



Operating Instructions **optoNCDT 1750**

ILD1750-2
ILD1750-10
ILD1750-20
ILD1750-50
ILD1750-100

ILD1750-200
ILD1750-500
ILD1750-750

ILD1750-2LL
ILD1750-10LL
ILD1750-20LL
ILD1750-50LL

ILD1750-20BL
ILD1750-200BL
ILD1750-500BL
ILD1750-750BL

Intelligent laser optical displacement measurement

MICRO-EPSILON
MESSTECHNIK
GmbH & Co. KG
Koenigbacher Str. 15

94496 Ortenburg / Germany

Tel. +49 (0) 8542 / 168-0
Fax +49 (0) 8542 / 168-90
e-mail info@micro-epsilon.com
www.micro-epsilon.com

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1. Safety

The handling of the sensor assumes knowledge of the operating instructions.

1.1 Symbols Used

The following symbols are used in this operating instructions:



Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.



Indicates a situation that may result in property damage if not avoided.



Indicates a user action.



Indicates a tip for users.

Measure

Indicates hardware or a software button/menu.

1.2 Warnings

Avoid unnecessary laser radiation to be exposed to the human body.



Switch off the sensor for cleaning and maintenance.



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

Caution - use of controls or adjustments or performance of procedures other than those specified may cause harm.



Connect the power supply and the display-/output device in accordance with the safety regulations for electrical equipment.

> Risk of injury

> Damage to or destruction of the sensor

NOTICE

Avoid shocks and impacts to the sensor.

> Damage to or destruction of the sensor

Mount the sensor only to the existing holes on a flat surface. Clamps of any kind are not permitted

> Damage to or destruction of the sensor

The power supply may not exceed the specified limits.

> Damage to or destruction of the sensor

Protect the sensor cable against damage. Attach the cable load-free, hold the cable after appr. 25 cm and hold the pigtail on the connector e.g. zip tie.

> Destruction of the sensor

> Failure of the measuring device

Avoid continuous exposure to fluids on the sensor.

> Damage to or destruction of the sensor

Avoid exposure to aggressive materials (washing agent, penetrating liquids or similar) on the sensor.

> Damage to or destruction of the sensor

1.3 Notes on CE Marking

The following apply to the optoNCDT 1750:

- EU directive 2014/30/EU
- EU directive 2011/65/EU, "RoHS" category 9

Products which carry the CE mark satisfy the requirements of the EU directives cited and the European harmonized standards (EN) listed therein. The EU Declaration of Conformity is available to the responsible authorities according to EU Directive, article 10, at:

MICRO-EPSILON MESSTECHNIK
GmbH & Co. KG
Koenigbacher Str. 15
94496 Ortenburg / Germany

The sensor is designed for use in industrial environments and meets the requirements.

1.4 Intended Use

- The optoNCDT 1750 system is designed for use in industrial and laboratory applications.
- It is used
 - for measuring displacement, distance and position
 - for in-process quality control and dimensional testing
- The system must only be operated within the limits specified in the technical data, see Chap. 3.3.
- The sensor must be used in such a way that no persons are endangered or machines and other material goods 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: IP 65 (applies only when the sensor cable is plugged in)

Lenses are excluded from protection class. Contamination of the lenses leads to impairment or failure of the function.

- Temperature range
 - Operation: 0 °C ... 50 °C (+32 up to +104 °F)
 - Storage: -20 °C ... 70 °C (-4 up to +158 °F)
- Humidity: 5 - 95 % (non-condensing)
- Ambient pressure: Atmospheric pressure

i The protection class is limited to water, no penetrating liquids or similar!

2. Laser Safety

The optoNCDT 1750 sensors operate with a semiconductor laser with a wavelength of 670 nm (visible/red) resp. 405 nm (visible/blue). The sensors fall within Laser Class 2 (II). The laser is operated on a pulsed mode, the average power is ≤ 1 mW. The pulse frequency depends on the adjusted measuring rate (0.3 ... 7.5 kHz). The pulse duration of the peaks is regulated depending on the measuring rate and reflectivity of the target and can be 0 up to 3333 μ s.

i Comply with all regulations on lasers!

CAUTION

Never deliberately look into the laser beam!
Consciously close your eyes or turn away immediately if ever the laser beam should hit your eyes.

Although the laser output is low looking directly into the laser beam must be avoided. Due to the visible light beam eye protection is ensured by the natural blink reflex. The housing of the optical sensors may only be opened by the manufacturer, see Chap. 12. For repair and service purposes the sensors must always be sent to the manufacturer.

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

The following warning labels must be attached to the cover (front and/or rear side) of the sensor housing. The laser warning labels for Germany have already been applied. Those for other non German speaking countries an IEC standard label is included in delivery and the versions applicable to the user's country must be applied before the equipment is used for the first time. Laser operation is indicated by LED, see Chap. 5.3.



Fig. 1 Warning label and laser label, ILD1750-x

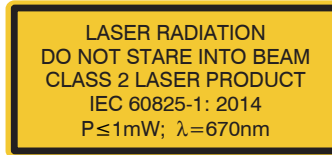


Fig. 2 Laser label, ILD1750-xBL



Only for USA

During operation of the sensor the pertinent regulations acc. to IEC 60825-1 on „radiation safety of laser equipment“ must be fully observed at all times.
The sensor complies with all applicable laws for the manufacturer of laser devices.

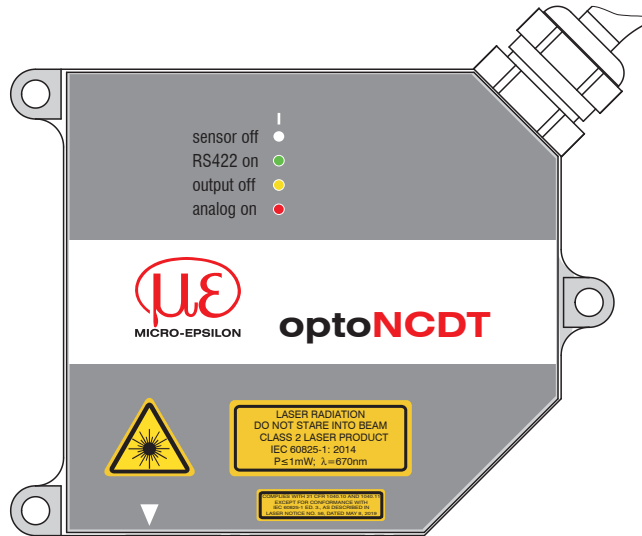


Fig. 3 True reproduction of the sensor with its actual location of the warning labels, ILD1750

i If both warning labels are covered over when the unit is installed the user must ensure that supplementary labels are applied.

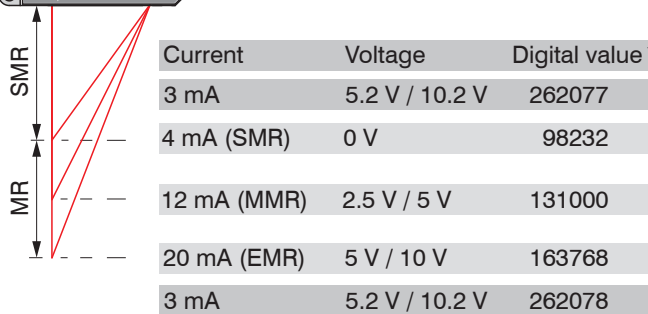
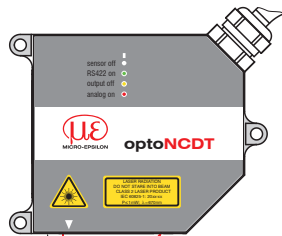
3. Functional Principle, Technical Data

3.1 Short Description

The optoNCDT 1750 uses the principle of optical triangulation, that is, a visible, modulated point of light is projected onto the target surface.

The diffuse part of the reflection of this point of light is displayed depending on distance on a position-resolving element (CMOS) by an receiver optic which is arranged to the optical axis of the laser beam in a defined angle.

A signal processor in the sensor calculates the distance of the point of light on the measuring object to the sensor by means of the output signal of the CMOS elements. The distance value is linearized and output by means of the analog or RS422 interface.



- MR = Measuring range
- SMR = Start of measuring range
- MMR = Mid of measuring range
- EMR = End of measuring range

1) For distance values without zero setting resp. mastering only.

Fig. 4 Definition of terms

3.2 Real Time Control (RTSC)

The CMOS element determines the intensity of incident light during the exposure. This enables the sensor to compensate for fluctuations in brightness on the object being measured. What is more, it does so in a range from almost total absorption to almost total reflection. The RTSC (Real-Time-Surface-Compensation) allows an accurate real-time surface compensation in the measurement process with a high dynamic range.

3.3 Technical Data

Model	ILD1750-	2	10	20	50	100	200	500	750
Measuring range		2 mm	10 mm	20 mm	50 mm	100 mm	200 mm	500 mm	750 mm
Start of measuring range		24 mm	30 mm	40 mm	45 mm	70 mm	70 mm	200 mm	200 mm
Midrange		25 mm	35 mm	50 mm	70 mm	120 mm	170 mm	450 mm	575 mm
End of measuring range		26 mm	40 mm	60 mm	95 mm	170 mm	270 mm	700 mm	950 mm
Linearity		1.6 μm	6 μm	12 μm	30 μm	60 μm	160 μm	350 μm	670 μm
	% FSO	$\leq \pm 0.08$	$\leq \pm 0.06$				$\leq \pm 0.08$	$\leq \pm 0.07$	$\leq \pm 0.09$
Repeatability ²⁾		0.1 μm	0.4 μm	0.8 μm	2 μm	4 μm	8 μm	20 μm	30 μm
Measuring rate		Continuously adjustable between 0.3 ... 7.5 kHz adjustable in 6 steps: 7.5 kHz / 5 kHz / 2.5 kHz / 1.25 kHz / 625 Hz / 300 Hz							
Light source		Semiconductor laser <1 mW, 670 nm (red)							
Permissible ambient light		10,000 lx (with 2.5 kHz)							
Laser safety class		Class 2 according to IEC 60825-1 : 2014							
Spot diameter	SMR	80 μm	110 μm	320 μm	570 μm	740 μm	1300 μm	1500 μm	
	MMR	35 μm	50 μm	45 μm	55 μm	60 μm	1300 μm	1500 μm	
	EMR	80 μm	110 μm	320 μm	570 μm	700 μm	1300 μm	1500 μm	
Temperature stability ¹⁾		$\pm 0.0125\%$ FSO/K	$\pm 0.005\%$ FSO/K						
Temperature range	operation	0 ... +50 °C							
	storage	-20 ... +70 °C							
Control inputs/outputs		1x HTL/TTL Laser on/off; 1 x HTL/TTL Multifunction input Trigger in / slave in / (zero setting / mastering / teach 2x error output (error & limit value): npn, pnp, push pull) 1x RS422 synchronization input (trigger in, sync in, master/slave, master/slave alternating)							

Model	ILD1750-	2	10	20	50	100	200	500	750
Measurement value output	analog	4 ... 20 mA (0 ... 5 V / 0 ... 10 V); 16 bit; freely scalable within the measuring range							
	digital	RS422 / 16 bit							
Operation	Button	Select & function buttons for interface selections, mastering (zero), teach, presets, quality slider, frequency selection, factory settings							
	Web interface	Application-specific presets; peak selection, video signal; freely selectable averaging possibilities; data reduction; setup management ²⁾							
Power supply		11 ... 30 V DC, 24 V / P <3 W							
Sensor cable	Standard	0.25 m pigtail with 14-pole ODU connector							
	Option	Extension: 3 / 10 m							
Synchronization		possible for simultaneous or alternating measurements							
Protection class		IP 65							
Vibration		2 g / 20 ... 500 Hz							
Shock		15 g / 6 ms							
Weight (with 25 cm cable)		appr. 550 g						appr. 600 g	
Housing size		S						M	

The specified data apply to a white, diffuse reflecting surface (reference: ceramics)

FSO = Full Scale Output

SMR = Start of measuring range; MMR = Mid of measuring range; EMR = End of measuring range

1) based on digital output

2) Connection to PC via IF2001/USB (optionally available)

Model	ILD1750-	2LL	10LL	20LL	50LL
Measuring range		2 mm	10 mm	20 mm	50 mm
Start of measuring range		24 mm	30 mm	40 mm	45 mm
Midrange		25 mm	35 mm	50 mm	70 mm
End of measuring range		26 mm	40 mm	60 mm	95 mm
Linearity		1.6 μm	6 μm	12 μm	30 μm
	% FSO	$\leq \pm 0.08$		$\leq \pm 0.06$	
Repeatability ²⁾		0.1 μm	0.4 μm	0.8 μm	2 μm
Measuring rate		Continuously adjustable between 0.3 ... 7.5 kHz adjustable in 6 steps: 7.5 kHz / 5 kHz / 2.5 kHz / 1.25 kHz / 625 Hz / 300 Hz			
Light source		Semiconductor laser <1 mW, 670 nm (red)			
Permissible ambient light		10,000 lx (with 2.5 kHz)			
Laser safety class		Class 2 according to IEC 60825-1 : 2014			
Spot diameter	SMR	85 x 240 μm	120 x 405 μm	185 x 485 μm	350 x 320 μm
	MMR	24 x 280 μm	35 x 585 μm	55 x 700 μm	70 x 960 μm
	EMR	64 x 400 μm	125 x 835 μm	195 x 1200 μm	300 x 1940 μm
Temperature stability ¹⁾		± 0.0125 % FSO/K	± 0.005 % FSO/K		
Temperature range	operation	0 ... +50 °C			
	storage	-20 ... +70 °C			
Control inputs/outputs		1x HTL/TTL Laser on/off; 1 x HTL/TTL Multifunction input Trigger in / slave in / (zero setting / mastering / teach 2x error output (error & limit value): npn, pnp, push pull) 1x RS422 synchronization input (trigger in, sync in, master/slave, master/slave alternating)			

Model	ILD1750-	2LL	10LL	20LL	50LL
Measurement value output	analog	4 ... 20 mA (0 ... 5 V / 0 ... 10 V); 16 bit; freely scalable within the measuring range			
	digital	RS422 / 16 bit			
Operation	Button	Select & function buttons for interface selections, mastering (zero), teach, presets, quality slider, frequency selection, factory settings			
	Web interface	Application-specific presets; peak selection, video signal; freely selectable averaging possibilities; data reduction; setup management ²⁾			
Power supply		11 ... 30 V DC, 24 V / P <3 W			
Sensor cable	Standard	0.25 m pigtail with 14-pole ODU connector			
	Option	Extension: 3 / 10 m			
Synchronization		possible for simultaneous or alternating measurements			
Protection class		IP 65			
Vibration		2 g / 20 ... 500 Hz			
Shock		15 g / 6 ms			
Weight (with 25 cm cable)		appr. 550 g			
Housing size		S			

The specified data apply to a white, diffuse reflecting surface (reference: ceramics)

FSO = Full Scale Output

SMR = Start of measuring range; MMR = Mid of measuring range; EMR = End of measuring range

1) based on digital output

2) Connection to PC via IF2001/USB (optionally available)

Model	ILD1750-	20BL	200BL	500BL	750BL
Measuring range		20 mm	200 mm	500 mm	750 mm
Start of measuring range		40 mm	70 mm	200 mm	200 mm
Midrange		50 mm	170 mm	450 mm	575 mm
End of measuring range		60 mm	270 mm	700 mm	950 mm
Linearity		$< \pm 12 \mu\text{m}$	$< \pm 160 \mu\text{m}$	$< \pm 350 \mu\text{m}$	$< \pm 670 \mu\text{m}$
	% FSO	$\leq \pm 0.06$	$\leq \pm 0.08$	$\leq \pm 0.07$	$\leq \pm 0.09$
Repeatability ¹		0,8 μm	15 μm	20 μm	45 μm
Measuring rate ²		Continuously adjustable between 0.3 ... 7.5 kHz adjustable in 6 steps: 7.5 kHz / 5 kHz / 2.5 kHz / 1.25 kHz / 625 Hz / 300 Hz			
Light source		Semiconductor laser $< 1 \text{ mW}$, 405 nm (blue)			
Permissible ambient light		10,000 lx			
Laser safety class		Class 2 according to IEC 60825-1 : 2014			
Spot diameter ($\pm 10 \%$)	SMR, μm	320	1300	1500	1500
	MMR, μm	45			
	EMR, μm	320			
Temperature stability ³	% FSO/K	± 0.03			
Temperature range	operation	0 ... +50 °C			
	storage	-20 ... +70 °C			
Control inputs/outputs		1x HTL/TTL Laser on/off; 1 x HTL/TTL Multifunction input Trigger in / slave in / zero setting / mastering / teach (2x error output (error & limit value): npn, pnp, push pull) 1x RS422 synchronization input (trigger in, sync in, master/slave, master/slave alternating)			

Model	ILD1750-	20BL	200BL	500BL	750BL
Measurement value output	analog	4 ... 20 mA (0 ... 5 V / 0 ... 10 V); 16 bit; freely scalable within the measuring range			
	digital	RS422 / 16 bit			
Operation	button	Select & function buttons for interface selections, mastering (zero), teach, presets, quality slider, frequency selection, factory settings			
	Web interface	Application-specific presets; peak selection, video signal; freely selectable averaging possibilities; data reduction; setup management ⁴			
Power supply		11 ... 30 V DC, <3 W (24 V)			
Sensor cable	standard	0.25 m pigtail with 14-pole ODU connector			
	option	Extension: 3 / 10 m			
Synchronization		possible for simultaneous or alternating measurements			
Protection class		IP 65			
Vibration		2 g / 20 ... 500 Hz			
Shock		15 g / 6 ms in 3 axes			
Weight (with 25 cm cable)		appr. 550 g (incl. pigtail)		appr. 600 g (incl. pigtail)	
Housing size		S		M	

The specified data apply to a white, diffuse reflecting surface (reference: ceramics)

FSO = Full Scale Output

SMR = Start of measuring range; MMR = Mid of measuring range; EMR = End of measuring range

1) Measuring rate 5 kHz, median 9

2) Factory setting 5 kHz; modifying the factory settings requires the IF2001/USB converter (optionally available)

3) Based on digital output

4) Connection to PC via IF2001/USB (optionally available)

4. Delivery

4.1 Unpacking, Included in Delivery

- 1 Sensor ILD1750
- 1 Assembly instruction
- 1 CD with program <ILD1750 DAQ Tool.exe> and instruction manual
- 1 Calibration protocol
- Laser warning labels acc. IEC norm

- ➡ Carefully remove the components of the measuring system from the packaging and ensure that the goods are forwarded in such a way that no damage can occur.
- ➡ 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 available in the appendix, see Chap. [A 1](#)

4.2 Storage

Storage temperature: -20 up to +70 °C (-4 °F up to +158 °F)

Humidity: 5 - 95 % (non-condensing)

5. Installation

5.1 Instructions for Installation

5.1.1 Reflection Factor of the Target Surface

In principle the sensor evaluates the diffuse part of the reflected laser light.

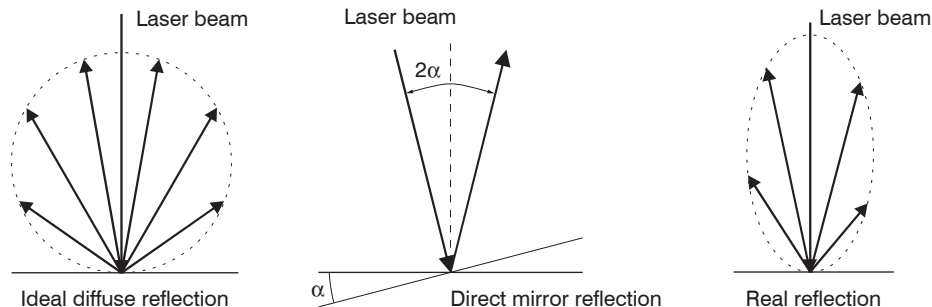


Fig. 5 Reflection factor of the target surface

A statement concerning a minimum reflectance is difficult to make because even a small diffuse fraction can be evaluated from highly reflecting surfaces. This is done by determining the intensity of the diffuse reflection from the CMOS signal in real time and subsequent compensation, see Chap. 3.2. Dark or shiny objects being measured, e.g. black rubber, may require longer exposure times. The exposure time is dependent on the measuring rate and can only be increased by reducing the sensor's measuring rate.

5.1.2 Error Influences

5.1.2.1 Light from other Sources

Thanks to their integrated optical interference filters the optoNCDT 1750 sensors offer outstanding performance in suppressing light from other sources. However, this does not preclude the possibility of interference from other light sources if the objects being measured are shiny and if lower measuring rates are selected. Should this be the case it is recommended to use suitable shields to screen the other light sources. This applies in particular to measurement work performed in close proximity to welding equipment.

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 differences in combination with changes of penetration depth may lead to measuring errors.

5.1.2.3 Temperature Influences

When the sensor is commissioned a warm-up time of at least 20 minutes is required to achieve uniform temperature distribution in the sensor. If measurement is performed in the micron accuracy range, the effect of temperature fluctuations on the sensor holder must be considered. Due to the damping effect of the heat capacity of the sensor, sudden temperature changes are only measured with delay.

5.1.2.4 Mechanical Vibration

If the sensor is to be used for resolutions in the μm to sub- μm range, special care must be taken to ensure stable and vibration-free mounting of sensor and target.

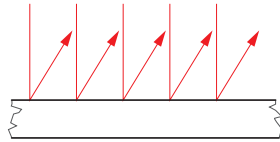
5.1.2.5 Movement Blurs

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

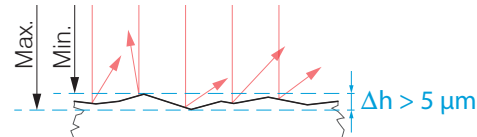
5.1.2.6 Surface Roughness

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. using a caliper, detects a much larger area of the measurement object. In case of traversing measurements, surface roughnesses of $5\ \mu\text{m}$ and more lead to an apparent distance change.

Suitable parameters for the averaging number may improve the comparability of optical and mechanical measurements.



Ceramic reference surface



Structured surface

Recommendation for parameter choice:

The averaging number should be selected in such a way that a surface area the size of which is comparable to those with mechanical measurements is averaged.

5.1.2.7 Angle Influences

Tilt angles of the target in diffuse reflection both around the X and the Y axis of less than 5° only have a disturbing effect with surfaces which are highly reflecting. Tilt angles between 5° and 15° lead to an apparent distance change of approximately 0.12 ... 0.2 % of the measuring ranges, see Fig. 6.

These influences have to be explicitly considered when scanning profiled surfaces. Basically the angle behavior of triangulation is liable to the reflectivity of the measuring object surface.

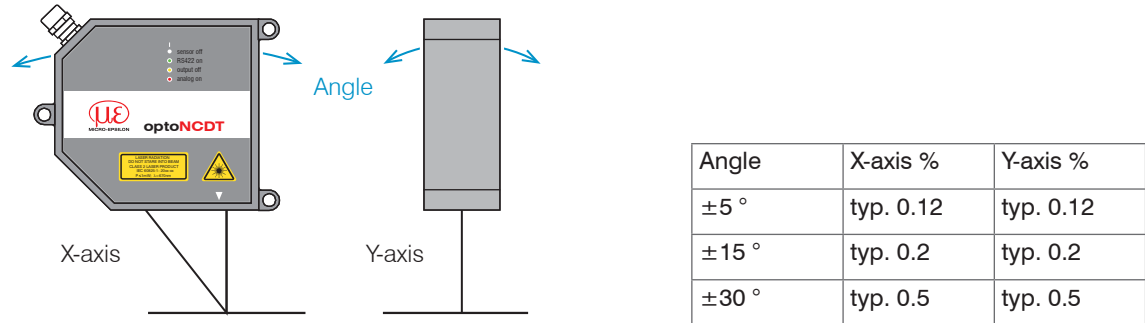
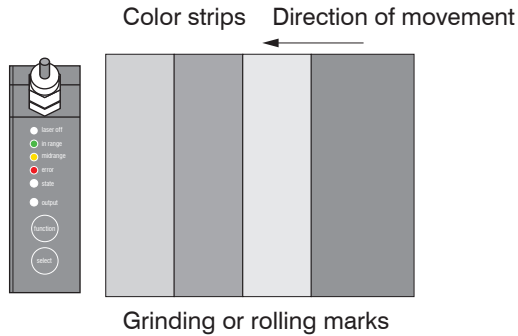


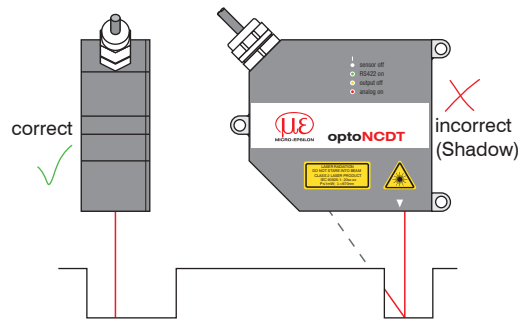
Fig. 6 Measurement errors through tilting with diffuse reflection

5.1.3 Optimizing the Measuring Accuracy



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.

Fig. 7 Sensor arrangement in case of ground or striped surfaces

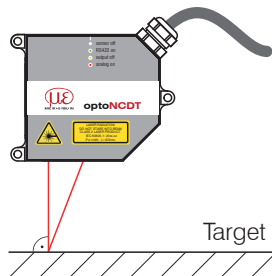


In case of bore holes, blind holes and edges in the surface of moving targets the sensor must be arranged in such a way that the edges do not obscure the laser spot.

Fig. 8 Sensor arrangement for holes and ridges

5.2 Mounting, Dimensions

The optoNCDT 1750 sensor is an optical system for measurements with micrometer accuracy. The laser beam must be directed perpendicularly onto the surface of the target.



i Make sure it is handled carefully when installing and operating. Mount the sensor only to the existing holes on a flat surface. Clamps of any kind are not permitted. Do not exceed torques.

