



Operating Instructions  
**optoCONTROL 2520**

optoCONTROL 2520-46  
optoCONTROL 2520-46(090)  
optoCONTROL 2520-95  
optoCONTROL 2520-95(270)

Laser micrometer

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## 1. Safety

System operation assumes knowledge of the operating instructions.

### 1.1 Symbols Used

The following symbols are used in these 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 button/menu.

### 1.2 Warnings



Connect the power supply and the display / output device according to the safety regulations for electrical equipment.

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



Avoid shocks and impacts to the light source and the receiver.

- > Damage to or destruction of the light source / receiver

Protect the cables against damage.

- > Failure of the measuring device

The supply voltage must not exceed the specified limits.

- > Damage to or destruction of the sensor

Avoid damage (scratches) to the protective windows of the light source and receiver through unsuitable cleaning-methods or cleaning solvents.

- > Inaccurate, erroneous measuring values

Do not touch the protective windows of light source and receiver with the fingers. Wipe off any fingerprints immediately.

- > Inaccurate, erroneous measuring values

Avoid permanent action of splashed water on the light source and the receiver.

- > Damage to or destruction of the sensor

Avoid exposure to aggressive materials (washing agent, cooling emulsions).

- > Damage to or destruction of the sensor

### 1.3 Notes on CE Marking

The following apply to the optoCONTROL 2520:

- 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 relevant applicable harmonized European standards (EN) listed therein. The measuring system is designed for use in industrial environments.

The EU Declaration of Conformity is available to the responsible authorities according to EU Directive, article 10.

## 1.4 Intended Use

- The optoCONTROL 2520 is designed for use in the industrial and laboratory areas. It is used for
  - measuring displacement, distance, position and thickness
  - in-process quality and dimensional testing
- The system must only be operated within the limits specified in the technical data, [see 3.6](#), [see 3.7](#).
- The system 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 system.
- Take additional precautions for safety and damage prevention in case of for safety-related applications.

## 1.5 Proper Environment

- Protection class: IP64; when plugged in or on the Ethernet socket with protective cap <sup>1</sup>
- The protection class is limited to water (no penetrating liquids, detergents or similar aggressive media).  
Use a protective housing if the effects of water are continuous.

Optical windows are excluded from protection class. Contamination leads to impairment or failure of the function.

- Temperature range:
  - Operation: 0 ... +50 °C (+32 ... +122 °F)
  - Storage: -20 ... +70 °C (-4 ... +158 °F)
- Humidity: 5 - 95 % RH (non-condensing)
- Ambient pressure: Atmospheric pressure

1) For operation without Ethernet / EtherCAT cable, the protective cap for the M12 connector must be plugged to achieve the IP degree of protection!

## 2. Laser Safety

The optoCONTROL operates with a semiconductor laser with a wavelength of 670 nm (visible / red). The maximum optical output power is 2 mW.

The sensors fall within laser class 1M.

The accessible radiation is harmless under predictable conditions.

Do not view the radiation with optical instruments (e.g., converging lenses, magnifying glasses).

For class 1 laser devices, impairment of color vision and disturbances, e.g., from a glare effect, cannot be excluded.

Consequently, you can use Class 1M laser equipment without further protective measures.

Lasers of Class 1M 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 attached. For other non German speaking countries, an IEC standard label is included in delivery and the versions valid for the user's country must be attached before the device is put into operation for the first time.



Fig. 1 Laser warning sign and laser label

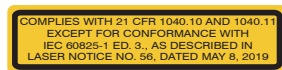


Fig. 2 Only for USA

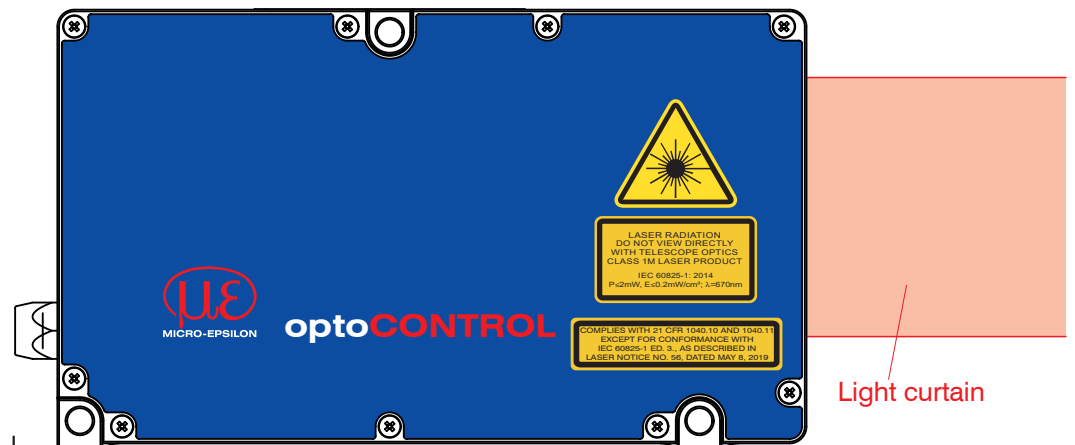


Fig. 3 Sensor with laser labels

The housing of the optical sensors may only be opened by the manufacturer, see 12.

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



*Fig. 4 True reproduction of the light source optoCONTROL 2520-95 with its actual location of the warning label.*

- 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

optoCONTROL 2520 is a laser-based sensor with an integral high resolution line scan camera for the measurement of geometrical quantities such as gap, edge position and diameter. By the high measuring rate and exactness measurements are also possible in quick processes.

The optoCONTROL 2520 sensor consists of a light source and a receiver, which are connected about a three-pole connection cable with each other. The receiver contains also the whole controller.

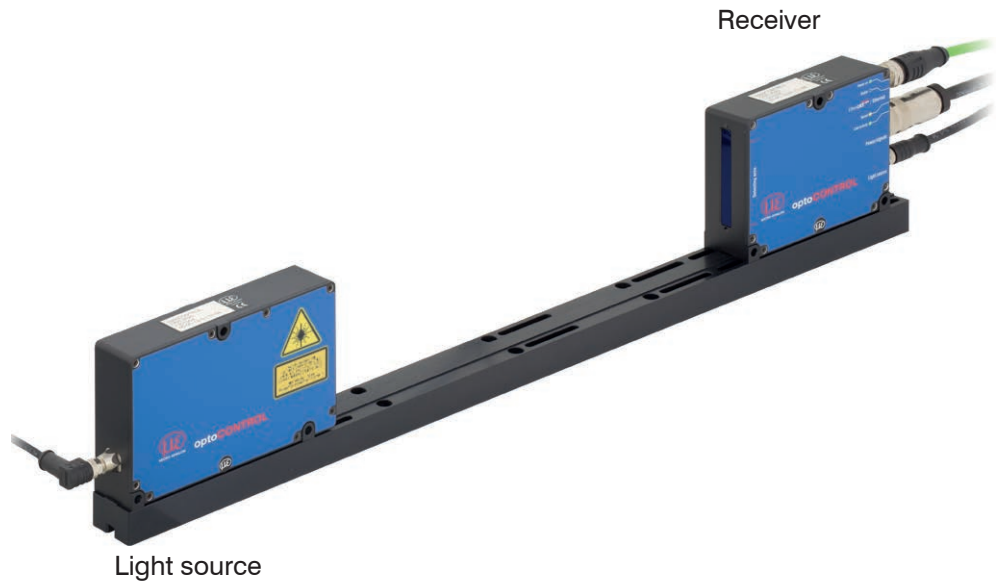


Fig. 5 Sensor optoCONTROL 2520-46

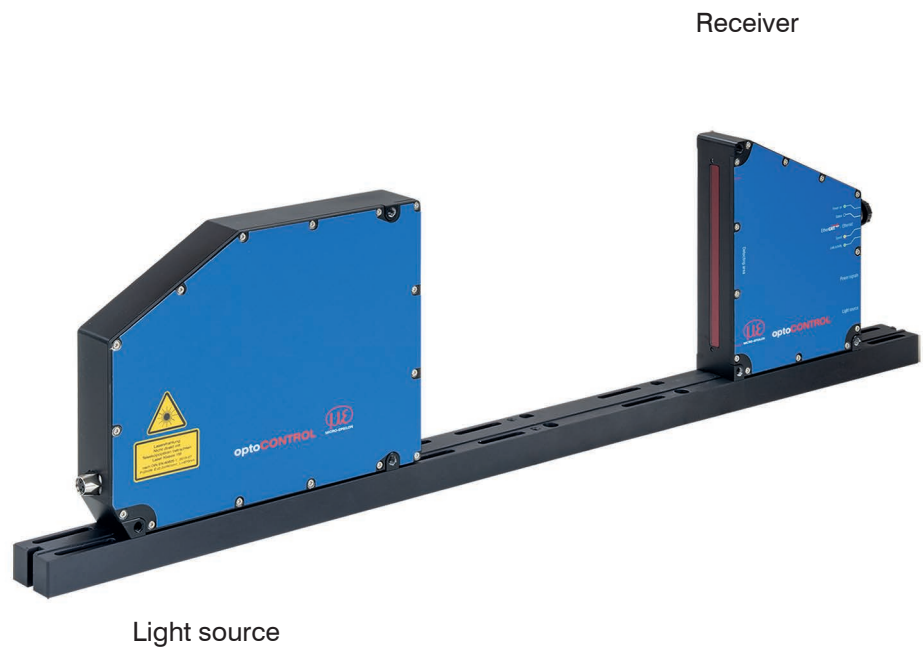


Fig. 6 Sensor optoCONTROL 2520-95

### 3.2 Measurement Principle

The optoCONTROL 2520 measures the dimension of a target or the position of an edge on a body according to the shadow principle and without making physical contact.

A parallel light curtain is produced with the laser light source, which sends a very homogeneous light by the high-quality illumination optics. The laser light source disposes of no moved parts, so that the sensor works nearly non-expendable.

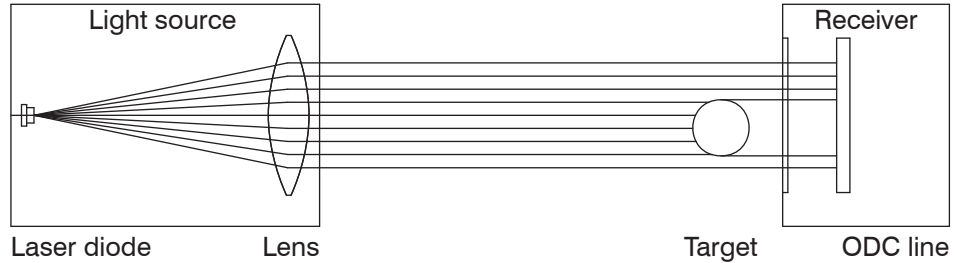


Fig. 7 Measurement principle optoCONTROL 2520

The ODC line in the receiver reproduces the shadow principle of the target with high accuracy.

### 3.3 Block Diagram

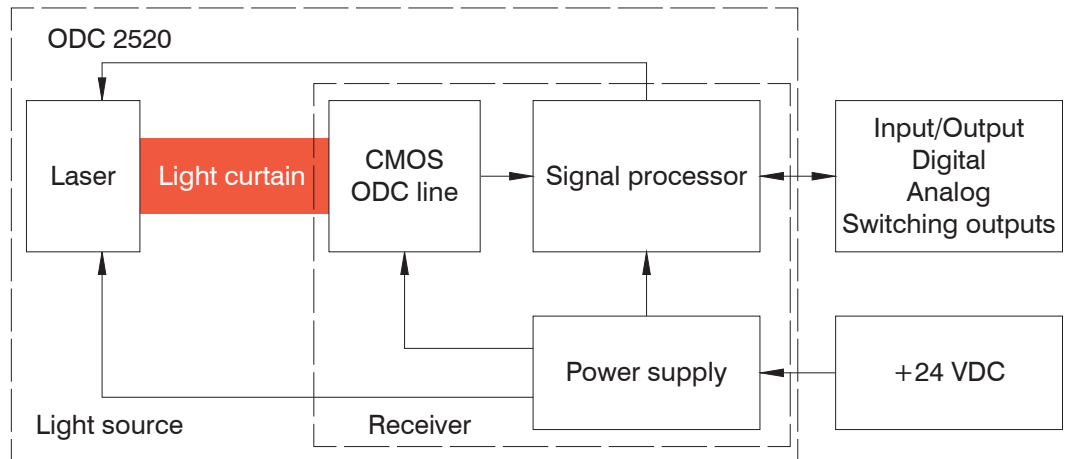


Fig. 8 Block diagram sensor ODC 2520

The integrated electronics evaluates the signal of the ODC line and outputs the measuring values via the analog and digital interfaces.

For parametrization a web interface (Ethernet) and ASCII commands are available.

### 3.4 Functions

The optoCONTROL 2520 sensor supports the following functions:

- Edge measurement in shadow principle procedures (edge low-high; edge high-low)
- Diameter, width, gap width measurement
- Any segment situations or widths
- Freely selectable edges
- Direction of counting switchable
- Calculation of central axes between edges
- Counting of edges and segments (pins or gaps)
- Web diagram with user levels via web interface
- Ethernet / EtherCAT
- Data logger function
- Define the measurement range (to hide protruding machine parts)
- Triggering and synchronization
- Adjustable threshold
- Statistic values such as Min / Max, Peak to Peak and various types of averaging
- Output of up to 8 segments, 16 edge positions and their center axis at the same time

### 3.5 Operating Modes

Diagram	Operating Mode	Description
	Edge low-high	Position of first low-high edge (Distance to beginning of line)
	Edge high-low	Position of first high-low edge (Distance to beginning of line)
	Diameter / width	Measure, position and central axis of an outer diameter or width of a metal (first low-high and last high-low edge)
	Gap	Measure, position and central axis of a gap (first high-low edge and next edge)
	Any segments	Differences, positions and middle axis of any edges

Fig. 9 Operating modes optoCONTROL 2520

You will find further informations to selection and parametrization at the measuring programs, see 6.4.3.



### 3.6 Technical Data ODC2520-46

Model	ODC2520-46	ODC2520-46(090)
Measuring range	46 mm	
Min. target size	typ. $\geq 0.5$ mm	
Distance of light source - receiver (free space)	With mounting rail 100 ... 300 mm; without mounting rail free to 2000 mm	
Measuring distance (measured object - receiver)	20 mm ... 2000 mm; optimum distances: 20, 50, 100, 150 mm	
Measuring rate	2.5 kHz	
Resolution <sup>1</sup>	1 $\mu$ m	
Linearity <sup>2</sup>	$< \pm 12 \mu$ m	
Repeatability <sup>3</sup>	$\leq 5 \mu$ m	
Light source	Semiconductor laser 670 nm (red)	
Laser safety class	Laser class 1M ( $P_{\max}$ 2 mW) according to DIN EN 60825-1: 2014	
Permissible ambient light	Approx. 20.000 lx	
Analog output	0 ... +10 V not electrically separated, 14 Bit D/A	
Digital interface	RS 422 (max. 4 MBaud), full duplex, not electrically separated; Ethernet, electrically separated EtherCAT / EtherNet/IP <sup>5</sup> / PROFINET <sup>5</sup>	
Switching output	2 outputs, optionally for errors or limits, not electrically separated, 24 V logic (HTL), High level depends on operating voltage	
Signal input	Zeroing/mastering, resetting to factory defaults; not electrically separated, 24 V logic (HTL), High level depends on operating voltage; TrigIn / SyncIn (via RS422 level)	
Digital output	SyncOut symmetrical, RS422 level, terminating resistor (120 Ohm) and can be switched using software, not electrically separated	
Connection	Receiver	3-pin socket M8 for supply of light source, 14-pin socket M16 for power supply & signals, 4-pin socket M12x1 for Ethernet /EtherCAT
	Light source	3-pin socket M8 for supply
Mounting	Mounting rail (see accessories), mounting holes	
Temperature range	Storage	-20 ... +70 °C (-4 ... +158 °F)
	Operation	0 ... +50 °C (+41 ... +122 °F)
Supply voltage	+24 VDC (11...30 VDC)	
Max. current consumption	$< 1$ A	
Shock (DIN-EN 60068-2-27)	15 g / 6 ms	
Vibration (DIN-EN 60068-2-6)	2 g / 20 ... 500 Hz	
Protection class (DIN-EN 60529)	Receiver / light source	IP64
Material	Receiver / light source	Aluminum housing
Weight	1.25 kg (without cable)	
Measuring programs	Edge light-dark; edge dark-light; (outside) diameter / width incl. edges & center axis gap / (inside diameter) incl. edges & center axis; any segments incl. segment edges & center axes	
Control and display elements	Web interface for setting parameters and display; color LEDs for Power on, Status, Speed, Link/activity	
Features	Measurements server for transmission of several measurements to the PC; (optional other periphery devices, see operating instructions)	

The data listed are for a consistent room temperature of 20 °C, sensor operating constantly, signal outputs open and sensor mounted on included mounting rail.

Measured at light source - receiver 300 mm, measured object - receiver distance 20 mm, operating mode: Edge light-dark

1) At the digital interface

2) Linearity (for distances between target and receiver, measured with 3 s: 20 mm  $< \pm 12 \mu$ m / 50 mm  $< \pm 12 \mu$ m / 100 mm  $< \pm 15 \mu$ m / 150 mm  $< \pm 15 \mu$ m

3) Measured with a moving average over 32 values

4) Smallest detectable object, not measurable

5) Connection via interface module (see accessories)

## 3.7 Technical Data ODC2520-95

Model	ODC2520-95	ODC2520-95(270)
Measuring range	95 mm	
Min. target size	typ. $\geq 2.0$ mm / $100 \mu\text{m}$ <sup>4</sup>	
Distance of light source - receiver (free space)	With mounting rail 100 ... 300 mm; without mounting rail free to 2000 mm	
Measuring distance (measured object - receiver)	20 mm ... 2000 mm; optimum distances: 20, 50, 100, 150 mm	
Measuring rate	2.0 kHz	
Resolution <sup>1</sup>	2 $\mu\text{m}$	
Linearity <sup>2</sup>	$< \pm 15 \mu\text{m}$	
Repeatability <sup>3</sup>	$\leq 6 \mu\text{m}$	
Light source	Semiconductor laser 670 nm (red)	
Laser safety class	Laser class 1M ( $P_{\text{max}}$ 2 mW) according to DIN EN 60825-1: 2014	
Permissible ambient light	Approx. 15.000 lx	
Analog output	0 ... +10 V not electrically separated, 14 Bit D/A	
Digital interface	RS 422 (max. 4 MBaud), full duplex, not electrically separated; Ethernet, electrically separated EtherCAT / EtherNet/IP <sup>5</sup> / PROFINET <sup>5</sup>	
Switching output	2 outputs, optionally for errors or limits, not electrically separated, 24 V logic (HTL), High level depends on operating voltage	
Signal input	Zeroing/mastering, resetting to factory defaults; not electrically separated, 24 V logic (HTL), High level depends on operating voltage; TrigIn / Syncln (via RS422 level)	
Digital output	SyncOut symmetrical, RS422 level, terminating resistor (120 Ohm) and can be switched using software, not electrically separated	
Connection	Receiver	3-pin socket M8 for supply of light source, 14-pin socket M16 for power supply & signals, 4-pin socket M12x1 for Ethernet /EtherCAT
	Light source	3-pin socket M8 for supply
Mounting	Mounting rail (see accessories), mounting holes	
Temperature range	Storage	-20 ... +70 °C (-4 ... +158 °F)
	Operation	0 ... +50 °C (+32 ... +122 °F)
Supply voltage	+24 VDC (11 ... 30 VDC)	
Max. current consumption	$< 1$ A	
Shock (DIN-EN 60068-2-27)	6 g / 6 ms in X, Y, Z axis, 1000 shocks each	
Vibration (DIN-EN 60068-2-6)	2 g / 10 ... 500 Hz in X, Y, Z axis, 10 cycles each	
Protection class (DIN-EN 60529)	Receiver / light source	IP64
Material	Receiver / light source	Aluminum housing
Weight	2.0 kg (without cable)	
Measuring programs	Edge light-dark; edge dark-light; (outside) diameter / width incl. edges & center axis gap / (inside diameter) incl. edges & center axis; any segments incl. segment edges & center axes	
Control and display elements	Web interface for setting parameters and display; color LEDs for Power on, Status, Speed, Link/activity	
Features	Measurements server for transmission of several measurements to the PC; (optional other periphery devices, see operating instructions)	

The data listed are for a consistent room temperature of 20 °C, sensor operating constantly, signal outputs open and sensor mounted on included mounting rail.

Measured at light source - receiver 300 mm, measured object - receiver distance 20 mm, operating mode: Edge light-dark

1) At the digital interface

2) Linearity (for distances between target and receiver, measured with 3 s: 20 mm  $< \pm 15 \mu\text{m}$  / 50 mm  $< \pm 20 \mu\text{m}$  / 100 mm  $< \pm 20 \mu\text{m}$  / 150 mm  $< \pm 20 \mu\text{m}$ )

3) Measured with a moving average over 32 values

4) Smallest detectable object, not measurable 5) Connection via interface module (see accessories)

## 4. Delivery

### 4.1 Unpacking, Included in Delivery

- 1 Light source
- 1 Receiver
- 1 Mounting rail
- 1 Accessories bag /mounting kit with mounting screws
- 2 Laser warning labels USA and EU area
- 1 Assembly instructions
- 1 Test report

➡ Carefully remove the components of the measurement system from the packaging and ensure that the goods are forwarded in such a way that no damage can occur.

• Do not touch the optical windows. Dirt on the optical window will eventually affect the functionality.

➡ Check the delivery for completeness and shipping damage immediately after unpacking.

➡ If there is damage or parts are missing, immediately contact the manufacturer or supplier.

Optional accessories are available in the appendix, [see A 1](#).

### 4.2 Notes about Cables

Cables are optional accessory, [see A 1](#).

- To connect the light source with the receiver a cable CE2520 is required.
- To connect the power supply and the periphery a cable PC/SC2520 is required.
- Always recommended for commissioning, required for the Ethernet interface: Digital output cable SCD2520-3

### 4.3 Storage

- Temperature range storage: -20 ... +70 °C (-4 ... +158 °F)
- Humidity: 5 to 95 % RH, non-condensing

## 5. Mounting

### 5.1 General

- Do not touch the optical windows. Dirt on the optical window will eventually affect functionality.

No sharp-edged or heavy object should be allowed to affect the cable. Kinks in the cables must always be avoided.

Do not exceed the bending radius of 60 mm.

The connection cable between light source and receiver and the Ethernet cable are not cable carriers suitable.

**NOTICE**

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

> Inaccurate, erroneous measuring values

### 5.2 Light Source and Receiver

#### 5.2.1 Dimensions

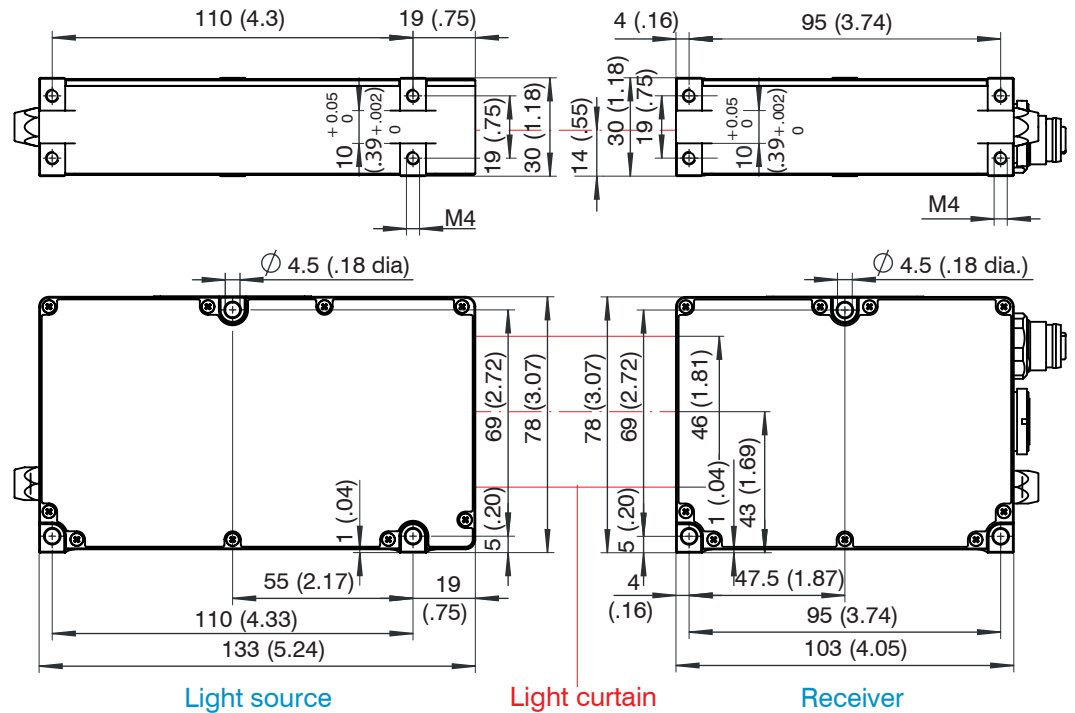


Fig. 10 Dimensional drawing optoCONTROL 2520-46, dimensions in mm, not to scale

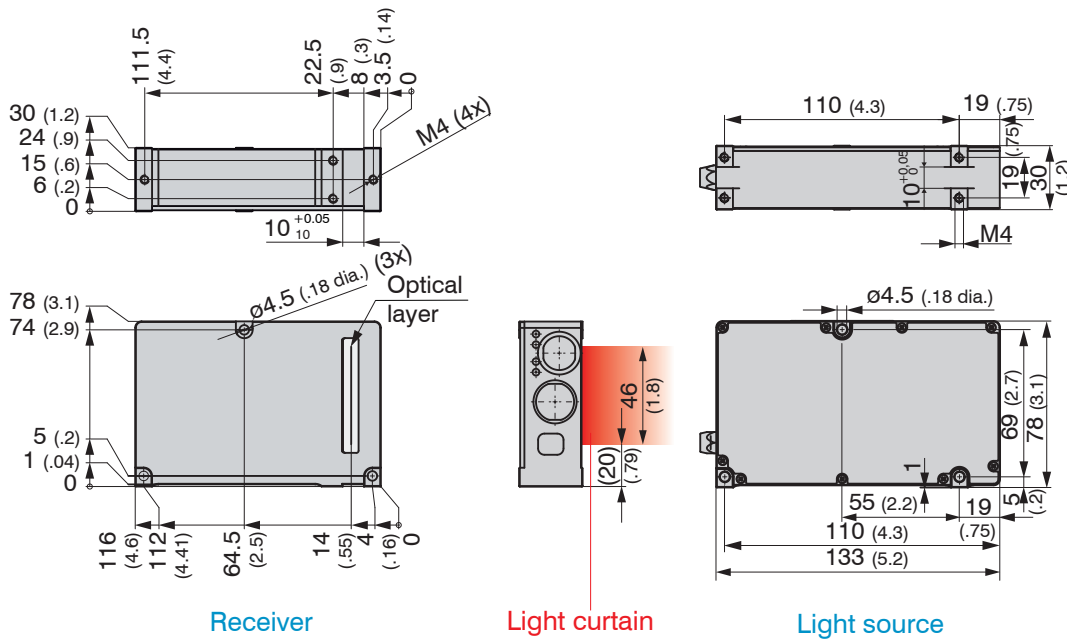


Fig. 11 Dimensional drawing optoCONTROL 2520-46(90), dimensions in mm, not to scale

Light source and receiver can be attached using the three through-holes  $\varnothing 4.5$  mm each (bolt connection) or, if the mounting rail is not used, using the four M4 threaded holes in each housing bottom, which ensure a maximum screwing depth of 5 mm (direct screw connection).

**i** Also observe the additional information and notes on this topic in the next two chapters!

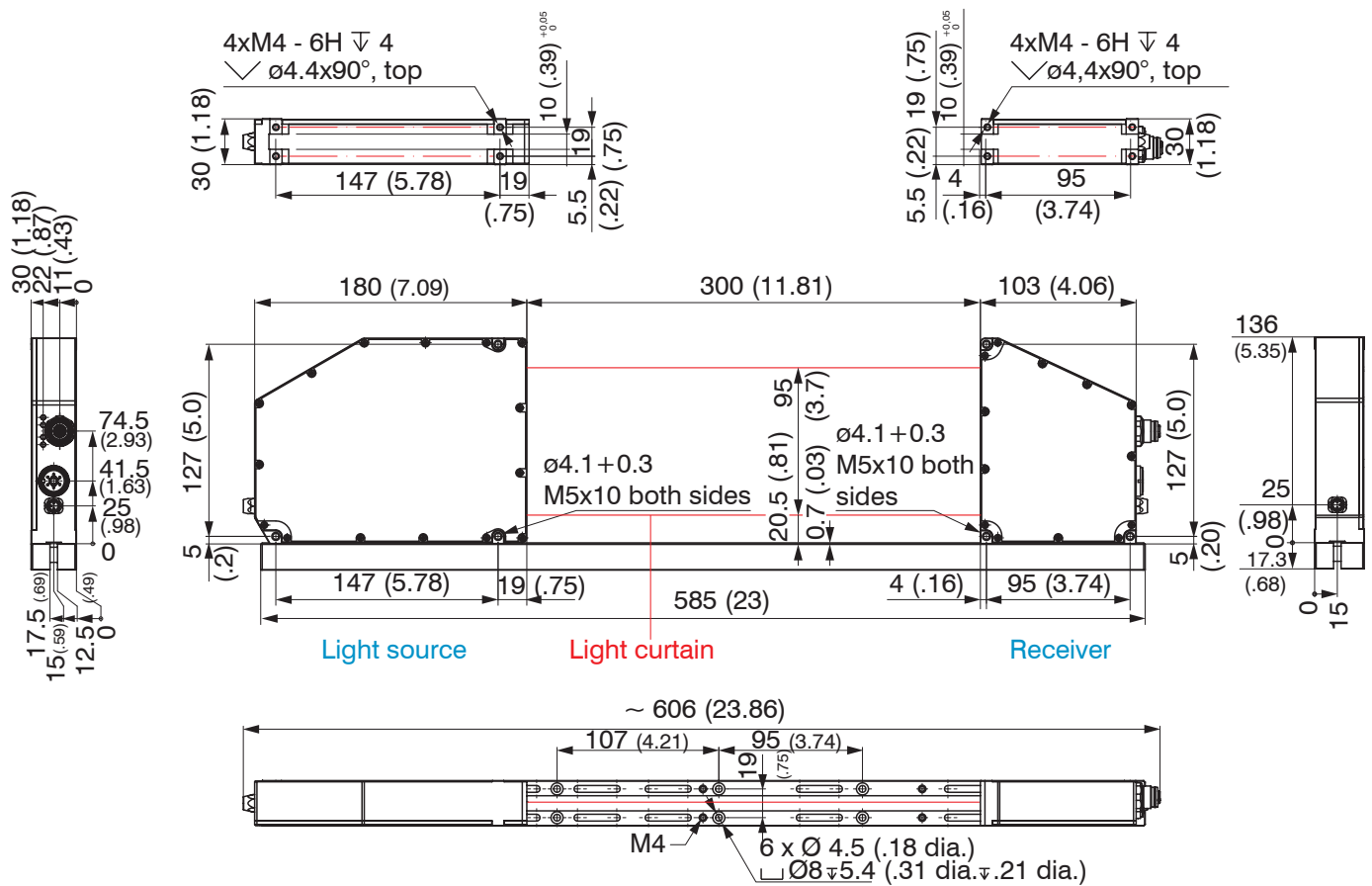


Fig. 12 Dimensional drawing optoCONTROL 2520-95, dimensions in mm, not to scale

Light source and receiver can be attached using the three through-holes  $\varnothing 4.1 + 0.3$  mm each (bolt connection) or the M5x10 threaded holes on both sides (direct screw connection). The mounting rail also features several  $\varnothing 4.5$  through-holes that are countersunk at  $\varnothing 8$  and M4 threaded holes to attach/receive the measuring system, see Fig. 12.

Alternatively, if the mounting rail is not used, the four M4 threaded holes in each housing bottom, which ensure a maximum screwing depth of 5 mm, can be used for attachment.

**i** Also observe the additional information and notes on this topic in the next two chapters!

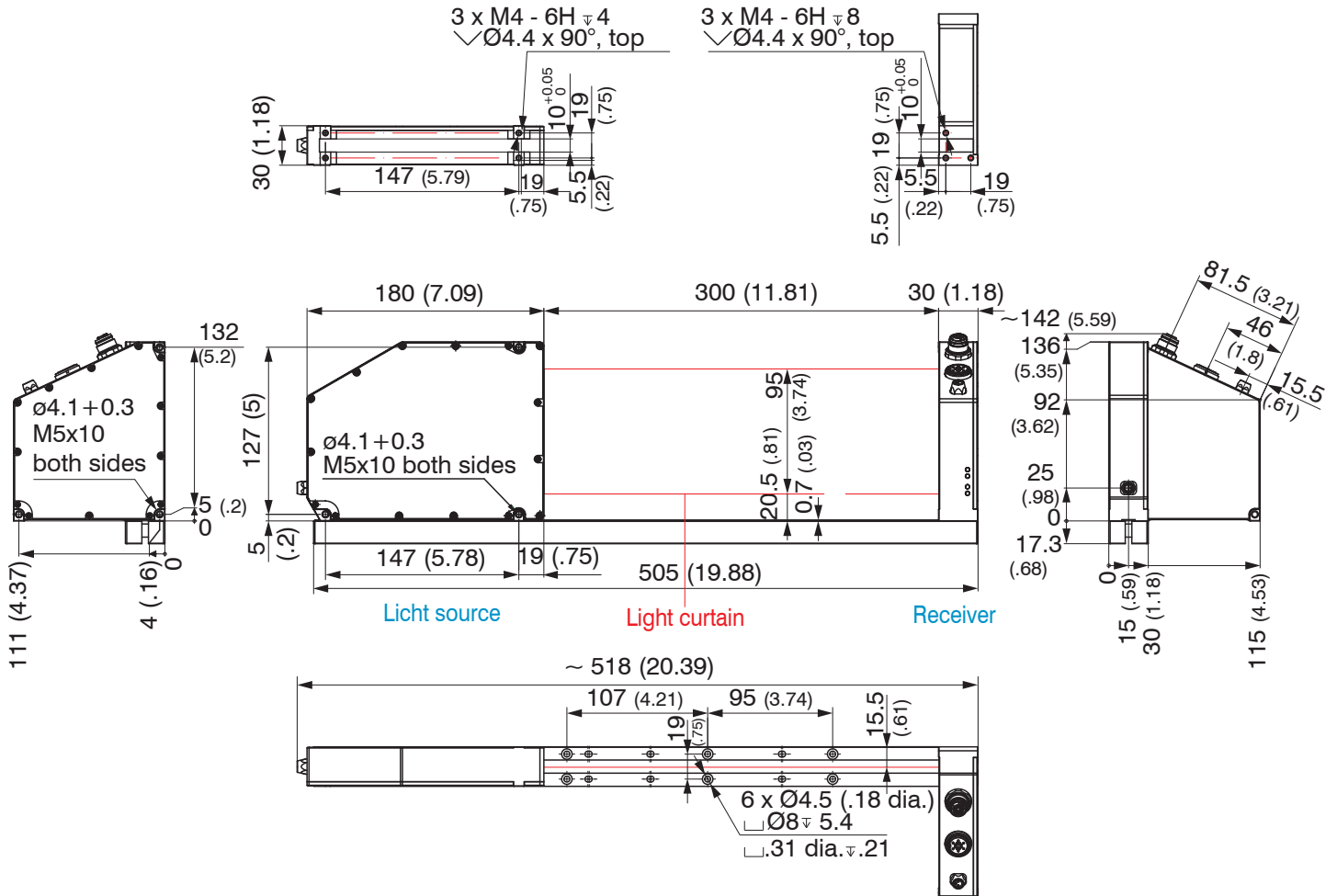


Fig. 13 Dimensional drawing optoCONTROL 2520-95(270), dimensions in mm, not to scale

**i** The dimension 15.5 mm deviates with this option (standard 14 mm).

**5.2.2 Mounting on DIN-Rail**

The sensor unit, consisting of the light source, receiver and mounting rail, is pre-assembled, see Fig. 14. The light source can be fitted to the mounting rail at two different distances to the receiver.

The adjustable distance between the light source and receiver is with rail 100 ... 300 mm.

The alignment with each other is ensured by the 10 mm wide and 0.7 mm high guidance on the mounting rail.

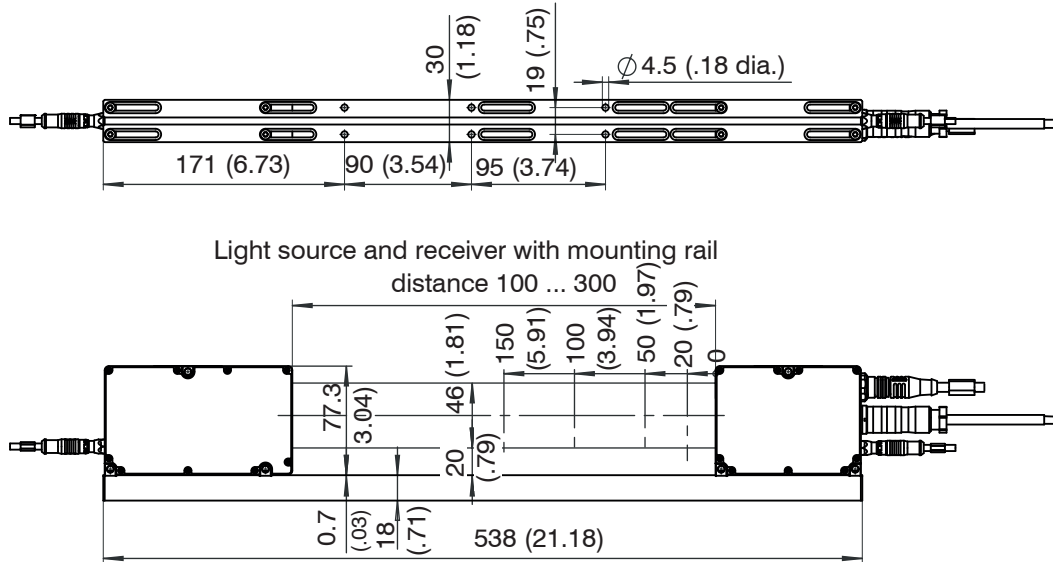


Fig. 14 Light source and receiver optoCONTROL 2520-46 with mounting rail, dimensions in mm, not to scale

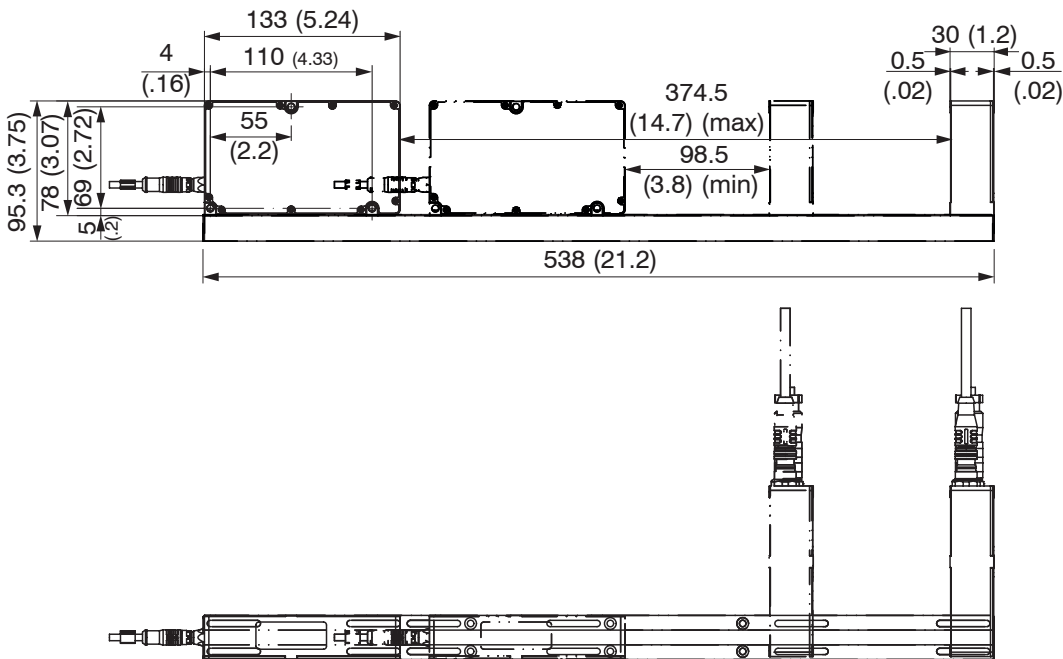


Fig. 15 Light source and receiver optoCONTROL 2520-46(090) with mounting rail, dimensions in mm, not to scale

**i** The mounting rail must be fixed so that it is not bended respectively twisted.

A horizontal measurement arrangement reduces contamination on the optical system and should therefore be preferred.

Please refer to the previous drawings, for the assembly drawing of the optoCONTROL 2520-95 and the option optoCONTROL 2520-95(270) for mounting on the DIN rail, see Fig. 12, see Fig. 13.

### 5.2.3 Free Mounting

If light source and receiver must be mounted without the delivered mounting rail, attention must be given to the precise alignment of the components.

A greater distance between the light source to the receiver is possible with reduced linearity. The maximum distance (free space) between light source and receiver is 2 m.

The threaded depth in each light source and receiver is 5 mm. For bolting on, the three 4.5 mm through holes in both components can be also used. The supplied screws should be used for fixing.

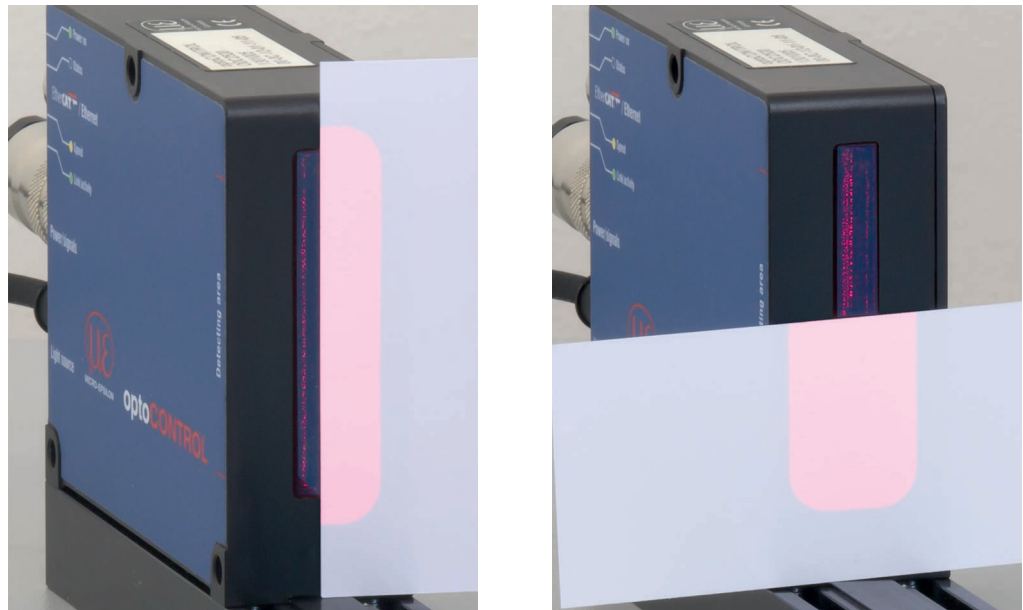
- The light source and receiver must lie in one plane and must not be tilted with respect to another.

Use squares or rails for alignment of light source and receiver.

Control and adjust the centered alignment of the light beam at the receiver after installation of the light source and of the receiver in the correct displacement. You may loosen the light source for an accurate positioning if required.

You may control the concentric orientation of the light beam both in the horizontal and the vertical orientation.

For this purpose, MICRO-EPSILON Eltrotec GmbH recommends, to keep a white paper as a projection plane ahead of the receiver and to cover the window halfway through, see Fig. 16. For orientation the glued-in window can be used. The light beam should illuminate this symmetrically.



*Fig. 16 Adjustment controlling with white paper in front of the receiver, the left vertical and right horizontal orientation*

- The laser light must hit concentric on the entry window of the receiver.
- The greater the distance between light source and receiver, the more accurate must be aligned!



### 5.2.4 Calibrated Measuring Distances

The sensor optoCONTROL 2520 is calibrated to 4 different measuring distances (distance between target and receiver):

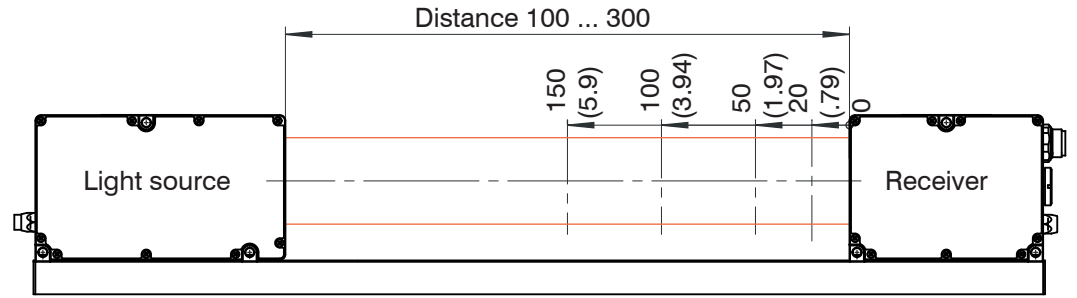


Fig. 17 Calibrated measuring distances ODC 2520, example optoCONTROL 2520-46

The calibrated measurement distances apply for the optoCONTROL 2520-46, the optoCONTROL 2520-46(090) option, the optoCONTROL 2520-95 and the optoCONTROL 2520-95(270) option:

20 mm (Standard setting), 50 mm, 100 mm, 150 mm

For accurate results, the target should be located as possible in one of these distances.

If the measuring distance changes during the measurement or if the target edge has a large thickness parallel to the laser beam, a considerable linearity error can occur.

The distance between target and receiver can be set via the web interface.

If necessary, choose the closest distance.

