MICRO-EPSILON

Operating Instructions

optoCONTROL 2700

ODC2700

Laser Micrometer

MICRO-EPSILON
Eltrotec GmbH
Manfred-Wörner-Straße 101

73037 Göppingen / Germany

Tel: +49 (0) 7161 / 98872-300
Fax: +49 (0) 7161 / 98872-303
E-Mail: eltrotec@micro-epsilon.de
www.micro-epsilon.com/contact/worldwide/
Web: www.micro-epsilon.com

Contents

1 Safety

1.1 Symbols used

System operation assumes knowledge of the operating instructions.

The following symbols are used in these operating instructions:

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

1.2 Warnings

⚠ VORSICHT

Connect the power supply according to the regulations for electrical equipment.

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

NOTICE

Avoid shocks and impacts to the light source and 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 agents.

- Inaccurate or incorrect measurements

Do not touch the protective windows of the light source and receiver. Immediately wipe off any fingerprints.

- Inaccurate or incorrect measurements

Avoid constant exposure of light source and receiver to splashes of water.

- Damage to or destruction of the sensor

Avoid exposure of sensor to aggressive media (detergents, cooling emulsions).

- Damage to or destruction of the sensor

1.3 Notes on product marking

1.3.1 CE marking

The following apply to the product:

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

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

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

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

1.3.2 UKCA marking

The following apply to the product:

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

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

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

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

1.4 Intended Use

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

It is used for

Measuring distance, position, geometry, and thickness

Monitoring Quality and Checking Dimensions

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

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

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

1.5 Proper Environment

Protection class:	IP67

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

Optical windows are excluded from the protection class. This is because soiling of the windows will cause impairment or failure of the function.

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

2 Functional Principle, Technical Data

2.1 Description

The optoCONTROL 2700 is a high-resolution, two-sided telecentric micrometer for measuring dimensional quantities – such as diameters, gaps, positions, and segments – using a shadow-casting or light section process.

The sensor consists of a light source and a receiver, which are electrically connected via an eight-pin cable. A mounting rail forms the mechanical connection between the light source and receiver.

The sensor offers a high measuring rate with accuracies in the micrometer range. This enables precise measurements to be achieved even in the context of fast processes.

When using the sensor to determine a diameter, tilted targets in the xy direction will lead to distorted measurement results. The active tilt correction feature corrects this error during operation at the full measuring rate.

All evaluation takes places inside the receiver.

Fig. 2.1: The optoCONTROL 2700 Sensor

2.2 Functional Principle

The sensor relies on the shadow-casting principle and contactlessly measures the dimensions of a target or the position of an object's edge.

The light source uses a high-quality telecentric optical system to produce a collimated light beam. The light source is aligned with the receiver, where the transmitted light hits an image matrix after passing through a telecentric lens. If a target is located between the light source and the receiver, part of the light is obstructed and does not hit the image matrix.

Dark patches or shadows are detected on the image matrix. In this way, it is possible to detect edge positions and to evaluate dimensional quantities obtained from the shadow – such as diameters, gaps, and positions – as well as multiple segments.

Neither the light source nor the receiver contain any moving parts, making the sensor virtually wear-free.

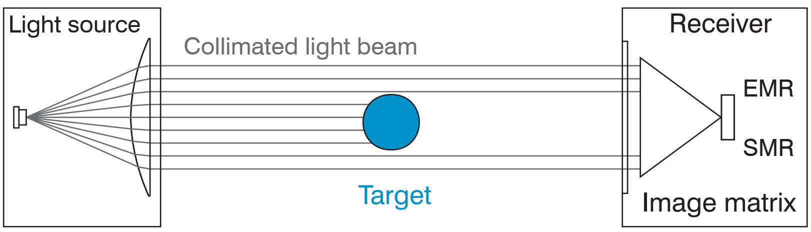


Fig. 2.2: optoCONTROL 2700 Measuring Principle

The search direction defines the starting point for an edge definition and, in turn, the numbering/order.

- Standard: Search begins at SMR (start of measuring range)
- Inverse: Search begins at EMR (end of measuring range)

Falling edge measuring program: The sensor searches for a light-dark transition.

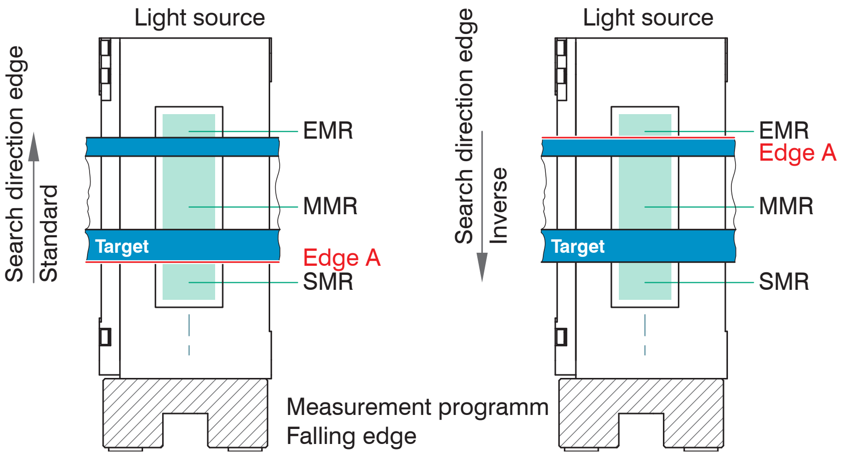


Fig. 2.3: Edge Assignment with Falling Edge Measuring Program

Rising edge measuring program: The sensor searches for a dark-light transition

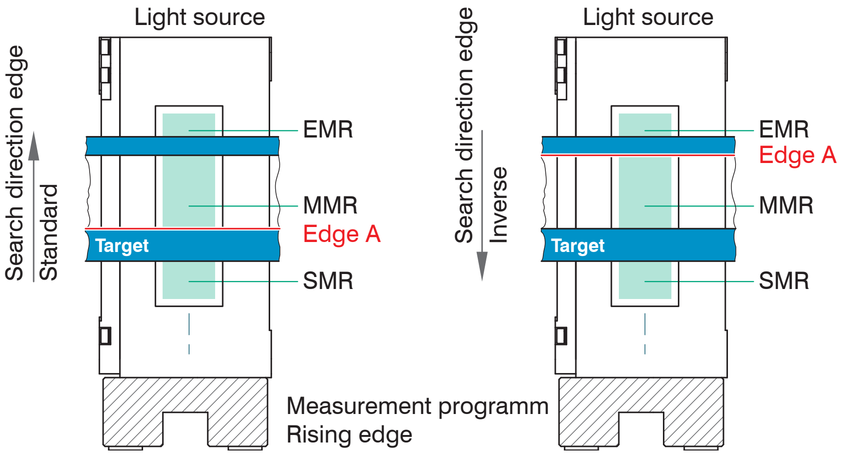


Fig. 2.4: Edge Assignment with Rising Edge Measuring Program

i The `search direction` and `measurement direction` parameters in the measuring program (data acquisition) affect the analog and digital outputs by changing the edge assignment.

2.3 Block Diagram

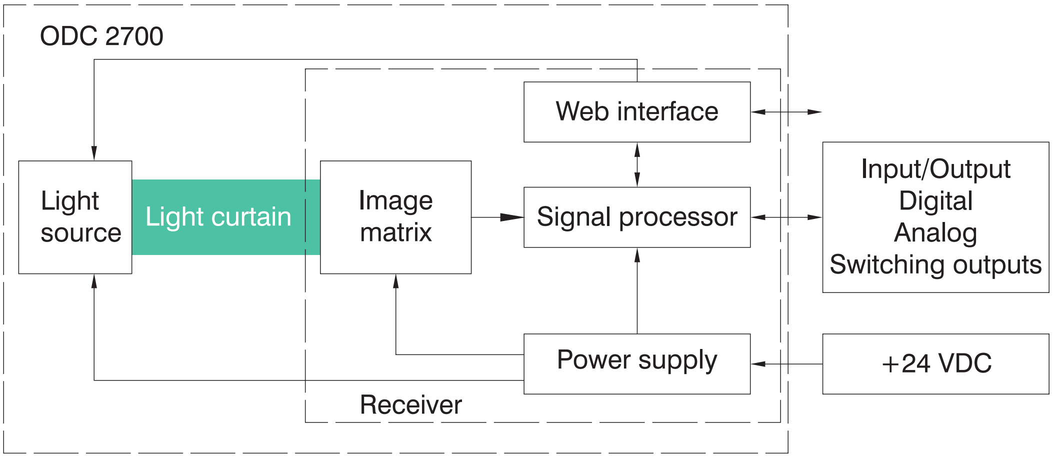


Fig. 2.5: Block Diagram of the ODC2700 Sensor

The integrated controller evaluates the image matrix and outputs the measured values via analog or digital interfaces.

Various parameterization methods are available, including a web interface (Ethernet) and ASCII commands.

2.4 Functions

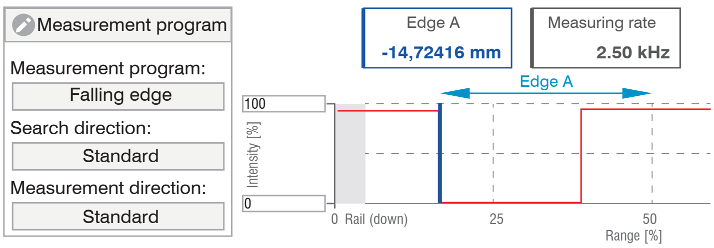
The optoCONTROL 2700 sensor supports the following functions:

- Edge measurements using a shadow-casting process (edge light-dark; edge dark-light)
- Diameter, width, gap width measurement
- Any segment layers or widths
- Freely selectable edges
- Reversible counting direction
- Calculation of center axes between edges
- Counting of edges and segments (pins or gaps)
- Online chart with user levels via web interface
- Ethernet
- Data logger function
- Limitation of the measuring range (for masking out protruding machine parts)
- Triggering and synchronization
- Adjustable switching thresholds
- Statistical values, such as min./max., peak-to-peak, and various types of averaging
- Simultaneous output of up to 8 segments, 16 edge positions, and their center axis
- Setup mode via web interface

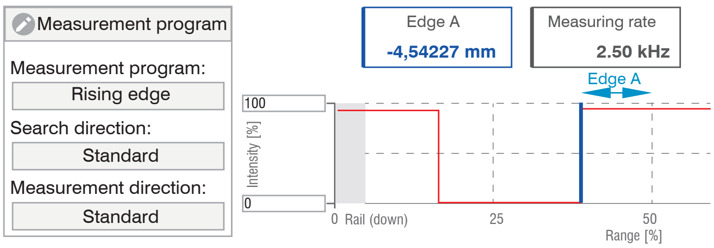
2.5 Operating modes

A preset is a predefined configuration of settings that achieves the best results for the selected measurement task.

Preset Strip edge

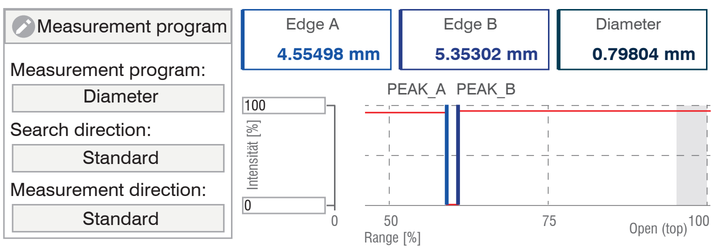


Sets the controlling and measurement of strip edges, such as paper, glass, sheet metal or film. The signal quality should be adapted to the material (paper webs - high averaging, sheet metal webs - median, film - low averaging).

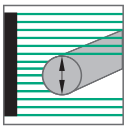


Measurement direction
Determines the reference point of the measured value
standard: measures the position from the MMR (m mid of measuring range) towards the mounting rail
reverse: measures the position from the MMR (mid of measuring range) towards the EMR (end of measuring range)

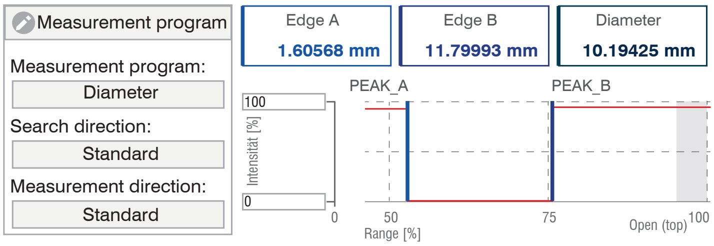
Preset Wire measurement



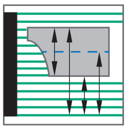
Measuring a thin, fast-moving object (e.g. wire). Signal and video averaging are disabled. The measurement provides the current measurement value at all times and is therefore insensitive to vibrations



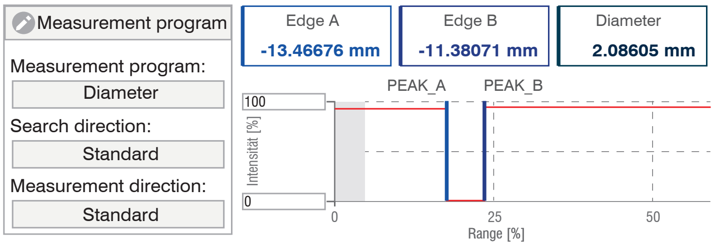
Preset Diameter



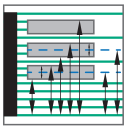
For measuring the diameter of cylindrical objects (e.g. dowel pins, bolts, bar stock, pipes, hydraulic lines). The tilt angle of the object in relation to the measurement plane is compensated for in real time by the active tilt correction.



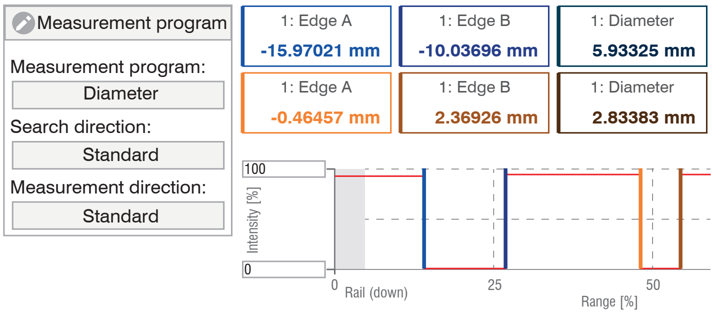
Preset Contour measurement



For measuring component contours on a stepped turned part. The lower edge (A), upper edge (B), center axis (C), diameter (D) and the encoder value are detected.

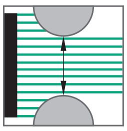


Preset Multi-segment

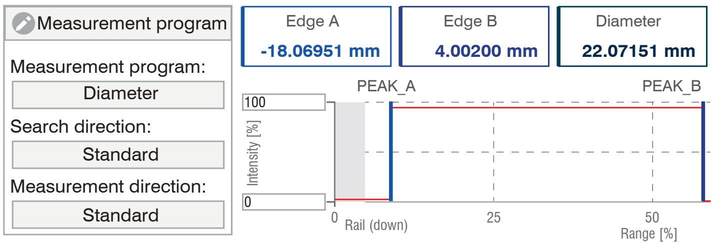


Simultaneous measurement of several objects in the beam path, e.g. strips or wires, or targeted detection of segments selected by the user. The individual definition of user and application-specific segments is possible.

The Multi-segment preset enables individual assignment of the edges to each other. Detailed information is available in the Advanced settings chapter.



Preset Gap measurement



Measures the gap between two objects. The width of the gap and the angular deviations of the gap edges (AT and BT) are output. Application in rolling systems such as calender rolls.

Further information on selection and programming can be found in the measuring programs

2.6 Technical Data

Model		ODC 2700-40
Measurement area		40 mm
Min. target size		0.3 mm
Distance light source - receiver		300 mm
Measuring distance target - receiver		150 (±10) mm
Sampling rate [1]		15.0 kHz
Measuring rate[2]		5.0 kHz
Exposure time [3]		8.5 µs
Resolution [4]		10 nm
Linearity [5] [6]		≤ 1 µm
Repeatability [5]		≤ 0.1 µm
Light source		LED turquoise 508 nm (blue-green)
Laser class		no laser, LED according to DIN EN 62471 risk group 0
Permissible ambient light		30,000 lx indirect; 5000 lx direct irradiation
Supply voltage		11 … 30 VDC
Max. current consumption		≤ 1 A
Signal input		3x inputs optionally for encoder, zero point, reset, trigger; light on/off (can be switched off via menu)
Digital interface [7]		Ethernet, RS422 (up to 2 MBaud) EtherCAT, EtherNet/IP, PROFINET
Analog Output		0 ... 10 VDC / 4 ... 20 mA (16 bit, freely scalable within the measuring range)
Switching output		3 outputs, optionally for errors and 2x limit values, not electrically separated 24V logic (HTL), high level depends on operating voltage Switchable TTL level
Digital output		Synchronization
Connection	Light source	integrated cable 0.8 m, with 8-pin M8 socket for power supply
	Receiver	8-pin M12 plug for light source supply, 12-pin M12 socket for power supply and signals, 4-pin M12x1 socket for Ethernet 17-pin M12 plug for analog sync inputs (trigger/encoder)
Installation		integrated mounting rail with mounting holes
Temperature range [8]	Storage	-20 ... +70 °C
	Operation	0 ... +50 °C
Shock (DIN EN 60068-2-27)		15 g / 6 ms in XY axis, 100 shocks each
Vibration (DIN EN 60068-2-6)		2 g / 20 … 500 Hz in XY axis, 10 cycles each
Protection class (DIN EN 60529)		IP67
Material		Aluminum housing
Weight	Light source	approx. 500 g
	Receiver	approx. 1400 g
	Mounting rail	approx. 1000 g
Measuring programs		Diameter / gap / segment measurement / edge measurement with rising or falling edge / search and measurement direction / additional detection of edge positions and center axes

[1] Number of measurements taken per second

[2] Number of measured values that are output at the sensor interface

[3] With video averaging switched on = 3 x 8.5 µs exposures per measurement

[4] At the digital interface

[5] The specified data apply to a constant room temperature of 20°C, after a warm-up time of 30 min | 95% confidence interval for diameter measurement when averaging 1024 over a period of 5 minutes in a temperature-stabilized environment

[6] Measured with 2 mm testing pin at a measurement distance of 150 mm in measuring field 1 (Z=±2.5 mm). In measuring field 2 (Z=±10 mm) linearity ≤ 3 µm - 95% confidence interval

[7] EtherCAT, PROFINET and EtherNet/IP: Connection either via interface module (see accessories) or as a sensor option

[8] Relative humidity % 5 ... 95 (non-condensing)

Model	ODC 2700-40
Presets	Strip edge / wire measurement / (outer) diameter incl. inclination correction / contour measurement incl. encoder value / Multi-segment as well as roller, gap and angle measurement
Control and indicator elements	4x LED (power, status, link, speed) Website: Tilt angle correction, contamination display, 6 application-specific presets, freely selectable averaging, data reduction, 8 editable user programs, measured value time diagrams, measured value display in mm / inch, video signal, set-up mode with measuring line and measuring object; menu language German, English
Special features	Including "sensorTOOL" software for data acquisition and processing, "MedaQLib" programming database

3 Delivery

3.1 Unpacking, Included in Delivery

- 1 light source with pigtail
- 1 receiver
- 1 mounting rail
- 1 set of assembly instructions
- 1 acceptance report

The light source and receiver are mounted on the mounting rail as a single unit.

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

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

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

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

Optional accessories are listed in the appendix.

3.2 Storage

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

4 Installation and Assembly

4.1 General

The optoCONTROL sensor is an optical system used to measure in the µm range.

i Ensure careful handling during installation and operation.

NOTICE

Do not touch the optical windows.
> Functionality impaired due to soiling.

No sharp or heavy objects should be allowed to affect the cables. Avoid folding the cables.
> Damage or destruction of the cables, failure of the measuring device.

Observe the minimum bending radii of 60 mm.

Only attach the sensor using the existing holes on a flat surface. Any type of clamping is not permitted.
> Inaccurate or incorrect measurements

The connection cables between the light source and receiver and the Ethernet cable are not drag chain-compatible.

4.2 Light Source and Receiver

4.2.1 Dimensions

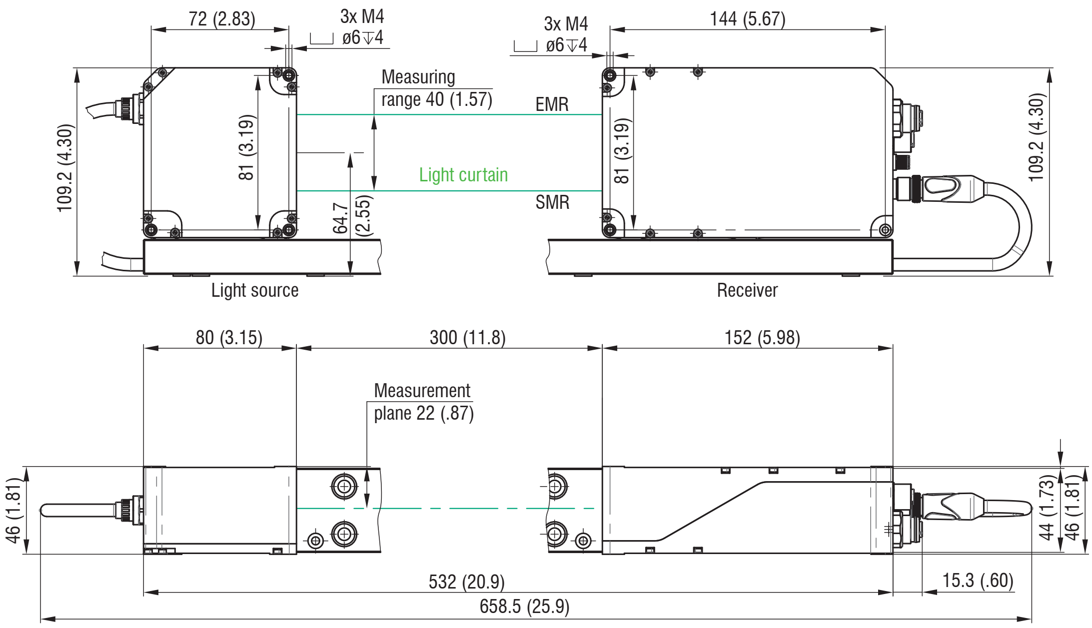


Fig. 4.1: Dimensional Drawing of Light Source and Receiver, Dimensions Stated in mm

4.2.2 Attachment to Mounting Rail

The sensor unit – comprising the light source, receiver, and mounting rail – is preassembled.

The mounting rail ensures that the components are correctly aligned with one another.

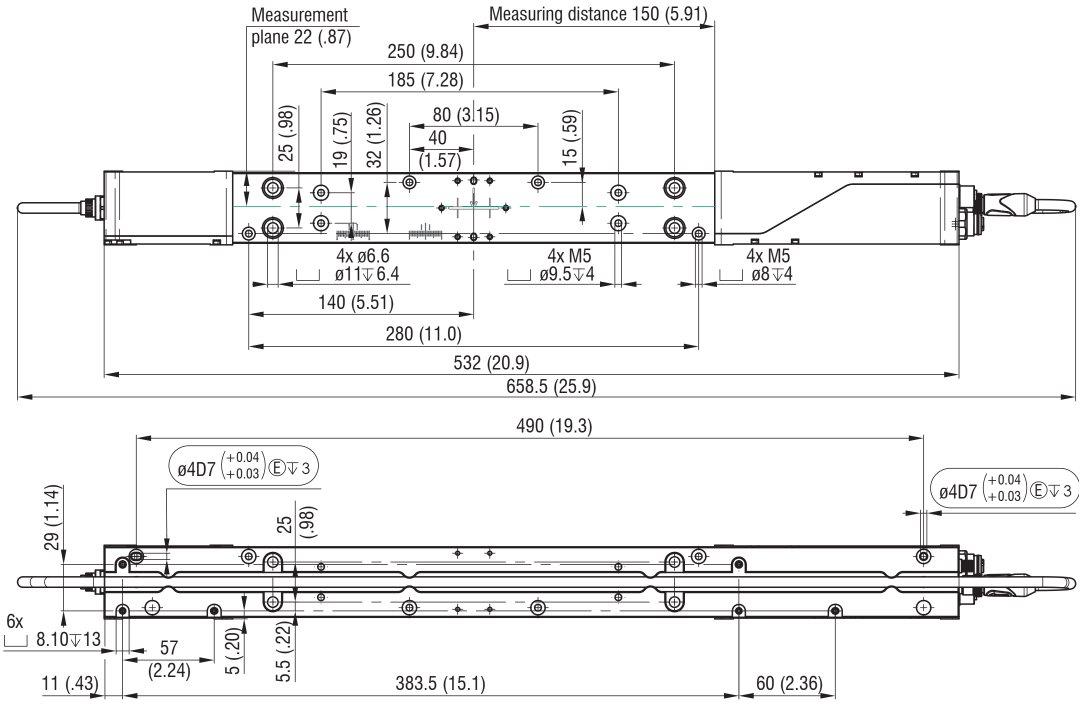


Fig. 4.2: Dimensional Drawing of Light Source and Receiver with Mounting Rail, Dimensions Stated in mm

i	The mounting rail must be attached without bending or twisting it.

A horizontal measurement setup is preferable because it results in less soiling of the optical windows.

Mounting Rail, Standard Attachment Method

- Ideally, you should mount the mounting rail so that it lies flat against the four M5 mounting holes (highlighted in blue).

