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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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

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

Sensors and systems for displacement, position, color and temperature
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 1320
Compact laser triangulation displacement sensor for high speed, precision measurements

Measuring ranges (mm) 10 | 25 | 50 | 100
Linearity 0.12 % FSO
Repeatability from 1 µm
Measuring rate 2 kHz

optoNCDT 1420/1420 CL1
Smart laser triangulation displacement sensor for fast and precise measurements

Measuring ranges (mm) 10 | 25 | 50 | 100 | 200 | 1500
Linearity ±0.08 % FSO
Repeatability from 0.5 µm
Measuring rate 4 kHz

optoNCDT 1610/1630
High speed PSD sensor

Measuring ranges (mm) 4 | 10 | 20 | 50 | 100
Linearity ±0.2 % 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) 21 | 10 | 20 | 100 | 200 | 500 | 750
Linearity ≤ ± 0.06 % FSO
Repeatability from 0.1 µm
Measuring rate 7.5 kHz

optoNCDT 1700BL / 2300BL / 2300-2DR
Laser sensor with Blue Laser Technology for metals and organic materials

Measuring ranges (mm) 21.5 | 20 | 50 | 200 | 500 | 750 | 1000
Linearity ±0.03 % FSO
Resolution 0.0015 % FSO
Measuring rate 49 kHz

Measuring ranges (mm) 2 | 5 | 10 | 20 | 50 | 100 | 200 | 300
Linearity ±0.02 % FSO
Resolution 0.0015 % FSO
Measuring rate 49 kHz

Measuring ranges (mm) 10 | 20 | 40 | 50 | 1000
Linearity ±0.03 % 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 ±0.01 % FSO
Measuring rate 4 kHz
Measuring widths (mm) 200 | 400

optoNCDT 1750LL / 2300LL
Laser sensors for shiny metallic objects

Measuring ranges (mm) 21 | 10 | 20 | 50 | 100 | 200 | 500 | 750
Linearity ±0.02 % FSO
Resolution 0.0015 % FSO
Measuring rate 49 kHz

Measuring ranges (mm) 10 | 20 | 40 | 50 | 100 | 200 | 300
Linearity ±0.03 % FSO
Resolution 0.005 % FSO
Measuring rate 49 kHz

Measuring ranges (mm) 10 | 25
Linearity ±0.02 % FSO
Measuring rate 4 kHz
Measuring widths (mm) 200 | 400

optoNCDT 1710 / 2310
Long-range sensors for large distances

Measuring ranges (mm) 10 | 20 | 40 | 50 | 100 | 200 | 300
Linearity ±0.03 % FSO
Resolution 0.005 % FSO
Measuring rate 49 kHz

Measuring ranges (mm) 10 | 25
Linearity ±0.02 % FSO
Measuring rate 4 kHz
Measuring widths (mm) 200 | 400

optoNCDT 2300
Highly dynamic laser sensor in the 50 kHz class

Measuring ranges (mm) 2 | 10 | 20 | 50 | 100 | 200 | 500 | 750 | 1000
Linearity ≤ ± 0.06 % FSO
Repeatability from 0.1 µm
Measuring rate 7.5 kHz

Measuring ranges (mm) 10 | 20 | 40 | 50 | 100 | 200 | 300
Linearity ±0.02 % FSO
Resolution 0.0015 % FSO
Measuring rate 49 kHz

Measuring ranges (mm) 10 | 25
Linearity ±0.01 % FSO
Measuring rate 4 kHz
Measuring widths (mm) 200 | 400

optoNCDT 1710 / 2310
Long-range sensors for large distances

Measuring ranges (mm) 10 | 20 | 40 | 50 | 100 | 200 | 300
Linearity ±0.03 % FSO
Resolution 0.005 % FSO
Measuring rate 49 kHz

Measuring ranges (mm) 10 | 25
Linearity ±0.02 % FSO
Measuring rate 4 kHz
Measuring widths (mm) 200 | 400
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

Confocal chromatic principle
Non-contact displacement sensors

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

IFS2402
Miniature sensors (gradient index lens) for the inspection in tightest spaces

