MICRO-EPSILON

Instruction Manual

optoNCDT 1610/1630

LD1610-0.5
LD1610-2
LD1610-4
LD1610-10
LD1610-20
LD1610-50

LD1610-100
LD1610-200

LD1630-0.5
LD1630-2
LD1630-4
LD1630-10
LD1630-20
LD1630-50

Analog
Ethernet

Intelligent laser-optical displacement measurement

MICRO-EPSILON
MESSTECHNIK
GmbH & Co. KG
Königbacher Strasse 15

94496 Ortenburg / Germany

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

Certified acc. to DIN EN ISO 9001: 2008

Contents

1. Safety

The handling of the sensor assumes knowledge of the instruction manual.

1.1 Symbols Used

The following symbols are used in this instruction manual:

⚠ CAUTION	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a situation which, if not avoided, may lead to property damage.
➔	Indicates a user action.
i	Indicates a user tip.
`Measure`	Indicates a hardware or a button/ menu in the software

1.2 Warnings

⚠ CAUTION

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

NOTICE

The power supply must not exceed the specified limits.
> Damage to or destruction of the sensor

Avoid shock and vibration to the sensor and controller.
> Damage to or destruction of the sensor and/or controller

Avoid exposure to aggressive materials (washing agent, cooling emulsions) on the sensor.
> Damage to or destruction of the sensor

Protect the sensor cable against damage.
> Destruction of the sensor

> Failure of the measuring device

Avoid continuous exposure to fluids on the sensor.
> Damage to or destruction of the sensor

1.3 CE Compliance

The following applies to the optoNCDT 1610/1630:
- EU directive 2004/108/EC
- EU directive 2011/65/EC, “RoHS” category 9

Products which carry the CE mark satisfy the requirements of the EMC directives and the standards (EN) listed therein.

The EC declaration of conformity is kept available according to EC regulation, article 10, by the authorities responsible at

MICRO-EPSILON MESSTECHNIK
GmbH & Co. KG
Königbacher Straße 15
94496 Ortenburg

The system is designed for use in industry and satisfies the requirements of the standards
- EN 61 000-6-2: 2005 (EN 50081-2)
- EN 61 000-6-4: 2007 (EN 50082-2)

The system satisfies the requirements if they comply with the regulations described in the instruction manual for installation and operation.

1.4 Proper Use

- The optoNCDT 1610/1630 is designed for use in industrial and laboratory areas.
- It is used
  - for displacement, distance, position and thickness measurement
  - for in-process quality control and dimensional testing
- The system may only be operated within the limits specified in the technical data, see Chap. 3.2, see Chap. 3.3.
- Use the system 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.

1.5 Proper Environment

- Protection class:
  - Sensor: IP 64
  - Controller: IP 40

  Lenses are excluded from protection class. Contamination of the lenses leads to impairment or failure of the function.
- Operating temperature: 0 ... 50 °C (+32 ... +122 °F)
- Storage temperature: -20 ... 70 °C (-4 ... +158 °F)
- Humidity: 5 - 95 % (no condensation)
- Ambient pressure: Atmospheric pressure
- EMC: Acc. to EN 61 000-6-2: 2005 (EN 50081-2)
  EN 61 000-6-4: 2007 (EN 50082-2)

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

2. Laser Class

2.1 General

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 optoNCDT 1610/1630 may only be opened by the manufacturer, see Chap. 10. For repair and service purposes the sensors must always be sent to the manufacturer.

During operation of the sensor the pertinent regulations acc. to EN 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.

⚠ 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.

i Comply with all regulations on lasers!

2.2 optoNCDT 1610

The optoNCDT 1610 operates with a semiconductor laser with a wavelength of 670 nm (visible/red).

The laser is operated on a pulsed mode, the pulse frequency is 54 kHz. The pulse duration is 10.7 µs. The maximum optical output power is ≤1.72 mW. The sensors fall within Laser Class 2.

The following warning labels are attached to the cover (front side) of the sensor housing.

The laser warning labels for Germany have already been applied (see above). 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.

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

Only for USA

Fig. 1 True reproduction of the sensor optoNCDT 1610 with its actual location of the warning label

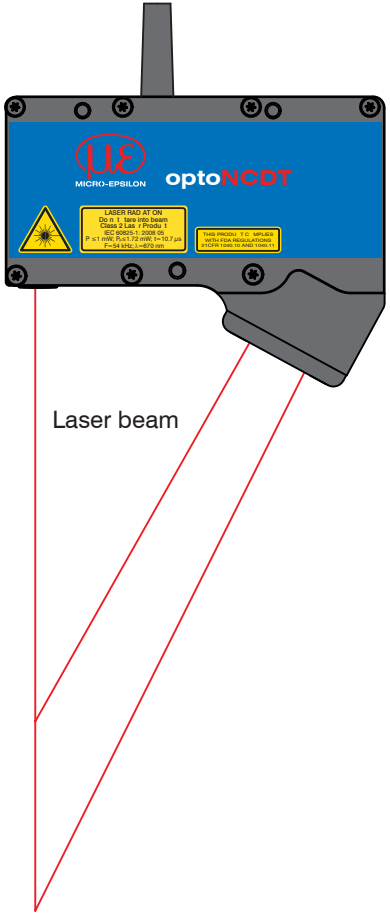


Fig. 2 True reproduction of the sensor optoNCDT 1610 with its actual location of the warning label

2.3 optoNCDT 1630

The optoNCDT 1630 operates with a semiconductor laser with a wavelength of 670 nm (visible/red).

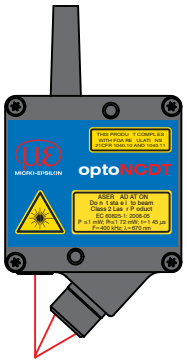
The laser is operated on a pulsed mode, the pulse frequency is 400 kHz. The pulse duration is 1.45 µs. The maximum optical output power is ≤1.72 mW. The sensors fall within Laser Class 2.

The following warning labels are attached to the cover (front side) of the sensor housing.

The laser warning labels for Germany have already been applied (see above). 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.

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

Only for USA



Laser beam

Fig. 3 True reproduction of the sensor optoNCDT 1630 with its actual location of the warning label

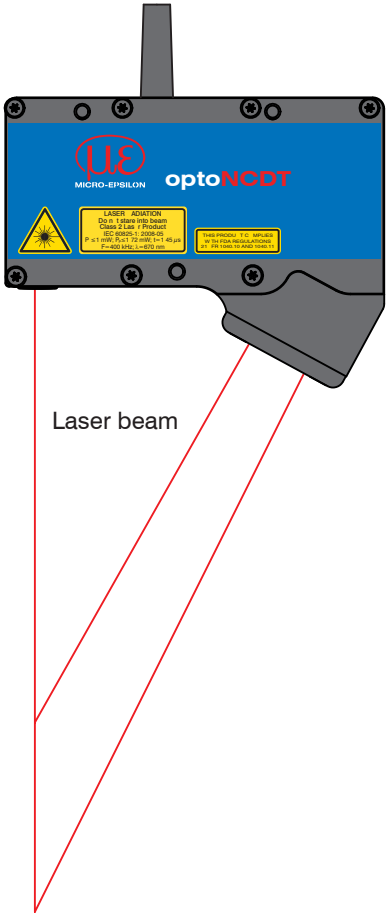


Fig. 4 True reproduction of the sensor optoNCDT 1630 with its actual location of the warning label

3. Functional Principle, Technical Data

3.1 Functional Principle

The optoNCDT1610/1630 consists of a laser-optical sensor and a controller. Das optoNCDT1610/1630 uses the principle of optical triangulation, that is, a visible, modulated point of light is projected onto the target surface.

