MICRO-EPSILON

Operating Instructions
opto**NCDT** 5500 PROFINET

ILD5500-10   ILD5500-100
ILD5500-25   ILD5500-200
ILD5500-50

Intelligent laser-optical displacement measurement

Contents

1 Safety

1.1 Symbols used

System operation assumes knowledge of the operating instructions.

The following symbols are used in these operating instructions:

⚠ CAUTION	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a situation that may result in property damage if not avoided.
►	Indicates a user action.
i	Indicates a tip for users.
Measurement	Indicates hardware or a software button/menu.
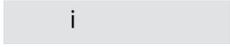
1.2 Warnings

Do not expose yourself to unnecessary laser radiation.

► Switch off the sensor for cleaning and maintenance.
► Switch off the sensor for cleaning and maintenance if the sensor is integrated into a system.

Caution - the use of controls or settings or the performance of procedures not specified in the operating instructions may cause damage.

⚠ CAUTION	Connect the power supply according to the regulations for electrical equipment.
	• Risk of injury
	• Damage to or destruction of the sensor
NOTICE	Avoid knocks and impacts to the sensor.
	• Damage to or destruction of the sensor
	Only attach the sensor to the existing mounting holes/threaded holes on a flat surface; clamping of any kind is not permitted.
	• Damage to or destruction of the sensor
	The supply voltage must not exceed the specified limits.
	• Damage to or destruction of the sensor
	Protect the sensor cable from damage. Attach the cable load-free, catch the cable after approx. 25 cm and catch the pigtail on the plug, e.g. with cable ties.
	• Destruction of the sensor
	• Failure of the measuring device
	Avoid constant exposure of the sensor to splashes of water.
	• Damage to or destruction of the sensor
	Avoid exposure of sensor to aggressive media (detergents, cooling emulsions).
	• Damage to or destruction of the sensor

1.3 Notes on product marking

1.3.1 CE marking

The following apply to the product:

• Directive 2014/30/EU ("EMC")
• Directive 2011/65/EU ("RoHS")

Products which carry the CE marking satisfy the requirements of the EU Directives cited and the relevant applicable harmonized European standards (EN).

The product is designed for use in industrial and laboratory environments.

The EU Declaration of Conformity and the technical documentation are available to the responsible authorities according to the EU Directives.

1.3.2 UKCA marking

The following apply to the product:

- SI 2016 No. 1091 ("EMC")
- SI 2012 No. 3032 ("RoHS")

Products which carry the UKCA marking satisfy the requirements of the directives cited and the relevant applicable harmonized standards.

The product is designed for use in industrial and laboratory environments.

The UKCA Declaration of Conformity and the technical documentation are available to the responsible authorities according to the UKCA Directives.

1.4 Intended use

The sensor is designed for use in industrial and laboratory environments.

It is used for

- Displacement, distance, position and thickness measurements
- Monitoring Quality and Checking Dimensions

The sensor must only be operated within the values specified in the technical data.

The sensor must be used in such a way that no persons are endangered and no machines or other physical items of property are damaged in the event of malfunction or total failure of the sensor.

Take additional precautions for safety and damage prevention in case of safety-related applications.

1.5 Proper environment

Protection class:	IP67
Temperature range:	
- Operation:	0 ... +45 °C[1]
- Storage:	-20 ... +70 °C
Humidity:	5 ... 95 % RH (non-condensing)
Ambient pressure:	Atmospheric pressure

> i The protection class is limited to water (no penetrating liquids, detergents, or similar aggressive media).

The protection class does not apply to optical windows, as contamination will impair or prevent their function.

[1] 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.

2 Laser safety

The sensor works with a semiconductor laser at a wavelength of 670 nm (visible/red).

The sensors fall within laser class 2. The laser is operated in pulsed mode, the maximum optical power is ≤1 mW. The pulse frequency depends on the set measuring rate (0.25 ... 20 kHz). The pulse duration of the peaks is controlled depending on the measuring rate and the reflectivity of the object being measured and can be 0.5 ... 3994.5 µs.
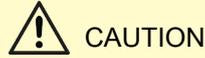
> ⚠ CAUTION
>
> Laser radiation Eyes could become irritated or damaged. Close your eyes, or immediately turn away if the laser beam hits the eye.

Relevant regulations must be observed when operating the sensors. The following apply accordingly:

- With class 2 laser devices, the eye is not endangered by random, brief exposure to laser radiation, i.e. exposure times of up to 0.25 s.
- Class 2 laser devices may therefore be used without further protective measures if you do not intentionally look into the laser beam or into specular-reflected radiation for more than 0.25 s.
- Because the presence of the eyelid protective reflex should not normally be assumed, one should deliberately close the eyes or turn away immediately if the laser beam hits the eye.

Lasers of Class 2 are not subject to notification and a laser protection officer is not required.

The following signs are attached to the sensor housing:

Fig. 2.1: Laser information and laser warning label

> i   If the present information signs are covered over when the unit is installed, the user must ensure that supplementary information signs are attached at the installation location.

Operation of the laser is indicated visually by the LED on the sensor.

The housings of the optical sensors may only be opened by the manufacturer, see Chap. 10.

For repair and service purposes, the sensors must always be sent to the manufacturer.

Observe national regulations, e.g., the German Occupational Health and Safety Ordinance on Artificial Optical Radiation (OStrV).

Recommendations for the operation of sensors that emit laser radiation in the visible or non-visible range can be found in DIN EN 60825-1 (from 07/2022), among others.
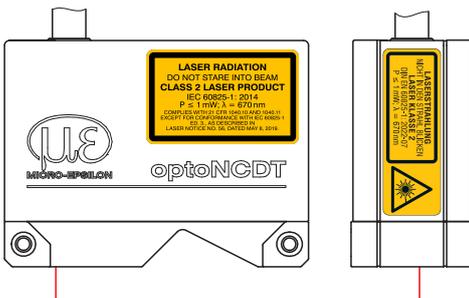
Fig. 2.2: Laser information and laser warning label on the sensor housing

3 Functional principle, technical data

3.1 Short description

The optoNCDT 5500 operates according to the principle of optical triangulation, i.e. a visible, modulated light spot is projected onto the surface of the measuring object.

The diffuse part of the reflection of this light spot is imaged on a spatial resolution element (CMOS) by a receiver optic arranged at a certain angle to the optical axis of the laser beam.

A signal processer in the sensor calculates the distances between the light spot on the target and the sensor from the output signal of the CMOS element. The distance value is linearized and output via the fieldbus interface.

	262077	0x7FFFFF05
e-SMR	depends on measuring range	
SMR	98232	Millimeter
MMR	131000	Millimeter
EMR	163768	Millimeter
e-EMR	depends on measuring range	
	262078	0x7FFFFF06
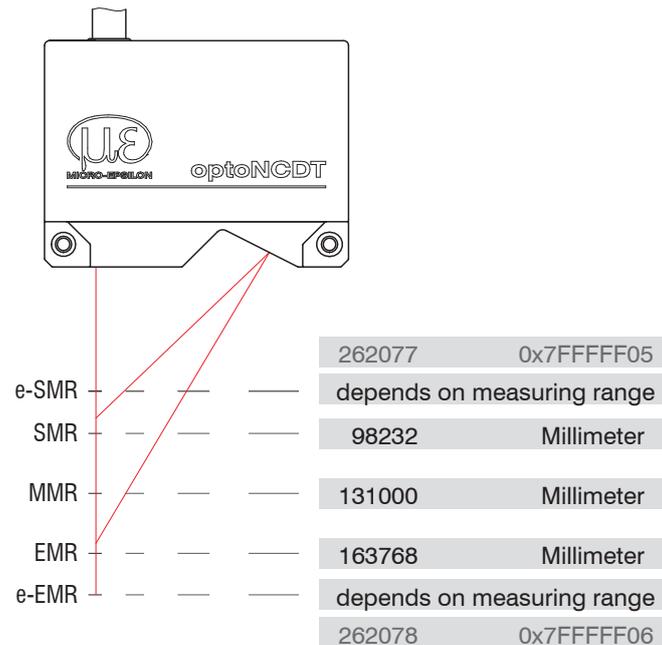
Fig. 3.1: Term definitions

e-SMR	Extended start of measuring range
SMR	Start of measuring range
MMR	Mid of measuring range
EMR	End of measuring range
e-EMR	Extended end of measuring range

The digital values apply to distance values without zeroing or mastering.

3.2 Advanced Surface Compensation

The sensor is equipped with intelligent surface control. New algorithms generate stable measurement results even on demanding surfaces where changing reflections occur. In addition, the new algorithms compensate for ambient light of up to 50,000 lux. The sensor therefore has the highest ambient light resistance in its class and can also be used in highly illuminated environments.

3.3 Technical data

General technical data	ILD5500-x with integrated Industrial Ethernet interface
Measuring rate[2]	0,25 kHz ... 20 kHz
Temperature stability [3]	± 0,008 % FSO / K
Light source	Laser 670 nm
Laser class	Class 2 in accordance with IEC 60825-1: 2022-07
Supply voltage	12 … 30 VDC
Power consumption	max. 5 W
Signal input	Laser on/off
Digital interface	EtherCAT / PROFINET
Switching output	1 or 2 switching outputs (error & limit value): npn, pnp, push pull
Connection	integrated pigtail 0.3 m with 12-pin M12 plug; optional extension to 3 m / 6 m / 9 m / 15 m (see accessories for suitable connection cables)
Mounting	Support points with locating holes for centering sleeves for reproducible clamping of the sensor 2 x M4 direct or M3 bolt connection
Temperature range	Storage	-20 ... 70 °C (non-condensing)
	Operation	0 ... 45 °C (non-condensing)
Shock (DIN EN 60068-2-27)	15 g / 6 ms in 3 axes
Vibration (DIN EN 60068-2-6)	50 g / 20 … 500 Hz / max. displacement 3.6 mm
Protection class (DIN EN 60529)	IP67
Material	Aluminum housing
Weight	approx. 310 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; 3 x color LEDs for "STATE", "RUN/SF", "ERR/BF"
Permissible ambient light [5]	≥ 200,000 lx

3.4 Technical data, measuring range

Model	ILD5500-10	ILD5500-25	ILD5500-100	ILD5500-200
Measuring range	10 mm	25 mm	100 mm	200 mm
Start of measuring range	30 mm	40 mm	70 mm	100 mm
Mid of measuring range	35 mm	52.5 mm	120 mm	200 mm
End of measuring range	40 mm	65 mm	170 mm	300 mm
Linearity [6]	1.5 µm	5 µm	30 µm	80 µm
	0.015% FSO	0,015% FSO	0.03% FSO	0.04% FSO
Repeatability [7]	< 0,04 µm	< 0,09 µm	< 1,5 µm	< 4,5 µm

[2] Factory setting 4 kHz

[3] Related to digital output 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.

[4] Access to web interface requires connection to PC

[5] ≥ 200,000 lx with background suppression | Default settings with 20 kHz measurement frequency: 50,000 lx

[6] Value applies only to the standard measuring range; FSO = Full Scale Output; measurement according to DIN 32877 with 10 or 1024 measurements per position, Ethernet, 20 kHz, on a white, diffusely reflecting surface (Micro-Epsilon reference ceramic for optoNCDT sensors)

[7] Value applies only to the standard measuring range; value for median 9 + moving average 4096; Ethernet, 20 kHz, in the mid of the measuring range, on white, diffuse reflecting surfaces (Micro-Epsilon reference ceramic for optoNCDT sensors)

Model		ILD5500-10	ILD5500-25	ILD5500-100	ILD5500-200
Light spot diameter [8]	SMR	85 x 200 µm	140 x 310 µm	200 x 500 µm	780 x 1800 µm
	MMR	60 x 75 µm	60 x 90 µm	200 x 500 µm	780 x 1800 µm
	EMR	130 x 250 µm	230 x 380 µm	640 x 1100 µm	780 x 1800 µm
	smallest Ø	30 x 47 µm with 34,5 mm	46 x 66 µm with 51,1 mm	82 x 117 µm with 99 mm	-

3.5 Control and indicator elements

State LED	Meaning
Green	Measuring object within the measuring range
Yellow	Measuring object in the mid of the measuring range
Red	No distance value available, e.g. measuring object outside the measuring range, reflection too low
Yellow flashing, 1 Hz	Bootloader
Yellow flashing, 8 Hz	Installation active
Yellow (briefly), red, yellow, green, off, alternating	Ethernet setup mode
Off	Laser switched off
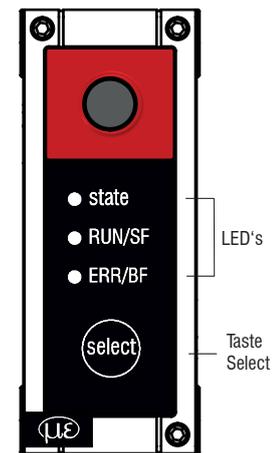
	Meaning
Select button	Resetting to factory setting

LED		Meaning
SF (system error) General designation: COM 0	Duo LED red/green	
	Off	No error
	Red flashing, 1 Hz	DCP signal service is triggered by the bus
	Red	Watchdog time-out; channel, generic or extended diagnosis exist; system error
BF (bus error) General designation: COM 1	Duo LED red/green	
	Off	No error
	Red flashing, 2 Hz	No data exchange
	Red	No configuration; or slow physical connection or no physical connection at all

[8] ±20 %; SMR = start of measuring range; MMR = mid of measuring range; EMR = end of measuring range; light spot diameter determined with point-shaped laser with Gaussian fit (full 1/e² width)

4 Delivery

4.1 Unpacking, included in delivery

- 1 ILD5500 sensor
- 1 setup guide
- 2 laser warning labels in German, 2 laser warning labels in English, 2 laser warning labels in French
- Accessories (2 pc. centering sleeves, 2 pc. M3 x 40)

▶ Carefully remove the components of the sensor from the packaging, handling them in such a way that no damage can occur.

| i | Do not touch the optical windows. Soiling of the optical windows will impair the functionality. |

▶ Check the delivery for completeness and shipping damage immediately after unpacking.
▶ If there is damage or parts are missing, immediately contact the manufacturer or supplier.

Optional accessories are listed in the appendix.

4.2 Storage

Temperature range:	-20 ... +70 °C
Humidity:	5 ... 95 % RH (non-condensing)

4.3 Return of packaging

Micro-Epsilon Messtechnik GmbH & Co. KG offers customers the opportunity to return the packaging of products purchased from Micro-Epsilon by prior arrangement so that it can be reused or recycled.

To arrange the return of packaging, for questions about the costs and / or the exact return procedure, please contact us directly at

info@micro-epsilon.de

5 Installation

5.1 Notes on operation

5.1.1 Reflectance of target surface

In principle, the sensor evaluates the diffuse portion of the reflections of the laser light spot.
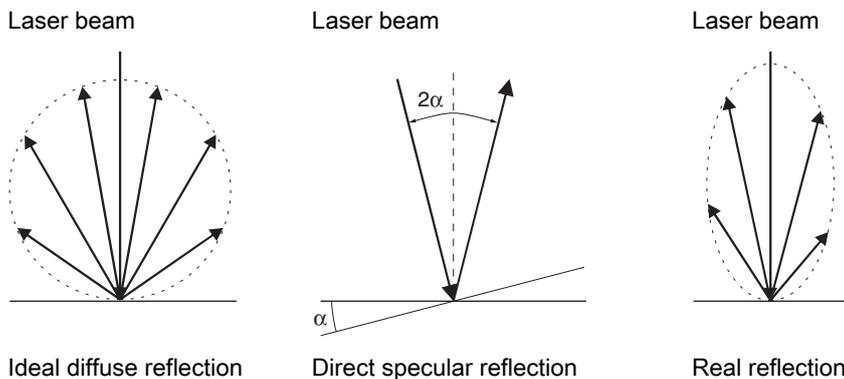
Tab. 5.1: Reflectance of target surface

Any statement about a minimum reflection factor is only possible with reservations, since small diffuse portions can be evaluated even of reflecting surfaces. This is done by determining the intensity of the diffuse reflection from the CMOS signal in real time and subsequent controlling, see Chap. 3.2 However, a longer exposure time may be required for dark or shiny objects, such as black rubber. The maximum exposure time is coupled to the measuring rate and can only be increased by lowering the measuring rate of the sensor.

