OPERATING INSTRUCTIONS

MRS1000P

3D LiDAR sensor

SICK
Sensor Intelligence.

Described product

MRS1000P

Manufacturer

SICK AG
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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 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 MRS1000P is a programmable 3D LiDAR sensor. It features four scan planes and is suitable for applications that demand precise, non-contact optical contour measurement and environment perception.

The device is programmed on a PC using the **SICK AppStudio** software development environment.

Depending on the application, a browser-based, graphical user interface (HMI) can be created, which provides opportunities defined by the application developer to influence an application at operator level.

The device offers various interfaces and operating elements for controlling, programming, and operating purposes, which can be activated as necessary via development environments, control systems (programmable logic controllers), or applications. However, configuration, programming, and control requires various technical skills, depending on how the device is connected and used.

The devices are primarily designed for use in industrial and logistics areas, and they meet the requirements for industrial ruggedness, interfaces and data processing.

SICK AG assumes no liability for losses or damage arising from the use of the product, either directly or indirectly. This applies in particular to use of the product that does not conform to its intended purpose.

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

2.4.1 Programmable device

The MRS1000P is a programmable device. The respective programmer is therefore responsible for his/her programming work and the resultant operation of the device.

The liability and warranty of SICK AG is limited to the device specification (hardware functionality and any programming interfaces) according to the agreed conditions.

Therefore, SICK AG is not liable, among other things, for damages that are caused by programming of the customer or third parties.

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

Activities	Qualification
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 ■ Knowledge of the programming of systems and network components
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

Item	Component	Comments
1	Device in the version ordered	Depending on version Without connecting cables and brackets
1	Set of protective caps for electrical connections	Attached to the connections
1	Printed safety notes, multilingual	Quick guide and general safety notes

3.2 Status indicators

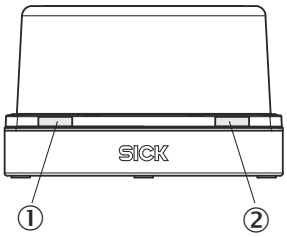


Figure 1: Status indicators

① LED1
② LED2

The following LED statuses are implemented in the device and cannot be programmed.

All other LED statuses can be programmed by the user.

LED1 (color)	LED2 (color)	Description
● (Red)	● (Red)	Start up, parameterization, firmware update

● = illuminated; ☼ = flashing

3.3 Type code

Type code structure

MRS abccd – efghijk

Position	Description	Characteristic
-	Device name type	MRS: Multilayer Range Sensor
a	Device type	1: MRS1000
b	Version (10% range & field of view (FOV))	1: 16m @10%, FOV 275°
c	Module (sender and receiver units (SRU))	04: 4 SEE (-2.5°; 0°; 2.5°; 5°)
d	Application	P: Programmable
–		

Position	Description	Characteristic
e	Housing version	0: IP65 enclosure rating 1: IP67 enclosure rating 9: Special version
f	Connection	1: Rotatable connector, 3 x M12 9: Special version
g	Version	1: Standard 9: Special version
h	Laser type	0: Laser class 1, infrared
i	Motor frequency	1: 12.5 Hz
j	Color tone / label	0: blue (RAL 5012) 1: gray (RAL 7042)

3.4 Type label

The type label gives information for identification of the sensor.