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

Fig. 9 Sensor mounting with diffuse reflection

Bolt connection				
Housing size	Through length	Screw	Washer	Torque
		ISO 4762-A2	ISO 7089-A2	$\mu = 0.12$
	mm			Nm
S	30	M4	A4.3	2
M	35	M4	A4.3	2

Fig. 10 Mounting conditions

Recommended tightening torque \Leftrightarrow max. + 10 % permissible, not exceeded min. -20 %!

The tightening torques specified in the table are approximate and may vary depending on the application.

Basis of considerations $\mu = 0.12$.

► Mount the sensor by means of 3 screws type M4.

MR	2	10	20	50	100	200
SMR	24	30	40	45	70	70
Y	1.5	6.5	10	23	33.5	60

MR = Measuring range

SMR = Start of measuring range

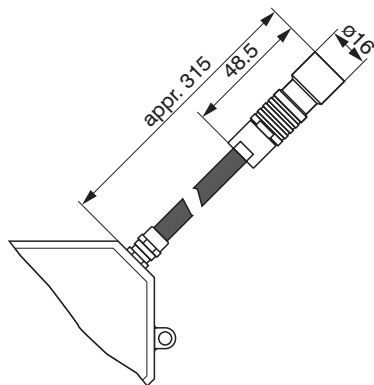


Fig. 11 Dimensional drawing sensor cable

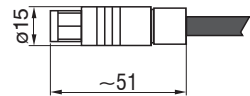


Fig. 12 Dimensional drawing male connector sensor cable

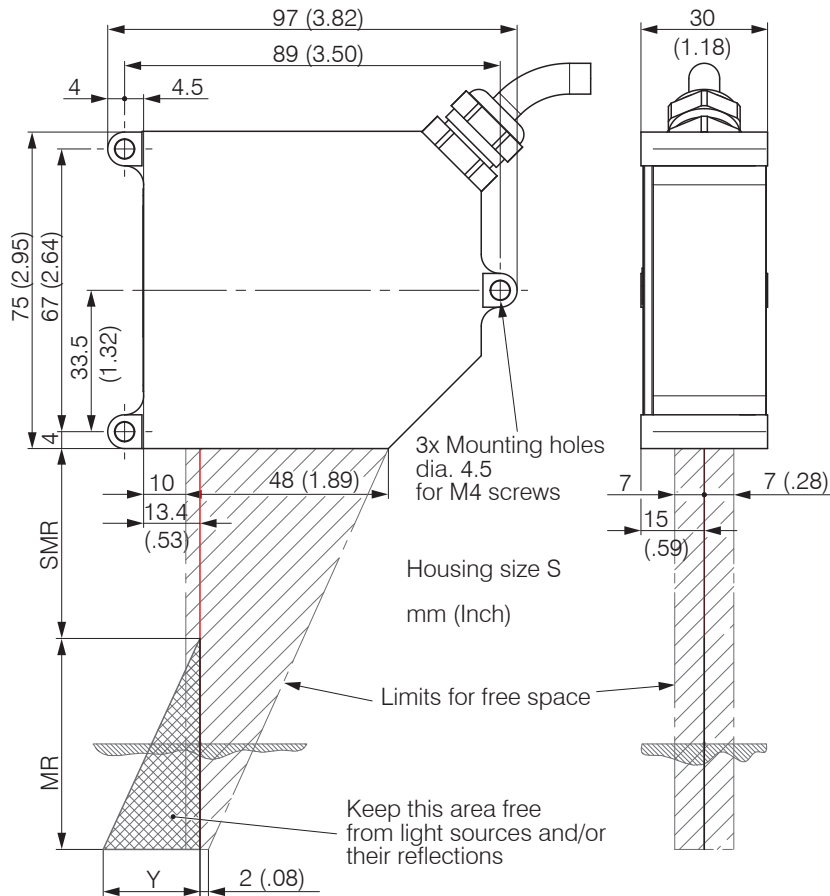


Fig. 13 Dimensional drawing and free space, ILD1750-2/10/20/50/100/200, ILD1750-2LL/10LL/20LL/50LL, ILD1750-20BL/200BL

MR	500	750
SMR	200	200
Y	180	270

MR = Measuring range

SMR = Start of measuring range

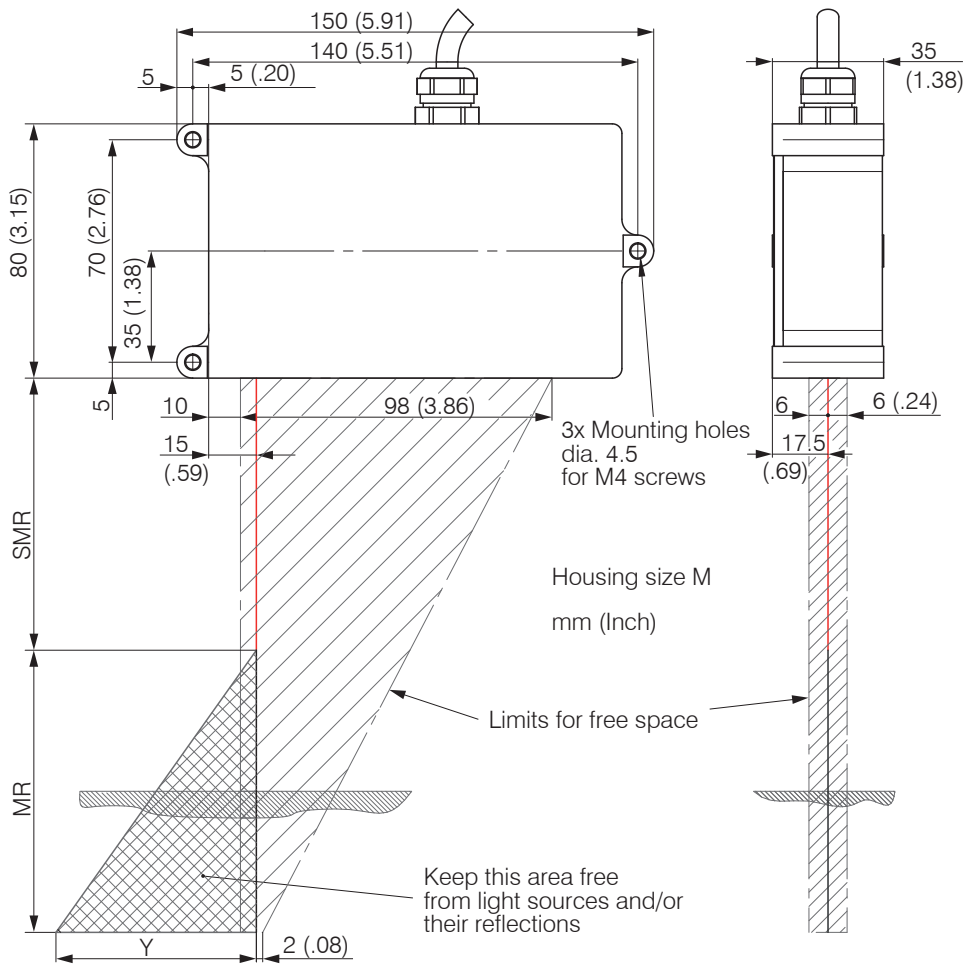
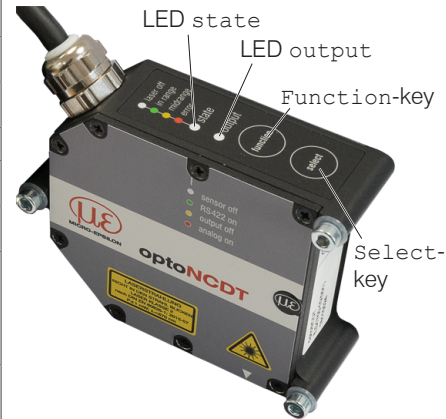


Fig. 14 Dimensional drawing and free space, ILD1750-500/750, ILD1750-500BL/750BL

5.3 Indicator Elements at Sensor

LED State	Meaning
green	Measuring object within sensor range
yellow	Mid range
red	Error - e.g. Poor target or out of range
off	Laser off
LED Output	Meaning
green	RS422 measurement value output
yellow	RS422 and analog output are switched off. The RS422 or the analog output can be switched on. The web interface can also be switched on.
red	Measurement value output: current with 4 ... 20 mA or voltage with 0 ... 5 V resp. 0 ... 10 V
off	Sensor off, no supply



The programmable touch key `Select` calls up the functions `Masters` or `Teaching`. By factory default both keys are only active for the first 5 minutes after power up. After that it will be automatically locked.

The touch key `Function` calls up the settings menu.

The key lock can be programmed via internal websites or ASCII commands.

5.4 Electrical Connections

5.4.1 Connection Possibilities

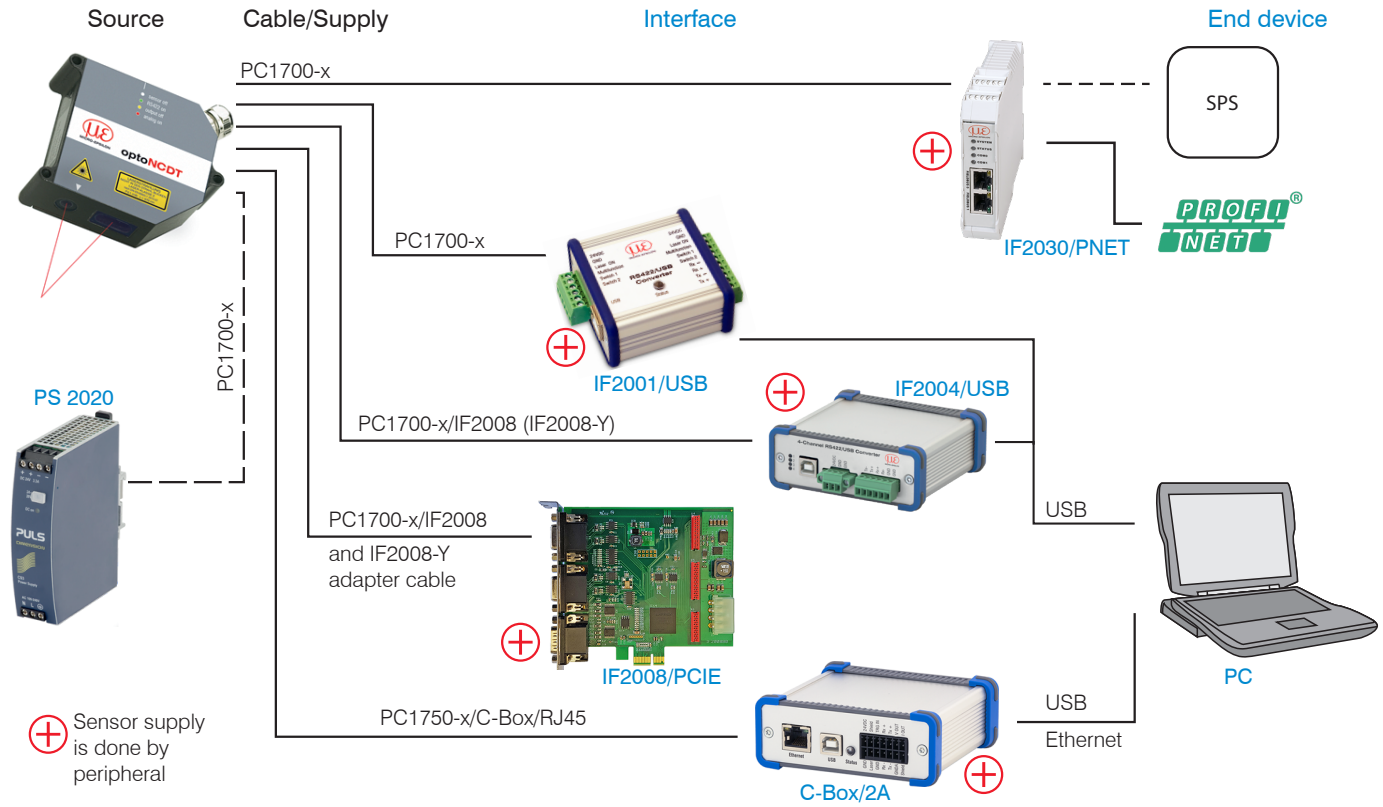


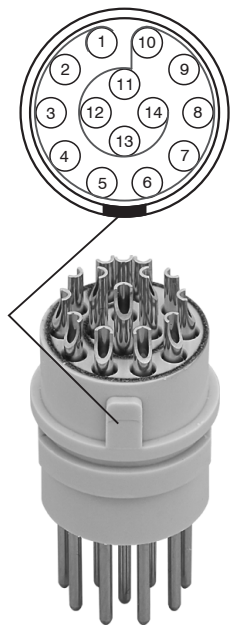
Fig. 15 Connection examples on ILD1750

The different periphery devices can be connected by the illustrated connection cables to the 14-pin sensor plug, see [Fig. 15](#). The single converter IF2004/USB, double converter C-Box/2A, 4-times converter IF2004/USB and the PCI interface card IF2008 also supply the operating voltage (24 V DC) of the sensor.

Peripheral	Sensor channels	Interface
IF2001/USB, RS422-USB converter	one	RS422
IF2030/PNET	one	
C-Box/2A	two	
IF2004/USB	four	
IF2008/PCIE, PCI interface card	four	
SPS, ILD1750 or the like	---	Functional input: trigger
Switch, key, PLC or the like	---	Switching input laser On/Off

Fig. 16 Max. sensor channels on the peripheral devices

5.4.2 Pin Assignment



View: Solder-pin side male cable connector, insulator

1) Used as trigger inputs in mode „Triggering“.

Signal	Pin	Description	Specification	Color sensor cable PC1700-x
+U _B	5	Supply voltage (11 ... 30 VDC)		red
GND	6	System ground for power supply, switch signals (Laser on/off, Zero, Limits)		black
Analog output	13	Current 4 ... 20 mA	$R_B < (U_B - 6 \text{ V}) / 20 \text{ mA}$, see Chap. 5.4.5	Coaxial inner conductor
		Voltage 0 ... 5 VDC Voltage 0 ... 10 VDC	$R_i = 50 \text{ Ohm}$, $I_{\text{max}} = 5 \text{ mA}$	
AGND	14	Reference potential for analog output		Coaxial screening, black
Laser on/off	9	Switching input	Laser in operation, if Pin 9 is connected with GND, see Chap. 5.4.4	red-blue
Multifunction input	10	Switching input	TrigIn, Zero/Master, TeachIn, SlaveIn, see Chap. 5.4.6	white-green
Switch output 1	8	Error/Limit 1	Programmable switching characteristic: (NPN, PNP, Push-Pull), see Chap. 5.4.8	grey-pink
Switch output 2	7	Limit 2		violet
Sync +	3	Symmetrical synchron output (Master) or input (Slave) ¹	RS422 level, terminating resistor 120 Ohm switchable, input or output selected depending on the synchronization mode	blue
Sync -	4			pink
Tx +	1	RS422 - Output (symmetric)	Terminate receiver with 120 Ohm	green
Tx -	2			brown
Rx +	12	RS422 - Input (symmetric)	Internally terminated with 120 Ohm	grey
Rx -	11			yellow

The sensor cable PC1700 is cable carriers suitable. One end has a molded female cable connector, the other end has free leads with ferrules. **Plug connector:** ODU MINI-SNAP, 14-pin, series B, dimension 2, Code 0, IP 68 ; More information on www.odu.de

NOTICE

Don't cut the coaxial inner cable (pin 13 / white) and the coaxial screening (pin 14 / black). Twist the outer braid, (pin 14), otherwise the analog output cannot be connected to the terminals of the customer electronics.

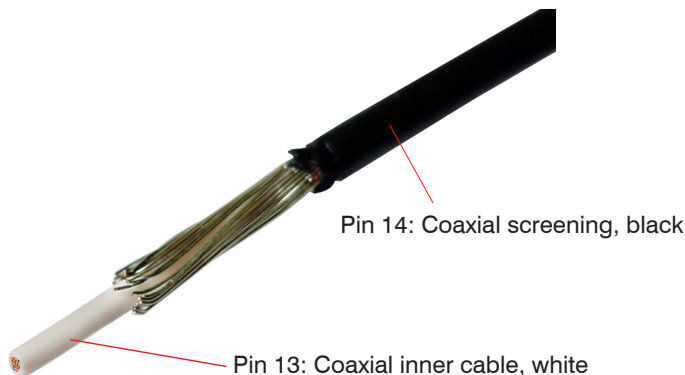
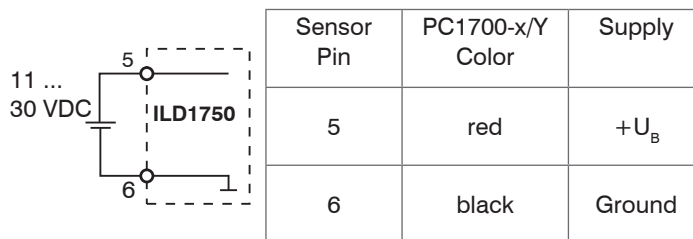


Fig. 17 View on pin 13 / pin 14, PC1700

5.4.3 Supply voltage

Nominal value: 24 V DC (11 ... 30 V, P < 3 W).

- ➡ Switch on the power supply unit once wiring is completed.
- ➡ Connect the inputs „5“ and „6“ at the sensor with a 24 V voltage supply.



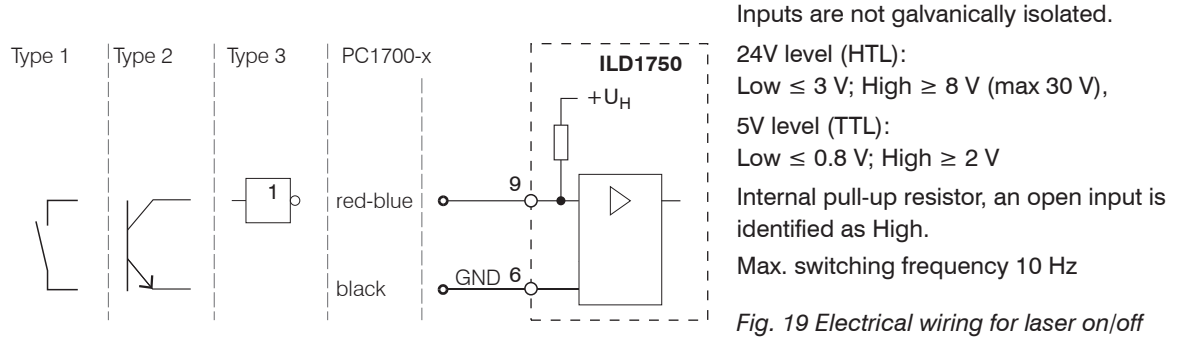
Use the supply voltage for measurement instruments only and not for drive units or similar sources of pulse interference at the same time. MICRO-EPSILON recommends using an optional available power supply unit PS2020 for the sensor.

Fig. 18 Connection of supply voltage

5.4.4 Laser On

The measuring laser on the sensor is activated via an switch input (HTL or TTL level). This is advantageous if the sensor has to be switched off for maintenance or similar. Switching can be done with a transistor (for example open collector in an optocoupler), a relay contact or a digital TTL/HTL signal.

i If pin 9 is not connected electrically with Pin 6, the laser is off.



There is no external resistor for current limiting required. Connect Pin 9 with Pin 6 for permanent „Laser on“.
 Reaction Time for Laser-On: Correct measuring data are sent by the sensor approximately 1 ms after the laser was switched on.

5.4.5 Analog Output

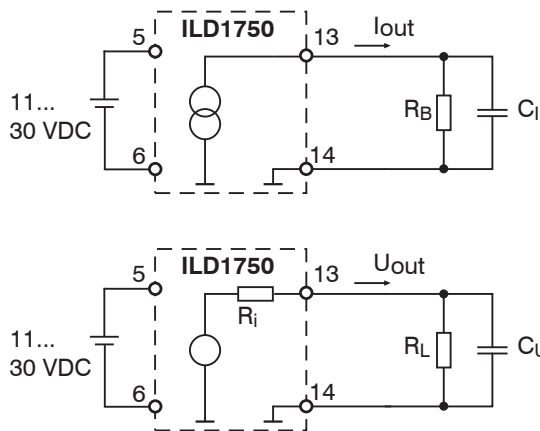
The sensor alternatively provides a

- current output with 4 ... 20 mA or a
- voltage output with 0 ... 5 V resp. 0 ... 10 V.

i The output may not be continuously operated in short circuit operation without load resistor. The short circuit operation leads to durable thermal overload and thus for automatic overload shutdown of the output.

➡ Connect the output 13 (white, coaxial inner conductor) and 14 (black) on the sensor to a measuring device.

Sensor	
14-pin female cable connector	Sensor cable
OUT (Pin 13)	white
GND (Pin 14)	black
$R_i = 50 \text{ Ohm}$	



Current output

$$R_B < (U_B - 6 \text{ V}) / 20 \text{ mA};$$

$$R_B \text{ max.} = 250 \text{ Ohm at}$$

$$U_B = 11 \text{ V}$$

$$C_i \leq 33 \text{ nF}$$

Voltage output

$$R_i = 50 \text{ Ohm, } I_{\text{max}} = 5 \text{ mA,}$$

short circuit protection at 7 mA

$$R_L > 20 \text{ MOhm}$$

$$C_U \leq 100 \text{ nF}$$

Fig. 20 Wiring for analog output

5.4.6 Multifunction Input

The multifunctional input enables the functions Triggering, Zeroing/Mastering, Teaching. The function is dependent on the programming of the input and of the time behavior of the input signal. The inputs are not galvanically isolated, the maximum switching frequency is 10 kHz.

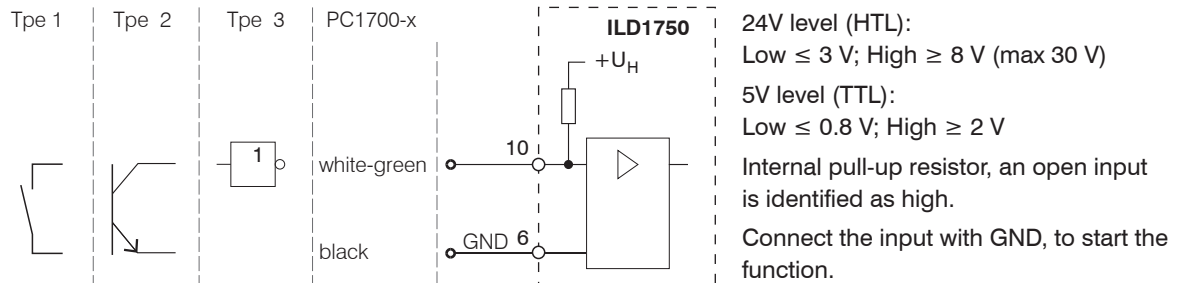


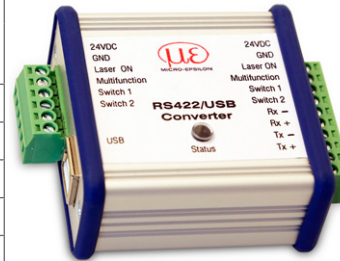
Fig. 21 Electrical wiring for multifunctional input

5.4.7 RS422 Connection with USB Converter IF2001/USB

Cross the lines for connections between sensor and PC.

i Disconnect or connect the D-sub connection between RS422 and USB converter when the sensor is disconnected from power supply only.

Sensor		End device (converter)
14-pin cable connector	Sensor cable	Type IF2001/USB from MICRO-EPSILON
Tx + (Pin 1)	green	Rx + (Pin 3)
Tx -(Pin 2)	brown	Rx -(Pin 4)
Rx + (Pin 12)	grey	Tx + (Pin 1)
Rx -(Pin 11)	yellow	Tx -(Pin 2)
GND (Pin 6)	black	GND (Pin 9)



Symmetric differential signals acc. to EIA-422, not galvanically isolated from supply voltage.

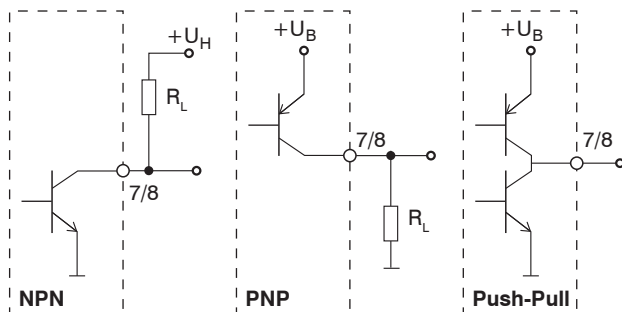
Use a shielded cable with twisted cores e.g. PC1700-x.

Fig. 22 Pin assignment IF2001/USB

5.4.8 Digital Output

The switching characteristic (NPN, PNP, Push-Pull, Push-Pull negated) of both digital outputs depends on the programming.

The NPN output is e.g. suitable for adjustment to TTL logics with an auxiliary voltage $U_H = +5\text{ V}$. The digital outputs are protected against reverse polarity, overloading ($> 100\text{ mA}$) and over temperature.



Output is not galvanically isolated.

