensor: -50 ... +200 °C (-58 to +392 °F)
  - Sensor cable: -50 ... +150 C (-58 to +302 °F)
  - Controller, preamplifier: +10 ... +50 °C (-50 to +122 °F)
- Humidity: 5 - 95 % (non condensing)
- Ambient pressure: atmospheric pressure
- EMC: according to   DIN EN 61326-1: 2006-10
                            DIN EN 61326-2-3: 2007-05
- Storage temperature: 0 ... +75 °C (0 to +167 °F)
- The space between the sensor surface and the target must have an unvarying dielectric constant.
- The space between the sensor surface and the target may not be contaminated (for example water, rubbed-off parts, dust, et cetera)

2. Functional Principle, Technical Data

2.1 Measuring Principle

The principle of capacitive distance measurement with the capaNCDT system is based on the principle of the parallel plate capacitor. For conductive targets, the sensor and the target opposite form the two plate electrodes.

If a constant AC current flows through the sensor capacitor, the amplitude of the AC voltage at the sensor is proportional to the distance between the capacitor electrodes. The AC voltage is demodulated, amplified and output as an analog signal.

The capaNCDT system evaluates the reactance X_c of the plate capacitor which changes strictly in proportion to the distance.

$$X_c = \frac{1}{j\omega C}; \quad \text{capacitance } C = \varepsilon_r * \varepsilon_o * \frac{\text{area}}{\text{distance}}$$

i A small target and bent (uneven) surfaces cause a non-linear characteristic.

This theoretical relationship is realized almost ideally in practice by designing the sensors as guard ring capacitors.

The linear characteristic of the measuring signal is achieved for electrically conductive target materials (metals) without any additional electronic linearization. Slight changes in the conductivity or magnetic properties do not affect the sensitivity or linearity.

The capaNCDT system also measures reliably against insulating materials. The linear behavior for this category of targets is achieved by special electronic circuitry. A constant relative dielectric of the material is, however, a prerequisite for accurate measurement.
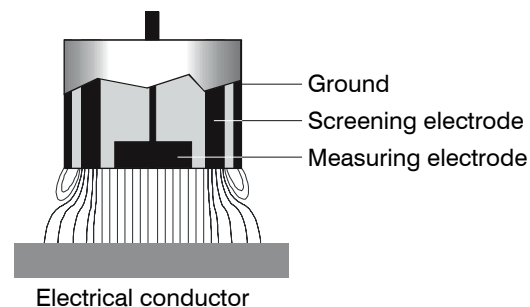

Ground
Screening electrode
Measuring electrode

Electrical conductor

Fig. 1 Functional principle of the guard ring capacitor

2.2   Structure

The non-contact, single-channel measuring system installed in an aluminum housing, consists of:
- Sensor,
- Sensor cable
- Preamplifier (DT6310 only)
- Preamplifier cable (DT6319 only)
- Controller

Two versions with different kind of preamplifier are available:
- DT6300: Controller with integrated preamplifier, distance sensor and controller: 1 m
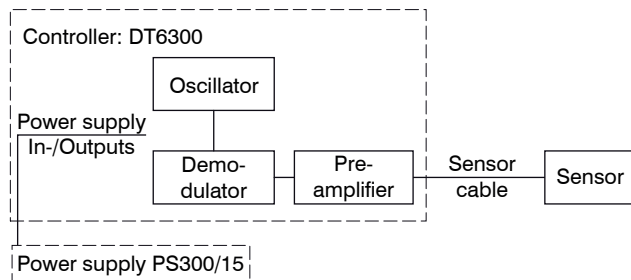- DT6310: Controller with external preamplifier, distance sensor and controller: up to 20 m
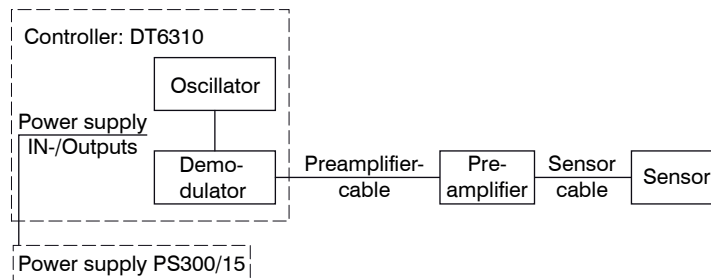

Fig. 2 Block diagram capaNCDT 6300

Fig. 3 Block diagram capaNCDT 6310

2.2.1 Sensors

For this measurement system, several sensors can be used.

➡ In order to obtain accurate measuring results, keep the surface of the sensor clean and free from damage.

The capacitive measuring process is area-related. A minimum area (see table) is required depending on the sensor model and measuring range. In the case of insulators the dielectric constant and the target thickness also play an important role.

Sensors for electrical conducting targets (metals)

Sensor model	Measuring range	Min. target diameter
CS005	0.05 mm	3 mm
CS02	0.2 mm	5 mm
CSH02	0.2 mm	7 mm
CSH02FL	0.2 mm	7 mm
CS05	0.5 mm	7 mm
CSE05	0.5 mm	6 mm
CSH05	0.5 mm	7 mm
CSH05FL	0.5 mm	7 mm
CS08	0.8 mm	9 mm
CS1	1 mm	9 mm
CSE1	1 mm	8 mm
CSH1	1 mm	11 mm
CSH1FL	1 mm	11 mm
CS1HP	1 mm	9 mm
CSH1.2	1.2 mm	11 mm
CSH1.2FL	1.2 mm	11 mm
CSH2FL	2 mm	17 mm
CS2	2 mm	17 mm
CSH2	2 mm	17 mm
CSE2	2 mm	14 mm
CS3	3 mm	27 mm

CS5	5 mm	37 mm
CS10	10 mm	57 mm
CSG0.50	0.5 mm	ca. 7 x 8 mm
CSG1.00	1.00 mm	ca. 8 x 9 mm

Sensors for insulating targets materials.

The sensors also measure reliable against insulating materials. The linear behavior for this category of targets is achieved by special linearization, see Chap. 5.4. The measuring ranges of the respective sensors depend on the ε_r of the target.

2.2.2   Sensor Cable

The sensor and controller respectively sensor and preamplifier are connected by a special, double screened, 1 m (3 ft) long sensor cable.

Do not shorten or lengthen these special cables.

Usually, a damaged cable can not be repaired.

i Switch off the device when plugging and removing connectors.
Do not crush the sensor cable.
Do not modify to the sensor cable.

The sensors of type CSH have integrated a 1.4 long sensor cable. Cable lengths of 2.8 m are available too if required.