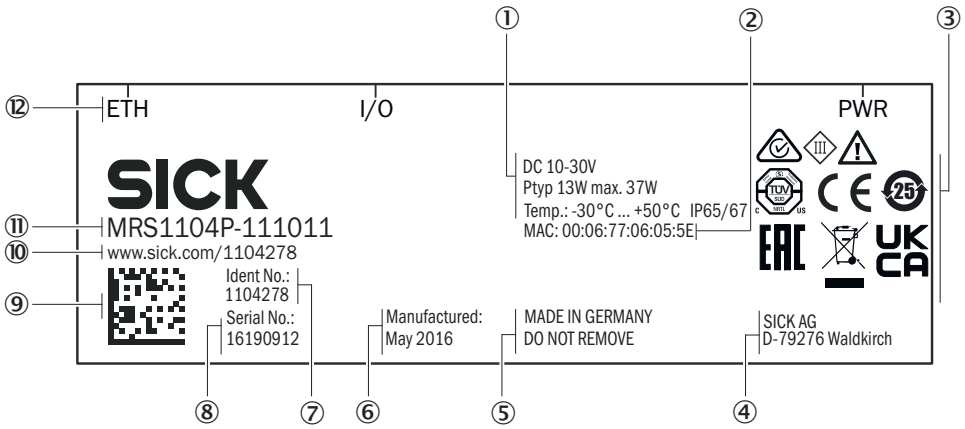


Figure 2: MRS1000P type label (example)

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

3.5 SICK AppSpace

The SICK AppSpace eco-system reveals new paths leading to solutions for customer-specific applications and consists of software tools and programmable sensors or devices. The SICK AppStudio SDK is used for developing sensor apps on programmable SICK devices. Its user interface for machine operators can be created individually as a web GUI. The SICK AppManager software tool supports the service in the field in the simple distribution and management of sensor apps.

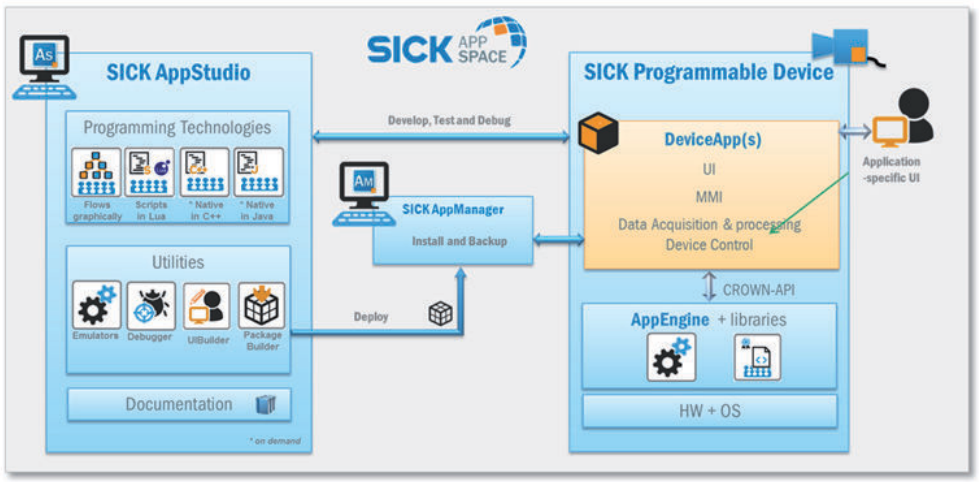


Figure 3: SICK AppSpace

Detailed instructions on the SICK AppStudio as well as programming the device can be found at **supportportal.sick.com**.

3.6 Principle of operation

3.6.1 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.

With the MRS1000, this is done in 4 spread-out scan layers (layers 1 to 4).

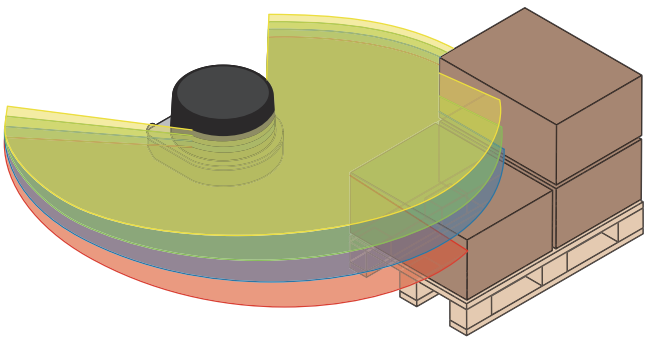
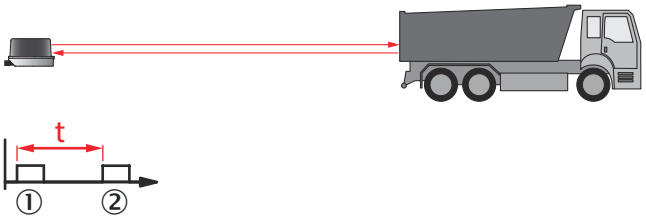