24V level (HTL),

$$I_{\max} = 100\text{ mA},$$

$$U_{H\max} = 30\text{ V saturation voltage at } I_{\max} = 50\text{ mA:}$$

$$U_{\text{sat, low}} < 1.5\text{ V (output - GND)},$$

$$U_{\text{sat, high}} < 1.5\text{ V (output - } +U_B)$$

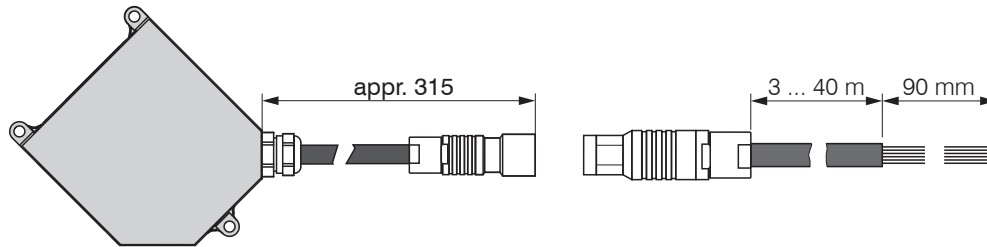
Fig. 23 Electrical wiring digital output

Switching characteristic		
Description	Output active (error, limit value)	Output passive (no error, no off-limit condition)
NPN (Low side)	GND	appr. $+U_H$
PNP (High side)	$+U_B$	appr. GND
Push-Pull	$+U_B$	GND
Push-Pull, negated	GND	$+U_B$

Fig. 24 Switching characteristic digital output

The digital outputs are activated when measuring object is missing, measuring object too close/too far, no valid measurement value or with an off-limit condition.

5.4.9 Connector and Sensor Cable



ILD1750 with pigtail

PC1700 with open ends

➔ Never fall below the bending radius for the sensor cable of 55 mm (dynamic).

•
i The fixed connected sensor cable is cable carriers suitable.

•
i Unused open cable ends must be insulated to protect against short circuits or malfunction of the sensor.

MICRO-EPSILON recommends to use the cable carriers suitable standard connection cable PC1700 of the optional accessories, see Chap. A 1.

The connector and the cable component are marked with red markings which have to be aligned opposite each other before connection. In addition, they come with guidance grooves to prevent them from being wrongly connected. To release the plug-in connection, hold the plug-in connector on the grooved grips (outer sleeves) and pull apart in a straight line. Pulling on the cable and the lock nut will only lock the plug-in connector (ODU MINI-SNAP FP - lock) and will not release the connection.

➔ Mount the cable connector if you use a cable carriers suitable sensor cable PC1700.

➔ Avoid excessive pulling to the cables. Provide strain relieves near the connectors when cables > 5 m are vertically free hanging.

➔ Do not twist the connectors in opposite directions when connected.

- ➡ 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 leads next to or together with power cables or pulse-loaded cables (e.g. for drive units and solenoid valves) in a bundle or in cable ducts. Always use separate ducts.

Recommended strand cross-section for self-made connection cables: $\geq 0.14 \text{ mm}^2$ (AWG 25).

6. Operation

6.1 Getting Ready for Operation

- ▶ Install and assemble the optoNCDT 1750 in accordance with the instructions set out, see Chap. 5.
- ▶ Connect the sensor with the indicator or monitoring unit and the power supply.

The laser diode in the sensor can only be activated if at the input Laser on/off Pin 9 is connected with Pin 6, see Chap. 5.4.4.

Once the operating voltage has been switched on the sensor runs through an initialization sequence. This is indicated by the momentary activation of all the LEDs. Once initialization has been completed, the sensor transmits a „->“ via the RS422 interface. The initialization takes up to 3 seconds.

For reproducible measurements the sensor typically requires a start-up time of 20 minutes.

If the LED `output` is off, this means that there is no supply voltage.

If the LED `state` is off, this means that the laser light source has been switched off.

6.2 Operation via Web Interface

6.2.1 Preconditions

In the sensor, dynamic Web pages are created that contain the current settings of the sensor and the peripheral. The operation is only possible as long as an RS422 connection to the sensor exists.

The sensor is connected to a PC/notebook via a RS422 converter, supply voltage persist.

➡ Start the program `SensorFinder Vx.x.x.`

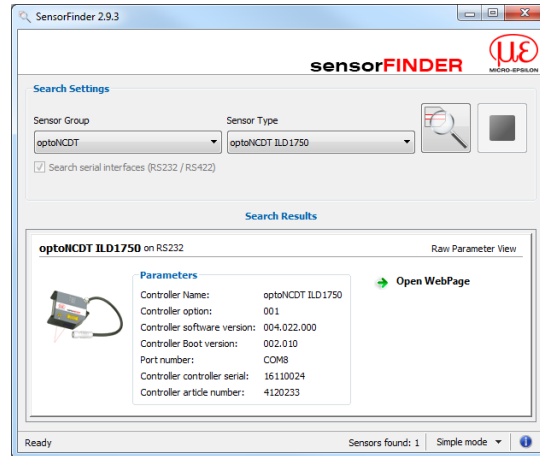


Fig. 25 Auxiliary program for sensor search and to start web interface

The tool searches for connected ILD1750 sensors by means of an internal auxiliary program on available interfaces.

You need a web browser (e.g. Mozilla Firefox or Internet Explorer) on a PC/notebook.

➡ Choose the desired sensor. Click on the button `Open WebPage`.

6.2.2 Access via Web Interface

➡ Start the web interface of the sensor, see Chap. 6.2.1

Interactive websites for programming the sensor now appear in the web browser.

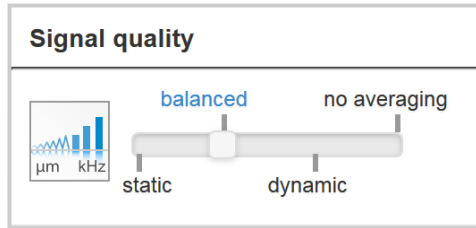


In the top navigation bar other auxiliary functions (settings, measurement chart etc.) are available.

The appearance of the web-sites can change dependent of the functions. Each page contains descriptions of parameters and so tips for filling the website.

Fig. 26 First interactive website after selection of the web interface

The sensor is active and supplies measurement values. The ongoing measurement can be operated by means of function buttons in the area.



Averaging	Description
Static Moving, 128 values	In the area <i>Signal quality</i> you can switch between four given basic settings (static, balanced, dynamic and no averaging). You can instantly see the reaction in the diagram and system configuration.
Balanced Moving, 64 values	
Dynamic Median, 9 values	
no averaging	

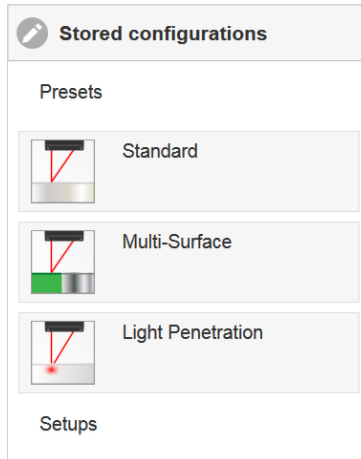
The area *System configuration* displays the current settings for measuring rate, averaging and RS422 in blue lettering. Changes to the settings are possible by means of the slide *Signal quality* or by means of the tab *Settings*.

The area *Diagram type* enables the change between graphical display of the measurement value or the video signal, each as value time diagram.

- **i** After programming all the settings are to be stored permanently in a set of parameters. The next time you turn on the sensor they are available again. Therefore use the button *Save settings*.
- **i** If the sensor starts with user defined measurement setting (setup), changing the signal quality is not possible.

6.2.3 Measurement Configuration

Common measurement configurations (presets) for various target surfaces are stored on the sensor. Those enable to quickly start the respective measurement task. Choosing a target causes a predefined configuration of the settings which achieves the best results for the chosen material.



Standard

Ceramics, metal

Multi-Surface ¹

Printed circuit boards (PCB),
hybrid material

Light penetration ¹

Plastics (Teflon, POM),
materials with large penetration depth of
the laser

¹) Available for ILD1750-2/10/20/50/2LL/10LL/20LL/50LL/20BL sensors

6.2.4 Measurement Presentation via Web Browser

➔ Start the measurement value display with the tab **Measurement chart** in the horizontal navigation bar.

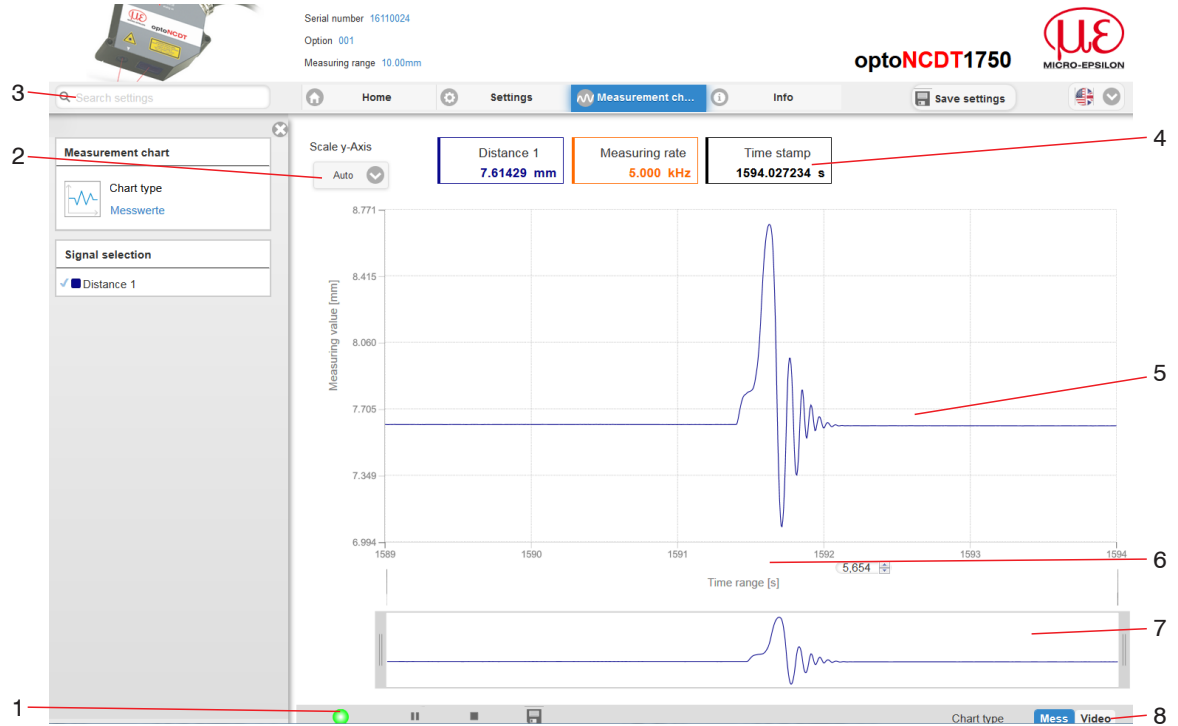



Fig. 27 Website measurement (distance measurement)

- 1 Stop stops the diagram; data selection and zoom function are still possible. Pause interrupts recording. Save opens the Windows selection dialog for file name and storage location to save the last 10,000 values in a CSV file (separation with semicolon).

- 2 For scaling the measurement value axis (y-axis) of the graphics you can either choose `Auto` (= auto-scaling) or `Manual` (= manual setting).
 - 3 The search function enables time-saving access to functions and parameters.
 - 4 In the text boxes above the graphics current values for distance, current measuring rate and timestamp are displayed.
 - 5 Mouse over function. When moving the mouse over the graphic in stopped state curve points are marked with a circle symbol and the related values are displayed in text boxes above the graphic. Peak intensity is also updated.
 - 6 Scaling of the x-axis can be defined by means of a input field below the time axis.
 - 7 Scaling of the x-axis: you can enlarge (zoom) the overall signal by means of the left slider during ongoing measurement. If the diagram is stopped, you can also use the right slider. The zoom window can also be moved by means of the mouse in the middle of the zoom window (arrow cross).
 - 8 Choice of a diagram type: measurement or video signal representation.
- i** If you leave the diagram display in a separate tab or window of the browser running, you do not have to restart the description each time.
-  Click the button `Start`, for starting the display of the measurement results..

6.2.5 Video Signal via Web Browser

▶ Start the video signal display with the function `Video` in the area `Diagram` type.

The diagram in the big graphic window on the right displays the video signal of the recipient filed. The video signal in the graphic window displays the intensity distribution above the pixels of the recipient field. 0 % (distance small) on the left and 100 % (distance big) on the right. The related measurement value is marked by means of a vertical line (peak marking).

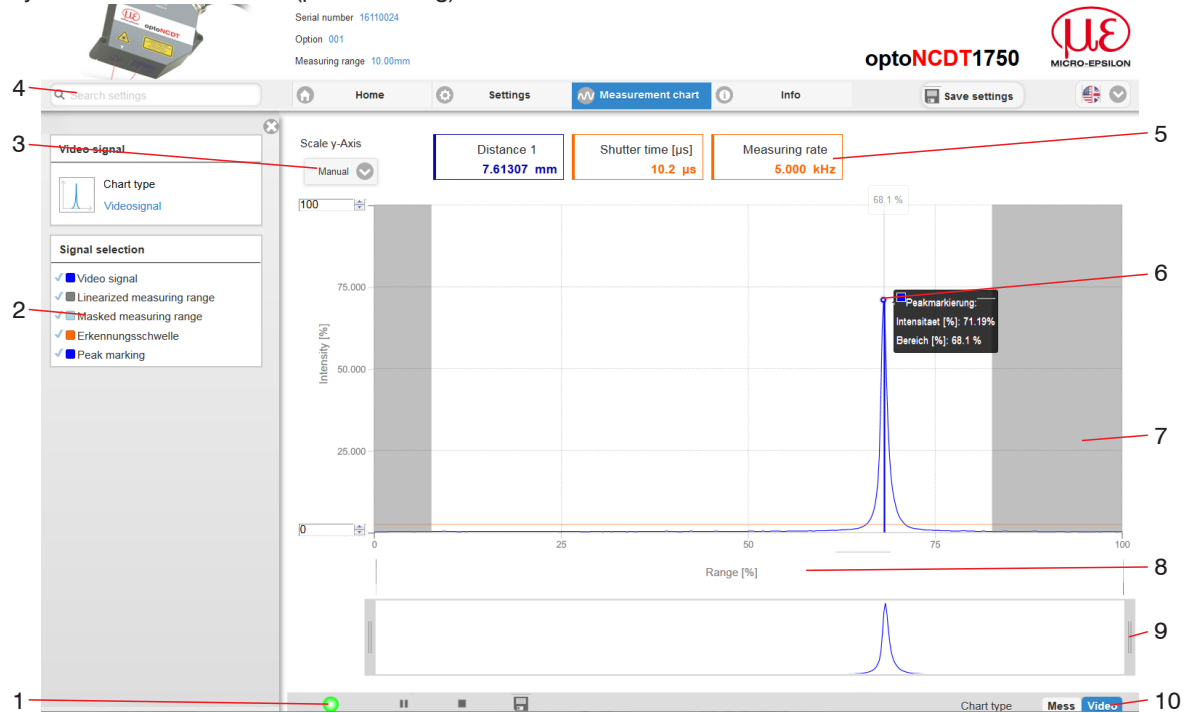


Fig. 28 Display of video signals

- 1 `Stop` stops the diagram; data selection and zoom function are still possible. `Save` opens the Windows selection dialog for file name and storage location to save the video signal in a CSV file.
- 2 The video curves to be displayed while or after measurement can be switched on or off. Non active curves are highlighted in gray and can be added by clicking the hook. If you only want to see a single signal, then click on its name.
 - Peak marking (vertical blue line), corresponds to the calculated measurement value
 - Linearized measuring range (limited by means of gray shading), cannot be changed
 - Masked range (limited by means of light blue shading), changeable
- 3 For scaling the measurement value axis (y-axis) of the graphics you can either choose `Auto` (= auto scaling) or `Manual` (= manual setting).
- 4 The search function enables time-saving access to functions and parameters.
 - ASCII commands to the sensor can also be sent via the search function.
- 5 In the text boxes above the graphics current values for distance, exposure time and current measuring rate are displayed.
- 6 Mouse over function. When moving the mouse over the graphic in stopped state curve points are marked with a circle symbol and the related intensity is displayed. The related x position in % appears above the graphic filed.
- 7 The linearized range is between the gray shading in the diagram and cannot be changed. Only peaks which centers are within this range can be calculated as measurement value. The masked range can be limited on request and is additionally limited by means of a light blue shading on the right and on the left. The remaining peaks in the resulting range are used for evaluation.
- 8 Scaling of the x-axis can be defined by means of a input field below the time axis.
- 9 Scaling of the x-axis: you can enlarge (zoom) the overall signal by means of the left slider during ongoing measurement. If the diagram is stopped, you can also use the right slider. The zoom window can also be moved by means of the mouse in the middle of the zoom window (arrow cross).
- 10 Choice of a diagram type: measurement or video signal representation.

By displaying the video signal, you can detect effect of the adjustable measurement task (target material), choice of peak and possible interfering signals by means of reflections.

There is no linear relationship between the position of the peaks in the video signal and the output measurement value.

6.3 Programming via ASCII Commands

As an added feature you can program the sensor via an ASCII interface, physically the RS422. This requires, that the sensor must be connected either to a serial RS422 interface via a suitable interface converter, see Chap. A 1, or a plug-in-card to a PC / PLC.

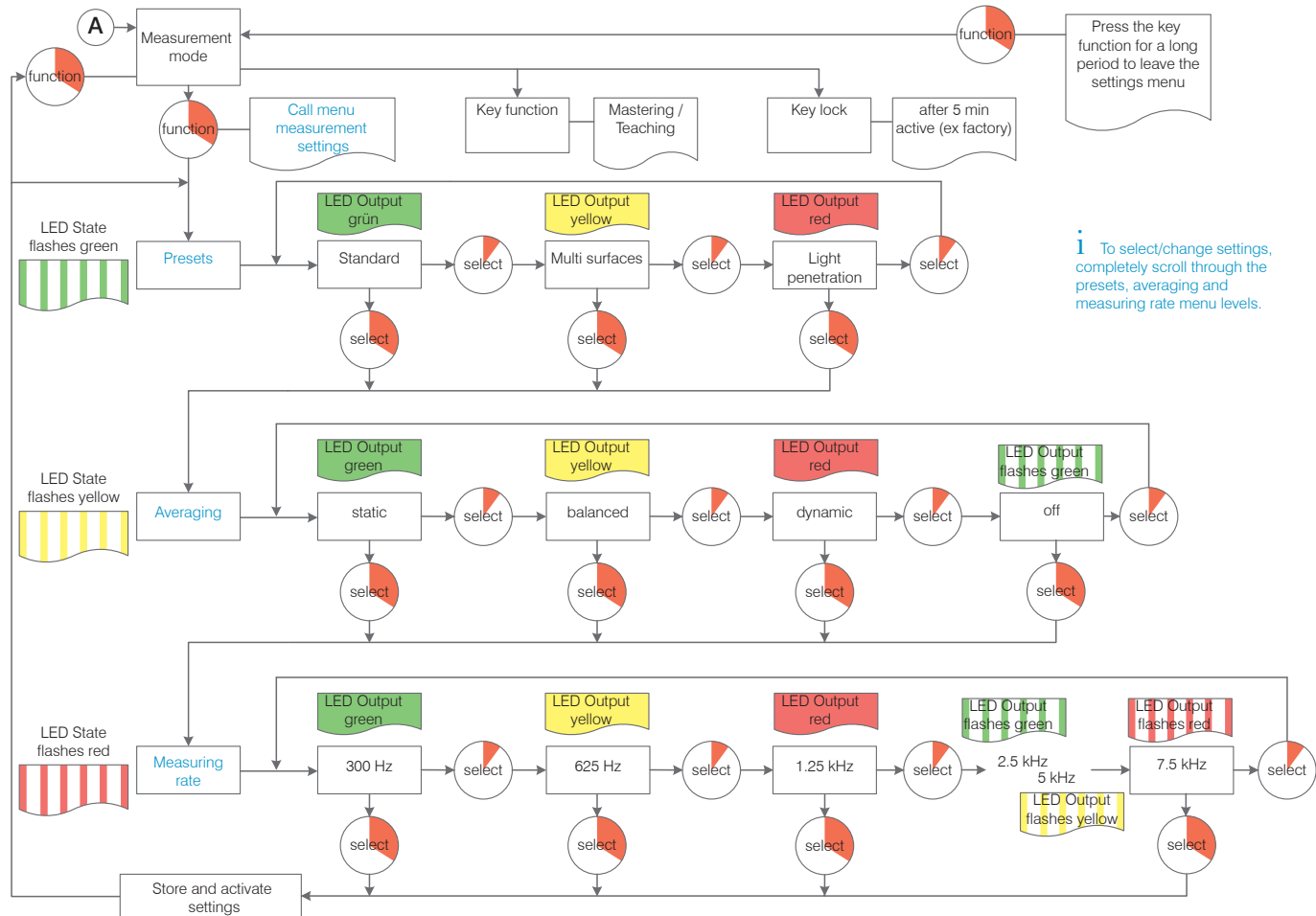
Pay attention in the programs used to the correct RS422 default setting.

Once connected, you can transmit the commands via the terminal to the sensor.

6.4 Timing, Measurement Value Flux

The sensor requires four cycles for measurement and calculation without triggering:

Each cycle takes $133.3 \mu\text{s}$ at a measuring rate of 7.5 kHz. The measured value N is available at the output after four cycles. The delay between acquisition and output is therefore $553 \mu\text{s}$. As the processing in the cycles occurs parallel, after another $133.3 \mu\text{s}$, the next measured value (N+1) is output.



7. Setting Sensor Parameters

7.1 Preliminary remarks about the setting possibilities

There are different ways to program the optoNCDT 1750:

- using the web browser via the ILD1750 DAQ tool and the sensor web interface
- using the ASCII command set and the terminal program via RS422

i If the programming is not permanently stored on the sensor, the settings will be lost after switching off the sensor.

7.2 Overview Parameter

The following parameters can be set or changed in the optoNCDT 1750, see tab *Settings*.

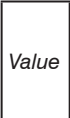
Inputs	Laser power, Synchronization, Multi-function input
Data recording	Measurement task, Measuring rate, Input trigger, Masked area, Exposure mode, Peak selection, Error handling
Signal processing	Averaging, Zeroing/Mastering, Output trigger, Data reduction
Outputs	RS422, Analog output, Digital output, Output interface
System settings	Unit on website, Key lock, Load & Store, Import & Export, Access permission, Reset sensor (factory settings)

7.3 Inputs

➡ Change to the `Input` menu in the `Settings` tab.

Laser power	<i>Full / Reduced / Off</i>			<i>The laser light source is active only, if pin 9 is connected to GND.</i>
Synchronization	<i>Slave / Slave alternating</i>	Termination	<i>On / Off</i>	<i>If several sensors measure the same target synchronously, the sensors may be synchronized with each other. The synchronization output of the first sensor (master) controls the sensors connected to the synchronization inputs (slaves).</i>
	<i>Slave MFI</i>			
	<i>Master / Master alternating</i>			
	<i>inactive</i>			
Level Multi-function input	<i>TTL / HTL</i>			<i>Defines the input level of both switching inputs Laser on/off and Multi-function. TTL: Low $\leq 0,8$ V; High ≥ 2 V HTL: Low ≤ 3 V; High ≥ 8 V</i>

 Grey shaded fields require a selection.

 Dark-bordered fields require you to specify a value.

7.4 Synchronization

7.4.1 Synchronization via Sync +/- Connections

If two or more optoNCDT 1750 measure against the same target, the sensors can be synchronized. The optoNCDT 1750 distinguishes between two types of synchronization.

NOTICE

The synchronous connections may not be temporarily connected to the operating voltage and / or GND

Risk of destruction of the sensor by overloading.

Type		Used for
Simultaneous synchronization	Both sensors measure in the same cycle	Measurement of differences (thickness, difference in height) on opaque objects. Here, Sensor 1 must be programmed as the “Master” and Sensor 2 as the “Slave”, see Chap. 7.3.
Alternating synchronization	Both sensors measure alternatively Output rate \leq measuring rate / 2	Thickness measurements on translucent objects or measurements of difference on closely spaced measurement points. The alternating synchronization requires that the lasers are switched on and off alternately so that the two sensors do not interfere with each other optically. Therefore one sensor is to program as “Master alternating” and one as “Slave alternating”. There can be only one master to be connected to a slave.

Fig. 29 Characteristics of and uses for the different types of synchronization

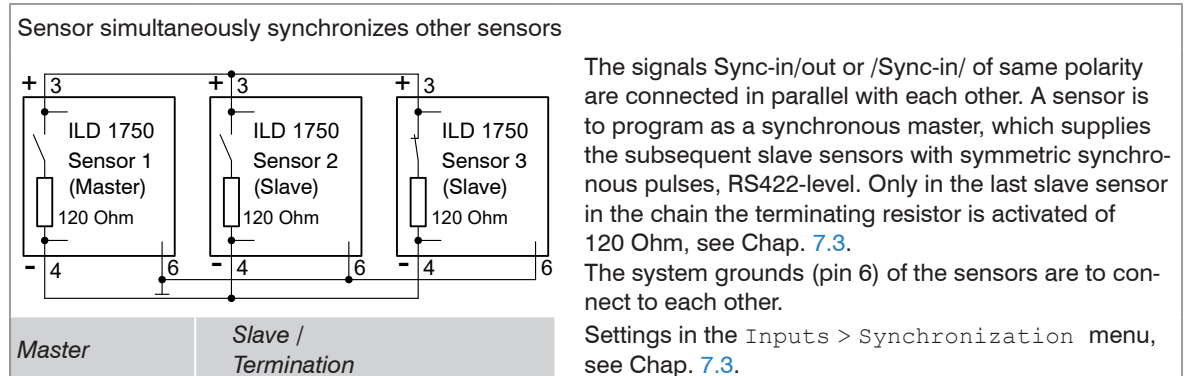
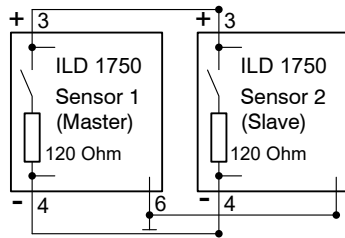


Fig. 30 Sensor 1 synchronizes other sensors

Sensor alternately synchronizes another sensor



Master alternating

Slave alternating / Termination

The signals Sync-in/out or /Sync-in/ of same polarity are connected in parallel with each other. A sensor is to program as a synchronous master, which supplies the subsequent slave sensor with symmetric synchronous pulses, RS422-level. Only in the last slave sensor in the chain the terminating resistor is activated of 120 Ohm, see Chap. 7.3.

