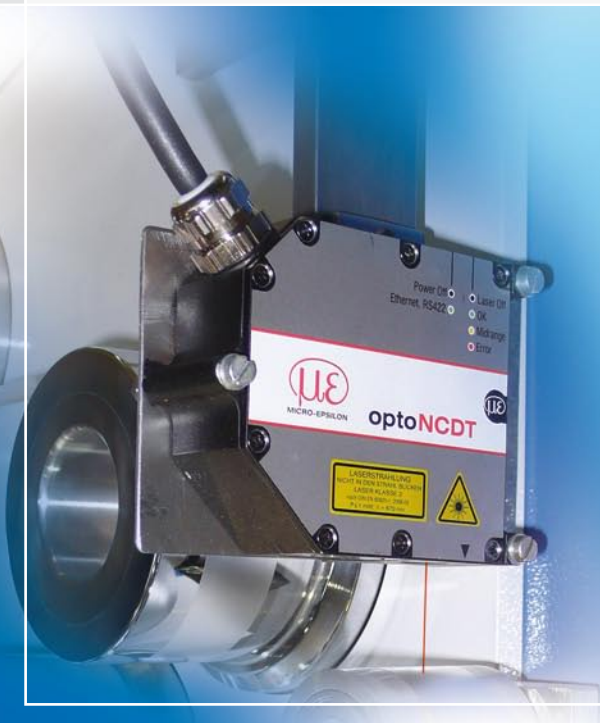**MICRO-EPSILON**

Laser Triangulation Displacement Sensors

- **Non-contact and wear-free**
- **Large stand off**
- **Tiny measuring spot for small targets**
- **High speed measurement**
- **High precision**
- **Almost all targets can be measured**

The optoNCDT product group represents the highest precision in laser-based optical displacement and position measurement.

Laser-based optical displacement sensors measure from a large distance to the target using a very small spot which enables measurements on the very small parts. The large measurement distance in turn enables measurements to be taken against difficult target surfaces such as hot metals.

The non-contact principle enables wear-free measurements as the sensors are not subject to any physical contact with the target.

Furthermore, the laser triangulation principle is ideal for very fast measurements with high accuracy and resolution.

Leadership in laser displacement measurement

Micro-Epsilon has a long-standing success of developing laser displacement sensors. Already a pioneer in the field of CCD sensors, Micro-Epsilon has continually raised the bar in industrial laser displacement measurement. The current optoNCDT range now offers five series, each of which is amongst the best in its class.
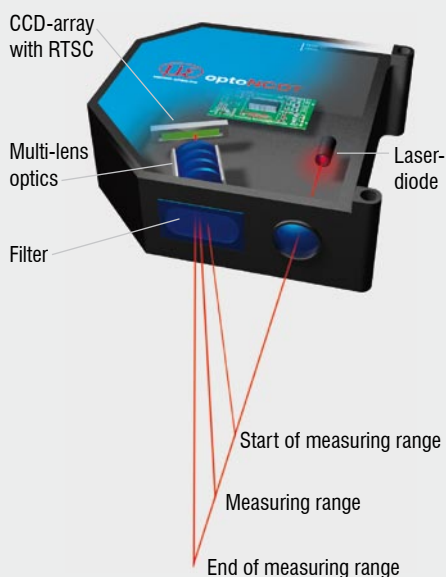
Measurement principle: Laser triangulation

Laser triangulation sensors operate with a laser diode which projects a visible light spot onto the surface of the measurement target. The light reflected from the spot is imaged by an optical receiving system onto a position-sensitive element. If the light spot changes its position, this change is imaged on the receiving element and evaluated. With the 1607 Series an analogue PSD module is used as the position-sensitive measuring element, whereas with the remaining sensors CMOS elements and CCD elements are used.

CCD-array with RTSC

Multi-lens optics

Filter

Laser-diode

Start of measuring range

Measuring range

End of measuring range

LASER RADIATION
Do not stare into the beam
CLASS 2 LASER PRODUCT
IEC 60825-1: 2008-05
P≤1mW; λ=670nm

IEC - Standard

optoNCDT sensors use a semiconductor laser with a wavelength of 670nm (visible/red). The maximum optical output power is 1mW. The sensor is classified as laser class II. A warning sign is attached to the sensor housing. The optoNCDT 1700BL uses a semiconductor laser with a wavelength of 405nm.
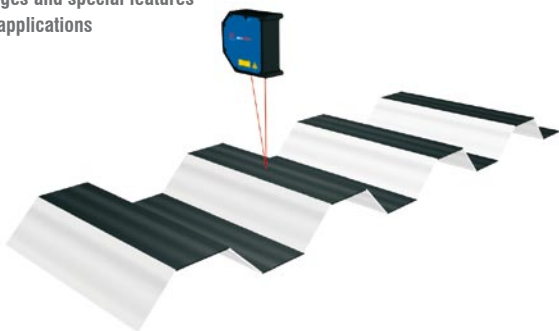
GENERAL INFORMATION

optoNCDT Laser triangulation sensors

Advantages and special features
Typical applications

COMPACT & LOW COST

Series 1302 / 1402 / 1402SC

Ranges 5 - 600mm
Resolution from 1μm
For tiny installation rooms

→ CMOS sensor element
→ Output analogue / digital
→ Integrated controller
→ Auto Target Compensation (ATC)
→ Trigger input and teach in
→ DAQ and configuration software (series 1402/SC)
→ Performance certificate (series 1402/SC)
→ High flex cables rated for drag chain use
→ Robot rated cable (optional)
→ Adjustable measuring rate (series 1402/SC)
→ Version 1402SC with stainless steel housing

HIGH PERFORMANCE WITH INTEGRATED CONTROLLER

Series 1700

Ranges 2 - 750mm
Resolution from 0.025μm
No external controller

→ CCD sensor element
→ Output analogue / digital
→ Integrated controller
→ Auto Target Compensation (ATC)
→ Real-Time-Surface-Compensation (RTSC)
→ Adjustable filter functions
→ DAQ and configuration software
→ Performance certificate
→ High flex cables for drag chain use
→ Robot rated cable
→ Adjustable measuring rate

HIGHEST PRECISION SENSORS

Series 2200 / 2220 / 2300

Ranges 2 - 200mm
Resolution from 0.03μm
Unmatched accuracy
Measuring rate up to 49kHz

→ CCD sensor element
→ Output analogue / digital
→ Auto Target Compensation (ATC)
→ Real-Time-Surface-Compensation (RTSC)
→ Adjustable filter functions
→ DAQ and configuration software
→ Performance certificate
→ High flex cables for drag chain use

LASER SENSORS FOR SHINY METALLIC AND ROUGH SURFACES

Series 1700LL / 2200LL / 2220LL

Ranges 2 - 50mm
LL option for metallic
or rough surfaces

→ Technical data see series 1700, 2200 and 2220
→ LL models with small Laser Line averages across shiny metallic or structured surfaces

LARGE STAND OFF

Series 1710-50 / 2210 / 1710-1000

Ranges 10 - 1000mm
Resolution from 0.5μm
Large stand off

→ CCD sensor element
→ Output analogue / digital
→ Auto Target Compensation (ATC)
→ Real-Time-Surface-Compensation (RTSC)
→ Adjustable filter functions
→ DAQ and configuration software
→ Performance certificate
→ High flex cables for drag chain use
→ 1710-1000 with measuring range up to 1000mm

BLUE LASER TECHNOLOGY

Series 1700BL

Ranges 20 - 1000mm
Resolution from 1.5μm
Suitable for red glowing metals, silicon and organic matters

→ Blue Laser technology
→ Output analog / digital
→ Integral controller
→ Real-Time-Surface-Compensation (RTSC)
→ Adjustable filter functions
→ Performance certificate I
→ High flex cables for dragchain or robot use
→ Adjustable measuring rate

THE HIGH SPEED TRUE ANALOGUE SENSORS

Series 1607

Ranges 0.5 - 200mm
Resolution from 0.1μm
Selectable frequencies up to 37kHz (-3dB)

→ PSD sensor element
→ Output analogue / digital
→ Auto Target Compensation (ATC)
→ Performance certificate
→ Very small sensor head
→ High flex cables for drag chain use

Designed for industrial applications

The sensors in the optoNCDT product range are designed for industrial applications. Due to their robust construction and user friendly technical features, they achieve precise measurement results even in harsh ambient conditions. Each series is available in a number of measurement ranges, covering one of the widest laser measurement product ranges in the market.

Analogue and digital output types

The optoNCDT sensors are equipped with a number of outputs to fulfil many industrial user requirements. Both analogue and digital interfaces are available, to maximise flexibility of sensor integration to your existing production environments. Sensors with USB interfaces can be configured using an external PC and software supplied as standard.

Compact with integrated controller

Despite their very compact dimensions, Series 1302, 1402, 1700, 1700LL and 2300 have a fully integrated controller. As a result, simple, rapid installation and wiring is possible. The sensors can be integrated easily into the tightest installation space.

Cables suitable for drag chain systems

All sensor cables for optoNCDT sensors are rated for use in drag chains and are therefore suitable for various fields of applications. For integration with robot systems, robot-compatible cables for the 1302, 1402, 1700, 1700LL and 2300 Series can be supplied as an option.

High measuring rate

High measuring rates are required for fast moving targets or measurements on difficult surfaces.
Sensors in the 2300 Series achieve a measuring rate of up to 49 kHz. The high-speed 1627 Series achieves measuring rates of up to 37kHz (-3dB).

Certified quality: Calibration certificate

To document the performance capability of the optoNCDT sensors, each sensor is calibrated before delivery and supplied with its own calibration certificate. This document is supplied with the sensor and is used as proof to the achieved measurement precision.
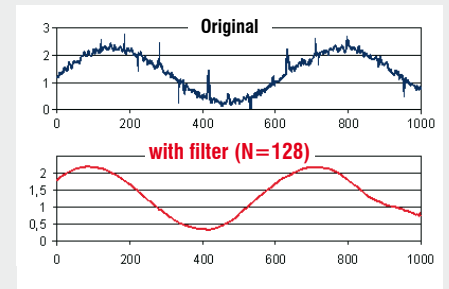[available for all series except 1302]

Adjustable filter functions

A number of filters are available in order to obtain optimum results for each application: sliding mean, recursive mean and median. The filters are applied directly to the measurement results inside the controller before output.
[available for all series except 1302, 1607]

**Vibration measurement with sliding mean**
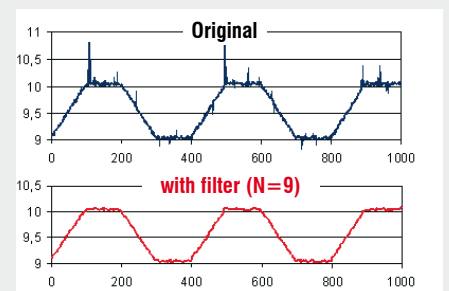
Profile measurement with median

# A world first: Real Time Surface Compensation (RTSC)

Through the unique RTSC function, the amount of reflection from the target surface is compensated during continuous exposure and in real-time. The exposure time or the amount of light produced by the laser is optimally matched to the reflection characteristics of the target surface. Unique to Micro-Epsilon sensors, this innovative real-time control always achieves optimum results, even with rapidly changing surface types.

Standard, commercially-available laser triangulation sensors normally operate with a time-shift control, which builds on previous measurement cycles. In this case, the amount of reflection from previous measurements is used to derive the degree of reflection for the next measurement. With changing or textured surfaces the measurement results therefore deviate noticeably from the actual measurement value, whereas optoNCDT is controlled in real time and as such, is adjusted to the optimum reflection conditions without needing to apply averaging filters.
[available for 1710-50, 2210 and for all series except 1302, 1402, 1607]
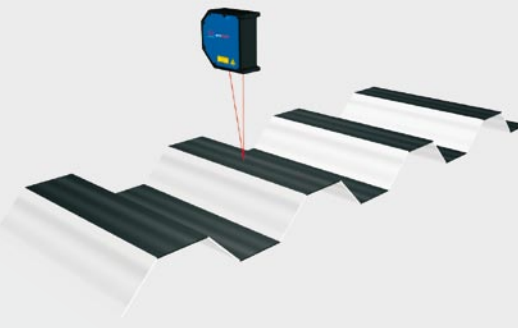
Comparison: optoNCDT with RTSC and conventional sensor

optoNCDT with RTSC real-time control
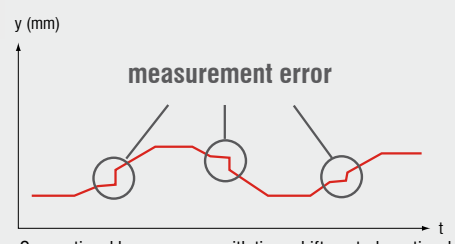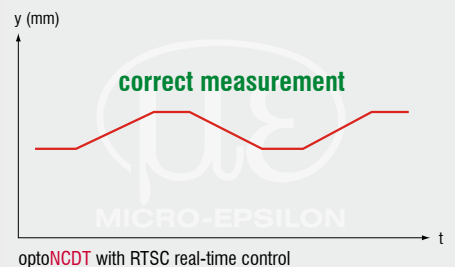
Conventional laser sensors with time-shift control - noticeable errors in measurement during change of surface conditions.

Measurement with multiple sensors

For many applications, it is necessary to measure or acquire data simultaneously using multiple sensors. The following range of functions are available to support synchronised measurements.