The diffuse element of the reflection of the light spot is imaged by a receiver optical element onto a highsensivity resolution element (PSD). The controller outputs the signal of the PSD element via analog interface (current, voltage) as well as an Ethernet interface.

The complete sensor configuration is effected via a web interface.

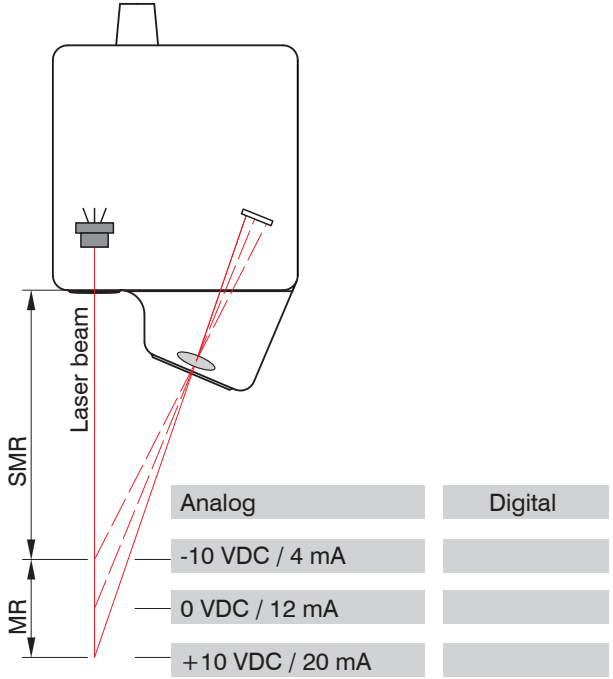


Fig. 5 Definition of terms, output signal

SMR = Start of measuring range | EMR = End of measuring range

3.2 Technical Data optoNCDT 1610

Type	optoNCDT 1610	0.5	2	4	10	20	50	100	200
Measuring range	mm (inches)	0.5 (0.02)	2 (0.08)	4 (0.16)	10 (0.39)	20 (0.89)	50 (1.97)	100 (3.93)	200 (7.87)
Start of measuring range (SMR)	mm (inches)	23.75 (0.94)	23 (0.91)	22 (0.87)	40 (1.57)	55 (2.17)	115 (4.5)	170 (6.69)	240 (9.45)
Linearity	± µm	1	4	8	20	40	100	200	400
Resolution [1]	20 Hz, µm	0.02	0.1	0.2	0.5	1	2.5	6	20
	10 kHz, µm	0.3	1.3	2.6	6.5	13	32.5	65	200
Light spot diameter	mm (inches)	0.1 (0)	0.2 (0.01)	0.3 (0.01)	0.6 (0.02)	0.9 (0.02)	1.5 (0.06)	1.5 (0.06)	2 (0.08)
Weight	g	250					480		
Light source		Laser, wave length 670 nm, red visible, class 2 acc. to DIN EN 60825-1: 2008-05							
Digital output [2]	Ethernet	TCP/IP; factory setting IP address 169.254.168.150; A/D sample rate 1 / 5 / 10 / 15 / 20 / 25 / 30 kHz							
Analog output [2]	Displacement signal	±10 V (optional 0 ... 10 V / 0 ... 5 V); 4 ... 20 mA							
	Output impedance	Approximately 0 Ohm (10 mA max.)							
	Angle error	At 30 ° of target tilt (axis A): about 0.5 % at white target							
	Limit frequency	DC ... 10 kHz							
	Temperature drift	0.02 % °C of measuring range							
	Light intensity	0 V to 10 V							

Type	optoNCDT 1610	0.5	2	4	10	20	50	100	200
Switching outputs with display	MIN	+24 V / 5 mA, when lower than MIN, LED yellow							
	OK	+24 V / 5 mA, when MIN exceeded and when lower than MAX, LED green							
	MAX	+24 V / 5 mA, when higher than MAX, LED orange							
	Error	+24 V / 5 mA, LED red							
	Reaction time	0.03 msec							
	Switching hysteresis	Approximately 0.5 % of measuring range							
Permissible ambient light		20.000 LUX							
Operating time		50.000 h for laser diode							
Insulation voltage		200 VDC, 0 V against housing							
Max. vibration		10 g up to 1 kHz (Sensor head, 20 g optional)							
Operating temperature		0 ° ... +50 °C (+32 ... +122 °F)							
Storage temperature		-20 ° ... +70 °C (-4 ... +158 °F)							
Humidity		Up to 90 % RH, no condensation							
Protection class		Sensor: IP 64, controller: IP 40							
Power supply		+24 VDC / 200 mA (10 – 30 V)							
Connector on the device		25-pin D connector							
Sensor cable length, standard		2 m							
Electromagnetic compatibility (EMC)		EN 61 000-6-2: 2005 (EN 50081-2) and EN 61 000-6-4: 2007 (EN 50082-2)							

1) Measurement on white target
2) The Standard version is delivered with analog output. The digital output (Ethernet) is available as option.

3.3 Technical Data optoNCDT 1630

Type	optoNCDT 1630	0.5	2	4	10	20	50	100	200
Measuring range	mm (inches)	0.5 (0.02)	2 (0.08)	4 (0.16)	10 (0.39)	20 (0.89)	50 (1.97)	100 (3.93)	200 (7.87)
Start of measuring range (SMR)	mm (inches)	23.75 (0.94)	23 (0.91)	22 (0.87)	40 (1.57)	55 (2.17)	115 (4.5)	170 (6.69)	240 (9.45)
Linearity	± µm	1.5	6	12	30	60	150	300	600
Resolution [1]	230 Hz, µm	0.05	0.2	0.4	1	2	7.5	15	50
	100 kHz, µm	0.8	3.5	7	17.5	35	50	100	330
Light spot diameter	mm	0.1	0.2	0.3	0.6	0.9	1.5	1.5	2
Weight	g	250					480		
Light source		Laser, wave length 670 nm, red visible, class 2 acc. to DIN EN 60825-1:2008-05							
Digital output [2]	Ethernet	TCP/IP; factory setting IP address 169.254.168.150 A/D sample rate 1 / 5 / 10 / 15 / 20 / 25 / 30 kHz							
Analog output [2]	Displacement signal	±10 V (optional 0 ... 10 V / 0 ... 5 V); 4 ... 20 mA							
	Output impedance	Approximately 0 Ohm (10 mA max.)							
	Angle error	At 30 ° of target tilt (axis A): about 0.5 % at white target							
	Limit frequency	DC ... 100 kHz							
	Temperature drift	0.02 % °C of measuring range							
	Light intensity	0 V bis 10 V							

Type	optoNCDT 1630	0.5	2	4	10	20	50	100	200
Switching outputs with display	MIN	+24 V / 5 mA, when lower than MIN, LED yellow							
	OK	+24 V / 5 mA, when MIN exceeded and when lower than MAX, LED green							
	MAX	+24 V / 5 mA, when higher than MAX, LED orange							
	Error	+24 V / 5 mA, LED red							
	Reaction time	0.03 msec							
	Switching hysteresis	Approximately 0.5 % of measuring range							
Permissible ambient light		20.000 LUX							
Operation time		50.000 h for laser diode							
Insulation voltage		200 VDC, 0 V against housing							
Max. vibration		10 g up to 1 kHz (sensor head, 20 g optional)							
Operating temperature		0 ° ... +50 °C (+32 ... +122 °F)							
Storage temperature		-20 ° ... +70 °C (-4 ... +158 °F)							
Humidity		Up to 90 % RH, no condensation							
Protection class		Sensor: IP 64, controller: IP 40							
Power supply		+24 VDC / 200 mA (10 – 30 V)							
Connector on the device		25-pin D connector							
Sensor cable length, standard		2 m							
Electromagnetic compatibility (EMC)		EN 61 000-6-2: 2005 (EN 50081-2) and EN 61 000-6-4: 2007 (EN 50082-2)							

1) Measurement on white target
2) The Standard version is delivered with analog output. The digital output (Ethernet) is available as option.