The system grounds (pin 6) of the sensors are to connect to each other.

Settings in the `Inputs > Synchronization` menu, see Chap. 7.3.

Fig. 31 Sensor 1 synchronizes another sensor

i Do not ever connect two masters with each other. If two masters are connected to one another, the laser diodes switch off. No measurement is possible.


Signal	Sensor	
	Pin	
GND	6	
Sync-in/out	3	
/Sync-in/out	4	

Fig. 32 Sensor round pin plug, view: Solder-pin side male cable connector

7.4.2 Synchronization via Multi-Function Input

i Do not ever connect two masters with each other. If two masters are connected to one another, the laser diodes switch off. No measurement is possible.

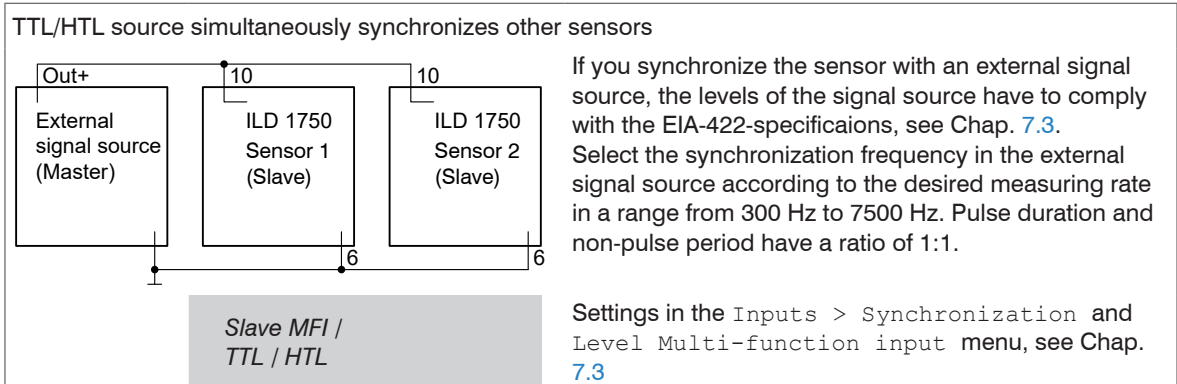


Fig. 33 Signal source synchronizes sensors

Signal	Sensor
	Pin
GND	6
Multi-function input	10

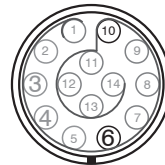


Fig. 34 Sensor round pin plug, view: Solder-pin side male cable connector

7.5 Data Recording

7.5.1 Preliminary Remark

➡ Change to the `Data recording` menu in the `Settings` tab .

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 recording` are displayed.

7.5.2 Measuring Rate

The measuring rate indicates the number of measurements per second.

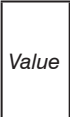
➡ Select the required measuring rate.

Measuring rate	300 Hz / 625 Hz / 1.25 kHz / 2.5 kHz / 5 kHz / 7.5 kHz /	Use a high measuring rate for bright and mat measurement objects. Use a low measuring rate for dark or shiny measurement objects (e.g. black painted surfaces) to improve the measurement result.
	Free measuring rate	

At a maximum measuring rate of 7.5 kHz, the CMOS element is exposed 7500 times per second. The lower the measuring rate, the longer the maximum exposure time.

The measuring rate is factory set to 2.5 kHz.

 Grey shaded fields require a selection.

 Dark-bordered fields require you to specify a value.

7.5.3 Triggering

7.5.3.1 General

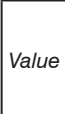
The value input and output on the optoNCDT 1750 can be controlled through an external electrical trigger signal or commands. Both analog and digital outputs are affected. The measured value to the trigger point is output delayed, see Chap. 6.4.

- Triggering does not influence the preset measuring rate or the timing so that 4 cycles + 1 cycle (jitter) are between the trigger event (level change) and the output reaction
- Micro-Epsilon does not recommend any data reduction e.g. by subsampling when the trigger is used.
- The multi-function or synchronization inputs are used as external trigger inputs, see Chap. 5.4.6.
- Factory settings: no triggering, the sensor starts transmitting data output as soon as it is switched on.
- “Trigger in” pulse duration is at least 50 µs.

The triggering of the measured value recording and output have the same timing.

<i>Input trigger Output trigger Trigger source</i>	<i>Multi-function input / Synchroni- zation input</i>	<i>Trigger type</i>	<i>Edge / Level</i>		
		<i>Trigger level</i>	<i>high rising edge / low falling edge</i>		
		<i>Number of mea- sured values</i>	<i>Infinite</i>		
			<i>Manual selection</i>	<i>Value</i>	<i>Range: 1 ... 16382</i>
	<i>Software</i>	<i>Trigger type</i>	<i>Edge / Level</i>		
		<i>Trigger level</i>	<i>high rising edge / low falling edge</i>		
		<i>Number of mea- sured values</i>	<i>Infinite</i>		
			<i>Manual selection</i>	<i>Value</i>	<i>Range: 1 ... 16382</i>
		<i>Start triggering</i>			<i>Button starts data recording</i>
		<i>Stop triggering</i>			<i>Sensor outputs continuous data</i>
<i>Inactive</i>			<i>No triggering</i>		

 Grey shaded fields require a selection.

 Dark-bordered fields require you to specify a value.

Implemented trigger conditions:

Level triggering with High level / Low level.

Continuous value input/output for as long as the selected level is active. Then the data recording/output stops.

Pulse duration must last for at least one cycle. The subsequent pause must also last for at least one cycle.

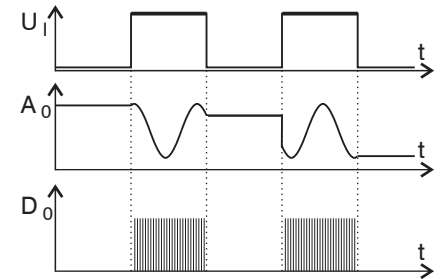


Fig. 35 Trigger level High (above) with analog output A0 and digital output signal D0 (below).

Edge triggering with rising or falling edge.

Starts data recording as soon as the selected edge is active to the trigger input. If trigger conditions are met, the sensor outputs a defined number of measurements. Value range between 1 and 16382. After completion of data output the analog output remains standing at the last value.

The duration of the pulse must be at least 50 μ s.

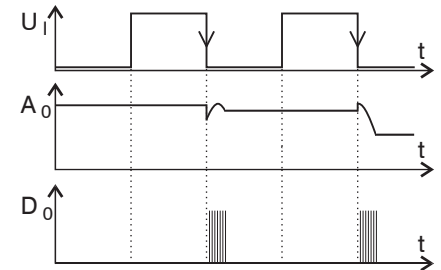


Fig. 36 Trigger edge HL (above) with analog output A0 and digital output signal D0 (below).

Software triggering. Data recording is caused by the TRIGGERSW SET command. The sensor outputs the previously set number of measured values or initiates a continuous measured value output after the trigger event.

Measurement value output can also be stopped via a command.

7.5.3.2 Triggering Data Recording

The data recording trigger processes measurements which are recorded from the trigger event. Previously acquired measurement values are rejected. The record triggering therefore directly influences the subsequent processing of measured values. In particular, the average calculation only includes values measured from the trigger event.

Activating the data recording trigger deactivates the data output trigger.

7.5.3.3 Triggering Data Output

Measurement values are calculated continuously and independently of the trigger event. A trigger event simply triggers the value output via a digital or an analog interface. Therefore, any values measured immediately before the trigger event are included in calculating mean values (averages).

Activating the data recording trigger deactivates the data recording trigger.

7.5.4 Masking the Evaluation Range, ROI

Masking limits the evaluating range (ROI - Region of Interest) for the distance calculation in the video signal. This function is used in order to e.g. suppress interfering reflections or ambient light.

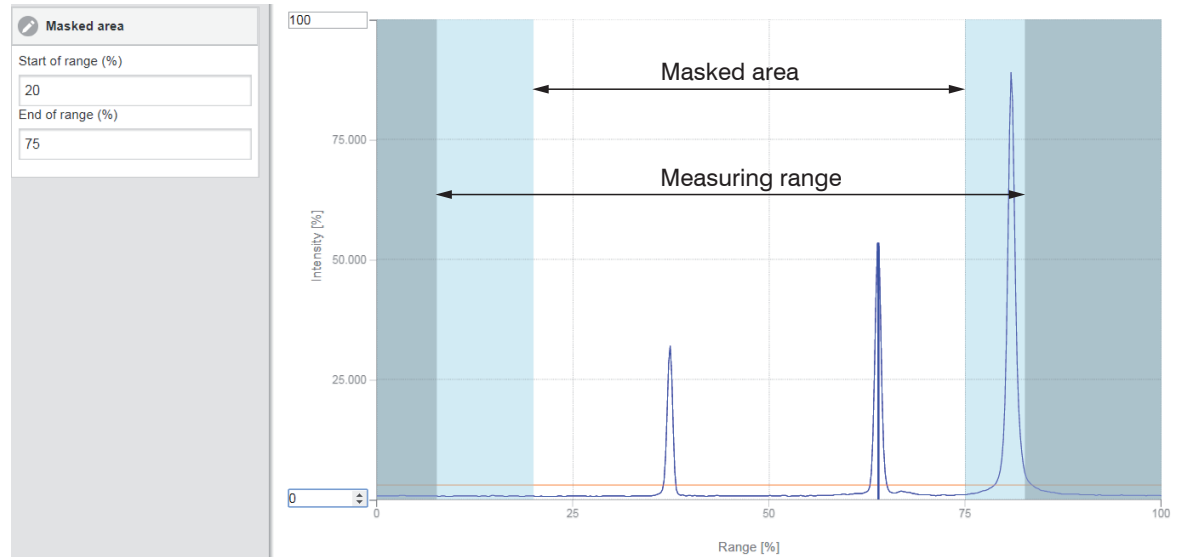
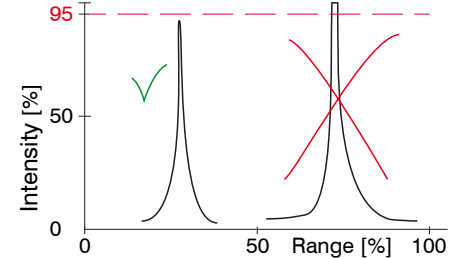


Fig. 37 Light blue areas limit the evaluation range

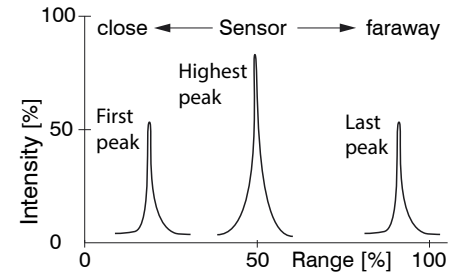
7.5.5 Exposure Mode

Exposure mode	<i>Automatic mode / Manual mode</i>	<p><i>In the automatic mode, the sensor determines the optimal exposure time in order to achieve the highest possible signal intensity</i></p> <p><i>In the manual mode, when the video signal is displayed, the user determines the exposure time</i></p> <p><i>Vary the exposure time in order to achieve a signal quality up to a maximum of 95 %.</i></p> <p><i>In both cases, the set measuring rate is hold.</i></p>
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7.5.6 Peak Selection

Peak selection	<i>First peak / Highest peak / Last peak / Widest peak</i>	<p><i>Defines which signal is used for the evaluation in the line signal.</i></p> <p><i>First peak: Nearest peak to sensor.</i></p> <p><i>Highest peak: standard, peak with the highest intensity.</i></p> <p><i>Last peak: widest peak to sensor.</i></p> <p><i>Widest peak: peak with maximum area.</i></p>
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If a measurement object contains multiple transparent layers, a correct measurement result is determined only for the first peak.

Grey shaded fields require a selection.

Dark-bordered fields require you to specify a value.

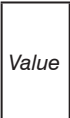
7.5.7 Error Processing

The error processing controls the behavior of the analog output and the RS422 interface in the event that an error occurs.

Error handling	<i>Digital output, no value</i>	<i>The analog output supplies 3 mA resp. 5.2 / 10.2 V instead of measurement value. The RS422 interface outputs an error value.</i>	
	<i>Hold last value infinite</i>	Analog output and RS422 interface stop at the last valid value.	
	<i>Hold last value</i>	1 ... 1024	Value

If no valid reading can be obtained, an error is issued. Should this be a problem for processing, the last valid value can be hold for a certain period of time, and will be issued repeatedly. After this period has expired, an error value is output.

 Grey shaded fields require a selection.

 Dark-bordered fields require you to specify a value.

7.6 Signal Processing

7.6.1 Preliminary Remark

➡ Change to the `Signal processing` menu in the `Settings` tab.

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` area are displayed.

7.6.2 Averaging

7.6.2.1 General

Averaging is recommended for static measurements or slowly changing measured values.

Averaging	<i>Inactive</i>			<i>Measurement values are not averaged.</i>
	<i>Moving N values</i>	2 / 4 / 8 ... 128	<i>Value</i>	<i>Indication of averaging mode. The averaging number N indicates the number of consecutive measurement values to be averaged in the sensor.</i>
	<i>Recursive N values</i>	2 ... 32768	<i>Value</i>	
	<i>Median N values</i>	3 / 5 / 7 / 9	<i>Value</i>	

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

Averaging

- improves the resolution,
- allows masking individual interference points, and
- ‘smoothes’ the reading.

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.

- 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.

Grey shaded fields require a selection.

Dark-bordered fields require you to specify a value.

7.6.2.3 Recursive average

Formula:

$$M_{\text{rek}}(n) = \frac{MV_{(n)} + (N-1) \times M_{\text{rek}}(n-1)}{N}$$

- MV Measurement value,
- N Averaging number,
- n Measurement value index
- M_{rek} Averaging value respectively output value

Methods:

The weighted value of each new measured value MV(n) is added to the sum of the previous average values M_{rec}(n-1).

Special features:

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. Range of values for the averaging number N is 1 ... 32768.

7.6.2.4 Median

A median value is formed from a preselected number of measurements.

Methods:

The incoming measured values (3, 5, 7 or 9 measurement values) are also sorted again after each measurement. Then, the average value is provided as the median value. 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: average value from five readings

... 0 1 2 4 5 1 3 → Sorted measurement values: 1 2 3 4 5 Median_(n) = 3

... 1 2 4 5 1 3 5 → Sorted measurement values: 1 3 4 5 5 Median_(n+1) = 4

7.6.3 Zeroing and Mastering

Use zeroing and setting masters to calculate the measurement value based on a selectable reference value and to output it. This shifts the output range. This feature can be useful, for example, when several sensors carry out measurements simultaneously in thickness and planeness measurements.

Zero setting/ Mastering	Select source	<i>Inactive</i>	<i>Normal measurement value resp. Zeroing/Mastering is undone.</i>
		<i>Select button / Multifunction input</i>	<i>Select control element for mastering.</i>
	Master value	<i>Value</i>	<i>Indication e.g. of thickness of a master part. Value range -2 up to max. +2 x measuring range</i>
	Set master value		<i>Adopts the master value but does not execute it.</i>
	Activate master value / reset		<i>Mastering/reset is done via buttons in the web interface.</i>

Mastering (setting masters) 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 target value. The master value is the reading that is issued as result of measuring a master object. Zeroing is when you set a master with 0 (zero) as the master value. When setting a master, the sensor characteristic is moved in parallel. Moving the characteristic reduces the relevant measuring range of a sensor (the further master value and master position are located, the greater the reduction).

Setting masters/Zeroing – Step-by-Step:

- ➡ Place target and sensor into their required positions.
- ➡ Send the master command.

The master command waits for a maximum of 2 seconds for the next measurement value and uses this as master value. If no value is measured within this time, e.g. in case of external triggering, the command returns with the error „E220 Timeout“. After setting the master, the sensor will issue new readings that relate to the master value. If you click the *Inactive* button to undo the mastering process, the system reverts to the state that existed before the master was set. An invalid master value, e.g. no peak present, is acknowledged with the Error E602 *Master value is out of range*.

Grey shaded fields require a selection.

Dark-bordered fields require you to specify a value.

i Mastering or zeroing requires a target object to be present in the measuring range. Mastering and zeroing influence the digital and the analog output.

7.6.3.1 Zeroing, Mastering using the Select Button

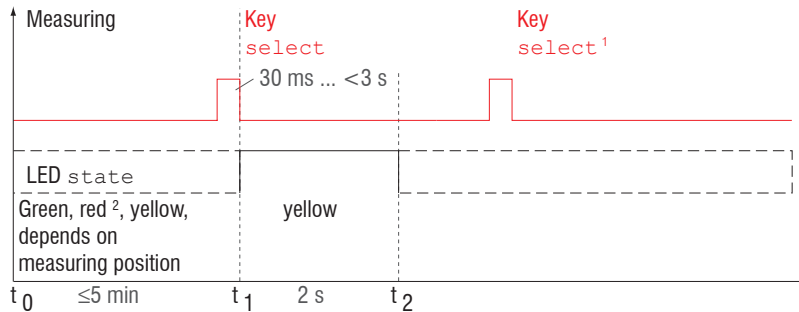


Fig. 38 Flow chart for zeroing, mastering (Select button)

i The Select button is, according to the factory settings, locked after 5 minutes. You can deactivate the key lock e.g. via the web interface, see Chap. 7.8.3.

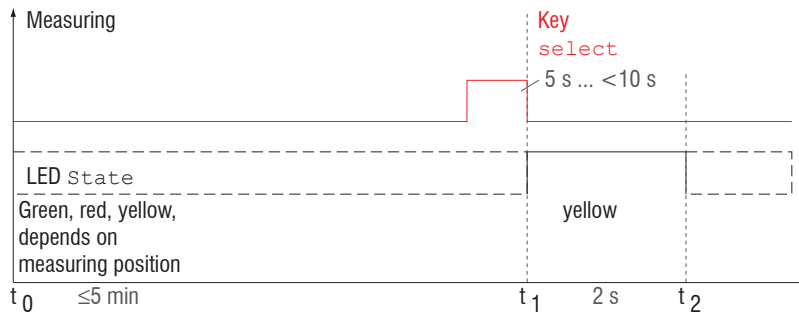


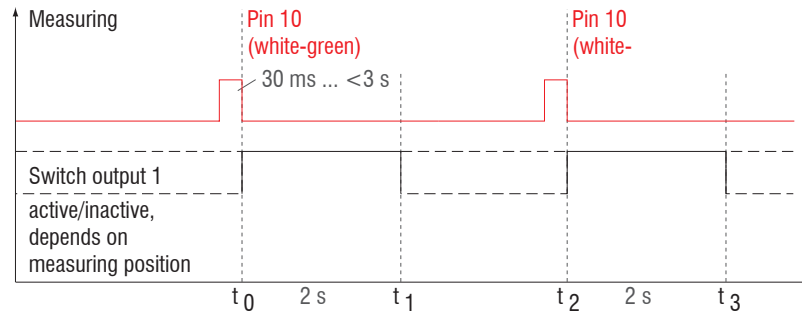
Fig. 39 Flow chart for resetting zeroing/mastering

The zeroing/mastering function can be applied several times in a row. Maintain a break of 1s before repeating the zeroing/mastering function.

1) The Select button has no effect as the key lock is active.

2) When the State LED is red, the master value is not accepted. Flashing frequency of the red State LED is 8 Hz for 2 s.

7.6.3.2 Zeroing, Mastering via Hardware Input



i A pulse at the multi-function input is possible at pin 10 pigtail or the white-green wire of the sensor cable or PC1700-x. For details about the hardware input, please refer to the electrical connections, see Chap. 5.4.6.

Fig. 40 Flow chart for zeroing, mastering (hardware input)

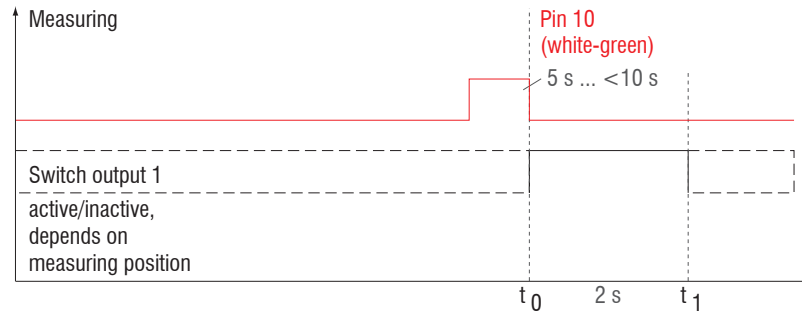


Fig. 41 Flow chart for resetting zeroing/mastering

The zeroing/mastering function can be applied several times in a row. Maintain a break of 1 s before repeating the zeroing/mastering function.

- 1) If the master position is outside the measuring range, the master value is not accepted.

7.6.4 Output Trigger

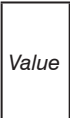
Details can be found in Triggering, see Chap. 7.5.3.

7.6.5 Data Reduction, Output Data Rate

Data reduction	<i>Value</i>	<i>Indicates the sensor which data is to be excluded from output, thus the data amount to be transmitted is reduced.</i>
Reduction relates to	<i>RS422 / Analog</i>	<i>Interfaces to be used for undersampling are to be selected via the checkbox.</i>

You can reduce the measurement output in the sensor if you set the output of every nth measurement value in the web interface or by command. Data reduction causes only every nth measured value to be output. The other measurement values are rejected. The reduction value n can range from 1 (each measurement value) to 3,000,000. This allows you to adjust slower processes, such as a PLC, to the fast sensor without having to reduce the measuring rate.

 Grey shaded fields require a selection.

 Dark-bordered fields require you to specify a value.

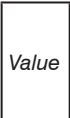
7.7 Outputs

7.7.1 Overview

RS422	Baud rate	9.6 / 115.2 / 230.4 / 460.8 / 691.2 / 921.6 / 2000 / 3000 / 4000 kbps			Transmission speed, binary data format
	Output data	Distance / Non-linearized focal point / Intensity / Exposure time / Sensor state / Measurement counter / Time stamp / Video signal			Data to be transmitted are to be activated via the checkbox.
Analog output	Output range	0-5 V / 0-10 V / 4-20 mA			Select voltage or current output
	Scaling	Standard scaling			Start of measuring range 0 V oder 4 mA, End of measuring range 5 V/10 V / 20 mA
		Two-point scaling	Minimum	Value	Always 2 points are taught which mark start and end of the new measuring range. With two point scaling reversal of the output signal is possible.
			Maximum	Value	
Digital output 1 / 2	Configuration	Full scale error / Distance is outside the analog range / Distance is out of limit			
Compare to limit	Lower / Upper / Both	Limit min	Value	The minimum hold time defines how long the output must be active at least.	
		Limit max	Value		
Switching level	NPN / PNP / PushPull / PushPull negative			The hysteresis defines a dead band around the selected limit values.	
Minimum holding period	1 ... 1000 ms	Value			
Hystereses	0 ... 2 x Measuring range	Value			

Output interface	RS422 / Analog output / digital output 1 / digital output 2	<i>Defines which interface is used for output of measured values. A parallel output of measured values via multiple channels is not possible. RS422 and analog output cannot be operated simultaneously. The switching outputs 1 and 2 can be activated regardless of any other channel. While using the web interface, the output is switched off via RS422.</i>
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 Grey shaded fields require a selection.

 Dark-bordered fields require you to specify a value.

7.7.2 Digital Output, RS422

7.7.2.1 Values, Ranges

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

Value	Length	Variables	Value range	Formula
Distance	18 Bit	x = digital value	[0; 230604]	$d \text{ [mm]} = \frac{x - 98232}{65536} * \text{MR [mm]}$
		MR = Measuring range [mm]	{2/10/20/50/100/200}	
		d = Distance [mm]	without mastering [-0.01MR; 1.01MR]	
			with mastering [-2MR; 2MR]	
Exposure time	16 Bit	x = digital value	[1334; 33333]	$\text{ET } [\mu\text{s}] = \frac{1}{10} x$
		ET = Exposure time [μs]	[133.4; 3333.3]	
Intensity	16 Bit	x = digital value	[0; 1023]	$I \text{ [%]} = \frac{100}{1023} x$
		I = Intensity [%]	[0; 100]	
Sensor state	18 Bit	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)
				Bit 15: Measurement value is triggered
				Bit 16, 17: Status LED; - 00 – off 10 – red - 01 – green 11 – yellow

Measured Value Counter	18 Bit	x = digital value	[0; 262143]	
Time Stamp	2 words, à 16 Bit	x = digital value Lo	[0; 65535]	$t [\mu s] = \frac{1}{1000} (65536y + x)$
		y = digital value Hi	[0; 65535]	
		t = time stamp [μs]	[0; 1h11m34.967s]	
Unlinearized center of gravity	18 Bit	x = digital value	[0; 262143]	$CG [\%] = \frac{100}{262143} x$
		CG = center of gravity [%]	[0; 100]	
Video signal	16 Bit	512 pixels	[0; 1023]	
Measurement frequency	18 Bit	x = digital value f = frequency [Hz]	[3000; 75000]	$f [Hz] = \frac{x}{10}$

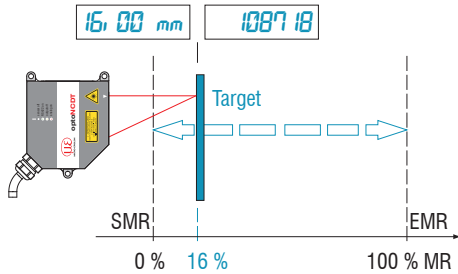
State information transferred in the distance value

Distance value	Description
262075	Too much data for selected baud rate
262076	There is no peak present
262077	Peak is located in front of the measuring range (MR)
262078	Peak is located after the measuring range (MR)
262080	Measurement value cannot be evaluated
262081	Peak is too wide
262082	Laser is off

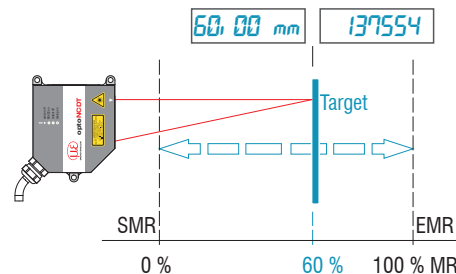
7.7.2.2 Behavior of the Digital Output

Master values based on the zeroing or master function are coded with 18 bits. Master value range: 0 ... 2x measuring range. The examples demonstrate the behavior of the digital value with an ILD1750-100, measuring range 100 mm.