5.1.2 Interferences

5.1.2.1 Ambient light

The sensors are very good at suppressing ambient light thanks to their built-in optical interference filter. However, ambient light disturbances can occur with shiny measuring objects and at a reduced measuring rate. In these cases it is recommended to provide shielding against ambient light or to switch on the `Background suppression` function. This applies in particular to measurement work performed in the vicinity of welding devices.

5.1.2.2 Color differences

Because of intensity compensation, color difference of targets affect the measuring result only slightly. However, such color differences are often combined with different penetration depths of the laser light into the material. Different penetration depths then result in apparent changes of the measuring spot size. Therefore color changes in combination with penetration depth changes may lead to measurement uncertainties.

5.1.2.3 Thermal influences

When the sensor is commissioned a warm-up time of at least 30 minutes is required to achieve uniform heat distribution in the sensor.

If measurement is performed in the µm accuracy range, the effect of temperature fluctuations on the sensor holder must be considered.

Rapid temperature changes are not detected immediately due to the damping effect of the sensor's heat capacity.

5.1.2.4 Mechanical vibrations

If resolutions in the µm range are to be achieved with the sensor, particular attention must be paid to stable or vibration-damped sensor and target mounting.

5.1.2.5 Movement blur

If the objects being measured are fast moving and the measuring rate is low, it is possible that movement blurs may result. Therefore, always select a high measuring rate for high-speed operations to prevent errors.

5.1.2.6 Surface Roughness

Laser-optical sensors detect the surface using an extremely small laser spot. They also track slight surface unevenness. In contrast, a tactile, mechanical measurement, e.g. with a caliper gauge, covers a much larger area of the measuring object. Surface roughnesses in the order of 5 µm and more lead to an apparent change in distance with traversing measurements.

A suitable averaging number can improve the comparability of the optical and mechanical measurements.
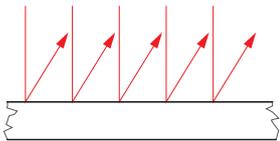
Ceramic reference surface   Structured surface
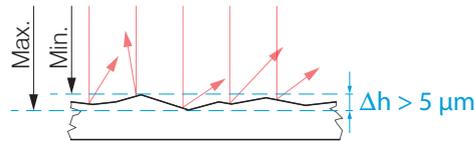
Recommendation for parameter choice:

Select the averaging number so that a comparably large surface area is averaged as for the mechanical measurement.

5.1.2.7 Angular influences

Target tilt angles around both the X and y-axis of less than 5° in the case of diffuse reflection only cause problems with surfaces that produce strong direct reflection.

These influences are particularly important when scanning profiled surfaces. In principle, angular behavior during triangulation is also affected by the reflectivity of the target surface.
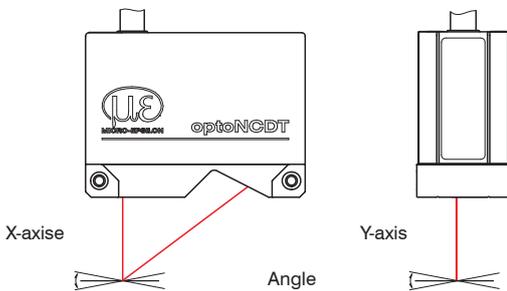
5.1.2.8 Error detection during peak evaluation - MR10 MR25 MR50

The ILD5500 is a highly sensitive optical sensor that measures even poorly diffusely reflective targets very quickly.

In principle, reflections may be detected that do not originate from the target itself, but from between the target and the optics or from within the optics. This may cause false detections during peak evaluation, especially with highly reflective targets and at low measurement frequencies.

i	Micro Epsilon recommends limiting the maximum possible shutter with `EXPOSURELIMIT`, especially at low measurement frequencies.

Measuring range	Recommended for measurement frequencies less than	Recommended value for `EXPOSURELIMIT`
10		
25	1 kHz	1000 µs
50	1.6 kHz	600 µs
100		
200		

5.1.3 Optimization of measurement accuracy

Colored stripes Direction of movement

Grinding and milling marks
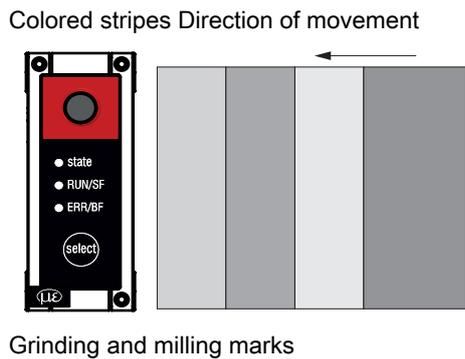
In case of rolled or polished metals that are moved past the sensor, the sensor plane must be arranged in the direction of the rolling or grinding marks. The same arrangement must be used for color strips.

Tab. 5.2: Sensor arrangement for sanded or striped surfaces
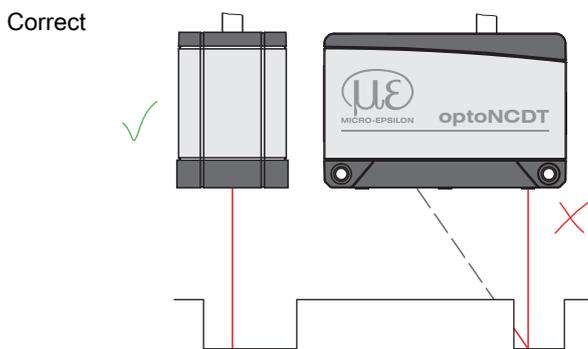
In case of bore holes, blind holes and edges in the surface of moving parts, the sensor must be arranged in such a way that the edge does not obscure the laser spot.

Tab. 5.3: Sensor arrangement for holes and edges

5.2 Mechanical fastening

5.2.1 General

The sensor is an optical system that measures in the µm range. If the laser beam does not strike the object surface at a perpendicular angle, measurements might be inaccurate.
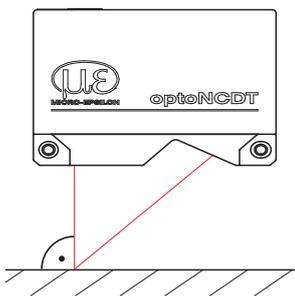
Fig. 5.1: Sensor mounting with diffuse reflection

The bearing surfaces surrounding the through-holes (fastening holes) are slightly raised.

> i   Ensure careful handling of the sensor during installation and operation. Mount the sensor only to the existing through-bores on a flat surface. Any type of clamping is not permitted. Do not exceed torques.

5.2.2 Mounting, dimensional drawing ILD5500

Depending on the installation position, it is recommended to define the sensor position using centering elements and fitting bores. The cylindrical counterbore ø6 H7 is intended for the position-defining centering elements. This allows for the sensor to be mounted in a reproducible and exchangeable way.

Through-bolt connection

0.75 Nm
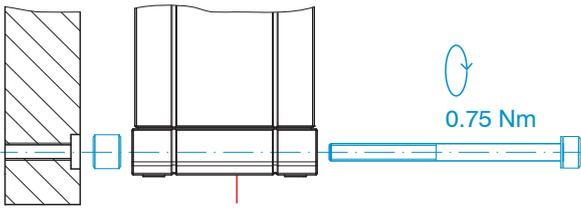
M3 x 40; ISO 4762, A2-70

Direct fastening

2.0 Nm

min 10 (.04)
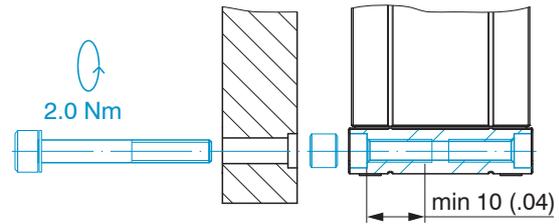
M4; ISO 4762, A2-70 | screw-in depth at least 10 mm

> i Only attach the sensor to the existing through-holes on a flat surface or screw it on directly. Any type of clamping is not permitted.

— Start of measuring range
■ Standard measuring range
■ Extended measuring range

ILD 5500-10

ILD 5500-25

ILD 5500-100

ILD 5500-200

100 mm   200 mm   300 mm   400 mm
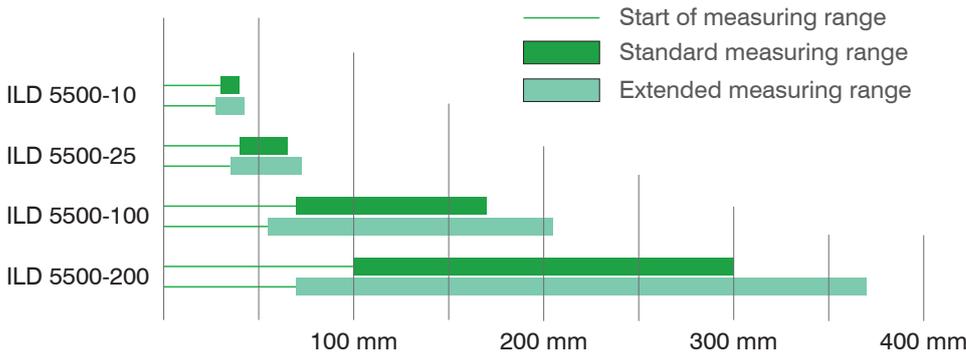
Fig. 5.2: Measuring ranges for distance measurement with extended and standard measuring range

80 (3.15)

31 (1.22)

15.5 (.61)

17 (.67)

LASER RADIATION
DO NOT STARE INTO BEAM
CLASS 2 LASER PRODUCT
IEC 60825-1: 2014
P ≤ 1 mW, λ = 670 nm
COMPLIES WITH 21 CFR 1040.10 AND 1040.11
EXCEPT FOR CONFORMANCE WITH IEC 60825-1
ED. 3, AS DESCRIBED IN
LASER NOTICE NO. 56, DATED MAY 8, 2019.

LASERSTRAHLUNG
NICHT IN DEN STRAHL BLICKEN
LASER KLASSE 2
DIN EN 60825-1:2015/07
P ≤ 1 mW, λ = 670 nm

MICRO-EPSILON

optoNCDT

2x ø6 (2367 max / 2362 min)

2x ø6 (2367 max / 2362 min)

60 (2.36)

4x M4

6 (.24)
0

5 (.20)

70 (2.76)

0.4 (.016)

8.5 (.33)

3.2 (.13)

11 (.43)

9 (.35)

9 (.35)

18 (.71)

14 (.55)

32 (1.26)

e-SMR
SMR

MR

EMR
e-EMR

Laser beam

Limits for free space

Keep this area free from other
light sources and/or their reflections

3   3 (.12)

Y   X

Fig. 5.3: Dimensional drawing ILD5500-10/25

MR[9]	10	25
e-SMR[10]	27.5	35
SMR[11]	30	40
MMR[12]	35	52.5
EMR[13]	40	65
e-EMR[14]	42.5	72.5
X standard MR	49	52
X with e-MR	49	53
Y standard MR	17	32
Y with e-MR	26	51

Tab. 5.4: Extended measuring range and free space, ILD5500-10/25
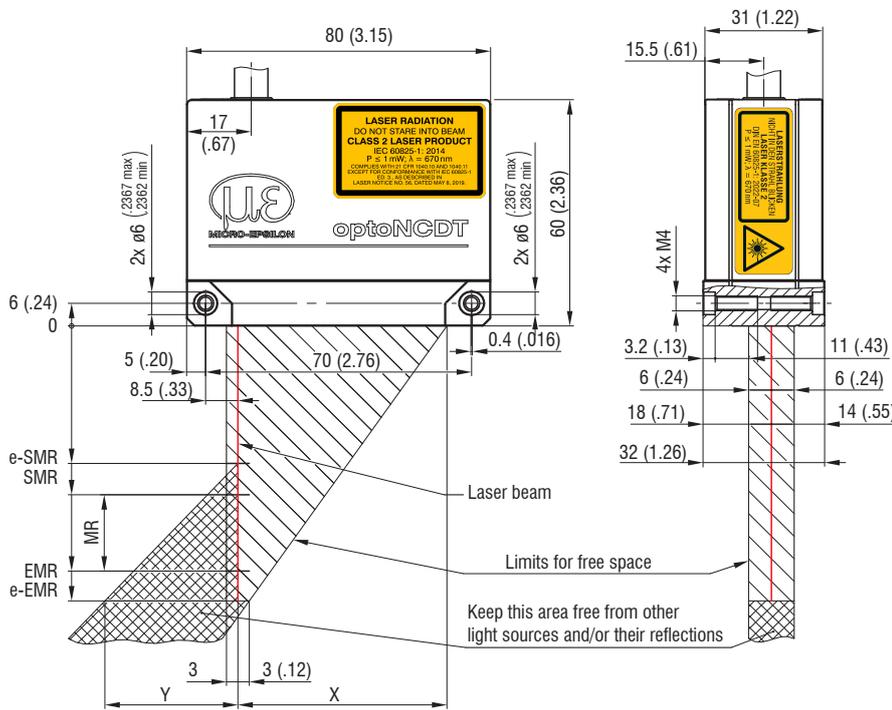
Fig. 5.4: Dimensional drawing ILD5500-100/200

MR[9]	100	200
e-SMR[10]	55	70
SMR[11]	70	100
MMR[12]	120	200
EMR[13]	170	300
e-EMR[14]	205	370
X standard MR	58	59
X with e-MR	59	60
Y standard MR	64	92
Y with e-MR	106	167

Tab. 5.5: Extended measuring range and free space, ILD5500-100/200

[9]   MR = Measuring range

[10] e-SMR = Extended start of measuring range

[11] SMR = Start of measuring range

[12] MMR = Start of measuring range + 0.5*measuring range

[13] EMR = End of measuring range

[14] e-EMR = Extended end of measuring range
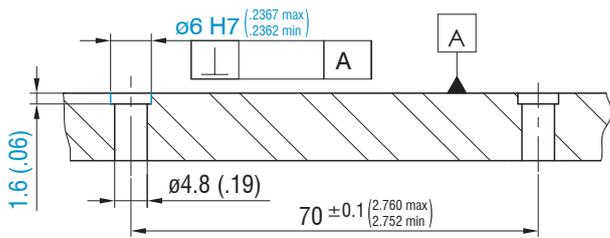
Fig. 5.5: Dimensional drawing of mounting plate

5.3 Electrical connections

5.3.1 Connection RJ45
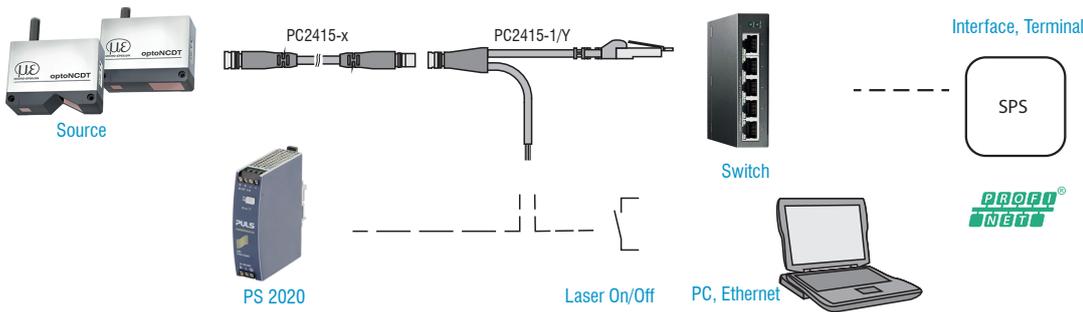
Fig. 5.6: Connection example with ILD5500-x-PROFINET, supply via optional power supply unit, laser on/off via hardware

5.3.2 Pin assignment

Signal	PC1900- IE-x/OE-RJ45	Remarks	
V_+	Red	Power supply	12 ... 30 VDC, typ. 24 VDC
GND	Blue	Reference ground	
Laser on/off +	Black	Switching input	Laser in the sensor is active if both pins are connected to each other.
Laser on/off -	Violet		

Tab. 5.6: Open-end connections, PC1900- IE-x/OE-RJ45

Signal	Pin	Remarks		
V_+	1	Power supply	12 ... 30 VDC, typ. 24 VDC	
GND	2	Reference ground		
Laser on/off +	7	Switching inputs		
Laser on/off -	8			

12-pin plug-in connector, M12, pin side of pigtail cable connector

Tab. 5.7: Pigtail connections on the sensor

5.3.3 Supply voltage

The sensor is supplied via the PC1900-IE-x cable or PC2415-x/PC2415-1/Y cable.

