OPERATING INSTRUCTIONS

LRS4000

2D LiDAR sensor

SICK
Sensor Intelligence.

Described product

LRS4000

Manufacturer

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Legal information

Original document

This document is an original document of SICK AG.

Contents

1 About this document

1.1 Information on the operating instructions

These operating instructions provide important information on how to use devices from SICK AG.

Prerequisites for safe work are:

- Compliance with all safety notes and handling instructions supplied.
- Compliance with local work safety regulations and general safety regulations for device applications

The operating instructions are intended to be used by qualified personnel and electrical specialists.

NOTE
Read these operating instructions carefully to familiarize yourself with the device and its functions before commencing any work.

The operating instructions are an integral part of the product. Store the instructions in the immediate vicinity of the device so they remain accessible to staff at all times. Should the device be passed on to a third party, these operating instructions should be handed over with it.

These operating instructions do not provide information on the handling and safe operation of the machine or system in which the device is integrated. Information on this can be found in the operating instructions for the machine or system.

1.2 Explanation of symbols

Warnings and important information in this document are labeled with symbols. Signal words introduce the instructions and indicate the extent of the hazard. To avoid accidents, damage, and personal injury, always comply with the instructions and act carefully.

DANGER
... indicates a situation of imminent danger, which will lead to a fatality or serious injuries if not prevented.

WARNING
... indicates a potentially dangerous situation, which may lead to a fatality or serious injuries if not prevented.

CAUTION
... indicates a potentially dangerous situation, which may lead to minor/slight injuries if not prevented.

NOTICE
... indicates a potentially harmful situation, which may lead to material damage if not prevented.

NOTE
... highlights useful tips and recommendations as well as information for efficient and trouble-free operation.

1.3 Further information

More information can be found on the product page.

The product page can be accessed via the **SICK Product ID**: **pid.sick.com/{P/N}/{S/N}**

{P/N} corresponds to the part number of the product, see type label.

{S/N} corresponds to the serial number of the product, see type label (if indicated).

The following information is available depending on the product:

- Data sheets
- This document in all available language versions
- CAD files and dimensional drawings
- Certificates (e.g., declaration of conformity)
- Other publications
- Software
- Accessories

2 Safety information

2.1 Intended use

The LRS4000 2D LiDAR sensor features 1 scan plane and is designed for the following applications:

- Detection of objects during continuous output of measurement data as required.
- Detection and position determination of structures and objects.

It is suitable for applications which demand precise, non-contact optical measuring contours and dimensioning. Typical applications include profile detection in container handling, volume measurement in coal piles and boom protection on cranes.

2.2 Improper use

Any use outside of the stated areas, in particular use outside of the technical specifications and the requirements for intended use, will be deemed to be incorrect use.

- The device does not constitute a safety component in accordance with the respective applicable safety standards for machines.
- The device must not be used in explosion-hazardous areas, in corrosive environments or under extreme environmental conditions.
- Any use of accessories not specifically approved by SICK AG is at your own risk.

WARNING
Danger due to improper use!

Any improper use can result in dangerous situations.

Therefore, observe the following information:

- Product should be used only in accordance with its intended use.
- All information in the documentation must be strictly observed.
- Shut down the product immediately in case of damage.

2.3 Cybersecurity

Overview

To protect against cybersecurity threats, it is necessary to continuously monitor and maintain a comprehensive cybersecurity concept. A suitable concept consists of organizational, technical, procedural, electronic, and physical levels of defense and considers suitable measures for different types of risks. The measures implemented in this product can only support protection against cybersecurity threats if the product is used as part of such a concept.

You will find further information at www.sick.com/psirt, e.g.:

- General information on cybersecurity
- Contact option for reporting vulnerabilities
- Information on known vulnerabilities (security advisories)

2.4 Limitation of liability

Relevant standards and regulations, the latest technological developments, and our many years of knowledge and experience have all been taken into account when compiling the data and information contained in these operating instructions. The manufacturer accepts no liability for damage caused by:

- Non-adherence to the product documentation (e.g., operating instructions)
- Incorrect use

- Use of untrained staff
- Unauthorized conversions or repair
- Technical modifications
- Use of unauthorized spare parts, consumables, and accessories

2.5 Modifications and conversions

NOTICE
Modifications and conversions to the device may result in unforeseeable dangers.

Interrupting or modifying the device or SICK software will invalidate any warranty claims against SICK AG. This applies in particular to opening the housing, even as part of mounting and electrical installation.

2.6 Requirements for skilled persons and operating personnel

WARNING
Risk of injury due to insufficient training.
Improper handling of the device may result in considerable personal injury and material damage.

- All work must only ever be carried out by the stipulated persons.

The following qualifications are required for various activities:

Table 1: Activities and technical requirements

Activities	Qualification
Mounting, maintenance	■ Basic practical technical training ■ Knowledge of the current safety regulations in the workplace
Electrical installation, device replacement	■ Practical electrical training ■ Knowledge of current electrical safety regulations ■ Knowledge of the operation and control of the devices in their particular application
Commissioning, configuration	■ Basic knowledge of the computer operating system used ■ Basic knowledge of the design and setup of the described connections and interfaces ■ Basic knowledge of data transmission
Operation of the device for the particular application	■ Knowledge of the operation and control of the devices in their particular application ■ Knowledge of the software and hardware environment for the particular application

2.7 Operational safety and specific hazards

Please observe the safety notes and the warnings listed here and in other sections of this product documentation to reduce the possibility of risks to health and avoid dangerous situations.

CAUTION
Optical radiation: Class 1 Laser Product

The accessible radiation does not pose a danger when viewed directly for up to 100 seconds. It may pose a danger to the eyes and skin in the event of incorrect use.

- Do not open the housing. Opening the housing may increase the level of risk.
- Current national regulations regarding laser protection must be observed.

Caution – Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

It is not possible to entirely rule out temporary disorienting optical effects, particularly in conditions of dim lighting. Disorienting optical effects may come in the form of dazzle, flash blindness, afterimages, photosensitive epilepsy, or impairment of color vision, for example.

WARNING
Electrical voltage!

Electrical voltage can cause severe injury or death.

- Work on electrical systems must only be performed by qualified electricians.
- The power supply must be disconnected when attaching and detaching electrical connections.
- The product must only be connected to a voltage supply as set out in the requirements in the operating instructions.
- National and regional regulations must be complied with.
- Safety requirements relating to work on electrical systems must be complied with.

WARNING
Risk of injury and damage caused by potential equalization currents!

Improper grounding can lead to dangerous equipotential bonding currents, which may in turn lead to dangerous voltages on metallic surfaces, such as the housing. Electrical voltage can cause severe injury or death.

- Work on electrical systems must only be performed by qualified electricians.
- Follow the notes in the operating instructions.
- Install the grounding for the product and the system in accordance with national and regional regulations.

3 Product description

3.1 Scope of delivery

The delivery of the device includes the following components:

Table 2: Scope of delivery

No. of units	Component	Remarks
1	Device in the version ordered	Depending on version
1	Set of protective caps for electrical connections	Attached to the connections
1	Printed safety notes, multilingual	Brief information and general safety notes

3.2 Status indicators

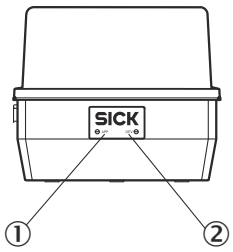


Figure 1: Status indicators

① **APP** LED

② **DEV** LED

APP LED (color)	DEV LED (color)	Description
● (Red)	● (Red)	Starting up
- –	● (Red)	Configuration
- –	–	Off
–	● (Green)	On / Ready for operation
- –	● (Yellow)	Warning
✳ Slow (red)	✳ Slow (red)	Error that can be corrected by the customer
✳ Fast (red)	✳ Fast (red)	Fatal error
- –	● (Yellow)	Standby / Power save
✳ (Red) ✳ (Yellow) ✳ (Green)	✳ (Red) ✳ (Yellow) ✳ (Green)	Identification of the device
✳ (Red)	✳ (Green)	Firmware update

● = illuminated; ✳ = flashing

3.3 Type label

The type label gives information for identification of the device.

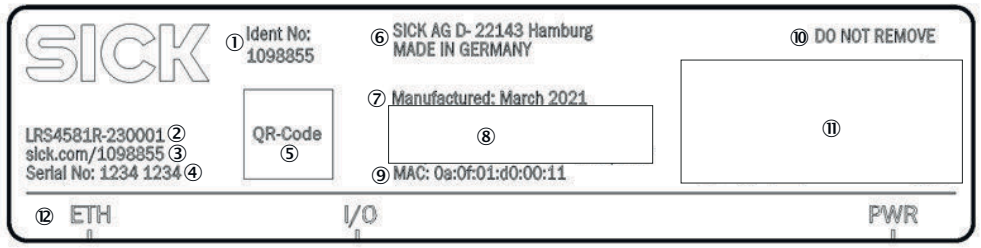


Figure 2: LRS4000 type label (example)

① Part number
② Type code
③ Web address of product page
④ Serial number
⑤ Data Matrix code with product data and link to product page
⑥ Manufacturer, place of production
⑦ Production date
⑧ Voltage supply, typical power, max. power, operating temperature, enclosure rating
⑨ MAC address
⑩ Note: Do not remove type label
⑪ Conformity mark/certification mark, symbol: Observe the operating instructions!
⑫ Labeling of connections

3.4 Principle of operation

3.4.1 Measurement principle

The device is an optoelectronic LiDAR sensor that contactlessly scans the outline of its surroundings with the help of laser beams. The device measures its surroundings in two-dimensional polar coordinates, relative to its measurement origin. This is marked by a circular indentation in the center of the optics cover. If a laser beam strikes an object, the position of that object is determined in terms of distance and angle.

