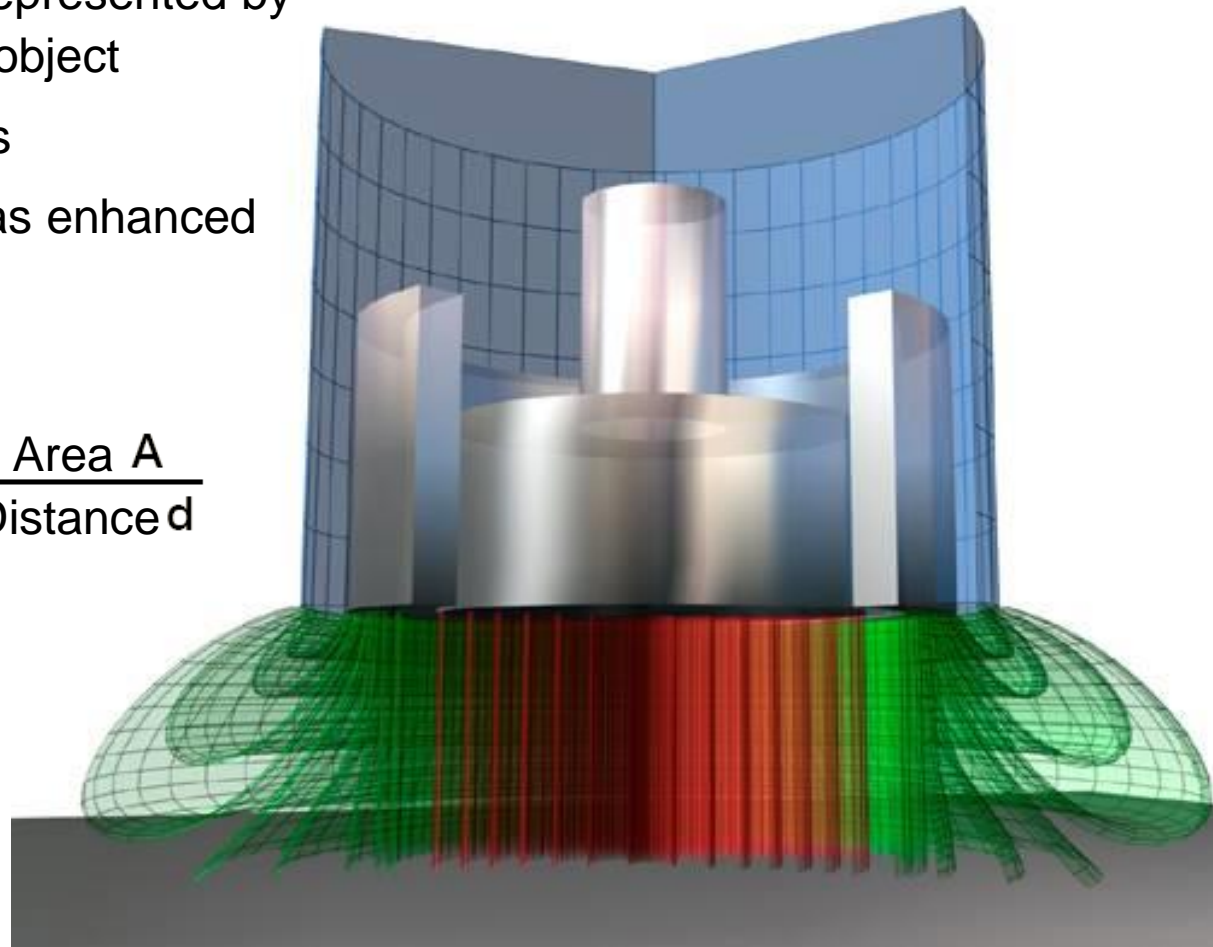


Measuring principle capacitive sensors

- Principle of ideal plate capacitor
- Two plate electrodes are represented by sensor and measurement object
- Measurement on insulators
- The capacitive principle was enhanced by Micro-Epsilon

$$\text{Capacity } C = \epsilon_r \cdot \epsilon_0 \cdot \frac{\text{Area } A}{\text{Distance } d}$$