Model	Cable length	2 axial connector	1x axial + 1x 90 °	For sensors
CC1C	1 m	x		0.05 - 0.8 mm
CC2C	2 m	x		0.05 - 0.8 mm
CC3C	3 m	x		0.05 - 0.8 mm
CC4C	4 m	x		0.05 - 0.8 mm
CC1C/90	1 m		x	0.05 - 0.8 mm
CC2C/90	2 m		x	0.05 - 0.8 mm
CC3C/90	3 m		x	0.05 - 0.8 mm
CC4C/90	4 m		x	0.05 - 0.8 mm
CC1B	1 m	x		1 ... 10 mm
CC2B	2 m	x		1 ... 10 mm
CC3B	3 m	x		1 ... 10 mm
CC4B	4 m	x		1 ... 10 mm
CC1B/90	1 m		x	1 ... 10 mm
CC2B/90	2 m		x	1 ... 10 mm
CC3B/90	3 m		x	1 ... 10 mm
CC4B/90	4 m		x	1 ... 10 mm

Minimum bending radius:
10 mm (once)
38 mm (permanently)

2.2.3 Preamplifier (DT6310 only)

The preamplifier is necessary as connector between sensor and controller. With this preamplifier it is possible to deal with greater distances between sensor and controller. The sensor cable length is fixed at 1 m (4 m with additional adjustment of the controller) and must not be modified by the user.

Fig. 4 Preamplifier CP6001

2.2.4 Preamplifier Cable (DT6310 only)

The cable carriers capable preamplifier cable connect the preamplifier with the controller. It is possible to handle a distance of up to 20 m.

The user may not shorten or lengthen these special cables. Usually, a damaged cable can not be repaired.

Model	Cable length	Min. bending radius, permanent
CA5	5 m	
CA10	10 m	33 mm
CA20	20 m	
CA25	25 m	

2.2.5 Controller

The controller principally consists of an oscillator- and a demodulator unit. Both are stored in an aluminum housing.
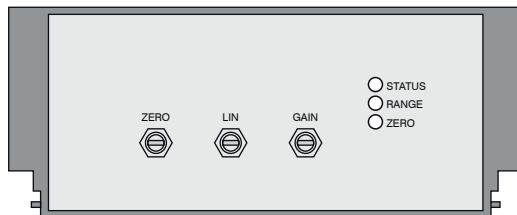
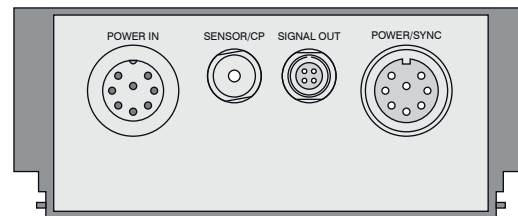

Fig. 5 Front view DT6300/6310

Fig. 6 Rear view DT6300/6310

Oscillator

The oscillator supplies the sensor with constant frequency and amplitude-stable alternating current. The frequency is 31 kHz.

Demodulator

Demodulation, linearization and amplifying of the distance-dependent measuring signal are tasks of the demodulator unit. The three trim-pots, see Fig. 5, allow a special

- Linearity
- Gain
- Zero

adjustment of the complete measuring channel, see Chap. 5.3, see Chap. 5.4.

i   Output voltage can achieve up to 14 VDC, if the sensor is disconnected respectively exceedance of measuring range.

2.3   Technical Data

Controller type	DT6300/DT6310
Resolution static	0.001 % FSO
Resolution dynamic	0.01 % FSO (8 kHz)
Limit frequency	8 kHz
Limit frequency adjustable	20 Hz / 1 kHz / 8 kHz
Linearity	±0.2 % FSO (all sensors interchangeable without calibration) Option LC: ±0.1 % FSO (tuned to one sensor)
Max. sensitivity deviation	±0.1 % FSO
Long term stability	≤ 0.02 % FSO / month
Synchronous operation	yes
Insulator measurement	yes
Temperature stability	±0.01 % FSO / °C
Temperature range (operation)	+10 … +50 °C
Temperature range (storage)	-10 … +75 °C
Supply	±15 VDC (±2 %) / ±150 mA
Output	0 - 10 VDC (max. 10 mA short circuit proof)
	4 ... 20 mA (load max. 500 Ω)
Suitable for sensors	all sensors
Sensor cable standard	≤ 1 m
Sensor cable (matched)	up to 4 m
Proper environment sensor	Humidity 5 to 95 % (non condensing)
Protection class	IP 54 (Controller and sensors)
Electromagnetic compatibility (EMC)	DIN EN 61326-1: 2006-10 and DIN EN 61326-2-3: 2007-5

FSO = Full Scale Output

3.   Delivery

3.1   Unpacking

1 Controller

1 Plug (if PC3/8 was not ordered)
  + 1 plug for 4-pole signal output

1 Instruction manual

Optional accessories, separately packed:

1 Sensor

1 Sensor cable with plug

1 Power and output cable PC3/8

3.2   Storage

Storage temperature: 0 °C up to +75 °C (+32 °F to +167 °F)

Humidity: 0 - 95 % RH (non condensing)

1 Preamplifier (DT6310 only)

1 Preamplifier cable (DT6310 only)

➡ Remove the parts of the system carefully from the packaging and transport them in such a way that they are not damaged.

➡ Check for completeness and shipping damages immediately after unpacking. In case of damage or missing parts, please contact the manufacturer or supplier.

4.   Installation and Assembly

4.1   Precautionary Measures

No sharp-edged or heavy objects may get into contact with the sensor cable sheath.

➡ Protect the cable against pressure loads in pressurised rooms.

➡ Avoid kinks in any case.

➡ Check the connections for tight fit.

i   A damaged cable cannot be repaired.

4.2   Sensor

The sensors may be mounted free-standing or flush.

When assembling, make sure that the polished sensor surface is not scratched.

4.2.1   Radial Point Clamping with Grub Screw, Cylindric Sensors

This simple type of fixture is only recommended for a force and vibration-free installation position. The grub screw must be made of plastic so that it cannot damage or deform the sensor housing.
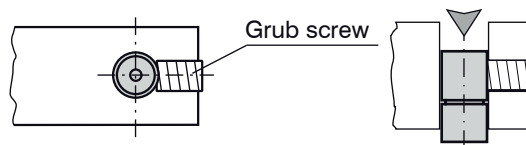
Grub screw

Fig. 7 Radial point clamping with grub screw

NOTICE   Do not use metal grub screws!
> Danger of damaging the sensor

4.2.2   Circumferential Clamping, Cylindric Sensors

This sensor mounting option offers maximum reliability because the sensor is clamped around its cylindrical housing. It is absolutely necessary in difficult installation environments, for example on machines, production plants et cetera.
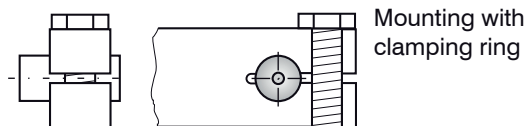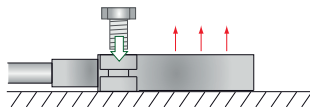
Mounting with clamping ring

Fig. 8 Circumferential clamping

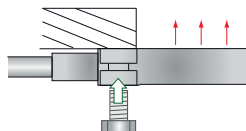i   Tension at the cable is inadmissible!