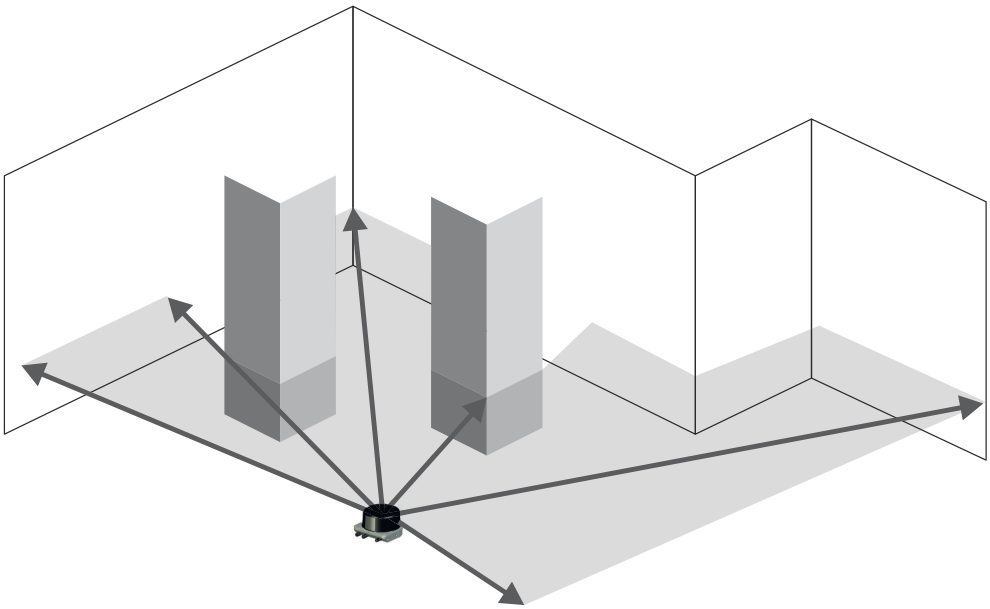
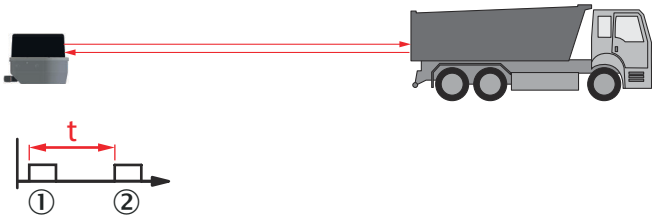


Figure 3: LiDAR sensor with one scan plane

3.4.2 Distance measurement

The device emits beams pulsed by a laser diode. If the laser beam is reflected by an object, the reflected beam is received by the sensor.

The distance to the object is calculated on the basis of the time that the pulsed light beam requires to be reflected and received by the sensor.



① Emitted pulse
② Receive pulse

3.4.3 Direction measurement

The laser beams are emitted using an internally rotating sender-receiver unit (SRUs) and scan the surroundings orbitally. The received measured values are assigned to the associated angular cut and thus to the direction.

3.4.4 Impact of object surfaces on the measurement

Remission value

Remission is the ability of a material to reflect light. The remission correlates with the amount of laser light emitted by the LiDAR sensor which is reflected by an object (see Lambert's law).

Glossy surfaces have different remissions at the same distance with different angles of impact. In the case of shiny surfaces, maximum remission is achieved when the beam makes vertical impact.

Matt and dull surfaces have diffuse remission. They therefore exhibit similar relative remissions with the same angle of impact regardless of the distance from the zero point.

Table 3: Typical remissions of frequently used materials

Material	Typ. relative remission
Rubber tires (vulcanized, black)	2%
Foam rubber (black)	2.4%
Photographic board (black, matte)	10%
Cardboard (gray)	20%
Wood (untreated fir, soiled)	40%
PVC (gray)	50%
Paper (white, matte)	80%
Plaster (white)	100%
Aluminum (black anodized)	110 ... 150%
Steel (stainless, shiny)	120 ... 150%
Steel (high gloss)	140 ... 200%
Reflector	> 1,000%

The received signal from a perfectly diffuse reflection from a white surface (diffuse Lambertian reflector) corresponds to a remission of 100%. By this definition, surfaces that reflect the light in bundles (specular surfaces, reflectors) have remissions of over 100%.

Reflection

Most surfaces produce a diffuse reflection of the laser beam in all directions. The structure (smooth or rough), shape (flat or curved), and color (light or dark) of the surface determine how well the laser beam is reflected.

On very rough surfaces, a large proportion of the energy is lost due to absorption. Curved surfaces produce a higher diffusion. Dark surfaces reflect the laser beam worse than light ones (brilliant white plaster reflects approx. 100% of the light, while black foam rubber reflects approx. 2.4%). The aforementioned surface characteristics can reduce the scanning range of the device, in particular for surfaces with low remission values.

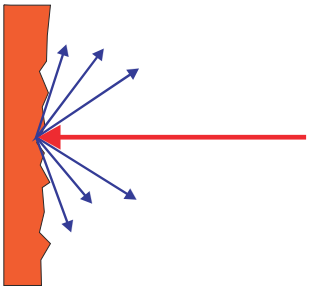


Figure 4: Reflection of light on the surface of the object

Angle of reflection

The angle of reflection corresponds to the angle of incidence. If the laser beam hits a surface at right angles, the energy is optimally reflected. If the laser beam hits a surface at an oblique angle, energy and range are lost accordingly.

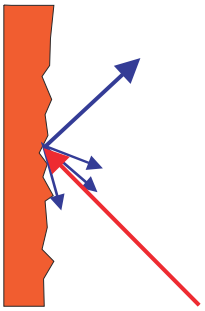


Figure 5: Angle of reflection

Retroreflection

If the reflective energy is greater than 100%, the beam is not reflected diffusely in all directions; instead it is reflected in a targeted way (retroreflection). Thus a large part of the emitted energy can be received by the laser distance measurer. Plastic reflectors (cat's eyes), reflective tape, and triple prisms have these properties.

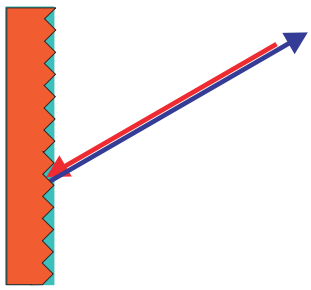


Figure 6: Retroreflection

Reflective surfaces

The laser beam is almost completely deflected on reflective surfaces. This means that an object hit by the deflected beam may be detected instead of the reflective surface.

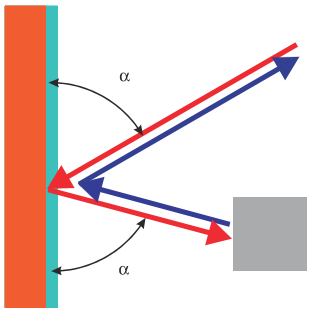


Figure 7: Specular surfaces

Small objects

Objects that are smaller than the diameter of the laser beam cannot reflect the laser light's full energy. The portion of the light beam that does not reach the object is lost. If all of the light reflected to the sensor is insufficient, the object may not be detected.

The portion of the light that does not reach the front object can be reflected by a larger object in the background. If all of the light reflected to the sensor is sufficient, this object is detected. This can lead to a corruption of the measured value.

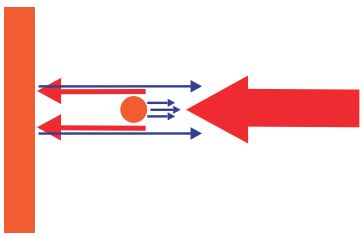


Figure 8: Object smaller than the laser beam diameter

3.4.5 Object sizes

As the distance from the device increases, the laser beam expands. As a result, the diameter of the light spot on the surface of the object increases.

Figure 9: Beam expansion

① Expanded laser beam

② Optical axis

Values required to calculate the light spot size:

- Light spot size on the device cover: 7 mm (rounded up)
- Divergence of single light spot: 0.023 deg (0.4 mrad) horizontally, 0.15 deg (2.6 mrad) vertically
- Additional factor HDDM+ (The real spot size consists of several overlapping single spots. The number of individual spots depends on the selected scan configuration)

Formula for calculating the light spot width:

(Light spot divergence horizontal [mrad] + HDDM+ supplement [mrad]) x distance [m] + light spot size on the device cover [mm] = light spot width [mm]

Calculation example of light spot width at 30 m distance and 0.04° angular resolution:

(0.4 mrad + 0.698 mrad) * 30 m + 7 mm = 40 mm

Cannot be used for overlapping resolutions 0.020°/12.5 Hz and 0.040°/25 Hz. Spot size here corresponds to 0.040°/12.5 Hz and 0.080°/25 Hz.

Formula for calculating the height of the light spot:

Light spot divergence [mrad] x distance [m] + light spot height at the device cover [mm] = light spot height [mm]

Calculation example of spot height at 30 m distance: 2.6 mrad * 30 m + 7 mm = 85 mm

Formula for calculating the minimum object size (horizontal):

Angular resolution [mrad]) x distance [m] = minimum object size [mm]

Calculation example of minimum object size (horizontal) at 30 m distance and 0.04° angular resolution: 0.7 mrad) * 30 m = 21 mm

Cannot be used for overlapping resolutions 0.020°/12.5 Hz and 0.040°/25 Hz. Minimum object sizes here correspond to 0.040°/12.5 Hz and 0.080°/25 Hz.