Sensor Pin	Color	Power supply	
1	Red	V_+	
2	Blue	GND	

Voltage supply only for measuring devices, not to be used for drives or similar sources of impulse interference at the same time. MICRO-EPSILON recommends using the optionally available PS2020 power supply unit for the sensor.

▶ Only turn on the power supply after wiring has been completed.
▶ Connect the inputs Pin 1 and Pin 2 at the sensor with a 24V power supply.

5.3.4 Turning on the laser

The measuring laser on the sensor is switched on via a software command or a switching input. This is advantageous when it comes to switching the sensor off for maintenance work or the like. Response time: after the laser is switched on, the sensor needs depending on the measuring rate five cycles to send correct measured data.

A switching transistor with an open collector (e.g. in an optocoupler), a relay contact or a digital TTL or HTL signal are suitable for switching.

Activation is possible with the PC1900-IE-x cable or the PC2415-x/PC2415-1/Y cable.
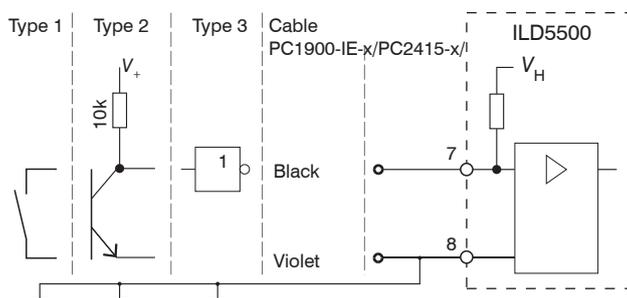
Fig. 5.7: Principle for laser activation

The inputs are not electrically separated.

Internal pull-up resistor, an open input is detected as High. Max. switching frequency 10 Hz. The ground of the logic circuit must be galvanically connected to "Laser on/off -".

An external resistor is not required for current limitation. For permanent "Laser on", connect the black and violet wires.

5.3.5 Plug connection, supply and output cables
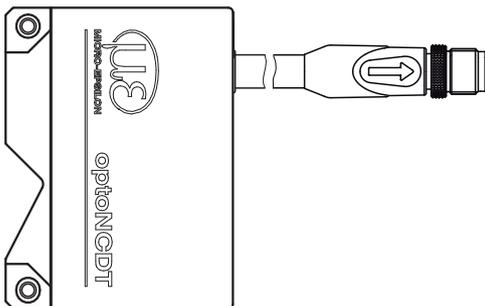
Fig. 5.8: ILD5500-x with pigtail

▶ Do not bend the sensor cable more tightly than 30 mm (fixed installation) or 75 mm(permanently flexible).

> i The firmly connected sensor cable is drag-chain suitable.
> Unused open cable ends must be insulated to protect against short circuits or sensor malfunctions.

MICRO-EPSILON recommends the use of the drag-chain compatible standard connection cable PC1900-IE from the optional accessories

▶ Fasten the plug connection of the cable plug and socket when using a drag-chain compatible PC1900-IE sensor cable.

- ► Avoid excessive pull on the cables. If a cable of over 5m in length is used and it hangs vertically without being secured, make sure that some form of strain relief is provided close to the connector.
- ► Do not twist a mated connection.
- ► Connect the cable shield to the potential equalization (PE, protective earth conductor) on the evaluator (control cabinet, PC housing) and avoid ground loops.
- ► Never lay signal lines next to or together with power cables or pulse-loaded cables (e.g., for drives or solenoid valves) in a single bundle or duct. Always use separate ducts.

6 Operation

6.1 Getting ready for operation

► Mount the sensor according to the installation instructions., see Chap. 5
► Connect the sensor to downstream display or monitoring units and the power supply.

The laser diode in the sensor is only activated

- due to software command or
- when the black and violet wires of the PC1900-IE-x are connected

Once the power supply has been switched on, the sensor runs through an initialization sequence. Already within the first second a connection to the sensor can be established and the measurement can be started.

During the first three seconds, an internal function check in the sensor is indicated by the Status LED, which lights up in the colors red, yellow and green one after another.

Initialization takes a maximum of 3 seconds. Within this period, only the RESET or the BOOTLOADER command is executed via the `Select` button.

The sensor requires a warm-up time of typically 30 minutes for reproducible measurements.

If the `State` LED is off, the laser light source is switched off.

If all LEDs are off, no power is being supplied.

6.2 Operation via web interface

6.2.1 General

The sensors start with the last stored operating mode. PROFINET is set by default.

| i | The ILD5500-x with PROFINET has no IP address by default. The IP address and the device name are assigned via the PROFINET Discovery Protocol. The IP address and the device name can be assigned, e.g., via the TIA Portal software , see Chap. 8.8 |

A web server is implemented in the sensor; the web interface displays, among other things, the current settings of the sensor. Operation is only possible while there is an Ethernet connection to the sensor.

PROFINET operation

► Assign an IP address to the sensor.

You can find an example of this in the appendix, see Chap. A 3.

► Start your web browser and type the IP address of the sensor into the address bar.

Firmware update is possible with PROFINET operation.

6.2.2 Access via web interface

► Start the sensor's web interface.

Interactive web pages for configuring the sensor now appear in the web browser. The sensor is active and provides measurement values.
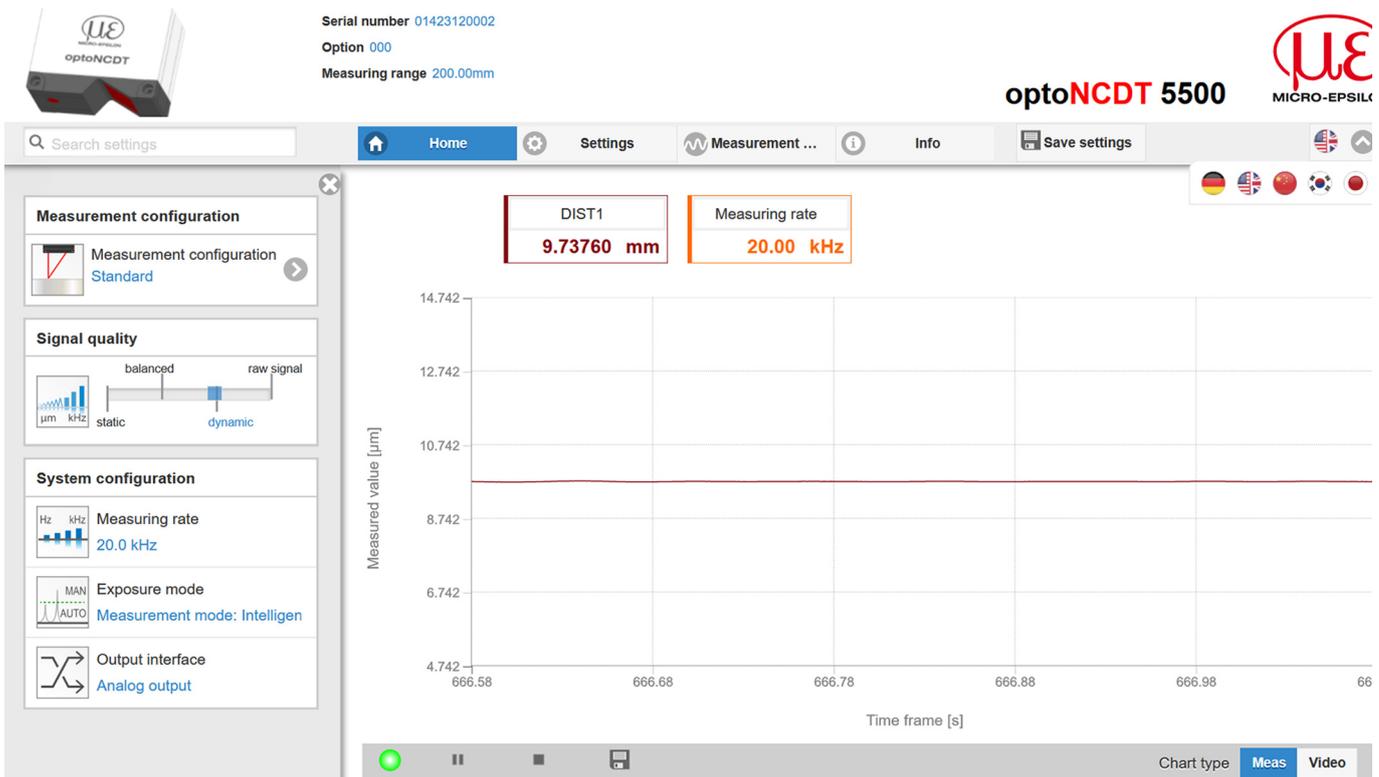
The horizontal navigation contains the following functions:

- The search function enables time-saving access to functions and parameters.
- `Home`. The web interface starts automatically in this view with Measurement chart, `Measurement configuration` and `Signal quality`.
- `Settings`. This menu contains all sensor parameters.
- `Measurement chart`. Measurement chart with digital display or video signal display.
- `Info`. Contains information about the sensor, including serial number, software version and an overview of all sensor parameters.
- Web interface language selection

The appearance of the web pages may change depending on the functions. Dynamic help texts with excerpts from the operating instructions support you in configuring the sensor.

i	Depending on the selected measuring rate and the PC used, measured values may be reduced dynamically in the display. That is, not all measured values are transmitted to the web interface for display and saving.

	Averaging	Description
	balanced Median with 9 values + Moving with 64 values	In the Signal quality section you can switch between four predefined basic settings (static, balanced, dynamic and without averaging). The reaction in the chart and the system configuration is immediately visible.
	Raw signal, without averaging	
	Static Median with 9 values + Moving with 128 values	
	Dynamic Median, 9 values	

i	If the sensor starts up with a user-defined measurement setting (setup), see Chap. 7.7.3, the signal quality cannot be changed.

The Signal quality function allows the predefined presets to be refined for the individual measurement task.

The System configuration section in the Home tab shows the current settings, including for the measuring rate and the averaging in blue. You can change the settings using the Signal quality slider or in the Settings tab.

The Chart type section enables you to switch between the graphical presentation of the measurement values over time and the video signal.

> i   After parameterization, store all settings permanently in a parameter set so that they are available again the next time the sensor is switched on. To do this, use the Save settings button.

6.2.3   Presets, setups, selection of measurement configuration

Definiton

- Preset: Manufacturer-specific program containing settings for common measuring tasks that cannot be overwritten.
- Setup: User-specific program containing the relevant settings for a measurement task.
- Initial setup at boot (sensor start): a favorite can be selected from the setups, which is automatically activated at sensor start. If no favorite is determined from the setups, the sensor activates the Standard preset at startup.

Upon delivery of the sensor from the factory

- the presets Standard, Multi-Surface and Light Penetration are possible
- no setups are available.
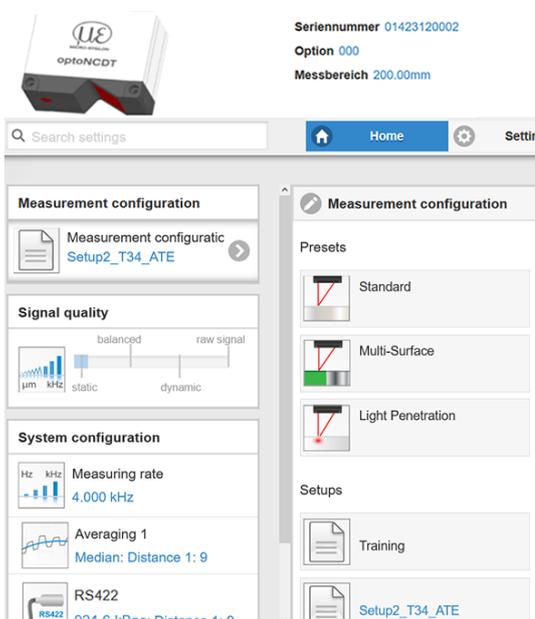
You can select a preset in the tab
- `Home > Measurement configuration`

You can select a setup in the tab
- `Home > Measurement configuration`
- `Settings` in the menu `System settings > Load & Save > Saved measurement settings`

A maximum of 8 setups can be permanently stored.

Tab. 6.1: Extract from the web interface, Home tab

For all presets, the averaging can be individually adapted to the measurement task via the `Signal quality` slider.

> i   If the sensor starts with a user-specific measurement setting (setup), the signal quality cannot be changed.

	Averaging	Description
Signal quality balanced μm kHz static dynamic	Balanced Median with 9 values + Moving with 64 values	In the `Signal quality` section you can switch between four predefined basic settings (static, balanced, dynamic and without raw signal). The reaction in the chart and system configuration is immediately visible.
	Raw signal, without averaging	
	Static Median with 9 values + Moving with 128 values	
	Dynamic Median with 9 values	

These presets enable quick startup of the respective measurement task. Selecting a preset which is suitable for the target surface activates a predefined configuration of settings that will produce the best results for the target material selected.

Measurement configuration

Presets

Standard

Multi-Surface
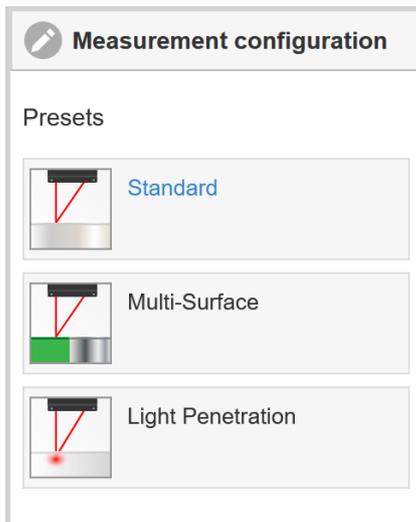
Light Penetration

Selection of configuration

Standard	Ceramics, metals
Multi-Surface	PCBs, hybrid materials
Light Penetration	Plastics (Teflon, POM), materials with strong laser penetration depth

> i   After parameterization, store all settings permanently in a parameter set so that they are available again the next time the sensor is switched on. To do this, use the `Save settings` button.

6.2.4   Video signal display in the web browser

▶   Display the video signal using the `Video` function in the `Chart type` section.