4.2.3   Flat Sensors

Flat sensors are mounted by means of a tap hole for M2 (in case of sensors 0.2 and 0.5 mm) or by a through hole for M2 screws. The sensors can be bolted on top or below.
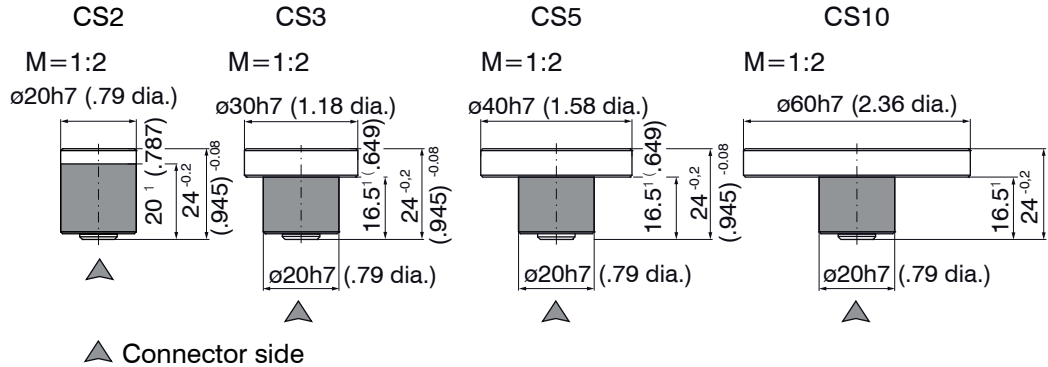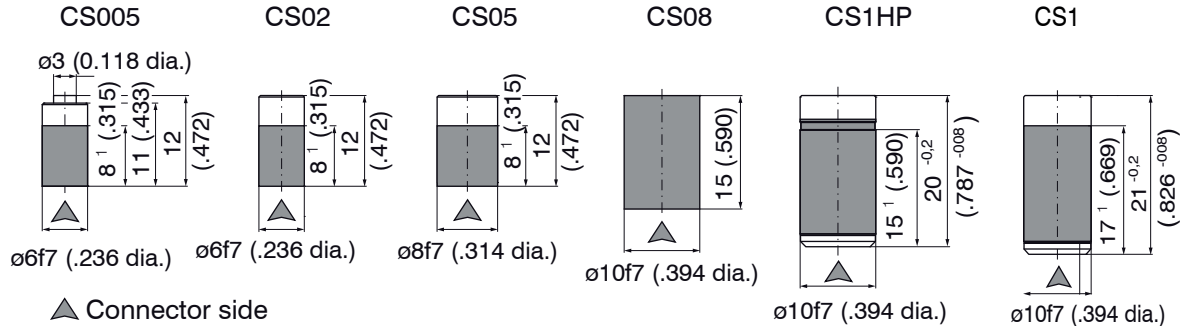
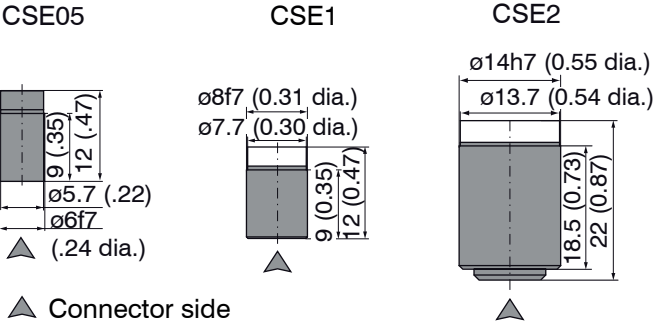**Screwing from above**   **Screwing from bottom**
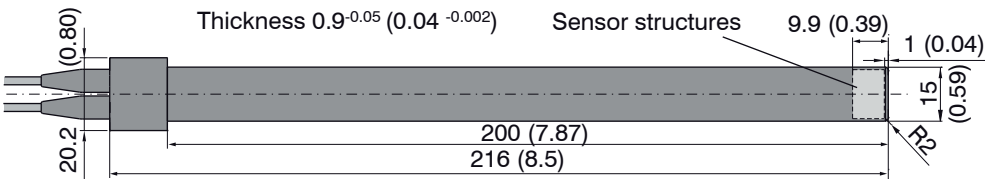
4.2.4 Dimensional Drawings Sensors

CS005

ø3 (0.118 dia.)

8 ^{1} (.315)
11 (.433)
12 (.472)

ø6f7 (.236 dia.)

CS02

8 ^{1} (.315)
12 (.472)

ø6f7 (.236 dia.)

CS05

8 ^{1} (.315)
12 (.472)

ø8f7 (.314 dia.)

CS08

15 (.590)

ø10f7 (.394 dia.)

CS1HP

15 ^{1} (.590)
20 $^{-0,2}$ (.787 $^{-008}$)

ø10f7 (.394 dia.)

CS1

17 ^{1} (.669)
21 $^{-0,2}$ (.826 $^{-008}$)

ø10f7 (.394 dia.)

▲ Connector side

CS2

M=1:2

ø20h7 (.79 dia.)

20 ^{1} (.787)
24 $^{-0,2}$ (.945) $^{-0.08}$

ø20h7 (.79 dia.)

CS3

M=1:2

ø30h7 (1.18 dia.)

16.5 ^{1} (.649)
24 $^{-0,2}$ (.945) $^{-0.08}$

ø20h7 (.79 dia.)

CS5

M=1:2

ø40h7 (1.58 dia.)

16.5 ^{1} (.649)
24 $^{-0,2}$ (.945) $^{-0.08}$

ø20h7 (.79 dia.)

CS10

M=1:2

ø60h7 (2.36 dia.)

16.5 ^{1}
24 $^{-0,2}$

ø20h7 (.79 dia.)

▲ Connector side

1) Adjustment area for radial point respectively circumferential clamping

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

1 μm = 0.001 mm
= 1 micron

CSE05

9 (.35)
12 (.47)

ø5.7 (.22)
ø6f7
▲ (.24 dia.)

▲ Connector side

CSE1

ø8f7 (0.31 dia.)
ø7.7 (0.30 dia.)

9 (0.35)
12 (0.47)

▲

CSE2

ø14h7 (0.55 dia.)
ø13.7 (0.54 dia.)