Formula for calculating the minimum object size (vertical):

(Light spot divergence vertical [mrad]) x distance [m] = minimum object size [mm]

Calculation example of minimum object size (vertical) at 30 m distance: 2.6 mrad * 30 m + 7 mm = 85 mm

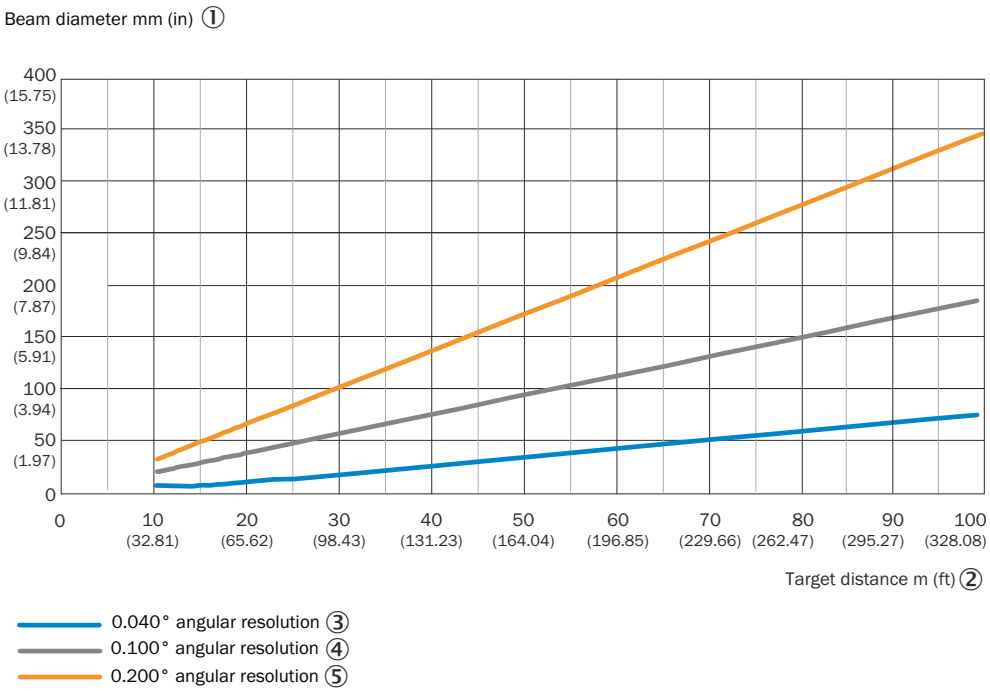
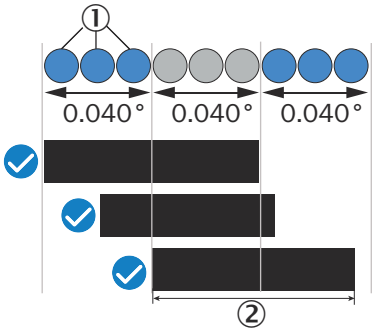


Figure 10: Minimum object size as a function of distance

① Minimum object size in mm (inch)
② Distance in m (ft)
③ Minimum object size at angular resolution 0.040°
④ Minimum object size at angular resolution 0.100°
⑤ Minimum object size at angular resolution 0.200°

NOTE

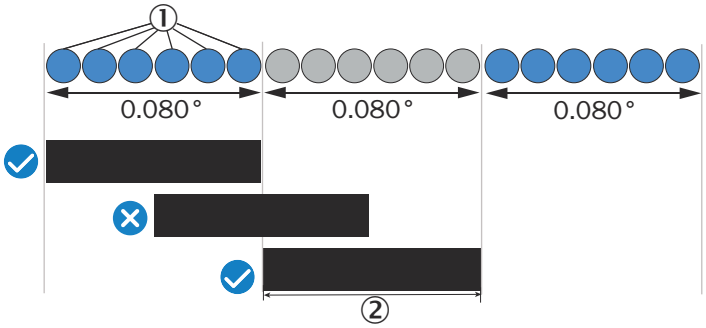
Depending on the angular resolution selected, the number of single spots used varies. For uninterrupted measurement of an object, it is important to hit the object with the entire light spot width (all single spots). That means an object should be larger than the minimum object size (continuous detection).



① Single spots
② object size

NOTE

In static applications, a target with the minimum object size may not be detected if the entire light spot width (all single spots) does not hit the object. In moving applications such as collision avoidance, the target would be measured alternately.



① Single spots

② object size

3.4.6 Multi-echo analysis

The distance between the device and an object is calculated via the time-of-flight of the emitted pulse. The device can evaluate up to three echo signals for each measuring beam to deliver reliable measurement results, even under adverse ambient conditions.

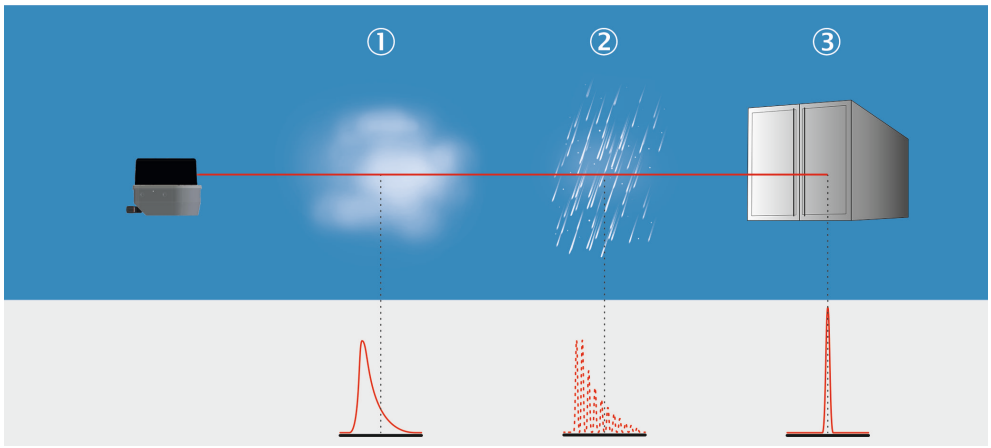


Figure 11: Multi-echo analysis: example industrial application for ports, cranes, and traffic.

① Fog

② Rain

③ Measuring object

3.4.7 Filter

By using digital filters to pre-process and optimize the measured distance values, the device can be tailored to the specific requirements of the respective application. This makes it possible to prevent virtually all faults.

You can arbitrarily combine the filters. If several filters are active, then the filters are applied sequentially to the results of the preceding filter. Processing occurs in the following sequence: particle filter, echo filter, average filter. It should be noted, however, that the measurement data output may be delayed due to the multiple calculation steps.

For many applications, it is useful to use a combination of the median filter and the mean filter. The median filter can eliminate the larger outliers, which “smooths” the scan line. The values calculated by the median filter are then averaged over a configurable number of scans by the mean filter.

The active filter functions affect the outputted measured values. It is not possible to recalculate the original measured values from the filtered output values.

3.4.7.1 Particle filter

The particle filter blanks small, irrelevant reflection pulses in dusty environments and in rain or snow which are caused by dust particles, raindrops, snowflakes or the like.

In doing so, successive scans are continuously evaluated in order to detect static objects.

NOTE
If the particle filter is activated, measurement data output is delayed by one scan.

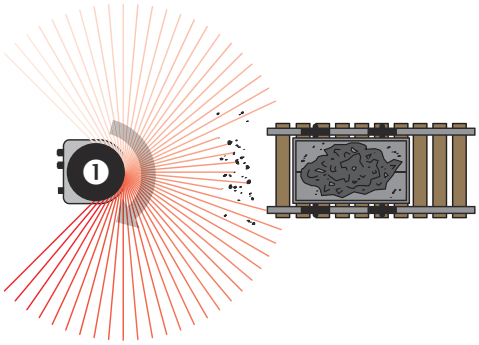


Figure 12: Without the particle filter: Violation of the contour due to dust particles in the vicinity of the object.

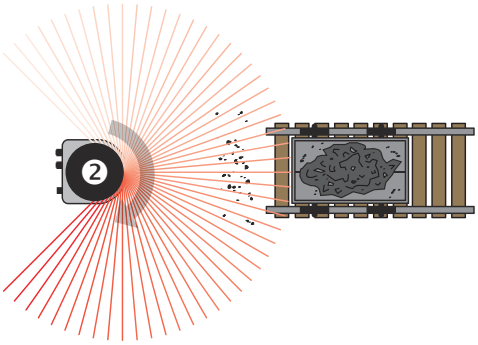


Figure 13: Using the particle filter: The response to dust particles in the detection field is delayed by one scan. Particles can thereby be blanked.

3.4.7.2 Echo filter

The echo filter screens out unwanted measurement data and signals caused by edge hits, rain, dust, snow and other ambient conditions.

You can set whether the first, the last, or all three echoes are output.

The other pulses triggered by undesirable ambient conditions are not taken into account.

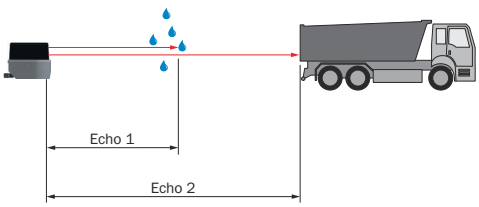


Figure 14: Without the echo filter: The device receives unwanted echoes from ambient conditions such as rain.

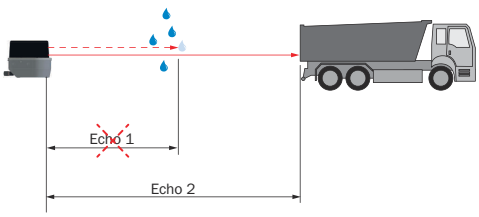


Figure 15: Using the echo filter (setting: last echo): the device screens out unwanted echoes from ambient conditions as per the settings chosen.

3.4.7.3 Median filter

This filter is suitable for excluding individual outliers from the calculation of an average value.

The moving median filter sorts the measured values according to their size and selects the middle value from this sequence. The values taken into consideration are defined by a matrix, the size of which is configurable.

A 3 x 3 matrix, for example, takes into consideration 9 measured values consisting of the distance values of a point and its two neighboring points, along with the distances values of these points determined from the preceding and following scan. The fifth largest measured value is outputted as the distance value.

Median calculation: 850 (lowest value) | 850 | 950 | 1,100 | **1150** (median) | 1,150 | 1,200 | 1,200 | 1,250 (highest value)

Table 4: Example: Median for scan 2 and angle 3 (3 x 3 matrix: scan 1 to 3, angle 2 to 4)

	Angle (distance values)					
Scan	**1**	**2**	**3**	**4**	**5**	**...**
1	0	**0**	**850**	**1100**	1150	...
2	0	**0**	**950**	**1200**	1250	...
3	0	**0**	**850**	**1150**	1200	...
...	...	...	...	...	...	...

Median calculation: 0 (lowest value) | 0 | 0 | 850 | **850** (median) | 950 | 1,100 | 1,150 | 1,200 (highest value)

Table 5: Example: Median for scan 2 and angle 4 (3 x 3 matrix: scan 1 to 3, angle 3 to 5)

	Angle (distance values)					
Scan	**1**	**2**	**3**	**4**	**5**	**...**
1	0	0	**850**	**1100**	**1150**	...
2	0	0	**950**	**1200**	**1250**	...
3	0	0	**850**	**1150**	**1200**	...
...	...	...	...	...	...	...

