

Instruction Manual

optoNCDT 1700

optoNCDT 1710

ILD1700-2
ILD1700-10
ILD1700-20
ILD1700-40
ILD1700-50
ILD1700-100

ILD1700-200
ILD1700-250VT
ILD1700-500
ILD1700-750

ILD1700-2DR
ILD1700-10DR
ILD1700-20DR

ILD1700-2LL
ILD1700-10LL
ILD1700-20LL
ILD1700-50LL

ILD1710-1000

Intelligent laser optical displacement measurement

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1. Safety

1.1 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 herein may result in hazardous radiation exposure.

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

- > Danger of injury
- > Damage to or destruction of the sensor

Avoid banging and knocking the sensor.

- > Damage to or destruction of the sensor

The power supply may not exceed the specified limits.

- > Damage to or destruction of the sensor

Avoid continuous exposure to spray 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

1.2 Notes on CE Identification

The following applies to the optoNCDT1700: EMC regulation 2004/108/EC

The sensor is designed for use in industry and to satisfy the requirements of the standards

- EN 61326-1: 2006-10
- DIN EN 55011: 2007-11 (Group 1, class B)
- EN 61000-6-2: 2006-03

1.3 Proper Use

- The optoNCDT1700 is designed for use in industrial areas. It is used
 - for measuring displacement, distance, position and elongation
 - for in-process quality control and dimensional testing
- The sensor may only be operated within the limits specified in the technical data (see Chap. 3.4).

➡ Use the sensor only in such a way that in case of malfunctions or failure personnel or machinery are not endangered.

➡ Take additional precautions for safety and damage prevention for safety-related applications.

1.4 Proper Environment

- Protection class: IP 65 (Only with sensor cable connected)
- Operating temperature: 0 to +50 °C (+32 to +104 °F)
- Storage temperature: -20 to +70 °C (-4 to +158 °F)
- Humidity: 5 - 95 % (no condensation)

2. Laser Class

The optoNCDT1700 sensors operate with a semiconductor laser with a wavelength of 670 nm (visible/red). The laser is operated on a pulsed mode, the pulse frequency corresponding to the measuring frequency. The duration of the pulse is regulated in dependency on the object to be measured and can form an almost permanent beam. The maximum optical power is ≤ 1 mW. The sensors fall within Laser Class 2 (II).

Class 2 (II) lasers are not notifiable and a laser protection officer is not required either.

The following warning labels are attached to the cover (front and/or rear side) of the sensor housing:

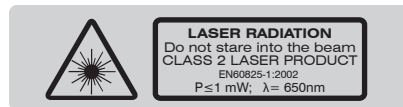


Fig. 1: IEC label



Fig. 2: Only for USA

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

Laser operation is indicated by LED (see Fig. 5).

3. Technical Data Measuring Range, Start and End

3.4.1 Diffuse Reflection

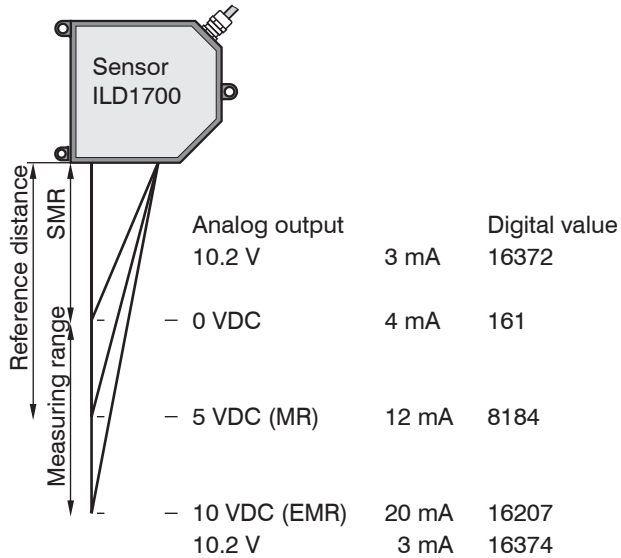


Fig. 3: Defintion of terms, output signal

SMR = Start of measuring range

MMR = Midrange

EMR = End of measuring range

3.1 Direct Reflection

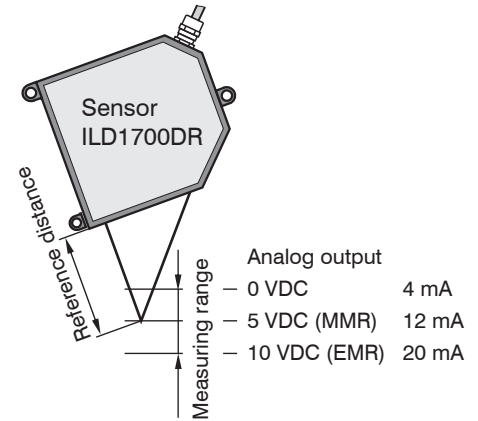


Fig. 4: Defintion of terms, output signal

Type	ILD 1700-	2	10	20	40	50	100	200	250VT	500	750
Measuring range	mm	2	10	20	40	50	100	200	250	500	750
Start of measuring range	mm	24	30	40	175	45	70	70	70	200	200
Reference distance (MR)	mm	25	35	50	195	70	120	170	195	450	575
End of measuring range	mm	26	40	60	215	95	170	270	320	700	950

optoNCDT1700 - for direct reflective surfaces

Type	ILD 1700-	2DR	10DR	20DR
Measuring range	mm	2	10	20
Start of measuring range	mm	see Fig. 11 to 13		
Reference distance (MR)	mm			
End of measuring range	mm			

optoNCDT 1710 - for long distance to the target

Type	ILD 1710-1000	
Measuring range	mm	1000
Start of measuring range	mm	1000
Reference distance (MR)	mm	1500
End of measuring range	mm	2000

3.3 Control and Indicator Elements



Fig. 5: Keys and LED's on the sensor

(1) „select/zero“ key
 Measurement mode: Sets analog output to „Mid-point“ or „Master“ (see Chap. 6.7)
 Setup mode: For changing the sensor parameters (see Chap. 6.5)

(2) „function / enter“ key
 For switching between measurement mode and setup mode.

(3) LEDs (see Fig. 6)






LED	Color	Meaning	
output	o	Current (4 ... 20 mA)	
		red green	Voltage (0 ... 10 V) Serial (RS422)
speed	o	Measurement frequency 1 = 2.5 kHz	
		red green yellow	1/2 = 1.25 kHz 1/4 = 625 Hz 1/8 = 312.5 Hz
	o	Average: 1 (Median: 3)	
avg		red green yellow	4 (5) 32 (7) 128 (9)
zero		red flashing	Mid-point set / mastered Slave not synchronized
state	o	Laser off	
		red green yellow	Error O.K. MMR (midrange)

Fig. 6: Meanings of the LEDs in measurement mode

Note: In measurement mode (factory setting) only the LED „state“ lights up, subject to the current position of the object to be measured.

i If the “function/enter” key is pressed more than 5 sec, all parameters are overwritten by the factory settings.