The graph displayed in the large chart area on the right represents the video signal and the receiving row. The video signal displayed in the chart area displays the intensity distribution of the pixels in the receiving row. The display covers the entire line, including the extended measuring range. Left 0 % (small distance) and right 100 % (large distance). The corresponding measured value is marked by a vertical line (peak marking).
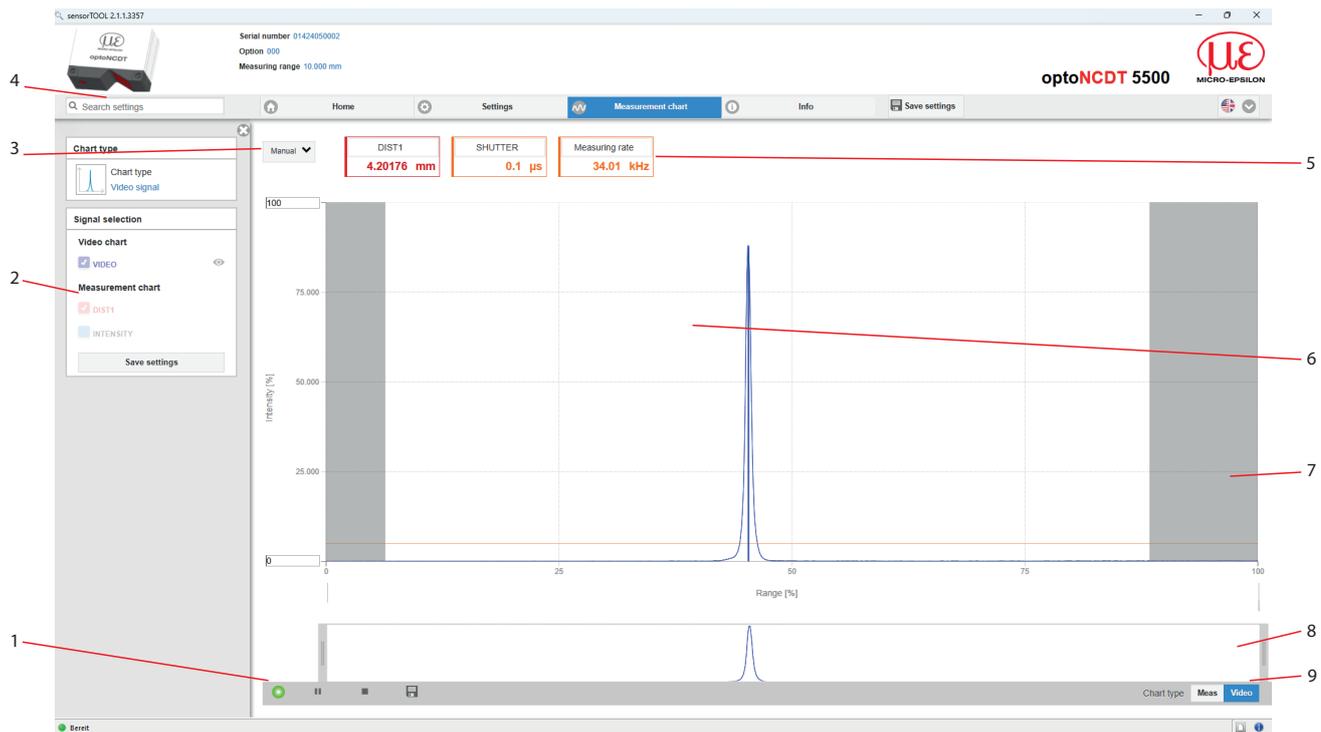
Fig. 6.1: Video signal web page

1   The LED visualizes the state of measured value transmission.

green Transmission of measured values in progress

yellow Waiting for data in trigger mode

gray Transmission of measured values stopped

The data query is controlled using the buttons Play/Pause/Stop/Save of the transmitted measured values Stop stops the chart; data selection and the zoom function are still possible. Save opens a Windows selection dialog for the file name and storage location to save the video signal in a CSV file.

Click on the Start button to display the video signal.

2   In the left-hand window, the video curves to be displayed can be switched on or off during or after the measurement. Inactive curves are grayed out and can be added by clicking on the check mark. If you want to have displayed one single signal, click on its name.

- Peak marking (vertical blue line), corresponds to the evaluated measurement value
- Linearized measuring range (limited by gray hatching), not changeable
- Masked range (limited by light blue hatching), changeable

3   For scaling the intensity axis (y-axis) of the graph, you can either select Auto (= Auto-scaling) or Manual (= manual setting).

4   The search function permits time-saving access to functions and parameters.

i	ASCII commands to the sensor can also be entered directly in the search field.

5   The text boxes display the current values for distance, exposure time, current measuring rate, display rate and time stamp.

6   Mouseover function. When stopped, moving the mouse over the graph marks curve points with a circle symbol and displays the associated intensity. The corresponding x-position in % appears above the graphic field.

7   The linearized range lies between the gray shades in the chart and cannot be changed. Only peaks whose middles lie within this range can be calculated as a measured value. The masked area can be restricted if necessary and is then limited by an additional light blue shading on the right and left. The peaks remaining in the resulting range are used for the evaluation.

8   X axis scaling: The chart displayed above is zoomable with both sliders on the right and on the left side in the lower total signal. The overall signal can also be moved to the side using the mouse in the center of the zoom window (arrow cross).

9   Select a chart type: measurement values or video signal

The display shows how the adjustable measurement task (target material), peak selection and possible interfering signals due to reflections or similar affect the video signal. There is no linear relationship between the position of the peak in the video signal display and the output measured value.

6.3 Parameter setting via PROFINET

The ILD5500-x-PROFINET can be parameterized acyclically via records.

It is also possible to cyclically turn the laser on and off, as well as to master it, which is done via the Automation Interface (AIF).

An overview of the available Records can be found in the documentation of the parameters, see Chap. 8.1

6.4 Time response, measurement value flow

The sensor requires 4 cycles to measure and process without triggering:

The cycle time is 50 µs at a maximum measuring rate of 20 kHz. The measured value N is available at the output after five cycles. The delay time between detection and start of output is therefore at least 250 µs. As the cycles are processed in parallel, the next measured value (N+1) is output after another cycle.

i	At a measuring rate of 20 kHz, the cycle time is 50 µs. Accordingly, the delay time between detection and the start of output is at least 250 µs.

Triggering always occurs at the beginning and not at the end of the 5 cycles. If the trigger timing is unfavorable, a previous value can be selected (jitter).

7 Set sensor parameters, web interface

7.1 Preliminary remarks concerning the setting options

There are two ways to parameterize the optoNCDT 5500:

- Using the web browser and sensor web interface,
- by means of PROFINET and the manufacturer-specific records43

| i | If you do not permanently save the parameter set in the sensor, the settings are lost when the sensor is turned off. |

After completing the settings in the web interface:

▸ Go to `Settings > System settings > Load & Save` or click the `Save settings button`, , see Chap. 7.7.3

The sensor now also saves the settings to the records for use in PROFINET mode.

7.2 Overview of parameters

You can set or change the following parameters in the optoNCDT 5500, see `Settings` tab.

Inputs	Synchronization, Terminating resistor, MFI Level
Data acquisition	Measuring rate, Measuring task, Evaluation range (ROI), Exposure mode, Peak selection, Reset counter, Output trigger
Signal processing	Measurement value averaging
Postprocessing	Zeroing/Mastering, Statistics, Triggering (data output), Data reduction, Error handling
Outputs	Switching duration, Error outputs 1/2, Output interface, Ethernet settings
System settings	Unit on the web interface, Key lock, Load & Save, Import & Export, Access authorization, Reset controller (factory settings), Laser power

7.3 Inputs

▸ In the `Settings` tab, switch to the `Inputs` menu.

Laser power	Full	Full power for standard surfaces	The laser light source is active only when Pin 7 is connected to Pin 8
	Medium	Optimized power for strongly reflecting surfaces and small measuring ranges	
	Reduced	Minimum power for service purposes	
	Off	Laser is off	

Tab. 7.1:

| i | Pay attention to the signal intensity when switching the laser power. You achieve best possible results with a signal intensity of 25 ... 50 %. |

7.4 Data recording

7.4.1 Preliminary remarks

▸ In the `Settings` tab, switch to the `Data acquisition` menu.

According to the previous setting in the Diagram type area, a diagram is displayed in the right part of the display. The diagram is active and all settings become immediately visible. Notes on the chosen settings are displayed below.

In the left area, the menus for the `Data acquisition` are displayed.

7.4.2 Measurement configuration

Details can be found in the web interface operation, see Chap. Presets, setups, selection of measurement configuration, see Chap. 6.2.3

7.4.3 Measurement task

Details can be found in the web interface operation, see Chap. Presets, setups, selection of measurement configuration, see Chap. 6.2.3

7.4.4 Measuring rate

The measuring rate indicates the number of measurements per second.

► Select the required measuring rate.

Measuring rate	250 Hz / 500 Hz / 1 kHz / 2 kHz / 4 kHz / 8 kHz / 10 kHz/ 20 kHz		Use a high measuring rate for bright and mat measuring objects. Use a low measuring rate for dark or shiny measuring objects (e.g. black painted surfaces) to improve the measurement result. The maximum free measuring rate depends on PROFINET and the bus cycle time.
	free measuring rate	value	

7.4.5 Counter reset

You can reset the counter readings for the measured values and the time stamps. It is not possible to display the counter readings in the web interface.

7.4.6 Masking the region of interest, ROI

Masking limits the region of interest (ROI) for the distance calculation in the video signal. This function is used in order to e.g. suppress interfering reflections or ambient light.
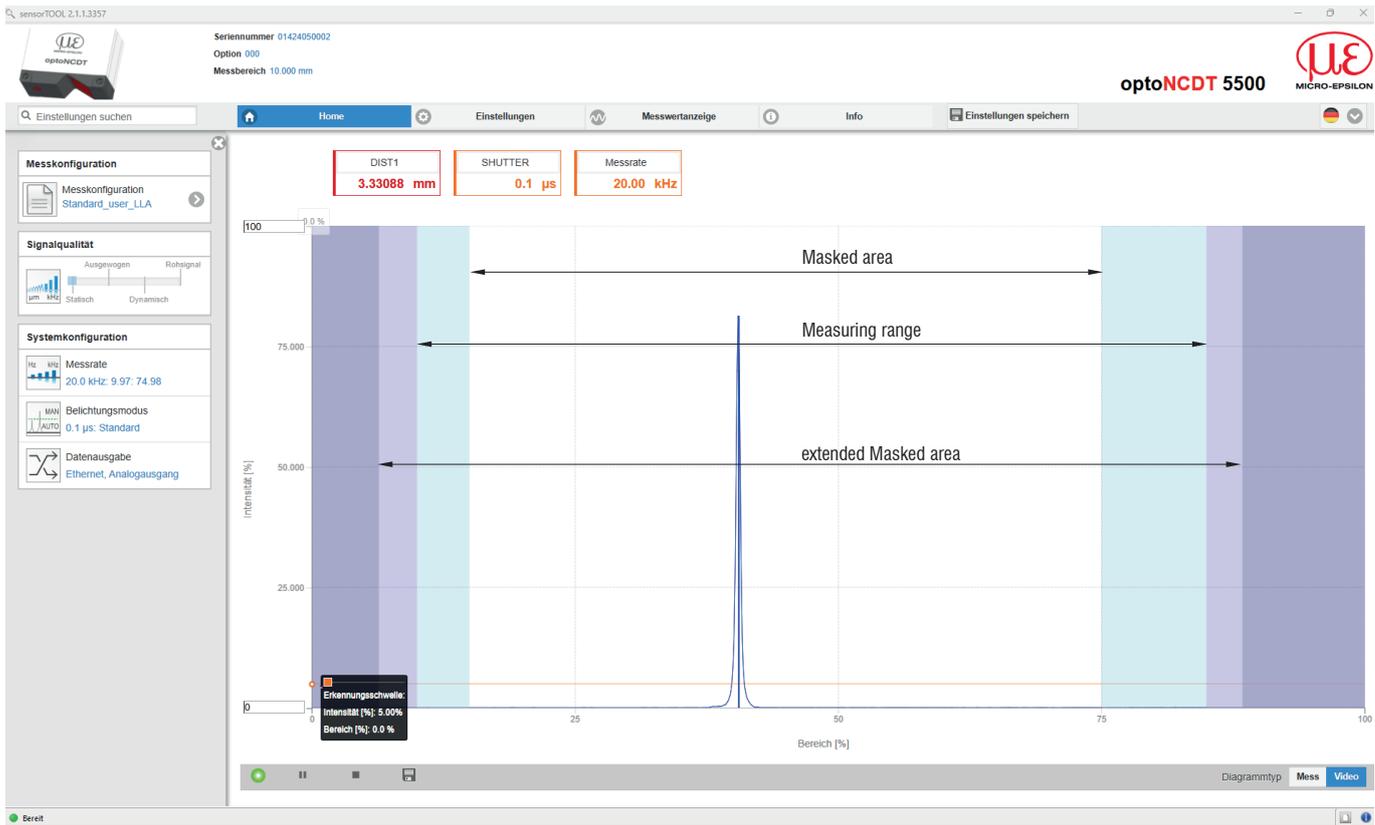
Fig. 7.1: ROI Standard

The exposure control optimizes the peaks in the region of interest. Therefore, small peaks can be optimally adjusted when a high interference peak is outside the region of interest.

7.4.7 Exposure mode

Exposure mode	Automatic mode	Standard / Intelligent control / Background suppression		 *Standard: The sensor determines the optimal exposure time itself and regulates the intensity to approx. 50 to 60%.* *Intelligent control: This intelligent algorithm is particularly advantageous for measurements on moving objects or in the case of transitions between different materials.* *Background suppression: Suppresses interference caused by ambient light. This significantly improves the ambient light tolerance of the sensor. The output rate of the sensor is halved.*
	Manual mode	Exposure time in *µs*	Value	*In manual mode, with the video signal shown, the exposure time is set by the user. Vary the exposure time in order to obtain a signal intensity of up to 95%.*

7.4.8 Peak selection

Peak selection	First peak / Highest peak / Latest peak / widest peak	Defines which signal in the array signal is used for the evaluation. First peak: Nearest peak to sensor. Highest peak: Standard, peak with the highest intensity. Last peak: Peak furthest away from sensor. Widest peak: Peak with largest area.	

If a measuring object contains multiple transparent layers, a correct measurement result is determined only for the first peak.

7.5 Signal processing

7.5.1 Preliminary remarks

► In the Settings tab, switch to the Signal processing menu.

According to the previous setting in the Diagram type area, a diagram is displayed in the right part of the display. The diagram is active and all settings become immediately visible. Notes on the chosen settings are displayed below.

In the left area, the menus for the Signal processing are displayed.

7.5.2 Averaging

7.5.2.1 General

It is recommended to use averaging of the measured values for statistical measurements or slowly changing measurement values.

The Averaging 1 function is executed before the Averaging 10 function.

Averaging	No averaging			Measurements are not averaged.
	Moving N values	2 ... 4096	Value Value	Specification of the averaging type. The averaging number N indicates how many consecutive measured values are averaged in the sensor.
	Recursive N values	2 ... 32767	Value	
	Median N values	3 / 5 / 7 / 9	Value	

Measurement averaging is performed after the distance values have been calculated, and before they are issued through the relevant interfaces.

Measurement averaging

- improves the resolution,
- allows the masking of individual interference points, or
- "smooths" the measurement result.

Linearity is not affected by averaging.

The average values are continuously recalculated with each measurement. The desired averaging depth is only achieved after the number of recorded measurement values corresponds at least to the averaging depth.

Note	The defined type of average value and the averaging number must be stored in the sensor to ensure they are hold after it is switched off.

Averaging has no effect on the measuring rate or data rate in case of digital measurement value output. The averaging numbers can also be programmed via the digital interfaces. The sensor is delivered with "Median 9" as factory settings, i.e. median averaging over 9 measurement values.