Median calculation: 850 (lowest value) | 850 | 950 | 1,100 | **1150** (median) | 1,150 | 1,200 | 1,200 | 1,250 (highest value)

3.4.7.4 Average filter

Using the mean filter, a blockwise (not moving) arithmetic average is calculated from the configured number of scans and then outputted. The big advantage when using this filter: Potential noise, i.e. minimal deviation of values, is reduced, which also lowers the quantity of data.

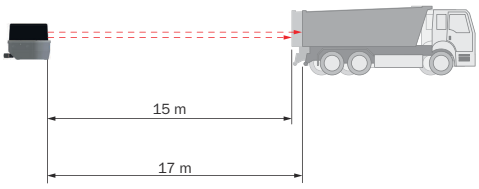


Figure 16: Without the mean filter: The device detects and processes all received signal values.

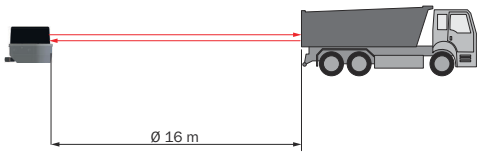


Figure 17: Using the mean filter: The device calculates an average value from several signal values.

3.4.8 Contamination indication

The device has an optics cover to protect it. This optics cover can get dirty. Contamination reduces the energy emitted and received by the laser beam. As a result, scanned objects appear to have a lower remission factor than they actually have and, from a certain degree of contamination, it will no longer be possible to perform measurements.

The contamination is constantly measured by a separate system during operation. A contamination warning is output first for the different degrees of contamination. If the optics cover is not cleaned and contamination increases, then a contamination error is output.

Depending on the application in which the device is used, you can choose from different contamination indication strategies.

The device supports a contamination indication over the full 360°. 12 sectors are monitored independently. When a scan configuration of -144° to +144° is selected, segments without measurement are set to deactivated status. Each sector can be assigned an evaluation strategy. Each sector can be individually enabled for the contamination display.

Strategies

- **Inactive**: Warning and error device status display is deactivated. The contamination measurement for the individual sectors continues to be performed but has no effect on the device status.
- **Highly available**: If all sectors have the same or a higher value, the device status “Contamination warning” or “Contamination error” is displayed.
- **Sensitive**: At least one sector must have a level of “Warning” or “Error” for a contamination warning or contamination error to be displayed.

Thresholds: Low, medium, high: Threshold for triggering contamination warnings and errors. The parameter makes it possible to tailor the display to the specific requirements of the application.

Response time: This can be used to define how quickly the contamination should result in an error or warning.

Hiding of sectors: If an accessory is used that limits the angular range used, this can be specified in the contamination indication. The covered sectors are then automatically hidden. For customization purposes, there is an additional parameter selection to select all areas individually.

Associated parameters

- ContaminationConfig
- ContaminationData
- ContaminationActiveSectors
- ContaminationResult

Default setting: In the default setting, the contamination display is deactivated. The monitoring of individual sectors is active and can be seen for each sector in the user interface and the command interface to assist with integrating the device into the application.

Strategy and evaluation are deactivated so no device warnings or errors are triggered. All associated parameters can be permanently changed.

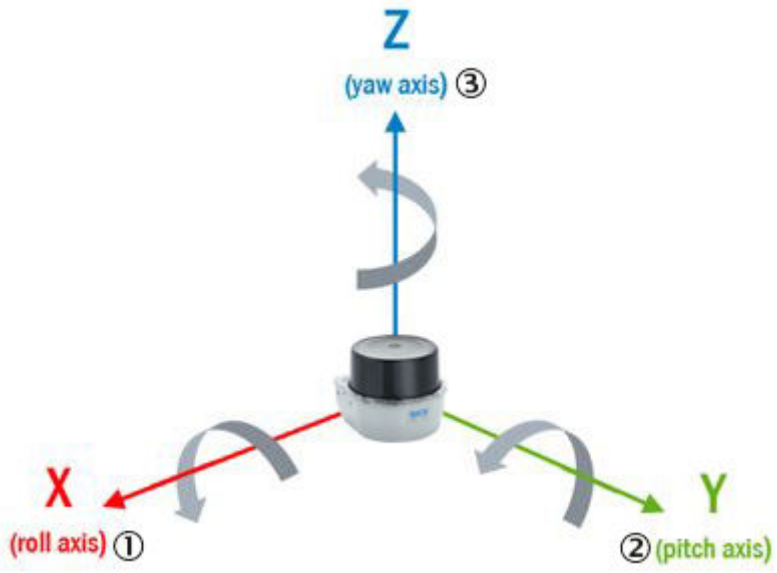
NOTE

- The cleaner the application environment is, the lower you can set the contamination indication sensitivity. If a high precision of the measured values is required, the contamination indication must be set to the most sensitive level.
- If a weather protection hood is mounted on the device, the accessory combination used must be communicated to the device in SOPASair.

Contamination warnings and contamination errors are indicated on the display elements of the device see "Status indicators", page 10.

3.4.9 Inertial measuring unit (IMU)

The device is equipped with an inertial measuring unit (IMU). This can be used to identify vibrations and movements of the device. The IMU can output accelerations in X, Y and Z as well as the position angle in yaw, pitch and roll. The orientation of the IMU data is based on the coordinate system of the device.



① Roll angle
② pitch angle
③ Yaw angle

3.4.10 3D scan recording

Many applications require 2D data to be transformed into 3D data. To create especially high-resolution 3D point clouds, 2D LiDAR sensors can be pivoted or moved in the horizontal axis. The movement data are then linked to the scan data via the web server user interface (SOPASair) to thereby add the third dimension.

The function provides two different methods for creating the third scan axis.

- **Internal inertial measuring unit (IMU)**: The internal inertial measuring unit can read out the movements of the device, see "Inertial measuring unit (IMU)", page 21. This data is linked with the scan data. The use of the internal IMU for 3D data output is only recommended for simple application tests and demo mode because it can lead to variances in the position data.
- **External encoder**: The device is equipped with an encoder input, see "Connecting encoder", page 31. Using an external encoder, information about the position and movement of the device can be linked to the scan data. The use of 3D scan recording with the help of an external encoder is recommended for testing applications and solving simple applications.

The maximum recording time is 30 seconds and is controlled via the web server user interface or via telegram commands. Recorded 3D data can be exported directly in PCD format.

3.4.11 RSSI values

RSSI (Received Signal Strength Indicator) is the measure of the signal strength that the device receives. This value is calculated for every measurement. The device therefore provides, for every echo signal, an associated RSSI value for the signal strength.

The resolution of the RSSI data output can be switched between 8 bit and 16 bit.

- **8 bits**: The RSSI values have a resolution of 8 bits with whole-number values between 1 and 255, where 1 represents the weakest signal and 254 the strongest signal (e.g., with a reflector). A value of 255 means "blinded".
- **16 bits**: The RSSI values have a resolution of 16 bits with whole-number values between 1 and 65,535, where 1 stands for the weakest signal and 65,534 for the strongest signal (e.g. with one reflector). A value of 65,535 means “dazzled”.

The value 0 (zero) means that the received energy was too low to produce a valid measured value. A valid distance measurement has an RSSI value of at least 1.

If the RSSI value is 0, then no distance measurement is possible. There can be two reasons for this:

- The target object lies outside the sensing range.
- The target object has an extremely low remission.

Please note that white paper can have very similar values as a reflector at a short distance.

The RSSI values are sensor-specific, relative values that can vary slightly between different devices and during the service life of the device.

3.4.12 Synchronization of the external clock and device clock

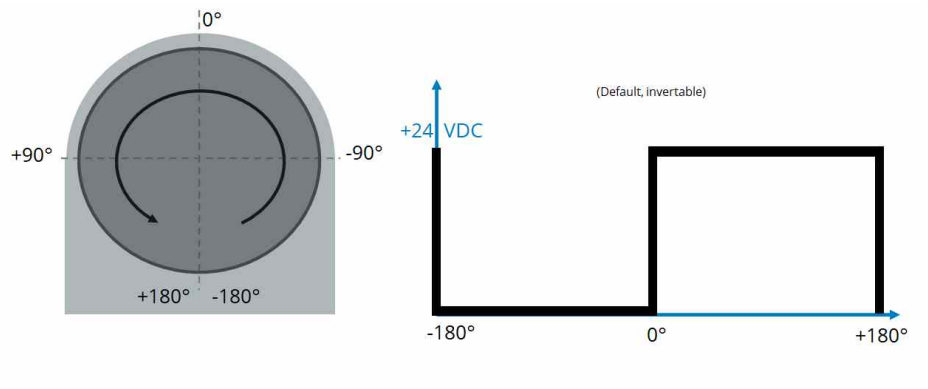
For precise control, the contour data of the device and the calculations in the external computer must be synchronized as accurately as possible in time.

The measurement data from the device is provided with the internal time stamp. The internal time stamp in the device is a 32-bit counter which increases in increments of 1 every 1 ms.

The scan data output starts at -180°.

There are two ways to synchronize the internal time of the device with the system time of the controller:

- Via telegram: The computer queries the internal time of the device using a telegram. The device writes its internal time in a telegram and sends this to the computer. Sending can happen with a delay time of up to a few milliseconds, which results in some uncertainty.
- Via index (pulse at hardware output): The device outputs a signal depending on the sender/receiver position. This signal is used, for example, to synchronize scans with the position of a swivel device for 3D measurement.



4 Transport and storage

4.1 Transport

NOTICE
Damage due to improper transport!

- The product must be packaged with protection against shock and damp.
- Recommendation: Use the original packaging.
- Note the symbols on the packaging.
- Do not remove packaging until immediately before you start mounting.

4.2 Unpacking

- To protect the device against condensation, allow it to equilibrate with the ambient temperature before unpacking if necessary.
- Handle the device with care and protect it from mechanical damage.

