![MICRO-EPSILON logo]

# More Precision

**optoNCDT** // Laser displacement sensors (triangulation)
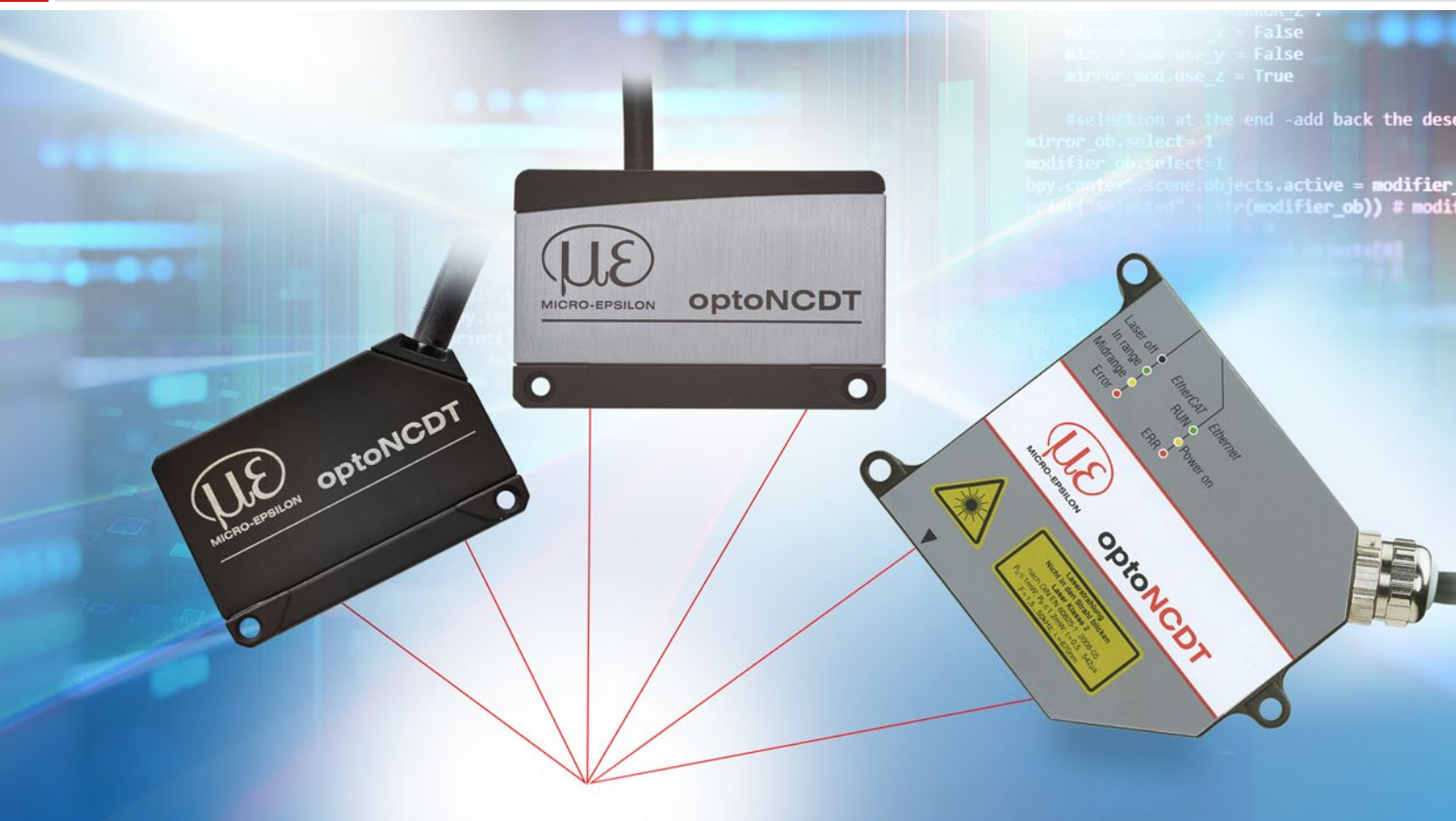
# Smart laser sensors for precise measurements
## optoNCDT 1900

- For common surfaces
- Hz Measuring rate up to 10 kHz
- INTER FACE Analog (U/I) / RS422 / PROFINET / EtherNet/IP / EtherCAT
- ASc Advanced Surface Compensation
- Repeatability <0.1 $\mu m$
- Ideal for series and OEM applications
- Highest immunity to ambient light
- High resistance to shocks and vibrations

### Next-generation laser sensors

The optoNCDT 1900 laser sensors are used for dynamic displacement, distance and position measurements and offer a unique combination of performance, design and integration capability. The integrated high-performance controller enables fast and highly precise processing and output of measurement values.

These innovative sensors are used whenever maximum precision is combined with the latest technology, e.g., in sophisticated automation, automotive production, 3D printing and coordinate measuring machines.

### Advanced Surface Compensation –
### The intelligent exposure control for demanding surfaces

The optoNCDT 1900 laser sensors are equipped with an intelligent surface control feature. Innovative algorithms enable stable measurement results even on demanding surfaces where changing reflections occur. Furthermore, these new algorithms compensate for ambient light up to 50,000 lux. Therefore, these are the sensors with the highest resistance to ambient light in their class and can even be used in strongly illuminated environments.

**Advanced Surface Compensation**
With rapidly changing surfaces, the exposure control enables reliable measurement results.

## Industrial Ethernet for easy integration

The latest optoNCDT 1900 laser triangulation sensors are also available with integrated Industrial Ethernet interface. Depending on the model, you can integrate the full sensor performance into your PLC directly via EtherCAT, EtherNet/IP or PROFINET without any additional interface module. You benefit from real-time data without time delay as well as reduced installation and wiring effort.

