WELOTEC®

OWLL SERIES - LASER DISTANCE SENSORS
MANUAL

WELOTEC

Welotec GmbH
Zum Hagenbach 7, D-48366 Laer
T: +49 (0)2554/9130-00
F: +49 (0)2554/9130-10
info@welotec.com

www.welotec.com

Contents

1 General information

1.1 Concerning the contents of this document

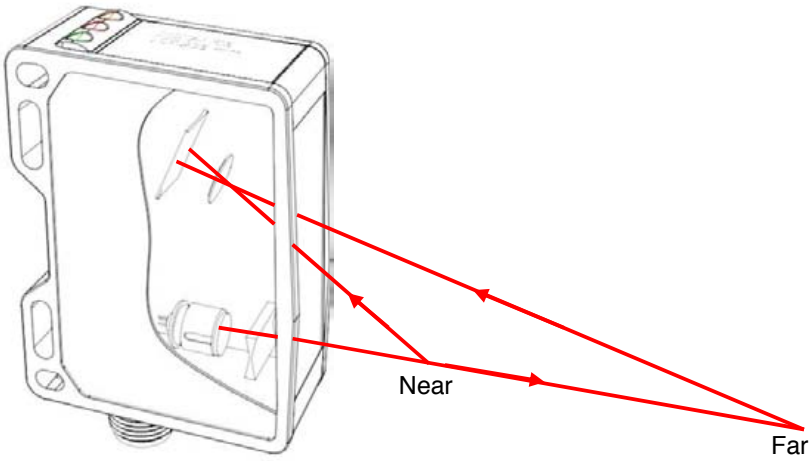
This manual contains information about the installation and initial setup of Welotec OWLL laser point / laser line sensors.
It is a supplement to the mounting instructions supplied with each sensor.

Read these operating instructions carefully and follow the safety instructions!

1.2 Intended use

The Welotec OWLL laser point / laser line sensor measures distances to objects. It was specially developed for easy handling, flexible use, and highly accurate measurement.

1.2.1 Functional principle of triangulation

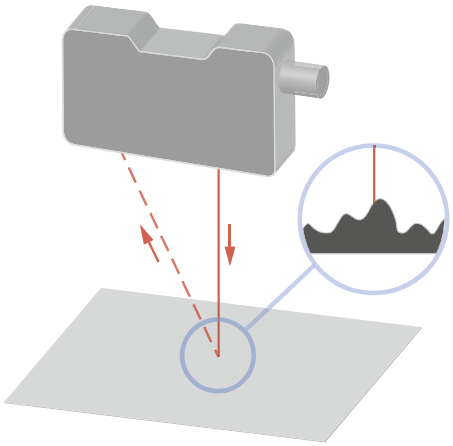


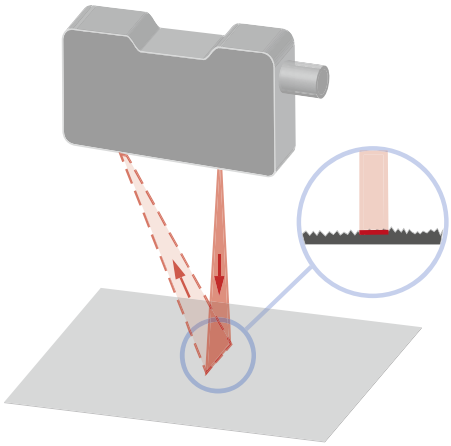
In the triangulation principle, the sensor transmits a light point or light beam to the object to be measured, and the reflected light strikes a receiver line in the sensor at a special angle. Depending on the distance, the angle of incidence changes and thus so does the position of the light spot or light beam on the receiver. The micro-controller allows the suppression of interfering reflections, thus providing reliable data even on critical surfaces.

1.2.2 Laser point or laser line

OWLL laser point
For small objects, if accurate positioning of the laser point is important, or for sharp transitions, a sensor with a laser point is suitable.

OWLL laser line
Stable measurements on rough surfaces and textured color surfaces thanks to a fine laser line < 10 mm





1.3 Safety

NOTE
Provides helpful operation instructions or other general recommendations.

ATTENTION!
Indicates a potentially hazardous situation. Avoid these situations in order to prevent any personal injury or damage to the device.

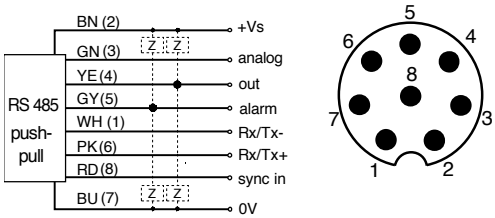
2 Quick start-up guide

After connection and installation, the sensor is configured using the display. The sensor is then ready for operation and shows the measured value in mm on the screen. Optionally, the analog output can also be limited or the switching output configured.

1	Connection
2	Installation
3	Application-specific settings
4	Let's get started

1 Connection

Connect the sensor according to the connection diagram. A shielded connection cable (8-pole M12) must be used.
When everything is correctly connected, the sensor starts up.



Key functions

ESC	= Back
ESC 2 sec.	= Run mode
UP	= Up/increase value
DOWN	= Down/decrease value
SET	= OK
SET 2 sec.	= Save value

Slide over all 4 keys:

---->	= Enables the panel if locked
<----	= Jump to run mode

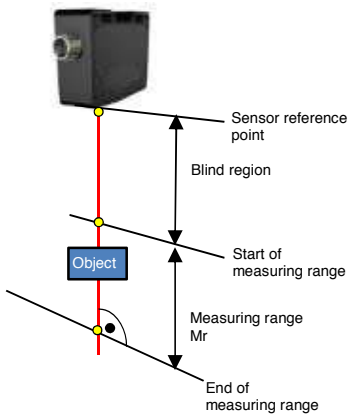
Setting the language

The language is selected and confirmed by pressing SET for 2 seconds.

English
Deutsch
Italiano
Français

2 Installation

For standard applications, the sensor is mounted and aligned at right angles to the measuring axis. See Alignment Chapter.
The object must be within the measuring range Mr, i.e. between the start of the measuring range Sdc, and the end of the measuring range Sde.



3 Application-specific settings

The sensor indicates the distance to the object, measured from the front surface.

Precision (filter)

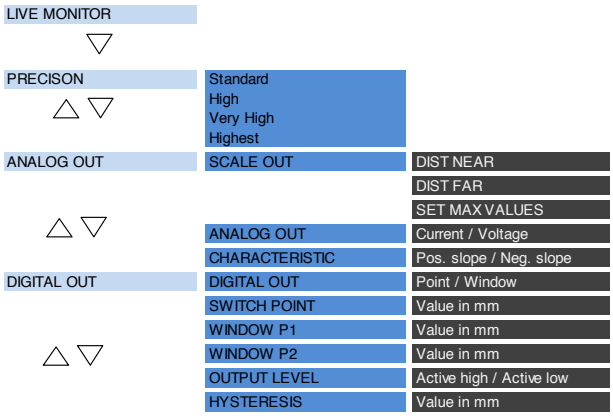
To achieve better resolution, it is possible to alternate between Standard, High, Very High and Highest by filtering the output values.

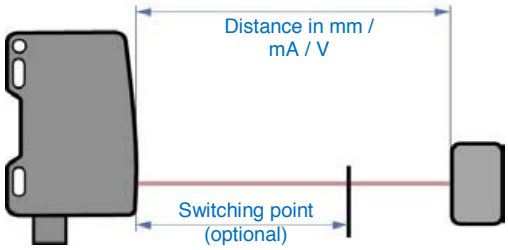
Analog Out

With SCALE OUT, the start of measuring range Sdc and the end of measuring range Sde can be changed, thus optimizing resolution and linearity of the analog output. 0V or 4 mA apply for the start of measuring range Sdc, and 10V or 20 mA apply for the point at the end of measuring range Sde. The voltage or current output is also selected under ANALOG OUT. The characteristic curve can also be inverted under CHARACTERISTIC.

Digital output (switching point)

The sensor is equipped with a switching output that can be configured either as a THRESHOLD or as a WINDOW using the DIGITAL OUT function.
Threshold: As soon as the measured value exceeds the specified threshold, the switching output is switched.
Window: As soon as the measured value is outside the specified window, the switching output is switched. The output level can also be inverted and the hysteresis set here.





4 Let's get started

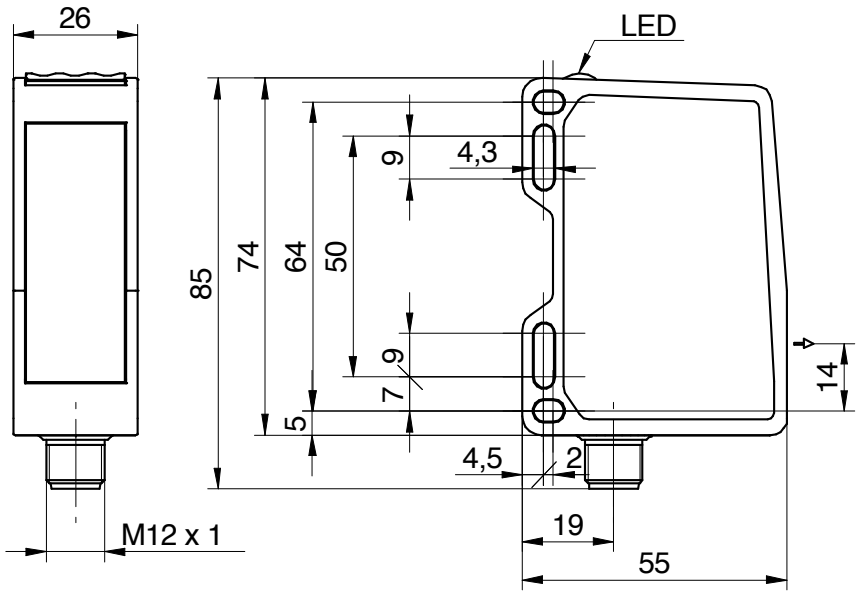
The sensor continuously shows the measured value in mm on the display and transmits it to the controller through the analog output. Alternatively, the measuring value can also be retrieved from the RS-485 interface.

3 Mounting and connections

ATTENTION!

Connection, installation and commissioning may only be performed by qualified personnel. Protect optical surfaces from moisture and dirt.