4.3 Transport inspection

Immediately upon receipt in Goods-in, check the delivery for completeness and for any damage that may have occurred in transit. In the case of transit damage that is visible externally, proceed as follows:

- Do not accept the delivery or only do so conditionally.
- Note the scope of damage on the transport documents or on the transport company's delivery note.
- File a complaint.

NOTE
Complaints regarding defects should be filed as soon as these are detected. Damage claims are only valid before the applicable complaint deadlines.

4.4 Storage

- Electrical connections are provided with a protective cap.
- Do not store outdoors.
- Store in a place protected from moisture and dust.
- Recommendation: Use the original packaging.
- To allow any residual dampness to evaporate, do not package in airtight containers.
- Do not expose to any aggressive substances.
- Protect from sunlight.
- Avoid mechanical shocks.
- Storage temperature: see "Technical data", page 39.
- Relative humidity: see "Technical data", page 39.
- For storage periods of longer than 3 months, check the general condition of all components and packaging on a regular basis.

5 Mounting

5.1 Mounting instructions

- Observe the technical data.
- Protect the sensor from direct sunlight.
- To prevent condensation, avoid exposing the device to rapid changes in temperature.
- The mounting site has to be designed for the weight of the device.
- It should be mounted so that it is exposed to as little shock and vibration as possible. Optional mounting accessories are available, see "Accessories", page 43.
- In application areas with severe vibrations or shocks caused by vibrations, jolts or abrupt changes in directions (e.g., when mounted to a manned forklift truck), mounting with vibration dampers is to be carried out (see "Accessories", page 43). Mount the device in a freely suspended manner.
- Regularly check the tightness of the fixing screws.
- Avoid having shiny or reflective surfaces in the scanning range, e.g., stainless steel, aluminum, glass, reflectors, or surfaces with these types of coatings.
- Protect the device from moisture, contamination, and damage.
- Make sure that the status indicator is clearly visible.
- Do not affix any labels or stickers to the optics cover.
- Do not subject the device to excessive shock or vibrations. In systems subjected to heavy vibrations, secure the fixing screws with screw-locking devices.

5.2 Mounting device

1. Mount the device in a suitably prepared bracket using the fixing holes provided (see "Dimensional drawing", page 41). Mounting brackets are available as accessories, "Accessories", page 43.
2. Make the electrical connection. Attach and tighten the tension-free cable, see "Connecting device electrically", page 31.
3. Align the vertical center line of the field of view of the device with the center of the area to be monitored. The marking on the upper side of the optics cover serves as a bearing alignment aid. An optional alignment aid is available as an accessory "Accessories", page 43.
4. Switch on the supply voltage.

✓ The **DEV** status LED lights up green after successful initialization. The device is ready for use.

5. Perform a fine adjustment using a test target and, if necessary, use the alignment aid.

6 Electrical installation

6.1 Wiring instructions

NOTE

Pre-assembled cables can be found on the product page.

The product page can be accessed via the **SICK Product ID**: **pid.sick.com/{P/N}/{S/N}**

{P/N} corresponds to the part number of the product, see type label.

{S/N} corresponds to the serial number of the product, see type label (if indicated).

NOTICE

Faults during operation and defects in the device or the system

Incorrect wiring may result in operational faults and defects.

- Follow the wiring notes precisely.

All electrical connections of the device are configured as M12 round connectors.

The enclosure rating stated in the technical data is achieved only with screwed plug connectors or protective caps.

All circuits connected to the device must be configured as SELV or PELV circuits. SELV = safety extra-low voltage, PELV = protective extra-low voltage.

Connect the connecting cables in a de-energized state. Do not switch on the supply voltage until installation is complete and all connecting cables are connected to the device and control.

Wire cross-sections in the supply cable from the customer's power system must be implemented in accordance with the applicable standards.

In the case of open end cables, make sure that bare wire ends do not touch. Wires must be appropriately insulated from each other.

Wire cross-sections of the data and switching signal cables have to also be designed in accordance with the applicable national standards.

Use shielded cables. Position the cable shield on both sides and connect to earth on the control side with a large surface area. Take appropriate measures to prevent equipotential bonding currents flowing through the cable shield.

6.2 Prerequisites for safe operation of the device

WARNING
Risk of injury and damage caused by electrical current!

As a result of equipotential bonding currents between the device and other grounded devices in the system, faulty grounding of the device can give rise to the following dangers and faults:

- Dangerous voltages are applied to the metal housings.
- Devices will behave incorrectly or be destroyed.
- Cable shielding will be damaged by overheating and cause cable fires.

Remedial measures

- Only skilled electricians should be permitted to carry out work on the electrical system.
- If the cable insulation is damaged, disconnect the voltage supply immediately and have the damage repaired.
- Ensure that the ground potential is the same at all grounding points.
- Where local conditions do not meet the requirements for a safe earthing method, take appropriate measures. For example, ensure low-impedance and current-carrying equipotential bonding.

The device is connected to the peripheral devices (any local trigger sensor(s), system controller) via shielded cables. The cable shield – for the data cable, for example – rests against the metal housing of the device.

The device can be grounded through the cable shield or through a blind tapped hole in the housing, for example.

If the peripheral devices have metal housings and the cable shields are also in contact with their housings, it is assumed that all devices involved in the installation have the **same ground potential**.

This is achieved by complying with the following conditions:

- Mounting the devices on conductive metal surfaces
- Correctly grounding the devices and metal surfaces in the system
- If necessary: low-impedance and current-carrying equipotential bonding between areas with different ground potentials

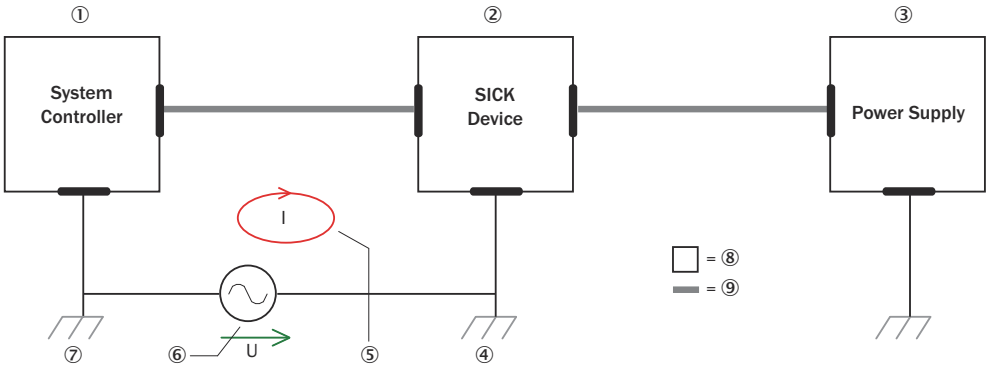


Figure 18: Example: Occurrence of equipotential bonding currents in the system configuration

① System controller
② Device
③ Voltage supply
④ Grounding point 2
⑤ Closed current loop with equalizing currents via cable shield
⑥ Ground potential difference
⑦ Grounding point 1
⑧ Metal housing
⑨ Shielded electrical cable

If these conditions are not fulfilled, equipotential bonding currents can flow along the cable shielding between the devices due to differing ground potentials and cause the hazards specified. This is, for example, possible in cases where there are devices within a widely distributed system covering several buildings.

Remedial measures

The most common solution to prevent equipotential bonding currents on cable shields is to ensure low-impedance and current-carrying equipotential bonding. If this equipotential bonding is not possible, the following solution approaches serve as a suggestion.

NOTICE

We expressly advise against opening up the cable shields. This would mean that the EMC limit values can no longer be complied with and that the safe operation of the device data interfaces can no longer be guaranteed.

Measures for widely distributed system installations

On widely distributed system installations with correspondingly large potential differences, the setting up of local islands and connecting them using commercially available **electro-optical signal isolators** is recommended. This measure achieves a high degree of resistance to electromagnetic interference.

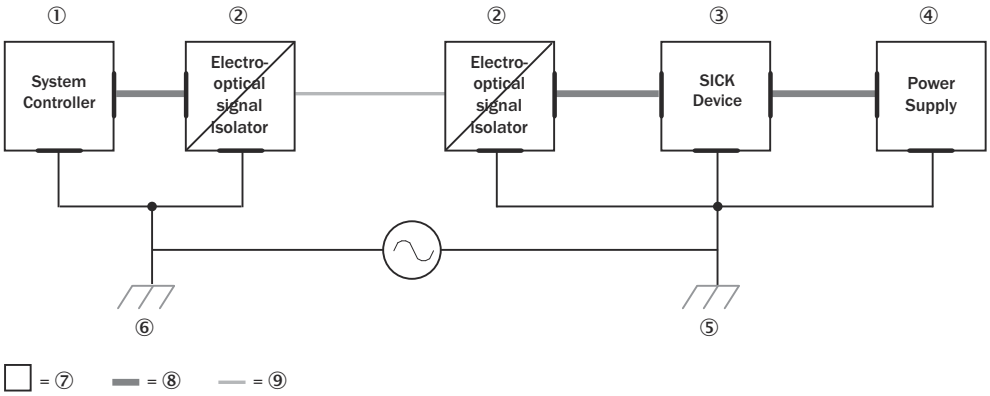


Figure 19: Example: Prevention of equipotential bonding currents in the system configuration by the use of electro-optical signal isolators

① System controller
② Electro-optical signal isolator
③ Device
④ Voltage supply
⑤ Grounding point 2
⑥ Grounding point 1
⑦ Metal housing
⑧ Shielded electrical cable
⑨ Optical fiber

The use of electro-optical signal isolators between the islands isolates the ground loop. Within the islands, a stable equipotential bonding prevents equalizing currents on the cable shields.

Measures for small system installations

For smaller installations with only slight potential differences, insulated mounting of the device and peripheral devices may be an adequate solution.