The sensor parameters can be set directly via Industrial Ethernet or still via web interface. For high speed measurements, the sensor offers an Oversampling feature which allows, depending on the fieldbus, measurement data to be detected or transmitted eight times faster than the bus cycles.

EtherCAT.    EtherNet/IP    PROFINET

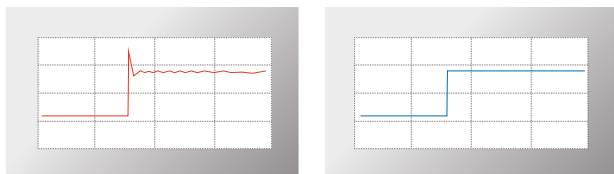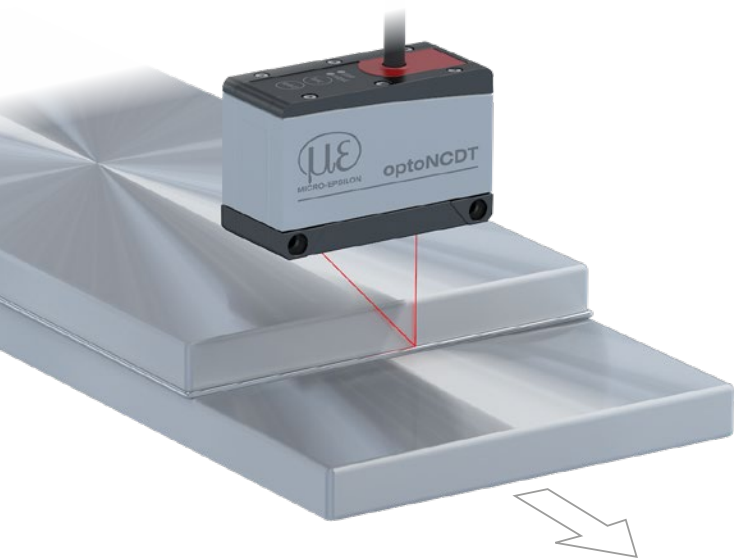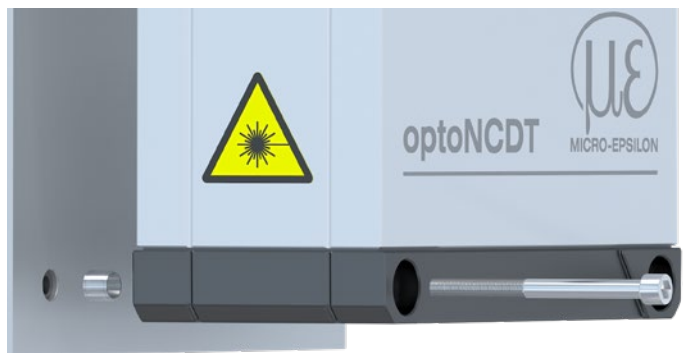| Model | Technology | Measuring range | Repeatability | Linearity |
|---|---|---|---|---|
| optoNCDT 1900 | | 2 - 500 mm | 0.1 $\mu m$ | from 0.02 % |
| optoNCDT 1900LL | | 2 - 50 mm | 0.1 $\mu m$ | from 0.02 % |





The two-step measurement value averaging enables smooth signal courses when measuring edges (right). Otherwise, interfering signals occur (left).

**Patented installation**
Easy mounting and high repeatability when replacing the sensor

## Highest stability based on intelligent signal optimization

For the first time, a two-step measurement value averaging feature is available to optimize the signal. This enables a smooth signal at edges and steps. Especially for high speed measurements of moving parts, measurement averaging enables a precise signal course.

## Simple mounting and initial operation

Mounting the sensor using fitting sleeves automatically aligns the sensor in the correct position. This enables both easy sensor replacement and even higher precision in solving measurement tasks. Thanks to its small dimensions, the laser sensor can also be integrated in confined spaces.