### 5.3 Electrical Connections

#### 5.3.1 Receiver


	Ethernet/ EtherCAT	Connection to a PC or PLC
	Power/ signals	Power supply, switching outputs, zeroing/mastering, synchronization/triggering, RS422, analog output
	Light source	Power supply light source (laser)

Fig. 18 Female connector arrangement on ODC 2520-46, receiver


	Ethernet/ EtherCAT	Connection to a PC or PLC
	Power/ signals	Power supply, switching outputs, zeroing/mastering, synchronization/triggering, RS422, analog output
	Light source	Power supply light source (laser)

Fig. 19 Female connector arrangement on ODC 2520-95, receiver

The female connectors are labeled and designated on the labels of the receiver.

- For operation without Ethernet / EtherCAT cable, the protective cap for the M12 connector must be plugged to achieve the IP degree of protection!

### 5.3.2 Light Source

The light source is supplied by the receiver.



Fig. 20 Female connector on ODC 2520-46, light source



Fig. 21 Female connector on ODC 2520-95, light source

- ➔ Connect the light source and receiver, female connector Light source, before switching on the power supply.
- ⓘ Use only the connection cable CE2520-x or CE2520/90-x by MICRO-EPSILON Eltrotec GmbH, cable length x = 1, 2 or 5 m.

To connect the light source to the receiver, there are differently long three-pole connection cables according to order, each optional with either straight (CE2520-x) or angled connectors (CE2520/90-x).

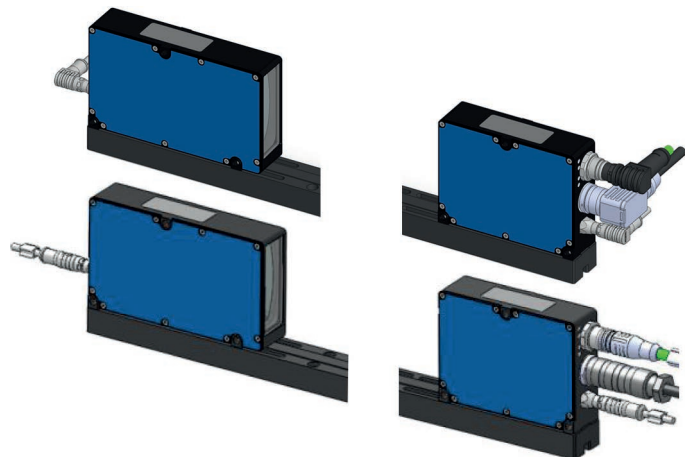


Fig. 22 Connection cable on ODC 2520<sup>1</sup> with straight and angled connectors

1) Example optoCONTROL 2520-46

5.3.3 Connection Possibilities

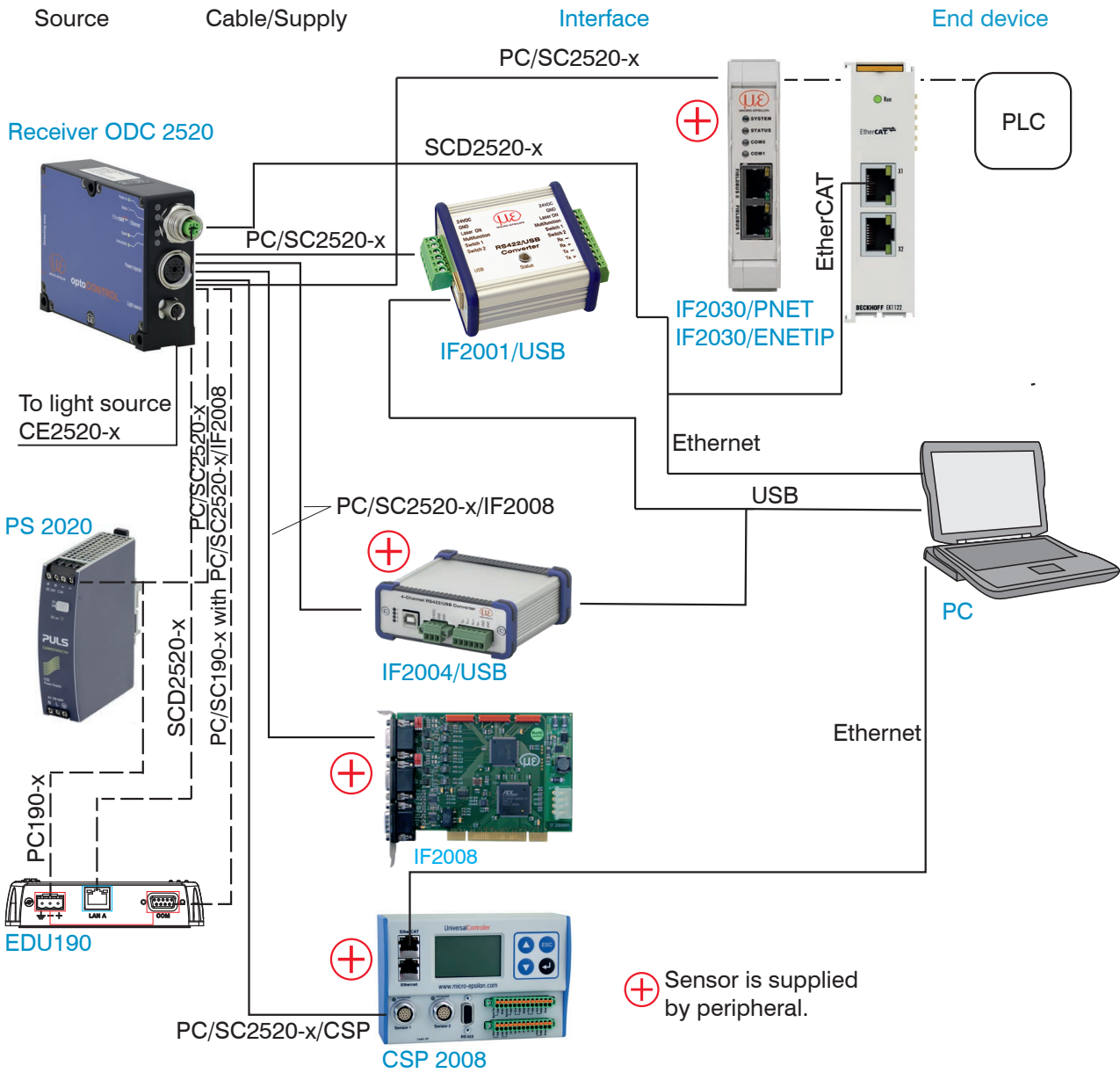


Fig. 23 Connection examples on ODC 2520-46

The same connection options apply to the optoCONTROL 2520-95 measuring system; CSP 2008 is supported only by the optoCONTROL 2520-46 measuring system.

Various peripheral devices, see Fig. 23, let themselves connect with the shown connection cables at the 14-pin female connector Power / signals. The devices PCI interface card IF2008, 4-channel IF2004/USB converter and universal controller CSP2008 also supply the sensor with the operating voltage (24 V DC) via the suitable connection cable.

Periphery	Sensor channels	Interface
RS422 USB converter	one	RS422
IF2004/USB	four	
IF2008, PCI interface card	four	
CSP2008, universal controller	two	
2x RS422 extension terminal CSP2008	+ two	
Ethernet (network, PC)	any	Ethernet
EtherCAT (Master)	any	EtherCAT
PLC, signal light, ejector or the like	---	Switching outputs (Out 1/2)
Switch, button, PLC, or the like	---	Switching input (In)
AD amplifier, PLC, high impedance display etc.	---	Analog output (voltage)

Fig. 24 Max. sensor channels on the periphery devices

### 5.3.4 Power Supply, Inputs/Outputs, RS422

The power supply and the input/output at sensor is effected by the 14-pin. female connector on receiver.

Signal	Description	Comments	Color on cable PC/SC2520-3	Pin
+24 V DC	Operating voltage	11 ... 30 VDC, $I_{max} < 200 \text{ mA}$ at 24VDC <sup>3</sup>	Red	E
GND	Operating voltage ground	Ground reference for power, Out, In, Sync, RS422	Black	R
Out 1	Switching output 1	Error or limits, not electrically isolated, 24V logic (HTL), $I_{max} = 0.1 \text{ A}$ , $U_{max} = 30 \text{ V}$	Blue	P
Out 2	Switching output 2	Saturation voltage at $I_{max} = 0.1 \text{ A}$ : Low < 2.5 V (output GND), High < 2.5 V (output - operating voltage)	Pink	O
In	Zeroing/mastering or reset to factory settings	not electrically isolated, 24V logic (HTL), Low level $\leq 3 \text{ V}$ , High level $\geq 10 \text{ V}$ (max 30 V),  Internal Pull-up resistor, open input is recognized as High.	Gray/pink	T
Sync In/out	Synchronization or triggering, Synchronous output	Symmetrical, RS422 level, load resistance (120 Ohm) and direction via soft- ware switchable, not electrically isolated	White/green	U
/Sync In/out			Red/blue	L
RX - 422	RS422	Interface RS422, symmetrical, RX internally terminated with 100 Ohm, max. 4 MBaud, Full-Duplex, not electrically isolated	Brown	M
/RX - 422			Green	A
/TX - 422			Yellow	N
TX - 422			Gray	C
GND- RS422		Equipotential equalization RS422 / Sync when none other galvanic connection is available.	Violet	J
Analog Out	Voltage output	0 ... 10 V, not electrically isolated, 14 Bit D/A, $R_i$ approx. 50 Ohm,  Load: $C_l < 22 \text{ nF}$ , $R_a > 10 \text{ kOhm}$	White <sup>1</sup>	S
Analog GND	Ground analog output	Ground reference for voltage output	Inner shield <sup>1</sup>	G
PE	Total outer shield	Connect with PE of the system	Black <sup>2</sup>	Housing

Fig. 25 Pin assignment 14-pin. round male connector (Power / signals)



Fig. 27 14-pin. male cable connector for supply and signals

MICRO-EPSILON Eltrotec GmbH recommends the cable carriers suitable multifunction cable PC/SC2520-3. It has both an internal coaxial cable for the analog output as well as the right matched twist for the RS422 interface and synchronization.

- 1) Internal coaxial cable for voltage output in PC/SC2520-3.
- 2) Shrinking hose with wire end
- 3) With open switching outputs

### 5.3.5 Power Supply

- Operation voltage: 11 ... 30 VDC
- Current consumption:  $I_{max} < 1 \text{ A}$

**i** Use the current supply only for measuring devices, not at the same time for drive units or similar impulse interference sources. MICRO-EPSILON Eltrotec GmbH recommends the power supply PS2020.

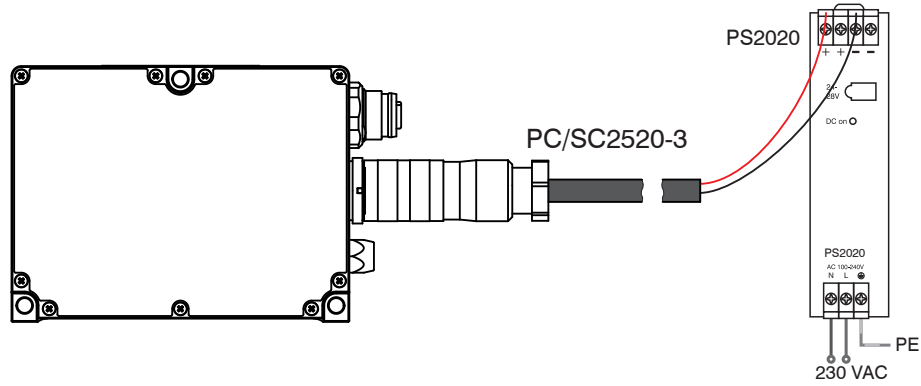


Fig. 28 Connection power supply, example ODC2520-46

After switching on the power supply the Power on LED lights, see 5.4.

### 5.3.6 Ethernet, EtherCAT

Potential-separate M12 female connector for connection of ODC 2520 receiver with an Ethernet network (PC) or with an EtherCAT bus system.

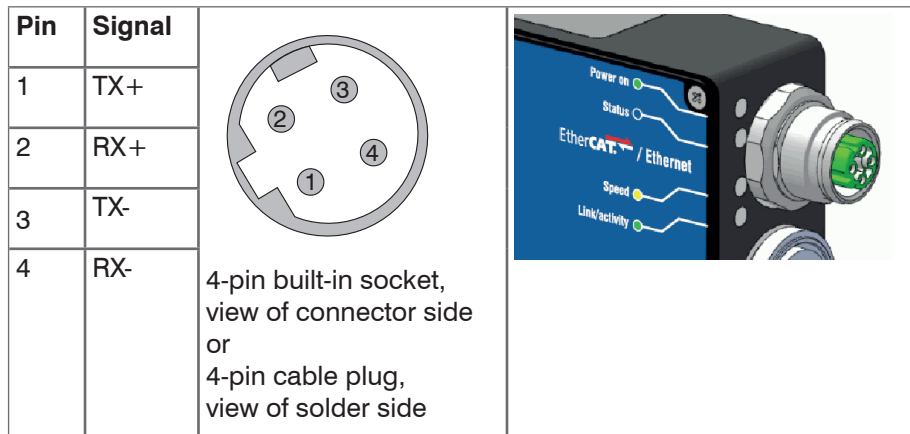


Fig. 29 Ethernet/EtherCAT socket, optoCONTROL 2520-46

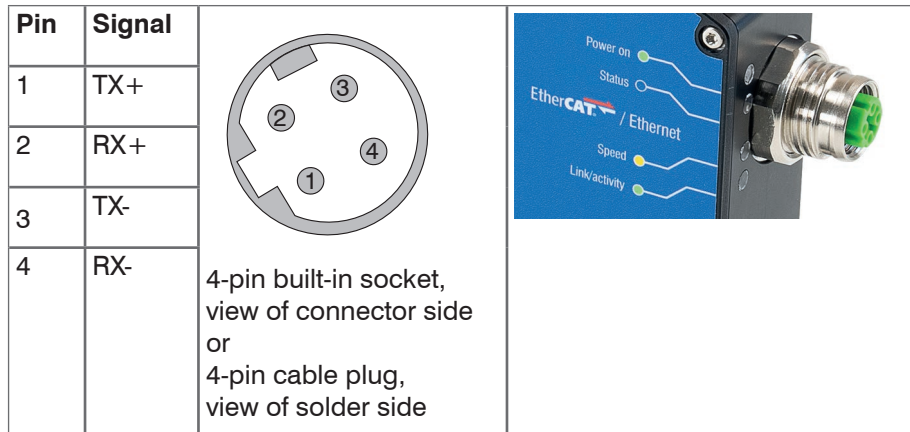


Fig. 31 Ethernet/EtherCAT socket, optoCONTROL 2520-95

MICRO-EPSILON Eltrotec GmbH recommends the Ethernet cable SCD2520-3, see 4.2.

**i** For operation without Ethernet / EtherCAT cable, the protective cap for the M12 connector must be plugged to achieve the IP degree of protection!

### 5.3.7 Wiring Switching Input

The switching input IN can be wired as follows:

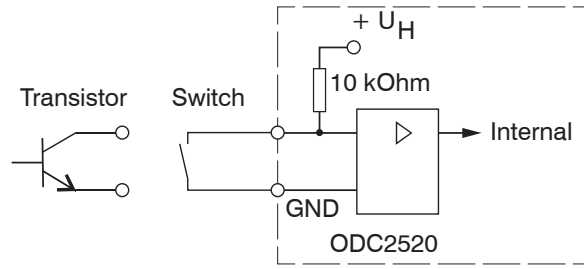


Fig. 32 Wiring of switching input (schematic)

Signal	Description	Comments	Color on cable PC/SC2520-3	Pin
In	Zeroing/ mastering or reset to factory settings	not electrically isolated, 24V logic (HTL), Low level $\leq 3$ V, High level $\geq 10$ V (max 30 V), Internal Pull-up resistor, open input is recognized as High.	gray/pink	T

Switching input is not isolated galvanically, an open input is recognized as high.		This input, for appropriate time connected with GND, triggers different operations:	
24 V logic (HTL)		Time < 2 s	Mastering Reset statistic values
Low level	$\leq 3$ V	Time 2 s up to 5 s	Reset mastering Reset statistic values
High level	$\geq 10$ V (max 30 V)	Time > 10 s	Rest to factory settings

**i** A reset to the factory settings using the switch input requires the professional user level.

### 5.3.8 Wiring of the Switching Outputs

The two switching outputs Out1/Out2 can be wired as follows:

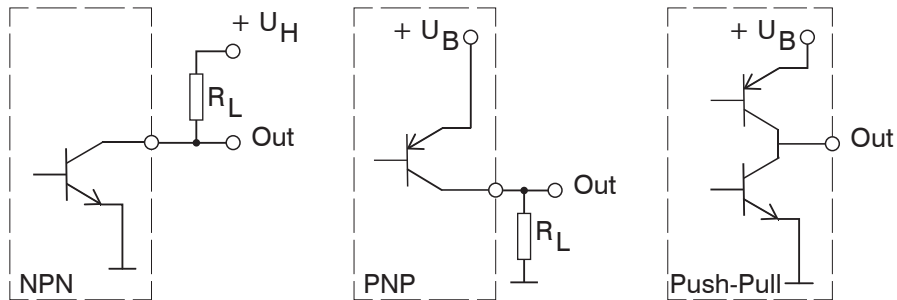


Fig. 33 Wiring of the switching outputs (schematic)



The switching behavior (NPN, PNP, push-pull) is programmable, see 7.6.4.

The NPN output is for example suitable for the adaptation to a TTL logic with an auxiliary voltage  $U_H = 5$  V.

The switching outputs are protected against reverse polarity, overload ( $< 150$  mA), over temperature and have an integrated free-wheeling diode for inductive loads.

Signal	Description	Comment	Color on cable PC/SC2520-3	Pin
Out 1	Switching output 1	Error or limits, not electrically isolated, 24V logic (HTL), $I_{max} = 0.1$ A, $U_{max} = 30$ V	blue	P
Out 2	Switching output 2	Saturation voltage at $I_{max} = 0.1$ A: Low $< 2.5$ V (output GND), High $< 2.5$ V (output - operating voltage)	pink	O

### 5.4 LEDs on Receiver

LED	Color	Meaning	Adjustment	
Power on	Green	Operating voltage on	 <p>optoCONTROL 2520-46</p>	
	Yellow	with synchronization error		
Status	Red flashing	Ethernet, interference		
	yellow	Load factory settings		
	Green	Zeroing / mastering		
	With active EtherCAT interface, the meaning depends on the EtherCAT guidelines, see A 8.8.			
Speed	Yellow	Baud rate 100 Mb		
	Off	Baud rate 10 Mb		
Link/activity	Green	Active link		 <p>optoCONTROL 2520-95</p>
	Off	Inactive link		
	Flashing	Network activity		



## 6. Operation

### 6.1 Initial Operation

- Connect the light source and receiver with connection cable, [see 5.3](#).
- Connect the sensor to a power supply 24 V DC, [see 5.3.5](#).
- Switch on the power supply.

After switching on the sensor the initialization follows. After approx. 10 s the sensor is ready for use.

The configuration is possible over in the web pages integrated in the sensor, by means of ASCII instructions or EtherCAT objects. A parallel operation via web browser and ASCII commands is possible; the last setting applies. MICRO-EPSILON Eltrotec GmbH recommends to adjust the sensor over the integrated web page, [see 6.2](#).

Let the sensor warm up about 30 min for precise measurements.

### 6.2 Control via Ethernet




#### 6.2.1 Requirements

Dynamic web pages are generated in the optoCONTROL 2520 which contain the current settings of the controller and the peripherals. Operation is only possible while there is an Ethernet connection to the optoCONTROL 2520.

You need a web browser (e.g. Mozilla Firefox or Internet Explorer) on a PC with a network connection. To support a basic first commissioning of the optoCONTROL 2520, the optoCONTROL 2520 is set to a direct connection.

If you have configured your browser to access the internet via a proxy server, in the browser settings you will need to add the IP address of the optoCONTROL 2520 to the list of addresses which should not be routed through the proxy server. The MAC address of the unit can be found on the nameplate of the optoCONTROL 2520 and on the test certificate calibration report.

JavaScript must be enabled in the browser so that measurement results can be displayed graphically.

Direct connection to PC, static IP (factory setting)		Network
PC with static IP	PC with DHCP	Sensor with dynamic IP, PC with DHCP
<p>➤ Connect the sensor to a PC using a direct Ethernet connection (LAN). To do so, use the SCD2520-3 cable in the optional accessories.</p>		<p>➤ Connect the sensor to a switch using a direct Ethernet connection (LAN). To do so, use a SCD2520-3 cable.</p>
<p>➤ Start the program <code>sensorFinder Vx.x.x</code>, see Fig. 34.</p> <p>➤ In the <code>Sensor Group</code> dropdown menu, select <code>optoCONTROL</code>, in the <code>Sensor Type</code> dropdown menu, select <code>optoCONTROL ODC2520</code>.</p> <p>➤ Click the  button.</p> <p>➤ Now select the desired ODC2520 from the list.</p> <p>➤ To change the address settings, click the <code>Configure Sensor IP</code> button.</p> <ul style="list-style-type: none"> <li>• Address type: static IP address</li> <li>• IP address: 169.254.168.150<sup>1</sup></li> <li>• Subnet mask: 255.255.0.0</li> </ul> <p>➤ Click the <code>Apply</code> button to transmit the changes to the ODC2520.</p> <p>➤ Click the <code>Open Webpage</code> button to display the web page of the sensor in your standard browser. Alternatively, change the IP settings according to the settings on your PC (IP address ranges must match).</p>	<p>Wait until Windows has established a network connection (connection with limited connectivity).</p> <p>➤ Start the program <code>sensorFinder Vx.x.x</code>, see Fig. 34.</p> <p>➤ In the <code>Sensor Group</code> dropdown menu, select <code>optoCONTROL</code>, in the <code>Sensor Type</code> dropdown menu, select <code>optoCONTROL ODC2520</code>.</p> <p>➤ Click the  button.</p> <p>➤ Now select the desired ODC2520 from the list.</p> <p>➤ Click the <code>Open Webpage</code> button to display the web page of the sensor in your standard browser.</p>	<p>➤ Enter the sensor in the DHCP/register the sensor with your IT department. IP address assignment by your DHCP server. You can query this IP address with the program <code>sensorFinder Vx.x.x</code>.</p> <p>➤ Start the program <code>sensorFinder Vx.x.x</code>, see Fig. 34.</p> <p>➤ In the <code>Sensor Group</code> dropdown menu, select <code>optoCONTROL</code>, in the <code>Sensor Type</code> dropdown menu, select <code>optoCONTROL ODC2520</code>.</p> <p>➤ Click the  button.</p> <p>➤ Now select the desired ODC2520 from the list.</p> <p>➤ Click the <code>Open Webpage</code> button to display the web page of the sensor in your standard browser.</p> <p>OR: When using DHCP with the DHCP server coupled to the DNS server, access to the sensor is possible using a host name with the structure "ODC2520_SN&lt;Serial number&gt;".</p> <p>➤ Start a web browser on your PC. To reach an ODC2520 with serial number "01234567", type "ODC2520_SN01234567" into the address bar of the browser.</p>

Interactive web pages for setting the sensor and peripherals are now shown in the web browser.

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

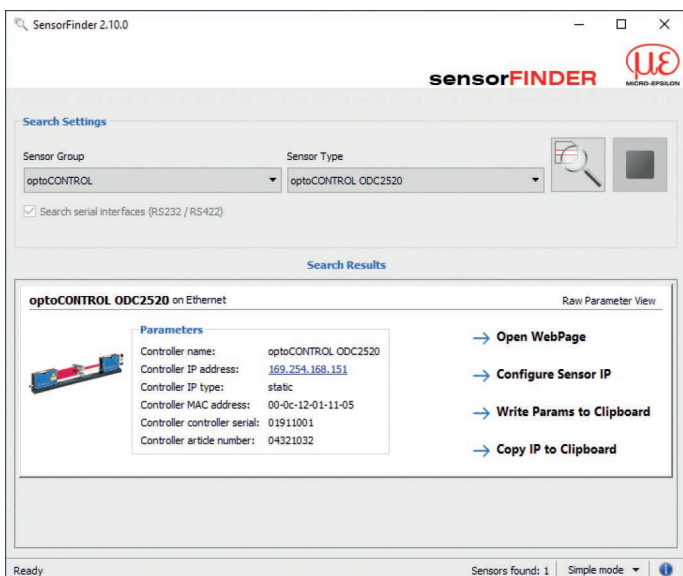
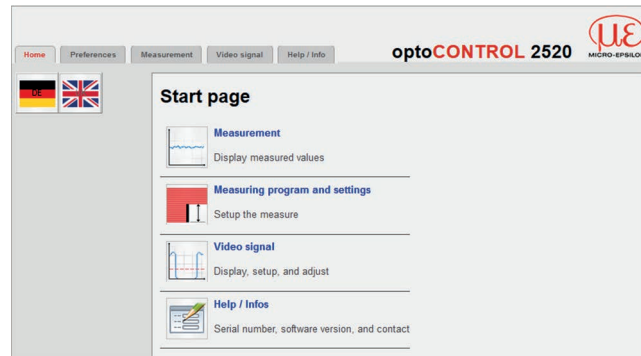


Fig. 34 sensorFINDER auxiliary program for sensor search

The sensorFINDER Vx.x.x program is available online at <http://www.micro-epsilon.com/service/download/software>.

The sensorFINDER Vx.x.x program searches the available interfaces for connected sensors.

### 6.2.2 Access via Ethernet



Use the upper navigation bar to access features (settings, video signal etc.).

All settings on the web page are applied immediately in the sensor after pressing the Submit button.

Fig. 35 First interactive web page after calling the IP address

Parallel operation with keyboard and web browser is possible; the last setting applies. Do not forget to save your settings.

The appearance of the web pages may vary depending on functions and peripherals. Each page contains parameter descriptions and tips on configuring the optoCONTROL 2520.

### 6.2.3 Measuring Value Presentation with Ethernet (Web Browser)

Diagram control and display are loaded in the browser and runs there autonomously, while the optoCONTROL 2520 regardless continues to operate and provides measuring values.

➤ Start Measurement display in the horizontal navigation bar.

i By letting the diagram display run in a separate tab or browser window, you avoid having to restart the display every time.

➤ Click the Start button, if the measurement or display of measurement results have not started automatically.

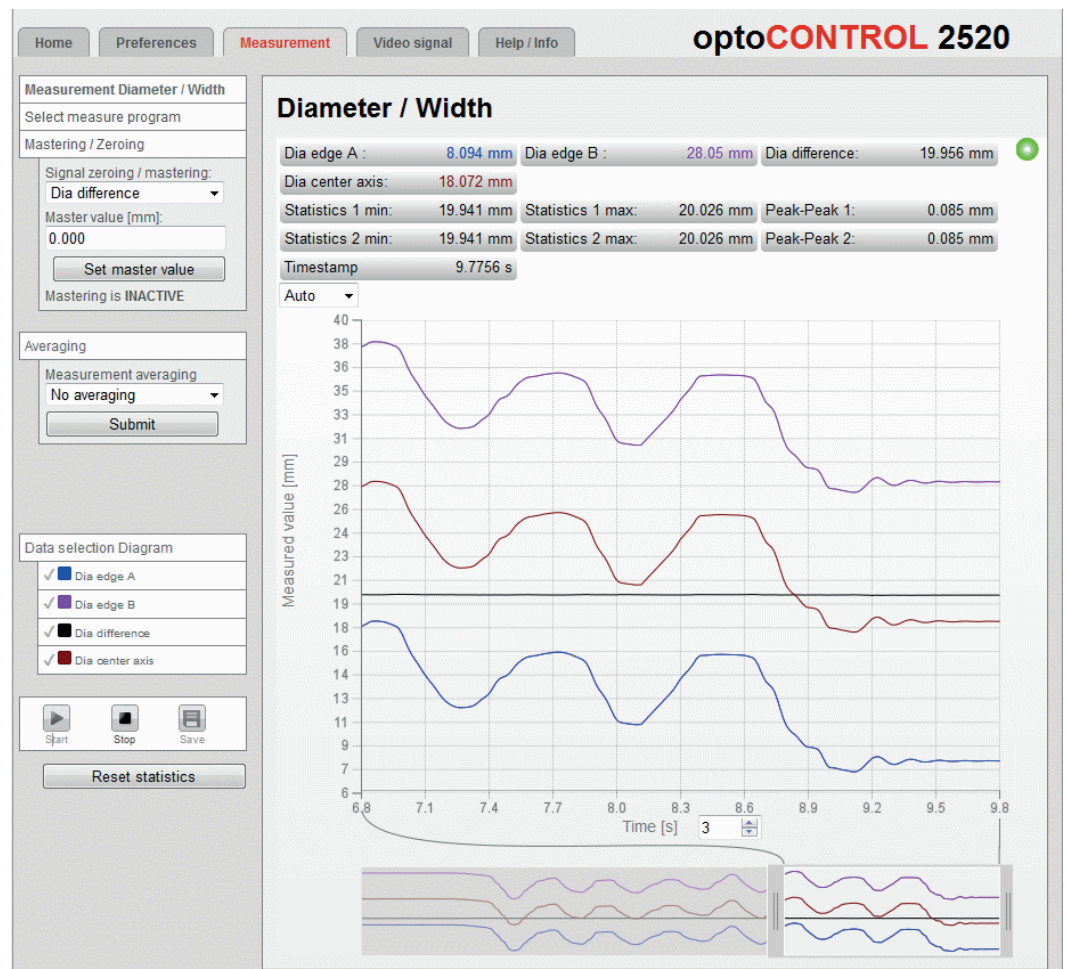


Fig. 36 Displaying measurement results, program Diameter/Width

## 6.3 Video Signal

### 6.3.1 Light Source Reference

The light source reference is to be performed once after the assembly. In modified ambient light and high precision requirements, a more frequent repetition is recommended. The light source reference ensures an appropriate laser power, a good ambient light correction as a basis for accurate measurements and a relatively uniform light corrected signal.

To detect the light signal, the sensor requires a warm-up time of approximately 30 min.

**i** There must not be any object between the light source and the receiver when executing the light source reference. If this is not possible, a suitable masking of the evaluation area is possible, see 7.13. The light source reference is accessible only from the web page Video signal.

**➡** Confirm the button Start light source reference in the web page Video signal > Light source reference.

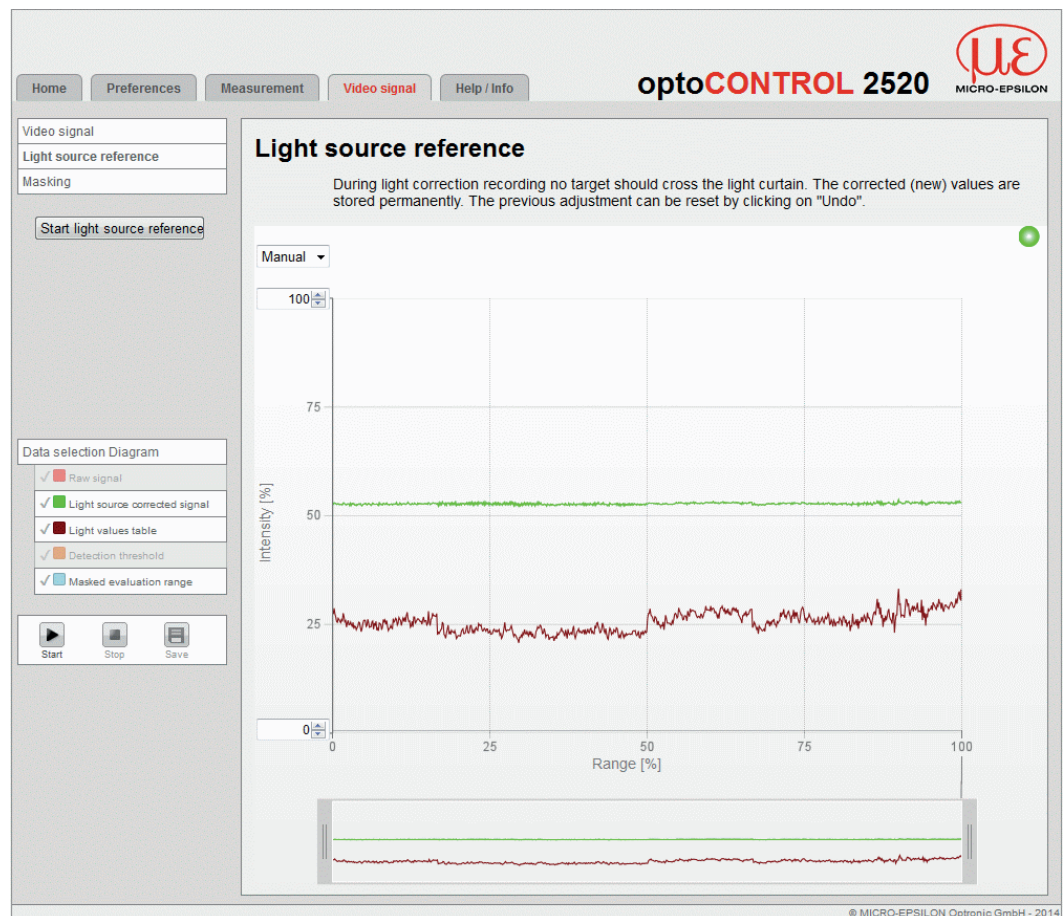


Fig. 37 Web page Light source reference

After end of the light source reference, the corrected signal (green) shows a straight line. At the same time the Undo button is released. The result of the adjustment is saved. The previous adjustment can be restored via Undo.

### 6.3.2 Video Signal, Edge Detection

➡ Click on the tab `Video signal` in the top navigation bar.

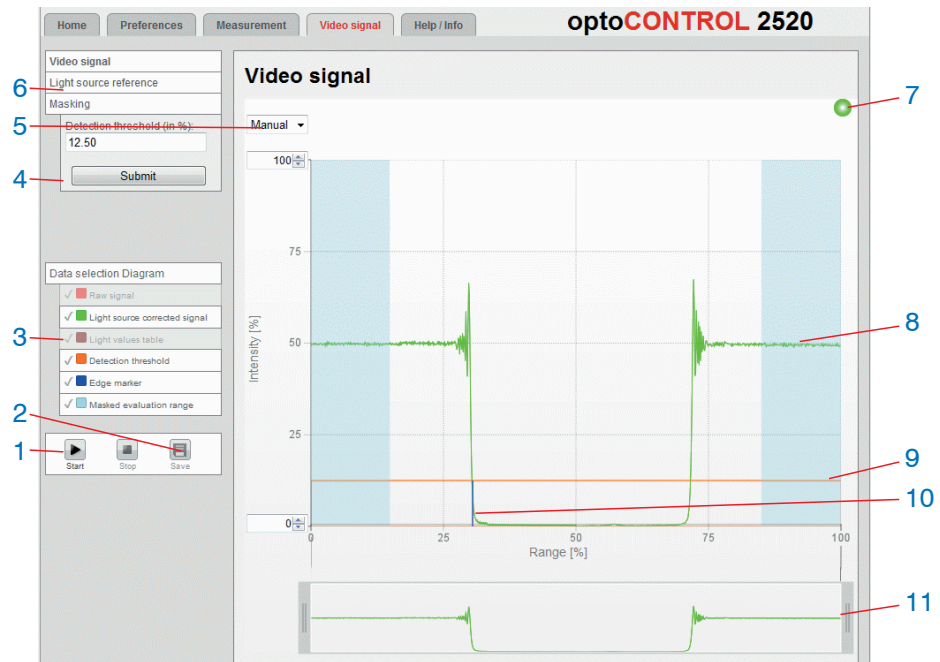


Fig. 38 Web page `Video signal`

The `Video signal` web page includes the following functions:

- 1 Start measuring video signals by clicking the `Start` button (bottom left) and end it by clicking `Stop`.
- 2 Use the `Save` button to save the displayed graph in CSV format (time stamp and captured values). This will open the Windows dialog box for selecting a location and file name.
- 3 In the window on the left, the video graph can be enabled or disabled (both during and after measuring):
  - Raw signal (uncorrected CCD signal, red),
  - Light source corrected signal (green)
  - Light values table (table generated in response to light referencing, brown),
  - Detection threshold (orange).
  - Edge marker
  - Masked evaluation range
- 4 In the window on the left you can quickly adjust detection threshold (in %). You can optionally increase the detection threshold to measure a transparent target with reduced linearity. Please do not change as possible. Click `Submit` to accept the new values.
- 5 `Auto` (= automatic scaling) or `Manual` (= manual setting) allow for scaling the intensity axis (Y axis) of the graph.
- 6 From the `Video signal` page, you can launch the `Light source reference` and `Masking` features directly.
- 7 Status Display
  - Green: OK; data transfer is active
  - Yellow: data transfer is stopped
  - Red: sensor connection is disturbed
- 8 The light source corrected video signal of the receiver line is displayed in the right diagram. The left is the beginning of the line (0) close to the rails and the right the upper end of line (100), see Fig. 10.
- 9 The detection threshold is a horizontal straight line that corresponds to the pre-set value. For a measurement at least one transition from low to high or vice versa should be visible in the corrected video signal, which intersects the horizontal detection threshold.

10 Relevant edges for the selected measuring program are marked with a colored vertical line corresponding to the segment. Thus, the respective segment edges in the video signal can be identified, see Fig. 39.

11 X axis scaling: The diagram displayed above is zoomable with both sliders on the right and on the left side in the lower total signal. Move it sideways also with the mouse in the center of the zoom window (cross arrow).

The following measurement was performed with the Segments program, see 7.2. Together with the Masking function, see 7.13, and the segment definition, see 7.2.2, sections of a target can be selected for the evaluation. Thereby a segment can extend over several edges. Coloring the edges enables a fast assignment of the edges in the video signal.

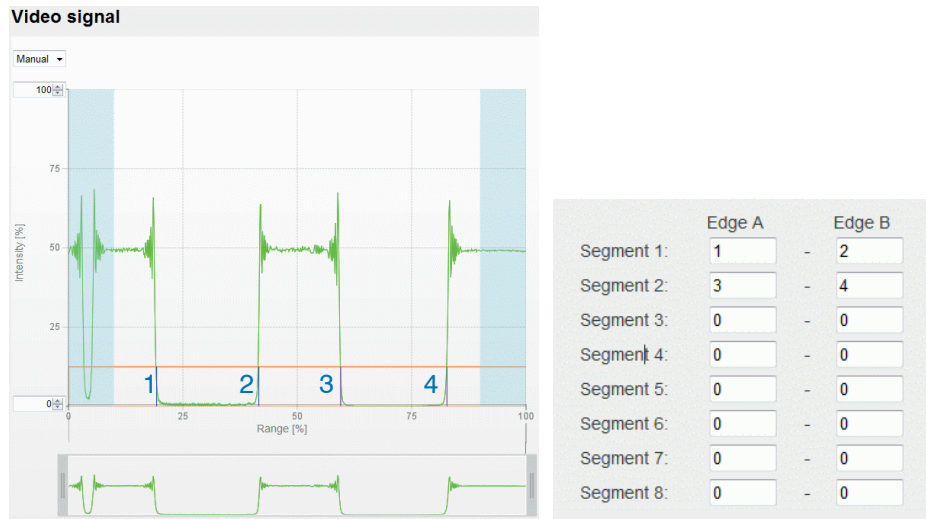


Fig. 39 Video signal with defined segments

## 6.4 User Interface, Basic Preferences

### 6.4.1 Introduction

The following chapters describe any controller settings that are required to get starts and quickly achieve first measuring results.

You can access additional submenus, e.g. for measuring rates and triggers, through the navigation bar on the left side of a web page.

**i** 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 or the measurement is restarted.

For details about other measuring control settings and features, such as setting masters or triggers in the Chapter Advanced settings, [see 7](#).

### 6.4.2 Measurement Distance

The measurement device optoCONTROL 2520 was calibrated for several distances and the corresponding calibration tables have been saved.

For accurate results, the target should be located at a set distance from the receiver.

Calibrated measurement distances: Target - receiver: 20 mm, 50 mm, 100 mm, 150 mm

➡ Select a calibrated distance from the list, confirm with `Submit`.

Calibrated measurement distances between target and receiver: 20 mm, 50 mm, 100 mm, 150 mm.

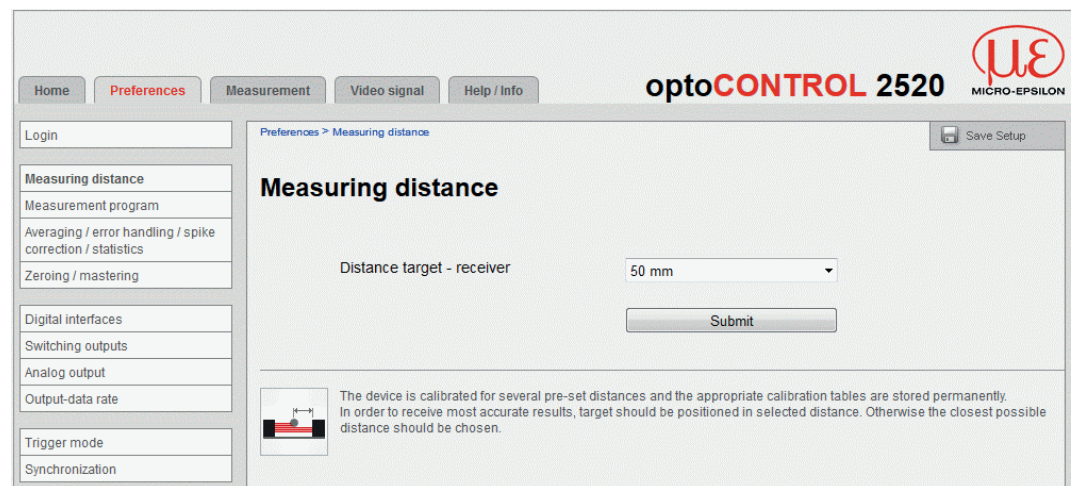


Fig. 40 Setting of measuring distance

Linearity uncertainties may occur,

- if the measurement distance changes during the measurement or
- the edge to be measured has a large thickness in parallel to the laser beam.

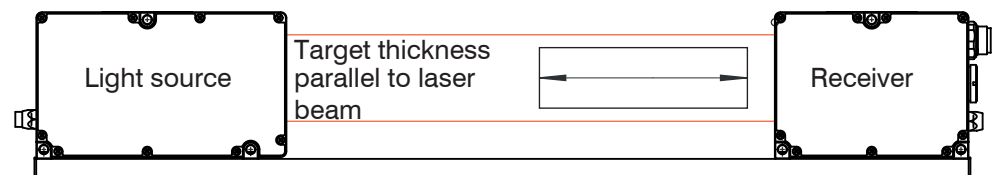


Fig. 41 Definition target thickness

### 6.4.3 Measurement Program

#### 6.4.3.1 Definitions

The measurement programs, which measure more than one edge, the positions of both single edges (edge A and B) as well as their center axis (average from edge A and B) can be output also beside the difference (diameter, gap or segment width).

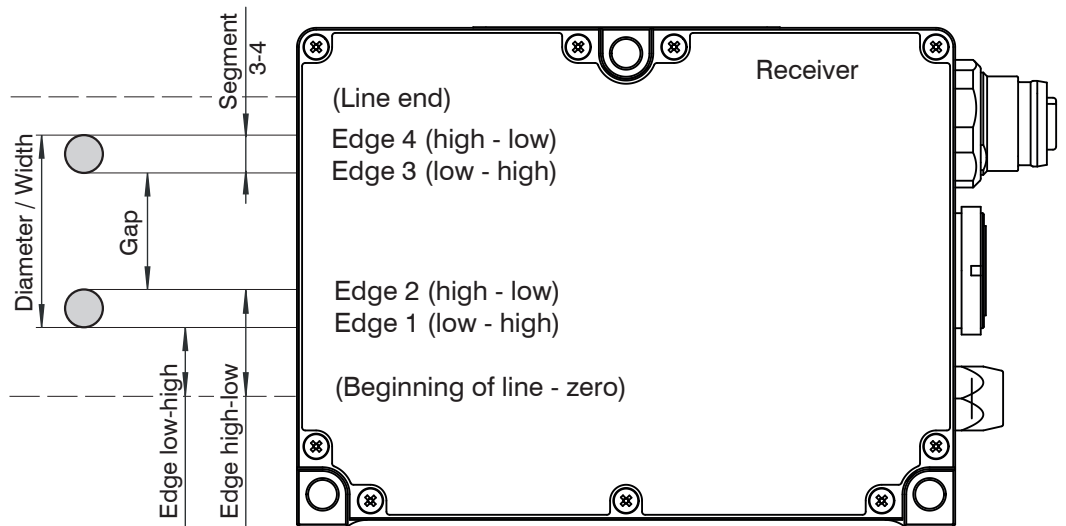


Fig. 42 Definition of terms for the measurement programs, standard method of counting the edges in search direction and measuring direction

Measurement program	Views	
Edge low-high Position of the first low-high edge (distance to beginning of line)		
Edge high-low Position of the first high-low edge (distance to beginning of line)		
Diameter / Width Length, position of single edges and middle axis (first low-high edge and last high-low edge)		
Gap Length, position of single edges (first high-low edge and subsequent edge)		
Any segments Measurement between two selectable edges, even possible from edge zero (SMR), see 7.2.		
	Example for a segment between 3rd and 4th edge Edge A: 3      Edge B: 4	Example for a segment between 1st and 4th edge Edge A: 1      Edge B: 3

Fig. 43 Measurement programs optoCONTROL 2520

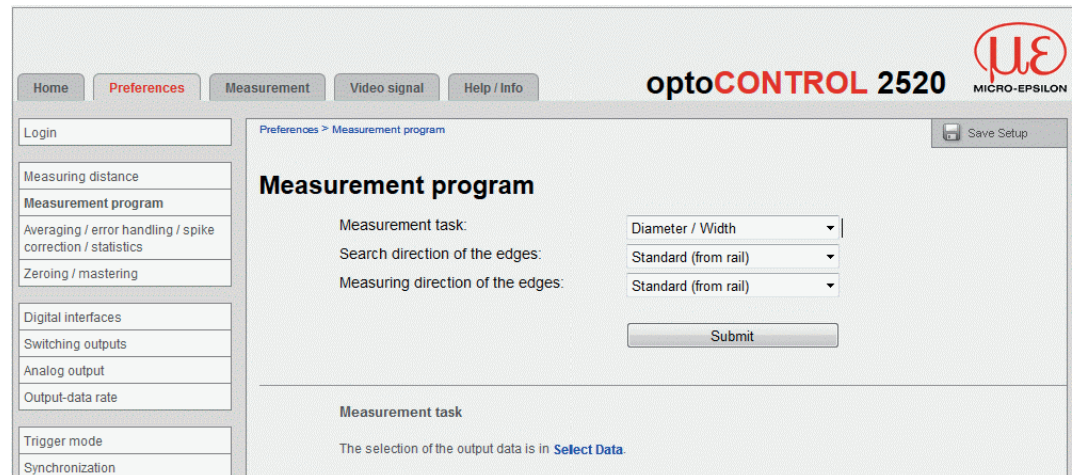
D = Difference from edge A and B,

M = Middle axis from edge A and B



### 6.4.3.2 Program Selection

➡ Go to the Preferences menu > Measurement program.