3.4 Front View Controller, LED

Fig. 6 Controller and functionality of the LEDs - standard version

Fig. 7 Controller and functionality of the LEDs - Ethernet version [1]

	Error		MIN		OK		MAX		10/100	Link	Power	
	off	red	off	orange	off	green	off	orange	yellow	yellow	yellow	green
Controller in operation, target within range			○			●	○					●
Controller in operation, target out of range		●			○							●
Ethernet connection available [1]										●		●
Ethernet Link activity [1]									☼			●
FPGA self test OK	○											●
Limit fallen below / exceeded				●				●				●
No power supply											○	
Power supply available												●

LED legend

○ off

☼ flashes

● on

2) The Standard version is delivered with analog output. The digital output (Ethernet) is available as option.

4. Delivery

4.1 Unpacking

1 Sensor LD1610-x / LD1630-x; Standard version with analog output [1]

1 Controller

1 Instruction manual

1 Test log

➪ Check for completeness and shipping damage immediately after unpacking. In case of damage or missing parts, please contact the manufacturer or supplier.

4.2 Storage

Storage temperature:	-20 ... +70 °C (-4 ... +158 °F)
Humidity:	Up to 90 % RH, no condensation

1) The Standard version is delivered with analog output. The digital output (Ethernet) is available as option.

5. Installation and Assembly

5.1 Sensor

The optoNCDT 1610/1630 sensor is an optical system for measurements with micrometer accuracy.

Make sure it is handled carefully when installing and operating.

- Mount the sensor with 2 M4 screws.
- Install the sensor so that the laser beam is perpendicular to the target surface. Otherwise measurement uncertainties can not be excluded, see Chap. 8.3

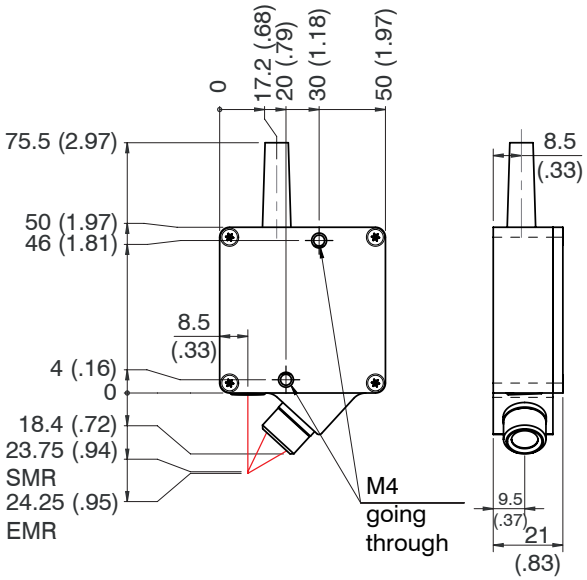


Fig. 8 Dimensional drawing LD1610-0.5 / LD1630-0.5

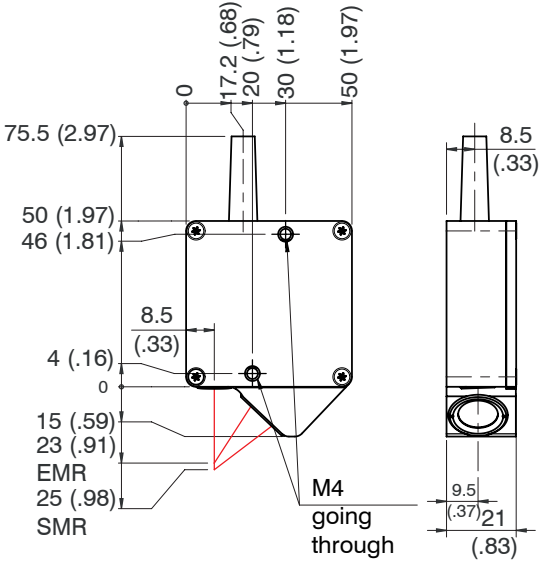
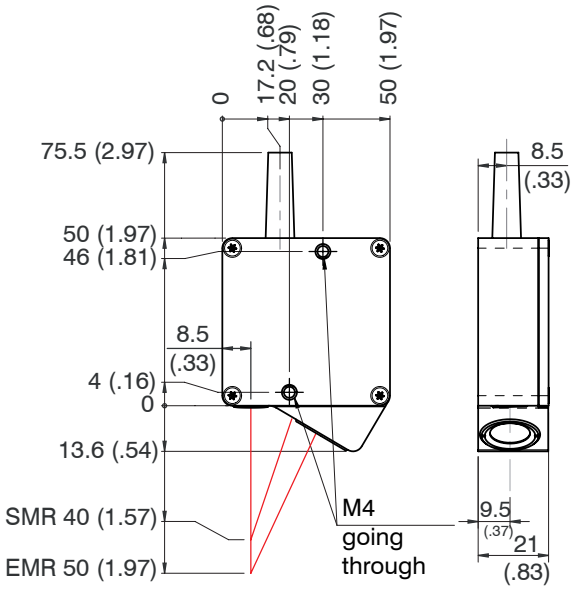