18.5 (0.73)
22 (0.87)

▲

CSG0.50-CAm2.0 and CSG1.00-CAm2.0

(0.80)
Thickness 0.9$^{-0.05}$ (0.04 $^{-0.002}$)   Sensor structures   9.9 (0.39)
1 (0.04)
15 (0.59)
20.2
200 (7.87)
216 (8.5)
R2

Sensor structures

2.9
(0.11)
5.4 (0.21)
4.2 (0.17)
4.5
(0.18)

CSG0.50-CAm2.0

4.2 (0.17)
4.4 (0.17)
6.2 (0.24)
3.85
(0.15)

CSG1.00-CAm2.0   Dimensions in mm (inches), not to scale

CSH02, CSH05

ø8g6 (.315 dia.)

ca. 9.4 (.37)

10 ¹ (.39)

14 (.39)

ø7.5 (.30 dia.)

33 (1.30)

ca. 37 (1.46)

ø2.2 (.09 dia.)

CSH1, CSH1.2

ø12g6 (.473 dia.)

ca. 9.4 (.37)

10 ¹ (.39)

14 (.39)

ø11.5 (.45 dia.)

33 (1.30)

ca. 37 (1.46)

ø2.2 (.09 dia.)
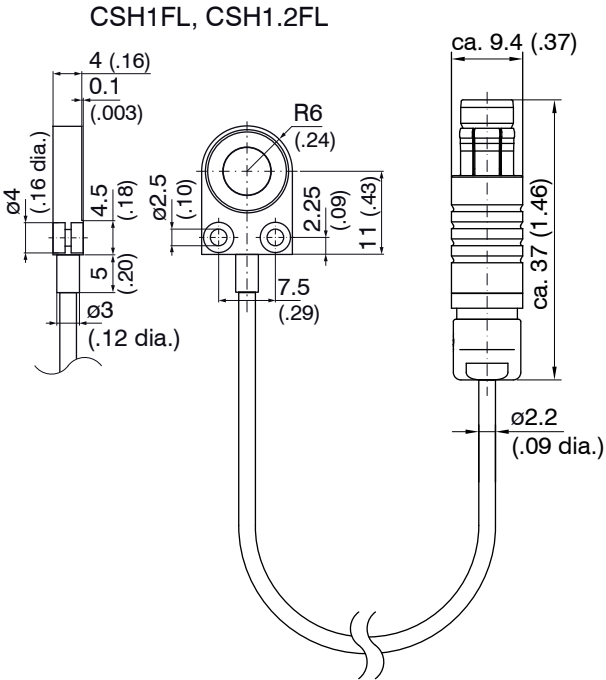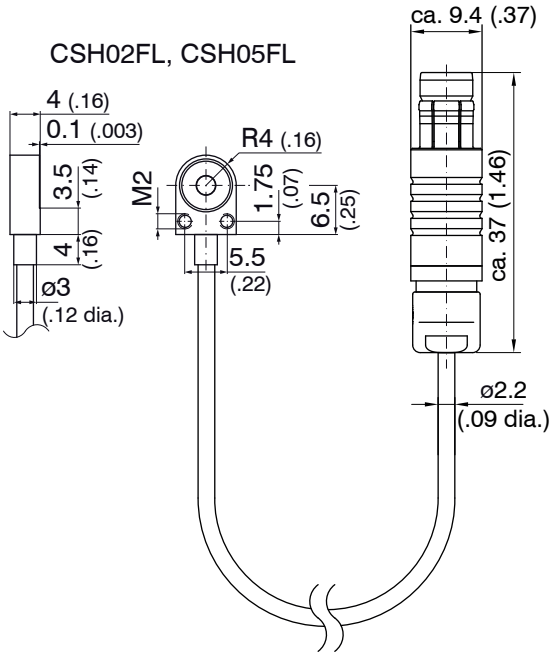
Dimensions in mm (inches), not to scale

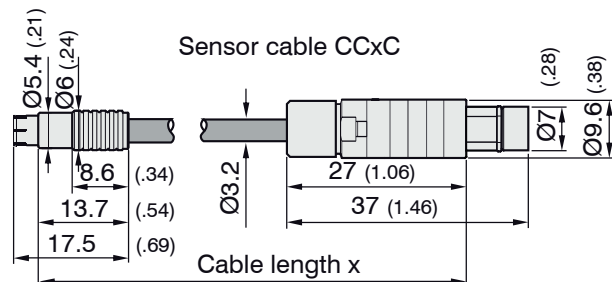1) Adjustment area for radial point respectively circumferential clamping

CSH2

ø20g6
(0.79 g6 dia.)

Clamp area

ca. 9.4 (.37)

33 (1.3)

10 (.39)

14 (.55)

ø19.5
(.77 dia.)

ca. 37 (appr. 1.46)

ø2.2
(.09 dia)

Dimensions in mm (inches), not to scale

CSH02FL, CSH05FL

4 (.16)
0.1 (.003)
3.5 (.14)
M2
R4 (.16)
1.75 (.07)
6.5 (.25)
4 (.16)
ø3 (.12 dia.)
5.5 (.22)

ca. 9.4 (.37)
ca. 37 (1.46)
ø2.2 (.09 dia.)

CSH1FL, CSH1.2FL

4 (.16)
0.1 (.003)
ø4 (.16 dia.)
4.5 (.18)
5 (.20)
ø3 (.12 dia.)
R6 (.24)
ø2.5 (.10)
2.25 (.09)
11 (.43)
7.5 (.29)

ca. 9.4 (.37)
ca. 37 (1.46)
ø2.2 (.09 dia.)

Dimensions in mm (inches), not to scale

CSH2FL

5 (.20)
ø2.2 (.09 dia)
1.6 (.06)
ø4 (.16 dia)
0.1 (.004)
20 (.79)
15.5 (.61)
15.5 (.61)
20 (.79)
7.6 (.30)
ø3 (.12 dia.)
ca. 9.4 (.37)
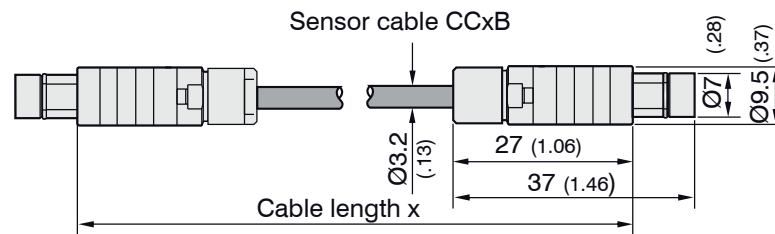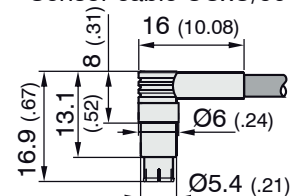ca. 37 (1.46)
ø2.2 (0.09 dia.)