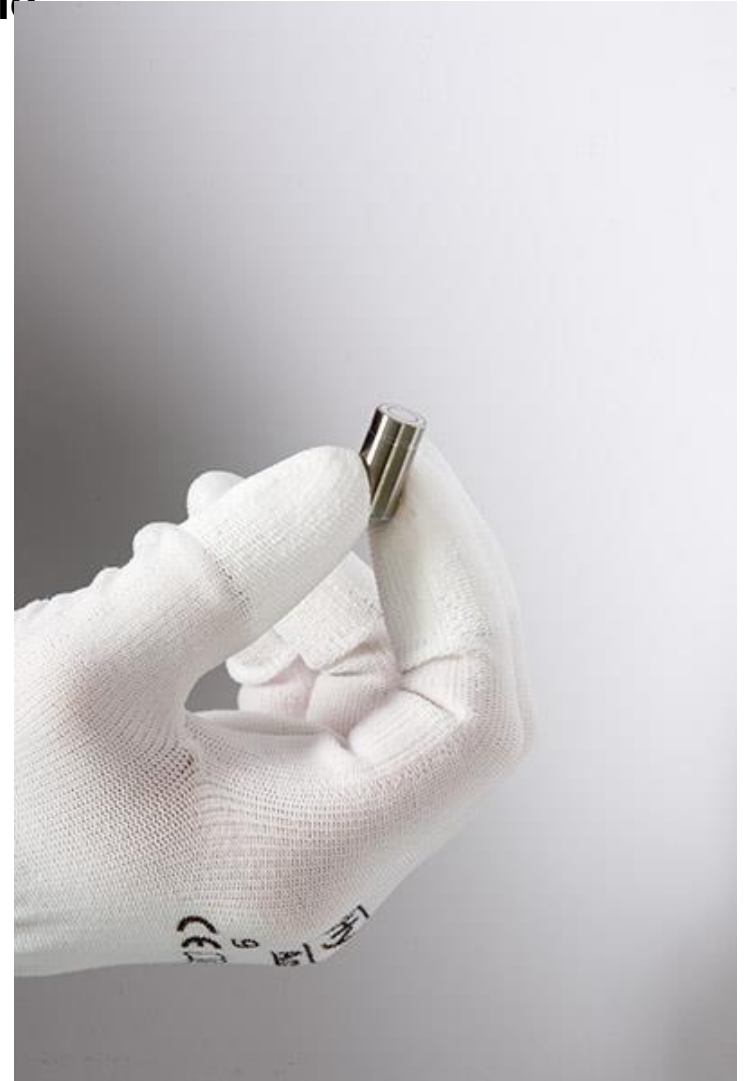


Benefits of the capacitive measuring principle

- High accuracy and stability
- Wear-free and non-contact measurement
- Sensors do not affect the measuring object
- Independent from conductance fluctuations and electrical conductive measuring objects

Please consider:

- Highest precision in clean environment
- Best measuring results against electrical conductive objects



Benefits of capacitive sensors:

- Tri electrode and active guard ring
- Fast sensor change without calibration
- Largest product range worldwide (flat sensors, sensors with integrated cable)
- Extreme stability

