



# More Precision


## Product Guide



Displacement  
Distance  
Position

Dimension  
Temperature  
Color





As a technology leader, Micro-Epsilon pursues the need to develop high precision sensors, measurement devices and systems. This need is the drive for continuous high performance in measurement technology. Behind Micro-Epsilon is a powerful group of companies that provide strategies that focus on different sensor technologies, facilitating the group's leadership in this field. As well as on sensors for displacement, distance, position, color and temperature, we also focus on surface inspection systems. Continuous development efforts, extensive know-how and a wide cooperation network enable us to develop high precision sensors. Further developing of measuring techniques and technical innovations is our basis for the creation of sensor products providing our customers with a significant added value.



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## Application fields

Sensors and measurement devices from Micro-Epsilon are used in numerous industries. Whether it is for quality assurance, applications in maintenance, process and machine monitoring, automation or R&D - sensors make a vital contribution to the improvement of products and processes. From global major groups to medium-sized companies and engineering service providers - sensors and solutions from Micro-Epsilon ensure reliable measurement results with highest precision all over the world. From machine building and automated production lines in the food industry, to integrated OEM solutions - nearly all industries benefit from sensor technology.

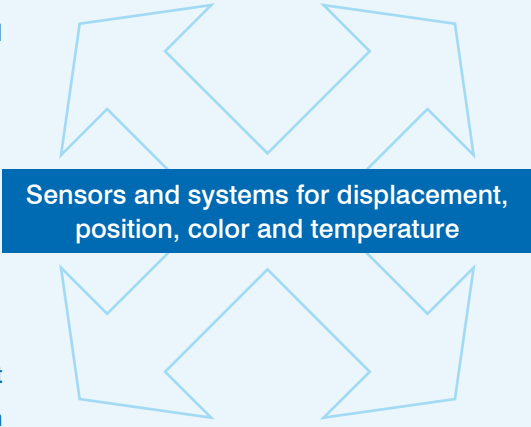


### **Automation processes**

Quality assurance of products  
Production control  
Process monitoring and control

### **OEM Integration**

Finished products  
Vehicles  
Machines, devices and appliances



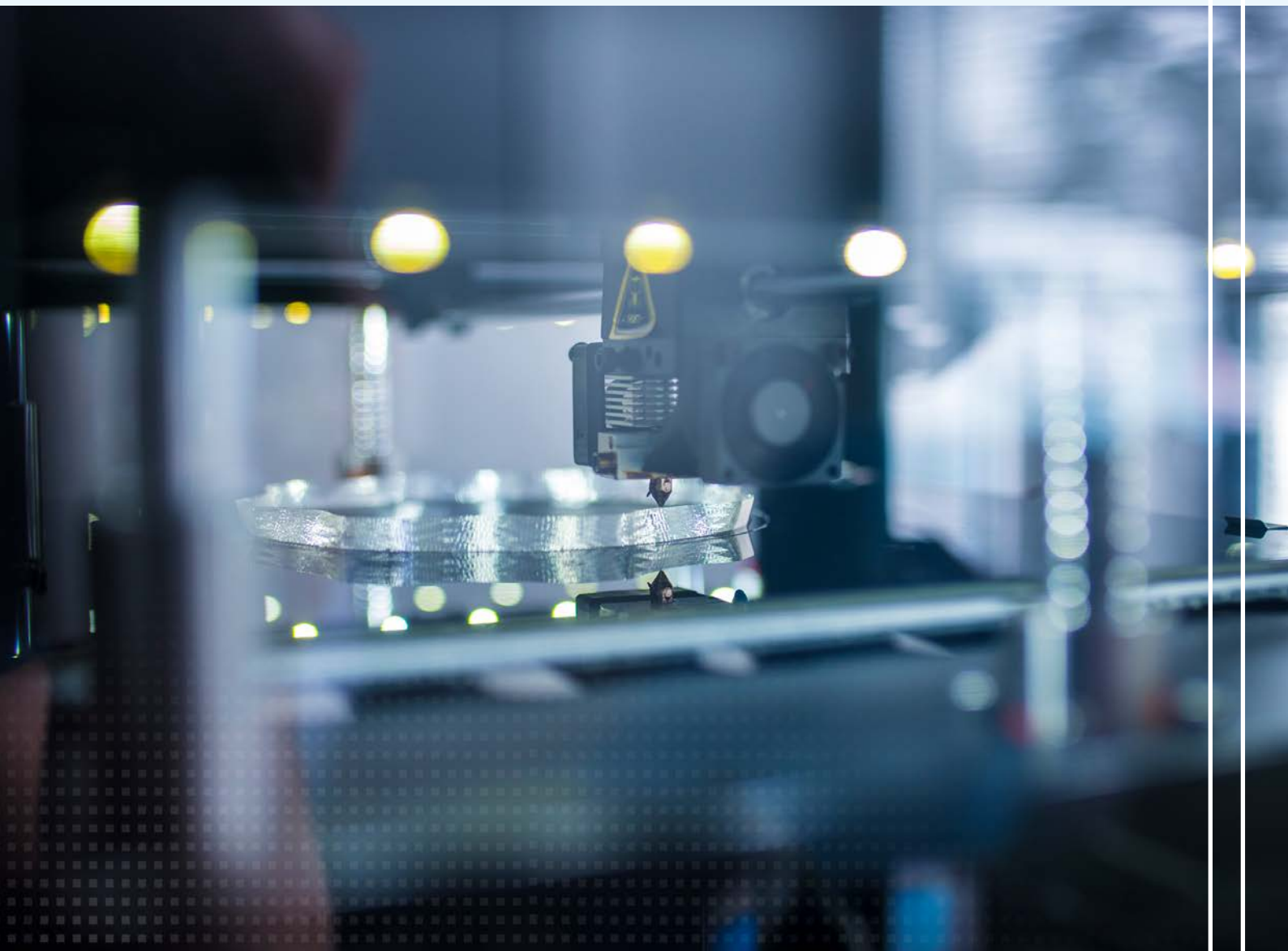
**Sensors and systems for displacement,  
position, color and temperature**

### **Research and development**

Product and process optimization  
Test bench and road test  
Basic research in industry

### **Machine building and plant engineering**

Machine monitoring  
Plant controller  
Care and maintenance







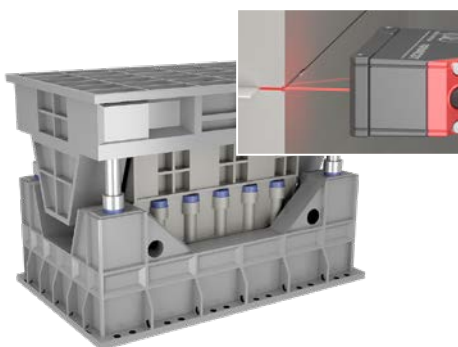
## Laser triangulation

### Non-contact displacement and position sensors

optoNCDT sensors are based on the principle of optical triangulation for non-contact displacement measurement. A sensor emits a laser beam that becomes an extremely small light spot on the target surface. This spot is projected onto a very sensitive linear detector via an imaging optics. A change in position of the laser point is imaged onto the detector and processed by a signal processor. Nearly all models operate with a high-resolution CCD or CMOS line and a digital signal processor.

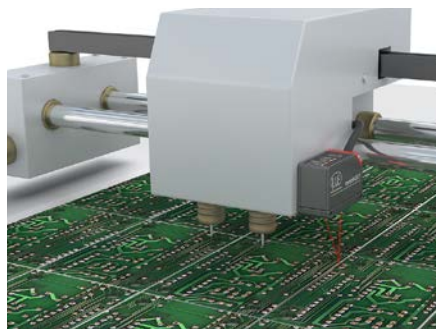
#### Advantages

- Detection of smallest targets due to point-shaped measurement
- Large measuring ranges
- Large reference distance
- High resolution
- Excellent linearity
- High measuring rates
- Synchronization of several sensors
- Measurement of shiny metallic and rough surfaces



#### Monitoring the sheet metal infeed during pressing

During forming in the pressing plant, the presence detection and the detection of the exact sheet metal position are required. Therefore, optoNCDT sensors measure on the sheet between the dies.



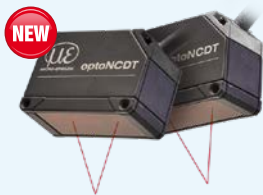
#### Measuring scribe lines on PCB panels

Scribe lines are pressed into printed circuit boards for separation purposes. Laser sensors inspect the line depth which should be consistent in order to ensure reliable separation.



#### Models with small laser line

The LL series is designed for shiny metallic and rough surfaces. With a small laser line, these sensors compensate for varying reflections.