Dimensions in mm (inches), not to scale
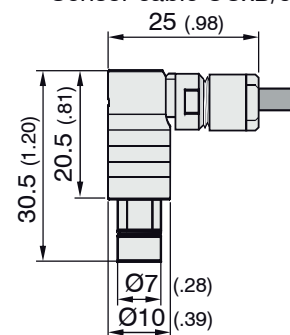
4.3   Sensor Cable

The sensor is connected to the controller by the sensor cable. The connection is made by simple plugging. The connector locks automatically. The tight fit can be checked by pulling the connector housing (cable bushing). The lock can be released and the connector can be opened by pulling the knurled housing sleeve of the cable bushing.

Sensor cable CCxC

Sensor cable CCxC/90

Sensor cable CCxB

Sensor cable CCxB/90

Dimensions in mm (inches), not to scale
Minimum bending radius: 10 mm (once)   X = 1 or 4 m
38 mm (permanently)

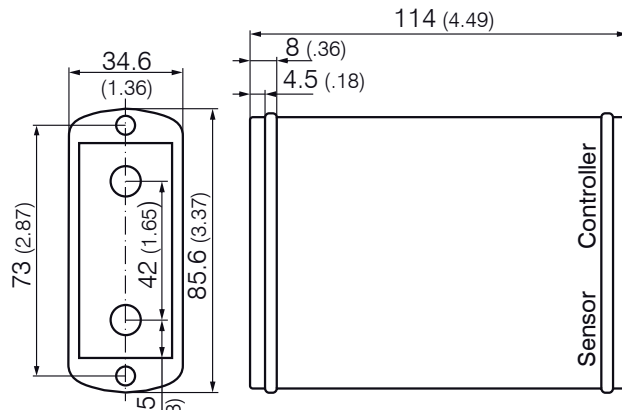| Model	2 axial connectors	1x axial + 1x 90 °	for sensors
CCxC	•		< 1 mm
CCxC/90		•	< 1 mm
CCxB	•		≥ 1 mm
CCxB/90		•	≥ 1 mm

4.4 Preamplifier CP6001

Fig. 9 Preamplifier CP6001, dimensions in mm, not to scale

Mounting preamplifier with mounting device (CP6001)

➡ Remove the four black protecting caps at the housing screws, dimension 73.

➡ Remove the four housing screws.

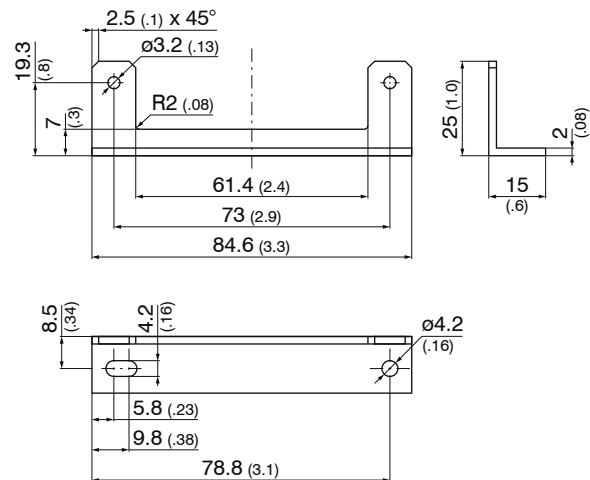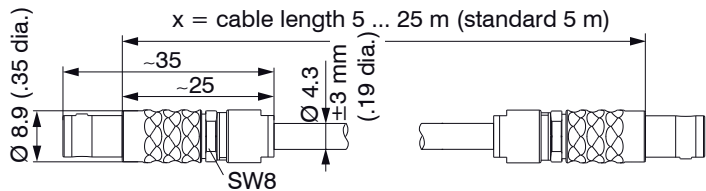➡ Fix the both mounting devices at the preamplifier. Use the screws contained in the delivery.

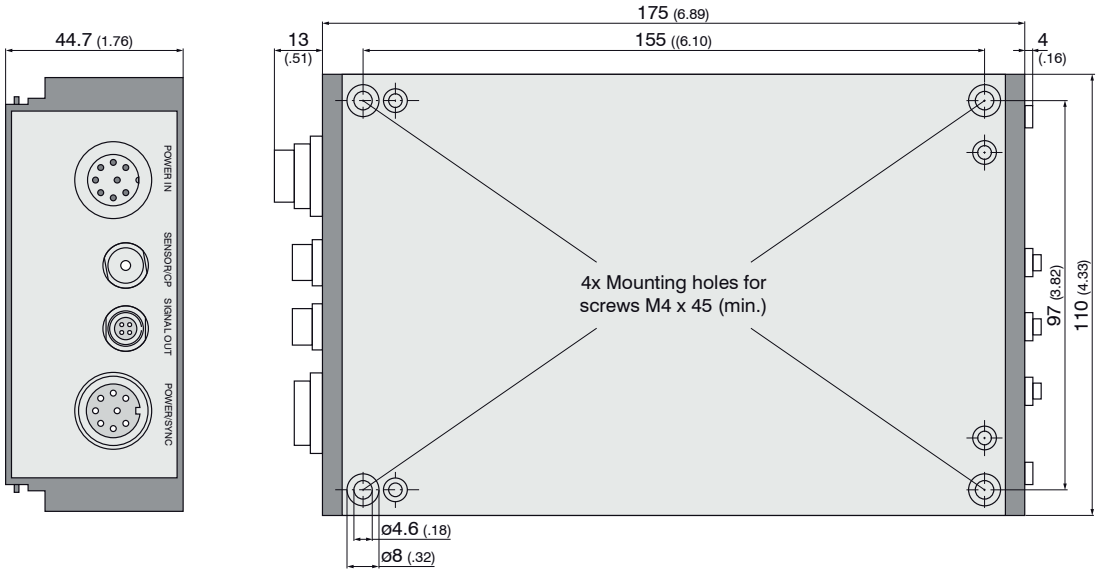*Fig. 10 Mounting device for preamplifier, dimensions in mm, not to scale*

4.5   Preamplifier Cable

Dimensions in mm Inches), not to scale

Model	Cable length	Min. bending radius, permanent
CA5	5 m	
CA10	10 m	33 m
CA20	20 m	
CA25	25 m	

4.6   Controller

44.7 (1.76)

POWER IN

SENSOR/CP

SIGNAL OUT

POWER/SYNC

175 (6.89)

155 ((6.10)

13 (.51)

4 (.16)

4x Mounting holes for
screws M4 x 45 (min.)

97 (3.82)

110 (4.33)

ø4.6 (.18)

ø8 (.32)

Dimensions in mm (inches), not to scale

4.7   Ground Connection, Earthing

➡️ Make sure you have a sufficient grounding of the measuring object, for example connect it with the sensor or the supply ground.

Non-contact target earthing

In several applications, the target earthing is difficult or even impossible.