Genuine synchronisation of two sensors

A „true synchronous" measurement is required to precisely acquire moving or oscillating objects during thickness or differential measurements. In this case, one optoNCDT acts as the master, which provides the corresponding cycle pulse for the second sensor (slave). This function facilitates the genuine synchronous pulsing of two sensors.
[available for 1710-50, 2210 for all series except 1302, 1402, 1607]

Synchronisiation at thickness measurements of two sensors
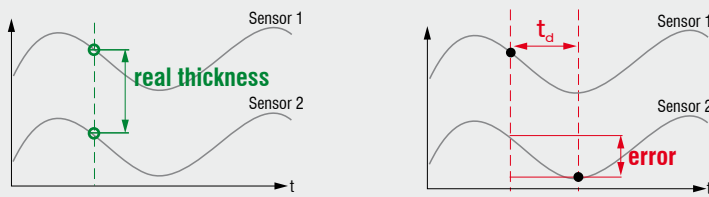
Genuine synchronisation during thickness measurement using two optoNCDT sensors with simultaneous data acquisition

Conventional laser sensor with usual time offset erroneous measurement

IF2008 Interface Card for synchronous data acquisition

The IF2008 Interface Card is designed for the data acquisition of up to eight sensors (6x digital, 2x analogue) and two encoder. This enables the simultaneous evaluation of multiple signals. Here, the sensors can be located opposite one another, e.g. for thickness measurement, or mounted in one plane, e.g. for differential height measurement. The interface card reads out the data from all the connected devices simultaneously and passes them to an external PC for further processing. Whereas the simultaneous measurement method is intended for opaque targets, alternating synchronisation, which prevents possible interference, can be set up for transparent objects.
[technical data on page 34]

CSP 2008: Controller for up to six sensors

The CSP2008 controller can be used to process between two and six digital or analogue input signals (2 x internal plus 4 x external via Ethercat modules from Beckhoff of almost all Micro-Epsilon displacement sensors. Ethercat can also be used as an external interface for connecting further sensors and I/O modules. The controller has a high luminance display so that measured values can be easily read, even from a long distance.
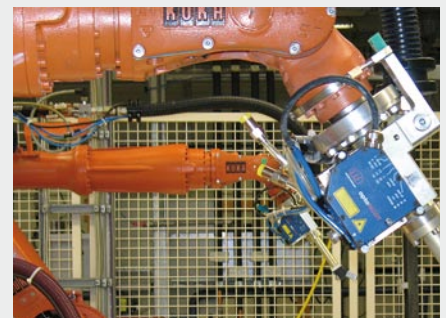[technical data on page 35]
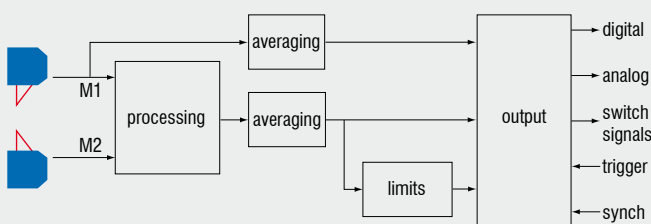
Thickness measurement with 2 optoNCDT laser sensors

optoNCDT on trimming systems of saw mills

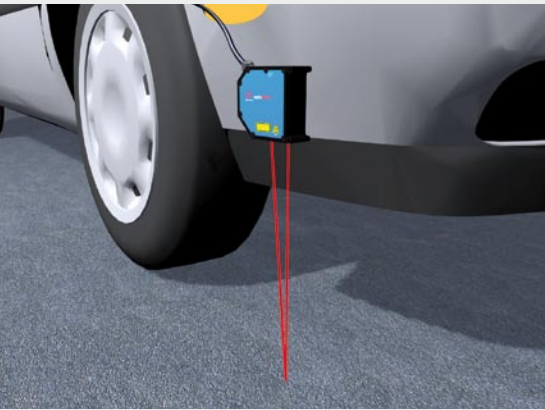Profile measurement of marine propellers

optoNCDT on robots in car production

Strip thickness measurement with two sensors


High speed measurement of black rubber

Distance of vehicle to road surface

In road tests, pitching and rolling movements, spring compression during braking and other quantities are measured with optoNCDT sensors. optoNCDT is particularly suitable here due to its compact construction and the possibility of powering the sensor from the vehicle power supply. For these applications, special models with increased resistance to extraneous light and vibration are available.
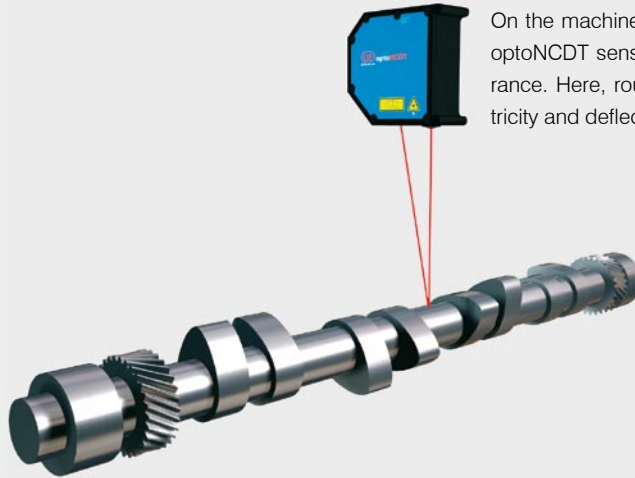
Measurement of automotive parts

On the machined surfaces of metal products, optoNCDT sensors are used for quality assurance. Here, roundness, concentricity, eccentricity and deflection can be acquired.
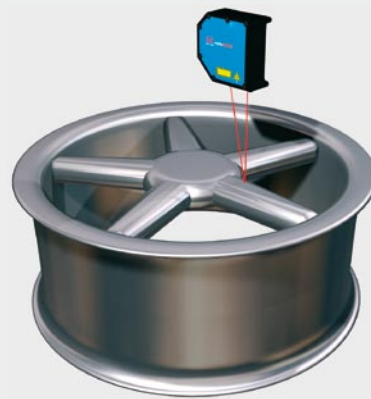
Shape conformance on aluminum wheels

After casting, aluminum wheels are measured for a range of properties, e.g. hub depth, roundness and bulging.

Car Body positioning in production lines

For automated processing of car bodies or vehicles, an exact determination of the position relative to the processing tool is necessary (drilling, punching, fitting, subassemblies). With its Real Time Surface Compensation, the optoNCDT sensor is ideally suited to the high-precision acquisition of sprayed surfaces.
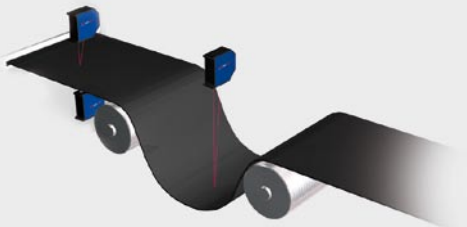
Deflection

Black rubber, an extremely difficult material to measure, is already measured directly after the calender with optoNCDT sensors. The sensors provide an error-free production of the rubber web.
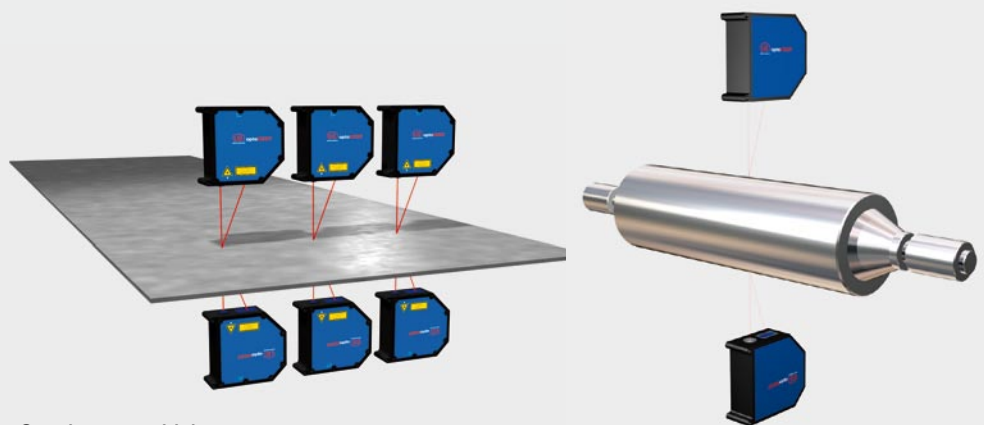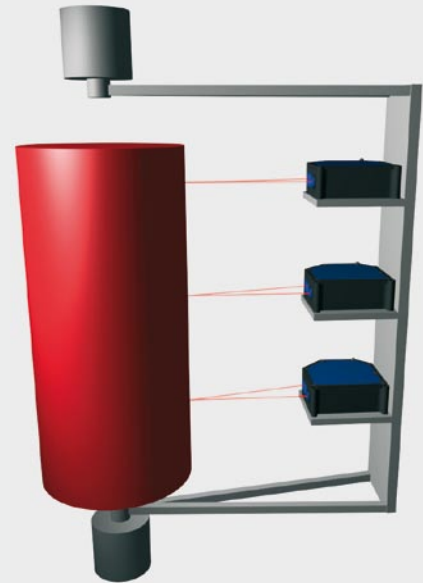
Synchronous thickness measurement

optoNCDT sensors are ideally suited to the thickness measurement of a variety of (web) materials. Due to the high measuring rate and the possibility of synchronising multiple sensors, even moving and oscillating targets can be reliably acquired.
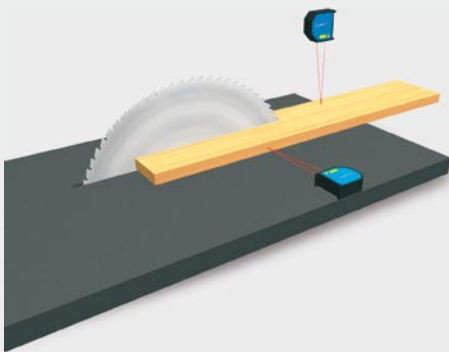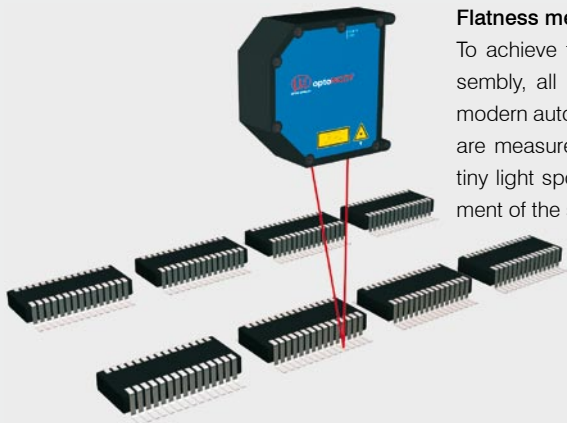
Dimension measurement in wood production

optoNCDT sensors are used in woodworking plants to ensure the dimensional conformance of the work pieces. Here, both treated and untreated pieces are acquired.

Flatness measurement of IC pins

To achieve the best quality during board assembly, all IC pins must lie in one plane. In modern automatic placement systems, the ICs are measured directly before placement. The tiny light spot diameters enable the measurement of the smallest pin geometries.
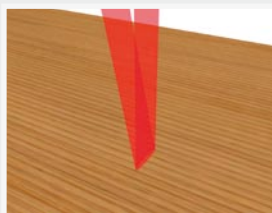
Contour measurement

During the production of ceramic catalytic converters for the automotive industry the billets are measured for roundness and diameter at multiple radial tracks for classification. Using the IF2004 interface card, the encoder and sensor signals are synchronised and mapped to obtain precise profile.

optoNCDT LL series - Anti speckle sensor

The distance information for the triangulation principle is obtained via the reflection of the laser beam. Thereby, surface roughness in the sub-micrometre range causes interference in the laser spot, whereby false measurement results can be obtained. This physical effect is particularly predominant in shiny, highly polished objects and cannot be avoided using currently available products on the market. Micro-Epsilon, as a specialist in measurement technology, announces its new optoNCDT LL, which also makes reliable measurements on shiny metallic objects thanks to an oval light spot. The point-shaped laser beam has now been widened using a special cylindrical lens and projected onto the target. The light spot is absorbed by a receiving array and evaluated. As the light spot is averaged using a special software algorithm, interference is completely filtered out.

Another application area for the optoNCDT LL is structured surfaces, where the distance and not the structure itself needs to be measured. The distance information is not influenced by the structure of the surface but instead provides a constantly reliable value of the distance from the target. The optoNCDT 2200LL is based on the successful optoNCDT 2200 model and therefore has all the other advantages of the series, such as fast measured data evaluation or automatic exposure regulation in real-time. The optoNCDT 1700LL has the advantages of the integrated controller, thus making mounting of the sensor in confined spaces, or on robots much more practical.
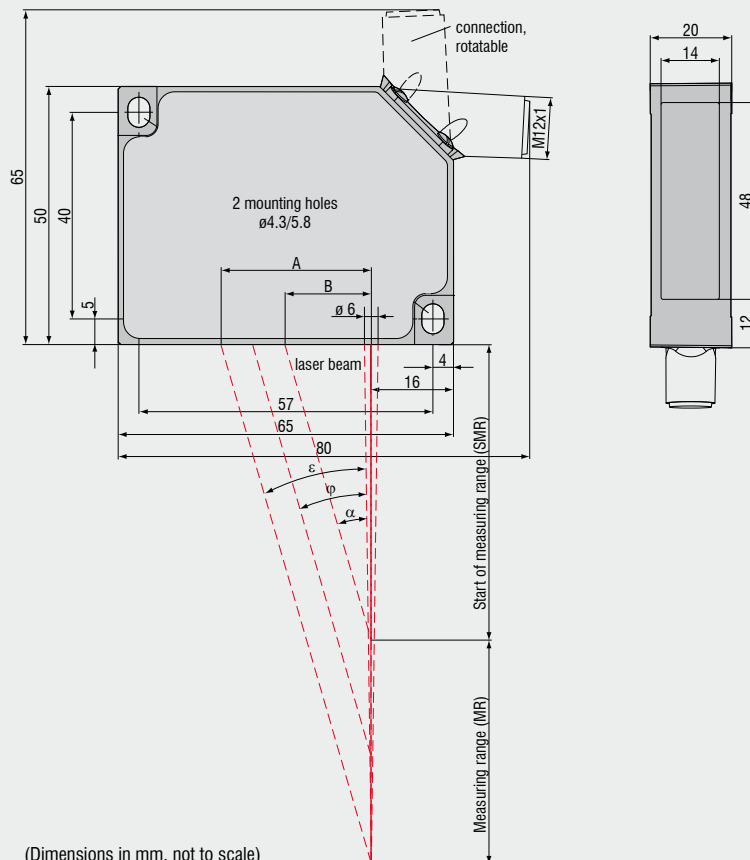
Four models with measuring ranges from 20mm to 200mm

Ideal for OEM applications

Compact design with integrated controller

Measuring rate up to 750Hz

*A*nalog / *D*igital **Analogue (U/I) and digital output**

*T*rigger / *T*eachIn **Trigger input and teach-in**

High flex cables for dragchain or robot use

//www. **Configuration via software www.micro-epsilon.com/download**

The miniaturised optoNCDT 1302 is a low-cost laser sensor for common measuring tasks. The extremely small design facilitates its integration even in areas with limited space. Despite the small dimensions, the 1302 series provides precise measurement results and is suitable for machine integration and automation technology.

optoNCDT 1302

2 mounting holes ø4.3/5.8

connection, rotatable

M12x1

laser beam

Start of measuring range (SMR)

Measuring range (MR)

(Dimensions in mm, not to scale)

MR	SMR	α	φ	ε	A	B
20	30.0	31.2	27.9	25.8	24.2	18.2
50	45.0	25.1	19.6	16.9	28.9	21.1
100	50.0	23.1	14.4	11.3	30.1	21.3
200	60.0	20.1	9.4	6.8	30.8	22.0

| Model	ILD 1302-20	ILD 1302-50	ILD 1302-100	ILD 1302-200
Measuring range	20mm	50mm	100mm	200mm
Start of measuring range SMR	30mm	45mm	50mm	60mm
Midrange MR	40mm	70mm	100mm	160mm
End of measuring range EMR	50mm	95mm	150mm	260mm
Linearity	40µm	100µm	200µm	400µm
	±0.2 % FSO			
Resolution averaged with averaging factor 64	4µm	10µm	20µm	40µm
	0.02 % FSO			
Resolution dynamic 750Hz	10µm	25µm	50µm	100µm
	0.05 % FSO			
Measuring rate	750Hz			
Light source	semiconductor laser <1mW, 670nm (red)			
Laser safety class	class 2 IEC 60825-1 : 2008-05			
Spot diameter SMR	210µm	1100µm	1400µm	2300µm
Spot diameter MR	530µm	110µm	130µm	2200µm
Spot diameter EMR	830µm	1100µm	1400µm	2100µm
Protection class	IP 67			
Vibration	15g / 10Hz…1kHz			
Shock	15g / 6ms (IEC 68-2-29)			
Weight (without cable)	approx. 83g			
Temperature stability	0.03 % FSO/°C		0.08 % FSO/°C	
Operating temperature	0…+50°C			
Storage temperature	-20...+70°C			
Output analogue	4...20mA (1...5V with cable PC 1402-3/U)			
Output digital	RS422			
Control I/O	1x open collector output (switching output, switch, error); 1x input (teach in, trigger); 1x laser on/off			
Power supply	11...30VDC, 24VDC / 50mA			
Controller	integrated signal processor			
Electromagnetic compatibility (EMC)	EN 61326-1:2006 / EN 55011 Class B (Interface emission) EN 61326-1:2006 / EN 61000-4-2:1995 + A1:1998 + A2:2001 (Interference resistance)			

FSO = Full scale output   All specifications apply for a diffusely reflecting matt white ceramic target
SMR = Start of measuring range; MR = Midrange; EMR = End of measuring range
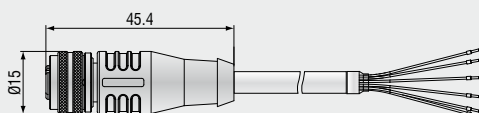
Connector axial

Ø15
45.4

12-pin-connector
(view on solder termination side of male inserts)
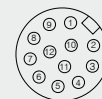
Pin	Description		colour PC1402-x/I
3	RS422 Rx+	serial input	green
4	RS422 Rx-	serial input	yellow
5	RS422 Tx+	serial output	grey
6	RS422 Tx-	serial output	pink
7	$+U_B$	11-30VDC type 24V	red
8	Laser off	switch input	black
9	Teach in	switch input	violet
10	Error	switch output	brown
11	I_{OUT}	4 ... 20mA	white
12	GND	supply and signal ground	blue
1/2	n.c.		