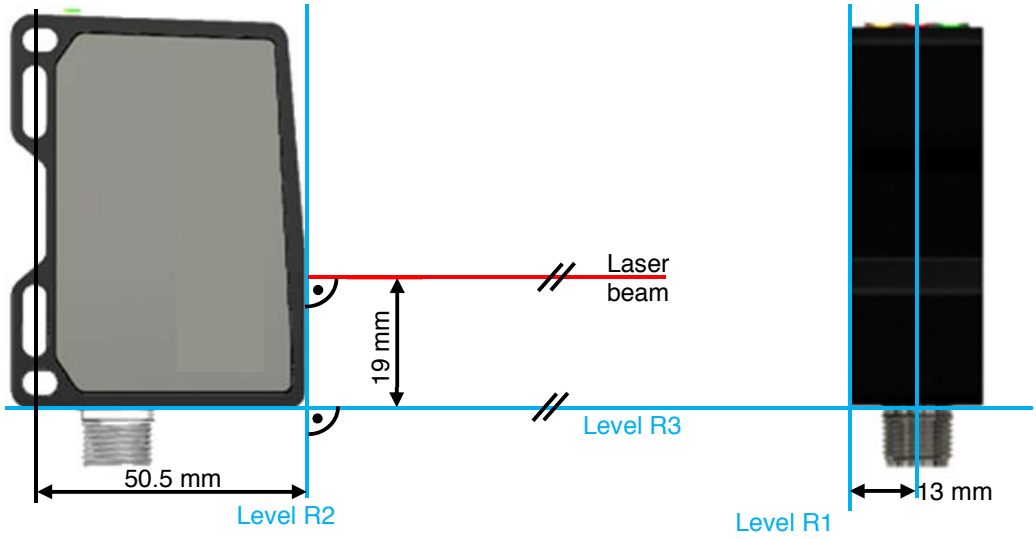
3.1 Dimensions



*Optical axis

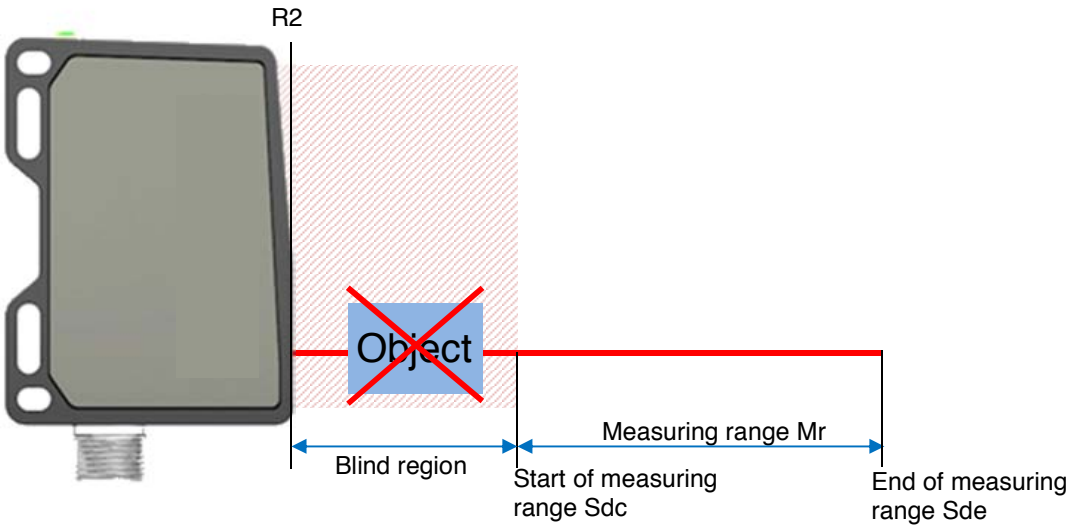
3.1 Sensor reference levels

The sensor can be aligned by the following surfaces:
The laser beam of the sensor runs parallel (//) to level R3 and is at a right angle to levels R1 and R2. Levels R1, R2, and R3 serve as a reference for sensor alignment during installation.



3.2 Definition of the measuring range

The sensor measures distances within the measuring range. The important definitions are described in the following figure. The reference level R2 applies as a reference for 0.



3.2.1 Blind region

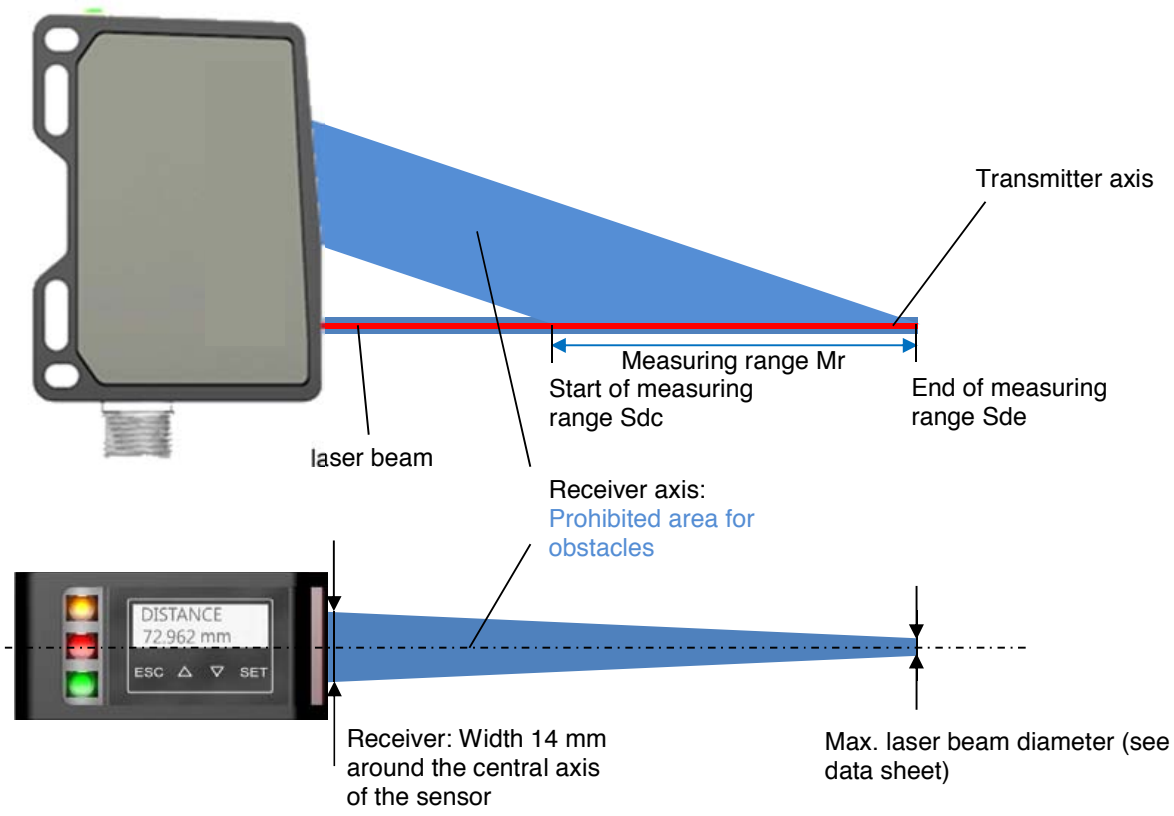
The area from the reference level R2 up to the start of measuring range Sdc is called the blind region, the sensor cannot detect any objects there.
If there are any objects in this region, this can lead to incorrect measured values.

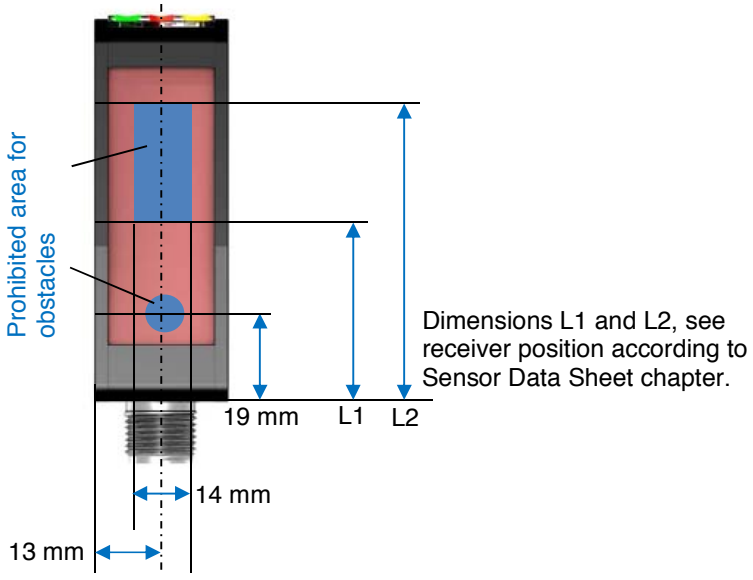
NOTE

See chapter ANALOG OUT for further information on the analog output.

3.2.2 Transmitter and receiver axis

The transmitter and receiver axes must not be covered by obstacles, since this could adversely affect precise measurements.



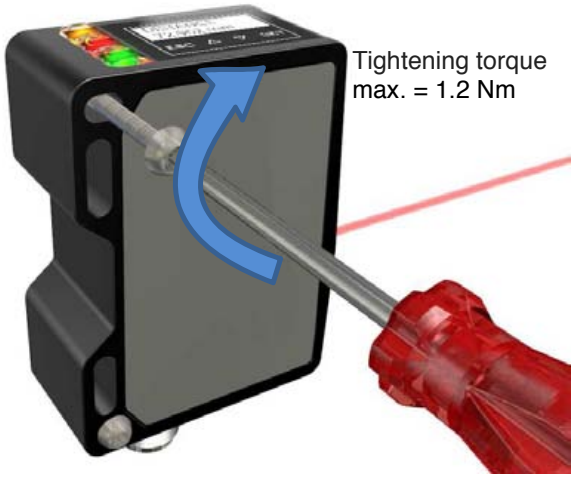


3.2.3 qTarget

The field of view is aligned with the housing reference surfaces at the factory. The beam position is in the same place for every sensor, which simplifies planning and sensor replacement.