Measurement task	Edge low-high / edge high-low / diameter width / gap	Search direction of the edges	Standard (from rail) / Opposite	Selection of light transitions to define the desired measurement parameter
		Measuring direction of the edges	Standard (from rail) / Opposite	
	Any Segments	Search direction of the edges	Standard (from rail) / Opposite	
		Measuring direction of the edges	Standard (from rail) / Opposite	
Definition segments	Segment 1 ... segment 8 edge A	Edge number		
	Segment 1 ... segment 8 edge B	Edge number		

**i** The selected measurement program is used as the standard measurement program on startup.

➡ Select the desired measurement program e.g. Edge low-high and confirm with Submit.

The selection of data to be output for each measurement program is made by clicking on the link to the web page Data selection diagram, see 7.5.3.

 Fields with a gray background require a selection.

 *Value* Fields with dark border require entry of a value.

### 6.4.3.3 Change Search and Measuring Direction of Edges

The search direction determines the numbering respectively the sequence of edges, see Fig. 44. For certain installation situations, it may be useful to change this setting - for example, if not the first, but the last edge should be measured.

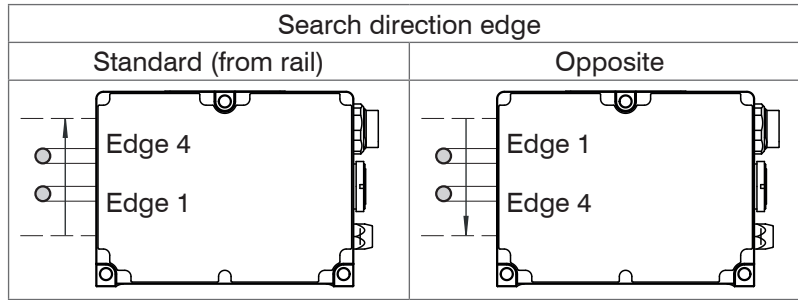


Fig. 44 Search direction of edges (examples)

The measuring direction determines the calculation of the measuring value, see Fig. 45.

For certain measurement tasks it may be useful to change the setting - for example, if the deviation of an edge is to be calculated in the opposite direction.

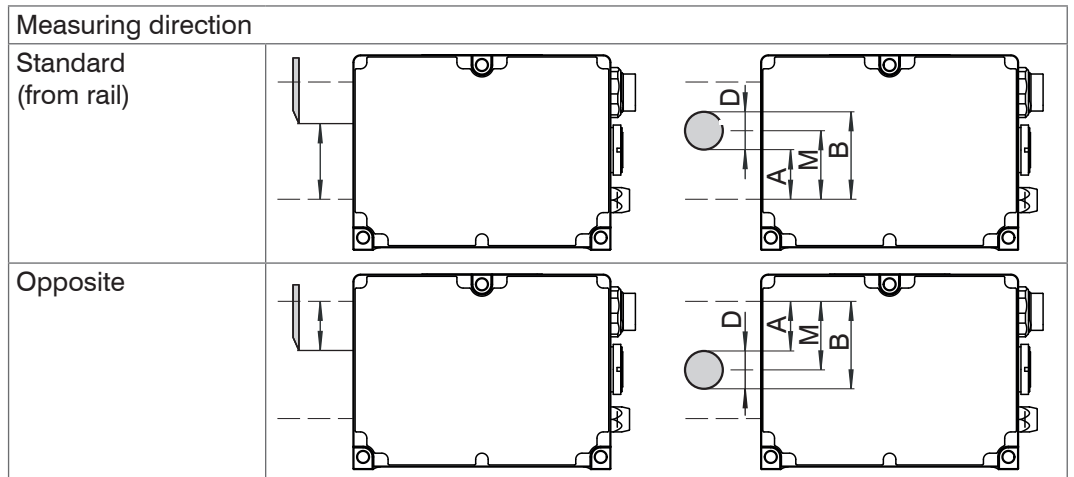
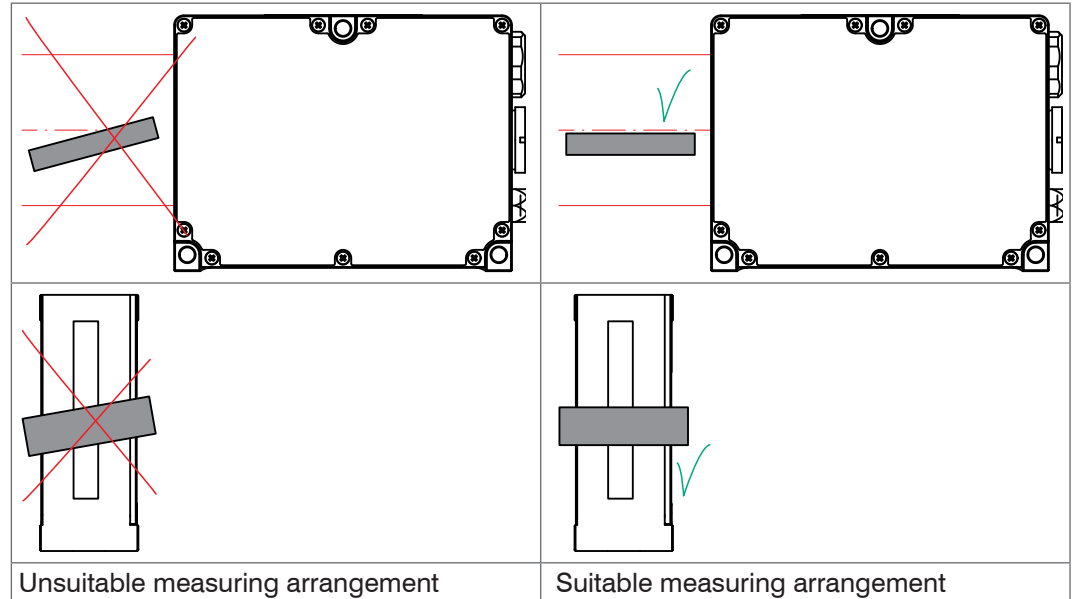


Fig. 45 Measuring direction of edges (examples)

### 6.5 Measurements with Web Page Display

- ➔ Place a target in the selected measuring distance to the receiver, possibly in the middle of the range.
- ➔ Pay attention to correct alignment of the sensor to the target.



- ➔ Click on **Measurement** menu in the top navigation bar.

You will see a web page with a timing diagram of measurement, according to the selected measurement program and the corresponding parameters, see Fig. 46.

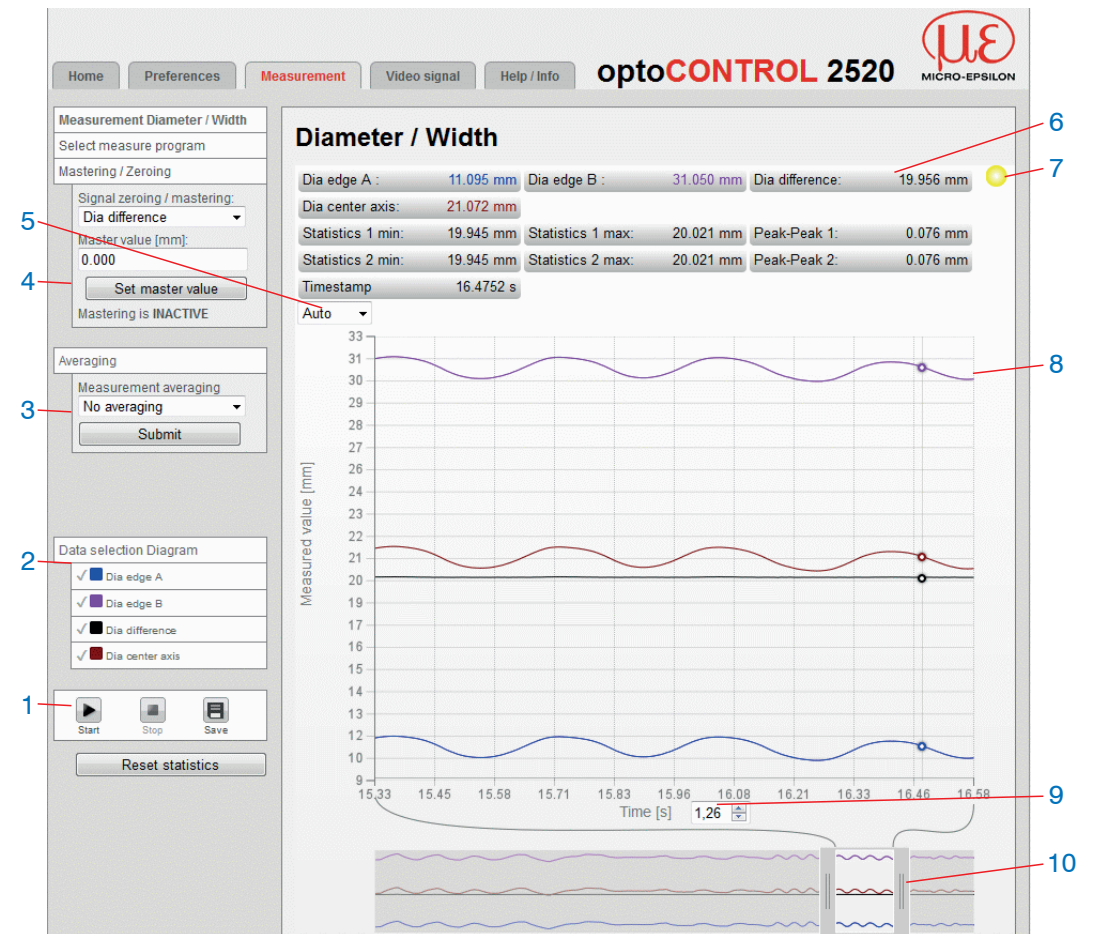


Fig. 46 Web page Measurement, example any segments

The web page includes the following functions:

- 1 Start the measurement by pushing the `Start` button (bottom left), end by clicking `Stop`.  
With the `Save` button the indicated measuring curves from (2) can be saved in the CSV format (time stamp and measuring values). Besides, the Windows selection dialog for data name and memory place opens.
- 2 In the window on the left, the result graphs can be enabled or disabled (both during and after measuring). The selection for the graphic display is effected by the link `Data selection diagram`.
- 3 In the window on the left, the type of averaging and the number of values can be set. Press `Submit` to accept the value.
- 4 The functions `Mastering` and `Zeroing` can be performed during the measurement. With the link `Zeroing / mastering` go to the menu `Preferences > Mastering / Zeroing`. There, you specify the signal to which the `Zeroing` respectively `Mastering` function is applied. Masters or zero setting is done with the `Set master value` respectively `Reset master value` button.  
  
The `Mastering` and `Zeroing` setting function is limited to the listed signals in the `Data selection diagram` (2).
- 5 `Auto` (= automatic scaling) or `Manual` (= manual setting) allow for scaling the intensity axis (Y axis) of the graph.
- 6 The current values of the selected signals (2) are displayed.  
The statistic values minimum, maximum and peak-to-peak of the last evaluation range refer to the selected statistic signals, [see 7.3](#).
- 7 Status Display
  - Green: OK; data transfer is active
  - Yellow: data transfer is stopped
  - Red: sensor connection is disturbed
- 8 Representation of the signals in time diagrams.
- 9 Displayed time range for the graphical representation, value range from 0.1 to 20 s.
- 10 X axis scaling: The diagram displayed above is zoomable with both sliders on the right and on the left side in the lower total signal. Move it sideways also with the mouse in the center of the zoom window (cross arrow).

The manipulations in the diagram can be carried out with running as well as standing measurement (`Stop`). The `Save` function is only possible with finished measurement.

## 6.6 Save / Load Settings in Sensor

### 6.6.1 Preliminary Remarks

In this menu you can save current device settings to the controller and recall saved settings. You can permanently save eight different parameter sets in the controller.

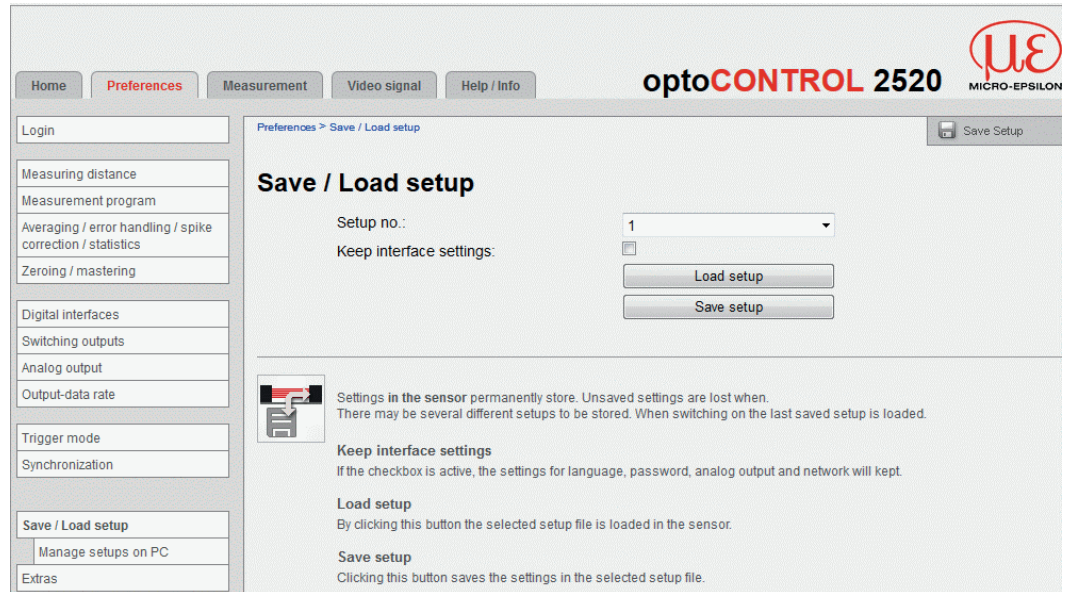


Fig. 47 Web page Save / Load setup

### 6.6.2 Save in Sensor

Current settings are saved in the sensor using the selected parameter set number. We recommend saving settings after programming the sensor, as the settings will be lost when the controller is switched off.

How to load settings:

- Select the required parameter set.
- Click the `Save setup` button.

The current settings are even available in the sensor after switching off / switching on.

For a fast saving to the last saved setup use the `Save setup` button in every preferences page.

**i** Switching on the sensor loads the set of parameters that was last saved in the sensor.

### 6.6.3 Load from the Sensor

The settings that are saved for the selected parameter setup number in the controller are enabled.

How to load settings:

- Select the required setup no. of parameters.

Only maintain interface settings, if the sensor is used with the same network and RS422 baud rate. If the checkbox is enabled, the settings for language, password, analog output and network.

- Select the `Keep interface settings` checkbox if desired.
- Click the `Load Setup` button.

The sensor uses the settings from the selected parameter set.

## 7. Advanced Settings

### 7.1 Login, Switching User Level

#### 7.1.1 Preliminary Remarks to Password Protection

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

- i** A software update will not change the standard password or a custom password.
- l** The user level password is setup-independent, and is not loaded or saved during setup. When an professional restores the factory settings (`Preferences` menu > `Extras` > `Factory Settings`), the professional level password is reset to 000.

User can do the following:

	User	Professional
Password required	no	yes
View settings	yes	yes
Change settings, change password	no	yes
View measuring values, video signal	yes	yes
Scale graphs	yes	yes
Restore factory settings	no	yes

Fig. 48 Permissions within the user hierarchy

#### 7.1.2 Change User Level

➡ Go to the `Settings` > `Login` menu.

**User > professional**

**Login**

Currently, you are logged as user

Password for login:

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

➡ Fix in the `User level at restart` field, in which user level the sensor should work after a restart.

**Professional > user**

**Login**

Currently, you are logged on as Professional.

Change to user level:

User level at restart:


➡ Click on `Logoff` button.


➡ Click on the `Save setup` button to save the user level permanently.


### 7.1.3 Password Assignment


In `Professional` mode, you can use the change password features to assign a custom password.

Password	<i>Value</i>	<i>All passwords are case-sensitive. Numbers are allowed, but special characters are not permitted.</i>
User level at restart	<i>User / Professional</i>	<i>Defines the user level that is enabled when the sensor starts the next time. MICRO-EPSILON Eltrotec GmbH recommends to select Professional level.</i>

 Enter your old password and the new password, including 1 x repeat and confirm with `Submit`.

 When an professional restores the factory settings (`Preferences` menu > `Extras` > `Factory Settings`), the Professional level password is reset to `000`.

 Fields with a gray background require a selection.

 *Value* Fields with dark border require entry of a value.

## 7.2 Measurement Program Segments

### 7.2.1 Preliminary Remark

More than 100 edges can be detected, but only up to 8 segments can be defined with the optoCONTROL 2520 sensor. The limits of a segment are to be defined by the edges A and B.

The sensor calculates the two edge positions (A, B) from the video signal for each segment, the difference (D) between two edges (A, B) and the position of the center axis (M).

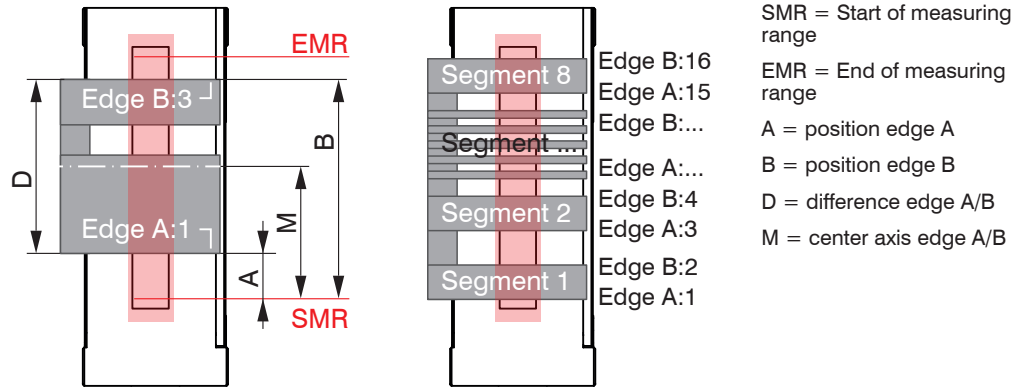


Fig. 49 Examples for segments

➡ Go to the Preferences > Measurement program.

When selecting the measurement program **Segments** an additional menu item / link to another web page **Definition segments** will appear.

### 7.2.2 Definition of Segments

Segment	Edge A	Edge B
Segment 1:	1	2
Segment 2:	3	12
Segment 3:	0	0
Segment 4:	0	0
Segment 5:	0	0
Segment 6:	0	0
Segment 7:	0	0
Segment 8:	0	0

Fig. 50 Web page Definition segments

➡ Select the appropriate segments and edges and confirm with **Submit**.

- Edge 0 is the start of measuring range.
- 1 Edge 1 is the edge, which the sensor finds as first in the selected searching direction, segments with  $A = 0$  and  $B = 0$  are ignored.

For the selection of the edges and segments, the display of video signal can be helpful in a separate window, see 6.3.2.

➡ To display the measurement values for the different segments, go to **Measurement > Data selection Diagram**, see Fig. 36.



### 7.3 Averaging / Error Handling / Spike Correction / Statistics


#### 7.3.1 Notes on Averaging


Measured value averaging	No averaging			Specify the type of averaging. N defines how many sequential measurements the sensor will use for averaging, before issuing the next reading
	Moving for N values	2 / 4 / 8 ... 128	Value	
	Recursive for N values	2 ... 32768	Value	
	Median for N values	3 / 5 / 7 / 9	Value	
Error handling	Error output, no measurement value			Sensor displays an error number.
	Hold last value	0 ... 1024	Value	If no valid reading can be obtained, the last valid value can be hold for a certain period of time, and will be issued repeatedly. If the reading is 0, the last valid value is hold permanently.
	Keep last value infinitely			The last valid value is output infinite.
Spike correction	No			
	Yes	Evaluation length	Value	This filter removes individual very high spikes from a relatively constant course of measurement value. Smaller spikes are preserved.
		1 ... 10		
		Max. tolerance range (mm)	Value	
0 ... 46 or 0 ... 95				
	Number of corrected values	Value		
	1 ... 100			
Statistics	2 / 4 / 8 / 16 ... 8192 / all measured values			The statistical values Minimum, Maximum and Peak-to-Peak are calculated and output from a predefined number of measuring values.
Reading for statistics calculation	Segment n edge A Segment n edge B Segment n difference Segment n center axis			The measuring value for the statistics calculation is selectable and will if not already done, added to the output via Ethernet automatically.

The measuring value averaging reduces the noise or suppresses spikes. The calculated measuring values are averaged at the end of processing. The measuring rate remains unchanged.

#### 7.3.2 Processing Sequence

1. Determination of the edges
2. Calculation of differences (diameter, gap, segment) and middle axes
3. Troubleshooting when there is no valid measuring value
4. Spike correction of the measuring values
5. Measuring value averaging
6. Statistics

 Fields with a gray background require a selection.

 Value Fields with dark border require entry of a value.

### 7.3.3 Measuring Value Averaging

Measuring value averaging is performed after measurement values have been calculated, and before they are issued or processed through the relevant interfaces.

Measuring value averaging

- improves the resolution,
- allows masking individual interference points or
- “smooths” the reading.

ⓘ Linearity is not affected by averaging. Averaging has no effect on measuring rate and output rate.

The internal average value is re-calculated for each measuring cycle.

ⓘ The defined type of average value and the number of values must be saved in the controller to ensure they are hold after it is switched off.

The optoCONTROL 2520 is delivered without measuring value averaging.

#### Moving average

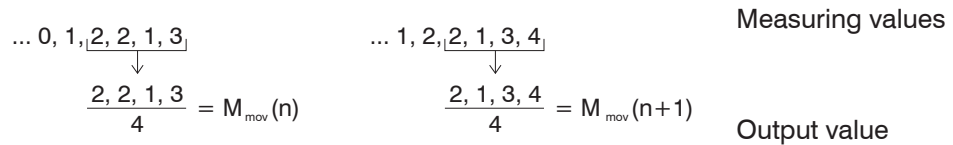
The definable number N for successive measurements (window width) is used to calculate the arithmetic average  $M_{mov}$  according to the following formula:

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

MV = Measuring value,  
 N = Averaging number,  
 k = Continuous index (in the window)  
 $M_{gl}$  = Averaging value respectively output value

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

**Example:** N = 4



ⓘ Moving average in the sensor allows only potentials of 2 for N. The highest averaging number is 128.

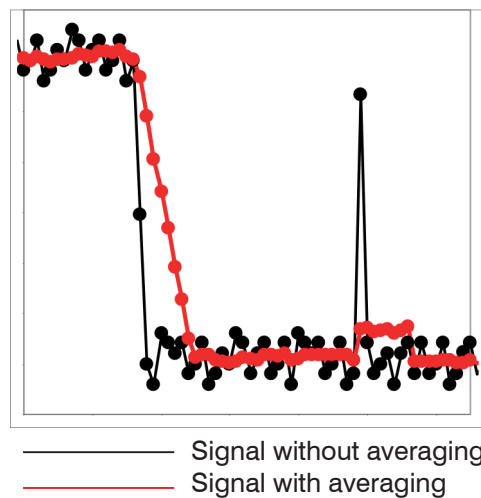


Fig. 51 Moving average, N = 8

#### Application tips

- Smooths measured values
- The effect can be finely controlled in comparison with the recursive averaging
- With uniform noise of the measured values without spikes
- At a slightly rough surface, in which the roughness should be eliminated
- Also suitable for measured value jumps at relatively low settling time

### Recursive average

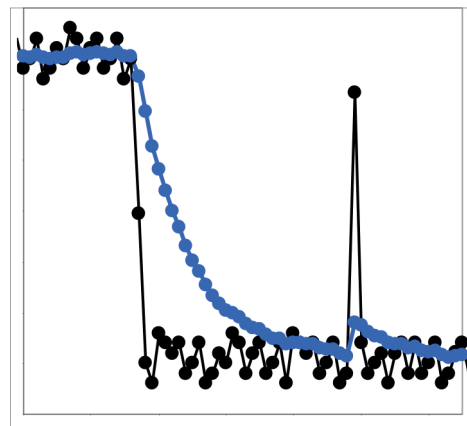
Formula:

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

$MV$  = Measuring value,  
 $N$  = Averaging number,  $N = 1 \dots 32768$   
 $n$  = Measurement index  
 $M_{rec}$  = Averaging value or output value

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

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.



————— Signal without averaging  
————— Signal with averaging

Fig. 52 Recursive average,  $N = 8$

#### Application tips

- Permits a high degree of smoothing of the measurement values. However, it requires extremely long transient recovery times for measured value jumps (low-pass behavior)
- Permits a high degree of smoothing for noise without strong spikes
- For static measurements, to smooth signal noise
- For dynamic measurements on rough surfaces, to eliminate the roughness, e. g. roughness of paper
- For the elimination of structures, e. g. parts with uniform grooves, knurled rotary parts or roughly milled parts
- Unsuitable for highly dynamic measurements

### Median

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

When creating a median value for sensor, incoming readings are sorted after each measurement. Then, the average value is provided as the median value.

3, 5, 7 or 9 readings are taken into account. This means that individual interference pulses can be suppressed. However, smoothing of the measurement curves is not very strong.

**Example:** Median value from five readings

$\dots 0 \ 1 \ \underline{2 \ 4 \ 5 \ 1 \ 3} \rightarrow$  Sorted measuring values: 1 2 3 4 5     Median<sub>(n)</sub> = 3  
 $\dots 1 \ 2 \ \underline{4 \ 5 \ 1 \ 3 \ 5} \rightarrow$  Sorted measuring values: 1 3 4 5 5     Median<sub>(n+1)</sub> = 4

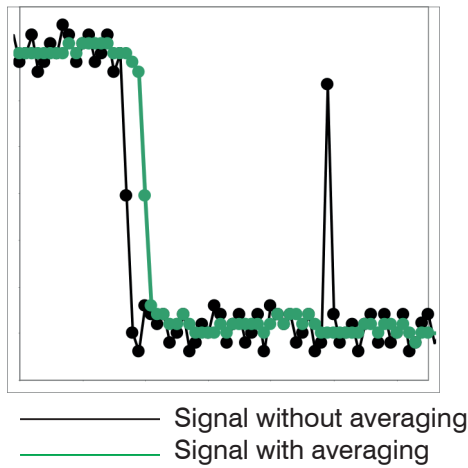


Fig. 53 Median,  $N = 7$

Application tips

- The measurement value curve is not smoothed to a great extent, used to eliminate spikes
- Suppresses individual interference pulses
- In short, strong signal peaks (spikes)
- Also suitable for edge jumps (only minor influence)
- For rough, dusty or dirty environment, to eliminate dirt or roughness
- Further averaging can be used after the median filter

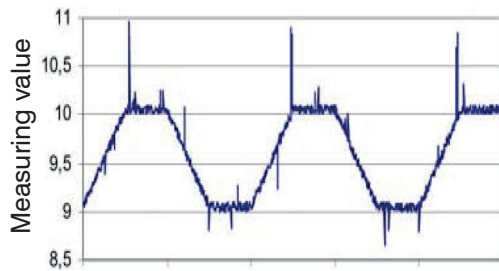


Fig. 54 Original profile

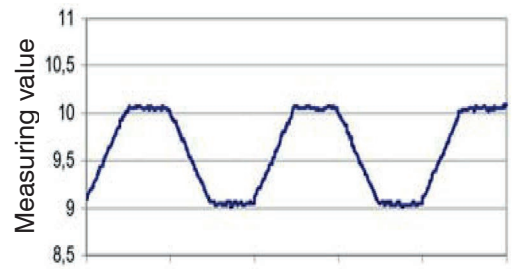


Fig. 55 Profile with Median,  $N = 9$

**7.3.4 Error Handling (Hold Last 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.

Between 1 and 1024 values can be hold.

When `Keep last value infinitely`, the last value is hold until a new, valid reading is obtained.

### 7.3.5 Spike Correction

This special form of filtering is used to remove very high spikes from a relatively constant course of measurement values, though while retaining any smaller spikes. A median would remove all the spikes.

The assessment of whether a measurement is a spike (outlier) is based on the mean of a particular number of previous valid readings. The permissible deviation from the next value is calculated using the tolerance range. If the new measured value deviates too much, it will be corrected to the previous value. A maximum number of consecutive measured values to be corrected must also be stated.

Attention: In the event of several consecutive spikes (outliers), the previous corrected value is used in the correction of the following measured value. Use this function only in appropriate applications. Improper use can lead to a distortion of the measured value sequence! Check the possible impact of a changed measured value sequence on the measuring environment and subsequent controllers/systems.

This function acts the same way on all output distances; the differences (thicknesses) are calculated on the basis of the corrected distances.

- x Evaluation length. Number of previous measured values to be assessed (max. 10).
- y Max. tolerance range (mm); the spike (outlier) correction comes into play when the value is not met or is exceeded
- z Number of corrected values (maximal 100)

Example:  $x = 3 / y = 0.05 / z = 1$

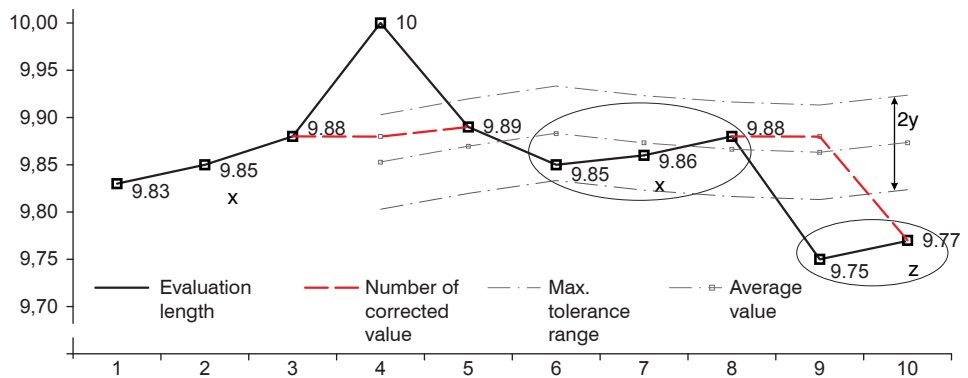
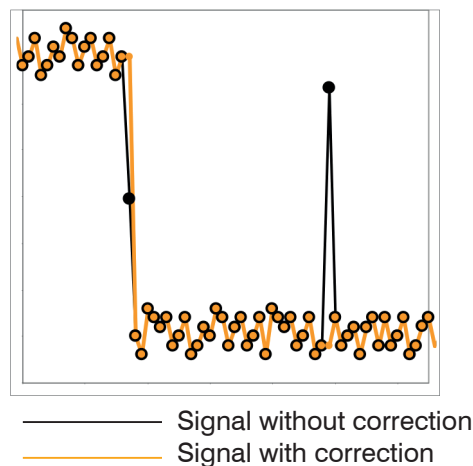


Fig. 56 Correction of measuring values



#### Application tips

- Eliminating spikes with an adjustable threshold
- For highly dynamic data acquisition of fast moving objects
- With measurement jumps suitable, especially those with interfering peaks
- With edge jumps and with some bent edge transitions
- Execution is done before other averages take place

### 7.3.6 Statistics

The sensor derives the following statistical values from the measurement result:

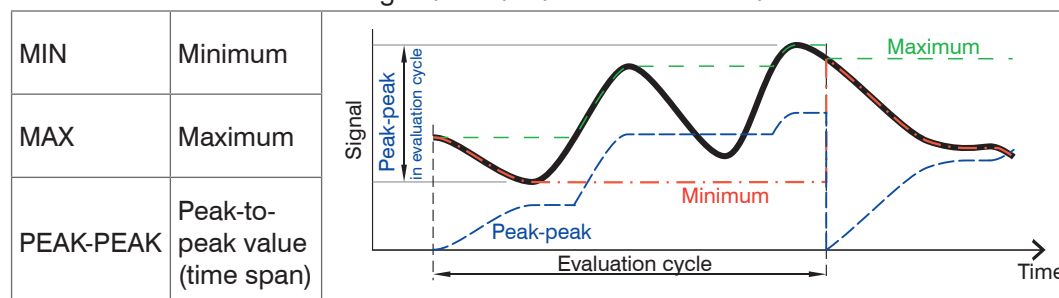


Fig. 57 Evaluation cycle of statistical values

Statistical values are calculated from measurements within an evaluation cycle. The number of measurements used for calculation can be between 2 and 8192 (potential of 2), or include all measurements.

Use the `Statistics reset` button or the `RESET STATISTICS` command to start a new evaluation cycle (storage period).

Mastering or reset mastering via the switching input, [see 7.4.3](#), also resets the statistical values.

When a new cycle starts, previous statistical values are deleted.

Statistical values are displayed in the web interface (`Measurement` section) or issued via the interfaces.

## 7.4 Zeroing / Mastering

### 7.4.1 General

Use zeroing and setting masters to define a target value within the measuring range. This shifts the output range. This feature can be useful, for example, for a diameter determination. Here can be mastered to a nominal value of a test pin or a zero setting of a paper edge in its desired position.

Mastering (setting masters) is used to compensate for mechanical tolerances in the sensor measurement setup or to correct chronological (thermal) changes to the sensor. 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.

Signal zeroing/ mastering	Program edge low-high	Edge low-high	Selection at the measuring programs "Diameter", "Gap" and "Any segments", otherwise the measuring value of the selected measuring program applies.
	Program edge high-low	Edge high-low	
	Program diameter/width	Diameter edge A / Diameter edge B / Diameter diff. / diameter center axis	
	Program gap	Gap edge A / Gap edge B / Gap diff. / gap center axis	
	Program any segments	Segment n edge A / Segment n edge B / Segment n difference / Segment n center axis	
Master value	Millimeter / Inches	Value	Specifying, for example, the diameter of a master piece. Value range: -46.0 mm ... +46.0 mm (-1.811 ... +1.811 "). -95.0 mm ... +95.0 mm (-3,74 ... +3,74")

### 7.4.2 Setting Zeroing / Masters

- ➡ Place target and sensor into their required positions.
- ➡ Change to the `Preferences > Zeroing / mastering` menu.

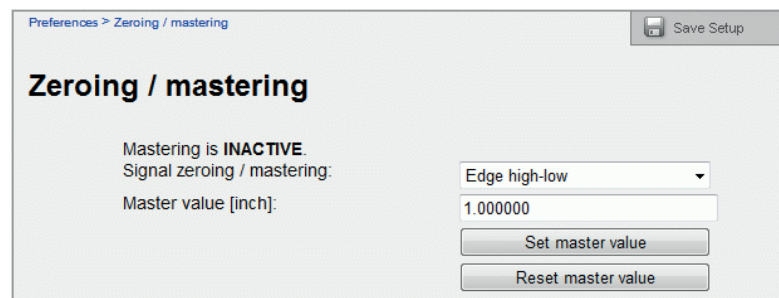




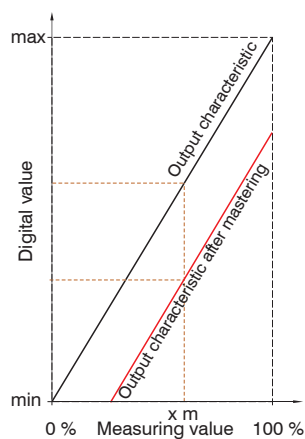
Fig. 58 Web page Zeroing / mastering

- ➡ Change the corresponding signal in the `Signal zeroing / mastering` field and enter the `Master value`.
- ➡ Click `Set master value`.

After setting the master, the sensor will issue new readings that relate to the master value. If you click the `Reset master value` button to undo the mastering process, the system reverts to the state that existed before the master was set.

 Fields with a gray background require a selection.

 *Value* Fields with dark border require entry of a 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). However, this applies only for the RS422 and the analog output.

- i** Mastering or zeroing requires a target object to be present in the measuring range and affects both analog and digital outputs.

Fig. 59 Moving the characteristic when mastering

### 7.4.3 Mastering or Zeroing via Switching Input (In)

The input In can trigger the zeroing or the mastering of the ODC 2520 by connecting to GND. The connection can be done e.g via an external switch or transistor. The connection time triggers thereby various operations, see 5.3.7.

- Time < 2 s            Mastering, reset statistic values
- Time 2 s to 5 s      Reset mastering, reset statistic values
- Time > 10 s         Load factory setting

The function mastering or zero setting through the switching input is independent of the user level.



## 7.5 Digital Interfaces

### 7.5.1 Overview Menu Structure

Select digital interfaces	<i>Output in the web diagram / Ethernet measurement transfer/ RS422</i>	<i>Defines which interface is used for data output. No parallel data output via multiple channels.</i>	
Select data	<i>Difference / edge A / edge B / center axis</i>  <i>Statistics: min / max / peak-to-peak) /</i>  <i>Number: edges / pins / gaps</i> <i>Sensor state / Measured value counter / Time stamp</i>	<i>Select the relevant check boxes to choose which data are used for transmission. The data are issued one after the other in a defined sequence. RS422 allows transmission of no more than 32 records.</i>  <i>The data selection is required for the interfaces Ethernet and RS422.</i>	
Settings Ethernet	IP settings of basic device	<i>Static IP-address / DHCP</i>	<i>Values for IP address / gateway / subnet mask. Only for static IP address</i>
	Ethernet measured value transfer settings	<i>Server / Client</i>	<i>Values for port and IP address</i> <i>TCP/IP / UDP/IP</i>
Settings RS422	Baudrate	<i>9.6 / 115.2 / 230.4 / 460.8 / 691.2 / 921.6 / 1500 / 2000 / 2500 / 3000 / 3500 / 4000 kbps</i>	
Ethernet/ EtherCAT	Operating mode after start	<i>Ethernet / EtherCAT</i>	

### 7.5.2 Select Digital Interfaces

The optoCONTROL 2520 has three digital interfaces that can be used as an alternative data output in conjunction with parameterization.


➡ Change to the Preferences > Digital interfaces > Select digital interfaces menu.


➡ Select the designated digital interface for data output and confirm with Submit.

- Web diagram: Measuring value and video data can be transmitted. Configuring the measuring device can be done via the web interface or by ASCII commands via a terminal program.
- Ethernet measuring value transmission: allows fast data transfer, but provides no real-time capabilities (packet-based data transfer). Both measurement and video data can be transferred. Use to capture measurements without any direct process control, for subsequent analysis. Parameterization is provided through the web interface or ASCII commands.
- RS422: provides a real-time capable interface with a lower data rate.

Ethernet	Recording of measuring values without direct process control, for subsequent analysis.
RS422	Process control, data acquisition in real time.

For a configuration of the sensor via the web interface Ethernet is also required. The HyperTerminal® program has an interface for the serial communication with sensor via RS422, as well as the Telnet® program via Ethernet, see A 7.

 Fields with a gray background require a selection.

 *Value* Fields with dark border require entry of a value.

### 7.5.3 Select Data

This menu allows the selection of data to output via Ethernet or RS422. The output data are then output successively in a fixed order. You will find details about the data format and the in the ASCII description, see A 6.5.

➡ Go to the Preferences > Digital interfaces > Select data menu.

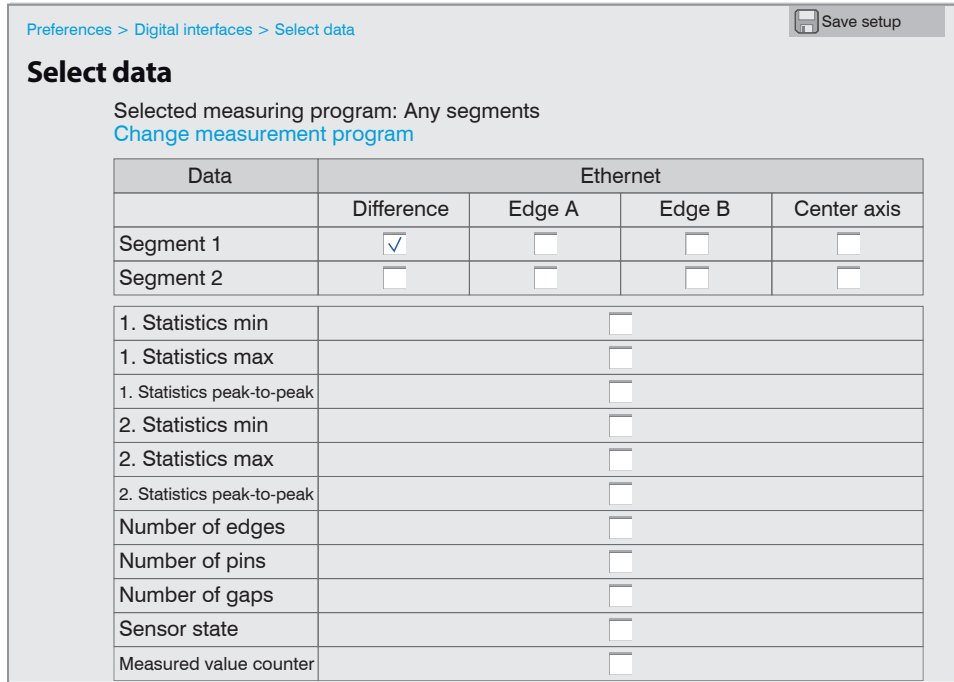


Fig. 60 Web page Select data

➡ Select the appropriate data and confirm with Submit.

In addition to the specific measuring values of the measurement program, the following data can be selected in the table for output:

Statistics min, max, peak-to-peak: applies to a selected measurement, see 7.3.1.	
Number of edges: All the detected low-high and high-low transitions	
Number of pins: All high ranges, which are limited by two edges, completely lying within the measuring range	
Number of gaps: All low ranges, which are limited by two edges, completely lying within the measuring range	
Sensor Status: Error and status of the outputs	
Measurement value counter: Allows the assignment of the selected signals to the video signal	
Time stamp: Allows the temporal assignment of measuring values	

Fig. 61 Declaration to the output data

In each measuring program, the number of detected edges is determined.

The number of edges, for example, are used to monitor whether parts with multiple edged lie completely within the measuring range of optoCONTROL 2520.

By means of the count functions, the number of pins or gaps can be output. Pins are dark ranges which are limited by two edges.

In the pictured example, see Fig. 61, 8 edges, 3 pins and 4 gaps are recognized.

The selected data, see Fig. 60, are transmitted in a frame.

### 7.5.4 Ethernet

When using a static IP address, you need to specify values for IP address, gateway and subnet mask; this is not necessary when using DHCP.

The sensor is factory set to the static IP address 169.254.168.150.

The optoCONTROL 2520 transmits TCP/IP or UDP/IP packages with an Ethernet transfer rate of 10 Mbit/s or 100 Mbit/s. The transfer rate is selected automatically depending on the connected network or PC.

Any output values and additional information to be transmitted that are logged at one point in time are combined to form a value frame. Multiple value frames are combined as one measurement block and enclosed by an additional header. The header must be located at the start of a UDP/IP or TCP/IP packet. One current header per packet is transmitted.

When transmitting measurement data to a measurement server, following successful connection (TCP or UDP), the sensor sends each measurement to the measurement server or to the connected client. No explicit request is required.

If any changes are made to the transmitted data or the frame rate, a new header will be sent automatically. Distance and thickness values are transmitted as 32 bit signed integer with 1 nm resolution. Limiting the amount of data is possible, see Chap. 7.8.

Video signals are transmitted the same way as measurement data are sent to a measurement server via Ethernet with one exception: only one video signal per measurement cycle is transmitted in a measuring value block.

This measuring value block can vary also over different TCP/IP or UDP/IP packets depending on the size of the video signal.

You can program the optoCONTROL 2520 also with the Telnet program and the ASCII command set. This requires an existing Ethernet connection, see A 6.5.

### 7.5.5 RS422

The interface RS422 has a maximum baud rate of 4000 kBaud. As a factory setting, the baud rate is set to 115.2 kBaud. Use ASCII commands or the web interface to configure.

Data format: Binary. Interface parameter: 8 data bits, no parity, 1 stop bit (8N1).

The baud rate is selectable.

Transfer settings for the optoCONTROL 2520 and PC must match.

**i** Do not forget to save your settings, before you switch off the sensor.

Via the interface RS422 18 bit per output value is transmitted. In addition, up to 32 output values are transmitted in parallel.

The maximum number of measuring values that can be transferred for a measuring point, depend on a transmission rate of the RS422 interface. As far as possible the highest available transmission rate (baud rate) should be used.

Baud rate	Max. number of measuring data		Baud rate	Max. number of measuring data	
	MR 46 <sup>1</sup>	MR 95 <sup>1</sup>		MR 95 <sup>1</sup>	MR 95 <sup>1</sup>
9600	---	---	1500000	20	25
115200	1	1	2000000	26	33
230400	3	3	2500000	33	41
460800	6	7	3000000	40	50
691200	9	11	3500000	46	58
921600	12	15	4000000	53	66

Fig. 62 Number of the transferable measuring data in dependence of the baud rate <sup>2</sup>

Example: With a baud rate of 230400 Bd only 3 measuring data belonging to each other, e.g. the diameter, the center axis and the measuring value counter can be transferred with 2.5 kHz.

1) MR = Measuring range

2) Applies for the RS422 setting 8N1 (8 data bits, N no parity, 1 stop bit), if no filter/averaging is activated.