## Application examples
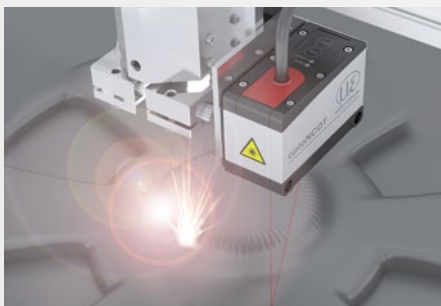


Distance measurement of print heads
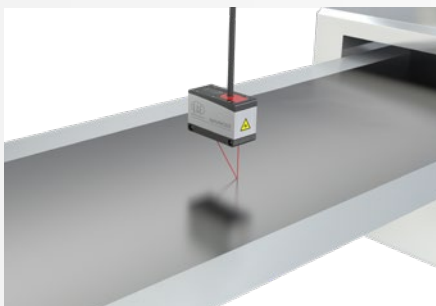


Thickness measurement of electrode film



Wear inspection of wheel tires

# optoNCDT 1900 with integrated Industrial Ethernet interface (General technical data)

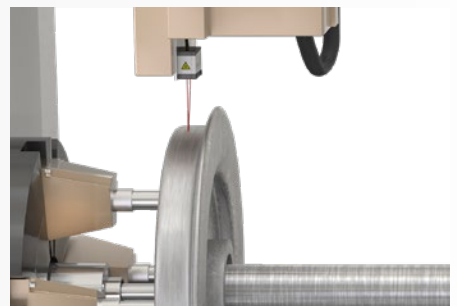| Model | ILD1900-xx with integrated Industrial Ethernet interface | |
|---|---|---|
| Measuring rate [1] | 7 adjustable stages: 10 kHz / 8 kHz / 4 kHz / 2 kHz / 1 kHz / 500 Hz / 250 Hz | |
| Temperature stability [2] | ±0.005 % FSO / K | |
| Light source | Semiconductor laser ≤ 1 mW, 670 nm (red) with laser class 2 | |
| Laser class | Class 2 in accordance with IEC 60825-1: 2014 (Class 3 available on request) | |
| Supply voltage [3] | 11 … 30 VDC or PoE | |
| Power consumption | < 3 W (24 V) | |
| Signal input | 1 x HTL/TTL Laser on/off | |
| Digital interface | EtherCAT / EtherNet/IP / PROFINET | |
| Connection | integrated pigtail 0.3 m with 12-pin M12 plug; optional extension to 3 m / 6 m / 9 m (see accessories for suitable connection cables) | |
| Temperature range | Storage | -20 … +70 °C (non-condensing) |
| | Operation | 0 … +50 °C (non-condensing) |
| Shock (DIN EN 60068-2-27) | 15 g / 6 ms in 3 axes | |
| Vibration (DIN EN 60068-2-6) | 30 g / 20 … 500 Hz | |
| Protection class (DIN EN 60529) | IP67 | |
| Material | Aluminum housing | |
| Weight | approx. 185 g (incl. pigtail) | |
| Control and indicator elements [4] | Select key: factory settings, switching the operation mode; web interface for setup: application-specific presets, peak selection, video signal, freely selectable averaging possibilities, data reduction, setup management; 1 x color LED for power / status; 2 x color LEDs for fieldbus status | |

[1] Maximum measuring rate depending on fieldbus and bus cycle time; factory settings: measuring rate 4 kHz, median 9

[2] In the mid of the measuring range; the specified value is only achieved by mounting on a metallic sensor holder.
Good heat dissipation from the sensor to the holder must be ensured; value is valid in a range from 20 °C to 50 °C

[3] PoE not possible with PROFINET

[4] Connection to PC via network cable (with EtherCAT: sensor in Ethernet setup mode)

# Technical data
## optoNCDT 1900

### Laser point - optoNCDT 1900 / Measuring ranges 2 - 25

| Model | | ILD1900-2 | ILD1900-6 | ILD1900-10 | ILD1900-25 |
|---|---|---|---|---|---|
| Measuring range | | 2 mm | 6 mm | 10 mm | 25 mm |
| Start of measuring range | | 15 mm | 17 mm | 20 mm | 25 mm |
| Mid of measuring range | | 16 mm | 20 mm | 25 mm | 37.5 mm |
| End of measuring range | | 17 mm | 23 mm | 30 mm | 50 mm |
| Linearity [1] | | < ±1 $\mu$m | < ±1.8 $\mu$m | < ±2 $\mu$m | < ±5 $\mu$m |
| | | < ±0.05 % FSO | < ±0.03 % FSO | < ±0.02 % FSO | < ±0.02 % FSO |
| Repeatability [2] | | < 0.1 $\mu$m | < 0.25 $\mu$m | < 0.4 $\mu$m | < 0.8 $\mu$m |
| Light spot diameter [3] | SMR | 60 x 75 $\mu$m | 85 x 105 $\mu$m | 115 x 150 $\mu$m | 200 x 265 $\mu$m |
| | MMR | 55 x 65 $\mu$m | 57 x 60 $\mu$m | 60 x 65 $\mu$m | 70 x 75 $\mu$m |
| | EMR | 65 x 75 $\mu$m | 105 x 120 $\mu$m | 120 x 140 $\mu$m | 220 x 260 $\mu$m |
| | smallest Ø | 55 x 65 $\mu$m with 16 mm | 57 x 60 $\mu$m with 20 mm | 60 x 65 $\mu$m with 25 mm | 65 x 70 $\mu$m with 35 mm |
| Permissible ambient light | | 50,000 lx | | | |

[1] FSO = Full Scale Output; the specified data apply to white, diffuse reflecting surfaces (Micro-Epsilon reference ceramic for ILD sensors)
[2] Typical value with measurements at 4 kHz and median 9
[3] ±10 %; SMR = Start of measuring range; MMR = Mid of measuring range; EMR = End of measuring range
Light spot diameter determined using a point-shaped laser with Gaussian fit (full 1/e² width); for ILD1900-2: determined with emulated 90/10 knife-edge method

### Laser point - optoNCDT 1900 / Measuring ranges 50 - 500

| Model | | ILD1900-50 | ILD1900-100 | ILD1900-200 | ILD1900-500 |
|---|---|---|---|---|---|
| Measuring range | | 50 mm | 100 mm | 200 mm | 500 mm |
| Start of measuring range | | 40 mm | 50 mm | 60 mm | 100 mm |
| Mid of measuring range | | 65 mm | 100 mm | 160 mm | 350 mm |
| End of measuring range | | 90 mm | 150 mm | 260 mm | 600 mm |
| Linearity [1] | | < ±10 $\mu$m | < ±30 $\mu$m | < ±100 $\mu$m | < ±400 $\mu$m |
| | | < ±0.02 % FSO | < ±0.03 % FSO | < ±0.05 % FSO | < ±0.08 % FSO |
| Repeatability [2] | | < 1.6 $\mu$m | < 4 $\mu$m | < 8 $\mu$m | < 20 … 40 $\mu$m |
| Light spot diameter [3] | SMR | 220 x 300 $\mu$m | 310 x 460 $\mu$m | 950 x 1200 $\mu$m | 950 x 1200 $\mu$m |
| | MMR | 95 x 110 $\mu$m | 140 x 170 $\mu$m | | |
| | EMR | 260 x 300 $\mu$m | 380 x 410 $\mu$m | | |
| | smallest Ø | 85 x 90 $\mu$m with 55 mm | 120 x 125 $\mu$m with 75 mm | - | - |
| Permissible ambient light | | 50,000 lx | 30,000 lx | 10,000 lx | 10,000 lx |