The cable screen is connected with the sensor housing. The interface and power supply cable are robot rated and UL certfied. At one end there is a 12pin M12 connector, the other end is open.

Eight models with measuring ranges from 5mm to 600mm

Ideal for OEM applications

Compact design with integrated controller

312Hz
375Hz
1000Hz
Adjustable measuring rate up to 1.5kHz

Analog
Digital
Analogue (U/I) and digital output

Trigger
TeachIn
Trigger input and teach-in

Filter
inside
Adjustable filter functions Peak selection (firmware)

High flex cables for dragchain or robot use

Certified
Calibration certificate included

//www.
Configuration via software www.micro-epsilon.com/download
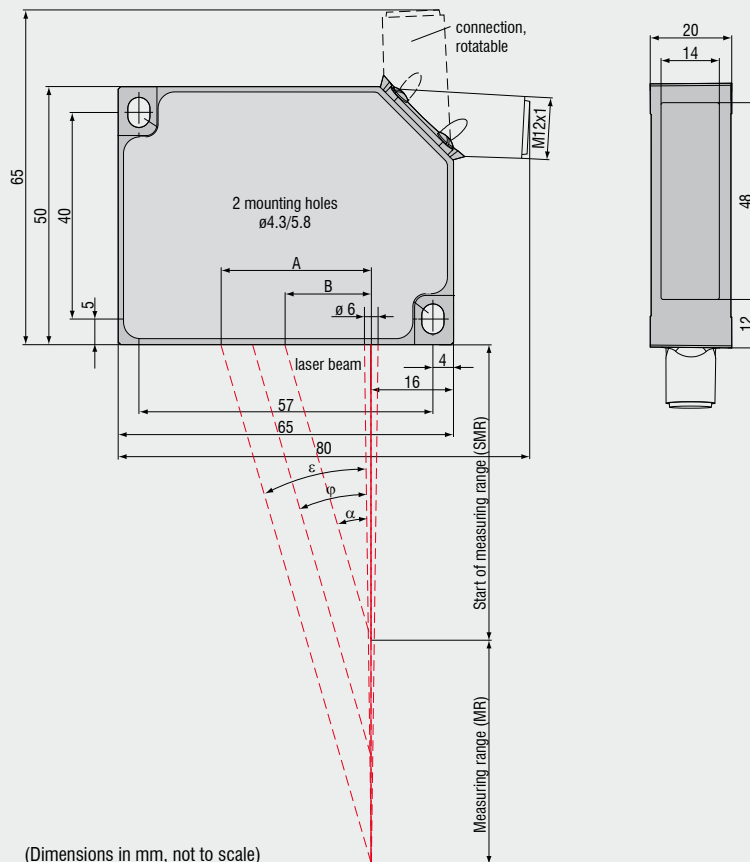
The miniature optoNCDT 1402 series is the leading sensor in this price/ performance category. The compact construction enables integration inside small areas. The optoNCDT 1402 series is ideally suited for integration into machines and automation applications.

optoNCDT 1402

(Dimensions in mm, not to scale)

MR	SMR	α	φ	ε	A	B
5	20.0	33.5	35.5	37.1	18.9	13.2
10	20.0	33.5	32.9	32.4	19.1	13.2
20	30.0	31.2	27.9	25.8	24.2	18.2
50	45.0	25.1	19.6	16.9	28.9	21.1
100	50.0	23.1	14.4	11.3	30.1	21.3
200	60.0	20.1	9.4	6.8	30.8	22.0
250VT	100.0	14.7	7.6	5.5	33.9	26.2
600	200.0	9.7	4.3	3	41.6	33.7

Model	ILD 1402-5	ILD 1402-10	ILD 1402-20	ILD 1402-50	ILD 1402-100	ILD 1402-200	ILD 1402-250VT	ILD 1402-600
Measuring range	5mm	10mm	20mm	50mm	100mm	200mm	250mm	600mm
Start of measuring range SMR	20mm	20mm	30mm	45mm	50mm	60mm	100mm	200mm
Midrange MMR	22.5mm	25mm	40mm	70mm	100mm	160mm	225mm	500mm
End of measuring range EMR	25mm	30mm	50mm	95mm	150mm	260mm	350mm	800mm
Linearity	5...9μm	5...18μm	7...36μm	12...90μm	20...180μm	40...360μm	50...1200μm	120...3000μm
	≤0.18% FSO						≤0.5% FSO	
Resolution [1] averaged with averaging factor 64	0.6μm	1μm	2μm	5μm	10μm	13μm	32μm	80μm
	0.01% FSO							
dynamic 1.5 kHz	1...3μm	2...5μm	5...10μm	6...25μm	12...50μm	13...100μm	32...300μm	80...600μm
	0.02...0.05% FSO						0.02...0.12% FSO	
Measuring rate, programmable	1.5kHz; 1kHz; 750Hz; 375Hz; 50Hz							
Light source	semiconductor laser <1mW, 670nm (red)							
Laser safety class	class 2 IEC 60825-1 : 2008-05							
Spot diameter SMR	110μm	110μm	210μm	1100μm	1400μm	2300μm	5000μm	2.6 x 5mm
MMR	380μm	650μm	530μm	110μm	130μm	2200μm	5000μm	2.6 x 5mm
EMR	650μm	1200μm	830μm	1100μm	1400μm	2100μm	5000μm	2.6 x 5mm
Protection class	IP 67							
Vibration	15g / 10Hz … 1kHz						20g / 10Hz…1kHz	
Shock	15g / 6ms (IEC 68-2-29)							
Weight (without cable)	appr. 83g						appr. 130g	
Temperature stability	0.03 % FSO/°C					0.08 % FSO/°C		
Operation temperature	0 …+50°C							
Storage temperature	-20 ... +70°C							
Output analogue	4 ... 20mA (1 ... 5V with cable PC 1402-3/U); free scalable within the nominal range							
digital	RS422 / 14bit							
Control I/O	1x open collector output (switching output, switch, error); 1x input (teach in, trigger); 1x laser on/off							
Supply	11 ... 30VDC, 24VDC / 50mA							
Controller	integrated signal processor							
Software	free setup and aquisition tool + SDK (software development kit)							
Electromagnetic compatibility (EMC)	EN 61326-1:2006 / EN 55011 Class B (Interface emission) EN 61326-1:2006 / EN 61000-4-2:1995 + A1:1998 + A2:2001 (Interference resistance)							

FSO = Full scale output   All specifications apply for a diffusely reflecting matt white ceramic target
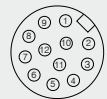[1] resolution digital output 14bit   [2] tide to measurement rate
SMR = Start of measuring range   MMR = Midrange   EMR = End of measuring range

Connector axial

45.4
Ø15

12-pin-connector
(view on solder termination side of male inserts)

Pin	Description		colour PC1402-x/I
3	RS422 Rx+	serial input	green
4	RS422 Rx-	serial input	yellow
5	RS422 Tx+	serial output	grey
6	RS422 Tx-	serial output	pink
7	$+U_B$	11-30DV 24V MP	red
8	Laser off	switch input	black
9	Teach in	switch input	violet
10	Error	switch output	brown
11	I_{OUT}	4 ... 20mA	white
12	GND	supply and signal ground	blue
1/2	n.c.		

The cable screen is connected with the sensor housing. The interface and power supply cable are robot rated and UL certfied. At one end there is a 12pin M12 connector, the other end is open.

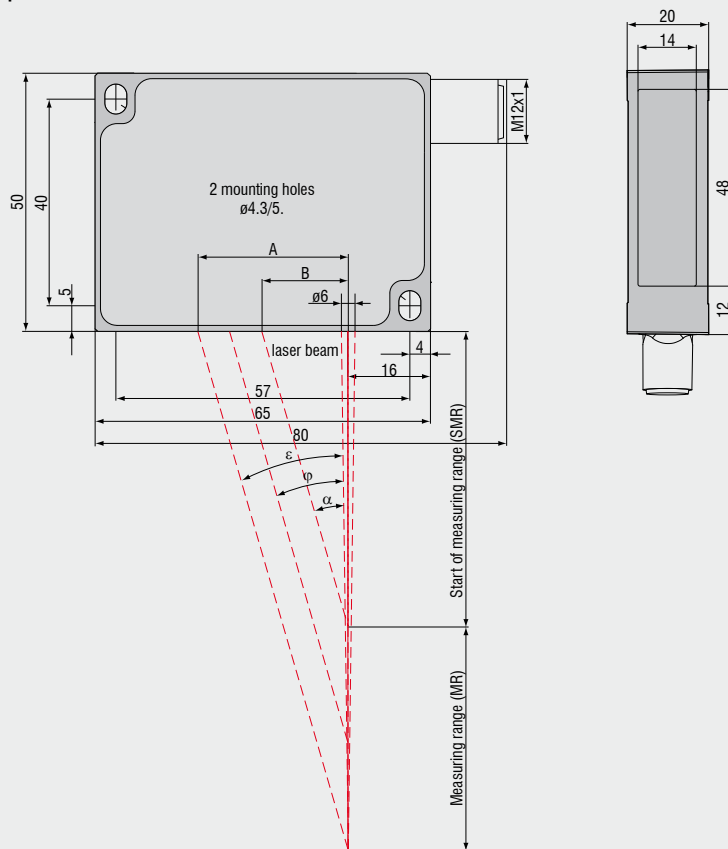| | Eight models with measuring ranges from 5mm to 600mm |
	Ideal for OEM applications
	Compact sensor with stainless steel housing
312Hz 375Hz 1000Hz	Adjustable measuring rate up to 1.5kHz
*A*nalog *D*igital	Analogue (U/I) and digital output
*T*rigger	Trigger input
*F*ilter inside	Adjustable filter functions Peak selection (firmware)
	Telemetry qualified by low power consumption
IP69K	Protection class IP69K for harsh environments
//www.	Configuration via software www.micro-epsilon.com/download

The optoNCDT 1402SC sensor is protected to IP69K and is available in all measuring ranges between 5mm and 600mm. Due to its very robust design, the sensor is suitable for the food industry, outdoor use or for demanding process manufacturing applications. The housing for this model comprises V4A steel and complies with all food industry requirements. In this version, the sensor is resistant to high pressure jet washing and to aggressive cleaning detergents and disinfection agents, including hydrogen peroxide and other alkaline-based cleaning materials and cleaning materials that contain chlorine. The sensor electronics are similar to those used by the optoNCDT 1402 standard model.

optoNCDT 1402SC

(Dimensions in mm, not to scale)

MR	SMR	α	φ	ε	A	B
5	20.0	33.5	35.5	37.1	18.9	13.2
10	20.0	33.5	32.9	32.4	19.1	13.2
20	30.0	31.2	27.9	25.8	24.2	18.2
50	45.0	25.1	19.6	16.9	28.9	21.1
100	50.0	23.1	14.4	11.3	30.1	21.3
200	60.0	20.1	9.4	6.8	30.8	22.0
250VT	100.0	14.7	7.6	5.5	33.9	26.2
600	200.0	9.7	4.3	3	41.6	33.7

Model	ILD 1402-5SC	ILD 1402-10SC	ILD 1402-20SC	ILD 1402-50SC	ILD 1402-100SC	ILD 1402-200SC	ILD 1402-250SC	ILD 1402-600SC
Measuring range	5mm	10mm	20mm	50mm	100mm	200mm	250mm	600mm
Start of measuring range SMR	20mm	20mm	30mm	45mm	50mm	60mm	100mm	200mm
Midrange MMR	22.5mm	25mm	40mm	70mm	100mm	160mm	225mm	500mm
End of measuring range EMR	25mm	30mm	50mm	95mm	150mm	260mm	350mm	800mm
Linearity	5...9μm	5...18μm	7...36μm	12...90μm	20...180μm	40...360μm	50...1200μm	120...3000μm
	≤0.18% FSO						≤0.5% FSO	
Resolution [1] averaged with averaging factor 64	0.6μm	1μm	2μm	5μm	10μm	13μm	32μm	80μm
	0.01% FSO							
Resolution [1] dynamic 1.5 kHz	1...3μm	2...5μm	5...10μm	6...25μm	12...50μm	13...100μm	32...300μm	80...600μm
	0.02...0.05% FSO						0.02...0.12% FSO	
Measuring rate, programmable	1.5kHz; 1kHz; 750Hz; 375Hz; 50Hz							
Light source	semiconductor laser <1mW, 670nm (red)							
Laser safety class	class 2 IEC 60825-1 : 2008-05							
Spot diameter SMR	110μm	110μm	210μm	1100μm	1400μm	2300μm	5000μm	2.6 x 5mm
Spot diameter MMR	380μm	650μm	530μm	110μm	130μm	2200μm	5000μm	2.6 x 5mm
Spot diameter EMR	650μm	1200μm	830μm	1100μm	1400μm	2100μm	5000μm	2.6 x 5mm
Protection class	IP 69 K							
Vibration	15g / 10Hz … 1kHz						20g / 10Hz…1kHz	
Shock	15g / 6ms (IEC 68-2-29)							
Weight (without cable)	appr. 173g							
Temperature stability	0.03 % FSO/°C				0.08 % FSO/°C			
Operation temperature	0 …+50°C							
Storage temperature	-20 ... +70°C							
Output analogue	4 ... 20mA (1 ... 5V with cable PC 1402-3/U); free scalable within the nominal range							
Output digital	RS422 / 14bit							
Control I/O	1x open collector output (switching output, switch, error); 1x input (trigger)							
Supply	11 ... 30VDC, 24VDC / 50mA							
Controller	integrated signal processor							
Software	free setup and aquisition tool + SDK (software development kit)							
Electromagnetic compatibility (EMC)	EN 61326-1:2006 / EN 55011 Class B (Interface emission) EN 61326-1:2006 / EN 61000-4-2:1995 + A1:1998 + A2:2001 (Interference resistance)							