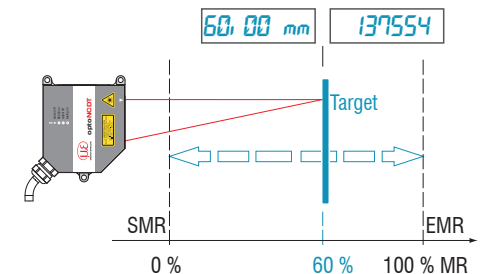
Target with 16% of the measuring range



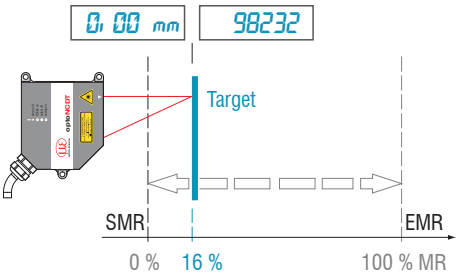
Target with 60% of the measuring range



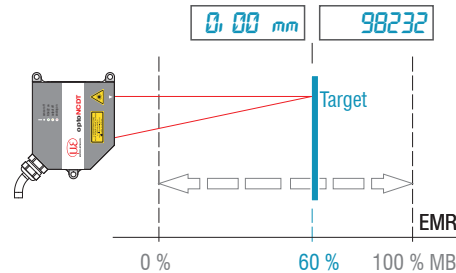
Target with 60% of the measuring range



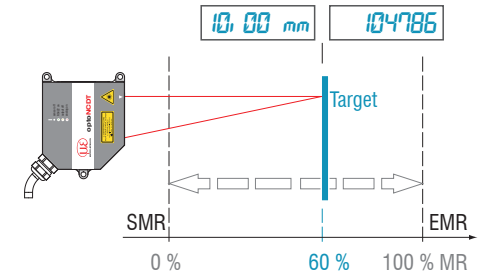
Zero setting (master value = 0 mm)



Zero setting (master value = 0 mm)



Setting master value 10 mm



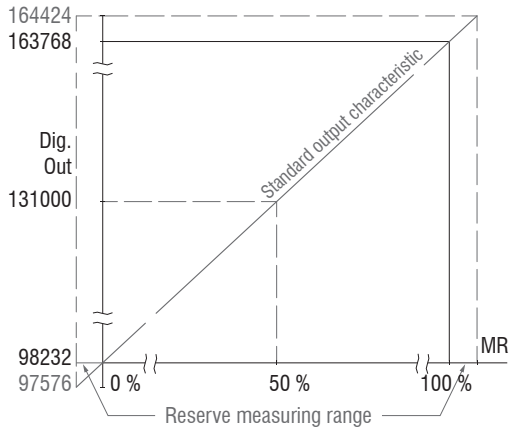


Fig. 42 Digital values without zeroing or mastering

Target with 80% of the measuring range (80 mm)

➔ Setting master value 200 mm

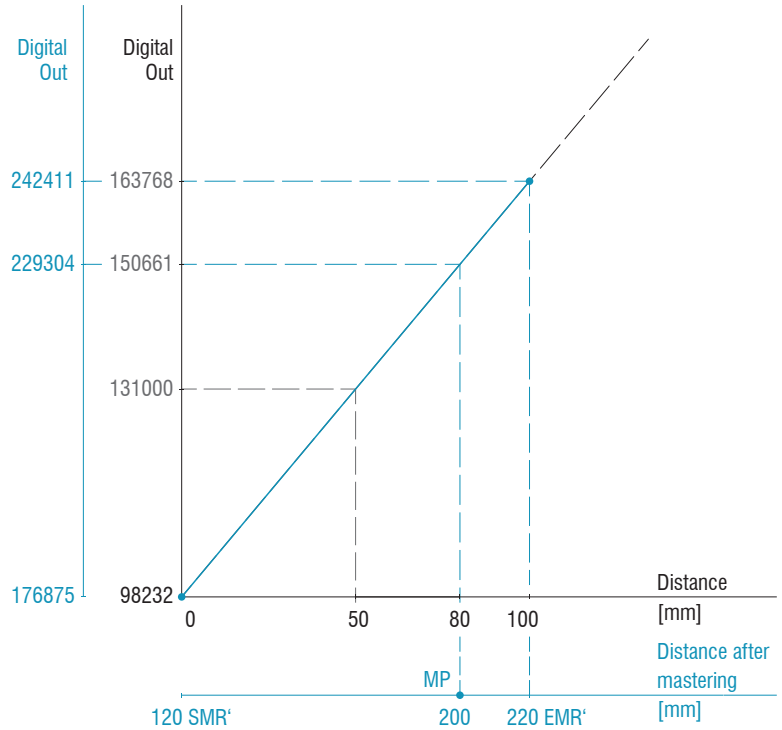


Fig. 43 Digital values ILD1750-100 after mastering with 200 mm

7.7.3 Analog Output

7.7.3.1 Output Scaling

- Max. output range: 4 mA ... 20 mA or 0 V ... 5 V / 0 V ... 10 V
- Output amplification ΔI_{OUT} : 16 mA or ΔU_{OUT} : 5 V / 10 V; corresponds to 100 % MR
- Error value: 3.0 mA ($\pm 10 \mu\text{A}$) or 5.2 V or. 10.2 V

Teaching scales the analog output. This allows you to optimize the resolution for the analog output. The behavior of the analog and switching outputs will change. In every case, 2 points are taught which characterize the start and the end of the new measuring range. The teaching is performed via the built-in **Select** button, the multi-function input, ASCII command or via web interface.

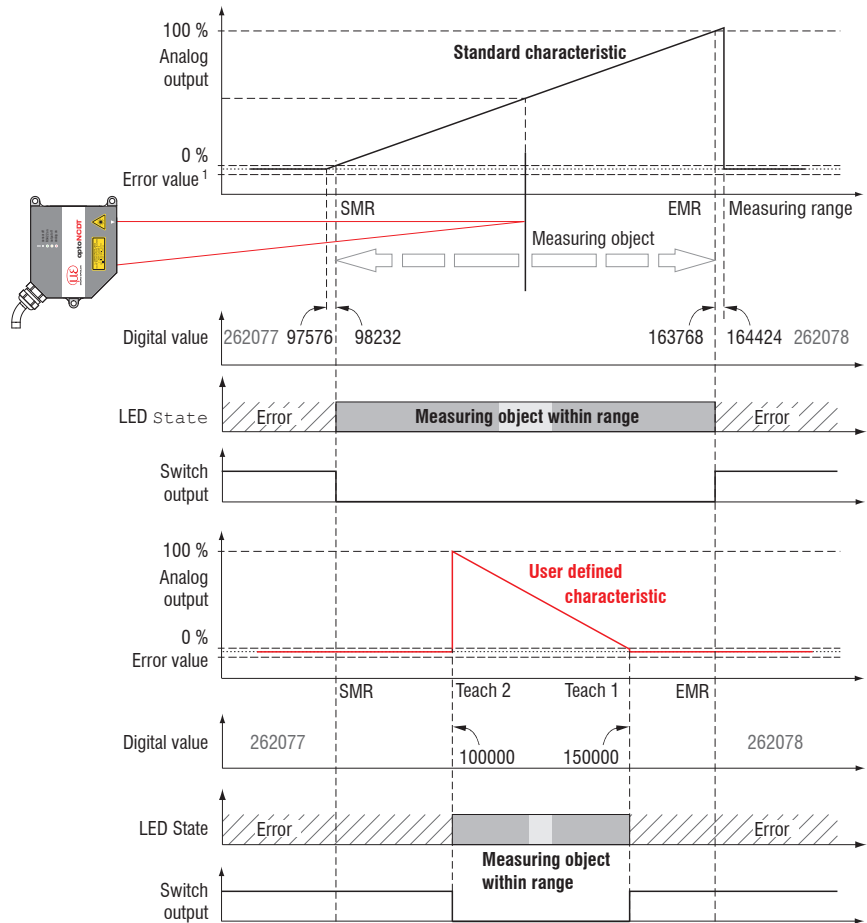
i In conjunction with a user-specific output characteristic, you can use the switching outputs, see Chap. 5.4.8, as movable limit switches.

The target position for Teach 1 and Teach 2 must be different. The teaching process requires a valid measurement signal. In case of

- no object, object cannot be evaluated,
- too close to the sensor - outside the SMR, or
- too far from the sensor - outside the EMR

the teaching process is aborted.

Fig. 44 Standard characteristic (black), reversed, user-specific characteristic (red)



1) With current output 3.0 mA.

7.7.3.2 Output Scaling with the Select Button

- i** Preparation
- Deactivate key lock (menu System settings)
 - Teaching process with Select button (menu Outputs)

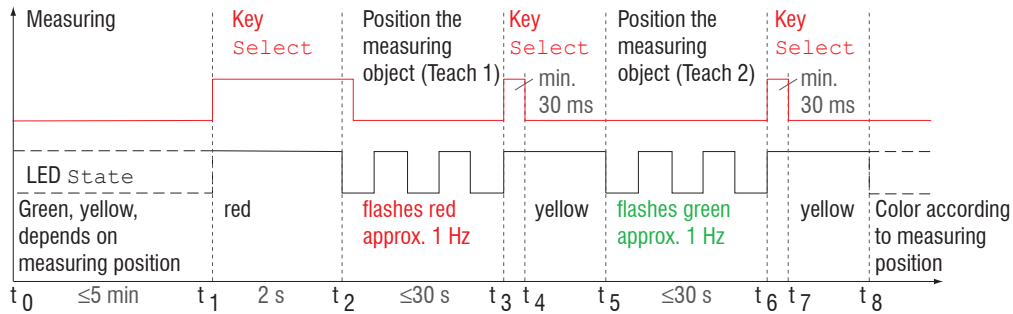


Fig. 45 Flow chart for output scaling

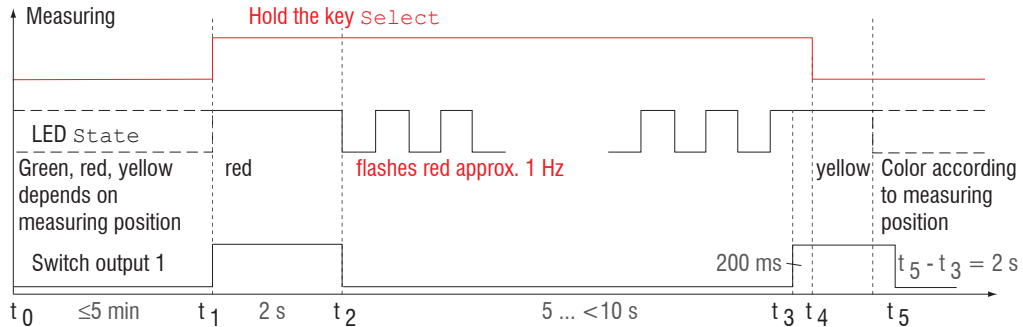


Fig. 46 Flow chart for resetting the output scaling

When the Select button is pressed longer than 10 s or not within the time frame when resetting the output scaling, the State LED will display as error. The State LED then flashes for two seconds with 8 Hz.

7.7.3.3 Output Scaling via Hardware Input

Scaling the analog output is possible via a pulse at the multi-function input, at pin 10 pigtail or the white-green wire of the sensor cable or PC1700-x.

- i** Preparation
- Teaching process with Select button (menu Outputs)

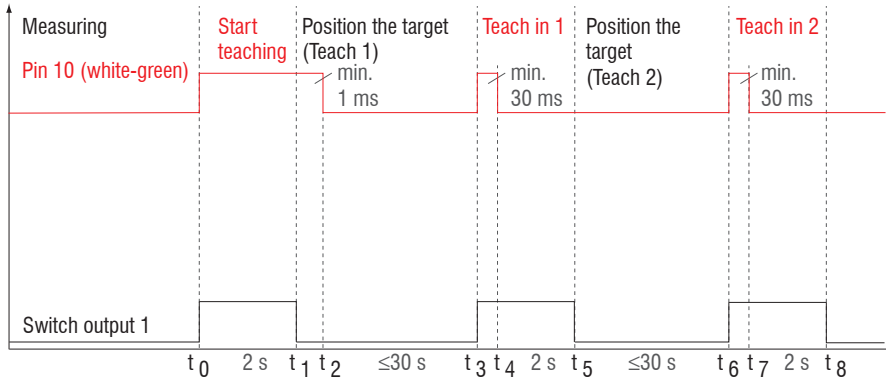


Fig. 47 Flow chart for output scaling

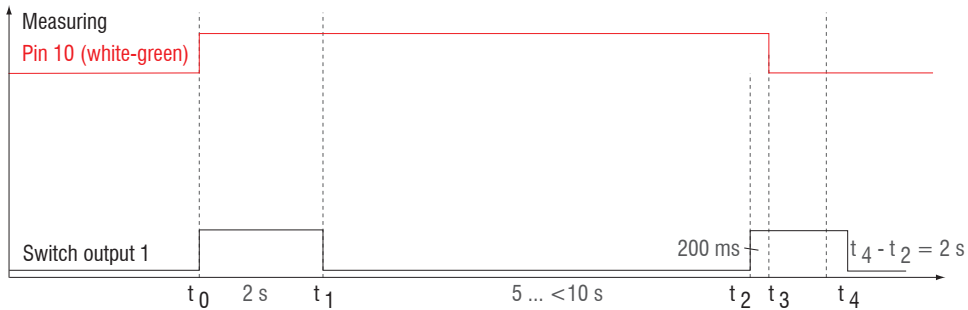


Fig. 48 Flow chart for resetting the output scaling

7.7.3.4 Calculation of the Measurement Value at the Current Output

Current output (without mastering, without teaching)

Variables	Value range	Formula
I_{OUT} = current [mA]	[3.8; <4] SMR reserve [4; 20] Measuring range [>20; 20.2] EMR reserve	$d \text{ [mm]} = \frac{(I_{OUT} \text{ [mA]} - 4)}{16} * MR \text{ [mm]}$
MR = Measuring range [mm]	{2/10/20/50/100/200}	
d = Distance [mm]	[-0.01MR; 1.01MR]	

Current output (with mastering), reference value midrange

Variables	Value range	Formula
I_{OUT} = current [mA]	[3.8; <4] SMR reserve [4; 20] Measuring range [>20; 20.2] EMR reserve	$d \text{ [mm]} = \frac{(I_{OUT} \text{ [mA]} - 12)}{16} * MR \text{ [mm]}$
MR = Measuring range [mm]	{2/10/20/50/100/200}	
MP = Master position [mm]	[0; MR]	
d = Distance [mm]	for MP ≤ 0.5MR: [-MP; 0.5MR] for MP > 0.5MR: [-0.5MR; MR - MP]	

Current output (with teaching)

Variables	Value range	Formula
I_{OUT} = current [mA]	[3.8; <4] SMR reserve [4; 20] Measuring range [>20; 20.2] EMR reserve	$d \text{ [mm]} = \frac{(I_{OUT} \text{ [mA]} - 4)}{16} * n \text{ [mm]} - m \text{ [mm]} $
MR = Measuring range [mm]	{2/10/20/50/100/200}	
m, n = Teaching range [mm]	[0; MR]	
d = Distance [mm]	[m; n]	

Current output (with mastering and teaching)

Variables	Value range	Formula
I_{OUT} = current [mA]	[3.8; <4] SMR reserve [4; 20] Measuring range [>20; 20.2] EMR reserve	$d [mm] = \frac{(I_{OUT} [mA] - 12)}{16} * n [mm] - m [mm] $
MR = Measuring range [mm]	{2/10/20/50/100/200}	
MP = Master position [mm]	[0; MR]	
m, n = Teaching range [mm]	for MP ≤ 0.5MR: [-MP; 0.5MR] for MP > 0.5MR: [-0.5MR; MR - MP]	
d = Distance [mm]	[m; n]	

7.7.3.5 Calculation of the measurement value from the voltage output

Voltage output (without mastering, without teaching)

Variables	Value range	Formula
U_{OUT} = Voltage [V]	[-0.05; <0] SMR reserve [0; 5] Measuring range [>5; 5.05] EMR reserve	$d [mm] = \frac{U_{OUT} [V]}{5} * MR [mm]$
	[-0.1; <0] SMR reserve [0; 10] Measuring range [>10; 10.1] EMR reserve	$d [mm] = \frac{U_{OUT} [V]}{10} * MR [mm]$
MR = Measuring range [mm]	{2/10/20/50/100/200}	
d = Distance [mm]	[-0.01MR; 1.01MR]	

Voltage output (with mastering), reference value midrange

Variables	Value range	Formula
U _{OUT} = Voltage [V]	[-0.05; <0] SMR reserve [0; 5] Measuring range [>5; 5.05] EMR reserve	$d \text{ [mm]} = \frac{(U_{\text{OUT}} \text{ [V]} - 2.5)}{5} * \text{MR [mm]}$
	[-0.1; <0] SMR reserve [0; 10] Measuring range [>10; 10.1] EMR reserve	$d \text{ [mm]} = \frac{(U_{\text{OUT}} \text{ [V]} - 5)}{10} * \text{MR [mm]}$
MR = Measuring range [mm]	{2/10/20/50/100/200}	
MP = Master position [mm]	[0; MR]	
d = Distance [mm]	for MP ≤ 0.5MR: [-MP; 0.5MR]	
	for MP > 0.5MR: [-0.5MR; MR - MP]	

Voltage output (with teaching)

Variables	Value range	Formula
U _{OUT} = Voltage [V]	[-0.05; <0] SMR reserve [0; 5] Measuring range [>5; 5.05] EMR reserve	$d \text{ [mm]} = \frac{U_{\text{OUT}} \text{ [V]}}{5} * n \text{ [mm]} - m \text{ [mm]} $
	[-0.1; <0] SMR reserve [0; 10] Measuring range [>10; 10.1] EMR reserve	$d \text{ [mm]} = \frac{U_{\text{OUT}} \text{ [V]}}{10} * n \text{ [mm]} - m \text{ [mm]} $
MR = Measuring range [mm]	{2/10/20/50/100/200}	
m, n = Teaching range [mm]	[0; MR]	
d = Distance [mm]	[m; n]	

Voltage output (without mastering and teaching)

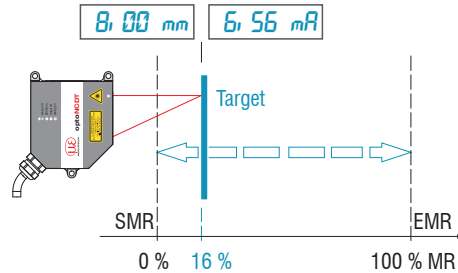
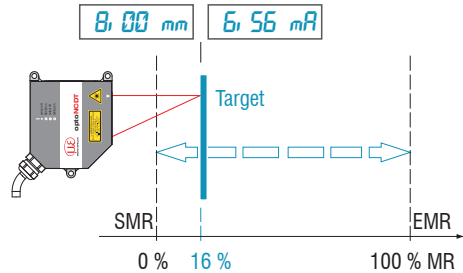
Variables	Value range	Formula
U_{OUT} = Voltage [V]	[-0.05; <0] SMR reserve [0; 5] Measuring range [>5; 5.05] EMR reserve	$d \text{ [mm]} = \frac{(U_{OUT} \text{ [V]} - 2.5)}{5} * n \text{ [mm]} - m \text{ [mm]} $
	[-0.1; <0] SMR reserve [0; 10] Measuring range [>10; 10.1] EMR reserve	$d \text{ [mm]} = \frac{(U_{OUT} \text{ [V]} - 5)}{10} * n \text{ [mm]} - m \text{ [mm]} $
MR = Measuring range [mm]	{2/10/20/50/100/200}	
MP = Master position [mm]	[0; MR]	
m, n = Teaching range [mm]	for $MP \leq 0.5MR$: [-MP; 0.5MR]	
	for $MP > 0.5MR$: [-0.5MR; MR - MP]	
d = Distance [mm]	[m; n]	

7.7.3.6 Behavior Distance Value and Analog Output

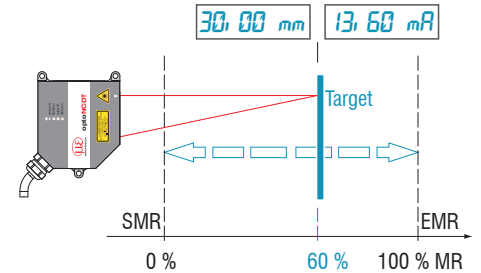
The mastering or zeroing function sets the analog output to half of the output range regardless of the master value. Current output: 12 mA; voltage output: 2.5 V or 5 V.

The examples show the behavior of the current output and the distance value based on the ILD1750-50, measuring range 50 mm.

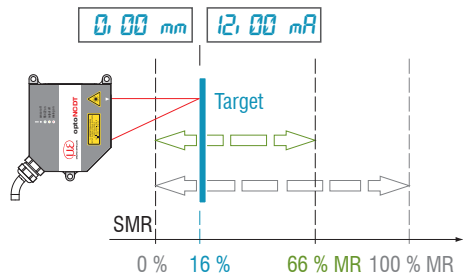
Target with 16 % of the measuring range



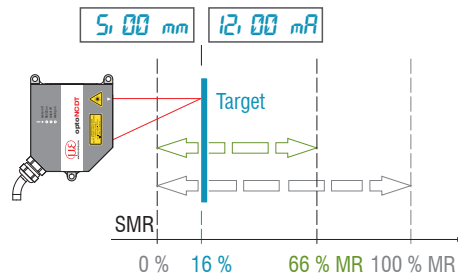
Target with 60 % of the measuring range



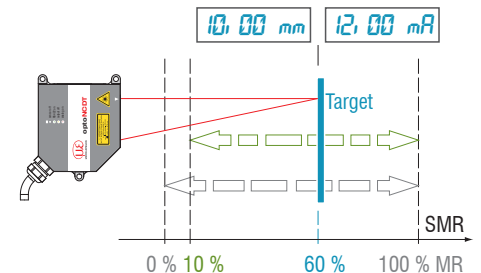
➔ Zero setting (master value = 0 mm)



➔ Setting master value 5 mm



➔ Setting master value 10 mm



Analog output achieves maximum value with 66 % of the MR

Analog output achieves minimum value with 10 % of the MR

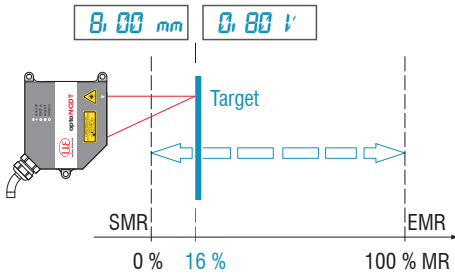
MR = Measuring range, SMR = Start of measuring range, EMR = End of measuring range

Setting Sensor Parameters

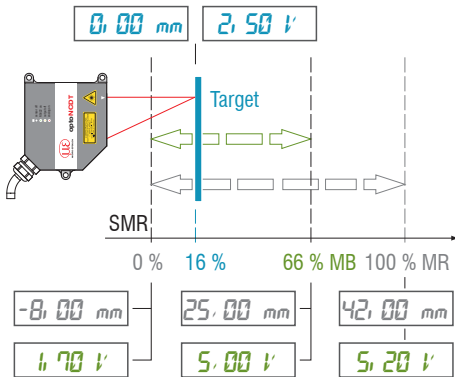
The examples demonstrate the behavior of the voltage output and the distance value based on the ILD1750-50, MR = 50 mm.