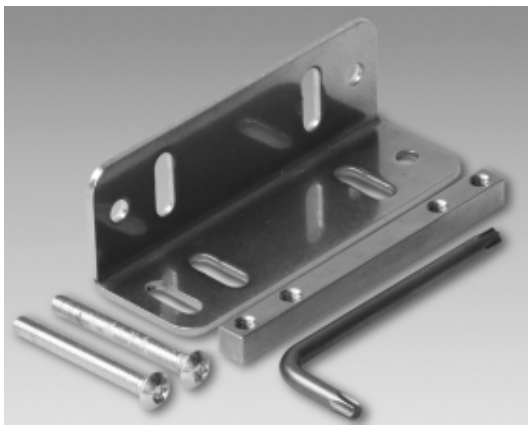
3.3 Mounting

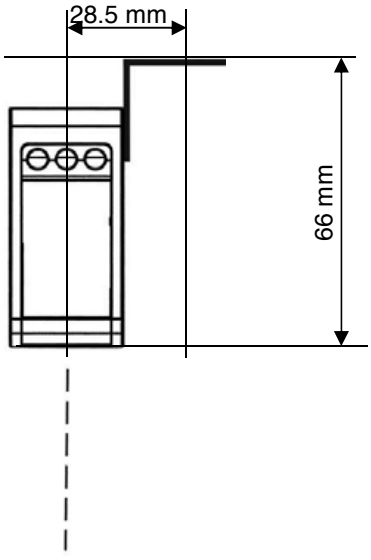
The sensor has four mounting holes for flexible alignment and mounting. The use of 2 M4x35 screws as well as suitable washers is recommended for mounting. The tightening torque is max. 1.2 Nm.



3.3.1 Mounting kit for standard installation

With the mounting bracket for standard installation, the sensor can be mounted quickly and easily at a 90° angle to the reference surface.





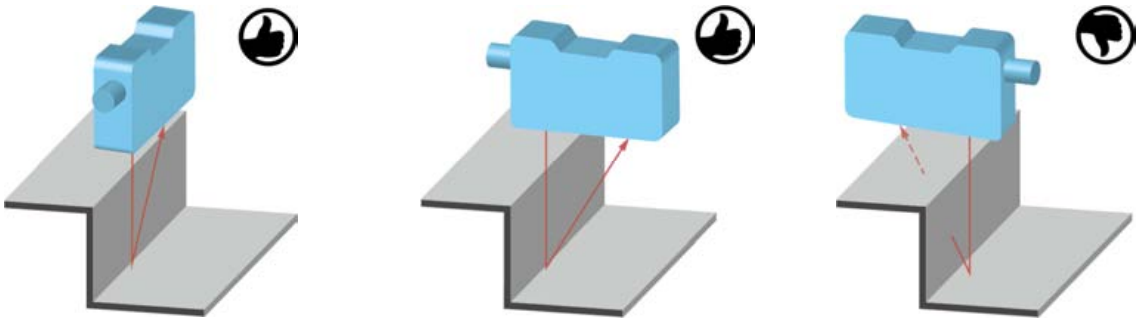
Mounting kit
Contents of this set:

- 90° mounting bracket
- Threaded plate
- 2x spherical head screw M4x35 Torx
- 1x Torx tool T20

3.4 Alignment

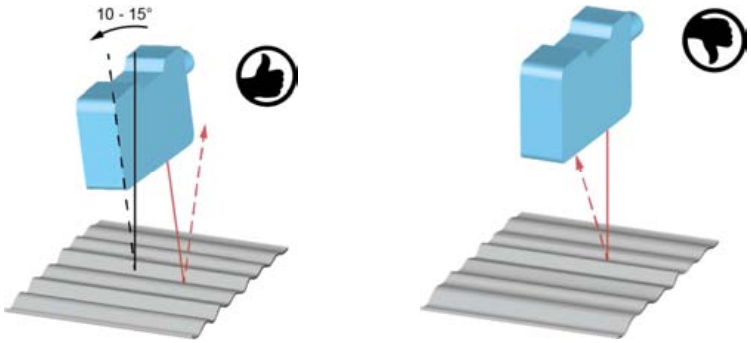
To achieve as reliable and exact measured values as possible, the following hints and tips for mounting should be followed.

3.4.1 Steps / edges



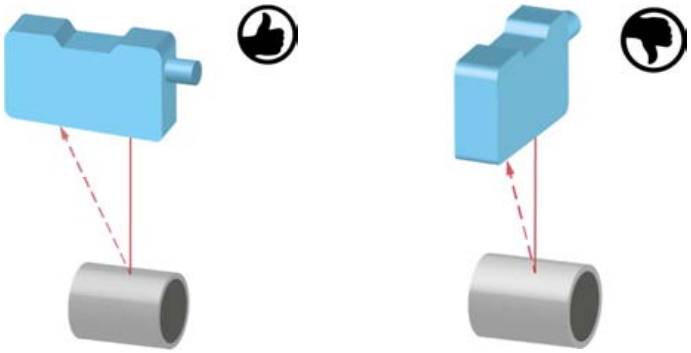
If measurements are carried out directly beside steps/edges, make sure that the reception beam is not covered by the step/edge. The same applies when the depth of holes and cracks is measured.

3.4.2 Shiny surfaces



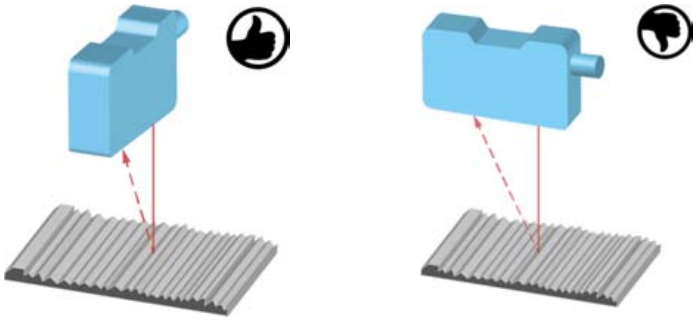
With shiny surfaces, it is important to ensure that the direct reflection does not strike the receiver. This can be prevented by tilting the sensor slightly. To check this, place a sheet of white paper on the disc of the receiver; the direct reflection can then be seen clearly.

3.4.3 Round, shiny surfaces



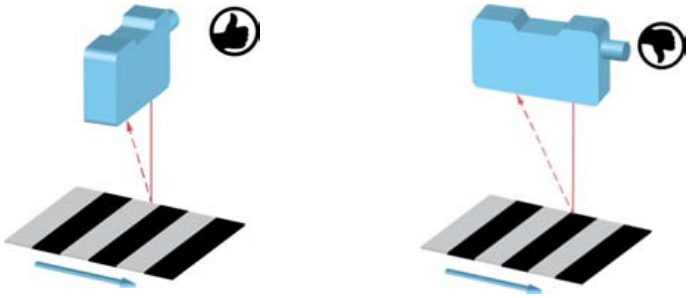
With round, shiny surfaces, the sensor should be aligned in the same axis as the round object in order to avoid reflections.

3.4.4 Shiny objects with evenly aligned structure



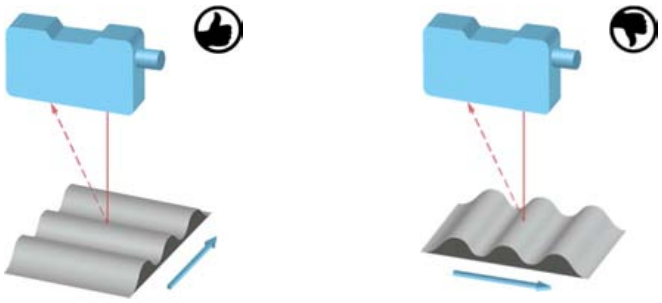
Particularly with shiny objects, for example turned parts, ground surfaces, extruded surfaces and the like, the installation position affects the measuring result.

3.4.5 Objects with evenly aligned colored edges



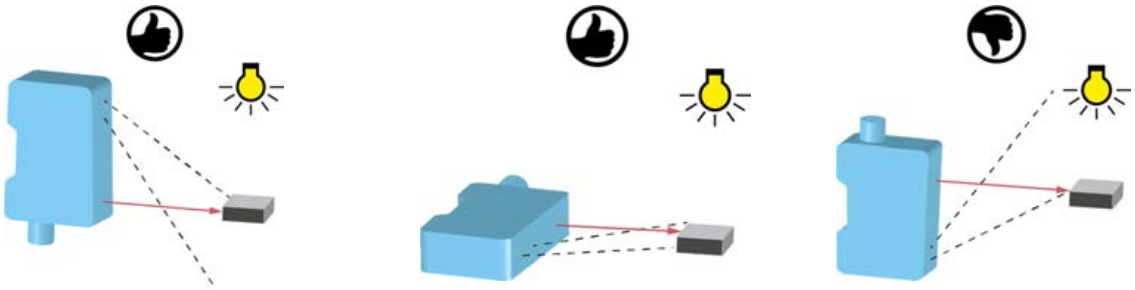
In the correct orientation, the influence on the measuring accuracy is low. In the wrong orientation, the deviations depend on the differences in reflectivity of the various colors.

3.4.6 Moving objects



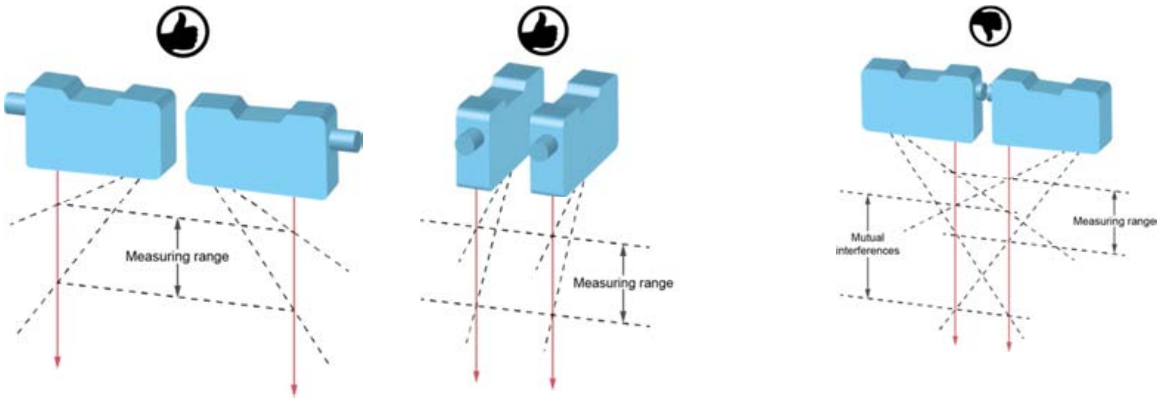
If the contour of an object is measured, it is important to ensure that the object moves at right angles to the sensor, to avoid shadowing and reflections on the receiver.

3.4.7 Protection from ambient light



When installing optical sensors, it is important to ensure that there is no strong ambient light in the area of detection of the receiver.

3.4.8 Reciprocal influence



If several optical sensors are used, they may mutually influence one another. During installation, ensure that only the sensor's own laser spot is in the detection range of the receiver. Up to a measuring range of 600 mm, the sensors can be lined up in a row without them influencing each other (picture in the middle).
If the mutual interference cannot be avoided through installation, the sensors can be operated asynchronously using the Sync-In input, see chapter TRIGGER MODE.

3.5 Connection

ATTENTION!