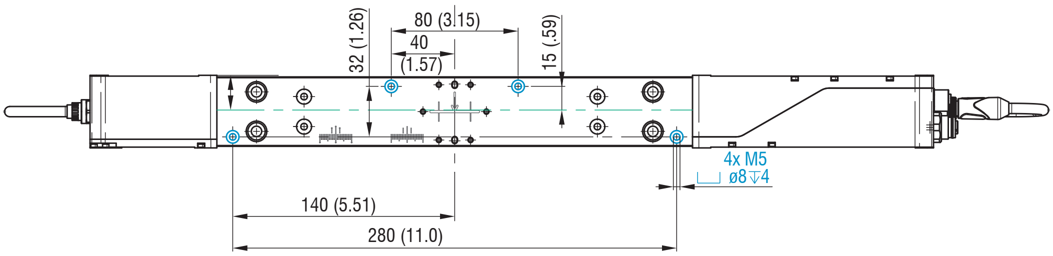


Fig. 4.3: Dimensional Drawing of Mounting Rail, Standard Mounting Method

Mounting Rail, Optional Attachment Method

- Mount the mounting rail so that it lies flat against the four M5 mounting holes (highlighted in blue) or
- Mount the mounting rail so that it lies flat against the four ø6.6 mounting holes (highlighted in blue).

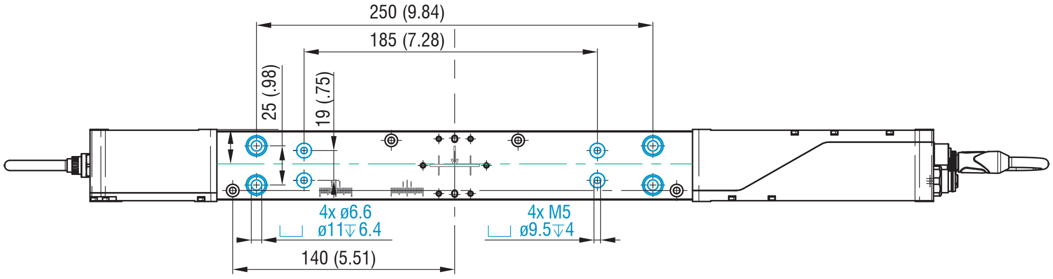


Fig. 4.4: Dimensional Drawing of Mounting Rail, Optional Mounting Method

4.2.3 Freestanding Mounting

Micro-Epsilon recommends initially mounting the sensor with the mounting rail attached. Once the sensor has been mounted, this rail can be removed.

Only attach the light source and receiver using the existing holes on a flat surface. Any type of clamping is not permitted.

> Inaccurate or incorrect measurements

If light source and receiver must be installed without the supplied mounting rail, you must make sure that the components are exactly aligned with each other.

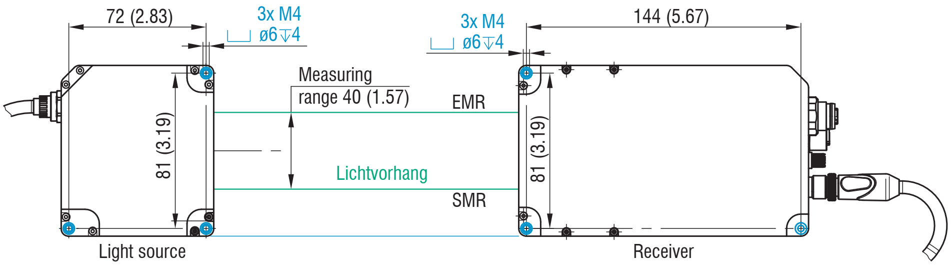


Fig. 4.5: Mounting Thread for Direct Screw Connection, Dimensions Stated in mm

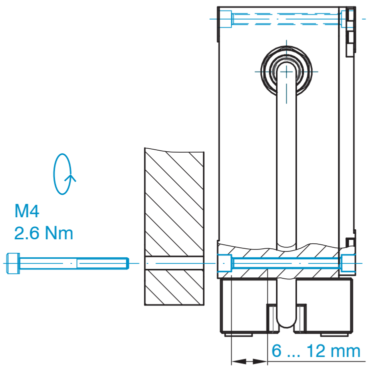


Fig. 4.6: Sensor Secured with Direct Screw Connection

The distance between the light source and receiver is 300 mm.

i	Light source and receiver must be located on the same plane and must not be tilted in relation to each other.

Use a stop bracket or rails to align the light source and receiver.

Once the light source and receiver have been installed at the correct distance from each other, check that the light band is aligned centered on the receiver, and adjust if necessary.

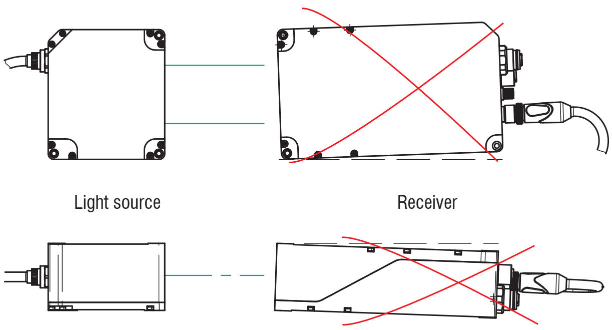


Fig. 4.7: Adjustment Errors to Avoid During Freestanding Mounting

If necessary, loosen the light source for exact positioning. Check the central orientation of the continuous light band both horizontally and vertically.

Micro-Epsilon recommends holding a white piece of paper in front of the receiver as a projection screen and covering half of the screen. The strip light must illuminate the glass sheet symmetrically.

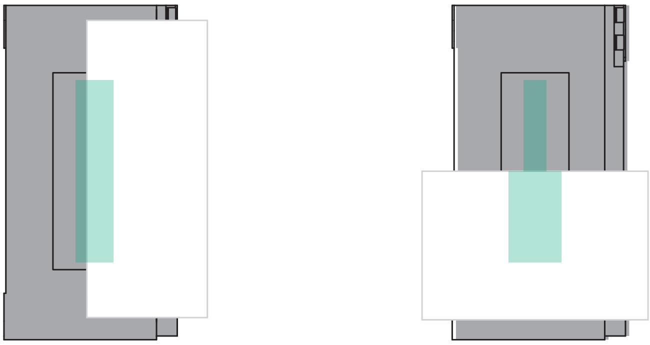


Fig. 4.8: Adjustment Check with Projection Screen (Paper) in Front of Receiver, Left Vertical and Right Horizontal Orientation

i	The light band must hit the receiver's inlet window exactly in the center.

4.2.4 Calibrated measurement distance

The sensor delivers the specified technical data at the measuring distance between the target and receiver.

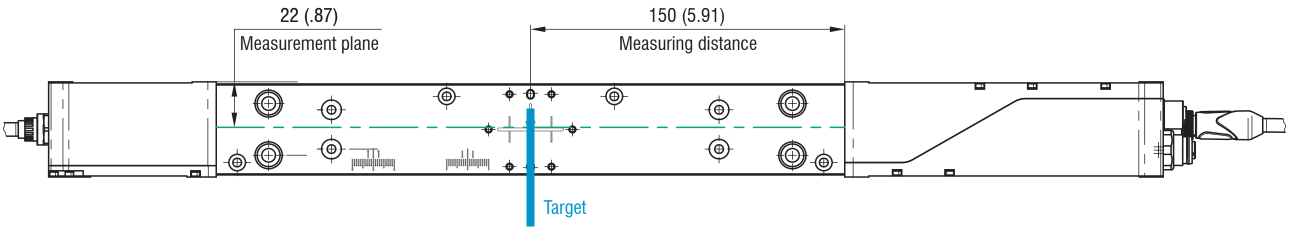


Fig. 4.9: Calibrated measurement distance

If necessary, take lateral guides into account to avoid lateral movements of the measuring object.

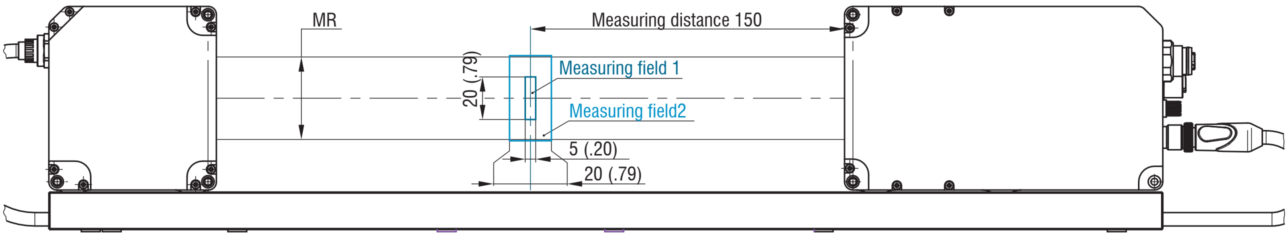


Fig. 4.10: Optimum position of the measuring object within the measuring fields

4.3 Electrical connections

4.3.1 Light Source

The light source is supplied with power by the receiver.

Fig. 4.11: Integrated Power Supply Cable on Light Source

► Connect the integrated cable of the light source to the receiver before switching on the power supply.

4.3.2 Receiver

The connection sockets are labeled on both sides of the receiver housing.

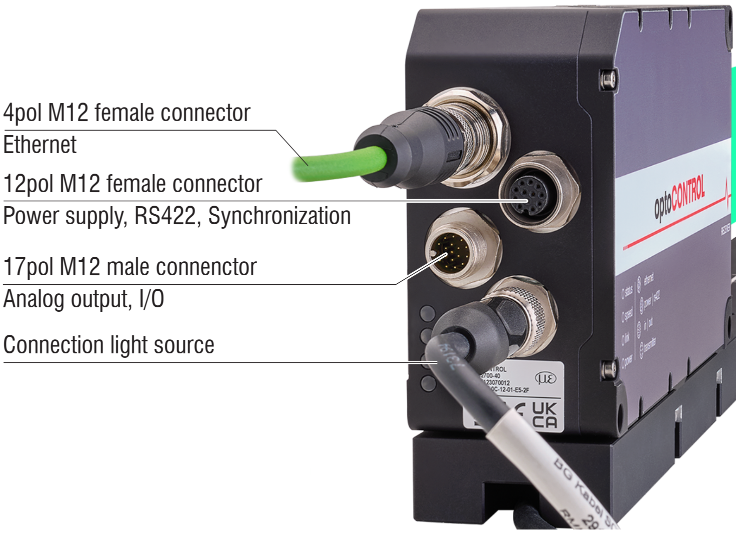


Fig. 4.12: Electrical connections of receiver

Housing screen printing	Signal(s)	Optional cable
ethernet	Ethernet	SCD2700-5 M12
power / rs422	Supply, RS422, Synchronization	PC/SC2700-x
in / out	Analog output, switching outputs, function inputs	SCA2700-x

transmitter	Light source	Included in delivery

Fig. 4.1: Connector assignment

i Unnecessary connections must be fitted with protective caps in order to achieve the possible IP protection class.

4.3.3 Connection options

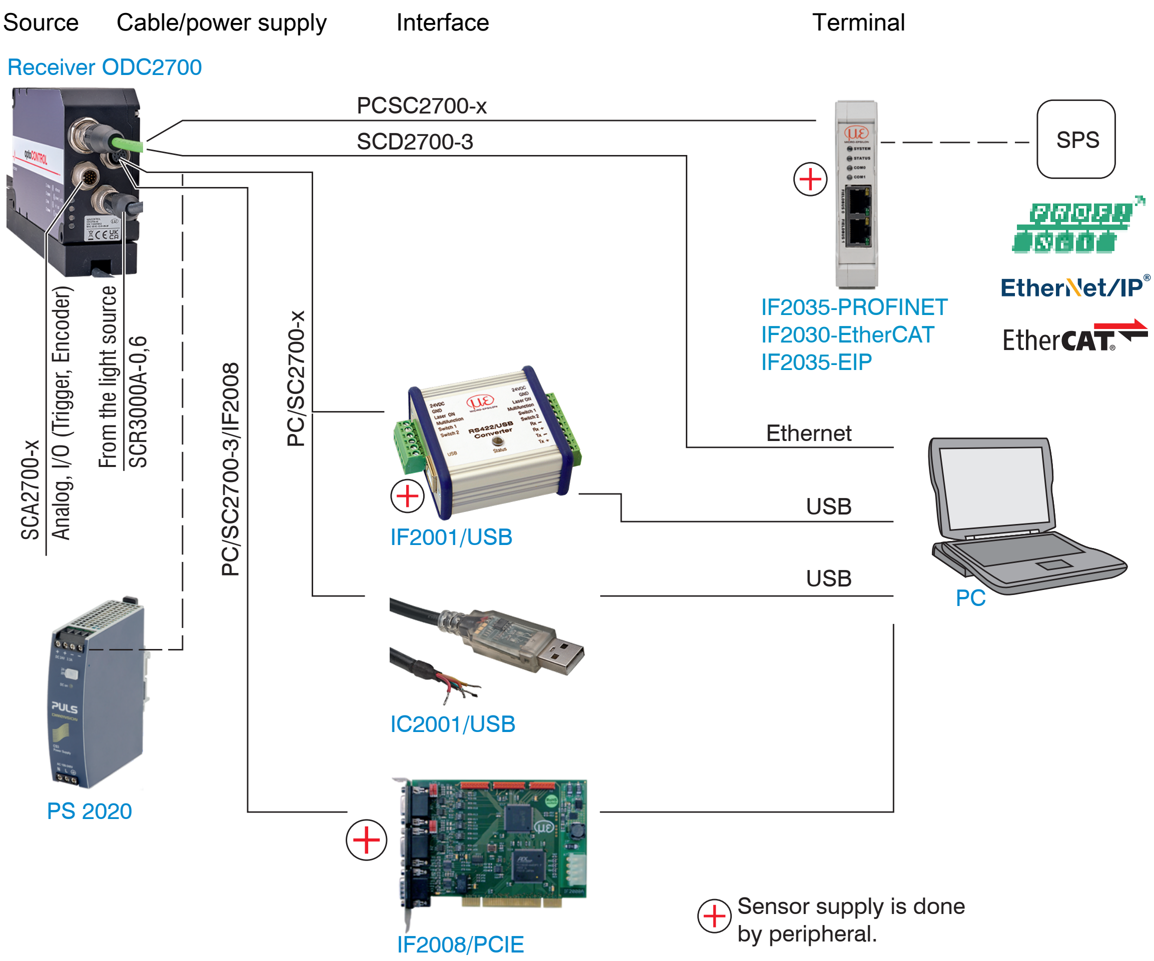


Fig. 4.2: Connection examples with the optoCONTROL 2700

4.3.4 Pin Assignment

Signal	Pin	PC/SC2700-x wire color, explanation		Notes
V_+	9	Red	Supply voltage	11 … 30 VDC, typically 24 VDC, I_{max} 230 mA at 24 VDC
GND	2	Blue	Reference ground	Reference ground for Power, Sync, RS422
Sync +	1	Brown	Synchronization or triggering	Symmetrical, RS422 level, terminating resistor (120 ohms), direction can be switched using software, not electrically separated
Sync -	3	White		
Tx +	5	Pink	RS422, 32 bits	RS422 interface, symmetrical, Rx internally terminated with 100 ohms, max. 4 Mbaud, full duplex, not electrically separated
Tx -	8	Gray		
Rx +	4	Green		
Rx -	6	Yellow		

Fig. 4.3: Pin Assignment, 12-Pin M12 Female Connector for Power Supply, Synchronization, and RS422

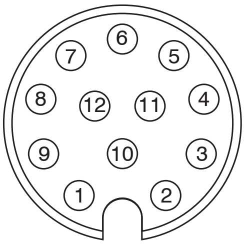


Fig. 4.13: 12-Pin Cable Connector of PC/SC2700-x, View of Solder Side

The PC/SC2700-x has a 12-pin M12 male connector on one side and open ends on the other.

Signal	Pin	SCA2700-x wire color, explanation		Notes
Analog Output	1	White	Not electrically separated, 14-bit D/A	Current 4 ... 20 mA Voltage 0 ... 5 VDC Voltage 0 ... 10 VDC
AGND	2	Black	Ground analog output	
Switching output 1	11	White	Switching behavior: NPN, PNP, push-pull, or push-pull negated; function can be set to either limit value or edge count mode	
Switching output 2	9	Green		
Switching output 3	16	Yellow		
Multifunction input 1	15	Pink	24V logic (HTL): Low ≤ 3 V; High ≥ 8 V (max. 30 V) 5V logic (TTL): Low ≤ 0.8 V; High ≥ 2 V Internal pull-up resistor, an open input is detected as High. Connect the input to GND in order to trigger the function. Function can be set to triggering or encoder mode.	
Multifunction input 2	12	Red/blue		
Multifunction input 3	17	Gray/pink		
GND	10	Brown	Reference ground for switching inputs and outputs	
GND	8	Gray		

Fig. 4.4: Pin Assignment, 17-Pin M12 Male Connector for Analog Output, Switching Inputs, and Switching Outputs

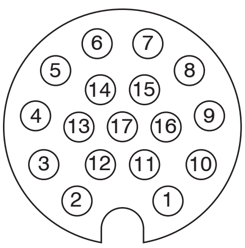


Fig. 4.14: 17-Pin Female Cable Connector of SCA2700-x, View of Solder Side

4.3.5 Supply Voltage

Nominal value: 24 V DC (11 ... 30 V, P < 6 W).

- ► Only turn on the power supply after wiring has been completed.
- ► Connect inputs “9” and “2” on the 12-pin M12 female connector to a 24 V power supply

power | rs422 12-pin M12 female connector, pin	PC/SC2700-x Wire color	Signal
9	Red	V_+
2	Blue	GND

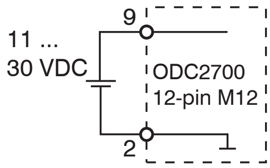


Fig. 4.5: Supply voltage connection

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

4.3.6 Analog Output

The sensor offers the following alternatives:

- A 4 ... 20 mA current output
- A 0 ... 5 V or 0 ... 10 V voltage output

> i The current output must not be used continuously in short-circuit operation without a load. Continuous short-circuit operation leads to thermal overloading and thus causes the output to switch off automatically.

- ► Connect outputs 1 (white, inner coaxial conductor) and 2 (black, coaxial shield) on the 12-pin M12 female connector to a measuring device.

in | out 17-pin M12 male connector, pin	SCA2700-x Wire color
1	White
2	Black

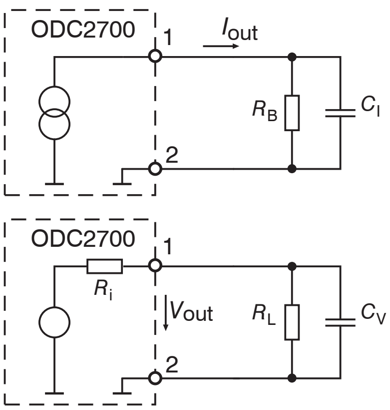


Fig. 4.6: Analog output switching

Current output	Voltage output
R_B max. = 250 ohms at V_+ > 11 V	R_i = 50 ohms
R_B max. = 500 ohms at V_+ > 17 V	R_L > 100 kilohms

4.3.7 Multifunction Input

The multifunction inputs support the triggering and encoder functions. The function depends on how the inputs are programmed and on the input signal time response. The inputs are not electrically separated.

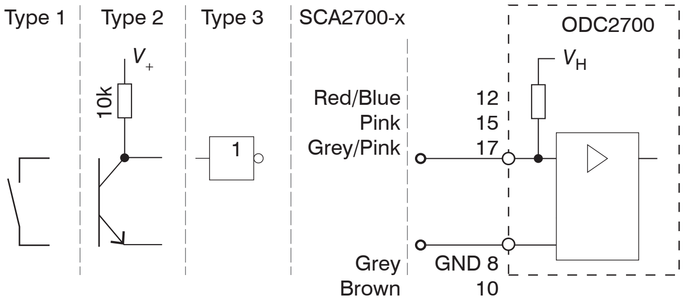


Fig. 4.15: Wiring for Multifunction Inputs

5V logic (TTL): Low ≤ 0.8 V; High ≥ 2 V
24V logic (HTL): Low ≤ 3 V; High ≥ 8 V (max. 30 V)

Internal pull-up resistor, an open input is detected as High.
Connect the inputs to GND in order to trigger the function.

Signal	Pin
Multifunction input 1	15
Multifunction input 2	12
Multifunction input 3	17

4.3.8 Switching output

The switching outputs Out1/Out2/Out3 are connected as follows:

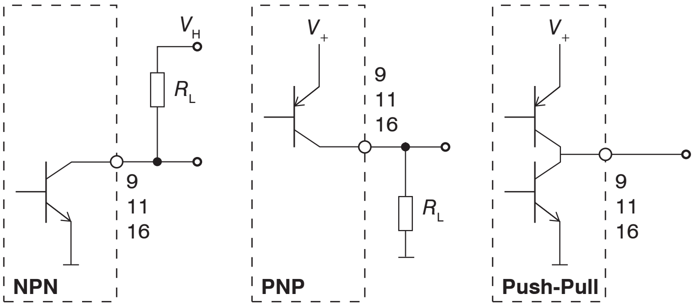


Fig. 4.16: Output configuration (schematic)

The switching behavior (NPN, PNP, push-pull, push-pull negated) of both switching outputs depends on the programming.

The NPN output is, for example, suitable for adaptation to a local TTL logic circuit with auxiliary voltage of V_H = 5 V. The switching outputs are protected against polarity reversal, overload (< 150 mA), excessive temperature and have an integrated self-induction recuperation diode for inductive loads.

in | out 17-pin M12 plug	SCA2700-x Wire color	Signal	Comments
11	White	Switching output 1	Limit value or number of edges not electrically separated, 24 logic (HTL), I_{max} = 0.1 A, V_{max} = 30 V Saturation voltage with I_{max} = 0.1 A: Low < 2.5 V (output - GND), High < 2.5 V (output - supply voltage)
9	Green	Switching output 2	
16	Yellow	Switching output 3	

Fig. 4.7: Switching outputs characteristics

Name	Output active (e.g. limit value exceeded)	Output passive (e.g. no limit value violation)
NPN (Low side)	GND	V_H
PNP (High side)	V_+	approx. GND
Push-pull	V_+	GND
Push-pull, negated	GND	V_+

Fig. 4.8: Switching Behavior of Error Outputs

4.3.9 RS422 Connection with USB Converter IF2001/USB

For the connection between sensor and PC, the lines must be crossed.

> i Only disconnect or connect the sub-D connection between the RS422 and USB converter when no voltage is present.

power | rs422 12-pin M12-socket	PC/SC2700-x Wire color	End device (converter) Type IF2001/USB from Micro-Epsilon 10-pin terminal block
V+	Red	24 VDC
GND	Blue	GND
Tx - (8)	Gray	Rx -
Tx + (5)	Pink	Rx +
Rx - (6)	Yellow	Tx -
Rx + (4)	Green	Tx +

Fig. 4.9:

Symmetrical differential signals according to EIA-422, not electrically separated from the supply voltage.

Use a shielded cable with twisted wires, e.g. PC/SC2700-x/OE.

IF2001/USB 6-pin terminal block
24 VDC
GND
Laser ON
Multifunction
Switch 1
Switch 2

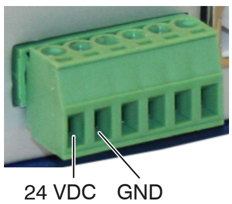


Fig. 4.10: Connecting the Power Supply to the IF2001/USB Converter

4.3.10 Synchronization

The Sync + and Sync - pins serve as the symmetrical outputs/inputs for synchronization or act as trigger inputs. The function and direction (I/O) are programmable.

All GND conductors are interconnected with one another and to the supply ground.

- Connect the Sync + connections to each other.
- Connect the Sync - connections to each other.

power | rs422 12-pin M12 female connector, pin	PC/SC2700-x Wire color	Signal
1	Brown	Sync +
3	White	Sync -

Fig. 4.11: Synchronization Connection

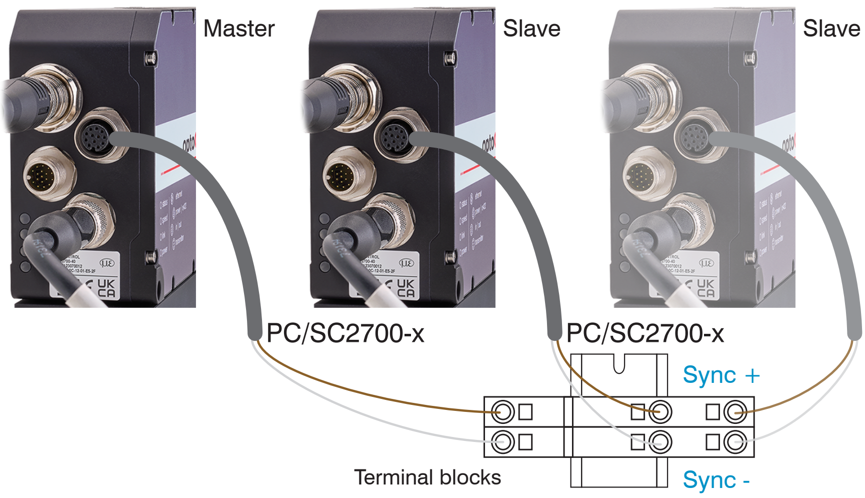


Fig. 4.17: Synchronization of Multiple Sensors

4.4 LEDs on Receiver

Speed LED	Meaning
Yellow	If baud rate is 100 Mb
Off	If baud rate is 10 Mb
Link LED	Meaning
Green	If link active
Off	If link inactive
Flashing	If network activity
Power LED	Meaning
Green	Supply voltage ON / operation
Yellow	Booting / bootloader

Fig. 4.12: LEDs on Receiver

5 Operation

5.1 Initial Operation

- Connect the light source and receiver with the connection cable.
- Connect the sensor to a 24 V DC power supply.
- Turn on the power supply.

After the sensor is switched on, initialization is performed. The sensor is ready for operation after approx. 10 s.

You can configure the software using the web pages or the ASCII commands integrated in the sensor. Parallel operation with web browser and ASCII commands is possible; the last setting applies.

Micro-Epsilon Eltrotec GmbH recommends setting the sensor via the integrated website.

To ensure precise measurements, let the sensor warm up for approx. 30 minutes.

