Leuze

Translation of original operating instructions

ROD 500
Laser Scanner

The Sensor People

We reserve the right to make technical changes
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Leuze electronic GmbH + Co. KG
In der Braike 1
73277 Owen / Germany
Phone: +49 7021 573-0
Fax: +49 7021 573-199
www.leuze.com
info@leuze.com

1 About this document

1.1 Other applicable documents

The information on the laser scanner is distributed over several documents to make working with the documents easier. You will find the documents and software for the laser scanner in the following table:

Tab. 1.1: Other applicable documents

Document / software title	Purpose and target group of the document / software	Source
ROD Config	Software for machine users for diagnosing the laser scanner in the event of a fault and for machine design engineers for configuring the laser scanner	Leuze website, on the device's product page under the *Downloads* tab
ROD 300/500 operating instructions (this document)	Instructions for operating the device and information for the machine design engineer	
ROD 300/500 user instructions	Notices regarding mounting, alignment and connection of the laser scanner	Print document, supplied with the laser scanner
ROD x00 Ethernet protocol	Operation of the laser scanner via the Ethernet protocol	Leuze website, on the device's product page under the *Downloads* tab

Downloading configuration software from the Internet

- Call up the Leuze website: **www.leuze.com**.
- Enter the type designation or part number of the device as the search term.
- The configuration software can be found on the product page for the device under the *Downloads* tab.

1.2 Used symbols and signal words

Tab. 1.2: Warning symbols and signal words

	Symbol indicating dangers to persons
	Symbol indicating dangers from harmful laser radiation
	Symbol indicating possible property damage
NOTE	Signal word for property damage Indicates dangers that may result in property damage if the measures for danger avoidance are not followed.
CAUTION	Signal word for minor injuries Indicates dangers that may result in minor injury if the measures for danger avoidance are not followed.
WARNING	Signal word for serious injury Indicates dangers that may result in severe or fatal injury if the measures for danger avoidance are not followed.

Tab. 1.3: Other symbols

	Symbol for tips Text passages with this symbol provide you with further information.
	Symbol for action steps Text passages with this symbol instruct you to perform actions.
	Symbol for action results Text passages with this symbol describe the result of the preceding action.

2 Safety

2.1 Intended use

The ROD 300/500 is a laser scanner that can scan a circular segment of 275° at a maximum distance of 25 m. Objects located within this area are detected.

Areas of application

ROD 300/500 series laser scanners are designed for the following areas of application:

- Profile measurement
- Contour detection
- Navigation

Restrictions due to environmental conditions

Certain environmental conditions can severely impair the intended use. These include, in particular, airborne particles and interfering light.

Airborne particles

Vapors, smoke, dust and all particles visible in the air can cause the machine to switch off unintentionally.

↳ Do not use the safety sensor in environments in which heavy vapors, smoke, dust or other visible particles occur at the beam level.

Interfering light

Light sources can impair the sensor's availability. Interfering light sources are:

- Infrared light
- Fluorescent light
- Strobe light

↳ Ensure that there are no interfering light sources at beam level.

↳ Prevent reflective surfaces at beam level.

↳ Where applicable, take protective field addition distances into account.

↳ Implement all additional measures to ensure that beam types caused by a particular application do not affect the sensor's operation.

2.2 Foreseeable misuse

Any use other than that defined under "Intended use" or which goes beyond that use is considered improper use.

In principle, the sensor is **not** suitable as a protective device for use in the following cases:

- In the event of danger posed by ejected objects or the spraying of hot or hazardous liquids from within the danger zone.
- Applications in explosive or easily flammable atmospheres.
- Use for outdoor applications or under extreme temperature fluctuations.
  Humidity, condensation and other weather influences can impair function.
- Use on vehicles with combustion engines.
  The alternator or ignition system can cause EMC interferences.

	NOTICE
	**Do not modify or otherwise interfere with the device!** ↳ Do not carry out modifications or otherwise interfere with the device. The device must not be tampered with and must not be changed in any way. ↳ The device must not be opened. There are no user-serviceable parts inside. ↳ Repairs must only be performed by Leuze electronic GmbH + Co. KG.

2.3 Competent persons

Connection, mounting, commissioning and adjustment of the device must only be carried out by competent persons.

Prerequisites for competent persons:

- They have a suitable technical education.
- They are familiar with the rules and regulations for occupational safety and safety at work.
- They are familiar with the operating instructions for the device.
- They have been instructed by the responsible person on the mounting and operation of the device.

Mounting

Specialist knowledge and experience needed for the safe and correct mounting and alignment of the sensor with regard to the respective machine.

Certified electricians

Electrical work must be carried out by a certified electrician.

Due to their technical training, knowledge and experience as well as their familiarity with relevant standards and regulations, certified electricians are able to perform work on electrical systems and independently detect possible dangers.

In Germany, certified electricians must fulfill the requirements of accident-prevention regulations DGUV (German Social Accident Insurance) provision 3 (e.g. electrician foreman). In other countries, there are respective regulations that must be observed.

Operation and maintenance

Specialist knowledge and experience needed for the regular inspection and cleaning of the sensor following instruction by the person responsible.

Servicing

Specialist knowledge and experience in the mounting, electrical installation and the operation and maintenance of the sensor in accordance with the requirements listed above.

Commissioning and testing

- Experience and specialist knowledge in the rules and regulations of labor protection, safety at work and safety technology that are necessary for being able to assess the safety of the machine and the use of the sensor, including experience with and knowledge of the measuring equipment necessary for performing this work.
- In addition, an activity in the environment of the object of the inspection is carried out in a timely manner and the person's level of knowledge is kept up to date through continuous training in the latest technology – a “qualified person” as defined by the German Industrial Safety Regulation and other national legal requirements.

2.4 Disclaimer

Leuze electronic GmbH + Co. KG is not liable in the following cases:

- The device is not being used properly.
- Reasonably foreseeable misuse is not taken into account.
- Mounting and electrical connection are not properly performed.
- Changes (e.g., constructional) are made to the device.

2.5 Laser safety notices

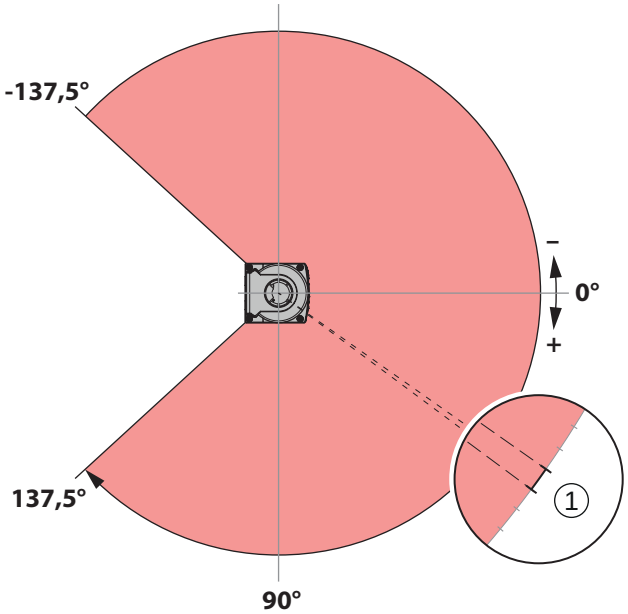
	ATTENTION
	**LASER RADIATION – CLASS 1 LASER PRODUCT** The device satisfies the requirements of IEC 60825-1:2014 / EN 60825-1:2014+A11:2021 safety regulations for a product of **laser class 1** and complies with 21 CFR 1040.10 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019. ↳ Observe the applicable statutory and local laser protection regulations. ↳ The device must not be tampered with and must not be changed in any way. There are no user-serviceable parts inside the device. **CAUTION!** Opening the device may result in hazardous radiation exposure! Repairs must only be performed by Leuze electronic GmbH + Co. KG.

3 Device description

The ROD 300/500 is a 2D laser scanner that scans a single curtain over an angle of 275°. The laser scanner outputs accurate measurement data at a high scanning frequency via Ethernet communication, enabling further processing and integration into systems for a wide range of applications. In intralogistics, the sensor is used for the SLAM navigation of automated guided vehicles or autonomous robots. The invisible laser curtain and the precise measurement data can also be used in a variety of applications, e.g. for area monitoring in factory automation or for profiling objects in vehicle classification.

The laser scanner contains a rotating mirror that deflects periodically transmitted light pulses, thereby scanning the surrounding area in two dimensions. The light pulses are scattered in all directions by obstacles, e.g. shelf legs or objects such as pallets. A part of the light pulses is received again by the safety sensor and evaluated.

The angular resolution, i.e. the angular distance between two distance measurement values, is adjustable and is 0.1° at 40 Hz in the ROD 300/500 series laser scanners as supplied. Objects are detected within a maximum scanning range of 275°, depending on which monitoring area is configured.