## 7.6 Switching Outputs

### 7.6.1 General

Assignment of the switch outputs (digital I/O)	Switch output „Error 1“ Switch output „Error 2“	Measurement error / No output / Lower limit value (Gr1) / Upper limit value (Gr2) / Gr1 or Gr2 / Incorrect number of edges	
Limit value settings	Lower limit value (in mm / ")	Value	
	Upper limit value (in mm / ")	Value	
	Reading, referred to by the limits	Program edge low-high	Edge low-high
		Program edge high-low	Edge high-low
		Program diameter/width	Diameter edge A / Diameter edge B / Diameter diff. / diameter center axis
		Program gap	Gap edge A / gap edge B / gap diff. / gap center axis
Program any segments	Segment n edge A / Segment n edge B / Segment n difference / Segment n center axis		
Switch threshold of the error outputs	Switching output 1 / Switching output 2	npn / pnp / push-pull / push-pull inverted	

### 7.6.2 Assignments of the Switch Outputs (Digital I/O)

The two switching outputs (Out 1 / 2) can be assigned different meanings:

- Measurement error: Measuring values can not be determined because no or too few edges for the selected measurement program are recognized.
- Lower limit: Switches when the specified lower limit is undercut.
- Upper limit: Switches when the specified upper limit is undercut.
- Size 1 or size 2: Switches, when undercut or exceeding of designated limit values (“not ok“ = nok) exists.
- Wrong number of edges: There are less than the specified edges detected, for example, to monitor the correct positioning of the target.

The limit values are displayed in the measurement diagram, if at least a switching output is set to limit monitoring in the menu item Preferences > Switching outputs.

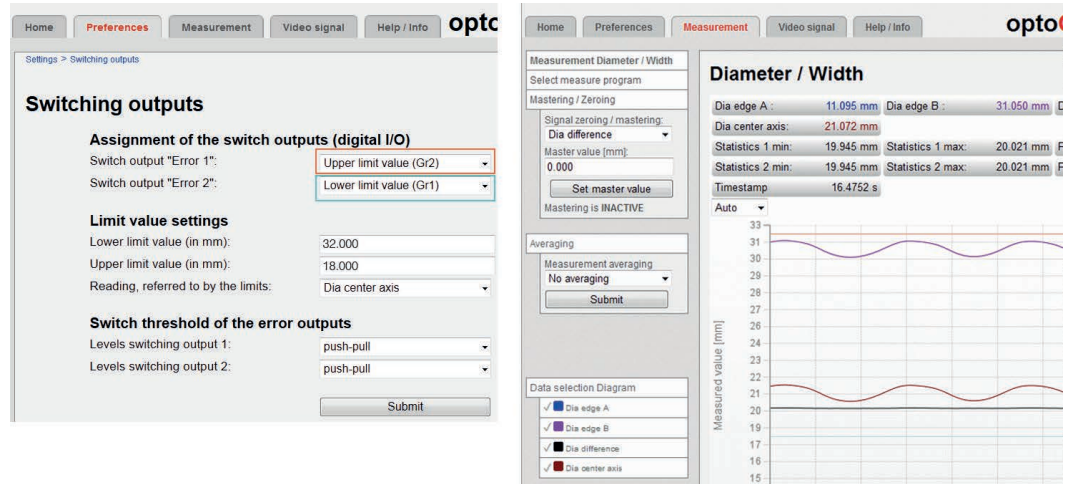


Fig. 63 Using the limit values for the measurement

Fields with a gray background require a selection.

Value Fields with dark border require entry of a value.

### 7.6.3 Limit Value Settings

Only a selectable measuring value can be monitored. In this case, enter lower and upper limit values.

If mastering is active, the limit values refer to the mastered measuring values.

### 7.6.4 Switch Behavior of Error Outputs

The switch behavior (switch behavior, switch level) of the outputs Out 1/2 can be set, if an error appears or the upper limit is exceeded / the lower limit is undercut. Hardware switching outputs, see Chap. 5.3.7.

	Output active (with error, limit value exceeding)	inactive
Switch behavior	Output connects in series	
NPN (Low side)	GND	approx. $+U_H$ <sup>1</sup>
PNP (High side)	$+U_B$	approx. GND
Push-Pull	$+U_B$	GND
Push-Pull, negated	GND	$+U_B$

➡ Take the requested settings and confirm with `Submit`.

1)  $U_H < 30\text{ V}$

## 7.7 Analog Output

### 7.7.1 General

Be output measuring value	Program edge low-high	Edge low-high	
	Program edge high-low	Edge high-low	
	Program diameter width	Diameter edge A / diameter edge B / Diameter diff. / Diameter center axis	
	Program gap	Gap edge A / Gap edge B / Gap diff. / Gap center axis	
	Program any segments	Segment n edge A / Segment n edge B / Segment n difference / Segment n center axis	
Output range	0V ... 10V / inactive		
Scaling	Standard		
	Two-point	0V corresponds (in mm / ")	Value
		10V corresponds (in mm / ")	Value

### 7.7.2 Setting Analog Output

Only a measuring value can be transmitted at the analog output. This only applies for the measurement programs *Diameter* / *Width*, *Gap* and *Any segments*.

The resolution of the analog output is 16 bit.


➡ Go to the *Preferences > Analog output* menu.


Fig. 64 Web page analog output

Output area:

- 0 V Start of measuring range
- 10 V End of measuring range
- 10.3 V Error

➡ Take the desired settings and confirm with *Submit*.

 Fields with a gray background require a selection.

 *Value* Fields with dark border require entry of a value.

### 7.7.3 Two-Point Scaling

If you use only one part of the measuring range, the output area of the analog output can be also spread or be turned. The sensor calculates factor and movement itself.

**i** If only the output needs to be moved, we recommend to use the `Zeroing / Mastering`.

Two-point scaling enables the user to specify separate start and end values (in millimetre) for the sensor's measuring range. The available output range of the analog output is then spread between the minimum and maximum values, see Fig. 65. This allows for decreasing analog characteristics.

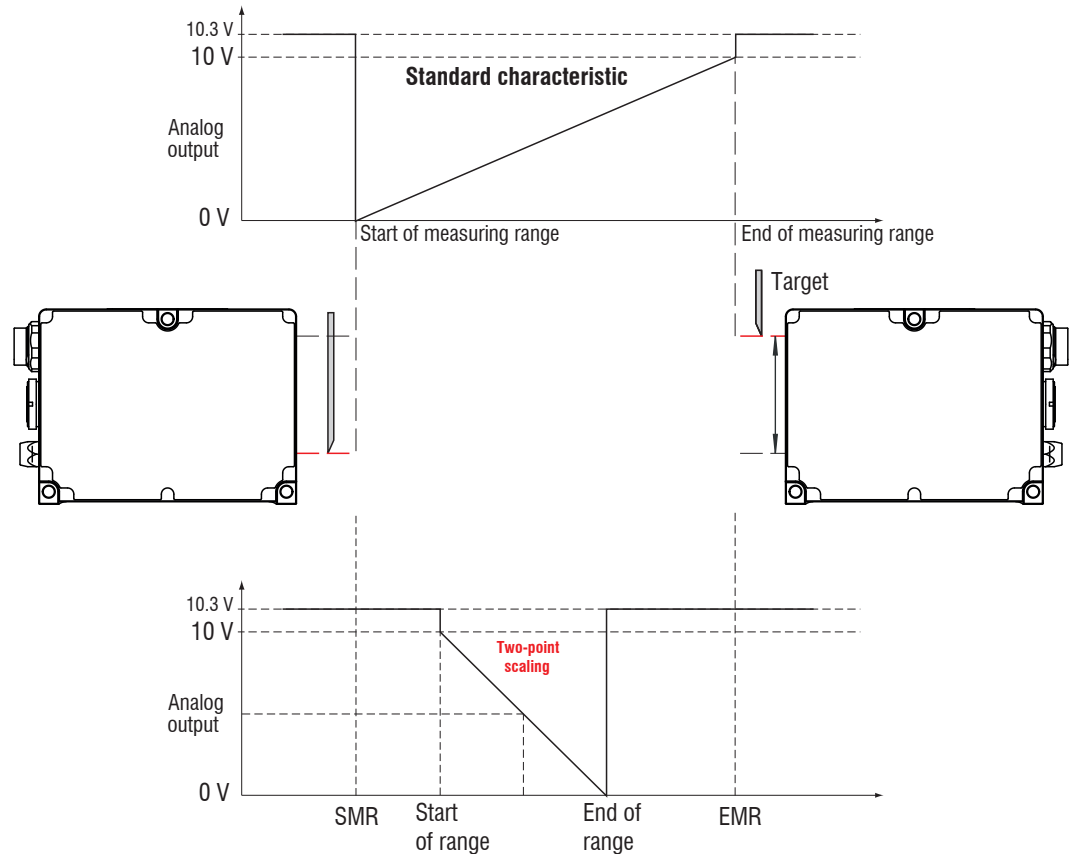


Fig. 65 Scaling of analog signal, measurement program edge low-high

### 7.8 Output Data Rate

The reduction of output data rate means that only every *n*th measuring value is output. The other measuring values are rejected.

**i** A possibly desired averaging over *n* values must be set separately.

**➡** Go to the `Preferences > Output data rate` menu.


Measuring value	<i>Value</i>	<i>Only every n<sup>th</sup> measuring value is output. n = 1: every n = 2 ... 150000</i>
Reducing interfaces	Analog / RS422 / Ethernet	Select the relevant check boxes to choose which interfaces are used for data reductions.


**➡** Select the desired reduction of output data rate and confirm with `Submit`.

**i** Do not forget to save the setup before you switch off the sensor.

EMR = End of measuring range

SMR = Start of measuring range

 Fields with a gray background require a selection.

 *Value* Fields with dark border require entry of a value.

## 7.9 Trigger Mode

### 7.9.1 Preliminary Remarks

Value input and output on the optoCONTROL 2520 can be controlled through external electrical trigger signals or commands. Both analog and digital outputs are affected. The measured value to the trigger point is output delayed, see 7.15.

- Triggering does not affect preset measuring rates.
- The Sync input (Sync in) is used as external trigger input. Trigger source can be, for example, an encoder with RS422-level or a level converter which resets the TTL / HTL signals in RS422 level. Micro-Epsilon recommends the level converter SU4-x from LEG Industrie-Elektronik, see Chap. A 1, see Chap. 7.9.5.
- Factory settings: no triggering, the sensor starts transmitting data as soon as it is switched on.
- Pulse duration of trigger signal is 5  $\mu$ s or more.

<i>Level triggering</i>	Measuring value input Measuring value output	Level low / Level high	
<i>Edge triggering</i>	Measuring value input Measuring value output	Starts the output of measuring data	Falling edge / Rising edge
		Number of measuring value	Value [1 ... 16383]
<i>Software triggering</i>	Measuring value input Measuring value output	Number of measuring value	Value [1 ... 16383]
<i>No triggering</i>		<i>continuous measuring value output</i>	


### 7.9.2 Setting the Trigger Mode


➡ Go to the Preferences > Trigger mode menu.

Fig. 66 Web page trigger mode

The checkbox Termination of the Sync/Trig input switches the internal 120 Ohm terminating resistor at the trigger input on or off.

- ➡ Select the trigger mode and the assignment of the trigger event to measuring value input / output as well as the termination and confirm with Submit.
- ➡ Go to the appropriate subpage Preferences of the edge / level / software triggering.

 Fields with a gray background require a selection.

 Value Fields with dark border require entry of a value.



**Level triggering.** Continuous value input/output as long as the selected level is active. After that the controller stops the input/output of the values. Pulse duration must last for at least one cycle. The subsequent pause must also last for at least one cycle.

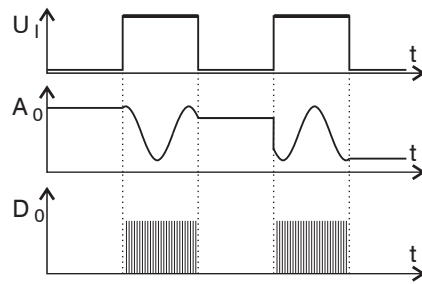


Fig. 67 Active high level trigger ( $U_i$ ), relevant analog signal ( $A_o$ ) and digital signal ( $D_o$ )

**Edge triggering.** Starts value input/output as soon as the selected edge is active to the trigger input. If trigger conditions are met, the controller outputs a defined number of measurements.

Value range:

- 1 ... 16382: Number of measuring values, to be output after a trigger pulse.
- 16383: Start an infinite measuring value output after a trigger pulse.
- 0: Stops data output.

After termination of the data output, the analog output remains at the last value (Sample & Hold).

The duration of the pulse must be at least 5  $\mu$ s.

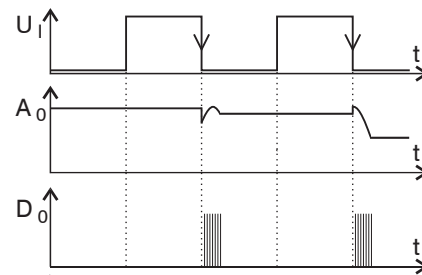


Fig. 68 Falling edge trigger ( $U_i$ ), relevant analog signal ( $A_o$ ) and digital signal ( $D_o$ )

**Software triggering.** Starts outputting values as soon as a software command (instead of the trigger input) or the Start triggering button is activated. The point in time is not defined as accurately. If trigger conditions are met, the sensor outputs a defined number of measuring values.

Value range:

- 1 ... 16382: Number of measuring values to be output after a trigger pulse.
- 16383: Start an infinite measuring value output after a trigger pulse.
- 0: Stops the data output.

The measuring value output can be terminated by a command, see A 6.

### 7.9.3 Triggering the Measuring Value Output Recording

The current array signal is only further processed after a valid trigger event and the measuring values are calculated from this. The measurement data is then transferred for further calculation (e.g. averaging or statistics), as well as the output via a digital or analog interface.

When calculating averages or statistics, measuring values immediately before the trigger event cannot be included; instead older measuring values are used, which had been entered during previous trigger events.

### 7.9.4 Triggering the Measuring Value Output

The calculation of the measuring values is performed continuously and independently of the trigger event. A trigger event only triggers the output of the values via a digital or analog interface. Thus values measured immediately before the trigger event are used when calculating means (averages) or statistics. The triggering of the measuring value recording and output have the same timing, see 7.15.

### 7.9.5 Example

The trigger inputs on the sensor expect RS422 level. The following example shows the adjustment of a 24V trigger source with the level converter SU4-1 from the optional accessories.

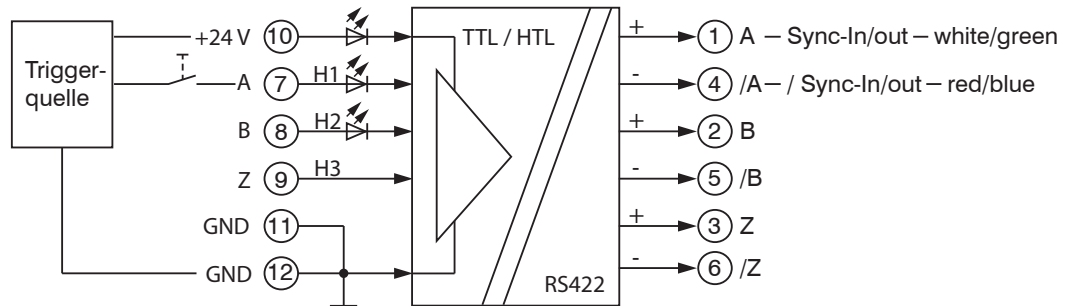


Fig. 69 Trigger example

### 7.10 Synchronization

If two or more sensors optoCONTROL 2520 measure the same target synchronously, the receiver may be synchronized with each other.

The synchronization of several sensors is used in the thickness / width measuring of larger targets.

Follow the time behavior of the sensor, see 7.15.

Synchronization of more measuring systems	No synchronization	The sensor works autarkic and no synchronous signal is output via the bidirectional synchronous line.
	Master	The sensor outputs a synchronous signal via the bidirectional synchronous line. This synchronous signal is used for synchronization of another sensor in the "Slave" mode. Both sensors start their measurement simultaneously.
	Slave	The sensor awaits a synchronous signal via the bidirectional synchronous line. This synchronous signal is generated by another sensor in the "Master" or a frequency generator.
Termination of the Sync/Trig input	Checkbox (on / off)	Checkbox is activated: $R_T = 120 \text{ Ohm}$ between input "Sync In" and "/Sync In"

- ➡ Connect the operating voltage grounds of all sensors with each other.
- ➡ Connect the inputs Sync IN/Out with each other.
- ➡ Connect the inputs /Sync IN/Out with each other.
- ➡ Connect the cable screens of all sensors with each other.
- ➡ Complete the last slave in the row with the internal termination resistor (120 Ohm).

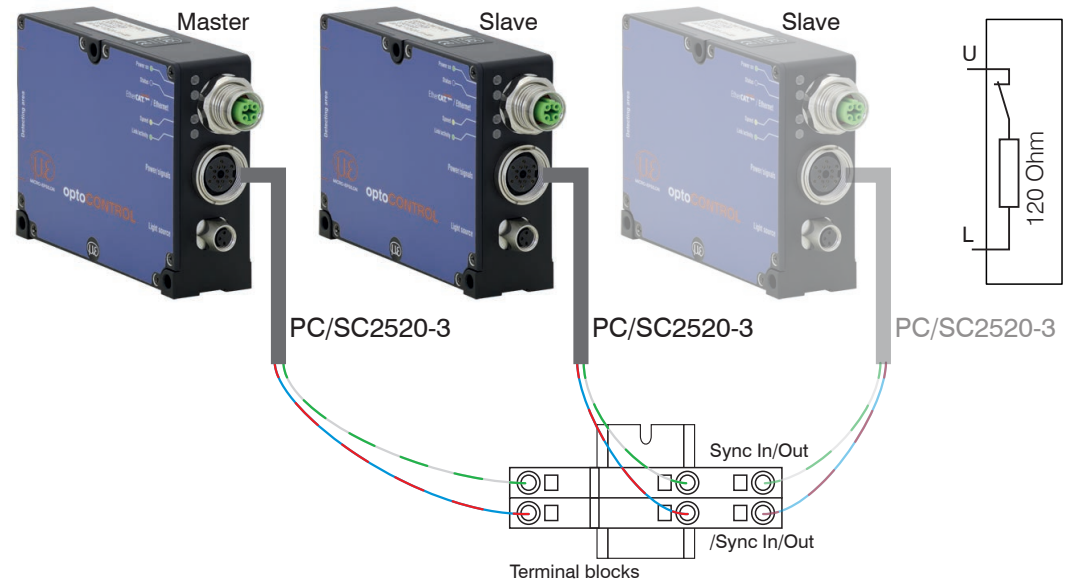


Fig. 70 Synchronization of several sensors, example optoCONTROL 2520-46

If the sensors are operated via an EtherCAT interface, synchronization can be realized even without a synchronization line.

Using the universal controller CSP2008, two or more sensors can be synchronized and calculated.

➡ Take the required settings and confirm with **Submit**.

**i** Do not forget to save the setup before you switch off the sensor.

Fields with a gray background require a selection.

Value Fields with dark border require entry of a value.

### 7.11 Manage Setups on PC

Use this menu to save a backup copy of the sensor data to a PC or to restore backed up setup files to the sensor. You can also use this feature to configure an additional sensor.

**i** Save the sensor settings in a setup, before exporting or importing setup data.

Setup no.	1 / 2 / 3 ... 8	You can save 8 different parameters in the sensor permanently.
Keep interface settings:	Checkbox	Interface settings include network properties, such as the baud rate for the RS422 interface.  If the checkbox is enabled, the settings for language, login, analog output and digital interfaces are maintained.


➡ Go to the Preferences > Save / load setup > Manage setups on PC menu.


➡ Fix the setup number.

➡ Make the selection, if you want to keep the interface settings.

Export setup data	Import setup data
<p>➡ Click the <code>Export setup</code> button.</p> <p>A Windows dialog box for saving a file opens. In the Windows dialog box, the file name <code>Setup_ODC2520_0n.meo</code> (n = setup-no.) proposed.</p> <p>➡ Change the file name of the setup file (*.meo) and the folder, if necessary and click the <code>Save</code> button.</p> <p>Any currently selected setup files will be backed up to the PC.</p>	<p>➡ Click the <code>Browse</code> button.</p> <p>A Windows dialog box for selecting the file opens.</p> <p>➡ Select the setup-file to be imported in the Windows selection dialog (Open). The selected setup file is registered in the <code>Select setup file</code> selection dialog.</p> <p>➡ Click the <code>Import setup</code> button.</p> <p>This will import the selected configuration from the selected setup file and activates them. The imported configuration is not automatically saved in the sensor.</p>

**i** Do not forget to save the setup before you switch off the sensor.

 Fields with a gray background require a selection.

 *Value* Fields with dark border require entry of a value.

## 7.12 Extras

### 7.12.1 Set Factory Settings

➡ Go to the Preferences > Extras > Factory settings menu.

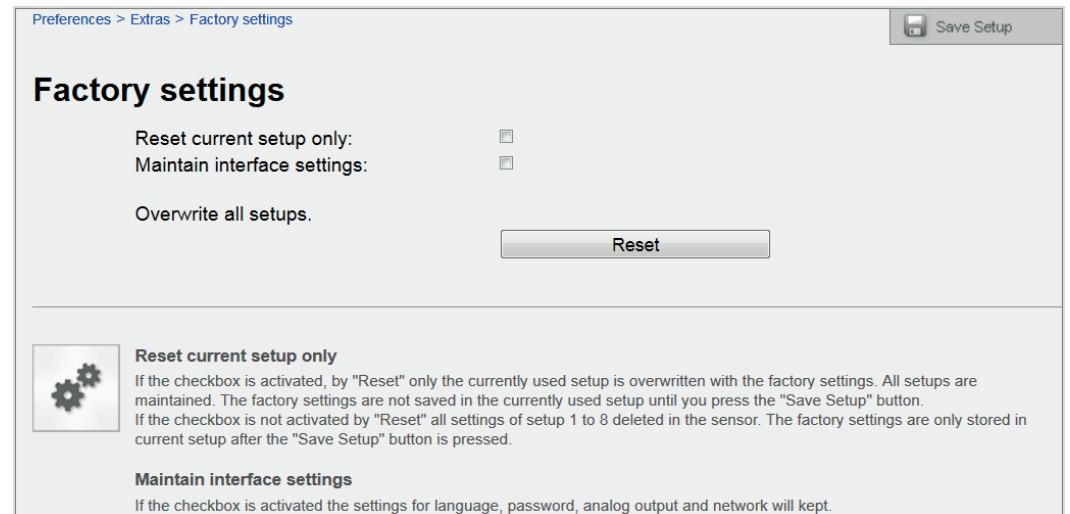


Fig. 71 Web page

- Only reset current setup
    - If the checkbox is activated, only the currently used setup is overwritten by the factory settings `Reset`. The other setups remain.
    - If the checkbox is not activated, all settings of the setups 1 ... 8 are deleted in the sensor by `Reset`.
  - Maintain interface settings
    - If the checkbox is activated, the settings for language, password, analog output and network will kept.
- ➡ Make the selection whether you want to reset the current setup and / or to maintain the interface settings and then press the `Reset` button.
- ⓘ Factory setting is not saved in the currently used setup until you press the `Save setup` button.

Resetting the sensor to the factory settings is also possible via the digital `Switching input IN`, see Chap. 5.3.7. To do this, connect the input for more than 10 seconds to the supply ground in the `professional user level`.

### 7.12.2 Reset the Sensor

➡ Go to the Preferences > Extras > Reset of sensor menu.

The `Reset` button releases a new start of the sensor.

- ⓘ The measurement is stopped, any unsaved changes will be lost.

Reset corresponds to the switching off and on of the sensor (`Power on`).

### 7.12.3 Select Measuring Unit

➡ Go to the Preferences > Extras > Measuring unit menu.

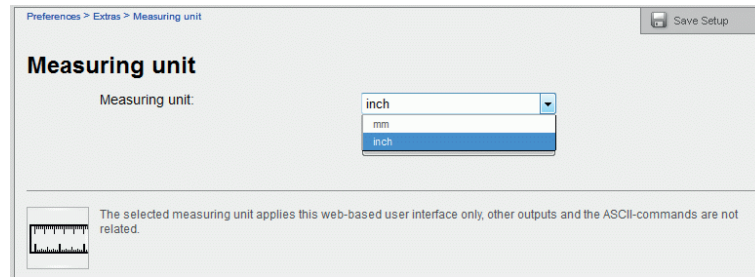


Fig. 72 Web page units

Changes the measurement display on the web pages. The command has no effect on other outputs.

### 7.13 Masking Evaluation Range

The masking limits the range for the evaluation in the video signal, for example if shadowings of the video signal are available by devices.

➡ Open the web page Video signal in the top navigation bar.

➡ Go to the menu item Masking.

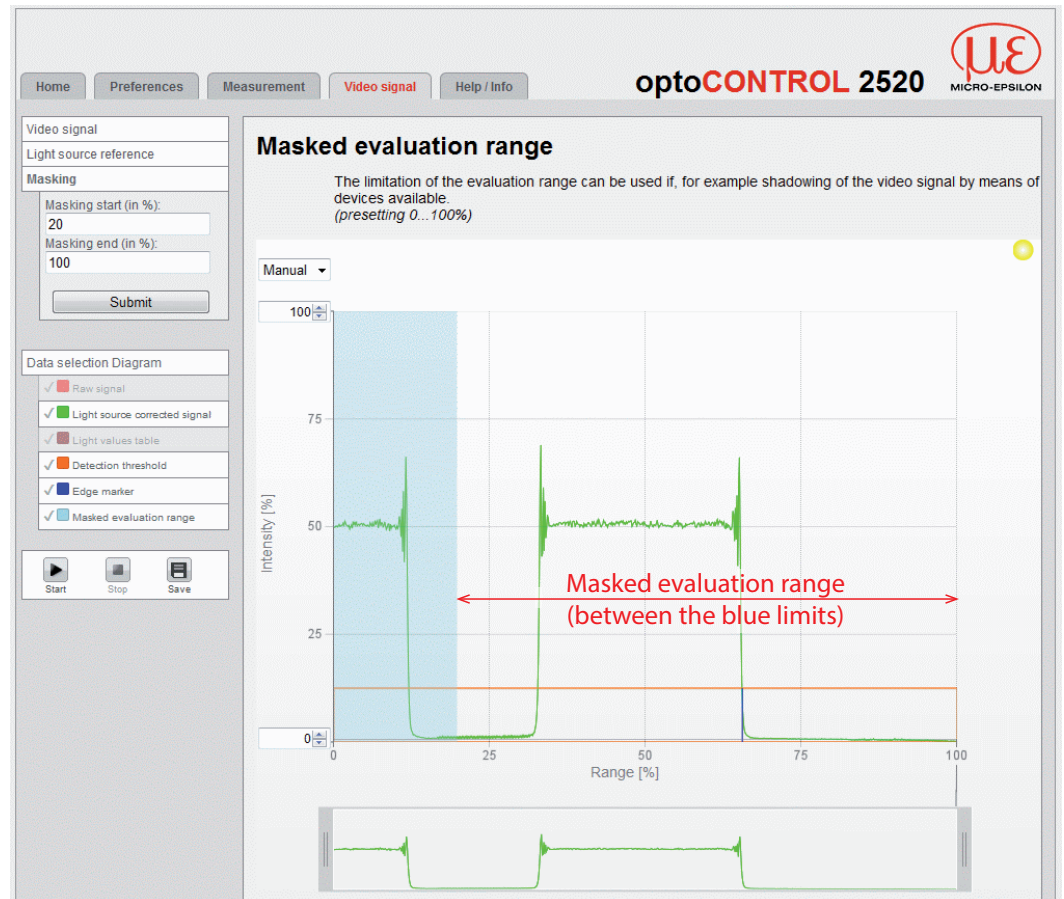


Fig. 73 Web page Masked evaluation range

! The measuring range can be reduced by the masking.

Ex works the mark is set to 0 % (beginning) and 100 % (end).

➡ Choose beginning and end of the masked area and confirm with Submit.

The new masking is visible in the diagram and in the setup of the sensor.

➡ Save the settings in the sensor in a setup before you switch off the sensor, see Chap. 6.6.2.

### 7.14 Help / Info

This page contains information such as the sensors serial and version numbers, saved calibration tables and an address block.

The `Save diagnostic file` function writes the current sensor settings in an ASCII file.

### 7.15 Timing, Measuring Value Flux

The device operates in cycles for measuring and processing:

1. Exposure: Charging the incoming light in the receiver,
2. Conversion of the video signal as digital values and calculation of the edges,
3. Calculation of diameter, gap and segments, averaging,
4. Measuring value output.

The measured value N is available after three cycles on the output.

The processing of the cycles occurs sequentially in time and parallel in space (pipelin-ing). After another cycle the next measurement value (N + 1) is output.

Each cycle takes about 0.4 ms at a measuring rate of 2.5 kHz (46 mm) and 2.0 kHz (95 mm). The delay time between the input reaction and output signal is therefore about 1.6 ms for this measuring rate.

Cycle	1. (N)	2. (N+1)	3. (N+2)	4. (N+3)
Time	0.4 ms	0.8 ms	1.2 ms	1.6 ms
1. Layer	Exposure N	Computing N	Computing N	Output N
2. Layer	---	Exposure N+1	Computing N+1	Computing N+1
3. Layer	---	---	Exposure N+2	Computing N+2
4. Layer	---	---	---	Exposure N+3

Fig. 74 optoCONTROL 2520 timing after switching on

The measuring value output is available 3 cycles after the incoming trigger signal with active triggering.

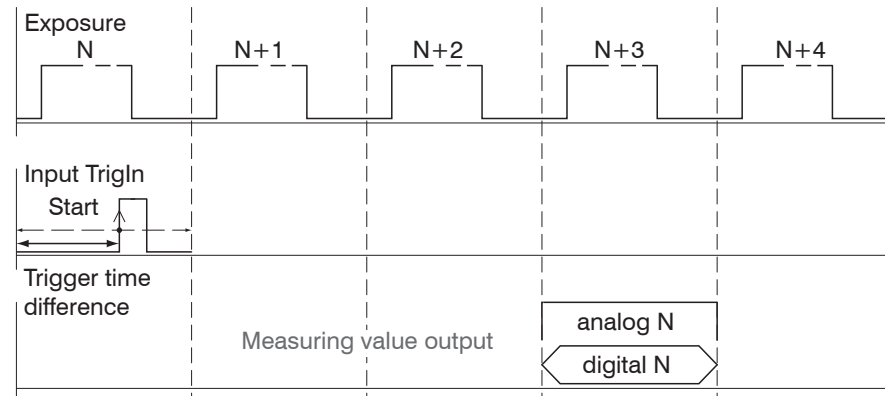


Fig. 75 Timing with triggering, rising edge, one measuring value output

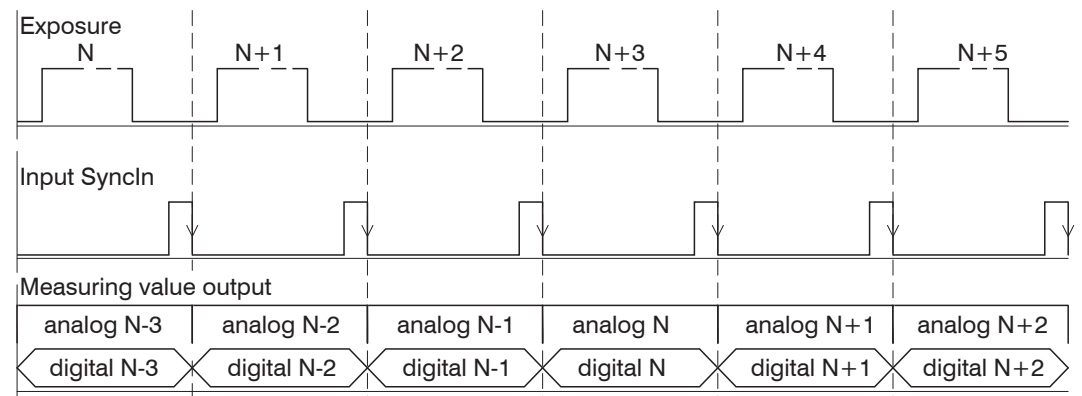


Fig. 76 Timing with synchronization, steady state

## 8. Errors, Repair

### 8.1 Communication

➡ If an error page is displayed in the web browser, please check the following:

- Check if the sensor is connected correctly, see Chap. 5.3.
- Check the IP configuration of PC and sensor, find the sensor with `sensorFINDER Vx.x.x` program, see Chap. 6.2.1, see Fig. 34.  
The `sensorFINDER` program is available online at <https://www.micro-epsilon.de/service/download/software/>.  
If sensor and PC are connected directly, IP address detection may take up to 2 minutes.
- Check the proxy settings. If the sensor uses a separate network adapter to connect to the PC, you need to disable the use of a proxy server for this connection. Contact your network specialist or administrator!

### 8.2 Optical Influences

#### 8.2.1 Pollutions

All targets in the beam path cast a shadow. The parallel laser light leads in particular to diffraction and interference. Avoid flying dust in the measuring channel between receiver and light source and dust deposits on the windows. Prefer, if possible, the horizontal measurement arrangement.

In dusty environments, the receiver and the laser are constantly blowing off with cleaned (dust and oil-free) compressed air via a standard nozzle.

- Use a clean, soft, lint-free cloth or lens cleaning paper and pure alcohol (isopropanol). Do not use commercial glass cleaner or other cleansing agents.

#### 8.2.2 Ambient Light

A filter in the receiver provides for a maximum foreign light suppression of ambient light of 20,000 lux out of range (indirect exposure) and 1,000 lux with direct irradiation of fluorescent lamps into the receiver.

Avoid a direct irradiation of directed light sources on the receiver, as for example, reflector lamps or sunlight.

Provide here by suitable measures (weakly black shielding walls, housings etc.) that possibly no ambient light seems directly into the receiver. This applies also for varying light reflections and backgrounds (window, lamps, people or similar).

- Avoid direct irradiation of ambient light into the receiver range.

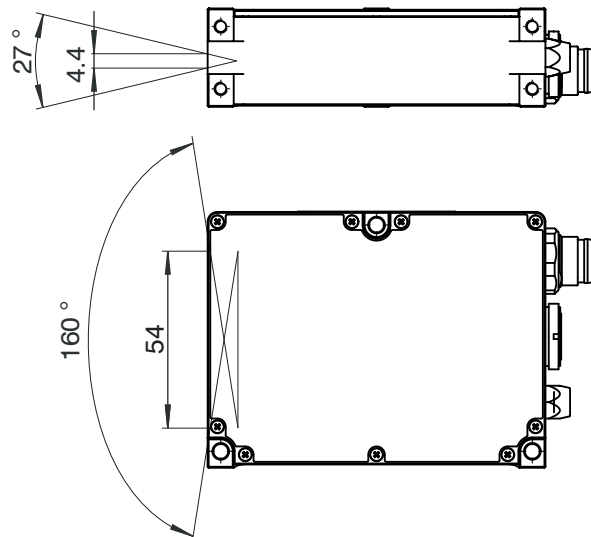


Fig. 77 Ambient light photosensitive ranges in input range



### 8.2.3 Shadowing of the Laser Light

In free space no fading (shadowing) of the laser light may occur.

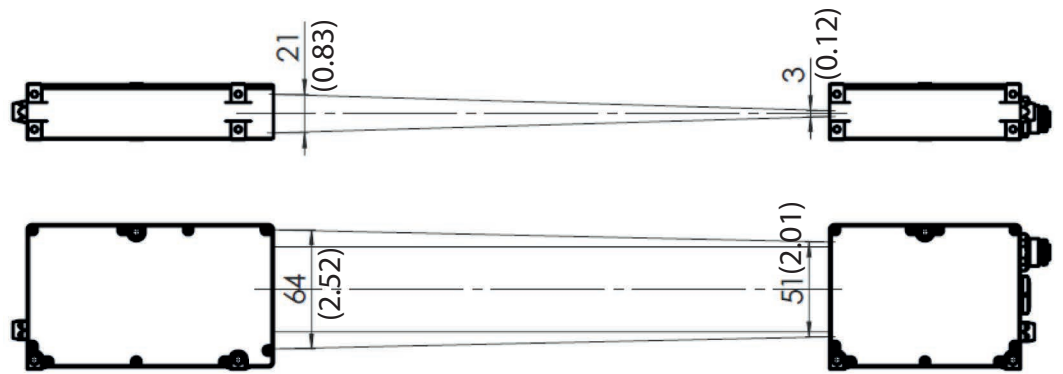


Fig. 78 Free space for the light band between light source and receiver, example optoCONTROL 2520-46

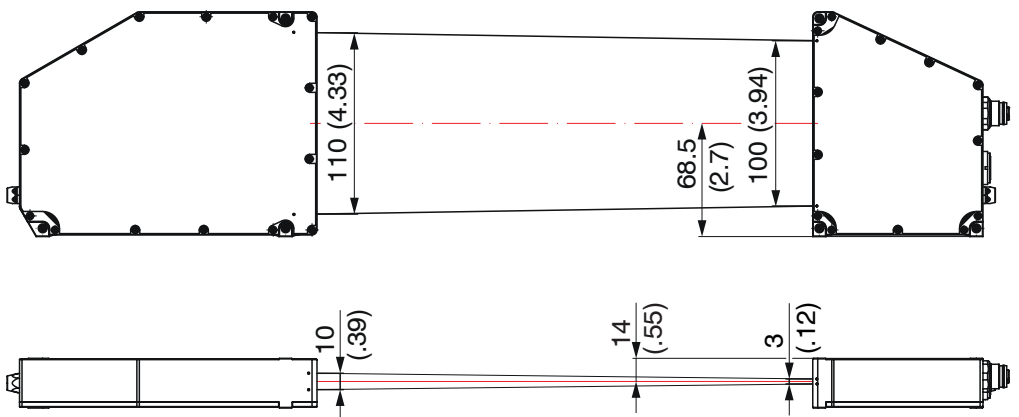


Fig. 79 Free space for the light band between light source and receiver, example optoCONTROL 2520-95

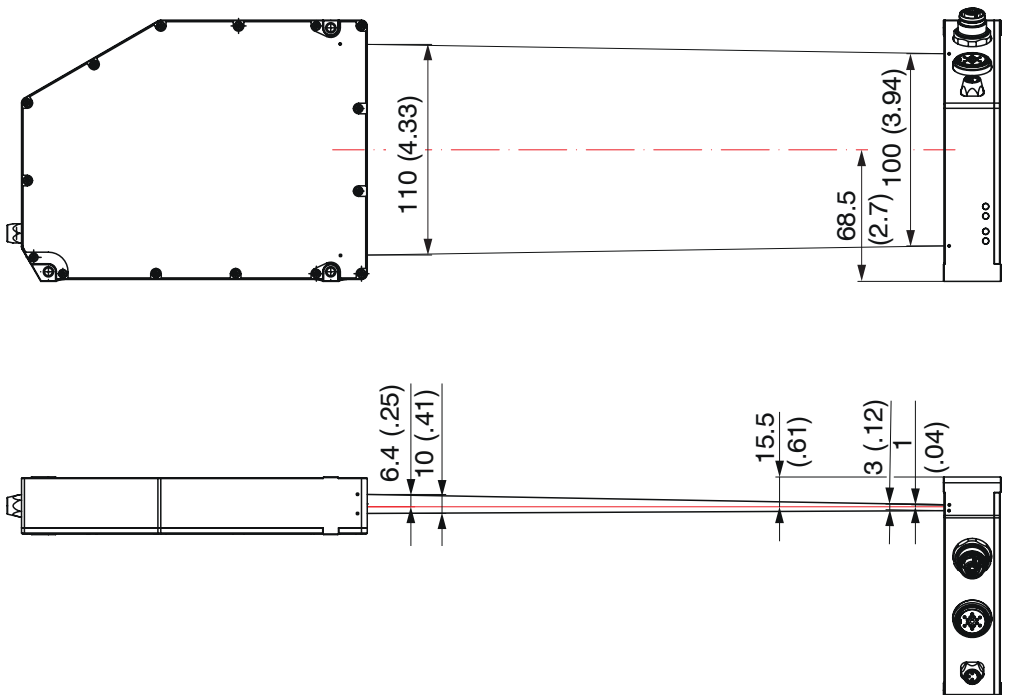


Fig. 80 Free space for the light band between light source and receiver, example optoCONTROL 2520-95(270)

Dimensions in mm (inches), not to scale

If targets (edges) rise in the light band, which are not used in the measuring process, these must be taken into account (hidden) during measurement program editing. To do

this, use the masked evaluation range in the video signal, [see 7.13](#), or the measurement program Any segments, [see 7.2](#). There you are free to choose between which edges is to be measured.

### 8.2.4 Temperature Differences

In the area of the laser light, the air should only have uniform temperature. Bigger heat sources can cause that a temperature profile in the air forms with different refractive indices, which deflects the parallel laser light as a lens and can lead to large measurement errors.

### 8.2.5 Edge Jumps

The photosensitive area of the receiver is only  $64\ \mu\text{m}$  high. Should a continuous course (e.g. cable diameter or cone) be gauged, this is realizable with a theoretical lateral resolution of  $64\ \mu\text{m}$ .

However, special rules apply for edge jumps and grooves, since the laser light band is influenced by diffraction effects.

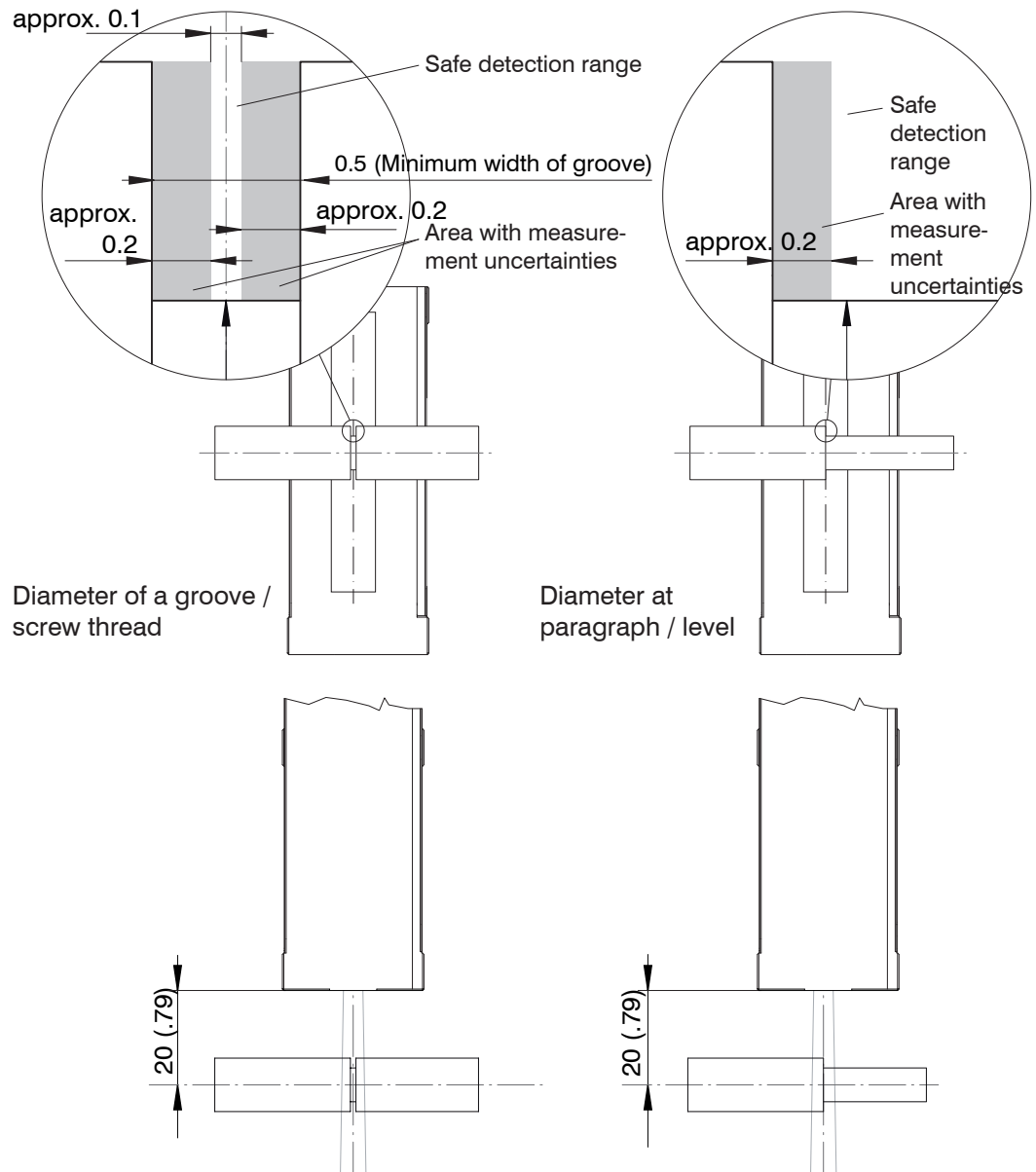


Fig. 81 Limitations with measurements at screw threads and edge transitions

If the allowable distance area is exceeded, the measurement uncertainty increases.

### 8.2.6 Thin Targets

If the diameter of very thin wires ( $<0.5$  mm) should be measured, this is not possible on grounds of the bending and interferences in the laser light with this sensor. However, the position of the wire can be often still measured.

Working in the smallest possible distance, look at the video signal, select a suitable measurement program and threshold height.