#### optoNCDT 1220/1320

Compact laser triangulation displacement sensor for fast and precise measurements

Measuring ranges (mm)	10   25   50   100
Linearity	$\leq \pm 0.1 \% \text{ FSO}$
Repeatability	from $1 \mu\text{m}$
Measuring rate	1 kHz   2 kHz



#### optoNCDT 1420/ 1420 CL1

Smart laser triangulation displacement sensor for fast and precise measurements

Measuring ranges (mm)	10   25   50   100   200   500
Linearity	$\leq \pm 0.08 \% \text{ FSO}$
Repeatability	from $0.5 \mu\text{m}$
Measuring rate	4 kHz



#### optoNCDT 1610/1630

High speed PSD sensor

Measuring ranges (mm)	4   10   20   50   100
Linearity	$\leq \pm 0.2 \% \text{ FSO}$
Resolution	0.005 % FSO
Frequency response	up to 100 kHz (-3 dB)



#### optoNCDT 1750

Universal sensor with integrated controller for industrial applications

Measuring ranges (mm)	2   10   20   50   100   200   500   750
Linearity	$\leq \pm 0.06 \% \text{ FSO}$
Repeatability	from $0.1 \mu\text{m}$
Measuring rate	7.5 kHz



#### optoNCDT 1750BL/2300BL/2300-2DR

Laser sensor with Blue Laser Technology for metals and organic materials

Measuring ranges (mm)	2   5   10   20   50   100   200   500   750   1000
Linearity	$\leq \pm 0.03 \% \text{ FSO}$
Resolution	0.0015 % FSO
Measuring rate	49 kHz



#### optoNCDT 2300

Highly dynamic laser sensor in the 50 kHz class

Measuring ranges (mm)	2   5   10   20   50   100   200   300
Linearity	$\leq \pm 0.02 \% \text{ FSO}$
Resolution	0.0015 % FSO
Measuring rate	49 kHz



#### optoNCDT 1750LL / 2300LL

Laser sensors for shiny metallic objects

Measuring ranges (mm)	2   10   20   50
Linearity	$\leq \pm 0.02 \% \text{ FSO}$
Resolution	0.0015 % FSO
Measuring rate	49 kHz



#### optoNCDT 1710 / 2310

Long-range sensors for large distances

Measuring ranges (mm)	10   20   40   50   1000
Linearity	$\leq \pm 0.03 \% \text{ FSO}$
Resolution	0.005 % FSO
Measuring rate	49 kHz



#### thicknessSENSOR

The sensor for non-contact thickness measurements of strip and plate material

Measuring ranges (mm)	10   25
Linearity	$\pm 0.01 \% \text{ FSO}$
Measuring rate	4 kHz
Measuring widths (mm)	200   400



## Confocal chromatic principle

### Non-contact displacement sensors

The confocalDT measuring system consists of a controller with a white light source and a sensor. Both components are connected via long optical-fiber cable up to 50 m. Polychromatic white light is focused onto the target surface by a multilens optical system. The distance between the focal point and the sensor varies due to the chromatic aberration of the sensor lens. A certain distance is assigned to each wavelength in the controller. The reflected light is directed onto the receiving optics which detects the spectral intensity distribution. This unique measuring principle enables high precision measurements on diffuse and reflecting surfaces. With transparent objects, distance measurements as well as one-sided thickness measurements of single- and multi-layered materials can be performed.

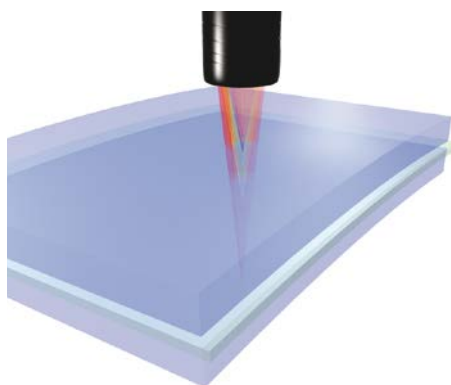
#### Advantages

- Extremely high resolution
- Suitable for all surfaces
- Extremely small, constant spot size
- Compact beam path
- One-sided thickness measurement of transparent materials
- Vacuum-suitable sensor design on request



#### Thickness measurement of sleeves

Two synchronized sensors detect the bottom thickness of sleeves in a two-sided arrangement.



#### One-sided thickness measurement of transparent materials

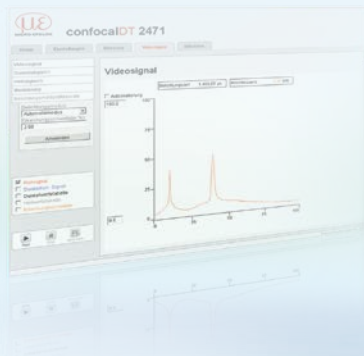
The unique measuring principle enables one-sided thickness measurement of transparent materials and even multi-layer materials to nanometer accuracy using just one single sensor.



#### Measuring the thickness and roundness of bottles

confocalDT 2422 is used to measure the thickness and roundness of glass bottles with two channels. Thickness calibration enables varying distances between the sensor and the bottles without influencing the measurement accuracy.





#### confocalDT 2421/2422

Single and dual-channel controller with integrated light source for industrial applications and measuring rates up to 6.5 kHz

#### confocalDT 2451

Universal controller with integrated light source for measuring rates up to 10 kHz

#### confocalDT 2461

High-performance controller with integrated light source for measuring rates up to 25 kHz

#### confocalDT 2471 HS

High-speed controller with integrated or external light source for measuring rates up to 70 kHz

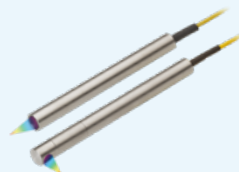


#### IFS2402

Miniature sensors (gradient index lens) for the inspection in tightest spaces

Measuring ranges (mm)	0.4   1.5   2.5   3.5
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available with axial or radial (90°) beam path



#### IFS2403

Confocal hybrid sensors with narrow gradient index lens and relay lens

Measuring ranges (mm)	0.4   1.5   4   10
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Extended offset distances



#### IFS2404-2

Confocal chromatic sensors for high precision applications in restricted spaces

Measuring ranges (mm)	2
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Resolution (μm)	0.040
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#### IFS2405

Standard sensors for precise distance and thickness measurements

Measuring ranges (mm)	0.3   1   3   10   28   30
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Large offset distance and tilt angle



#### IFS2406

Compact confocal sensors for precise displacement and thickness measurements

Measuring ranges (mm)	2.5   3   10
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available with axial or radial beam path



#### IFS2407

Compact confocal sensors for precise measurements of distance, roughness and thickness

Measuring ranges (mm)	0.1   0.3
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Small measurement spot size and large tilt angle



## Time-of-flight principle

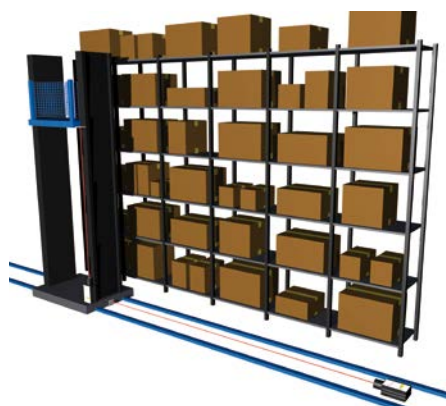
### Non-contact laser gauging and distance sensors

Optoelectronic optoNCDT ILR sensors are designed for non-contact distance and displacement measurements with large measuring ranges. The 118x series is based on the phase comparison principle, where modulated laser light is permanently transmitted to the object. The receiver compares the phase shift of the transmitted signal with the received signal, enabling the distance to be precisely calculated.

All other optoNCDT ILR sensors operate according to the time-of-flight principle. Here, a laser pulse is transmitted and the time it takes for the reflected pulse to arrive back at the sensor is precisely measured. The distance can be measured based on the speed of light and the measured time period. Depending on the application and the required measuring range, the sensors operate on diffuse reflecting surfaces or on a special reflector plate.

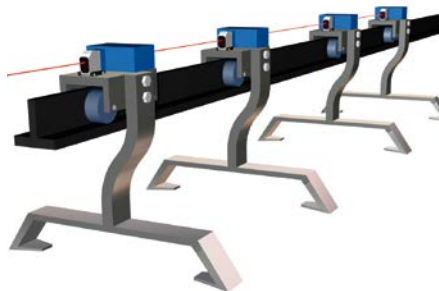
#### Advantages

- Very large measuring range
- High repeatability
- Fast response time
- Excellent price/performance ratio
- Open interfaces



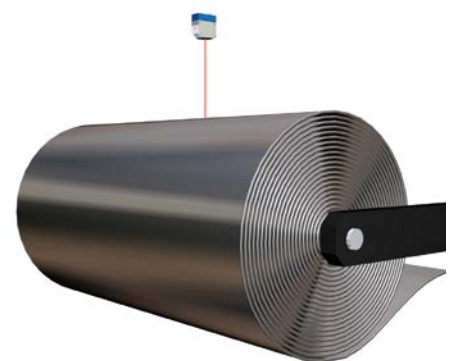
#### Position measurement in stacker cranes

Fast response times combined with high measurement accuracy facilitate the exact positioning of stacker cranes.



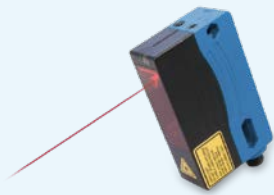
#### Distance measurement of overhead conveyors

The distance between the conveyors is detected in order to efficiently control the production flow.



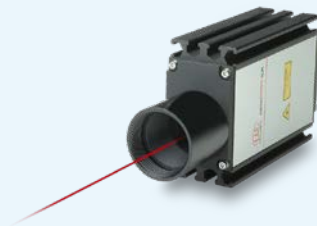
#### Measurement of coil diameters

The quantity of steel wound on and off is monitored via the detection of the coil diameter using laser gauging sensors.



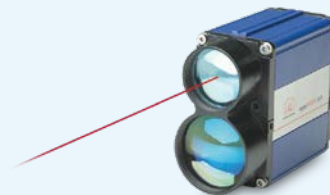
**optoNCDT ILR 1030/1031**  
Compact laser distance sensors

Measuring ranges	no reflector 0.2 - 15 m
	with reflector 0.2 - 50 m
Linearity	± 20 mm
Repeatability	< 5 mm
Response time	10 ms



**optoNCDT ILR 1181/1182/1183**  
Precise laser distance sensors

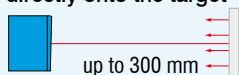
Measuring range	0.1 - 150 m
Linearity	± 2 mm
Repeatability	< 0.5 mm
Response time	20 ms



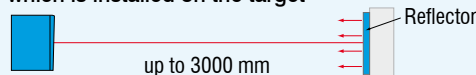
**optoNCDT ILR 1191**  
Laser distance sensors

Measuring range	0.5 - 3000 m
Linearity	± 20 mm
Repeatability	< 20 mm
Response time	0.5 ms

Measurement is performed directly onto the target



Measurement against a reflector which is installed on the target



	ILR	1030	1031	1181	1182	1183	1191
Measuring range in gauging mode (without reflector)	8 m	•					
	15 m	•					
	50 m			•	•	•	
	300 m						•
Measuring range with reflector	50 m		•				
	150 m			•	•	•	
	3000 m						•

optoNCDT ILR sensors are particularly suitable for filling level measurement, safety applications, height measurement of lifting systems, overhead conveyors, crane systems and for positioning lifts. The optoNCDT ILR 1191 is specially designed for outdoor use and port facilities.