1 Angular resolution between 0.025 ... 0.2° (depending on configuration and type)

Fig. 3.1: Light pulses area

3.1 Device overview

The ROD 300 and ROD 500 series laser scanners are optoelectronic, two-dimensional measuring sensors. They are equipped with the following features:

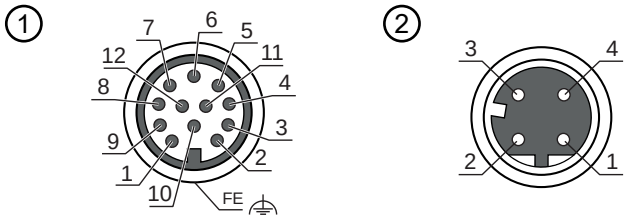
- LED indicator
- Electrical connection to the machine via connection cable

1 Compass and center point
2 Transmitter and receiver unit
3 Status LEDs
4 Contamination display
5 Nameplate (on the underside of the scanner)

Fig. 3.2: ROD 300/500 device overview

3.2 Device connections

The ROD 300 and ROD 500 series laser scanners have the following device connections:



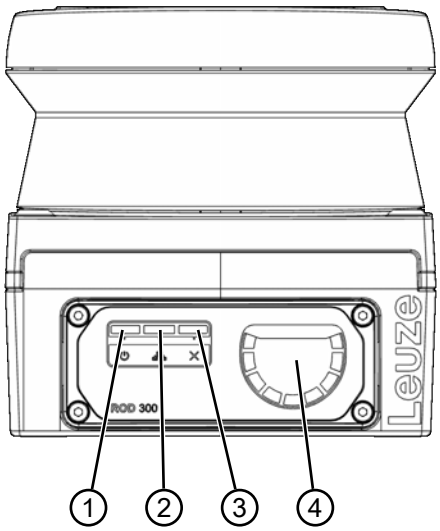
1	Voltage supply	M12 connector, 12-pin, A-coded
2	Ethernet connection	M12 socket, 4-pin, D-coded

Fig. 3.3: Device connections

3.3 Display elements

The display elements provide information about the laser scanner's energy status, the Ethernet connection, the error status and any soiling of the optics cover.

LED indicator



1	LED 1	Power/voltage supply status
2	LED 2	Ethernet connection status
3	LED 3	Error status
4	LED circular segment	Contamination display

Fig. 3.4: Display elements

The laser scanner has three three-color LEDs, which are referred to as LED 1, LED 2 and LED 3 in the following illustration, as well as a row of 9 LEDs arranged in a semi-circle, which indicate the degree of contamination of the optics cover.

LED 1/2/3

LEDs 1/2/3 show the power status, the Ethernet connection and the error status.

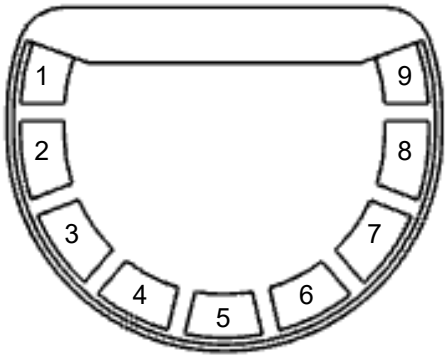
Tab. 3.1: LED status indicator

LED	Color/state	Device status
LED 1	Off	Power supply off No supply voltage
LED 1	Green	Power on
LED 1	Red	External power supply error
LED 2	Off	No Ethernet connection
LED 2	Green	Ethernet connection stabilized; no measurement data transfer
LED 2	Green flashing 3x/s	Transfer of Ethernet measurement data
LED 3	Off	Switching off; No supply voltage
LED 3	Green	Normal operation, no errors
LED 3	Orange	Internal error
LED 3	Red	Fatal error

LED circular segment

The LED circular segment indicates which section of the scanning range at the transmission area is contaminated. It is divided into 9 areas that light up as soon as soiling is detected.

Each of these LEDs can light up to visually indicate where soiling has been detected so that the problem can be identified and rectified immediately.



1	0°-32.5°	2	32.5°-62.5°	3	62.5°-92.5°
4	92.5°-122.5°	5	122.5°-152.5°	6	152.5°-182.5°
7	182.5°-212.5°	8	212.5°-242.5°	9	242.5°-275°

Fig. 3.5: Arrangement of the 9 angular segments of the contamination display

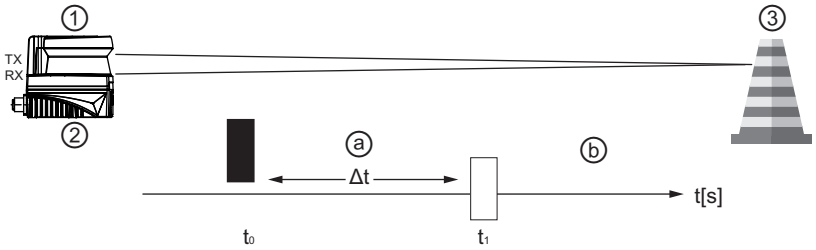
The 9 segments represent the scanning angle of 275°, divided into individual sections. The illuminated LED indicates the position and severity of the soiling:

- LED flashing orange at 0.5 Hz: Contamination warning
- LED lights up constantly red: Contamination error, the measuring function is faulty at this point.

4 Functions

4.1 Measurement principle

The ROD 300 and ROD 500 series laser scanners use time-of-flight technology to measure the distance to objects. The laser scanner contains a rotating mirror that deflects periodically transmitted light pulses, thereby scanning the surrounding area in two dimensions. The light pulses are scattered in all directions by obstacles. A part of the light pulses is received again by the laser scanner and evaluated. The laser scanner calculates the precise position of the object from the propagation time of the radiated light and the current angle of the deflection unit at that time.



1 Transmitter
2 Receiver
3 Object
a Emitted light pulses
b Reflected laser light
Δt Light propagation time

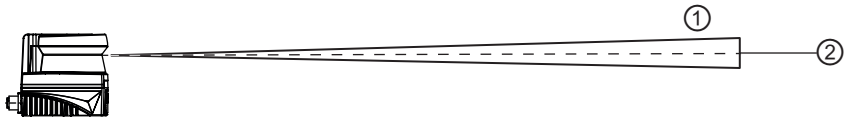
Fig. 4.1: Measurement principle: Time-of-flight

4.2 Light spot size

The laser beam widens as the distance from the device increases. This increases the diameter of the light spot on the surface of the object. The measurements are taken where 90% of the spot's energy is concentrated. The laser scanner can therefore provide navigation data with greater detail and high reliability.

The two factors that determine the size of the light spot are:

- Light spot diameter: 12.5 mm x 1.5 mm at 1 meter distance
  These measurements are taken where 90% of the spot's energy is concentrated.
- Beam divergence: The change in the diameter of the light spot over a certain distance
  The longitudinal beam divergence is 12.5 mm/m, the transverse beam divergence is 1.5 mm/m.



1 Widening of the laser beam
2 Optical axis

Fig. 4.2: Beam widening

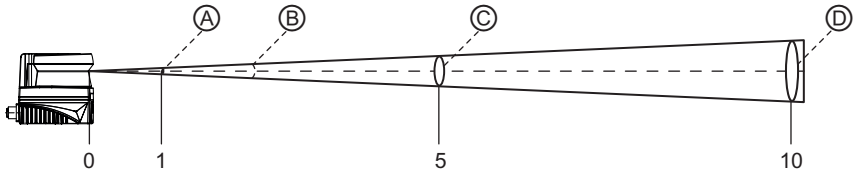


Fig. 4.3: Light spot size versus distance

Pos.	Distance	Light spot size
A	1 m	12.5 mm
C	5 m	62.5 mm
D	10 m	125 mm
B	Laser beam opening angle: 0.72°	

4.3 Scanning frequency

The laser scanner delivers accurate measurement data at a high and adjustable scanning frequency of 80 Hz / 50 Hz / 40 Hz via Ethernet communication.

With other parameters set to default settings, the scanning frequency would correlate with the angular resolution and the number of data points output for each scan:

- 80 Hz: Angular resolution of 0.2°, one scan corresponds to 1376 data points.
- 50 Hz: Angular resolution of 0.2°, one scan corresponds to 1376 data points.
- 40 Hz: Angular resolution of 0.1°, one scan corresponds to 2752 data points.

4.4 Angular resolution

The angular resolution can be configured according to the requirements of the application:

- 0.2° at 80 Hz – ROD 300/ROD 500
- 0.2° at 50 Hz – ROD 300/ROD 500
- 0.1° at 40 Hz – ROD 300/ROD 500
- 0.05° at 20 Hz – ROD 500
- 0.025° at 10 Hz – ROD 500

4.5 Accuracy of measurement

The ROD 300 and ROD 500 series laser scanners offer highly stable and accurate distance measurements with a measurement speed of 110,080 measurements per second.