4. Installation and Mounting

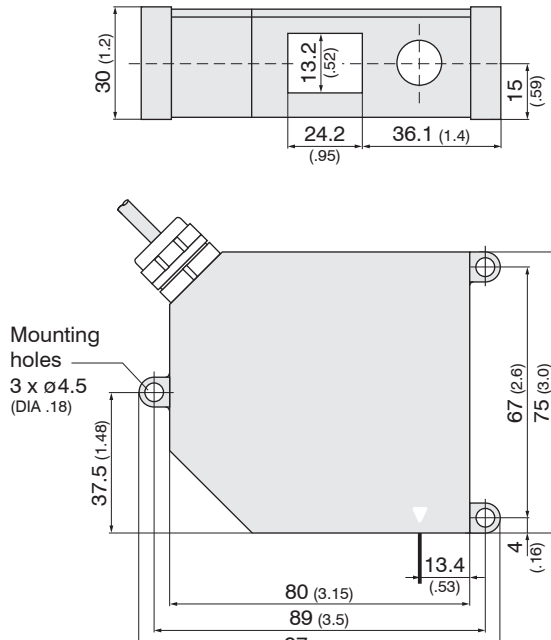


Fig. 7: Dimensional drawing
optoNCDT 1700-2/10/20/50/
100/200/250VT, dimensions in inches,
not to scale

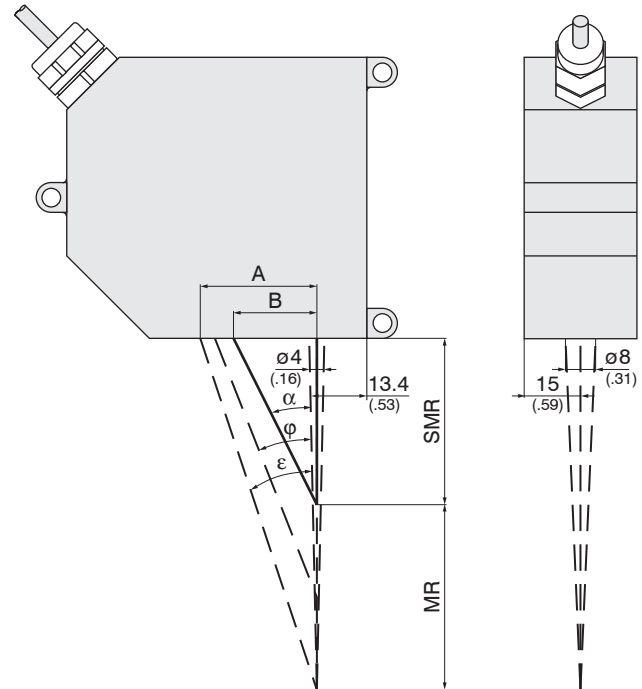


Fig. 8: Free space for optics,
dimensions in inches,
not to scale

MR	SMR	α	ϕ	ϵ	A	B
2	24	35.0°	40.0°	44.8°	25.8	16.8
10	30	34.3°	35.2°	35.6°	28.7	20.5
20	40	28.8°	27.5°	26.7°	30.1	22.0
50	45	26.5°	23.0°	18.3°	31.5	22.5
100	70	19.0°	15.4°	10.9°	32.6	24.1
200	70	19.0°	9.8°	7.0°	33.1	24.1
250VT	70	19.0°	8.4°	6.0°	33.5	24.1

SMR = Start of measuring range
MR = Measuring range

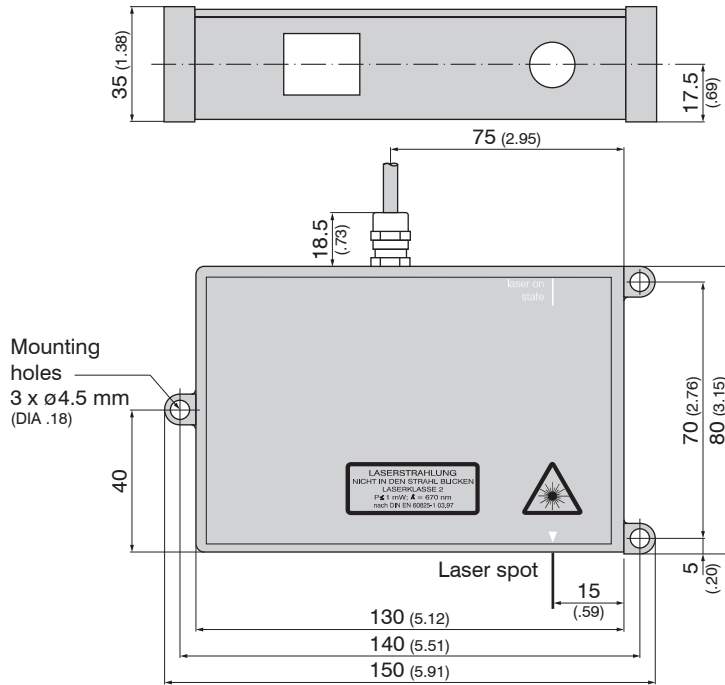
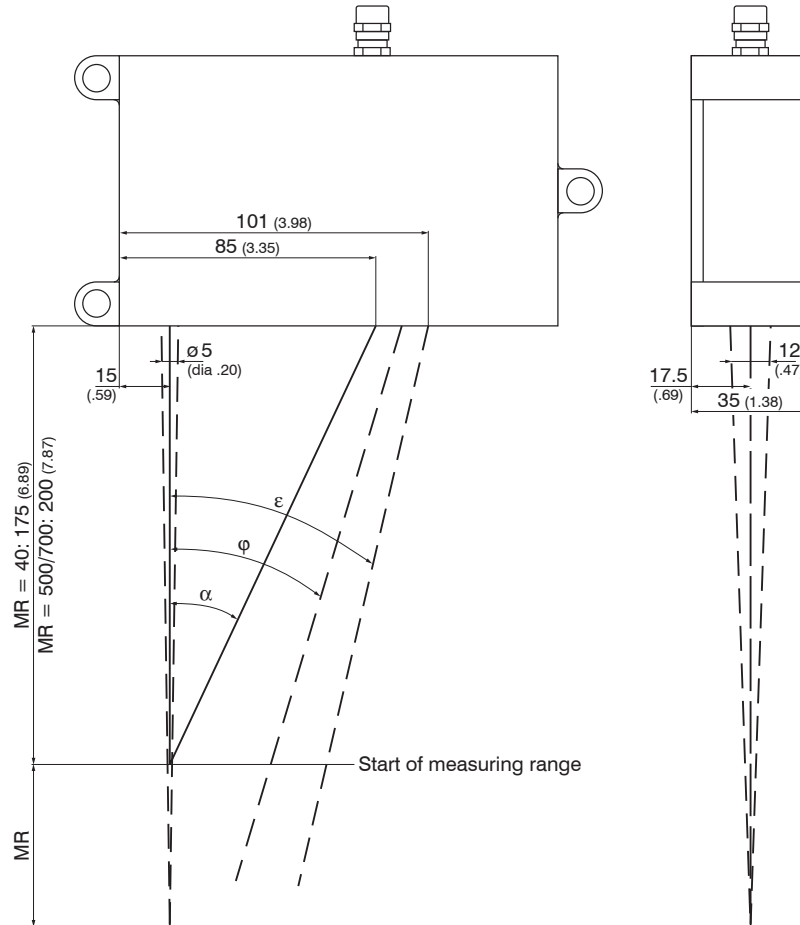