## Non-contact, capacitive displacement and position sensors



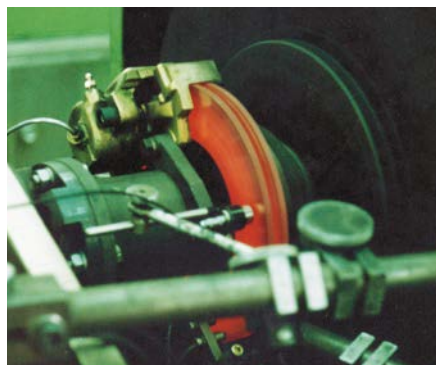
Capacitive displacement sensors are based on the principle of the ideal plate capacitor. The sensor acts as an electrode while the ground electrode is the target. This technique enables measurements against all conducting and semiconducting objects. Micro-Epsilon has extended the capacitive measuring principle with some innovative functions, which enable highly linear output characteristics, nanometer precise resolution and very stable measurement results. The linear characteristic of the measurement signal is obtained for measurements against electrically-conducting materials without any additional electronic linearization. These non-contact sensors are ideal for industrial applications in production plants, in-process quality assurance and test bench applications.

### Advantages

- High precision
- High speed and high resolution
- Large temperature range
- Material-independent with conducting materials
- Extreme signal stability



Capacitive sensors are also used for air gap measurement in large electric motors.



Even under harsh conditions in the test bench, capacitive sensors provide highest precision e.g. when measuring wear on a brake disk.



Non-contact, capacitive displacement sensors are used for nanometer adjustments of lenses in objectives for wafer exposures.



#### capaNCDT 6110

Compact single-channel system

Measuring ranges (mm)	0.05   0.2   0.5   0.8   1   2   3   5   10
Linearity	$\leq \pm 0.05$ % FSO
Resolution	0.01 % FSO
Frequency response	up to 20 kHz (-3dB)



#### capaNCDT 61x0/IP

Measuring system for industrial applications

Measuring ranges (mm)	0.5   1   1.25   2   3   4   6
Linearity	$\leq \pm 0.1$ % FSO
Resolution	0.01 % FSO
Frequency response	1 kHz (-3dB)



#### capaNCDT 6200

Modular multi-channel system

Measuring ranges (mm)	0.05   0.2   0.5   0.8   1   2   3   5   10
Linearity	$\leq \pm 0.025$ % FSO
Resolution	0.0005 % FSO
Frequency response	up to 20 kHz (-3dB)



#### capaNCDT 6500

Modular multi-channel system

Measuring ranges (mm)	0.05   0.2   0.5   0.8   1   2   3   5   10
Linearity	$\leq \pm 0.025$ % FSO
Resolution	0.000075 % FSO
Frequency response	8.5 kHz (-3dB)



#### combiSENSOR

One-side thickness measurement of plastic films and coated metals

Target thickness	40 $\mu$ m to max. 6 mm
Working distance	2 to 10 mm
Resolution	0.0018 % FSO
Frequency response	1 kHz (-3dB)



#### capaNCDT MD6-22

Capacitive mobile gap measurement with high precision

Gap	max. 12 mm
Linearity	$\leq \pm 0.2$ % FSO
Resolution	0.02 % FSO
Frequency response	100 Hz (-3dB)



#### Large range of capacitive sensors

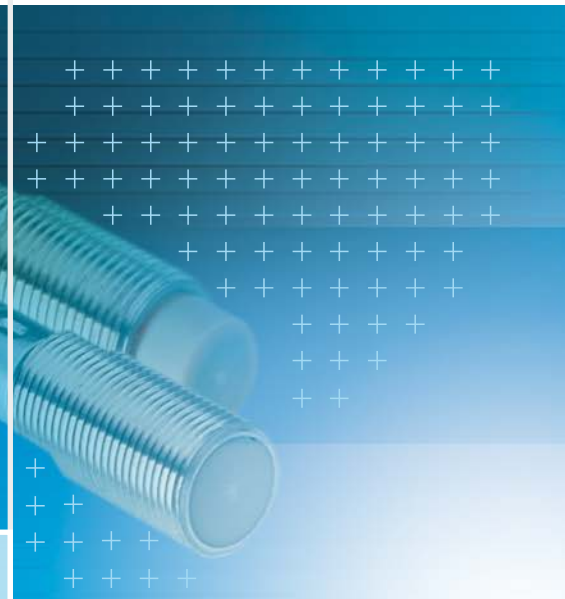
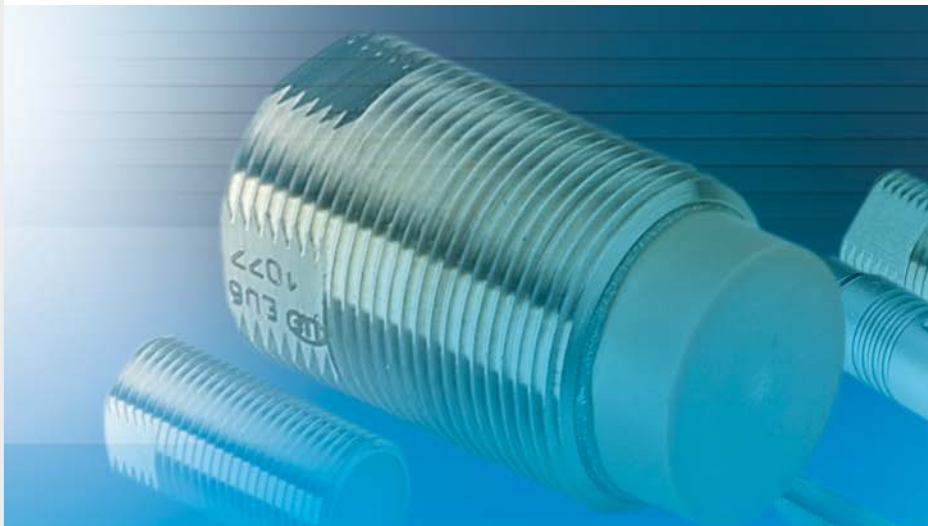
Capacitive displacement sensors from Micro-Epsilon are available in different designs and versions. They differ with respect to measuring range, design and manufacturing technology. Capacitive sensors are available in a cylindrical design (with integrated cable or socket) or as flat sensors (with integrated cable). These sensors can be exchanged without recalibration; the sensor replacement can be completed rapidly. Most sensors can be used in clean rooms as well as in ultra-high vacuum.

#### Specific sensors for OEM applications

Micro-Epsilon sensors can be adapted to customer requirements with respect to:

- Shape & size
- Sensor material
- Cable
- Miniaturization
- Cryogenic or high temperatures
- Integrated controller with sensor for OEM design





## Eddy current

### Non-contact displacement and position sensors

Non-contact eddyNCDT displacement sensors are based on the eddy current principle. They enable non-contact and wear-free measurements without exerting any forces onto the measurement object. Eddy current sensors are used for electrically conductive materials. The objects may have ferromagnetic and non-ferromagnetic characteristics. Due to its immunity to e.g. oil, dirt, water and electromagnetic interference fields, this measuring principle is also ideally suitable for applications which require precise measurements in harsh industrial environments.

#### Extreme temperature stability

Eddy current sensors from Micro-Epsilon can be used in a large temperature range from -50 °C to +350 °C. Their large temperature range and resistance to dirt and dust enable a wide application variety in industrial environments. While conventional eddy current sensors are subject to an extreme drift in case of fluctuating temperatures in the ambient, an active temperature compensation provides eddyNCDT sensors with maximum signal stability. This is how eddy current sensors perform reliable measurements even in large temperature ranges.

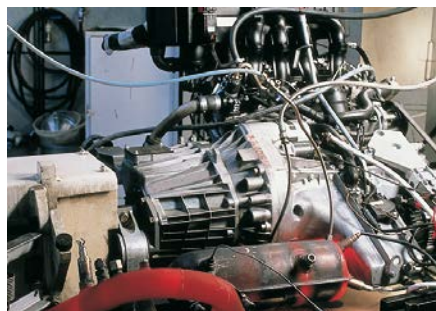
#### Advantages

- Non-contact and wear-free
- High resolution and linearity
- Stable measurement signals
- High dynamics
- Excellent temperature range and temperature stability
- For industrial applications



#### Example: machine monitoring

Eddy current sensors monitor the fluctuating thickness of yarns in textile machines.



#### Example: test bench

In the automotive industry, eddy current sensors operate inside a running combustion engine under harsh test conditions.



#### Example: power supply

Non-contact displacement sensors monitor the blade gap, enabling low-wear and long-term operation in gas turbines.





#### eddyNCDT 3001

Compact eddy current sensors with integrated controller

Measuring ranges (mm)	2   4   6   8
Linearity	$\leq \pm 0.7\%$ FSO
Resolution	0.1 % FSO
Frequency response	5 kHz



#### eddyNCDT 3005

Miniature eddy current measuring system, ideal for integration into plant and machinery

Measuring ranges (mm)	1   2   3   6
Linearity	$\leq \pm 0.25\%$ FSO
Resolution	0.05 % FSO
Frequency response	5 kHz (-3dB)



#### eddyNCDT 3060

A new performance class in inductive displacement measurements

Measuring ranges (mm)	1   2   3   4
Linearity	$\leq \pm 0.1\%$ FSO
Resolution	0.002 % FSO
Frequency response	20 kHz (-3dB)



#### eddyNCDT 3300

High precision eddy current system for industrial applications

Measuring ranges (mm)	0.4   0.8   1   2   3   4   6   8   15   22   40   80
Linearity	$\leq \pm 0.2\%$ FSO
Resolution	0.005 % FSO
Frequency response	100 kHz (-3dB)
Standard and miniature sensors	



#### Largest sensor range worldwide

Our long-term technology leadership in the field of eddy current sensor technology is reflected by the range of products – more than 400 sensors are available in different designs for different applications.