Figure 4: LiDAR sensor with 4 scan layers

3.6.2 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 Send pulse

② Receive pulse

The device uses SICK's own HDDM+ (High Definition Distance Measurement plus) technology. With this measurement process, a measured value is formed statistical evaluation of multiple single pulses. The multi-pulse feature of HDDM+ evaluates up to 165000 echoes per second. Every single HDDM+ measured value output therefore provides even more information because it is not just composed of a single time-of-flight measurement, but includes evaluated information from numerous pulses. In this process, the digitized echoes are compiled into data packages which overlap during evaluation. This ensures a significantly more stable time and distance measurement.

3.6.3 Direction measurement

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

3.6.4 Impact of object surfaces on the measurement

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.

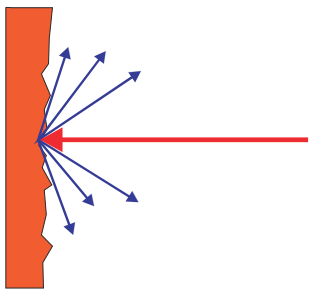


Figure 5: Reflection of light on the surface of the object

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.

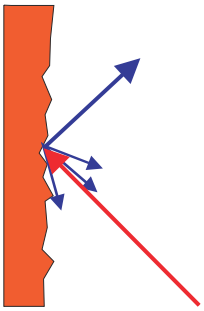


Figure 6: Angle of reflection

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.

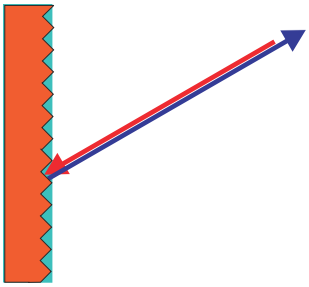


Figure 7: Retroreflection

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.

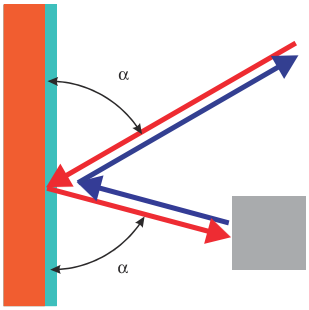


Figure 8: Specular surfaces

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.

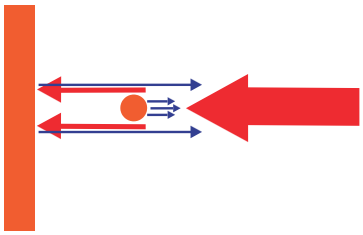


Figure 9: Object smaller than the laser beam diameter

3.6.5 Scanning range

The scanning range of the device depends on the remission of the object to be detected. The better a surface reflects the incident beam back to the device, the greater the scanning range of the device.

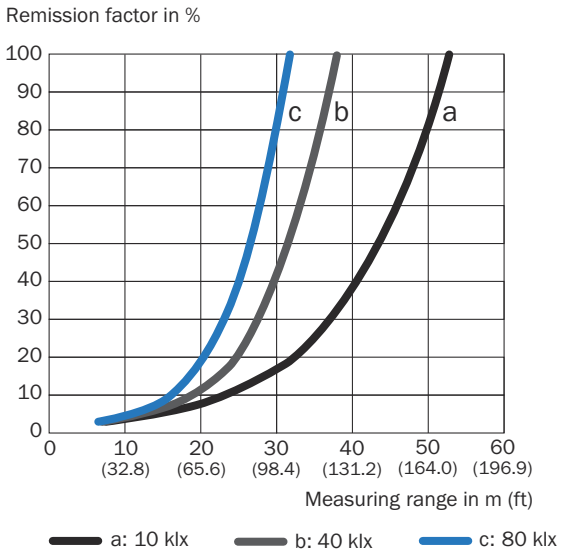


Figure 10: Scanning range as a function of the remission factor for various ambient light influences (no filter activated; no affect from fog, rain or dust)