[1] FSO = Full Scale Output; the specified data apply to white, diffuse reflecting surfaces (Micro-Epsilon reference ceramic for ILD sensors)
[2] Typical value with measurements at 4 kHz and median 9
[3] ±10 %; SMR = Start of measuring range; MMR = Mid of measuring range; EMR = End of measuring range
Light spot diameter determined using a point-shaped laser with Gaussian fit (full 1/e² width); for ILD1900-2: determined with emulated 90/10 knife-edge method

Limits for
free space

Keep this area free from other light sources
and/or their reflections
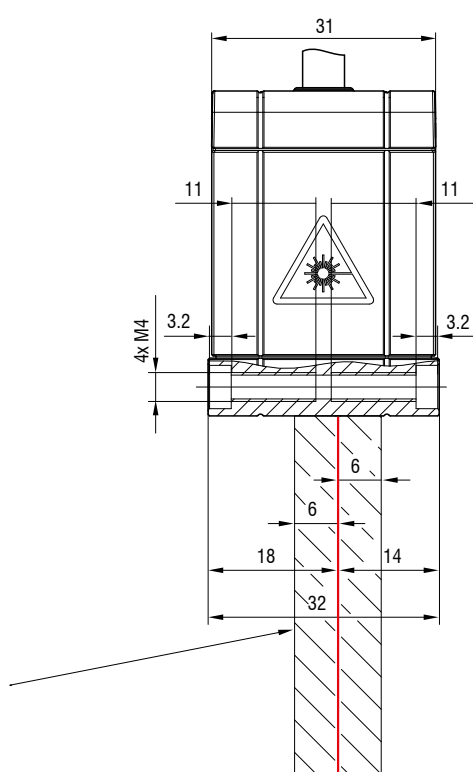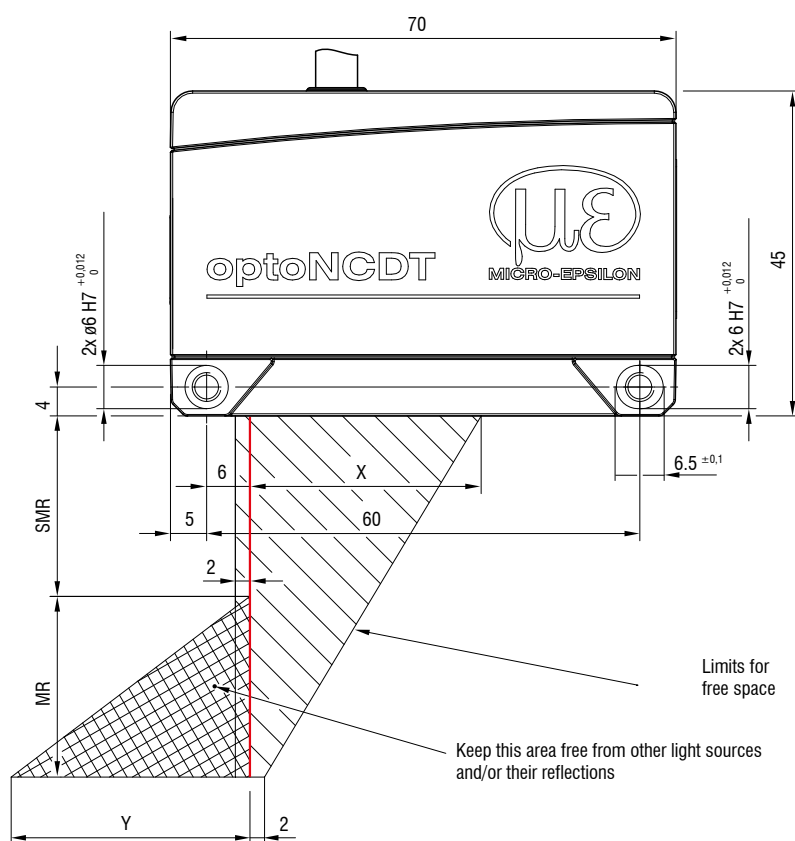
| MR | SMR | X | Y |
|-----|-----|-----|-----|
| 2 | 15 | 23 | 3 |
| 6 | 17 | 27 | 9 |
| 10 | 20 | 33 | 14 |
| 25 | 25 | 33 | 33 |
| 50 | 40 | 36 | 45 |
| 100 | 50 | 37 | 75 |
| 200 | 60 | 39 | 130 |
| 500 | 100 | 43 | 215 |

(Dimensions in mm, not to scale)
MR = measuring range; SMR = start of measuring range
MMR = mid of measuring range; EMR = end of measuring range

### Connector (sensor side)

## Installation options

| Bolt connection | Direct fastening |
|---|---|
| M3x40 | M4     min 10 |
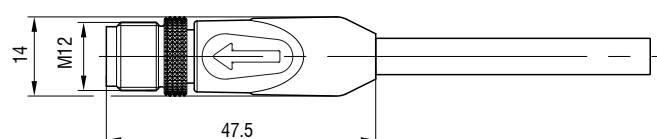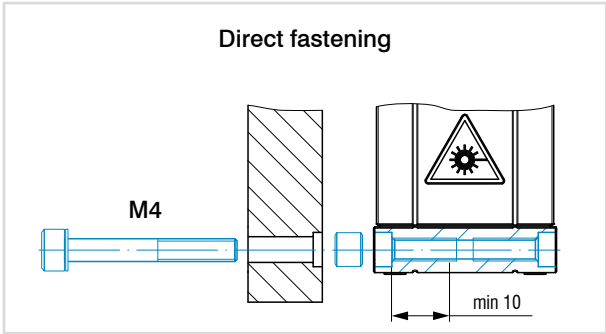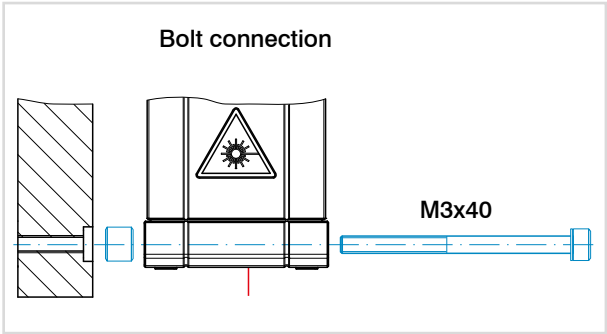
## Accessories for optoNCDT 1900/1910