Fig. 9: Dimensional drawing optoNCDT 1700-40/500/750, dimensions in inches, not to scale



MR	α	φ	ϵ
40	22.1 °	21.9 °	21.8 °
500	19.3 °	9.8 °	7.0 °
750	19.3 °	7.7 °	5.0 °

MR = Measuring range

Fig. 10: Free space for optics, ranges 40/500/750 mm, dimensions in inches, not to scale

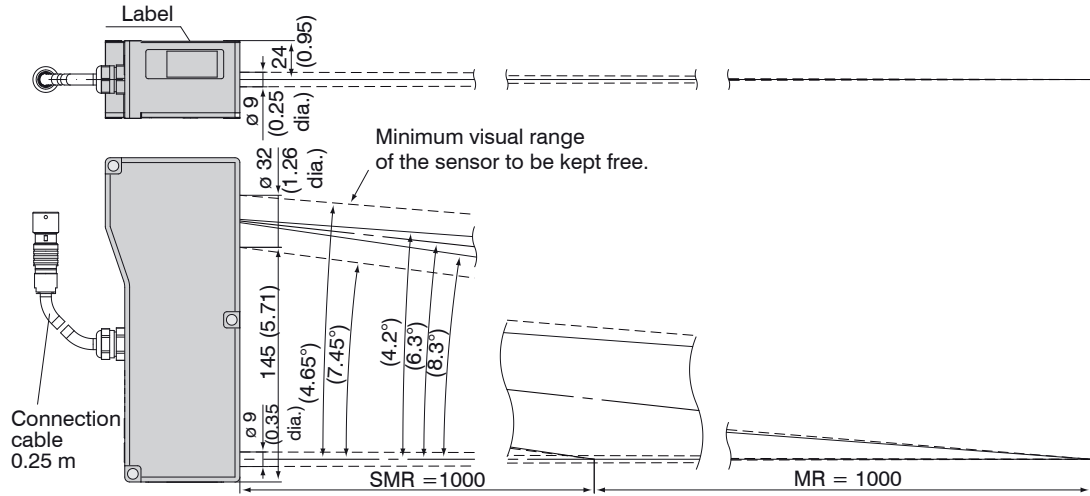


Fig. 12: Free space for optics optoNCDT ILD 1710-1000, dimensions in inches, not to scale

SMR = Start of measuring range

MR = Measuring range

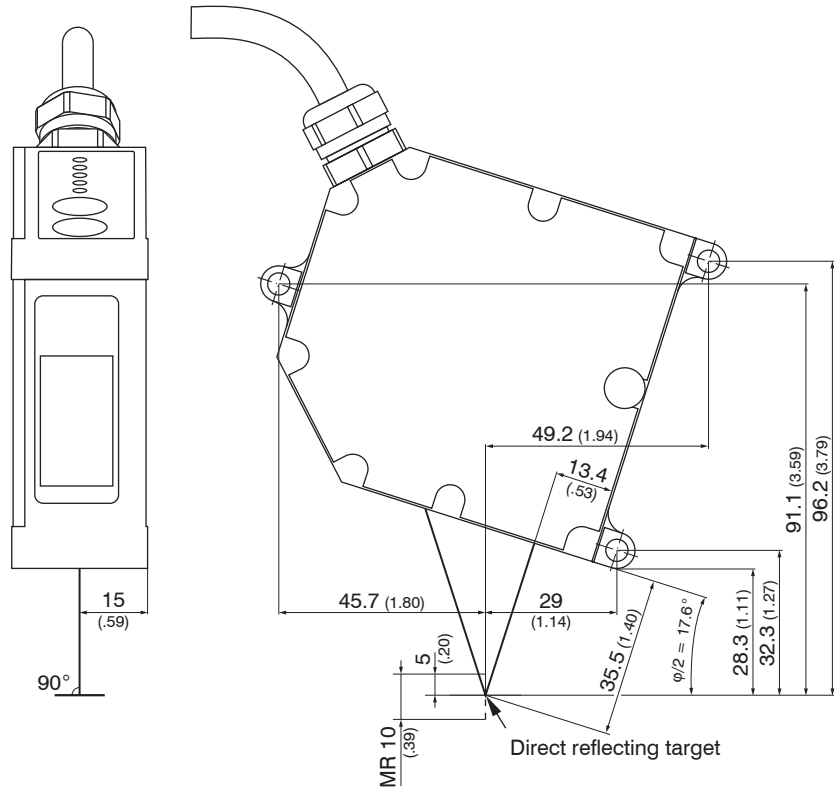


Fig. 14: Dimensional drawings optoNCDT1700-10DR, dimensions in inches, not to scale

MR = Measuring range

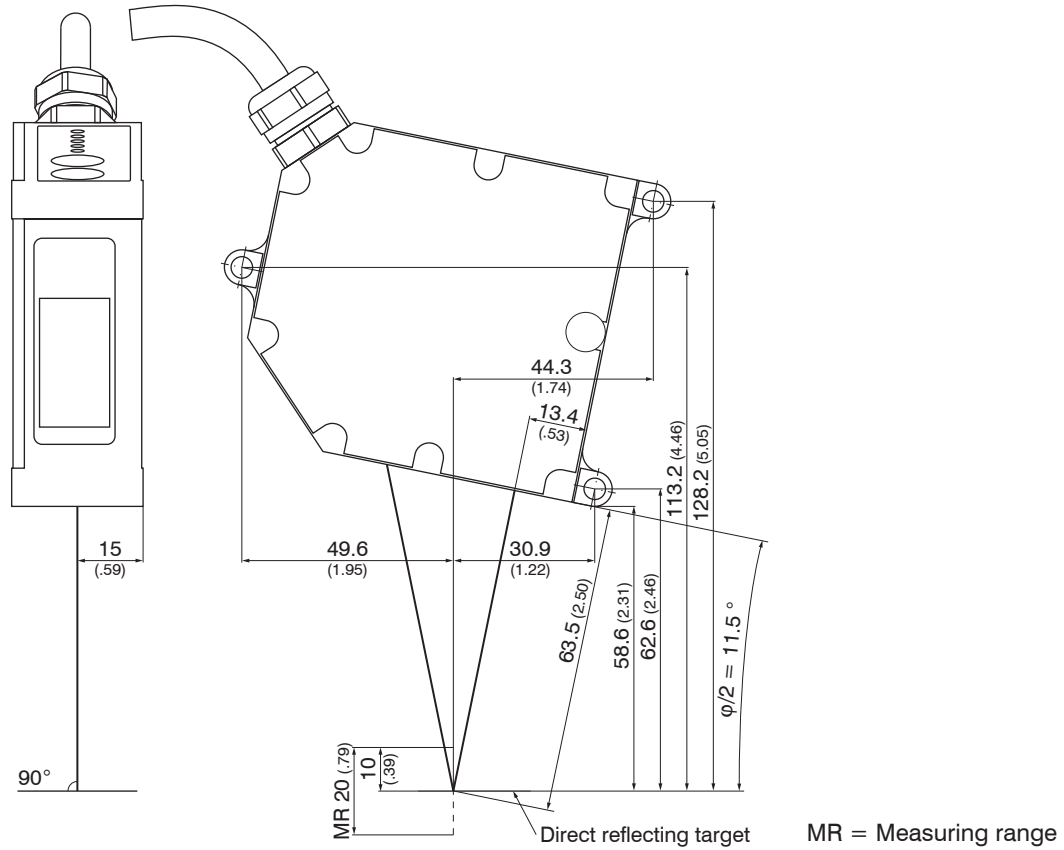


Fig. 15: Dimensional drawings optoNCDT1700-20DR, dimensions in inches, not to scale

4.2 Connector and Sensor Cable

Never bend the sensor cable by more than the bending radius of 60 mm.