Fig. 9 Dimensional drawing LD1610-2 and LD1610-4 / LD1630-2 and LD1630-4

Dimensions in mm (inches), not to scale



Dimensions in mm
(inches), not to scale

Fig. 10 Dimensional drawing LD1610-10 / LD1630-10

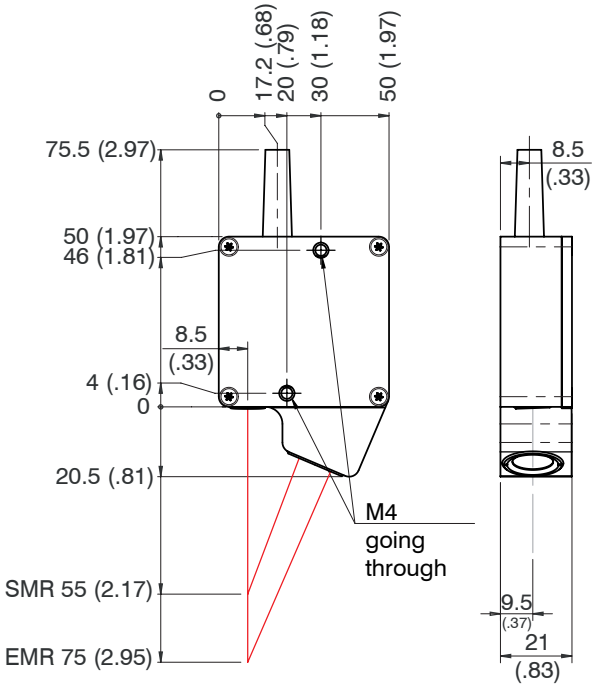
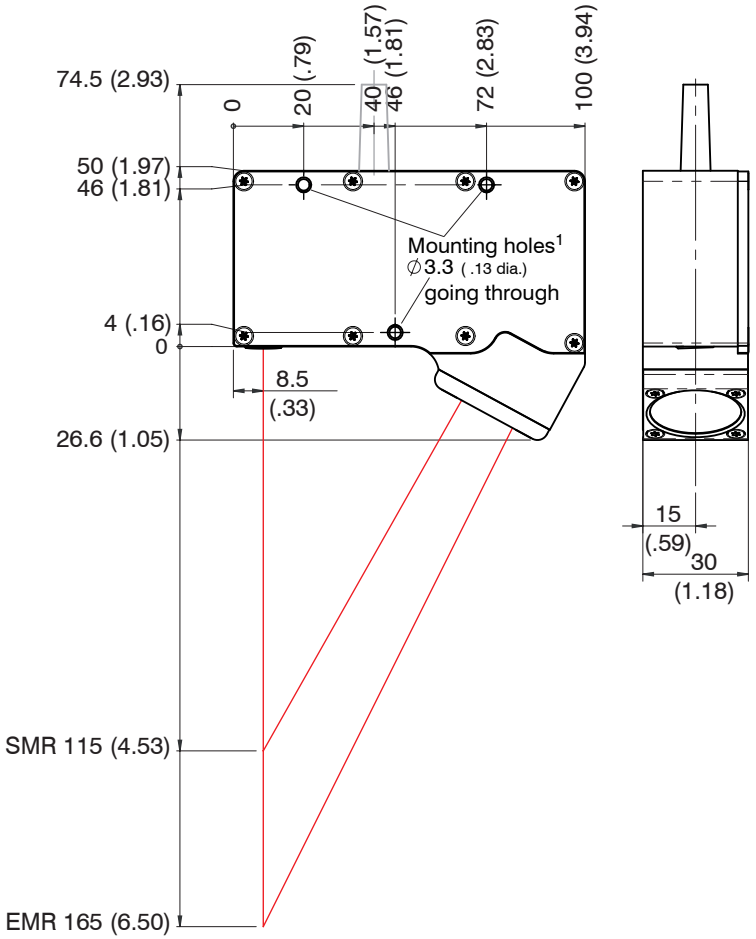


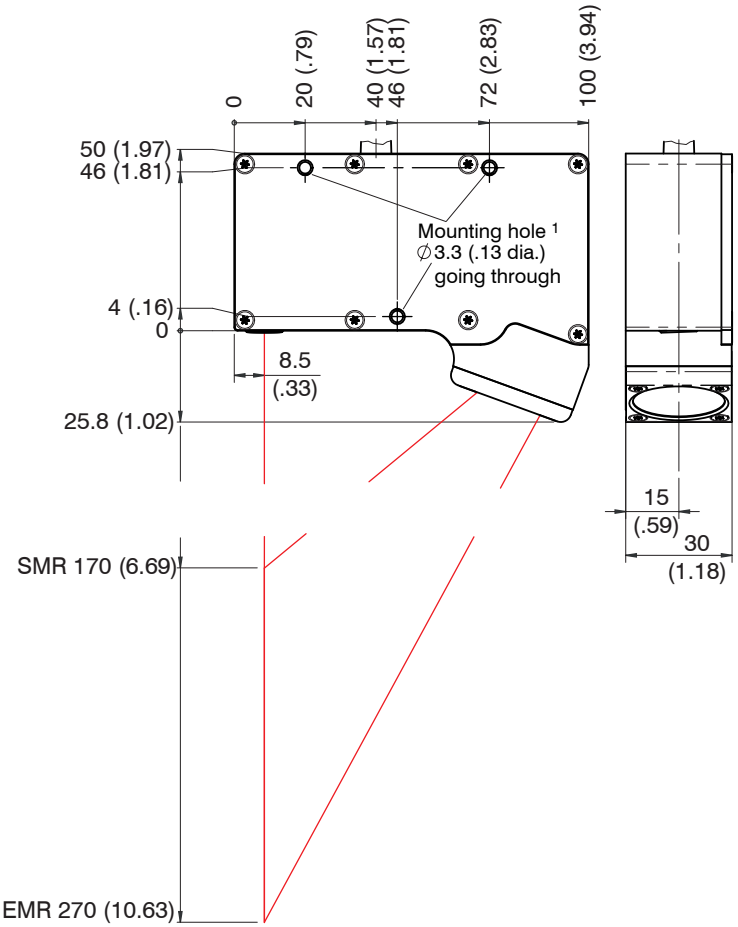
Fig. 11 Dimensional drawing LD1610-20 / LD1630-20