Incorrect supply voltage will destroy the device!

ATTENTION!

Connection, installation and commissioning may only be performed by qualified personnel.

ATTENTION!

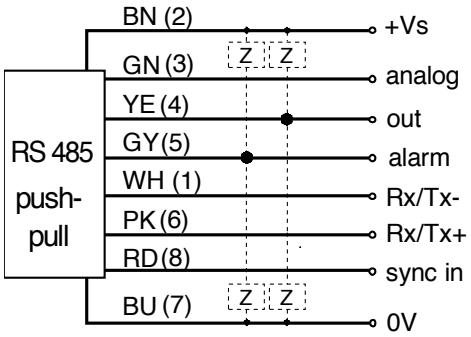
The IP protection class is valid only if all connections are connected as described in the technical documentation.

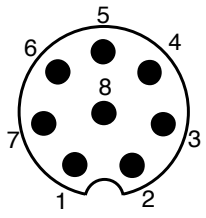
ATTENTION!

Products with laser class 1 laser beams in accordance with EN 60825-1:2014 can be operated safely without additional safety precautions. Nevertheless direct contact between the eye and beam should be avoided.

3.5.1 Pin assignment and connection diagram

	Color	Function	Description
Pin 1	WH = white	Rx/Tx-	RS 485 receive/transmit- (B)
Pin 2	BN = brown	+ Vs	Voltage supply (+15…+28 VDC)
Pin 3	GN = green	analog	Analog output (4…20 mA or 0…10V)
Pin 4	YE = yellow	out	Switching output, push-pull
Pin 5	GY = gray	alarm	Alarm output, push-pull
Pin 6	PK = pink	Rx/Tx+	RS-485 receive/transmit+ (A)
Pin 7	BU = blue	0V	Ground GND
Pin 8	RD = red	sync in	Input synchronization





Top view of plug

NOTE

We recommend that you connect unused cables to GND (0V).

3.5.2 Connection cable

An 8-pole, shielded connection cable (connector) is required.

When the analog output is used, the cable length affects signal noise. Signal noise increases the longer the connection cable is.

Analog output I_OUT

Noise: 5.92 µA (1 sigma) (10m cable and 680 Ohm)
3.59 µA (1 sigma) (2m cable and 680 ohms)

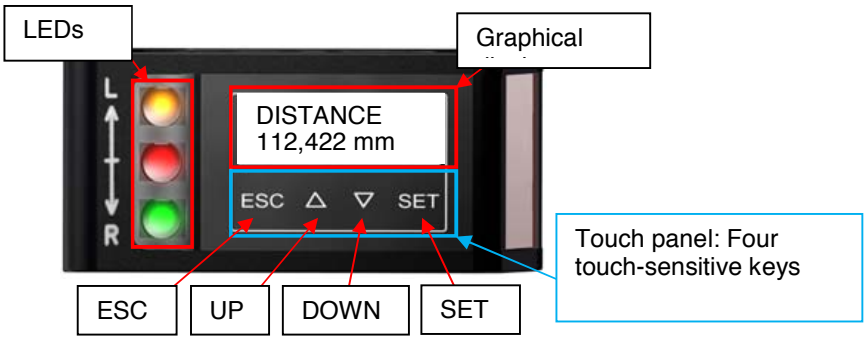
Analog output U_OUT

Noise: 4.80 mV (1 sigma) (10m cable and 100 kOhm)
3.03 mV (1 sigma) (2m cable and 100 kOhm)

We recommend that you use the RS-485 interface for high-precision applications.

4 Configuration

4.1 Overview of control elements



4.1.1 Display modes

112,422 mm	**Run mode** The sensor is in run mode, the measuring value is displayed in large characters.
DISTANCE 112,422 mm	**Main menu** In the main menu the active mode is displayed at the top, and the measuring value is displayed at the bottom.
PRECISION STANDARD	**Scroll bar** The square on the right indicates the position within the current menu. The next menu item can be accessed using the arrow keys.
PRECISION VERY HIGH	**Change value** If the function/mode at the top is highlighted in black, the value of the lower line can be adjusted using the UP/DOWN keys and saved with SET (hold).
OK	**Process successful** The display background lights up green: Value successfully saved
FAILURE	**Error** The display background lights up red: Error during the save process or wrong value entered.
	Setting mode As soon as the sensor is in setup mode, the display background lights up blue.
112,422 mm	**Keys locked** If this symbol is on the left side of the screen, the four pushbuttons are locked for operation.
DISTANCE 112,422 mm	**Warming up** The warm-up sign appears in the top right of the display. The sensor is not yet in thermal equilibrium; optimum measurement performance is reached after the symbol disappears.

4.1.2 Functions of the individual keys

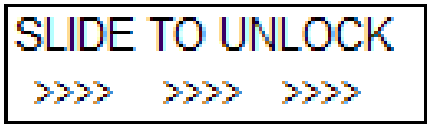
Key	Pressed briefly	Pressed >2 s.
ESC	Back	Jump to run mode
UP △	Up/increase value	
DOWN ▽	Down/decrease value	
SET	OK/submenu/next entry**	Save new value*

*Only in setup mode menu when the top line is highlighted in black (change value)
**When entering strings of numbers, use OK to jump to the right. Once the end is reached, the cursor jumps back to the left to the beginning

4.1.3 Locking the touch panel

The keys on the control panel are locked when they are not pressed for 5 minutes. A key symbol appears, and the measuring value is displayed in large lettering.

When it is pressed, the following text appears:



To re-enable the touch panel, it is required to quickly slide a finger over all four keys from left to right (slide over ESC, UP, DOWN, and SET).

When controlled via RS-485:
When the sensor is controlled using RS-485, it cannot be operated with the display at the same time. The keys are disabled. When the keys are pressed, the following text appears on the display:

RS-485 controls
the sensor

Disconnect briefly from the power supply or use an RS-485 command to enable the display and operate the sensor using the display

Locking via RS-485 command:
The sensor keys can be permanently locked with a RS-485 command. This locking remains activated even if the senor is no longer controlled via RS-485. The keys must be unlocked with a RS-485 command. When the locked keys are touched, the following text appears on the display:

RS-485 locks
the touch keys

4.1.4 Further key functions

Action	Reaction
Slide over all keys from left to right	**Unlock locked touch panel** Only if touch panel is locked
Slide over all keys from right to left	**Jump directly to run mode** Can be used from any menu

4.1.5 LEDs on the sensor

LED	Lights up	Flashes
Yellow	**out1 activated** Switching output1 active	-
Red	**out2 activated** Alarm output active. No measuring object within the field of measurement or signal quality is inadequate.	**Insufficient excess gain** Object close to signal reserve or signal quality not ideal
Green	**Supply voltage** Sensor ready for operation.	**Short circuit** Check connection at switch or alarm output.

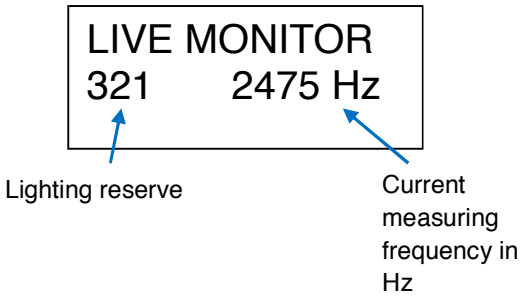
4.2 Function tree

The menu that can be accessed via the touch panel is shown below.

LIVE MONITOR		
▽		
PRECISON	Standard High Very High Highest	
△ ▽		
ANALOG OUT	SCALE OUT	DIST NEAR
		DIST FAR
		SET MAX VALUES
△ ▽	ANALOG OUT	Current / Voltage
	CHARACTERISTIC	Pos. slope / Neg. slope
DIGITAL OUT	DIGITAL OUT	Point / Window
	SWITCH POINT	Value in mm
	WINDOW P1	Value in mm
△ ▽	WINDOW P2	Value in mm
	OUTPUT LEVEL	Active high / Active low
	HYSTERESIS	Value in mm
SYSTEM	TRIGGER MODE	Continuous/Single shot
	RS485 BAUD	38400 57600 115200 230400 460800 921600 1500000
△ ▽	RS485 ADDR	number
	SENSOR INFO	SENSOR TYPE
		SERIAL NUM
	LANGUAGE	English Deutsch Inglese Français
	RESET	Factory Set
SETTINGS	APPLY	Setting 1 Setting 2 Setting 3
	STORE	Setting 1 Setting 2 Setting 3
△	SHOW ACTIVE	Values
	SHOW SETTING 1	Values
	SHOW SETTING 2	Values
	SHOW SETTING 3	Values

4.3 LIVE MONITOR

The installation conditions can be checked quickly and easily by displaying the lighting reserve as well as the measuring frequency.



4.3.1 Lighting reserve

This factor specifies by how many times an object may become darker in order to obtain a valid measurement nevertheless. For a valid measurement, a minimum of factor 1 is required.
The higher this value is, the shorter the object has to be exposed, which increases the measuring frequency.
Below factor 1, the sensor gets too little light back and does not specify any measured value, the alarm output is active.

4.3.2 Measuring frequency in Hz

Displays the current measuring frequency in Hz.
For more information, see the chapter on measuring frequency, measuring repeat time and response time.

NOTE

For the fastest response time as well as maximum exposure reserve, the object should be as bright as possible (not shiny).

4.4 PRECISION

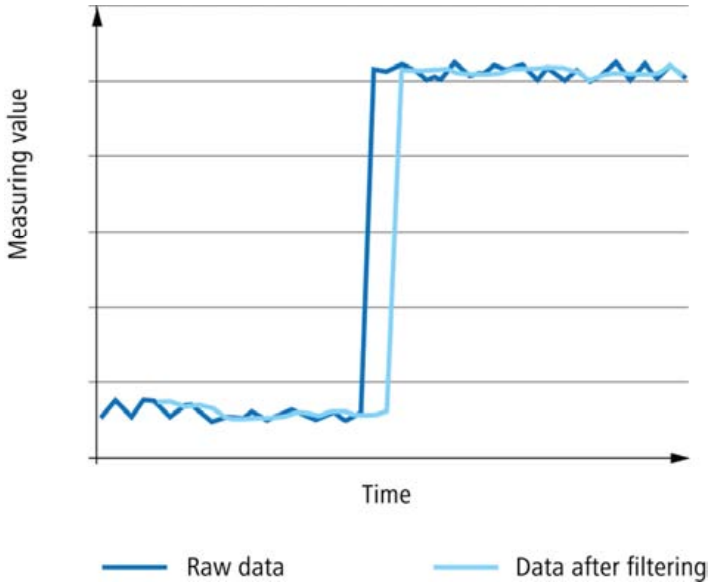
Activating filtering can reduce noise and thus increase resolution and repeat accuracy. This increases the response time, but the measuring frequency remains unchanged.