FSO = Full scale output   All specifications apply for a diffusely reflecting matt white ceramic target
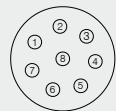[1] resolution digital output 14bit   [2] tide to measurement rate
SMR = Start of measuring range   MMR = Midrange   EMR = End of measuring range

Connector axial

45.5

Ø15

8-pin-connector

Pin	Description	colour
1	I_{OUT}	white
2	Error	brown
3	RS422 Rx+	green
4	RS422 Rx−	yellow
5	RS422 Tx+	grey
6	RS422 Tx−	pink
7	GND	blue
8	$+U_B$	red
	Laser off	
	Teach in	

Intelligent sensor with integrated controller for industrial applications

optoNCDT 1700

- **Eleven models with measuring ranges from 2mm to 1000mm**
- **Compact design with integrated controller**
- *RTSC* **Real Time Surface Compensation**
- 312Hz 375Hz 1000Hz **Adjustable measuring rate up to 2.5kHz**
- *Analog Digital* **Analogue (U/I) and digital output**
- *Filter inside* **Adjustable filter functions (firmware)**
- **High flex cables for dragchain or robot use**
- *Certified* **Calibration certificate included**
- //www. **Configuration via software www.micro-epsilon.com/download**

The benchmark
in laser triangulation sensors

The optoNCDT 1700 series is truly a world leading laser displacement sensor. Featuring Real Time Surface Compensation (RTSC), remote software programming and excellent linearity & resolution the optoNCDT 1700 is difficult to match at this price level. Integrated conditioning electronics allows the sensor to have a very unique and compact design.

Adjustable limit switches

As well as for precise measurement, the optoNCDT 1700 sensors are also used for tolerance or limit monitoring. Two switching points are available which can be configured and adjusted via the remote software (USB connection). The switching hysteresis can also be individually adjusted for each limit point.
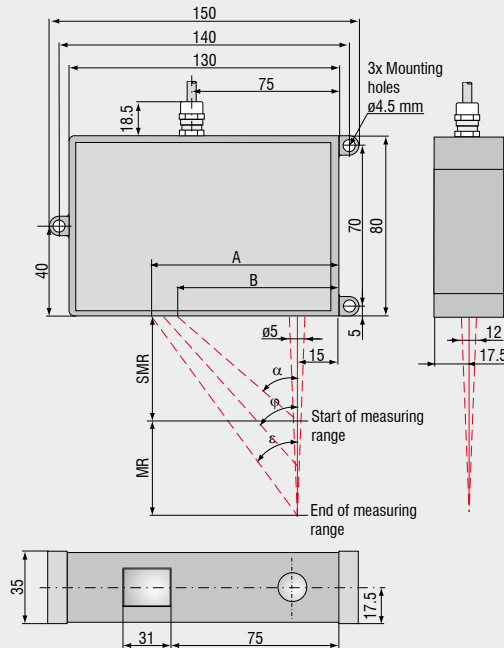
Adjustable exposure time/measuring rate

For poor reflecting targets, the measuring rate can be reduced to enable a longer exposure time. The set measurement rate always remains constant so that with closed-loop control the system response time is always the same.
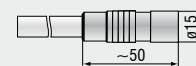
optoNCDT 1700 (2/10/20/50/100/200/250VTmm)
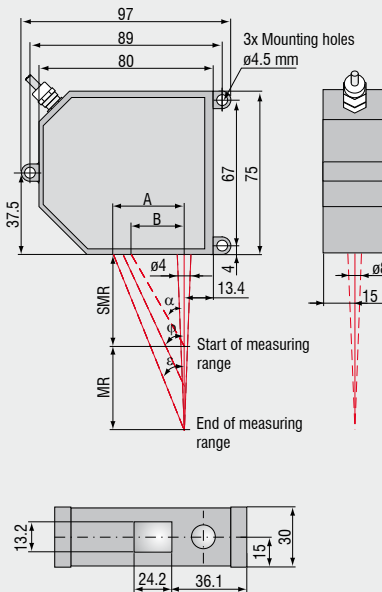
optoNCDT 1700 (40/500/750mm)

MR	SMR	α	φ	ε	A	B
2	24	35°	40°	44.8°	25.8	16.8
10	30	34.3°	35.2°	35.6°	28.7	20.5
20	40	28.8°	27.5°	26.7°	30.1	22.0
50	45	26.5°	23.0°	18.3°	31.5	22.5
100	70	19.0°	15.4°	10.9°	32.6	24.1
200	70	19.0°	9.78°	6.97°	33.1	24.1
250VT	70	19.0°	8.4°	6.0°	33.5	24.1
40	175	22.1°	21.9°	21.8°	101	86
500	200	19.3°	9.8°	7.0°	101	85
750	200	19.3°	7.7°	5.0°	101	85

Connector (sensor side)
Article Number: 0323243

Connector (sensor cable)
Article Number: 0323272
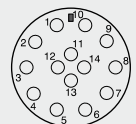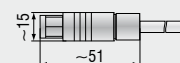
14-pin-connector
(Pin side female cable connector or solder-pin side male cable connector)

(Dimensions in mm, not to scale. All CAD files are available online.)

Model	ILD 1700-2	ILD 1700-10	ILD 1700-20	ILD 1700-40	ILD 1700-50	ILD 1700-100	ILD 1700-200	ILD 1700-250VT	ILD 1700-500	ILD 1700-750
Measuring range	2mm	10mm	20mm	40mm	50mm	100mm	200mm	250mm	500mm	750mm
Start of measuring range	24mm	30mm	40mm	175mm	45mm	70mm	70mm	70mm	200mm	200mm
Midrange	25mm	35mm	50mm	195mm	70mm	120mm	170mm	195mm	450mm	575mm
End of measuring range	26mm	40mm	60mm	215mm	95mm	170mm	270mm	320mm	700mm	950mm
Linearity	2µm	8µm	16µm	32µm	40µm	80µm	200µm	630µm	400µm	750µm
Linearity FSO	≤0.1%	≤0.08%					≤0.1%	≤0.25%	≤0.08%	≤0.1%
Resolution (at 2.5kHz without averaging)	0.1µm	0.5µm	1.5µm	4µm	3µm	6µm	12µm	50µm	30µm	50µm
Measuring rate	2.5kHz / 1.25kHz / 625Hz / 312.5Hz (adjustable)									
Light source	semiconductor laser <1mW, 670nm (red)									
Permissable ambient light (at 2.5kHz)	10,000lx							15,000lx	10,000lx	
Laser safety class	class 2 acc. DIN EN 60825-1 : 2008-05									
Spot diameter SMR	80µm	110µm	320µm	230µm	570µm	740µm	1300µm	1500µm	1500µm	1500µm
Spot diameter MMR	35µm	50µm	45µm	210µm	55µm	60µm	1300µm	1500µm	1500µm	1500µm
Spot diameter EMR	80µm	110µm	320µm	230µm	570µm	700µm	1300µm	1500µm	1500µm	1500µm
Temperature stability*	0.025% FSO/°C	0.01 % FSO/°C						0.025% FSO/°C	0.01 % FSO/°C	
Operation temperature	0 ...+50°C							0 ...+55°C	0 ...+50°C	
Storage temperature	-20 ... +70°C									
Output — measurements	selectable: 4 ... 20mA / 0 ... 10V / RS 422 / USB (optional with cable PC1700-3/USB)									
Output — switching outputs	1 x error or 2 x limit (each pogrammable)									
Switch Input	laser ON-OFF / zero									
Operation	via touch screen on sensor or via PC with ILD 1700 tool									
Power supply	24VDC (11 ... 30VDC), max. 150mA									
Electromagnetic compatibility (EMC)	EN 61000-6-3 EN 61000-6-2									
Sensor cable length (with connector)	0.25m (integrated cable with connector) option: 3m or 10m									
Synchronisation	possible for simultaneous or alternating measurements									
Protection class	IP 65									
Vibration	2g / 20 ... 500Hz									
Shock	15g / 6ms									
Weight (with 0.25m cable)	~ 550g			~ 600g		~ 550g			~ 600g	

FSO = Full Scale Output   All specifications apply for a diffusely reflecting white ceramic target
* based on digital output
SMR = Start of measuring range   MMR = Midrange   EMR = End of measuring range

Custom Sensor Modifications

For applications where the above standard sensors do not meet your requirements, it may be possible to supply a sensor with modified specification. Please contact us for further information.

Options

- Non standard measuring range and stand off
- Custom housing or mounting geometry
- Non standard signal interfaces
- Special cable length of electrical connector
- 90° beam deflection
- Vacuum suitability
- Reduced mass
- Increased shock and vibration resistance

Seven models with measuring ranges from 2mm to 200mm

Sensor head and separate controller

20kHz **Measurement rate up to 10kHz/20kHz**

RTSC **Real Time Surface Compensation**

*A*nalog / *D*igital **Analogue and digital output**

*F*ilter inside **Adjustable filter functions (firmware)**

Certified **Calibration certificate included**

//www. **Configuration via software www.micro-epsilon.com/download**

At the head of the Micro-Epsilon laser family stands the optoNCDT 2200 series. Extreme accuracy, high measuring rate and constant signal stability, can be achieved at maximum speed without any signal averaging. This is world's first in terms of capability, enabling the sensor to solve the most demanding measurement applications. The digital output signal can be combined with the IF2008 PCI card (also designed and supplied by Micro-Epsilon) to synchronise multiple sensors at full measurement rate for easy data acquisition direct to a PC.

The optoNCDT 2220 provides a genuine 20kHz measurement rate for every measurement task. The series is ideally suited to super-fast, complex applications and offers a high speed measurement with excellent resolution.

Controller

optoNCDT 2200 (2/10/20/50/100mm)
optoNCDT 2220 (2/10/20/50/100mm)
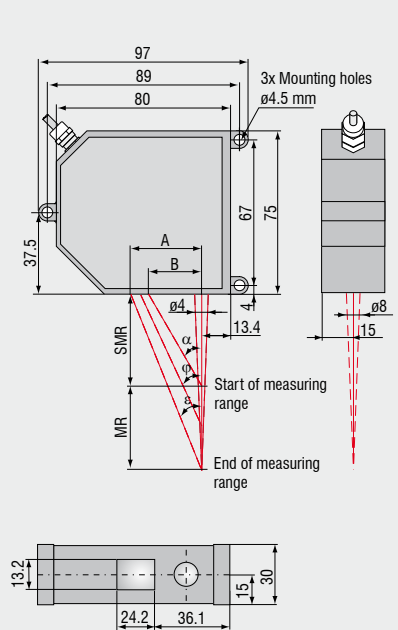
optoNCDT 2200 (40/200mm)
optoNCDT 2220 (200mm)
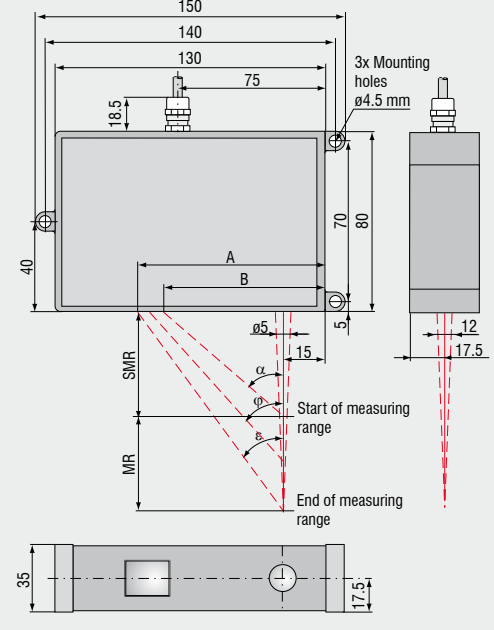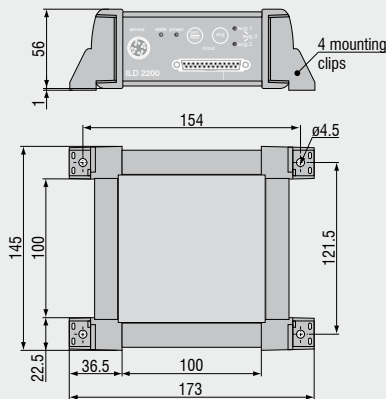
(Dimensions in mm, not to scale. All CAD files are available online.)

MR	SMR	α	φ	ε	A	B
2	24	35.0°	40.0°	44.8°	25.8	16.8
10	30	34.3°	35.2°	35.6°	28.7	20.5
20	40	28.8°	27.5°	26.7°	30.1	22
50	45	26.5°	23.0°	18.3°	31.5	22.5
100	70	19.0°	15.4°	10.9°	32.6	24.1
40	175	22.1°	21.9°	21.8°	101	86
200	130	25.1°	16.7°	13.1°	91.6	76

Model	ILD 2200-2 ILD 2220-2	ILD 2200-10 ILD 2220-10	ILD 2200-20 ILD 2220-20	ILD 2200-40	ILD 2200-50 ILD 2220-50	ILD 2200-100 ILD 2220-100	ILD 2200-200 ILD 2220-200
Measuring range	2mm	10mm	20mm	40mm	50mm	100mm	200mm
Start of measuring range	24mm	30mm	40mm	175mm	45mm	70mm	130mm
Midrange	25mm	35mm	50mm	195mm	70mm	120mm	230mm
End of measuring range	26mm	40mm	60mm	215mm	95mm	170mm	330mm
Linearity	$1\mu m$	$3\mu m$	$6\mu m$	$12\mu m$	$15\mu m$	$30\mu m$	$60\mu m$
	$\leq$0.05% FSO	$\leq$0.03% FSO					
Resolution [1] (without averaging)	$0.03\mu m$	$0.15\mu m$	$0.3\mu m$	$0.6\mu m$	$0.8\,\mu m$	$1.5\mu m$	$3\mu m$
	0.0015% FSO						
Measuring rate ILD 2200	10kHz						
Measuring rate ILD 2220	20kHz						
Permissable ambient light	30,000lx						
Spot diameter SMR	$80\mu m$	$110\mu m$	$160\mu m$	$230\mu m$	$215\mu m$	$350\mu m$	$1300\mu m$
Spot diameter MMR	$35\mu m$	$50\mu m$	$60\mu m$	$210\mu m$	$80\mu m$	$130\mu m$	$1300\mu m$
Spot diameter EMR	$80\mu m$	$110\mu m$	$160\mu m$	$230\mu m$	$215\mu m$	$350\mu m$	$1300\mu m$
Light source	semiconductor laser <1mW, 670nm (red)						
Laser safety class	class 2 IEC 60825-1 : 2008-05						
Protection class	sensor: IP 65 / controller: IP 50						
Temperature stability	0.025% FSO/°C	0.01% FSO/°C					
Operation temperature	0 ... +50°C						
Storage temperature	-20 ... +70°C						
Output	analogue: ±5V digital: RS 422 / 691.2kBaud						
Power supply	24VDC (±15%), max. 500mA						
Sensor cable length	standard: 2m - integrated option: 5m/10m						
Controller	functions: auto zero / signal averaging dimensions: 143mm x 145mm x 52mm - without mounting clips						
Electromagnetic compatibility (EMC)	EN 55011/12.1998 and EN 50082-2/ 02.1996						
Vibration	2g / 20 ... 500Hz						
Shock	15g / 6ms / 3 axis						
Weight sensor	~550g			~600g		~550g	~600g
Weight controller	~1000g						

FSO = Full Scale Output   All specifications apply for a diffusely reflecting matt white ceramic target
SMR = Start of measuring range   MMR = Midrange   EMR = End of measuring range
[1] resolution digital output 16bit

Custom Sensor Modifications

For applications where the above standard sensors do not meet your requirements, it may be possible to supply a sensor with modified specification. Please contact us for further information.