1) Both ends with M4 thread about 8 mm deep



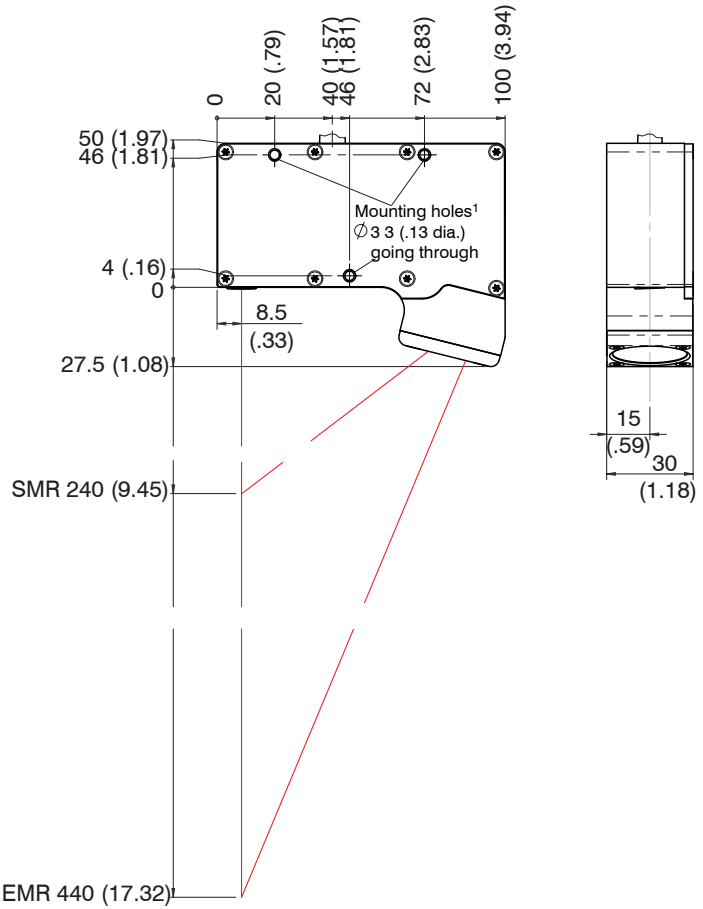
Dimensions in mm (inches), not to scale

Fig. 12 Dimensional drawing LD1610-50 / LD1630-50



Dimensions in mm
(inches), not to scale

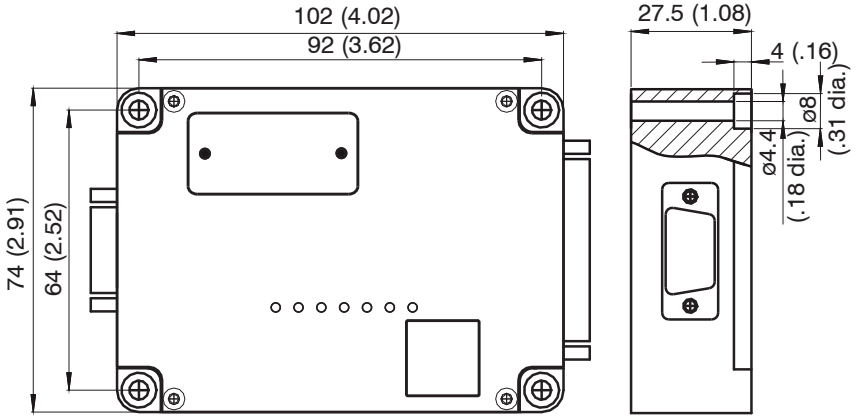
Fig. 13 Dimensional drawing
LD1610-100 / LD1630-100



Dimensions in mm
(inches), not to scale

Fig. 14 Dimensional drawing
LD1610-200 / LD1630-200

5.2 Controller



Dimensions in mm
(inches), not to scale

Fig. 15 Dimensional drawing controller

5.3 Sensor Cable

➡ Never bend the sensor cable under the bending radius.

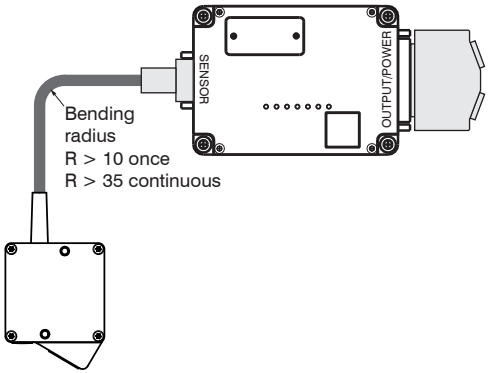
The sensor comes with a permanently mounted connection cable of 2 m in length.

➡ Do not shorten or modify the sensor cable.

This leads to a failure of measuring device and/or loss of the specified technical data.

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.

➡ Connect the sensor cable to the controller.

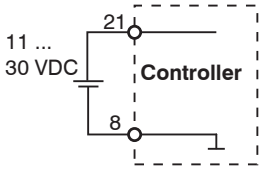


5.4 Power Supply

Nominal value: 24 V DC (12 ... 30 V, max. 240 mA).

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

➡ Connect the inputs “21“ and “8“ on the sensor with a 24 V power supply.



Controller pin	Power supply
21	$+U_B$
8	Ground

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. 16 Connection power supply

5.5 Inputs and Outputs

25-pin. SUB-D	Assignment
1	Displacement signal ±10 VDC
2	Error output, +24 VDC / 5 mA
5	OK, +24 VDC / 5 mA
6	Displacement signal 4 ... 20 mA
8	Power supply GND
14	Analog GND
16	MAX, +24 VDC / 5 mA
19	MIN, +24 VDC / 5 mA
20	Intensity 0 ... 10 VDC
21	+24 VDC power supply

i The Standard version is delivered with analog output. The digital output (Ethernet) is available as option.

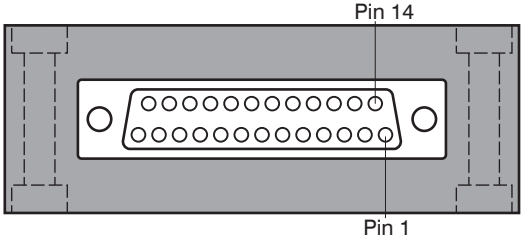


Fig. 17 25-pin power supply and output connector, view on solder pin side

5.6 Ethernet

The Standard version is delivered with analog output. The digital output (Ethernet) is available as option.

For connecting the controller via the Ethernet interface, the internet protocol TCP/IP is used. This requires generally a PC with a web browser such as Mozilla Firefox and a free Ethernet interface or a network connection.

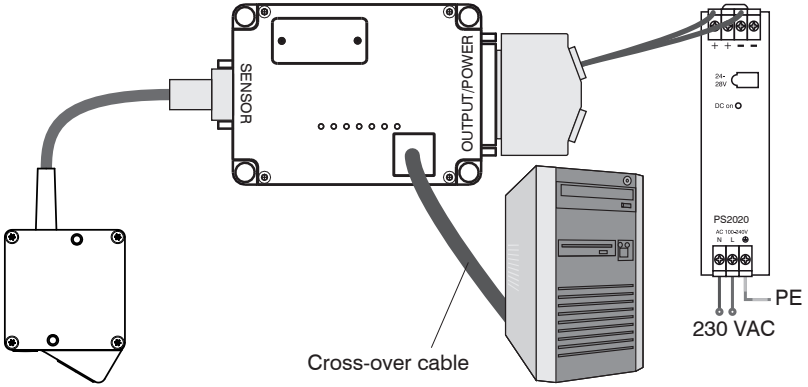


Fig. 18 Measurement setup with Ethernet direct connection

Controller 1	LAN cable (CAT-5e), max. 200 m	Switch	LAN cable (CAT-5e), max. 200 m	100 MBit-network card (for sensors only)	PC
...	...				
Controller 90	LAN cable (CAT-5e), max. 200 m				

Controller 1	Cross-over cable (CAT-5e) max. 200 m	100 MBit-network card	PC

Fig. 19 Connection options via Switch or direct connection

6. Operation

6.1 Getting Ready for Operation

➡ Install and assemble the optoNCDT1610/1630 in accordance with the instructions set out, see Chap. 5.

Once the operating voltage has been switched on the controller runs through an initialization sequence. This is indicated by the momentary activation of all the LEDs.

To be able to produce reproducible measurements the sensor typically requires a start-up time of 10 minutes.

Once this has elapsed the sensor will be in measurement mode and the “POWER“ and “OK“ LEDs on controller are illuminated.

6.2 Linearization

The Sensor element (PSD) does not provide an output voltage, linear to the distance. Therefore, in the controller a linearization is on. The linearization considers different reflecting factors of the surface and provides an output voltage proportional to the measuring distance.

6.3 Reaction Time and Frequency Response

The rise time of the analog output is very fast. It is about 50 microseconds with an increase to 90 % of the final value. The rise time/ integration time can be increased by DIP switches in the controller, whereby the noise is reduced and the measurement accuracy is increased.

6.4 Noise

The system has a different noise depending on the reflectance of the target. The noise is reduced with good stray light reflection (matt white). The noise limits the resolution of the sensor. The noise is reduced substantially by extending the filter setting, see Chap. 6.5.

6.5 Limit Frequency Analog Output

The limit frequency of the lowpass filter is set via a DIP switch in the controller. The potentiometer may not be changed. The internal sampling rate of the sensor is not changed by the DIP switch settings. These filter frequencies correspond to the -3 dB band width of the lowpass filter. Higher frequencies and noise are damped increasingly.