Standard	= normal resolution[1][2]
High	= resolution is approximately twice as high[1][2]
Very high	= resolution about three times as high[1][2]
Highest	= resolution about four times as high[1][2]

4.4.1 Influences of the PRECISION filter

The higher the precision is set, the more response times and release times increase, which means that the response time for moving objects slows down. The measuring frequency is not affected by the use of this filter.
PRECISION works with moving median as well as moving average filters.

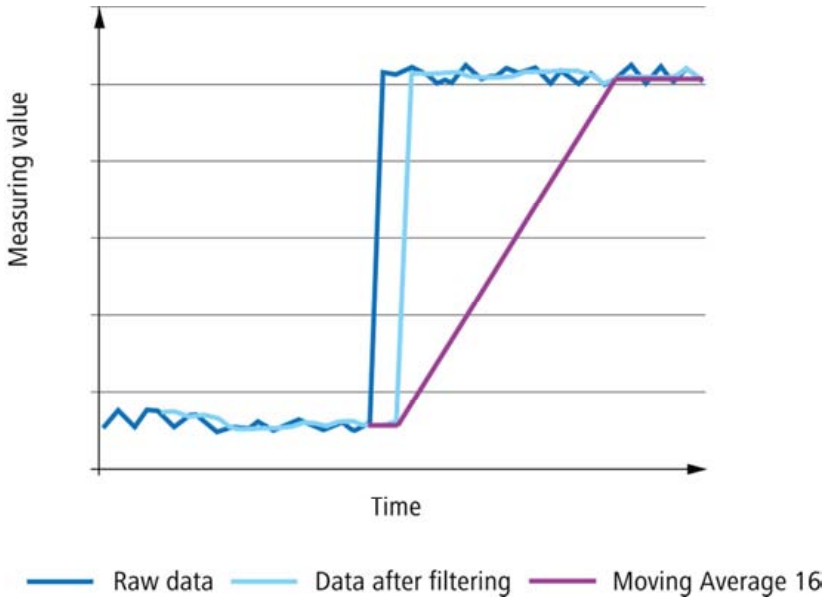
Moving median
The median of a finite list is the measurement with the middle measured value of a string of numbers (e.g. median of {3, 3, 5, 9, 11} is 5). The number of measured values saved in an array is called the number of measured values, e.g. {3, 3, 5, 9, 11} corresponds to 5 measured values. When a new measured value is added, the oldest is removed (moving filter). A sudden change in measured values will only lead to a changed after half of the saved number of measured values (e.g. number of measured values = 5 means that the measured value at the output is only affected after 3 measured values).



This diagram shows the effects of the median (number of measured values 5). The filter is used to suppress measurement errors. The output only changes after a defined number of measured values (number of measured values/2). The measuring frequency is not affected by this filter, but the response time is.

[1] In accordance with chapter Sensor Data Sheet
[2] Depending on the object to be measured

Moving average
The output value of the moving average filter is the average of the defined number of measured values which have been saved. When a new measured value is added, the oldest is removed (moving filter).



As shown in the diagram, the moving average evens out the output value. In contrast to the median filter, it is possible that with the moving average, the displayed measured values were never measured as such. The measuring frequency is not affected by this filter, but the response time is.

Number of measured values required until the correct measured value is displayed:

- In the PRECISION = HIGH mode, the distance must be stable for 4 + 16 measured values before the correct value is displayed
- In the PRECISION = VERY HIGH mode, the distance must be stable for 8 + 128 measured values before the correct value is displayed

Example
Calculate the response time with a measurement frequency of 500 Hz, PRECISION = HIGH

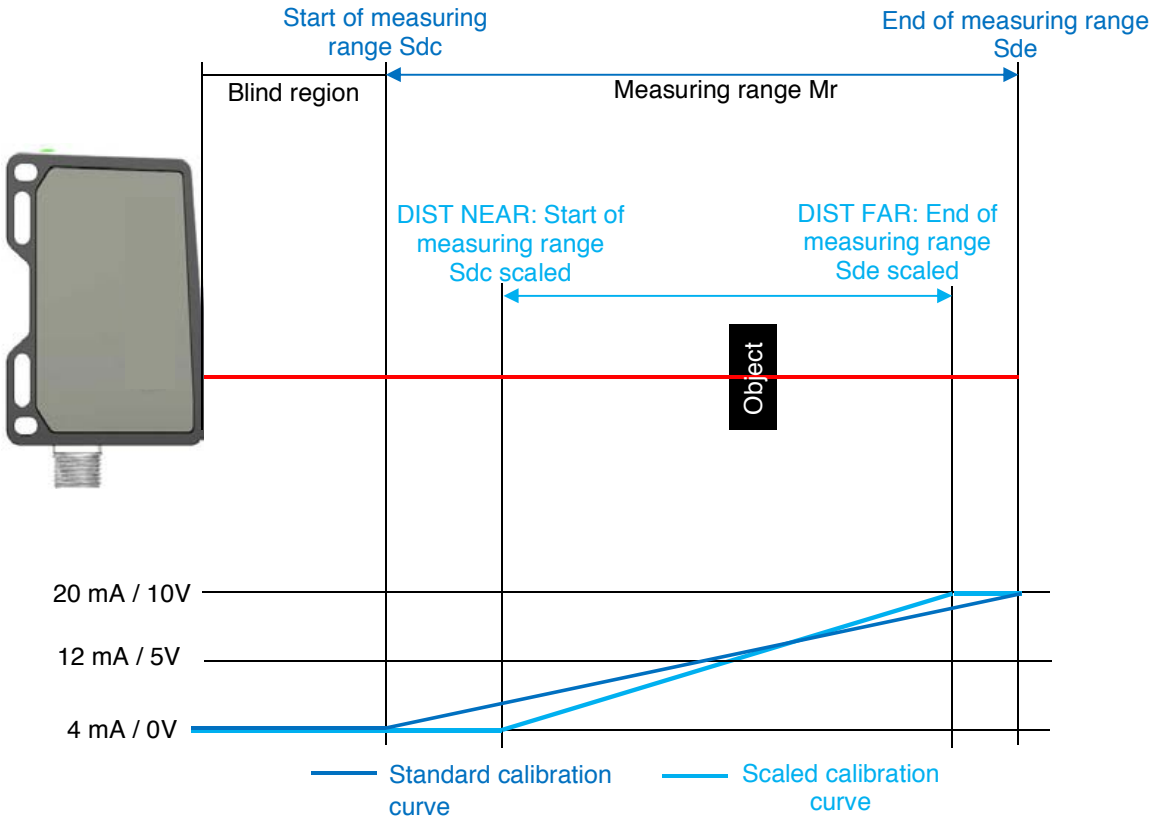
1 / 500 Hz = **0.002 s**
Median = 7 / 2 (formula: measured value / 2) = 4
Average = **16**
Response time = 0.002 * (4 + 16) = 0.04 s = 40 ms

4.5 ANALOG OUT

The settings of the analog output are defined here.
The display shows the sensitivity of the analog output in µA/mm or mV/mm (depending on the setting ANALOG OUT current/voltage). Adjusting the analog calibration curve using DIST NEAR and DIST FAR changes the displayed sensitivity value of the analog output. This value can be used to convert the analog signal (µA/mm or mV/mm) into a value in mm or vice versa.

4.5.1 SCALE OUT

In the factory setting, the analog output runs across the entire measuring range Mr (start of measuring range Sdc - end of measuring range Sde) from 0...10V (voltage mode) or from 4...20mA (current mode). The start and end of the measuring range can be reset (taught) with SCALE OUT, reducing the measuring field and changing the calibration curve. This means that limiting the measuring range to reduced limits can improve the resolution and linearity of the analog output.



4.5.1.1 DIST NEAR

Scaled start of measuring range Sdc in mm for analog output value 4 mA / 0V.
DIST NEAR >= Start of measuring range Sdc
DIST NEAR <= DIST FAR (observe the minimum analog output window size)

4.5.1.2 DIST FAR

Scaled end of measuring range Sde in mm for analog output value 20 mA/10V.
DIST FAR <= End of measuring range Sde
DIST FAR >= DIST NEAR (observe the minimum analog output window size)

4.5.1.3 SET MAX VALUES

SCALE OUT is reset to the standard setting (maximum measuring field) with the "set max values" command.

Example Scaling the measuring range with SCALE OUT
The sensor should display 4 mA at a distance of 110 mm and 20 mA at a distance of 140 mm.

Set DIST NEAR to 110 mm
Set DIST FAR to 140 mm

NOTE

Through the reduced measuring field, the resolution as well as the linearity of the analog output are improved, see chapter Sensor Data Sheet.

NOTE

As soon as the alarm output is active, the analog and switching outputs for 75 measuring cycles are kept at the last valid value. See chapter Alarm Output.

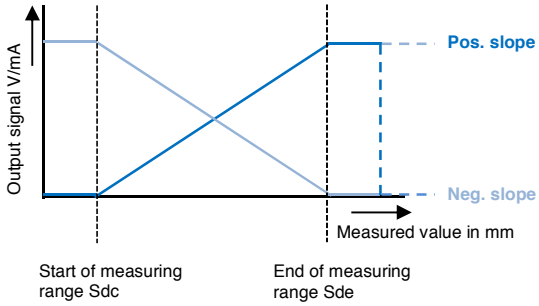
4.5.2 ANALOG OUT

The analog output can be reset to voltage (0-10 V) or current (4-20 mA), depending on the intended purpose. In order to minimize interference in the wiring, we recommend using the current output.

- Current
- Voltage

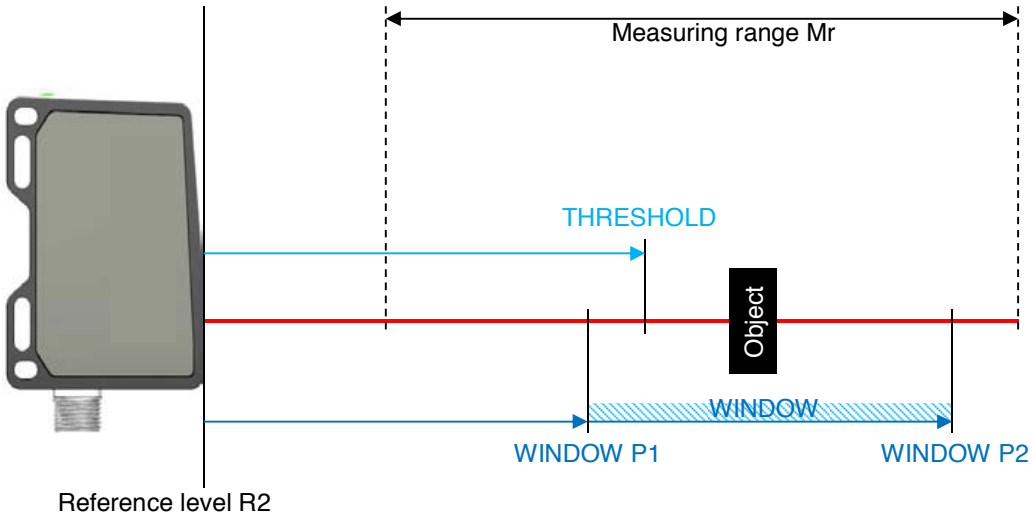
4.5.3 CHARACTER.