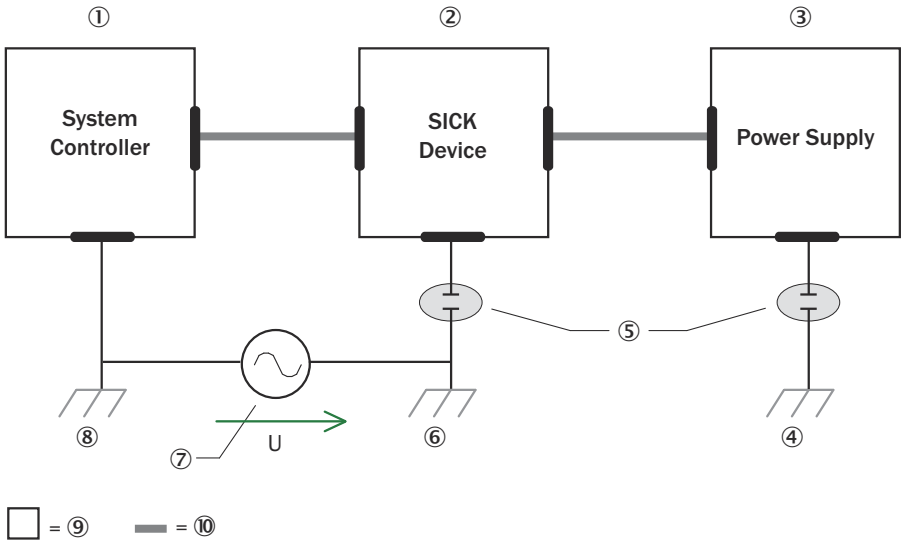


Figure 20: Example: Prevention of equipotential bonding currents in the system configuration by the insulated mounting of the device

① System controller
② Device
③ Voltage supply
④ Grounding point 3
⑤ Insulated mounting
⑥ Grounding point 2
⑦ Ground potential difference
⑧ Grounding point 1
⑨ Metal housing
⑩ Shielded electrical cable

Even in the event of large differences in the ground potential, ground loops are effectively prevented. As a result, equalizing currents can no longer flow via the cable shields and metal housing.

NOTICE

The voltage supply for the device and the connected peripheral devices must also guarantee the required level of insulation.

Under certain circumstances, a tangible potential can develop between the insulated metal housings and the local ground potential.

6.3 Connection diagram

NOTE

The recommended connecting cables and their associated technical data can be found on the online product page.

The product page can be accessed via the **SICK Product ID: pid.sick.com/{P/N}/{S/N}**

{P/N} corresponds to the part number of the product, see type label.

{S/N} corresponds to the serial number of the product, see type label (if indicated).

PWR connection

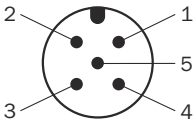


Figure 21: Male connector M12, 5-pin, A-coded

Table 6: Pin assignment for PWR connection

Pin	Identification	Description	Wire color, part number 2095733
1	Vs	Supply voltage: +10 ... +30 V DC	Brown
2	- –	Reserved	White
3	GND	Supply voltage: 0 V	Blue
4	IN8 / OUT8	Digital input 8 / digital output 8	Black
5	–	Reserved	Gray

1) Information only valid when using the specified open-ended connecting cable which is available as an accessory

Ethernet connection

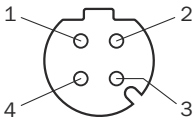


Figure 22: M12 female connector, 4-pin, D-coded

Table 7: Pin assignment for Ethernet connection

Pin	Identification	Description
1	TX+	Sender+
2	RX+	Receiver+
3	TX-	Sender-
4	RX-	Receiver-

Connection I/O and encoder

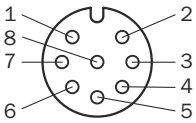


Figure 23: Female connector, M12, 8-pin, A-coded

Table 8: Pin assignment for I/O connection

Pin	Identification	Description	Wire color, part number 2134055 1)
1	IN1	Encoder input 1	White
2	IN2	Encoder input 2	Brown
3	IN3 / OUT3	Digital input 3 / digital output 3	Green
4	IN4 / OUT4	Digital input 4 / digital output 4	Yellow
5	IN5 / OUT5	Digital input 5 / digital output 5	Gray
6	IN6 / OUT6	Digital input 6 / digital output 6	Pink
7	GND INx / OUTx	Ground for all digital inputs / outputs	Blue

Pin	Identification	Description	Wire color, part number 2134055 [1]
8	IN7 / OUT7	Digital input 7 / digital output 7	Red

1) Information only valid when using the specified open-ended connecting cable which is available as an accessory

6.4 Connecting device electrically

1. Connect the communication interface (Ethernet, 4-pin M12 female connector) of the LiDAR sensor to the computer.
2. Switch on computer.
3. Supply the LiDAR sensor with voltage (5-pin M12 male connector, supply voltage 10 ... 30 V).

✓ After successful initialization, the **DEV** status LED lights up green. The device is ready for use.

6.5 Connecting encoder

If the device is mounted for mobile use or if the objects to be measured are in motion, the application will usually also need position data to further process the measured values. Encoders can be connected for this purpose.

The encoder data is then available with the other measured values in a single scan and at the same interface. A volume, for example, can be calculated by evaluating the measurement data and position data (encoder ticks).

The input frequency of the encoder signal must not exceed 50 kHz.

The following incremental encoders with a push-pull output stage (HTL) can be used:

- Single-channel, only connected at encoder IN1, no direction detection.
- Dual-channel (phase), connected at encoder IN1 and encoder IN2; the pulses have a phase shift of 90°, making direction detection possible. By definition, during forward motion (CW = clockwise) phase 1 precedes phase 2; conversely, during reverse motion (CCW = counterclockwise) edge 2 rises before edge 1.
- Dual-channel (level), connected at encoder IN1 and encoder IN2; the pulses are at encoder 1; at encoder 2, the direction is indicated by level 0 or level 1.

NOTE

Incremental encoder transmits a zero index signal often (encoder Z). This signal is not processed by the device. It is therefore not necessary to apply the signal to the device.

7 Operation

7.1 Operation using SOPASair

The browser-based SOPASair software can be used to parameterize the device and for service and diagnostic purposes.

To parameterize the device, you will require a computer with a web browser installed and a free Ethernet connection. Alternatively, the connection can be established via a USB connection using an Ethernet USB adapter.

7.1.1 Opening the web server user interface (SOPASair)

Before opening the user interface, perform the following work steps:

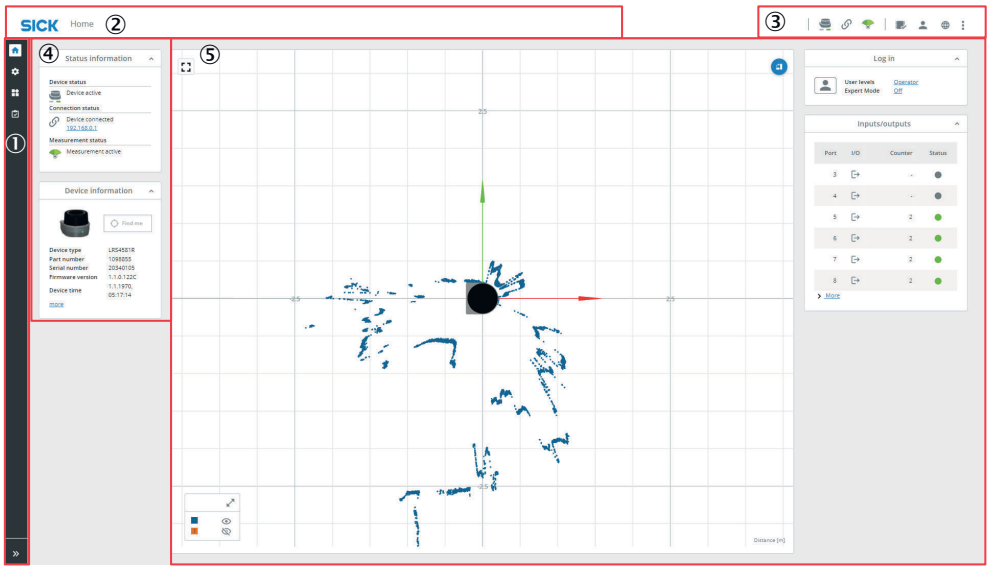
- Connect the device to the computer via Ethernet.
- Set up the voltage supply for the device.
- Ensure that the computer and device are located in the same network.
- Ensure that the computer uses a different IP address than the device, but is in the same IP address range (e.g. 192.168.0.xxx)

Opening user interface:

1. Open web browser (recommendation: Google Chrome).
2. Enter the device IP address into the address line. The standard IP address is: 192.168.0.1

✓ The SOPASair user interface is displayed.

7.1.2 Overview



① Show and hide menu list
② Displays the opened menu
③ Status indicators | toolbar
④ **Status information** and **Device information** menu panel
⑤ Workspace with scan view and menu panels

Status indicators

LED display

Device connection status


Measurement status

Toolbar


Save permanently


Open login window


Change user interface language

Device menu

Navigation

1. Click on the desired menu in the menu bar.

✓ The workspace changes depending on the selected menu.

7.1.3 User levels

The device has different user levels.

The user levels have different authorizations for configuring the device.

The current user level is displayed in the **Log in** panel.

1. Click on the  button.

✓ The **Log in to device** input screen opens.

2. Select user level(**User level**), enter a password(**Password**) then click **Login** in.

User levels	Password	User and authorizations
Maintenance	main	Customers: Display only, no configuration
Authorized customer	client	Technical staff: Install and configure device
Service	service	Service staff: Make advanced configuration settings

NOTE

Change the passwords during initial commissioning to protect your device.

A higher user level can change the password of a lower user level.

7.1.4 Resetting the password

NOTE

The responsible SICK sales company or the responsible SICK service partner carefully checks each code request to reset the password. A risk of deception by third parties nevertheless exists. The operating entity should therefore take suitable security measures.

The operating entity should also take suitable measures to limit, as best as possible, access to the product. This includes, in particular, physical access as well as access to the software interfaces of the product.

Resetting the password for the Service user

1. Click on the  button.

✓ The **Log in to device** input screen opens.

2. Click on **Password forgotten?**.

Resetting the password for the Authorized client/Maintenance personnel user

1. The password for the **Service** user has been reset.
2. Save the device parameterization using the parameter export in SOPAS ET.
3. Click on the ⋮ button.
4. Select **Reset to factory settings.**

7.2 Operation in SOPAS ET

Execute the functions listed below via the SOPAS ET configuration software.