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.

➡ Connect the cable shield to the potential equalization (PE, protective earth conductor) on the evaluator (control cabinet, PC housing) and avoid ground loops.

5. Operation

5.1 Getting Ready for Operation

The laser diode in the sensor can only be activated if the input „Laser on/off“ (Pin 9 or the red-blue wire in the sensor cable) is connected to GND.

To be able to produce reproducible measurements the sensor typically requires a start-up time of 20 minutes. Once this has elapsed the sensor will be in measurement mode and, in accordance with the factory settings (see Chap. 14.4), only the “state“ LED will be illuminated.

If the “state“ LED is not on, this means that

- either there is no operating voltage or
- the laser has been switched off.

Operating Voltage

- Nominal value: 24 VDC (11 ... 30 V, max. 150 mA).
- Use the power supply unit for measurement instruments only, and not for drive units or similar sources of pulse interference at the same time.

➡ Switch on the power supply unit, if wiring is done.

5.2 Membrane Keys

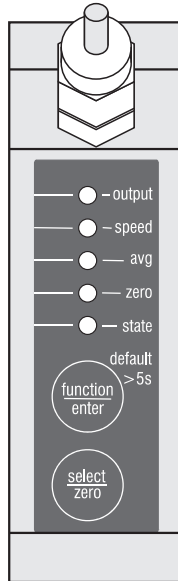


Fig. 16: op view of the optoNCDT1700

The two membrane keys „function/enter“ and „select/zero“ have dual assignments, depending on the operating status.

Measurement mode (normal operation):

- „zero“ key:
 - Sets the analog output to the value for the mid-point of the measurement range, i.e. 5 VDC or 12 mA.
 - Pressing the „zero“ key again resets the function. See Chap. 6.7.
- „function“ key:
 - Switches the sensor to setup mode (see Chap. 6.5).

Pressing and holding the „function/enter“ key for longer than 5 seconds overwrites all the parameter values with the factory settings (default values, see Chap. 13.4).

Setup mode („function“ key actuated):

- „function“ key:
 - For running through the levels and parameters.
- „select“ key
 - To open the selection list and
 - select the value of the parameter in sequence.
- „enter“ key:
 - For saving the selected parameter value and
 - returning to measurement mode.

If approx. 15 seconds have elapsed since the last press of the “function“ key or 30 seconds since the last press of the “select“ key, the sensor returns to measurement mode without changing the parameters.

5.3 LED-Functions

LED	Status	Measurement mode	Setup mode
state	illuminated	Object is in the measurement range or error	...
	off	Sensor off or laser off	
	flashes slowly	...	Selected parameter value matches the saved value
	flashes quickly	...	Selected parameter value does not match the saved value
output speed avg	illuminated or flashing	Indication of the parameter value from level 1	Selected parameter value
	flashing red		Status „off“
zero	illuminated	Sensor „master“ or „ set to mid-point“	
	off	Normal operation	
	flashing	Sensor as slave without synchronous signal	

5.4 Inputs and Outputs

Pin	Signal	Explanation	Configuration	Color sensor cable PC1700-x
5	+U _B	Power supply (11 ... 30 VDC)		red
6	GND	System ground for power supply switch signals (Laser on/off, Zero, Limits)		black
13	Analog output	Current 4 ... 20 mA	$R_{\text{Limit}} < (U_B - 6 \text{ V}) / 20 \text{ mA}$; $R_{\text{Limit}} \text{ max.} = 250 \text{ Ohm}$ with $U_B = 11 \text{ V}$	Coaxial inner conductor, white
		Voltage 0 ... 10 VDC	$R_i = 100 \text{ Ohm}$, $I_{\text{max}} = 5 \text{ mA}$, short-circuit protection from 7 mA, ²	
14	AGND	Reference potential for analog output		Coaxial screening
9	Laser on/off	Switching input	Laser operates if pin 9 is connected with GND	red and blue
10	Zero	Switching input, Chap. 6.7	Connect 0.5 ... 3 s with GND: SET, connect 3 ... 6s with GND: RESET	white and green
8	Switching output 1	Error or limit output 1	Open-Collector (NPN), $I_{\text{max}} = 100 \text{ mA}$, $U_{\text{max}} = 30 \text{ VDC}$,	grey and pink
7	Switching output 2	Limit output 2	Interrupt supply voltage to cancel the short-circuit protection	violet
3	Sync +	Symmetrical synchron output (Master) or input (Slave) ¹		blue
4	Sync -			pink
1	Tx +	Serial output RS422	Terminate with 120 Ohm receive-site	green
2	Tx -			brown
12	Rx +	Serial input RS422	Internally terminated with 120 Ohm	grey
13	Rx -			yellow

1) Input is used for triggering in trigger mode (see Chap. 6.13).

2) The use of a 10 nF capacitance at the entrance for interference suppression is recommended.

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

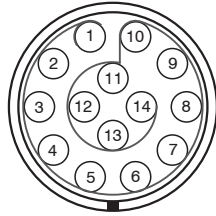


Fig. 17: View: Solder-pin side male cable connector

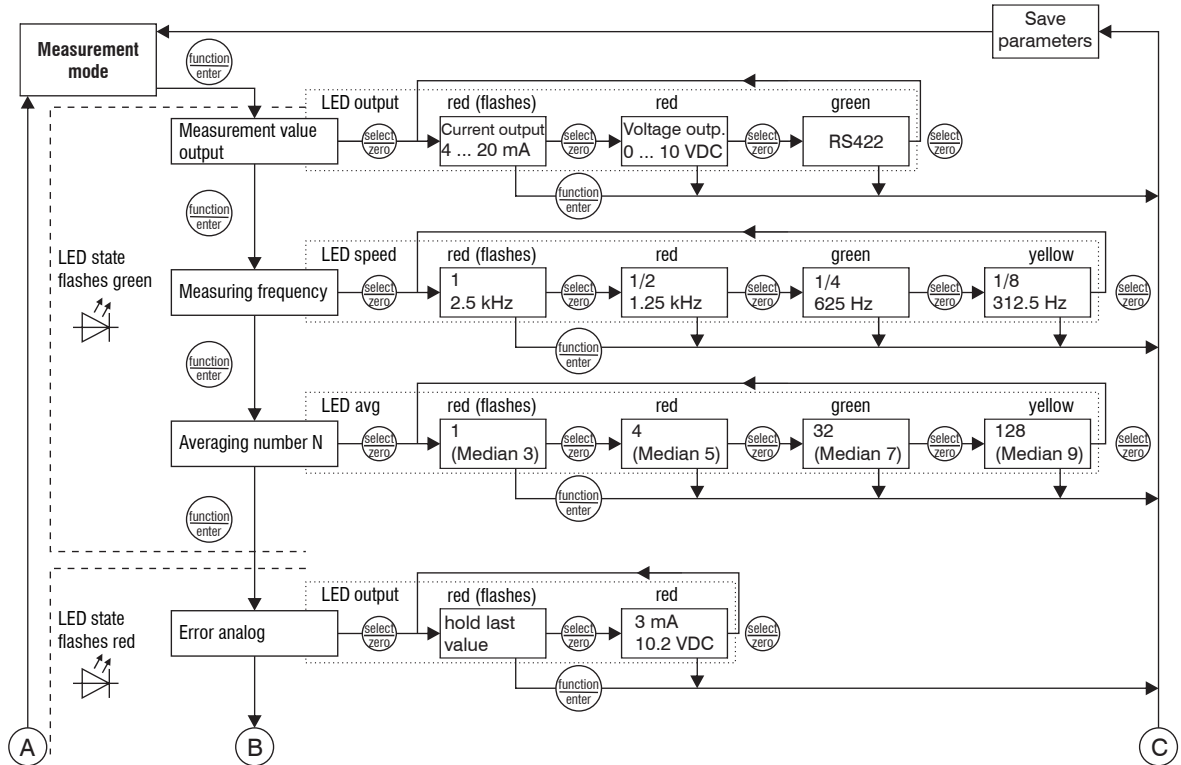
Plug connector:

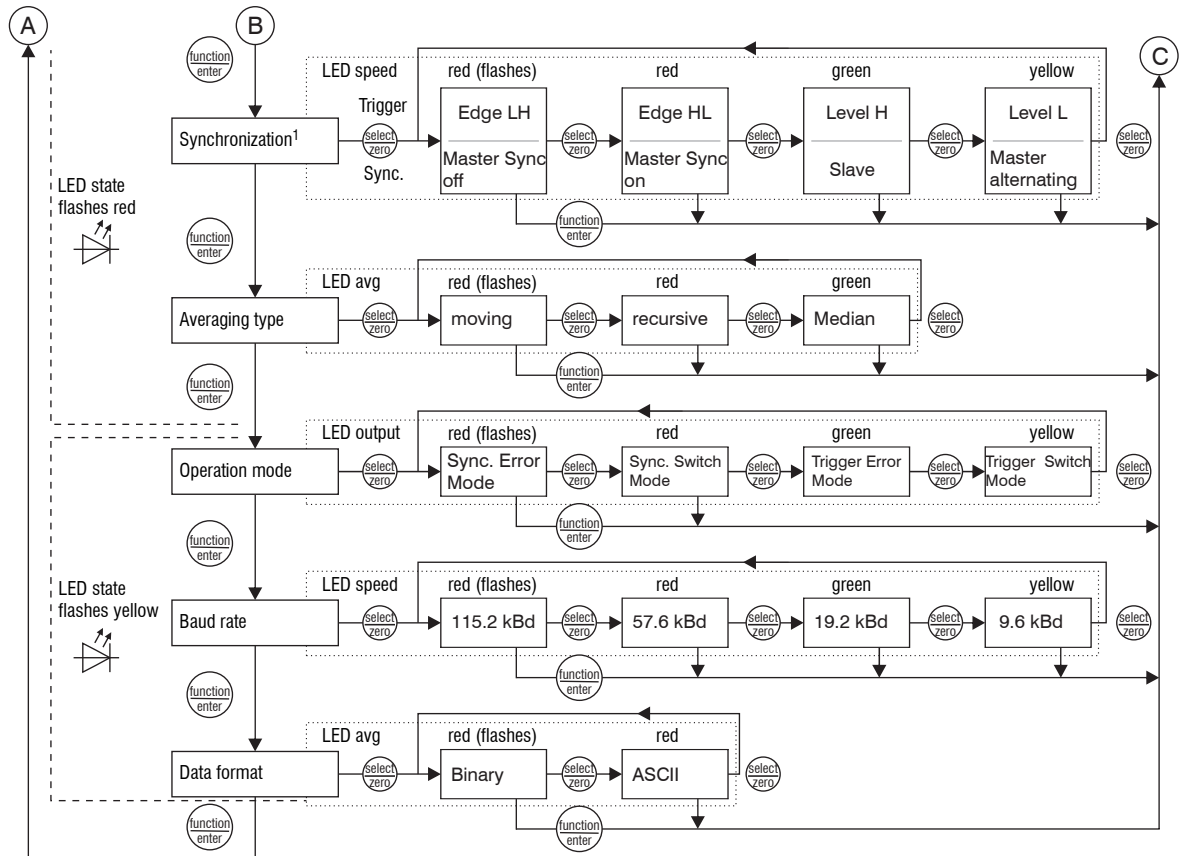
ODU MINI-SNAP, 14-pin, series B, Dimension 2, Code 0, IP 68

More information on www.odu.de

5.5 Menue, Setting the Parameters

The sensor parameters can be set in setup mode using the „function/enter“ and „select/zero“ keys.





1) Depends on operation mode settings (synchronization or trigger).

5.6 Operation Mode

5.6.1 Error Mode (Error Control)

In error mode, the switching output 1 is used as an error output. The switching output 2 remains inactive. The error mode can be programmed using both the keypad and the programming interface.

The error output is activated (conducting to GND) when:

- the object to be measured is outside
- the measurement range, see Fig. 18 there is no object to be measured present, or
- if the object to be measured is unsuitable (too dark, polished metal, insufficiently reflective).

Transparent objects can be penetrated by the light of the laser and the laser spot unacceptably enlarged, resulting in unreliable measurements. This will also trigger the error output.

5.6.2 Switch Mode (Limit Control)

In switch mode, both switching outputs are used as limit switches, see Fig. 19.

The individual limits can be programmed using the digital programming interface (see Chap. 8.5.7, 8.5.8).

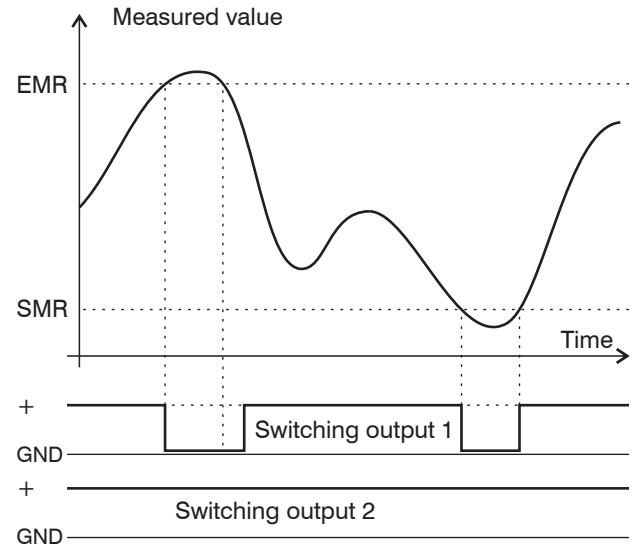


Fig. 18: Signal sequence for the switching outputs in the operation mode „Sync error“ und „Trigger error“

Error mode: Zero setting only, no limit control

Switch mode: Mastering only, limit control

The following four values are used:

- Upper limit (UL),
- Lower limit (LL),
- Upper hysteresis value (UH),
- Lower hysteresis value (LH).