The calibration curve can be inverted here. In a positive curve, the output signal increases when the measured value rises, while the output signal decreases in a negative curve.



4.6 DIGITAL OUT

With Pin 4 (out), the user has a configurable switching output.
This can be defined as a threshold or as a window. Pin 4 switches as soon as the defined values are exceeded or undershot.
The switching points can be set within as well as outside the analog measuring field limited by SCALE OUT, as long as they are within the maximum measuring range (see also SCALE OUT).
For a reliable switching signal, there is an adjustable hysteresis.



4.6.1 DIGITAL OUT

Whether Pin 4 is to be operated as a **threshold** or as a **window** is defined here.

4.6.2 THRESHOLD

The switching point is defined from the sensor reference level in mm. The point must be within the measuring field, but is independent of the analog measuring field SCALE OUT.

4.6.3 WINDOW P1

Window Point 1 (for WINDOW) is defined from the sensor reference level in mm. The point must be within the measuring range and must be smaller than WINDOW P2, but is independent of the analog measuring field SCALE OUT.
See the minimum digital output window size in accordance with chapter Sensor Data Sheet.

4.6.4 WINDOW P2

Window Point 2 (for WINDOW) is defined from the sensor reference level in mm. The point must be within the measuring range and must be greater than WINDOW P1, but is independent of the analog measuring field SCALE OUT.
See the minimum digital output window size in accordance with chapter Sensor Data Sheet.

4.6.5 LEVEL

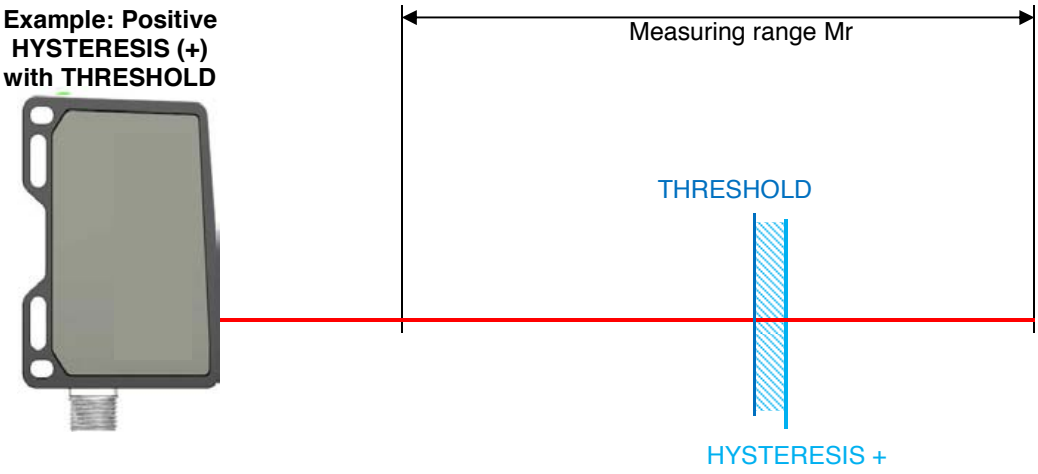
The output level can be inverted with **active high** or **active low** here. The inversion applies equally to the yellow LED on the sensor.

4.6.6 HYSTERESIS

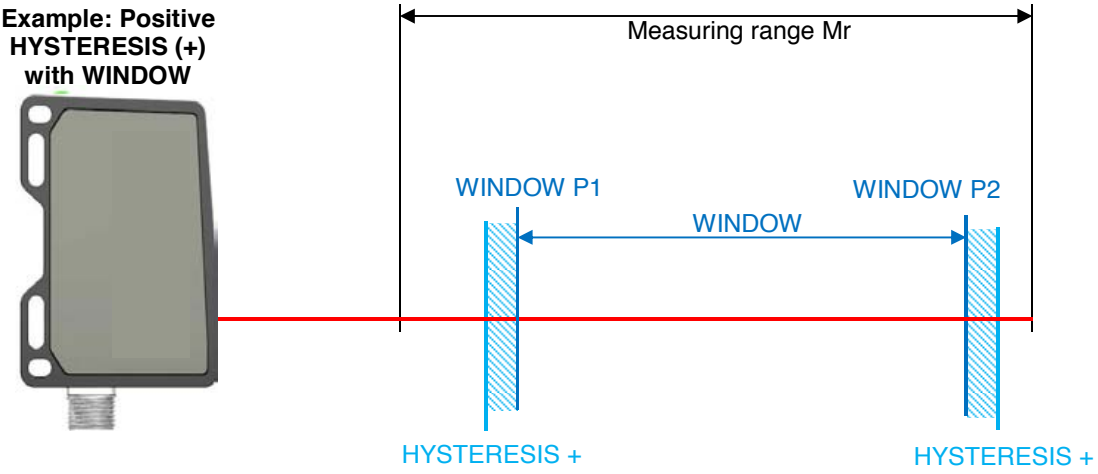
The hysteresis is the difference between the switching point and the reset point, and is specified as a value in mm. Without hysteresis, *H* objects in the border area of the switching point could lead to the switching output switching on and off continuously, or to bouncing. For reasons of reliability, the use of hysteresis is recommended (at least as great as the resolution of the sensor).

With THRESHOLD, a positive value (+) means away from the sensor, with WINDOW towards the outside. A negative value (-) means closer to the sensor (THRESHOLD), or inside (WINDOW).

Example: Positive HYSTERESIS (+) with THRESHOLD

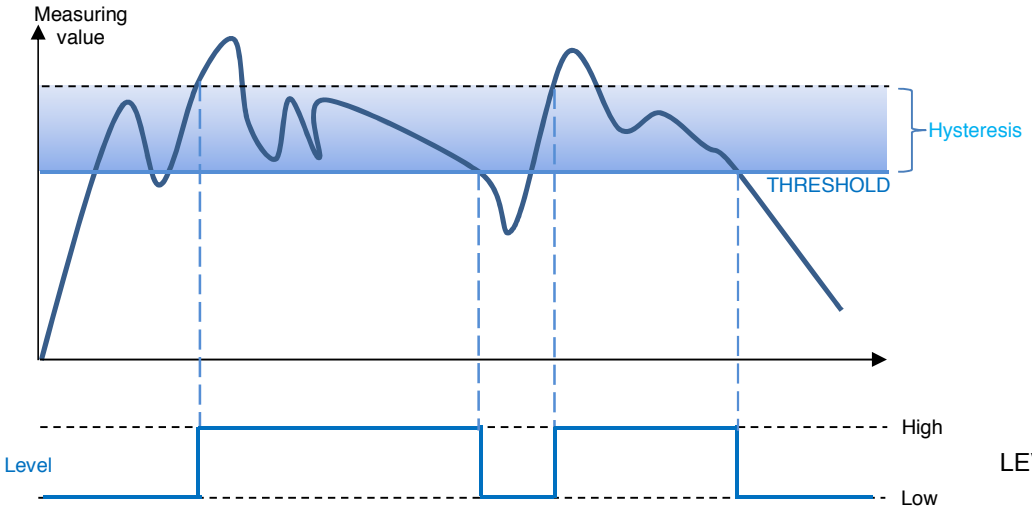


Example: Positive HYSTERESIS (+) with WINDOW



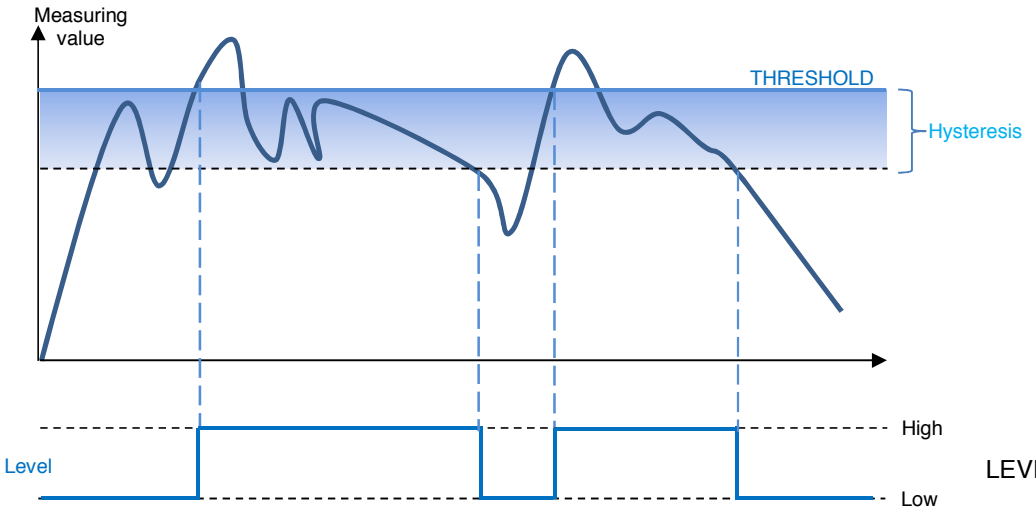
Behavior of the switching output for THRESHOLD