#### Customer-specific sensors

Modifications to the standard eddy current sensors are often required, particularly for small and large series. We can modify the measuring systems according to your specific requirements. e.g. changes to the cable, sensor material and design. For example, sensors with integrated electronics in an industry-grade housing or special sensor designs are often requested by systems integrators.

#### Subminiature sensors for confined installation space

As well as standard sensors in conventional designs, miniature sensors with the smallest possible dimensions that achieve high precision measurement results are also available. Pressure-resistant versions, screened housings, ceramic types and other special features characterize these sensors, which achieve highly accurate measurement results despite their small dimensions. Miniature sensors are employed in high-pressure applications, e.g. in combustion engines.



Smallest sensors worldwide



## Inductive displacement and position sensors

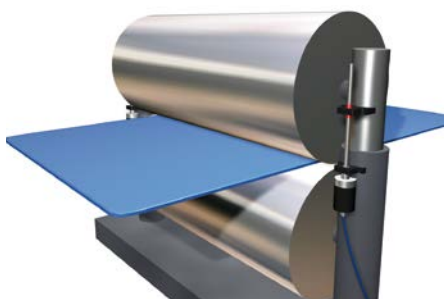


Inductive displacement sensors are used extensively in applications such as automated processes, quality assurance, test rigs, hydraulics, pneumatic cylinders, and automotive engineering. The advantages of these displacement sensors are well known and highly valued, and include ruggedness, reliability under harsh conditions, high signal quality and good temperature stability. Electromagnetic induSENSOR models are based on the well-proven, inductive and eddy current principle.

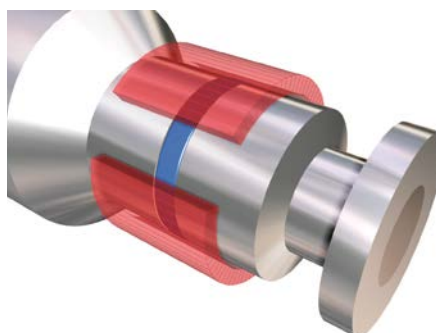
As well as proven serial systems, numerous OEM systems have been developed for customer-specific measurement tasks that are used in different applications.

### Advantages

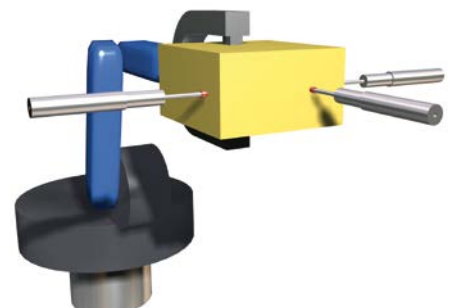
- More than 250 different models with measuring ranges from 1 to 630 mm
- Integrated or separate controller
- High accuracy
- Extreme stability and durability
- Different designs with plunger, tube or measuring ring
- High temperature stability



In automated production plants, inductive sensors monitor the manufacturing specifications of the process. Alternative designs enable their integration even under minimal space conditions.



To monitor the clamping position of tools, a VIP sensor is integrated into the release device and directly measures the clamping stroke of the drawbar.



In test equipment, inductive gauging sensors measure the geometry of workpieces for quality assurance purposes.



#### induSENSOR Series LVDT

Gauging sensor with external controller

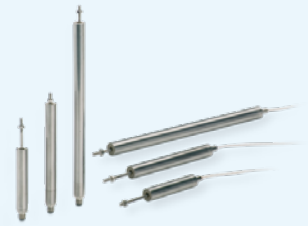
Measuring ranges (mm)	$\pm 1$   3   5   10
Linearity	$\pm 0.3$ % FSO
Frequency response	300 Hz (-3dB)
Target	Plunger with spring



#### induSENSOR Series LVDT

Displacement sensors with external controller

Measuring ranges (mm)	$\pm 1$   3   5   10   15   25
Linearity	$\pm 0.15$ % FSO
Frequency response	300 Hz (-3dB)
Target	Plunger



#### induSENSOR Series LDR

Linear displacement sensors with external controller for high temperatures up to 160 °C

Measuring ranges (mm)	10   25   50
Linearity	$\pm 0.3$ % FSO
Frequency response	300 Hz (-3dB)
Target	Plunger



#### induSENSOR Series EDS

Displacement sensors with integral controller

Measuring ranges (mm)	75   100   160   200   250   300   370   400   500   630
Linearity	$\pm 0.3$ % FSO
Resolution	0.05 % FSO
Frequency response	150 Hz (-3dB)
Target	Measuring tube
Pressure resistance	450 bars



#### Miniature sensor controller for inductive sensors

The new MSC7401 controller is designed to be operated with LVDT and LDR measuring gages and displacement sensors. Due to its robust aluminum housing protected to IP67, this single-channel controller is predestined for industrial measurement tasks. A large variety of compatible, inductive displacement sensors and gages from Micro-Epsilon combined with an optimized price/performance ratio opens up numerous fields of applications in automation technology and machine building.

Micro-Epsilon also develops sensors for special requirements that are not met by standard models. Inductive sensors from the standard range can be suitably modified. A commercial implementation can already be achieved with medium-sized quantities. For special applications where high volumes are required, Micro-Epsilon develops sensors that are precisely tailored to the customer's requirements.

#### Ambient conditions

Depending on the location, environment, and application, different circumstances occur that require adapted sensors:

- Ambient temperature
- Pressure
- Interference fields
- Dirt, dust, and moisture
- Vibration, shock
- Seawater, IP69K







## Magneto-inductive distance sensors



Magneto-inductive sensors measure displacement, distance or position of a defined magnetic target. The measuring range is 45 mm as standard, but can be adjusted from 20 mm to 55 mm by changing the magnet. This physical measuring principle means the output signal is linear (2 - 10 V and 4 - 20 mA) and is independent of the measuring range.

Due to this physical effect, measurements can be taken without any interference from non-ferromagnetic materials between the sensor and the target such as aluminum, plastic or ceramics. This is very useful when measuring in a closed system. The installation in non-ferromagnetic materials is also possible.

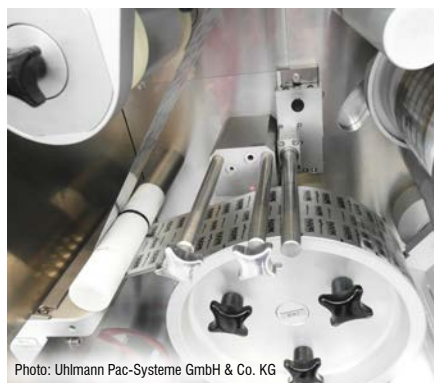
Their flexible sensor design offers a lot of possibilities. The sensor is available as a simple PCB, in a plastic housing or in housings made from stainless steel, which are resistant to chemicals, oil and dirt.

### Advantages

- Large measuring range
- Linear output signal
- High dynamics
- Measuring range can be adjusted via magnets
- Different shapes / Compact design



**OEM integration in the damper of washing machines**  
Magnet integrated in the damper and sensor mounted externally



**Foreign body detection in medical technology**  
MDS sensor recognizes foreign bodies in blister machines during the tablet packaging process.



**Valve lift measurement in the food industry**  
The sealed stainless steel housings of the MDS-45-Mxx series are ideal for the food industry.



#### MDS-45-M18-SA

Measuring ranges	20 - 55 mm*
Output	2 - 10 V
Linearity	< $\pm 3$ % FSO
Resolution	0.05 % FSO
Pressure resistance	up to 400 bars (front)
Frequency response	3 kHz (-3dB)



#### MDS-45-M12

Measuring ranges	20 - 55 mm*
Output	2 - 10 V
Linearity	< $\pm 3$ % FSO
Resolution	0.05 % FSO
Axial cable output or connector	
Frequency response	3 kHz (-3dB)



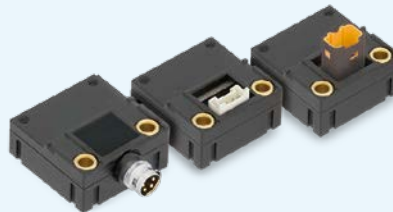
#### MDS-45-M30-SA

Measuring ranges	20 - 55 mm*
Output	2 - 10 V / 4 - 20 mA
Linearity	< $\pm 3$ % FSO
Resolution	0.05 % FSO
Pressure resistance	50 bars (front)
Frequency response	1 kHz (-3dB)



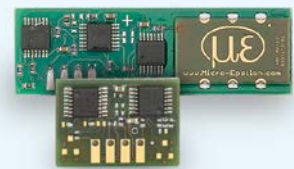
#### MDS-35-M12-HT

Measuring ranges	20 - 55 mm*
Output	2 V $\pm$ 0.4 V ... 9.6 V $\pm$ 0.4 V
Linearity	< $\pm 5$ % FSO
Resolution	< 0.05 % FSO
Axial cable output or connector	
Frequency response	5 kHz (-3dB)
Temperature range	up to 120°C



#### MDS-40-MK

Measuring ranges	approx. 40 mm*
Output	different kinds
Linearity	< $\pm 3$ ... < $\pm 5$ % FSO
Resolution	0.05 % FSO
Quantity	preferred types 1 / 10 pcs freely configurable from 200 pcs.



#### MDS-40-LP

Measuring ranges	approx. 40 mm*
Output	square
Linearity	< $\pm 9$ % FSO
Resolution	0.05 % FSO
Quantity	> 2,000 / 5,000 pieces / years

\*depends on the magnet

#### Accessories

Measuring ranges of magnets: 20 mm, 27 mm, 35 mm, 45 mm, 55 mm

Power and output cables with M8x1 connector in different types



#### Flexible sensor design for OEM applications

Due to the flexible sensor design and the significant advantages of this physical measuring principle, various possibilities are available for adjusting the sensor to specific high volume applications. In OEM projects, the requirements of certain applications can be met at a very competitive price level.