5.2 Control via Ethernet

5.2.1 Requirements

Dynamic web pages containing the current settings for the sensor and peripherals are generated in the sensor. Control is only possible when there is a live Ethernet connection to the sensor. A web browser is required (for example Mozilla Firefox or Internet Explorer) on a PC with a network connection. To facilitate initial operation of the sensor, it is configured ready for direct connection.

If your browser is set to access the Internet via a proxy server, please add the sensor IP address to the IP addresses in the browser settings that are not to be routed through the proxy server. The MAC address of the measuring device is given on the sensor rating plate and in the calibration log.

To allow graphical display of the measurement results, JavaScript must be enabled in the browser.

5.2.2 Direct Connection to PC

5.2.2.1 PC with static IP

- Connect the sensor to a PC using a direct Ethernet connection (LAN). Use the SCD2700-5-M12 cable for this.
- Start the `sensorTOOL` program.

You can find this program online at https://www.micro-epsilon.de/fileadmin/download/software/sensorTool.exe.

- Click the `Sensor` button.
- Select the required sensor from the list.
- Switch to the `Settings` > `Outputs` > `Ethernet` settings menu to change the IP address.
  - IP type: static
  - IP address: 169.254.168.150 [9]
  - Subnet mask: 255.255.0.0
  - Gateway: 169.254.1.1
- Click the `Apply settings` button to transmit the changes to the sensor.

[9] This assumes that the LAN connection on the PC uses the following IP address, for example: 169.254.168.1.

- Click the `Open Website` button to display the website of the sensor in your standard browser. Alternatively, change the IP settings according to the settings on your PC (IP address ranges must match).

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

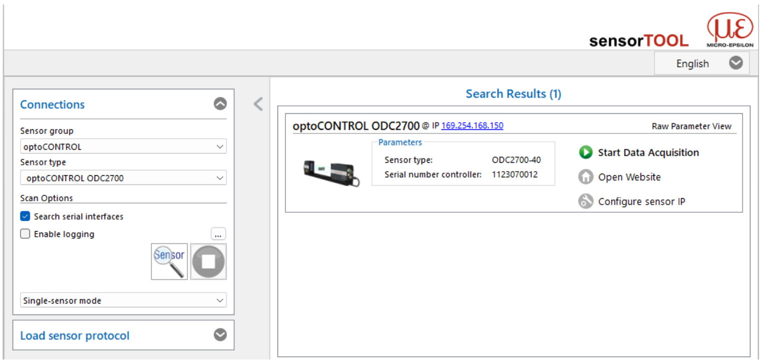


Fig. 5.1: Assistance program `sensorTOOL` for sensor search

5.2.2.2 PC with DHCP

- Connect the sensor to a PC using a direct Ethernet connection (LAN). To do this, use the SCD2700-5-M12 cable.

Wait until Windows has established a network connection (connection with limited connectivity).

- Start the `sensorTOOL` program.
- Click on the `Sensor` button.
- Now select the desired sensor from the list.
- Click on the `Open webpage` button to display the web page of the sensor in your default browser.

5.2.3 Network

Sensor with dynamic IP, PC with DHCP

- Connect the sensor to a switch using a direct Ethernet connection (LAN). To do this, use the SCD2700-5-M12 cable.
- 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 `sensorTOOL` program.

- Start the `sensorTOOL` program.
- Click on the `Sensor` button.
- Now select the desired sensor from the list.
- Click on the `Open webpage` button to display the web page of the sensor in your default browser.

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 “ODC2xxx_SN<Serial number>”.

- Start a web browser on your PC. To reach a sensor with serial number “01234567”, type “ODC2xxx_SN01234567” into the address bar of the browser.

5.2.4 Access via Ethernet

► Launch the web interface of the sensor.

Interactive web pages for configuring the sensor now appear in the web browser. The sensor is active and provides measured values.

The horizontal navigation contains the following functions:

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

Fig. 5.1: Start Page after Accessing the Web Interface

Parallel operation with web browser and ASCII commands is possible; the last setting applies. Don’t forget to save.

The appearance of the web pages can change depending on the functions and the peripherals. Each page contains parameter descriptions and thus tips for configuring the sensor.

5.3 Video Signal

5.3.1 Light Correction

The light correction must be performed once after mounting. If there are any changes in the extraneous light or if a high level of accuracy is required, we recommend repeating the process more frequently. The light correction function ensures effective extraneous light correction as a basis for accurate measurements and a relatively uniform light-corrected signal.

Before it can capture the light signal, the sensor must be allowed to warm up for approx. 30 min.

> i During the light correction, there must not be any objects present between the light source and receiver. If this is not possible, the evaluation range (ROI) must be appropriately masked before the light correction is performed.

► Switch to the menu `Settings` > `Corrections/Referencing`. Press the `Execute` button.

Fig. 5.2: `Light Correction` *Web Page*

The result of the referencing is stored.

5.3.2 Video Signal, Edge Detection

► Under “Chart type”, click on `Video`; see figure.

The chart displayed in the large chart area on the right shows the video signal of the receiver line. The video signal in the chart area shows the intensity distribution over the pixels of the receiver line. Left 0 % (direction: mounting rail or start of measuring range) and right 100 % (direction: end of measuring range).

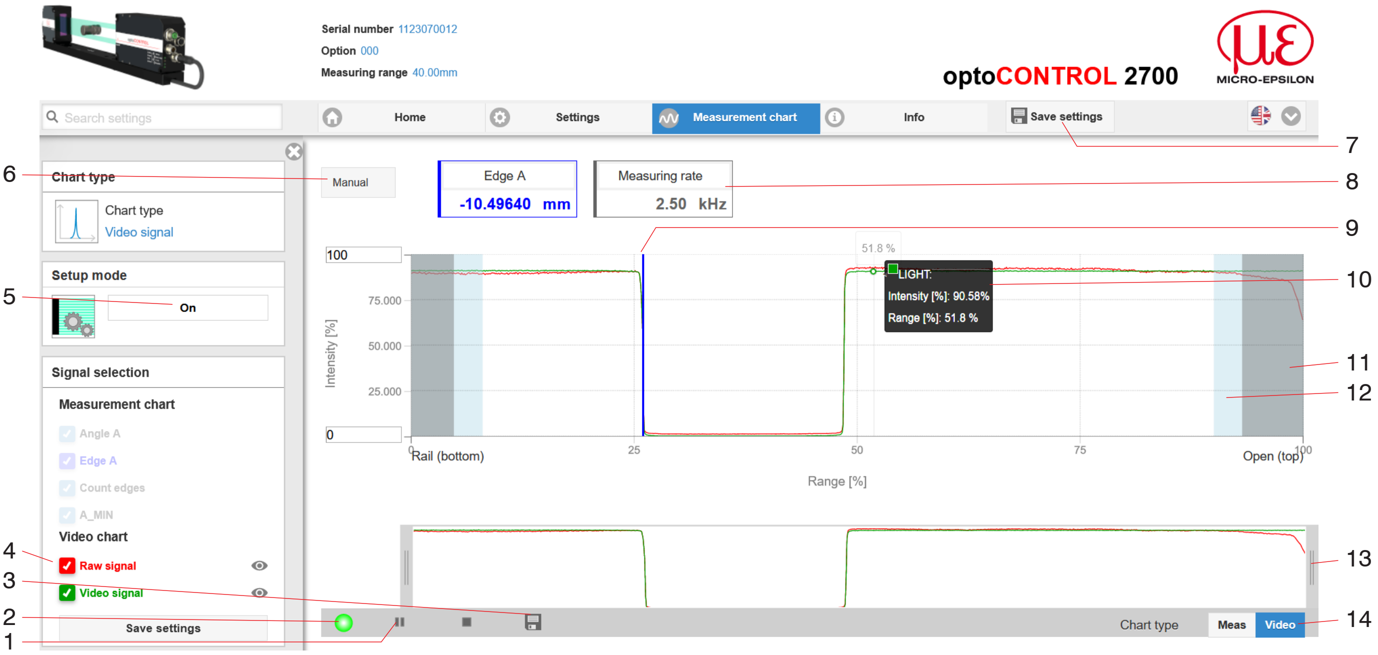


Fig. 5.3: `Video` *Web Page*

The video signal web page contains the following functions:

1 `Start`, `Pause`, and `Stop` buttons for controlling a video signal measurement.
`Stop` stops the diagram; you can still continue to use the data selection and zoom functions.
`Start` initiates display of the video signal.
`Pause` pauses the recording.

2 Status indicator:

- Green: OK, data transmission active
- Yellow: Chart stopped
- Red: Faulty sensor connection

3 The Save button can be used to save the displayed measurement curves in CSV format (timestamp and measured values). Pressing it opens the Windows dialog for selecting the file name and save location.

4 The video curves to be displayed can be switched on or off during or after the measurement. Inactive curves are grayed out.

5 Positioning aid in setup mode.

6 Scaling of the intensity axis (Y axis) in the graph

- `Auto` = automatic scaling
- `Manual` = manual scaling

7 All changes only become effective when you click on the `Save settings` button.

8 The current values and selected measuring rate are shown in addition in the text boxes above the graph.

9 The edges of relevance to the selected measuring program are marked with a vertical bar that is color-coded to match the segment. This makes it possible to identify the respective segment edges in the video signal. The search direction determines the edge order.

10 Mouseover function. Moving the mouse over the graph, marks curve points or the peak marking with a circle symbol and displays the corresponding intensity. The corresponding x-position in % appears above the graph field.

11 The linearized range lies between the gray shades in the diagram and cannot be changed. Only peaks whose middles lie within this range can be calculated as a measured value.

12 The evaluation range (ROI) can be restricted if necessary and is then limited by additional light blue shading on the right and left. The peaks remaining in the resulting range are used for the evaluation.

13 X axis scaling: The diagram shown above can be enlarged (zoomed in on) with the two sliders on the right and left in the lower entire signal. It can also be moved sideways with the mouse in the middle of the zoom window (four-sided arrow).

14 Chart type selection: Measurement or video signal display.

The following measurement was performed using the `multi-segment` program. The segment definition can be used to select specific areas of a target for evaluation. Within this context, one segment can span several edges; the color-coded highlighting of the edges enables you to identify them rapidly in the video signal.

Fig. 5.4: Video Signal with Defined Segments

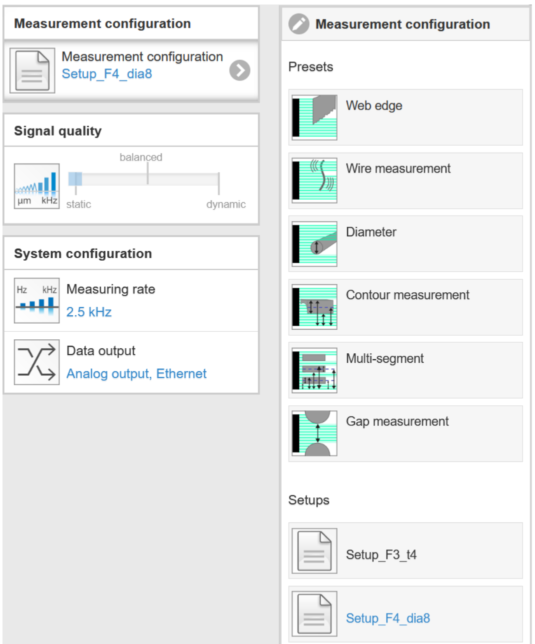
5.4 Presets, Setups, Measurement Configuration Selection

Definition

- Preset: Manufacturer-specific program containing settings for common measuring tasks that cannot be overwritten
- Setup: User-specific program containing the relevant settings for a measuring task
- Initial setup on booting (sensor startup): A favorite setting can be selected from the setups for automatic activation on sensor startup. If no favorite has been identified from the setups, the sensor starts with the most recently saved settings/setup or the sensor activates the web edge preset.

Upon delivery of the sensor from the factory:

- the web edge, wire measurement, diameter, contour measurement, multi-segment, and gap measurement presets can be used,
- but no setups are available.



You can select a preset in the tab

- `Home` > `Measurement configuration`

You can select a setup in the tab

- `Home` > `Measurement configuration`
- `Settings` in the menu `System settings > Load & Save` > `Saved measurement settings`

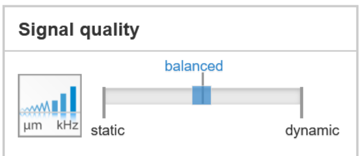
A maximum of 8 setups can be permanently saved in the sensor.

Fig. 5.2: Excerpt from Web Interface, Home Tab

For all presets, the averaging function can be customized for the measurement task by moving the `Signal quality` slider control.

In the signal quality section, you can switch between three basic settings (static, balanced, or dynamic). The reaction in the chart and system configuration is immediately visible.

i If the sensor starts up with a set of user-specific measurement settings (a setup), the signal quality cannot be changed.



Preset	Averaging, measuring rate	
Web edge	Static	Moving with 8 values; 2.5 kHz
	Balanced	Moving with 8 values; 2.5 kHz
	Dynamic	Moving with 8 values; 2.5 kHz
Wire measurement	Static	Moving with 128 values; 5 kHz
	Balanced	Moving with 64 values; 5 kHz
	Dynamic	Median with 9 values; 5 kHz
Diameter	Static	Moving with 128 values; 2.5 kHz
	Balanced	Moving with 64 values; 2.5 kHz
	Dynamic	Median with 9 values; 2.5 kHz
Contour measurement	Static	Moving with 128 values; 2.5 kHz
	Balanced	Moving with 64 values; 2.5 kHz
	Dynamic	Median with 9 values; 2.5 kHz
Multi-segment	Static	No averaging; measuring rate 2 kHz `Thickness` calculation function `Thickness` = center of segment 2 - center of segment 1
	Balanced	
	Dynamic	
Gap measurement	Static	Moving with 128 values; 2 kHz
	Balanced	Moving with 64 values; 2 kHz
	Dynamic	Median with 9 values; 2 kHz

i After parameterization, permanently save all settings in a parameter set so that they will be available again the next time you switch on the sensor. To do this, use the `Save settings` button.

5.5 Setup Mode

In setup mode, the two-dimensional video signal of the receiver line is displayed.

Advantages of setup mode:

- Helps to position the target within the measuring range
- Horizontal and vertical guide lines with a grid spacing of 0.5 mm
- Decision-making aid for assessing edge profiles
- Measuring range in Z direction with ±5 mm

You can access setup mode via the menu `Measurement chart` > `Setup mode`.

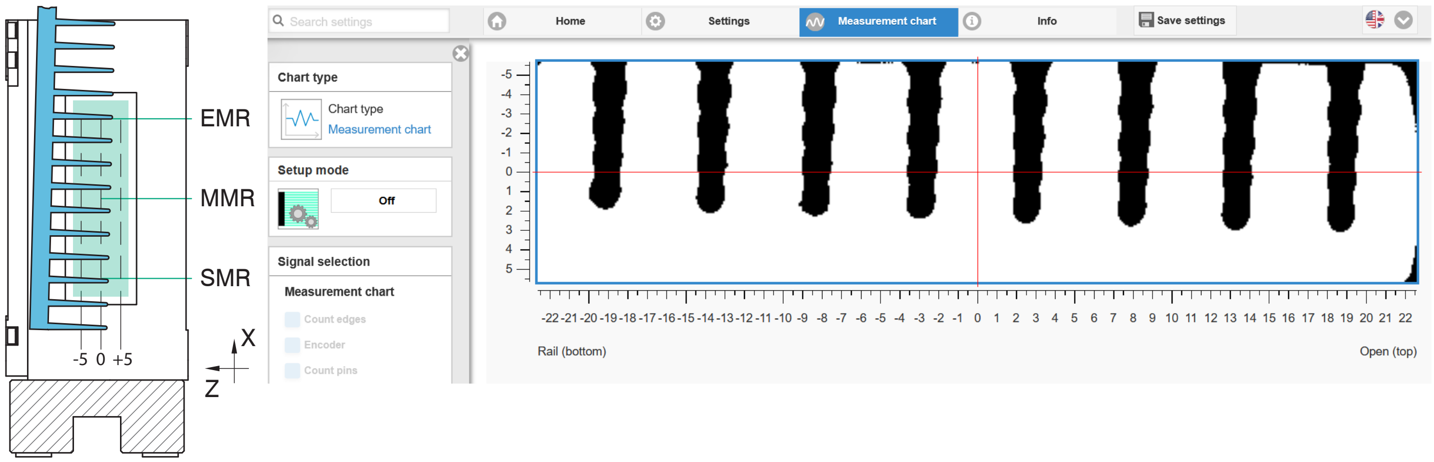


Fig. 5.3: Tilted Fin Profile (Left) and Associated Video Signal (Right), Viewed in Direction of Light Source

5.6 Measurement Chart

The following description is based on the `multi-segment` measuring program.

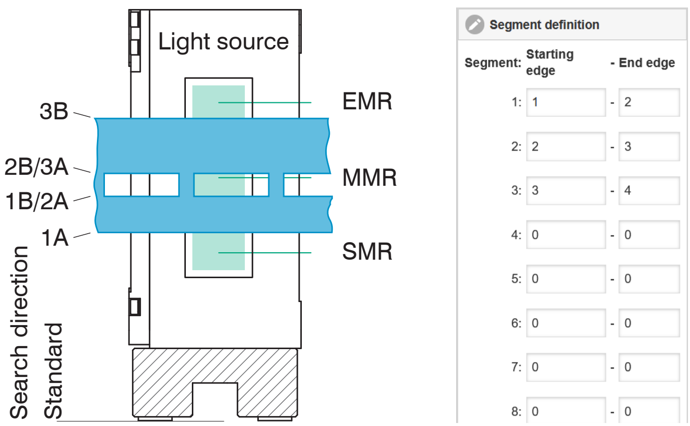


Fig. 5.4: Punching Profile with Edge Assignment (Left) and Associated Definition of Segments (Right), Viewed in Direction of Light Source

► Use the `Measurement chart` tab to start displaying measured values.

► Under “Chart type”, click on `Measurement`; see figure.

The chart displayed in the large chart area on the right shows the desired measured values as a function of time.

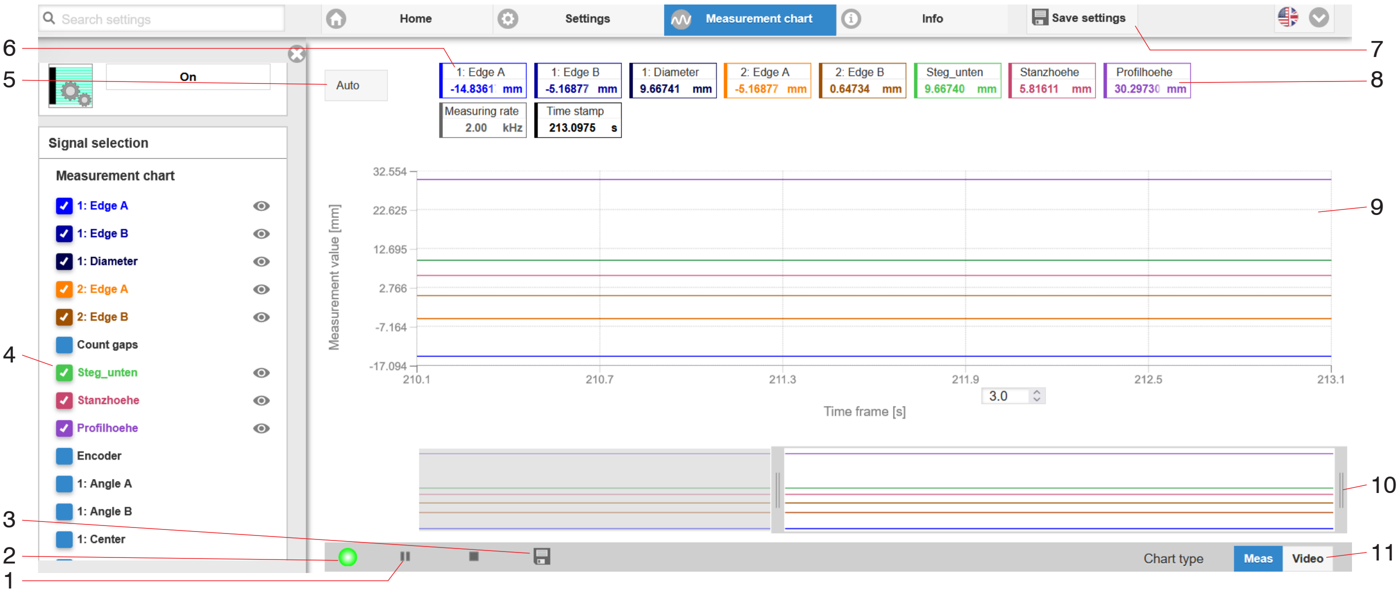


Fig. 5.5: `Measurement` *Web Page*

The measurement chart web page contains the following functions:

1 `Start`, `Pause`, and `Stop` buttons for controlling display of the measured values.
`Stop` stops the diagram; you can still continue to use the data selection and zoom functions.
`Start` initiates display of the measured values.
`Pause` pauses the recording.

2 Status indicator:
- Green: OK, data transmission active
- Yellow: Chart stopped
- Red: Faulty sensor connection

3 The Save button can be used to save the displayed measurement curves in CSV format (timestamp and measured values). Pressing it opens the Windows dialog for selecting the file name and save location.

4 The measured values to be displayed can be switched on or off during or after the measurement. Inactive curves are grayed out.
All changes only become effective when you click on the `Save settings` button.

5 Scaling of the measured value axis (Y axis) in the graph
- `Auto` = automatic scaling
- `Manual` = manual scaling

6 Segment number

7 All changes only become effective when you click on the `Save settings` button.

8 The current values, selected measuring rate, and a timestamp are shown in addition in the text boxes above the graph.

9 Mouseover function. When the chart has been stopped and you move the mouse over the graph, points on the curve are marked with a circle and the associated values are displayed in the text boxes above the graph.

10 X axis scaling: The diagram shown above can be enlarged (zoomed in on) with the two sliders on the right and left in the lower entire signal. It can also be moved sideways with the mouse in the middle of the zoom window (four-sided arrow).

11 Chart type selection: Measurement or video signal display.

6 Advanced Settings

6.1 Preliminary Remarks Concerning the Setting Options

You can parameterize the sensor in various ways:

- Using the web browser and sensor web interface
- Using the ASCII command set and terminal program via RS422

The following sections describe how to make the sensor settings using the web interface.

6.2 Inputs

6.2.1 Synchronization

If two or more sensors are to measure the same target at the same time, the receivers can be synchronized with one another. The synchronization output of the first sensor (= master) is connected to the synchronization inputs of other sensors (= slaves).

The feature for synchronizing multiple sensors is used when measuring the thickness/width of larger targets, for example.

Synchronization	*Master*	*With this setting, the sensor is the master, i.e., it outputs synchronization pulses at the Sync connections.*
	Slave Sync/Trig	*With this setting, the sensor is the slave and waits for synchronization pulses – e.g., from another ODC2700 or a similar pulse source – at the Sync connections.*
	Slave TrigIn	*With this setting, the sensor is the slave. The synchronization signal is received via the Trigger interface. You can select HTL or TTL level.*
	Inactive	*No synchronization. The sensor works autonomously. No synchronizing signal is output via the bidirectional synchronizing line.*

Selecting Synchronization

- ► Switch to the tab `Settings` > `Inputs` > `Synchronization`.
- ► Make the desired settings and confirm them by pressing `Save settings`.

Notes about electrical connection are available in the “Installation and Assembly” section, see Chap. 4.3.10.

6.2.2 Input level

This menu item defines the logic level of the multifunction inputs, see Chap. 4.3.7.

In this way, different output levels of encoders or of a trigger level can be adjusted to match the sensor.

Input level	*TTL*	*Low ≤ 0.8 V, High ≥ 2 V*
	HTL	*Low ≤ 3 V, High ≥ 8 V*

Selecting the Input Level

- ► Switch to the tab `Settings` > `Inputs` > `Input level`.
- ► Make the desired settings and confirm them by pressing `Save settings`.

6.2.3 Encoder

6.2.3.1 Overview

The values of an encoder can be assigned to the measurement data exactly, output, and also used as a triggering condition. This exact assignment to the measured values is ensured by the fact that precisely those encoder values are output that were present in half of the exposure time of the measured value; the exposure time can vary due to the regulation process. Tracks A and B enable direction recognition.

Encoder input	Interpolation (depth)	*single / double / quadruple resolution*	*Track A, B: Interpolation increases the resolution of an encoder. The counter reading is incremented or decremented with each interpolated pulse edge.*
	Maximum Value	*Value*	*When the maximum value is exceeded, the encoder starts again at zero. This could be the pulse count of a rotary encoder without a reference track, for example.* *Value range of 1 ... 4294967295*
	Effect on Reference Track	*No effect / Set to value once for mark / Set to value for all marks*	*No effect: The encoder counter keeps on counting; resetting takes place when the sensor is switched on or when the "Set to value" button is pressed.* *Set to value once for mark: Sets the encoder counter to the defined value when the first reference marker is reached. The applicable mark is the first one after sensor switch-on.* *Set for all marks: Sets the encoder counter to the start value in the case of all marks.*
	Set to Value	*Value*	*Value range of 0 ... 4294967294*
	Set encoder value via software		
	Reset the detection of the first reference mark		

Selecting the Encoder Setting

- Switch to the tab `Settings` > `Inputs` > `Encoder inputs`.
- Make the desired settings and confirm them by pressing `Save settings`.

6.2.3.2 Interpolation

Interpolation increases the resolution of an encoder. The counter reading is incremented or decremented with each interpolated pulse edge.