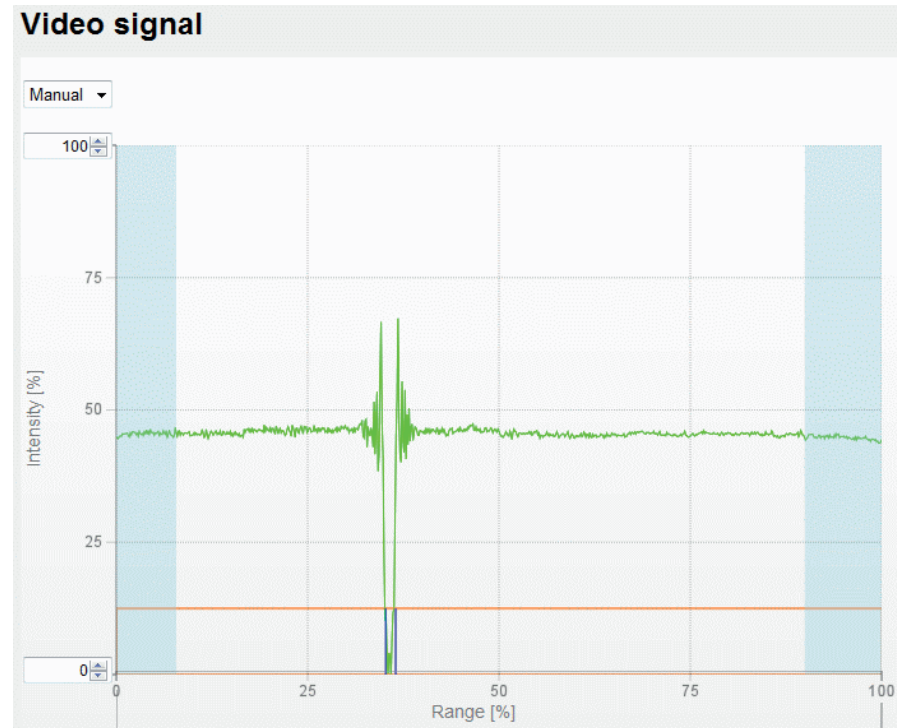


Fig. 82 Video signal thin wire (0.2 mm)

### 8.2.7 Transparent Targets

Although the sensor can measure very low interferences in the beam path due to its mode of action with parallel laser light can measure, MICRO-EPSILON Eltrotec GmbH recommends to perform tests with various measurement distances with a measurement of transparent materials (e.g. edges of clear films and slices or transparent round materials, glass pipes).

To assess the measurability of transparent targets, the video signal is also suitable, see Chap. 6.3.2

Transparent targets do not completely overshadow the laser light. Here merely the edge of a glass plate causes a small shadowing, which is sufficient for the determination of the edge position.

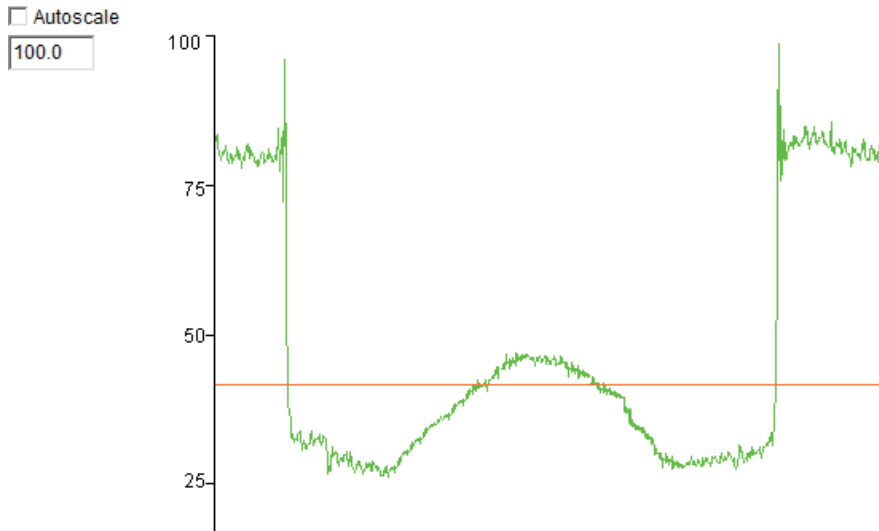


Fig. 83 Video signal with glass pipe as target

The glass pipe also still works as a cylindrical lens. In addition, areas are thereby lightened on the left and to the right of the target. The diameter is well measurable (mastering measuring value).

Select preferably the measurement program *Diameter*, see Fig. 43, since in this case the first and final edge for the measurement of outer diameter can be used.

**i** Also watch for extreme cleanness!

Diffuse-transparent material can be measured generally well.

### 8.2.8 Wrong Edge Number

If should be measured, for example, in the measurement program *Gap*, at least one high-low and a low-high edge must be in the measuring range, otherwise a measuring value error is output.

Example: Measurement program *Any segments*, the measurement is between edge 5 and 6. The target has at least 6 edges.

## 9. Software Update

### 9.1 Procedure

A software update (firmware) is performed via an Ethernet connection.

➤ Connect the receiver („Ethernet“ female connector) to a PC using an Ethernet direct connection (LAN). Use an optional available cable SCD2520-3.

ⓘ A software update does not affect the parameter settings. Newly added parameters are set to default settings.

You will find the latest firmware update tool `UpdateSensor.exe` on our web page: [www.micro-epsilon.com/optical-micrometer/micrometer/index.html](http://www.micro-epsilon.com/optical-micrometer/micrometer/index.html) in the field optoCONTROL 2520.

Obtain the firmware at the appropriate sales representatives in our house.

### 9.2 Troubleshooting

If a running software update is interrupted, the originally existing software version (factory image) can be restored. To do this, set the sensor to the factory settings via the 4-pin. Ethernet / EtherCAT connector.

If a software update is interrupted and the sensor is unable to boot, the sensor can temporarily be started with the originally present software (factory image). Then repeat the software update.

➤ Start (boot) the sensor with short-circuited 4-pin. Ethernet / EtherCAT connector.

This function is only available starting from SN15xxxx. If you have a device with the SN13xxxx or 14xxxx, which will not be able to reboot please send it back to us for checking, see Chap.

ⓘ This process does not replace permanently the current software version, but includes a permanent reset to the factory settings. Use this feature with care.

#### Required hardware

- Ethernet / EtherCAT connecto, see Fig. 84



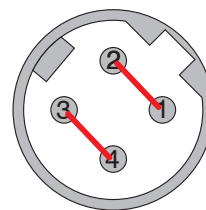
Fig. 84 Ethernet/EtherCAT connector

- Connector with jumpers

#### Procedure

➤ Switch off the sensors power supply.

➤ Connect the pins Tx+ (1) with Rx+ (2) and Tx- (3) with Rx- (4), see figure.



➤ Switch on the sensors power supply.

➤ Wait until the end of the boot process in the sensor.

Booting finished:

- LED Speed flashes yellow
- LED Link/activity flashes green



➤ Remove the jumpers on the 4-pole connector.

## 10. Software Support with MEDAQLib

A documented driver DLL is available to you with MEDAQLib, in order to contain the sensor in an existing or customized PC software.

- RS422/USB converter (optional accessory) and suitable connection cable PC/SC2520-x or
- the 4-way converter IF2004/USB and connection cable PC/SC2520-x/IF2008 or
- PCI interface card IF 2008 and connection cable PC/SC2520-x/IF2008 or
- Ethernet.

You need no knowledge about the sensor protocol to communicate with the individual controllers. 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

- 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 including documentation at:

[www.micro-epsilon.com/service/download/](http://www.micro-epsilon.com/service/download/)

[www.micro-epsilon.de/link/software/medaqlib/](http://www.micro-epsilon.de/link/software/medaqlib/)

## 11. ODC Demo Tool

A demo tool, [see A 3](#), is available for continuous measurement value recording and parameterization. You will find the tool for free under:

[https://www.micro-epsilon.de/download/software/ODC2520\\_Tool\\_Setup.zip](https://www.micro-epsilon.de/download/software/ODC2520_Tool_Setup.zip)

## 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. Service, Repair

If the receiver or light source is defective:

- If possible, save the current sensor settings in a parameter set, [see 7.11](#), to reload them the settings back into the sensor after the repair.
- Please send us the affected parts for repair or exchange.
- Describe the error as precisely as possible. Please always send both components (light source and receiver) for repair or calibration.

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eltrotec@micro-epsilon.com  
www.micro-epsilon.com

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

## 14. Decommissioning, Disposal








- Remove the power supply and output cable and the Ethernet cable on receiver as well as the connection cable between receiver and light source.

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.








## Appendix







## A 1 Optional Accessories

PC/SC2520-x		Power supply and output cable, one side 14-pin round connector M16, other side open end, cable length x = 3, 10, 20 or 30 m, cable carriers suitable <sup>1</sup>
PC/SC2520/90-5		Power supply and output cable, one side 14-pin round connector M16 angled, other side open end, cable length 5 m, cable carriers suitable <sup>1</sup>
CE2520-x CE2520/90-x		Connection cable sender-receiver, cable length x = 1, 2 or 5 m; also available with two-sided 90° angle connectors
PC/SC2520-3/IF2008		Interfaces and connection cable for connection to the interface card IF2008 or the 4-way converter IF2004/USB, cable length 3 m <sup>1</sup>
PC/SC2520-3/CSP		Interface and power supply cable for connection to the controller CSP2008, cable length 3 m <sup>1</sup>
SCD2520-3 SCD2520/90-3		Digital output cable for connection to an Ethernet/EtherCAT interface; one side 4-pin male connector M12, other side RJ45 connector; length SCD2520: x = 3 m, 5 m, 15 m, 20 m, 30 m; length SCD2520/90: x = 3 m, 5 m, 8 m, 10 m and 12 m; round connector M12 also 90° angled
SCD2520-5 M12		Digital output cable, 5 m long, for connection to an Ethernet / EtherCAT interface (both sides 4-pin round cable connector M12), cable carriers suitable.

1) Min. bending radius permanently flexible min. 7.5 x cable outside diameter



<p>Mounting rail</p>		<p>Mounting rail, length 70 cm</p> <hr/> <p>Mounting rail, length 1 m</p> <hr/> <p>Mounting rail, length 1.50 m</p>
<p>IF2001/USB</p>		<p>IF2001/USB single channel RS422/USB converter</p>
<p>IF2004/USB</p>		<p>4-way converter from RS422 to USB suitable for cable PC/SC2520-3/IF2008, including drivers, connections: 2×Sub-D, 1×terminal block</p>
<p>IF2030/PNET IF2030/ENETIP</p>		<p>Interface module for PROFINET or EtherNet/IP connection of a Micro-Epsilon sensor with RS485 or RS422 interface, suitable for PC/SC2520-x cables, top-hat rail housing, incl. GSDML file for software integration in the PLC</p>
<p>PS2020</p>		<p>Power supply for DIN rail mounting, input 230 VAC, output 24 VDC/2.5 A</p>
<p>IF2008</p>		<p>Interface card IF2008 for the synchronous detection of 4 digital sensor signals series optoCONTROL 2520 or others and 2 encoder. In connection with IF2008E, a total of 6 digital signals, 2 encoder, 2 analog signals and 8 I/O signals can be recorded synchronously.</p>
<p>IF2008-Y-adapter cable</p>		<p>For the connection of two interface cables PC/SC2520-3/IF2008</p>

<p>optoCONTROL EDU190</p>		<p>Digital display for displaying measurements and parameters from the optoCONTROL ODC with digital interface. <sup>1</sup></p>
<p>CSP2008</p>		<p>Only for the measuring range -46: Universal controller for two sensor signals</p>
<p>RS422 extension terminal for CSP2008</p>		<p>Bus terminal in connection to CSP2008, for two more sensor signals, max. two RS422 extension terminals are operated on CSP2008</p>
<p>EK1122/CSP2008 bus terminal</p>		<p>2-port EtherCAT junction of two sensor signals</p>
<p>Level converter SU4-1 Level converter SU4-2</p>		<p>Signal converter, 3 channels HTL on RS422, Signal converter, 3 channels TTL on RS422 for trigger signal sources</p>
<p>Manual workstation set for single value triggering</p>		<p>Consisting of: <sup>2</sup> 1x IF2004/USB 1x push button 1x PC / SC2520-3 / IF2008 interface and power cable with SubD15pol connector 1x connection cable pushbutton / trigger with round plug Includes free demo ODC2520 <sup>3</sup> single-value recording tool.</p>

1) For measuring range -95 still under preparation!

2) Not included in set, but required: ODC2520-46, CE2520-x connecting cable and SCD2520-x cable. They can be ordered as separate accessories.

3) Demo ODC2520, see 11 as well as sample screenshot, see A 3.

Please use a 24 VDC voltage supply to operate the ODC2520 via IF2004/USB. We recommend our PS2020 series built-in device. Optionally we recommend the ODC2520 demo prism for reliable, reproducible positioning of your test objects.

## A 2 Factory Setting

### A 2.1 Parameter

Parameter	Factory setting
Language	German
User group (reboot)	Professional
Pass word (professional)	000
Measurement program	Edge low-high
Search direction of the edges	Standard (from rail)
Measuring direction of the edges	Standard (from rail)
Measuring value averaging	No averaging
Troubleshooting no valid measuring value	Troubleshooting, no measuring value
Use spike correction	No
Statistics number of measuring values for calculation	All measuring values
Measuring value for the 1 <sup>st</sup> statistics calculation	Edge low-high
Measuring value for the 2 <sup>nd</sup> statistics calculation	Edge low-high
Mastering	Inactive
Signal Zeroing / Mastering	Edge low-high
Master value in Millimeter / Inches	0.000
Laser	ON
Used interface for the data output	Web diagram
Ethernet address type	static IP address
IP address	169.254.168.150
Gateway	169.254.1.1
Subnet mask	255.255.255.0
Ethernet transmission type	Server TCP/IP
Port number	1024
RS422 Baud rate	115.2 kBps
Parameter of the RS422 interface (fixed)	8 data bits, no parity, 1 stop bit (8N1)
Operating mode after system start	Ethernet
Assignment switching output „Error 1“	Measuring value error
Assignment switching output „Error 2“	No output
Lower limit (in mm / inches)	0.000
Upper limit (in mm / inches)	46.000 mm / 1.811 " 95.000 mm / 3.740 "
Measuring value, to which the limits refer	Edge low-high
Levels switching output 1	Push pull
Levels switching output 2	Push pull
Hold switching output 1 <sup>1</sup>	No
Hold switching output 2 <sup>1</sup>	No
Analog output - be output measurement	Edge low-high
Analog output - output area	0 V ... 10 V
Analog output - scaling	Standard scaling
Output data rate	Each measuring value is output
Reduction applies for the following interfaces	Analog, RS422, Ethernet
Trigger mode	No triggering
Termination of the sync / trig input	Yes (120 Ohm)
Synchronization mode	No synchronization
Setup no.	1
Maintained interface settings	No

Parameter	Factory setting
Detection threshold (in %)	12.50
Masking beginning (in %)	0
Masking end (in %)	100

1) With manual activation of the switching outputs, the default value for the hold time is 10 ms.

## A 2.2 Set Default Settings

Resetting the sensor to the factory settings is possible via:

- Web interface (browser): Preferences > Extras > Factory settings menu, see Chap. 7.11.1.
- ASCII command (RS422, Ethernet): SETDEFAULT, see Chap. A 4.5.6.3
- EtherCAT(TwinCAT o. a.): Object 2105 Factory settings, see A 8.3.3.7.
- Hardware: Digital Switching input IN

The hardware factory setting via the digital input IN is carried out as follows:

### Required hardware

- 14-pin supply and output connector, see Fig. 85



Fig. 85 Supply and output connector

- Supply and output cable PC/SC2520-x

### Procedure

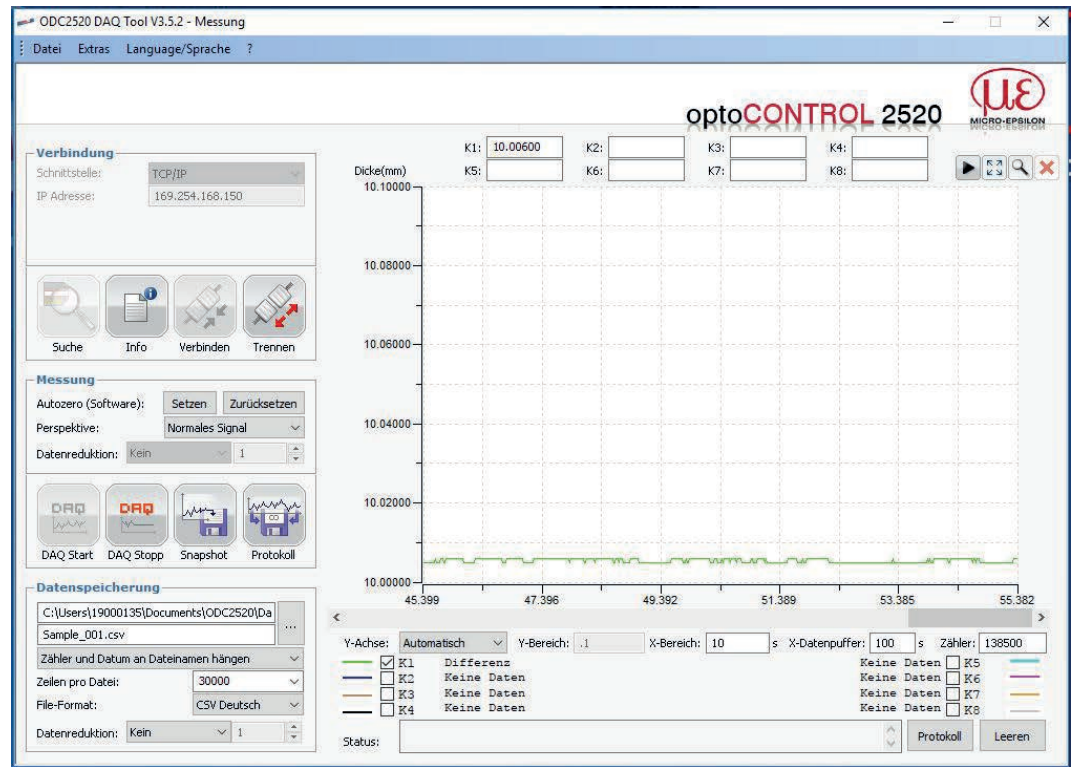
- ➡ Connect the sensor to a power supply, use therefore the cable e.g. PC/SC2520-x.
- ➡ Switch on the sensor power supply.
- ➡ Connect the input In (pin T resp. the gray/pink wire) for more than 10 seconds to the supply ground, see Fig. 29.

The LED power switches shortly from green to yellow.

- ➡ Remove the connection on the input IN.

The process is completed when the LED power flashes green again. The sensor does not boot again.

### A 3 Demo Tool for Recording Measurement Data



### A 4 Software sensorTOOL

The sensorTOOL offers you a documented software.

It is available at [www.micro-epsilon.com](http://www.micro-epsilon.com).

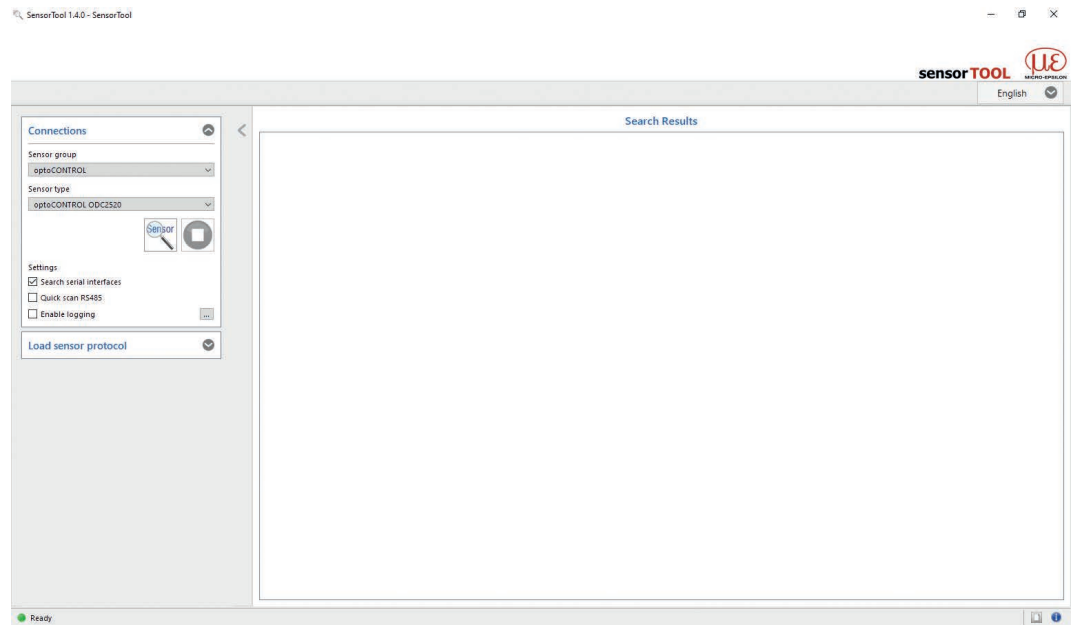


Fig. 86 First interactive site after calling the sensorTOOL

## A 5 RS422, Connection to RS422 Converter

### A 5.1 IF2001/USB Converter

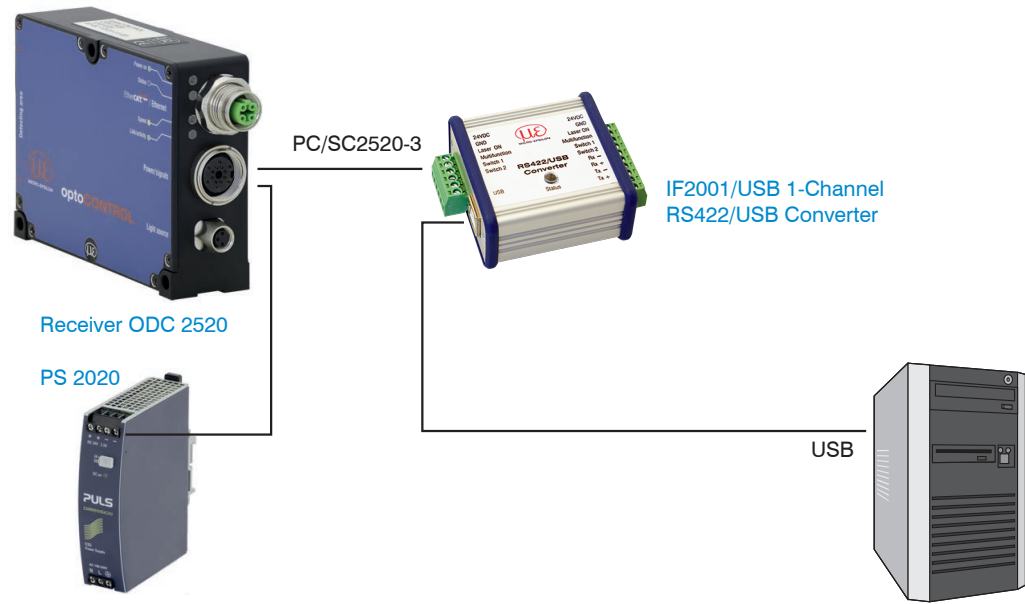


Fig. 87 USB connection to PC, example optoCONTROL 2520-46

The lines must be crossed for the connection between the sensor optoCONTROL 2520 and the periphery (PC).

ODC2520			IF2001/USB	
Signal	Color PC/SC2520-3	PIN 14-pin female cable connector	Signal	Pin
RX-	green	A	TxD-	1
RX+	brown	M	TxD+	2
TX+	gray	C	RxD+	3
TX-	yellow	N	RxD-	4
GND - RS422	violet	J	Ground	-

Fig. 88 RS422 connection ODC 2520 with IF2001/USB converter

### A 5.2 IF2004/USB 4-Channel RS422/USB Converter

The IF2004/USB converter can be used to operate 4 optoCONTROL 2520 sensors on a USB port via RS422, see A 1.

The 4 COM ports can be switched one after another.

Please refer to the operating instructions and the assembly instruction IF2004/USB 4-channel RS422/USB converter for more details. You will find them on our MICRO-EPSILON homepage <https://www.micro-epsilon.com/download/manuals/ass--IF2004-USB--en.pdf>.

For connection, please use, e.g., the PC/SC2520-3/IF2008 cable.

### A 5.3 RS422-USB Converter

The USB converter <sup>1</sup> is an alternative to the IF2001/USB converter, see A 5.1:

ODC 2520			RS422-USB converter	
Signal	Color PC/SCD2520-3	Pin 14-pin female cable connector, receiver	Signal	Pin
RX-	green	A	TX-	1
RX+	brown	M	TX+	2
TX+	gray	C	RX+	3
TX-	yellow	N	RX-	4
GND - RS422	violet	J	Ground	5

Fig. 89 RS422 connection ODC 2520 with converter

1) Discontinued model  
optoCONTROL 2520

## A 6 ASCII Communication

### A 6.1 General

The ASCII commands can be sent to the controller via the RS422 interface or Ethernet (Port 23). All commands, inputs and error messages are in English. A command always consists of the command name and zero or more parameters, which are separated by spaces and are completed with LF. If spaces are used in parameters, the parameters must be placed in quotation marks (e.g. "password with spaces").

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 hex 0A or hex 0D0A)

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

The output format is:

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

The reply can be used again as command for the parameter setting without changes. In this case, optional parameters are returned only where necessary. For example, `OUT_ADD_ETH`, will return enabled output values only.

After processing a command, the system always returns a line break and a command prompt. In the event of an error, an error message starting with "Exx" will appear before the prompt, where xx represents a unique error number. In addition, the system may display a warning ("Wxx") instead of an error message. Warnings are structured like error messages. Warnings do not prevent commands from being executed.

### A 6.2 Commands Overview

Group	Chapter	Command	Short info
<b>General</b>			
	<a href="#">Chap. A 6.3.1.1</a>	HELP	Help
	<a href="#">Chap. A 6.3.1.2</a>	GETINFO	Sensor Information
	<a href="#">Chap. A 6.3.1.3</a>	ECHO ON/OFF	Reply type
	<a href="#">Chap. A 6.3.1.4</a>	PRINT	Overview parameters
	<a href="#">Chap. A 6.3.1.5</a>	SYNC	Synchronization
	<a href="#">Chap. A 6.3.1.6</a>	RESET	Booting the sensor
<b>User level</b>			
	<a href="#">Chap. A 6.3.2.1</a>	LOGIN	Change of the user level
	<a href="#">Chap. A 6.3.2.2</a>	LOGOUT	Change to user level „Operator“
	<a href="#">Chap. A 6.3.2.3</a>	GETUSERLEVEL	Request user level
	<a href="#">Chap. A 6.3.2.4</a>	STDUSER	Set user level
	<a href="#">Chap. A 6.3.2.5</a>	PASSWD	Change password
<b>Video signal</b>			
	<a href="#">Chap. A 6.3.3.1</a>	LIGHTCORR	Light source reference
	<a href="#">Chap. A 6.3.3.2</a>	THRESHOLD	Edge detection threshold
	<a href="#">Chap. A 6.3.3.3</a>	ROI	Reduce region of interest

<b>Measurement</b>			
	<a href="#">Chap. A 6.4.1.1</a>	MEASDIST	Calibration selection for a measuring distance
	<a href="#">Chap. A 6.4.1.2</a>	MEASDISTINFO	Current calibration for a measuring distance
	<a href="#">Chap. A 6.4.1.3</a>	MEASDISTTABLE	Table of all calibrated measuring distances
	<a href="#">Chap. A 6.4.2.1</a>	MEASMODE	Measurement program selection
	<a href="#">Chap. A 6.4.2.2</a>	SEARCHDIR	Search direction edges
	<a href="#">Chap. A 6.4.2.3</a>	MEASDIR	Measuring direction edges
	<a href="#">Chap. A 6.4.2.4</a>	EXPEDGES	Expected number of edges
	<a href="#">Chap. A 6.4.2.5</a>	DEFSEG1 DEFSEG2 DEFSEG3 DEFSEG4 DEFSEG5 DEFSEG6 DEFSEG7 DEFSEG8	Definition of segments
	<a href="#">Chap. A 6.4.2.6</a>		Signal names
<b>Measuring value processing</b>			
	<a href="#">Chap. A 6.4.3.1</a>	AVERAGE	Measuring value averaging
	<a href="#">Chap. A 6.4.3.2</a>	SPIKECORR	Spike correction
	<a href="#">Chap. A 6.4.3.3</a>	OUTHOLD	Troubleshooting
	<a href="#">Chap. A 6.4.3.4</a>	STATISTICSIGNAL	Selection of the measuring value of 1. statistics
	<a href="#">Chap. A 6.4.3.5</a>	STATISTIC2SIGNAL	Selection of the measuring value of 2. statistics
	<a href="#">Chap. A 6.4.3.6</a>	STATISTICDEPTH	Setting the statistics calculation
	<a href="#">Chap. A 6.4.3.7</a>	RESETSTATISTIC	Resetting the statistics calculation
	<a href="#">Chap. A 6.4.3.8</a>	MASTERSIGNAL	Selection of measuring value for mastering / zeroing
	<a href="#">Chap. A 6.4.3.9</a>	MASTERMV	Mastering / zeroing
<b>Data output</b>			
	<a href="#">Chap. A 6.5.1.1</a>	OUTPUT	Selection of digital output
	<a href="#">Chap. A 6.5.1.2</a>	IPCONFIG	Ethernet IP settings
	<a href="#">Chap. A 6.5.1.3</a>	OUTHOLD	Setting for Ethernet transmission of measuring value
	<a href="#">Chap. A 6.5.1.4</a>	BAUDRATE	Setting the RS422 baud rate
	<a href="#">Chap. A 6.5.1.5</a>	ETHERMODE ETHERNET/ETHERCAT	Switching Ethernet / EtherCAT
	<a href="#">Chap. A 6.5.1.6</a>	OUTREDUCE	Reducing the output data rate



<b>Selection of measuring values to be output</b>			
	<a href="#">Chap. A 6.5.2.2</a>	OUTEDGEHL_RS422 OUTEDGEHL_ETH	Output of measuring values Edge low-high
	<a href="#">Chap. A 6.5.2.3</a>	OUTEDGELH_RS422 OUTEDGELH_ETH	Output of measuring values Edge low-high
	<a href="#">Chap. A 6.5.2.4</a>	OUTDIA_RS422 OUTDIA_ETH	Output of diameter data
	<a href="#">Chap. A 6.5.2.5</a>	OUTGAP_RS422 OUTGAP_ETH	Output of gap data
	<a href="#">Chap. A 6.5.2.6</a>	OUTSEG_RS422 OUTSEG_ETH	Output of segment data
	<a href="#">Chap. A 6.5.2.7</a>	OUTADD_RS422 OUTADD_ETH	Output of additional data
	<a href="#">Chap. A 6.5.2.8</a>	OUTSTATISTIC_ RS422 OUTSTATISTIC_ETH	Output of statistics data
	<a href="#">Chap. A 6.5.2.9</a>	OUTVID_ETH	Output of video signals
<b>Switching outputs</b>			
	<a href="#">Chap. A 6.5.3.1</a>	ERROROUT1 ERROROUT2	Assignment of the switch outputs
	<a href="#">Chap. A 6.5.3.2</a>	ERROROUTHOLD	Hold period of switching outputs
	<a href="#">Chap. A 6.5.3.3</a>	ERRORLIMIT	Set the limit values
	<a href="#">Chap. A 6.5.3.4</a>	ERRORLEVELOUT1 ERRORLEVELOUT2	Active level of switching output 1 Active level of switching output 2
<b>Analog output</b>			
	<a href="#">Chap. A 6.5.4.1</a>	ANALOGOUT	Data selection for analog output
	<a href="#">Chap. A 6.5.4.2</a>	ANALOGRANGE	Disable/enable the analog output
	<a href="#">Chap. A 6.5.4.3</a>	ANALOGSCALE STANDRD	Scaling the analog output
<b>Triggering</b>			
	<a href="#">Chap. A 6.5.5.2</a>	TRIGGER	Trigger type
	<a href="#">Chap. A 6.5.5.3</a>	TRIGGERAT	Effect of the trigger input
	<a href="#">Chap. A 6.5.5.4</a>	TRIGGERLEVEL	Trigger level
	<a href="#">Chap. A 6.5.5.5</a>	TRIGGERCOUNT	Number of output values
	<a href="#">Chap. A 6.5.5.6</a>	TRIGGERSW	Software trigger pulse
<b>Parameter management, load / save settings</b>			
	<a href="#">Chap. A 6.5.6.1</a>	STORE	Save parameter set
	<a href="#">Chap. A 6.5.6.2</a>	READ	Load parameter set
	<a href="#">Chap. A 6.5.6.3</a>	SETDEFAULT	Resetting to factory settings
	<a href="#">Chap. A 6.5.6.4</a>	Unit	Changes measurement unit

## A 6.3 General Commands

### A 6.3.1 General

#### A 6.3.1.1 Help

```
HELP [<command>]
```

Help is displayed for a command. If no command is specified, general help information is displayed.

#### A 6.3.1.2 Sensor Information

Sensor data are queried. Output as per example below:

```
->GETINFO
Name:          ODC2520
Serial:        1301001
Option:        000
Article:       4321021
MAC-Address:   00-0C-12-01-11-01
Version:       005.024.035
Image:         Ethernet
Imagetype:     User
Hardware-Rev:  008
Measuring range 46.00mm or 95.00mm
->
```

Name: Model name of sensor

Serial: Serial number of sensor

Option: Option number of the sensor

Article: Article number of the sensor

MAC-Address: Address of network adapter

Version: Version of the booted software

Image: Active software Ethernet or EtherCAT

Image type: Type of booted software (Factory- oder User-Image)

Hardware-Rev: State of the used (programmable hardware)

**i** The Factory Image is installed by the manufacturer of the controller and cannot be overwritten.

An update of User Images can be done by the end user, [see 9](#). If an error occurs when updating the User Images, then the Factory Images is loaded when the system starts the next time.

Error	Description
E34	The sensor has not been trained or lost of flash memory -> Send the sensor back to the manufacturer

#### A 6.3.1.3 Reply Type

```
ECHO ON|OFF
```

The reply type describes the structure of a command reply.

ECHO ON: The command name and the command reply or an error message is output.

ECHO OFF: Only the command reply or an error message is returned.

#### A 6.3.1.4 Parameter Overview

```
PRINT
```

This command outputs a list of all setting parameters and its values.

```
PRINT ALL
```

This command outputs a list of all setting parameters and its values, as well as information such as GETINFO.

### A 6.3.1.5 Synchronization

SYNC NONE|MASTER|SLAVE| [TERMON|TERMOFF]

Setting the type of synchronization:

- NONE: No synchronization
- MASTER: Receiver is master, i.e it outputs synchronization pulses
- SLAVE: Receiver is slave and receives synchronous pulses from another ODC 2520

Setting the termination of the sync / trigger input:

- TERMON: Termination (type 120 Ohm) on
- TERMOFF: No termination (terminating resistor 120 Ohm off)

In the MASTER mode, the second parameter is not evaluated.

Error	Description
E02	Incorrect parameter type (not a valid type of synchronization)
E11	Parameter 1 is too long (more than 31 characters)

- The synchronous connection (Sync In) is alternatively an input or an output.
- ! Only one of the receivers may be always switched to master (and all the others on slave).  
Moreover, the synchronous connection also serves as a trigger input, see Chap. 7.9, "Triggering".

### A 6.3.1.6 Booting the Sensor

RESET

The receiver restarts.

## A 6.3.2 User Level

### A 6.3.2.1 Changing the User Level

LOGIN <Password>

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

- USER: Read access to all elements + use of web diagrams
- PROFESSIONAL: Read/write access to all elements

Error	Description
E06	Access denied -> Incorrect password
E11	Password is too long (more than 31 characters)

### A 6.3.2.2 Changing to User Level

LOGOUT

Sets the user level to USER.

### A 6.3.2.3 Querying the User Level

GETUSERLEVEL

Request the current user level.

For possible responses, see Chap. A 4.3.2.1, „Changing the User Level“.

### A 6.3.2.4 Setting the User Level on Restart (Standard User)

STDUSER USER|PROFESSIONAL

Sets the standard user, who is logged in after system start.

### A 6.3.2.5 Changing the Password

```
PASSWD <Old password> <New password> <New password>
```

Changes the password for the professional level. The default (preset) password is “000”.

The old password must be entered once, and the new password twice. If the new passwords do not match, an error message is displayed. Passwords are case sensitive.

A password may only contain letters (A to Z) and numbers, but no special characters and no letters with accents or umlauts. The maximum length is 31 characters.

Returning to the factory settings (SETDEFAULT) by the professional, the password is reset to “000” (professional).

### A 6.3.3 Video Signal

#### A 6.3.3.1 Light Correction

```
LIGHTCORR
```

Performs a light correction.

#### A 6.3.3.2 Edge Detection Threshold

```
THRESHOLD <Threshold>
```

Setting the detection threshold in % (0.0 up to 99.0 %, is given with one decimal place).

Please do not change the standard value as possible, since linearity is affected (only for transparent targets reasonable).

#### A 6.3.3.3 Reduction of Region of Interest

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

Set region of interest. ROI for start and end must be between

- 46 mm: 0 ... 767 pixels
- 95 mm: 0 ... 1535 pixels.

The specification is effected in the unit pixels. “Start” value is smaller than “End” value.

## A 6.4 Measurement

### A 6.4.1 Measurement Distance Calibration Tables

#### A 6.4.1.1 Calibration Selection for a Measuring Distance

```
MEASDIST [<number>]
```

Each measurement distance is deposited a calibration table. Maximum 9 measuring distances can be selected. The parameter <number> = 0 ... 8 corresponds to the position in the table for the selectable measuring distances (see MEASDISTTABLE).

#### A 6.4.1.2 Current Calibration Table for a Measuring Distance

```
MEASDISTINFO
```

Lists the current position of the measuring distance table and the associated measuring distance.

### A 6.4.1.3 Table of all Calibrated Measuring Distances

MEASDISTTABLE

Lists all available calibrated measuring distances.

```
->MEASDISTTABLE

Pos, Measuring distance
0, 20.000 mm
1, 50.000 mm
2, 100.000 mm
3, 150.000 mm
4, unavailable
5, unavailable
6, unavailable
7, unavailable
8, unavailable

->
```

### A 6.4.2 Setting the Measurement Task

#### A 6.4.2.1 Measurement Program Selection

MEASMODE EDGEHL | EDGELH | DIA | GAP | SEGMENT

- EDGEHL: Edge low - high; Position of the first low-high edge (distance from the beginning of the line)
- EDGELH: Edge high - low; Position of the first high-low edge (distance from the beginning of the line)
- DIA: Diameter/width: Measure, position of single edges and center axis (first low-high and last high-low edge) of an outer diameter
- GAP: Gap: Measure, position of single edges and center axis (first high-low edge and next edge).
- SEGMENT: Any segments: Measurement between 2 selectable edges, also possible from edge zero (SMR).

#### A 6.4.2.2 Search Direction Edges

SEARCHDIR STANDARD | INVERSE

Specifies the direction of the edge search. The search direction determines the numbering respectively sequence of the edges, [see Fig. 44](#).

- STANDARD: Standard (from rail)
- INVERSE: Reverse (from edge toward rail)

#### A 6.4.2.3 Measuring Direction Edges

MEASDIR STANDARD | INVERSE

The measuring direction determines the reference point of the measuring values, [see Fig. 45](#)

- STANDARD: Standard (from rail)
- INVERSE: Reverse (from edge toward rail)

#### A 6.4.2.4 Number of Expected Edges

EXPEDGES <value>

SMR =  
Start of measuring range

If a certain edge number is always required for a correct measurement, this can be monitored, [see command ERROROUT1](#) respectively [ERROROUT2](#).

### A 6.4.2.5 Definition of Segments

```
DEFSEG1 <edge A> <edge B>
DEFSEG2 <edge A> <edge B>
DEFSEG3 <edge A> <edge B>
DEFSEG4 <edge A> <edge B>
DEFSEG5 <edge A> <edge B>
DEFSEG6 <edge A> <edge B>
DEFSEG7 <edge A> <edge B>
DEFSEG8 <edge A> <edge B>
```

Up to 8 segments can be measured.

The difference between two edges, the both single edges and the center axis is calculated in each case.

The sensor numbers internally all found edges in standard search direction (from start of measuring range).

The edges are selected for the respective segments with the performed commands

The sensor can process a maximum of 64 edges.

The value range for <edge A> and <edge B> is 0,1,2...64 and 0 is the start of measuring range.

### A 6.4.2.6 Signal Names

- EHL: Edge low-high
- ELH: Edge high-low
- DA: Diameter, edge position A (first low-high edge)
- DB: Diameter, edge position B (last high-low edge)
- DD: Diameter (Difference  $|A-B|$ )
- DC: Diameter, center axis  $((A+B)/2)$
- GA: Gap, edge position A (first high-low edge)
- GB: Gap, edge position B (the edge, following on A)
- GD: Gap (difference  $|A-B|$ )
- GC: Gap, center axis  $((A+B)/2)$
- SnA: Edge position A of segment n ( $n = 1...8$ , e.g. S3A)
- SnB: Edge position B of segment n
- SnD: Difference between the edge positions A and B of segment n
- SnC: Center axis of segment n  $((A+B)/2)$

The selectable signals depend on the selected measurement program, [see A 6.4.2.1](#):

- EDGEHL: EHL
- EDGELH: ELH
- DIA: DA, DB, DD, DC
- GAP: GA, GB, GD, GC
- SEGMENT: SnA, SnB, SnD, SnC

### A 6.4.3 Measuring Value Processing

#### A 6.4.3.1 Averaging of Measuring Value

AVERAGE NONE|MOVING|RECURSIVE|MEDIAN[<Averaging depth>]

- NONE: No averaging value
- MOVING: Moving averaging (averaging depth 2, 4, 8, 16, 32, 64 and 128 possible)
- RECURSIVE: Recursive averaging (averaging depth 2 to 32768 possible)
- MEDIAN: Median (averaging depth 3, 5, 7 and 9 possible)

The averaging value always acts on all to be output edge, difference and center axis values.

#### A 6.4.3.2 Spike Correction

SPIKECORR [ON|OFF][[<Number of evaluated measured values>][[<Tolerance range in mm>][<Number of corrected values>]]]

Spike correction is not enabled in the factory settings.

Parameter	Factory setting	Min	Max
Number of measuring values evaluated	3	1	10
Tolerance range in mm	0,100	0,0	46 mm
			95 mm
Number of corrected values	1	1	100

Fig. 90 Evaluation range spike correction

#### A 6.4.3.3 Error Processing

OUTHOLD NONE|0|<Number>

Setting the behavior of the measuring value output in case of error

- NONE: No holding the last measuring value, output of error value
- 0: Infinite holding of the last measuring values
- Number: Holding the last measuring value on the number of measuring cycles; then an error value (maximum of 1024) is output.

#### A 6.4.3.4 Selection of the Measuring Value for the 1<sup>st</sup> Statistics

STATISTICSIGNAL EHL|ELH|DA|DB|DD|DC|GA|GB|GD|GC|  
S1A|S1B|S1D|S1C|S2A|S2B|S2D|S2C|S3A|S3B|S3D|S3C|S4A|S4B|S4D|S4C|  
S5A|S5B|S5D|S5C|S6A|S6B|S6D|S6C|S7A|S7B|S7D|S7C|S8A|S8B|S8D|S8C

Designation of the signal for which the 1<sup>st</sup> statistical calculation is to be performed.

Signal names, see A 6.4.2.6

#### A 6.4.3.5 Selection of the Measuring Value for the 2<sup>nd</sup> Statistics

STATISTIC2SIGNAL EHL|ELH|DA|DB|DD|DC|GA|GB|GD|GC|  
S1A|S1B|S1D|S1C|S2A|S2B|S2D|S2C|S3A|S3B|S3D|S3C|S4A|S4B|S4D|S4C|  
S5A|S5B|S5D|S5C|S6A|S6B|S6D|S6C|S7A|S7B|S7D|S7C|S8A|S8B|S8D|S8C

Designation of the signal for which the 2<sup>nd</sup> statistical calculation is to be performed.

Signal names, see A 6.4.2.6

#### A 6.4.3.6 Setting the Statistics Calculation

STATISTICDEPTH ALL|2|4|8...|8192

Input about how many measuring values the statistics data minimum, maximum and peak-peak are determined.

The number of measuring values for the calculation can be between 2 and 8192 (in powers of 2) or include all measuring values.

### A 6.4.3.7 Resetting the Statistics Calculation

```
RESETSTATISTIC
```

Reset the statistics data of the selected measuring value.

### A 6.4.3.8 Selection of Measuring Value for Mastering / Zeroing

```
MASTERSIGNAL EHL|ELH|DA|DB|DD|DC|GA|GB|GD|GC|
S1A|S1B|S1D|S1C|S2A|S2B|S2D|S2C|S3A|S3B|S3D|S3C|S4A|S4B|S4D|S4C
S5A|S5B|S5D|S5C|S6A|S6B|S6D|S6C|S7A|S7B|S7D|S7C|S8A|S8B|S8D|S8C
```

Detection of the signal to be applied for the mastering respectively zeroing.

Signal names, see A 6.4.2.6

### A 6.4.3.9 Mastering / Zeroing

```
MASTERMV NONE|MASTER <Master value>
```

- NONE: Reset the mastering
- MASTER: Setting the current measuring value to the master value
- Master value: Default value in millimeter,  
value range: min: - measuring range [mm]  
max: + measuring range [mm]

Zeroing: Master value = 0

In case of master value is 0, then the mastering function has the same functionality as the zero setting. The master command awaits the next measurement value a maximum of 2 seconds and uses it as master value. If no measurement value is received within this time, for example, by external triggering, the command returns with the error "E32 Time-out". The master value is processed with three decimal places.

Both the mastering/zeroing as well as the resetting mastering/zeroing function resets the statistics.

## A 6.5 Data Output via Digital Interfaces

### A 6.5.1 Interface Settings

#### A 6.5.1.1 Selection Digital Output

```
OUTPUT NONE|RS422|ETHERNET
```

- NONE: No measuring value output
- RS422: Output of the measuring values via RS422
- ETHERNET: Output of the measuring values via Ethernet

#### A 6.5.1.2 Ethernet IP Settings

```
IPCONFIG DHCP | STATIC [<IPAddress> [<Netmask> [<Gateway>]]]
```

Set Ethernet interface.

DHCP: IP address and gateway are automatically requested by DHCP.

System looks for a LinkLocal address after approximately 2 minutes if no DHCP server is available.

STATIC: Set IP address, the netmask and the gateway in format xxx.xxx.xxx.xxx

Values stay the same if neither IP address, net mask nor gateway is typed in.

The sensor optoCONTROL 2520 uses the following factory settings:

Ethernet address type: static IP address

IP address: 169.254.168.150

Gateway: 169.254.1.1

Subnet mask: 255.255.255.0

Ethernet transmission type: Server TCP/IP

Port number: 1024



### A 6.5.1.3 Setting for Ethernet Measuring Value Transmitting

```
MEASTRANSFER NONE | SERVER/TCP [<PORT>] | (CLIENT/TCP | CLIENT/UDP
 [<IPAddress> [<Port>]])
```

The ODC 2520 can be operated as a server as well as a client for measurement output via Ethernet.