### Power supply unit
PS2020 (power supply 24 V / 2.5 A, input 100 - 240 VAC, output 24 VDC / 2.5 A, mounting onto symmetrical standard rail 35 mm x 7.5 mm, DIN 50022)

### Protective film
Transparent protective film 52 x 15 mm for ILD1900

### Protective housings
with air purge and cooling, see page 60

## Scope of supply

- 1 Sensor ILD1900/1910
- 1 Assembly instructions
- 1 Calibration protocol
- Accessories (2 pc. centering sleeves, 2 pc. M3 x 40)

## Article designation

| ILD1900- | 6 | LL | CL3B | EtherCAT |
|---|---|---|---|---|
| | | | | **Interface**<br>No indication: RS422, current, voltage (standard)<br>integrated fieldbus: EtherCAT, EtherNet/IP, PROFINET |
| | | | **Laser class**<br>No indication: class 2 (standard)<br>3B: on request<br>3R: on request | |
| | | **Laser type**<br>No indication: Red laser point (standard)<br>LL: Laser Line | | |
| | **Measuring range** in mm | | | |
| **Series**<br>ILD1900: Laser displacement sensor for Advanced Automation | | | | |

# Connection possibilities
## optoNCDT 1900

### Connection possibilities for sensors with integrated cables

| | |
|---|---|
| Cable diameter: | 5.80 ±0.2 mm |
| Drag chain: | yes |
| Robot: | no |
| Temperature range: | -25 … 80 °C (moving) |
| | -40 … 80 °C (not moving) |
| Bending radius: | > 30 mm (fixed installation) |
| | > 75 mm (dynamic) |

| Sensor | Cables | Type | Connection possibilities and accessories | |
|---|---|---|---|---|
| LD1900-xx<br>ILD1900-xxLL<br><br>ILD1910-xx | Integrated cable<br>length 3 m | Open ends | **Supply voltage connection**<br>Power supply unit PS2020 | |
| | | | **Interface module of RS422 to USB**<br>IF2001/USB<br>IC2001/USB | |
| | | | **Interface module for Industrial Ethernet connection**<br>IF2035-PROFINET<br>IF2035-EIP<br>IF2035-EtherCAT | |

### Drag-chain suitable connection cables for sensors with pigtail

| | |
|---|---|
| Cable diameter: | 6.7 ±0.2 mm |
| Drag chain: | yes |
| Robot: | no |
| Temperature range: | -25 … 80 °C (moving) (up to +105 °C for max. 3000 hrs) |
| | -40 … 80 °C (not moving) |
| Bending radius: | > 34 mm (fixed installation) |
| | > 67 mm (dynamic) |
| | > 81 mm (drag chain) |

| Sensor | Cables | Type | Connection possibilities and accessories | |
|---|---|---|---|---|
| ILD1900-xx<br>ILD1900-xxLL<br><br>ILD1910-xx | **Extension cable pigtail**<br>Length 3 m / 6 m / 9 m / 15 m<br><br>*Art. no.*    *Designation*<br>29011218    PC1900-3/OE<br>29011219    PC1900-6/OE<br>29011220    PC1900-9/OE<br>29011221    PC1900-15/OE | Open ends | **Connection supply voltage**<br>PS2020 | |
| | | | **Interface module of RS422 to USB**<br>IF2001/USB<br>IC2001/USB | |
| | | | **Interface module for Industrial Ethernet connection**<br>IF2035-PROFINET<br>IF2035-EIP<br>IF2035-EtherCAT | |
| | **Adapter cable for PC interface card**<br>Length 3 m / 6 m / 9 m / 15 m<br><br>*Art. no.*    *Designation*<br>29011316    PC1900-3/IF2008 PCIE<br>29011317    PC1900-6/IF2008 PCIE<br>29011318    PC1900-9/IF2008 PCIE<br>29011319    PC1900-15/IF2008 PCIE | Sub-D | **Interface card for synchronous data acquisition**<br>IF2008PCIe / IF2008E | |
| | | | **4-fold interface module from RS422 to USB**<br>IF2004/USB | |
| | **Adapter cable for sensor calculation**<br>Length 3 m / 6 m / 9 m / 15 m<br><br>*Art. no.*    *Designation*<br>29011320    PC1900-3/C-Box<br>29011321    PC1900-6/C-Box<br>29011322    PC1900-9/C-Box<br>29011323    PC1900-15/C-Box | Sub-D | **Controller for D/A conversion and evaluation of up to 2 sensor signals**<br>Dual Processing Unit | |
| | **Adapter cable for sensor calculation**<br>Length 2 m<br><br>*Art. no.*    *Designation*<br>29011326    PCE1900-3/M12 | M12 | **Interface module for Ethernet connection of up to 8 sensors**<br>IF2008/ETH | |