Functions

- Terminal program
- Install firmware updates
- Import and export data

The most up-to-date version of the SOPAS ET software can be downloaded from www.sick.com/software, category: **Configuration software**, software type: **SOPAS ET**.

7.2.1 Installing and starting the configuration software

1. Download and install the latest version of the SOPAS ET configuration software, as well as the current device description files (*.sdd): www.sick.com. In this case, select the “Complete” option as suggested by the installation wizard. Administrator rights may be required on the computer to install the software.
2. Start the “SOPAS ET” program option after completing the installation. Path: **Start** > **Programs** > **SICK** > **SOPAS ET Engineering Tool** > **SOPAS**.

✓ SOPAS ET automatically starts searching for connected devices and displays connected devices in the **Device search** window.

3. Select the appropriate LiDAR sensor from the list of available devices:
   - Use LRS4000 (port 2111) to configure the device.
4. Click on **Add** to establish communication.

✓ SOPAS ET establishes communication with the LiDAR sensor, loads its current device description (parameters), and displays it in the **New Project** window.

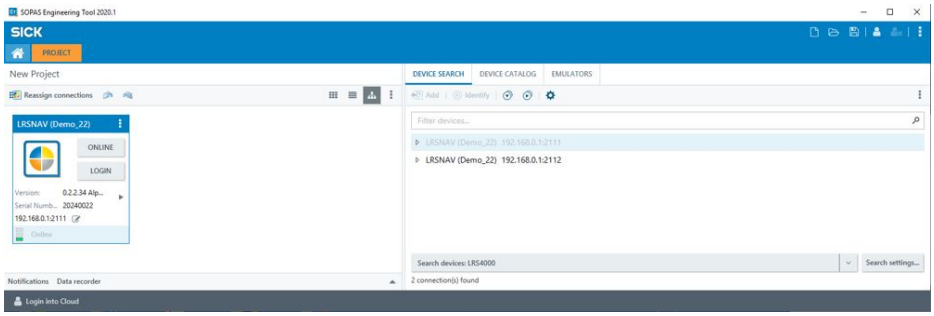


Figure 24: SOPAS ET: main window

7.2.2 Logging into the device

1. In the project window, click **Login** to establish communication.
2. Select `Autorisierter Kunde` as the **as user level** and enter the **password** `client` . Click the **Login** button.

7.2.3 Output of measured values via terminal program

Example commands for output of measured values

If the LiDAR sensor receives one of the two example commands by telegram through the Ethernet interface, it will start the output of measured values through this data interface.

The detailed structure of the output telegram as well as the flow of requests and outputs is described in the “Measurement output telegram” section in the Telegram Listing available at www.sick.com/8014631.

Request for output of measured values:

Table 9: Telegram structure: sRN LMDscandata

Telegram part	Description	Variable type	Length (byte)	Value range
Command type	Request (SOPAS read by name)	string	3	sRN
Command	Request data	string	11	LMDscandata

*Table 10: Example: **sRN LMDscandata***

Telegram type	Command
ASCII	<STX>sRN{SPC}LMDscandata<ETX>
HEX	02 73 52 4E 20 4C 4D 44 73 63 61 6E 64 61 74 61 03
Binary	02 02 02 02 00 00 00 0F 73 52 4E 20 4C 4D 44 73 63 61 6E 64 61 74 61 05

Request for continuous output of measured values:

*Table 11: Telegram structure: **sEN LMDscandata** measurement start/stop*

Telegram part	Description	Variable type	Length (byte)	Value range
Command type	Request (SOPAS event by name)	string	3	sEN
Command	Request data	string	11	LMDscandata
StartStop measurement		Enum8	1	0: Stop output of measured values 1: Start output of measured values

*Table 12: Example: **sEN LMDscandata***

Telegram type	Command
ASCII	<STX>sEN{SPC}LMDscandata{SPC}1<ETX>
HEX	02 73 45 4E 20 4C 4D 44 73 63 61 6E 64 61 74 61 20 31 03
Binary	02 02 02 02 00 00 00 11 73 45 4E 20 4C 4D 44 73 63 61 6E 64 61 74 61 20 01 33

Note:

For the content of the response telegram for the measured value request, see the Telegram Listing at www.sick.com/8014631, under ‘Send Data Permanently’ in Section 4. The telegram consists of one part with information on the configuration of the device and the time stamp, one part with measured data, and a status part with information on the device status and the statuses of the inputs/outputs.

After starting the measurement mode, the device needs some time to reach status 1 (“ready”). You should therefore query the status of the device using the **sRN SCdevicestate** telegram.

Then request measured data via telegram at the data interface from which you want to receive measured data. This can be achieved in two ways:

- The request of exactly one measured value with the **sRN LMDscandata** telegram – the last measured scan is transmitted.
- Continuous request of measured data with the **sEN LMDscandata 1** telegram – measured data is transmitted until the output of measured values is stopped with the **sEN LMDscandata 0** telegram.

Activating the output of the measured values in SOPAS on a test basis:

1. Start the terminal emulator: **Tools** menu > **Terminal**.
2. In the dialog window in the **Connections** menu, select the **Create new connection** function.
3. In the connection wizard, select the communication interface (**Ethernet**) and connection settings (default IP address: 192.168.0.1) and establish the connection (**Finish** button).
4. Enter in the input line one of the two example telegrams from the annex as they appear (automatically framed by **STX** and **ETX** when sending in the default setting). Pay attention to blank characters in the string.
5. Use the button to transmit the telegram to the LiDAR sensor.

✓ The LiDAR sensor responds by providing the data as a one-off or continuously in the display area of the terminal emulator.

Data output format of the measured values

The data output format per scan is comprised of the configuration information, measured values, radial distance, RSSI, , device and status information, and time stamp.

In the default settings, the distance is output as a measured value (in mm).

To output the reflectance values in the telegram: Open the device window (**Device**> **Open** menu) and, in the **Distance measurement** view, select the **RSSI** check box under **Output data format**.

8 Maintenance

8.1 Maintenance plan

During operation, the device works maintenance-free.

NOTE
No maintenance is required to ensure compliance with the laser class.

Depending on the assignment location, the following preventive maintenance tasks may be required for the device at regular intervals:

Table 13: Maintenance plan

Maintenance work	Interval	To be carried out by
Check device and connecting cables for damage at regular intervals.	Depends on ambient conditions and climate.	Specialist
Clean housing and optics cover.	Depends on ambient conditions and climate.	Specialist
Check the screw connections and plug connectors.	Depends on the place of use, ambient conditions or operating requirements. Recommended: At least every 6 months.	Specialist
Check the mounting accessories and vibration dampers used.	Depends on the place of use, ambient conditions or operating requirements. Recommended: At least every 6 months.	Specialist
Check that all unused connections are sealed with protective caps.	Depends on ambient conditions and climate. Recommended: At least every 6 months.	Specialist

8.2 Cleaning

NOTICE
Equipment damage due to improper cleaning.
Improper cleaning may result in equipment damage.

- Only use recommended cleaning agents and tools.
- Never use sharp objects for cleaning.

► Clean the optics cover at regular intervals and in the event of contamination with a lint-free lens cloth and plastic cleaning agent. Rinse off coarse dirt first with water. The cleaning interval essentially depends on the ambient conditions.

9 Troubleshooting

9.1 General faults, warnings, and errors

Possible faults and corrective actions are described in the table below for troubleshooting. In the case of faults that cannot be rectified using the information below, please contact the SICK Service department. To find your agency, see the final page of this document.

NOTE
Before calling, make a note of all type label data such as type designation, serial number, etc., to ensure faster assistance.

Table 14: Troubleshooting questions and replies

Question / status	Response / remedial actions
Both LEDs flash red.	Device error: Read out error code via SOPASair and eliminate the cause of error.
LEDs indicate an undefined status.	Check device status. If necessary, contact SICK Service.
Measurement data show anomalies.	Optics cover is dirty. Clean the optics cover.
Other fault, warning or error arises.	Call up diagnostic information in SOPASair.

9.2 Repairs

Repair work on the device may only be performed by qualified and authorized personnel from SICK AG. Interruptions or modifications to the device by the customer will invalidate any warranty claims against SICK AG.

9.3 Returns

- ► Only send in devices after consulting with SICK Service.
- ► The device must be sent in the original packaging or an equivalent padded packaging.

NOTE
To enable efficient processing and allow us to determine the cause quickly, please include the following when making a return:

- Details of the contact person
- Description of the application
- Description of the fault that occurred

9.4 Disposal

If a device can no longer be used, dispose of it in an environmentally friendly manner in accordance with the applicable country-specific waste disposal regulations. Do not dispose of the product along with household waste.

NOTICE
Danger to the environment due to improper disposal of the device.
Disposing of devices improperly may cause damage to the environment.
Therefore, observe the following information:

- Always observe the national regulations on environmental protection.
- Separate the recyclable materials by type and place them in recycling containers.

10 Technical data

NOTE

The relevant online product page for your product, including technical data, dimensional drawing, and connection diagrams, can be downloaded, saved, and printed from the Internet.

The product page can be accessed via the **SICK Product ID: pid.sick.com/{P/N}/{S/N}**

{P/N} corresponds to the part number of the product, see type label.

{S/N} corresponds to the serial number of the product, see type label (if indicated).

Please note: This documentation may contain further technical data.

10.1 Features

Application	Outdoor
Light source	Infrared (wavelength 886 nm; max. output power 4.6 W; pulse duration 2.44 ns)
Laser class	Laser class 1 (EN 60825-1:2014+A11:2021, IEC 60825-1:2014) Complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3 as described in Laser Notice No. 56, dated May 8, 2019.
Horizontal aperture angle	Up to 360°
Scan field flatness (typ.)	Conical error: ± 0.075° Tilt: ± 0.15°
Scanning frequency	12.5 Hz, 25 Hz
Angular resolution	12.5 Hz: 0.020°, 0.040°, 0.060°, 0.100°, 0.120° 25 Hz: 0.040°, 0.080°, 0.120°, 0.200°, 0.240°
Heating	Self-heating
Working range	0.2 m ... 130 m
Scanning range for 10% remission factor	40 m
Scanning range for 90% remission factor	130 m
Single spot size (vertical/horizontal)	2.6 mrad (0.150°) / 0.4 mrad (0.023°)
Spot size HDDM+ (vertical/horizontal)	2.6 mrad (0.150°) / 0.4 mrad (0.023°) + angular resolution
Number of echoes evaluated	3

1) The aperture angle is limited to 288° with angular resolution 0.020°/12.5 Hz and 0.040°/25 Hz.