Different to other systems, with capaNCDT systems is no target earthing necessary.

Two synchronized capaNCDT sensors, measuring against a mill, are shown, see Fig. 11. Due to the unique synchronizing technique of Micro-Epsilon in most cases a special target earthing is not needed.
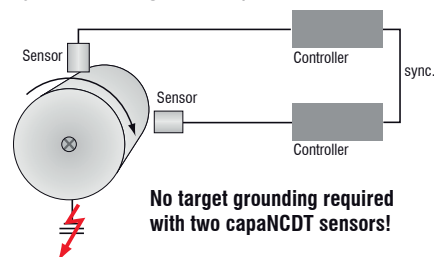

Fig. 11 Position and unbalance measurement with two systems

4.8   Power Supply, the Display/Output Device and Synchronization

The power supply and the signal output are located at the backside of the controller. Regarding jacks and plugs for the cable are included in the standard scope of delivery for customized cable assembling.

Furthermore, several controller DT6300/6310 can be synchronized and supplied with the PSCC30.

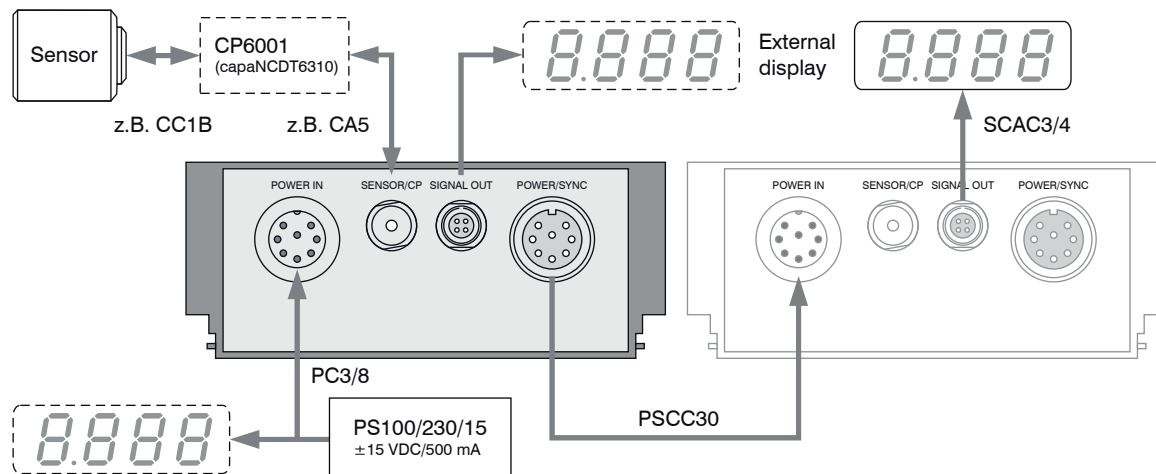➡️ In this case, use the cable SCAC3/4 for signal output only.

Fig. 12 System assembly and synchronization with a second controller

Synchronization in multi-channel mode

Several measuring systems capaNCDT 6300/6310 can simultaneously be used as multi-channel system. With the synchronization of the systems, a mutual influence to the sensors is avoided:

➡ Plug the synchronize cable PSCC30 (accessory) into the jack POWER/SYNC at controller 1.

➡ Plug the second end of PSCC30 into the jack POWER IN at the second controller.

- The oscillator of controller 2 switches automatically into synchronization, this means, depending on the oscillator of controller 1.
- An influence of poor earthed target is excepted.

➡ Where necessary, synchronize more measuring systems with the cable PSCC30.

i   To ensure perfect synchronization, the master with the highest serial number must always be used!

4.9   Pin Assignment

Pin	Assignment	Color PC 3/8	
		Inner cable	**Outer cable**
1	Sync In		white
2	+15 VDC		brown
3	U_{OUT} (Load min. 10 kOhm)	green	
4	-15 VDC		yellow
5	Supply ground		grey
6	NC		green
7	Analog ground	blue	
8	I_{OUT} (Load max. 500 Ohm)	red	

PC3/8 1 is a 3 m (9.84 ft) long, pre-assembled 8-wire power supply and output cable. It is supplied as an optional accessory.
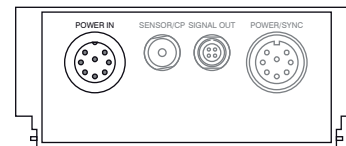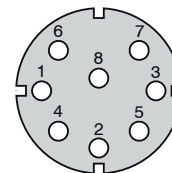

Fig. 13 Power supply input at controller, 8-wire DIN-plug (DIN 45326)
- black: outer screen
- bare: inner screen (connect with Pin 7, blue)

View on solder pin side, 8-pole DIN female cable connector

1) In addition the following should be noted when assembling the user-side connecting cable:
- Use a double screened cable!
- Outer screening mesh surrounds all cable wires
- Inner screening mesh surrounds signal wires PIN 3, 7, 8
- Inner screening mesh at pin 7
 Total screen via connector housing to housing ground
- Recommended conductor cross-section 0.14 mm^2

The EMC regulations, see Chap. 1.3, are only satisfied if these basic conditions have been observed.

Pin	Assignment	Conductor color SCAC 3/4
1	U_{OUT} (Load min. 10 kOhm)	brown
2	I_{OUT} (Load max. 500 Ohm)	yellow
3	Analog ground	grey
4	Analog ground	white

Fig. 14 Signal output at the controller, 4-wire plug

Analog ground connected internally.

SCAC3/4 is a 3 m (9.84 ft) long, pre-assembled 4-wire multi-channel output cable. It is supplied as an optional accessory.
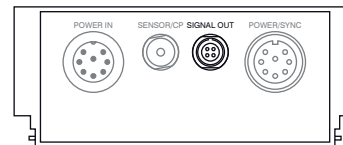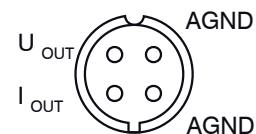

View on solder pin side, 4-pole male cable connector

Pin	Assignment	Wire color PSCC 30	
		Inner cable	Outer cable
1	Sync OUT		white
2	+15 VDC		brown
3	NC	green	
4	-15 VDC		yellow
5	Supply ground		green
6	NC		green
7	Analog ground	blue	
8	NC	red	

PSCC 30 is a 0,3 m (0.98 ft) long, pre-assembled power and synchronization cable. It is supplied as an optional accessory.
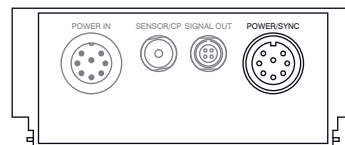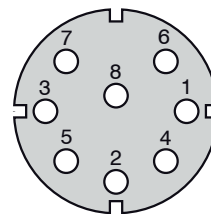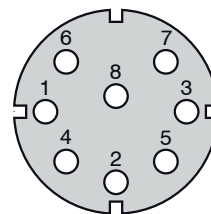

Fig. 15 Outputs for synchronization, 8-pole DIN-jack (DIN 45326)

View on solder pin side, 8-pole DIN male cable connector

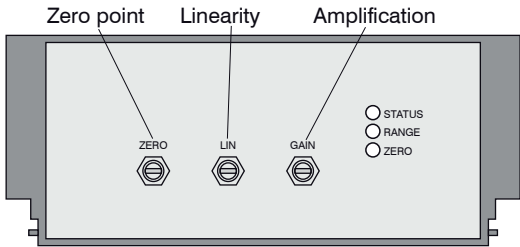View on solder pin side, 8-pole DIN female cable connector

5. Operation

5.1 Starting Up

➡ Connect the the display/output devices through the signal output socket, see Chap. 4.8, see Chap. 4.9, before connecting the device to the power supply and switching on the power supply.