Options

- Non standard measuring range and stand off
- Custom housing or mounting geometry
- Measuring rate 2.5 / 5 / 10 / 20kHz
- Non standard signal interfaces
- Special cable length of electrical connector
- 90° beam deflection
- Vacuum suitability
- Reduced mass
- Increased shock and vibration resistance

# Extreme dynamic laser sensor with integrated controller

optoNCDT 2300

Six models with measuring ranges from 2 to 200mm	
Compact design with integrated controller	
Adjustable measuring rate up to 49.02kHz	
INTERFACE	Ethernet / Ethercat / RS422
A-RTSC	**Advanced Real Time Surface Compensation**
Certified	**Calibration certificate included**
Measurement of diffuse and specular surfaces	
Thickness measurement of transparent materials	
Configuration via Web-Interface	

The optoNCDT 2300 is the latest high-end model of laser triangulation sensors from Micro-Epsilon. The new series offers an adjustable measuring rate up to 49.02 kHz. An impressive and worldwide unique fact regarding this sensor class is that the complete electronics has already been integrated in the compact sensor..

The new A-RTSC (Advanced Real-Time-Surface-Compensation) is a further development of the proven RTSC. Therefore, a more precise real-time surface compensation during the measuring process is ensured due to an increased dynamic range.
By means of the software, the threshold of the areas for compensation can be set easily.

The data are output via Ethernet, Ethercat or RS422. The complete sensor configuration is effected via a comfortably designed web interface.
The optoNCDT 2300 is especially used in the case of fast measurements such as vibration monitoring or measurements against challenging surfaces.

optoNCDT 2300-2 ... 2300-100
Diffuse reflection
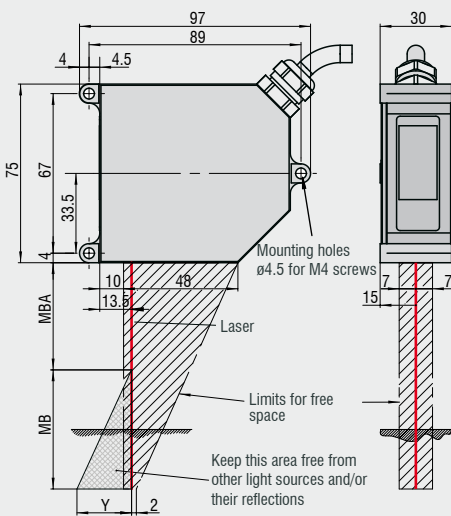
MR	SMR	Y
2	24	1.5
10	30	6.5
20	40	10.0
50	45	23.0
100	70	33.5

optoNCDT 2300-2 ... 2300-20
Direct reflection
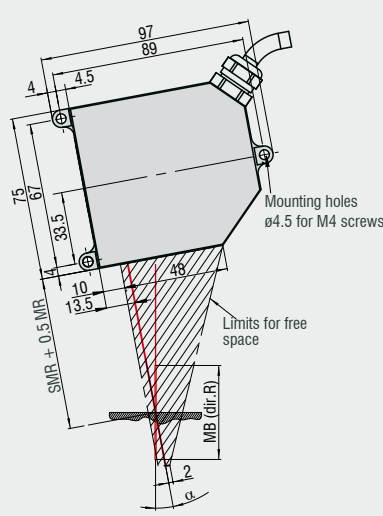
MR	SMR + 0.5 MR	α
2	25	20.5°
10	35	17.5°
20	50	13.8°

optoNCDT 2300-200
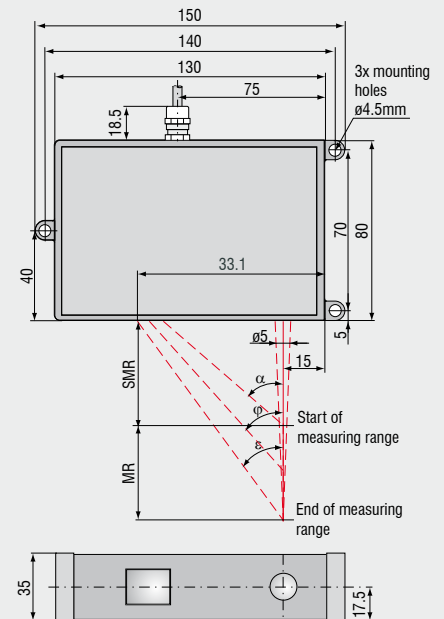
α	φ	ε
19,0°	9,78°	6,97°

Model		ILD 2300-2	ILD 2300-10	ILD 2300-20	ILD 2300-50	ILD 2300-100	ILD 2300-200
Measuring range [1]		2 (2) mm	10 (5 mm	20 (10) mm	50 (25) mm	100 (50) mm	200 (100) mm
Start of measuring range	SMR	24 (24) mm	30 (35) mm	40 (50) mm	45 (70) mm	70 (120) mm	130 (230) mm
Midrange	MMR	25 (25) mm	35 (37.5) mm	50 (55) mm	70 (82.5) mm	120 (145) mm	230 (280) mm
End of measuring range	EMR	26 (26) mm	40 (40) mm	60 (60) mm	95 (95) mm	170 (170) mm	330 (330) mm
Linearity		0.6μm	2μm	4μm	10μm	20μm	60μm
		≤ ±0.03% FSO		≤ ±0.02% FSO			≤ ±0.03% FSO
Resolution (20kHz)		0.03 μm	0.15μm	0.3μm	0.8μm	1.5μm	3μm
				0.0015% FSO			
Measuring rate		adjustable via software 49.02 / 30 / 20 / 10 / 5 / 2.5 / 1.5kHz (49.02kHz with reduced measuring range)					
Permissable ambient light		10,000…40,000lx					
Spot diameter	SMR	80μm	110μm	160μm	215μm	350μm	1300μm
	MMR	23 x 23μm	32 x 45μm	46 x 45μm	70 x 70μm	130μm	1300μm
	EMR	35 x 85μm	110 x 160μm	140 x 200μm	255 x 350μm	350μm	1300μm
Light source		semiconductor laser <1mW / 670nm (red)					
Protection class		IP 65					
Operation temperature		0 ... +50°C					
Storage temperature		-20 ... +70°C					
Inputs / Outputs		Ethernet / Ethercat RS422 Analog ouput via CSP2008					
Inputs		Laser on/off; synchronization/trigger input					
Power supply		24 Vdc (11…30V); PV < 3W					
LED		Status / Power / Ethernet / Ethercat					
Sensor cable	Standard	0.25m (with cable connector)					
	Option	3 / 6 / 9m with Sub D 15 pin connector					
Electromagnetic compatibility (EMC)		EN 61326-1: 2006-10 DIN EN 55011: 2007-11 (group 1. class B) EN 61 000-6-2: 2006-03					
Vibration		2g / 20 ... 500Hz					
Shock		15g / 6ms / 3 axes					

FSO = Full Scale Output   All specifications apply for a diffusely reflecting matt white ceramic target
SMR = Start of measuring range MMR = Midrange EMR = End of measuring range
[1] Numbers in brackets refer to full measurement rate 49.02 kHz
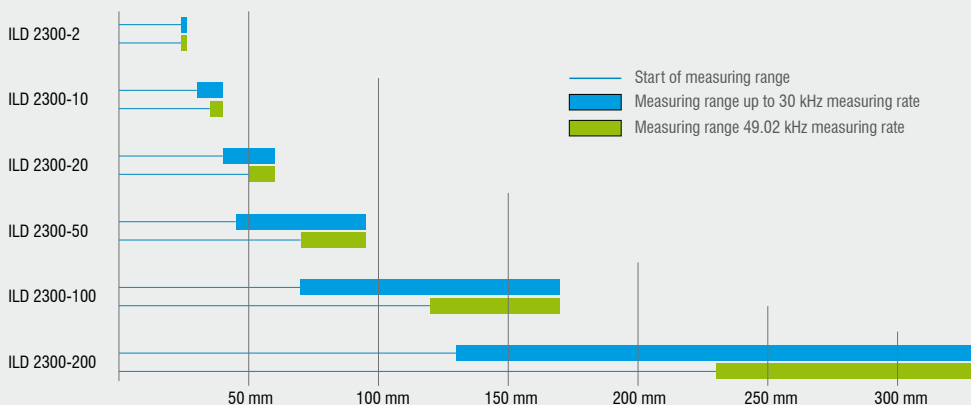
Laser Line averages across shiny metallic or structured surfaces

**Four models** with measuring ranges from 2mm to 50mm

Compact design with integrated controller

RTSC **Real Time Surface Compensation**

312Hz
375Hz
1000Hz
Adjustable measuring rate up to 2.5kHz

*A*nalog
*D*igital
Analogue (U/I) and digital output

*F*ilter inside
Adjustable filter functions (firmware)

High flex cables for dragchain or robot use

Certified **Calibration certificate included**

//www. **Configuration via software** www.micro-epsilon.com/download

Designed for shiny and rough surfaces where high accuracy measurements are required. The optoNCDT 1700LL provides precision accuracy with an integrated controller. The laser spot is optically enlarged to make an oval point thus reducing the physical interference making measurements on rough surfaces considerably easier to perform. The 1700LL combines the advantages of both the 1700 and the 2200LL series offering high precision and flexibility with a compact sensor size.

optoNCDT 1700LL (2/10/20/50mm)
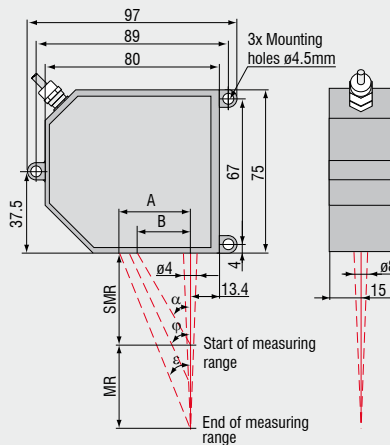
MR	SMR	α	φ	ε	A	B
2	24	35°	40°	44.8°	25.8	16.8
10	30	34.3°	35.2°	35.6°	28.7	20.5
20	40	28.8°	27.5°	26.7°	30.1	22.0
50	45	26.5°	23.0°	18.3°	31.5	22.5

Connector (sensor side)
Article Number: 0323243
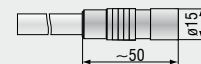
Connector (sensor cable)
Article Number: 0323272

(Dimensions in mm, not to scale. All CAD files are available online.)

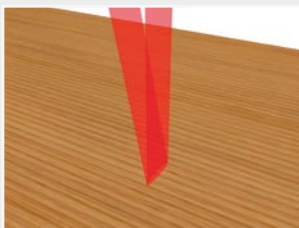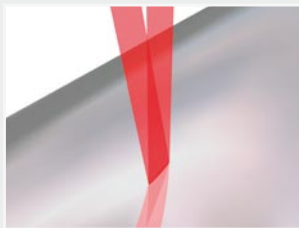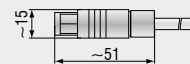| Model	ILD1700-2LL	ILD 1700-10LL	ILD 1700-20LL	ILD 1700-50LL
Measuring range	2mm	10mm	20mm	50mm
Start of measuring range	24mm	30mm	40mm	45mm
Midrange	25mm	35mm	50mm	70mm
End of measuring range	26mm	40mm	60mm	95mm
Linearity	2µm	8µm	16µm	40µm
FSO	≤0.1%		≤0.08%	
Resolution [1] (at 2.5kHz without averaging)	0.1µm	0.5µm	1.5µm	3µm
Measuring rate	2.5kHz / 1.25kHz / 625Hz / 312.5Hz (adjustable)			
Light source	semiconductor laser <1mW, 670nm (red)			
Permissable ambient light at 2.5kHz	10,000lx			
Laser safety class	class 2 acc. DIN EN 60825-1 : 2008-05			
Spot diameter SMR	85 x 240µm	120 x 405µm	185 x 485µm	350 x 320µm
MMR	24 x 280µm	35 x 585µm	55 x 700µm	70 x 960µm
EMR	64 x 400µm	125 x 835µm	195 x 1200µm	300 x 1940µm
Temperature stability [2]	0.025% FSO/°C	0.01 % FSO/°C		
Operation temperature	0 ...+50°C			
Storage temperature	-20 ... +70°C			
Output measurements	selectable: 4 ... 20mA / 0 ... 10V / RS 422 / USB (optional with cable PC1700-3/USB)			
switching outputs	1 x error or 2 x limit (each pogrammable)			
Switch Input	laser ON-OFF / zero			
Operation	via touch screen on sensor or via PC with ILD 1700 tool			
Power supply	24VDC (11 ... 30VDC), max. 150mA			
Electromagnetic compatibility (EMC)	EN 61000-6-3 EN 61000-6-2			
Sensor cable length (with connector)	0.25m (integrated cable with connector) option: 3m or 10m			
Synchronisation	possible for simultaneous or alternating measurements			
Protection class	IP 65			
Vibration	2g / 20 ... 500Hz			
Shock	15g / 6ms			
Weight (with 0.25m cable)	~ 550g			

FSO = Full Scale Output   All specifications apply for a diffusely reflecting white ceramic target
SMR = Start of measuring range   MMR = Midrange   EMR = End of measuring range
[1] for measurements against high glossy surfaces (targets), resolution depends on the material
[2] based on digital output

Custom Sensor Modifications

For applications where the above standard sensors do not meet your requirements, it may be possible to supply a sensor with modified specification. Please contact us for further information.