## Robot-suitable connection cables

| | |
|---|---|
| Cable diameter: | approx. 7.3 mm |
| Drag chain: | no |
| Robot: | yes |
| Temperature range: | -40 … 90 °C (moving) |
| | -50 … 90 °C (not moving) |
| Bending radius: | > 37 mm (fixed installation) |
| | > 73 mm (dynamic) |

| Sensor | Cables | | Type |
|---|---|---|---|
| LD1900-xx<br>ILD1900-xxLL<br><br>ILD1910-xx | **Extension cable pigtail**<br>Length 3 m / 6 m / 9 m / 15 m<br><br>*Art. no.*     *Designation*<br>29011404    PC1900R-3/OE<br>29011405    PC1900R-6/OE<br>29011406    PC1900R-9/OE<br>29011407    PC1900R-15/OE | | Open ends |

| Connection possibilities and accessories | |
|---|---|
| **Connection supply voltage**<br>PS2020 | |
| **Interface module of RS422 to USB**<br>IF2001/USB<br>IC2001/USB | |
| **Interface module for Industrial Ethernet connection**<br>IF2035-PROFINET<br>IF2035-EIP<br>IF2035-EtherCAT | |

## Connection cables for sensors with integrated Industrial Ethernet interface

| | |
|---|---|
| Cable diameter: | 7.5 ±0.2 mm |
| Drag chain: | yes |
| Robot: | no |
| Temperature range: | -40 … 90 °C (moving) |
| | -50 … 90 °C (not moving) |
| Bending radius: | > 38 mm (fixed installation) |
| | > 75 mm (dynamic) |

| Sensor | Cables | Type |
|---|---|---|
| ILD1900-xx-PROFINET*<br>ILD1900-xxLL-PROFINET*<br><br>ILD1900-xx-EtherCAT<br>ILD1900-xxLL-EtherCAT<br><br>ILD1900-xx-EtherNet/IP<br>ILD1900-xxLL-EtherNet/IP | **Connection cables PoE, laser On/Off hardware**<br>Length 3 m / 6 m / 9 m / 15 m<br><br>*Art. no.*     *Designation*<br>29011332    PC1900-IE-3/OE-RJ45<br>29011333    PC1900-IE-6/OE-RJ45<br>29011334    PC1900-IE-9/OE-RJ45<br>29011444    PC1900-IE-15/OE-RJ45 | Open ends<br>& RJ45 |
| ILD1900-xx-EtherCAT<br>ILD1900-xxLL-EtherCAT<br><br>ILD1900-xx-EtherNet/IP<br>ILD1900-xxLL-EtherNet/IP | **Connection cables PoE, laser On/Off Software**<br>Length 3 m / 6 m / 9 m / 15 m<br><br>*Art. no.*     *Designation*<br>29011338    PC1900-IE-3/RJ45<br>29011355    PC1900-IE-6/RJ45<br>29011356    PC1900-IE-9/RJ45<br>29011445    PC1900-IE-15/RJ45 | RJ45 |

| Connection possibilities and accessories |
|---|
| **Signal / Supply PoE**<br><br>optional: PoE Switch |

*PoE not possible with PROFINET

## Other cables

| | |
|---|---|
| Cable diameter: | 6.7 mm |
| Drag chain: | yes |
| Robot: | no |
| Temperature range: | -40 … 80 °C |
| Bending radius: | > 27 mm (fixed installation) |
| | > 51 mm (dynamic) |

| Input | Cables | | Type |
|---|---|---|---|
| 2 x Sub-D<br><br>(PC1900-x/<br>IF2008 PCIE) | **Adapter cable for the connection of two sensors per Sub-D connector**<br>Length 0.1 m<br><br>*Art. no.*     *Designation*<br>2901528    IF2008-Y-adapter cable | | Sub-D |

| Connection possibilities and accessories | |
|---|---|
| **Interface card for synchronous data acquisition**<br>IF2008PCIe / IF2008E | |
| **4-fold USB converter & parameter setting**<br>IF2004/USB | |

# Accessories
## optoNCDT

**IF2035: Interface module for
Industrial Ethernet connection**

- Connection of RS422 or RS485 interfaces to PROFINET / Ethernet/IP / EtherCAT
- Synchronization output for RS422 sensors
- 2 network connections for different network topologies
- Data rate up to 4 MBaud
- 4-fold oversampling (with EtherCAT)
- Ideal for confined spaces due to a compact housing and DIN rail mounting



**EtherCAT®**

**EtherNet/IP®**

**PROFINET®**

RS422 →
- PROFINET
- EtherNet/IP
- EtherCAT
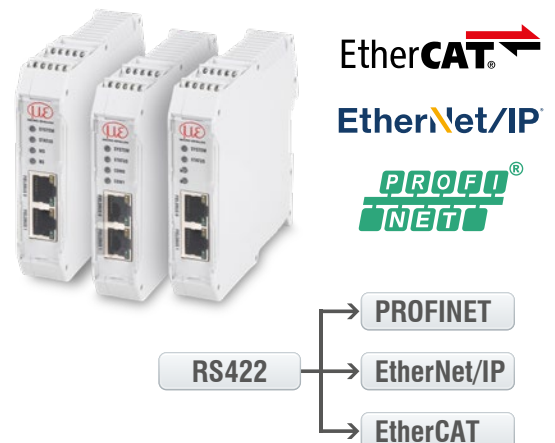
**IF2008PCIe / IF2008E:
Interface card for synchronous data acquisition**

- IF2008PCIe - Basic PCB: 4 digital signals and 2 encoders
- IF2008E - Expansion board: 2x digital signals, 2x analog signals and 8x I/O signals
- Absolutely synchronous data acquisition for multi-channel applications (e.g. for planarity or thickness measurement)