Depending on the type of average and the number of averaged values, different transition response times result thereof

7.5.2.2 Moving mean

The definable number N for successive measurements (window width) is used to calculate the arithmetic average M_{mov} according to the following formula:

$$M_{mov} = \frac{\sum_{k=1}^{N} MV(k)}{N}$$

MV	Measurement value
N	Averaging number
k	Continuous index (in the window)
M_{mov}	Average value or output value

Methods:

Each new measured value is added, and the first (oldest) value is removed from the averaging (from the window). This produces short settling times in case of measurement jumps.

Example: N = 4

... 0, 1, |2, 2, 1, 3|　　　　　... 1, 2, |2, 1, 3, 4|　　　　Measured values

$$\frac{2, 2, 1, 3}{4} = M_{mov}(n) \qquad\qquad \frac{2, 1, 3, 4}{4} = M_{mov}(n+1) \qquad \text{Output value}$$

Special features:

All values are permitted for the averaging number N in the sensor's moving average. The range of values for the averaging number N is 1 ... 4096.

7.5.2.3 Recursive average

Formula:

$$M_{rek}(n) = \frac{MW_{(n)} + (N-2) \times M_{rek\,(n-1)}}{N}$$

N = Averaging number, N = 2 ... 32767

n = Measured value index

MV = Measurement value

M_{rec} = average or output value

Methods:

Each new measured value $MV_{(n)}$ is weighted and added to the sum of the previous average values $M_{rec}(n\text{-}1)$.

Please note:

Recursive averaging allows for very strong smoothing of the measurements, however it requires long response times for measurement jumps. The recursive average value shows low-pass behavior. The range of values for the averaging number N is 2 .. 32767.

7.5.2.4 Median

A median value is formed from a preselected number of measured values.

Methods:

The incoming measured values (3, 5, 7 or 9 measurement values) are also sorted again after each measurement. The middle value is then output as the median. 3, 5, 7 or 9 measured values are taken into account for the calculation of the median, i.e. there is no median 1.

Special features:

This averaging type suppresses individual interference pulses. However, smoothing of the measurement curves is not very strong.

Example: N = 5

... 0 1 $\underline{2\ 4\ 5\ 1\ 3}$ → Sorted measurements: 1 2 $\boxed{3}$ 4 5 Median$_{(n)}$ = 3

... 1 2 $\underline{4\ 5\ 1\ 3\ 5}$ → Sorted measurements: 1 3 $\boxed{4}$ 5 5 Median$_{(n+1)}$ = 4

Tab. 7.2: Example median N=5

7.5.3   Zeroing, mastering

Use zeroing and mastering to define a nominal value within the measuring range. This shifts the output range. This feature can be useful, for example, when several sensors perform simultaneous measurements in thickness and planarity measurements or during sensor replacement.

Mastering is used to compensate for mechanical tolerances in the sensor measurement setup or to correct chronological (thermal) changes to the measuring system. The master value, also called calibration value, is defined as the nominal value.

> i   `Mastering` or `Zeroing` requires a target object to be present in the measuring range. `Mastering` or `Zeroing` affects the digital output and the display equally.
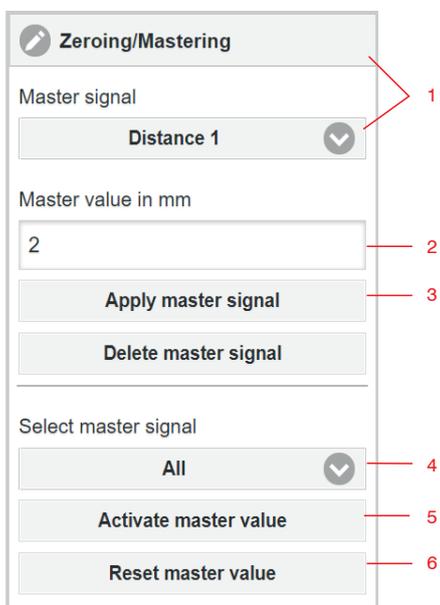
1	Selecting a signal for the function, assigning master value.
2	Saves master value in volatile memory[15].
3	Deletes master value in volatile memory.
4	Selection of a certain signal or function
5	Starting the function
6	Ending the function, returning to absolute measurement.

Mastering / zeroing sequence:

▶   Bring the measuring object and sensor into the desired relative position

▶   Send the command `Enable master` (PROFINET) or click the `Activate master value` button. After setting the master, the controller will issue new readings that relate to the master value. By resetting with the `Reset master value` button, the status before mastering is restored.

7.6   Digital values

7.6.1   Values, ranges

The digital measurement values are issued as unsigned digital values (raw values). 16 or 18 bits per value are transmitted. Below you will find a compilation of the output values and the conversion of the digital value.

---

[15] The `Save settings` function permanently saves the master value to a setup.

Value	Length	Variables		Value range	Formula
Distance	18 bits	x	Digital value	[0; 230604]	$d = \dfrac{x - 98232}{65536} * MR$
		MR	Measuring range in mm	{2/6/10/25/50/100/200/500}	
		d	Distance in mm	without mastering [-0.01MR; 1.01MR]	
				with mastering [-2MR; 2MR]	
Exposure time	16 bits	x	Digital value	[1000; 40000]	$BZ\,[\mu s] = \dfrac{1}{10}\,x$
		ET	Exposure time in µs	[100; 4000]	
Intensity	16 bits	x	Digital value	[0; 1023]	$I = \dfrac{100}{1023}\,x$
		I	Intensity in %	[0; 100]	

Value	Length	Variables		Value range	Formula
Sensor status	18 bits	x	Digital value	[0; 242143]	Bit 0 (LSB): peak starts before ROI
			Bit coding	[0; 1]	Bit 1: peak ends after ROI
					Bit 2: No peak found
		SMR	Start of measuring range		Bit 5: Distance before SMR (extended)
		EMR	End of measuring range		Bit 6: Distance after EMR (extended)
Measurement counter	18 bits	x	Digital value	[0; 262143]	

Value	Length	Variables		Value range	Formula
Timestamp	32 bits	x	Digital value	[0; 4294967295]	$t = \dfrac{1}{1000}\,x$
		t	Time stamp in µs	[0; 1h11m34.967s]	
Non-linearized focal point	18 bit	x	digital value	[0; 262143]	$US\,[\%] = \dfrac{100}{262143}\,x$
		US	Focal point in %	[0; 100]	
Measurement frequency	18 bits	x	Digital value	[2500; 100000]	$f = \dfrac{x}{10}$
		f	Frequency in Hz		

State information transferred in the distance value

Distance value	Description
262076	No peak is present
262077	Peak is before the measuring range (MR)
262078	Peak is after the measuring range (MR)
262080	Measurement value cannot be evaluated
262081	Peak is too wide
262082	Laser is off

i	The sensor sends the cyclic process data in little-endian format. The acyclic demand data is also in little-endian format; records are read as little-endian and must also be written as little-endian. If the PLC uses the big-endian format, the byte order must be swapped.

7.6.2 Behavior of the digital output

Measured values based on the Zeroing/Mastering function are coded with 18 bits. The master can assume twice the measuring range. The examples demonstrate the behavior of the digital value with an ILD5500-100, measuring range 100 mm.

Target at 16 % measuring range

| 16,00 mm | 108718 |

SMR | EMR
0 % | 16 % | 100 % *MR*

► Zero setting (master value = 0 mm)

| 0,00 mm | 98232 |

SMR | EMR
0 % | 16 % | 100 % *MR*

| - 16,00 mm | 84,00 mm |
| 87746 | 153282 |

Target at 60 % measuring range

| 60,00 mm | 137554 |

SMR | EMR
0 % | 60 % | 100 % *MR*

► Zero setting (master value = 0 mm)

| 0,00 mm | 98232 |

0 % | 60 % | 100 % *MR*

| -60,0 mm | 40,00 mm |
| 58910 | 124446 |

Target at 60 % measuring range

| 60,00 mm | 137554 |

SMR | EMR
0 % | 60 % | 100 % *MR*

► Set master value 10 mm

| 10,00 mm | 104786 |

SMR | EMR
0 % | 60 % | 100 % *MR*

| -50,0 mm | 50,00 mm |
| 65464 | 131000 |

Digital minimum reached at 10 % MR

Fig. 7.2: Digital values without zeroing or mastering

Fig. 7.3: Digital values of an 5500-100 after mastering with 200 mm master value

7.7 System Settings

7.7.1 General

After programming, all settings must be saved permanently under a parameter set so that they are available again the next time the sensor is switched on.

7.7.2 Unit, Language

The web interface supports units in millimeters (mm) and inches in the display of the measurement results. German, English, Chinese or Japanese can be selected as web interface language. Switch the language in the menu bar.
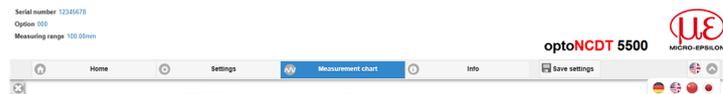
7.7.3 Loading, saving

All the sensor settings can be saved permanently in user programs, which are known as setups.
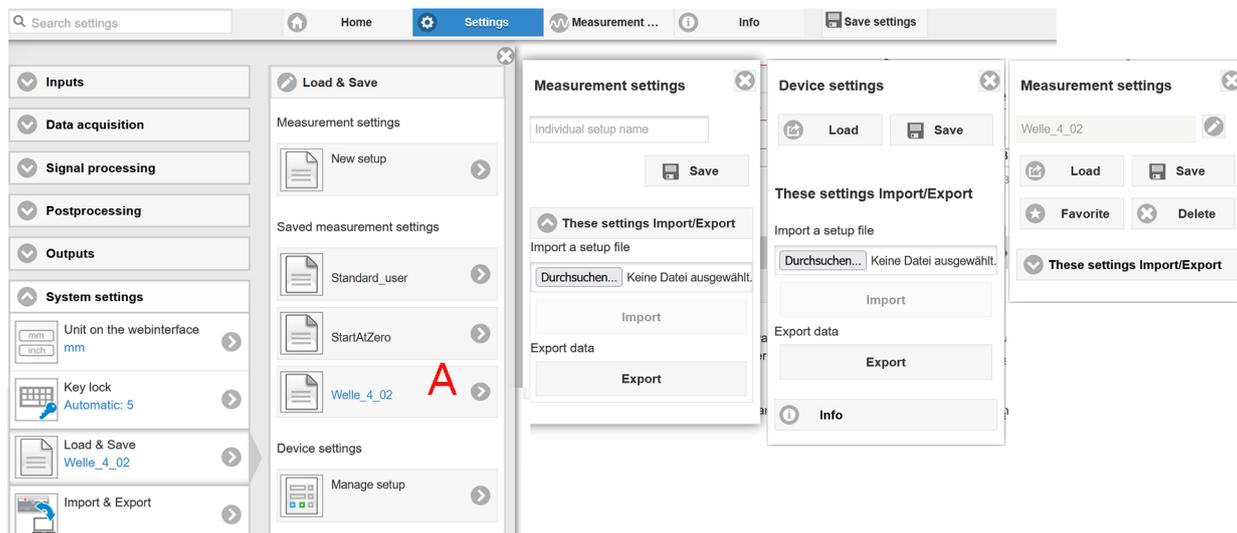
Fig. 7.4: Managing user programs

Managing setup in the sensor, options and procedure - see example "A"			
Saving the settings	**Activating existing setup**	**Saving changes in the active setup**	**Determining setup after booting**
`New setup` menu	`Load & Save` menu	Menu bar	`Load & Save` menu
Enter the name for the setup in the `Individual setup name` field, e.g. `Shaft 4_02` and confirm the entry with the `Save` button.	The desired setup can be found in section A. Left-click on the setup. The following dialog opens: `Measurement settings`. Click on the `Load` button.	Click on the button ![Save settings]	Left-click on the setup. The following dialog opens: `Measurement settings`. Click on the `Favorite` button.
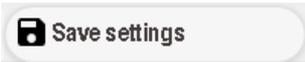
Exchange setup with PC/notebook, options	
Saving setup on PC	**Loading setup from PC**
`Load & Save` menu	`Load & Save` menu
Left-click on the setup. The `Measurement settings` dialog opens. Click on the `Export` button.	Left-click on `New setup`. The `Measurement settings` dialog opens. Click `These settings Import/Export`. A Windows dialog for file selection opens. Select the desired file and click the `Open` button. Click on the `Import` button.

7.7.4 Import, export

A parameter set includes the current settings, setup(s) and the initial setup when booting the sensor.

The `Import & Export` menu allows you to easily exchange parameter sets with a PC/notebook.

Exchange of parameter sets with PC/notebook, possibilities		
Storing parameter set on PC	**Loading parameter set from PC**	
`Import & Export` menu	`Import & Export` menu	
Click on the button `Parameter set` with the left mouse button. The `Choose export data` dialog opens. Compose a parameter set by selecting/deselecting the checkboxes. Click on the `Transmit file` button. A Windows dialog for data transfer opens. The operating system automatically stores the parameter set in the `Downloads` area. The file name for the adjacent example is therefore `\ Downloads\ILD5500_BA-SICSETTINGS_MEASSET-TINGS_... .JSON>` Open the download via the open menu window by clicking on `Open file`.	Click the `Select file` button. A Windows dialog for file selection opens. Select the desired file and click on the `Open` button. The `Choose import data` dialog opens. Determine the operations to be performed by selecting/deselecting the checkboxes. Click on the `Transmit file` button.	

In order to avoid that an already existing setup is overwritten unintentionally during import, an automatic security request is carried out (see adjacent figure).

7.7.5 Reset sensor

Reset sensor	Measurement settings	Button	Deletes the settings for measuring rate, trigger, region of interest, peak selection, error handling, averaging, zeroing/mastering, data reduction and the setups. Loads the 1st preset.
	Device settings	Button	Deletes the baud rate, language, unit, key lock and echo mode settings and loads the default parameters.
	Reset all	Button	Deletes the settings for the sensor, the measurement settings, the access authorization, password and the setups. Loads the 1st preset.
	Reboot controller	Button	Reboots the sensor with the settings from the favorites setup, see Chap. 7.7.3.

7.7.6 Boot mode

`Industrial Ethernet`: The sensor starts or switches to the regular PROFINET mode.

▶ Save your settings when you have finished programming,, see Chap. 7.7.3

The sensor must have an IP address so that the web interface and the PLC can access the sensor in parallel via Ethernet (TCP/IP and UDP protocols).

8 PROFINET - Documentation

8.1 Preliminary remarks

The sensor starts with the last stored operating mode. PROFINET is set by default.

PROFINET operation enables easy parameter setting of a sensor

- via web interface, see Chap. 6.2.1, see Chap. 7
- Records, see Chap. 8.6

8.2 General, initial operation

The ILD5500-x-IE with PROFINET is a PROFINET IO device that can exchange data cyclically and acyclically with a PROFINET IO controller. The sensor supports PROFINET with RT (real-time communication) and PROFINET IRT (isochronous real-time communication).

Maximum measurement frequency (RT)	20 kHz (via oversampling)
Minimum bus cycle period (RT)	1 ms
Supported I&M records	0 to 3
Minimum cyclic process data size	4 byte
Maximum cyclic process data size	288 byte
Number of input modules	8
Number of input submodules	48

In the delivery state, the ILD5500-x-IE with PROFINET has no IP address and also no device name. These settings must be made once. The IP address and the device name are assigned via the PROFINET Discovery Protocol. The IP address and the device name can be assigned, e.g., via the `TIA Portal` software.

i	To use the ILD5500-x-IE with PROFINET, you need the GSDML file associated with the sensor. This is an XML file that you must include in your PLC environment, see Chap. 8.7

i	Define the modules in the device overview, see Chap. 8.7. Note the instructions and examples for acyclic reading and writing of records, see Chap. 8.7

8.3 Cyclic data traffic

In RT mode, the ILD5500-x-IE with PROFINET achieves a minimum bus cycle time of 1 ms. In addition, the sensor measures at the internal measuring rate.