Measurement accuracy:

- Systematic error: ±20 mm
- Statistical error (1σ) depending on the operating range:
  ≤6 mm (0,08 – 7 m)
  ≤10 mm (7 – 10 m)
  ≤15 mm (10 – 15 m) *
- Statistical errors for reflectors: ≤6 mm (0.08 – 25 m)

(*) Typical value at 10% reflectance up to an operating range of 7 m or as specified. The actual values depend on the environmental conditions and the target object.

4.6 Measurement data output

The distance measurement data is output in the data packet in the UDP/IP and TCP/IP protocols according to the user settings. The measurement data range is output in sequence from 0° to 275.2°.

The measurement data can be reduced so that only the measured values within the zone of interest are output in the data packet. The data can be reduced in the following way:

- Set the scanning angle: The angle range can be reduced by setting the *angle start* and *angle stop* parameters.

	NOTICE
	Only the measurement data in the set scanning angle is output in the scan data. However, the data is only output after a complete scanning process. This means the speed of data transmission does not change.

- Set skip spot: The measurement points can be skipped to reduce the amount of data output. “Skip spot x” means that the sensor would output the points n, (n+1) +x, ... Skipping light spots leads to a higher angular resolution.

(Angular resolution = (angular resolution)*x)

Further information on the size of the data packets can be found in the additional document “Ethernet protocol ROD x00”.

4.7 Amplitude data output

The amplitude data is the measured energy of the laser beam returning from the target to the sensor. The amplitude value depends on the reflectance of the target object, which is determined by the target object’s color, shape and surface properties. For example, the light energy can be refracted by the uneven surface or absorbed by the dark surface of the target object, which reduces the amplitude value.

The amplitude values for each measurement point can be output as part of the data packet if the data packet type is set to *distance and amplitude*.

	NOTICE
	The amplitude value of objects that are very close to the sensor (0 to 0.5 m distance) may appear lower than outside this close range. It may be difficult to distinguish the amplitude value between white paper and reflectors.

Amplitude values are relative and may vary slightly between different devices and over the course of the devices’ service life.

4.8 Reflector detection

The laser scanner can be used to detect the presence of reflectors by identifying data points with high amplitude values.

The amplitude value of the same target can deteriorate as distance increases. Data points with amplitude values above the threshold value can be determined as reflectors.

	NOTICE
	The reflectors' amplitude value is reduced at short distances within 0.5 m of the device and at very long distances. Shiny or bright surfaces can sometimes reflect the laser beam at certain angles and produce a high amplitude value that can be identified as a reflector. Reflectors can appear wider than they actually are.

Scanning plane definition

The scanning plane represents the plane to which the laser scanner directs its laser beams in order to capture information.

5 Applications

The following applications are to be understood as typical areas of application.

Contour measurement

Profile measurement of objects during passage. Contours can also be detected on different surfaces.

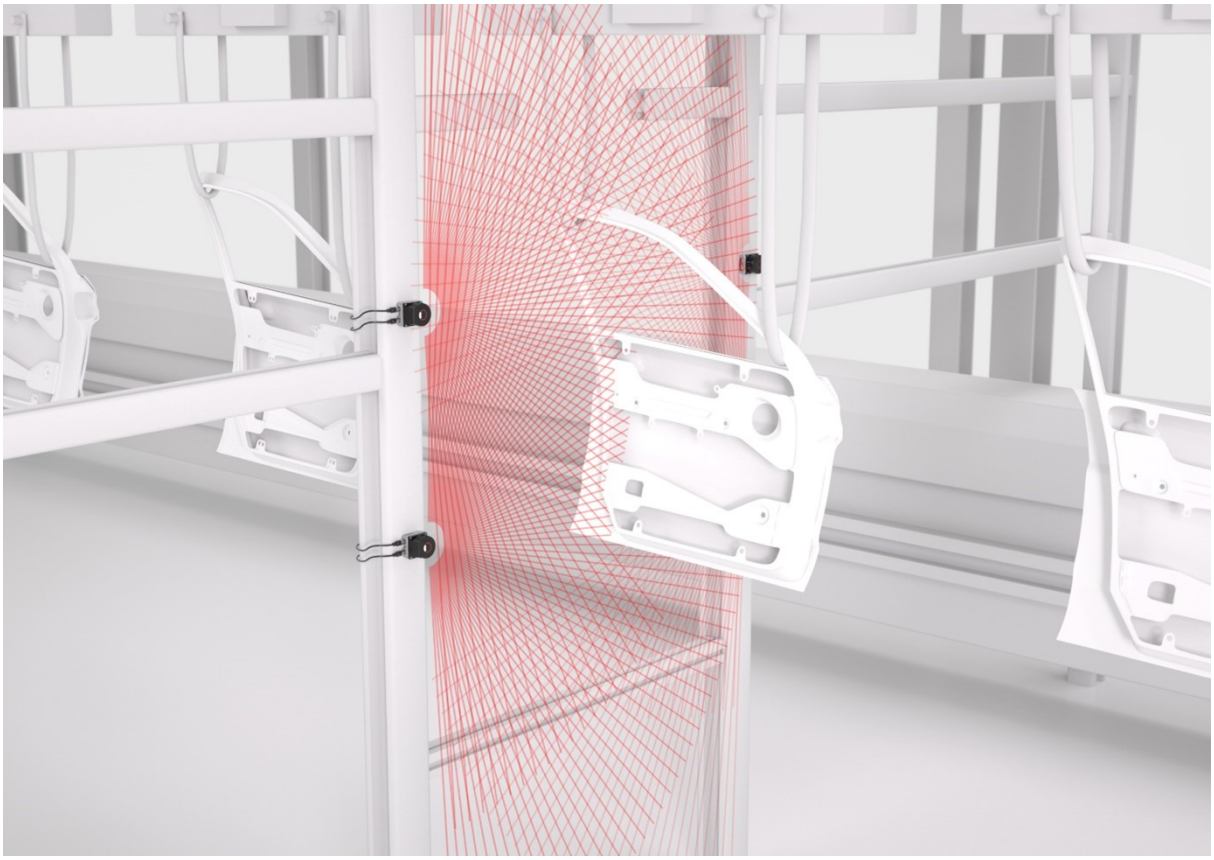


Fig. 5.1: Contour measurement

Pallet checking

- Pallets can be checked for completeness.
- A more detailed evaluation of the pallet’s dimensions and contents is possible.
- Even fast-moving pallets can be precisely detected.