	Frequency	10	7	4	1	0.25	0.1	0.025	0.02
LD1610	SW1	-	ON	-	-	-	-	-	ON
	SW2	-	-	ON	ON	-	-	-	ON
	SW3	-	-	-	ON	-	-	ON	ON
	SW4	-	-	-	-	ON	-	ON	ON
	SW5	-	-	-	-	-	ON	-	ON
	SW6	-	-	-	-	-	-	ON	ON

Fig. 20 Selection of integration time for the sensor LD1610

	Frequency [kHz]	100	70	40	10	2.5	1	0.25	0.23
LD1630	SW1	-	ON	ON	-	-	-	-	ON
	SW2	-	-	ON	ON	-	-	-	ON
	SW3	-	-	-	ON	-	-	-	ON
	SW4	-	-	-	-	ON	-	-	ON
	SW5	-	-	-	-	-	ON	ON	ON
	SW6	-	-	-	-	-	-	ON	ON

Fig. 21 Selection of integration time for the sensor LD1630

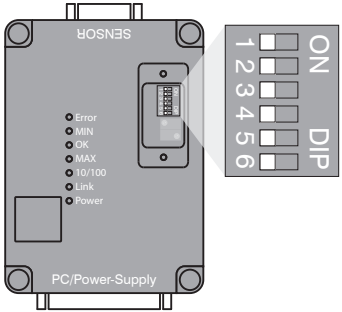


Fig. 22 Assembly of the DIP switches in controller

6.6 Repeatability

Unlike mechanical measuring systems, the optical displacement sensor does not exhibit any hysteresis or inconsistent repeat accuracies. Accuracy is limited by noise and surface condition. Observe the accuracy and temperature frequency of the mechanical conditions when using for measurements in the µm range. With mechanically processed parts (lathing, milling, grinding), the formation of mini prisms and mirroring on the grooved surface structure can distort results. The sensor always should be used with its lens axis pointing in the direction of the grind marks.

6.7 Analog Output

The distance signal is shown as the voltage [expressed in V] proportional to the distance [mm]. The zero point or reference distance is in the middle of the measuring range. Targets farther away yield a positive voltage (up to +10 V), while closer targets yield a negative voltage.

The “Light intensity“ analog output supplies additional information on the intensity of the reflected light. Voltage ranges from 0 to 10 V. The sensor provides a voltage of about 6 ... 8 V for a matte white target.

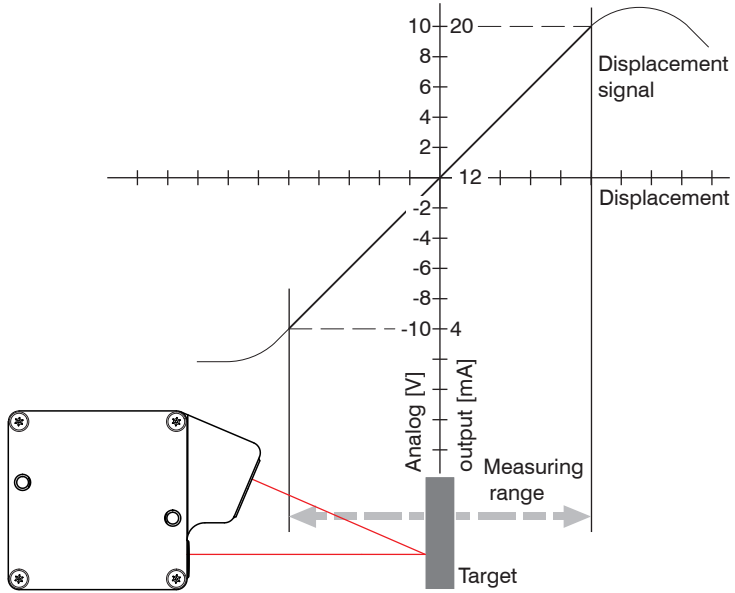


Fig. 23 Output characteristic displacement signal

6.8 Thresholds Minimum, Maximum

The optoNCDT series 1610/1630 has two switching levels in the controller that can be adjusted for minimum and maximum threshold values. The thresholds can be adjusted over the entire measuring range via the web interface, see Chap. 6.10.2. Each threshold with a small hysteresis, approximately 0.4 % from the measuring range in order to avoid vibration of the output with slow transitions. When the minimum is undershot, the MIN output activates. When the maximum is overshot, the MAX output activates.

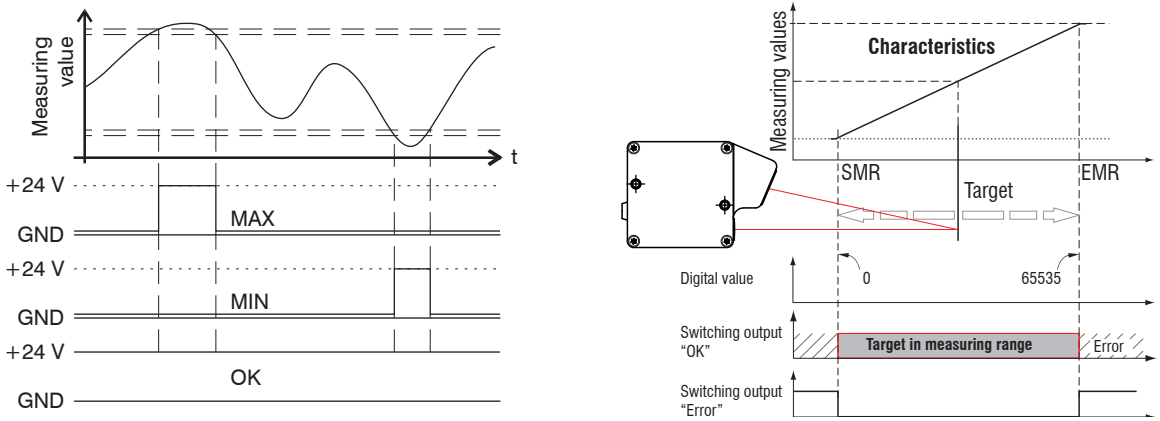


Fig. 24 Signal sequence of the thresholds

It should be noted that the switching levels are only unique within the measuring range. If the object is much closer or farther away than the permitted measuring range, ambiguities can occur. In order to simplify initial application, the limit values are set at the factory to the correct limits of the application range:

The digital output OK is assigned to pin 5 of the 25-pin SUB-D connector.

Electrical characteristics

- Output active: +24 VDC / 5 mA max.
- Output passive: near 0 V

6.9 Test Log

Each system comes with a test log, which shows the individual measuring error of the system graphically and clearly larger. The diagram shows the relative error on matte white surface.

The absolute error is output as a table.

6.10 Operation via Ethernet

6.10.1 Preconditions

You need a web browser (for example Mozilla Firefox or Internet Explorer) on a PC with a network connection. The sensor operates with a static IP address.

➡ Connect the controller to a PC or Switch via a direct Ethernet connection (LAN), see Chap. 5.6.

The sensors are supplied with the following default settings:

- IP address 169.254.168.150 [1]
- Subnet mask 255.255.0.0

➡ Start the web browser and type the IP address in the address bar of your web browser.

6.10.2 Access via Ethernet

Once the sensor is provided with an IP address, which is valid for your environment, you can connect the system with a web browser, see Chap. 6.10.1.

An interactive website for programming the controller now appears in the web browser.