ℹ Allow the measuring system to warm up before the first measurement or calibration:
DT 6300: ca. 10 min.
DT 6310: ca. 30 min.

5.2 Basic Settings

The gain, zero and linearity point of the measuring channel are adjusted with the 'GAIN', 'ZERO' and 'LIN' trimmer potentiometers, see Fig. 16, (the setting range is approximately 15 turns per potentiometer).

The end settings at the left and right stops are recognizable by a slight click.

LED	Color		Function
STATUS	○		Controller failure
	☀	orange	Controller OK
RANGE	☀	green	Target in measuring range
		red	Target out of measuring range
ZERO	○		Factory setting
	☀	red	Controller operates with changed factory setting

Fig. 16 Control elements at the controller

⚠ CAUTION

Disconnect the power supply before touching the sensor surface.
> Static discharge

> Danger of injury

The potentiometer are ex works at the right stop (maximum level).

Trimmer Setting

Zero: Shifts the output signal in negative direction to left.

Lin: Reduce the quadrate component by turning the trimmer to left.

Gain: Reduce the characteristic line slope by turning the trimmer to left.
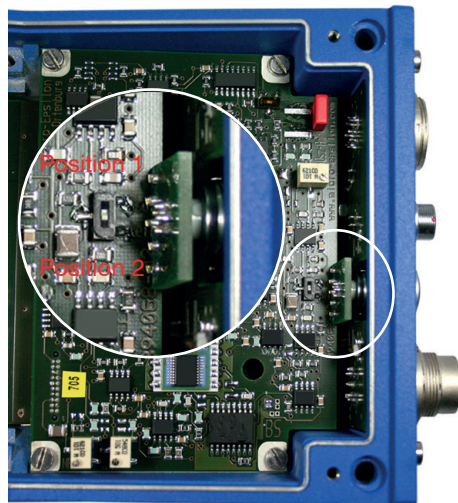
Lin and Gain only are active by insulating measurement.

Fig. 17 Electronics in the controller

Choice of target

Choose with a slide switch, see Fig. 17, between conducting and nonconducting target.

In position 2 zero point setting with the zero trim-pot is active only. Gain is set to 0 up to 10 V through the whole measuring range.

Position 1 (Insulator), non-conducting

Position 2 (Metal), conducting

5.3   Calibration with Metal Targets

Preconditions:
- Specific resistance of the target < 1 kΩcm.
- Slide switch on the demodulator in position 2 (metals, see Fig. 17).

For metallic targets the demodulator´s linearization function is switched off since a linear characteristic is already available automatically on account of the measuring principle and sensor construction.

The measuring device is set to a sensitivity of 10 Volts corresponding to the measuring range of each sensor model.

The electrical zero point can be set across the whole measuring range with the .zero. potentiometer of the demodulator module. The start of the measuring range (= mechanical zero point) is on the front face of the sensor.

A tilted sensor or measuring object results in a reduced measuring range and zero point shifting according to the tilting.

Curved target surfaces cause linearity reductions if the distance between the sensor and the target is small.

Also with small target surfaces losses in linearity and sensibility occur.

Extension of the measuring range:

The sensor measuring ranges by metal measurement can be extended considerably (by a factor of 2-3) with some loss in linearity and sensitivity.

▶ To do this, move the slide switch on the demodulator board to position 1.

▶ Make the necessary linearity adjustment, see Chap. 5.4.

In step 1 here the following potentiometer setting is assumed:
- zero: right stop
- gain: left stop
- linearity: right stop

▶ Carry out the complete calibration up to step 4.

5.4   Linearity Adjustment and Calibration with Insulator Targets

Preconditions:
- Specific resistance of the target $> 10^6$ Ωcm.
- Slide switch on the demodulator in position 1

The measuring channel must be individually linearized and calibrated prior to measurements against insulator targets. Adjustment takes place at defined distances which are prescribed by a reference. A special micrometer calibration device with a non-rotating micrometer spindle (for example MC25 from MICRO-EPSILON) has proved to be particularly suitable. Spacer discs are not suitable.

The following parameters influence the calibration. Later operating conditions should be simulated as accurately as possible for the calibration. If one of these parameter changes, recalibration is recommended:
- Resistivity of the target
- Dielectric constant of the target
- Shape and thickness of the insulator
- With thin targets, metal behind the target may influence the propagation of the field lines.

The greater the relative dielectric constant, the higher is the sensitivity of the measurement system.

Step 1:

Settings: .zero. right stop, .gain. middle, .linearity. middle

➡ Record the measuring curve of the sensor at least 10 points.

➡ Choose a range of low and as constant as possible curvature from this curve and determine the points:
- A Start of measuring range
- B Centre of measuring range
- C End of measuring range

The output signal at point C should not exceed 10 V in the chosen measuring range. If necessary, the sensitivity can be reduced with the .gain. potentiometer.
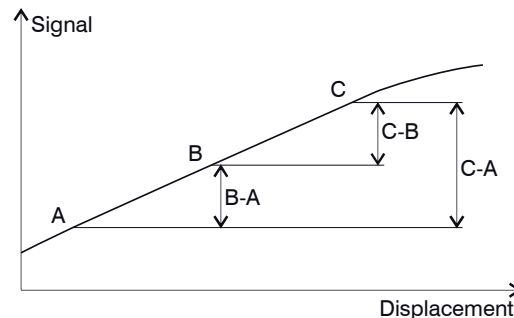

Fig. 18 Define the active measuring range

Step 2: Linearity

The measured value differences B-A and C-B are calculated from the fixed measuring points A B C and compared with each other. The setting of the .linearity. potentiometer is now altered until B-A and C-B are identical.

If the setting is not valid, you can do the following:

➡ Add with the trimmer .linearity. a quadratic component to the characteristic, which compensates the physical not linear element of insulators.