<table>
<thead>
<tr>
<th>Measuring ranges (mm)</th>
<th>0.4</th>
<th>1.5</th>
<th>2.5</th>
<th>3.5</th>
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<tbody>
<tr>
<td>available with axial or radial (90°) beam path</td>
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IFS2403
Confocal hybrid sensors with narrow gradient index lens and relay lens

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<tr>
<td>Extended offset distances</td>
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IFS2404-2
Confocal chromatic sensors for high precision applications in restricted spaces

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<td>Resolution (µm)</td>
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IFS2405
Standard sensors for precise distance and thickness measurements

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<tbody>
<tr>
<td>Large offset distance and tilt angle</td>
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IFS2406
Compact confocal sensors for precise displacement and thickness measurements

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<tbody>
<tr>
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IFS2407/90-0.3
Compact, confocal 90° sensors for precise displacement and roughness measurements

<table>
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<th>Measuring ranges (mm)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Small measurement spot and large tilt angle</td>
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</tbody>
</table>

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

IFS2401
Confocal chromatic sensors for high precision applications in restricted spaces

IFS2403
Confocal hybrid sensors with narrow gradient index lens and relay lens

IFS2402
Miniature sensors (gradient index lens) for the inspection in tightest spaces

IFS2404-2
Confocal chromatic sensors for high precision applications in restricted spaces

IFS2406
Compact confocal sensors for precise displacement and thickness measurements

IFS2407/90-0.3
Compact, confocal 90° sensors for precise displacement and roughness measurements
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

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**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 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.
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.
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
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.

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

**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.
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.

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.

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.

eddyNCDT 3001
Compact eddy current sensors with integrated controller
- Measuring ranges (mm): 2 | 4 | 6 | 8
- Linearity: ±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: ± 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: ≤ ±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: ±0.2 % FSO
- Resolution: 0.005 % FSO
- Frequency response: 100 kHz (-3dB)
- Standard and miniature sensors

eddyNCDT 3001
Compact eddy current sensors with integrated controller
- Measuring ranges (mm): 2 | 4 | 6 | 8
- Linearity: ±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: ± 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: ≤ ±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: ±0.2 % FSO
- Resolution: 0.005 % FSO
- Frequency response: 100 kHz (-3dB)
- Standard and miniature 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.
Additional features
The induSENSOR product group offers additional features and properties as a substantial advantage compared to conventional inductive probes and sensors. The versions in the series differ from one another in construction, accuracy class and therefore also in their fields of application. The sensors are designed with integral or external electronics and use a plunger and a measuring tube as the target. As a result, new fields of application are opening up due to the versatile methods of installation.

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 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.
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.

### 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

#### Measuring Ranges and Outputs

**MDS-45-M18-SA**
- Measuring ranges: 20 - 55 mm*
- Output: 2 - 10 V
- Linearity: ±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: ±3 % FSO
- Resolution: 0.05 % FSO
- Pressure resistance: up to 400 bars (front)
- Frequency response: 3 kHz (-3dB)

**MDS-45-M30-SA**
- Measuring ranges: 20 - 55 mm*
- Output: 2 - 10 V / 4 - 20 mA
- Linearity: ±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 ±0.4 V … 9.6 V ±0.4 V
- Linearity: < ± 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: ±3 % - 5 % FSO
- Resolution: 0.05 % FSO
- Pressure resistance: 50 bars (front)
- Frequency response: 1 kHz (-3dB)

**MDS-40-LP**
- Measuring ranges: approx. 40 mm*
- Output: square
- Linearity: ±9 % FSO
- Resolution: 0.05 % FSO
- Quantity: > 2,000 / 5,000 pieces / years

*depends on the magnet
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.
Different sensor series cover the complete application spectrum of draw-wire sensors. The miniaturized 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.