Options

- Non standard measuring range and stand off
- Custom housing or mounting geometry
- Non standard signal interfaces
- Special cable length of electrical connector
- 90° beam deflection
- Vacuum suitability
- Reduced mass
- Increased shock and vibration resistance

Laser line averages across shiny metallic or structured surfaces

Four models with measuring ranges from 2mm to 50mm

Sensor head and separate controller

20kHz **Measurement rate up to 20kHz**

RTSC **Real Time Surface Compensation**

*A*nalog / *D*igital **Analogue and digital output**

*F*ilter inside **Adjustable filter functions (firmware)**

Certified **Calibration certificate included**

//www. **Configuration via software www.micro-epsilon.com/download**

The optoNCDT 2200LL series uses a small laser line, instead of a spot, to provide accurate measurement against shiny metallic surfaces. The use of the laser line allows the sensor to perform an average across the line. This makes it possible to measure rough surfaces with greater accuracy than before. The sensor can also be used for measuring directly reflecting surfaces without the need to angle the sensor.

The optoNCDT 2220LL series uses a small laser line, instead of a spot, to provide accurate measurement against shiny metallic surfaces all at high speed.

optoNCDT 2200LL (2/10/20/50mm)
optoNCDT 2220LL (2/10/20/50mm)

3x Mounting holes ø4.5 mm

Start of measuring range

End of measuring range

(Dimensions in mm, not to scale. All CAD files are available online.)

Controller
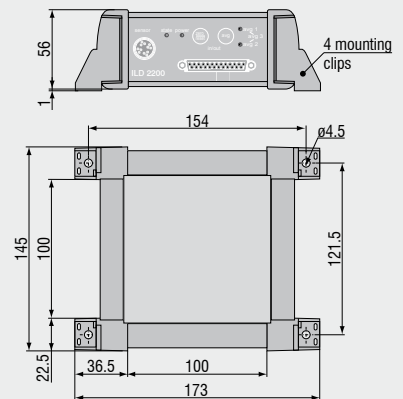
4 mounting clips

MR	SMR	α	φ	ε	A	B
2	24	35.0°	40.0°	44.8°	25.8	16.8
10	30	34.3°	35.2°	35.6°	28.7	20.5
20	40	28.8°	27.5°	26.7°	30.1	22
50	45	26.5°	23.0°	18.3°	31.5	22.5

Model	ILD 2200-2LL ILD 2220-2LL	ILD 2200-10LL ILD 2220-10LL	ILD 2200-20LL ILD 2220-20LL	ILD 2200-50LL ILD 2220-50LL
Measuring range	2mm	10mm	20mm	50mm
Start of measuring range	24mm	30mm	40mm	45mm
Midrange	25mm	35mm	50mm	70mm
End of measuring range	26mm	40mm	60mm	95mm
Linearity	1μm	3μm	6μm	15μm
	≤0.05% FSO	≤0.03% FSO		
Resolution [1] [2] (without averaging)	0.03μm	0.15μm	0.3μm	0.8μm
	0.0015% FSO			
Measuring rate — ILD 2200	10kHz			
Measuring rate — ILD 2220	20kHz			
Permissable ambient light	30,000lx			
Spot diameter — SMR	85 x 240μm	120 x 405μm	185 x 485μm	350 x 320μm
Spot diameter — MMR	24 x 280μm	35 x 585μm	55 x 700μm	70 x 960μm
Spot diameter — EMR	64 x 400μm	125 x 835μm	195 x 1200μm	300 x 1940μm
Light source	semiconductor laser <1mW, 670nm (red)			
Laser safety class	class 2 IEC 60825-1 : 2008-05			
Protection class	sensor: IP 65 / controller: IP 50			
Temperature stability	0.025% FSO/°C	0.01 % FSO/°C		
Operation temperature	0 ... +50°C			
Storage temperature	-20 ... +70°C			
Output	analogue: ±5V digital: RS 422 / 691.2kBaud			
Power supply	24VDC (±15%), max. 500mA			
Sensor cable length	standard: 2m - integrated option: 5m/10m			
Controller	functions: auto zero / signal averaging dimensions: 143mm x 145mm x 52mm - without mounting clips			
Electromagnetic compatibility (EMC)	EN 55011/12.1998 and EN 50082-2/02.1996			
Vibration	2g / 20 ... 500Hz			
Shock	15g / 6ms / 3 axis			
Weight	sensor: ~550g controller: ~1000g			

FSO = Full Scale Output   SMR = Start of measuring range   MMR = Midrange   EMR = End of measuring range
All specifications apply for a diffusely reflecting white ceramic target
[1] for measurements against high glossy surfaces (targets), resolution depends on the material
[2] resolution digital output 16bit

Custom Sensor Modifications

For applications where the above standard sensors do not meet your requirements, it may be possible to supply a sensor with modified specification. Please contact us for further information.

Options

- Non standard measuring range and stand off
- Custom housing or mounting geometry
- Measuring rate 2.5 / 5 / 10 / 20kHz
- Non standard signal interfaces
- Special cable length of electrical connector
- 90° beam deflection
- Vacuum suitability
- Reduced mass
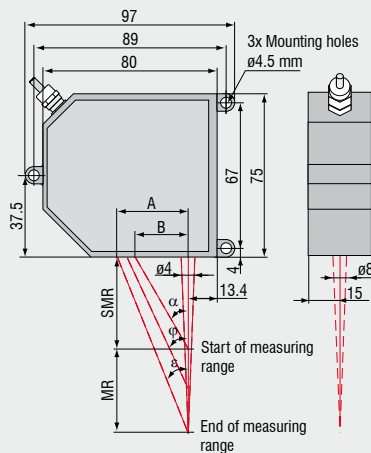- Increased shock and vibration resistance

High accuracy and long standoff distances

Three models with measuring ranges from 10mm to 50mm

10 kHz   **Measurement rate up to 10kHz**

RTSC   **Real Time Surface Compensation**

*A*nalog / *D*igital   **Analogue and digital output**

*F*ilter inside   **Adjustable filter functions (firmware)**

Certified   **Calibration certificate included**

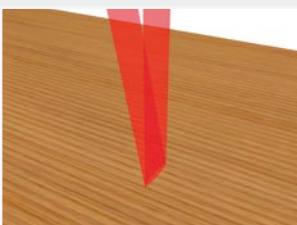//www.   **Configuration via software www.micro-epsilon.com/download**

In contrast to conventional laser sensors, the Long-Range series allows accurate measurements to be taken at much longer stand off distances than normal. This is an important advantage, especially if the sensor cannot be mounted close to the target due to the environment the target is within. The long stand off is particularly useful if you need to look through a window at a target in a pressure chamber or similar vessel. A special CCD line and the Real Time Surface Compensation enable the sensor to be used even on changing surfaces.
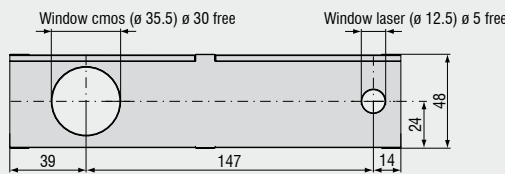
Controller optoNCDT 2210

optoNCDT 1710-50 (50mm)

optoNCDT 2210 (10/20mm)
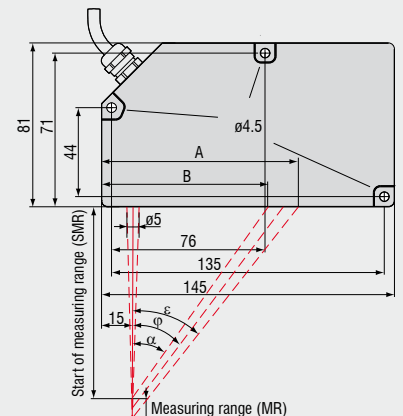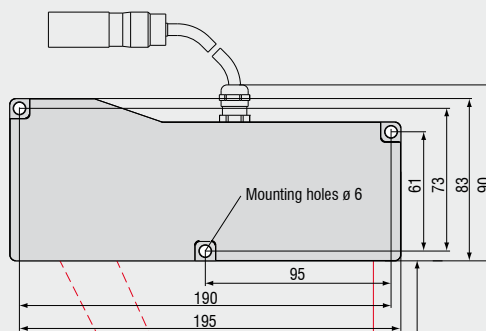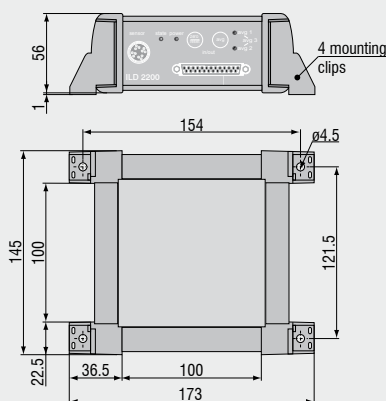
(Dimensions in mm, not to scale.)

MR	SMR	α	φ	ε	A	B
10	95	34.6°	36.9°	38.8°	99.4	80.6
20	90	36.1°	36.9°	37.5°	99.4	80.6

Model	ILD 1710-50	ILD 2210-10	ILD 2210-20
Measuring range	50mm	10mm	20mm
Start of measuring range	550mm	95mm	90mm
Midrange	575mm	100mm	
End of measuring range	600mm	105mm	110mm
Linearity	50μm ≤0.1% FSO	3μm ≤0.03% FSO	6μm
Resolution dynamic [1]	5μm 0.01% FSO	0.5μm 0.005% FSO	1μm
Measuring rate	2.5kHz / 1.25kHz / 625Hz / 312.5Hz (adjustable)	10kHz	
Permissable ambient light	10,000lx	30,000lx	
Spot diameter SMR	400 x 500μm	130μm	200μm
MMR	400 x 500μm	60μm	60μm
EMR	400 x 500μm	130μm	200μm
Light source	semiconductor laser <1mW, 670nm (red)		
Laser safety class	class 2 IEC 60825-1 : 2008-05		
Protection class	IP 65	sensor: IP 65 controller: IP 50	
Temperature stability	0.01 % FSO/°C		
Operation temperature	0 ... 50°C		
Storage temperature	-20 ... 70°C		
Output analogue	4 ... 20mA (0 ... 10V)	±5V (-10V ... +10V)	
digital	RS 422 / USB (optional with cable PC1700-3/USB)	RS422 / 687.5kBaud	
switching outputs	1 x error or 2 x limit (each pogrammable)	-	
Switch Input	laser ON-OFF / zero	-	
Operation	via touch screen on sensor or via PC with ILD 1700 tool	-	
Power supply	24VDC (11 ... 30VDC), max. 150mA	24VDC (±15%), max. 500mA	
Sensor cable length	standard: 0.25m - integrated	standard: 2m - integrated option: 5m/10m on request	
Synchronisation	possible for simultaneous or alternating measurements	-	
Controller	-	functions: auto zero / signal averaging	
Electromagnetic compatibility (EMC)	EN 50081-1 and EN 50082-2		
Vibration	2g / 20 ... 500Hz		
Shock	15g / 6ms	15g / 6ms / 3 axis	
Weight sensor	~800g	~500g	
controller	-	~1000g	

FSO = Full Scale Output
All specifications apply for a diffusely reflecting matt white ceramic target   SMR = Start of measuring range   MMR = Midrange   EMR = End of measuring range
[1] series 1710-50: at 2.5 kHz without averaging, series 2210: at 10 kHz without averaging

Custom Sensor Modifications

For applications where the above standard sensors do not meet your requirements, it may be possible to supply a sensor with modified specification. Please contact us for further information.

Options

- Non standard measuring range and stand off
- Custom housing or mounting geometry
- Measuring rate 2.5 / 5 / 10 / 20kHz
- Non standard signal interfaces
- Special cable length of electrical connector
- Vacuum suitability
- Reduced mass
- Increased shock and vibration resistance

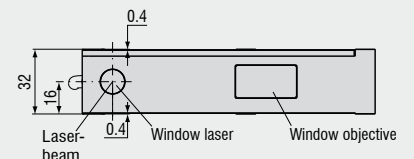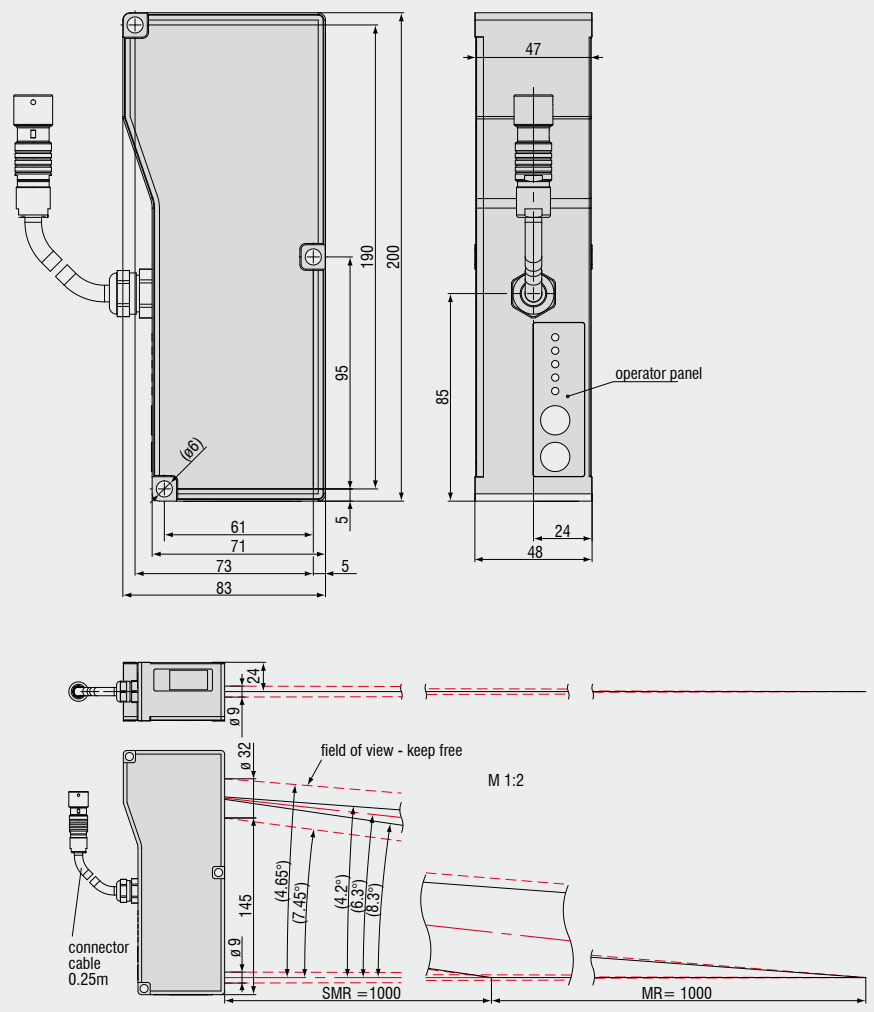|	
	High accuracy and long standoff distances
	Model with measuring range up to 1000mm
	Compact design with integrated controller
312Hz 375Hz 1000Hz	**Adjustable measuring rate up to 2.5kHz**
RTSC	**Real Time Surface Compensation**
*A*nalog *D*igital	**Analogue (U/I) and digital output**
*F*ilter inside	**Adjustable filter functions (firmware)**
Certified	**Calibration certificate included**
//www.	**Configuration via software www.micro-epsilon.com/download**