Interface card
IF2008PCIe, IF2008E
for individual signal
processing
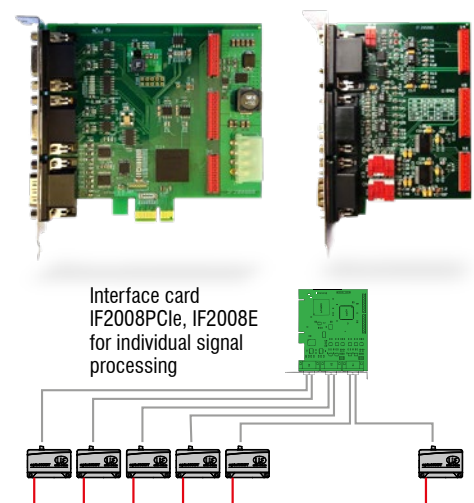
**Dual Processing Unit: Controller for D/A conversion and
evaluation of up to 2 sensor signals**

- Fast D/A conversion (16 bit, with a maximum of 100 kHz) of 2 digital input signals or calculation of 2 digital sensor signals
- Averaging functions and calculation of thickness, step, diameter, ovality and radial run out
- Trigger input
- Multi-function output
- Measurement value output via Ethernet, USB, analog output 4 ... 20 mA/0 ... 5 V / 0 ... 10 V / ±5 V / ±10 V (scalable via web interface)
- 2x switching outputs for sensor or Dual Processing Unit status
- Parallel data output via three output interfaces
- Two filter possibilities
- Post-linearization of measured values or calculated values
- Easy parameter setting via web interface (controller and sensors)



RS422
RS422 → +/- →
- Analog (U/I)
- USB
- Ethernet
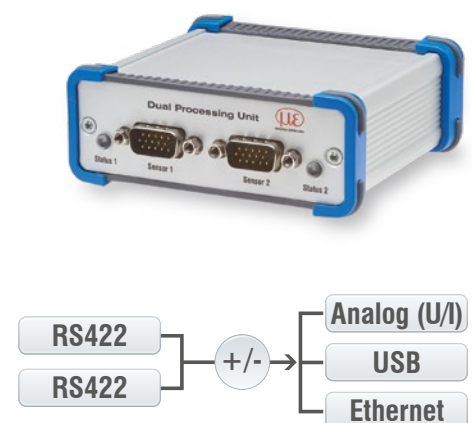
## IF2008/ETH: Interface module for Ethernet connection of up to 8 sensors

- Integration of eight sensors or encoders with RS422 interface in Ethernet network
- Four programmable switching in-/outputs (TTL and HTL logic)
- Fast data acquisition and output up to 200 kHz
- Simple parameter set up via web interface

RS422 → Ethernet

---

## IC2001/USB Single-channel converter cable RS422/USB

- Conversion from RS422 to USB
- 5-core interface cable without outer shield
- Easy sensor connection via USB
- Supports baud rates from 9.6 kBaud to 1 MBaud
- Ideal for integration into plant and machinery

RS422 → USB

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## IF2001/USB: Interface module from RS422 to USB

- Conversion from RS422 to USB
- Signals and functions such as laser on/off, switch signals and function output
- Supports baud rates from 9.6 kBaud to 12 MBaud
- Robust aluminum housing
- Easy sensor connection via screw terminals (plug and play)
- Parameter setting (converter and sensors) via software

RS422 → USB

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## IF2004/USB: 4-fold interface module from RS422 to USB

- Conversion of 4 digital signals (RS422) to USB
- 4x trigger inputs, 1x trigger output
- Synchronous data acquisition
- Parameter setting (converter and sensors) via software

RS422
RS422
RS422 → USB
RS422
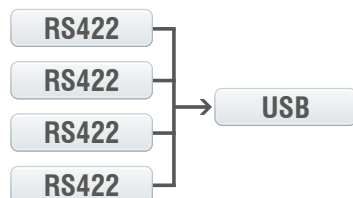
Connection of 4 sensors via
IF2008-Y-adapter cable

# Protective housings for demanding environments
## optoNCDT

| SGH & SGHF models | | | | SGHF-HT model |
|---|---|---|---|---|
| **Protective housing Size S** | | **Protective housing Size M** | | |
| SGH | SGHF | SGH | SGHF | |
| (140 x 140 x 71 mm) | | (180 x 140 x 71 mm) | | (260 x 180 x 154 mm) |
| Water-resistant housing protects the sensor from solvents and detergents. | Ideal with high ambient temperatures. The integrated air cooling of the housing offers optimum protection for the sensor. | Water-resistant housing protects the sensor from solvents and detergents. | Ideal with high ambient temperatures. The integrated air cooling of the housing offers optimum protection for the sensor. | Water-cooled protective housing with window and compressed-air connection for measurement tasks in ambient temperatures up to 200 °C.<br><br>Maximum temperature of cooling water T(max) = 10 °C<br>Minimum water flow rate Q(min) = 3 liters/min |
| Size S suitable for | | Size M suitable for | | Suitable for |
| ILD1750-20BL | | ILD1750-500BL | | ILD1750-500BL |
| ILD1750-200BL | | ILD1750-750BL | | ILD1750-750BL |
| ILD2300-2 / -2LL / -2BL | | ILD2300-200 | | ILD2300-200 |
| ILD2300-5 / -5BL | | ILD2300-300 | | ILD2300-300 |
| ILD2300-10 / -10LL / -10BL | | ILD2310-10 | | ILD2310-10 |
| ILD2300-20 / -20LL | | ILD2310-20 | | ILD2310-20 |
| ILD2300-50 / -50LL | | ILD2310-40 | | ILD2310-40 |
| ILD2300-100 | | | | ILD2310-50BL |

| Protective housing SGHF ILD1900 |
|---|
| Compact protective housing which is simply attached to the sensor. The protective housing has an air purge for cleaning the protective windows. It also cools the sensor. |
| Suitable for |
| ILD1900-6 / -6LL |
| ILD1900-10 / -10LL |
| ILD1900-25 / -25LL |
| ILD1900-50 / -50LL |
| ILD1900-100 |
| ILD1900-200 |
| ILD1900-500 |