In PROFINET, the structure of the process data is defined by the modules and submodules. Modules can be placed in slots and submodules in subslots. When a submodule is placed in a subslot, the parameters of the submodule are selected for cyclic process data transfer. A submodule contains at least one parameter.

The ILD5500-x-IE with PROFINET dynamically adapts to the module configuration that you have made in the PLC. You can reconfigure the module by rebooting the sensor.

The ILD5500-x-IE with PROFINET

- defines 20 different input modules
- each containing 9 submodules.

The 20 input modules can only be placed in slot 1, which means that only one module can be selected at a time. By choosing an input module, you are deciding on a type of oversampling. Oversampling 1 to 20 are available for selection.

Oversampling is a mechanism that enables the sensor to measure faster than the bus cycle. Process data is collected in the sensor over several measurement cycles and written to the process data frame one after the other.

With oversampling, a process data frame thus contains the same parameter several times from different measurement cycles.

With an oversampling of, e.g. 3, the process data frame contains each parameter of a submodule 3 times.

The further forward a parameter is in the process data frame, the older the parameter is in time. In RT mode, oversampling enables the sensor to measure at a maximum measurement frequency of 20 kHz, although the sensor itself only supports bus cycles of 1 kHz.

Name of input module	Number of submodules	Oversampling	Size of process data in bytes
Oversampling 1 Input	6	1	4 to 36
Oversampling 2 Input	6	2	8 to 72
Oversampling 3 Input	6	3	12 to 108
Oversampling 4 Input	6	4	16 to 144
Oversampling 5 Input	6	5	20 to 180
Oversampling 6 Input	6	6	24 to 216
Oversampling 7 Input	6	7	28 to 252
Oversampling 8 Input	6	8	32 to 288
...	...	...	...
Oversampling 20	6	20	80 to 720

Tab. 8.1: Input modules available for selection

You must select at least 1 submodule per module. The submodules can be placed anywhere in subslot 1 to 6. If you select a submodule with a larger oversampling than 1, the parameters of a submodule are transmitted several times in succession.

With an oversampling of 2, this means, for example, that for the Frequency + Shutter submodule , the frequency from the previous measuring cycle is transmitted in bytes 0 to 3 and the frequency from the current measuring cycle is transmitted in bytes 4 to 7.

Submodule, name	Parameter	Size of process data in bytes
Frequency	UINT32 Frequency	8
	UINT32 Exposure time	
Shutter	UINT32 Frequency	8
	UINT32 Exposure time	
Frame time stamp	UINT32 Time stamp	4
Frame count	UINT32 Measurement counter	4
Frame status	UINT32 Status	4
Ulin	UINT32 Unlinearized distance	12
	UINT32 Intensity	
	UINT32 Linearized distance	
Intensity	UINT32 Unlinearized distance	12
	UINT32 Intensity	
	UINT32 Linearized distance	
Lin	UINT32 Unlinearized distance	12
	UINT32 Intensity	
	UINT32 Unlinearized distance	
Peak 1 Distance	UINT32 Peak distance	4

Tab. 8.2: Oversampling 1 Input, submodules available for selection

Submodule, name	Parameter	Size of process data in bytes
Frequency	UINT32 Frequency 0 / 1	16
	UINT32 Exposure time 0 / 1	
Shutter	UINT32 Frequency 0 / 1	16
	UINT32 Exposure time 0 / 1	
Frame time stamp	UINT32 Time stamp 0 / 1	8

Frame count	UINT32 Measurement counter 0 / 1	8
Frame status	UINT32 Status 0 / 1	8
Ulin	UINT32 Unlinearized distance 0 / 1	24
	UINT32 Intensity 0 / 1	
	UINT32 Linearized distance 0 / 1	
Intensity	UINT32 Unlinearized distance 0 / 1	24
	UINT32 Intensity 0 / 1	
	UINT32 Linearized distance 0 / 1	
Lin	UINT32 Unlinearized distance 0 / 1	24
	UINT32 Intensity 0 / 1	
	UINT32 Linearized distance 0 / 1	
Peak 1 Distance	UINT32 Peak distance 0 / 1	8

Tab. 8.3: Oversampling 2 Input, submodules available for selection

Submodule, name	Parameter	Size of process data in bytes
Frequency	UINT32 Frequency 0 / 1 / 2	24
	UINT32 Exposure time 0 / 1 / 2	
Shutter	UINT32 Frequency 0 / 1 / 2	24
	UINT32 Exposure time 0 / 1 / 2	
Frame time stamp	UINT32 Time stamp 0 / 1 / 2	12
Frame count	UINT32 Measurement counter 0 / 1 / 2	12
Frame status	UINT32 Status 0 / 1 / 2	12
Ulin	UINT32 Unlinearized distance 0 / 1 / 2	36
	UINT32 Intensity 0 / 1 / 2	
	UINT32 Linearized distance 0 / 1 / 2	
Intensity	UINT32 Unlinearized distance 0 / 1 / 2	36
	UINT32 Intensity 0 / 1 / 2	
	UINT32 Linearized distance 0 / 1 / 2	
Lin	UINT32 Unlinearized distance 0 / 1 / 2	36
	UINT32 Intensity 0 / 1 / 2	
	UINT32 Linearized distance 0 / 1 / 2	
Peak 1 Distance	UINT32 Peak distance 0 / 1 / 2	12

Tab. 8.4: Oversampling 3 Input, submodules available for selection

Submodule, name	Parameter	Size of process data in bytes
Frequency	UINT32 Frequency 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	64
	UINT32 Exposure time 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	
Shutter	UINT32 Frequency 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	64
	UINT32 Exposure time 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	
Frame time stamp	UINT32 Time stamp 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	32
Frame count	UINT32 Measurement counter 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	32
Frame status	UINT32 Status 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	32
Ulin	UINT32 Unlinearized distance 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	96
	UINT32 Intensity 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	
	UINT32 Linearized distance 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	
Intensity	UINT32 Unlinearized distance 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	96
	UINT32 Intensity 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	
	UINT32 Linearized distance 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	

Lin	UINT32 Unlinearized distance 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	96
	UINT32 Intensity 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	
	UINT32 Linearized distance 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	
Peak 1 Distance	UINT32 Peak distance 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7	32

Tab. 8.5: Oversampling 8 Input, submodules available for selection

The parameters and the respective sizes of the process data for oversampling from 4 to 20 are defined analogously to the mentioned schemes.

8.4 Automation Interface

The Automation Interface (AIF enables to change selected parameters of the sensor via cyclic data and receive corresponding statuses.

The AIF in Profinet is organized into modules and submodules. The **AIF Base** module is intended for use with the ILD5500 and can be used as needed. This module is plugged in or removed from the Profinet master accordingly.

The AIF Base contains only a single submodule (Sub1) that is permanently assigned to the module. This submodule contains 8 bytes of output and input data each. Parameters can be changed and actions performed on the sensor via the output data, and corresponding statuses are displayed via the input data.

Only the marked data is relevant for the ILD5500.
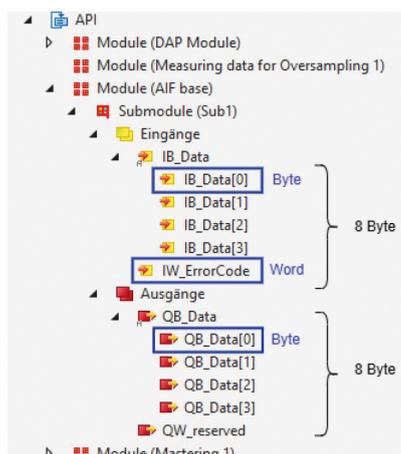
Fig. 8.1: AIF view in TwinCAT

QB_Data[0]	Bit		
	0	unused	
	1	Disable measuring results	True = All measurement results show error code 0x0000
	2	Laser off	True = Laser is off
	3	unused	
	4	Execute mastering	Rising edge causes mastering depending on bit7
	5	unused	
	6	unused	
	7	Mastering method	False = Mastering executes set, True = Mastering executes reset

Tab. 8.6: Output data

IB_Data[0]	Bit		
	0	unused	
	1	unused	
	2	Laser off	True when laser is off
	3	unused	

	4	Mastering success	True when mastering was successful
	5	unused	
	6	unused	
	7	Master on	True when master values are mastered

Tab. 8.7: Input data
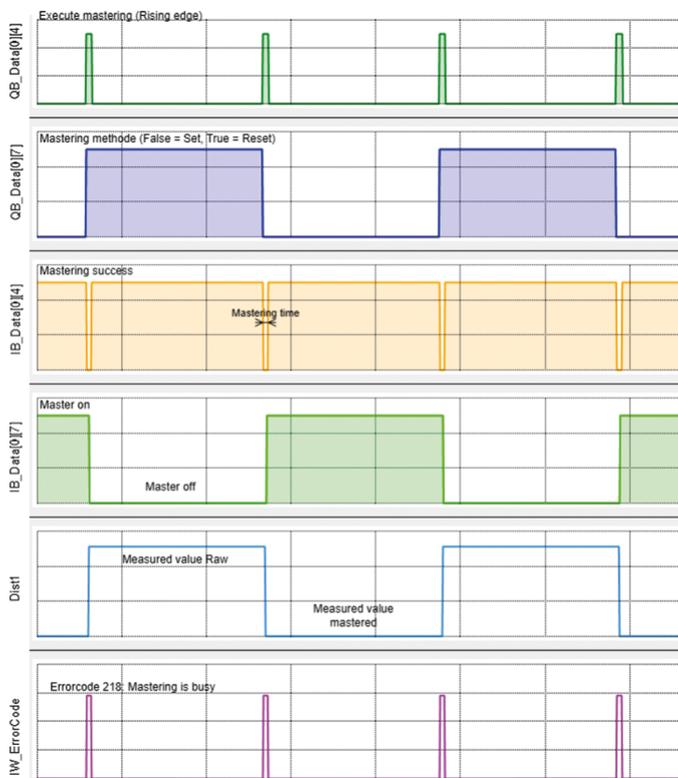
Fig. 8.2: Timing diagram mastering

8.5 Data format, little-endian

The sensor sends the cyclic process data in little-endian format.

The acyclic demand data is also in little-endian format; records are read as little-endian and must also be written as little-endian.

If the PLC uses the big-endian format, the byte order must be swapped.

AllenBradley	Big-endian
BECKHOFF	Big-endian
Festo	Little-endian
Omron	Big-endian
SIEMENS S7-300	Big-endian
SIEMENS S7-1200/150	Little-endian

Tab. 8.8: Data format, examples of some manufacturers

8.6 Acyclic reading and writing of records with RDREC or WRREC

8.6.1 General

The ILD5500-x-IE with PROFINET can be parameterized via acyclic data that are not transmitted cyclically. These acyclic data are organized in PROFINET in the so-called records.

A record is a contiguous block

- of one or more parameters,
- which can be accessed in read or write mode.

When writing or reading a record, you must fill the read or write request with AR, API, slot, subslot, index, and the read/ write length.

8.6.2   I&M records

PROFINET defines so-called `Identification and Maintenance Records`, which contain various device information. These records are available in every PROFINET device.

The read and write request is addressed as follows:

Parameter	Length in bytes	value
AR	0	Permanently 0
API	4	Permanently 0
Slot	2	Permanently 0
Subslot	2	Permanently 1
Index	2	0xAFF0 – 0xAFF3
Length	4	see Block length

The ILD5500-x-IE with PROFINET supports the I&M records 0 to 3

	Parameter	Data type	Info
Block Header	Block Type	UINT16	0x0020
	Block Length	UINT16	0x0038
	Block Version High	UINT8	0x01
	Block Version Low	UINT8	0x00
I&M0	Manufacturer ID	UINT16	0x0426 (MICRO-EPSILON Messtechnik GmbH)
	Order ID	UINT8(20)	„4120xxx.001"
	Serial number	UINT8(16)	
	Hardware revision	UINT16	e.g., 0x0003
	Software revision prefix	UINT8	Character describing the software of the (sub) module.Allowed values: 'V', 'R', 'P', 'U' and 'T
	Software revision X	UINT8	Function Enhancement (Major Version Number)
	Software revision Y	UINT8	Bug Fix (Minor Version Number)
	Software revision Z	UINT8	Internal Change (Build Version Number)
	Revision counter	UINT16	Starting from 0, shall increment on each parameter change)
	Profile ID	UINT16	0
	Profile specific type	UINT16	5
	IM version	UINT16	The I&M version. (Default value 0x0101)
	IM supported	UINT16	Bit list describing the I&M variants supported by the (sub) module: 0x02 -> I&M1 Supported 0x04 -> I&M2 Supported 0x08 -> I&M3 Supported 0x10 -> I&M4 Supported 0x20 -> I&M5 Supported

Tab. 8.9: Structure I&M0 record, index: 0xAFF0, access: read-only

	Parameter	Data type	Info
Block Header	Block type	UINT16	0x0021
	Block Length	UINT16	0x0038
	Block Version High	UINT8	0x01
	Block Version Low	UINT8	0x00
I&M1	Function tag	UINT8(32)	
	Location tag	UINT8(32)	

Tab. 8.10: Structure I&M1 record, index: 0xAFF1, access: read-write

	Parameter	Data type	Info
Block Header	Block type	UINT16	0x0022
	Block Length	UINT16	0x0012
	Block Version High	UINT8	0x01
	Block Version Low	UINT8	0x00
I&M2	Installation date	UINT8(16)	Installation date
	Reserved	UINT8(38)	Reserved

Tab. 8.11: Structure I&M2 record, index: 0xAFF2, access: read-write

	Parameter	Data type	Info
Block Header	Block type	UINT16	0x0023
	Block Length	UINT16	0x0038
	Block Version High	UINT8	0x01
	Block Version Low	UINT8	0x00
I&M3	Descriptor	UINT8(54)	Description text

Tab. 8.12: Structure I&M3 record, index: 0xAFF3, access: read-write

For more information about the I&M records, please refer to https://www.profibus.com/download/PROFINET-specification

8.6.3 Parameters documentation

8.6.3.1 General

To configure parameters in the sensor, an additional addressing level, the parameter ID, is used. Each parameter has a unique parameter ID.

Via the parameter ID, starting from 50000, individual parameters such as the measuring rate in the sensor can be selected. To do this, you must first write the desired parameter ID in the 0x2000 records. After that you can read and write the parameter.