Target is at 16% measuring range,

$U_{OUT} = 0 \dots 5 \text{ V}$

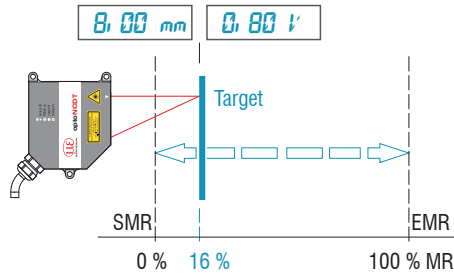


➡ Zero setting (master value = 0 mm)

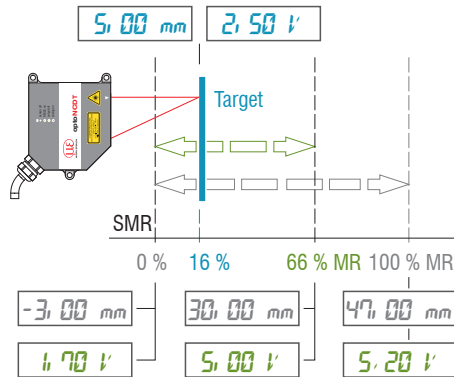


Analog output achieves maximum value with 66% of the MR

MR = Measuring range, SMR = Start of measuring range, EMR = End of measuring range

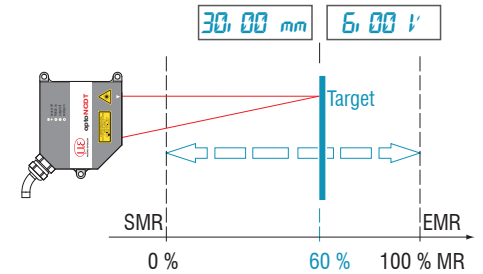


➡ Setting master value 5 mm

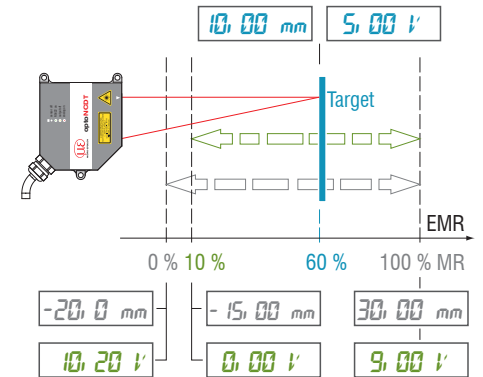


Target is at 60% measuring range,

$U_{OUT} = 0 \dots 10 \text{ V}$



➡ Setting master value 10 mm



Analog output achieves minimum value with 10% of the MR

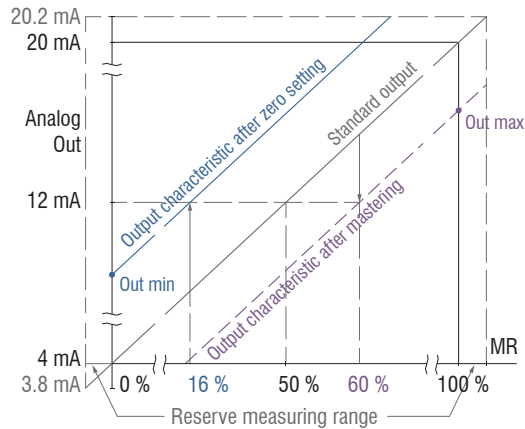


Fig. 49 Current output with zeroing or mastering

Master point	Master value	$I_{Out\ min}$	$I_{Out\ max}$
16 % (8 mm)	0 mm	9.44 mA (-8 mm)	20.0 mA (25 mm)
60 % (30 mm)	10 mm	4.00 mA (-15 mm)	18.40 mA (30 mm)

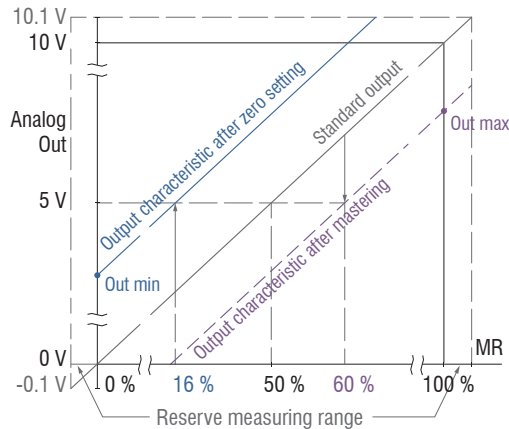


Fig. 50 Voltage output with zeroing or mastering; $U_{OUT} = 0 \dots 10\text{ V}$

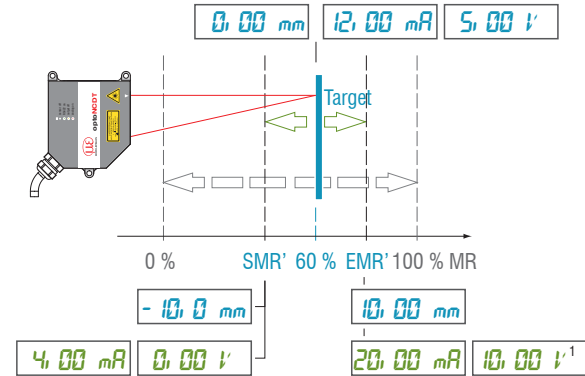
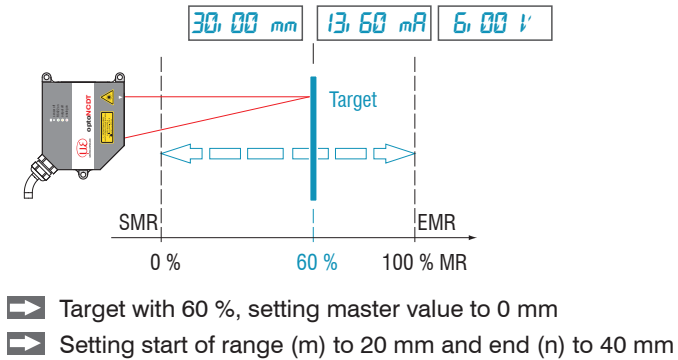
Master point	Master value	$U_{Out\ min}$	$U_{Out\ max}$
16 % (8 mm)	0 mm	1.70 V (-8 mm)	10.0 V (25 mm)
60 % (30 mm)	10 mm	0.00 V (-15 mm)	9.00 V (30 mm)

7.7.3.7 Analog output mastering and teaching

Please observe the following order:

1. Mastering or zeroing, menu Signal processing
2. Teaching output, menu Outputs

The mastering or zeroing function sets the analog output to half of the output range, see Chap. 7.7.3.6.



i $n < m$ enables an inverse characteristic curve.

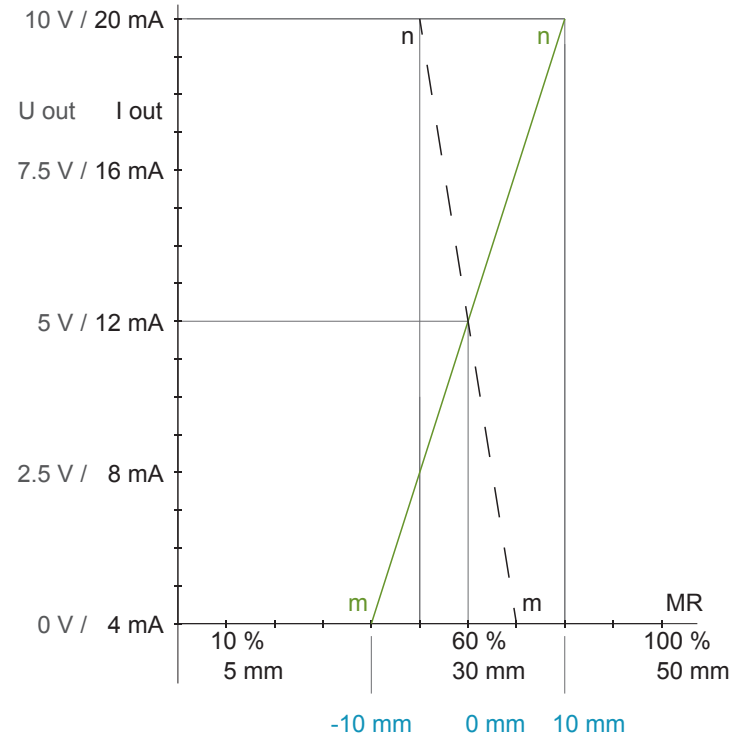


Fig. 51 Output characteristic after mastering and scaling with an ILD1750-50

1) $U_{OUT} = 0 \dots 10 \text{ V}$

7.7.4 Switching Outputs

The two switching outputs can be used independently of each other for error or limit value monitoring of the output value *Distance 1*.

Measuring range error	Target outside the measuring range, target is absent or inappropriate target (too dark, metallic polished, insufficient reflection).
Distance outside scaled analog range	If the distance is outside the scaled range, the switching output is activated.
Distance outside limit values	If the value exceeds or falls below a defined limit, the switching outputs are activated. If limit value monitoring is chosen with both switching outputs, warning and alarm thresholds can be realized.

The switching outputs are activated depending on the set switching behavior.

- EMR = End of measuring range
- Max = Maximum
- HV = Hysteresis value
- Min = Minimum
- SMR = Start of measuring range

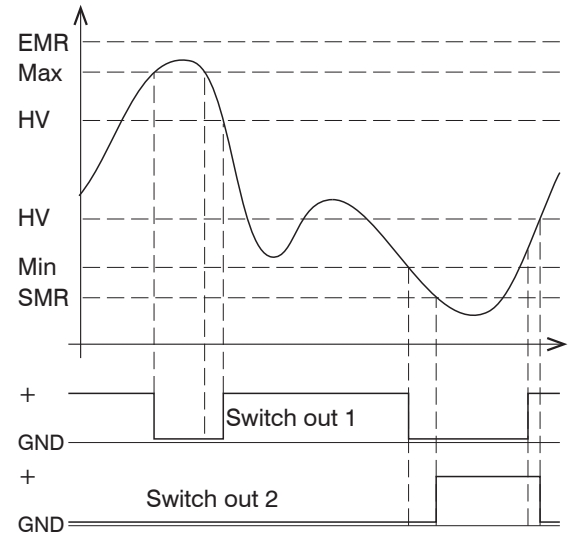


Fig. 52 Switching output 1 with limit values (NPN), Switching output 2 with measuring range error(PNP)

When exceeding the upper limit value (maximum), the assigned switching output 1 is activated (conductive) and is then deactivated again when the next hysteresis value is not reached. The same applies when the lower limit value (minimum) is not reached. Switching output 2 reacts to a measuring range violation. The function of the switching outputs is generally independent of the analog output.

When active, the respective transistor of a switching output is conductive. The switching outputs are short circuit proof.

Resetting the short circuit protection:

- Eliminate the external short circuit,
- Switch the sensor off and on again or
- send software command `Reset` to the sensor.

7.7.5 Data Output

Measurement data output via individual channels can be activated/deactivated in this menu. Please refer to RS422 and Analog output, see Chap. [7.7.2](#), see Chap. [7.7.3](#) for the interface settings.

7.8 System Settings

7.8.1 General

When programming has been completed, store all settings permanently in a set of parameters to ensure that these settings are available when the sensor is switched on the next time.

7.8.2 Unit, Language

The web interface promotes the units millimeter (mm) and inch when displaying measuring results. You can choose German or English in the web interface. You can change the language in the menu bar.

Serial number 16110024

Option 001

Measuring range 10.00mm

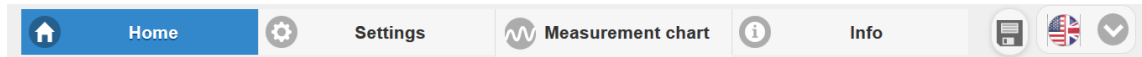


Fig. 53 Language selection in the menu bar

7.8.3 Key Lock

The key lock function for the **Function** and **Select** keys, see Chap. 5.3, avoids unauthorized or unintended button operation. The key lock can only be deactivated in the **Expert** level.

Key lock	Automatic	Countdown 1 ... 60 [min]	Value	The key lock starts after expiry of the defined time. Clicking the button Refresh extends the interval until key lock starts.
		Refresh		
	Active			
Inactive				The keys are active in any user level

Grey shaded fields require a selection.

Dark-bordered fields require you to specify a value.

7.8.4 Load and Safe

All settings on the sensor can be permanently saved in user programs, so-called setups, in the sensor.

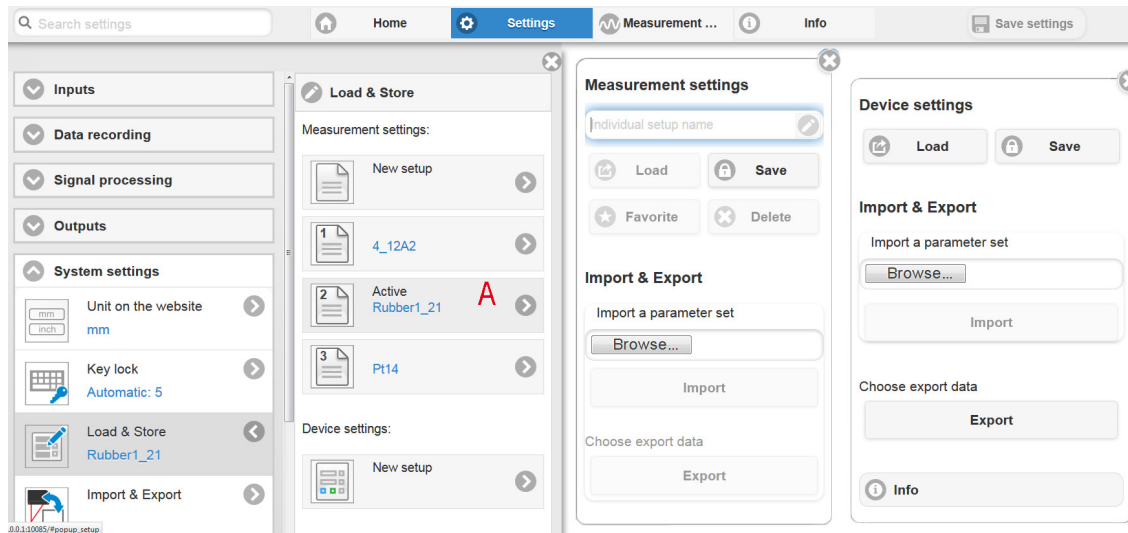
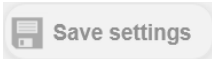


Fig. 54 Administration of user settings

Mange setups in the sensor, possibilities and procedure			
Store the Settings	Activate existing setup	Save changes in active setup	Define setup after booting
Menu New setup	Menu Load & Safe	Menu bar	Menu Load & Safe
<p>➡ Enter the name for</p> <p><input type="text" value="Individual setup name"/></p> <p>e.g. Rubber1_21 and click the button Save.</p>	<p>➡ Click on the desired setup with the left mouse button, area A.</p> <p>The dialog Measurement settings opens.</p> <p>➡ Click on the button Load.</p>	<p>➡ Click on the button</p> <p></p>	<p>➡ Click on the desired setup with the left mouse button, area A.</p> <p>The dialog Measurement settings opens.</p> <p>➡ Click on the button Favorite.</p>

Exchange setups with PC/notebook, possibilities	
Safe setup on PC	Load setup from PC
Menu Load & Safe	Menu Load & Safe
<p>➡ Click on the desired setup with the left mouse button, area A.</p> <p>The dialog <code>Measurement settings</code> opens.</p> <p>➡ Click on the button <code>Export</code>.</p>	<p>➡ Click on <code>New setup</code> with the left mouse button.</p> <p>The dialog <code>Measurement settings</code> opens.</p> <p>➡ Click on the button <code>Search</code>.</p> <p>A Windows dialog for file selections opens.</p> <p>➡ Choose the desired file and click on the button <code>Open</code>.</p> <p>➡ Click on the button <code>Import</code>.</p>

7.8.5 Import, Export

A parameter set includes the current settings, setup(s) and the initial setup when booting the sensor. The `Import` & `Export` menu enables easy exchange of parameter sets with a PC/notebook.

Exchange of parameter sets with PC/notebook, possibilities	
Storing parameter set on PC	Loading parameter set from PC
Menu <code>Import & Export</code>	Menu <code>Import & Export</code>
<p>➡ Click on the button <code>Parameter set</code> with the left mouse button.</p> <p>The dialog <code>Choose export data</code> opens.</p> <p>➡ Compose a parameter set by selecting/deselecting the checkboxes.</p> <p>➡ Click on the button <code>Transmit parameter set</code>.</p> <p>A Windows dialog for data transfer opens.</p> <p>➡ Acknowledge the dialog with <code>OK</code>.</p> <p>The operating system files the parameter set in <code>Download</code>. The file name for the adjacent example is <code><... \Downloads\ILD1750_BA-SICSETTINGS_MEASSETTINGS_...</code></p>	<p>➡ Click on the button <code>Search</code>.</p> <p>A Windows dialog for file selections opens.</p> <p>➡ Choose the desired file and click on the button <code>Open</code>.</p> <p>The dialog <code>Choose import data</code> opens.</p> <p>➡ Determine the operations to be performed by selecting/deselecting the checkboxes.</p> <p>➡ Click on the button <code>Transmit parameter set</code>.</p>

✕

Choose export data

Settings:

4_12A2

Rubber1_21

Pt14

Initial Setup at booting:

Rubber1_21

General device settings:

General device settings

Transmit parameter set

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

Options during import:

- Overwrite existing Setups (with the same name)**
- Apply settings of the imported boot setup**

7.8.6 Access Authorization

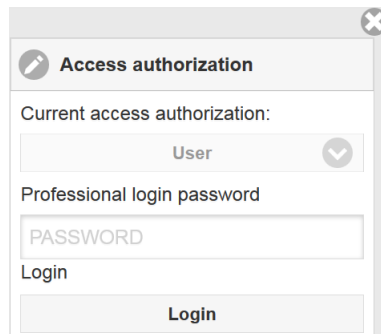
Assigning passwords prevents unauthorized changes to sensor settings. Password protection is not enabled as a factory setting. The sensor works on the Professional level. After the sensor has been configured, you should enable password protection. The standard password for the Professional level is “000”.

i A software update will not change the standard password or a custom password. The Professional level password is setup-independent, and is not loaded or stored during setup.

User can do the following:

	User	Professional
Password required	no	yes
Read inputs, signal processing, outputs, system settings	yes	yes
Change inputs, signal processing, outputs, system settings	no	yes
Change password	no	yes
Toggling between measurement chart and video signal	no	yes
Scale graphs	yes	yes
Restore factory settings	no	yes

Fig. 55 Permissions within the user hierarchy



Enter the standard password “000” or a custom password into the Password box, and click Login to confirm.

Change to the User level by clicking the Logout button.

Fig. 56 Changing to professional level

The user management enables to define a user-specific password in Expert mode.

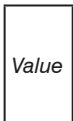
Password	<i>Value</i>	<i>All passwords are case-sensitive. Numbers are allowed, but special characters are not permitted. The maximum length is 31 characters.</i>
User level when restarting	<i>User / Professional</i>	<i>Defines the user level that is enabled when the sensor starts the next time. MICRO-EPSILON recommend to select User level.</i>

After the sensor has been configured, you should enable password protection. Please write down the password for later use.

7.8.7 Reset Sensor

Reset sensor	<i>Measurement settings</i>	<i>The settings for measuring rate, trigger, evaluation range, selection of peak, error handling, averaging, Zeroing/Mastering, reduction of data and setups are deleted. The 1st preset is loaded.</i>
	<i>Device settings</i>	<i>The settings baud rate, language, unit, key lock and echo mode are deleted and the default parameters are loaded.</i>
	<i>Reset all</i>	<i>By clicking the button the settings for the sensor, measurement settings, access permission, password and setups are deleted. The 1st preset is loaded.</i>
	<i>Restart sensor</i>	<i>By clicking the button the sensor is rebooted with the settings made in the favorite setup, see Chap. 7.8.4.</i>

 Grey shaded fields require a selection.

 Dark-bordered fields require you to specify a value.

8. Digital Interfaces RS422

8.1 Preliminary Remarks

The interface RS422 has a maximum baud rate of 4 MBaud. The factory-set baud rate is 921.6 kBaud.

Data format: Measurement values in binary format, commands as an ASCII string.

Interface parameter: 8 Data bits, no parity, one stop bit (8N1).

I Disconnect or connect the D-sub connection between RS422 and USB converter when the sensor is disconnected from power supply only.

8.2 Measurement Data Format

18 bits are transmitted per output value. An output value is divided into three bytes that differ in the two most significant bits. The transmission of additional output values is optional.

Output value 1 / additional:

L-Byte	0	0	D5	D4	D3	D2	D1	D0
M-Byte	0	1	D11	D10	D9	D8	D7	D6
H-Byte	1	0 ¹	D17	D16	D15	D14	D13	D12

Output sequence: L-Byte, M-Byte, H-Byte.

1) Bit 7 in the H byte is set to 0 for the last output value. This simultaneously represents the identifier of a new block. With all previous output values in the same block, the 7th is in the H byte 1. Depending on the measuring rate, baud rate and output data rate output all data can be output in one block. If data output is overloaded, an error value is transmitted within the distance value. Use the command GETOUTINFO_RS422 to query for data selection and output sequence.

8.3 Conversion of the Binary Data Format

For conversion purposes the H-Byte, M-Byte and L-Byte must be identified on the basis of the two first bits (flag bits), the flag bits deleted and the remaining bits compiled into a 18 bit data word.

Result of conversion:

D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
-----	-----	-----	-----	-----	-----	-----	-----	----	----	----	----	----	----	----	----	----	----

Conversion must be done in the application program.

i The sensor continues to deliver measurement values to the RS422 output even while communicating with the sensor.

For the data transmission with a PC the MICRO-EPSILON IF2008 PCI BUS interface card is suitable. This can be connected to the sensor via the PC1700-x/IF2008 interface cable, which is also available as an option. The IF2008 combines the three bytes for the data word and saves them in the FIFO. The 18 bits are used for measurement values and error values. As standard, the IF2008 interface card is suitable for connecting two or (via a Y intermediate cable available as an option) up to four sensors plus two additional incremental encoders. For further information, please refer to the descriptions of the IF2008 interface card and associated MEDAQLib driver program.

You will find the latest program routine at: www.micro-epsilon.com/link/software/medaqlib.

9. Cleaning

Cleaning of the protective screens is recommended periodically.

Dry Cleaning

Therefore an optics anti-static brush is suitable or bleeding the screen with dehumidified, clean and oil-free compressed air.

Wet Cleaning

For cleaning the protective screen use a clean, soft, lint-free cloth or lens cleaning paper with pure alcohol (isopropyl).

Never use standard glass cleaner or other cleaning agents.

10. Protective Housing

The protective housing are designed to be used especially if the sensor operates in diffuse reflection mode and in a dirty environment or higher ambient temperature. It is available as an accessory. If these protective housings are used, the linearity of the sensors in the complete system may deteriorate. For the sole purpose of protection against mechanical damage a simple protective shield with sufficiently large opening is therefore more advantageous. Installation of the sensors in the protective housings should be performed by the manufacturer, because especially in case of short reference distances the protective window must be included in the calibration.

10.1 Versions

- SGH size S, M: without air purging (with inlet and exhaust for cooling) and
- SGHF size S, M: with air purging.

10.2 Guidelines

- The maximum ambient temperature within the protective housing is 45 °C.
- The requirements for compressed-air are:
 - Temperature at the inlet < 25 °C
 - The compressed-air must be free of oil and water residues. It is recommended to use two oil separators in series arrangement.
- With a flow rate for example 240 l/min (2.5E+5 Pa or 36.2 psi) the maximum outside temperature is 65 °C.
- For higher ambient temperatures it is recommended to use an additional water-cooled carrier and cover plates outside the protective housing.
- No direct heat radiation (including sunlight!) on the protective housing. In case of direct heat radiation additional thermal protective shields must be installed.
- It is recommended that the protective window is cleaned from time to time with a soft alcohol-soaked cloth or cotton pad.

10.3 Delivery

The rotatable plug-nipple glands type LCKN-1/8-PK-6 (FESTO) for the compressed-air tubes with a inner diameter of 6 mm, the air plate (SGHF) and the sensor fastening accessories are included in the delivery of the protective housing.

i The protection class is limited to water (no penetrating liquids or similar).