- Improved dynamics
- Different housing shapes and materials
- Various output signals
- Special features such as pressure resistance, integrated cables, etc.





## Draw-wire sensors for displacement, position and length



The draw-wire principle enables sensors with small dimensions to measure large displacements. The wire is directly fixed on the measurement object. Draw-wire displacement sensors measure the linear movement of a component using a wire made of highly flexible stainless steel strands, which is wound onto a drum by means of a long-life spring motor. The winding drum is axially coupled with a multi-turn potentiometer, an incremental encoder, or an absolute encoder. With the draw-wire principle, a linear movement is transformed into a rotary movement and then converted into a resistance change or into countable increments.

Sensors with integrated controller already output displacement-proportional voltage or current. Different sensor designs range from easy low-cost models to extremely robust designs for industrial applications.

### Advantages

- High accuracy
- Large measuring ranges
- Robust and compact
- Easy installation and handling
- Compact design
- Excellent price/performance ratio



Modified OEM draw-wire sensors measure the lifting height on forklift trucks. Despite their compact construction, lifting heights of up to 30 m can be detected.



In test benches during load tests, several draw-wire sensors measure the deformation of rotor blades for wind turbines



Customer-specific draw-wire sensors as important OEM component: Draw-wire sensors monitor the height of lifting platforms on automobile production lines.





**wireSENSOR**  
**MK30/MK46/MK77/MK60 / MK88/MK120**  
OEM miniature sensors with plastic housing

Measuring ranges (mm)	50   150   250   500   750   1000   1250   1500   2100   2300   2400   3000   3500   5000   7500
Analog outputs	Potentiometer, voltage, current
Digital output	Encoder



**wireSENSOR MT**  
Miniature draw-wire sensors with aluminum housing

Measuring ranges (mm)	40   80   130
Analog output	Potentiometer
Smallest design	



**wireSENSOR MPM/MP/MPW**  
Robust miniature sensors with aluminum housing

Measuring ranges (mm)	50   100   150   250   300   500   1000
Analog output	Potentiometer
Option with wire acceleration up to 100 g	
Option with protection class IP67	



**wireSENSOR P60/P96/ P115**  
Industrial sensors with aluminum housing

Measuring ranges (mm)	100   150   300   500   750   1000   1500   2000   2500   3000   4000   5000   7500   10,000   15,000
Analog outputs	Potentiometer, voltage, current
Digital outputs	HTL, TTL, SSI, PB, CO



**wireSENSOR P200**  
Long-range industrial sensors with aluminum housing

Measuring ranges (mm)	30,000   40,000   50,000
Digital outputs	HTL, TTL, SSI, PB, CO



**wireSENSOR K**  
OEM industrial sensors with plastic housing

Measuring ranges (mm)	2300   5000
Analog outputs	Potentiometer, voltage, current
Ideal for high volume applications	

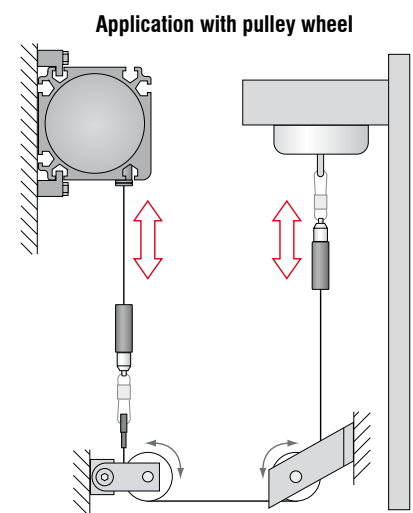
#### wireSENSOR mechanics

The P96, P115 and P200 series are available as mechanics for mounting with customer-specific encoders.

#### Compact, reliable and low cost

Different sensor series cover the complete application spectrum of draw-wire sensors. The miniature sensors are very favorably priced and suitable for the integration into restricted installation space due to their miniaturized design. Industrial sensors are extremely robust and used in applications with large measuring ranges. A clear advantage of this draw-wire measuring principle is that the measuring cable can be diverted over deflection pulleys. This property differentiates draw-wire sensors from other measuring principles which normally only measure on one axis.

The sensor housings are kept extremely compact. The well-conceived sensor design enables large measuring ranges to be realized in a space-saving manner. Since only high-quality components are used, the rugged sensors have an extremely long service life - even in continuous use under industrial conditions.





## Laser line triangulation

### Non-contact 2D/3D profile sensors

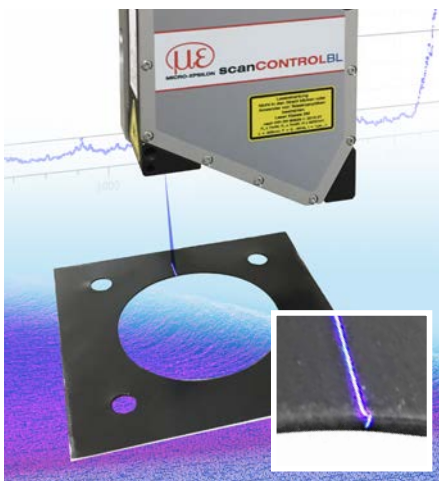


scanCONTROL laser line scanners use the laser triangulation principle for two-dimensional profile detection on different target surfaces.

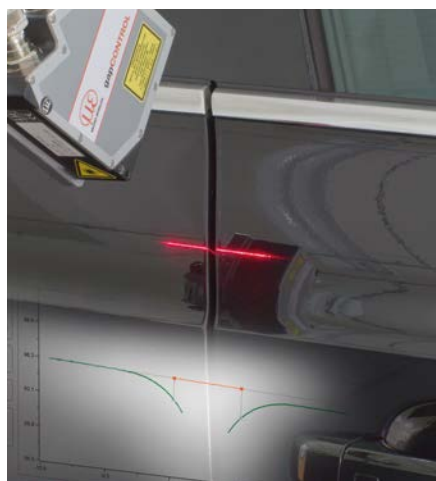
Unlike conventional point laser sensors, a line optical system projects a laser line onto the surface of the object to be measured. The diffusely reflected light is replicated on a sensor matrix by a high quality optical system. The controller calculates the distance information (z-axis) and the position alongside the laser line (x-axis) in a two-dimensional coordinate system. In the case of moving objects or a traversing sensor, it is therefore possible to obtain 3D measurement values.

### Advantages

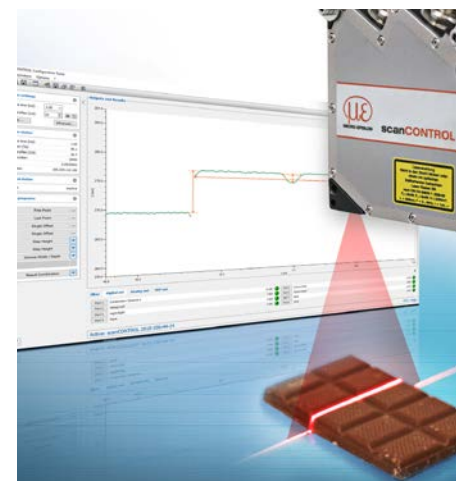
- High accuracy and profile frequency
- High performance signal processor
- Trigger and synchronization options
- Different options for integration by customer
- System solutions from a single source



Inline burr measurement on sheet edges in body manufacture



Gap and flushness measurement on bodywork parts



Quality control in chocolate production



### scanCONTROL 26xx

Perfect for automation

Measuring ranges	Z-axis	up to 265 mm
	X-axis	up to 143.5 mm
Resolution	X-axis	640 points/profile
Profile frequency		up to 4000 Hz

### scanCONTROL 29xx

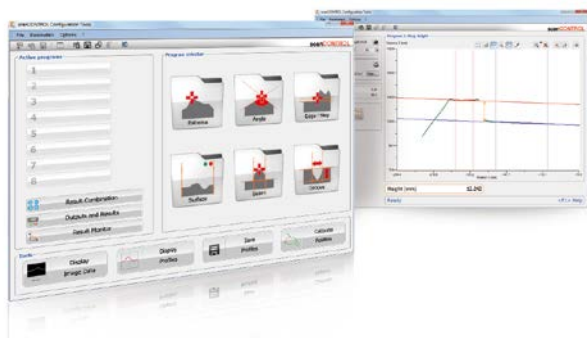
High-end automation scanner

Measuring ranges	Z-axis	up to 265 mm
	X-axis	up to 143.5 mm
Resolution	X-axis	1,280 points/profile
Profile frequency		up to 2000 Hz

### scanCONTROL 30xx

High-performance blue laser scanner

Measuring ranges	Z-axis	up to 15 mm
	X-axis	up to 26.8 mm
Resolution	X-axis	2,048 points/profile
Profile frequency		up to 10,000 Hz



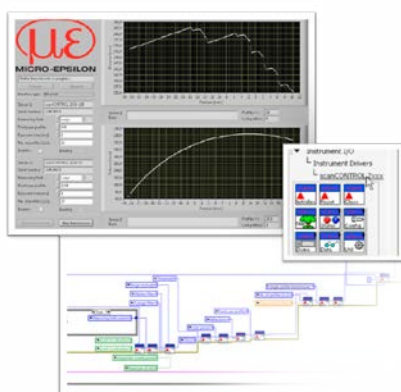
### scanCONTROL Configuration Tools

- Configuration of different measuring programs by mouse click
- Dynamic tracking of evaluations in the profile
- Parameterizing outputs and displaying measured values
- Output of measured values across a large number of interfaces