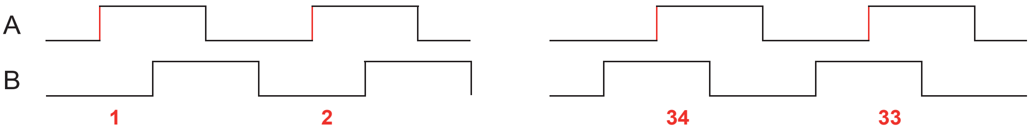


Fig. 6.1: Encoder Signal Pulse Image, Single Resolution, Add Up (Left), Decrease (Right)

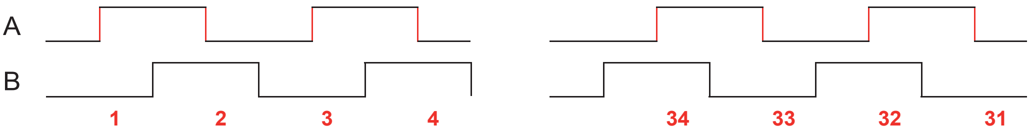


Fig. 6.2: Encoder Signal Pulse Image, Single Resolution, Add Up (Left), Decrease (Right)

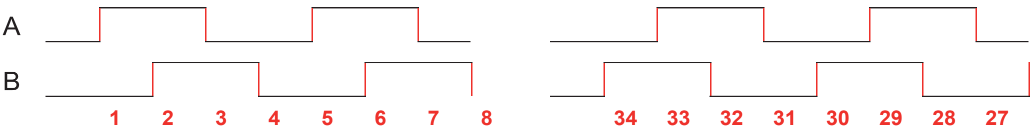


Fig. 6.3: Encoder Signal Pulse Image, Quadruple Resolution, Add Up (Left), Decrease (Right)

6.2.3.3 Effect of Reference Track

`No effect`. The encoder counter keeps on counting; the resetting takes place when the sensor/controller is switched on or when the `Set to value` button is pressed.

`Set to value once for mark`. Sets the encoder counter to the defined value when the first reference marker is reached. The applicable mark is the first one after sensor/controller switch-on.

`Set for all marks`. Sets the encoder counter to the start value in the case of all marks.

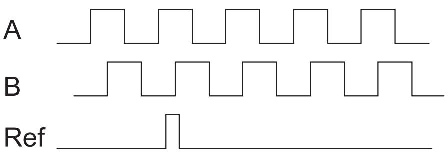


Fig. 6.4: Reference Signal of an Encoder

6.2.3.4 Set to Value

This function sets the encoders to this value

- every time the controller is switched on,
- with the Set to value button.

The start value must be less than the maximum value and is max. 4,294,967,294 (2^32-2).

6.2.3.5 Reset Reference Marker

Resets the reference marker detection.

6.2.4 Digital Input Assignment

This menu item assigns the encoder track or a trigger function to the multifunction inputs, see Chap. 4.3.7.

The integrated logic makes the assignment process easier. This ensures that the selection options can be assigned to a multifunction input only once.

- Track A / Track B / Reference track
- Trigger

Digital input assignment	Digital input 1 Digital input 2 Digital input 3	*Encoder track A / Track B / Reference track / Trigger*

If a reference track is required for the encoder, it is not possible to use the “trigger via multifunction inputs” function.

Selecting Digital Inputs

► Switch to the tab `Settings` > `Inputs` > `Digital input assignment`.

► Make the desired settings and confirm them by pressing `Save settings`.

6.3 Data Recording

6.3.1 Measuring Line Width

The width of the measuring line can be adapted to the requirements of the measurement task. One pixel corresponds to approx. 22 µm.

- Narrow measuring line: Measurements close to steps

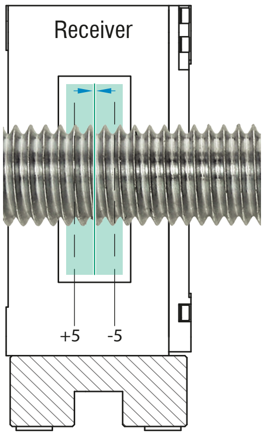


Fig. 6.5: Narrow Measuring Line for Measurements on Steep Edges and Corners, e.g., for Measurements on Threaded Rods

- Wide measuring line: Reduces signal noise

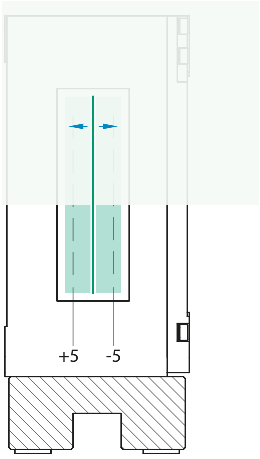


Fig. 6.6: Wide Measuring Line, e.g., Edge Tracing on a Paper Web

Changing the Width of the Measuring Line

► Switch to the tab `Settings` > `Data acquisition` > `Measuring line width` and select a suitable width for the measurement task.

6.3.2 Measuring program

Initial setup on booting (sensor startup): A favorite setting can be selected from the setups for automatic activation on sensor startup. If no favorite has been identified from the setups, the sensor starts with the most recently saved settings/ setup or the sensor activates the web edge preset.

Preset	Active Tilt correction	Measuring program	Search direction	Measurement direction
Strip edge	No	Falling edge	Standard	Standard
Wire measurement Diameter Contour measurement	Yes	Diameter		
Multi-segment	Yes	Segment		
Gap measurement	Yes	Gap		

Fig. 6.1: Overview of factory settings for the presets and their measuring program

Selecting preset or setup

- Switch to the `Home` > `Measurement configuration` tab and select a preset or individual setup suitable for the measurement task.

Here you can adapt a measuring program.

Measuring program	Search direction Standard	Search direction Reverse
Falling edge	Sensor searches for a light-dark transition, start is SMR	Sensor searches for a light-dark transition, start is EMR
Rising edge	Sensor searches for a dark-light transition, start is SMR	Sensor searches for a dark-light transition, start is EMR
Diameter	Sensor searches for the first light-dark and the last dark-light transition, start is SMR	Sensor searches for the first light-dark and the last dark-light transition, start is EMR
Gap	Sensor searches for the first dark-light and the next light-dark transition, start is SMR	Sensor searches for the first dark-light and the next light-dark transition, start is EMR
Segment	Sensor searches for all dark-light and light-dark transitions, start is SMR	Sensor searches for all dark-light and light-dark transitions, start is EMR

Fig. 6.2: Edge assignment for the measuring programs

Don't forget to save!

- Save individual adjustments to the measurement programs in a setup, see Chap. 6.7.2.

6.3.2.1 Search Direction and Edge Order, Examples

The search direction determines the edge numbering/order.

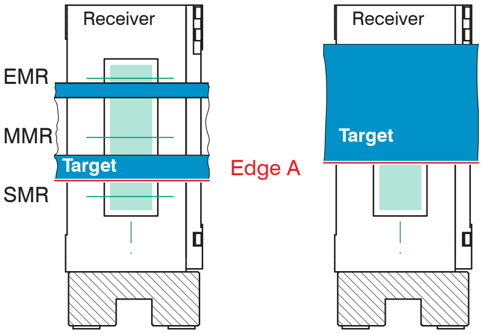
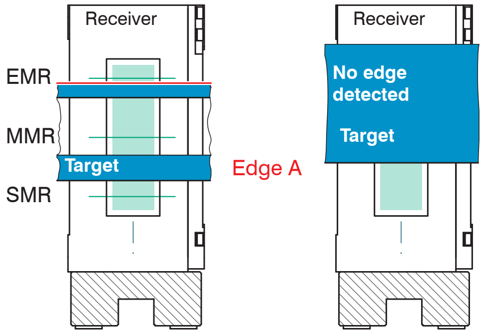
Measuring program	Standard search direction	Inverse search direction
Falling edge	 Sensor searches for a light-dark transition, start is SMR	 Sensor searches for a light-dark transition, start is EMR

Fig. 6.3: Edge Assignment for Falling Edge Measuring Program, Examples

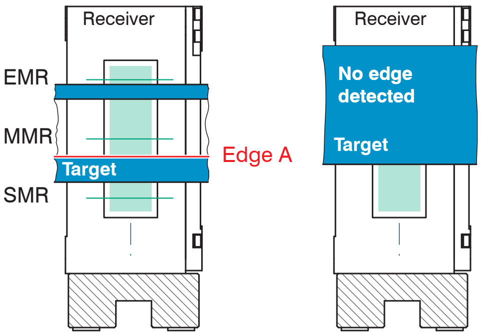
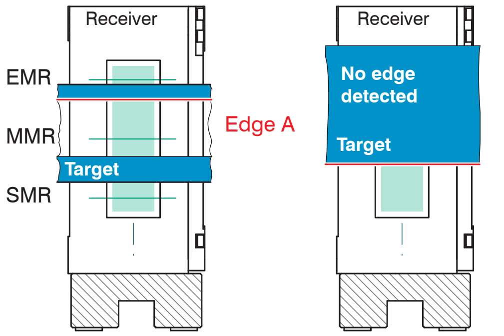
Measuring program	Standard search direction	Inverse search direction
Rising edge	 Sensor searches for a dark-light transition, start is SMR	 Sensor searches for a dark-light transition, start is EMR

Fig. 6.4: Edge Assignment for Rising Edge Measuring Program, Examples

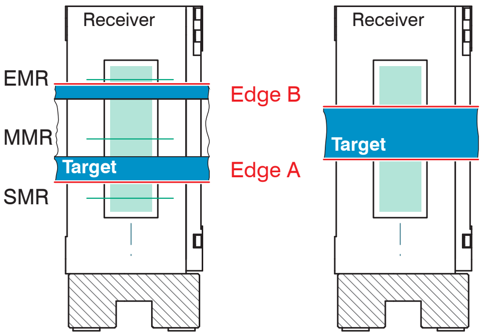
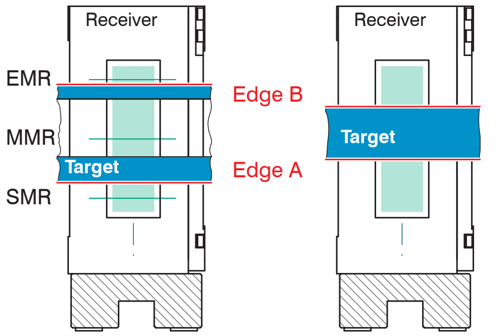
Measuring program	Standard search direction	Inverse search direction
Diameter	 Sensor searches for the first light-dark transition and the last dark-light transition, start is SMR	 Sensor searches for the first light-dark transition and the last dark-light transition, start is EMR

Fig. 6.5: Edge Assignment for Diameter Measuring Program, Examples

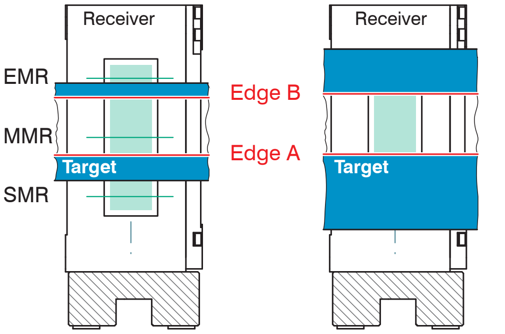
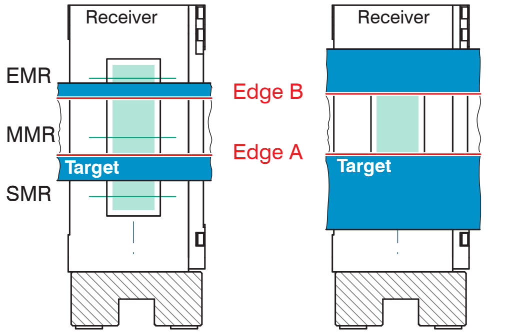
Measuring program	Standard search direction	Inverse search direction
Gap	 Sensor searches for the first dark-light transition and the next light-dark transition, start is SMR	 Sensor searches for the first dark-light transition and the next light-dark transition, start is EMR

Fig. 6.6: Edge Assignment for Gap Measuring Program, Examples

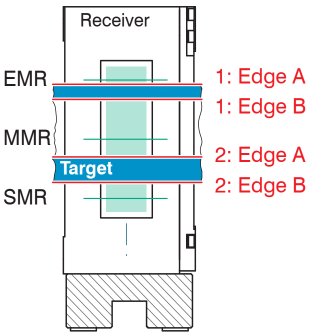
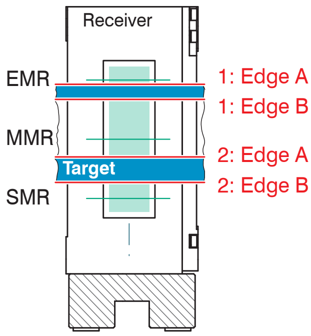
Measuring program	Standard search direction	Inverse search direction
Segment	 Sensor searches for all dark-light and light-dark transitions, start is SMR	 Sensor searches for all dark-light and light-dark transitions, start is EMR

Fig. 6.7: Edge Assignment for Segment Measuring Program, Examples

6.3.2.2 Measurement Direction

The measurement direction determines the reference point for the measured value. The reference point is the mid point of the measuring range (MMR).

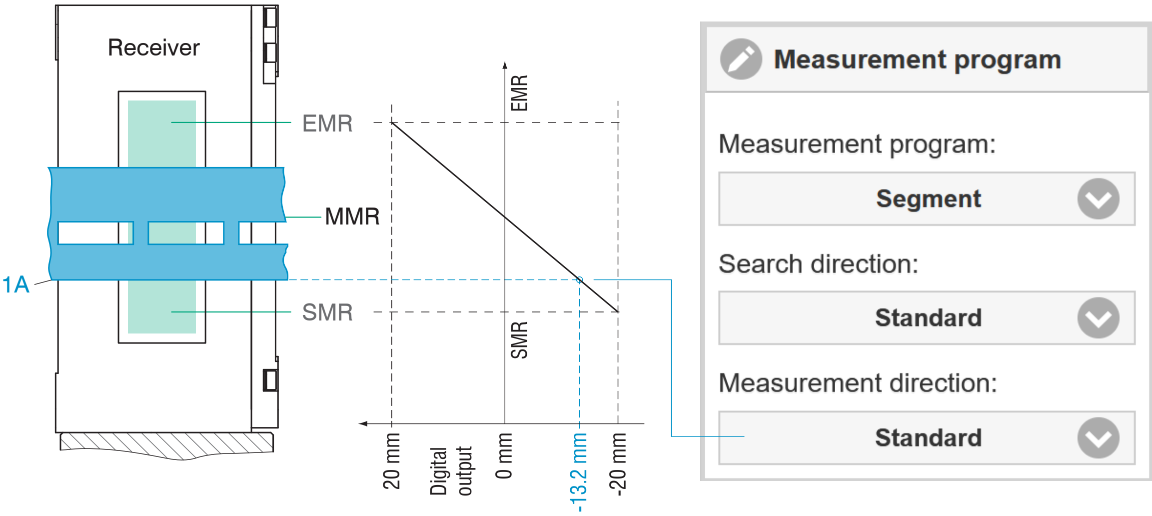


Fig. 6.7: Digital Output with Standard Measurement Direction

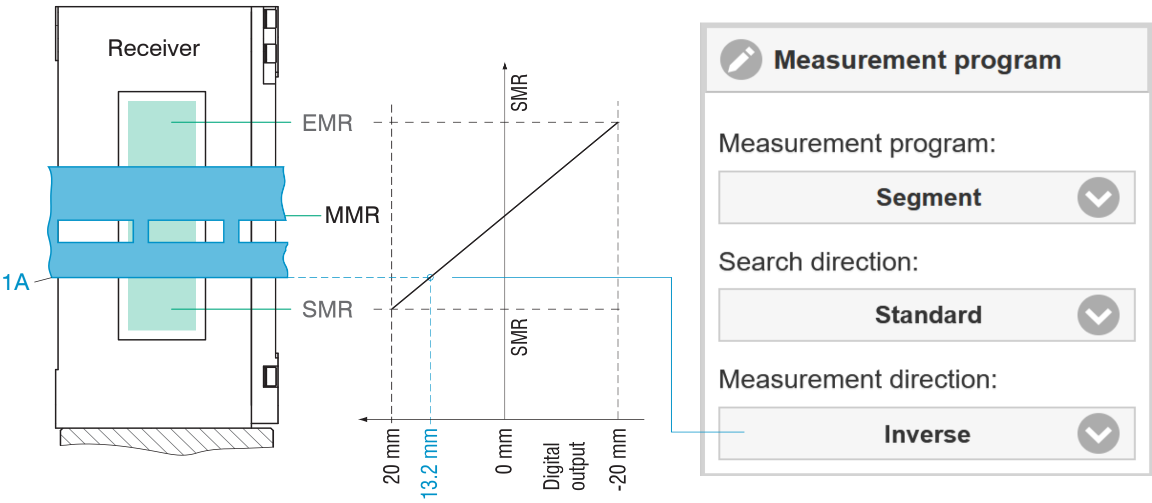


Fig. 6.8: Digital Output with Inverse Measurement Direction

6.3.3 Defining segments

This function is possible in conjunction with the Multi-segment preset and setups derived from it.

The detection of four edges is factory-set, see figure.

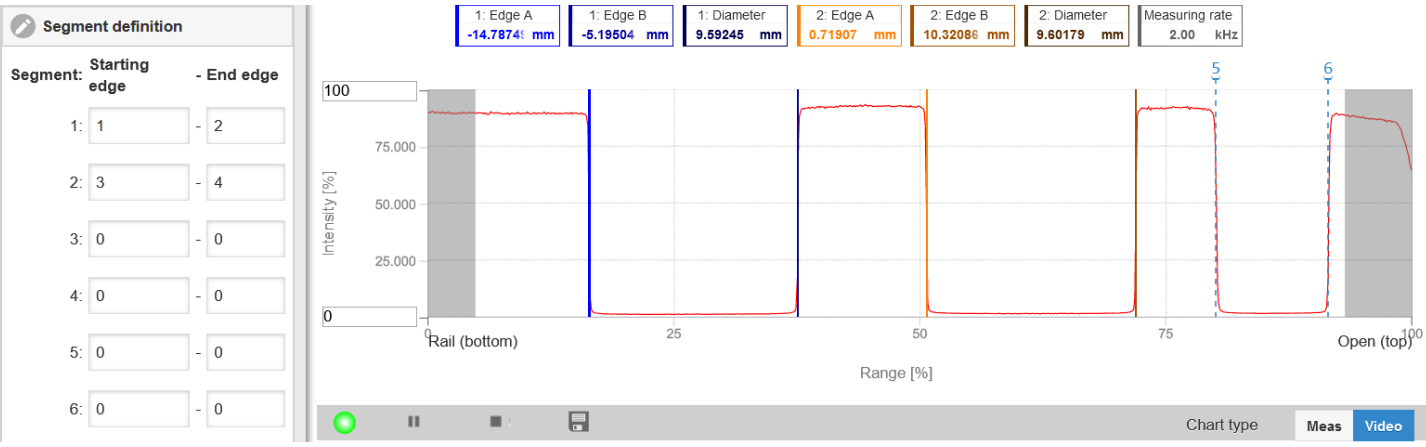


Fig. 6.9: Factory-set segment definition in the multi-segment preset

Measuring object with fewer than four edges: unused text boxes contain "No peak".

Measuring object with more than four edges: additional edges are numbered in the video signal with vertical, blue peak markers.

A maximum of 8 segments or 16 edges can be defined. Edge 1 is the edge that the sensor finds in the standard search direction (from the start of the measuring range). Further edges are numbered in ascending order. Edge 0 is the start of the measuring range. A 0-0 segment is ignored.

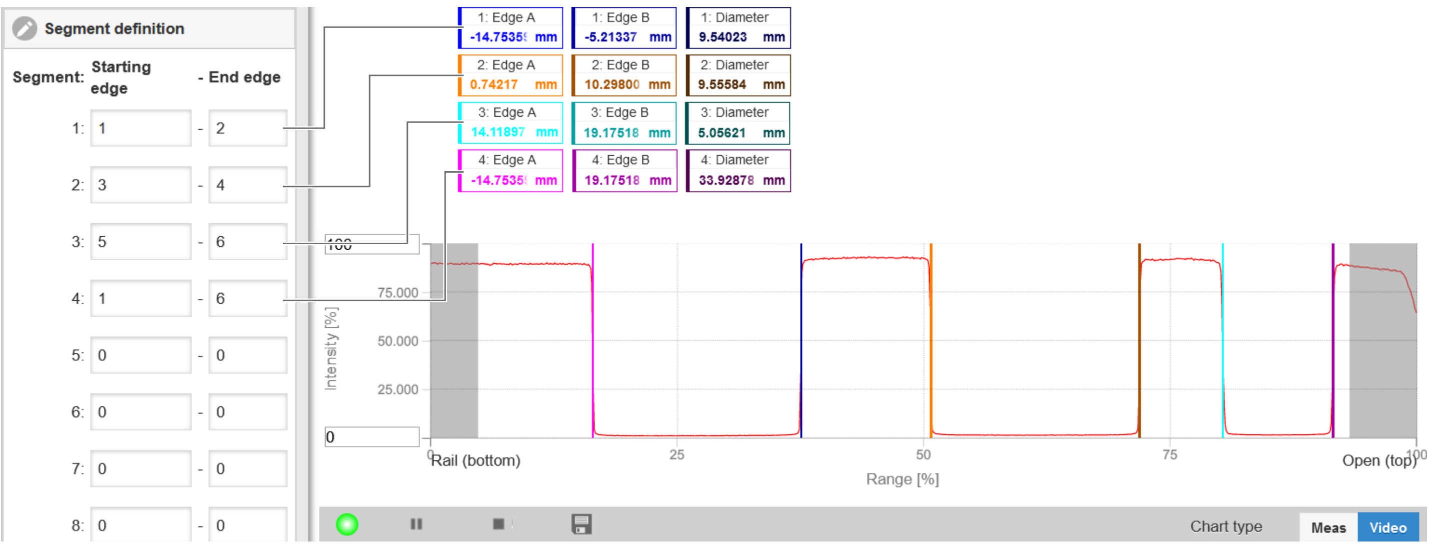


Fig. 6.10: Individual segment definition

Segment definition process

- ► Switch to the tab `Settings` > `Data acquisition` > `Segment definition`.
- ► Define the edge references to suit your measuring object.
- ► Save the resulting setup under a new name.

6.3.4 Measuring Rate

The maximum sampling rate is 15 kHz.

The selection of the measuring rate is made in the menu `Settings > Data recording > Measuring rate`. The measuring rate is continuously adjustable within a range from 0.1 kHz to 5 kHz. The increment is 1 Hz.

Changing the Measuring Rate

- Switch to the tab `Settings > Data acquisition > Measuring rate`.
- Select the desired measuring rate.

Observing the video signal is useful for selecting the measuring rate.

If the video signal or the setup signal is output via an interface, the measuring rate is reduced to 100 Hz.

6.3.5 Frame Averaging

Frame averaging is activated by default (= `ON`). It provides an optimum signal-noise ratio.

ON: Several video recordings are created, averaged, and undergo further processing.

OFF: One video recording is created and undergoes further processing. This is necessary for fast-moving targets.

Deactivating Frame Averaging

- Switch to the tab `Settings > Data acquisition > Frame averaging`.
- For fast-moving objects, switch frame averaging off (= `OFF`).

When operating without the frame averaging function, the sensor automatically varies the exposure time for the line scan camera.

6.3.6 Counter Reset

You can reset the measured value counter or the timestamp by pressing the relevant button.

Counter Reset Procedure

- Switch to the menu `Settings > Data acquisition > Counter reset` and click on the relevant button.

6.3.7 Region of interest

The region of interest can be set individually in the sensor. Masking limits the evaluating range (ROI - Region of Interest) for the edge detection and thus the distance calculation in the video signal. This function is used, for example, to suppress interfering edges. Masking (start and end) is entered into the two boxes on the left (in %). The factory settings are 0 % (start) and 100 % (end).

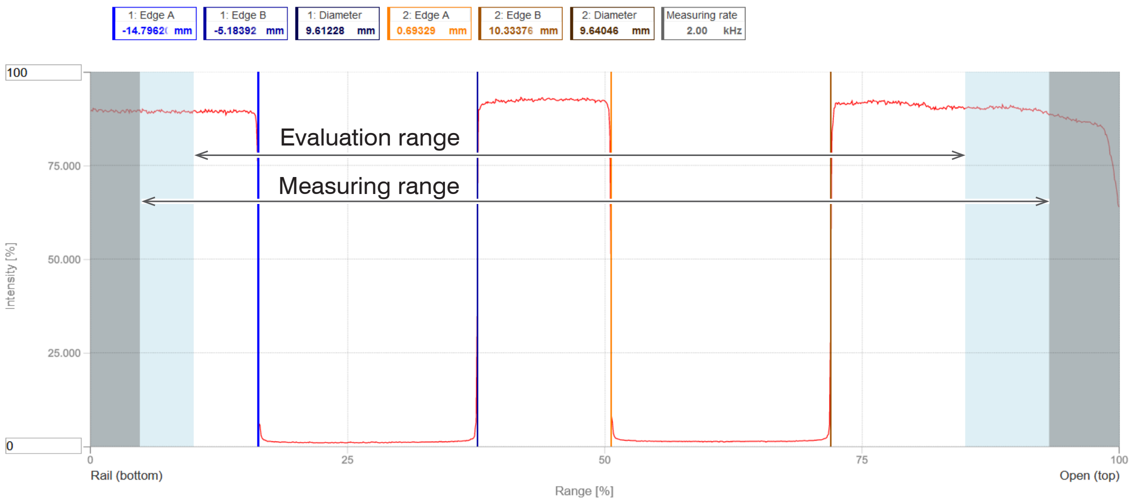


Fig. 6.11: Limiting the video signal used

Help text: Region of interest (ROI). The range of interest can be restricted if, for example, ambient light of a certain wavelength (blue, red, IR) causes interference in the video signal. The value for the "Start of range" must be smaller than the value for the "End of range". Value range from 0 ... 100 %.

Region of interest (ROI)	Start of range	*Value*	*Value range from 0 ... 100 %. The value for the "Start of range" must be smaller than the value for the "End of range".*
	End of range	*Value*	

Defining the region of interest

- Go to the tab `Settings` > `Data acquisition` > `Evaluation range (ROI)`.
- Make the desired settings and confirm them by pressing `Save settings`.