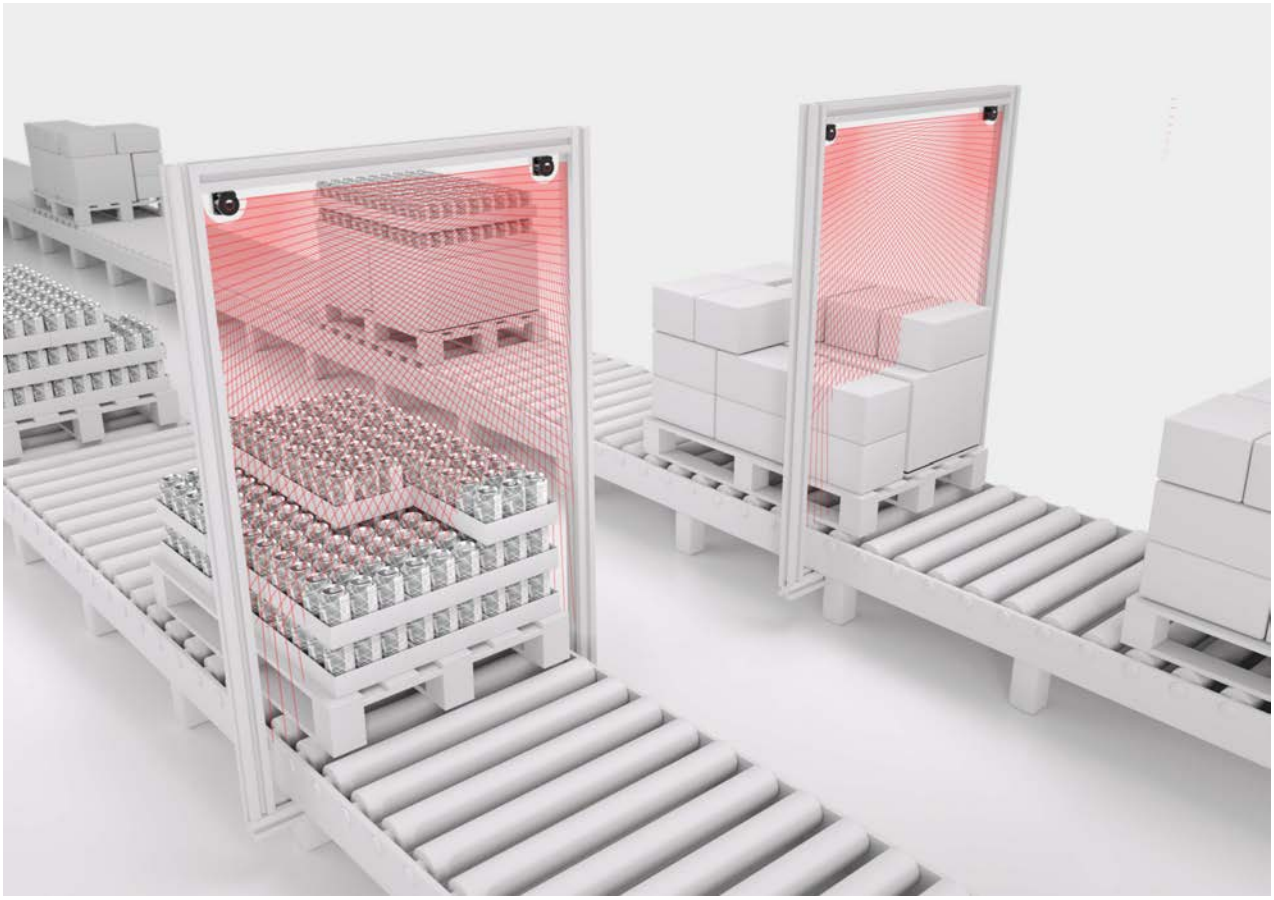


Fig. 5.2: Pallet checking

Navigation

The laser scanner detects the surroundings of the automated guided vehicle system in the measurement range. This enables both AGV navigation and collision avoidance.

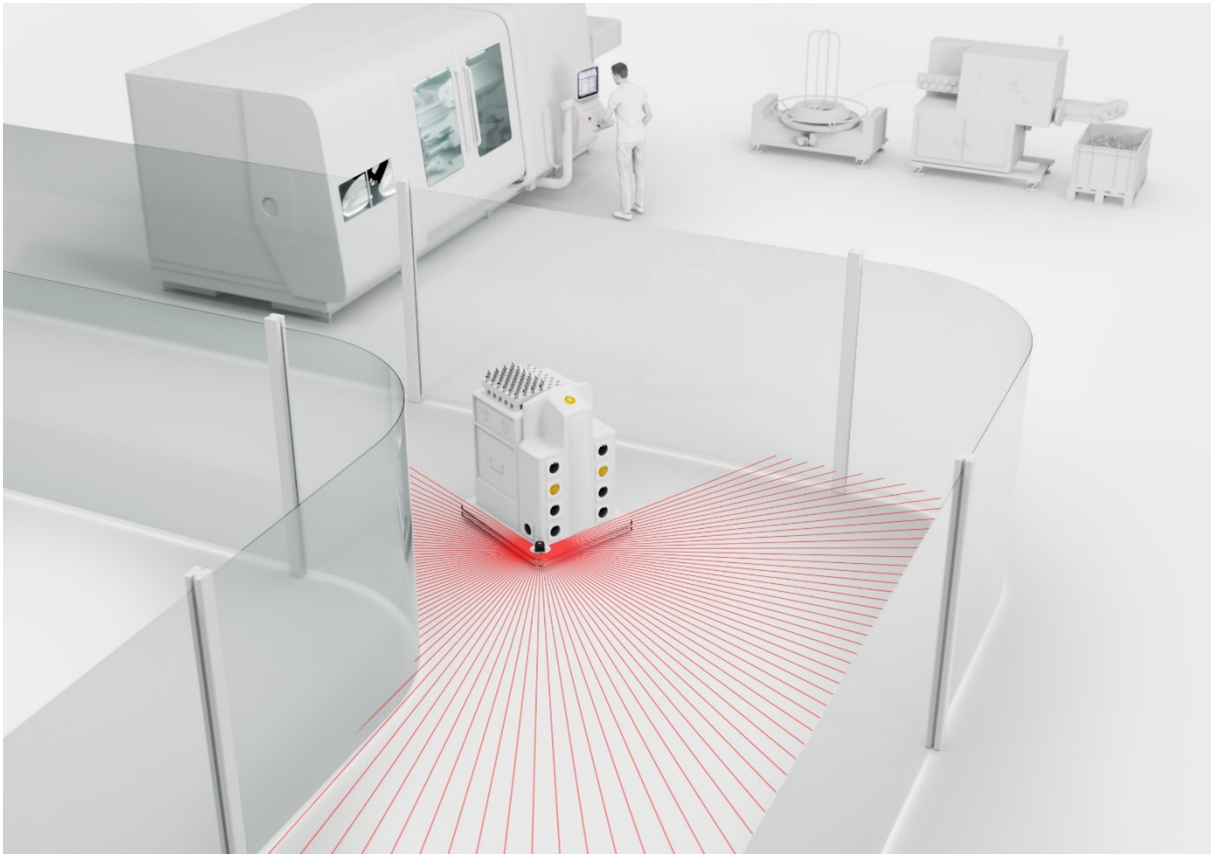


Fig. 5.3: Navigation

Media control

The scanner returns the positions of objects via a defined area. Precise gesture control can be achieved through the precise detection of the smallest movements.

Fig. 5.4: Media control

Other applications:

- Collision protection
- Access control
- Volume measurement

6 Mounting

NOTICE
Protection class IP67 Protection class IP67 is achieved only if the connectors are screwed into place and caps installed.

6.1 Installation environment

The ROD 300 and ROD 500 series laser scanners are designed for use in various industrial environments. However, users must note the following:

- Avoid extreme shocks. Make sure that the product is firmly attached to the base or mounting bracket with all M5 screws. Install the device so that it is insulated from shock and vibration.

NOTICE
Scratches or smudges on the optical window impair the measurement result. - Keep the optical window clean. - Ensure that you do not touch the device's optical window while handling or installing the product.

- Keep the detection field clear. Make sure that no wires or objects are obstructing the view of the device, as this may hinder regular operation.
- Avoid high-pressure cleaning. Use laser cleaning processes such as evaporating pressure, dry or steam cleaning, selective vaporization, etc.
- Prevent internal condensation in the scanner: As condensation can seriously damage the laser, you must take extra precautions to prevent this.
- Avoid direct or indirect sunlight. The infrared radiation of sunlight can interfere with the IR radiation of the laser scanner and impair the result.

WARNING
Dangers when using the device in non-intended areas Using the laser scanner in areas that are not covered by the intended use can lead to dangerous situations. - Ensure that the relevant safety standards for machines, e.g. the Machinery Directive, are applied when a device is used for a safety application. - Do not install the device in potentially explosive or corrosive environments.

6.2 Mounting the laser scanner

6.2.1 Fastening holes at the bottom of the device

There are four fastening holes with M5 threads on the underside of the laser scanner, each 10 mm deep.

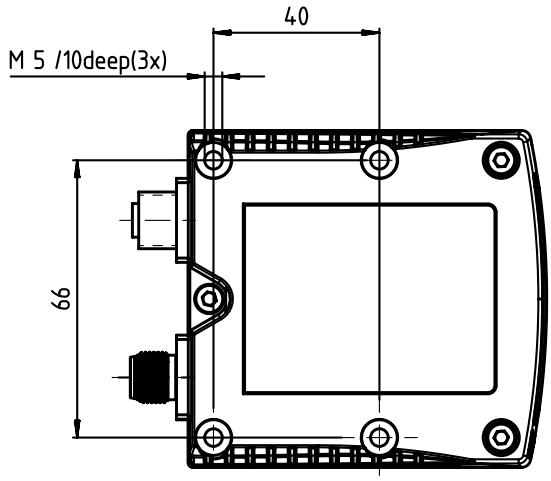


Fig. 6.1: Fastening holes at the bottom of the device

↳ Use all four threaded holes for direct mounting so that the impact resistance and vibration values specified in the technical parameters are achieved.

- Maximum screw-in depth: 8 mm
- Recommended tightening torque: 4.5 – 5 Nm

NOTICE	
	If you mount the device directly on the machine without a mounting bracket, you must ensure that it is securely fastened. Use all four threaded holes for direct mounting so that the impact resistance and vibration values specified in the technical parameters are achieved (see chapter 12.1 "General specifications").

↳ After mounting, make sure that the device's status indicators are clearly visible.

6.2.2 Fastening holes at the rear of the device

There are two M5 threaded holes on the rear side of the laser scanner, each with a depth of 8 mm.