- NONE: No measuring value transmission via Ethernet follows.
- SERVER/TCP: Sensor provides a server for the typed in port, under which the measured values can be sent. This is only possible via TCP/IP.
- CLIENT/TCP: Sensor sends measured values via TCP/IP connection oriented to server. The specifying of the IP address and server port are required.
- CLIENT/UDP: Sensor sends connectionless measuring values via UDP/IP to server. Therefore the IP address and the server port are specified.
- IPAddress: IP address of the server, to which measuring values are sent when in client mode, (only valid for CLIENT/TCP or CLIENT/UDP).
- Port: Port, to which the server gets assigned to in server-mode or to which the measured values are sent in client-mode (min: 1024, max: 65535).  
Commands are expected for port 23; the data port is set to 1024 by default.

### A 6.5.1.4 Setting RS422 Baud Rate

```
BAUDRATE <Baudrate>
```

Adjustable baud rates in examples:

```
9600, 115200, 230400, 460800, 691200, 921600, 1500000, 2000000, 2500000, 3000000,
3500000, 4000000
```

### A 6.5.1.5 Change Ethernet / EtherCAT

```
ETHERMODE ETHERNET | ETHERCAT
```

#### From Ethernet to EtherCAT:

```
ETHERMODE ETHERCAT
```

You can not change directly to the EtherCAT interface through the web page. Restart your receiver to do this (Power on).

Ethernet is no longer available.

- Save the current settings with the STORE n (Setup n = 1,2, ... 8) command before switching to EtherCAT.

#### From EtherCAT to Ethernet:

The RS422 interface for transmitting an ASCII command is available in both Ethernet mode as well as in the EtherCAT mode.

Send the OUTPUT ETHERNET command via a RS422 connection to return to the Ethernet mode.

Ethernet is then available again after a reboot (Power on) of the receiver.

- When you return to the factory settings, it can also be reset to Ethernet, [see A 6.5.6.3](#).

You will find further instructions how to change from EtherCAT interface to Ethernet in the appendix EtherCAT.

### A 6.5.1.6 Reduce the Output Data Rate

```
OUTREDUCE <Out> [ANALOG | RS422 | ETHERNET | NONE]
```

Reducing the measuring value output via the specified interfaces.

- 1: Output each measuring value
- 2...150000: Output of each nth measuring value

## A 6.5.2 Select Measuring Values to be Output

### A 6.5.2.1 Preliminary Remarks on the Measuring Value Selection

Setting the values to be output via the RS422 or Ethernet interface.

Maximum 32 measurement values are transmitted with RS422 in parallel.

The maximum output rate via the Ethernet interface depends on the number of output values.

The measuring values, which can be output depend on the selected measuring program. The edge programs can output only one edge, the measurement programs diameter and gap the both edge positions, the difference and the center axis position of these edges. With the measuring program segments maximum 32 measuring values can be output with 8 defined segments.

Note when you select data:

The settings of some other parameters have the effect of an inevitable output of measuring values.

Example:

- Measurement program edge low-high selected, analog output enabled,
- but the measuring value output locked with OUTEDGEHL\_ETH NONE.

If you select the Ethernet interface for measuring value output, the measuring value EHL is output.

A request OUTEDGEHL\_ETH without parameter returns OUTEDGEHL\_ETH EHL as reply.

The cause is the enabled analog output which must process a measuring value.

When activating the functions limit value monitoring, statistics or zeroing / mastering at least a measuring value is output, for which this function has been set.

### A 6.5.2.2 Output of Measuring Values Edge Low-High via RS422 and Ethernet

```
OUTEDGEHL_RS422 NONE|EHL
OUTEDGEHL_ETH NONE|EHL
```

Signal names, see A 6.4.2.6

### A 6.5.2.3 Output of the Measuring Values Edge High-Low via RS422 and Ethernet

```
OUTEDGELH_RS422 NONE|ELH
OUTEDGELH_ETH NONE|ELH
```

Signal names, see A 6.4.2.6

### A 6.5.2.4 Output of the Diameter Data via RS422 and via Ethernet

```
OUTDIA_RS422 NONE|([DD] [DA] [DB] [DC])
OUTDIA_ETH NONE|([DD] [DA] [DB] [DC])
```

Signal names, see A 6.4.2.6

### A 6.5.2.5 Output of the Gap Data via RS422 and Ethernet

```
OUTGAP_RS422 NONE|([GD] [GA] [GB] [GC])
OUTGAP_ETH NONE|([GD] [GA] [GB] [GC])
```

Signal names, see A 6.4.2.6

**A 6.5.2.6 Output of the Segment Data via RS422 and Ethernet**

```
OUTSEG_RS422 NONE| ([S1D] [S1A] [S1B] [S1C] [S2D] [S2A] [S2B] [S2C]
                   [S3D] [S3A] [S3B] [S3C] [S4D] [S4A] [S4B] [S4C]
                   [S5D] [S5A] [S5B] [S5C] [S6D] [S6A] [S6B] [S6C]
                   [S7D] [S7A] [S7B] [S7C] [S8D] [S8A] [S8B] [S8C])
```

```
OUTSEG_ETH NONE| ([S1D] [S1A] [S1B] [S1C] [S2D] [S2A] [S2B] [S2C]
                  [S3D] [S3A] [S3B] [S3C] [S4D] [S4A] [S4B] [S4C]
                  [S5D] [S5A] [S5B] [S5C] [S6D] [S6A] [S6B] [S6C]
                  [S7D] [S7A] [S7B] [S7C] [S8D] [S8A] [S8B] [S8C])
```

Signal names, [see A 6.4.2.6](#)

**A 6.5.2.7 Output of the Additional Data via RS422 and Ethernet**

```
OUTADD_ETH NONE| ([NBEDGES] [NBPINS] [NBGAPS] [COUNTER] [STATE]
                  [TIMESTAMP])
OUTADD_RS422 NONE| ([NBEDGES] [NBPINS] [NBGAPS] [COUNTER] [STATE]
                   [TIMESTAMP])
```

Designation of additional outputs. Several additional data can also be output via Ethernet.

- NONE: No further outputs
- NBEDGES: Output of the number of edges
- NBPINS: Output of the number of pins
- NBGAPS: Output of the number of gaps
- COUNTER: Output of the edge counter
- STATE: Output of the error state
- TIMESTAMP: Output of the time stamp

**A 6.5.2.8 Output of the Statistics Data via RS422 and Ethernet**

```
OUTSTATISTIC_RS422 NONE| ([MIN] [MAX] [PEAK2PEAK] [MIN2] [MAX2]
                          [PEAK2PEAK2])
OUTSTATISTIC_ETH NONE| ([MIN] [MAX] [PEAK2PEAK] [MIN2] [MAX2]
                       [PEAK2PEAK2])
```

- NONE: No output of statistics
- MIN: Output of the minimum 1<sup>st</sup> statistic
- MAX: Output of the maximum 1<sup>st</sup> statistic
- PEAK2PEAK: Output of peak to peak 1<sup>st</sup> statistic
- MIN2: Output of the minimum 2<sup>st</sup> statistic
- MAX2: Output of the maximum 2<sup>st</sup> statistic
- PEAK2PEAK2: Output of peak to peak 2<sup>st</sup> statistic

Output of the selected statistics data, [see A 6.4.3.4](#)

**A 6.5.2.9 Output of Video Signals via Ethernet**

```
OUTVID_ETH NONE| ([RAW] [LIGHT] [LIGHTTAB] [THRES])
```

- NONE: No output of video signals
- RAW: Output of the raw signal
- LIGHT: Output of the light corrected signal
- LIGHTTAB: Output of the light correction table
- THRES: Output of the threshold table

### A 6.5.3 Switching Outputs

#### A 6.5.3.1 Assignment of the Switch Outputs

```
ERROROUT1 NONE|LI1|LI2|LI12|ER1|ER2
ERROROUT2 NONE|LI1|LI2|LI12|ER1|ER2
```

Setting the error switching outputs.

- NONE: No output on the error switching outputs
- LI1: Switching output is switched in case of deceeding the lower limit.
- LI2: Switching output is switched in case of exceeding the upper limit.
- LI12: Switching output is switched in case of deceeding the lower limit or exceeding the upper limit.
- ER1: Switching output is switched with edge number wrongly to be expected.
- ER2: Switching output is switched with a measuring value error (e.g. no edge found).

#### A 6.5.3.2 Hold Period of Switching Outputs

```
ERROROUTHOLD1 NONE|<hold period [ms]>
ERROROUTHOLD2 NONE|<hold period [ms]>
```

Setting the hold period of switching outputs

- NONE: No hold period
- Hold period [ms]: 1 ... 10000, activation a hold period, that means the deactivation of the active switching output is delayed by the hold period.

#### A 6.5.3.3 Setting Limit Values

```
ERRORLIMIT EHL|ELH|DA|DB|DD|DC|GA|GB|GD|GC |
S1A|S1B|S1D|S1C|S2A|S2B|S2D|S2C|S3A|S3B|S3D|S3C|S4A|S4B|S4D|S4C
S5A|S5B|S5D|S5C|S6A|S6B|S6D|S6C|S7A|S7B|S7D|S7C|S8A|S8B|S8D|S8C
[<lower limit> [<upper limit>]]
```

Selection of the signal and setting the limits for a limit consideration via the switching outputs.

EHL...S8C: The limit values refer to measuring value edge low-high (EHL).

Signal names, [see A 6.4.2.6](#)

The limits are specified in millimeters and must be between

- 46 mm: -100.0 ... +100.0
- 95 mm: -200.0 ... +200.0

#### A 6.5.3.4 Switching Level (Active Level)

```
ERRORLEVELOUT1 NPN|PNP|PUSHPULL|PUSHPULLNEG
ERRORLEVELOUT2 NPN|PNP|PUSHPULL|PUSHPULLNEG
```

- NPN: Switching output is active upon error.
- PNP: Switching output is active upon error.
- PUSHPULL: Switching output is high upon error.
- PUSHPULLNEG: Switching output is low upon error.

Wiring of the switching outputs, [see Chap. 5.3.8](#).

### A 6.5.4 Analog Output

#### A 6.5.4.1 Data Selection for the Analog Output

```
ANALOGOUT EHL|ELH|DA|DB|DD|DC|GA|GB|GD|GC |
S1A|S1B|S1D|S1C|S2A|S2B|S2D|S2C|S3A|S3B|S3D|S3C|S4A|S4B|S4D|S4C
S5A|S5B|S5D|S5C|S6A|S6B|S6D|S6C|S7A|S7B|S7D|S7C|S8A|S8B|S8D|S8C
```

Selection of the signal which should be output via the analog output.

Signal names [see A 5.4.2.6](#)

- Only one measuring value can be transmitted analogously.

### A 6.5.4.2 Disable / Enable the Analog Output

```
ANALOGRANGE NONE|0-10V
```

- NONE: No analog output (inactive)
- 0 - 10 V: The analog output outputs a voltage of 0 to 10 volts.

### A 6.5.4.3 Scaling of the Analog Output

```
ANALOGSCALE STANDARD|(TWOPOINT <Minimaler Messwert> <Maximaler  
Messwert>)
```

Setting the scaling of analog output.

STANDARD: The standard setting is fixed by 0 to MR (MR = measuring range).

TWOPOINT: „Two-point scaling“: The available output range of the analog output is then spread between the minimum and maximum measuring value.

The minimum and maximum measuring value is output in millimeters. The minimum and maximum measuring value must be between

- 46 mm: -100.0 ... +100.0
- 95 mm: -200.0 ... +200.0.

In case of minimum and maximum measuring value is ,0', the default scaling is used.

### A 6.5.5 Triggering

#### A 6.5.5.1 Preliminary Remarks to the Triggering

The trigger input serves also as synchronous input, which means triggering is possible only alternatively to sync mode, see Chap. 7.9.

#### A 6.5.5.2 Trigger Type

```
TRIGGER NONE|EDGE|PULSE|SOFTWARE [TERMON|TERMOFF]
```

- NONE: No triggering
- PULSE: Level triggering
- EDGE: Edge triggering
- SOFTWARE: Software triggering

Setting the termination of the sync / trigger input:

- TERMON: Termination (load resistance 120 Ohm) on
- TERMOFF: No termination (load resistance 120 Ohm off)

#### A 6.5.5.3 Effect of the Trigger Input

```
TRIGGERAT [INPUT|OUTPUT]
```

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

Triggering of measuring value recording (INPUT) is enabled as a factory default setting.

#### A 6.5.5.4 Trigger Level (Active Level of the Trigger Input)

```
TRIGGERLEVEL HIGH|LOW
```

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

### A 6.5.5.5 Number of Output Measuring Values

```
TRIGGERCOUNT <1...16382>|16383
```

Number of measuring values which are displayed when edge or software triggering.

- 1...16382: Number of measurement values which are displayed after a trigger impulse when edge triggering or software triggering.
- 16383: Start infinite output of measurement values after a trigger impulse when edge triggering or software triggering.
- 0: Stop triggering

### A 6.5.5.6 Software Trigger Pulse (Creating a Software Trigger Signal)

```
TRIGGERSW
```

Creates a software trigger pulse.

Error	Description
E43	Software triggering is disabled, software trigger pulse cannot be triggered.

## A 6.5.6 Parameter Management, Load / Save Settings

### A 6.5.6.1 Save Parameter Set

```
STORE 1|2|3|4|5|6|7|8
```

Save the current parameter under the specified setup number from the flash of the receiver.

### A 6.5.6.2 Load Parameter Set

```
READ ALL|DEVICE|MEAS 1|2|3|4|5|6|7|8
```

Load the parameter under the specified number from the flash.

In addition, the size of the loaded data needs to be specified:

- ALL: All parameters are loaded.
- DEVICE: Only the standard device settings are loaded (interface parameter).
- MEAS: Only the measurement settings are loaded (all features for the measurement).

### A 6.5.6.3 Reset to Factory Settings

```
SETDEFAULT ALL|CURRENT [NODEVICE]
```

Set the default settings (reset to default setting).

- ALL: All setups are deleted and default parameters are loaded.
- NODEVICE: All setups are deleted and default parameters are loaded. Settings of IP address and RS422 and for language, password and analog output are kept temporarily.
- CURRENT: The current setup is reset to the factory setting.

### A 6.5.6.4 Measuring Unit Web Interface

```
UNIT MM|INCH
```

Changes the measurement display on the web pages. The command has no effect on the ASCII interface.

- MM: Representation in millimeter
- INCH: Representation in inches

### A 6.5.7 Measuring Data

#### A 6.5.7.1 Measuring Value Format

This chapter describes the assembly of measured value frames. Informations to transfer via Ethernet or RS422 succeed, see A 6.5.7.

The data block has a fixed structure (sequence):

- Video signals (+ adjustments) ( $N * 768^1 \text{ pixel} * 16 \text{ bit}$ ), with  $N = \{0,1,2,3,4,5,6,7\}$
- Measuring value counter ( $1 * 32 \text{ bit}$ )
- Time stamp ( $1 * 32 \text{ bit}$ )
- Error status ( $1 * 32 \text{ bit}$ )
- Number of edges
- Number of pins
- Number of gaps
- Measuring values (max.  $n * 32 \text{ bit}$ ), with  $n = \{0,1,2...32\}$  depends on the selected measuring program
- Statistic values (min/max/peak2peak/min2/max2/peak2peak2) (per 32 bit)

The measuring value frame is set up dynamically, that means not selected values, see Fig. 91, are not transmitted.

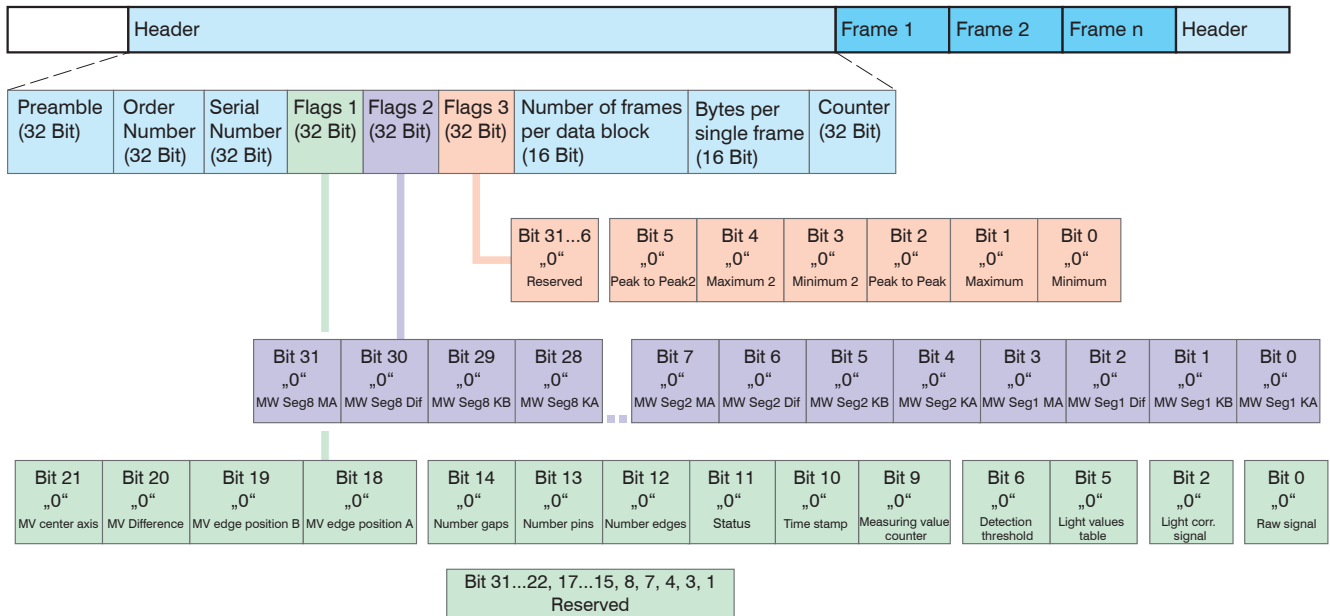


Fig. 91 Example for a data transmission via Ethernet

1) With -95 mm MR 1536 pixels

### A 6.5.7.2 Video Signal

Video signals, which were calculated in signal processing, can be transmitted. A video signal consists of the following pixels:

Sensor	Pixel
optoCONTROL 2520-46	768
optoCONTROL 2520-95	1536

A pixel is described by a 16 bit word. The used value range is 0 ... 4095.

There are four available video signals:

- Raw signal
- Light corrected signal
- Light values table
- Edge detection threshold

Data structure of video signals:

Pixel 0	Pixel 2	..	Pixel 511
Raw signal, 16 bit	Raw signal		Raw signal
Light corrected signal, 16 bit	Light corrected signal		Light corrected signal
Light values table, 16 bit	Light values table	..	Light values table
Peak detection threshold, 16 bit	Peak detection threshold		Edge detection threshold

### A 6.5.7.3 Measuring Value Counter

The transmission of the measuring value counter via Ethernet is effected as 32 bit value (unsigned integer).

On RS422 interface, only the lower 18 bits of the measuring value counter are transmitted.

### A 6.5.7.4 Time Stamp

Intrasystem the resolution of time stamp is 1  $\mu$ s. For the Ethernet transfer a 32 bit data word (unsigned integer) with the intrasystem resolution is output.

During transmission via RS422 only the bits 25 up to 8 of the time stamp are provided in a 18 bit data word. It follows a resolution of 0.25 ms, an overflow is effected after approximately 65 seconds.

### A 6.5.7.5 Number of Edges

The transmission of the number of edges via Ethernet takes place as a 32 bit value (unsigned integer). Bit 31 indicates whether the value is triggered.

On the RS422 interface, only the lower 18 bits of the number of edges are transmitted, i.e. the identification as triggered value is eliminated.

### A 6.5.7.6 Number of Pins

The transmission of the number of pins via Ethernet takes place as a 32 bit value (unsigned integer). Bit 31 indicates whether the value is triggered.

On the RS422 interface, only the lower 18 bits of the number of pins are transmitted, i.e. the identification as triggered value is eliminated.

### A 6.5.7.7 Number of Gaps

The transmission of the number of gaps via Ethernet takes place as a 32 bit value (unsigned integer). Bit 31 indicates whether the value is triggered.

On the RS422 interface, only the lower 18 bits of the number of gaps are transmitted, i.e. the identification as triggered value is eliminated.



### A 6.5.7.8 Status

The status word provides the status on the outputs (pins and LEDs).

Bit position	Description
0 up to 14	Reserved for general module error.
15	Measuring value is triggered.
16	IN 1, input from the output driver OUT 1
17	OE 1 Free circuit from the output driver OUT 1
18	IN 2 Input from the output driver OUT 2
19	OE 2 Free circuit from the output driver OUT 2
20	Synchronization active
21 up to 23	Reserved
24 + 25	LED „Link“ 00 off, 01 green, 10 red, 11 yellow, see Chap. 5.4 LEDs on Receiver
26 + 27	LED „Speed“ 00 off, 01 green, 10 red, 11 yellow, see Chap. 5.4 LEDs on Receiver
28 + 29	LED „Status“ 00 off, 01 green, 10 red, 11 yellow, see Chap. 5.4 LEDs on Receiver
30 + 31	LED „Power“ 00 off, 01 green, 10 red, 11 yellow, see Chap. 5.4 LEDs on Receiver

Fig. 92 Bit structure of the error status word

During transmission via RS422 only the upper bits 16 up to 31 of error status word are transmitted. For the Ethernet transfer are all 32 bits ready to issue.

Comment to bit 16 up to 19:

IN 1/2 and OE 1/2 are the internal inputs of the circuits to the switching outputs OUT 1/2:

IN (Signal):

IN = L  $\Rightarrow$  OUT switches to low (GND, down);

IN = H  $\Rightarrow$  OUT switches to high (+ UB, up)

OE (Output enable):

OE = L  $\Rightarrow$  OUT passive (open);

OE = H  $\Rightarrow$  OUT active (switched).

Thus, the switching behavior of the switching outputs OUT 1/2 can be realized as PNP, NPN, push-pull or push-pull-negated, see Chap. 5.3.8.

### A 6.5.7.9 Measuring Data

Up to maximum 32 measuring values can be output depending on the selected measuring program.

Measuring program	Max. number of measuring values n	Sequence according to selection
Edge low-high	1	EHL First edge low-high
Edge high-low	1	EHL First edge high-low
Diameter	4	DA First edge low-high DB Last edge low-high DD Difference (DB-DA) DC Center axis $((DA + DB)/2)$
Gap	4	GA First edge high-low GB Subsequent edge GD Difference (GB-GA) GC Center axis $((GA+GB)/2)$
Any segments	32	S1A Edge A segment 1 S1B Edge B segment 1 S1D Difference (S1B-S1A) S1C Center axis $((S1A+S1B)/2)$ ... S8A Edge A segment 1 S8B Edge B segment 1 S8D Difference (S1B-S1A) S8C Center axis $((S1A+S1B)/2)$

The measurement values are provided as 32 bit signed integer with 1 nm resolution. The RS422 interface outputs 18 bit signed integer values with the following resolution:

optoCONTROL 2520-46: 1  $\mu\text{m}$  with an offset = 131000

optoCONTROL 2520-95: 2  $\mu\text{m}$  with an offset = 131000

The measuring values are displayed as 32 bit signed integer value with a resolution of 1 nm. 18 bit signed integer values with a resolution of 1  $\mu\text{m}$  are output provided with an offset = 131000 via the RS422 interface.

### A 6.5.7.10 Statistic Values

The statistic values have the same format as the measuring values.

At first minimum, then maximum and at the end peak to peak is transmitted (if selected).

The statistic values are displayed as 32 bit signed integer value with a resolution of

optoCONTROL 2520-46: 1  $\mu\text{m}$

optoCONTROL 2520-95: 2  $\mu\text{m}$

respectively in format for the RS422 interface.

### A 6.5.8 Measuring Data Format

#### A 6.5.8.1 Data Format RS422 Interface

The output of edge positions, differences, center axes and statistic values via RS422 needs a subsequent conversion in micrometers ( $\mu\text{m}$ ). Other values as time stamp, measuring value counter or status data are transmitted as 18 bit data words, a conversion is not required.

Measuring value 1:

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

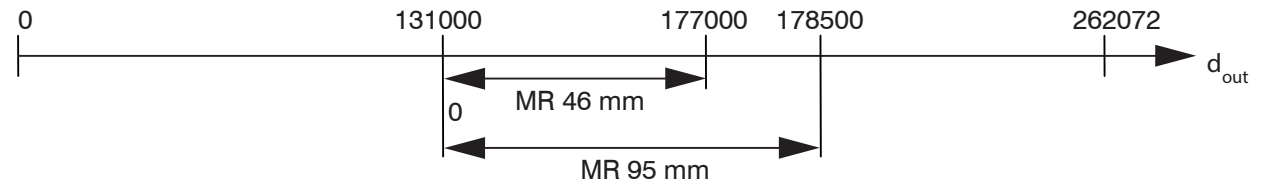
Measuring value 2 ... 32:

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

The linearized measuring values can be converted in  $\mu\text{m}$  using the following formula:

<b>Measuring range</b>	<b>-46</b>	<b>-95</b>
<b>Formula</b>	$x [\mu\text{m}] = d_{\text{out}} - 131000$	$x [\mu\text{m}] = 2 * (d_{\text{out}} - 131000)$

x	= Measuring value (edge position, difference, center axis) in $\mu\text{m}$
$d_{\text{out}}$	= digital output value; $d_{\text{out}} \geq 262072$ are error values



#### A 6.5.8.2 Error Codes RS422 Interface

All values greater than 262072 are error values and are defined as follows:

Fehler code	Description
262073	Scaling error RS422 interface underflow
262074	Scaling error RS422 interface overflow
262075	Too much data for selected baud rate <sup>1</sup>
262076	There is no edge present.
262079	Measuring value cannot be calculated.

To remove the error, there are the following possibilities:

- Increase the baud rate, [see A 6.5.1.4](#)
- Decrease data; if 2 data words have been selected, then reduce to a data word, [see A 6.5.2](#).
- Reduce output data rate, [see A 6.5.1.6](#)

For all the other data outputs except the measuring value data the restrictions are defined in the suitable segments, [see A 6.5](#)

1) This error occurs when more data are to be output as with selected baud rate can be transmitted.

**A 6.5.8.3 Measuring Data Transmission to a Measuring Value Server via Ethernet**

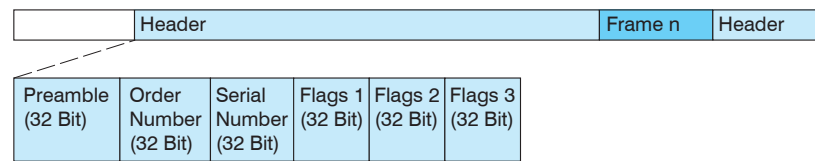
During the measurement data transmission to a measurement value server the sensor transmits each measurement value to the measurement value server or to the connected client after successful connection (TCP or UDP). Therefore no explicit requirement is necessary.

All distances and additional informations to be transmitted, which were recorded at a time, are combined to a measurement value frame. Different measurement value frames are combined to a measurement value block, which contains a header and fits a TCP/IP or UDP/IP packet. The header is mandatory at the start of a UDP or TCP packet. In case of changes of the transferred data or the frame rate a new header is automatically sent.

Il measurement data and the header are transmitted in the little Endian format.

Preamble (32 bit)	
Order number (32 bit)	
Serial number (32 bit)	
Flags 1 (32 bit)	
Flags 2 (32 bit)	
Flags 3 (32 bit)	
Frame number (16 bit)	Bytes per Frame (16 bit)
Counter (32 bit)	

Header input	Description
Preamble	Identifies the header - 0x4D454133 Measuring data or - 0x56494433 Video data
Order number	Order number of the sensor
Serial number	Serial number of the sensor
Flags 1	Provide information about the content of the measuring values.
Flags 2	
Flags 3	
Bytes per Frame	Number of bytes which a measuring value frame contains.
Frame number	Number of frames which covers this header.
Counter	Counter on the number of processed measuring values



Example: The data ... (for example diameter and center axis?) are transmitted.

**Description Flags 1**

Flag bit	Description
0	Raw signal
1	Reserved
2	Light corrected signal
3	Reserved
4	Reserved
5	Light values table
6	Threshold table
7 up to 8	Reserved
9	Measuring value counter
10	Time stamp
11	Status
12	Number of edges

13	Number of pins
14	Number of gaps
15 up to 17	Reserved
18	Measuring value edge position A
19	Measuring value edge position B
20	Measuring value difference
21	Measuring value center axis
22 up to 31	Reserved

Comment to flag bit 18 up to 21:

The output measuring values are designated for the measuring programs as follows:

Measuring program	When bit is set				Comment
	Edge A	Edge B	Difference	Center axis	
Edge low-high	X	-	-	-	
Edge high-low	X	-	-	-	
Diameter / width	X	X	X	X	depends on selection
Gap	X				depends on selection
Any segments	-	-	-	-	See Flags 2

#### Description Flags 2

Flag bit	Description
0	Measuring value segment 1 edge position A
1	Measuring value segment 1 edge position B
2	Measuring value segment 1 difference
3	Measuring value segment 1 center axis
4	Measuring value segment 2 edge position A
5	Measuring value segment 2 edge position B
6	Measuring value segment 2 difference
7	Measuring value segment 2 center axis
8	Measuring value segment 3 edge position A
9	Measuring value segment 3 edge position B
10	Measuring value segment 3 difference
11	Measuring value segment 3 center axis
12	Measuring value segment 4 edge position A
13	Measuring value segment 4 edge position B
14	Measuring value segment 4 difference
15	Measuring value segment 4 center axis
16	Measuring value segment 5 edge position A
17	Measuring value segment 5 edge position B
18	Measuring value segment 5 difference
19	Measuring value segment 5 center axis
20	Measuring value segment 6 edge position A
21	Measuring value segment 6 edge position B
22	Measuring value segment 6 difference
23	Measuring value segment 6 center axis
24	Measuring value segment 7 edge position A
25	Measuring value segment 7 edge position B
26	Measuring value segment 7 difference
27	Measuring value segment 7 center axis
28	Measuring value segment 8 edge position A
29	Measuring value segment 8 edge position B
30	Measuring value segment 8 difference
31	Measuring value segment 8 center axis

**Description Flags 3**

Flag bit	Description
0	1. Statistics minimum
1	1. Statistics maximum
2	1. Statistics peak to peak
3	2. Statistics minimum
4	2. Statistics maximum
5	2. Statistics peak to peak
6 up to 31	Reserved

**A 6.5.8.4 Error Codes Ethernet Interface**

Error code	Description
0x7fffffb	There is no edge present.
0x7fffff8	Measuring value cannot be calculated.

**A 6.5.8.5 Ethernet Video Signal Transmission****Set video output**

```
OUTVID_ETH NONE NONE | ([RAW] [LIGHT] [LIGHTTAB] [THRES])
```

Setting of the data which are transmitted in a video signal transmission.

- NONE: No output of video signals
- RAW: Output of the raw signal
- LIGHT: Output of the light corrected signal
- LIGHTTAB: Output of the light corrected table
- THRES: Output of the detection threshold

The video signal transmission is effected to a measurement value server via Ethernet, , see [A 6.5.8.3](#). This measuring value block can vary also over different TCP/IP or UDP/IP packets depending on the size of the video signal.

The preamble for the video signals is 0x56494445 (conforms „VIDE“).

**A 6.6 Warning and Error Messages**

The following table lists all warning messages:

Warning message	Description
W01 EtherCAT stopped.	EtherCAT has stopped.
W03 Reset Master	Zero setting/mastering has been disabled.
W04 The output starts after switch to mode EtherCAT.	The output is activated after switching to the EtherCAT mode.
W05 EtherCAT will be activated after saving the settings and restarting the sensor.	EtherCAT is only activated after saving the settings and restarting the sensor.
W07 There are more readings output as configured	There are more measuring values output as configured.
W08 The sensor must be rebooted.	The sensor must be restarted (reboot).
W10 Warning light source reference, light corrected signal bad (tolerance band).	Light corrected signal is bad (tolerance band).

The following table lists all error messages:

<b>Error message</b>	<b>Description</b>
E01 Unknown command	Unknown command (permissions too small to read).
E02 Wrong or unknown parameter type	A transferred parameter has a wrong type or it was the wrong number of parameters transferred.
E03 Internal error	Internal error code
E04 I/O operation failed	Can not write data to the output channel.
E05 The entered command is too long to be processed.	The entered command with the parameters is too long (greater than 255 bytes).
E06 Access denied	Access denied; login as professional is necessary.
E07 The answer is too long to be displayed by this interpreter.	Answer is too long.
E08 Unknown parameter	Unknown parameter
E09 The command or parameter processing has been canceled.	The command was canceled.
E10 The command or parameter processing is pending.	Command or parameters are being processed.
E11 The entered value is out of range or its format is invalid.	The parameter value is out of range of the value range.
E12 The info-data of the update are wrong.	For update only. The header of the update data contains an error.
E13 Error during the data transmission for the update	For update only. Error during update data transmission.
E14 Timeout during the update.	For update only: Timeout in the transfer of update data.
E15 Update file is too big.	For update only: The update data are too large.
E16 Timeout, command aborted.	The corrections have been aborted with a timeout.
E17 Processing aborted.	Upload data is too large, aborted process
E18 A signal transfer is already active. Please stop this.	A measuring value transmission is active. Please, only stop to be able to execute the command.
E19 The file is not valid for this sensor.	The transferred parameter file is for a different sensor type.
E20 Invalid file type	Invalid file type (setup file)
E21 Versions do not match.	The versions do not match (setup file)
E22 Checksum invalid	Checksum invalid (setup file)
E23 The set of parameters does not exist.	The set of parameters do not exist.
E26 No signals selected.	There were no measuring values selected for transmission.
E27 Invalid combination of signal parameters - please check measure mode and selected signals.	Invalid signal combination - please check the measuring program and selected signal.
E30 The master value is out of range.	The master value is out of range.
E32 Timeout	Timeout during mastering
E33 Wrong parameter count	Too high or too small number of parameters
E34 The sensor has no calibration data.	The sensor has no calibration data.

<b>Error Message</b>	<b>Description</b>
E35 Cannot start transfer of measurement data.	Measuring value output cannot boot (only adjustments).
E37 ROI start must be lower than end.	Value for the left side of the mask must be less than the right value.
E38 Too much output values for RS422 enabled.	Too much output values for RS422 enabled.
E41 The given passwords are not equal.	Errors in the repeated input of the new password.
E43 Software triggering is not active.	Software triggering is not enabled, no software trigger pulse can be triggered.
E46 Unsupported character	An unsupported character is received.
E51 The given signal is not selected for output.	The current signal is not selected for output.
E55 Synchronization and triggering at level or edge are not possible at the same time.	Synchronization and level or edge triggering cannot be specified.
E56 Video signal is too dark	The video signal is too dark.
E57 Measuring distance is unavailable.	Measuring distance is not available.
E58 Lower threshold is greater than upper threshold.	Lower threshold is greater than upper threshold.
E59 Error light source reference, video signal too dark at maximum laser power, lamp defective or dirty.	Error light source reference, video signal too high at laser maximum, lamp failure or dirty.
E60 Error light source reference, measured object in the measuring range.	Error light source reference, target in measuring range.
E61 Error light source reference, lamp out, but raw signal to light, lamp defective.	Error light source reference, raw signal too low when laser off, lamp defective.
E65 A segment 0-0 is used for the output or calculation.	A non-defined segment (0-0) is used for output or calculation.



## A 7 Telnet

The Telnet commands enable you to communicate with the optoCONTROL 2520 from your PC.

### A 7.1 General

#### A 7.1.1 Requirement

For communication with Telnet, you need an existing Ethernet connection between optoCONTROL 2520 and your PC. For Win 7 users: ask your system administrator, if the Telnet client does not work.

#### A 7.1.2 Link Connection

- Start the program `Telnet.exe` via Start menu > Process.
- Type in the command `telnet 169.254.168.150` or the IP address of the optoCONTROL 2520.

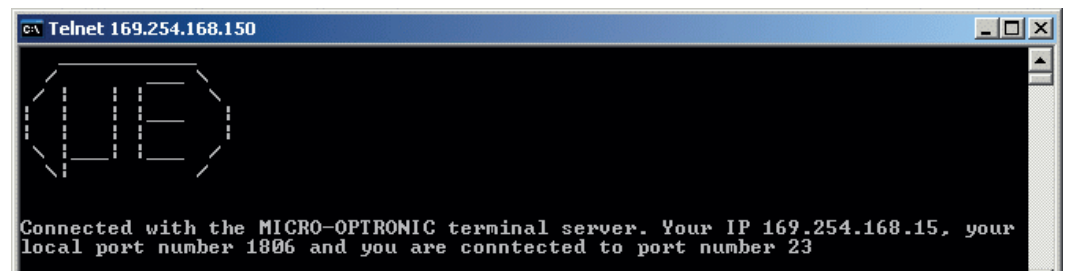


Fig. 93 Telnet start screen of the optoCONTROL 2520

A command always consists on the command name and zero or more parameters, separated by spaces. The currently selected parameter value is returned when a command without parameters is called.

The output format is:

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

The returned command can be used again for setting the parameter without changes. After processing a command a carriage return and a prompt return („->“) is always returned. If an error occurs an error message that begins with „Exx“, is before the prompt; where xx is a unique error number.

#### A 7.1.3 Error Messages

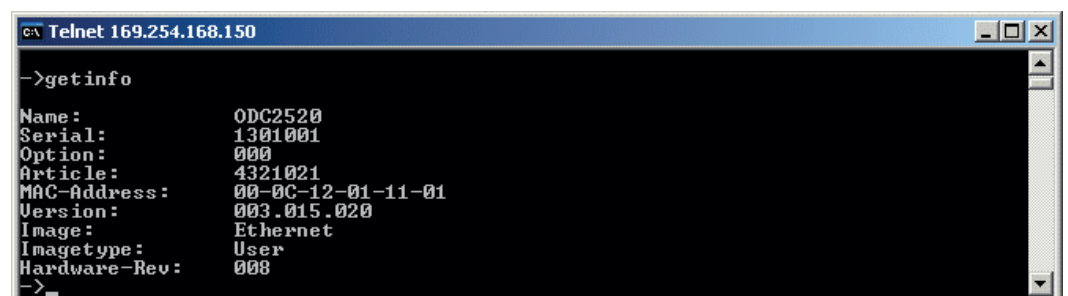
The following error messages may occur:

- E01 Unknown command: An unknown parameter ID was transferred.
- E06 Access denied: This parameter cannot be accessed currently. Maybe the sensor is not in the professional mode or the parameter is not visible by other settings.
- E08 Unknown parameter: There were too few parameters transferred.
- E11 The input value is outside the valid range, or the format is invalid: The transferred value is outside the valid range.

The text of the error messages depends on the selected language. The ID of the error message (Exx) is the same for each language.

### A 7.2 Example

Query the sensor information with the command `GETINFO`.



- Measured value transfer: Measured values are sent via port 1024 by default. However, measured value requests must be sent via port 23 by command.

## A 8 EtherCAT Documentation

### A 8.1 General

EtherCAT® is, from the Ethernet viewpoint, a single, large Ethernet station that transmits and receives Ethernet telegrams. Such an EtherCAT system consists of an EtherCAT master and up to 65535 EtherCAT slaves.

Master and slaves communicate via a standard Ethernet wiring. On-the-fly processing hardware is used in each slave. The incoming Ethernet frames are directly processed by the hardware. Relevant data are extracted or added from the frame. The frame is subsequently forwarded to the next EtherCAT® slave device. The completely processed frame is sent back from the last slave device. Various protocols can be used in the application level. CANopen over EtherCAT technology (CoE) is supported here. In the CANopen protocol, an object tree with Service Data Objects (SDO) and Process Data Objects (PDO) is used to manage the data.

Further information can be obtained from ® Technology Group ([www.ethercat.org](http://www.ethercat.org)) or Beckhoff GmbH, ([www.beckhoff.com](http://www.beckhoff.com)).

### A 8.2 Introduction

#### A 8.2.1 Structure of EtherCAT®-Frames

The transfer of data occurs in Ethernet frames with a special Ether type (0x88A4). Such an EtherCAT® frame consists of one or several EtherCAT® telegrams, each of which is addressed to individual slaves / storage areas. The telegrams are either transmitted directly in the data area of the Ethernet frame or in the data area of the UDP datagram. An EtherCAT® telegram consists of an EtherCAT® header, the data area and the work counter (WC). The work counter is incremented by each addressed EtherCAT® slave that exchanged the corresponding data.

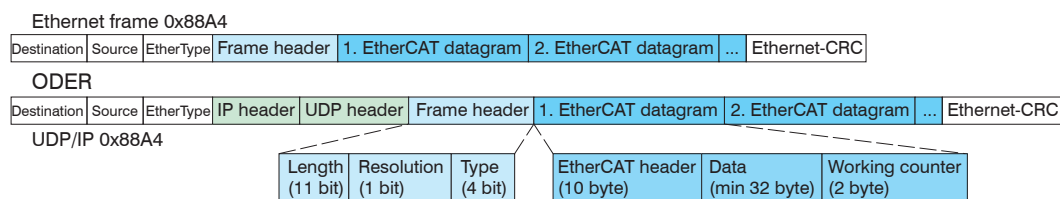


Fig. 94 Setup of EtherCAT frames

#### A 8.2.2 EtherCAT® Services

In EtherCAT® services for the reading and writing of data are specified in the physical memory of the slave hardware. The following EtherCAT® services are supported by the slave hardware:

- APRD (Autoincrement physical read, Reading of a physical area with auto-increment addressing)
- APWR (Autoincrement physical write, Writing of a physical area with auto-increment addressing)
- APRW (Autoincrement physical read write, Reading and writing of a physical area with auto-increment addressing)
- FPRD (Configured address read, Reading of a physical area with fixed addressing)
- FPWR (Configured address write, Writing of a physical area with fixed addressing)
- FPRW (Configured address read write, Reading and writing of a physical area with fixed addressing)
- BRD (Broadcast Read, Broadcast Reading of a physical area for all slaves)
- BWR (Broadcast Write, Broadcast Writing of a physical area for all slaves)
- LRD (Logical read, Reading of a logical storage area)
- LWR (Logical write, Writing of a logical storage area)
- LRW (Logical read write, Reading and writing of a logical storage area)

- ARMW (Auto increment physical read multiple write, Reading of a physical area with auto-increment addressing, multiple writing)
- FRMW (Configured address read multiple write, Reading of a physical area with fixed addressing, multiple writing)

### A 8.2.3 Addressing and FMMUs

In order to address a slave in the EtherCAT® system, various methods from the master can be used. The confocalDT 24x1 supports as full slave:

- Position addressing  
The slave device is addressed via its physical position in the EtherCAT® segment. The services used for this are APRD, APWR, APRW.
- Node addressing  
The slave device is addressed via a configured node address, which was assigned by the master during the commissioning phase. The services used for this are FPRD, FPWR and FPRW.
- Logical addressing  
The slaves are not addressed individually; instead, a segment of the segment-wide logical 4-GB address is addressed. This segment can be used by a number of slaves. The services used for this are LRD, LWR and LRW.

The local assignment of physical slave memory addresses and logical segment-wide addresses is implemented via the field bus Memory Management Units (FMMUs). The configuration of the slave FMMUs is implemented by the master. The FMMU configuration contains a start address of the physical memory in the slave, a logical start address in the global address space, length and type of the data, as well as the direction (input or output) of the process data.

### A 8.2.4 Sync Manager

Sync Managers serve the data consistency during the data exchange between EtherCAT® master and slaves. Each Sync Manager channel defines an area of the application memory. The confocalDT 24x1 has four channels:

- Sync-Manager Channel 0: Sync Manager 0 is used for mailbox write transfers (mailbox from master to slave).
- Sync-Manager Channel 1: Sync Manager 1 is used for mailbox read transfers (mailbox from slave to master).
- Sync-Manager Channel 2: Sync Manager 2 is usually used for process output data. Not used in the sensor.
- Sync-Manager Channel 3: Sync Manager 3 is used for process input data. It contains the Tx PDOs that are specified by the PDO assignment object 0x1C13 (hex.).

### A 8.2.5 EtherCAT State Machine

The EtherCAT® state machine is implemented in each EtherCAT®. Directly after switching on the sensor, the state machine is in the “Initialization” state. In this state, the master has access to the DLL information register of the slave hardware. The mailbox is not yet initialized, i.e. communication with the application (sensor software) is not yet possible. During the transition to the pre-operational state, the Sync Manager channels are configured for the mailbox communication. In the „Pre-Operational“ state, communication via the mailbox is possible, and it can access the object directory and its objects. In this state, no process data communication occurs. During the transition to the „Safe-Operational“ state, the process-data mapping, the Sync Manager channel of the process inputs and the corresponding FMMU are configured by the master. Mailbox communication continues to be possible in the „Safe-Operational“ state. The process data communication runs for the inputs. The outputs are in the „safe“ state. In the „Operational“ state, process data communication runs for the inputs as well as the outputs.

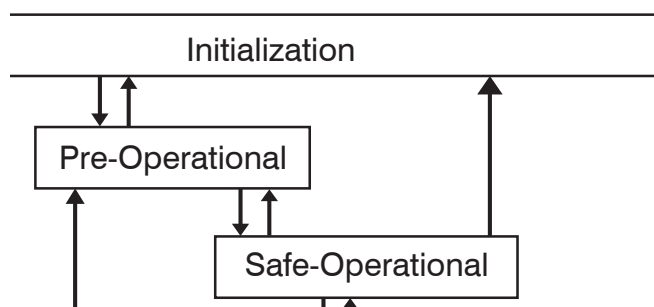


Fig. 95 EtherCAT State Machine

### A 8.2.6 CANopen over EtherCAT

The application level communication protocol in EtherCAT is based on the communication profile CANopen DS 301 and is designated either as “CANopen over EtherCAT” or CoE. The protocol specifies the object directory in the sensor, as well as the communication objects for the exchange of process data and acyclic messages. The sensor uses the following message types:

- Process Data Object (PDO). The PDO is used for the cyclic I/O communication, therefore for process data.
- Service Data Object (SDO). The SDO is used for acyclic data transmission.