8.6.3.2 Light source

Inputs

Name	Parameter ID	Data type	Description	Access
Laser power	55400	UINT8	Turning laser on and off	rw
			0 - Off	
			1 - Full	
			2 – Reduced	
			3 – Medium	

8.6.3.3   Measurement configuration, measuring rate, evaluation range (ROI), exposure, peak selection, error handling

Data recording

Name	Parameter ID	Data type	Description	Unit	Access
Measuring task	55500	UINT8	Measurement task, target properties 0 - Standard 1 - Multisurface 2 - Penetration		rw
Measuring rate	51500	FLOAT	Free measuring rate; 250 ... 20000 Hz Max. bus cycle 1 kHz, max. oversampling 20	Hz	rw
Start of range	51520	UINT16	Start of region of interest	%	rw
End of range	51521	UINT16	End of region of interest	%	rw
Shutter mode	55510	UINT8	Exposure mode, automatic or manual 0 - Manual 1 - Automatic		rw
Shutter value in μs	55520	FLOAT	Exposure time for manual mode; 1 ... 4000 μs	μs	rw
Exposure mode	51540	UINT8	Selection for automatic exposure 0 - Standard 1 - Intelligent 2 - Background		rw
Peak selection	51560	UINT8	Peak selection video signal for distance calculation 0 - Highest peak 1 - Widest peak 2 - Last peak 3 - First peak		rw

An example of how to implement the measuring rate in the TIA Portal is provided in the section describing the float parameters,

An example of how to implement peak selection in the TIA Portal is provided in the section describing the integer parameters,

8.6.3.4   Averaging

Signal processing

	Name	Parameter ID	Data type	Description		Access
Comp1	Comp1_type	52050	UINT8	Averaging type		rw
				0 - None 1 - Median	2 - Moving 3 - Recursive	
	Comp1_signal	52053	UINT32			rw
	Comp1_parameter	52067	UINT32			rw
Comp2	Comp2 type	52100	UINT8	Averaging type		rw
				0 - None 1 - Median	2 - Moving 3 - Recursive	
	Comp2_signal	52103	UINT32			rw
	Comp2_parameter	520117	UINT32			rw
Comp3	Comp3_type	52150	UINT8	Averaging type		rw
				0 - None 1 - Median	2 - Moving 3 - Recursive	
	Comp3_signal	52153	UINT32			rw
	Comp3_parameter	52167	UINT32			rw

Comp4	Comp4_type	52200	UINT8	Averaging type		rw
				0 - None 1 - Median	2 - Moving 3 - Recursive	
	Comp4_signal	52203	UINT32			rw
	Comp4_parameter	52217	UINT32			rw
Comp5	Comp5_type	52250	UINT8	Averaging type		rw
				0 - None 1 - Median	2 - Moving 3 - Recursive	
	Comp5_signal	52253	UINT32			rw
	Comp5_parameter	52267	UINT32			rw
Comp6	Comp6_type	52300	UINT8	Averaging type		rw
				0 - None 1 - Median	2 - Moving 3 - Recursive	
	Comp6_signal	52303	UINT32			rw
	Comp6_parameter	52317	UINT32			rw
Comp7	Comp7_type	52350	UINT8	Averaging type		rw
				0 - None 1 - Median	2 - Moving 3 - Recursive	
	Comp7_signal	52353	UINT32			rw
	Comp7_parameter	52367	UINT32			rw
Comp8	Comp8_type	52400	UINT8	Averaging type		rw
				0 - None 1 - Median	2 - Moving 3 - Recursive	
	Comp8_signal	52403	UINT32			rw
	Comp8_parameter	52417	UINT32			rw
Comp9	Comp9_type	52450	UINT8	Averaging type		rw
				0 - None 1 - Median	2 - Moving 3 - Recursive	
	Comp9_signal	52453	UINT32			rw
	Comp9_parameter	52467	UINT32			rw
Comp10	Comp10_type	52500	UINT8	Averaging type		rw
				0 - None 1 - Median	2 - Moving 3 - Recursive	
	Comp10_signal	52503	UINT32			rw
	Comp10_parameter	52517	UINT32			rw

8.6.3.5   Zeroing, mastering

Name	Parameter ID	Data type	Description	Access
Master enable	53050	UINT8	Determine signal DIST1 for zeroing/mastering 0 - False 1 - True	rw
Master set	53053	BOOL	Perform or end zeroing or mastering 0 - False 1 - True	rw
Master value	53154	FLOAT	Specification, e.g. of the thickness of a master piece. Value range -2 to +2 x measuring range	rw

Zeroing/mastering sequence

▶   `True` for `Master enable` (53050) specifies that the function is applied to the DIST1 signal.

▶   Pass the value for zeroing/mastering on to parameter 53053.

▶ Start zeroing or mastering with `True` for `Master set` (53003).

8.6.3.6 System setting, key lock, login, password, factory setting

Name	Parameter ID	Data type	Description	Access
Current user	55200	UINT8	User level query 1 - User 3 - Professional	ro
Login	55201	STRING (32)	Password for switching to the user level Professional	wo
Logout	55202	BOOL	Switch to User level 0 - No 1 - Yes	rw
Default user	55203	UINT8	Setting the user level after a restart of the sensor 0 - User 1 - Professional	rw
Old password	55210	STRING (32)	Create and change password for the Professional level	wo
New password	55211	STRING (32)		wo
Repeat password	55212	STRING (32)		wo
Meassettings reset	55010	BOOL	Reset measurement settings 0 - False 1 - True	wo
Basicsettings reset	55110	BOOL	Reset device settings 0 - False 1 - True	wo
Reset to factory all settings	55303	BOOL	Reset all 0 - False 1 - True	wo
Reboot sensor	55304	BOOL	Reboot sensor 0 - False 1 - True	wo

8.6.3.7 Load, save device settings

Name	Parameter ID	Data type	Description	Access
Load	55100	BOOL	Loads the saved device settings from the sensor 0 - False 1 - True	wo
Save	55101	BOOL	Saves the current device settings in the sensor 0 - False 1 - True	wo

8.6.3.8 Load and apply presets

Name	Parameter ID	Data type	Description	Access
Mode	55050	UINT8	Returns the currently used preset mode (signal quality); with <Parameter> the preset mode (signal quality) to be used is set. 0 - None 1 - Static 2 - Balanced 3 - Dynamic 4 - No averaging	rw
List	55051	STRING (32)	Lists all existing manufacturer-specific programs.	ro
Read	55052	STRING (32)	Password for a change to the Professional level	wo

8.6.3.9 Load, save and apply setups

Name	Parameter ID	Data type	Description	Access
Current	55000	UINT8	Returns the name of the currently used preset or setup.	ro
Read	55001	STRING (32)	Loads and executes a setup for use in the sensor.	wo
Store	55002	STRING (32)	Saves the current user-specific settings to a setup or a new setup is created in non-volatile memory.	wo
Delete	55003	STRING (32)	Deletes the associated setup	wo
Initial	55004	STRING (32)	Returns the name of the setup intended for the next start of the sensor. With <Name> a setup is determined, which will be used at the next start of the sensor. Presets cannot be indicated.	rw
List	55005	STRING (32)	Returns the names of all saved setups.	ro

8.6.3.10 Sensor information

Name	Parameter ID	Data type	Description	Access
Measuring range	50502	FLOAT	Returns the measuring range of the sensor	ro
Option	50500	STRING (32)	Contains the option number of the sensor	ro

8.6.4 Acyclic reading of the cyclic process data (index 0x6000)

The process data can also be read acyclically via the record with index 0x6000. The read request is addressed as follows:

Parameter	Length in bytes	Value
AR	0	Permanently 0
API	4	Permanently 0
Slot	2	Permanently 1
Subslot	2	Permanently 1
Index	2	0x6000
Length	4	4...36 bytes

The complete length of the record is 36 bytes. You do not have to read the full length of the record. If you specify a shorter length, reading stops at the end of that length, and you will receive only a portion of the parameters.

Name	Data type	Access
Exposure time	UINT32	Read
Frequency	UINT32	Read
Timestamp	UINT32	Read
Measurement counter	UINT32	Read
Status	UINT32	Read
Unlinearized distance	UINT32	Read
Intensity	UINT32	Read
Linearized distance	UINT32	Read
Peak distance	UINT32	Read

Tab. 8.13: Record structure 0x6000

8.6.5 Parameter records (index 0x2000 - 0x2FFF)

8.6.5.1 General

The sensor can be parameterized via the records 0x2000 to 0x2FFF.

The read/write request is addressed as follows:

Parameter	Length in bytes	Value
AR	0	Permanently 0
API	4	Permanently 0
Slot	2	Permanently 1
Subslot	2	Permanently 1
Index	2	0x2000 to 0x2FFF
Length	4	n bytes

0x2000 records are divided into subobjects. Each subobject is uniquely identified by a sub-index. The reading of a 0x2000 record is always done from the beginning starting with sub-index 0. All subobjects of a 0x2000 record are readable. A smaller part of a 0x2000 record is writable. For this purpose an additional header is coded into the user data of the write request, which makes it possible to address a single sub-index within a 0x2000 record:

Name	Data type	Info
Padding	UINT16	Padding bytes
Sub-index	UINT8	Sub-index for addressing a single sub-object in the record
Padding	UINT8	Padding bytes
Writing length	UINT32	Length to be written
Data	UINT8(n)	Data of the 0x2000 record to be written

Tab. 8.14: Parameter record structure

Reading 0x2000 records is done without the header.

8.6.5.2   Record parameter info 0x2501

The parameter info record can be used to read out metadata of a parameter. First, use the header to write the parameter ID to the record via sub-index 1. After that you can read the record starting from sub-index 0. The written parameter ID remains stored in the record. Restarting the sensor resets the parameter ID to the default parameter ID.

Sub-index	Access	Data type	Name
0	Read	UINT8	Sub-index 0
1	Read/Write	UIN16	Parameter ID
2	Read	STRING(14)	Name
3	Read	STRING(8)	Unit
4	Read	STRING(8)	Type

Tab. 8.15: Parameter info record 0x2501

8.6.5.3   Record float parameter 0x2510

This record allows reading and writing of the sensor's floating parameters. First, use the header to write the parameter ID to the record via sub-index 1. Then you can write the float value to sub-index 3 or read the complete record starting from sub-index 0. The written parameter ID remains stored in the record. Restarting the sensor resets the parameter ID to the default parameter ID.

Sub-index	Access	Data type	Name
0	Read	UINT8	Sub-index 0
1	Read/Write	UINT16	Parameter ID
2	Read/Write	UINT8	Reserved
3	Read/Write	FLOAT	Float value
4	Read	STRING(14)	Name of the parameter
5	Read	STRING(8)	Unit of the parameter
6	Read	FLOAT	Reserved
7	Read	FLOAT	Reserved

Tab. 8.16: Float parameter record 0x2510

8.6.5.4   Record signed-integer parameter 0x2520

Via this record, parameters of type INT8, INT16 and INT32 can be read and written. First, use the header to write the parameter ID to the record via sub-index 1. Then you can write the INT value to sub-index 3 or read the complete record starting from sub-index 0. You can also write sub-index 1 to sub-index 3 in a single write request to write parameter ID and INT value. The written parameter ID remains stored in the record. Restarting the sensor resets the parameter ID to the default parameter ID.

Sub-index	Access	Data type	Name
0	Read	UINT8	Sub-index 0
1	Read/Write	UINT16	Parameter ID
2	Read/Write	UINT8	Reserved
3	Read/Write	INT32	INT32 value
4	Read	STRING(14)	Name of the parameter
5	Read	STRING(8)	Unit of the parameter
6	Read	INT32	Reserved
7	Read	INT32	Reserved

Tab. 8.17: Signed-integer parameter record 0x2520

8.6.5.5   Record unsigned-integer parameter 0x2530

Via this record, parameters of type UINT8, UINT16 and UINT32 can be read and written. First, use the header to write the parameter ID to the record via sub-index 1. Then you can write the UINT value to sub-index 3 or read the complete record starting from sub-index 0. You can also write sub-index 1 to sub-index 3 in a single write request to write the parameter ID and UINT value at once. The written parameter ID remains stored in the record. Restarting the sensor resets the parameter ID to the default parameter ID.

Sub-index	Access	Data type	Name
0	Read	UINT8	Sub-index 0
1	Read/Write	UINT16	Parameter ID
2	Read/Write	UINT8	Reserved
3	Read/Write	UINT32 value	UINT32 value
4	Read	STRING(14)	Name of the parameter
5	Read	STRING(8)	Unit of the parameter
6	Read	UINT32 value	Reserved
7	Read	UINT32 value	Reserved

Tab. 8.18: Unsigned integer parameter record 0x2530

8.6.5.6   Record string parameter 0x2540

This record allows reading and writing of parameters of type STRING. First, use the header to write the parameter ID to the record via sub-index 1. Then you can write the STRING value to sub-index 3 or read the complete record starting from sub-index 0. You can also write sub-index 1 to sub-index 3 in a single write request to write parameter ID and STRING value. The written parameter ID remains stored in the record. Restarting the sensor resets the parameter ID to the default parameter ID.

When reading a string, the string is transferred in the maximum possible length of 246 bytes. When writing, the full 246 bytes do not need to be written. For shorter strings, the write length can be limited via the header.

| Sub-index	Access	Data type	Name
0	Read	UINT8	Sub-index 0
1	Read/Write	UINT16	Parameter ID
2	Read/Write	UINT8	Reserved
3	Read/Write	STRING(246)	String value
4	Read	STRING(14)	Name of the parameter

Tab. 8.19: String parameter record 0x2540

8.7   Installing the GSDML file

A PROFINET IO device is described by a GSDML file with XML structure.

▶   Add the GSDML of the ILD5500-x-IE with PROFINET via the menu Extras > Manage device description files (GSD).
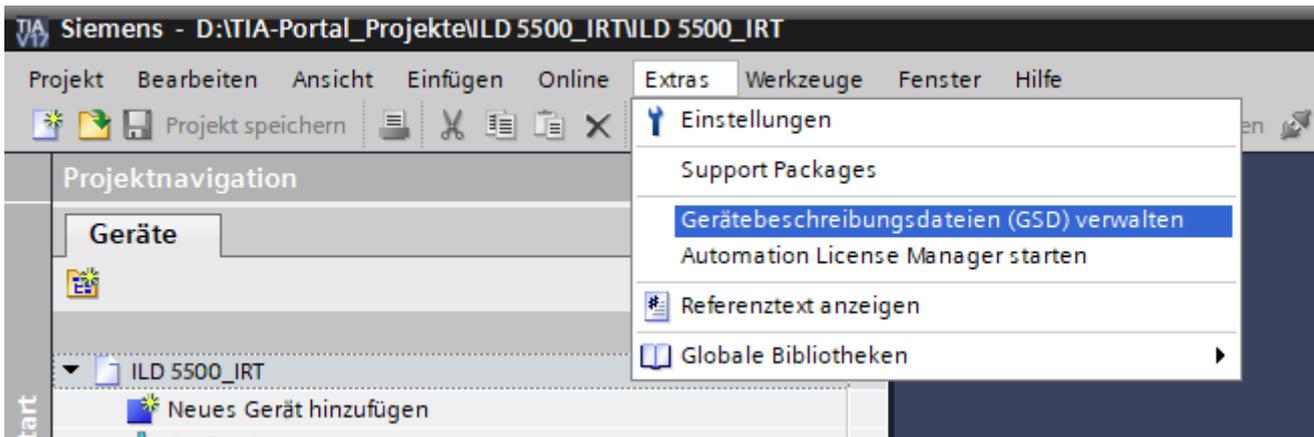
► Select the source path (1) and the desired XML file (2); confirm with the Install button (3).
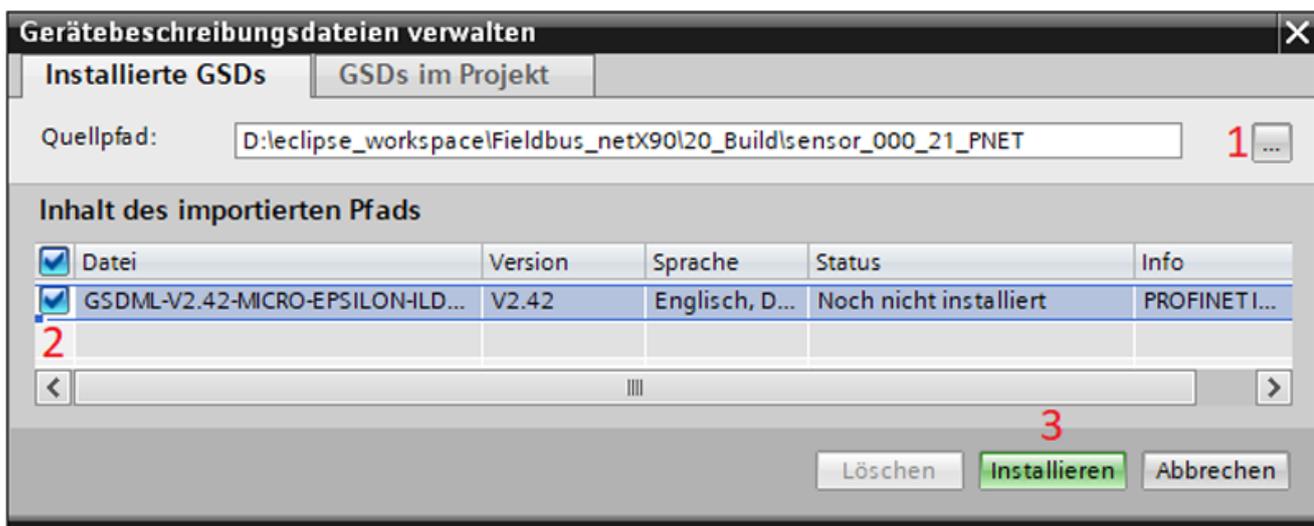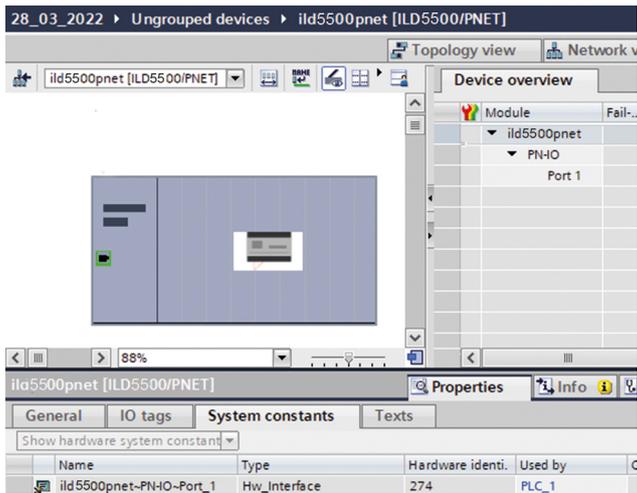

You can close the window after installing the GSDML file.

