











More Precision

optoNCDT // Laser displacement sensors (triangulation)



Smart laser sensors for precise measurements optoNCDT 1900

designed for advanced
AUTOMATION

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



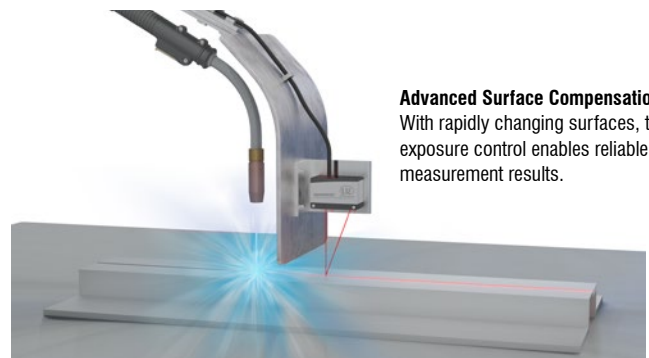
Next-generation laser sensors

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.

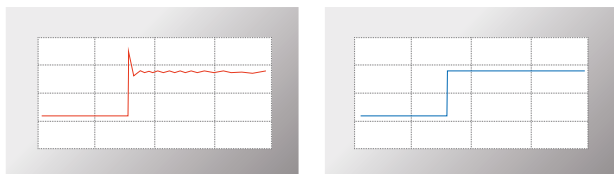
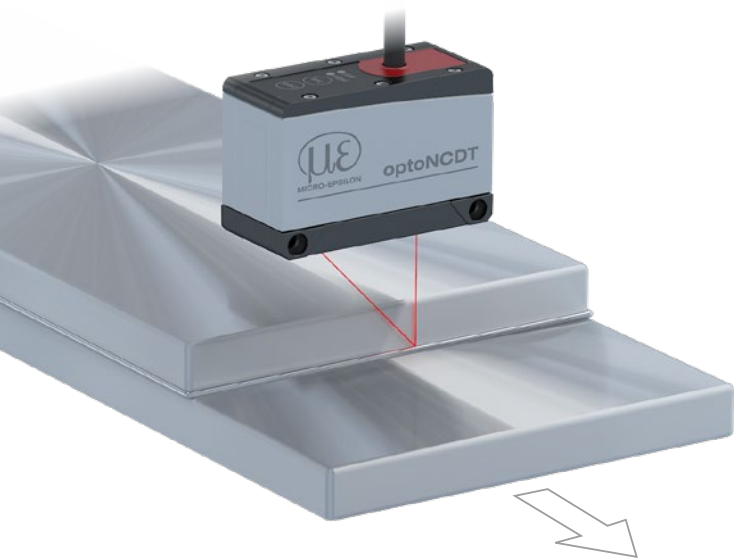
The sensor parameters can be set directly via Industrial Ethernet or still via web interface. For high speed measurements, the sensor offers an Oversampling feature which allows, depending on the fieldbus, measurement data to be detected or transmitted eight times faster than the bus cycles.

EtherCAT®

EtherNet/IP®

PROFI
NET®

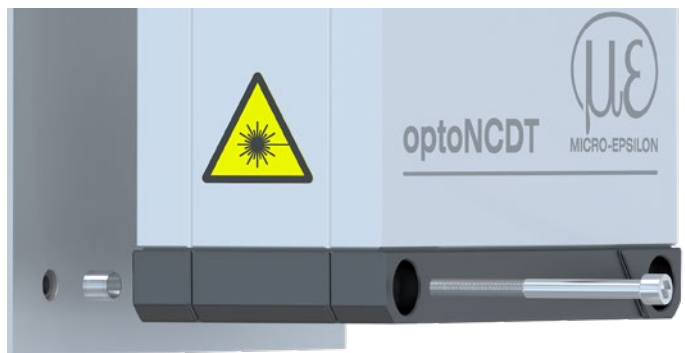
Model	Technology	Measuring range	Repeatability	Linearity
optoNCDT 1900		2 - 500 mm	0.1 μm	from 0.02 %
optoNCDT 1900LL		2 - 50 mm	0.1 μm	from 0.02 %



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

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.