The optoNCDT 1710-1000 laser sensors are unrivalled in measurement performance world-wide. The sensor can measure over a working range of 1,000mm. The start of measurement is 1,000mm from the sensor body which means that objects upto 2m in distance can be measured. The controller is integrated into the housing of the sensor which means that external electronic processing is not required. The sensor operates with automatic, real time surface compensation, RTSC which auto adapts the laser intensity to the surface being measured. Additionally built in, programmable limit switch give the sensor further integration flexibility.

operator panel

field of view - keep free

M 1:2

connector cable 0.25m

SMR =1000   MR= 1000

Model	ILD1710-1000
Measuring range	1000mm
Start of measuring range	1000mm
Midrange	1500mm
End of measuring range	2000mm
Linearity ≤ ±0.1% FSO	±1mm
Resolution (at 2.5kHz without averaging)	100μm
Measuring rate	2.5kHz / 1.25kHz / 625Hz / 312.5Hz (adjustable)
Light source	semiconductor laser <1mW, 670nm (red)
Permissable ambient light at 2.5kHz	10,000lx
Laser safety class	class 2 IEC 60825-1 : 2008-05
Spot diameter SMR	2.5…5mm
MMR	2.5…5mm
EMR	2.5…5mm
Temperature stability	0.01 % FSO/°C
Operation temperature	0 … 50°C
Storage temperature	-20 ... +70°C
Output measurements	switchable: 4 ... 20 mA / 0 ... 10 V / RS 422 / USB (optional via cable PC1700-3/USB)
switching outputs	1 x error or 2x limit values (configurable)
Switching input	Laser ON-OFF / Zero
Operation	via keypad directly on the sensor and/or via PC with ILD1700 Tool
Power supply	24VDC (11 … 30 VDC), max. 150mA
Electromagnetic compatibility (EMC)	EN 61000-6-3 and EN 61000-6-2
Sensor cable	standard 0.25m integrated
Synchronisation	possible for simultaneous or alternating measurements
Protection class	IP 65
Vibration	2g / 20 … 500Hz
Shock	15g / 6ms
Weight	~ 0.8kg

FSO = Full Scale Output   All specifications apply for a diffusely reflecting matt white ceramic target
SMR = Start of measuring range; MMR = Midrange; EMR = End of measuring range;

Six models with measuring ranges from 20 to 1000mm

Blue Laser Technology (Blue violet laser diode 405nm)

Compact design with integrated controller

RTSC **Real Time Surface Compensation**

312Hz 375Hz 1000Hz **Adjustable measuring rate up to 2.5kHz**

*A*nalog *D*igital **Analogue (U/I) and digital output**

*F*ilter inside **Adjustable filter functions (firmware)**

High flex cables for dragchain or robot use

Certified **Calibration certificate included**

Micro-Epsilon presents a worldwide novelty: The first triangulation sensor using blue laser technology.

In numerous applications, blue Laser sensors are clearly superior to the standard sensors with a red laser diode. During measurements on metals, particularly on red glowing metals and organic matters such as wood, skin, foodstuffs, veneers etc., the wavelength of the blue laser offers significant benefits.

In contrast to the red laser, the blue laser light does not penetrate the measuring object due to the reduced wavelength.

The blue laser generates a minimal laser point on the surface and therefore offers stable and precise results on measuring objects which are usually considered to be critical.

The design of triangulation sensors with Blue Laser technology was completely re-designed. The sensors are equipped with new high-end lenses, a new intelligent laser control and evaluation algorithms.

optoNCDT 1700BL (20/200 mm)
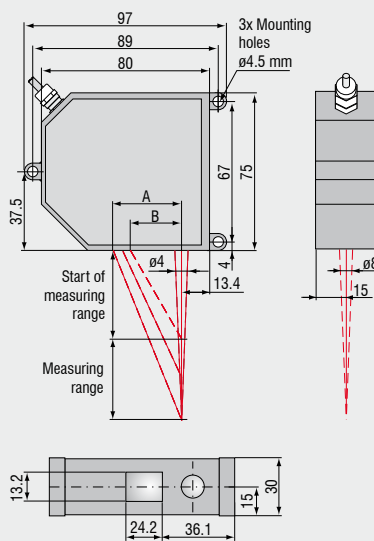
optoNCDT 1700BL (500/750 mm)
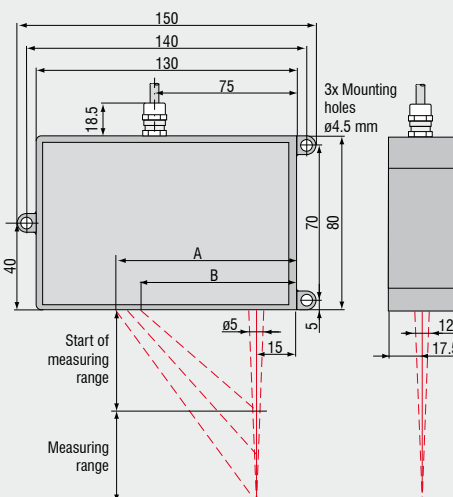
optoNCDT 1710 (50/1000 mm)

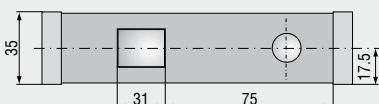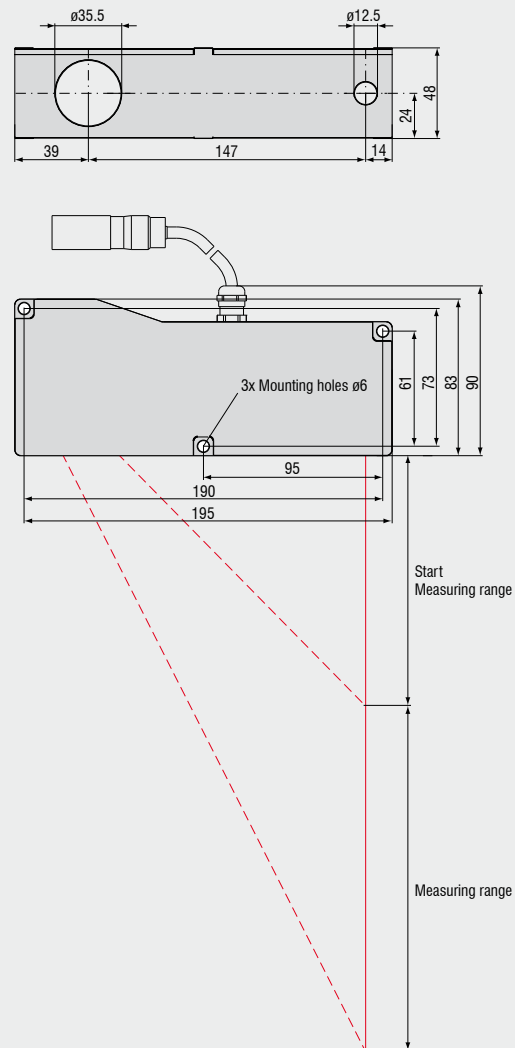| Model	ILD 1700-20BL	ILD 1700-200BL	ILD 1700-500BL	ILD 1700-750BL	ILD 1710-50BL	ILD 1710-1000BL
Measuring range	20mm	200mm	500mm	750mm	50mm	1000mm
Start of measuring range	40mm	100mm	200mm	200mm	550mm	1000mm
Midrange	50mm	200mm	450mm	575mm	575mm	1500mm
End of measuring range	60mm	300mm	700mm	950mm	600mm	2000mm
Linearity	16μm	200μm	400μm	750μm	50μm	±1mm
	≤±0.08% FSO	≤±0.1% FSO	≤±0.08% FSO	≤±0.1% FSO	≤±0.1% FSO	≤±0.1% FSO
Resolution (at 2.5kHz without averaging)	1,5μm	12μm	30μm	50μm	5μm	100μm
Measuring rate	2.5kHz / 1.25kHz / 625Hz / 312.5Hz (adjustable)					
Light source	semiconductor laser <1 mW, 405nm (blue violet)					
Permissable ambient light (at 2.5 kHz)	10,000lx					
Laser safety class	class 2 IEC 60825-1 : 2008-05					
Spot diameter SMR	320μm	1300μm	1500μm	1500μm	400x500μm	2.5…5mm
MMR	45μm	1300μm	1500μm	1500μm	400x500μm	2.5…5mm
EMR	320μm	1300μm	1500μm	1500μm	400x500μm	2.5…5mm
Temperature stability*	0.01% FSO/℃					
Operation temperature	0 ... +50 ℃					
Storage temperature	-20 ... +70 ℃					
Output measurements	selectable: 4 ... 20mA / 0 ... 10V / RS 422 / USB (option with cable PC1700-3/USB)					
switching outputs	1 x error or 2 x limit (each pogrammable)					
Switch input	Laser ON-OFF / Zero					
Operation	via touch screen on sensor or via PC with ILD 1700 tool					
Power supply	24VDC (11 ... 30VDC), max. 150mA					
Sensor cable length (with connector)	standard 0.25m integrated / optional: extension 3m or 10m					
Synchronisation	possible for simultaneous or alternating measurements					
Protection class	IP 65					
Vibration	2g / 20 ... 500Hz					
Shock	15g / 6ms					
Weight (with 25cm cable)	~ 550g	~ 550g	~ 600g	~ 600g	~ 800g	~ 800g

FSO = Full scale output   All specifications apply for a diffusely reflecting matt white ceramic target
*based to digital output ; SMR = Start of measuring range   MMR = Midrange   EMR = End of measuring range

Connector (sensor side)
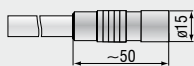
Connector (sensor cable)
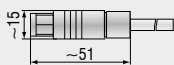
Eight models with measuring ranges from 0.5mm to 200mm

Sensor head and separate controller

Up to 37kHz true analogue frequency response

Analogue (U/I) and digital outputs

Adjustable filter functions (firmware)

Calibration certificate included

The true analogue optoNCDT 1607 is ideal for high speed measurements such as vibration amplitude, impact and drop tests. The 37kHz frequency response is available for all the measurement ranges from 0.5mm to 200mm and is most suited for tasks where targets move quickly and can be of fixed colour.

MR	α	A	B
2	45°	13	5
4	45°	13	5
10	29°	12	5
20	23°	12	5
50	28°	22	8
100	18°	22	8
200	12°	22	8

optoNCDT 1607 (0.5mm)
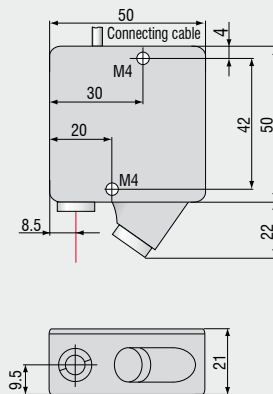
optoNCDT 1607 (2/4/10/20mm)
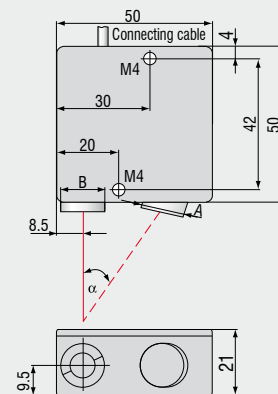
optoNCDT 1607 (50/100/200mm)
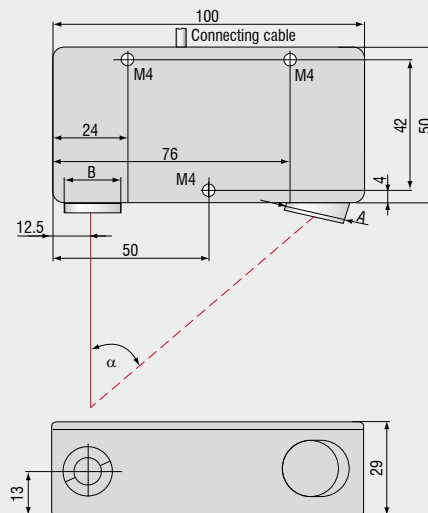
Controller
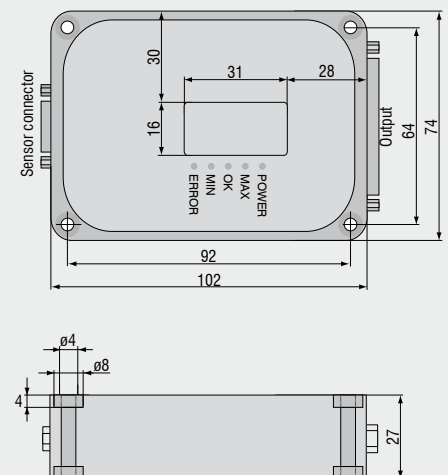
(Dimensions in mm, not to scale. CAD files are available online)

Model	LD 1607-0.5	LD 1607-2	LD 1607-4	LD 1607-10	LD 1607-20	LD 1607-50	LD 1607-100	LD 1607-200
Measuring range	0.5mm	2mm	4mm	10mm	20mm	50mm	100mm	200mm
Start of measuring range	23.75mm	23mm	22mm	40mm	55mm	95mm	170mm	240mm
Midrange	24mm	24mm	24mm	45mm	65mm	120mm	220mm	340mm
End of measuring range	24.25mm	25mm	26mm	50mm	75mm	145mm	270mm	440mm
Linearity	1μm	4μm	8μm	20μm	40μm	100μm	200μm	400μm
				≤0.2% FSO				
Resolution (Noise) [1] static	0.1μm	0.5μm	1μm	3μm	6μm	20μm	30μm	60μm
Frequency response	10kHz, 7kHz, 4kHz, 1kHz, 250Hz, 100Hz, 25Hz or 15Hz (-3dB), selectable with DIP switches optional: Model LD1627: 37kHz (-3dB)							
Temperature stability	±0.03 % FSO/°C							
Light source	laser <1mW, wavelength: 670nm (red)							
Life cycle typ.	50,000h (laserdiode)							
Laser safety class	class 2 (DIN EN 60825-1:2008-05)							
Spot diameter MMR	0.1mm	0.3mm	0.3mm	0.6mm	0.9mm	1.5mm	1.5mm	4mm
Permissible ambient light	20,000lx							
Output	displacement: ±10V / 4 - 20mA / RS232 / optional: 0 ... 10V intensity: 0 ... 10V							
Vibration	2g (IEC 68-2-6)							
Shock	15g (IEC 68-2-6)							
Operation temperature	0 ... +50°C							
Storage temperature / humidity	-20 ... +70°C / up to 90% RH							
Protection class	sensor: IP 64 / electronics: IP 40							
Supply	+ 24VDC / 200mA (10 ... 30VDC)							
Connector	25-pin Sub-D connector							
Weight Sensor	250g		240g				400g	
Weight Controller	275g							
Sensor cable length	2m							

FSO = Full Scale Output   All specifications apply for a diffusely reflecting matt white ceramic target
[1] Frequency response 15 Hz
SMR = Start of measuring range   MMR = Midrange   EMR = End of measuring range

switching outputs (connector) 24 V logic	
MIN	+24V / 10mA
OK	+24V / 10mA
MAX	+24V / 10mA
Hysteresis	appr. 0.4% FSO

Output of errors (connector)	
Too little light	+24V / 10mA
Too much light	+24V / 10mA