6.3.8 Edge Filter

The purpose of an edge filter is to suppress the overshooting of measured values in the context of rising edge transitions. The upper threshold activates the edge filter once. The lower threshold deactivates the filter and resets it so that it can be reactivated again the next time the upper threshold is exceeded. This filter should be applied with care because it can distort the measurement if used incorrectly.

The edge filter outputs the last value that was below the upper limit.

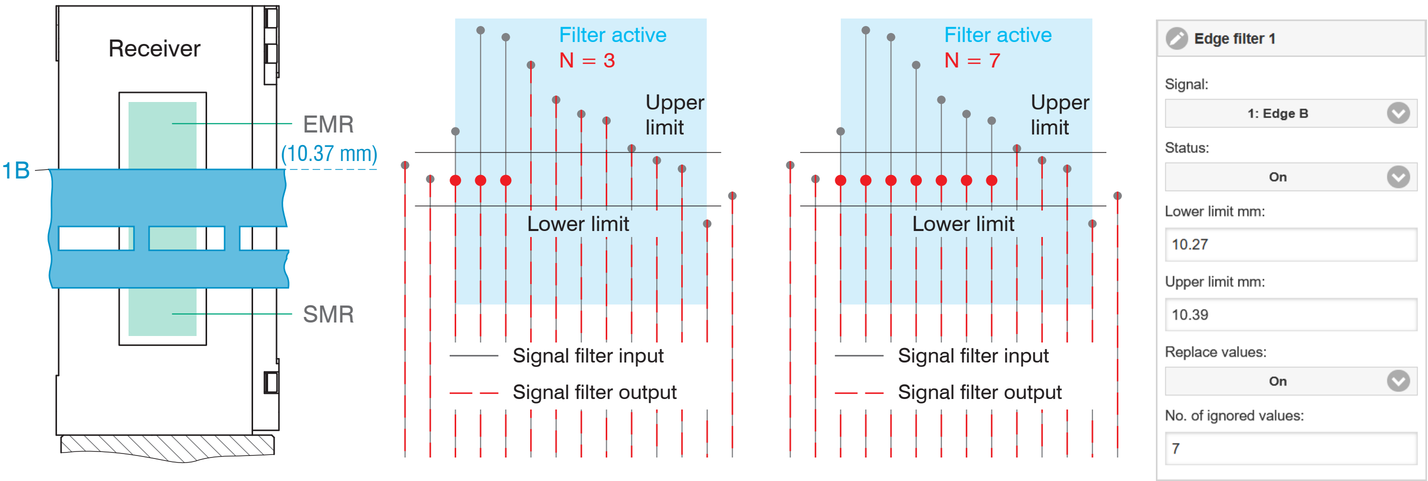


Fig. 6.12: Number of Ignored Values N Is Too Small, Minor Overshoot Remains (Left), N Set to the Ideal Value (Right)

Defining the Edge Filter

- Switch to the tab `Settings` > `Data acquisition` > `Edge filter`.
- Make the desired settings and confirm them by pressing `Save settings`.

6.3.9 Error Handling

If no valid measured value can be determined, an error is output. Alternatively, if this interferes with further processing, the last valid value can be held, i.e. output repeatedly, for a certain amount of time.

Error Handling	*Error output, no measured value*	*Interfaces output an error instead of a value.*	
	Hold last value infinitely	*Interfaces output the last valid value until a new, valid measured value is available.*	
	Hold last value	*Value*	*Possible number of values to be maintained between 1 and 1024. When number = 0, the last value is maintained until a new, valid measured value becomes available.*

Defining Error Handling

- Switch to the tab `Settings` > `Data acquisition` > `Error handling`.
- Make the desired settings and confirm them by pressing `Save settings`.

6.3.10 Triggering for Data Acquisition

6.3.10.1 General

The acquisition and output of measured values by the sensor can be controlled using an external electrical trigger signal or commands.

- The triggering does not affect the preselected measuring rate.
- The Sync/Trig inputs or multifunction inputs (TrigIn) are used as external trigger inputs, see Chap. 4.3.4.
- Factory setting: No triggering, the sensor starts transmitting data immediately after being switched on.
- The duration of the trigger signal pulse is at least 5 s.

<table>
<tr><td rowspan="4">Sync/Trig / TrigIn</td><td rowspan="4">Trigger type</td><td>Level</td><td>Trigger level</td><td colspan="2">High / Low</td></tr>
<tr><td rowspan="3">Edge</td><td>Trigger level</td><td colspan="2">Falling edge / rising edge</td></tr>
<tr><td rowspan="2">Number of measured values</td><td>Manual selection</td><td>Value</td></tr>
<tr><td colspan="2">Infinite</td></tr>
<tr><td colspan="3" rowspan="2">Software</td><td rowspan="2">Number of measured values</td><td>Manual selection</td><td>Value</td></tr>
<tr><td colspan="2">Infinite</td></tr>
<tr><td colspan="3" rowspan="3">Encoder</td><td colspan="2">Lower limit</td><td>Value</td></tr>
<tr><td colspan="2">Upper limit</td><td>Value</td></tr>
<tr><td colspan="2">Increment</td><td>Value</td></tr>
</table>

Inactive

When `Inactive` is selected, measured values are acquired/output continuously.

Notes on Triggering

`Level triggering`. Continuous measured value acquisition/output as long as the selected level is present. After that, the controller stops the data acquisition/output. The pulse duration must be at least as long as one cycle. The subsequent pause must also be at least as long as one cycle.
S = displacement signal

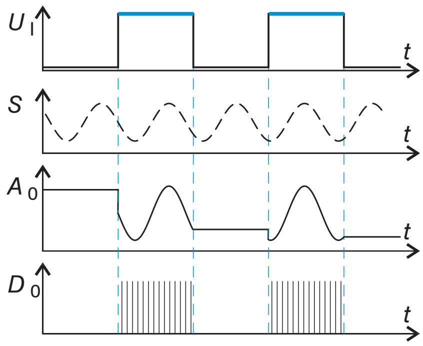


Fig. 6.13: Triggering with active high level (U_I), associated analog signal (A_O) and digital signal (D_O)

`Edge triggering`. Starts measured value input/output as soon as the selected edge is active to the trigger input. The pulse must be at least 5 µs.
S = displacement signal

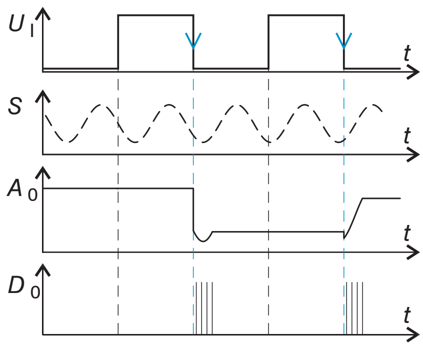


Fig. 6.14: Triggering with falling edge (U_I), associated analog signal (A_O) and digital signal (D_O)

`Software triggering`. Starts data recording as soon as a software command (instead of the trigger input) or the `Initiate trigger` button is activated.

`Encoder triggering`. Starts data acquisition/output via the encoder input.

Defining Triggering

- Switch to the tab `Settings` > `Data acquisition` > `Triggering`.
- Make the desired settings and confirm them by pressing `Save settings`.

6.3.10.2 Triggering for Measured Value Acquisition

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

When calculating averages or statistics, measured values immediately before the trigger event cannot be included; instead, the calculation incorporates older measured values that were captured during previous trigger events.

6.3.10.3 Example

The synchronization/triggering connections on the sensor expect RS422 levels. The following example shows a 24 V trigger source being adjusted with the SU4-1 level converter, which is available as an optional accessory.

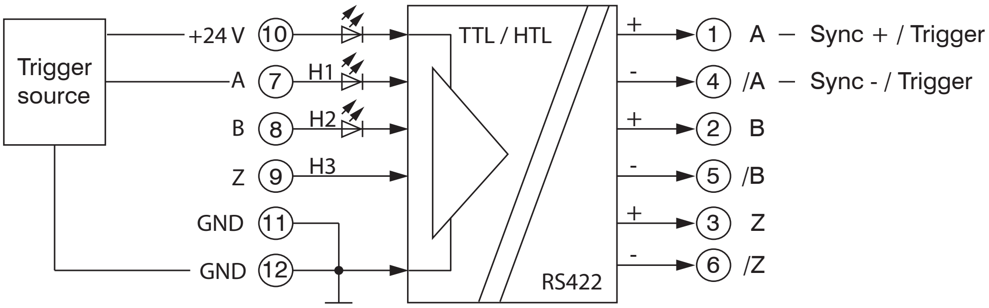


Fig. 6.15: Adjustment of the Level from HTL to RS422 Using the SU4-1 Level Converter

6.4 Signal Processing

6.4.1 Tilt Correction

The sensor detects tilted targets. The two-dimensional video signal is used to compensate for the resulting measuring errors.

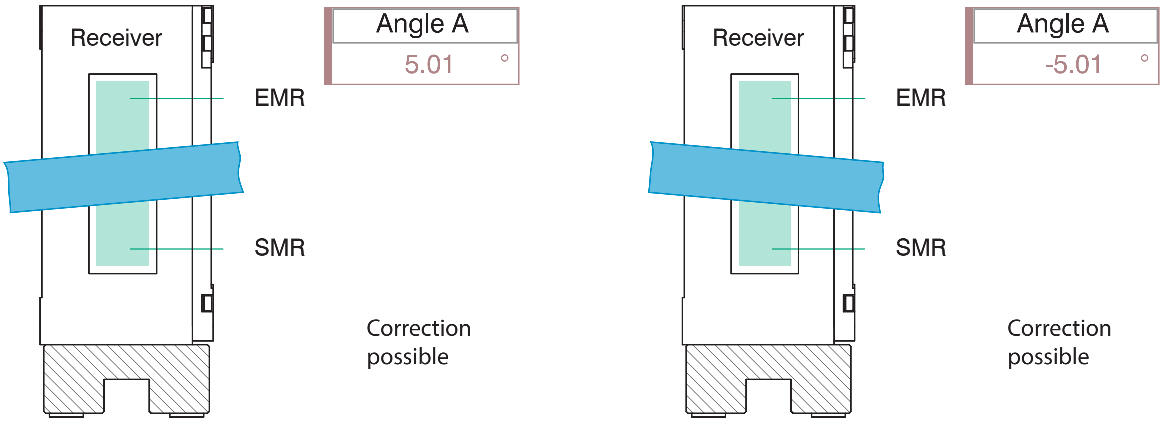


Fig. 6.8: Measurement Chart for Targets Titled Counterclockwise (Left) and Clockwise (Right)

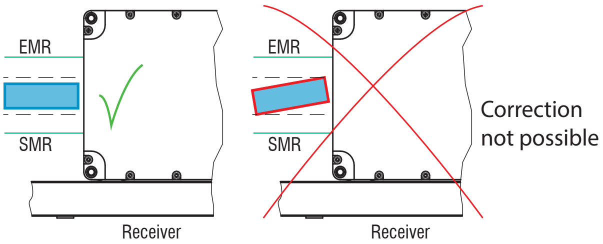


Fig. 6.16: Correct: Edges of Target Parallel with Light Curtain (Left), Incorrect Measurement Result due to Rotated Target (Right)

Upon delivery of the sensor, tilt correction is deactivated (off) by default.

Tilt correction is possible with the following presets: `wire measurement`, `diameter`, `contour measurement`, `multi-segment`, and `gap measurement`. Tilt correction is likewise possible in setups based on these.

Activating Tilt Correction

- Switch to the tab `Settings > Signal processing > Tilt correction` and select `On`.

The tilt correction function can handle a tilt angle of up to ±45° affecting the target.

6.4.2 Calculation

6.4.2.1 Data Source, Parameters, Computing Programs

One computing operation can be performed in each calculation block. The computing program, the data sources and the parameters of the computing program must be set for this.

`Median`		Signal or result Number of values
`Moving averaging`		Signal or result Number of values
`Recursive averaging`		Signal or result Number of values
`Thickness`	Calculating the difference	Signal or result Signal distance A < signal distance B
`Formula`	Distance B - distance A	
`Calculation`	Summation	Signal or result
`Formula`	Factor 1 * Distance A + Factor 2 * Distance B + Offset	
`Duplicate`		Signal or result

Fig. 6.9: Available computing programs

Completing the Calculation Function

► Switch to the tab `Settings` > `Signal processing` > `Calculation`.

Sequence for creating a calculation block:

- Select a program (1), e.g., average.
- Define the parameters (2).
- Define the data source(s) (3).
- Enter a block name (4).
- Click on the `Apply calculation` button.

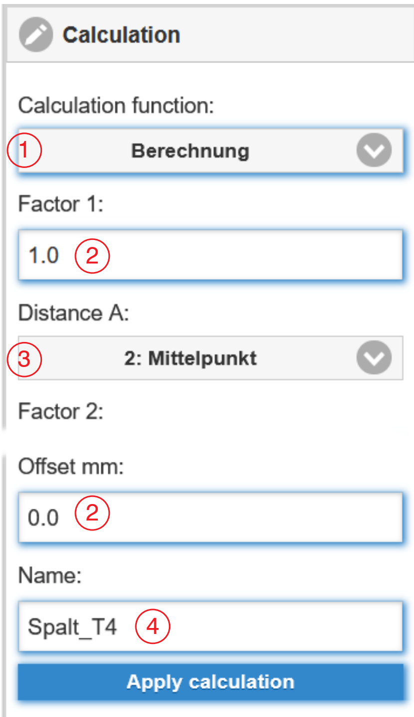


Fig. 6.10: Sequence for Program Selection

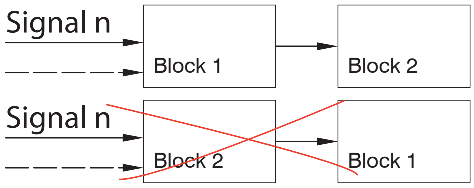
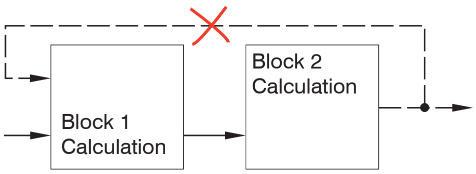
The programs calculation and thickness have two data sources. Averaging programs each have one data source.

Calculation / Thickness	Factor 1 / 2	*Value*	*-32768.0 ... 32767.0*
	Offset	*Value*	*-2147.0 mm ... 2147.0 mm*
Moving averaging / Recursive averaging / Median	Number of values	*Value*	*Moving: 2 / 4 / 8 / ... / 4096*
			Recursive: 2 ... 32767
			Median: 3/5/7/9
Duplicate		*Value*	*Name of the duplicated signal*

Fig. 6.11: Value Range of Computing Program Parameters

6.4.2.2 Definitions

Observe the following points when using the computing functions.

Signal(s)	n edge A / n edge B / ...
Max. 10 calculation blocks per channel/sensor. The calculation blocks are processed sequentially.	
Feedback couplings (algebraic loops) over one or several blocks are not possible. Only the signals or the computed results from the previous calculation blocks can be used as data sources.	
Processing sequence: 1. Determination of edges 2. Calculation of differences (diameter, gap, segments) and center axes 3. Error handling in the case of no valid measured value 4. Spike correction of measured values 5. Calculation functions (blocks) 6. Statistics	

6.4.3 Averaging

6.4.3.1 General

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

Measurement averaging

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

> i Linearity is not affected by averaging. Averaging has no effect on measuring rate and output rate. The defined type of average value and the number of values must be saved in the sensor to ensure they are maintained after it has been switched off.

Averaging is disabled by default on the sensor.

Defining Measurement Averaging

- ► Switch to the tab `Settings` > `Signal processing` > `Calculation`.
- ► Make the desired settings and confirm them by pressing `Save settings`.

6.4.3.2 Moving Average

Moving Average

The arithmetic average M_{mov} is calculated and output for a series of consecutive measured values according to the selectable filter width N. Each new measured value is added, and the first (oldest) value is removed from the averaging (from the window).

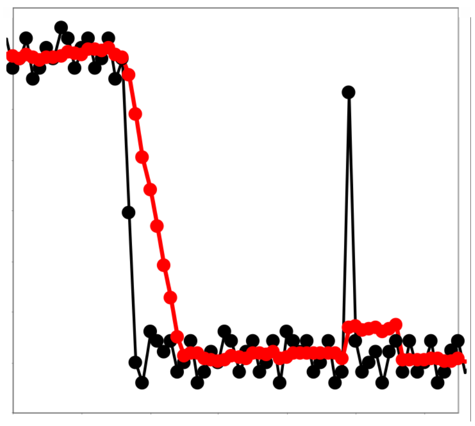
$M_{mov} = \frac{\sum_{k=1}^{N} MW(k)}{N}$	MW = measured value
	N = averaging value
	k = continuous index (in the window)
	M_{mov} = average value or output value

This produces short settling times in case of measurement jumps.

Example: N = 4

... 0, 1, 2, 2, 1, 3	... 1, 2, 2, 1, 3, 4	Measured values
$\frac{2, 2, 1, 3}{4} = M_{mov}(n)$	$\frac{2, 1, 3, 4}{4} = M_{mov}(n+1)$	Output value

Note	In the case of the moving average, only powers of 2 are permitted for the averaging value N. The highest averaging value is 512.



Application tips

- Smoothing of measured values
- In contrast to recursive averaging, the effect can be finely controlled.
- With uniform noise of the measured values without spikes
- In the case of a slightly rough surface whose roughness is to be eliminated.
- Also suitable for measured value jumps with relatively short settling times

Signal without averaging

Signal with averaging

Fig. 6.12: Moving average, N = 8

6.4.3.3 Recursive average

Recursive average

Each new measured value MW(n) is weighted and added to (n-1) times the previous average value.

Formula:

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

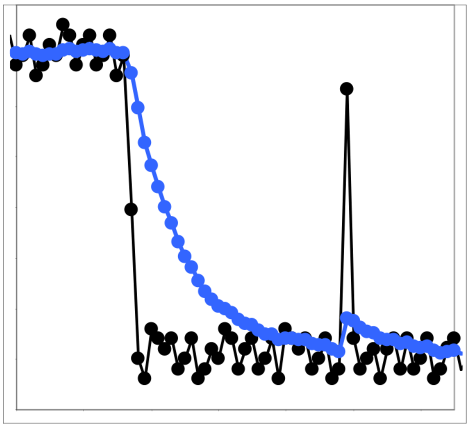
N = averaging value, N = 1 ... 32768

n = Measured value index

MW = measured value

M_{rec} = average value or output value

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.



Application tips

- Permits a high degree of smoothing of the measured values. Long settling times in the case of measured value jumps (low-pass behavior).
- High degree of smoothing for noise without strong spikes
- To especially smooth signal noise for static measurements
- To eliminate the roughness when performing dynamic measurements on rough target surfaces, e.g., roughness of paper.
- To eliminate structures, e.g., parts with uniform groove structures, knurled turned parts or coarsely milled parts
- Unsuitable for highly dynamic measurements

—— Signal without averaging

—— Signal with averaging

Fig. 6.13: Recursive average, N = 8

6.4.3.4 Median

Median

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

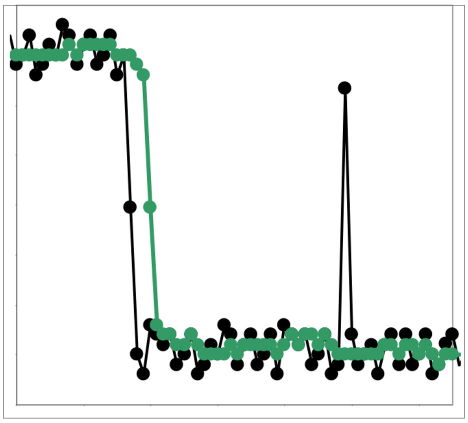
When creating a median value for the sensor, incoming measured values are sorted after each measurement. Then the average value is provided as the median value.

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

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

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



Application tips

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

—— Signal without averaging

—— Signal with averaging

Fig. 6.14: Median, N = 7

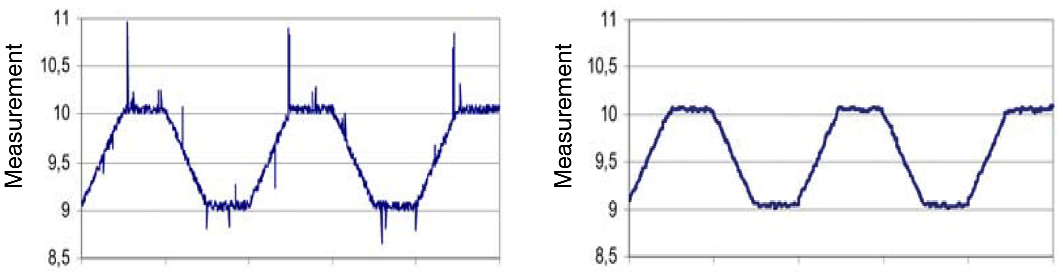


Fig. 6.17: Signal Curve – Profile without Median (Left), with Median N = 9 (Right)

6.5 Post-Processing

6.5.1 Zeroing/mastering

6.5.1.1 General

Use zeroing and mastering to define a nominal value within the measuring range. This shifts the output range. This function is useful for determining a diameter, for example. In this case, mastering can be performed with reference to a test pin nominal value or a paper edge can be zeroed at its desired position.

Mastering (the process of setting master signals and values) is also 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 nominal value.

The master value is the measured value that is output as result of measuring a master object.

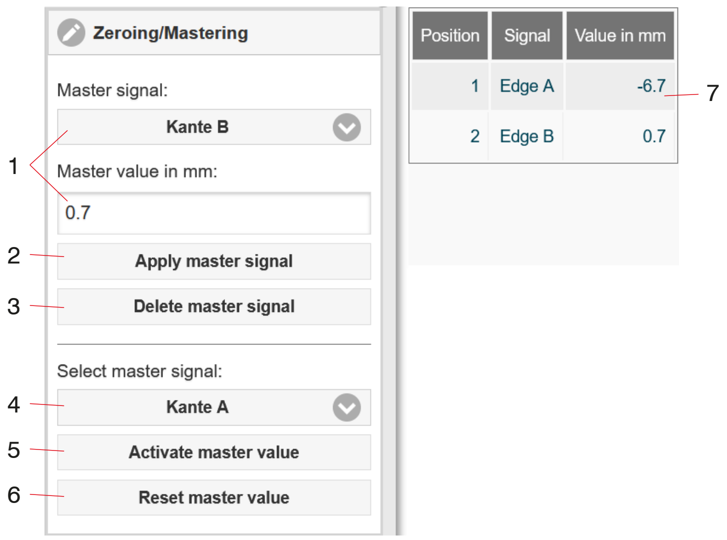
Zeroing is a special feature of mastering, since the master value is `0` here.

`Web edge` preset	Master signal	*Edge A*	*All master signals are internally determined values.* *Values calculated using the computing functions cannot serve as master signals.*
	Master value	*Value*	
`Wire measurement` preset	Master signal	*Edge A / Edge B / Diameter / Center*	
	Master value	*Value*	
`Diameter` preset	Master signal	*Edge A / Edge B / Diameter / Center*	
	Master value	*Value*	
`Contour measurement` preset	Master signal	*Edge A / Edge B / Diameter / Center*	
	Master value	*Value*	
`Multi-segment` preset	Master signal	*1: Edge A / ... / 8: Edge B / 1: Diameter / ... / 8: Diameter / 1: Center / ... / 8: Center*	
	Master value	*Value*	
`Gap measurement` preset	Master signal	*Edge A / Edge B / Diameter / Center*	
	Master value	*Value*	
`Inactive`			

6.5.1.2 Zeroing/Mastering Procedure

i	Mastering or zeroing requires a target to be present in the measuring range. The mastering and zeroing processes affect the analog and digital outputs.

- ► Position the target within the measuring range.
- ► Switch to the menu `Settings` > `Postprocessing` > `Zeroing/mastering`.



The sensor manages up to 10 master signals.

1 Select signal for function, assign master value.

2 Each master signal and associated master value must be confirmed by pressing the `Apply master signal` button.

3 The delete function relates to the master signal listed in (1).

4 It is possible to master a single master signal or all master signals at once.

5 Start function. The function can be performed several times in succession.

6 If you click on the `Reset master value` button to undo the mastering process, the system reverts to the state that existed before mastering.

7 Overview of all existing signals for the function.

Fig. 6.15: Mastering/Zeroing Dialog, Overview of the Individual Master Signal and Values

After mastering, the sensor will provide relative measured values with reference to the master value.

During mastering, 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).

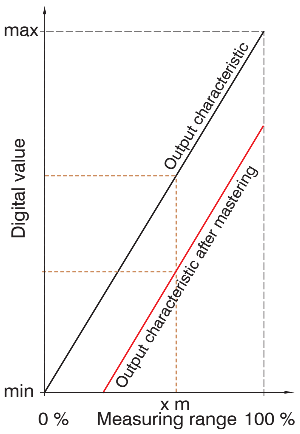


Fig. 6.18: Moving the Characteristic During Mastering

6.5.2 Statistics

The statistical values are calculated from the measured values within the evaluation range (ROI). The evaluation range is reset for each new measured value. The statistical values are displayed in the `measurement chart` section of the web interface or are output via the interfaces.