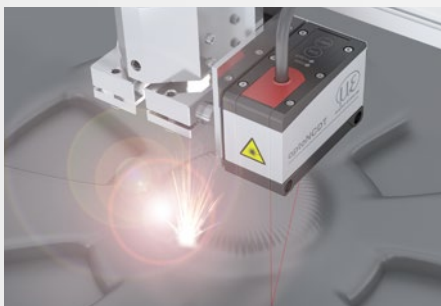
Patented installation

Easy mounting and high repeatability when replacing the sensor

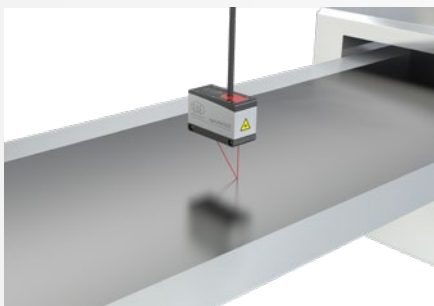
Simple mounting and initial operation

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.

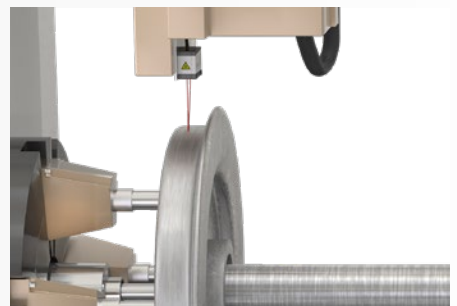
Application examples



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 µm	< ±1.8 µm	< ±2 µm	< ±5 µm
		< ±0.05 % FSO	< ±0.03 % FSO	< ±0.02 % FSO	< ±0.02 % FSO
Repeatability ^[2]		< 0.1 µm	< 0.25 µm	< 0.4 µm	< 0.8 µm
Light spot diameter ^[3]	SMR	60 x 75 µm	85 x 105 µm	115 x 150 µm	200 x 265 µm
	MMR	55 x 65 µm	57 x 60 µm	60 x 65 µm	70 x 75 µm
	EMR	65 x 75 µm	105 x 120 µm	120 x 140 µm	220 x 260 µm
	smallest Ø	55 x 65 µm with 16 mm	57 x 60 µm with 20 mm	60 x 65 µm with 25 mm	65 x 70 µm 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 µm	< ±30 µm	< ±100 µm	< ±400 µm
		< ±0.02 % FSO	< ±0.03 % FSO	< ±0.05 % FSO	< ±0.08 % FSO
Repeatability ^[2]		< 1.6 µm	< 4 µm	< 8 µm	< 20 ... 40 µm
Light spot diameter ^[3]	SMR	220 x 300 µm	310 x 460 µm	950 x 1200 µm	950 x 1200 µm
	MMR	95 x 110 µm	140 x 170 µm		
	EMR	260 x 300 µm	380 x 410 µm		
	smallest Ø	85 x 90 µm with 55 mm	120 x 125 µm 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)