## Measuring Ranges

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<tr>
<th></th>
<th>(mm)</th>
<th>50</th>
<th>150</th>
<th>250</th>
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<th>3000</th>
<th>3500</th>
<th>5000</th>
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## Sensors

### OEM miniature sensors
- **wireSENSOR MK30/MK46/MK77/MK60/MK88/MK120**
  - Measuring ranges: 50 | 150 | 250 | 500 | 750 | 1000 | 1250 | 1500 | 2100 | 2300 | 2400 | 3000 | 3500 | 5000 | 7500 |
  - Analog output: Potentiometer, voltage, current
  - Digital output: Encoder

### Industrial sensors
- **wireSENSOR P60/P96**
  - Measuring ranges: 100 | 150 | 300 | 500 | 750 | 1000 | 1500 | 2000 | 2500 | 3000 |
  - Analog output: Potentiometer, voltage, current
  - Digital outputs: HTL, TTL, SSI, PB, CO
- **wireSENSOR P115**
  - Measuring ranges: 3000 | 4000 | 5000 | 7500 | 10,000 | 15,000 |
  - Analog outputs: Potentiometer, voltage, current
  - Digital outputs: HTL, TTL, SSI, PB, CO
- **wireSENSOR P200**
  - Measuring ranges: 30,000 | 40,000 | 50,000 |
  - Analog outputs: Potentiometer
  - Option: with wire acceleration up to 100 g
  - Digital outputs: HTL, TTL, SSI, PB, CO

### Subminiature sensors
- **wireSENSOR MPM**
  - Measuring ranges: 50 | 150 | 250 |
  - Analog output: Potentiometer
  - Option: with wire acceleration up to 100 g

### Miniature sensors
- **wireSENSOR MP/MPW**
  - Measuring ranges: 100 | 300 | 500 | 1000 |
  - Analog output: Potentiometer
  - Option: with protection class IP67

## Application with pulley wheel

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

**Laser line triangulation**
Non-contact 2D/3D profile sensors

**Examples of use:**
- Gap and flushness measurement on bodywork parts
- Quality control in chocolate production
- Inline burr measurement on sheet edges in body manufacture
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

gapCONTROL Setup Software
Sophisticated software for automated gap/flush measurements
Evaluation of different gap types
Simple parameterization of measuring tasks
Configuration of outputs and display of measured values

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 LLTDLL or NI IMAQdx

<table>
<thead>
<tr>
<th>scanCONTROL 26xx</th>
<th>Perfect for automation</th>
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<tbody>
<tr>
<td>Measuring ranges</td>
<td>Z-axis up to 265 mm</td>
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<td>X-axis up to 143.5 mm</td>
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<tr>
<td>Resolution</td>
<td>X-axis 640 points/profile</td>
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<tr>
<td>Profile frequency</td>
<td>up to 4000 Hz</td>
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<table>
<thead>
<tr>
<th>scanCONTROL 29xx</th>
<th>High-end automation scanner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring ranges</td>
<td>Z-axis up to 265 mm</td>
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<tr>
<td></td>
<td>X-axis up to 143.5 mm</td>
</tr>
<tr>
<td>Resolution</td>
<td>X-axis 1280 points/profile</td>
</tr>
<tr>
<td>Profile frequency</td>
<td>up to 2000 Hz</td>
</tr>
</tbody>
</table>
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

Optical micrometers and fiber optic sensors
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

### optoCONTROL 1200
Compact high-speed micrometer (laser)
- Measuring ranges (mm): 2 | 5 | 10 | 16 | 20 | 30
- Linearity: ±40 µm (independent)
- Resolution: 10 µm
- Frequency response: 100 kHz
- Integrated controller

### optoCONTROL 1202
Compact micrometer with large measuring range (laser)
- Measuring ranges (mm): 75 | 98
- Linearity: ±150 µm
- Resolution: 8 µm
- Measuring rate: 800 Hz
- Integrated controller

### optoCONTROL 1200
Compact high-speed micrometer (laser)
- Measuring range (mm): 34
- Linearity: ±10 µm
- Resolution: 1 µm
- Measuring rate: 2.3 kHz
- External controller

### optoCONTROL 1220
Optical inline micrometer
- Measuring range (mm): 28
- Linearity: ±22 µm
- Resolution: typ. 2 µm
- Working distance: up to 2000 mm
- Integrated controller