The sensor works out the following statistical values based on the measurement result:

- Minimum
- Peak-peak (span)
- Maximum

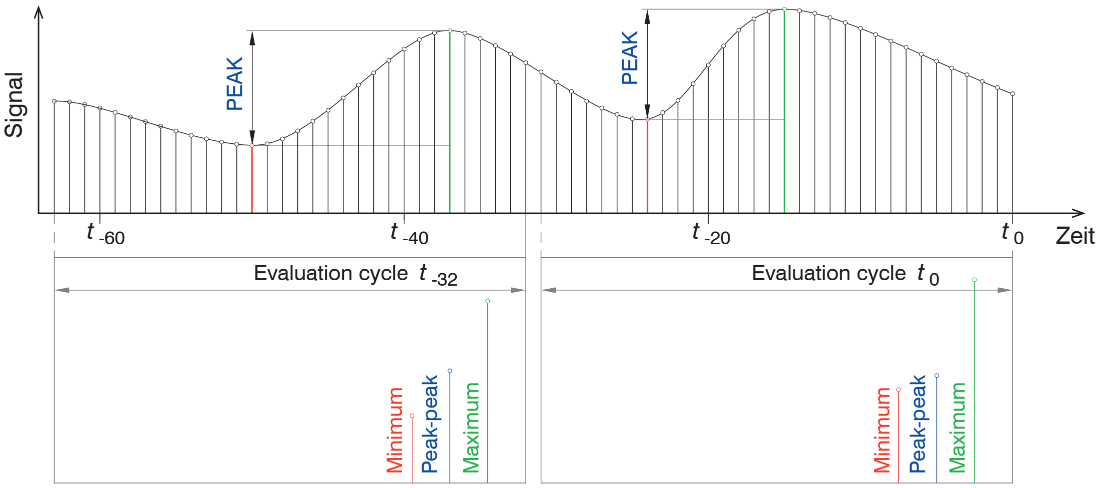


Fig. 6.19: Statistical values with 32 values in the evaluation range (ROI)

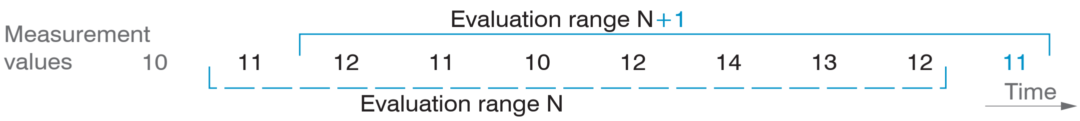


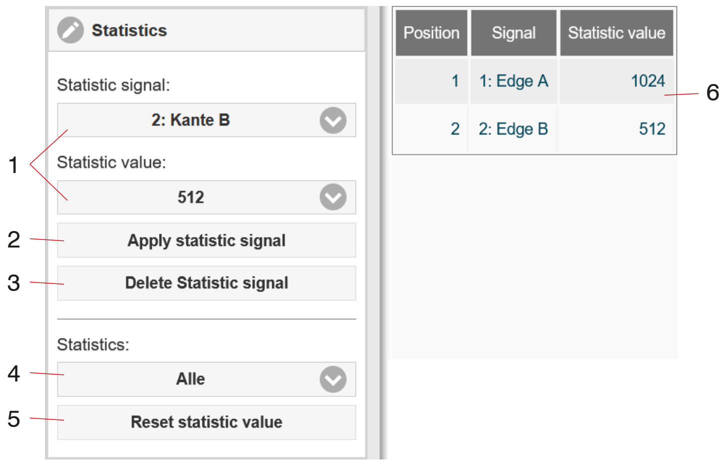
Fig. 6.20: Dynamic updating of the evaluation range using measured values, statistical value = 8

Defining Statistics

- ► Switch to the tab `Settings` > `Postprocessing` > `Statistics`.
- ► Make the desired settings and confirm them by pressing `Save settings`.

`Web edge` preset	Statistic signal	*Edge A*	*All statistic signals are internally determined values. Values determined using the computing functions cannot serve as statistic signals.*
	Statistical value	*Value*	
`Wire measurement` preset	Statistic signal	*Edge A / Edge B / Diameter / Center*	
	Statistical value	*Value*	
`Diameter` preset	Statistic signal	*Edge A / Edge B / Diameter / Center*	
	Statistical value	*Value*	
`Contour measurement` preset	Statistic signal	*Edge A / Edge B / Diameter / Center*	
	Statistical value	*Value*	
`Multi-segment` preset	Statistic signal	*1: Edge A / ... / 8: Edge B / 1: Diameter / ... / 8: Diameter / 1: Center / ... / 8: Center*	
	Statistical value	*Value*	
`Gap measurement` preset	Statistic signal	*Edge A / Edge B / Diameter / Center*	
	Statistical value	*Value*	

`Inactive`



The sensor manages up to 10 statistic signals.

1 Select signal for function, assign statistical value. Use `Inactive` to terminate the statistics function.

2 Each statistic signal and associated statistical value must be confirmed by pressing the `Apply statistic signal` button.

3 The delete function relates to the statistic signal listed in (1).

4 You can select one statistic signal or all of them at once for the purpose of performing the reset function.

5 When a reset is performed with the `Reset statistical value` button, it deletes the statistical values. New statistical values start being calculated immediately.

6 Overview of all existing signals for the function.

Fig. 6.16: Statistics Dialog, Overview of the Individual Statistic Signals and Statistical Values

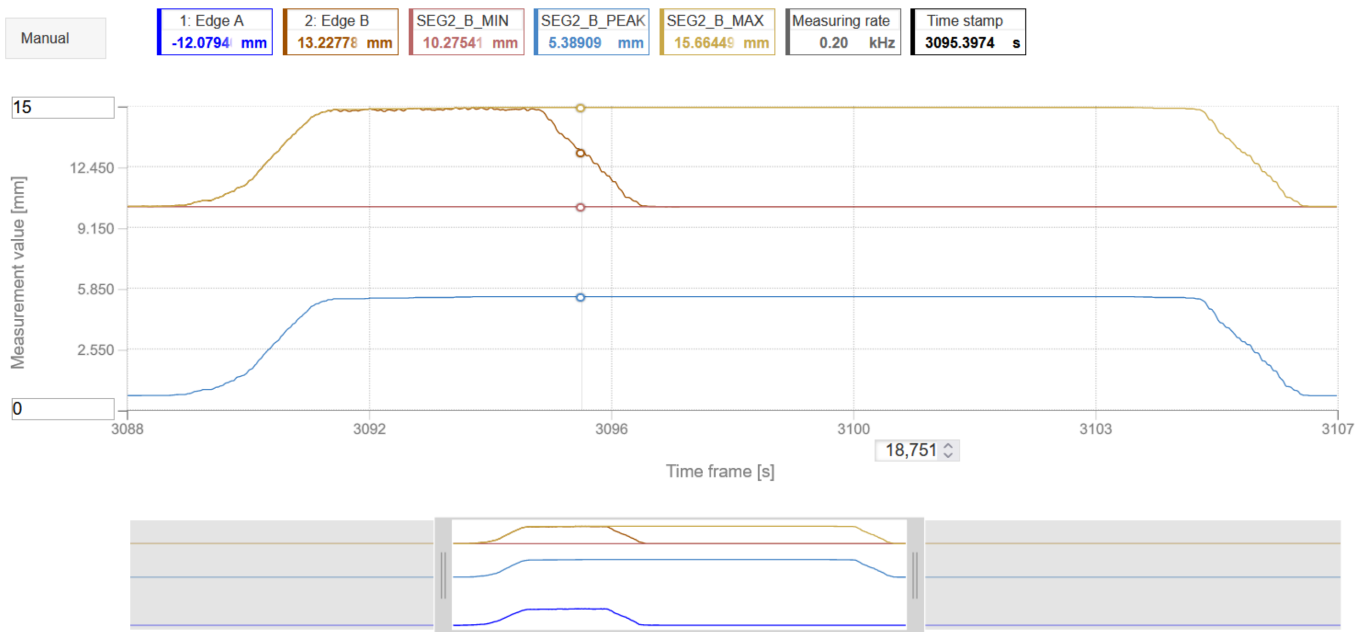


Fig. 6.21: Offline Analysis of the Statistical Values with the Mouseover Function

6.5.3 Data reduction

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

Data reduction	*Value*	*Instructs the sensor which data are excluded from the output, thus reducing the volume of data transmitted.*
Reduction applies to	*RS422 / Analog / Ethernet*	*The interfaces which are provided for the sub-sampling are to be selected with the checkbox.*

Defining a Data Reduction

- Switch to the tab `Settings` > `Postprocessing` > `Data reduction`.
- Make the desired settings and confirm them by pressing `Save settings`.

6.5.4 Triggering for Measured Value Output

The measured values are computed continuously and independently of the trigger event. A trigger event merely triggers output of the values via a digital or analog interface.

Consequently, the values measured immediately before the trigger event are included when calculating the averages or statistics. The triggering of the measured value acquisition and output have the same time response.

Detailed information about the function is available in the “Data Acquisition” section, see Chap. 6.5.4.

Defining Triggering for Measured Value Output

- Switch to the tab `Settings` > `Postprocessing` > `Triggering (data output)`.
- Make the desired settings and confirm them by pressing `Save settings`.

6.6 Outputs

6.6.1 Data output RS422

The RS422 interface has a maximum baud rate of 4000 kBaud. The baud rate is set to 921.6 kBaud when the interface is delivered. Use ASCII commands or the web interface to configure.

The transmission settings of the sensor and of the PC must match.

Data format: Binary.

Interface parameters: 8 data bits, no parity, 1 stop bit (8N1). Selectable baud rate.

The RS422 interface transmits 32 bits per output value. The resolution per value is 10 nm. The maximum number of measured values that can be transmitted for a measuring point depends on the measuring rate of the sensor and the transmission rate set for the RS422 interface. Where possible, use the maximum available transmission rate (baud rate).

Data output RS422	Baud Rate	*9.6 / 115.2 / 230.4 / 460.8 / 691.2 / 921.6 / 2000 / 3000 / 4000 kBps*
	Signals	*Raw signal / ... / Encoder / Edge A / Edge B / Angle A / Angle B / Diameter / Center point / ... / Number of edges / ... / Calculation result*

The output data from all internally determined values and the calculated values from the calculation modules are selected separately for each of the interfaces. These data are output in a rigidly defined order. The web interface displays this order.

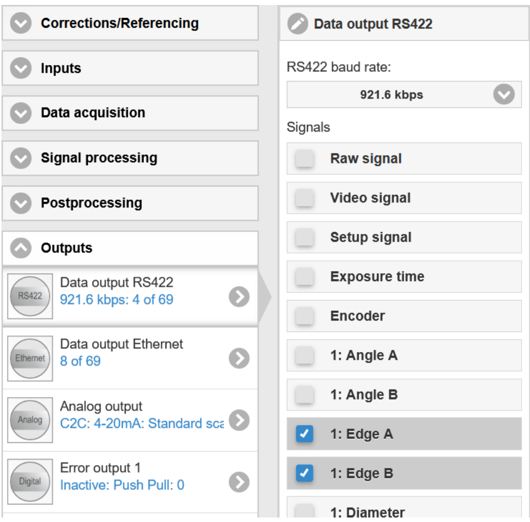


Fig. 6.22: Selection of Output Data via RS422

Data output only starts when the interface is activated, see Chap. 6.6.5.

Baud rate and signal selection

- Go to the tab `Settings` > `Outputs` > `Data output RS422`.
- Make the desired settings and confirm them by pressing `Save settings`.

6.6.2 Data output Ethernet

When using a static IP address it is necessary to enter the values for the IP address, Gateway and Subnet mask; this is not required when DHCP is used. The sensor is factory set to the static IP address 169.254.168.150

The sensor transmits the Ethernet 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.

All output values and additional information to be transferred, saved at a certain time, are consolidated to a measured value frame. Multiple measured value frames are combined into one measurement block and enclosed by another header. A header is added to the start of each measured value frame.

During transfer of measured value data, the controller sends each measured value (measurement block) to its connected counterpart after the connection has been successfully set up. No specific request is required for this.

If any changes are made to the transmitted data or the frame rate, a new header will be sent automatically. The measurement values are transmitted as 32 bit signed integer with 10 nm resolution. The quantity of data can be limited.

The video signal is transmitted in the same way as "Measurement data transmission to a measured value server via Ethernet" with the difference that only one video data set of a measurement cycle is transmitted in a measurement block.

This measurement block can also consist of several Ethernet packets, depending on the size of the FFT signal.

Data output Ethernet	Signals	*Raw signal / ... / Encoder / Edge A / Edge B / Angle A / Angle B / Diameter / Center point / ... / Number of edges / ... / Calculation result*

The selection of output data from all internally determined values and from the calculated values from the computing modules is done separately for the interfaces, see Fig. 6.22. These data are output in a rigidly defined order. The web interface displays this order.

Defining signal selection

- Switch to the `Settings` > `Outputs` > `Data output Ethernet` tab.
- Make the desired settings and confirm them by pressing `Save settings`.

Data output only starts when the interface is activated, see Chap. 6.6.5.

6.6.3 Analog Output

Only one measured value can be transmitted. The resolution of the analog output is 16 bit.

Data output from analog output	Output signal	*Edge A / Edge B / Diameter / Center*	*All output signals are internally determined values. Values calculated using the computing functions cannot serve as signals.*	
	Output range	*4 ... 20 mA / 0 ... 5 V / 0 ... 10 V*	*Either the voltage or the current output can be used on the sensor, but not both.*	
	Scaling	*Standard scaling*	*Scaling to 0 ... Measuring range*	
		Two-point scaling	Start of range	*Value*
			End of range	*Value*

The first value corresponds to the start of the measuring range and the second value to the end of the measuring range. If the analog range needs to be moved, we recommend using the zeroing or mastering function.

Two-point scaling enables the user to specify separate start and end values (in mm) for the sensor's measuring range. The available output range of the analog output is then spread between the minimum and maximum measured values.

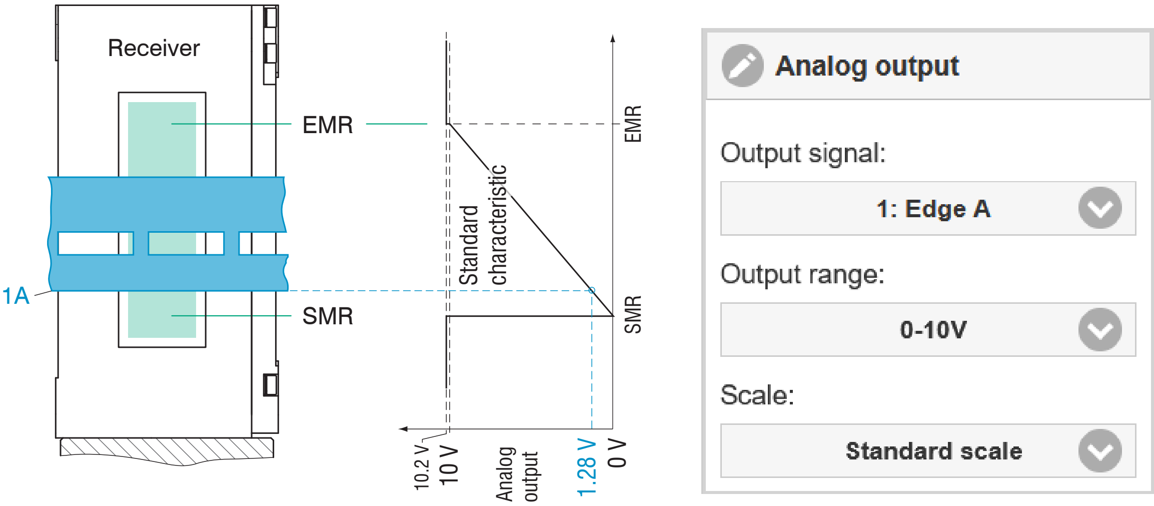


Fig. 6.23: Scaling of Analog Signal 0 ... 10 V, Example of Edge Tracing, Search and Measurement Directions: Standard

i	The `search direction` and `measurement direction` parameters in the measuring program (data acquisition) affect the analog output.

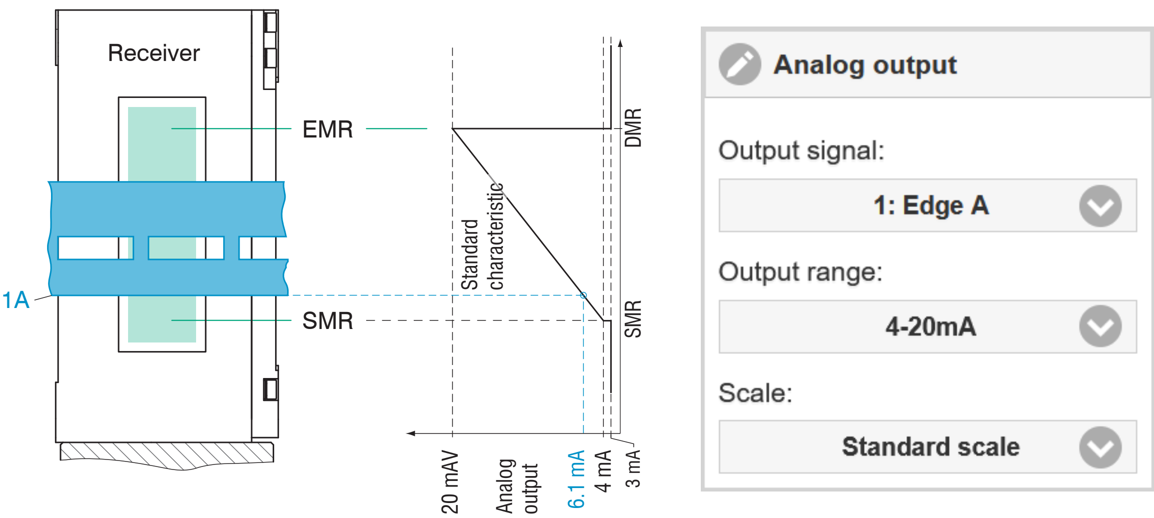


Fig. 6.24: Scaling of Analog Signal 4 ... 20 mA, Example of Edge Tracing, Search and Measurement Directions: Standard

Defining the Analog Output

- Switch to the tab `Settings` > `Outputs` > `Analog output`.
- Make the desired settings and confirm them by pressing `Save settings`.

Variables	Value range	Formula
V_{OUT} Voltage in V	[0; 5] Measuring range [0; 10] Measuring range	$d = \left(\frac{V_{OUT}}{5} * MR\right) - 0.5 * MR$ $d = \left(\frac{V_{OUT}}{10} * MR\right) - 0.5 * MR$
MR Measuring range in mm	{40}	
d Distance in mm	[-0.5MB; +0.5MB]	

Fig. 6.17: Calculating the Measured Value from the Voltage Output, Search and Measurement Directions: Standard

Variables	Value range	Formula
I_{OUT} Current in mA	[4; 20] Measuring range	$d = \left(\frac{I_{OUT} - 4}{20} * MR\right) - 0.5 * MR$
MR Measuring range in mm	{40}	
d Distance in mm	[-0.5MB; +0.5MB]	

Fig. 6.18: Calculating the Measured Value from the Current Output, Search and Measurement Directions: Standard

6.6.4 Switching Outputs

6.6.4.1 General, Overview

The switching outputs can be used independently of each other for signal-related error or limit value monitoring.

For operation, the NPN switching behavior (switching level) requires an auxiliary voltage and a load resistor.

For operation, the PNP switching behavior (switching level) requires a load resistor, see Chap. 4.3.8.

Once the settings are complete, the switching outputs must be enabled, see Chap. 6.6.5.

Possible Functions

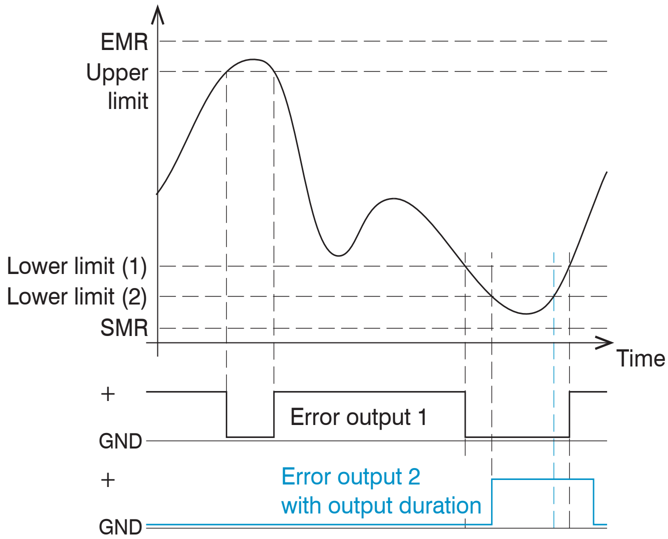
- Edge count monitoring
- Monitoring of limit value(s)

Switching output 1 Switching output 2 Switching output 3	Switching output configuration	*Expected edges*	Expected edges	*Value*
			Switching level in case of error	*NPN / PNP / Push-pull / Push-pull negated*
			Output duration ms	*Value*
		Limit	Signal	*Edge / Angle / Diameter / Center* [10]
			Valid limit values	*Upper limit / Lower limit / Both limits*
			Lower limit mm	*Value*
			Upper limit mm	*Value*
			Switching level in case of error	*NPN / PNP / Push-pull / Push-pull negated*
			Output duration ms	*Value*
		Inactive		

[10] The selected preset or setup determines which signals are possible.

6.6.4.2 Setting Limit Values

If a value falls above or below a limit value, the switching outputs are activated. Enter a lower and an upper limit value (in mm) for this purpose.



Limit value range -2147 ... +2147
EMR = end of measuring range
Upper limit = maximum for switching output 1
Lower limit (1) = minimum for switching output 1
Lower limit (2) = minimum for switching output 2
SMR = start of measuring range

Fig. 6.19: Switching Output 1 (Both Limit Values, NPN) and Switching Output 2 (Lower Limit Value, PNP)

6.6.4.3 Switching Logic

Notes about switching behavior are available under “Electrical Connections”, see Chap. 4.3.8.

6.6.5 Data Output

This menu item can be used to activate and deactivate the output of measured values via the individual channels.

- RS422: provides an interface capable of real-time output at a lower data rate.

  In the case of the RS422 interface, the data intended for transmission is selected in the RS422 data output section, see Chap. 6.6.1.
- Ethernet: Enables rapid – but not real-time – data transmission (packet-based data transfer). It can be used to transmit measured values and video data. It is suitable for capturing measured values without direct process control so that they can undergo subsequent analysis. Parameterization is carried out via the web interface or ASCII command set.

  In the case of the Ethernet interface, the data intended for transmission is selected in the Ethernet data output section , see Chap. 6.6.2.

Selecting/Activating Interfaces

► Switch to the tab `Settings` > `Outputs` > `Data output`.

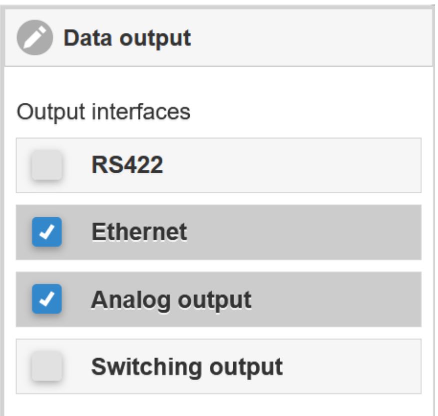


Fig. 6.25: Activating Output Interfaces

6.6.6 Ethernet Settings

Address type	*Static*	IP address	*Value*	
		Network mask	*Value*	
		Gateway	*Value*	
	DHCP			
Ethernet measured value transmission	*Server TCP/IP*	Server port	*Value*	
		Keep-alive signal	*Active / Inactive*	
		Number of frames	*Automatic*	
			Specify number	*Value*
	Client TCP/IP / Client UDP/IP	Server address	*Value*	
		Port	*Value*	
		Keep-alive signal	*Active / Inactive*	
		Number of frames	*Automatic*	
			Specify number	*Value*

Defining the Ethernet Interface

- Switch to the tab `Settings` > `Outputs` > `Ethernet settings`.
- Make the desired settings and confirm them by pressing `Save settings`.

6.7 System Settings

6.7.1 Web Interface Unit

The web interface supports units in millimeters (mm) and inches in the display of the measurement results. Data output via Ethernet/analog output is not affected by this setting.

Changing the Unit

- Switch to the tab Settings > System settings > Unit on the web interface.
- Make the desired settings and confirm them by pressing Save settings.

6.7.2 Load & Save

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

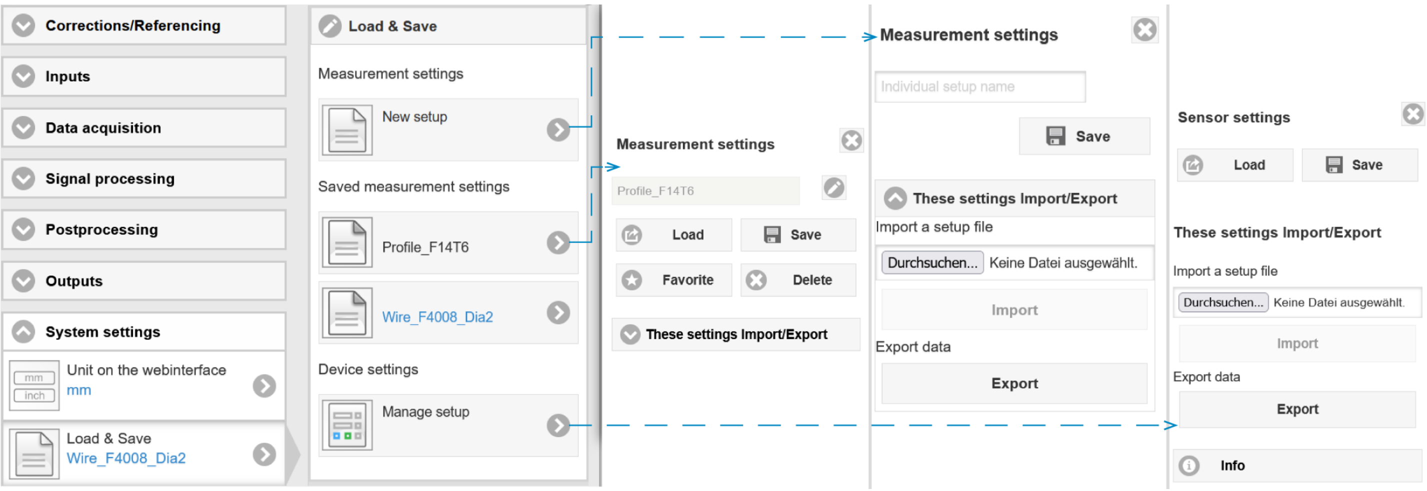


Fig. 6.26: Managing User Settings

Defining, Saving, or Loading Data Sets

- Switch to the tab Settings > System settings > Load & Save.
- Make the desired settings and confirm them by pressing Save settings.