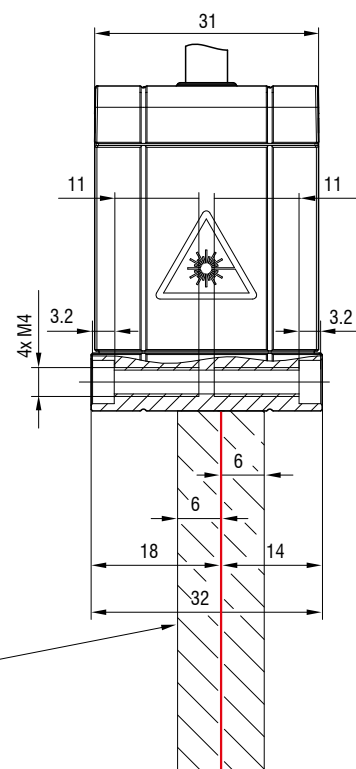
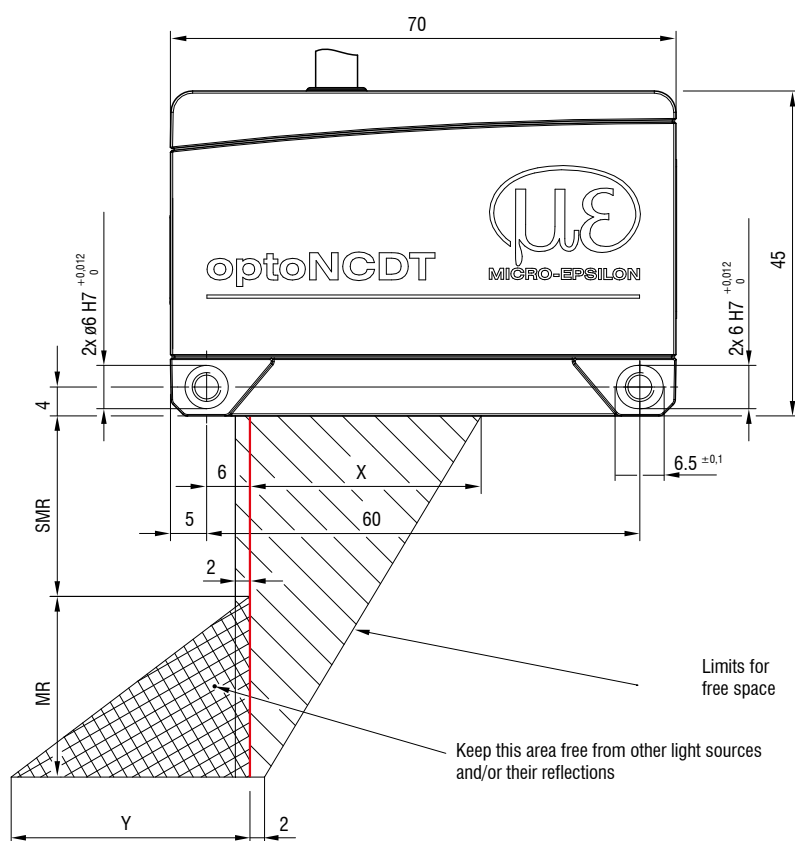
^[2] Typical value with measurements at 4 kHz and median 9

^[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

Dimensions

optoNCDT 1900



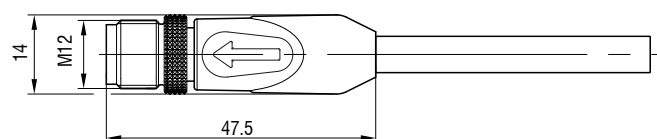
MR	SMR	X	Y
2	15	23	3
6	17	27	9
10	20	33	14
25	25	33	33
50	40	36	45
100	50	37	75
200	60	39	130
500	100	43	215

(Dimensions in mm, not to scale)

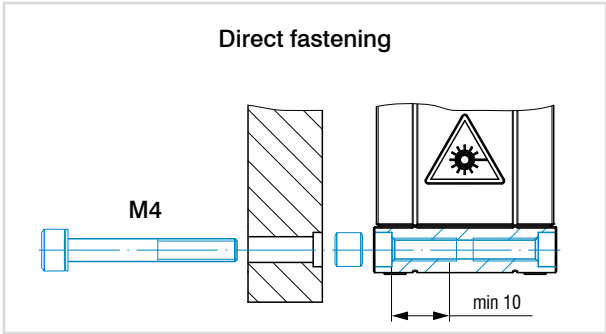
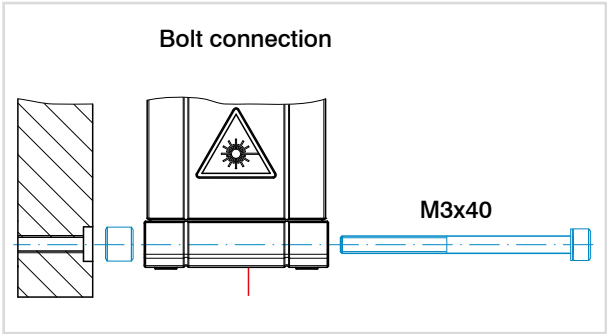
MR = measuring range; SMR = start of measuring range