Ranges 0.05 to 10mm

Resolution 0.04nm

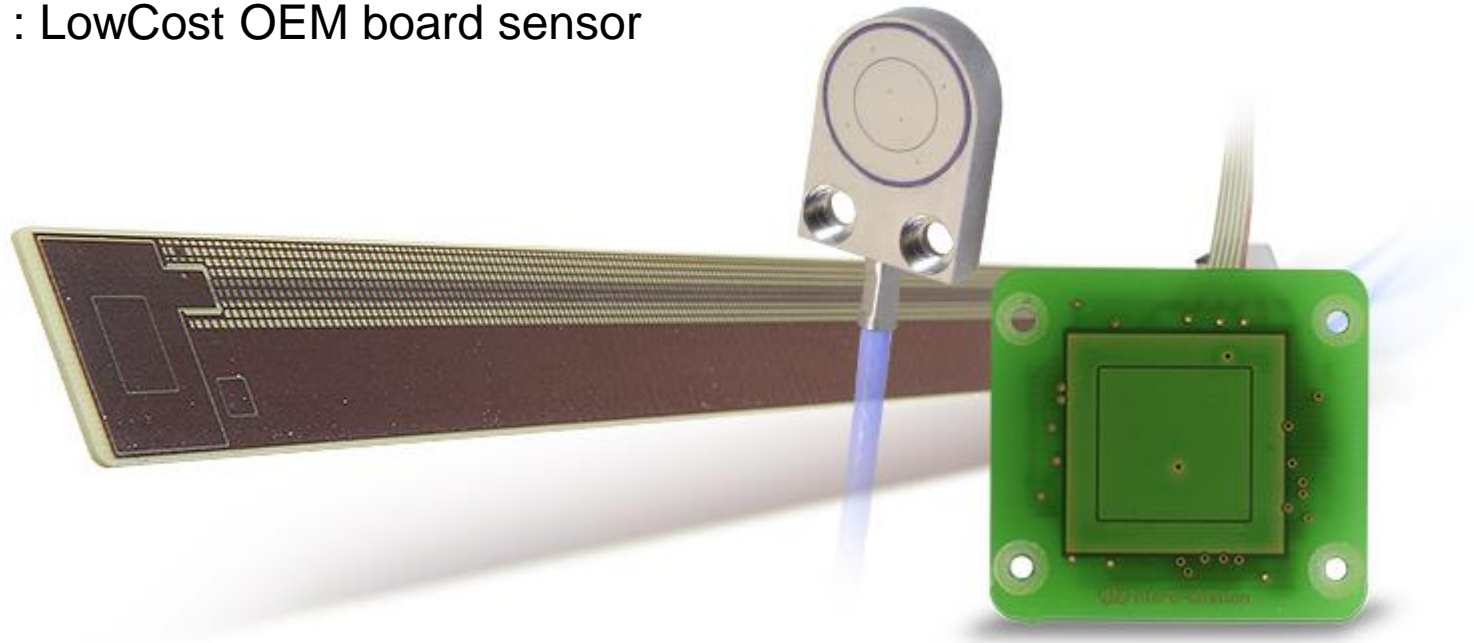
Temperature stability 11 ppm/° C



Capacitive sensors capaNCDT

capaNCDT sensors

- Capacitive gap sensors
- Enlarged ranges
- Capacitive flat sensors
- CSI : LowCost OEM board sensor



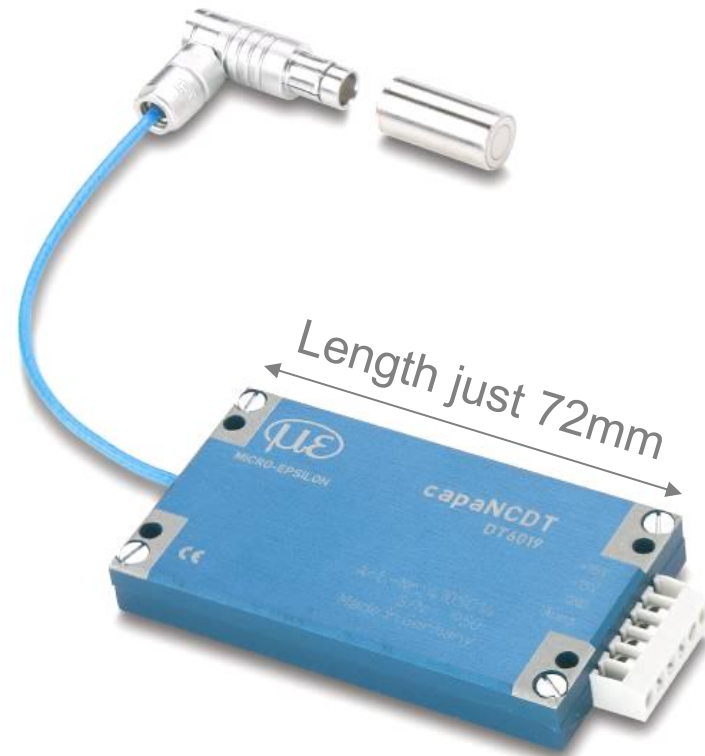
Capacitive displacement and position sensors

capaNCDT 6019

Miniature single-channel system

- For confined installation conditions
- Low power consumption
- Ideal for battery power supply