In position zero (left stop) no quadratic component is added.

➡ If the value C exceeds 10 V reduce the sensitivity (.gain.).

If the .linearity. potentiometer is at the stop and B-A and C-B are still not equal, points A and C have probably been badly chosen.

➡ Start again with step 1.

Step 3: Sensitivity

➡ In order to set a practicable sensitivity, first form the signal difference C-A and select a sensitivity which matches the measuring range (for example 1 V/mm).

➡ Calculate the required measured value C' and set the distance point C.

$$C' = C\frac{E}{(C - A)}$$

E ... desired signal span point A to C

C ... signal value at distance point C

A ... signal value at distance point A

If C' is not more than 10 V, set it with the .gain. potentiometer.

As a final check, run through the whole measuring curve and document it.

Step 4: Zero point

The electrical zero point can now be shifted without affecting the linearity and sensitivity.
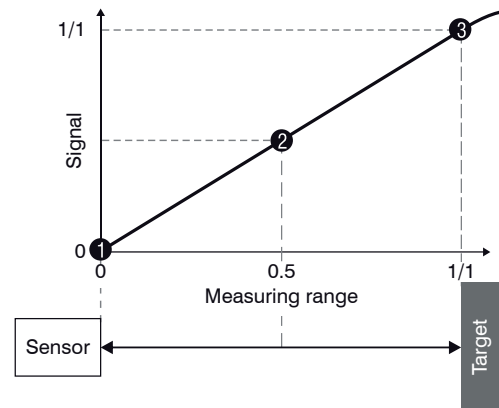

Fig. 19 Signal behavior of the output voltage

5.5 Changing Limit Frequency

The controller operates with a limit frequency of 8 kHz (factory setting). In the case that the limit frequency is reduced, the output signal is filtered more efficiently and the resolution is therefore improved. At the same time the dynamic of the system is reduced.

Procedure for changing the limit frequency:

➡ Open the controller.

➡ Set the requested limit frequency using the micro-switch, see Fig. 20.
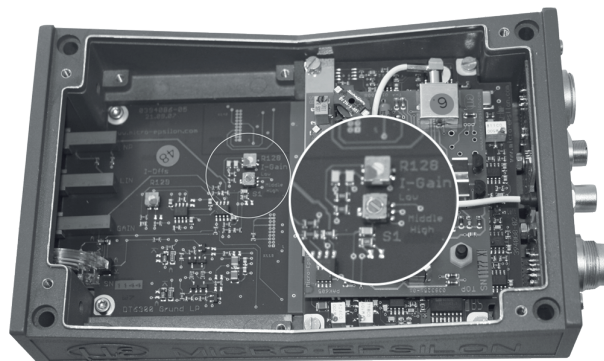
➡ Close the controller.

Fig. 20 Limit frequency

6.   Measurement

With the capaNCDT either the deflection or the compensation method of measurement can be applied.
- **Deflection method** for fast events, tolerance monitoring and for insulators:

Put the zero point in the centre of the measuring range, the output signal is then in proportion to the distance. Fast events are displayed on a suitable external recorder (oscilloscope, recorder, transient recorder).
- **Compensation method** for constant or slowly changing distances.

Compensation is carried out with the .zero. potentiometer until the output signal is 0 Volt. Sensitivity is not affected by doing this.

7.   Operation and Maintenance

Please take care of the following:

▶ Make sure that the sensor surface is always clean.

▶ Switch off the power supply before cleaning.

▶ Clean with a damp cloth; then rub the sensor surface dry.

Changing the target or very long operating times can lead to slight reductions in the operating quality (long term errors). These can be eliminated by recalibration, see Chap. 5.3, see Chap. 5.4.

⚠ CAUTION

▶ Disconnect the power supply before touching the sensor surface.

> Static discharge

> Danger of injury

In the event of a defect in the controller, the sensor or the sensor cable, the parts concerned must be sent back for repair or replacement. In the case of faults the cause of which is not clearly identifiable, the whole measuring system must be sent back for repair or replacement to

MICRO-EPSILON MESSTECHNIK GmbH & Co. KG
Königbacher Straße 15
94496 Ortenburg / Germany

8.   Liability for Material Defects

All components of the device have been checked and tested for functionality at the factory. However, if defects occur despite our careful quality control, MICRO-EPSILON or your dealer must be notified immediately.

The liability for material defects is 12 months from delivery. Within this period, defective parts, except for wearing parts, will be repaired or replaced free of charge, if the device is returned to MICRO-EPSILON with shipping costs prepaid. Any damage that is caused by improper handling, the use of force or by repairs or modifications by third parties is not covered by the liability for material defects. Repairs are carried out exclusively by MICRO-EPSILON.

Further claims can not be made. Claims arising from the purchase contract remain unaffected. In particular, MICRO-EPSILON shall not be liable for any consequential, special, indirect or incidental damage. In the interest of further development, MICRO-EPSILON reserves the right to make design changes without notification.

For translations into other languages, the German version shall prevail.

9.   Decommissioning, Disposal

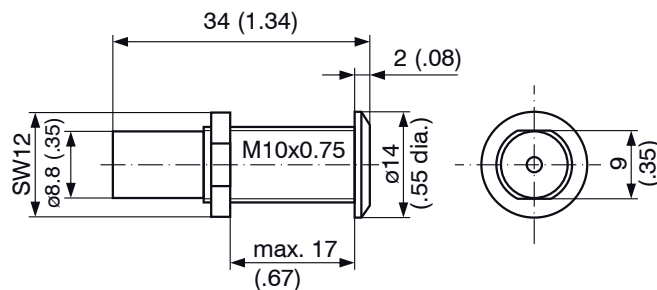➡ Remove the cable for electrical power and output signal on the controller.

Incorrect disposal may cause harm to the environments.

➡ Dispose of the device, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.

10.   Accessories, Service

Accessories

MC2.5	Micrometer calibration fixture, range 0-2.5 mm / 0-0.1 inch, division 1 μm for sensors CS005 ... CS2
MC25D	Digital micrometer calibration fixture, Range 0-25 mm / 0-1 inch, adjustable offset (zero), for all sensors
PC3/8	Power and output cable, 3 m (9.84 ft) length, 8-wire
CSP 301	Digital signal processing unit with display for synchronous processing of two channels
SCAC3/4	Output cable for multi-channel operation necessary
PSCC30	Supply- / synchronization cable for multi-channel operation necessary
PS100/230/15	Power supply unit for compact position measuring systems, input 230 VAC ($\pm$10 %), output $\pm$15 VDC /500 mA, housing dimensions 116x69x44 mm, connection via screw terminal
SWH	Vacuum feed through

Dimensions in mm (inches), not to scale

Service

Function and linearity check-out, inclusive 11-point protocol with graphic and post-calibration.