### scanCONTROL 3D View

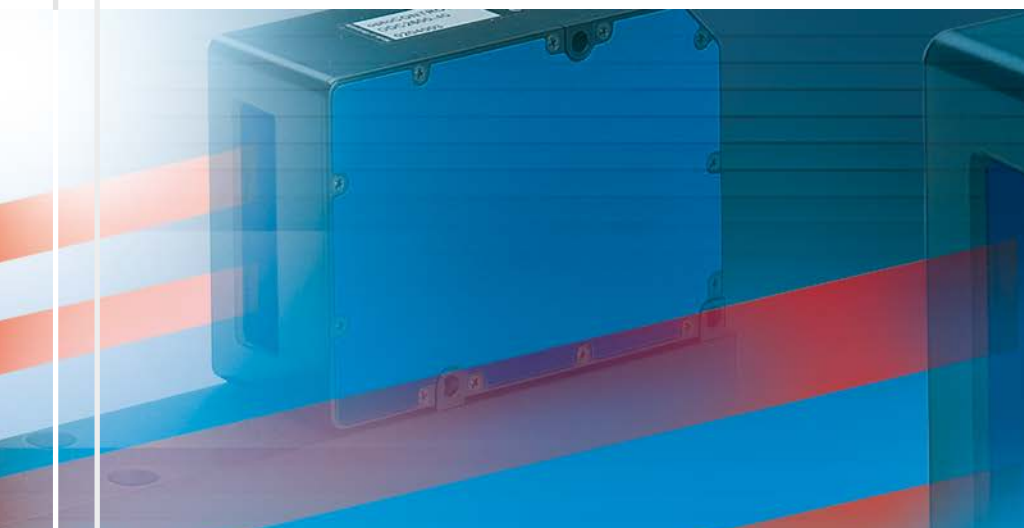
- Can be used with all scanCONTROL sensors
- Offline or real-time display of 3D profiles
- 2D export of profile sequences (png)
- 3D export (asc, stl) for CAD programs
- Intensity per point can be displayed and exported



### scanCONTROL Software integration

- Ethernet GigE Vision
- SDK for fast integration in C/C++ (Linux and Windows) or C# (Windows) applications
- Example VIs for NI LabVIEW for integration using LLT.DLL or NI IMAQdx





## Optical micrometers and fiber optic sensors



Optical optoCONTROL micrometers are based on various measuring techniques. As well as the CCD camera technique using laser or LED lighting, the principle of light quantity measurement is used. Micro-Epsilon micrometers consist of a light source and a receiver or a CCD camera. The light source generates a parallel, continuous light curtain, which is lined up with the receiver. If an object interrupts the light curtain, this shadow or darkening is detected at the receiver unit. The optoCONTROL 1200 series acquires the incident quantity of light, whereas the 1202, 25x0 and 2600 series measure the exact shadow via a CCD array. In this way, dimensional quantities such as diameter, gap, position and segment can be acquired.

The optoCONTROL CLS-K fiber optic sensors are used for applications in harsh environments. Using sophisticated optical fibers near to the target object, the electronic unit can be mounted at a safe distance away. The optoCONTROL CLS-K test and measurement amplifiers are offered as infrared types enabling measurement frequencies of 4 kHz.

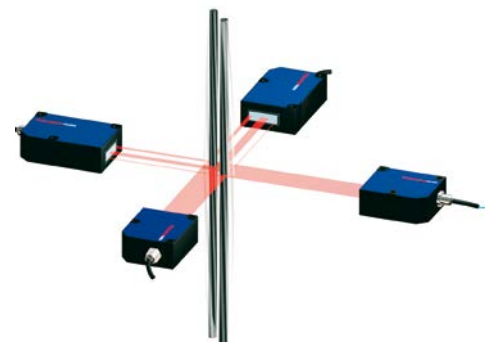
### Advantages

- Various models for different applications
- Laser or LED light source
- Extremely compact design
- High accuracy
- High speed measurements
- Large measuring ranges
- Perfect detection of edges, gaps, positions and diameters of round objects
- Inspection and detection of position and presence



During the stamping of threaded rods, micrometers are used for quality assurance in order to determine the exact thread guidance.

Optical micrometers are used for the detection of roller gaps to ensure a constant gap height.



Synchronized micrometers detect the oscillation of tensioned steel lift cables in order to control the oscillation behavior.



#### optoCONTROL 1200

Compact high-speed micrometer (laser)

Measuring ranges (mm)	2   5   10   16   20   30
Linearity	$\pm 40 \mu\text{m}$ (independent)
Resolution	$10 \mu\text{m}$
Frequency response	100 kHz
Integrated controller	



#### optoCONTROL 1202

Compact micrometer with large measuring range (laser)

Measuring ranges (mm)	75   98
Linearity	$\pm 150 \mu\text{m}$
Resolution	$8 \mu\text{m}$
Measuring rate	800 Hz
Integrated controller	



#### optoCONTROL 1220

Optical inline micrometer

Measuring range (mm)	28
Linearity	$\pm 22 \mu\text{m}$
Resolution	typ. $2 \mu\text{m}$
Working distance	up to 2000 mm
Integrated controller	



#### optoCONTROL 2500

High-resolution micrometer (laser)

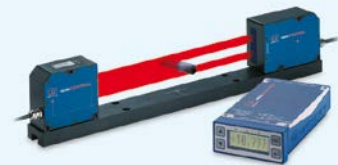
Measuring range (mm)	34
Linearity	$\pm 10 \mu\text{m}$
Resolution	$1 \mu\text{m}$
Measuring rate	2.3 kHz
External controller	



#### optoCONTROL 2520

Compact laser micrometer (class 1M)

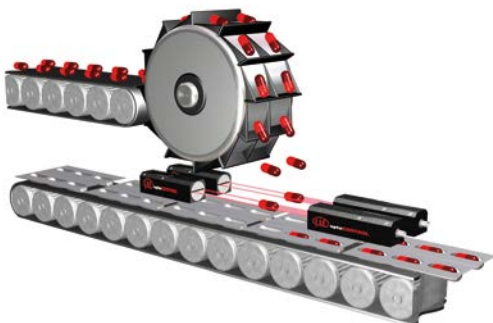
Measuring range (mm)	46
Linearity	$\pm 12 \mu\text{m}$
Resolution	$1 \mu\text{m}$
Measuring rate	2.5 kHz
Integrated controller (web interface)	



#### optoCONTROL 2600

High-resolution micrometer (LED)

Measuring range (mm)	40
Linearity	$\pm 3 \mu\text{m}$
Resolution	$0.1 \mu\text{m}$
Measuring rate	2.3 kHz
External controller	



#### Presence monitoring in fast processes

The 1200 series can solve measurement tasks as well as presence monitoring. The versatile concept with enormously high frequency response and compact design opens up numerous fields of application.

#### optoCONTROL CLS-K

Fiber optic sensors

##### Applications:

- Edge detection
- Counting tasks
- Assembly control
- Gap recognition
- Scanning tasks in Ex areas
- Presence monitoring and position control
- Recognition of brightness and reflection





## Color sensors, color measuring system and LED Analyzers



The colorSENSOR series is applied in color detection applications. The sensors compare the current color of the measured object with the target colors that were set up via the sensor's Teach-In function. The new colorSENSOR CFO operates with optical fibers close to the target object reducing influences by the environment. The color sensor using highly developed fiber optics close to the target object can be placed at a safe distance. The colorSENSOR OT series enables measurements from larger distances using a fixed lens. The non-contact colorCONTROL ACS7000 color measuring system detects slightest color differences ( $\Delta E < 0.08$ ) with measurement frequencies of up to 2000 Hz. These sensors are applied in automation technology, medical packaging, quality control, painting, surface-labelling and printing technology tasks. The colorCONTROL MFA LED Analyzers inspect function, color and intensity of LEDs, lamps and light sources at up to 495 testing positions in parallel.

### Advantages

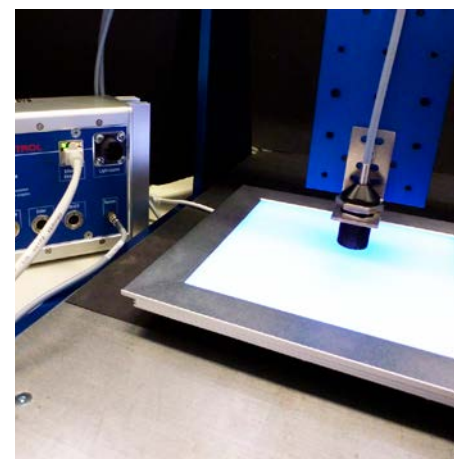
- Simple quality control
- Easy and fast commissioning
- Many sensors to suit any application
- Optical fiber close to the object to be measured
- Large distance from the object
- Non-contact color measurement
- Measurement accuracies  $\Delta E$  up to 0.08
- Measurement frequencies up to 30 kHz



Detection of the color identity of attachments in automotive manufacturing.



Color and intensity tests of vehicle lights.



Color and homogeneity measurements of LED/lighting panel.