LED - indicators		
POWER	GREEN	power on
MAX	RED	adjustable MAX value is exceeded
OK	GREEN	LED level indicator OK shows the position of the target within the set limits
MIN	YELLOW	adjustable value drops below the set MIN
ERROR	RED	too little light is reflected

Pin assignment controller		
Pin	Function	Cable Colors
1	Displacement output, ±10V	green
2	Too little light, +24V	-
3	Laser OFF Input +15 - 30V	white
4	TXD (RS232)	-
5	OK in range, +24V	-
6	4 ... 20mA	-
7	RXD (RS232)	-
8	0 V supply	brown
9-13	n.c.	-
14	Analogue ground	blue screen
15	Too much light +24V	-
16	MAX, +24V	-
17	n.c.	-
18	RTS (RS232)	-
19	MIN, +24V	-
20	Light intensity 0 - 10V	red
21	+24V supply (10 - 36V)	green
22-25	n.c.	-

Accessories for all optoNCDT Series

Power supply
PS 2020 (Power Supply 24 V / 2,5 A, Input 100 - 240 VAC, output 24 VDC / 2.5 A, for snap in mounting on DIN 50022 rail)

Controller
CSP 2008 (controller for processing of multiple sensor signals; analogue and digital interfaces)

Interface card
IF2008 (Interface card for individual signal processing; analogue and digital interfaces)

- -

Accessories optoNCDT 1302 / 1402

Supply and output cable, rated for moving cable tracks (also available in 90° version)
PC 1402-3/I (3m, output 4 ... 20mA)
PC 1402-6/I (6m, output 4 ... 20mA)
PC 1402-3/U (3m, with integral resistance, output 1 ... 5VDC)
PC 1402-6/U (6m, with integral resistance, output 1 ... 5VDC)
PC1402-3/IF2008 (3m, supply and output cable)
PC 1402-3/USB (3m, supply and output cable)
PC1401/1402-0.2 (0.2m, adapter cable 12-pin to 7-pin)
PC 1402-3/CSP (3m, required for CSP 2008, optoNCDT 1402 only)

Supply and output cable, robot rated (available in 90° version)
PCR 1402-3/l (3m)
PCR 1402-6/l (6m)
PCR 1402-8/l (8m)

Protective housing
SGH 1800
SGHF 1800

- -

Accessories optoNCDT 1607 / 1627

Supply and output cable
PC 1605-3 (3m)
PC 1605-6 (6m)
PC 1607-3/RS232 (3m, with 9-pin Sub-D connector for RS232)

Protective housing
SGF 1605-20 (for LD1607-2/4/10/20)
SGF 1605-200 (for LD1607-50/100/200)
SGL with connection for compressed air

- -

Accessories optoNCDT 1700/1700LL

Supply and output cable (drag chain rated)
PC 1700-3 (3m)
PC 1700-10 (10m)

PC 1700-10/3/IF2008 (10m, for use with interface card IF2008)
PC 1700-3/T (3m, for use with trigger box)
PC 1700-10/T (10m, for use with trigger box)
PC 1700-3/USB (3m, with USB-RS422-converter, power supply 90 ... 230 VAC)

Supply and output cable (robot rated)
PCR 1700-5 (5m)
PCR 1700-10 (10m)

Protective housing
SGH 1800 (for ILD 1700-2/10/20/50/100/200/250VT and ILD 1700-2LL/10LL/20LL/50LL)
SGH 2200-200 (for ILD 1700-40/500/750)
SGxF 1800 (option with compressed air clean setup)
SGxF 2200-200 (option with compressed air clean setup)

External trigger
Triggerbox 1700 (Electronics for triggering optoNCDT 1700 sensors. Acceptable trigger levels from +2.4VDC to +24VDC, L/W/H 98x64x34mm)

- -

Accessories optoNCDT 2200(LL) / 2220(LL) / 1710-50 / 2210

Supply and output cable (drag chain rated)
PC 1800-3 (3m)
PC 1800-8 (8m)
PC2200-3/10/RS485 (3m, RS 485 for use with interface card IF2008)
PC 2200-3/3/RS422 (3m, for IF2008/RS422/USB-converter)

Sensor cable extension (drag chain rated)
CE 1800-3 (3m)
CE 1800-8 (8m)

Protective housing (only for series 2200, 2200LL, 2220, 2220LL)
SGx 1800 (for ILD 2200-2/10/20/50/100, ILD 2200-2LL/10LL/20LL/50LL, ILD 2220-2/10/20/50/100, ILD 2220-2LL/10LL/20LL/50LL)
SGH 2200-200 (for ILD 2200-40/200, ILD 2220-200)
SGxF 1800 (option with compressed air clean setup)
SGxF 2200-200 (option with compressed air clean setup)

Accessories optoNCDT 2300

Supply and output cable
PC2300-0,5Y (Connecting cable to PC or SPS; for operation a PC2300-3/SUB-D will be required)
PC2300-3/SUB-D (3m; for operation a PC2300-0,5Y will be required)
PC2300-3/CSP (3m, connecting cable ILD2300 and CSP2008)
PC2300-10/CSP (10m, connecting cable ILD2300 and CSP2008)
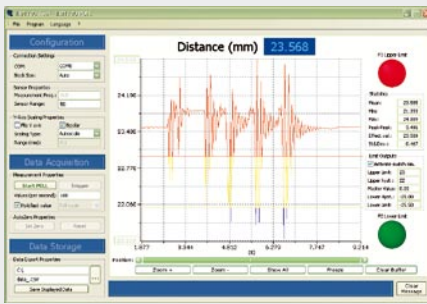PC2300-15/CSP (15m, connecting cable ILD2300 and CSP2008)
PC2300-3/IF2008 (3m, interface and supply cable)
PC2300-3/OE (3m)
PC2300-6/OE (6m)
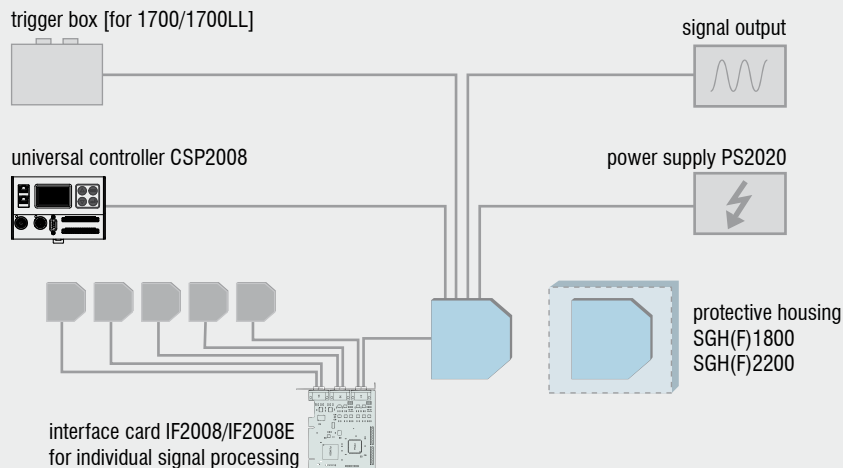PC2300-9/OE (9m)
PC2300-15/OE (15m)

Setup and configuration software

ILD Tools is the software included for easy sensor configuration. All the settings can be implemented conveniently via a Windows user interface on the PC. The sensor parameters are sent to the sensor via the serial port and can also be saved if required. ILD Tools also includes a module which can display and save measurement results. The link to the PC is made via the sensor cable with a USB converter. [available for all series except 1302 and 1607]

Driver support for customer software

For the optoNCDT sensors documented DLL drivers are available free of charge, which enables easy integration of the sensors into existing software.

**Software download free of charge from
www.micro-epsilon.com/download**

trigger box [for 1700/1700LL]

signal output

universal controller CSP2008

power supply PS2020

protective housing
SGH(F)1800
SGH(F)2200

interface card IF2008/IF2008E
for individual signal processing

Protective housing for harsh environment

To protect the laser sensors in extreme environments individual protective housings are available for all sensor models. Three options for the protective housing are offered.

Option SGH:

Completely enclosed housing with an integrated front window, where the sensor measures through the window. The water resistant housing (IP68) provides protection against aggressive solvents and detergents.

Option SGHF:

The SGHF version offers optimum protection for the sensor with integrated compressed air cooling and provides protection against fluids.

Option SGL:

Protective housing with open slot for air purging of the measurement gap and cooling purpose.

**Dimensions
SGx 16x7/20:** 74x80x58mm for
ILD 16x7-2/4/10/20

SGx 16x7/200: 125x80x58mm for
ILD16x7-50/100/200

SGx 1800: 140x140x71 mm for
ILD 1302 and ILD 1402
ILD 1700-2/10/20/50/100/200/250VT,
ILD 1700-2LL/10LL/20LL/50LL,
ILD 2200-2/10/20/50/100,
ILD 2200-2LL/10LL/20LL/50LL,
ILD 2220-2/10/20/50/100,
ILD 2220-2LL/10LL/20LL/50LL

SGx 2200: 140x180x71 mm for
ILD 1700-40/500/750,
ILD 2200-40/200,
ILD 2220-200

IF2008 - PCI interface card

The IF 2008 interface card is designed for installation in PCs and enables the synchronous capture of 4 digital sensor signals and 2 encoders. The absolutely synchronous data acquisition plays an important role particularly for planarity or thickness measurement tasks. The data are stored in a FIFO memory in order to enable resource-saving processing in the PC in blocks.

Particular Benefits

- 4x digital signals and two encoders with basic printed circuit board
- Additional expansion board for a total of 6x digital signals, 2x encoder and 2x analogue signals and 8x I/O Signals
- FIFO data memory
- Synchronous data acquisition

Interface card IF2008, IF2008E
for individual signal processing
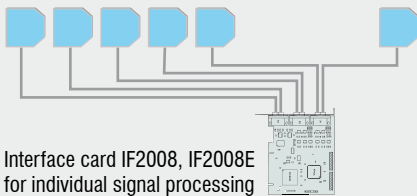
IF2008E - Expansion board

The IF 2008E expansion board is designed for installation in PCs and enables the synchronous capture of 2 digital sensor signals and 2 encoders as well as 8 I/O-Signals. The expansion board is connected to the basis board IF2008. The absolutely synchronous data acquisition plays an important role particularly for planarity or thickness measurement tasks.

Particular Benefits

- Two digital signals, two analogue signals and 8 I/O signals
- Overall with IF2008: 6 digital signals, 2 encoders and 2 analogue signals and 8 I/O Signals
- FIFO data memory
- Synchronous data acquisition
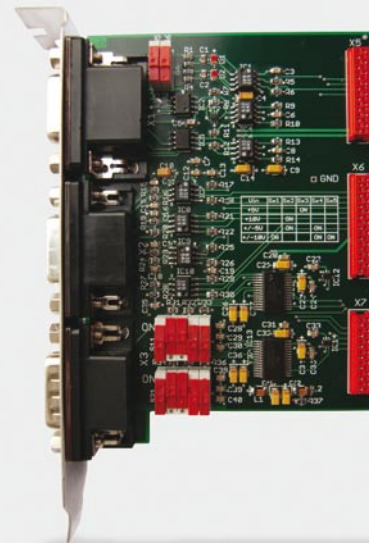
CSP2008 - Universal controller

The CSP2008 controller can be used to process two digital or analogue input signals of almost all Micro-Epsilon displacement sensors (2x internal plus 4x external via Ethercat modules from Beckhoff). Ethercat can also be used as an external interface (master) for connecting further sensors and I/O modules. The controller has a high luminance display so that measured values can be easily read, even from a long distance.

Features

- Real-time processing of input and output signals at upto 100kHz (user selectable)
- Unique user interface for the configuration of the controller via Ethernet on a PC or laptop. All user selectable functions of the controller and the measured values can be viewed, displayed and stored in real time via your own web browser without installing any 3rd part software
- Simple sensor connection with automatic sensor recognition, configuration of the sensor using buttons and display on controller or via laptop
- Modular system upgradable with additional I/O modules for customer-specific requirements. The internal communication between I/O components using Ethercat connection (CSP 2008 acts as master)
- Simple mounting using DIN rail TS 35
- Extremely flexible and powerful functionality; function modules can be combined in many ways. Application example:
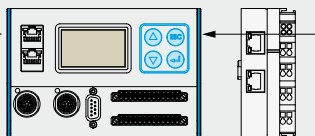
Universal controller with DIN rail TS 35
(dimensions not to scale)
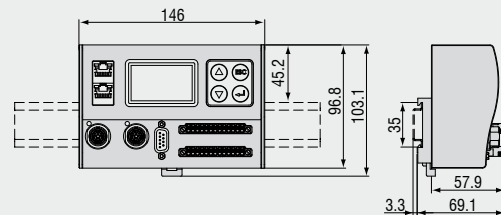
System setup

Sensors via RS422

optoNCDT 1402

optoNCDT 1700

optoNCDT 2200/2220

optoNCDT 2300

optoCONTROL 2500

optoCONTROL 2600

confocalDT

Beckhoff modules for extended inputs / outputs

EK1100 (EtherCat bus coupler)

EL2004 (4 channel digital output terminal 24VDC)

EL4132 (2 channel analogue output terminal for -10...10V, 16Bit)

EL1012/EL1014/EL1018 (2 / 4 / 8 channel digital output terminal for 24V DC)

EL3161/EL3162 (1 / 2 channel analogue output terminal for 0...10V, 16Bit)

EL3141/EL3142 (1 / 2 channel analogue output terminal for 0...20mA, 16Bit)

EL4112 (2 channel analogue output terminal for 0...20mA,16Bit)
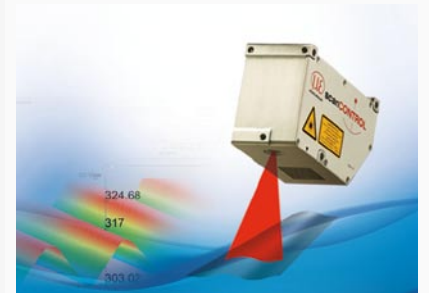
RS422 Extension terminal for CSP2008

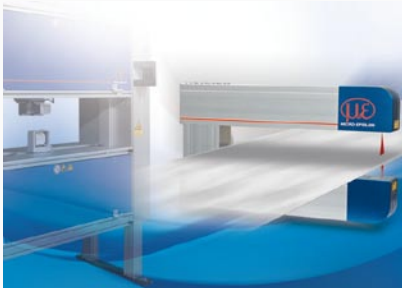# High performance sensors made by Micro-Epsilon

Sensors and systems for displacement
and position

Sensors and measurement devices for
non-contact temperature measurement

2D/3D profile sensors (laser scanner)

Measurement and inspection
systems for quality assurance

Optical micrometers, fiber optic sensors
and optical fibers

Color recognition sensors, LED analyzers
and color online spectrometer

MICRO-EPSILON

MICRO-EPSILON Headquarters
Koenigbacher Str. 15 · 94496 Ortenburg / Germany
Tel. +49 (0) 8542 / 168-0 · Fax +49 (0) 8542 / 168-90
info@micro-epsilon.com · **www.micro-epsilon.com**