8.8 Acyclic reading and writing of records via TIA Portal

8.8.1 Sequence when writing and reading acyclical data

► Determine the hardware identification (ID) of the module. To do this, switch to the `General > PROFINET inter-face > Advanced options` tab.

In the example, you get the value 273.

On the PLC, WRREC_DB is called with the input parameters (:=).

REQ // Start execution

ID // Hardware ID of the target device addressed

INDEX // Target address in the object directory

LEN // Length of the binary data block to be written

RECORD // Usable data for writing

RECORD, VALID, BUSY, ERROR, STATUS and LEN contain return parameters (=>) which can be used to determine the success or progress of the write command.
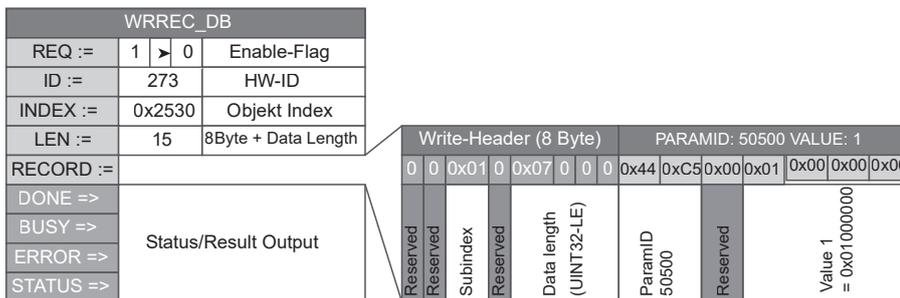

Fig. 8.3: Write command from the PLC with an 8-byte prefix to turn on the laser light source on the sensor
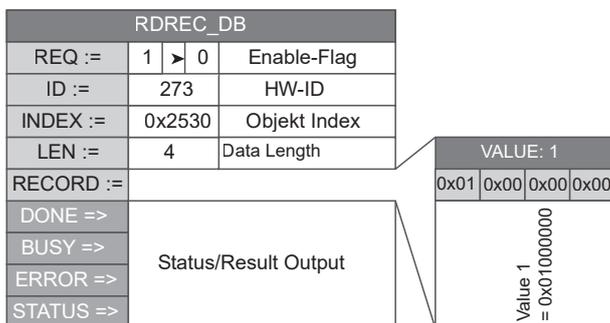

Fig. 8.4: Read command from the PLC

The examples below show how to turn off the laser light source on the sensor.
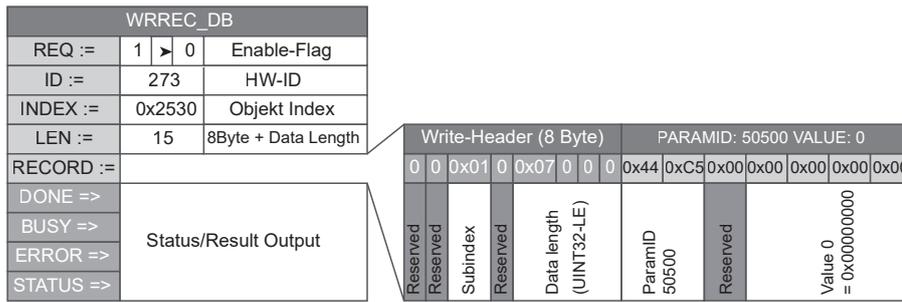
WRREC_DB			
REQ :=	1 ➤ 0	Enable-Flag	
ID :=	273	HW-ID	
INDEX :=	0x2530	Objekt Index	
LEN :=	15	8Byte + Data Length	
RECORD :=			
DONE =>			
BUSY =>	Status/Result Output		
ERROR =>			
STATUS =>			

Write-Header (8 Byte): 0 | 0 | 0x01 | 0 | 0x07 | 0 | 0 | 0 — Reserved, Reserved, Subindex, Reserved, Data length (UINT32-LE), ...

PARAMID: 50500 VALUE: 0 — 0x44 | 0xC5 | 0x00 | 0x00 | 0x00 | 0x00 | 0x00 — ParamID 50500, Reserved, Value 0 = 0x00000000

Fig. 8.5: Write command from the PLC with 8-byte prefix to turn off the laser light source on the sensor

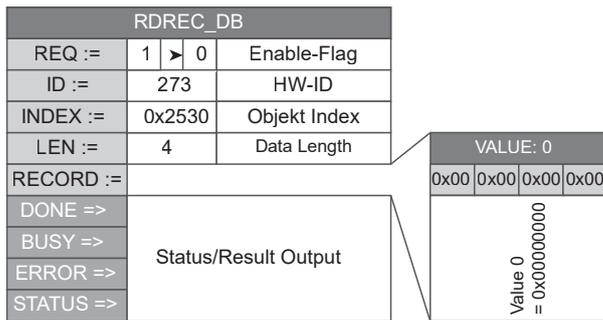| RDREC_DB			
REQ :=	1 ➤ 0	Enable-Flag	
ID :=	273	HW-ID	
INDEX :=	0x2530	Objekt Index	
LEN :=	4	Data Length	
RECORD :=			
DONE =>			
BUSY =>	Status/Result Output		
ERROR =>			
STATUS =>			

VALUE: 0 — 0x00 | 0x00 | 0x00 | 0x00 — Value 0 = 0x00000000

Fig. 8.6: Read command from the PLC, turn off laser light source on the sensor

8.8.2 Sequence when writing structured data

WRREC_DB			
REQ :=	1 ➤ 0	Enable-Flag	
ID :=	273	HW-ID	
INDEX :=	0x2530	Objekt Index	
LEN :=	15	8Byte + Data Length	
RECORD :=			
DONE =>			
BUSY =>	Status/Result Output		
ERROR =>			
STATUS =>			

Write-Header (8 Byte): 0 | 0 | 0x01 | 0 | 0x07 | 0 | 0 | 0 — Reserved, Reserved, Subindex, Reserved, Data length (UINT32-LE), ...

PARAMID: 51020, VALUE: 999 — 0x4C | 0xC7 | 0x00 | 0xE7 | 0x03 | 0x00 | 0x00 — ParamID 51020, Reserved, Value 999
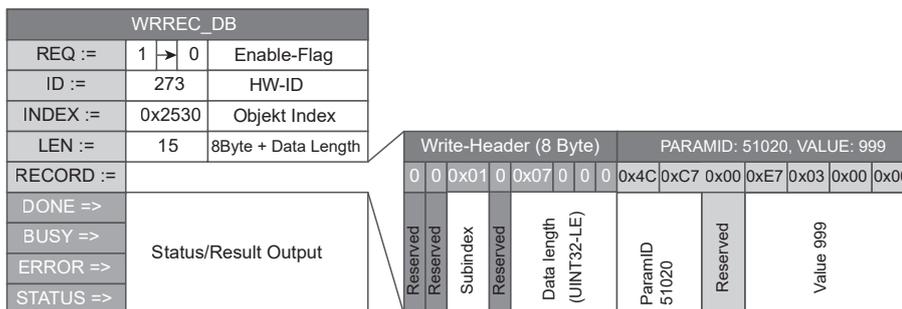
Fig. 8.7: Write command with data from PLC to sensor

9 Cleaning

We recommend cleaning the protective glass at regular intervals.

Do not expose yourself to unnecessary laser radiation.

► Switch off the sensor for cleaning and maintenance.

Dry cleaning

This can be accomplished with an anti-static lens brush or by blowing off the windows with dehumidified, clean, oil-free compressed air.

Wet cleaning

Use a clean, soft, lint-free cloth or lens cleaning paper and pure alcohol (isopropanol) to clean the protective screen.

NOTICE
► Never use commercially available glass cleaners or other cleaning agents.

10 Disclaimer

All components of the device have been checked and tested for functionality in the factory. However, should any defects occur despite careful quality control, these shall be reported immediately to Micro-Epsilon or to your distributor / retailer.

Micro-Epsilon undertakes no liability whatsoever for damage, loss or costs caused by or related in any way to the product, in particular consequential damage, e.g., due to

- non-observance of these instructions/this manual,
- improper use or improper handling (in particular due to improper installation, commissioning, operation and maintenance) of the product,
- repairs or modifications by third parties,
- the use of force or other handling by unqualified persons.

This limitation of liability also applies to defects resulting from normal wear and tear (e.g., to wearing parts) and in the event of non-compliance with the specified maintenance intervals (if applicable).

Micro-Epsilon is exclusively responsible for repairs. It is not permitted to make unauthorized structural and / or technical modifications or alterations to the product. In the interest of further development, Micro-Epsilon reserves the right to modify the design or the firmware.

In addition, the General Terms of Business of Micro-Epsilon shall apply, which can be accessed under Legal details | Micro-Epsilon https://www.micro-epsilon.com/legal-details/.

11 Service, repair

If the sensor or sensor cables are defective:

- If possible, save the current sensor settings in a parameter set to reload them into the sensor after the repair.
- Please send us the affected parts for repair or exchange.

If the cause of a fault cannot be clearly identified, please send the entire system including cables to:

MICRO-EPSILON
Optronic GmbH
Lessingstrasse 21
01465 Dresden-Langebrück / Germany

Tel: +49 (0) 35201 729-0
Fax: +49 (0) 35201 729 -90
optronic@micro-epsilon.de
www.micro-epsilon.com/contact/worldwide/
https://www.micro-optronic.de/

12   Decommissioning, disposal

In order to avoid the release of environmentally harmful substances and to ensure the reuse of valuable raw materials, we draw your attention to the following regulations and obligations:

- Remove all cables from the sensor and/or controller.
- Dispose of the sensor and/or the controller, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.
- You are obliged to comply with all relevant national laws and regulations.

For Germany / the EU, the following (disposal) instructions apply in particular:

- Waste equipment marked with a crossed garbage can must not be disposed of with normal industrial waste (e.g. residual waste can or the yellow recycling bin) and must be disposed of separately. This avoids hazards to the environment due to incorrect disposal and ensures proper recycling of the old appliances.

- A list of national laws and contacts in the EU member states can be found at https://ec.europa.eu/environment/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee_en. Here you can inform yourself about the respective national collection and return points.

- Old devices can also be returned for disposal to Micro-Epsilon at the address given in the legal details at https://www.micro-epsilon.com/legal-details.

- We would like to point out that you are responsible for deleting the measurement-specific and personal data on the old devices to be disposed of.

- Under the registration number WEEE-Reg.-Nr. DE28605721, we are registered at the foundation Elektro-Altgeräte Register, Nordostpark 72, 90411 Nuremberg, as a manufacturer of electrical and/or electronic equipment.

13 Optional accessories

PS2020

Power supply unit for DIN rail mounting
Input 230 VAC, output 24 VDC/2.5 A

PC1900-IE-x/RJ45

Interfaces and supply cable Length x = 3, 6 or 9 m 12-pin round socket and RJ45 plug for fieldbus connection

PC2415-x

Cable extension with 12-pin M12 socket and 12-pin M12 plug for power supply, RS422 or encoder, Industrial Ethernet; suitable for drag chains, cable length x = 3 m, 6 m, 9 m or 15 m

PC2415-1/Y

Supply/interface cable for IFD241x; with 12-pin M12 socket and open ends or RJ45 plug, cable length = 1 m

14 Factory settings

Measurement value averaging	Median, 9 values		Language	German
Peak selection	Highest peak		Measuring rate	4 kHz
Measuring range	100 % FSO: I = 20 mA, digital 163768			
	0 % FSO: I = 4 mA, digital 98232			
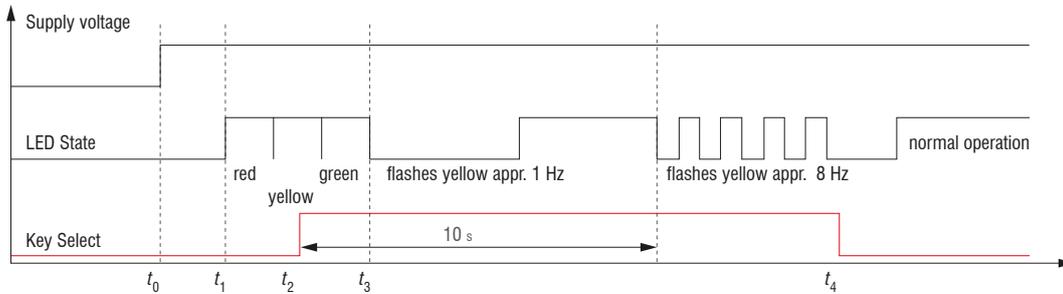
Fig. 14.1: Flowchart for starting a sensor with factory settings

t_0	:	Supply voltage is applied
t_1 ... t_3	:	Both LEDs signal the start sequence (red-yellow-green for 1 second each)
t_2	:	Select key is pressed during the start sequence(t_1... t_3)
t_4	:	Select key is released while the State LED flashes yellow
		$\Delta t = t_4 - t_2$; Δt (keystroke duration) must be at least 10 seconds, max. 15 seconds

Resetting to factory setting:

▶ Press the Select key after having switched on the sensor while the two LEDs light up „red - yellow - green".

▶ Hold the key pressed. After 10 seconds, the Status LED starts flashing quickly.

▶ If you release the key while it flashes quickly, the sensor is reset to factory settings.

▶ If you hold the key pressed for longer than 15 seconds, the sensor is not reset to factory settings.

If the Select key is kept pressed when switching on the sensor (or with a reset), the sensor switches to the Bootloader mode.

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