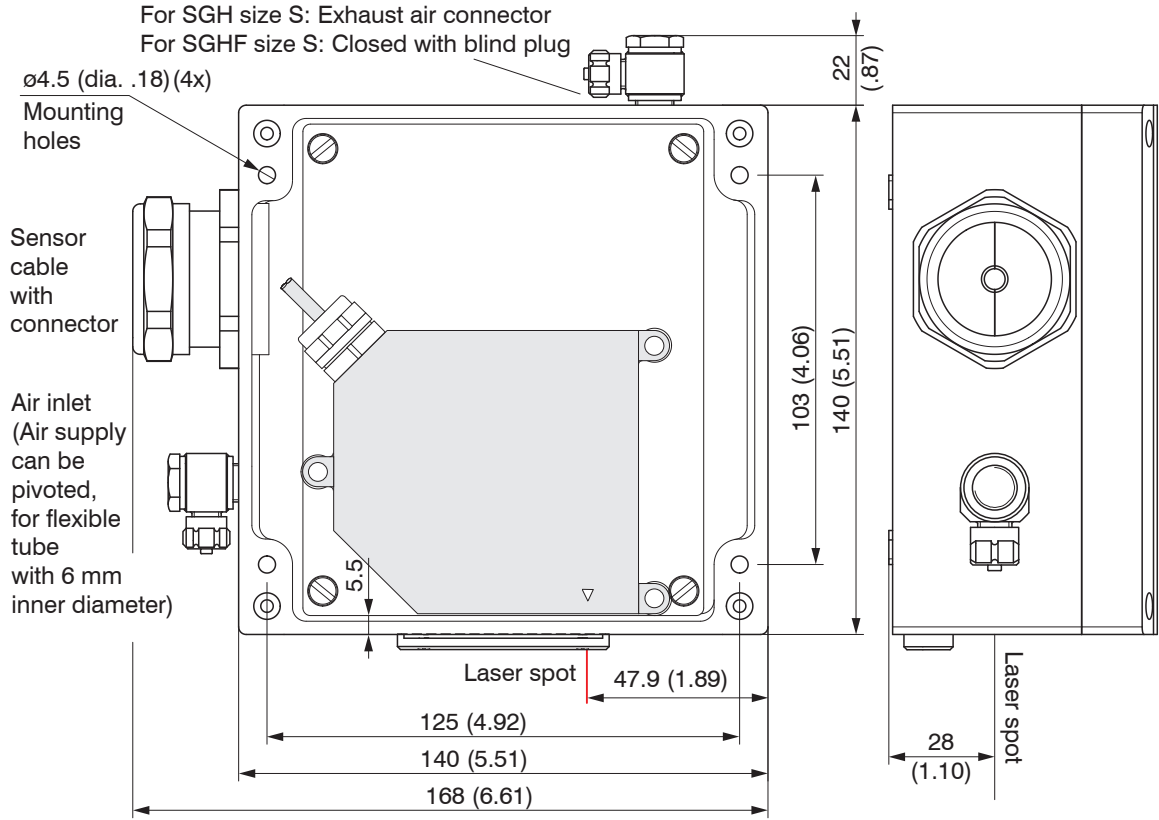


Fig. 57 Protective housing for measuring ranges 2/10/20/50/100/200 mm

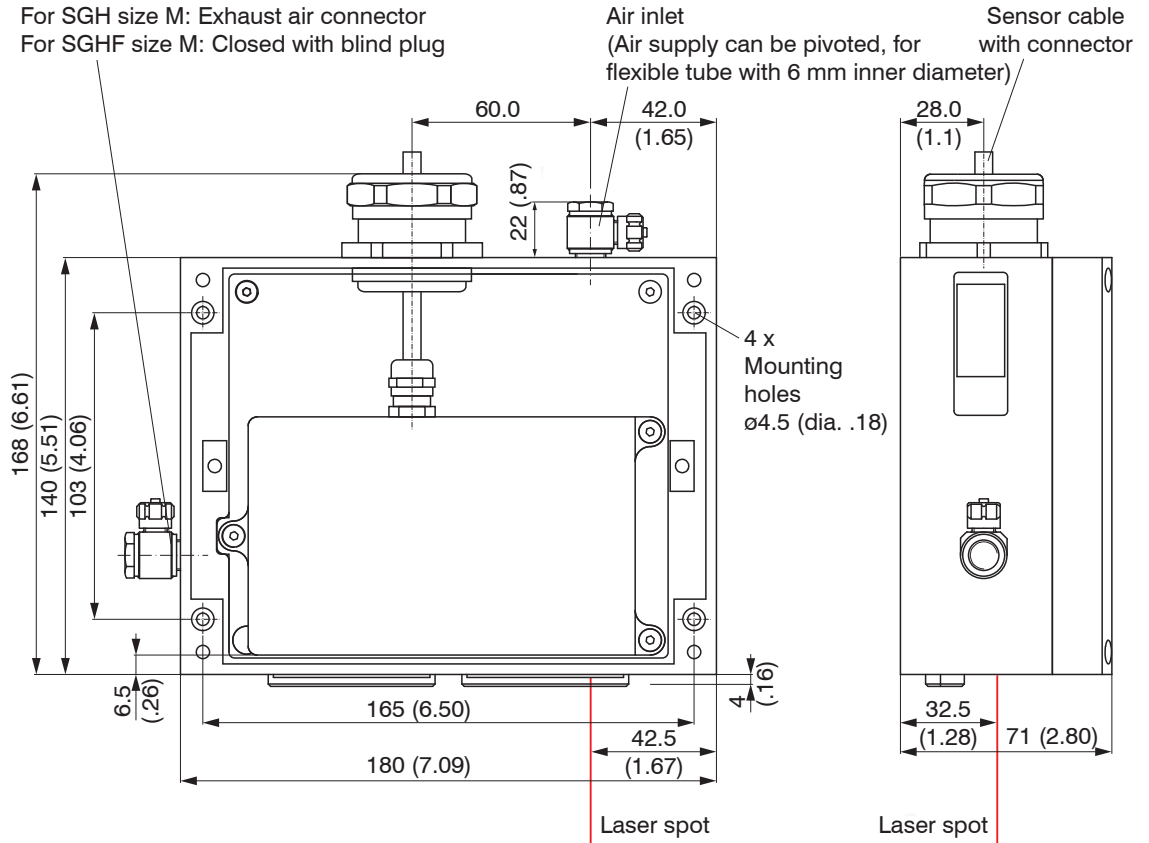


Fig. 58 Protective housing for measuring range 40 and 200 mm

11. Software Support with MEDAQLib

MEDAQLib offers you a documented driver DLL. Therewith you embed optoNCDDT laser sensors, in combination with

- the 1-way converter IF2001/USB or
- the 4-way converter IF2004/USB and connection cable PC1700-x/IF2008 (IF2008-Y) or
- the PCI interface card IF 2008 and connection cable PC1700-x/IF2008 and IF2008-Y-adapter cable

into an existing or a customized PC software.

MEDAQLib

- contains a DLL, which can be imported into C, C++, VB, Delphi and many additional programs,
- makes data conversion for you,
- works independent of the used interface type,
- features by identical functions for the communication (commands),
- provides a consistent transmission format for all MICRO-EPSILON sensors.

For C/C++ programmers MEDAQLib contains an additional header file and a library file. You will find the latest driver / program routine at:

www.micro-epsilon.com/service/download/

www.micro-epsilon.de/link/software/medaqlib/


12. Liability for Material Defects

All components of the device have been checked and tested for functionality at the factory. However, if defects occur despite our careful quality control, MICRO-EPSILON or your dealer must be notified immediately.

The liability for material defects is 12 months from delivery. Within this period, defective parts, except for wearing parts, will be repaired or replaced free of charge, if the device is returned to MICRO-EPSILON with shipping costs prepaid. Any damage that is caused by improper handling, the use of force or by repairs or modifications by third parties is not covered by the liability for material defects. Repairs are carried out exclusively by MICRO-EPSILON.

Further claims can not be made. Claims arising from the purchase contract remain unaffected. In particular, MICRO-EPSILON shall not be liable for any consequential, special, indirect or incidental damage. In the interest of further development, MICRO-EPSILON reserves the right to make design changes without notification. For translations into other languages, the German version shall prevail.

13. Decommissioning, Disposal

 Remove the power supply and output cable on the sensor.

Incorrect disposal may cause harm to the environment.

Dispose of the device, 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.

14. Service, Repair

If the sensor or sensor cable is defective:

- If possible, save the current sensor settings in a parameter, see Chap. 7.8.4, 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 measuring system to:

MICRO-EPSILON Optronik GmbH
Lessingstraße 14
01465 Langebrueck / Germany

Tel. +49 (0) 35201 / 729-0
Fax +49 (0) 35201 / 729-90
optronic@micro-epsilon.com
www.micro-epsilon.com

Appendix

A 1 Optional Accessories

IF2001/USB



Converter RS422 to USB, type IF2001/USB, useable for cable PC1700-x/I or PC1700-x/U, inclusive driver, connections: 1 × female connector 10-pin (cable clamp) type Würth 691361100010, 1x female connector 6-pin (cable clamp) type Würth 691361100006

IF2004/USB



4 channel converter RS422 to USB useable for cable PC1700-x/IF2008 (IF2008-Y), inclusive driver, connections: 2 × Sub-D, 1 × terminal block

C-Box/2A


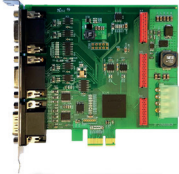



Computation of two digital input signals, useable for cable PC1750-x/C-Box/RJ45.
D/A conversion of a digital measurements, output through current and voltage output.

IF2030/PNET



Interface module for PROFINET connection of a Micro-Epsilon sensor with RS485 or RS422 interface, suitable for PCF1420-x/I or PCF1420-x/U cables, top-hat rail housing, incl. GSDML file for software integration in the PLC

<p>PS2020</p>		<p>Power supply for mounting on DIN rail, input 230 VAC, output 24 VDC/2.5 A</p>
<p>IF2008/PCIE</p>		<p>The IF2008/PCIE interface card enables the synchronous capture of 4 digital sensor signals series optoNCDT 1750 or others or 2 encoders. In combination with IF2008E a total of 6 digital signals, 2 encoder, 2 analog signals and 8 I/O signals can be acquired synchronously.</p>
<p>IF2008-Y adapter cable</p>		<p>Used to connect two sensors with interface cable PC2300-x/IF2008 to a port of the IF2008.</p>
<p>PC1700-x</p>		<p>Supply and output cable, Length x = 3, 5, 6, 10, 12, 20, 25 or 30 m 14-pin molded connector resp. open ends</p>
<p>PC1700-x/IF2008</p>		<p>Interface and supply cable Length x = 3, 6, 8 or 20 m 14-pin. molded connector resp. 15-pin Sub-D-connector</p>
<p>PC1750-3/C-Box</p>		<p>Supply and output cable Length x = 3, 6 or 9 m 15-pin Sub-D connector</p>

A 2 Factory Setting

Password	„000“
Measuring rate	5 kHz
Measuring range	100 % FSO: I = 20 mA , digital 163768
	0 % FSO: I = 4 mA, digital 98232
Output	Analog and switching output 1
Error handling	Error output, no measurement

Averaging	Median 9
Peak selection	Highest peak
RS422	921.6 kBaud
Trigger mode	No trigger
Language	German

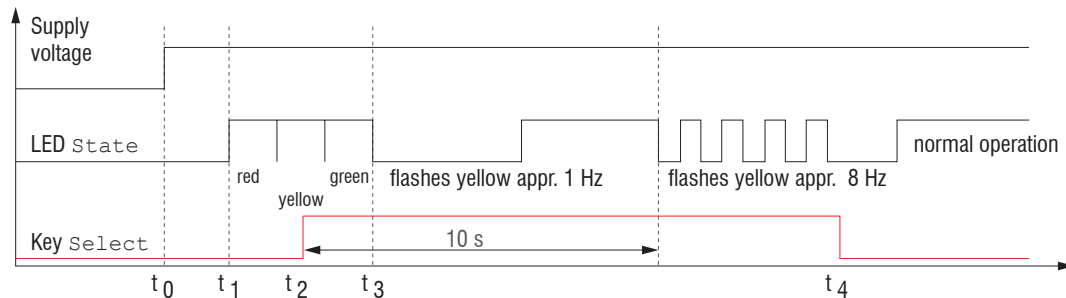


Fig. 59 Flow chart to start a sensor with factory setting

- t_0 : power supply is on
 - $t_1 \dots t_3$: both LEDs signalize the start sequence (red-yellow-green for 1 sec. each)
 - t_2 : Key Select is pressed during start sequence ($t_1 \dots t_3$)
 - t_4 : Key Select is released while the LED State is flashing red
- $\Delta t = t_4 - t_2$; Δt (key press period) must be at least 10 sec., max. 15 sec.

A 3 ASCII Communication with Sensor

A 3.1 General

The ASCII commands can be sent to the sensor via the RS422 interface. All commands, inputs and error messages are effected in English.

One command always consists of a command name and zero or several parameters, which are separated by blanks and are completed with LF. If blanks are used in parameters, the parameter must be set in quotation marks.

Example: Switch on the output via RS422

OUTPUT RS422 ↵

Advice: ↵ must include LF, but may also be CR LF.

Declaration: LF Line feed (line feed, hex 0A)

CR Carriage return (carriage return, hex 0D)

↵ Enter (depending on the system System hex 0A or hex 0D0A)

The currently set parameter value is returned, if a command is activated without parameters.

The input formats are:

```
<Command name> <Parameter1> [<Parameter2> [...]]
```

```
<Command name> <Parameter1> <Parameter2> ... <Parameter...>
```

or a combination thereof.

Parameters in []-brackets are optional and require the input of the parameter standing in front. Sequent parameters without []-brackets are to input compulsory, that is, it must not be omitted a parameter.

Alternative inputs of parameter values are displayed separately by „|“, for example the values „a“, „b“ or „c“ can be set for “a|b|c“. Parameter values in <> brackets are selectable from a value range.

Declarations on format:

„a b“	Value of the parameter can be set to the value “a“ or “b“.
„ P1 P2“	It requires that both parameters “P1“ and “P2“ are set.
„ P1 [P2 [P3]]“	The parameters “P1“, “P2“ and “P3“ can be set, whereby “P2“ may only be set, if “P1“ is set and “P3“ only if “P1“ and “P2“ are set.
„<a>“	The value of the parameter lies in a value range of “... to ...“, see parameter description.

Parameter values without peak brackets can only assume discrete values, see parameter description.

Parantheses are to be understood as a grouping, that is, for a better articulation „P1 P2 | P3“ is written as „(P1 P2)|P3“.

Example without []:

„PASSWD <Old password> <New password> <New password>“
 - To change the password, all three parameters are to be input.

The output format is:

<Command name> <Parameter1> [<Parameter2> [...]]

The reply can be used again as command for the parameter setting without changes. Optional parameters are only returned, if the returning is necessary. For example, the activated output values are returned by command Data selection additional values. After processing a command always a return and a prompt (“->“) is returned. In the case of an error an error message is before the prompt, that begins with „Exxx“, where xxx is a unique error number. Also warnings („Wxxx“) can be output instead of error messages.

These are analogous to the error messages. In case of warnings the command is executed.

The replies to the commands GETINFO and PRINT are useful for support requests to the sensor, because they contain sensor settings.

A 3.2 Overview Commands

Group	Chapter	Command	Short description
General			
	Chap. A 3.2.1.1	HELP	Help on commands
	Chap. A 3.2.1.2	GETINFO	Request sensor information
	Chap. A 3.2.1.3	LANGUAGE	Determine language of website
	Chap. A 3.2.1.4	RESET	Reboot sensor
	Chap. A 3.2.1.5	RESETCNT	Reset counter
	Chap. A 3.2.1.6	ECHO	Switching the command reply, ASCII interface
	Chap. A 3.2.1.7	PRINT	Output of all sensor settings
	Chap. A 3.2.1.8	SYNC	Synchronization
	Chap. A 3.2.1.9	TERMINATION	Terminating resistor
User Level			
	Chap. A 3.2.2.1	LOGIN	Change of user level
	Chap. A 3.2.2.2	LOGOUT	Change to user in the user level
	Chap. A 3.2.2.3	GETUSERLEVEL	User level request
	Chap. A 3.2.2.4	STDUSER	Setting the standard user
	Chap. A 3.2.2.5	PASSWD	Change password
Triggering			
	Chap. A 3.2.3.1	TRIGGERLEVEL	Active level triggering
	Chap. A 3.2.3.2	TRIGGERMODE	Trigger Type
	Chap. A 3.2.3.3	TRIGGERSOURCE,	Select Trigger Source
	Chap. A 3.2.3.4	TRIGGERAT	Effect of the Trigger Input
	Chap. A 3.2.3.5	MFILELEVEL	Select level for switching input
	Chap. A 3.2.3.6	TRIGGERCOUNT	Number of measurement values displayed
	Chap. A 3.2.3.7	TRIGGERSW	Software - Trigger Pulse

Interfaces			
	Chap. A 3.2.4.1	BAUDRATE	Setting transmission rate of RS422
	Chap. A 3.2.4.2	ERROROUT1/2	Activating switching outputs
	Chap. A 3.2.4.3	ERRORLEVELOUT1/2	Output level switching outputs
	Chap. A 3.2.4.4	ERRORLIMITCOMPARETO1/2	Monitoring function switching outputs
	Chap. A 3.2.4.5	ERRORLIMITVALUES1/2	Threshold switching output
	Chap. A 3.2.4.6	ERRORHYSTERESIS	Hysteresis value switching outputs
	Chap. A 3.2.4.7	ERROROUTHOLD	Min. switching time of active switching output
Handling of setups			
	Chap. A 3.2.5.1	IMPORT	Load parameters
	Chap. A 3.2.5.2	EXPORT	Export sensor settings
	Chap. A 3.2.5.3	MEASSETTINGS	Load/save measurement settings
	Chap. A 3.2.5.4	BASICSETTINGS	Load/save device settings
	Chap. A 3.2.5.5	SETDEFAULT	Factory settings
Analog output			
	Chap. A 3.2.6.1	ANALOGRANGE	Voltage or current output
	Chap. A 3.2.6.2	ANALOGSCALEMODE	Scaling analog output
	Chap. A 3.2.6.3	ANALOGSCALERANGE	Scaling limits analog output
	Chap. A 3.2.6.4	ANALOGSCALESOURCE	Port for teach function
Key function			
	Chap. A 3.2.7.1	KEYLOCK	Set key lock

Measurement			
	Chap. A 3.2.8.1	TARGETMODE	Choice of material-dependent measurement algorithm
	Chap. A 3.2.8.2	MEASPEAK	Peak selection, diffuse sensor arrangement
	Chap. A 3.2.8.3	MEASRATE	Select a Measuring Rate
	Chap. A 3.2.8.4	SHUTTER	Exposure time
	Chap. A 3.2.8.5	SHUTTERMODE	Automatic or manual exposure time
	Chap. A 3.2.8.6	LASERPOW	Selection of laser power
	Chap. A 3.2.8.7	ROI	Masking the Evaluation Range
	Chap. A 3.2.8.8	AVERAGE	Selection of measurement averaging
	Chap. A 3.2.8.9	MASTER	Start/stop mastering or zeroing
	Chap. A 3.2.8.10	MASTERSIGNAL	Master value
	Chap. A 3.2.8.11	MASTERSOURCE	Choose port for mastering
Data output			
	General		
	Chap. A 3.2.9.1	OUTPUT	Selection measurement value output
	Chap. A 3.2.9.2	OUTREDUCEDEVICE	Selection measurement value output for reduction
	Chap. A 3.2.9.3	OUTREDUCECOUNT	Reduction of measurement value output
	Chap. A 3.2.9.4	OUTHOLD	Setting of error processing
	Chap. A 3.2.9.5	GETOUTINFO_RS422	List intended data for RS422
	Chap. A 3.2.9.6	OUT_RS422	Measurement data output with RS422

A 3.2.1 General Commands**A 3.2.1.1 HELP**

Issues a help for every command.

Command without parameter

```
<Command> // Command is executed.
```

Command with parameter.

```
<Command> // Show current parameter value
```

```
<Command> <Parameter1> [<Parameter2> [...]] // Set parameters, number of parameters varies
```

```
<Command> <Parameter1> <Parameter2> ... <Parameter...> // Set parameters, number of parameters is fixed
```

Response to a command

```
->          Cursor, the sensor waits for an entry
E<dd> <Msg>  Error message, execution refused
W<dd> <Msg>  Warning
<ddd>       Three digits
<Msg>       Message
```

Format

```
()          Group
[]          Optional parameters
<>         Placeholder
|          Alternative
```

If spaces are used in parameters, the parameters must be placed in quotation marks.

Examples:

```
a|b // Use a or b
a b // Both parameters are required
a [b [c]] // Indefinite number of parameters: a, a b, or a b c
PASSWD <Old password> <New password> <New password> // In order to change the password, all parameters are required.
```

A 3.2.1.2 GETINFO, Sensor information

```
GETINFO
```

Controller data are queried. Output as per example below:

```
->GETINFO
Name:          ILD1750-10 //Model name sensor, sensor series
Serial:        17030001 // Serial number
Option:        001 //Option number of sensor
Article:       4120176 // Article number of sensor
Cable head:    Pigtail
Measuring range: 10.00mm // Measuring range of the sensor
Version:       003.018.001 //Software version
Hardware-rev:  00
Boot version:  002.010
->
```

A 3.2.1.3 LANGUAGE, Website

LANGUAGE DE | EN

Determines the language for the web interface

- DE: set language to German
- EN: set language to English

The website is displayed in the selected language.

A 3.2.1.4 RESET, boot sensor

RESET

The sensor is restarted.

A 3.2.1.5 RESETCNT, Reset counter

RESETCNT [TIMESTAMP] [MEASCNT]

Resets the internal counter in the sensor.

- TIMESTAMP: resets the time stamp
- MEASCNT: resets the measured value counter

A 3.2.1.6 ECHO, Switching the Command Reply, ASCII Interface

ECHO ON|OFF

Setting the command reply with an ASCII command:

- ON: command reply on, for example ok (or error message) ->
- OFF: command reply off, e.g. ->

A 3.2.1.7 PRINT, Sensor settings

PRINT

Print serves the output of all sensor settings

Example response:

```

GETUSERLEVEL PROFESSIONAL
STDUSER PROFESSIONAL
UNIT MM
LANGUAGE DE
KEYLOCK AUTO 5 (IS_ACTIVE)
BAUDRATE 921600
SYNC NONE
TERMINATION OFF
MFILEVEL HTL
LASERPOW FULL
MEASRATE 1.000
TARGETMODE STANDARD
MEASPEAK DISTA
AVERAGE MEDIAN 9
TRIGGERSOURCE NONE
TRIGGERMODE EDGE
TRIGGERLEVEL HIGH
TRIGGERAT INPUT
TRIGGERCOUNT 1
MASTERSIGNAL
MASTERSIGNAL DIST1 0.000
MASTERSOURCE NONE

```

```

OUTPUT RS422
OUTHOLD NONE
OUTREDUCEDEVICE RS422
OUTREDUCECOUNT 1000
OUT_RS422 DIST1 COUNTER
ANALOGRANGE 0-10V
ANALOGSCALEMODE STANDARD
ANALOGSCALERANGE 0.00000 10.00000
ANALOGSCALESOURCE NONE
ERROROUT1 LI1
ERROROUT2 DIST
ERRORLEVELOUT1 NPN
ERRORLEVELOUT2 NPN
ERROROUTHOLD 0
ERRORLIMITCOMPARETO1 LOWER
ERRORLIMITCOMPARETO2 LOWER
ERRORLIMITVALUES1 0.0000 10.0000
ERRORLIMITVALUES2 0.0000 10.0000
ERRORHYSTERESIS 0.0000
SHUTTERMODE MEAS
SHUTTER 100.0
->

```

A 3.2.1.8 SYNC

SYNC NONE | MASTER | MASTER_ALT | SLAVE | SLAVE_ALT | SLAVE_MFI

Setting the type of synchronization:

- NONE: No synchronization
- MASTER: The sensor is master, i.e. it transmits synchronization pulses on the output.
- MASTER_ALT: The sensor is master, i.e. it transmits synchronization pulses with every 2nd cycle. Both sensors measure alternately, e.g. thickness measurement using 2 sensor on transparent material
- SLAVE: Sensor is slave and expects synchronization pulses from another optoNCDT 1750.
- SLAVE_ALT: Sensor is slave and expects synchronization pulses from a master sensor. Both sensors measure alternately, e.g. thickness measurement using 2 sensor on transparent material
- SLAVE_MFI: Sensor is slave and expects synchronization pulses from an external source at the multi-function input. Synchronization is performed with rising edge.

A 3.2.1.9 TERMINATION

TERMINATION OFF | ON

Activation of a terminating resistor in synchronization instruction

Switches off/on the termination resistor at the Sync/Trig synchronization input in order to avoid reflection.

OFF: no terminating resistor

ON: with terminating resistor

A 3.2.2 User Level

A 3.2.2.1 LOGIN, Change of the User Level

LOGIN <Password>

Enter the password to switch to a different user level. The following user levels exist:

- USER (standard user): “read-only” access to all elements and graphical display of output values of web interface
- PROFESSIONAL (Expert): Read/write access to all elements

A 3.2.2.2 LOGOUT, Change into User Level

LOGOUT

Sets the user level to USER.

A 3.2.2.3 GETUSERLEVEL, User Level Request

GETUSERLEVEL

Request the current user level.

A 3.2.2.4 STDUSER, Set Standard User

STDUSER USER|PROFESSIONAL

Sets the standard user, who is logged in after system start. Standard user does not change with LOGOUT, i.e. login as standard user is done automatically after the command RESET or power supply of sensor is switched on.

A 3.2.2.5 PASSWD, Change Password

```
PASSWD <Old Password> <New Password> <New Password>
```

Changes the password for the PROFESSIONAL level.

The old password must be entered once, and the new password twice. If the new passwords do not match, an error message is displayed. A password may only contain letters (A to Z) and numbers, but no letters with accents or umlauts. Upper and lower case are distinguished. The maximum length is 31 characters.

A 3.2.3 Triggering

The multi-function input also serves as trigger input

A 3.2.3.1 TRIGGERLEVEL, Active level triggering

```
TRIGGERLEVEL HIGH | LOW
```

- HIGH: Edge triggering: Rising edge, level triggering: High-active
- LOW: Edge triggering: Falling edge, level triggering: Low-active

A 3.2.3.2 TRIGGERMODE

```
TRIGGERMODE EDGE | PULSE
```

Defines the trigger type.

- PULSE: Level triggering
- EDGE: Edge triggering

A 3.2.3.3 TRIGGERSOURCE, Trigger source

```
TRIGGERSOURCE NONE | MFI | SYNCIO | SOFTWARE
```

- NONE: Triggering is deactivated
- MFI: Use multi-function input for triggering.
- SYNCIO: Use synchronization ports for triggering
- SOFTWARE: Triggering is controlled by the TRIGGERSW command

A 3.2.3.4 TRIGGERAT, Effect of the Trigger Input

TRIGGERAT INPUT | OUTPUT

- INPUT: Triggering the measured value recording. When calculating the mean, measured values immediately before the trigger event are not included; instead older measurement values are used, which were output in previous trigger events.
- OUTPUT: Triggering the measurement value output. When calculating the mean, measured values immediately before the trigger event are used.

A 3.2.3.5 MFILELEVEL, Input Level Multi-Function Input

MFILELEVEL HTL | TTL

Selection of switching or trigger level for the multi-function input

- HTL: Input expects HTL level
- TTL: Input expects TTL level

A 3.2.3.6 TRIGGERCOUNT, Number of Output Measurement Values

TRIGGERCOUNT INFINITE | <n>

<1...16382>

Number of Output Measurement Values with Triggering

- INFINITE: Start of continuous output after the first trigger event
- <n>: Number of measured values to be output after every trigger event n = 1 ...16382.

A 3.2.3.7 TRIGGERSW, Software Trigger Pulse

TRIGGERSW SET | CLR

Generates a software trigger pulse.

- SET: Generates one single trigger pulse when edge triggering (EDGE) is active. Continuously generates trigger pulses with level triggering (PULSE)
- CLR: Stops trigger pulses with level triggering (PULSE). With edge triggering, an ongoing task is aborted. Abortion is also possible when selecting the trigger sources MFI and SyncIO.

A 3.2.4 Interfaces**A 3.2.4.1 BAUDRATE, RS422**

```
BAUDRATE 9600|115200|230400|460800|691200|921600|2000000|3000000|4000000
```

Set the baud rate for the RS422 interface.

A 3.2.4.2 ERROROUT1/2, Activate Switching Output

```
ERROROUT1 DIST|TEACH|LI1
```

```
ERROROUT2 DIST|TEACH|LI1
```

Choose error signal of the ERROR switching output.