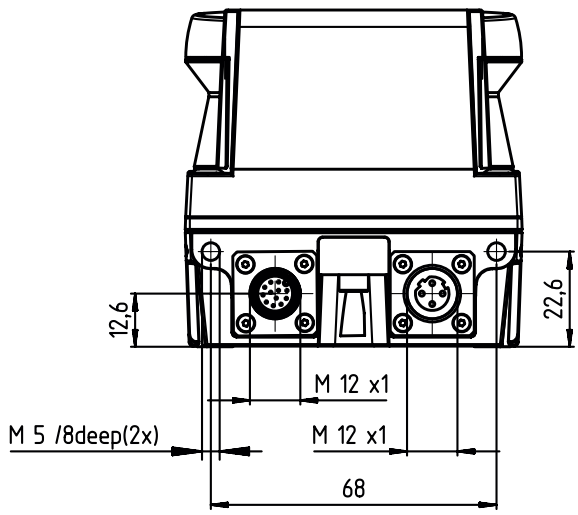


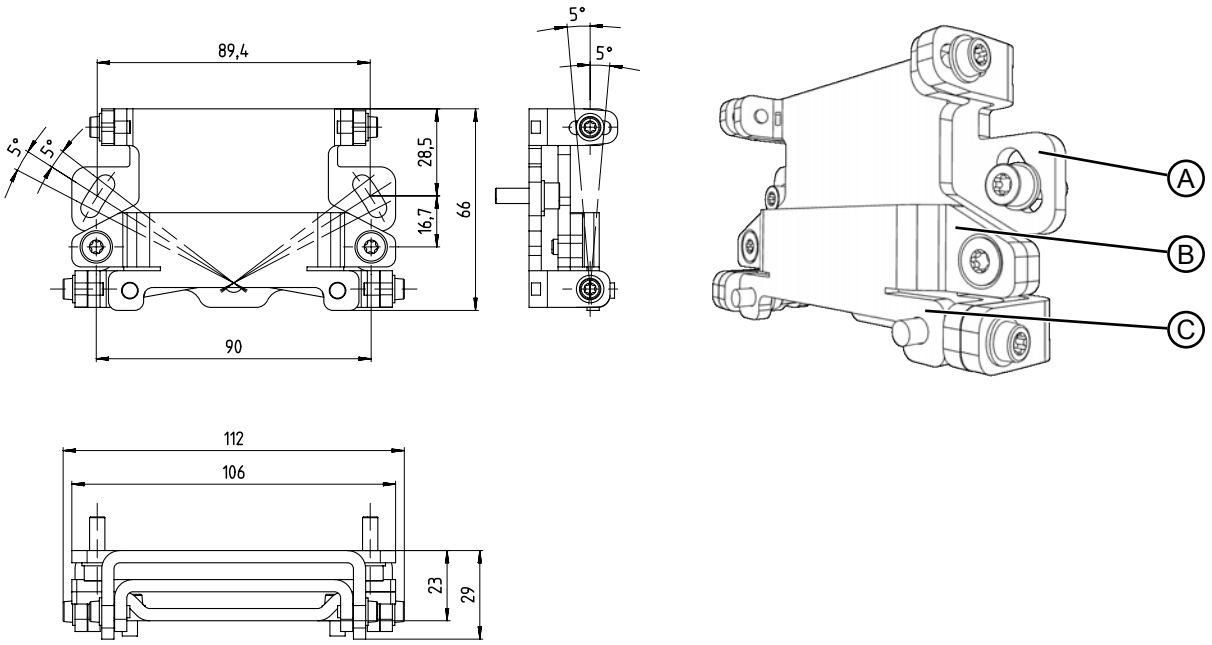
Fig. 6.2: Fastening holes at the rear of the device

Recommended tightening torque: 4.5 – 5 Nm

6.2.3 Mounting via BTU 510M mounting bracket

You can also use the BTU 510M mounting bracket to mount and adjust the laser scanner. For the ordering data for the mounting kit and the required accessories, see chapter 13 "Order guide and accessories".

You can use the mounting system to adjust the laser scanner horizontally and vertically by ±5 degrees when mounting.



All dimensions in mm

A Wall mount

B Mounting system

C Mounting adapter

Fig. 6.3: 3-piece mounting bracket BTU 510M

Mounting steps

- Mount the wall bracket on the system side. Two cylinder head screws M5x16 with washers are included for this purpose.
- Mount the laser scanner with the included M5x10 cylinder head screws on the mounting adapter (tightening torque = 2.3 Nm).
- Mount the laser scanner (with the mounting adapter) on the mounting system. In doing so, tighten the countersunk screw to 4.5 Nm.
- Align the laser scanner vertically and horizontally on the mounting system:
  – via the slotted holes in the wall section using the M5 cylinder head screws and
  – adjust the inclination using the slotted holes in the M4 cylinder head screws.
- After alignment, fix the laser scanner by tightening the four M4 cylinder head screws with 3.0 Nm and the on-site M5 cylinder head screws.

6.2.4 Mounting multiple devices

WARNING

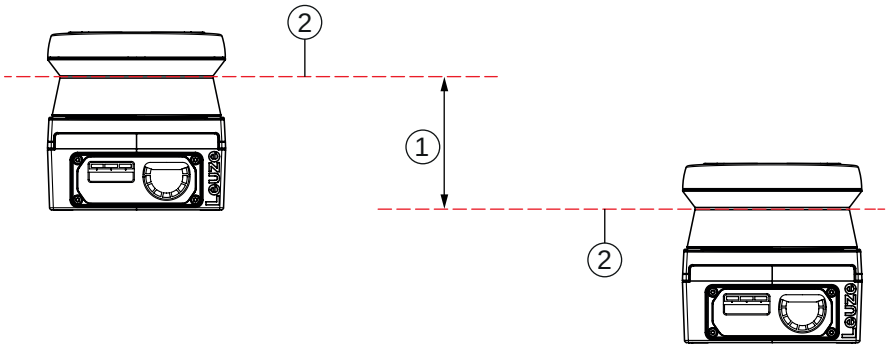
Danger due to malfunction of impaired devices!

If several devices are installed, there is a risk of interference from other devices. Radiation sources with a wavelength of 905 nm can cause interference if they act directly on a device.

↳ Arrange the devices in the following alignment variants.

Mounting with height offset

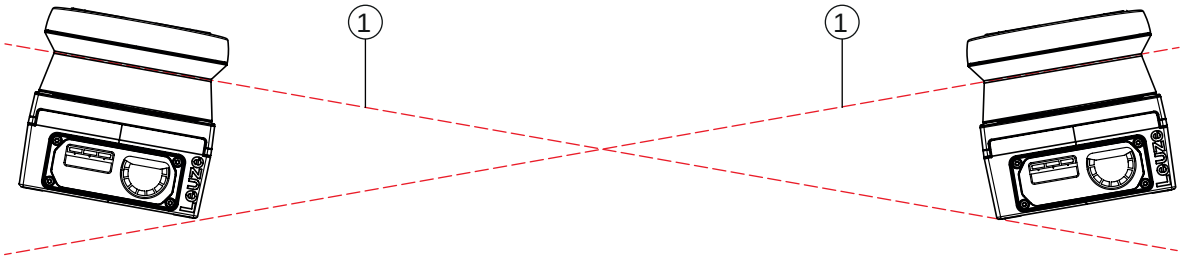
When mounting two devices on one axis level, maintain a minimum distance of 170 mm.



1 Minimum distance 170 mm
2 Scanning plane

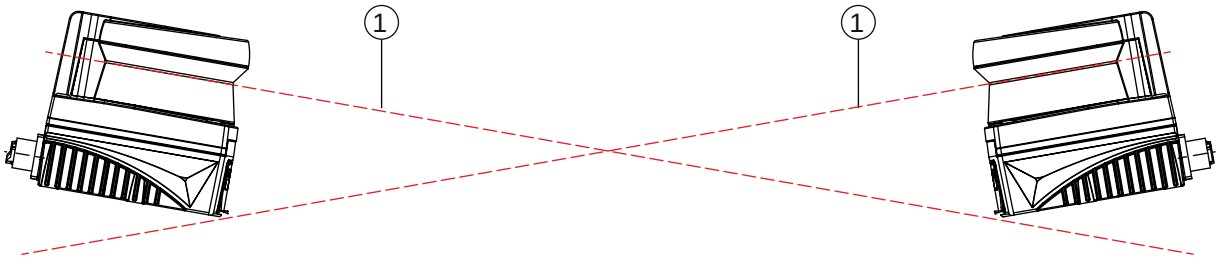
Fig. 6.4: Height offset mounting, parallel alignment

Mounting with crossed alignment



1 Scanning plane

Fig. 6.5: Mounting beside one another, without height offset, crossed alignment



1 Scanning plane

Fig. 6.6: Mutually opposing mounting, without height offset, crossed alignment

7 Electrical connection

CAUTION

UL applications!

For UL applications, use is only permitted in Class 2 circuits in accordance with the NEC (National Electric Code).

NOTICE

Protective Extra Low Voltage (PELV)!

The device is designed in accordance with protection class III for supply with PELV (Protective Extra-Low Voltage).

7.1 Pin assignment for control

The sensor is equipped with a 12-pin M12 connector (A-coded).