All settings in the website will be immediately executed in the controller after input of the SENSOR password and pressing the Send button.

1) Requires that the LAN connection on the PC uses, for example, the following IP address: 169.254.168.1.

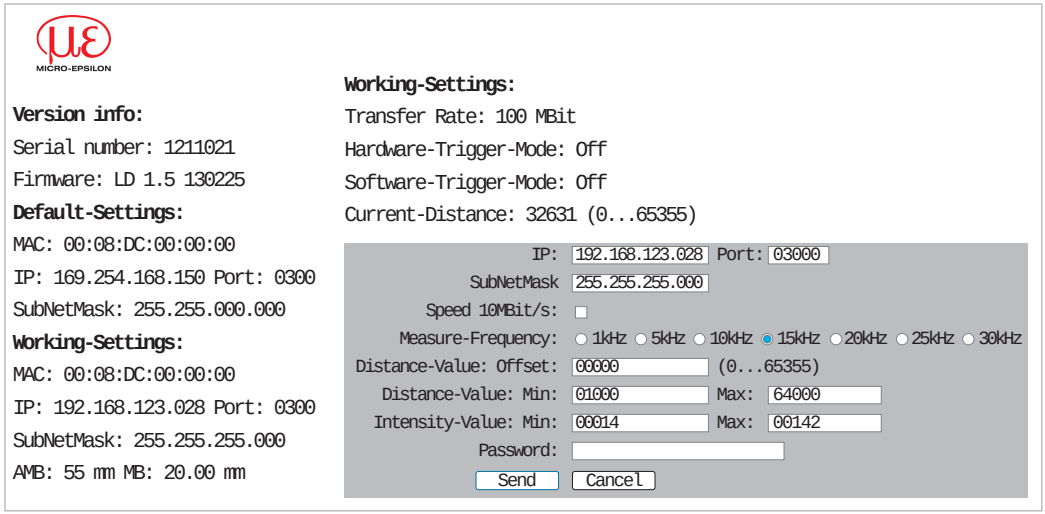


Fig. 25 Interactive website after selection of the IP address

The threshold values for the switching outputs MIN respectively MAX are defined with the parameters Distance-Value Min and Distance-Value Max, see Chap. 6.8.

6.10.3 Address Allocation with Web Browser

With the default IP address the user communicates with a controller, for example, for adjusting the IP address on the requirements of the target system. A network conflict in a system with more controllers occurs, if more than one controller uses the default address.

DHCP is not supported, permanently assigned IP addresses for the controller and the network card in PC must be used. The network card must be in the same logical segment as the controller, that means, the network address may only differ in the last three positions.

Network user must not only use the same addresses!

Changing the controller address:

- Connect the controller to the Switch/PC.
- Start the web browser and type the IP address in the address bar of your web browser.
- Type the new IP address / Subnet mask for the controller in the IP respectively SubNetMask field.
- Type the SENSOR password in the Password field and click the Send button.

Repeat the steps for any other controller.

7. Measuring Value Output

7.1 Current Output

Max. output range 4 mA ... 20 mA

Output amplification ΔI OUT 16 mA = 100 % measuring range

Calculation of a measuring value x in mm from analog current, reference value start of measuring range:

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

Example: Measuring range MR = 20 mm, I_{OUT} = 12 mA; result: x = 10 mm

7.2 Voltage Output

Max. output range -10 V ... +10 V

Output amplification ΔU OUT 20 V = 100 % measuring range

Calculation of a measuring value x in mm from analog voltage, reference value start of measuring range:

$$x\ [mm] = (U_{OUT} + 10\ V) * \frac{MR\ [mm]}{20\ [V]}$$

Example: Measuring range MR = 20 mm, U_{OUT} = 0 V; result: x = 10 mm

7.3 Digital Output

The data word of a displacement measuring value (AD values) of AD amplifier is output as 16 Bit unsigned Integer, see Chap. 9.3.

Max. output range 0 ... 65535

The displacement measuring value is set with following formula:

$$\text{Displacement measuring value} = \frac{\text{AD Value} * \text{Measuring range [mm]}}{65535}$$

8. Instructions for Operation

8.1 Change Reflection Factor

The controller have an automatic intensity control to adapt to well or poorly reflective targets. In case of changing the surface reflection during the measurement process it is automatically readjusted.

8.2 Surface-dependent Measurement Errors

8.2.1 Impairment due to Material and Color

Measurement objects are made from all possible materials, including metal, plastic, ceramic, rubber, paper, etc. Only in the case of highly reflective surfaces or liquids the application (use of the instrument) must be individually checked (tested). Measurement cannot be done on transparent objects such as glass or highly reflective surfaces.

8.2.2 Surface Reflection

The sensor requires a minimal surface reflection of 10 % for fault-free operation. Only diffuse reflection can be used for measurements.

8.2.3 Scratch within the Measurement Spot

A scratch on the target whose direction is transverse to the lens axis (transmission lens, receiving lens) can cause very strong light emissions, whereby the intensity of the emissions is highest next to the center of the light spot. This simulates a change in distance.

Substantially higher degrees of measuring accuracy can be achieved with this effect than with pure distance measurement when testing surfaces for scratches.

If it is a moving object that is in question, the mean (integral) reading remains constant while scanning the scratch area, i.e. the positive and negative flanks (caused by the scratch) cancel each other out.

8.2.4 Lateral Scattered Light

If there are highly reflective targets in the lateral scattered range of the measurement point that reflect this light directly back to the receiver, measurement errors can result. Homogeneous scattered targets with the same reflection do not cause this error. If the reflective area is outside of the measurement point, the error rate will be no higher than 2 %.

8.2.5 Penetration of the Beam into the Target

With semi-transparent plastics or cloudy liquids, the measuring beam penetrates a certain amount into the medium before the diffusely reflected light is sent back. Here, the true measurement plane is expanded to include the penetration depth. In isolated cases, this can only be determined by experimentation.

8.2.6 Light/Dark Change within the Measurement Point

If a displacement measurement is taken at an area that transitions from a diffusely reflecting material to a reflecting material (which translates into a severely changing reflection factor), measurement errors can result in this transition area. The maximum light intensity is here (due to the surface), not in the center of the measurement point. If the transition border line is in the direction of lens axis A (sensor longitudinal axis), error is minimal; error is greatest in axis B, siehe Fig. 27.

8.2.7 Change in Surface Reflection during Measurement

The optical sensor has an automatic light intensity regulation mechanism in order to adapt to highly reflective and semi-reflective media. If the surface emission changes during the measuring process, the sensor automatically adapts.

8.2.8 Sensor Orientation with Moving or Lined Targets

If moving or lined objects are to be measured, the sensor should be mounted with its long side transverse to the direction of motion and parallel to the lines. This allows better measurement results in edge areas.

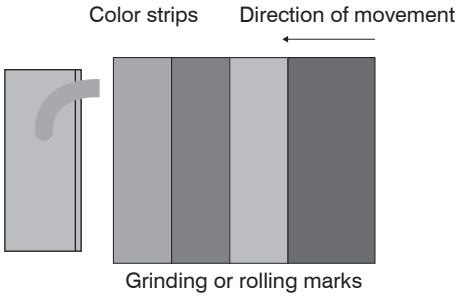


Fig. 26 Sensor arrangement in case of ground or striped surfaces

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, see Fig. 27.