Example: HYSTERESIS positive



LEVEL **Active low**

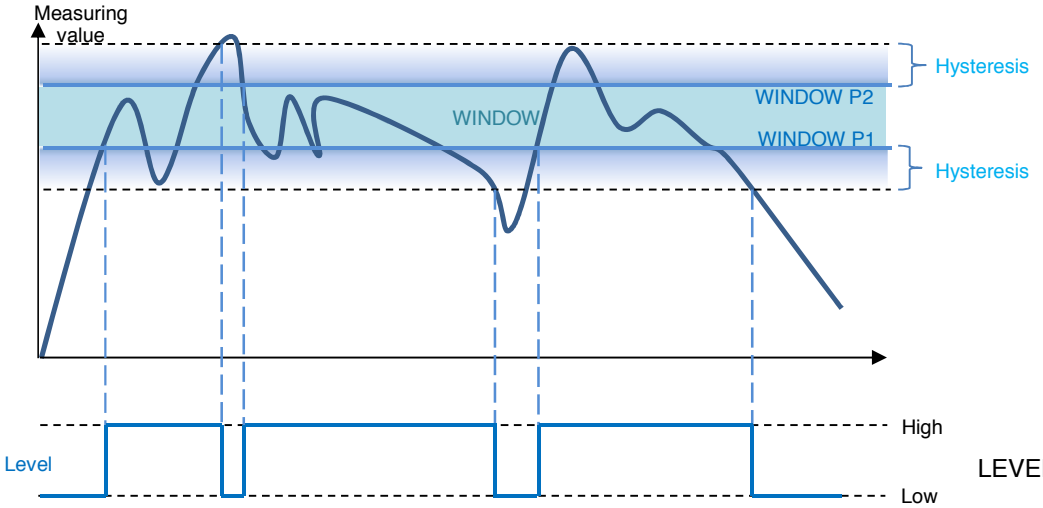
Example: Hysteresis negative



LEVEL **Active low**

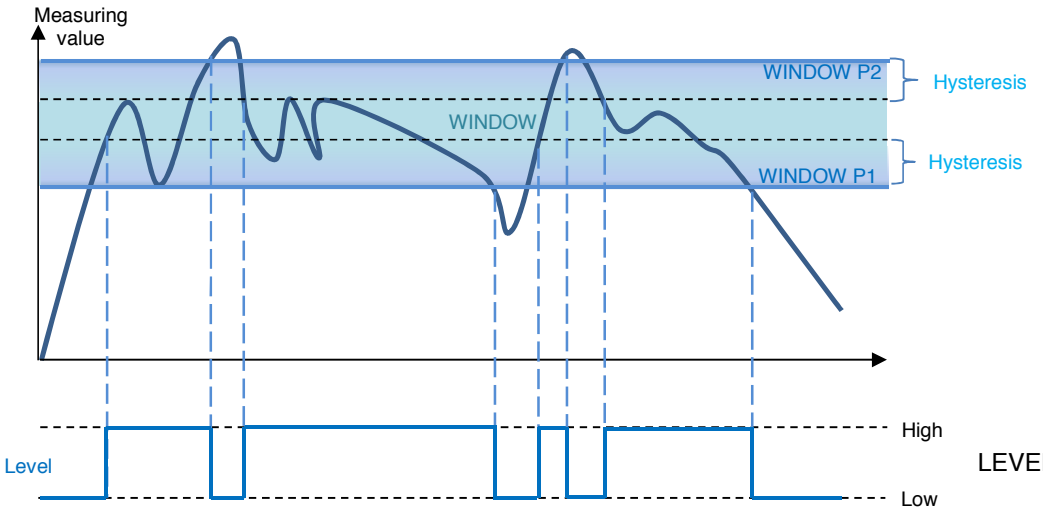
Behavior of the switching output for WINDOW

Example: HYSTERESIS positive



LEVEL **Active high**

Example: Hysteresis negative



LEVEL **Active high**

4.7 SYSTEM

4.7.1 TRIGGER MODE

In **Continuous** mode, the sensor measures permanently as long as the Sync line is set to Low. As soon as the Sync line is set to High, the sensor goes into hold mode shows no new measured values (the last measured value is frozen), the laser is disabled.
In **Single shot** mode the sensor measures exactly once on the trailing edge of the Sync signal and outputs the value. In single-shot measurements, the preset filters (see chapter PRECISION) have no effect.

Properties

- The previous measurement cycle is always completed first, even if Sync-In is on high
- While Hold is high, all outputs are frozen at their last state
- During the waiting time (Hold) the power of the laser beam is reduced (Laser off)
- Sync-In must remain on low for at least 5 µs in order for the sensor to begin measuring again

Sync-In	Level	Measurement
Sync-In low	0…2.5 V	Run
Sync-In high	8 V…UB (operating voltage)	Hold

NOTE

As soon as the Sync-In is set to high (Hold), all output functions are frozen at their last state until the next measurement, and the laser is switched off.

4.7.2 RS485 BAUD

The baud rate is the number of symbols transmitted per second. The baud rate of data transmission must be identical on the transmit and receive sides.
The sensor can be operated at the following baud rates:

- 38400
- 57600
- 115200
- 230400
- 460800
- 921600
- 1500000

4.7.3 RS485 ADDR

Every sensor has its own RS485 address, allowing the selected sensor to be addressed directly. This address is preset to 001 and can be changed in 3 digits. Sensors must not have the same address in the same network, to prevent the occurrence of bus conflicts. No more than 32 sensors may be connected to one bus.

4.7.4 SENSOR INFO

The sensor type and serial number are displayed here to enable clear identification of the sensor.

- SENSOR TYPE
- SERIAL NUMBER

4.7.5 LANGUAGE

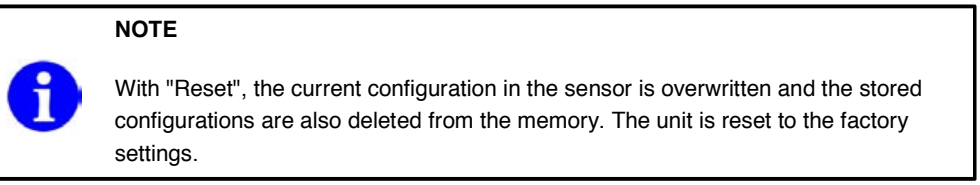
Language selection:

- English
- Deutsch
- Italiano
- Français

4.7.6 RESET (factory settings)

This resets all settings in sensor parameters to the factory settings.

PRECISION	= Very high
SCALE OUT	= Max. values
ANALOG OUT	= Current
CALIBRATION CURVE	= Positive sensitivity
DIGITAL OUT	= THRESHOLD (set to the center of the measuring range)
WINDOW P1	= Start of measuring range Sdc +10 mm
WINDOW P2	= End of measuring range Sde -10 mm
LEVEL	= Active High
HYSTERESIS	= % Mr
TRIGGER MODE	= continuous
RS485 lock	= 1 (activated)
RS485 BAUD	= 57600
RS485 ADR	= 1
ANALOG OUT	= Current



NOTE

With "Reset", the current configuration in the sensor is overwritten and the stored configurations are also deleted from the memory. The unit is reset to the factory settings.

4.8 SETTING

The settings entered in the sensor can be applied, stored or displayed here.

4.8.1 APPLY

The settings saved under SAVE can be activated here.

- Setting 1
- Setting 2
- Setting 3

4.8.2 SAVE

The settings entered in the sensor can be stored here.
Three storage spaces are available.

- Setting 1
- Setting 2
- Setting 3

4.8.3 SHOW

SHOW
Displays the setting values.

SHOW Active
Displays the active settings.

SHOW settings 1-3
Displays the settings stored in storage spaces 1-3

The values are displayed successively; it is possible to jump to the next value using the DOWN key.

PRECISION
DIST NEAR
DIST FAR
ANALOG OUT
CHARACTER.
DIGITAL OUT
THRESHOLD
WINDOW P1
WINDOW P2
LEVEL
HYSTERESIS
TRIGGER MODE

4.9 Configuration using the RS-485 interface

The precision (resolution, repeat accuracy and linearity) of the output values is higher through RS-485 than through the analog output. The use of this interface is recommended for high-precision applications. No more than 32 sensors may be connected to one bus during operation with RS-485.

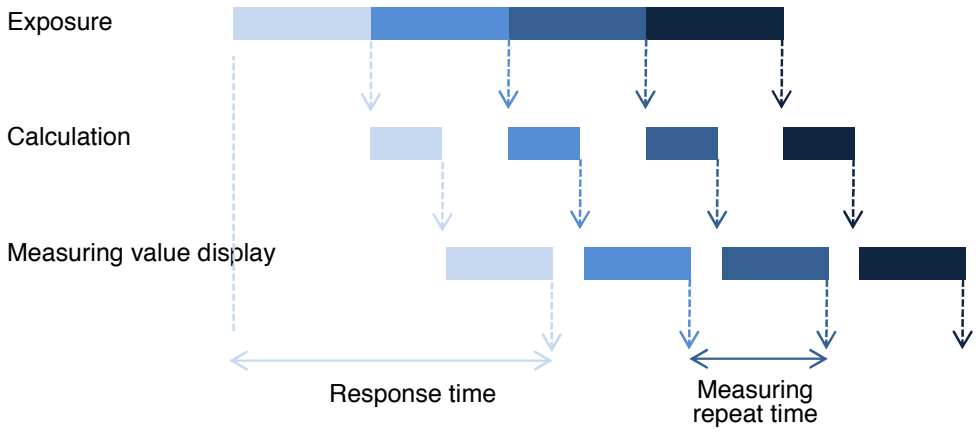
When the RS-485 interface is activated, the analog output, digital output and alarm output are deactivated or switched as if there were no object within the measuring range. Then the sensor can only be configured through RS-485; the display is locked for operation.
If required, the digital outputs as well as the display control can be reactivated using the relevant RS-485 commands.

See separate RS-485 manual for further information.

5 Operation

5.1 Measuring frequency, measuring repeat time and response time

A complete measuring cycle consists of exposure, calculation and measuring value display. In order to increase the measuring speed, process steps are executed simultaneously.



5.1.1 Measuring frequency and measuring repeat time

The time between two exposure times is referred to as measuring repeat time. This time can be converted into a frequency (Hz), which indicates how many measured values can be issued by the sensor in one second.

$$\textit{Measuring frequency [kHz]} = {}^{1}\!/_{\textit{maesuring repeat time [ms]}}$$

5.1.2 Automatic exposure control

The color and surface of the object have an influence on the amount of reflected light. A longer exposure time is required for dark objects than for light objects. The sensor automatically controls the exposure time on the basis of the amount of light reflected by the object. This slows down the measuring frequency and the response time. In this case, the degree of slowdown is dependent on the laser class of the sensor.

5.2 Alarm output

The alarm signal is output as a push-pull signal (active high) when the object is outside the measuring range or the signal quality is insufficient for evaluation. If the signal quality is insufficient, the analog and switching outputs for 75 measuring cycles are kept at the last valid value. After this time has elapsed, the analog and switching outputs are set as if an object were at the start of the measuring range.

NOTE

As soon as the alarm output is active, the analog and switching outputs for 75 measuring cycles are kept at the last valid value.

5.3 Influence of ambient light

Ambient light from lamps, the sun, etc. in the view field of the sensor can lead to malfunctions or a reduction of accuracy and should be avoided as much as possible.