Saving the Settings	Activate existing setup	Save change in active setup	Determine setup after booting
New setup menu	Load & Save menu	Menu bar	Load & Save menu
Enter the name for the setup in the Individual setup name field, e.g., Profile_F14T6 and confirm the entry with the Save button.	Click on the desired setup with the left mouse button. The Measurement settings dialog opens. Click on the Load button.	Click on the Save settings button in the horizontal menu bar.	Click on the desired setup with the left mouse button. The Measurement settings dialog opens. Click on the Favorite button.

Fig. 6.20: Managing Setups in the Sensor, Options and Sequence

Save setup on PC	Load setup from PC
Load & Save menu	Load & Save menu
Click on the desired setup with the left mouse button. The Measurement settings dialog opens. Click on the Export button.	Click on the desired setup with the left mouse button. The Measurement settings dialog opens. Click on the Browse button. A Windows dialogue for file selection opens. Select the desired file and click on the Open button.

	Click on the `Import` button.

Fig. 6.21: Exchanging Setups with a PC/Notebook, Options and Procedure

6.7.3 Import & Export

The `Import & Export` menu provides an easy way of exchanging parameter sets with a PC/notebook.

A parameter set contains:

- The current settings, setup(s)
- The initial setup for sensor booting
- The device settings

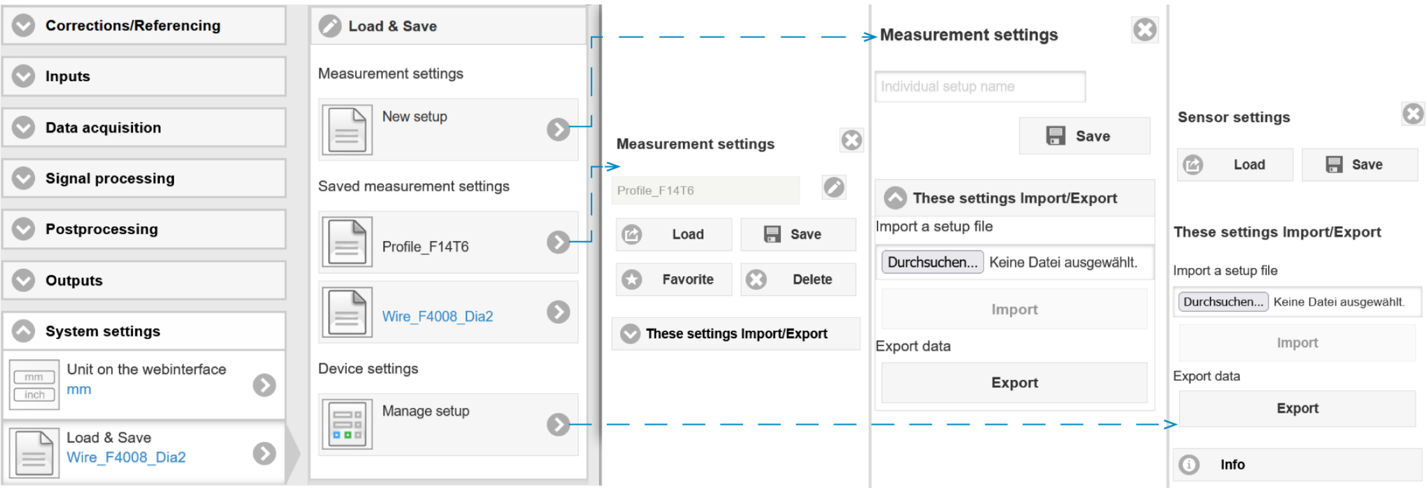


Fig. 6.27: Preparing a Data Set for Export

Save parameter set on PC	Load parameter set from PC
`Import & Export` menu	`Import & Export` menu
Click on the `Create a parameter set` button. The `Choose export data` dialog opens. Select/deselect the checkboxes to construct a parameter set. Click on the `Transmit file` button. The operating system places the parameter set in the `Download` area. The resulting file name for the adjacent example is `<...\Downloads\ODC2700_BASICSETTINGSTINGS_MEASSET-TINGS... .JSON>`	Click on the `Browse` button. A Windows dialogue for file selection opens. Select the desired file and click on the `Open` button. The `Choose import data` dialog opens. Select/deselect the checkboxes to determine which actions should be performed. Click on the `Transmit file` button.

Fig. 6.22: Exchanging Parameter Sets with a PC/Notebook, Options and Procedure

6.7.4 Access authorization

Assigning passwords prevents unauthorized changes to settings. The password protection disabled in the delivery condition and the `Professional` level is active. When the configuration has been completed, you should enable password protection. The standard password for the Professional level is “000”.

> i A software update will not change the default password or a user-defined password. The Professional password is independent of the setup and is therefore not loaded or saved together with the setup.

Users have the following functions available:

Action	User	Professional
Password required	no	yes
View settings	yes	yes
Change settings, change password	no	yes
View readings, video signals	yes	yes
Scale graphs	yes	yes
Restore factory settings	no	yes

Fig. 6.23: Permissions within the user hierarchy

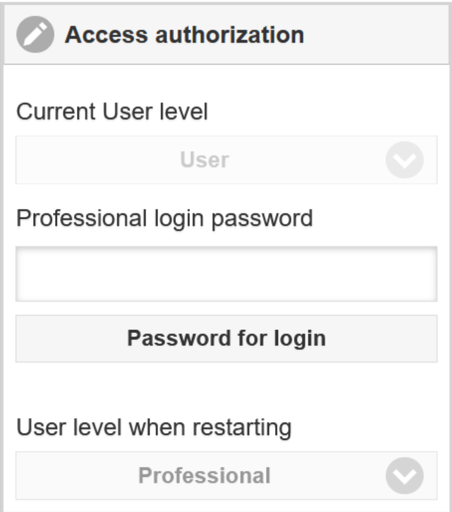


Fig. 6.28: Changing to Professional level

Changing to Professional level

- Switch to the `Settings` > `System settings` > `Access authorization` menu.
- Enter the standard password “000” or a custom password into the `Professional login password` box, and click `Password for login`.

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

Password	*Value*	*All passwords are case-sensitive. Numbers are allowed. Special characters are not permitted.*
User level on restart	*User / Professional*	Defines the user level that is enabled after restart. Micro-Epsilon recommends the selection Professional here.

6.7.5 Resetting the Sensor

You can reset individual settings to the factory setting in this menu area.

Measurement Settings	*Resets the preset to the web edge option and all parameters, except for interface settings, to the factory settings.*
Device settings	*Resets all settings for the Ethernet and RS422 interfaces to the factory settings.*
Reset all	*Resets the device and measurement settings to factory settings.*
Restart sensor	*The sensor is restarted with the most recently stored settings.*

Fig. 6.24:

Performing a Reset

- Switch to the tab `Settings` > `System settings` > `Reset sensor`.
- Select the desired function.

6.7.6 Light Source

This allows the light source to be switched on and off in the sensor.

Light Source On/Off

- Switch to the tab `Settings` > `System settings` > `Light source`.
- Select the desired function.

7 Disclaimer

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

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

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

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

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

In addition, the General Terms of Business of Micro-Epsilon shall apply, which can be accessed under

Legal details | Micro-Epsilon https://www.micro-epsilon.com/legal-details/.

8 Service, Repair

In the event of a receiver or light source defect:

- If possible, save the current sensor settings in a parameter set, see Chap. 6.7 to reload them 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.

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

MICRO-EPSILON
Eltrotec GmbH
Manfred-Wörner-Straße 101
73037 Göppingen / Germany

Tel: +49 (0) 7161 / 98872-300
Fax: +49 (0) 7161 / 98872-303
E-Mail: eltrotec@micro-epsilon.de
www.micro-epsilon.com/contact/worldwide/
Web: www.micro-epsilon.com

9 Decommissioning, disposal

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

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

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

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

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

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

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

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

10 Factory settings

Parameter	Factory settings
Analog Output	Current, 4 ... 20 mA
RS422 baud rate	921600 bps
Static IP address	169254168150
Gateway	169254001001
Subnet	255255000000
Calculation	Moving averaging, edge A, 8 values
Encoder, interpolation	1
Encoder, max. value	4294967295
Encoder, set to value	0
Encoder, reference track	no effect
Web interface language	German
Mastering, Zeroing	no
Measuring Rate	2.5 kHz
Region of interest	0 ... 100 %
Triggering	no
Measurement configuration, preset	Web edge
Signal Quality	Balanced
Statistics	Edge A, 256 values

11 Optional accessories

PC/SC2700-x

Cable for power supply, RS422 and synchronization; one side 12-pin socket M12, other side open ends; cable length x = 3 m, 5 m, 10 m, 20 m [11]

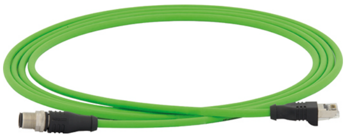
CE2700-1

Transmitter-receiver extension cable, cable length 1 m

PC/SC2700-3/IF2008

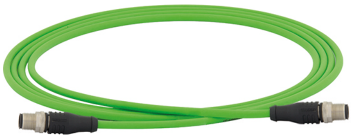
Interface and supply cable for connection to the IF2008/PCIE interface card or the IF2004/USB 4-way converter; cable length 3 m [11]

SCD2700-x



Digital output cable for connection to an Ethernet/ EtherCAT interface; with a 4-pin M12 male connector on one side and an RJ45 male connector on the other; cable length x = 3 m, 5 m, 10 m, 20 m

SCD2700-5 M12

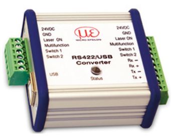


Digital output cable, 5 m long, for connection to an Ethernet/ EtherCAT interface (with a 4-pin M12 round male connector on both sides), drag chain-compatible

SCA2700-x

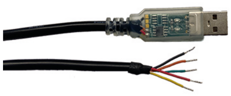
Cable for analog output, switching inputs and outputs; one side 17-pin plug M12, other side open ends; cable length x = 3 m, 5 m, 10 m, 20 m

IF2001/USB



IF2001/USB single-channel RS422/USB converter

IC2001/USB



IC2001/USB single-channel RS422/USB converter cable

IF2035-EtherCAT
IF2035-PROFINET
IF2035-EIP

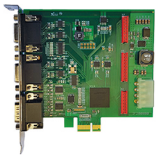
Interface module for connection to EtherCAT, PROFINET, or EtherNet/IP of a Micro-Epsilon sensor with RS485 or RS422 interface; suitable for cable PC/SC2700-x, top-hat rail housing, incl. GSDML file for software integration into the PLC

PS2020

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

[11] Minimum bending radius (permanently flexible) min. 7.5 x outer cable diameter

IF2008/PCIE



IF2008/PCIE interface card for the synchronous capture of 4 digital sensor signals or 2 encoders. In conjunction with the IF2008E, a total of 6 digital sensor signals, 2 encoders, 2 analog signals, and 8 I/O signals can be captured synchronously.

IF2004/USB

4-channel converter from RS422 to USB, suitable for cable PC/SC2700-3/IF2008; including driver, connections: 2 x sub-D, 1 x terminal block

PS2031

PS2031 universal plug-in power supply 100-240 V/24 V/ 1 A; 2 m PVC; terminal-2P-BU-ge; with additional male connector for UK and USA

IF2008-Y adapter cable

For connecting two PC/SC2700-3/IF2008 interface cables

EK1100 bus coupler

Bus coupler; for use on an EtherCAT master; can only be used together with EK1122

EK1122 bus terminal

Bus terminal; for use in conjunction with a bus coupler and SCD2700-x on an EtherCAT master; 2-port EtherCAT junction for two sensor signals

12 ASCII Communication

12.1 General

The ASCII commands can be sent to the sensor/controller via the RS422 or Ethernet (port 23) interfaces. All commands, inputs and error reports are in English. A command always consists of the command name and zero or several parameters that are separated with a space and end in LF. If spaces are used in parameters, the parameter must be placed in quotation marks, e.g. “Password with space”.

Example: Switching on output via RS422

OUTPUT RS422 <Enter>

Reference	<Enter>	Must contain LF, but can also be CR LF
Explana-tion	<LF>	Line feed (hex 0A)
	<CR>	Carriage return (hex 0D)
	<Enter>	Hex 0A or hex 0D0A, depending on system

The currently set parameter value is reset if a command is invoked without parameters.

The output format is:

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

The response can be used again without changes as a command for setting the password. Optional parameters are only returned as well if this is necessary.

(“->”) returned. In the event of an error, an error message beginning withExx, where xx stands for a unique error number, comes before the prompt. Moreover, instead of error messages, warning messages (“Wxx”) may be output. Warnings are structured analogously to error messages. Warnings do not prevent commands from being executed.

12.2 General Commands

12.2.1 Help on commands

```
HELP [HELP|<Command>]
```

Outputs a list of possible commands, along with general or command-specific help texts.

Commands without parameters

- <Command>: Execute command

Commands with parameters

- <Command>: Displays the current parameter settings
- <Command> <Parameter1> [<Parameter2> [...]]
  Generates any number of parameters.
- <Command> <Parameter1> <Parameter2> ... <Parameter...>
  Generates a fixed number of parameters.

Command response

Cursor – the sensor is ready for the input.

- E<ddd> <Msg>: Error message, execution canceled
- W<ddd> <Msg>: Warning, execution in progress
- <ddd>: Three-digit number
- <Msg>: Message

Format description

- (): Grouping

- []: Optional parameter
- <>: Placeholder
- |: List

If a parameter contains spaces, it must be placed inside quotation marks.

Examples

- a|b: Use either a or b
- a b: Both parameters are required
- a [b [c]]: Any number of parameters: a, a b, or a b c

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

Defines the Ethernet interface. You can select DHCP or STATIC with further parameters. If you define the gateway, you must also specify the IP address, its type, and the net mask.

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

To change the password, all parameters are required.

12.2.2 Retrieving Sensor Information

```
GETINFO
```

Outputs information regarding the sensor.

```
GETINFO
Name: ODC2700-40
Serial: 1123070012
Option: 000
Article: 4321034
MAC-Address: 00-0C-12-01-E5-2F
Variant: 000
Version: 005.004
Hardware-rev: 02
Boot-version: 004.000
BuildID: 23
Timestamp: 2024-02-19T12:45:47+01:00
Measuring range: 40.00mm
Output-variant: PHY
->
```

Fig. 12.1: Response of Sensor to GETINFO

12.2.3 Reply type

```
ECHO [ON|OFF]
```

The reply type describes the structure of a command reply. In read mode, the command name is always output.

- ON: The command name and the command reply or an error message is output.
- OFF: Nothing but the command reply or an error message is output.

12.2.4 Parameter overview

```
PRINT [ALL]
```

This command outputs a complete or partial list of all configuration parameters and their values.

12.2.5 Synchronization

`SYNC [NONE|SLAVE_SYNCTRIG|SLAVE_TRIGIN|MASTER|MASTER_ALT]`

Defines or displays the settings for synchronization.

- NONE: No synchronization
- SLAVE_SYNCTRIG: Works as a slave and waits for the synchronization pulse from an external source at the Sync/Trig input
- SLAVE_TRIGIN: Works as a slave and waits for the synchronization pulse from an external source at the digital input TrigIn
- MASTER: Operates as master and provides the synchronization pulse
- MASTER_ALT: Works as a master and provides the synchronization pulse for alternating mode (pulse is generated between two exposure times)

12.2.6 Reset

`RESET`

Resets the sensor and restarts it.

12.2.7 Reset Counter

`RESETCNT [TIMESTAMP] [MEASCNT]`

Resets the internal counter, e.g., for synchronization.

- TIMESTAMP: Timestamp
- MEASCNT: Measured value counter (profile counter)

12.3 User level

12.3.1 Changing to the “Professional” User Level

`LOGIN <password>`

Changes the current user level to PROFESSIONAL (see command GETUSERLEVEL)

Passwords must have at least 1 character and can contain a maximum of 31. The following characters are permitted: a-zA-Z0-9 _(),;.:-_/.

If the password contains spaces, the entire password must be placed inside quotation marks (“password”).

- password: Defined password

12.3.2 Changing to the “User” User Level

`LOGOUT`

Changes the current user level to USER

12.3.3 User level query

`GETUSERLEVEL`

Outputs the current user level.

12.3.4 Setting the user level on restart (standard user)

`STDUSER [USER|PROFESSIONAL]`

Sets the user level to Standard. The user is also stored after a RESET and restart of the system.

12.3.5 Changing the Password

`PASSWD <old_password> <new_password> <new_password>`

Changes the password for the PROFESSIONAL user level.

Passwords must have at least 1 character and can contain a maximum of 31. The following characters are permitted: a-zA-Z0-9 _(),;.:-_/.

If the password contains spaces, the entire password must be placed inside quotation marks (“password”).

12.4 Correction, Referencing

12.4.1 Light Referencing

`LIGHTCORR [ROI] [FORCE]`

Calibrates the light correction table (light referencing).

- ROI: Light referencing is only performed for the region of interest (defined by ROI command). Areas outside the ROI are set to the factory setting.
- FORCE: Overwrites the correction table even if soiling has been detected.

12.4.2 Light Correction Status

`LIGHTCORRSTATUS`

Shows the status of light referencing. Indicates whether or not a light correction is available.

- CLEAN: Light correction is available; no soiling was detected within the entire measuring range.
- WITH_RESTRICTIONS: Light correction is available; no soiling was detected within the ROI.
- SOILED: Light correction is available; however, soiling was detected during light referencing.
- NOT_AVAILABLE: No light correction available

12.4.3 Printing the Correction Table

`LIGHTCORR_PRINT`

Prints the light correction table.

12.4.4 Deleting the Correction Table

`LIGHTCORR_DEL`

Deletes the light correction table.

12.4.5 Soiling Check

`SOILINGCHECK [ROI] [OBJ_IGNORE]`

Checks the sensor for soiling.

- ROI: Only checks the ROI (region of interest, defined by the ROI command)
- OBJ_IGNORE: Ignores targets (measuring objects); the soiling check is only performed for the exposed sensor area. Completely dark areas with sharp edges are excluded from the check.

12.4.6 Soiling Status

`SOILINGSTATUS`

Indicates the current soiling status.

Indicates whether or not the soiling check was successful.

- CLEAN: No soiling was detected throughout the entire measuring range.
  WITH_RESTRICTIONS: No soiling in the ROI or in the entire measuring range where targets were ignored.
  SOILED: Soiling check failed

12.5 Multifunction inputs

12.5.1 Defining the TTL/HTL Input

`INPUT_LEVEL [TTL|HTL]`

Defines the input level for TTL/HTL.

- TTL: The input accepts a TTL level
- HTL: The input accepts a HTL level

12.5.2 Selecting the Multifunction Input Function

`INPUT_MUX [value]`

Assignment of digital inputs -> Encoder(A B R)/Trigger(T)

- value: ABT|ATB|BAT|BTA|TAB|TBA|ABR|ARB|BAR|BRA|RAB|RBA

1st letter: Multifunction input 1

2nd letter: Multifunction input 2

3rd letter: Multifunction input 3

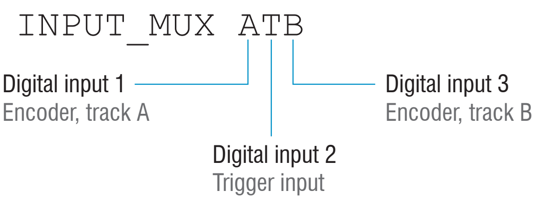


Fig. 12.2: Example Assignment of Multifunction Inputs

12.6 Triggering

12.6.1 Trigger source

`TRIGGERSOURCE [NONE|SYNCTRIG|TRIGIN|SOFTWARE|ENCODER1]`

Defines the source for detected trigger events.

- NONE: Ignores all trigger sources
- SYNCTRIG: Uses the Sync/Trig input
- TRIGIN: Uses the TrigIn input
- SOFTWARE: Uses the software trigger generated via the TRIGGERSW command
- ENCODER1: The encoder is used for triggering

12.6.2 Effect of Triggering

`TRIGGERAT [INPUT|OUTPUT]`

- INPUT: Triggers measurement data acquisition
- OUTPUT: Triggers measurement data output

12.6.3 Trigger mode

`TRIGGERMODE [EDGE|PULSE]`

This command sends a trigger based on a level or an edge if TRIGGERSOURCE has been set to SYNCTRIG or TRIGIN.

- PULSE: Level-based trigger
  EDGE: Edge-based trigger

See TRIGGERLEVEL

12.6.4 Trigger Level

`TRIGGERLEVEL [HIGH|LOW]`

Defines the level or the edge for triggering.

- HIGH: Rising edge / High
- LOW: Falling edge / Low

12.6.5 Software Trigger

`TRIGGERSW`

Generates a software trigger pulse when the trigger is set to SOFTWARE.

12.6.6 Number of Measured Values to be Output

`TRIGGERCOUNT [NONE|INFINITE|<n>]`

Specifies the number of values output in response to a trigger event.

- NONE: Stops triggering
  INFINITE: Starts continuous output after the first trigger event
  n: 1 ... 32766 The number of values output in response to each trigger event

12.6.7 Step Size

`TRIGGERENCSTEPSIZE [<value_of_step_size>]`

Defines the distance between the triggers.

If the value is set to 0 and the encoder value is between min. and max., all values are output.

If <value_of_step_size> is greater than 0, then TRIGGERENCMIN and TRIGGERENCMAX should be a multiple of <value_of_step_size>.

See TRIGGERENCMIN and TRIGGERENCMAX

- value_of_step_size: 0 .. 2^31-1

12.6.8 Encoder Trigger Minimum

```
TRIGGERENCMIN [<value>]
```

Defines the minimum encoder value for triggering.

If TRIGGERENCSTEPSIZE is greater than 0, then <value> should be a multiple of TRIGGERENCSTEPSIZE.

See TRIGGERENCMIN and TRIGGERENCSTEPSIZE

- value: 0 ... 4294967294

12.6.9 Encoder Trigger Maximum

```
TRIGGERENCMAX [<value>]
```

Defines the maximum encoder value for triggering.

If TRIGGERENCSTEPSIZE is greater than 0, then <value> should be a multiple of TRIGGERENCSTEPSIZE.

See TRIGGERENCMIN and TRIGGERENCSTEPSIZE

- value: 1 ... 4294967295

12.7 Encoder Settings

12.7.1 Encoder Interpolation

```
ENCINTERPOL [1|2|4]
```

This command can be used to set or retrieve the interpolation of the encoder.

12.7.2 Encoder Reference Track

```
ENCREF [NONE|ONE|EVER]
```

- NONE: No encoder reference track is used
- ONE: Encoder is only set to the start value on the first pulse
- EVER: Encoder is set to the start value on each pulse

12.7.3 Setting the Encoder Reference Track

```
ENCSET 1
```

Defines the encoder start value.

12.7.4 Encoder Start Value

```
ENCVALUE [<value>]
```

The command defines the start value for the encoder.

The start value must be less than the value of the ENCMAX command.

- value: 0 ... 4294967294

12.7.5 Maximum Encoder Value

```
ENCMAX [<value>]
```

This command allows you to set a maximum encoder value.

The maximum value has to be greater than the start value of the ENCVALUE command.

- value: 1 ... 2^32-1

12.7.6 Resetting the Encoder Reference Track

```
ENCRESET 1
```

Resets the reference track of the encoder counter. As a result, the next reference pulse becomes the first one again.

12.8 Interface Setting

12.8.1 Ethernet Settings

```
IPCONFIG DHCP|(STATIC [<IPaddress> [<netmask> [<gateway>]]])
```

Defines the settings for the Ethernet interface.

- DHCP: IP address and gateway are automatically queried via DHCP. If no DHCP server is available, the system searches for a LinkLocal address.
- STATIC: Sets an IP address, the net mask, and the gateway (format: ddd.ddd.ddd.ddd)

12.8.2 Settings for Transmitting Measured Values via Ethernet

```
MEASTRANSFER NONE
MEASTRANSFER SERVER/TCP [<port>]
MEASTRANSFER CLIENT/TCP [<IP> [<port>]]
MEASTRANSFER CLIENT/UDP [<IP> [<port>]]
```

Defines or displays the settings for Ethernet communication and data transfer.

- NONE: Ethernet connection is deactivated
- SERVER/TCP: The controller makes a TCP/IP server available
- CLIENT/TCP: The controller runs as a TCP/IP network station
- CLIENT/UDP: The controller runs as a UDP/IP network station
- IP: IP address of the server network
- Port: Communication port (1024 ... 65535), default is 1024

12.8.3 Ethernet Count Method

```
MEASCNT_ETH [0 | <count>]
```

Defines or displays the maximum number of frames per packet that are transmitted via Ethernet.

- 0: Number of frames per packet is assigned automatically
- count: Maximum number of frames per packet (0 ... 350)

12.8.4 Setting the RS422 Baud Rate

```
BAUD RATE [9600|115200|230400|460800|691200|921600|2000000|3000000|4000000]
```

Can be used to display or set the baud rate for the RS422 interface. The unit is bit/s

12.8.5 TCP Settings

```
TCPKEEPALIVE [ON|OFF]
```

The settings are applied to new TCP connections. Existing connections remain unaffected.

The possible command parameters are:

- ON: Activates the TCP keep-alive function (see RFC 1122)
  OFF: Deactivates the TCP keep-alive function

12.8.6 Terminating Resistor

`TERMINATION [OFF|ON]`

Defines whether a terminating resistor is connected in the synchronization line in order to avoid reflections.