MMR = mid of measuring range; EMR = end of measuring range

Connector (sensor side)



Installation options



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 62

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 No indication: RS422, current, voltage (standard) integrated fieldbus: EtherCAT, EtherNet/IP, PROFINET
				Laser class No indication: class 2 (standard) 3B: on request 3R: on request
				Laser type No indication: Red laser point (standard) LL: Laser Line
				Measuring range in mm
Series 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 ILD1900-xxLL ILD1910-xx	Integrated cable length 3 m	Open ends	<div> Supply voltage connection Power supply unit PS2020  </div> <div> Interface module of RS422 to USB IF2001/USB IC2001/USB  </div> <div> Interface module for Industrial Ethernet connection IF2035-PROFINET IF2035-EIP IF2035-EtherCAT  </div>




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 ILD1900-xxLL ILD1910-xx	Extension cable pigtail Length 3 m / 6 m / 9 m / 15 m <table><tr><td>Art. no.</td><td>Designation</td></tr><tr><td>29011218</td><td>PC1900-3/OE</td></tr><tr><td>29011219</td><td>PC1900-6/OE</td></tr><tr><td>29011220</td><td>PC1900-9/OE</td></tr><tr><td>29011221</td><td>PC1900-15/OE</td></tr></table>	Art. no.	Designation	29011218	PC1900-3/OE	29011219	PC1900-6/OE	29011220	PC1900-9/OE	29011221	PC1900-15/OE	Open ends	Connection supply voltage PS2020	
	Art. no.	Designation												
	29011218	PC1900-3/OE												
	29011219	PC1900-6/OE												
	29011220	PC1900-9/OE												
	29011221	PC1900-15/OE												
Adapter cable for PC interface card Length 3 m / 6 m / 9 m / 15 m <table><tr><td>Art. no.</td><td>Designation</td></tr><tr><td>29011316</td><td>PC1900-3/IF2008 PCIE</td></tr><tr><td>29011317</td><td>PC1900-6/IF2008 PCIE</td></tr><tr><td>29011318</td><td>PC1900-9/IF2008 PCIE</td></tr><tr><td>29011319</td><td>PC1900-15/IF2008 PCIE</td></tr></table>	Art. no.	Designation	29011316	PC1900-3/IF2008 PCIE	29011317	PC1900-6/IF2008 PCIE	29011318	PC1900-9/IF2008 PCIE	29011319	PC1900-15/IF2008 PCIE	Sub-D	Interface module of RS422 to USB IF2001/USB IC2001/USB		
	Art. no.	Designation												
	29011316	PC1900-3/IF2008 PCIE												
29011317	PC1900-6/IF2008 PCIE													
29011318	PC1900-9/IF2008 PCIE													
29011319	PC1900-15/IF2008 PCIE													
Adapter cable for sensor calculation Length 3 m / 6 m / 9 m / 15 m <table><tr><td>Art. no.</td><td>Designation</td></tr><tr><td>29011320</td><td>PC1900-3/C-Box</td></tr><tr><td>29011321</td><td>PC1900-6/C-Box</td></tr><tr><td>29011322</td><td>PC1900-9/C-Box</td></tr><tr><td>29011323</td><td>PC1900-15/C-Box</td></tr></table>	Art. no.	Designation	29011320	PC1900-3/C-Box	29011321	PC1900-6/C-Box	29011322	PC1900-9/C-Box	29011323	PC1900-15/C-Box	Sub-D	Interface module for Industrial Ethernet connection IF2035-PROFINET IF2035-EIP IF2035-EtherCAT		
	Art. no.	Designation												
	29011320	PC1900-3/C-Box												
29011321	PC1900-6/C-Box													
29011322	PC1900-9/C-Box													
29011323	PC1900-15/C-Box													
Adapter cable for sensor calculation Length 2 m <table><tr><td>Art. no.</td><td>Designation</td></tr><tr><td>29011326</td><td>PCE1900-3/M12</td></tr></table>	Art. no.	Designation	29011326	PCE1900-3/M12	M12	Interface card for synchronous data acquisition IF2008PCie / IF2008E								
	Art. no.	Designation												
29011326	PCE1900-3/M12													
4-fold interface module from RS422 to USB IF2004/USB														
			Controller for D/A conversion and evaluation of up to 2 sensor signals Dual Processing Unit											
			Interface module for Ethernet connection of up to 8 sensors 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	Connection possibilities and accessories	
LD1900-xx ILD1900-xxLL ILD1910-xx	Extension cable pigtail Length 3 m / 6 m / 9 m / 15 m <i>Art. no.</i> <i>Designation</i> 29011404 PC1900R-3/OE 29011405 PC1900R-6/OE 29011406 PC1900R-9/OE 29011407 PC1900R-15/OE	Open ends	Connection supply voltage PS2020	
	Interface module of RS422 to USB IF2001/USB IC2001/USB			
	Interface module for Industrial Ethernet connection IF2035-PROFINET IF2035-EIP 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	Connection possibilities and accessories											
ILD1900-xx-PROFINET* ILD1900-xxLL-PROFINET* ILD1900-xx-EtherCAT ILD1900-xxLL-EtherCAT ILD1900-xx-EtherNet/IP ILD1900-xxLL-EtherNet/IP	Connection cables PoE, laser On/Off hardware Length 3 m / 6 m / 9 m / 15 m <table><tr><th>Art. no.</th><th>Designation</th></tr><tr><td>29011332</td><td>PC1900-IE-3/OE-RJ45</td></tr><tr><td>29011333</td><td>PC1900-IE-6/OE-RJ45</td></tr><tr><td>29011334</td><td>PC1900-IE-9/OE-RJ45</td></tr><tr><td>29011444</td><td>PC1900-IE-15/OE-RJ45</td></tr></table>	Art. no.	Designation	29011332	PC1900-IE-3/OE-RJ45	29011333	PC1900-IE-6/OE-RJ45	29011334	PC1900-IE-9/OE-RJ45	29011444	PC1900-IE-15/OE-RJ45	Open ends & RJ45	Signal / Supply PoE optional: PoE Switch	
Art. no.	Designation													
29011332	PC1900-IE-3/OE-RJ45													
29011333	PC1900-IE-6/OE-RJ45													
29011334	PC1900-IE-9/OE-RJ45													
29011444	PC1900-IE-15/OE-RJ45													
ILD1900-xx-EtherCAT ILD1900-xxLL-EtherCAT ILD1900-xx-EtherNet/IP ILD1900-xxLL-EtherNet/IP	Connection cables PoE, laser On/Off Software Length 3 m / 6 m / 9 m / 15 m <table><tr><th>Art. no.</th><th>Designation</th></tr><tr><td>29011338</td><td>PC1900-IE-3/RJ45</td></tr><tr><td>29011355</td><td>PC1900-IE-6/RJ45</td></tr><tr><td>29011356</td><td>PC1900-IE-9/RJ45</td></tr><tr><td>29011445</td><td>PC1900-IE-15/RJ45</td></tr></table>	Art. no.	Designation	29011338	PC1900-IE-3/RJ45	29011355	PC1900-IE-6/RJ45	29011356	PC1900-IE-9/RJ45	29011445	PC1900-IE-15/RJ45	RJ45		
Art. no.	Designation													
29011338	PC1900-IE-3/RJ45													
29011355	PC1900-IE-6/RJ45													
29011356	PC1900-IE-9/RJ45													
29011445	PC1900-IE-15/RJ45													