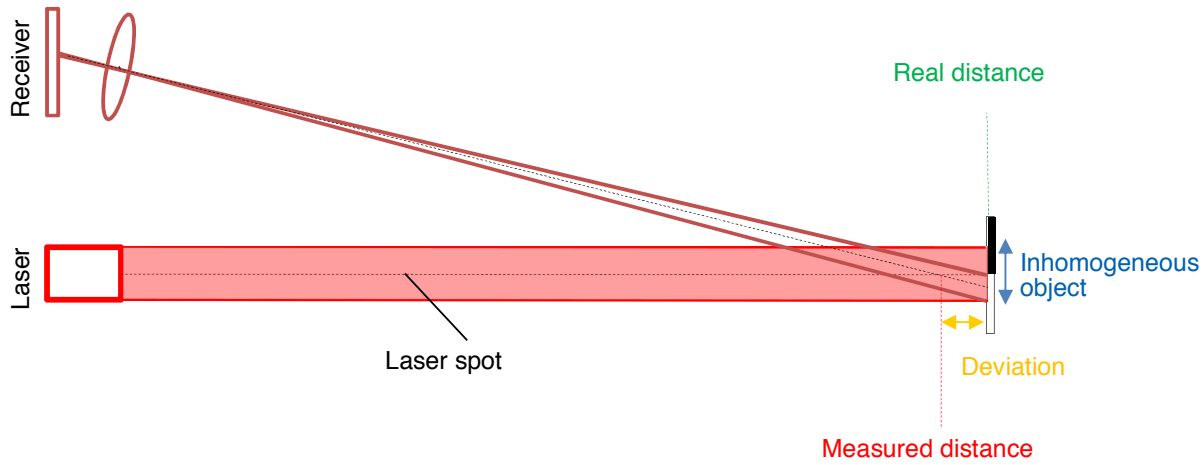
5.4 Focus distance and optimal measuring distance

The size of the light spot can have a large influence on the measurement accuracy. The measured value will not always be stable when the surface moves sideways, especially with surfaces that are inhomogeneous in color or structure. The reason for this is the so-called color edge effect. Differences in the reflectivity or gloss of the surface lead to a shift in the measured light distribution and thus to a distorted measured value.

5.4.1 Inhomogeneous surfaces and colored edge effect

The colour edge effect occurs with inhomogeneous surfaces. The measured value is distorted by the light/dark surface and changes when the inhomogeneous object is moved across the laser beam.

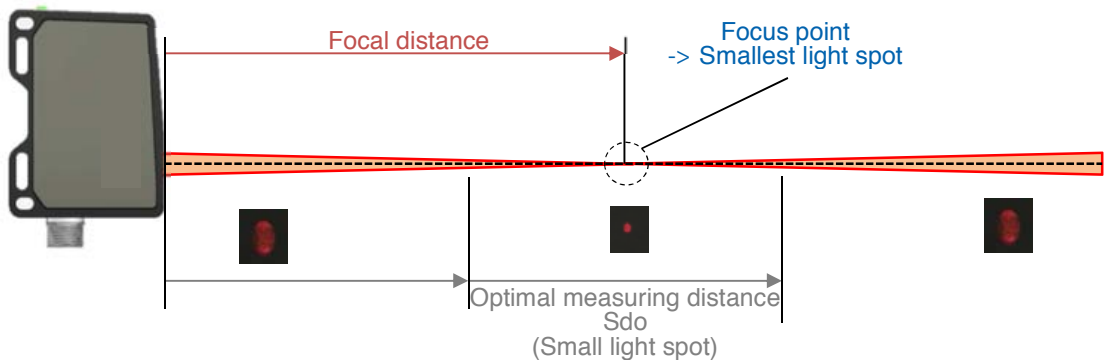
Color edge effect:



Examples for inhomogeneous objects:

5.4.2 Influence of the light spot size

The size of the light spot has a great influence on the colour edge effect. This influence can be greatly minimized by a small light spot and thus the accuracy of the measured value can be improved.



The focus distance determines the smallest light spot diameter, around this focus point lies the optimal measuring distance Sdo, in which the light spot is very small.

Summarized:

- To measure inhomogeneous surfaces robustly and accurately, it is recommended to measure as close as possible to the sensor and as close as possible to the focus point
- If the entire measuring range is to be used, it is recommended to use the sensor type with the focus point as far away from the sensor as possible

5.5 Error correction and tips

Error	Error correction
No function	• Check connection. Power supply 15…28 VDC on pin 2 (+Vs, brown) and pin 7 (GND, blue)
Green LED flashes	• Short circuit on switching outputs. Check connection.
Red LED lights up	• Object outside measuring field (near, far or to the side) • Amplitude of the received signal is insufficient (e.g. in case of soiling)
Touch panel cannot be operated	• Touch panel locked. Re-enable panel for operation by sliding a finger over the 4 keys from left to right. • RS-485 controls the sensor--> operation via the touch panel not possible at the same time • RS-485 locks the touch keys--> the touch panel was locked via RS-485 and can only be re-enabled with a command via RS-485
Touch panel does not react	• Clean panel. The panel is dirty or wet, which makes it harder to press the keys
Sensor does not provide the expected measuring results	• The object is not in the measuring range • Bright object, avoid direct reflexes from the transmitter to the receiver
Unreliable measuring value: The measuring value jumps back and forth	• The object is not in the measuring range • Avoid bright object • Avoid very dark object • Too much ambient light
Transmitting laser light is dim	Sync-In input is on High--> set to Low

6 Safety instructions and maintenance

6.1 General safety instructions

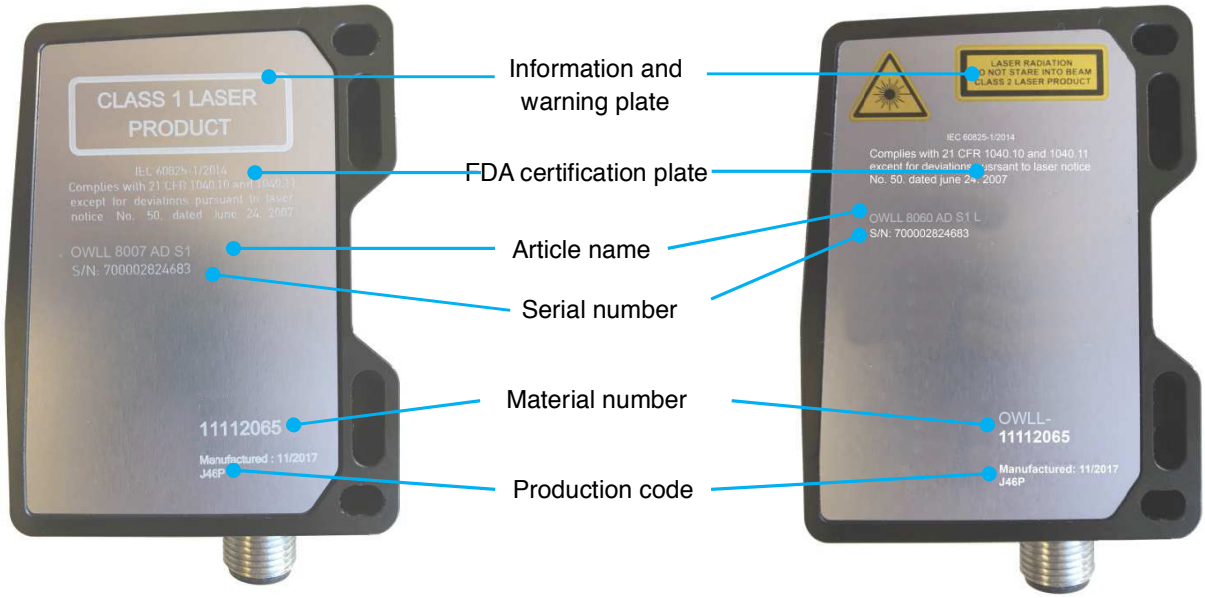
Intended use
This product is a precision device and is used for object detection and the preparation and/or provision of measuring values as electrical quantities for a subsequent system. Unless this product is specially labeled, it must not be used for operation in potentially explosive environments.

Commissioning
Installation, mounting and adjustment of this product may be performed only by a qualified person.

Installation
For mounting, use only the mechanical mountings and mechanical mounting accessories intended for this product. Unused outputs must not be wired. In cable versions with unused cores, these cores must be insulated. Always comply with admissible cable bending radii. Prior to electrical connection of the product, the system must be disconnected from the power supply. In areas where shielded cables are mandatory, they must be used as protection against electromagnetic disturbances. If the customer makes plug connections to shielded cables, an EMC version of the connectors should be used, and the shield must be connected to the connector housing across a large area.

Caution
Deviation from the procedures and settings specified here can lead to hazardous radiation effects.

6.2 Sensor inscriptions



Information and warning plate	**Class 1: No risk for eyes** **CLASS 1 LASER PRODUCT** Class 1 lasers are safe under reasonably foreseeable operational conditions of normal use, including direct long-term viewing of the beam, even when exposure occurs using a magnifying optic.	**Class 2:** LASER RADI ATION DO NOT S TARE IN TO BEAM Wavelength: 640...670nm IEC 60825-1, Ed. 3, 2014 CLASS 2 LASER PRODUCT Accidental short-term exposure (up to 0.25 s) does not damage the eye, because the corneal reflex can automatically protect the eye sufficiently from longer radiation. Class 2 lasers may be used without any further protection if intentional staring into the beam is not required for the application.
FDA certification plate	IEC 60825-1/2014 Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to laser notice No. 50, dated June 24, 2007	

6.3 Front optic

In the event of a broken front optic, defective display, or loose or exposed laser lens, the sensor must be disconnected from the power supply immediately. It must not be put into operation again. Non-compliance with these safety instructions may lead to the release of hazardous laser beams.

ATTENTION!

The use of a sensor with a broken front optic or loose or exposed lens can lead to hazardous laser radiation.

6.4 Cleaning the sensors

The laser distance sensors do not require any maintenance, except that the front window must be kept clean. Dust and fingerprints can impair sensor function. It is normally sufficient to wipe the windows with a dry, clean (!), soft lens cleaning cloth. Alcohol or soapy water can be used in case of severe soiling.
The display and the keys must be kept free from dirt and moisture. Water and dirt on the keys can impair their function.

6.5 Disposal

This sensor contains electronic components. Dispose of parts according to country-specific provisions.

7 Revision history

12/8/2017	tof	Manual released in version 1.0
01/11/2018	tof	Structural changes. Complete revision
05/30/2018	fof	New focal distance articles integrated, data sheet optimizations. Chapter “Focal distance”