Details to the object directory, [see A 8.3](#)

### A 8.2.7 Process Data PDO Mapping

Process Data Objects (PDOs) are used for the exchange of time-critical process data between master and slaves. Tx PDOs are used for the transmission of data from the slaves to the master (inputs), Rx PDOs are used to transmit data from the master to the slaves (outputs); not used in the confocalDT 24x1. The PDO mapping defines which application objects (measurement data) are transmitted into a PDO. The sensor has a Tx PDO for the measuring data. The following measurements are available as process data:

Designation	Description
Value counter	Measuring value counter (32 Bit)
Timestamp	Time stamp (32 Bit)
Sensor state	Error state
Number of edges	Number of edges
Number of pins	Number of pins
Number of gaps	Number of gaps
1 Statistic minimum value	1. Statistic value (minimum)
1 Statistic maximum value	1. Statistic value (maximum)
1 Statistic peak-peak value	1. Statistic value (Peak to Peak)
2 Statistic minimum value	2. Statistic value (minimum)
2 Statistic maximum value	2. Statistic value (maximum)
2 Statistic peak-peak value	2. Statistic value (peak to peak)
Position of the first high-low edge	Position of the first high-low edge
Position of the first low-high edge	Position of the first low-high edge
Diameter edge position A	Diameter / width, first low-high edge (A)
Diameter edge position B	Diameter / width, last high-low edge (B)
Diameter difference	Diameter / width
Diameter center axis	Diameter / width, center axis
Gap edge position A	Gap, position first high-low edge (A)
Gap edge position B	Gap, position following low-high edge (B)
Gap difference	Gap, gap difference
Gap center axis	Gap, center axis
Segment 1 edge position A	Segment 1, edge position A
Segment 1 edge position B	Segment 1, edge position B
Segment 1 difference	Segment 1, gap difference / width
Segment 1 center axis	Segment 1, center axis
Segment 2 edge position A ... Segment 8 center axes	Further measurements of segments 2 to 8

Fig. 96 Measurements of the optoCONTROL 2520

In EtherCAT the PDOs are transported in objects of the Sync Manager channel. The sensor uses the Sync Manager channel SM3 for input data (Tx data). The PDO assignments of the Sync Manager can only be changed in the “Pre-Operational” state. The mapping in the sensor is not carried out directly in the object 0x1A00, but rather by switching on and off individual measurements in the application object 0x21B0. The mapping result is available to the master after reloading the object directory.

**Note:** Subindex 0h of the object 0x1A00 contains the number of valid entries within the mapping report. This number also represents the number of application variables (parameters) that should be transmitted/received with the corresponding PDO. The subindices from 1h up to the number of objects contain information about the depicted application variables. The mapping values in the CANopen objects are coded in hexadecimal form.

The following table contains an example of the entry structure of the PDO mapping:

MSB			LSB		
31	16	15	8	7	0
Index e.g. 0x6065 (16 bits)		Subindex e.g. 0x02		Object length in bits, e.g. 20h = 32 bits	

Fig. 97 Entry structure of the PDO mapping, example

### A 8.2.8 Service Data SDO Service

Service Data Objects (SDOs) are primarily used for the transmission of data that are not time critical, e.g. parameter values.

EtherCAT specifies the SDO services as well as the SDO information services:

- SDO services make possible the read/write access to entries in the CoE object directory of the device.
- SDO information services make it possible to read the object directory itself and to access the properties of the objects.

All parameters of the measuring device can be read or changed in this way, or measurements can be transmitted. A desired parameter is addressed via index and subindex within the object directory.

## A 8.3 CoE – Object Directory

### A 8.3.1 Characteristics

The CoE object directory (CANopen over EtherCAT) contains all the configuration data of the sensor. The objects in CoE object directory can be accessed using the SDO services. Each object is addressed using a 16-bit index.

### A 8.3.2 Communication Specific Standard Objects (CiA DS-301)

#### A 8.3.2.1 Overview

Index (h)	Name	Description
1000	Device type	Device type
1001	Error register	Error register
1003	Error history	Predefined error field
1008	Device name	Manufacturer device name
1009	Hardware version	Hardware version
100A	Software version	Software version
1018	Identity	Device identification
1A00	Sample 0	TxPDO mapping
1A01	Sample 1	TxPDO Mapping (for oversampling)
...		
1A18	Sample 24	
1C00	Sync. manager type	Sync. manager type
1C13	TxPDO assign	TxPDO assign
1C33	SM input parameter	Synchronous mode parameter (DC)

#### A 8.3.2.2 Object 1000h: Device type

1000	VAR	Device type	0x00200000	Unsigned32	ro
------	-----	-------------	------------	------------	----

Provides informations about the used device profile and the device type.

**A 8.3.2.3 Object 1001h: Error register**

1001	VAR	Error register	0x00	Unsigned8	ro
------	-----	----------------	------	-----------	----

The error register contains generic informations about the kind of the internally adjacent device errors. The general error bit is set on each case.

Structure of error register

7	6	5	4	3	2	1	0
Manufacturer	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	General

**A 8.3.2.4 Object 1003h: Error history**

1003	RECORD	Error history			
------	--------	---------------	--	--	--

Subindices

0	VAR	Number of entries	1	Unsigned8	rw
1	VAR			Unsigned32	ro

The occurring device errors are registered here. The last error is saved in the error field. The entry under Sub-Index 0 contains the number of saved errors, by writing the value 0, the errors are eliminated.

**A 8.3.2.5 Object 1008h: Device name**

1008	VAR	Device name	IFC24x1	Visible String	ro
------	-----	-------------	---------	----------------	----

**A 8.3.2.6 Object 1009h: Hardware version**

1009	VAR	Hardware version	V x.xxx	Visible String	ro
------	-----	------------------	---------	----------------	----

**A 8.3.2.7 Object 100Ah: Software version**

100A	VAR	Software version	V x.xxx	Visible String	ro
------	-----	------------------	---------	----------------	----

**A 8.3.2.8 Object 1018h: Identity**

Shows the device identification, contains amongst others the stock and the serial number of the sensor.

1018	RECORD	Identity			
------	--------	----------	--	--	--

Subindices

0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Vendor ID	0x00000607	Unsigned32	ro
2	VAR	Product code	0x003EDE73	Unsigned32	ro
3	VAR	Revision	0x00010000	Unsigned32	ro
4	VAR	Serial number	0x009A4435	Unsigned32	ro

The article number is deposit in the product code, the serial number of the sensor in serial number. Vendor ID: membership number of the EtherCAT® Technology Group (ETG) for MICRO-EPSILON Optronik GmbH.

For further details, see [A 6.3.1.2](#)

**A 8.3.2.9 Object 1A00h: TxPDO mapping**

1A00	RECORD	TxPDO Mapping			
------	--------	---------------	--	--	--

Subindices

0	VAR	Number of entries	43	Unsigned8	ro
1	VAR	Position of the first high-low edge	0x6065:01, 323	Unsigned32	ro

**A 8.3.2.10 Object 1A01 up to 1A18: TxPDO mapping**

Contents are identical to object 1A00. The objects 1A01 - 1A18 are used for oversampling, see [A 8.7](#).

**A 8.3.2.11 Object 1C00h: Sync manager type**

1C00	RECORD	Sync manager type			ro
------	--------	-------------------	--	--	----

## Subindices

0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Sync manager 0	0x01	Unsigned8	ro
2	VAR	Sync manager 1	0x02	Unsigned8	ro
3	VAR	Sync manager 2	0x03	Unsigned8	ro
4	VAR	Sync manager 3	0x04	Unsigned8	ro

**A 8.3.2.12 Object 1C13h: TxPDO assign**

1C13	RECORD	TxPDO assign			
------	--------	--------------	--	--	--

## Subindices

0	VAR	Number of entries	1	Unsigned8	ro
1	VAR	Subindex 001	0x1A00	Unsigned16	ro

Further subindices possible (0x1A01, 0x1A02, ...) when oversampling, see [A 8.7](#).

**A 8.3.2.13 Object 1C33h: SM input manager**

1C33	RECORD	SM input parameter			ro
------	--------	--------------------	--	--	----

## Subindices

0	VAR	Number of entries	32	Unsigned8	ro
1	VAR	Sync mode	0	Unsigned8	ro
2	VAR	Cycle time	100000	Unsigned32	ro
4	VAR	Sync modes supported	0x4005	Integer16	ro
5	VAR	Minimum cycle time	1000000	Integer32	ro
6	VAR	Calc and copy time	0	Integer32	ro
8	VAR	Get cycle time	0	Integer16	rw
11	VAR	SM event missed counter	0	Integer32	ro
12	VAR	Cycle exceeded counter	0	Integer32	ro
32	VAR	Sync error	FALSE	Bool	ro



### A 8.3.3 Manufacturer Specific Objects

#### A 8.3.3.1 Overview

Index (h)	Name	Description
2001	User level	Login, logout, change password
2005	Sensor info	Sensor informations (further)
2010	Setup	Load/save settings
2011	Correction	Low and high correction
2050	Advanced settings	Measurement unit
2101	Reset	Reset sensor
2105	Factory settings	Reset factory settings
2132	Laser power	Turning off laser light source
2153	Measuring distance	Distance between light source - receiver
2154	Measuring program	Measuring program
2165	Edges segment	Options for segments
2181	Averaging/error handling/statistics	Averaging/error handling/statistics and spike correction
21B0	Digital interfaces	Digital interfaces, data selection
21B1	Value edge high-low	Select measurement edge high-low
21B2	Value edge low-high	Select measurement edge low-high
21B3	Values diameter	Select measurement diameter / width
21B4	Values gap	Select measurement gap
21B5	Values segments	Select measurement segment
21C0	Ethernet	Ethernet parameter (IP address, subnet, gateway)
21D0	Analog output	Analog output
21E0	Zeroing/mastering	Zeroing/mastering
21F1	Switching outputs	Switching outputs
2410	Trigger mode	Trigger modes
2550	Threshold	Peak detection threshold
2711	Range of interest	Reduction of Region of Interest
603F	Sensor error	Error message of the sensor
6065	Position of the first low-high edge	Measurement values, depending on measurement program and selection
...	...	
6069	Segment 1 position A	

#### A 8.3.3.2 Object 2001h: User level

2001	RECORD	User level			
Subindices					
0	VAR	Number of entries	7	Unsigned8	ro
1	VAR	Actual user	x	Unsigned8	ro
2	VAR	Login	*****	Visible string	wo
3	VAR	Logout	FALSE	BOOL	rw
4	VAR	Default user	x	Unsigned8	rw
5	VAR	Password old	*****	Visible string	wo
6	VAR	Password new	*****	Visible string	wo
7	VAR	Password repeat	*****	Visible string	wo

Actual user, Default user:

- x = 0 - User
- x = 1 - Professional

For changing the password, the three password fields Old, New and Repeat must be described in the specified sequence. The maximum length of a password is 31 characters.

Further details can be found in the section Login, see Chap. 7.1.

**A 8.3.3.3 Object 2005h: Sensor informations**

2005	RECORD	Sensor Info			ro
Subindices					
0	VAR	Number of entries	8	Unsigned8	ro
1	VAR	Name	ODC 2520	Visible String	ro
2	VAR	Measuring range	46 or 95	FLOAT32	
5	VAR	Serial No	xxxxxxx	Visible String	ro
6	VAR	Option No	xxx	Visible String	ro
7	VAR	Calibration Date	xx.xx.xxxx	Visible String	ro
8	VAR	Article No	xxxxxxx	Visible String	ro
10	VAR	Measuring distance	20.000	FLOAT32	ro

Further details can be found in the section sensor information, [see A 6.3.1.2](#).

**A 8.3.3.4 Object 2010h: Setup**

2010	RECORD	Setup			ro
Subindices					
0	VAR	Number of entries	5	Unsigned8	ro
1	VAR	Setup number	0x0000	Unsigned8	rw
2	VAR	Setup store	FALSE	BOOL	rw
3	VAR	Setup read	FALSE	BOOL	rw
4	VAR	Keep device settings	FALSE	BOOL	rw

Further details can be found in the section Load/save settings in the sensor, [see Chap. 6.6](#) and Parameter management, [see A 6.5.6](#).

**A 8.3.3.5 Object 2011h: Correction**

2011	RECORD	Correction			ro
Subindices					
0	VAR	Number of entries	3	Unsigned8	ro
2	VAR	Light correction	FALSE	BOOL	rw

Once light correction has been initiated via subindex 2, the read status changes to 10 in subindex 3. The value remains at 10 during the correction procedure. As soon as the correction is completed successfully, the value changes to 0. If an error occurs, the status changes to a value in the table, [see A 6.6](#) (Warning and error messages). This value then corresponds to the error message in object 603F;1.

➡ Check the sensor at the end of the light correction for possible errors with object 603Fh, [see A 8.3.3.27](#).

Further details can be found in the section light source reference, [see Chap. 6.3.1](#)

**A 8.3.3.6 Object 2050h: Advanced settings**

2050	RECORD	Advanced settings			
Subindices					
0	VAR	Number of entries	1	Unsigned8	ro
1	VAR	Measuring unit	FALSE	BOOL	rw

Selects the unit for the sensor parameterization: 0 - Millimeter, 1 - Inch

**A 8.3.3.7 Object 2101h: Reset**

2101	VAR	Reset	FALSE	BOOL	rw
------	-----	-------	-------	------	----

Further details can be found in the section reset, [see 7.12.2](#).

**A 8.3.3.8 Object 2105h: Factory settings**

2105	RECORD	Factory settings			ro
Subindizes					
0	VAR	Number of entries	3	Unsigned8	ro
1	VAR	Factory settings	FALSE	BOOL	rw
2	VAR	Keep device settings	FALSE	BOOL	rw
3	VAR	Reset current setup	FALSE	BOOL	rw

Further details can be found in the section Extras, [see 7.12.1](#)

**A 8.3.3.9 Object 2132h: Laser power**

2132	VAR	Laser power	TRUE	BOOL	rw
------	-----	-------------	------	------	----

Turning the laser source on and off.

**A 8.3.3.10 Object 2153h: Measuring distance**

2153	RECORD	Measuring distance			ro
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	Distance in mm	x	FLOAT32	rw
2	VAR	Measuring distances	x	Visible string	ro

Measuring distances: shows all teached measuring distances, e.g. "20,000mm".

Further details can be found in the section measurement distance, [see Chap. 6.4.2, see A 6.4.1](#)

**A 8.3.3.11 Object 2154h: Measuring program**

Determines the measurement program, search direction, measurement direction and the number of expected edges.

2154	RECORD	Measuring program			
------	--------	-------------------	--	--	--

Subindices

0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Measuring program		Unsigned8	rw
2	VAR	Search direction		Unsigned8	rw
3	VAR	Measuring direction		Unsigned8	rw
4	VAR	Expected edges		Unsigned8	rw

Measuring program:

- 0 – Edge high-low
- 1 – Edge low-high
- 2 – Diameter
- 3 – Gap
- 4 – Segment

Search direction / Measuring direction:

- 0 – Standard
- 1 – Invers

Expected edges:

- 1-64

Further details can be found in the section measurement program, [see Chap. 6.4.3, see A 6.4.2.](#)

**A 8.3.3.12 Object 2165h: Edges segment**

2165	RECORD	Edges segment			ro
------	--------	---------------	--	--	----

## Subindices

0	VAR	Number of entries	16	Unsigned8	ro
1	VAR	Segment 1 edge A		Unsigned8	rw
2	VAR	Segment 1 edge B		Unsigned8	rw
3	VAR	Segment 2 edge A		Unsigned8	rw
4	VAR	Segment 2 edge B		Unsigned8	rw
5	VAR	Segment 3 edge A		Unsigned8	rw
6	VAR	Segment 3 edge B		Unsigned8	rw
7	VAR	Segment 4 edge A		Unsigned8	rw
8	VAR	Segment 4 edge B		Unsigned8	rw
9	VAR	Segment 5 edge A		Unsigned8	rw
10	VAR	Segment 5 edge B		Unsigned8	rw
11	VAR	Segment 6 edge A		Unsigned8	rw
12	VAR	Segment 6 edge B		Unsigned8	rw
13	VAR	Segment 7 edge A		Unsigned8	rw
14	VAR	Segment 7 edge B		Unsigned8	rw
15	VAR	Segment 8 edge A		Unsigned8	rw
16	VAR	Segment 8 edge B		Unsigned8	rw

Further details can be found in the section segment, see Chap. 7.2, see A 6.4.2.

**A 8.3.3.13 Object 2181h: Averaging, error processing and statistics**

2181	RECORD	Averaging/error handling/statistics			ro
------	--------	-------------------------------------	--	--	----

## Subindices

0	VAR	Number of entries	17	Unsigned8	ro
1	VAR	Measured value averaging type	x	Unsigned8	rw
2	VAR	Number of values for moving average	x	Unsigned32	rw
3	VAR	Number of values for median	x	Unsigned32	rw
4	VAR	Number of values for recursive average	x	Unsigned32	rw
5	VAR	Statistic depth	x	Unsigned16	rw
6	VAR	Reset statistic	FALSE	BOOL	rw
7	VAR	Error handling	x	Unsigned8	rw
8	VAR	Number of held values	x	Unsigned16	rw
10	VAR	Signal for statistics 1	X	Unsigned8	rw
12	VAR	Use spike correction	FALSE	BOOL	rw
13	VAR	Spike correction evaluation length	x	Unsigned8	rw
14	VAR	Spike correction range	x.x	FLOAT32	rw
15	VAR	Spike correction count	x	Unsigned8	rw
17	VAR	Signal for statistics 2	X	Unsigned8	rw

Measured value averaging type:

- 0 – No averaging
- 1 – Moving average (Number of values moving average: 2, 4, 8, 16, 32, 64, 128)
- 2 – Recursive average (Number of values recursive average: 2 up to 32768)
- 3 – Median (Number of values median: 3, 5, 7 and 9)

Statistic depth:

- 2, 4, 8, 16 ... 8192;
- 0 = Infinite

Error handling:

- 0 – Output of error value
- 1 – Hold last valid value for a number of measurement values (Number of held values: 1 ... 1024)
- 2 – Hold last valid value infinitely

Signal for statistics: Measurement, for which the statistics 1 or statistics 2 is calculated.

Further details can be found in the section averaging, error processing, see Chap. 7.3, see A 6.4.3.

X value	Measurement identifier	Measurement program				
		Edge HL	Edge LH	Diameter	Gap	Segment
0	Segment 1 Edge A					x
1	Segment 1 Edge B					x
2	Segment 1 Edge difference					x
3	Segment 1 Edge center axes					x
4	Segment 2 Edge A					x
5	Segment 2 Edge B					x
6	Segment 2 Edge difference					x
7	Segment 2 Edge center axes					x
8	Segment 3 Edge A					x
9	Segment 3 Edge B					x
10	Segment 3 Edge difference					x
11	Segment 3 Edge center axes					x
12	Segment 4 Edge A					x
13	Segment 4 Edge B					x
14	Segment 4 Edge difference					x
15	Segment 4 Edge center axes					x
16	Segment 5 Edge A					x
17	Segment 5 Edge B					x
18	Segment 5 Edge difference					x
19	Segment 5 Edge center axes					x
20	Segment 6 Edge A					x
21	Segment 6 Edge B					x
22	Segment 6 Edge difference					x
23	Segment 6 Edge center axes					x
24	Segment 7 Edge A					x
25	Segment 7 Edge B					x
26	Segment 7 Edge difference					x
27	Segment 7 Edge center axes					x
28	Segment 8 Edge A					x
29	Segment 8 Edge B					x
30	Segment 8 Edge difference					x
31	Segment 8 Edge center axes					x
32	Edge High Low	x				
33	Edge Low High		x			
34	Diameter Edge A			x		
35	Diameter Edge B			x		
36	Diameter Difference			x		
37	Diameter Center axes			x		
38	Gap Edge A				x	
39	Gap Edge B				x	
40	Gap Difference				x	
41	Gap Center axes				x	

Fig. 98 Assignment X value to the measurement identifier

The data selection for statistics depends on the selected measurement program (object 2154h).

Use spike correction:

- 0 - without spike correction
- 1 - with spike correction

Spike correction evaluation length: Number of evaluated values (1 ... 10)

Spike correction range: max. tolerance range

- in 46 mm (0.0000000 ... 46.0000000)
- in 95 mm (0.0000000 ... 95.0000000)

Spike correction count: Number of corrected values (1 ... 100)

**A 8.3.3.14 Object 21B0h: Digital interfaces**

Digital interfaces, selection of transmitted data (measurement values).

21B0	RECORD	Digital interfaces			ro
------	--------	--------------------	--	--	----

Subindices

0	VAR	Number of entries	16	Unsigned8	ro
1	VAR	Output device	5	Unsigned8	rw
2	VAR	RS422 baud rate	x	Unsigned32	rw
3	VAR	Ethernet/EtherCAT	TRUE	BOOL	rw
5	VAR	Value counter	FALSE	BOOL	rw
6	VAR	Timestamp	FALSE	BOOL	rw
7	VAR	Sensor state	FALSE	BOOL	rw
8	VAR	Number of edges	FALSE	BOOL	rw
9	VAR	Number of pins	FALSE	BOOL	rw
10	VAR	Number of gaps	FALSE	BOOL	rw
11	VAR	1 Statistik min	FALSE	BOOL	rw
12	VAR	1 Statistik max	FALSE	BOOL	rw
13	VAR	1 Statistik P2P	FALSE	BOOL	rw
14	VAR	2 Statistik min	FALSE	BOOL	rw
15	VAR	2 Statistik max	FALSE	BOOL	rw
16	VAR	2 Statistik P2P	FALSE	BOOL	rw

Output device:

- 0 – No output channel
- 1 – RS422
- 5 – EtherCAT

RS422 baud rate: 9600, 115200, 230400, 460800, 691200, 921600, 1500000, 2000000, 3500000, 4000000

Ethercat-Ethernet: (Change of interface)

- 0 – Ethernet (works only from restarting, previously setup store)
- 1 – EtherCAT

➡ Save the settings with the object 2010:02 (Setup store).

➡ Then restart the sensor to activate the Ethernet interface.

Subindices 5 ... 16: Data selection for the PDO mapping

Statistics: Selection of the issued statistics data (subindices 11 ... 16), which were selected in the object 2181h. Further details can be found in the section statistics, see Chap. 7.3.6.

Further details for the subindices can be found in the section select data, see Chap. 7.5.3.

**A 8.3.3.15 Object 21B1h: Value edge high-low**

Select measurements to be output in the measurement program edge high-low.

21B1	RECORD	Value edge high-low			ro
------	--------	---------------------	--	--	----

Subindices

0	VAR	Number of entries	1	Unsigned8	ro
1	VAR	Position of the first high-low edge	FALSE	BOOL	rw

! The object is active in the measurement program edge high-low only, see A 8.3.3.12

**A 8.3.3.16 Object 21B2h: Value edge low-high**

Select measurements to be output in the measurement program edge low-high.

21B2	RECORD	Value edge low-high			ro
------	--------	---------------------	--	--	----

Subindices

0	VAR	Number of entries	1	Unsigned8	ro
1	VAR	Position of the first low-high edge	FALSE	BOOL	rw

**i** The object is active in the measurement program edge low-high only, [see A 8.3.3.12](#).

**A 8.3.3.17 Object 21B3h: Value diameter**

Select measurements to be output in the measurement program diameter.

21B3	RECORD	Value diameter			ro
------	--------	----------------	--	--	----

Subindices

0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Diameter edge position A	FALSE	BOOL	rw
2	VAR	Diameter edge position B	FALSE	BOOL	rw
3	VAR	Diameter difference	FALSE	BOOL	rw
4	VAR	Diameter center axes	FALSE	BOOL	rw

**i** The object is active in the measurement program diameter only, [see A 8.3.3.12](#).

**A 8.3.3.18 Object 21B4h: Value gap**

Select measurements to be output in the measurement program gap.

21B4	RECORD	Value gap			ro
------	--------	-----------	--	--	----

Subindices

0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Gap edge position A	FALSE	BOOL	rw
2	VAR	Gap edge position B	FALSE	BOOL	rw
3	VAR	Gap difference	FALSE	BOOL	rw
4	VAR	Gap center axes	FALSE	BOOL	rw

**i** The object is active in the measurement program edge high-low only, [see A 8.3.3.12](#).



**A 8.3.3.19 Object 21B5h: Value segment**

Select measurements to be output in the measurement program segment.

21B5	RECORD	Value segment			ro
------	--------	---------------	--	--	----

Subindices

0	VAR	Number of entries	32	Unsigned8	ro
1	VAR	Segment 1 edge position A	FALSE	BOOL	rw
2	VAR	Segment 1 edge position B	FALSE	BOOL	rw
3	VAR	Segment 1 difference	FALSE	BOOL	rw
4	VAR	Segment 1 center axes	FALSE	BOOL	rw
5	VAR	Segment 2 edge position A	FALSE	BOOL	rw
6	VAR	Segment 2 edge position B	FALSE	BOOL	rw
7	VAR	Segment 2 difference	FALSE	BOOL	rw
8	VAR	Segment 2 center axes	FALSE	BOOL	rw
9	VAR	Segment 3 edge position A	FALSE	BOOL	rw
10	VAR	Segment 3 edge position B	FALSE	BOOL	rw
11	VAR	Segment 3 difference	FALSE	BOOL	rw
12	VAR	Segment 3 center axes	FALSE	BOOL	rw
13	VAR	Segment 4 edge position A	FALSE	BOOL	rw
14	VAR	Segment 4 edge position B	FALSE	BOOL	rw
15	VAR	Segment 4 difference	FALSE	BOOL	rw
16	VAR	Segment 4 center axes	FALSE	BOOL	rw
17	VAR	Segment 5 edge position A	FALSE	BOOL	rw
18	VAR	Segment 5 edge position B	FALSE	BOOL	rw
19	VAR	Segment 5 difference	FALSE	BOOL	rw
20	VAR	Segment 5 center axes	FALSE	BOOL	rw
21	VAR	Segment 6 edge position A	FALSE	BOOL	rw
22	VAR	Segment 6 edge position B	FALSE	BOOL	rw
23	VAR	Segment 6 difference	FALSE	BOOL	rw
24	VAR	Segment 6 center axes	FALSE	BOOL	rw
25	VAR	Segment 7 edge position A	FALSE	BOOL	rw
26	VAR	Segment 7 edge position B	FALSE	BOOL	rw
27	VAR	Segment 7 difference	FALSE	BOOL	rw
28	VAR	Segment 7 center axes	FALSE	BOOL	rw
29	VAR	Segment 8 edge position A	FALSE	BOOL	rw
30	VAR	Segment 8 edge position B	FALSE	BOOL	rw
31	VAR	Segment 8 difference	FALSE	BOOL	rw
32	VAR	Segment 8 center axes	FALSE	BOOL	rw

**i** The object is active in the measurement program segment only, [see A 8.3.3.12](#).

**A 8.3.3.20 Object 21C0h: Ethernet**

21C0	RECORD	Ethernet			ro
Subindices					
0	VAR	Number of entries	8	Unsigned8	ro
1	VAR	IP address	xxx.xxx.xxx.xxx	Visible String	rw
2	VAR	Subnet mask	xxx.xxx.xxx.xxx	Visible String	rw
3	VAR	Gateway	xxx.xxx.xxx.xxx	Visible String	rw
4	VAR	DHCP	FALSE	BOOL	rw
5	VAR	Measured value server protocol	0	Unsigned8	rw
6	VAR	Measured value server IP-Address	xxx.xxx.xxx.xxx	Visible String	rw
7	VAR	Measured value server port	x	Unsigned16	rw
8	VAR	MAC address	xx.xx.xx.xx.xx.xx	Visible String	ro

DHCP:

- 0 – Static IP address
- 1 – DHCP

Measured value server protocol:

- 0 – No transmission
- 1 – Client/TCP
- 2 – Client/UDP
- 3 – Server/TCP

Further details can be found in the section Ethernet IP settings, [see A 6.5.1.2](#), [see A 6.5.1.3](#).

**A 8.3.3.21 Object 21D0h: Analog output**

Assign measurements and scaling of the analog output.

21D0	RECORD	Analog output			ro
Subindices					
0	VAR	Number of entries	1	Unsigned8	ro
1	VAR	Analog output	x	Unsigned8	rw
2	VAR	Analog output signal	x	Unsigned8	rw
3	VAR	Analog output type of scaling	x	Unsigned8	rw
4	VAR	Analog output two-point-scaling start	x.x	FLOAT32	rw
5	VAR	Analog output two-point-scaling end	x.x	FLOAT32	rw

Further details can be found in the section Analog output, [see Chap. 7.7](#), [see A 6.5.4](#).

Analog output:

- 1 - No analog output (inactive)
- 0 - Voltage 0 ... 10 V

Analog output signal: Further details can be found in the section measurement identifier, [see Fig. 98](#).

The x value selection depends on the selected measurement programm (object 2154h), [see A 8.3.3.12](#).

Analog output, type of scaling:

- 0 – Standard scaling
- 1 – Two-point scaling

Analog output two-point-scaling, start: corresponds to 0 V

Analog output two-point-scaling, end: corresponds to 10 V

Value range x.x: 0.000 to 46 mm or 95 mm

### A 8.3.3.22 Object 21E0h: Zeroing/Mastering

21E0	RECORD	Zeroing/Mastering			ro
------	--------	-------------------	--	--	----

Subindices

0	VAR	Number of entries	5	Unsigned8	ro
2	VAR	Master value	x.xx	FLOAT32	rw
3	VAR	Zeroing/Mastering active	FALSE	BOOL	rw
4	VAR	Zeroing/Mastering	FALSE	BOOL	rw
5	VAR	Reset master value	FALSE	BOOL	rw
6	VAR	Master signal	x	Unsigned8	rw

Master value:

- -46 ... 46 mm
- -95 ... 95 mm

Zeroing/Mastering active:

- 0 – Measured value not zeroed/ mastered
- 1 – Measured value moved by zeroing/ mastering

Master signal: Measurement value, which will be mastered. Further details can be found in the section measurement identifier, [see Fig. 98](#).

The x value selection depends on the selected measurement program (object 2154h), [see A 8.3.3.12](#).

Further details can be found in the section zeroing/mastering, see Chap. 7.4, [see A 6.4.3.9](#).

**A 8.3.3.23 Object 21F1h: Switching outputs**

21F1	RECORD	Switching outputs			ro
------	--------	-------------------	--	--	----

## Subindices

0	VAR	Number of entries	7	Unsigned8	ro
1	VAR	Switching output error 1	x	Unsigned8	rw
2	VAR	Switching output error 2	x	Unsigned8	rw
3	VAR	Lower limit value (mm)	x.xx	FLOAT32	rw
4	VAR	Upper limit value (mm)	x.xx	FLOAT32	rw
5	VAR	Signal for limit value output	x	Unsigned8	rw
6	VAR	Level of switching output error 1	x	Unsigned8	rw
7	VAR	Level of switching output error 2	x	Unsigned8	rw

Switching output error 1 and 2: Assignment of both switching outputs

- 0 - No output
- 1 - Switching output is switched in case of deceeding the lower limit
- 2 - Switching output is switched in case of exceeding the upper limit
- 3 - Switching output is switched in case of deceeding the lower limit or exceeding the upper limit
- 4 - Switching output is switched in case of wrong anticipated number of edges
- 5 - 4 - Switching output is switched in case of a measurement error, e.g. no edge detected

Lower and upper limit value:

46 mm: -100.0 ... +100.0

95 mm: -200.0 ... +200.0

Signal for limit value output: Further details can be found in the section measurement identifier, [see Fig. 98](#).

The x value selection depends on the selected measurement program (object 2154h), [see A 8.3.3.12](#).

Level of switching outputs:

- 0 - PNP
- 1 - NPN
- 2 - Push-Pull
- 3 - inverted Push-Pull

Further details can be found in the section switching outputs, see Chap. [7.6](#), [see A 6.5.3](#).

**A 8.3.3.24 Object 2410h: Trigger mode**

2410	RECORD	Trigger mode			ro
Subindices					
0	VAR	Number of entries	10	Unsigned8	ro
1	VAR	Trigger mode	0	Unsigned8	rw
2	VAR	Trigger edge/level	0	Unsigned8	rw
3	VAR	Number of values per trigger pulse	1	Unsigned16	rw
8	VAR	Software trigger pulse	FALSE	BOOL	rw
9	VAR	Trigger In/Out	FALSE	BOOL	rw
10	VAR	Termination synchronous/trigger input	FALSE	BOOL	rw

Trigger mode:

- 0 - No triggering
- 1 - Level triggering
- 2 - Edge triggering
- 3 - Software triggering
- 4 - Encoder triggering

Trigger edge/level:

- 0 - At edge triggering: falling edge; at level triggering: Low
- 1 - At edge triggering: rising edge; at level triggering: High

Number of value per trigger pulse: Number of output data after a trigger pulse for edge or software triggering:

- 1...16382,
- 16383 = infinite,
- 0 = Stop

Further details can be found in the section triggering, see Chap. 7.9, see A 6.5.5.

**A 8.3.3.25 Object 2550h: Threshold**

2550	VAR	Threshold	12.5	FLOAT32	rw
------	-----	-----------	------	---------	----

Adjustment of the detection threshold in % (1.00 % up to 99.00 %). The detection threshold is specified with two decimal places.

Further details can be found in the section edge detection, see Chap. 6.3.2, see A 6.3.3.2.

**A 8.3.3.26 Object 2711h: Range of interest**

Masking the evaluation range (ROI).

2711	RECORD	Range of interest			
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	Range of interest start	x	Unsigned16	rw
2	VAR	Range of interest end	x	Unsigned16	rw

Beginning and end (x) of the ROI must be between 0 up to 767. Unit is in pixels. The start value must be smaller than the end value.

Further details can be found in the section masking, see 7.13, see A 6.3.3.3.

**A 8.3.3.27 Object 603Fh: Sensor error**

603F	RECORD	Sensor error			
Subindices					
0	VAR	Number of entries	2	Unsigned8	ro
1	VAR	Sensor error number	x	Unsigned16	ro
2	VAR	Sensor error description	x	Visible String	ro

Sensor error number: Output of sensor error in communication

Sensor error description: Sensor error as plain text, e.g. „E11 The entered value is out of range or the format is invalid“.

Further details can be found in the section Error messages, [see A 6.6](#), [see A 8.4](#).

**A 8.3.3.28 Object 6060h: System values**

6060	RECORD	System values			ro
Subindices					
0	VAR	Number of entries	13	Unsigned8	ro
1	VAR	Value counter	x	Unsigned32	ro
...		...			

Shows all selected measurement values or parameters with object 21B0h.

**A 8.3.3.29 Object 6065h: Measuring value edge high-low**

Output of measurement edge high-low, selected with object 21B1h.

6065	RECORD	Measuring value edge high-low			ro
Subindices					
0	VAR	Number of entries	1	Unsigned8	ro
1	VAR	Position of the first high-low edge	x	Signed32	ro

**A 8.3.3.30 Object 6066h: Measuring value edge low-high**

Output of measurement edge low-high, selected with object 21B2h.

6066	RECORD	Measuring value edge low-high			ro
Subindices					
0	VAR	Number of entries	1	Unsigned8	ro
1	VAR	Position of the first low-high edge	x	Signed32	ro

**A 8.3.3.31 Object 6067h: Measuring values diameter**

Output of measurement diameter, selected with object 21B3h.

6067	RECORD	Measuring values diameter			ro
Subindices					
0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Diameter edge position A	x	Signed32	ro
...		...			

**A 8.3.3.32 Object 6068h: Measuring values gap**

Output of measurement gap, selected with object 21B4h.

6068	RECORD	Measuring values gap			ro
------	--------	----------------------	--	--	----

Sub-indices

0	VAR	Number of entries	4	Unsigned8	ro
1	VAR	Gap edge position A	x	Signed32	ro
...		...			

**A 8.3.3.33 Object 6069h: Measuring values segment**

Output of measurement segment, selected with object 21B5h.

6069	RECORD	Measuring values segment			ro
------	--------	--------------------------	--	--	----

Subindices

0	VAR	Number of entries	32	Unsigned8	ro
1	VAR	Segment 1 position A	x	Signed32	ro
...		...			

### A 8.4 Error Codes for SDO Services

In case of a negative evaluation of a SDO requirement, a corresponding error code is output in "Abort SDO Transfer Protocol".

Error code hexadecimal	Meaning
0503 0000	Toggle-Bit has not changed.
0504 0000	SDO protocol timeout expired
0504 0001	Invalid command registered
0504 0005	Not enough memory
0601 0000	Access to object (parameter) not supported.
0601 0001	Attempt to write to a "read-only parameter"
0601 0002	Attempt to write to a "read-only parameter"
0602 0000	Object (parameter) is not listed in the object directory.
0604 0041	Object (parameter) is not mapped on PDO
0604 0042	Number or length of objects to be transmitted exceeds PDO length.
0604 0043	General parameters incompatibility
0604 0047	General internal device incompatibility
0606 0000	Excess denied because of a hardware error
0607 0010	False data type or length of service parameter is incorrect.
0607 0012	False data type or length of service parameter is too large.
0607 0013	False data type or length of service parameter is too small.
0609 0011	Subindex does not exist
0609 0030	Invalid value of parameter (only for write access)
0609 0031	Value of the parameter too large
0609 0032	Value of the parameter too small
0609 0036	Maximum value exceeds minimum value.
0800 0000	General error
0800 0020	Data can not be transmitted or saved in application.
0800 0021	Data can not be transmitted or saved in application, because of local control.
0800 0022	Data can not be transmitted or saved in application, because device state.
0800 0023	Dynamic generation of object directory failed or no object directory is available



### A 8.5 Measurement Data Formats

- Measured value counter (1 \* 32 bit)
- Time stamp (1 \* 32 bit)
- Displacement values (n \* 32 bit)
- Error field (1 \* 32 bit)
- Statistic values (Min/Max/Peak2Peak) (i \* 32Bit)
- Number of edges (1 \* 32 bit)
- Number of pins (1 \* 32 bit)
- Number of gaps (1 \* 32 bit)

n = {1 ... 32}

n = 1: Edge measurement high-low/low-high,

n = 1 ... 4: Diameter/gap measurement

n = 1 ... 32: Segment measurement

i = {0 ... 6} Depends on activated statistic values

Further details to the setup of measured values can be found in the section measured value frame, [see A 6.5.7.1.](#)

## A 8.6 Distributed Clock

### A 8.6.1 Introduction

The synchronization of the ODC 2520 among each other in the EtherCAT is realized via the `Distributed Clock`.

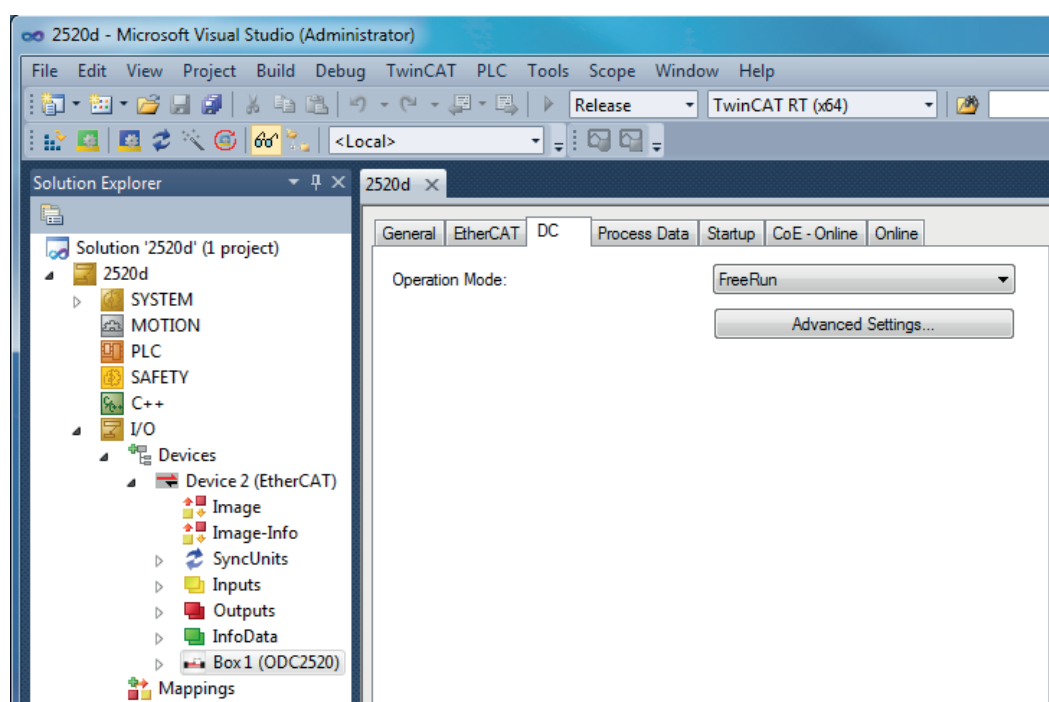
Thus it is not necessary or possible to transmit the synchronous signals via the synchronous input or output of the sensor.

Unlike the Ethernet the synchronization does not occur via external signals but about the clocks in the sensors. Using the EtherCAT this results in the synchronous modes `Synchronization off` (= `Free Run`) and `Slave`.

The minimum cycle time for distributed clock is  $400\ \mu\text{s}$  for the ODC 2520.

### A 8.6.2 Synchronization

Sensors, that support the synchronization in the EtherCAT mode, offer the additional tab `DC` in the TwinCat-Manager. In addition to the `FreeRun` mode (not synchronized), the sensor can be operated synchronously with different frequencies.



### A 8.6.3 Synchronization off

In the `FreeRun` mode no synchronization of sensors occurs.

### A 8.6.4 Slave

In the `DC_Synchron 2.5kHz` mode the sensor is switched in the synchronization mode `Slave`.

Besides `xxx` means the measuring rate. The sensor measures with the rate selected by `xxx`.

### A 8.6.5 Apply Selected Settings

Once the required synchronization mode is selected using the drop-down-menu, it is applied with `F4`.

### A 8.6.6 Setting Regardless of TwinCat

The setting of the synchronisation mode in EtherCAT occurs via the setting of the registers for the Distributed Clocks. You will find details under [www.beckhoff.de](http://www.beckhoff.de) or [www.ethercat.org](http://www.ethercat.org).

For reading the settings in the TwinCAT it is possible to display the requirements of the XML file using the button `Advanced Settings`.

### A 8.7 Oversampling

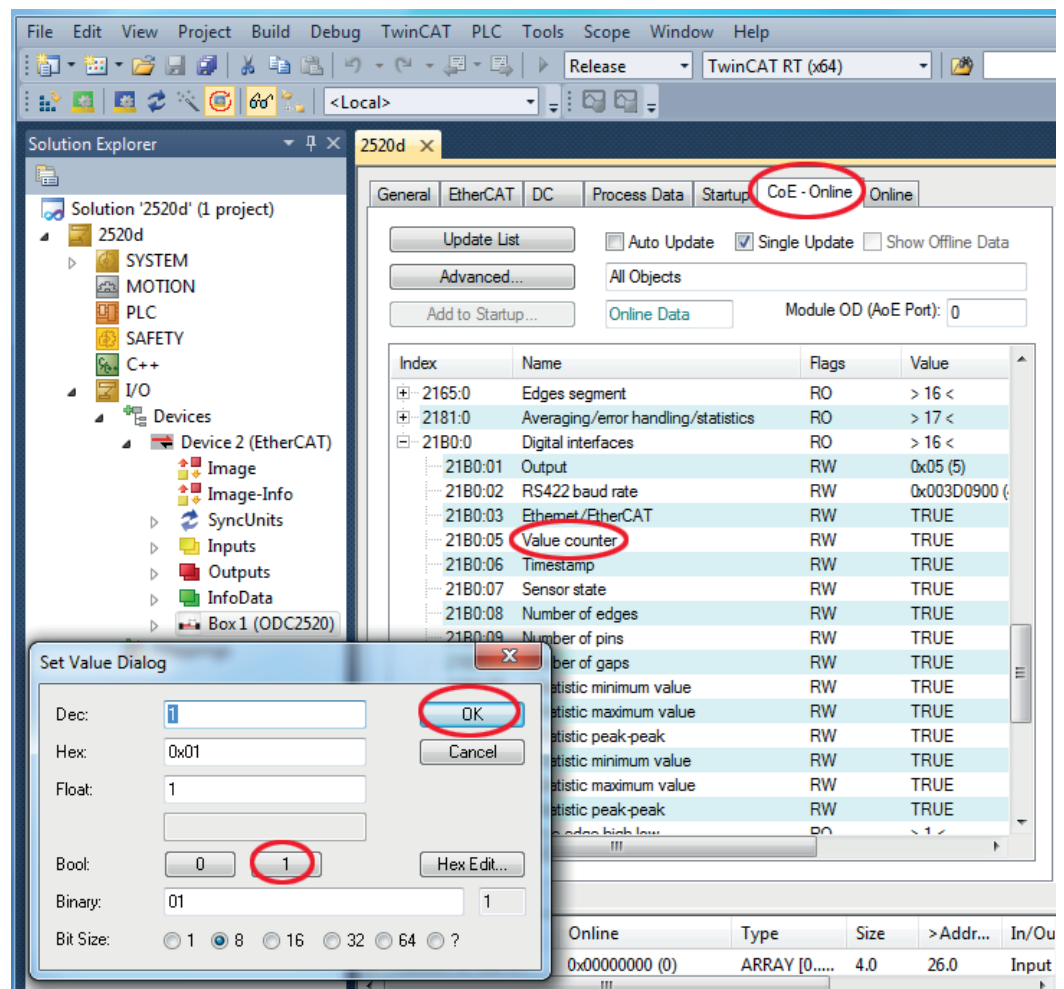
The last arised measurement value data record is transmitted to EtherCAT Master with each fieldbus cycle during operation without oversampling. Many measurement value data records are not available therefore for large fieldbus cycle times. All (or selectable) measurement value data records are collected with the configurable oversampling and are transmitted together to the master with the next fieldbus cycle.

**Example:**

The fieldbus/EtherCAT is operated with a cycle time of 1.2 ms, because, for example the PLC is operated with >1.2 ms cycle time. For this reason an EtherCAT frame is sent to the sensor for collection of process data every 1.2 ms. If the measurement frequency in the sensor is set to 46 mm: 2.5 kHz or 95 mm: 2.0 kHz, an oversampling of 3 must be set.