*PoE not possible with PROFINET

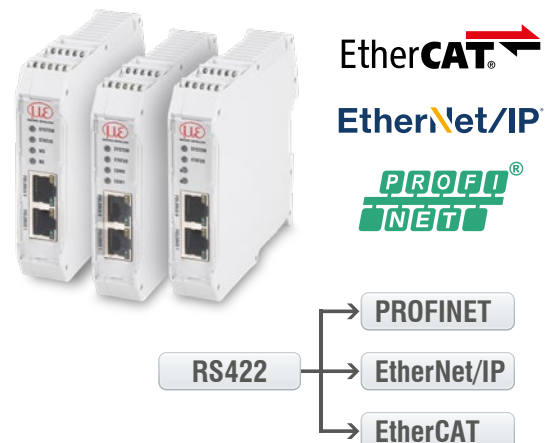
Other cables

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	Connection possibilities and accessories	
2 x Sub-D (PC1900-x/ IF2008 PCIE)	Adapter cable for the connection of two sensors per Sub-D connector Length 0.1 m <div>Art. no. Designation</div> <div>2901528 IF2008-Y-adapter cable</div> 	Sub-D	Interface card for synchronous data acquisition IF2008PCle / IF2008E 	
			4-fold USB converter & parameter setting IF2004/USB 	