## sensorTOOL

The Micro-Epsilon sensorTOOL is a powerful software that is used to operate one or more optoNCDT sensors. The sensorTOOL can be used to access the sensor connected to the PC, display its complete data stream and save it in a file (in Excel-compatible CSV format). The sensor is configured via its web interface.
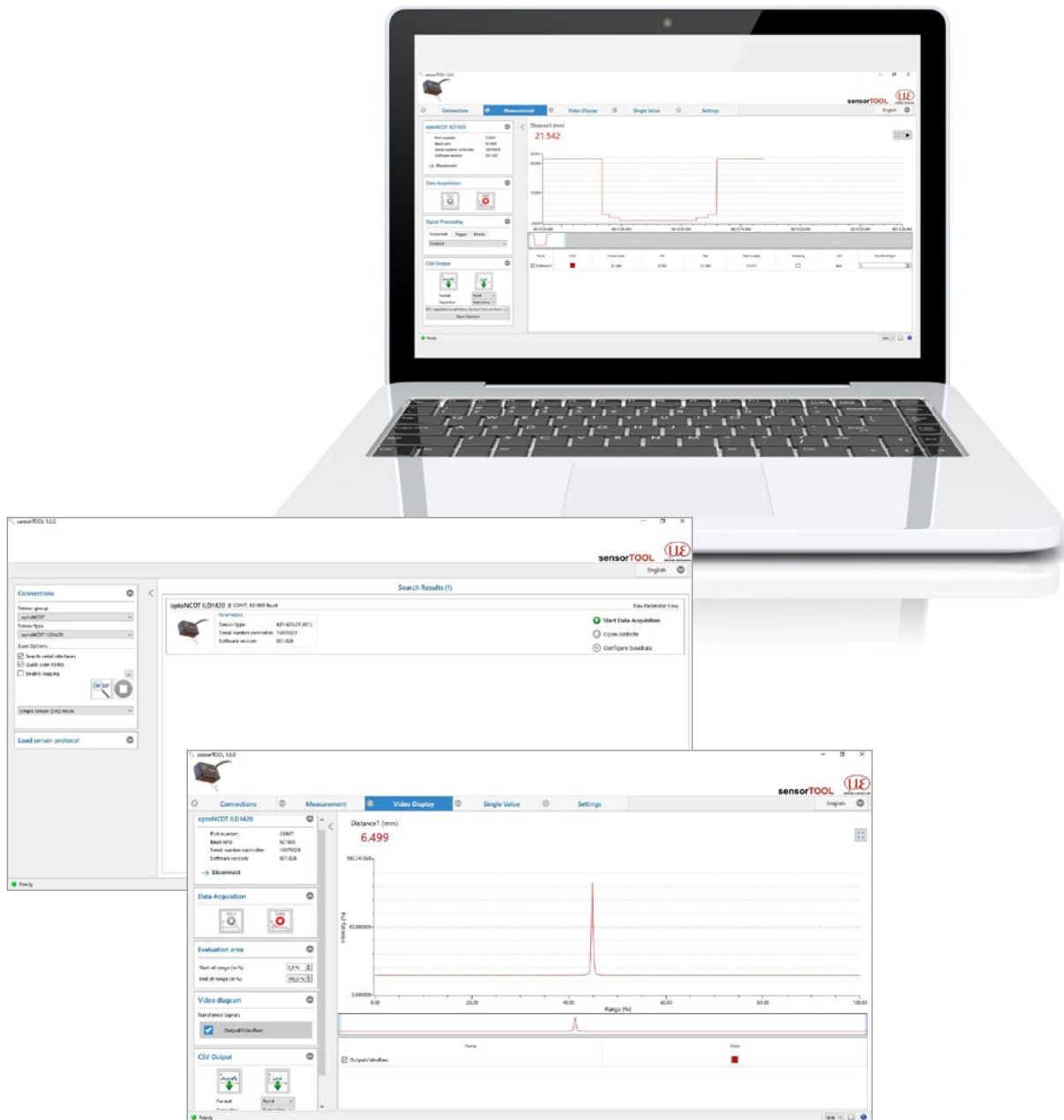


### Free download

All software tools, drivers and documented driver DLL for easy integration of the sensors into existing or internally-generated software are available free of charge under www.micro-epsilon.de/download
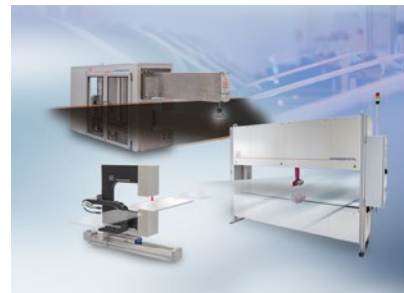
# Sensors and Systems from Micro-Epsilon



Sensors and systems for displacement, distance and position



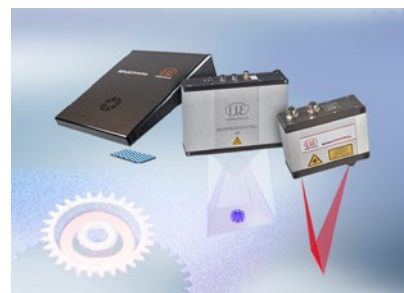Sensors and measurement devices for non-contact temperature measurement



Measuring and inspection systems for metal strips, plastics and rubber



Optical micrometers and fiber optics, measuring and test amplifiers



Color recognition sensors, LED analyzers and inline color spectrometers



3D measurement technology for dimensional testing and surface inspection