If the upper limit is exceeded the assigned switching output 1 will be activated (conducting), and deactivated again with the follow-on shortfall on the upper hysteresis value. The same applies in principle to a shortfall on the lower limit and switching output 2, see Fig. 19.

Standard setting

Upper limit (UL):

101 % FSO / Digital value: 16365

Upper hysteresis value (UH):

100 % FSO / Digital value: 16207

Lower hysteresis value (LH):

0 % FSO / Digital value: 161

Lower limit (LL):

-1 % FSO / Digital value: 0

In switch mode, both switching outputs are activated when:

- the object to be measured is outside the measurement range, see Fig. 19,
- there is no object to be measured present, or
- if the object to be measured is unsuitable (too dark, polished metal, insufficiently reflective).

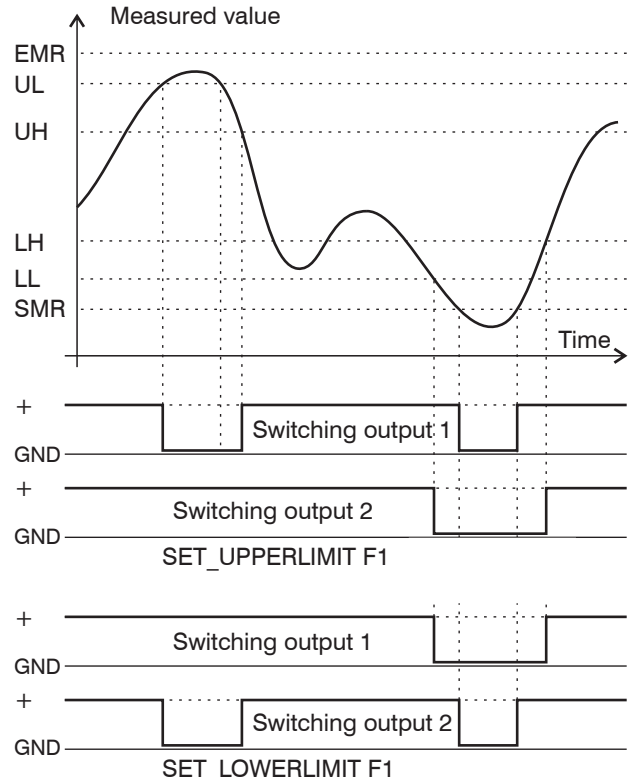


Fig. 19: Signal sequence for the switching outputs in operation mode „Sync switch“ and „Trigger switch“

5.6.3 Output Circuit for the Switching Outputs

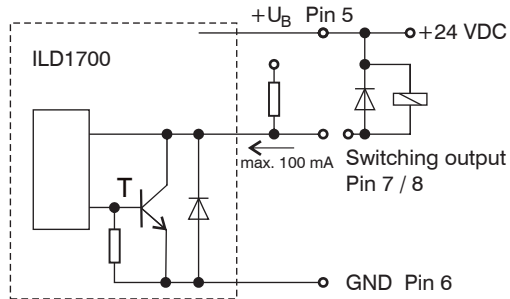


Fig. 20: Switching output, examples of external protective circuit with pull-up resistor or relay with protective diode

In the active state the transistor T is conductive.

The switch outputs are short-circuit-proof.

To reset the short-circuit protection:

- ➡ Clear the external short circuit,
- ➡ Switch off the sensor and switch on again, or send the software command "Reset" to the sensor.

The two limit outputs (Pin 7 and 8) may also be actuated in parallel as window comparator (OK/ Not OK separation).

5.7 Measurement Value Flux

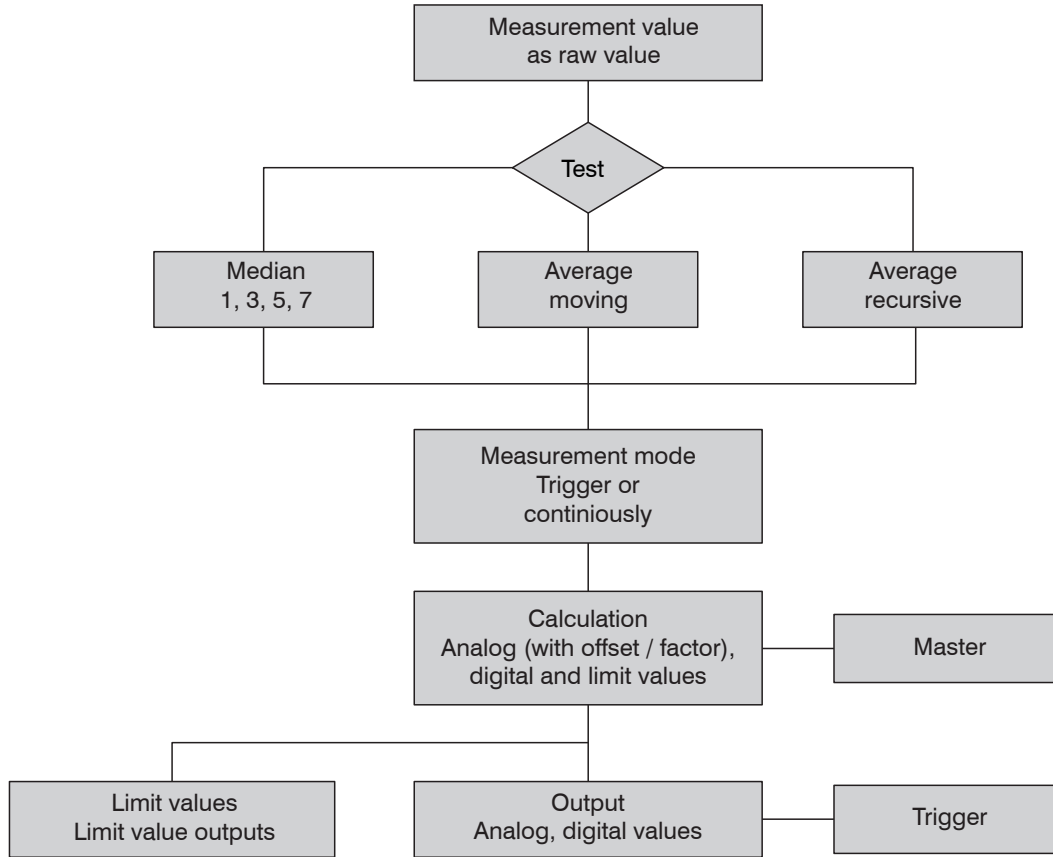


Fig. 21: Measurement value flux ILD 1700

6. Measurement Value Output

The optoNCDT1700 can issue the measurement values either via the analog output or the RS422 serial interface. The two different types of output cannot be used concurrently. The analog output can be programmed for use as a current output or a voltage output.