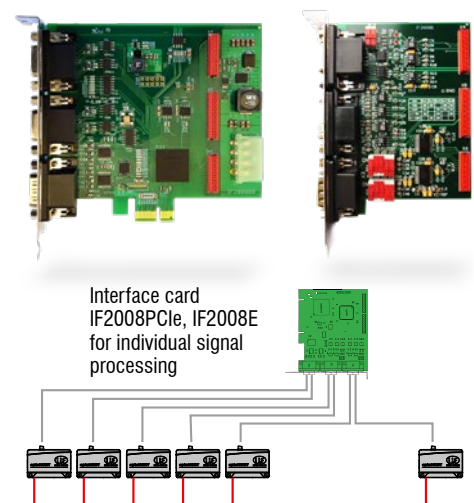
IF2035: Interface module for Industrial Ethernet connection

- 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



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)



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)



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



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



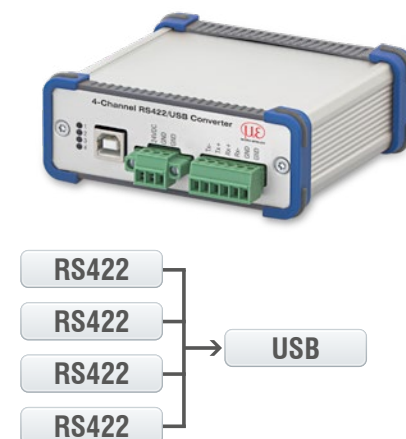
IF2001/USB: Interface module from RS422 to USB