#### colorSENSOR CFO

Color recognition using optical fibers close to the target object

Repeatability	$\Delta E \leq 0.3$
Software teach	1 - 254 colors can be saved
Teach-in via keys	1 - 254 colors can be saved



#### colorSENSOR OT-3-LD

Fixed lens color sensors with True-Color detection

Repeatability	$\Delta E \leq 0.9$
Color recognition from a large distance	up to 900 mm



#### colorCONTROL MFA

Color recognition of LEDs and self-luminous objects

5 to 495 measuring points
LED tests of function, color and intensity
Color inspection in HSI and RGB color spaces



#### Fiber optics

High precision optical fibers for adaption to colorSENSOR CFO sensors

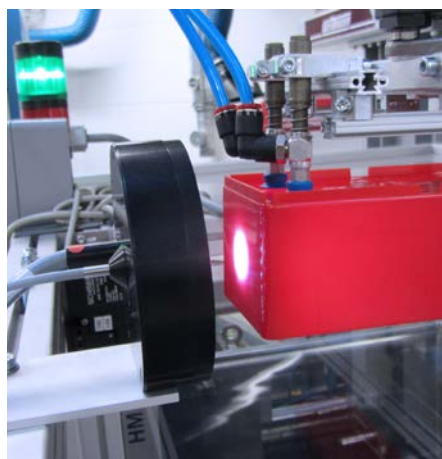
Ambient temperature	-40 °C to 400 °C
Distances	8 - 200 mm
Detection range	0.2 - 30 mm



#### colorCONTROL ACS7000

Inline color measuring system for non-contact measurements

Measurement geometries	Transmission sensor, circular sensor, 30°/0° sensor
Repeatability	$\Delta E \leq 0.08$
Spectral measuring range	390 - 780 nm
Measurement speed	2 kHz
Color recognition from a taught reference list	



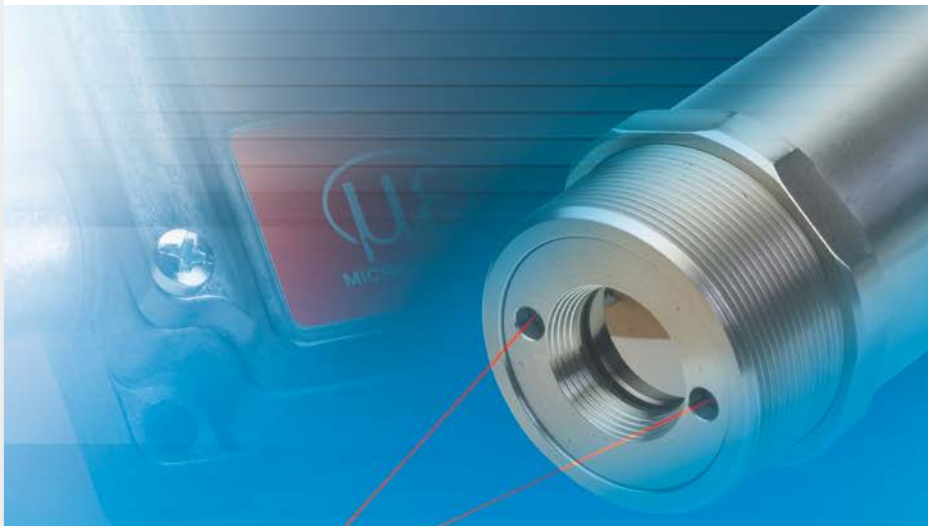
Inline color measurement of plastic injection-molded parts directly after demolding.



Inline color gradient measurement of transparent film and acrylic glasses.



Color measurement of continuous strip coating such as aluminum, zinc and paper during production.



## Non-contact IR temperature sensors



Infrared pyrometers determine the object temperature without contact based on the infrared radiation emitted by the object according to the radiation law of Planck and Boltzmann. A detector converts the incoming infrared radiation into an electrical signal. An amplified and linearized temperature value can then be used for further processing. The use of infrared pyrometers opens up various opportunities to measure and display temperature profiles in numerous fields of applications.

### Trend setting infrared sensor technology for process automation

thermoMETER IR sensors combine high accuracy with ambient temperatures of up to 250 °C without cooling. New IR sensor elements with small dimensions and high sensitivity enable outstanding sensor characteristics such as response times of 1 ms. Sophisticated temperature sensors are mainly used in research and development, maintenance and process monitoring.

### Advantages

- Ease of use
- Non-contact measurement
- No risk with inspections of hot and hard-to-access targets or components operating under load
- Robust, wear-free and reliable



**Temperature measurement in the plastics industry**  
Highly accurate detection of the surface temperature using infrared pyrometers



**Temperature measurement in the glass industry**  
Control of process temperatures and quality assurance in production plants.



**Temperature measurement in the metals industry**  
Temperature monitoring in the cooling processes of forged parts using the CTLaser M1



#### **thermoMETER CS / CSmicro / CSLaser**

Compact, miniature and low cost  
Temperature ranges from -40 °C to 1600 °C  
Robust, silicon-coated lens  
Integral controller  
Scalable analog output: 0-10 V / 0-5 V  
Ideal for OEMs, also available as two-wire model and high-resolution version



#### **thermoMETER CTRatioM1**

Glass fiber ratio thermometer  
Temperature ranges from 700 °C to 1800 °C  
Up to 250 °C ambient temperature without cooling  
Measurement depends only on the emissivity ratio but not on the absolute emissivity  
Extremely short response time of 5 ms



#### **thermoMETER CTLaser**

Extremely precise IR sensor with laser sighting  
Temperature ranges from -50 °C to +975 °C  
Infrared sensors with up to 75:1 optical resolution from 0.9 mm measurement spot  
Double laser marks the exact spot location from a spot size of 1 mm  
Response time from 9 ms



#### **thermoMETER CTLaser M1/M2/M3**

For metal production with reduced wavelength: 50 °C to 2200 °C

#### **thermoMETER CTLaser M5 (525 nm)**

For liquid metals: 1000 °C to 2000 °C

#### **thermoMETER CTLaserGLASS**

For glass measurement: 100 °C to 1650 °C

#### **thermoMETER CTLaserCOMBUSTION**

For measurement of flames: 200 °C to 1450 °C



#### **thermoMETER CT**

Extremely low cost and high accuracy  
Temperature ranges from -50 °C to +975 °C  
One of the smallest infrared sensors worldwide with 22:1 optical resolution  
Up to 180 °C ambient temperature without cooling

#### **thermoMETER CTP7 / CTP3**

For thin plastic films from 0 °C to 500 °C



#### **thermoMETER CTM1/M2/M3**

For metal processing  
Temperature ranges from 50 °C to 2200 °C

#### **thermoMETER CThot**

For difficult ambient conditions up to 250 °C ambient temperature without cooling

#### **thermoMETER CTM-3XL**

For laser welding processes from 100 °C to 1800 °C



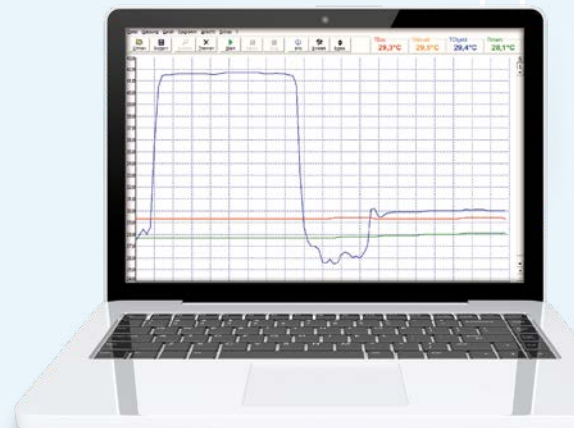
#### **thermoMETER CT Video/CS Video**

Infrared temperature sensors with crosshair laser sighting and video output  
Temperature ranges from 50 °C to 2200 °C  
Parallel use of video module and crosshair laser sighting for measuring field adjustment  
Measurements on hot metals, ceramics and composite materials  
Automatic snapshot feature for process monitoring and corresponding documentation



#### **thermoMETER TIM 8**

Intelligent spotfinder pyrometer  
Temperature ranges from -20 °C to 900 °C  
Robust and compact system with motorized focus  
Excellent optical resolution  
Autonomous operation with automatic spotfinder and direct analog output  
For temperature measurements in machine building and automation.



#### **License-free evaluation software**

Sensors with digital interfaces include the license-free compactCONNECT software for easy parameter set up, analysis and documentation purposes of measured temperature values.





## USB thermal imagers



### thermoIMAGER infrared cameras

Powered from a single USB cable, the system is truly plug-and-play. Data is streamed in real time from the camera to the software via USB interface. This process and analysis tool, provided with every camera, enables the user to capture, record and monitor real time thermal process images up to 128 Hz. The software stores the data in a file, which enables playback at user-defined speeds, e.g. in slow motion or frame-by-frame. Thermal images can be viewed either online with the camera connected, or offline at a later time without camera. In addition, the software can be used as a runtime application where the user is able to program and configure a custom environment (e.g. multiple monitoring windows, alarms, hot spot localization, line profiling etc.). Advanced interface concepts enable the integration into networks and automated systems.

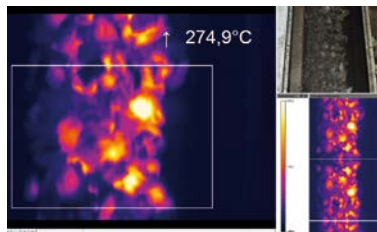
### Advantages

- Ease of use
- Non-contact measurement without influencing the target object
- Enables inspection of hot, fast moving or hard-to-access objects in hazardous environments
- Fast recognition of weak points in power distribution systems, machines and production processes
- Compact design
- Software Developer Kit incl. examples such as C, C++, C#

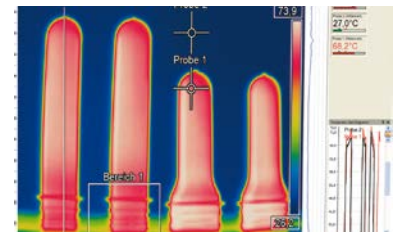
### Applications



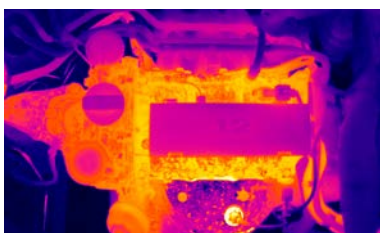
Temperature monitoring in hot rolling processes



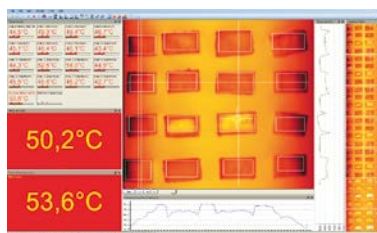
Monitoring a coal conveyor belt



Thermal image shots of preforms in PET bottle production



Razor-sharp infrared pictures and videos for process optimization



Exact temperature measurement on moving glass surfaces due to line scan feature



Temperature monitoring for building thermography



#### thermoIMAGER TIM 160

Temperature ranges:  
-20 °C to 900 °C (special model 1500 °C)  
Excellent thermal sensitivity (NETD) of 0.08 K  
Exchangeable lenses 6°/23°/48°/72° FOV  
Real-time thermography with 120 Hz frame rate via USB 2.0 interface  
Extremely lightweight (195 g) and robust (IP67)  
Extremely compact dimensions 45x45x62 mm  
Analog input and output, trigger interface