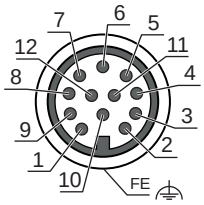


Fig. 7.1: M12 connector pin assignment

Tab. 7.1: Pin assignment

Pin	Signal	Function	Core color
1	Out1	Warning output	Brown
2	24V	Voltage supply	Blue
3	n.c.	-	White
4	n.c.	-	Green
5	Err	Warning/error output	Pink
6	n.c.	-	Yellow
7	0V	Voltage supply	Black
8	n.c.	-	Gray
9	n.c.	-	Red
10	n.c.	-	Violet
11	n.c.	-	Gray/pink
12	n.c.	-	Red/blue

7.2 Ethernet interface connection assignment (communication)

NOTICE
The sensor must not be connected to Ethernet cables or Ethernet networks that are routed outside.

The sensor is equipped with a 4-pin M12 socket (D-coded).

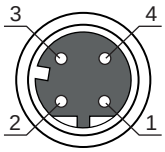


Fig. 7.2: Pin assignment of the Ethernet interface

Tab. 7.2: Pin assignment

PIN	Signal	Description
1	TX+	Data communication, transmission
2	RX+	Data communication, reception
3	TX-	Data communication, transmission
4	RX-	Data communication, reception

8 Starting up the device

ROD Config configuration software

The *ROD Config* software is used to configure and troubleshoot the ROD laser scanner and to monitor contamination.

ROD Config is a Windows software that allows you to configure the scanner and visualize the real-time detection point cloud. It is primarily used to adjust the device settings and monitor the scanner in real time.

In this chapter you will find instructions on how to install the software, its functions, the sensor parameters and more. Here you will find information on where you can download the ROS driver and the SDK for creating autonomous applications.

Installation

Proceed as follows to download the *ROD Config* configuration software and install it on your PC:

- Call up the Leuze website: **www.leuze.com**.
- Enter the type designation or part number of the device as the search term.
- The configuration software can be found on the product page for the device under the *Downloads* tab.
- Click on the software package.
  - ⇨ The package will be downloaded to your PC.
- After downloading, run the installation program and follow the instructions. You must allow the software to make changes to your PC.
- Click the [Finish] button to complete the installation process.
- Once the installation is complete, start the software.

	NOTICE
	The scanner's standard IP address is 192.168.61.100. It uses port 3050. Set the address on the PC accordingly to establish communication between the laser scanner and the software.

Configuration software functions

The configuration software allows the user to configure the scanner and visualize detection point clouds in real time. The other main functions of the software include:

- Configuring sensor parameters
- Visualizing the point cloud detection
- Saving and loading the configuration
- Troubleshooting with error logs and scanner status

Dashboard

The *ROD Config* configuration software contains seven menus at the top of the dashboard. These menus help the user to organize the laser scanner's functions. Apart from that, there are a number of functions on the software's dashboard.

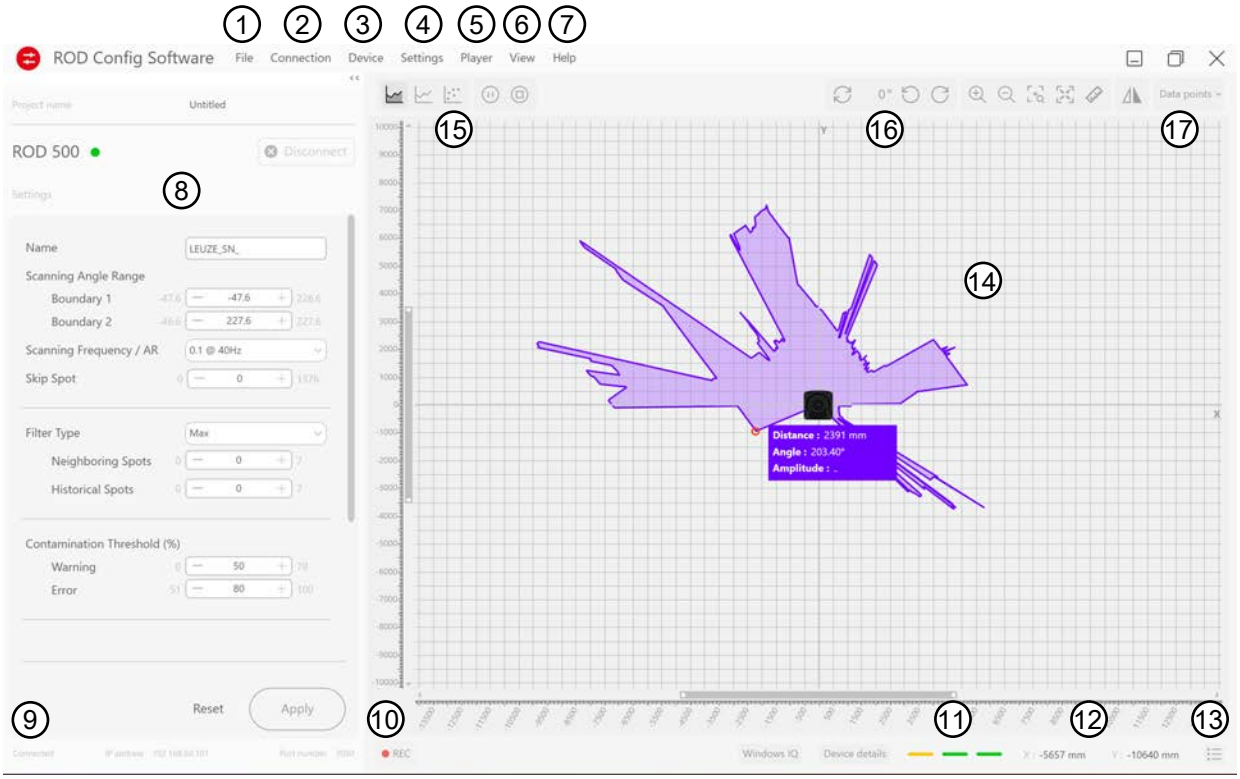


Fig. 8.1: ROD Config dashboard

Pos.	Operational control	Function
1	**File** menu	File management: • Creating new projects • Backup • Opening files or configurations
2	**Connection** menu	Establish or interrupt the connection to one or more scanners.
3	**Settings** menu	Adapting the software functions: Change the sensor parameters and save with the [Accept] button.
4	**Device** menu	Information about the device(s) connected to the software
5	**Player** menu	Saving measurement data
6	**View** menu	Various views within the coordinate system
7	**Help** menu	Information about the software and support options
8	Left control panel	Enter the project name in the *Name* field. The left control panel allows you to identify the sensor model and connect or disconnect the device.
9	**Sensor status** display	Sensor status (Ethernet connection): • Connected/not connected • IP address • Port
10	[Record] button	[Start/Stop] button to record a session of measurement data output for playback and analysis, even if you are not connected to the device.

Pos.	Operational control	Function
11	LED status bar	Real-time image of the LED indicator on the sensor (see chapter 3.3 "Display elements")
12	Mouse pointer coordinates	Coordinates of the mouse pointer when interacting with the area detected by the sensor
13	[Real-time measurement] button	The sensor’s real-time measurements
14	Coordinate system	Visualization of the laser point cloud of the connected laser scanner
15	Icon buttons	Buttons and icons for navigation
16	Icon buttons	Buttons and icons for navigation
17	Data view filter	*Data point* toolbox for filtering or highlighting certain data points in the point cloud view, e.g. by distance, amplitude, point index.

Sensor parameters

The sensor parameters refer to specific configurations that determine the operation of the connected laser scanner. This includes factors such as data filtering, scanning angle range, resolution, etc. These factors influence the sensor’s performance in capturing information from its environment.

The user can adjust these parameters to tailor the sensor’s response to specific conditions.

9 Diagnosis and troubleshooting

9.1 What to do in case of failure?

Information on the device status, as well as laser scanner diagnostics and troubleshooting can be displayed via the LED indicator and the configuration software.

LED indicator

If the LEDs on the front of the device indicate an error, detailed error descriptions can be viewed via the configuration software (see chapter 3.3 "Display elements").

9.2 Error log

The error log can be called up via the software. You can also check the type of error and the recommended corrective measures for this type of error.

Tab. 9.1: Error log

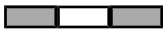
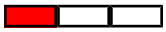
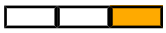
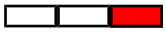
Error type	Recommendation
Power supply error	Check the power supply (voltage and capacity); make sure that it is within the permissible limits.
Internal voltage error	
Temperature error	Check the ambient temperature at the sensor's installation location; make sure that it is within the permissible limits.
Internal error	Restart the sensor. If the error persists, replace the sensor and send it in for inspection.
Internal communication error	Check the Ethernet connection.
Ethernet communication error	
System error	Restart the sensor. If the error persists, replace the sensor and send it in for inspection.
External error	Check the window to see if it is soiled or covered.
Unknown error	Restart the sensor. If the error persists, replace the sensor and send it in for inspection.