Working range diagram

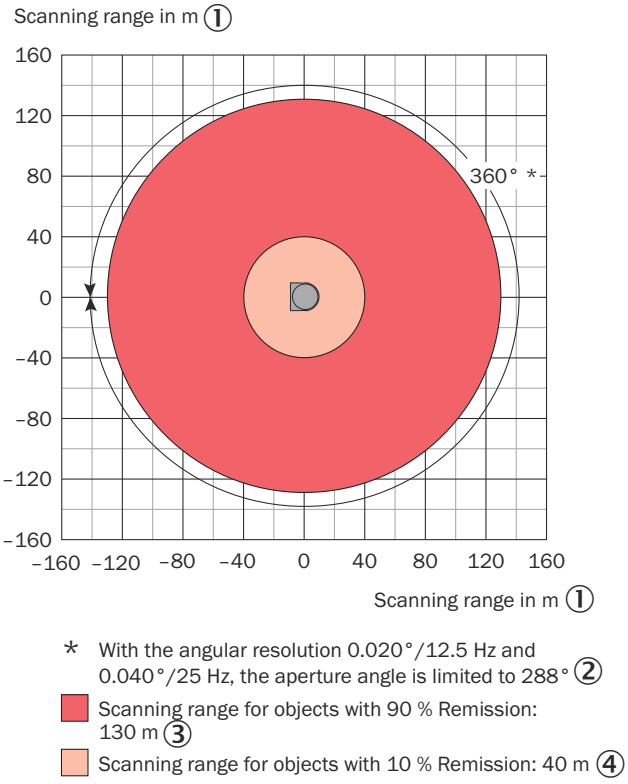


Figure 25: Working area diagram, top view

① Scanning range in m

② The aperture angle is limited to 288° with angular resolution 0.020°/12.5 Hz and 0.040°/25 Hz

③ Scanning range for objects with 90% remission factor: 130 m

④ Scanning range for objects with 10 % remission factor: 40 m

10.2 Mechanics/Electronics

Electrical connection	3 x M12
Supply voltage (V_s)	10 ... 30 V DC
Output current	≤ 0.25 A per output; max. combined current of all outputs 1 A
Power consumption	≤ 13 W (typical) plus digital outputs Max. 20 W plus digital outputs
Housing	ALSi12
Optics cover material	Polycarbonate
Housing color	Grey (RAL 7042)
Enclosure rating	IP65 / IP67 (IEC 60529:1989+AMD1:1999+AMD2:2013)
Protection class	III (IEC 61140:2016-11)
Electrical safety	IEC 61010-1:2010-06
Weight	1.7 kg
Dimensions (L x W x H)	151.9 mm x 150 mm x 126.7 mm

10.3 Dimensional drawing

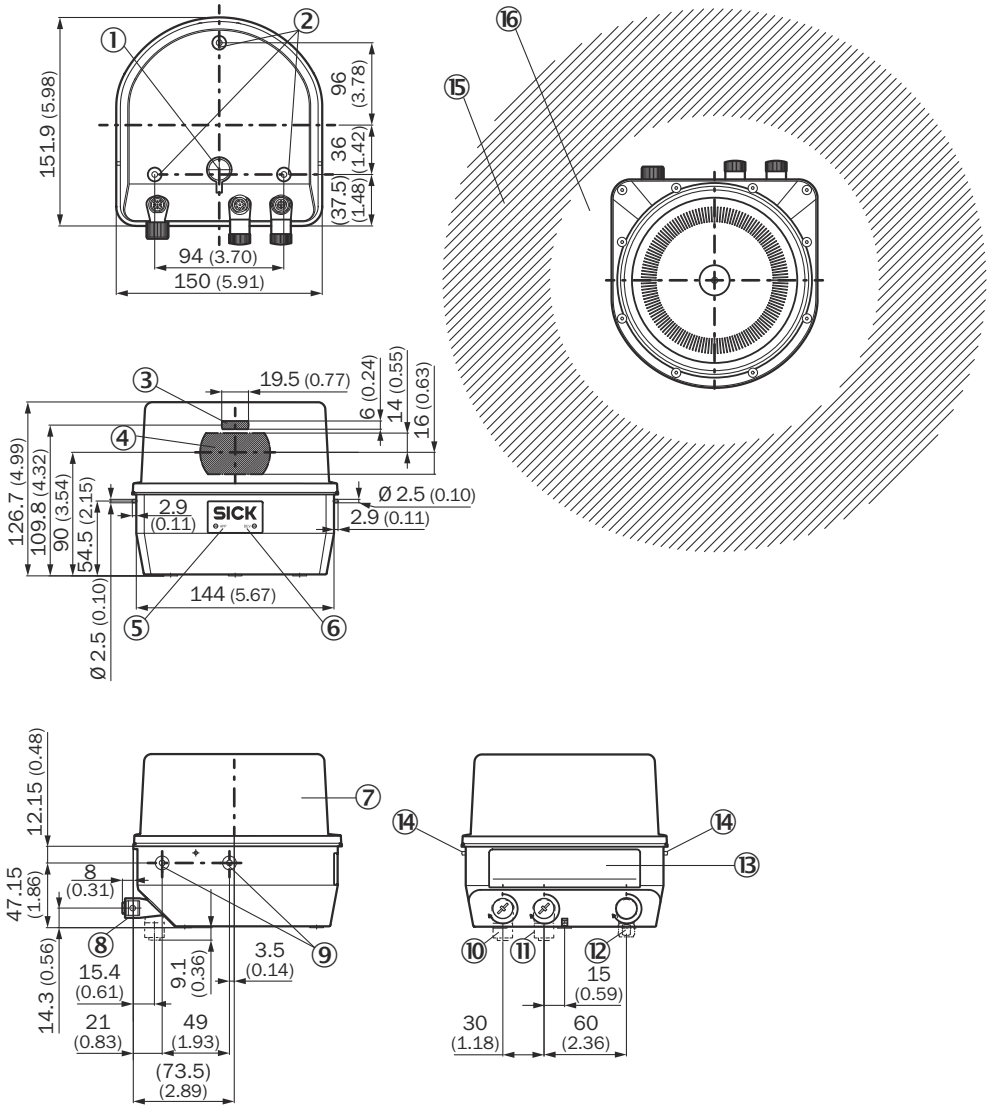


Figure 26: Device dimensions LRS4000; unit: mm (inch), decimal separator: period

① Ventilation element
② M5x7.5 fixing hole (3x)
③ Sender
④ Receiver
⑤ **APP** LED
⑥ **DEV** LED
⑦ Optics cover
⑧ Rotatable connections (max. 270°)
⑨ M5x7.5 fixing hole (2x)
⑩ Ethernet connection
⑪ I/O connection
⑫ Power connection
⑬ Type label
⑭ Locating pin for hooking into the bracket during mounting
⑮ > 500 mm measuring range
⑯ < 500 mm close range

10.4 Performance

Scan/frame rate	37,500 ... 225,000 measuring points/second
Response time	≥ 40 ms to ≥ 80 ms
Detectable object shape	Almost any
Systematic error (typ.)	• 12.5 Hz / 0.020° - 0.060°: ± 15 mm • 12.5 Hz / 0.100° - 0.120°: ± 10 mm • 25 Hz / 0.040° - 0.120°: ± 15 mm • 25 Hz / 0.200° - 0.240°: ± 10 mm
Statistical error (1 σ)	• 12.5 Hz / 0.020° - 0.060°: < 10 mm • 12.5 Hz / 0.100° - 0.120°: < 6 mm • 25 Hz / 0.040° - 0.120°: < 10 mm • 25 Hz / 0.200° - 0.240°: < 6 mm
Temperature drift (systematic)	± 0.2 mm/K (typ.)
Filter	Echo filter, median filter, average filter, particle filter

10.5 Interfaces

Ethernet	TCP/IP, UDP/IP Function: HOST Data transmission rate: 10/100 Mbit/s
Digital inputs	Number: 8 (two of which are dedicated encoder inputs) Input threshold High: min. 5.9 V max. 12.5 V Input threshold Low: min. 4.5 V max. 10.5 V Static input current: < 1 mA The values of the input thresholds depend on the supply voltage ($_{VS}$).
Digital output	Number: 6 High level: min.V_S-2V; max. V_S Low level: min. 0 V; max. 0.5 V Delay for index signal: < 1 µs
Optical displays	LEDs
Configuration software	Web server

10.6 Ambient data

Remission	2% ... 1,000% (reflector)
Electromagnetic compatibility (EMC)	Radiation emitted: (EN 61000-6-3:2007+AMD:A1:2011) Electromagnetic immunity: (EN 61000-6-2: 2005)
Vibration resistance	Vibration, sinusoidal (EN 60068-2-6:2007): 10 Hz ... 500 Hz, 0.35 mm, 5 g, 10 cycles
Shock resistance	Non-repetitive shock (EN 60068-2-27:2008): 50 g, 11 ms, 6 shocks per axis 25 g, 6 ms, 1,000 shocks per axis
Ambient operating temperature	-30 °C ... +50 °C
Storage temperature	-40 °C ... +75 °C
Permissible relative humidity	Max. 90% (non-condensing)
Ambient light immunity	80 klx

11 Accessories

NOTE

On the product page you will find accessories and, if applicable, related installation information for your product.

The product page can be accessed via the **SICK Product ID**: **pid.sick.com/{P/N}/{S/N}**

{P/N} corresponds to the part number of the product, see type label.

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12 Annex

12.1 Declarations of conformity and certificates

You can download declarations of conformity and certificates via the product page.

The product page can be accessed via the **SICK Product ID: pid.sick.com/{P/N}/{S/N}**

{P/N} corresponds to the part number of the product, see type label.

{S/N} corresponds to the serial number of the product, see type label (if indicated).

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