### optoCONTROL 2500
High-resolution micrometer (laser)
- Measuring range (mm): 46
- Linearity: ±12 µm
- Resolution: 1 µm
- Measuring rate: 2.5 kHz
- Integrated controller (web interface)

### optoCONTROL 2520
Compact laser micrometer (class 1M)
- Measuring range (mm): 40
- Linearity: ±3 µm
- Resolution: 0.1 µm
- Measuring rate: 2.3 kHz
- External controller

### optoCONTROL 2600
High-resolution micrometer (LED)
- Measuring range (mm): 75 | 98
- Linearity: ±150 µm
- Resolution: 8 µm
- Measuring rate: 800 Hz
- Integrated controller

### optoCONTROL 1220
Optical inline micrometer
- Measuring range (mm): 28
- Linearity: ±22 µm
- Resolution: typ. 2 µm
- Working distance: up to 2000 mm
- Integrated controller
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
colorSENSOR CFO
Color recognition using optical fibers close to the target object
- Repeatability: ΔE ≤ 0.3
- Software teach: 1 - 254 colors can be saved
- Teach-in via keys: 1 - 254 colors can be saved

colorSENSOR OT
Color recognition using fixed lens for distances from 10 to 800 mm
- Repeatability: ≥ ΔE 0.5
- Color sensors for different surfaces such as mat, shiny or structured surfaces

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: < ΔE 0.08
- Spectral measuring range: 390 – 780 nm
- Spectral resolution: 5 nm
- Color recognition from a taught reference list

Web interface - colorCONTROL ACS7000

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.
Infrared thermometers 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 either hand-held devices, thermal imaging cameras or sensors to be permanently installed 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 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 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 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 - 2000 °C
thermoMETER CTlaserGLASS
For glass measurement: 100 °C to 1650 °C
thermoMETER CTlaserCOMBUSTION
For measurement of flames: 200 °C to 1450 °C
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 CT M1/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 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 CTlaser M1/M2/M3
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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
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.
thermoMAGER 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 at 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 640
Thermography in VGA resolution
640 x 480 pixels
Temperature ranges: -20 °C to 900 °C
Excellent thermal sensitivity (NETD) of 0.075 K
Radiometric video recording with 32 Hz
Analog input and output, trigger interface

thermoIMAGER TIM G7 / G7 VGA
Thermal imaging camera with line scan feature for the glass industry
Image frequency of 80 Hz/125 Hz
Excellent thermal sensitivity (NETD) of 0.13 K
Radiometric video recording with 32 Hz
Analog input and output, trigger interface

thermoIMAGER Microscope lens
Thermal imager with microscope lens
Measuring 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 µm / 28 µm
Spectral range: 7.5 to 13µm

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 400/450
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 13°, 38° or 62° FOV & industrial accessories
Image recording in real time at 80 Hz
Analog input and output, trigger interface

thermoIMAGER TIM M1 / TIM M05
Thermal imaging camera for hot metal surfaces
Measuring ranges: 450 to 1800 °C /900 to 2000 °C
Excellent thermal sensitivity (NETD) of <1 K
Optical resolution 764 x 288 pixels
Spectral range 0.92 to 1.1 µm / 500 to 540 nm

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

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 (195g) and robust (IP67)
Extremely compact dimensions 45x45x62 mm
Analog input and output, trigger interface

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Integrated watchdog feature
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.

Innovative sensor solutions for specific applications

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

boreCONTROL
Non-contact interior wall inspection of bore holes
Sampling rate up to 25 kHz
Use in small bore holes from 4 mm
Precise diameter detection
Optical temperature compensation
Measuring ranges 4 mm - 10 mm, 6 mm - 12.8 mm und 10 mm - 16 mm

SGS Spindle Growth System
Sensor system developed for measuring the thermal extension of milling spindles
Measuring range 500 µm
Resolution 0.5 µm
High temperature range

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
Profiliometer
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 Automation
Inspection of shiny surfaces
Defect detection and 3D shape measurement