6.1 Voltage Output

Range for measurement voltages -0.1 V ... +10.1 V

Output amplification ΔU_{OUT} 10.0 V = 100 % Measuring range

Error value: 10.2 V (± 10 mV)

Calculation of a measurement value x in mm from analog voltage:

$$x \text{ [mm]} = U_{OUT} * \frac{MR \text{ [mm]}}{10.0 \text{ [V]}}$$

Reference value: SMR

$$x \text{ [mm]} = U_{OUT} * \frac{MR \text{ [mm]}}{10.0 \text{ [V]}} - MR/2$$

Reference value: MMR

Example: Measuring range = 10 mm, $U_{OUT} = 4.6$ V; Result: $x = 4.6$ mm resp. $x = -0.4$ mm

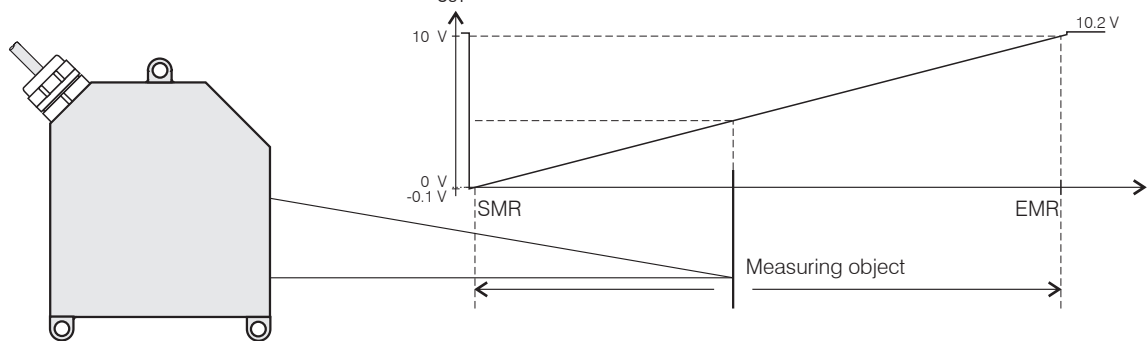


Fig. 22: Voltage output signal

SMR = Start of measuring range

MMR = Midrange

EMR = End of measuring range

6.2 Current Output

Max. range 4 mA ... 20 mA
 Output amplification ΔI_{OUT} 16 mA = 100 % Measuring range
 Error value: 3 mA ($\pm 3 \mu A$)

Calculation of measurement value x in mm from analog current

Reference value SMR:

$$x \text{ [mm]} = (I_{OUT} - 4 \text{ mA}) * \frac{MR \text{ [mm]}}{16 \text{ [mA]}}$$

Reference value MMR:

$$x \text{ [mm]} = (I_{OUT} - 4 \text{ mA}) * \frac{MR \text{ [mm]}}{16 \text{ [mA]}} - MR/2$$

Example: Measuring range = 10 mm, $I_{OUT} = 12 \text{ mA}$; Result: x = 5 mm resp. x = 0 mm

6.3 Digital Value Output

The digital measurement values are issued as unsigned digital values (raw values).

Digital value	Used for
0 ... 16367	Value range
0 ... 160	SMR back-up (1 %)
161 ... 16207	Measurement range

Digital value	Used for
16208 ... 16367	EMR back-up (1 %)
16370 ... 16383	Error codes

Calculation of a measurement value in mm from digital output

Reference value SMR:

$$x \text{ [mm]} = (\text{digital}_{OUT} * \frac{1.02}{16368} - 0.01) * MR \text{ [mm]}$$

Reference value MMR:

$$x \text{ [mm]} = (\text{digital}_{OUT} * \frac{1.02}{16368} - 0.51) * MR \text{ [mm]}$$

Example: MR = 10 mm, Reference value = SMR

Digital value	Conversion	Measurement value
8184	$(8184 * 6.23167e-5 - 0.01) * 10 \text{ mm}$	= 5 mm (=MMR)
10261	$(10261 * 6.23167e-5 - 0.01) * 10 \text{ mm}$	= 6.294 mm
161	$(161 * 6.23167e-5 - 0.01) * 10 \text{ mm}$	= 0 mm (=SMR)

Note: A digital value can be calculated from a measurement value (millimeter) as follows:

$$\text{digital}_{\text{OUT}} = \left[\frac{x \text{ [mm]}}{\text{MR [mm]}} + 0.01 \right] * \frac{16368}{1.02}$$

This formula can be used, for example, in the programming of switching thresholds (see Chap. 8.5.7).

6.4 Digital Error Modes

Digital error codes are issued in the same way as measurement values.

Value range for error codes:

16370 ... 16383 (digital OUT)

F1 bad objekt	16370 No object detected
F2 out of range +	16372 Too close to sensor
F3 out of range -	16374 Too far from sensor
F4 poor target	16376 Object cannot be evaluated
F5 Laser off	16378 external laser off
	16380 Sensor in trigger mode
	Trigger pulses come to fast.

7. Serial Interface RS422

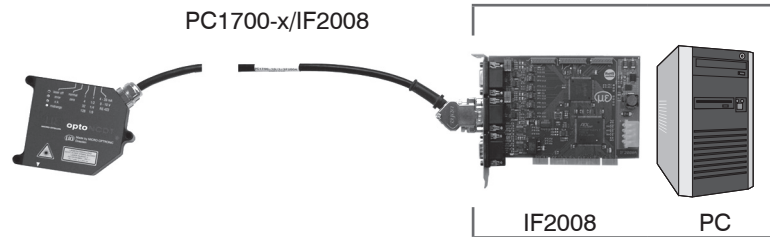


Fig. 23: System structure to operate the interface card IF2008

	Pin	Signal	Signal	Pin	
Sensor 1 15-pol. Sub-D	2	Rx + (Input)	Sensor 1/3 TxD+	2	IF2008, X1 und X2, 15-pol. Sub-D
	1	Rx - (Input)	Sensor 1/3 TxD -	1	
	4	Tx + (Output)	Sensor 1/3 RxD+	4	
	3	Tx - (Output)	Sensor 1/3 RxD -	3	
When using 3 sensors apply the optional available Y- adapter cable IF2008-Y.			0 V supply	5	
			Sensor 1/3 TRG+	6	
			Sensor 1/3 TRG -	7	
			Sensor 2/4 TRG+	8	
			Sensor 2/4 TRG -	9	
			+24 V supply ¹	10	
Sensor 2 15-pol. Sub-D	2	Rx +	Sensor 2/4 TxD+	12	
	1	Rx -	Sensor 2/4 TxD -	11	
	4	Tx +	Sensor 2/4 RxD+	14	
	3	Tx -	Sensor 2/4 RxD -	13	
	10	GND	GND	15	

Fig. 24: Pin assignment PC1700-x/IF2008 and IF2008

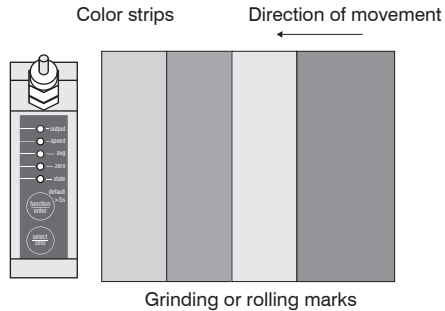
Required cables and program routines

- IF2008
RS422 interface card, for 1 to 4 laser-optic sensors from the ILD1700 series and 2 encoders, including MEDAQLib programming interface.
- PC1700-x/IF2008
Power supply and output cable, x = length with 3, 6 or 8 m.

Alternatively, data can be transferred with the demo software (ILD1700 Tool) and a RS422 converter to USB, see Chap. 10.