#### thermoIMAGER TIM 200/230

BI-SPECTRAL technology  
Temperature ranges:  
-20 °C to 900 °C (special model 1500 °C)  
Excellent thermal sensitivity (NETD) of 0.08 K  
Exchangeable lenses 6°/23°/48°/72° FOV  
Real-time thermography with 128 Hz frame rate  
Time synchronous, real-time image recording (VIS) with 32 Hz (640 x 480 pixels)



#### thermoIMAGER TIM QVGA/QVGA-HD

Detector with 382 x 288 pixels  
Temperature ranges:  
-20 °C to 900 °C (special model 1500 °C)  
Excellent thermal sensitivity (NETD) of up to 0.04 K  
Exchangeable lenses & industrial accessories  
Image recording in real time at 80 Hz  
Analog input and output, trigger interface



#### thermoIMAGER TIM 640 VGA

Thermography in VGA resolution  
640 x 480 pixels  
Temperature ranges:  
-20 °C to +900 °C (special model 1500 °C)  
Excellent thermal sensitivity (NETD) of 0.075 K  
Radiometric video recording with 32 Hz  
Analog input and output, trigger interface



#### thermoIMAGER TIM QVGA-G7/VGA-G7

Thermal imaging camera with line scan feature for the glass industry  
Frame rate up to 125 Hz  
Excellent thermal sensitivity (NETD) of 0.13 K  
Robust against ambient temperatures up to 70 °C without requiring additional cooling, up to 315 °C with cooling jacket



#### thermoIMAGER TIM M1/TIM M05

Thermal imaging camera for hot metal surfaces  
Temperature ranges:  
450 °C to 1800 °C / 900 °C to 2450 °C  
Excellent thermal sensitivity (NETD) of <1 K  
Optical resolution: 764 x 480 pixels  
Spectral range 0.92 to 1.1  $\mu\text{m}$  / 500 to 540 nm



#### thermoIMAGER TIM 40

Compact OEM thermal imaging camera  
Optical resolution: 382 x 288 pixels  
Temperature ranges:  
-20 °C to +900 °C  
Frame rate up to 80 Hz  
Excellent optical resolution with distance-to-spot-size-ratio up to 390:1  
Lenses with 18°, 29°, 53°, 80° FOV



#### thermoIMAGER Microscope lens

Thermal imager with microscope lens  
Temperature ranges:  
-20 °C to 100 °C / 0 °C to 250 °C / 150 °C to 900 °C  
Excellent thermal sensitivity (NETD):  
90 mK or 120 mK  
Optical resolution: 382x288 or 640x480 pixels  
Smallest spot size: 42  $\mu\text{m}$  / 28  $\mu\text{m}$   
Spectral range: 7.5 to 13  $\mu\text{m}$



#### thermoIMAGER NetPCQ

Embedded, industrial PC solution with passive cooling for thermoIMAGER applications  
Supports all thermoIMAGER TIM models  
Integrated watchdog feature



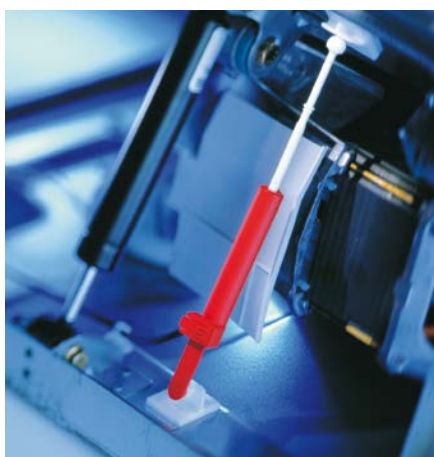
## Innovative sensor solutions for specific applications

As well as standard sensors based on various measuring principles, Micro-Epsilon has developed numerous sensor solutions for special applications, which go beyond pure displacement and position measurement.

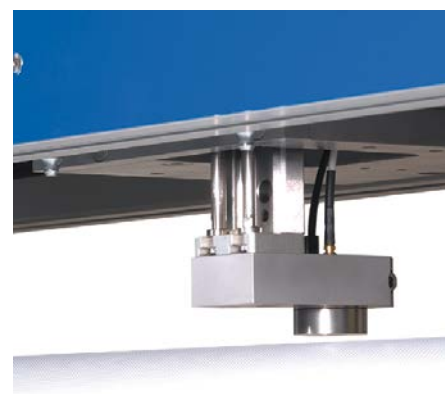
These application-specific sensors have been developed and optimized for special measurement tasks according to customers' specifications, incorporating the company's expertise gained from more than 45 years designing, developing and applying sensor systems. High performance and reliability at cost-effective OEM conditions are the main focus of Micro-Epsilon developments.



Inline yarn thickness measurement



Load detection in washing machines



Non-contact, inline thickness measurement of plastic films





#### DZ140

Sensors for rotational speed measurement of turbochargers for vehicle and test cell use

Optimized for modern, thin blades made from aluminum or titanium

Speed range from 200 to 400,000 rpm

Wide operating temperature range

Large distance between sensor & blade

No rotor modification required



#### idiamCONTROL

Non-contact inspection of extruder bores

Non-contact and wear-free measurement for all metals without additional calibration

Exact, non-destructive inspection



#### SGS Spindle Growth System

Sensor system developed for measuring the thermal extension of milling spindles

Measuring range 500  $\mu\text{m}$

Resolution 0.5  $\mu\text{m}$

High temperature range



#### capaNCDT DTV

Measuring the Disc Thickness Variation of brake discs

Multi-channel controller for multi-track thickness measurements

High dynamics up to 20 kHz

Robust sensor design for long-life operation

Comprehensive software package for ease of use and real-time evaluation of measured results

Analog interfaces, Ethernet, EtherCAT



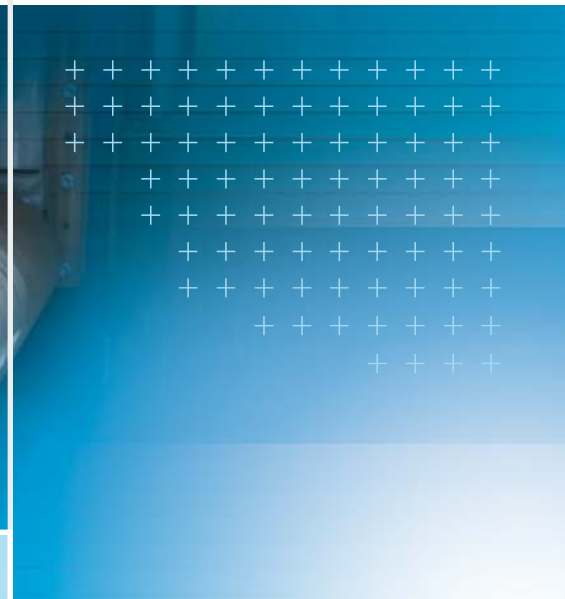
Rotational speed measurement of turbochargers



Measuring the thermal extension of spindles



Inspection of inner diameter in extruder bores



## Measuring and inspection systems

System solutions from Micro-Epsilon are measuring systems that go beyond pure sensor systems. Sensors, software and the mechanical system are blended together to form one integrated overall system, which is used for process monitoring and quality assurance in production lines. The sensor and software modules used originate from the Micro-Epsilon group, enabling optimum and efficient component matching.

Micro-Epsilon turnkey measuring systems are integrated into existing or newly designed production lines to execute fully automated quality control applications such as thickness measurement, surface inspection and parts classification.



For each measurement task there is a suitable measurement concept. As well as laser sensors, micrometers, eddy current and capacitive sensors, image processing solutions and special combined sensors are also used. Signal processing and output can be arranged to suit the application requirements. The measuring systems communicate with existing environments over various interfaces and can therefore also be integrated retrospectively into existing production lines.



### C-frame for metal thickness measurement

For high speed measurements  
Laser point or innovative laser line  
All alloys without calibration



### Powerful C-frames for harsh environments

Various measuring ranges  
Proven protection and cleaning concepts  
Several C-frames with only one IPC



### O-frame systems for the metal industry

Most modern thickness profile measurement  
Without isotopes and X-rays  
Reliable measurement independent from strip movement, tilt, surface type and alloys



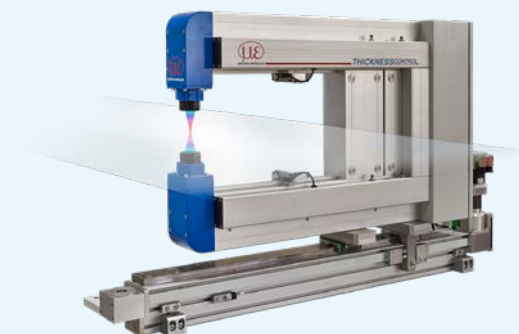
### Systems for the preparation area in the rubber and tire production

Profilometer  
Color code  
Length measurement



### Final finishing systems in the rubber and tire production

Tire geometry  
Tire marking  
Tire identity



### Systems for plastics inspection

C-frames for thickness measurement of flat film  
O-frame systems for profile thickness measurement  
Reverse-frame systems for the profile measurement of blown films



### surfaceCONTROL

3D inspection of mat surfaces  
Detection and evaluation of 3D surface data within a few seconds



### reflectCONTROL Automotive

Fully automatic surface inspection of painted car bodies  
Recognition of defects, inclusions, craters etc.



### reflectCONTROL Sensor

Inspection of shiny surfaces  
Defect detection and 3D shape measurement





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