For errors that are not listed and cannot be rectified, please contact Leuze Service (see chapter 11 "Service and support"). Please make a note of the details on the product label so that we can process your request as quickly as possible.

9.3 LED indicator troubleshooting

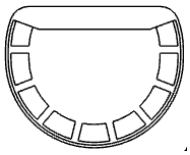
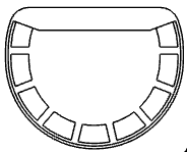
Status LEDs

Tab. 9.2: LED error display

LEDs 1-3	State LEDs	Error cause	Troubleshooting
	LED 1 is off. LED 3 is off.	No power supply	Check cable and connections.
	LED 1 lights up red.	Power supply outside the permissible limits	Check the power supply (voltage and capacity); make sure that it is within the permissible limits.
	LED 2 is off.	No Ethernet connection	Check Ethernet cable and connection.
	LED 2 lights up green.	Ethernet connection available but no data transfer.	Start data transfer.
	LED 3 lights up orange.	Internal error	Restart sensor.
	LED 3 lights up red.	Fatal error	Send in sensor for inspection.

LED circular segment

Tab. 9.3: LED circular segment error display

LEDs 1-9	State LEDs	Error cause	Troubleshooting
	LED flashes orange at 0.5 Hz	Contamination warning in the displayed angular segment	Clean the optics cover.
	LED lights up red.	Contamination error in the displayed angular segment	Clean the optics cover.

9.4 Ethernet communication

The measurement data is transmitted via Ethernet. These can be provided in the form of UDP or TCP/IP.

For further details and the ROD 300/500 laser scanner's complete command set, please see the supplementary document "Ethernet protocol ROD x00". This also includes information on Ethernet communication errors.

10 Care, maintenance and disposal

10.1 Cleaning the optics cover

Clean the optics cover as required by the application-related load rating.

Use the cleaning set consisting of special cleaning agent and cleaning cloths for cleaning (see chapter 13 "Order guide and accessories").

The procedure for cleaning depends on the kind of contamination.

NOTICE
The wrong cleaning agents or cloths will damage the optics cover! ↳ Do not use any scouring cleaning agents or scratching cloths. ↳ Use the Leuze cleaning set (see chapter 13 "Order guide and accessories").

NOTICE
If cleaning takes longer than four seconds, e.g. with fingerprints, the sensor displays a fault in the optics cover monitoring. After cleaning is complete, the sensor resets itself automatically. ↳ Clean the entire optical dome. ↳ Soak cloth with cleaning agent. ↳ Wipe optics cover clean in one swipe.

NOTICE
Internal monitoring of optics cover! The monitored area is dependent on the configuration and can be smaller than the entire scanning range of 275°. On account of device safety, the internal monitoring of the optics cover monitors a range that is larger than specified by the configured protective field.

10.2 Replacing the device

If the laser scanner test or an error message indicates a defective sensor, replace the device. Only an instructed and competent person may replace the sensor. The sensor is replaced in the following steps:

↳ Disconnect the defective device from the connection cables.

↳ Connect new sensor.

↳ Commission new sensor.

10.3 Servicing

The device does not normally require any maintenance by the operator.

Repairs to the device must only be carried out by the manufacturer.

↳ For repairs, contact your responsible Leuze subsidiary or Leuze customer service (see chapter 11 "Service and support").

10.4 Decommissioning and disposal

Decommissioning

- Switch off the power supply.
- Disconnect the power and Ethernet cable connected to the device.
- Remove the device from the mounting bracket/machine.

NOTICE
If you replace the product, you can transfer the value of the parameters to the replacement device using the *ROD Config* software.

Disposing

NOTICE
For disposal observe the applicable national regulations regarding electronic components.

11 Service and support

Service hotline

You can find the contact information for the hotline in your country on our website **www.leuze.com** under **Contact & Support**.

Repair service and returns

Defective devices are repaired in our service centers competently and quickly. We offer you an extensive service packet to keep any system downtimes to a minimum. Our service center requires the following information:

- Your customer number
- Product description or part description
- Serial number or batch number
- Reason for requesting support together with a description

Please register the merchandise concerned. Simply register return of the merchandise on our website **www.leuze.com** under **Contact & Support > Repair Service & Returns**.

To ensure quick and easy processing of your request, we will send you a returns order with the returns address in digital form.

12 Technical data

12.1 General specifications

Tab. 12.1: Optical data

Technology	Light propagation time measurement (ToF)
Laser class according to IEC 60825-1:2014 / EN 60825-1:2024 + A11:2021	Class 1
Wavelength	905 nm (infrared)
Maximum output power	28 W
Scanning angle	275°
Scanning frequency	80 Hz / 50 Hz / 40 Hz (adjustable)
Angular resolution	0.2° at 80 Hz 0.2° at 50 Hz 0.1° at 40 Hz 0.05° at 20 Hz (ROD 500 only) 0.025° at 10 Hz (ROD 500 only)
Scanning area	0.08 – 25 m 7 m at 1.8% reflectance 15 m at 10% reflectance 25 m at 90% reflectance
Light spot size • Light spot diameter • Beam divergence	 • 12.5 mm x 1.5 mm at 1 m (at 90% spot energy) • 12.5 mm/m (in longitudinal direction) x 1.5 mm/m (in transverse direction)
Scanning plan height / flatness	±0.2°
Accuracy of measurement • Measurement speed • Systematic errors • Statistical errors (1σ)	 • 110,080 measurements per second • ±20 mm • ≤6 mm (0.08 – 7 m) ≤10 mm (7 – 10 m) ≤15 mm (10 – 15 m) ≤6 mm (0.08 – 25 m) for reflectors

Tab. 12.2: Electrical data

Supply voltage	12 – 24 V DC -10% / +30%
Power consumption	<5.5 W

Tab. 12.3: Interfaces

Ethernet	TCP/IP, UDP/IP
Default IP address	192.168.61.100
Port	3050
Digital outputs	2 x PNP (max. 30 V DC / 100 mA)
Indicators	3 x status LEDs (three-color) 9 x LEDs for contamination display

Tab. 12.4: Mechanical data

Dimensions (H x W x D)	80 mm x 80 mm x 85 mm (without connections)
Weight	Approx. 630 g
Housing material	Zinc / plastic
Optical window material	Plastic / PC
Connections	1 x current/output, 12-pin, M12 connector, A-coded 1 x Ethernet, 4-pin, M12 socket, D-coded

Tab. 12.5: Environmental conditions

Ambient temperature, operation	-30°C … +60°C
Ambient temperature, storage	-40°C … +70°C
Relative humidity	<95 %, non-condensing
Ambient light immunity	100,000 lux (ambient light) 3,000 lux (IEC 61496-3)