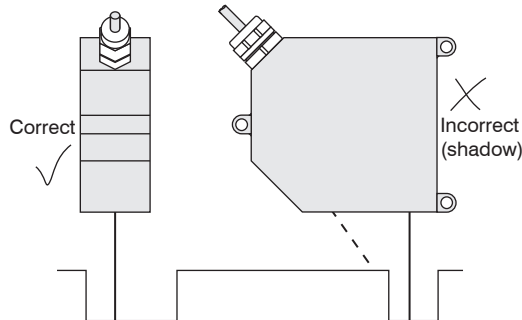
1) Supply voltage for the connected sensors and encoders, output current 1.25 A max.

8. Instruction for Operating



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 rinding marks. The same arrangement must be used for colour strips (Fig. 25).

Fig. 25: 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. 26).

Fig. 26: Sensor arrangement for holes and ridges

9. ILD1700 Tool

The software ILD1700 Tool

- transfers sensor parameter to the sensor and
- transmits measuring results and represent them in a diagramm.

All data are transmitted through a RS422 interface and can be saved on demand. The ILD1700 Tool does not work with the IF2008 interface card.

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

9.1 Installation and Preparation for Measurements

9.1.1 System Requirements

The following system requirements are recommended:

- Windows 2000 or Windows XP / Pentium III \geq 300 MHz / 256 MB RAM
- Free USB port

9.1.2 Cable and Program Routine Requirements

- PC1700-3/USB Sensor cable with RS422-USB converter and 24 V power supply
- ILD1700 Tool Configuration and measurement program
- USB-RS422 Converter Driver files for the USB-RS422 converter

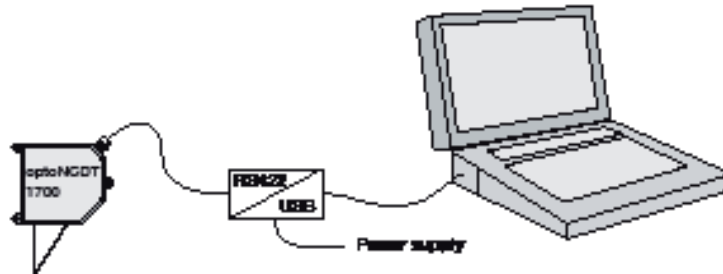


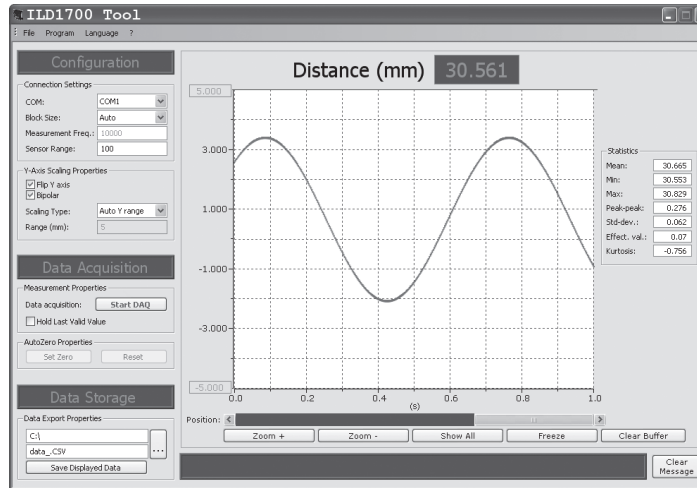
Fig. 27: Setup of the system for the demonstration software

You will find the actual drivers respectively program routines under:

Pin	Signal
1	RX
2	Tx +
3	TX
4	NC
5	GND
6	NC
7	NC
8	NC
9	Rx +

Fig. 28: Pin assignment, 9-pol. D SUB

9.2 Measurement



This sub program can be used to acquire, evaluate and store data from an ILD1700 sensor.

For further information, please refer to the online documentation.

Fig. 29: Start screen of the measurement program

10. DLL MEDAQLib

The Micro-Epsilon Data Acquisition Library offers you a high level interface library to access optoNCDT laser sensors from your Windows application in combination with

- RS422/USB converter (optional accessory) and a suitable PC1700-10/D-SUB/9pol cable or
- PC1700-3/USB cable or
- IF2008 PCI interface card and PC1700-x/IF2008 cable

into an existing or a customized PC software.

You need no knowledge about the sensor protocol to communicate with the individual sensors. The individual commands and parameters for the sensor to be addressed will be set with abstract functions. MEDAQLib translates the abstract functions in comprehensible instructions for the sensor.

MEDAQLib

- is a DLL/LIB usable for C, C++, VB, Delphi and many other Windows programming languages,
- supports functions to talk to the sensor
- hides the details on how to talk to the communication interface (RS232,RS422,USB,TCP)
- hides the details of the sensor protocol
- converts the incoming data to „expected data values“
- provides a consistent programming interface for all Micro-Epsilon sensors
- provides many programming examples many different programming languages
- the interface is documented in a large *.pdf file

You will find the latest MEDAQLib version at:

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

11. Factory Setting

Name	Setting		
	Level 1	Level 2	Level 3
LED	Current	Hold last value	Sync/Error
output	2.5 kHz	Master Synch off	115.2 KBaud
speed	1 (3)	Moving average	Binary format (no ASCII)
avg	off
zero			

Upper limit: 101 % FSO / Digital value: 16365

Upper hysteresis value: 100 % FSO / Digital value: 16207

Lower hysteresis value: 0 % FSO / Digital value: 161

Lower limit: -1 % FSO / Digital value: 0

Press the „function/enter“ key 5 seconds to activate the factory settings if the sensor is in measurement mode (the “state“ LED is illuminated).

12. Pin Assignment PC1700-x/x/USB/OE

The PC1700-x/x/USB/OE includes a RS422/USB converter, additional open leads for analog output signal and power supply unit for 90 ... 235 VAC. Length x = 3 or 10 m.

15-pin Sub-D	Pin	Assignment
	1	Rx -
	2	Rx +
	3	Tx -
	4	Tx +

2-pin cable	Color	Assignment
	red	4 ... 20 mA or 0 ... 10 V
	black	AGND

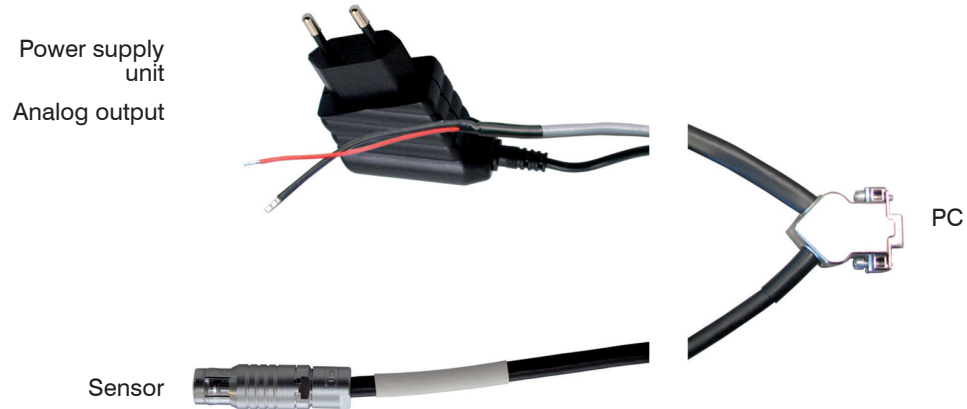


Fig. 31: Sensor cable PC1700-x/x/USB/OE



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