Ranges	0.2 - 10 mm
Consumption	8 mA ($\pm 12V \dots \pm 18V$)
Resolution	0.1 %
Measuring rate	500 Hz



Capacitive displacement and position sensors

capaNCDT 6100

Compact single-channel system

- High temperature stability
- Reproducibility in nanometer ranges
- Can be synchronised with ungrounded measuring object

Measuring ranges	0.2 - 10mm
Linearity	0.3% / 0.1%
Resolution	0.015%
Measuring rate	2kHz



Capacitive displacement and position sensors

capaNCDT 6300 / 6310

Compact high precision single-channel system

- High zero point stability and accuracy
- Extreme temperature stability
- Measurement against insulators
- Robust design

Measuring ranges	0.05 - 10mm
Linearity	0.2% / 0.1%
Resolution	0.001%
Measuring rate	8kHz (-3dB)



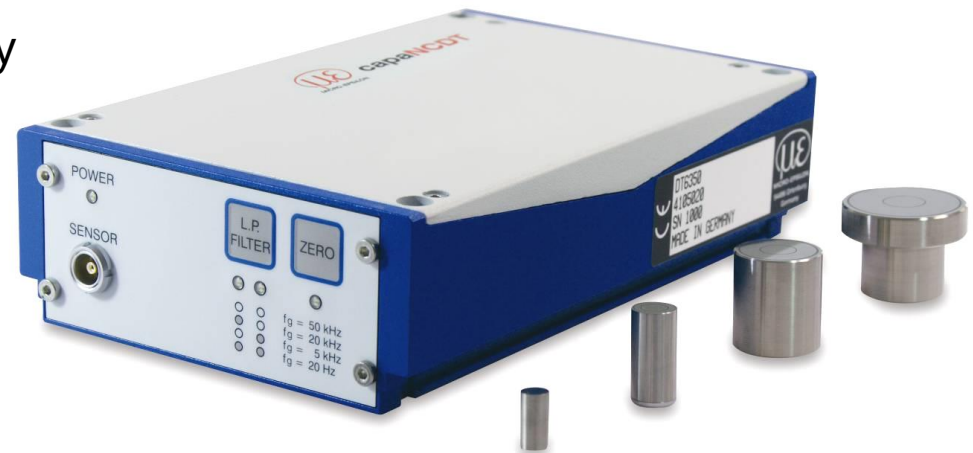
Capacitive displacement and position sensors

capaNCDT 6350

Compact high speed single-channel system

- Ideal for detection of high dynamic movements
- High zero point stability and accuracy
- Highest configurability (measuring range and cable length)

Measuring ranges	0.2 - 10mm
Linearity	0.3%
Resolution	0.005%
Measuring rate	50kHz (-3dB)

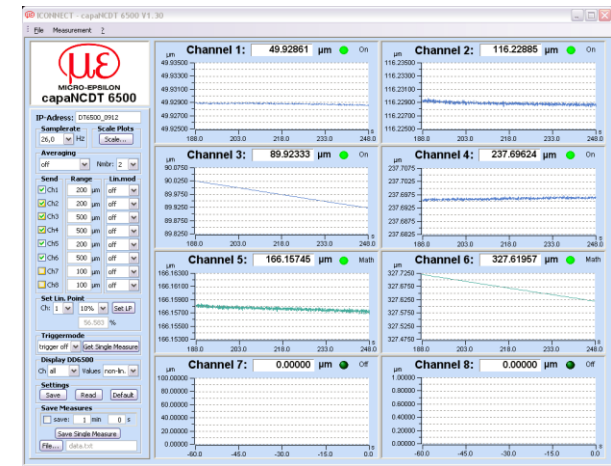


Capacitive displacement and position sensors

capaNCDT 6500

Extreme resolution multi-channel system

- Multi-channel system with sub-nanometre resolution
- Extreme temperature stability
- Ethernet interface and PC software
- Integrated configurable signal processing



Measuring ranges	0.05 - 10mm
Linearity	0.05%
Resolution	0.000075%
Measuring rate	8.5kHz (-3dB)



High resolution measuring system

Capacitive measuring system

Resolution: 70 picometre = $70 \cdot 10^{-12} \text{m} = 0.000\,000\,000\,070 \text{m}$



70 picometer
per millisecond



Grass grows within one week approx. 5cm (= 0.050m)
i.e. in one second approx. 80 nanometre and in
one thousands of a second 80 picometre.