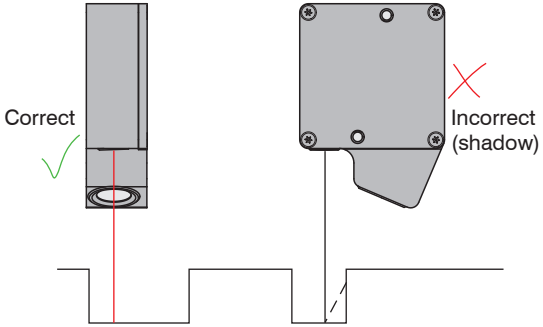


Fig. 27 Sensor arrangement for holes and ridges

8.3 Angle Dependency of Measurements

Measurement is slightly angle-dependent if the sensor is not perpendicular directed towards the object surface. The angle dependency for matt surfaces with a high degree of diffuse reflection is minimal. Angle dependency is less when tilted around the A axis of rotation than when tilted around axis B. The angle of rotation of the object around axis A can reach 30 ° without causing any significant measurement error, whereas only 15 ° is possible around axis B. Measurement error is present when the relationship between output voltage and distance changes. If the angle is constant, the influence can be eliminated by recalibrating.

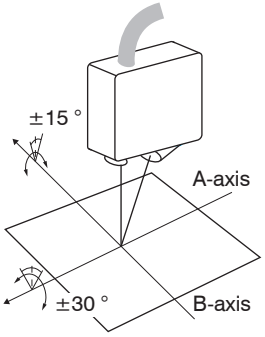


Fig. 28 Max. tilt of the target, definition of axis/orientation

8.4 Possible Interferences

8.4.1 Optical Interferences

- Do not let welding flashes cross the sensor when arc welding.
- Sunlight cast on the measurement object impairs measurement, resulting in minimal deviation error.
- Sunlight cast directly on the sensor can considerably reduce its accuracy.
- Light from tubular fluorescent lamps or incandescent lamps does not have a negative effect.

8.4.2 Electrical Interferences

- Power cables with high interference voltage running parallel to the sensor feed.
- Heavy interference on the 24 V supply line, e.g. half-wave rectification without charging capacitor.

9. Ethernet Interface

9.1 General

The controller automatically sends data in TCP/IP packages, if the power supply is switched on.

Besides, the TCP/IP protocol automatically looks after the fact that all data blocks come completely in the receiving PC.

9.2 Sensor Control

Register		Byte	Function register	Comment, value
HEX	DEZ			
0x1F	31	0	Software Reset *	The Ethernet module is restarted.
0x22	34	0	IP address, Port Network settings	M
		1		E
		2		L
		3		S
		4		E
		5		N
		6		S
		7		O
		8		R
		9		IP0(192)
		10		IP1(168)
		11		IP2(123)
		12		IP3(245)
		13		PORT-HI
		14		PORT-LO
		15		SPEED(10/100)
0x26	38	0	Max threshold setting	Max-High
		1		Max-Low
0x27	39	0	Min threshold setting	Min-High
		1		Min-Low

9.3 Header Data Format

LD1610 / LD1630	Byte no.	Length	Parameter / value	Data type
Protocol version	0	2	0x2302	unsigned int
Package size	2	2	Total length = 860 bytes	unsigned int
Serial number MJ	4	2	Four digits: Month, month + year, year e.g. 0311	unsigned int
Serial number Cnt	6	2	Production number; three digits; 001, 002, 003 …999	unsigned int
Switch-on counter	8	4	hh:mm:ss	unsigned long
Reserved	12	20		unsigned char
Data package number	32	2	Serial number; natural number, 0,1,2,3 ….999	unsigned int
Ethernet speed	34	1	1 10/100-MBit/s	unsigned char
Reserved 1	35	3		unsigned char
SMR	38	2	Start of measuring range	unsigned int
MR	40	2	Measuring range	unsigned int
MaxValue	42	2	Value set in the web browser	unsigned int
MinValue	44	2	Value set in the web browser	unsigned int
MaxIntensity	46	1	142	unsigned char
MinIntensity	47	1	14	unsigned char
TriggerStatus	48	2	Bit 0 = Min status; bit 1 = Max status	unsigned int
Reserved 2	50	2		unsigned int
ADZMaxValue	52	2	0xFFFF	unsigned int
ADI MaxValue	54	2	0xFF	unsigned int
AD Frequency	56	2	30000	unsigned int
AD ValuesMax	58	2	200	unsigned int
AD Values	60	400	2x200 values per 16 bit distance	unsigned int
ADI Values	460	200	1x200 values per 16 bit light intensity	unsigned char
ADLValues	660	200	1x200 values per 16 bit adjustment value	unsigned char
Total length		860		

10. Warranty

All components of the device have been checked and tested for perfect function in the factory. In the unlikely event that errors should occur despite our thorough quality control, this should be reported immediately to MICRO-EPSILON.

The warranty period lasts 12 months following the day of shipment. Defective parts, except wear parts, will be repaired or replaced free of charge within this period if you return the device free of cost to MICRO-EPSILON. This warranty does not apply to damage resulting from abuse of the equipment and devices, from forceful handling or installation of the devices or from repair or modifications performed by third parties.

No other claims, except as warranted, are accepted. The terms of the purchasing contract apply in full. MICRO-EPSILON will specifically not be responsible for eventual consequential damages. MICRO-EPSILON always strives to supply the customers with the finest and most advanced equipment. Development and refinement is therefore performed continuously and the right to design changes without prior notice is accordingly reserved. For translations in other languages, the data and statements in the German language operation manual are to be taken as authoritative.

11. Service, Repair

In the event of a defect on the controller, sensor or sensor cable please send us the effected parts for repair or exchange. In the case of faults the cause of which is not clearly identifiable, the whole measuring system must sent back to

MICRO-EPSILON
MESSTECHNIK GmbH & Co. KG
Königbacher Strasse 15
94496 Ortenburg / Germany
Tel. +49 (0) 8542 / 168-0
Fax +49 (0) 8542 / 168-90

info@micro-epsilon.de
www.micro-epsilon.com

12. Decommissioning, Disposal

➡ Disconnect the power supply and output cable on the sensor.

The optoNCDT1610/1630 is produced according to the directive 2011/65/EU (“RoHS“). The disposal is done according to the legal regulations (see directive 2002/96/EC).

Appendix

A 1 Pin Assignment PC1605-x

25-pin. SUB-D	Assignment	Color PC1605	
1	Displacement signal ±10 VDC	green	
14	Analog GND	blue, shield	
20	Intensity 0 ... 10 VDC	red	
2	Error output, +24 VDC / 5 mA	gray	
6	Displacement signal 4 ... 20 mA	yellow	
8	Power supply GND	brown	
21	+24 VDC power supply	green	
	Cable shield	black	

Inner cable area

Outer cable area

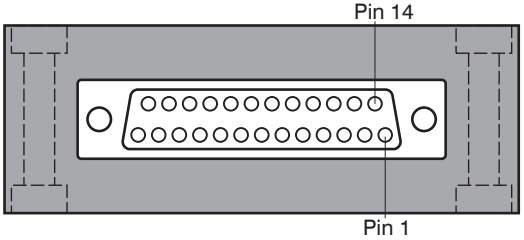


Fig. 29 25-pin power supply and output male cable connector, view on solder pin side

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

X9751295-A041025HDR