- OFF: No terminating resistor
  ON: Terminating Resistor

12.9 Parameter Management, Load/Save Settings

12.9.1 Basic Settings

`BASICSETTINGS READ | STORE`

- READ: Basic (connection) settings are read from the memory
- STORE: Basic (connection) settings are stored in the memory

12.9.2 Output of Changed Settings

`CHANGESETTINGS`

- MEASSETTINGS is output if any parameters in the measurement settings have changed since the MEASSETTINGS STORE command was last executed.
- BASICSETTINGS is output if any parameters in the basic settings have changed since the BASICSETTINGS STORE command was last executed.

12.9.3 Exporting Sensor Settings

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

Exports the sensor settings.

- MEASSETTINGS: Exports the measurement settings with the name <SettingName>
- BASICSETTINGS: Exports the basic settings only
- MEASSETTINGS_ALL: Exports all measurement settings
- ALL: Exports all basic and measurement settings

12.9.4 Importing Sensor Settings

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

Imports settings into the sensor.

- FORCE: Allows existing settings to be overwritten
- APPLY: Applies the imported settings
- ImportData: Data in JSON format

12.9.5 Factory Reset

`SETDEFAULT ALL | MEASSETTINGS | BASICSETTINGS`

Resets the sensor to its factory settings.

- ALL: Deletes all settings and loads the factory settings
- MEASSETTINGS: Deletes all measurement settings
- BASICSETTINGS: Deletes all basic settings

12.9.6 Measurement settings

```
MEASSETTINGS <subcommand> [<name>]
```

Settings for measurement task

Definitions

- Setup: User-specific program containing the relevant settings for a measuring task
- Preset: Manufacturer-specific program containing settings for common measuring tasks that cannot be overwritten
- Initial setup on booting (sensor startup): A favorite setting can be selected from the setups for automatic activation on sensor startup.

Loads manufacturer-defined presets or user-specific setups from the sensor or saves user-specific setups in the sensor.

Subcommands

- PRESETMODE: Returns the preset mode (signal quality) that is currently in use. If a setup is being used, the response is NONE.
- PRESETMODE <mode>: Sets a preset mode (signal quality) <mode> = STATIC|BALANCED|DYNAMIC.
- PRESETLIST: Provides a list of all available manufacturer-specific programs. Possible responses from the sensor include: WEB EDGE | FINE WIRE | DIAMETER.
- CURRENT: Provides the name of the preset or setup that is currently in use.
- READ <name>: Loads a preset or setup <name> from the non-volatile memory. The program is executed directly in the sensor. The program name is case-sensitive.
- STORE <name new>: Stores the current user-specific settings in a setup <name> or creates a new setup <name> in a non-volatile memory.
- RENAME <name> <name new> [FORCE]: Renames a measurement setting, FORCE can be used to overwrite an existing measurement setting.
- DELETE <name>: Removes the setup <name> from the memory.
- INITIAL AUTO: Executes the most recently stored setup or the last preset used when the sensor is started.
- INITIAL <name>: Defines what setup <name> should be used when the sensor is next started. Presets cannot be entered.
- Provides the name of the setup that has been defined for use when the sensor is next started. Alternatively, the sensor responds with MEASSETTINGS INITIAL AUTO if this command has been sent before.
- LIST: Lists the names of all stored setups
- FORCE: Allows stored setups to be overwritten
- <name> The name of a user-specific setting (setup)
- <name new> The name of a user-specific setting (setup). Names must have at least 2 characters and can contain a maximum of 31. The following characters are permitted: a-zA-Z0-9_. The names of the presets and the designation “AUTO” are not permitted.

12.10 Measurement

12.10.1 Selecting the Measuring Program

```
MEASMODE EDGEHL|EDGELH|DIA|GAP|SEGMENT
```

Defines the measuring program.

- EDGEHL: Light-dark edge; position of first light-dark edge
- EDGELH: Dark-light edge; position of the first dark-light edge
- DIA: Diameter (distance from first light-dark edge to dark-light edge) and position of the diameter center axis
- GAP: Gap (distance from first dark-light edge to light-dark edge) and position of the gap center axis
- SEGMENT: Segment (difference between the two selected edges and positions of the various center axes)
  See DEFSEG1...DEFSEG8

The position is the distance to the beginning of the line (see MEASDIR).

12.10.2 Edge Search Direction

```
SEARCHDIR STANDARD|INVERSE
```

Sets the edge search direction.

- STANDARD: Searches for edges by moving away from the mounting rail (the first edge is the one next to the mounting rail)
- INVERSE: Searches for edges by moving toward the mounting rail (the first edge is the one furthest away from the mounting rail)

12.10.3 Measurement Direction

```
MEASDIR STANDARD|INVERSE
```

Sets the measurement direction for the edges.

- STANDARD: The measurement direction begins at the start of the measuring range (SMR, mounting rail) and moves toward the end of the measuring range.
- INVERSE: The measurement direction begins at the end of the measuring range (EMR) and moves toward the start of the measuring range (mounting rail).

12.10.4 Number of Expected Edges

```
EXPEDGES <value>
```

Defines the number of expected edges for the ERROROUT command.

- Value: 0 ... 251

12.10.5 Defining 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>
```

Select the edges for each of the segments 1-8 (edge = 0...252 (252: last edge)).

12.10.6 Setting the Measuring Rate

```
MEASRATE <frequency>
```

Defines the measuring rate (frequency) in kHz.

12.10.7 Frame Averaging

```
FRAME_AVG [ON|OFF]
```

Switches frame averaging on or off. This command corresponds to frame averaging in the context of data acquisition.

12.10.8 Range of interest

```
ROI <begin> <end>
```

Defines the region of interest (0 <= begin < end <= 2047).

12.10.9 Edge filter

```
EDGEFILTER1 [ON|OFF [<low> <high> [<ignoreval>]]]
EDGEFILTER2 [ON|OFF [<low> <high> [<ignoreval>]]]
```

Edge filters 1 and 2 prevent signal jumps when measuring over rising edges and steps.

- ON|OFF: Activate or deactivate the edge filter
- Low: Limit value at which the filter is switched off. Value range: -2147.0 ... 2147.0 (unit mm)
- High: Limit value at which the following measured values are replaced by the last measured value before the limit value is exceeded Value range: -2147.0 ... 2147.0 (unit mm)
- ignoreVal: Maximum number of measured values for which the edge filter is applied.

12.10.10 Outputting a Signal with the Edge Filter

```
EDGEFILTER1SIGNAL [<signal>]
EDGEFILTER2SIGNAL [<signal>]
```

Sets or displays the selected signal for edge filter calculation 1 or 2. The META_EDGEFILTER1SIGNAL and META_EDGEFILTER2SIGNAL commands list all the available signals that can be used for the output.

12.10.11 List of Edge Filter Signals

```
META_EDGEFILTER1SIGNAL
META_EDGEFILTER2SIGNAL
```

Lists all the available signals that can be selected for the EDGEFILTER1SIGNAL and EDGEFILTER2SIGNAL commands.

12.10.12 Switching the LED On and Off

```
LED OFF | ON
```

Switches the LED on or off.

12.11 Edit measured value

12.11.1 Tilt Correction

```
TILTCORRECTION [ON|OFF]
```

Switches tilt correction on (ON) or off (OFF).

12.11.2 Calculation, Computing Module, Averaging

```
COMP [<id>]
COMP <id> MEDIAN <signal> <median data count>
COMP <id> MOVING <signal> <moving data count>
COMP <id> RECURSIVE <signal> <recursive data count>
COMP <id> CALC <factor1> <signal> <factor2> <signal> <offset> <name>
COMP <id> THICKNESS <signal> <signal> <name>
COMP <id> COPY <signal> <name>
COMP <id> NONE
```

The COMP command can be used to display, create, adjust, or delete individual settings for data processing and calculation processes. The MEDIAN, MOVING, and RECURSIVE averaging functions affect the <signal> output signal.

Value	Meaning
id	1 ... 10
signal	A measurement data signal (see META_COMP)
median data count	3|5|7|9
moving data count	2|4|8|16|32|64|128|256|512|1024|2048|4096
recursive data count	2 .. 32767
factor 1	-32768.0 .. 32767.0 (unit mm)
factor 2	-32768.0 .. 32767.0 (unit mm)
offset	-2147.0 .. 2147.0 (unit mm)
name	The name of the new signal. Names must have at least 2 characters and can contain a maximum of 5. The following characters are permitted: a-zA-Z0-9_. Each name must begin with a letter of the alphabet: a-zA-Z. Some names are not allowed, e.g., STATISTIC, MASTER, NONE, ALL.

List of predefined functions:

- MEDIAN: Sorts the last <median data count> values and outputs the middle value. Useful, for example, for eliminating spikes.
- MOVING: Outputs an average of the last <moving data count> values.

- RECURSIVE: The averaging function uses the previous average value when calculating the new average value. This permits a high degree of smoothing of the measurement values. A higher <recursive data count> will result in greater smoothing.
- CALC: Used to define custom calculations with one or more signals. The calculation will be performed as follows: (<factor1> * <signal>) + (<factor2> * <signal>) + <offset> The result of the calculation will be placed inside a new signal <name>.
- THICKNESS: Used to calculate the difference between two signals. This can also be achieved using a CALC calculation such as: (1 * <signal>) + (-1 * <signal>) + 0
- COPY: Used to make a copy of a signal.
- NONE: A special option for deleting an entry.

12.11.3 List of Possible Calculation Signals, Computing Module

```
META_COMP [<id>]
```

Lists the signals that can be used for the COMP command. The COMP command imposes restrictions concerning which signals can be used when, and in terms of which signals are permitted.

- id: 1 ... 10

12.11.4 Statistic Signals

```
META_STATISTICSIGNAL
```

Lists all the signals that are available for the STATISTICSIGNAL command.

12.11.5 Statistics signals settings

```
STATISTICSIGNAL [<signal>]
STATISTICSIGNAL <signal> NONE|INFINITE|<depth>
```

Display, configure or delete entries for the statistics settings

Entries for statistics settings generate new signals in the form of:

- <signal>_MIN
- <signal>_MAX
- <signal>_PEAK

These new signals output the minimum value, maximum value and peak value (maximum - minimum) of the last <depth> measurement cycle of <signal>. The INFINITE option can be selected instead of a fixed depth and causes the new signals to contain the statistics of all <signal> data. The NONE option is used to delete the statistical configuration. The STATISTIC and RESETSTATISTIC commands are used to reset the values for the new signals. The META_STATISTICSIGNAL command lists all available signals that can be used for this command.

- Signal: Measurement data signal (see META_STATISTICSIGNAL)
- Depth: 2|4|8|...|8192|16384
  Number of measured values used to calculate the statistical values of a signal.

12.11.6 Selecting Statistic Signals

```
META_STATISTIC
```

Lists all the signals configured with STATISTICSIGNAL that can be selected for the STATISTIC command.

12.11.7 Resetting Statistics

`STATISTIC ALL|<signal> RESET`

Resets the values for the STATISTICSIGNAL command.

- <signal>_MIN
- <signal>_MAX
- <signal>_PEAK
- signal: Measurement data signal (see META_STATISTIC)

12.11.8 List of Possible Mastering Signals

`META_MASTERSIGNAL`

Lists all the available signals that can be selected for the MASTERSIGNAL commands.

12.11.9 Configuring the Master Signal

`MASTERSIGNAL [<signal>]`

`MASTERSIGNAL <signal> <master value>`

`MASTERSIGNAL <signal> NONE`

- <signal> A measurement data signal (see META_MASTERSIGNAL)
- <master value> A value in mm between -2147.0 and 2147.0

For displaying, setting, or deleting master entries. The master value is the value with which the current measured value is aligned if mastering has been activated. Mastering can be activated with the MASTER command. The META_MASTER-SIGNAL command lists all the available signals that can be used for this command. The display output shows all signals and their currently set master values.

12.11.10 List of Configured Mastering Signals

`META_MASTER`

Lists the signals (configured with the MASTERSIGNAL command) that can be selected for the MASTER command.

12.11.11 Master Settings

`MASTER [<signal>]`

`MASTER [ALL|<signal> [SET|RESET]]`

Defines the mastering settings or displays the current master settings.

The SET master function takes a current measured value from <signal> and <signal> master value (configurable via MASTERSIGNAL) in order to define the offset. The offset is then applied to all subsequent measured values.

Example: If the master value is 0 and <signal> has a value of 0.5 mm according to the latest measurement, then an offset of -0.5 mm is applied to <signal>. The RESET function resets the offset to 0. The display output provides a list of signals and shows the word ACTIVE if mastering is currently active for the signal concerned. If mastering is not active, it shows the word INACTIVE.

- signal: A measurement data signal (see META_MASTER)

12.12 Data Output

12.12.1 Digital Output Selection

```
OUTPUT [NONE|([RS422] [ETHERNET] [ANALOG] [ERROROUT])]
```

Defines the interface for transmitting the measured values or displays the current setting.

- NONE: No output
- RS422: Output via RS422 (see OUT_RS422)
- ETHERNET: Output via Ethernet (see OUT_ETH)
- ANALOG: Output via analog output (see ANALOGOUT)
- ERROROUT: Error/status information is output via the error output (see ERRORLIMITSIGNAL1 and ERRORLIMIT-SIGNAL2)

12.12.2 Selecting the Interface for a Reduced Data Rate

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

Defines the interface via which the output of measured values is to be reduced by only transmitting every nth measured value.

- NONE: No reduction in data output
- RS422: Reduced data output via RS422
- ANALOG: Reduced data output via ANALOG
- ETHERNET: Reduced data output via ETHERNET

12.12.3 Reducing Data Output

```
OUTREDUCECOUNT [<n>]
```

Defines or displays the interval for the packets.

Reduces the data output by transmitting only every nth measurement packet.

- n: 1 ... 3000000 packet intervals (1 means that all packets will be transmitted)

12.12.4 Error Handling

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

Defines how measured values should be output in the event of an error.

- NONE: No hold period, error values are output
- INFINITE: Retains the last measured value infinitely
- n: 1 ... 1024

  Retains the last measured value for a maximum of <n> measurement cycles affected by errors; after that, error values are output.

12.13 Selecting the Measured Values to be Output

12.13.1 Selecting Ethernet Signals

```
OUT_ETH [<signal1>] [<signal2>] ... [<signalN>]
```

Defines the signals that are to be output via Ethernet. The META_OUT_ETH command lists all the signals available for the output.

12.13.2 Signals for Ethernet Output

`META_OUT_ETH [MEAS|VIDEO|CALC]`

Lists all the available signals that can be selected for the OUT_ETH command.

If one of the options MEAS, VIDEO, or CALC is available, the output is filtered and only the selected signal is displayed.

12.13.3 Information About the Output of Values via Ethernet

`GETOUTINFO_ETH`

Lists all selected output signals for the Ethernet interface.

12.13.4 Selecting RS422 Signals

`OUT_RS422 [<signal1>] [<signal2>] ... [<signalN>]`

Defines the signals that are to be output via RS422. The META_OUT_RS422 command lists all the signals available for the output.

12.13.5 Signals for RS422 Output

`META_OUT_RS422 [MEAS|VIDEO|CALC]`

Lists all the available signals that can be selected for the OUT_RS422 command.

If one of the options MEAS, VIDEO, or CALC is available, the output is filtered and only the selected signal is displayed.

12.13.6 Information About the Output of Values via RS422

`GETOUTINFO_RS422`

Lists all selected output signals for the RS422 interface.

12.14 Switching output

12.14.1 Limit Value Type for Switching Outputs

```
ERROROUT1 NONE|ERRORLIMIT|EXPEDGES
ERROROUT2 NONE|ERRORLIMIT|EXPEDGES
ERROROUT3 NONE|ERRORLIMIT|EXPEDGES
```

The command defines the signal output for the relevant switching output.

- NONE: No switching outputs
- ERRORLIMIT: Error limit defined by the commands
  `ERRORLIMITSIGNAL1, ERRORLIMITVALUES1, and ERRORLIMITCOMPARETO1`
  `ERRORLIMITSIGNAL2, ERRORLIMITVALUES2, and ERRORLIMITCOMPARETO2`
  `ERRORLIMITSIGNAL3, ERRORLIMITVALUES3, and ERRORLIMITCOMPARETO3`
- EXPEDGES: Error output if CNT_EDGE does not match the value of the EXPEDGES command.

12.14.2 Possible Signals for Error Outputs

```
META_ERRORLIMITSIGNAL1
META_ERRORLIMITSIGNAL2
META_ERRORLIMITSIGNAL3
```

Lists all the available signals that can be selected for the corresponding ERRORLIMITSIGNAL1, ERRORLIMITSIGNAL2, and ERRORLIMITSIGNAL3 commands.

12.14.3 Assigning the Error Output Signal

```
ERRORLIMITSIGNAL1 [<signal>]
ERRORLIMITSIGNAL2 [<signal>]
ERRORLIMITSIGNAL3 [<signal>]
```

The command defines or displays the signal for the corresponding switching output. This setting applies to the digital inputs and outputs (see OUTPUT ERROROUT).

The META_ERRORLIMITSIGNAL1, META_ERRORLIMITSIGNAL2, and META_ERRORLIMITSIGNAL3 commands list all the available signals of the corresponding switching outputs that can be used for the output.

See also ERRORLIMITCOMPARETO1 and ERRORLIMITVALUES1, ERRORLIMITCOMPARETO2 and ERRORLIMITVALUES2, ERRORLIMITCOMPARETO3 and ERRORLIMITVALUES3.

12.14.4 Setting the Upper (Overshooting)/Lower (Undershooting) Limit Value for the Switching Outputs

```
ERRORLIMITCOMPARETO1 [LOWER|UPPER|BOTH]
ERRORLIMITCOMPARETO2 [LOWER|UPPER|BOTH]
ERRORLIMITCOMPARETO3 [LOWER|UPPER|BOTH]
```

The command defines or returns the limit value for the corresponding error output.

- LOWER: Undershooting
- UPPER: Overshooting
- BOTH: Undershooting or overshooting

12.14.5 Limits for Overshooting/Undershooting of Switching Outputs

```
ERRORLIMITVALUES1 [<lower limit [mm]> <upper limit [mm]>]
ERRORLIMITVALUES2 [<lower limit [mm]> <upper limit [mm]>]
ERRORLIMITVALUES3 [<lower limit [mm]> <upper limit [mm]>]
```

This command defines the lower and upper limit values for the relevant switching output or displays the current setting.

The settings are applied to the relevant digital input/output (see ERROROUT1, ERROROUT2, ERROROUT3).

The ERRORLIMITCOMPARETO1, ERRORLIMITCOMPARETO2, and ERRORLIMITCOMPARETO3 commands define whether the lower limit value, upper limit value, or both limit values should be applied.

- <lower limit [mm]> = -2147.0 ... 2147.0
- <upper limit [mm]> = -2147.0 ... 2147.0

12.14.6 Switching Output Hold Period

`ERROROUTHOLD1 <hold period [ms]>`

`ERROROUTHOLD2 <hold period [ms]>`

`ERROROUTHOLD3 <hold period [ms]>`

This command defines the minimum hold period for the limit value of the ERROROUT1, ERROROUT2, ERROROUT3 commands.

See also:

`ERRORLIMITVALUES1`

`ERRORLIMITVALUES2`

`ERRORLIMITVALUES3`

- <hold period [ms]> = 0 ... 10000 [ms]

12.14.7 Switching Behavior of Error Outputs

`ERRORLEVELOUT1 [NPN|PNP|PUSHPULL|PUSHPULLNEG]`

`ERRORLEVELOUT2 [NPN|PNP|PUSHPULL|PUSHPULLNEG]`

`ERRORLEVELOUT3 [NPN|PNP|PUSHPULL|PUSHPULLNEG]`

This command defines the output type for the relevant switching output or displays the current setting.

12.15 Analog Output

12.15.1 Selecting the Signal for the Analog Output

`ANALOGOUT [<signal>]`

Select a signal for the analog output

- signal: Signal selected for output. The META_ANALOGOUT command lists all the signals available for an output.

12.15.2 Possible Signals for Analog Output

`META_ANALOGOUT`

Lists the available signals that can be used for the ANALOGOUT command.

12.15.3 Selecting the Output Range for the Analog Output

`ANALOGRANGE [0-5V|0-10V|4-20MA]`

Defines the output range for the analog output.

- 0-5 V: Measured value is specified in the 0-5 V range.
- 0-10 V: Measured value is specified in the 0-10 V range.
- 4-20mA: Measured value is specified in the 0-20 mA range.

12.15.4 Scaling of the Analog Output

`ANALOGSCALEMODE [STANDARD|TWOPOINT]`

Set or adjust the scaling of the analog output.

- STANDARD: Use measuring range of sensor
- TWOPOINT: The measured values are scaled to the range specified by the ANALOGSCALERANGE command.

12.15.5 Selecting the Scaling Range for the Analog Output

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

Sets the upper and lower scaling values for the analog output. The unit is mm.

- <limit 1> = (-2147.0 ... 2147.0) [mm], must not be the same as <limit 2>.
- <limit 2> = (-2147.0 ... 2147.0) [mm], must not be the same as <limit 1>.

12.16 Measurement Data Format

12.16.1 Transmission of Measurement Data to a Measured Value Server via Ethernet

When measured value data are transmitted to a measured value server, the sensor/controller sends each measured value to the measured value server or to the connected client after the connection (TCP or UDP) has been successfully established. No specific request is required for this.

All distances and additional information intended for transmission that were captured at a certain time are consolidated into a measured value frame. Several measured value frames are consolidated into a measured value block. This block is provided with a header and fits inside a TCP/IP or UDP/IP packet. It is absolutely essential for the header to be located at the beginning of a UDP or TCP packet. In the event of changes to the transmitted data or the frame rate, a new header is sent automatically.

All measurement data and the header are transmitted in little-endian format.

The same header structure is used for transferring video and measurement data and includes the following:

- Preamble (32 bits)
- Article number (32°bits)
- Serial number (32°bits)
- Length of video data (32 bits)
- Length of measurement data (32 bits)
- Number of frames (32 bits)
- Counter (32 bits)

Header entry	Description
Preamble	uint32_t - 0x41544144 “DATA”
Article number	
Serial number	
Length of video data	[bytes]
Length of measurement data	[bytes]
Number of frames	Number of frames covered by this header. In the case of video output, the field for the number of measurement data frames is set to one in the packet.
Counter	Number of frames covered by this header. In the case of video output, the field for the number of measurement data frames is set to one in the packet.

Fig. 12.1: Details of a header

Each data packet contains at least one measurement data frame and usually contains several.

Each measurement data frame includes one or more signals. The content of a measurement data frame can be set using the OUT_ETH command. The structure of a measured value frame can be queried via GETOUTINFO_ETH.

Each pixel of the video signal is represented by a 16-bit word. The value range used is 0 … 4095.

The measured values are represented as a 32-bit signed integer with a resolution of 10 nm.

12.16.2 Data Format of RS422 Interface

Video Signal

Description	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Pixel 1 (14 bits)	1	D00 ... D06						
	0	D07 ... D13						
Pixel n (14 bits)	1	D00 ... D06						
	0	D07 ... D13						
Pixel 512 (14 bits)	1	D00 ... D06						
	0	D07 ... D13						
Footer	0	0	0	0	0	0	1	0

Output value

Description	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Measured value (32 bits)	1	D00 ... D06						
	1	D07 ... D13						
	1	D14 ... D20						
	0	D21 ... D27						
	0	0	0	0	D28 ... D31			
Footer	0	0	0	0	0	0	0	0

12.16.3 Output values, data type and unit

Parameter	Signal	Data type / Value range	Scaling	Unit
MEASRATE	Sample rate	unit32_t 2000 ... 100000	10000 / value	kHz
TIMESTAMP	Time stamp	unit32_t 0 ... 2^32 - 1	value	µs
COUNTER	Measurement frame counter	unit32_t 0 ... 2^32 - 1		
STATE	Status word	unit32_t 0 ... 2^32 - 1	Bit 0: Status switching output 3 Bit 1: Switching output 3 active Bit 3: Encoder 1 track index status Bit 4: Encoder status 1 track B Bit 5: Encoder status 1 track A Bit 7: Trigger Bit 8: Status switching output 1 Bit 9: Switching output 1 active Bit 10: Status switching output 2 Bit 11: Switching output 2 active Bit 12: Sync/Trig active Bit 13: Status Sync/Trig Bit 14: Synchronization error Bit 15: Triggered frame Bit 24: Status LED Bit 26: Ethernet link LED Bit 27: Ethernet speed LED	
RAW	Raw signal (2048 x 16 bits)	0 ... 1023	value / 1024 * 100	%
RAW2D	reduced 2D raw signal (512 x 128 pixels * 1 bit	0 ... 1	View LSB as the first pixel of the image	Bright pixel
LIGHT	Light-corrected signal (2048 x 16 bits)	0 ... 1023	value / 1024 * 100	%

SHUTTER	Integration time (constant):	uint32 85	value / 10	µs
ENCODER1	Encoder value 1	unit32_t 0 ... 2^32 - 1		Ticks
CNT_EDGE	Number of edges	0 ... 0x7FF		Number
CNT_PIN	Number of pins	0 ... 0x7FF		Number
CNT_GAP	Number of gaps	0 ... 0x7FF		Number
TRIGGERTIMEDIFF	Trigger time difference describes the time between the start of the image and the set trigger signal	unit32_t 0 ... 100000	value / 10	µs
*[A|B]T		-18000 ... +18000	value / 100	Degrees
*[A|B|C|D]		0 ... 7FFFFEFF	value / 100000 0x7FFFFF04 No edge is present 0x7FFFFF07 Measured value cannot be calculated 0x7FFFFF08 Measured value is outside the displayable range	mm
USERNAMED VALUES		0 ... 7FFFFEFF	wie *[A|B|C|D]	mm

MICRO-EPSILON Eltrotec GmbH
Manfred-Wörner-Straße 101 73037 Göppingen / Germany
Tel: +49 (0) 7161 / 98872-300
E-Mail: eltrotec@micro-epsilon.de
www.micro-epsilon.com/contact/worldwide/

X9751487-A012074MSC