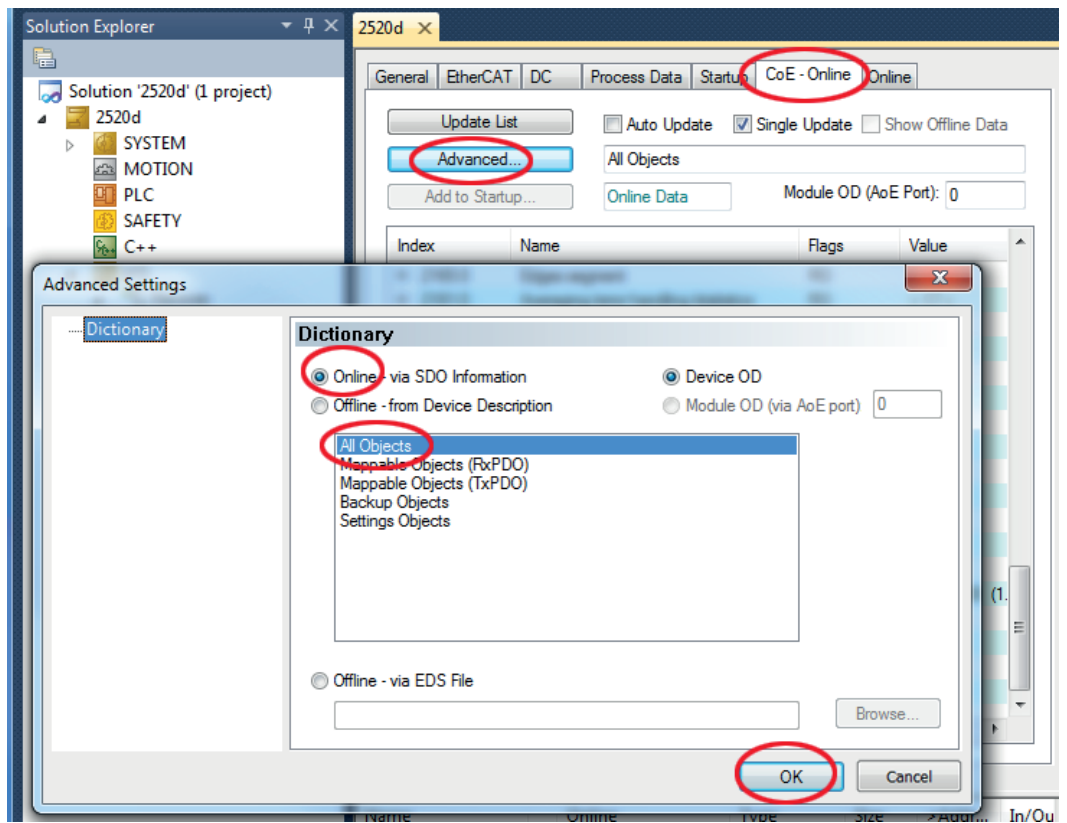
**Procedure:**

- Select the measuring data to be set in the object 0x21B0 (Digital interfaces) in preoperational state, for example - "Value counter"

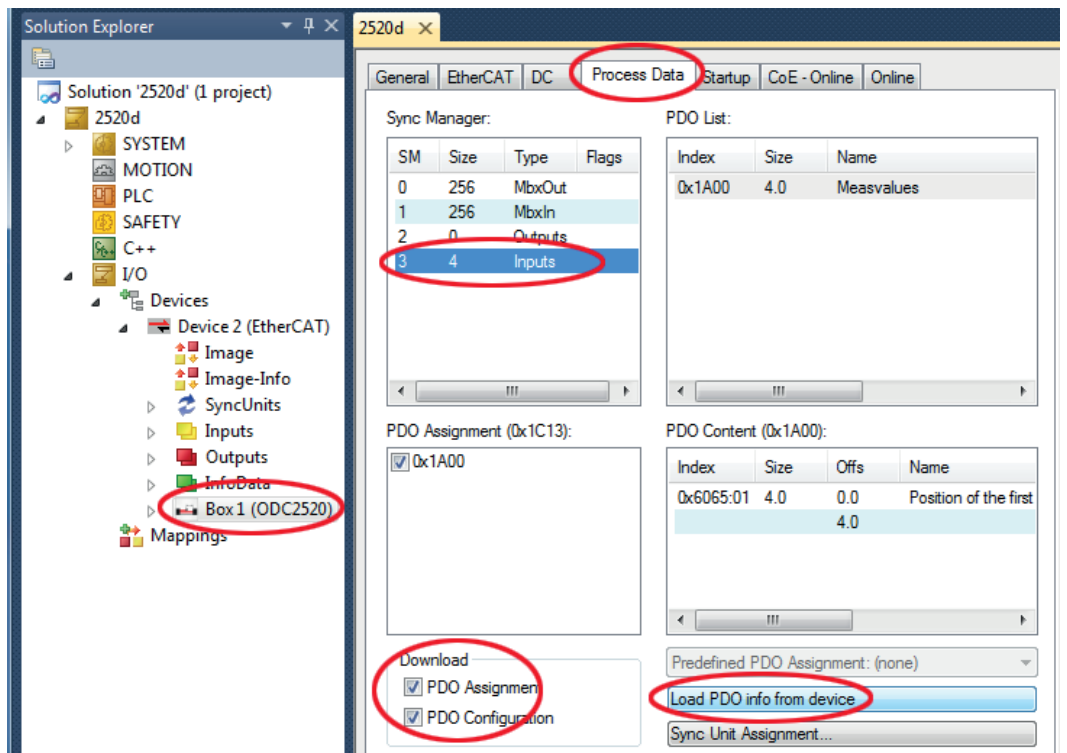


- Then read the object directory from the sensor.
- Select another input as All Objects (e.g. Mappable Objects (TxPDO)) in the Advanced Settings dialog and then select All Objects.

Otherwise, it may be, that TwinCAT only reads the values of the objects already known to it. This is important for the next steps, because the Mapping (objects 0x1A00, 0x1A01, ... and 0x1C13) has changed.



➔ Read the PDO info on the process data tab from the IFC24x1.



You can now view the size of the provided data and the mapping of SyncManager at delivery:

The screenshot shows the configuration interface with the following data:

SM	Size	Type	Flags
0	256	MbxOut	
1	256	MbxIn	
2	0	Outputs	F
3	52	Inputs	

Index	Size	Name	Flags	SM	SU
0x1A00	52.0	Sample 0	F	3	0
0x1A01	52.0	Sample 1	F		0
0x1A02	52.0	Sample 2	F		0
0x1A03	52.0	Sample 3	F		0
0x1A04	52.0	Sample 4	F		0
0x1A05	52.0	Sample 5	F		0
0x1A06	52.0	Sample 6	F		0
0x1A07	52.0	Sample 7	F		0
0x1A08	52.0	Sample 8	F		0
0x1A09	52.0	Sample 9	F		0
0x1A0A	52.0	Sample 10	F		0

<input checked="" type="checkbox"/>	0x1A00
<input type="checkbox"/>	0x1A01
<input type="checkbox"/>	0x1A02
<input type="checkbox"/>	0x1A03
<input type="checkbox"/>	0x1A04
<input type="checkbox"/>	0x1A05
<input type="checkbox"/>	0x1A06
<input type="checkbox"/>	0x1A07
<input type="checkbox"/>	0x1A08

Index	Size	Offs	Name	Type	Default (hex)
0x6060:02	4.0	0.0	Value counter	DINT	
0x6060:03	4.0	4.0	Timestamp	DINT	
0x6060:04	4.0	8.0	Sensor state	DINT	
0x6060:05	4.0	12.0	Number of edges	DINT	
0x6060:06	4.0	16.0	Number of pins	DINT	
0x6060:07	4.0	20.0	Number of gaps	DINT	
0x6065:01	4.0	24.0	Position of the first high-low edge	DINT	

To set the oversampling (in example 10), 10 measurement data sets (samples) ① are selected in the PDO mapping (0x1C13).

The screenshot shows the configuration interface with the following data:

SM	Size	Type	Flags
0	256	MbxOut	
1	256	MbxIn	
2	0	Outputs	F
3	520	Inputs	

Index	Size	Name	Flags	SM	SU
0x1A00	52.0	Sample 0	F	3	0
0x1A01	52.0	Sample 1	F	3	0
0x1A02	52.0	Sample 2	F	3	0
0x1A03	52.0	Sample 3	F	3	0
0x1A04	52.0	Sample 4	F	3	0
0x1A05	52.0	Sample 5	F	3	0
0x1A06	52.0	Sample 6	F	3	0
0x1A07	52.0	Sample 7	F	3	0
0x1A08	52.0	Sample 8	F	3	0
0x1A09	52.0	Sample 9	F	3	0
0x1A0A	52.0	Sample 10	F		0
0x1A0B	52.0	Sample 11	F		0

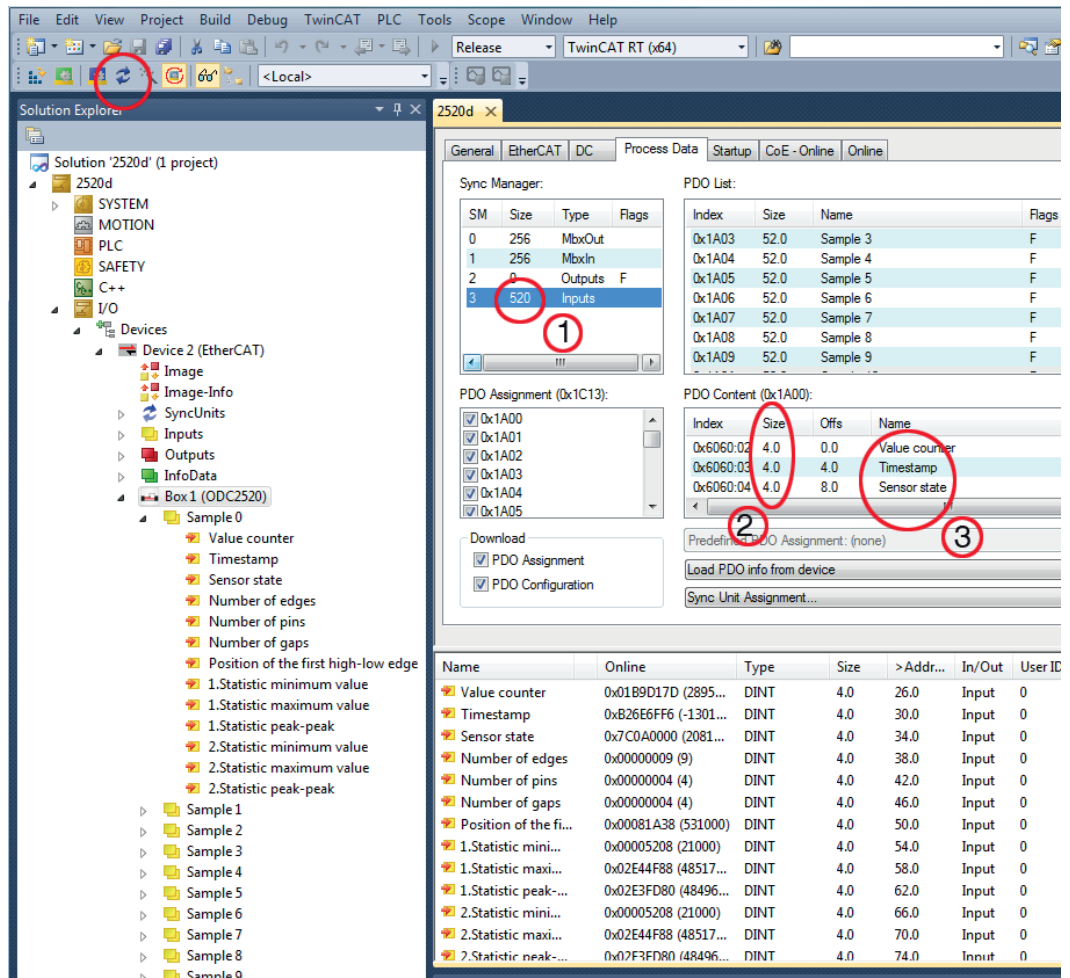
  

<input checked="" type="checkbox"/>	0x1A00
<input checked="" type="checkbox"/>	0x1A01
<input checked="" type="checkbox"/>	0x1A02
<input checked="" type="checkbox"/>	0x1A03
<input checked="" type="checkbox"/>	0x1A04
<input checked="" type="checkbox"/>	0x1A05
<input checked="" type="checkbox"/>	0x1A06
<input checked="" type="checkbox"/>	0x1A07
<input checked="" type="checkbox"/>	0x1A08
<input checked="" type="checkbox"/>	0x1A09
<input type="checkbox"/>	0x1A0A

Index	Size	Offs	Name	Type	Default (hex)
0x6060:02	4.0	0.0	Value counter	DINT	
0x6060:03	4.0	4.0	Timestamp	DINT	
0x6060:04	4.0	8.0	Sensor state	DINT	
0x6060:05	4.0	12.0	Number of edges	DINT	
0x6060:06	4.0	16.0	Number of pins	DINT	
0x6060:07	4.0	20.0	Number of gaps	DINT	
0x6065:01	4.0	24.0	Position of the first high-low edge	DINT	
0x6060:08	4.0	28.0	1.Statistic minimum value	DINT	
0x6060:09	4.0	32.0	1.Statistic maximum value	DINT	

➡ Load these settings with the **Reload Devices** button in the sensor.

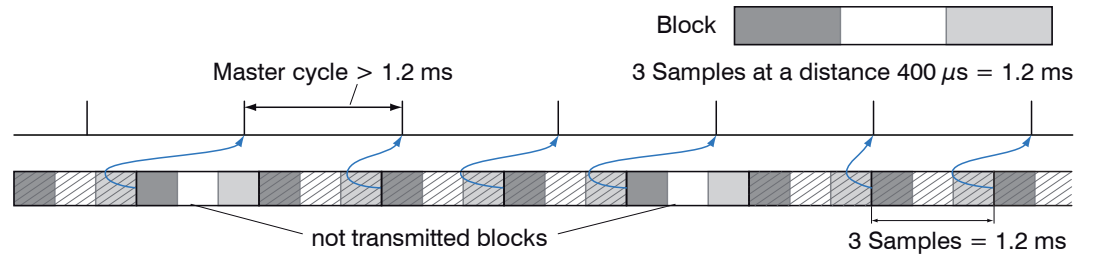


Every process data frame now contains 520 bytes <sup>①</sup> measuring data (13 measurement values <sup>③</sup> per 4 bytes <sup>②</sup> \* 10 measuring data records).

In order to ensure that no samples will disappear, due to the high asymmetry between master cycle and slave cycle, the master cycle time is subject to be less than the time which is required for the generation of a block consisting of x samples.

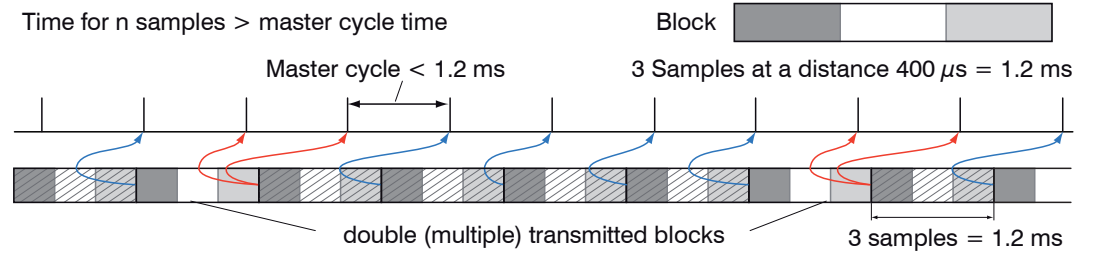
A complete block is generated from the stated samples and first presented to the EtherCAT side after all stated samples have been written into the block. If the time for the writing into the block is shorter than the master cycle time, unfortunately single blocks cannot be transmitted. It can happen that the next block has already been filled with samples, before the previous filled block has been picked up with a master cycle.

Example: time for 3 samples < master cycle time



Example: time for 3 samples > master cycle time

If the number of samples selected is too high, i.e. the time for the filling of a block is longer than the master cycle time, each block is picked up by a master cycle. However, single blocks and therefore samples are transmitted twice or even more often. This can be detected on the master side by the transmission of the time stamp or value counter, see object 0x21B0.



## A 8.8 Meaning of STATUS-LED in EtherCAT Operation



<b>Status LED</b>	<b>Green</b>	
	Green off	INIT status
	Green flashing 2.5 Hz	PRE-OP status
	Green Single Flash, 200 ms ON / 1000 ms OFF	SAFE-OP status
	Green on	OP status
	<b>Red (are displayed in the breaks of the green LED):</b>	
	Red off	No error
	Red flashing 2.5 Hz	Invalid configuration
	Red Single Flash, 200 ms ON / 1000 ms OFF	Not requested status change
	Red Double Flash, 200 ms ON / 200 ms OFF 200 ms ON 400 ms OFF	Timeout of the watchdog
	Red flashing 10 Hz	Error by initializing



## A 8.9 EtherCAT Configuration with the Beckhoff TwinCAT® Manager

For example the Beckhoff TwinCAT Manager can be used as EtherCAT Master on the PC.

- Copy the device description file (EtherCAT®-Slave Information) ODC2520-EtherCAT-XML.zip in the directory \\TwinCAT\3.1\Config\IO\EtherCAT before the measuring device can be configured via EtherCAT®.

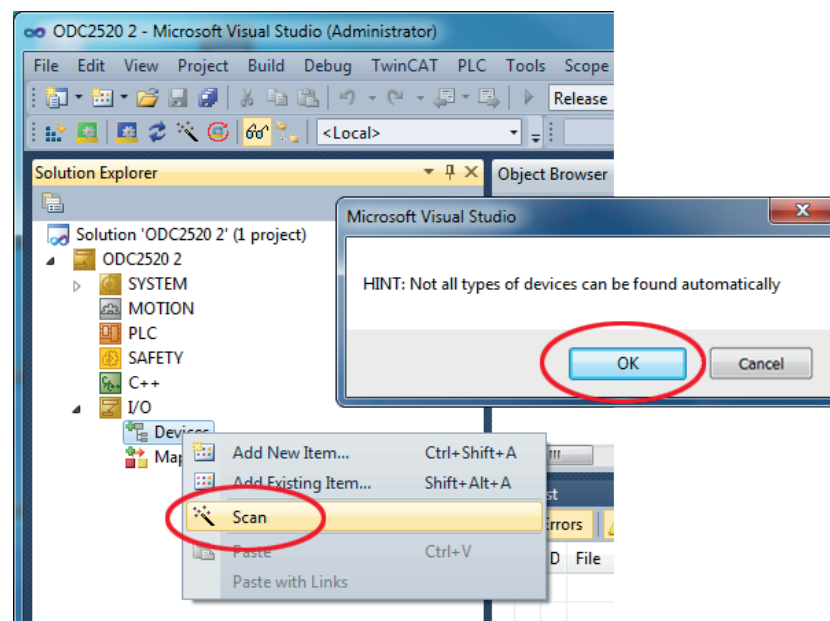
The device description file is available online at <https://www.micro-epsilon.de/download/software/ODC2520-EtherCAT-XML.zip>.

EtherCAT®-Slave information files are XML files, which specify the characteristics of the Slave device for the EtherCAT® Master and contain informations to the supported communication objects.

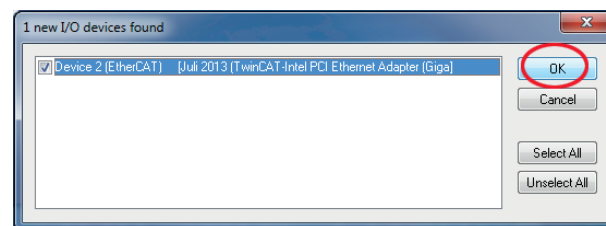
- Restart the TwinCAT Manager after copying.

### Searching for a device:

- Select the tab I/O Devices, then Scan Devices.
- Confirm with OK.

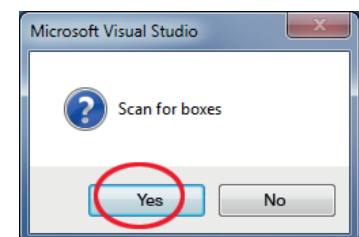


- Select a network card, where EtherCAT®-Slaves should be searched.



- Confirm with OK.

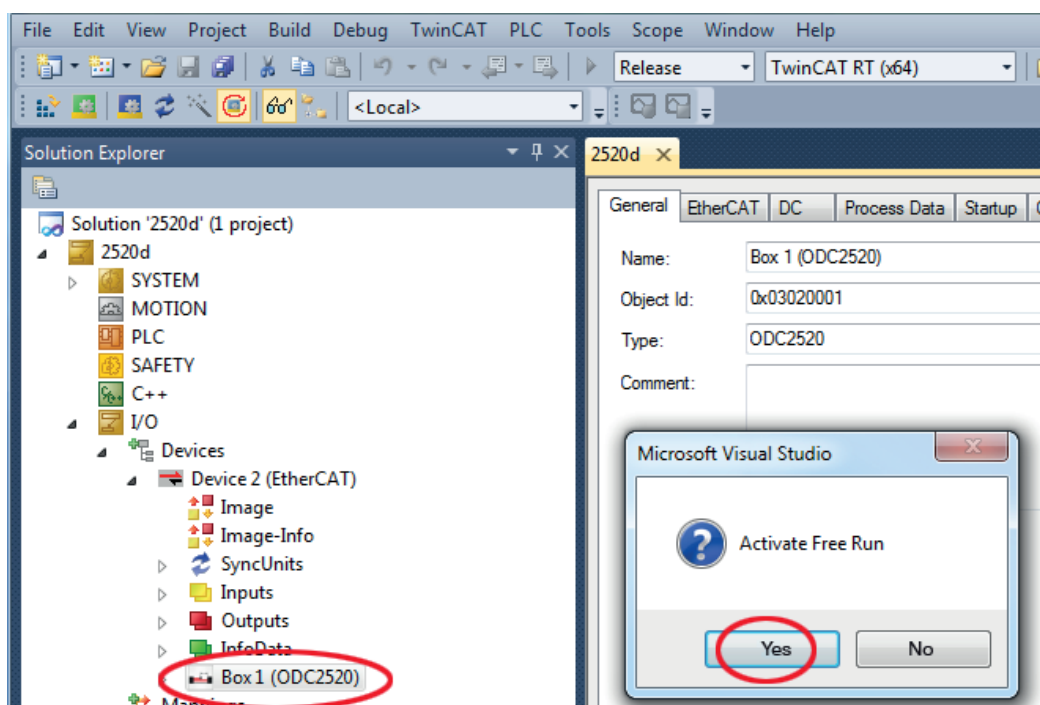
It appears the window Scan for boxes (EtherCAT®-Slaves).



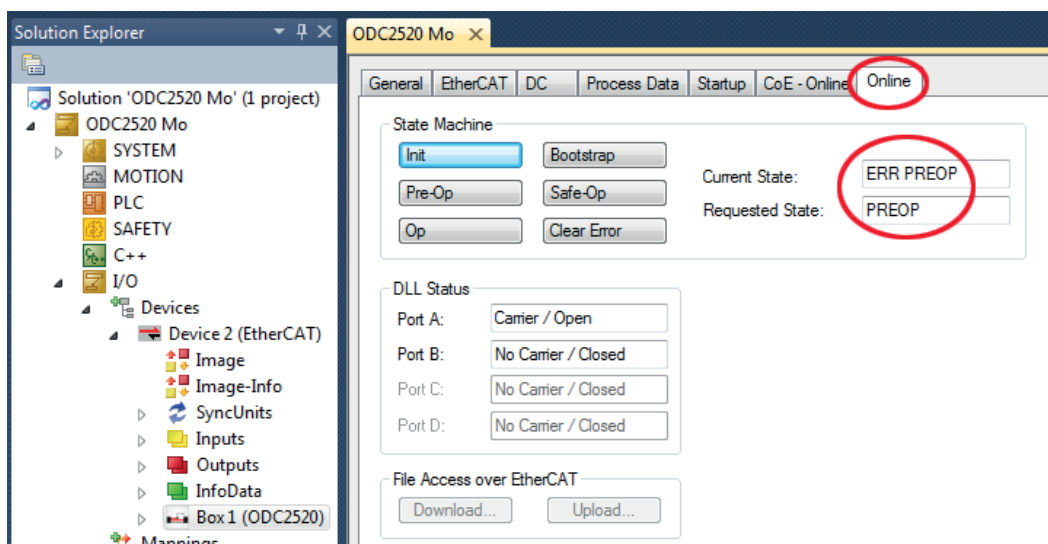
- Confirm with Yes.

The sensor is now shown in a list.

- Now confirm the window Activate Free Run with Yes.



The current status should be at least PREOP, SAFEOP or OP on the Online side.

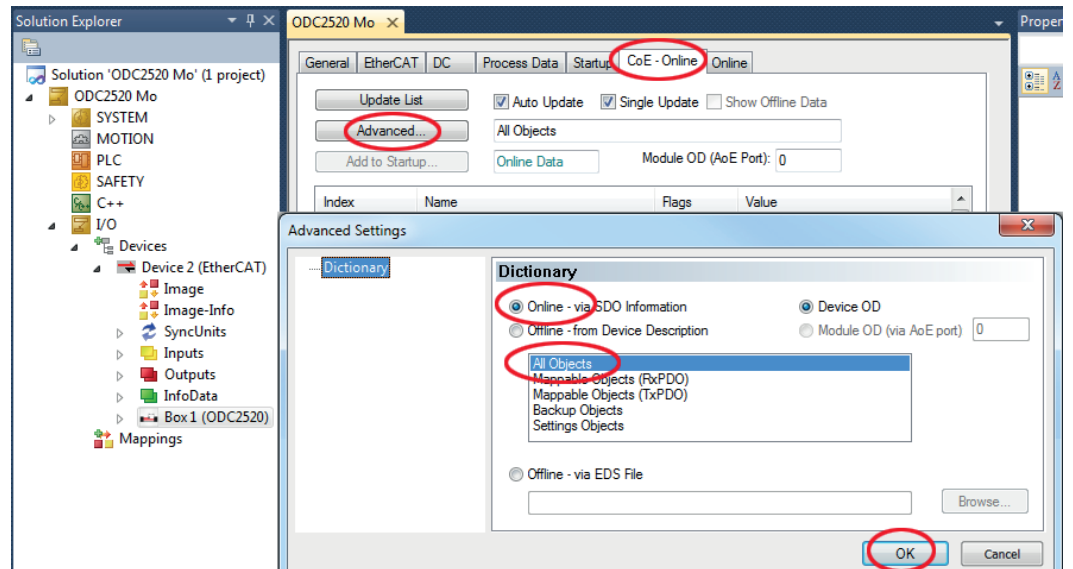


If ERR PREOP appears in the Current State, the cause is reported in the message window. In the example here the incorrect initialization of the synchronization manager is the reason. This will be the case if the settings for the PDO mapping in the sensor are different from the settings in the ESI file (optoCONTROL2520compact.xml).

On delivery of the sensor only one measurement value (position of the first edge high-low) is set as output size (in both the sensor and in the ESI file).

Additional data can be selected in the object 21B0h, for example time stamp or number of pins.

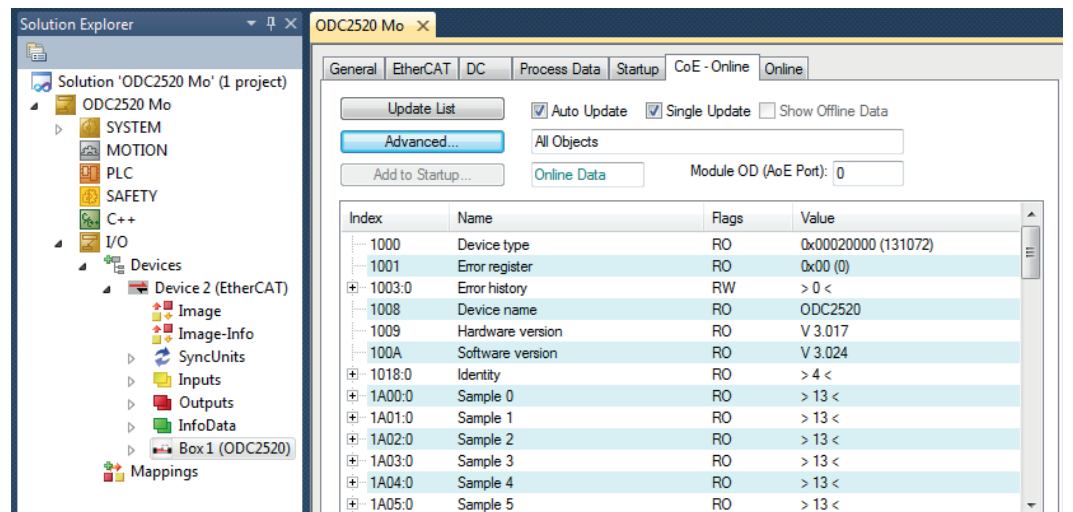
To configure the synchronous manager correctly, it is first necessary to read the object directory of the sensor.



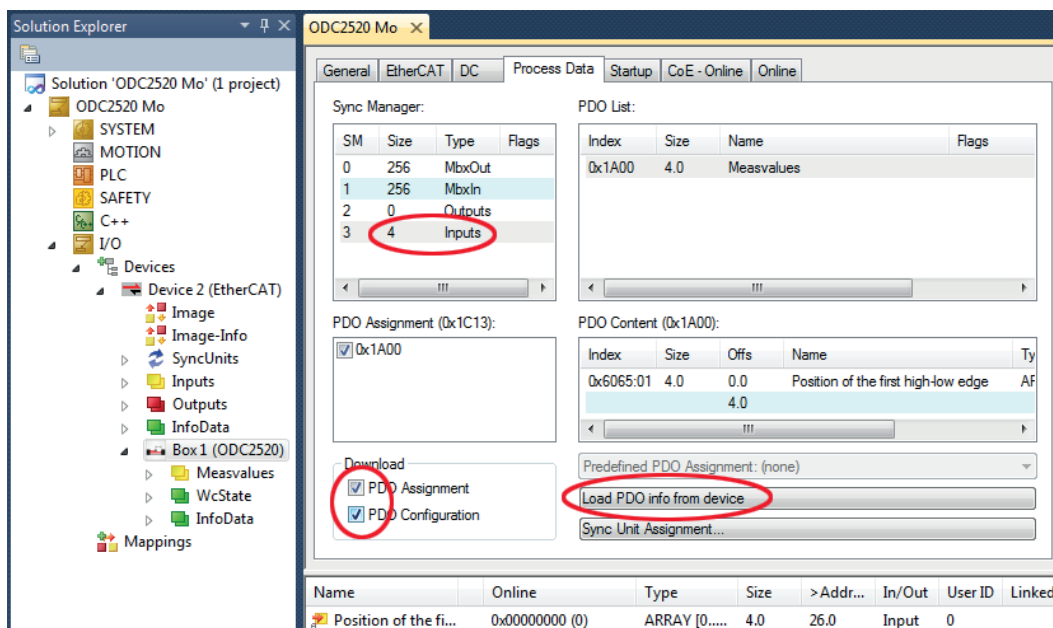
➔ Confirm with OK.

Thus TwinCAT reads all values of objects known to it. This is important for the next step, because the mapping (objects 0x1A00, 0x1A01, ... and 0x1A18) has changed.

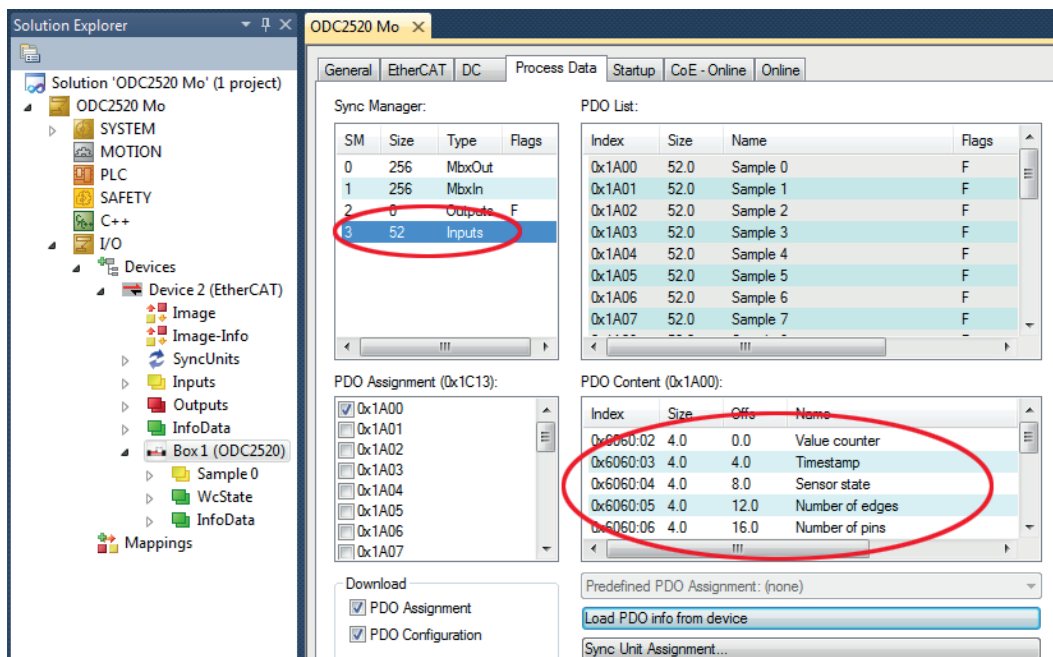
Example for a complete object directory (subject to change without prior notice).



On the Process Data side the PDO allocations can be read from the device.

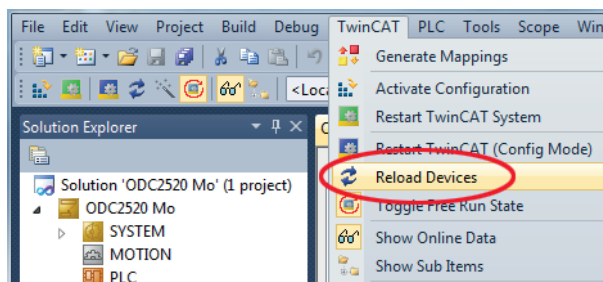


The scope of the provided process data and the assignment of the SyncManager may be viewed now.



➡ Now select the tab Reload Devices under the menu item TwinCAT.

The configuration is now complete.



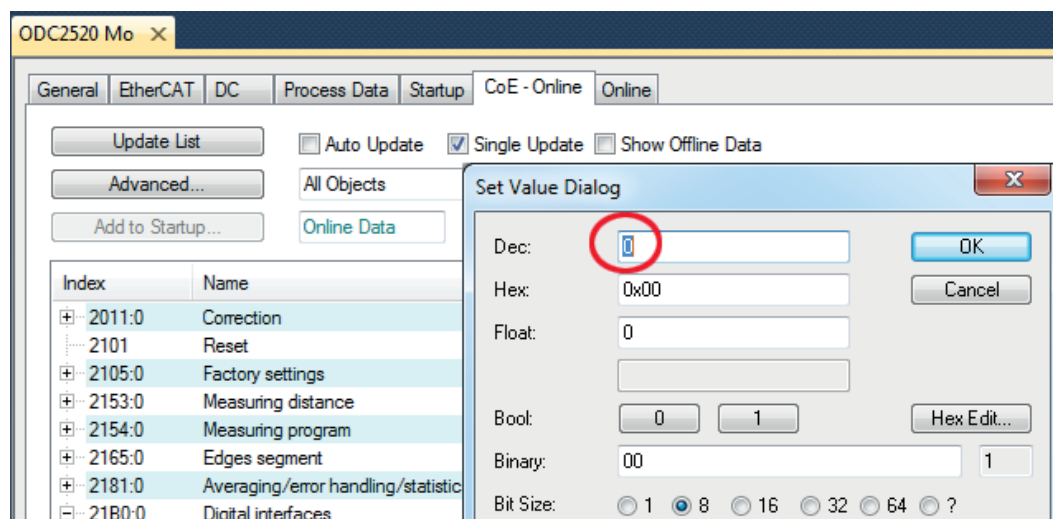
The selected measurement values are transmitted as process data in the status `SAFEOP` and `OP`.

Name	Online	Type	Size	>Address	In/Out	Us
Value counter	0x03AEC5DE (61785566)	DINT	4.0	26.0	Input	0
Timestamp	0xC12C4786 (-1054062714)	DINT	4.0	30.0	Input	0
Sensor state	0x7D0B0000 (2097872896)	DINT	4.0	34.0	Input	0
Number of edges	0x00000001 (1)	DINT	4.0	38.0	Input	0
Number of pins	0x00000000 (0)	DINT	4.0	42.0	Input	0
Number of gaps	0x00000000 (0)	DINT	4.0	46.0	Input	0
Position of the fi...	0x7FFFFFFB (2147483643)	DINT	4.0	50.0	Input	0
1.Statistic mini...	0x7FFFFFF8 (2147483640)	DINT	4.0	54.0	Input	0
1.Statistic maxi...	0x7FFFFFF8 (2147483640)	DINT	4.0	58.0	Input	0

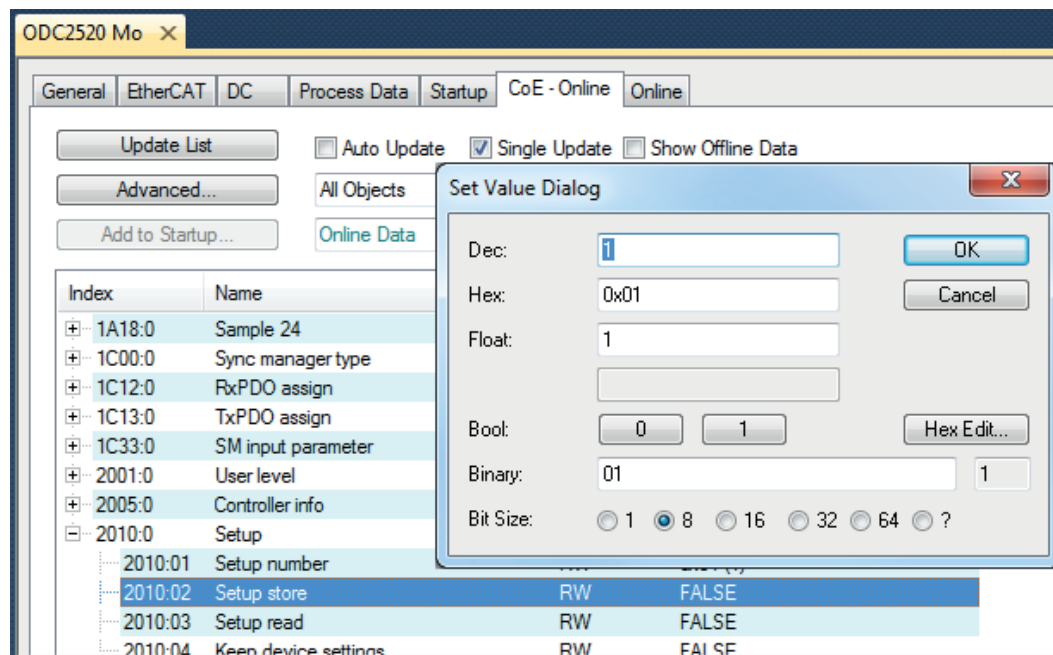
### A 8.10 Exit EtherCAT

The sensor is in Run mode; the LED EtherCAT / Ethernet on the sensor lights up green.

- Select the TwinCAT > Restart TwinCAT (Config Mode) menu item in the TwinCAT Manager. Confirm the Activate Free Run window with No.
- Select the object 21B0:03 and set the value of the parameter to 0. Confirm the dialog with OK.



- Select the object 2010:02 and set the value of the parameter to 1. Confirm the dialog with OK.



This procedure save the settings.

- Exit the TwinCAT-Manager.
- Restart the sensor.

The Status LED on the sensor is off. The sensor is now in the Ethernet mode.

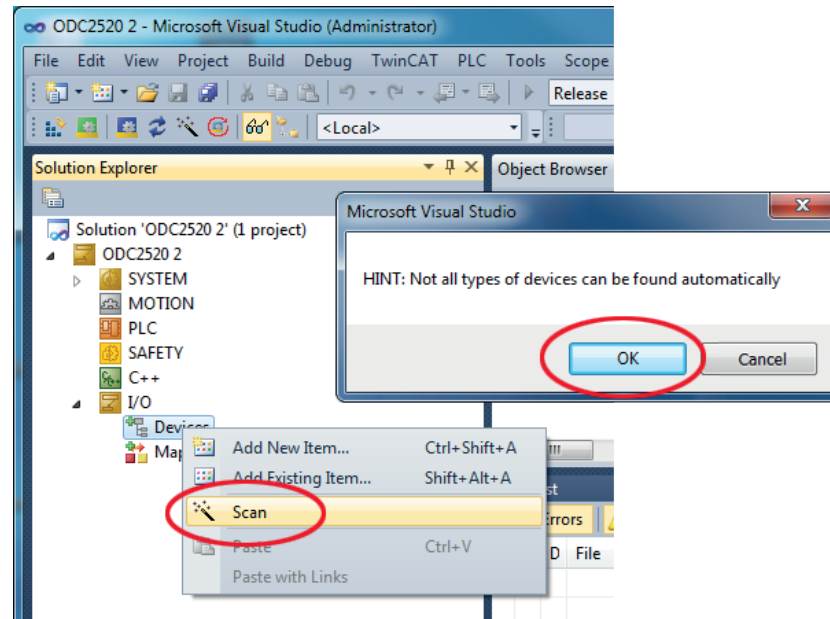
## A 9 Activate Ethernet Interface

Initial situation: The sensor is incorrectly set to EtherCAT. The sensor operates in the EtherCAT Run mode; the Status LED on the sensor lights up green.

Purpose: Enable Ethernet interface.

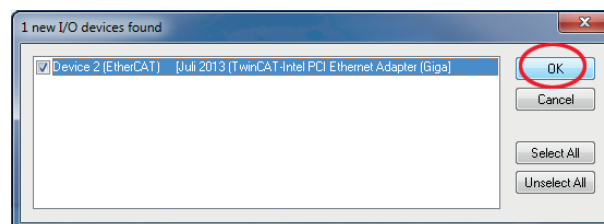
The TwinCAT-Manager program is installed, the device description file from the online directory <https://www.micro-epsilon.de/download/software/ODC2520-EtherCAT-XML.zip> is copied to the \\TwinCAT\3.1\Config\IO\EtherCAT directory.

- ➔ Restart the sensor.
- ➔ Restart the TwinCAT-Manager.
- ➔ Select the menu I/O Devices, then Scan.
- ➔ Confirm with OK.

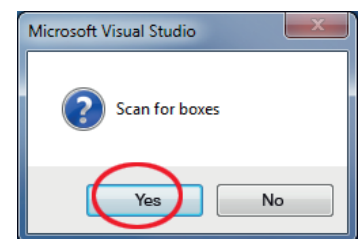


- ➔ Select a network card, where EtherCAT®-Slaves should be searched.

It appears the window Scan for boxes (EtherCAT®-Slaves).



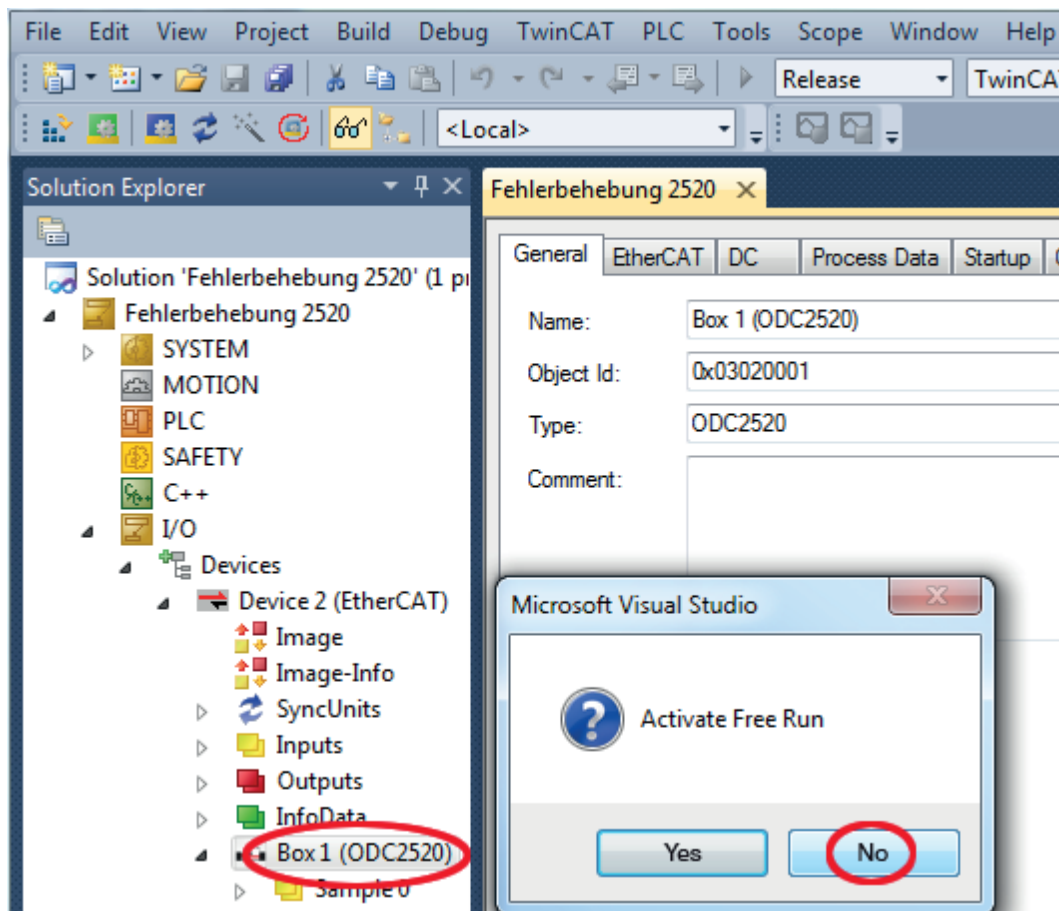
- ➔ Confirm with OK.



- ➔ Confirm with Yes.

The sensor is now shown in a list.

➡ Now confirm the window `Activate Free Run` with `No`.



➡ Continue with the instructions to exit EtherCAT, see Chap. A 6.10.







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