Tab. 12.6: General system data

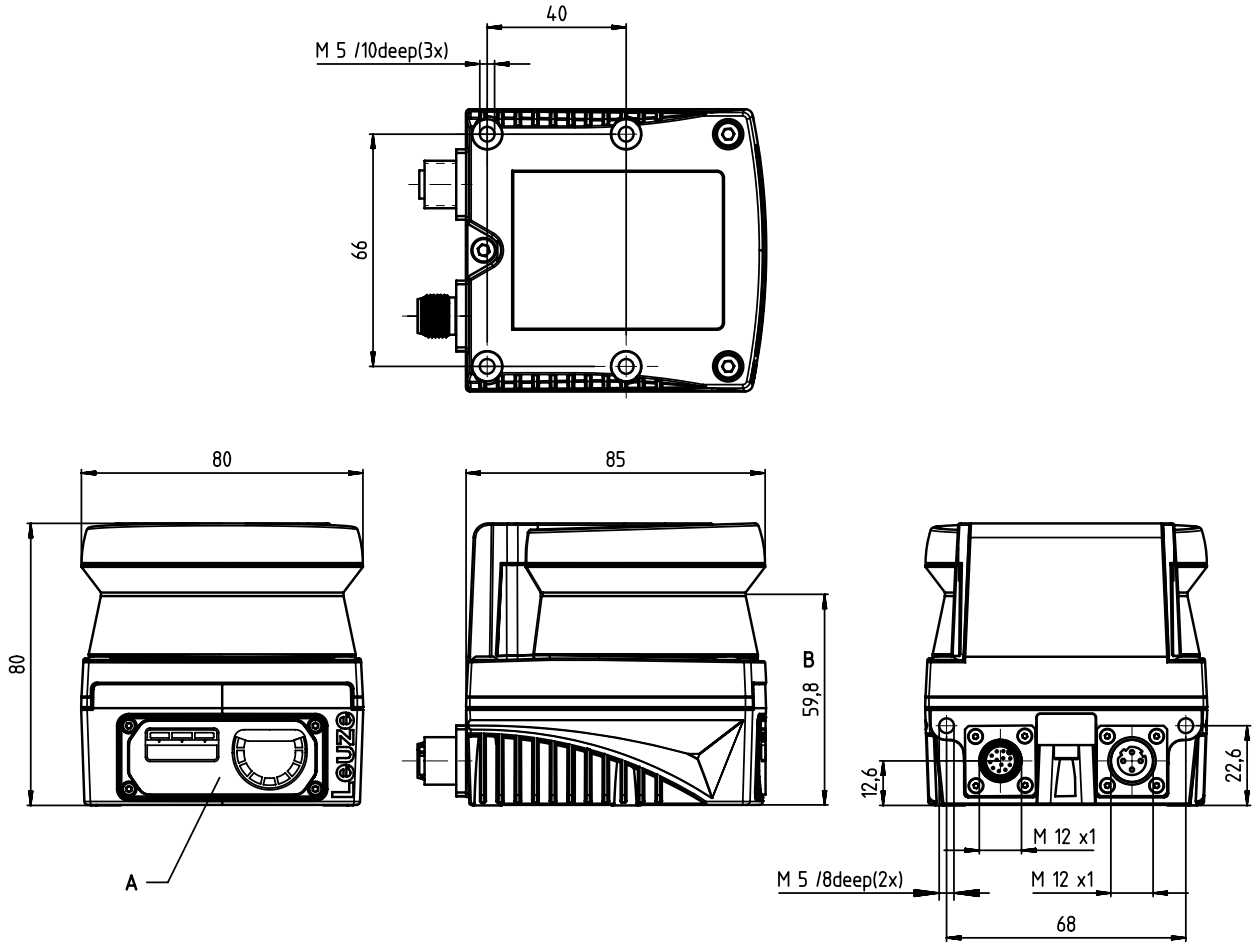
Protection class (IEC 60529)	IP67 (only with USB port cover attached)
Protection class (IEC 61140)	III
Immunity class (IEC 61000-6-2)	Industrial environments
Emission class (IEC 61000-6-4)	Industrial environments
Vibration resistance	Sinusoidal oscillations: 3.5 mm, 5 – 9 Hz (IEC 60721-3-5) 1.0 g, 9 – 200 Hz (IEC 60721-3-5) 1.5 g, 200 – 500 Hz (IEC 60721-3-5) 0.35 mm, 10 – 55 Hz (IEC 60068-2-6)
Shock resistance • Class (IEC 60721-3-5) • Single shock (IEC 60721-3-5) • Continuous shock (IEC 60068-2-27)	 • 5M2 • 15 g, 11 ms, 3 shocks per axis • 10 g, 16 ms, 1000 shocks per axis

CAUTION

UL applications!

For UL applications, use is only permitted in Class 2 circuits in accordance with the NEC (National Electric Code).

12.2 Dimensions



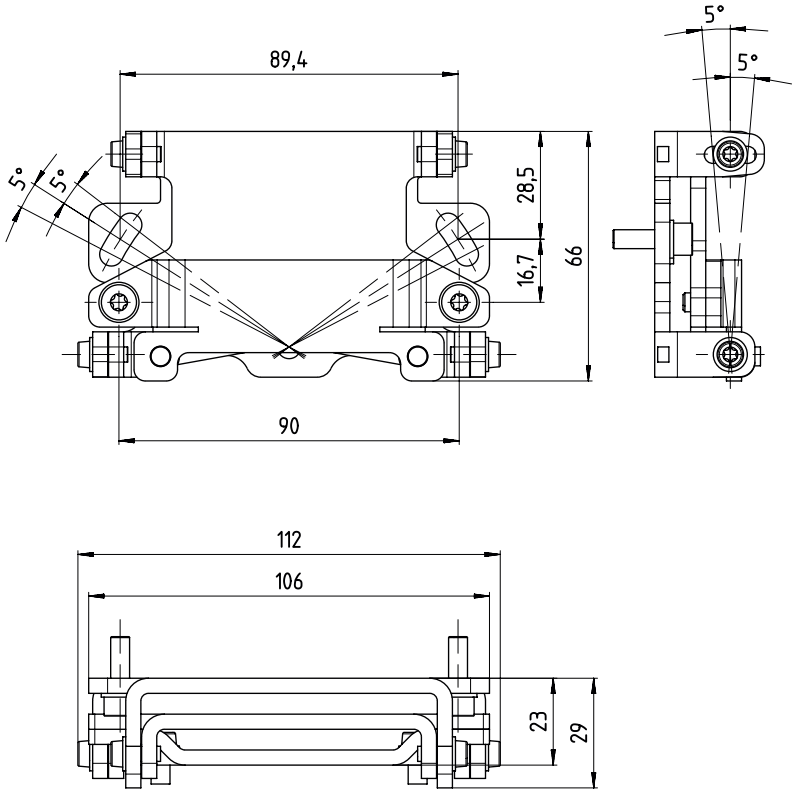
all dimensions in mm

A LED indicators

B Optical axis

Fig. 12.1: ROD 300/ROD 500 dimensions

12.3 Dimensioned drawings: Accessories



all dimensions in mm

Fig. 12.2: BTU 510M dimensions

13 Order guide and accessories

Part number code

Part designation: **ROD xyy**

ROD	Optical 2D laser scanner
x	Series: 3: ROD 300 5: ROD 500
y	Interface: 08: Ethernet

Laser scanner

Tab. 13.1: Type overview

Part no.	Article	Description
50153046	ROD 308	Optical 2D laser scanner
50153047	ROD 508	Optical 2D laser scanner, highly precise model

Connection technology

Tab. 13.2: Connection cables

Part no.	Article	Description
50130281	KD S-M12-CA-P1-020	M12 connection cable, axial, 12-pin, A-coded, 2 m
50130282	KD S-M12-CA-P1-050	M12 connection cable, axial, 12-pin, A-coded, 5 m
50130283	KD S-M12-CA-P1-100	M12 connection cable, axial, 12-pin, A-coded, 10 m
50149620	KD S-M12-CA-P1-150	M12 connection cable, axial, 12-pin, A-coded, 15 m
50149621	KD S-M12-CA-P1-250	M12 connection cable, axial, 12-pin, A-coded, 25 m
50134943	KD S-M12-CW-P1-050	M12 connection cable, angled, 12-pin, A-coded, 5 m

Tab. 13.3: Interconnection cables

Part no.	Article	Description
50135080	KSS ET-M12-4A-RJ45-A-P7-020	Interconnection cable RJ45, M12, axial, 4-pin, D-coded, 2 m
50135081	KSS ET-M12-4A-RJ45-A-P7-050	Interconnection cable RJ45, M12, axial, 4-pin, D-coded, 5 m
50135082	KSS ET-M12-4A-RJ45-A-P7-100	Interconnection cable RJ45, M12, axial, 4-pin, D-coded, 10 m
50135083	KSS ET-M12-4A-RJ45-A-P7-150	Interconnection cable RJ45, M12, axial, 4-pin, D-coded, 15 m
50135084	KSS ET-M12-4A-RJ45-A-P7-300	Interconnection cable RJ45, M12, axial, 4-pin, D-coded, 30 m
50138106	KSS ET-M12-4W-RJ45-A-P7-030	Interconnection cable RJ45, M12, angled, 4-pin, D-coded, 3 m
50136183	KSS ET-M12-4W-RJ45-A-P7-050	Interconnection cable RJ45, M12, angled, 4-pin, D-coded, 5 m
50136185	KSS ET-M12-4W-RJ45-A-P7-150	Interconnection cable RJ45, M12, angled, 4-pin, D-coded, 15 m

Tab. 13.4: Accessories – Adapter and power supply unit

Part no.	Article	Description
50149892	D U-M12-CA-K PWR27	Voltage supply adapter
50110748	NT 24-24W	Power supply unit

Mounting technology

Tab. 13.5: Accessories - mounting technology

Part no.	Article	Description
50153212	BTU 510M set	Mounting system Laser scanner for vertical and horizontal alignment incl. mounting adapter

Other accessories

Tab. 13.6: Other accessories

Part no.	Article	Description
430400	RS4-clean-Set1	Cleaning set with • cleaning fluid for plastic, 150 ml • Cleaning cloths, 25x, soft, fuzz-free

14 Declaration of Conformity

The ROD 300 and ROD 500 series laser scanners have been developed and manufactured in accordance with applicable European standards and directives.

	NOTICE
	You can download the EC Declaration of Conformity from the Leuze website. ↳ Call up the Leuze website: *www.leuze.com*. ↳ Enter the type designation or part number of the device as the search term. The article number can be found on the name plate of the device under the entry “Part. No.”. ↳ The documents can be found on the product page for the device under the *Downloads* tab.