With a resolution of 70 picometre the sensor
is able to detect the growing of grass within one millisecond!

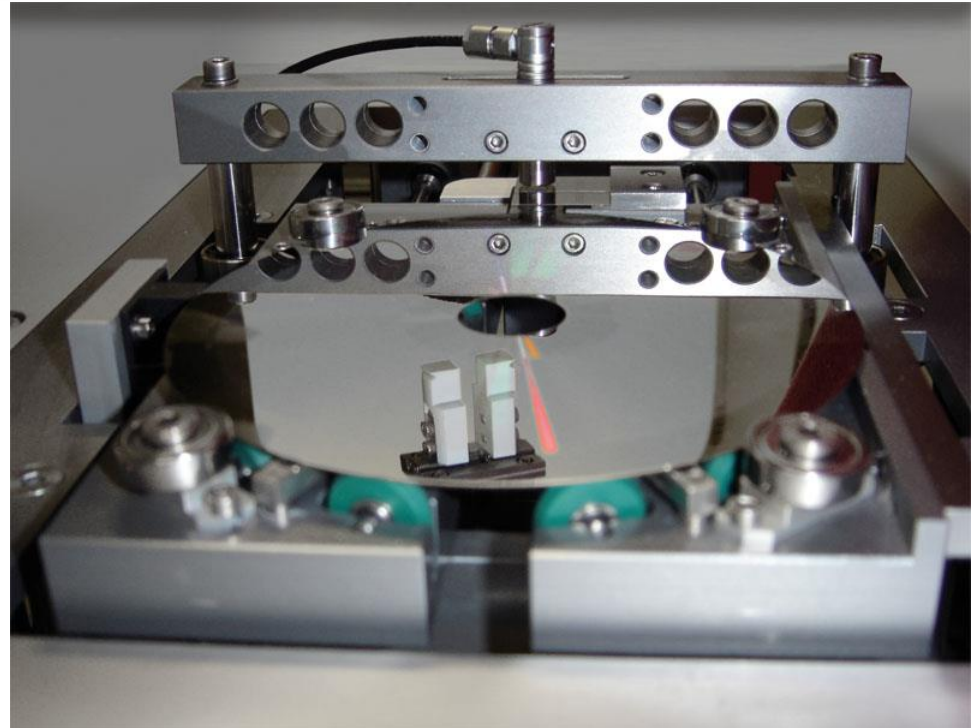
Thickness measurement of matrices for optical data carrier

Exact thickness detection for matrice controlling in the production process

- Fast and accurate measurement
- Wear-free
- Difference measurement

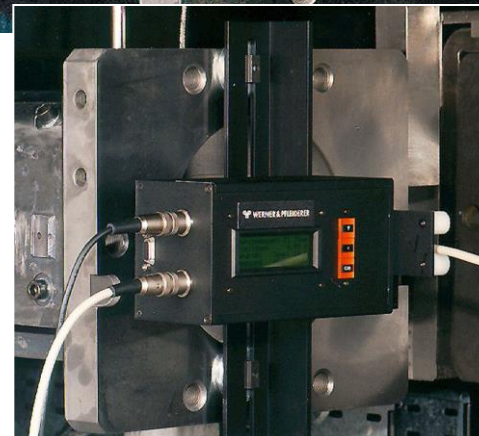
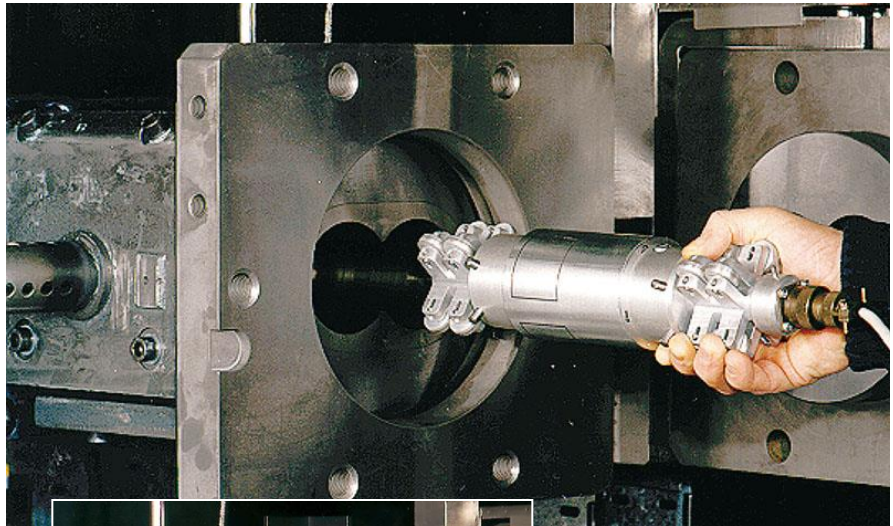
Technical data:

- Resolution $< 0.05\mu\text{m}$
- Repeat accuracy $< 0.25\mu\text{m}$
- Measuring range 2mm



Wear measurement of extruder bores

- Non-contact and wear-free measurement
- capaNCDT sensors are calibrated for all metals and independent of material inhomogeneity
- Thanks to the double sensor principle no exact centre position of the measuring head necessary.



Application capacitive sensors

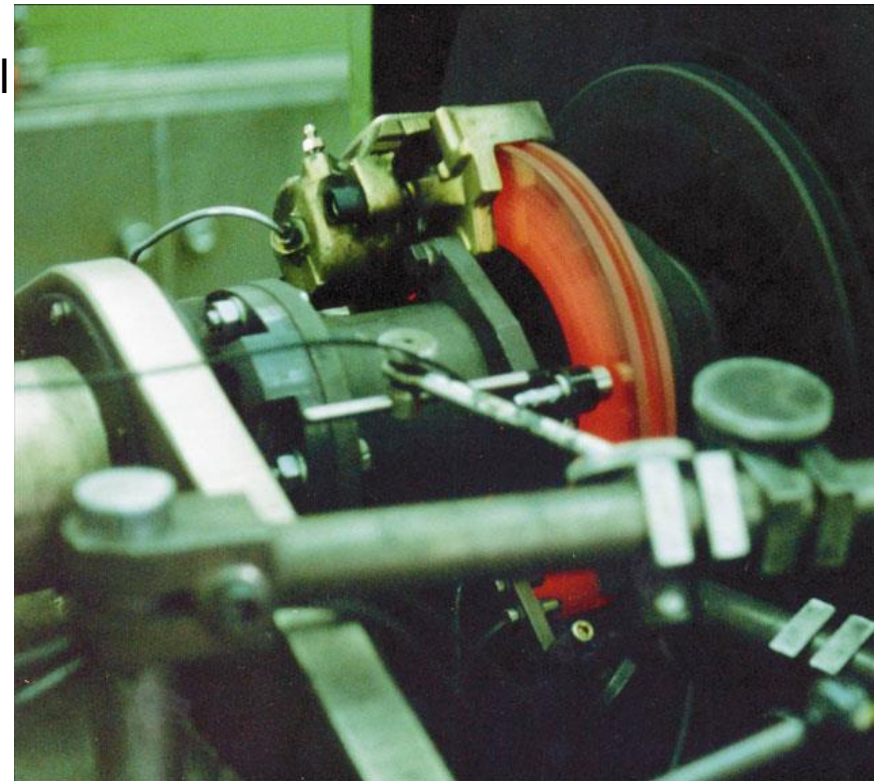
Wear free measurement on brake disks

Deformation of the brake disk friction ring

- High band width
- Measurement against red glowing metal
- Extreme temperature stability
- Very accurate measurements

Target temperature $>1000^{\circ}\text{C}$

Resolution: (dyn.) $0.4\mu\text{m}$



Application capacitive sensors

Measurement on wafers and semiconductors

Capacitive displacement sensors are used for nanometer adjustments of lenses in objectives for wafer exposures

Measuring range 1.2mm

Resolution 7nm (10Hz)
70nm (6kHz)