- 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



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



Connection of 4 sensors via IF2008-Y-adaptor cable

Protective housings for demanding environments

optoNCDT

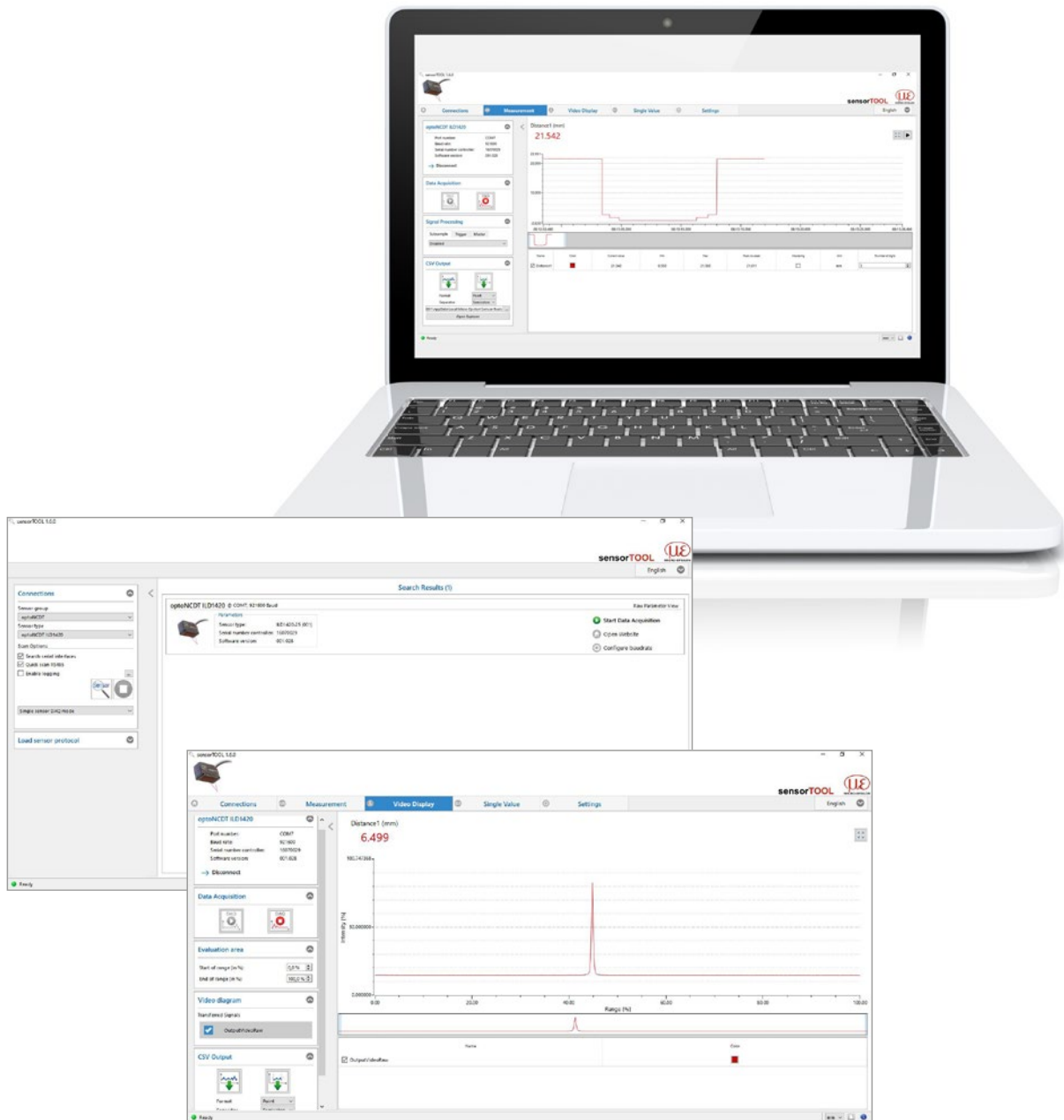
SGH & SGHF models				SGHF-HT model
Protective housing Size S		Protective housing Size M		
SGH	SGHF	SGH	SGHF	
				
(140 x 140 x 71 mm)		(180 x 140 x 71 mm)		(260 x 180 x 154 mm)
Water-resistant housing protects the sensor from solvents and detergents.	Ideal with high ambient temperatures. The integrated 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. Maximum temperature of cooling water T(max) = 10 °C Minimum water flow rate Q(min) = 3 liters/min
Size S suitable for ILD1750-20BL ILD1750-200BL ILD2300-2 / -2LL / -2BL ILD2300-5 / -5BL ILD2300-10 / -10LL / -10BL ILD2300-20 / -20LL ILD2300-50 / -50LL ILD2300-100		Size M suitable for ILD1750-500BL ILD1750-750BL ILD2300-200 ILD2300-300 ILD2310-10 ILD2310-20 ILD2310-40		Suitable for ILD1710-50 / -50BL ILD1710-1000 / -1000BL ILD1750-500BL ILD1750-750BL ILD2300-200 ILD2300-300 ILD2310-10 ILD2310-20 ILD2310-40 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

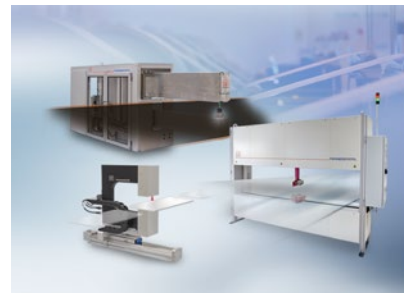
Sensors and Systems from Micro-Epsilon



Sensors and systems for displacement, distance and position



Sensors and measurement devices for non-contact temperature measurement



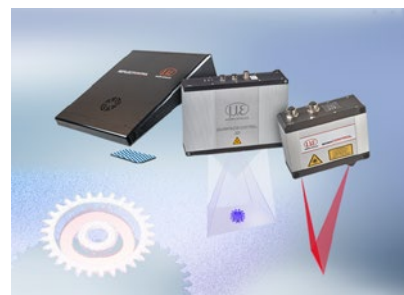
Measuring and inspection systems for metal strips, plastics and rubber



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