- DIST: no peak found or beyond measuring range (out of range)
- TEACH: Distance is out of scaled analog range
- LI1: Distance is greater than the limit value (ERRORLIMIT)

A 3.2.4.3 ERRORLEVELOUT1/2, Output Level Switching Output

```
ERRORLEVELOUT1 NPN|PNP|PUSHPULL|PUSHPULLNEG
```

```
ERRORLEVELOUT2 NPN|PNP|PUSHPULL|PUSHPULLNEG
```

Choice of output level for ERROROUT1.

- NPN: switching output is active in case of an error
- PNP: switching output is active in case of an error
- PUSHPULL: switching output is high in case of an error
- PUSHPULLNEG: switching output is low in case of an error

Wiring of ERROR1 switching output, see Chap. 5.4.8.

A 3.2.4.4 ERRORLIMITCOMPARETO1/2

```
ERRORLIMITCOMPARETO1 [LOWER|UPPER|BOTH]
```

```
ERRORLIMITCOMPARETO2 [LOWER|UPPER|BOTH]
```

Defines the monitoring function for the switching outputs.

- LOWER: Monitors if the measurement value falls short of the limit value
- UPPER: Monitors if the measurement value exceeds the limit value
- BOTH: Monitors excess/shortfall of limit values.

A 3.2.4.5 ERRORLIMITVALUES1/2

```
ERRORLIMITVALUES1 [<lower limit [mm]> [<upper limit [mm]>]]
```

```
ERRORLIMITVALUES2 [<lower limit [mm]> [<upper limit [mm]>]]
```

Defines the lower and upper limit value for the switching outputs.

Value range:

- <lower limit [mm]> = (-2 ... 2) * measuring range [mm]
- <upper limit [mm]> = (-2 ... 2) * measuring range [mm]

A 3.2.4.6 ERRORHYSTERESIS

```
ERRORHYSTERESIS <hysteresis [mm]>
```

Value by which the measured value must fall short of the limit value to deactivate the switching output.

Value range: 0 ... 2 * measuring range [mm].

A 3.2.4.7 ERROROUTHOLD

```
ERROROUTHOLD <hold period>
```

Indicates in ms how long the switching output must be active at least when the limit value is exceeded. This time period starts when the limit value is exceeded. Range: 0....1000 [ms].

A 3.2.5 Handling of Setups**A 3.2.5.1 IMPORT**

```
IMPORT [FORCE] [APPLY] <ImportData>
```

Import of data in JSON format to the sensor.

First, the import command returns a prompt (->). Afterwards, data can be sent. After importing a prompt (->) is returned.

- FORCE: Overwriting measurement settings (=MEASSETTINGS) with the same name (otherwise an error message is displayed when the name is the same). When importing all measurement settings or device settings (= BASICSETTINGS) FORCE must always be stated.
- APPLY : Activates the settings after importing / reading the Initial Settings.
- ImportData: Data in JSON format

A 3.2.5.2 EXPORT

```
EXPORT (MEASSETTINGS <SettingName>) | BASICSETTINGS | MEASSETTINGS_ALL | ALL
```

Export sensor settings.

- MEASSETTINGS: Only transmits measurement settings with the name <SettingName>.
- BASICSETTINGS: Only transmits device settings.
- MEASSETTINGS_ALL: Transmits all measurement settings.
- ALL: Transmits all device and measurement settings.

A 3.2.5.3 MEASSETTINGS, Load / Save Measurement Settings

```
MEASSETTINGS <Subcommands> [<Name>]
```

Settings of the measurement task.

Loads proprietary presets and user-specific settings from the sensor or stores user-specific setups in the sensor.

Subcommands:

- PRESETMODE: Returns the currently used Preset mode.
- PRESETMODE <mode>: Sets a preset mode, <mode> = STATIC|BALANCED|DYNAMIC|NOAVERAGING
- PRESETLIST: Listing of all existing manufacturer settings.
- CURRENT: Output of the name of current measurement setting
- READ <Name>: Loads a setting <Name> of non-volatile memory
- STORE <Name>: Saves the current setting <Name> in a non-volatile memory.
- RENAME <NameOld> <NameNew> [FORCE]: Renaming measurement setting. An existing measurement setting can be overwritten with FORCE.
- DELETE <Name>: Deletes a measurement setting.
- INITIAL AUTO: Loads the last saved setting when starting the sensor
- INITIAL <Name>: Loads the setting <Name> when starting the sensor. Presets cannot be indicated.
- LIST: Lists all saved measurement settings.

A 3.2.5.4 BASICSETTINGS, Load / Save Device Settings

BASICSETTINGS READ | STORE

- READ: Loads the stored device settings from the sensor.
- STORE : Saves the current device settings in the sensor.

A 3.2.5.5 SETDEFAULT, Factory Settings

SETDEFAULT ALL | MEASSETTINGS | BASICSETTINGS

Resets the sensor to factory settings.

- ALL: Deletes measurement and device settings and loads the standard preset for the measurement settings or the default parameters for the device settings.
- MEASSETTINGS: Loads the measurement settings and deletes the standard presets loaded.
- BASICSETTINGS: Deletes the device settings and loads the default parameters.

A 3.2.6 Analog Output**A 3.2.6.1 ANALOGRANGE**

ANALOGRANGE [0-5V|0-10V|4-20mA]

Sets the type of the analog output.

A 3.2.6.2 ANALOGSCALEMODE, Scaling the Analog Output

ANALOGSCALEMODE STANDARD|TWOPOINT

Choice of the scaling type of the analog output.

- STANDARD: using the measuring range of the sensor
- TWOPOINT: two-point scaling within the analog range
 - Minimum value: measurement value in mm which is matched to the lower analog value,
 - Maximum value: measurement value in mm which is matched to the upper analog value.

i The minimum value (in mm) can be higher than the maximum value (in mm), see Chap. [7.7.3](#).

A 3.2.6.3 ANALOGSCALERANGE, Scaling Limits with Two-Point Scaling

```
ANALOGSCALERANGE <limit 1> <limit 2>
```

Sets the scaling limits of the analog output with two-point scaling.

<limit 1>: Value range between 0 and EMR

<limit 2>: Value range between 0 and EMR

The scaling limits must not be identical.

A 3.2.6.4 ANALOGSCALESOURCE

```
ANALOGSCALESOURCE NONE | MFI | KEY_SELECT
```

Determination of the port for teaching.

- NONE: No port selected.
- MFI: Switching input triggers teaching function.
- KEY_SELECT: The Select key triggers the teaching function.

A 3.2.7 Key Function

A 3.2.7.1 KEYLOCK, Set Key lock

KEYLOCK NONE | ACTIVE | AUTO [<timeout period>]

Key lock configuration

- NONE: Key is active, no key lock
- ACTIVE: Key lock is activated immediately after restart
- AUTO: Key lock is only activated <timeout period>, 1 ... 60 minutes after reboot

A 3.2.8 Measurement

A 3.2.8.1 TARGETMODE, Measurement Task

TARGETMODE STANDARD | MULTISURFACE | PENETRATION

Choice of material dependent presets

- STANDARD: suitable for materials, e.g. made of ceramics, metal, plastics or wood
- MULTISURFACE: suitable for materials with changing surfaces, e.g. PCB or hybrid materials
- PENETRATION: suitable for materials with strong penetration depth of the laser light

A 3.2.8.2 MEASPEAK, Choice of the Peak in the Video Signal

MEASPEAK DISTA | DISTW | DIST1 | DISTL

- DISTA: output of peak with highest amplitude (standard)
- DISTW: output of peak with the largest area
- DIST1: output of first peak
- DISTL: output of last peak

A 3.2.8.3 MEASRATE, Measuring rate

MEASRATE <frequency>

Specifies the measuring rate in kHz, range 0.3 ... 7.5 kHz.

A 3.2.8.4 SHUTTER, Exposure Time

```
SHUTTER <exposure time>
```

Sets the exposure time to a fixed value with manual exposure time.

The maximum exposure time is the reciprocal of the measuring rate. Therefore, the manual exposure time is smaller than/equal to the maximum exposure time.

The exposure time is indicated in μs . Range: 0.1 ... 3333 μs , increments of 0.1 μs

A 3.2.8.5 SHUTTERMODE

```
SHUTTERMODE MEAS|MANUAL
```

MEAS: Exposure time is controlled automatically

MANUAL: Selectable exposure time

A 3.2.8.6 LASERPOW, Laser Power

```
LASERPOW FULL | REDUCED | OFF
```

- FULL: Laser power is switched to 100%
- REDUCED: Laser power is switched to 50%
- OFF: Laser is switched off.

A 3.2.8.7 ROI, Video Signal, Masking the Evaluation Range

```
ROI <Start> <End>
```

Sets the evaluation range for „Region of interest“. Start and end must be between 0 and 511. The “start” value is smaller than the “end” value.

A 3.2.8.8 AVERAGE, Averaged Measurements

```
AVERAGE NONE|MOVING [<AD>] |RECURSIVE [<AD>] |MEDIAN [<AD>]
```

The average acts on the distance value to be output.

- MOVING: Moving average (averaging depth <AD> of 2, 4, 8, 16, 32, 64, and 128 possible).
- RECURSIVE: Recursive average (averaging depth <AD> of 2 to 32768 possible)
- MEDIAN: Median (averaging depth <AD> of 3, 5, 7 and 9 possible)

A 3.2.8.9 MASTER

```
MASTER [DIST1]
MASTER ALL|DIST1 SET|RESET
```

The function uses the measurement value (DIST1) in order to generate an offset. This offset is then applied to the following measurement values.

Example: Zero is defined as master value, DIST1 currently provides 0.5 mm as measured value. Therefore, -0.5 mm is applied as offset to DIST1.

The Reset function resets the offset to zero.

The output lists the values and the word ACTIVE when mastering is currently used or the word INACTIVE without mastering.

A 3.2.8.10 MASTERSIGNAL

```
MASTERSIGNAL DIST1
MASTERSIGNAL DIST1 <master value>
MASTERSIGNAL DIST1 NONE
```

- <master value>: value in mm, value range -2 ... 2 * Measuring range

Displays, changes or deletes the master value. The master value is calculated with the current measurement value when mastering is active. Mastering can be triggered with the command MASTER.

If the master value is 0, the mastering function has the same functionality as the zero setting.

The output lists signals and the currently used master value.

A 3.2.8.11 MASTERSOURCE

```
MASTERSOURCE NONE | MFI | KEY_SELECT
```

Choice of port for mastering.

- NONE: No port (hardware) selected, mastering is possible via command.
- MFI: Use switching input in order to trigger mastering.
- KEY_SELECT: Use Select key in order to trigger mastering.

A 3.2.9 Data output**A 3.2.9.1 OUTPUT, Selection of Measurement Value Output**

```
OUTPUT NONE | ([RS422 | ANALOG] [ERROROUT1 | ERROROUT2 | ERROROUT1 ERROROUT2])
```

- NONE: No measurement value output
- RS422: Output of measurement values via RS422
- ANALOG: Output of measurement values via analog output
- ERROROUT1/2: Output of an error/status information via the switching outputs.

A parallel output of measured values via multiple channels is not possible. RS422 and analog output cannot be operated simultaneously.

A 3.2.9.2 OUTREDUCEDEVICE, Output Reduction of Measurement Value Output

```
OUTREDUCEDEVICE NONE | ([RS422] [ANALOG])
```

Selection of interface for data reduction.

- NONE: no data reduction
- RS422: output reduction for RS422
- ANALOG: output reduction for analog output

A 3.2.9.3 OUTREDUCECOUNT, Data Output Rate

```
OUTREDUCECOUNT <n>
```

Reduces the measured value output for all selected interfaces.

- 1: outputs each measurement value
- 2 ... 3000000: output of each n-th measured value

A 3.2.9.4 OUTHOLD, Error Processing

```
OUTHOLD NONE | INFINITE | <n>
```

Setting the behavior of the measurement value output in case of error.

- NONE: No holding of the last measured value, output of error value.
- INFINITE: Infinite holding of the last measurement value.
- <n>: Holding the last measured value over a number of measuring cycles n; then an error value is output.
n = (1 ... 1024).

A 3.2.9.5 GETOUTINFO_RS422, Query Selected Data

```
GETOUTINFO_RS422
```

The command lists all output data chosen for the RS422 interface. The displayed order corresponds to the output sequence.

A 3.2.9.6 OUT_RS422

```
OUT_RS422 ([DIST1] [SHUTTER] [COUNTER] [TIMESTAMP_LO] [TIMESTAMP_HI]  
[INTENSITY] [STATE] [UNLIN] [VIDEO] [MEASRATE])
```

This command is used to choose the signals for measurement data output via the RS422 interface.

- DIST1: Calibrated distance value
- SHUTTER: exposure time
- COUNTER: measured value counter
- TIMESTAMP_LO: Time stamp (16 Bit lower word)
- TIMESTAMP_HI: Time stamp (16 Bit upper word)
- INTENSITY: intensity
- STATE: Status word
- UNLIN: Non-calibrated distance value (raw value)
- VIDEO: video signal (raw value)
- MEASRATE: measuring rate (frequency)

A 3.3 Example Command Sequence During Selection of Measurement Value

Command	Content
MEASPEAK	Peak selection with distance measurement
MEASRATE	Measuring rate (by taking into consideration reflectivity and movement of the target)
AVERAGE	Averaged measurements (by taking into consideration reflectivity, structure and movement of the target)
OUTPUT	Selection of the output channel
OUTREDUCEDEVICE	Reduction of the output data rate (under consideration of the chosen output channel, its settings and the processing range of the target system)
OUTREDUCECOUNT	
OUTHOLD	Output behavior in the event of measuring errors
OUTADD_RS422	Selection of the additional values to be output for RS422 interface
BAUDRATE	Baud rate setting RS422 interface

A 3.4 Error Messages

If an error occurs with a command, the error message is listed.

Error message	Description
E100 Internal error	Internal error code
E104 Timeout	Timeout with mastering.
E200 I/O operation failed	Cannot write data on output channel.
E202 Access denied	Access denied; requires login as expert.
E204 Received unsupported character	An unsupported character was received.
E210 Unknown command	Unknown command (insufficient rights for reading).
E214 Entered command is too long to be processed	The indicated command with the parameters it too long (larger than 255 bytes).
E220 Timeout, command aborted	Timeout with mastering.
E232 Wrong parameter count	Too high or small number of parameters.
E234 Wrong or unknown parameter type	A transmitted parameter has a wrong type or a wrong number of parameters were transmitted.
E236 Value is out of range or the format is invalid	The parameter value is outside the range of values.
E262 Active signal transfer, please stop before	One measurement data output is active. End the measurement data output in order to execute the command.
E320 Wrong info-data of the update	Only with update: The header of the update data contains an error.
E321 Update file is too large	Only with update: The update is too large.
E322 Error during data transmission of the update	Only with update: Error with transmission of update data.
E323 Timeout during the update	Only with update: Timeout with transmission of update data.
E331 Validation of import file failed	Import file is invalid

E332 Error during import	Error with processing import data.
E333 No overwrite during import allowed	No overwrite of measurement and device settings allowed through import. Setting checkbox.
E350 The new passwords are not identical	Error with repeated entry of new password.
E360 Name already exists or not allowed	The measurement setting name already exists or is not allowed.
E361 Name begins or ends with spaces or is empty	Name for the measurement setting begins or ends with spaces or is empty.
E362 Storage region is full	Number of storable measurement settings is reached
E363 Setting name not found	Name of the measurement setting to be loaded not found
E364 Setting is invalid	Measurement or device setting is invalid
E600 ROI begin is greater than ROI end	Start of the evaluation range is larger than the end.
E602 Master value is out of range	The master value is outside the valid range.
E616 Software triggering is not active	Software trigger is not active.
Warning	Description
W320 The measuring output has been adapted automatically.	The measurement value output has been adapted automatically.
W570 The input has been adapted automatically to a limited range.	The input has been adapted automatically to a limited range.

A 4 Control Menu**A 4.1 Tab Home**

Measurement task	Presets	<i>Standard</i>	<i>Suitable for materials made of ceramics, metal or filled plastics</i>
		<i>Multi-Surface</i>	<i>Suitable for printed circuit boards, hybrid material</i>
		<i>Light penetration</i>	<i>Suitable for plastics, materials with large penetration depth of the laser</i>
	Setups	<i>Setup 1 ... Setup 8</i>	<i>Setups contain user-specific measurement settings. Unlike the presets they can be changed anytime.</i>
Signal quality		Static / balanced / dynamic / no averaging	<i>The signal quality affects averaging of measurement values.</i>

A 4.2 Tab Settings**A 4.2.1 Inputs**

Laser power	<i>Full / Reduced / Off</i>		<i>The laser light source is active only, if pin 9 is connected to GND.</i>
Synchronization	<i>Slave / Slave alternating</i>	Termination	<i>On / Off</i>
	<i>Slave MFI</i>		<i>If several sensors measure the same target synchronously, the sensors may be synchronized with each other. The synchronization output of the first sensor (master) controls the sensors connected to the synchronization inputs (slaves).</i>
	<i>Master / Master alternating</i>		
	<i>inactive</i>		
Level Multi-function input	<i>TTL / HTL</i>		<i>Defines the input level of both switching inputs Laser on/off and Multi-function.</i> <i>TTL: Low ≤ 0.8 V; High ≥ 2 V</i> <i>HTL: Low ≤ 3 V; High ≥ 8 V</i>

A 4.2.2 Data Recording

Measuring rate	300 Hz / 625 Hz / 1.25 kHz / 2.5 kHz / 5 kHz / 7.5 kHz /		Use a high measuring rate for bright and mat measurement objects. Use a low measuring rate for dark or shiny measurement objects (e.g. black painted surfaces) to improve the measurement result.	
	Free measuring rate	Value		
Input trigger Output trigger Trigger source	Multi-function input / Synchronization input	Trigger type	Edge / Level	
		Trigger level	high rising edge / low falling edge	
		Number of measured values	Infinite	
	Manual selection		Value Range: 1 ... 16382	
	Software	Trigger type	Edge / Level	
		Trigger level	high rising edge / low falling edge	
		Number of measured values	Infinite	
			Manual selection	Value Range: 1 ... 16382
		Start triggering	Button starts data recording	
	Stop triggering	Sensor outputs continuous data		
Inactive	No triggering			
Masked area	Start of range	0 ... 99 %	Value	Setting the evaluation range for the „Region of interest“, i.e. only this range is used for logging the measuring values. The Start of range value has to be smaller than the End of range value.
	End of range	1 ... 100 %	Value	

<p>Exposure mode</p>	<p><i>Automatic mode / Manual mode</i></p>	<p><i>In the automatic mode, the sensor determines the optimal exposure time in order to achieve the highest possible signal intensity.</i></p> <p><i>In the manual mode, when the video signal is displayed, the user determines the exposure time Vary the exposure time in order to achieve a signal quality up to a maximum of 95 %.</i></p> <p><i>In both cases, the set measuring rate is hold.</i></p>	
<p>Peak selection</p>	<p><i>First peak / Highest peak / Last peak / Widest peak</i></p>	<p><i>Defines which signal is used for the evaluation in the line signal.</i></p> <p><i>First peak: Nearest peak to sensor.</i></p> <p><i>Highest peak: standard, peak with the highest intensity.</i></p> <p><i>Last peak: widest peak to sensor.</i></p> <p><i>Widest peak: peak with maximum area.</i></p>	
<p>Error handling</p>	<p>Digital output, no value</p> <p>Hold last value infinite</p> <p>Hold last value</p>	<p><i>The analog output supplies 3 mA resp. 5.2 / 10.2 V instead of measurement value. The RS422 interface outputs an error value.</i></p> <p>Analog output and RS422 interface stop at the last valid value.</p> <p>1 ... 1024 Value</p>	

A 4.2.3 Signal Processing

Averaging	<i>Inactive</i>			<i>Measurement values are not averaged.</i>
	<i>Moving N values</i>	<i>2 / 4 / 8 ... 128</i>	<i>Value</i>	<i>Indication of averaging mode. The averaging number N indicates the number of consecutive measurement values to be averaged in the sensor.</i>
	<i>Recursive N values</i>	<i>2 ... 32768</i>	<i>Value</i>	
	<i>Median N values</i>	<i>3 / 5 / 7 / 9</i>	<i>Value</i>	
Zero setting/ Mastering	Select source	<i>Inactive</i>		<i>Normal measurement value resp. Zeroing/Mastering is undone.</i>
		Select button / Multifunction input		<i>Select control element for mastering.</i>
	Master value	<i>Value</i>		<i>Indication e.g. of thickness of a master part. Value range -2 up to max. +2 x measuring range</i>
	Set master value			<i>Adopts the master value but does not execute it.</i>
	Activate master value / reset			<i>Mastering/reset is done via buttons in the web interface.</i>
Data reduction	<i>Value</i>			<i>Indicates the sensor which data is to be excluded from output, thus the data amount to be transmitted is reduced.</i>
Reduction relates to	<i>RS422 / Analog</i>			<i>Interfaces to be used for undersampling are to be selected via the check-box.</i>

A 4.2.4 Outputs

RS422	Baud rate	9.6 / 115.2 / 230.4 / 460.8 / 691.2 / 921.6 / 2000 / 3000 / 4000 kbps			Transmission speed, binary data format
	Output data	Distance / Non-linearized focal point / Intensity / Exposure time / Sensor state / Measurement counter / Time stamp / Video signal			Data to be transmitted are to be activated via the checkbox.
Analog output	Output range	0-5 V / 0-10 V / 4-20 mA			Select voltage or current output
	Scaling	Standard scaling			Start of measuring range 0 V oder 4 mA, End of measuring range 5 V/10 V / 20 mA
		Two-point scaling	Minimum	Value	Always 2 points are taught which mark start and end of new measuring range. With two point scaling reversal of the output signal is possible
			Maximum	Value	
Digital output 1 / 2	Configuration	Full scale error / Distance is outside the analog range / Distance is out of limit			Regulates the switching performance of the digital output (Error), see Chap. 5.4.8. Range limit values: -2 ... +2 x Measuring range
	Compare to limit	Lower / Upper / Both	Limit min	Value	The minimum hold time defines how long the output must be active at least. The hysteresis defines a dead band around the selected limit values.
			Limit max	Value	
	Switching level	NPN / PNP / PushPull / PushPull negative			
	Minimum holding period	1 ... 1000 ms	Value		
	Hystereses	0 ... 2 x Measuring range	Value		

Output interface	RS422 / Analog output / digital output 1 / digital output 2	<i>Defines which interface is used for output of measured values. A parallel output of measured values via multiple channels is not possible. RS422 and analog output cannot be operated simultaneously. The switching outputs 1 and 2 can be activated regardless of any other channel. While using the web interface, the output is switched off via RS422.</i>
------------------	---	---

A 4.2.5 System Settings

Unit on website	<i>mm / Inch</i>		<i>Unit in measurement value display</i>	
Key lock	<i>Automatic</i>	<i>Countdown 1 ... 60 [min]</i>	<i>Value</i>	<i>The key lock starts after expiry of the defined time. Clicking the button <code>Refresh</code> extends the interval until key lock starts.</i>
		<i>Refresh</i>		
	<i>Active</i>		<i>The keys do not respond in any user level</i>	
	<i>Inactive</i>		<i>The keys are active in any user level</i>	
Load & Store	Measurement settings	<i>New setup / Setup 1 / ... / Setup 8</i>	<i>Load</i>	<i>Activates a saved measurement setting setup.</i>
			<i>Safe</i>	<i>Saves changed measurement settings to an existing setup.</i>
			<i>Favorite</i>	<i>Selects a setup which is used after reboot of the sensor.</i>
			<i>Delete</i>	<i>Deletes a setup.</i>
			<i>Search</i>	<i>You load an existing setup from a PC or the like to the ILD1750 with both buttons.</i>
			<i>Import</i>	
			<i>Export</i>	<i>Saves the setup on a connected PC or the like.</i>
	Device settings	<i>Create setup</i>	<i>Load</i>	<i>Activates the saved device settings.</i>
			<i>Safe</i>	<i>Saves changed device settings.</i>
			<i>Search</i>	<i>You load the device settings from a PC or the like to the ILD1750 with both buttons.</i>
			<i>Import</i>	
			<i>Export</i>	

Import & Export	Create a parameter set	Measurement settings	The measurement setting setups, the file with device settings and the boot file can be combined in one parameter set and exchanged with a PC or the like.
		Boot setup	
		Device settings	
	Search		Button starts file manager to select a parameter set.
Check file	Overwrite existing setups (with the same name)		Dialog prevents inadvertent overwriting of existing settings.
	Apply settings of the imported boot setup		
	Transmit data		

Access permission	Current access permission	Value		Read only	
	Logout / Login			Button starts change of access permission.	
	User level when restarting	Professional / User		Sets the user level the sensor starts with after re-boot. In this case MICRO-EPSILON recommends the selection user.	
	Change password	Old password	Value		Case-sensitive rules are observed for all passwords. Numbers are allowed. Special characters are not allowed. Maximum length is limited to 31 characters.
		New password	Value		
Repeat new password		Value			
Change password			Button causes change of password.		

Reset sensor	Measurement settings	<i>The settings for measuring rate, trigger, evaluation range, selection of peak, error handling, averaging, Zeroing/Mastering, reduction of data and setups are deleted. The 1st preset is loaded.</i>
	Device settings	<i>The settings baud rate, language, unit, key lock and echo mode are deleted and the default parameters are loaded.</i>
	Reset all	<i>By clicking the button the settings for the sensor, measurement settings, access permission, password and setups are deleted. The 1st preset is loaded.</i>
	Restart sensor	<i>By clicking the button the sensor is rebooted with the settings made in the favorite setup, see Chap. 7.8.4.</i>

Selection required or checkbox

Specification of a value required

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



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

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