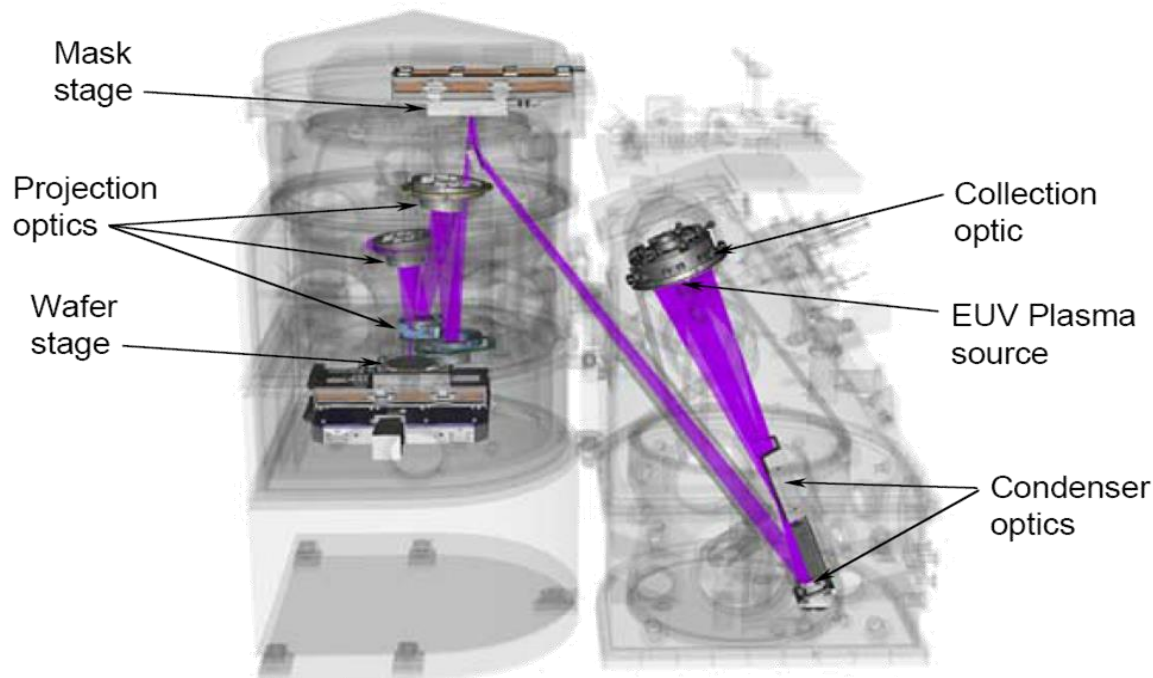
Linearity $\pm 2.4\mu\text{m}$



Application capacitive sensors

Alignment of lens system

- Optical lenses for wavelength < 15 nm not applicable
- Optical system using mirrors
- Requirements: Sub-Nanometer!



Application capacitive sensors

Alignment of lens systems

Folding of the beam patch for reducing construction height

Measuring range: 1200 μ m

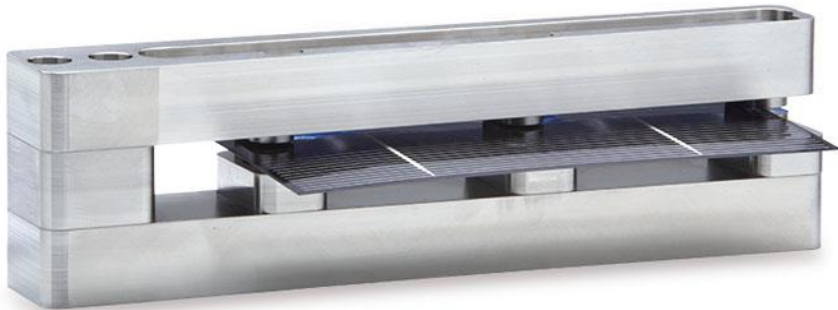
Resolution: 7nm

Positioning accuracy: 30nm



Thickness measurement of solar wafers in three measuring tracks

- Stable measuring system
- Synchronous acquisition of up to 8 channels
- Customer specific sensor design (extreme flat)



Application capacitive sensors

Travel displacement of a nano positioning unit at 4 K

Technical data:

- Constant technical characteristics at 4 K
- As small as possible thermal expansion
- Nanoresolution

Ambient conditions:

- Ambient temperature -270°C (4 K)
- Operating in ultrahigh vacuum