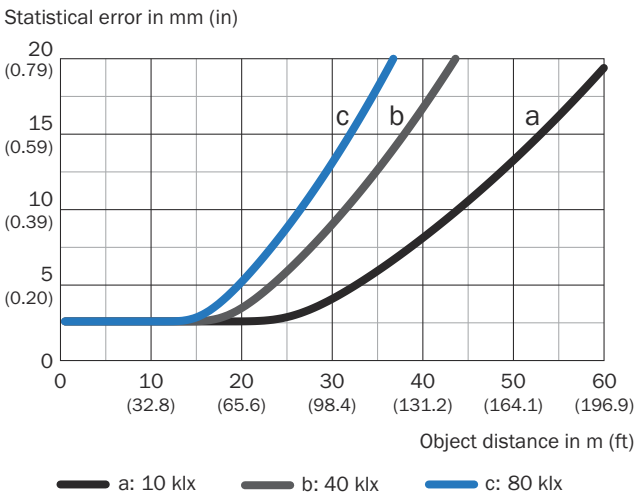


*Figure 11: Statistical error for **white objects** as a function of object distance for various ambient light influences*

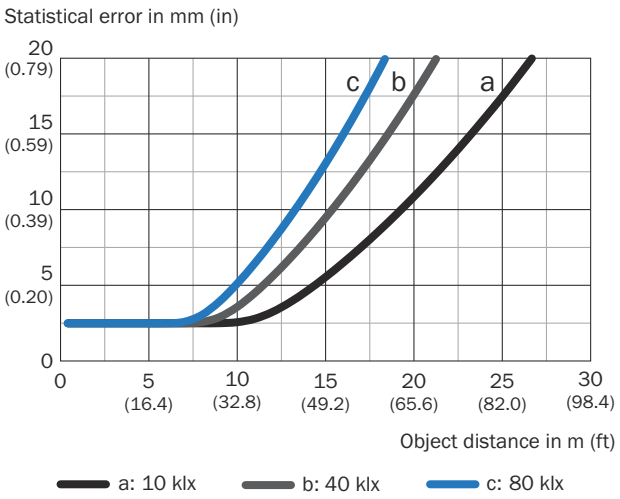


*Figure 12: Statistical error for **black objects** as a function of object distance for various ambient light influences*

3.6.6 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 13: 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 1 light spot: 0.59 deg (10.4 mrad)
- HDDM+ supplement (1 spot comprises several superimposed individual pulses): 0.50 deg (8.7 mrad)

Formula for calculating the light spot width:

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

Example calculation of the light spot width at a distance of 16 m (16000 mm):

(10.4 mrad + 8.7 mrad) * 16,000 mm + 7 mm = 312.6 mm

Formula for calculating the height of the light spot:

Light spot divergence [mrad] x Distance [mm] + Light spot height at the n device cover [mm] = Light spot width [mm]

Example calculation of the light spot height at a distance of 16 m (1,600 mm):

10.4 mrad * 16,000 mm + 7 mm = 173.4 mm

Formula for calculating the minimum object size:

(Light spot divergence [mrad] + angular resolution [mrad]) x distance [mm] + light spot height on the device cover [mm] = minimum object size [mm]

Example calculation of the minimum object size at a distance of 16 m (16,000 mm):

Angular resolution: 0.25° → 4.4 mrad

(10.4 + 8.7 + 4.4 mrad) * 16,000 mm + 7 mm = 383 mm

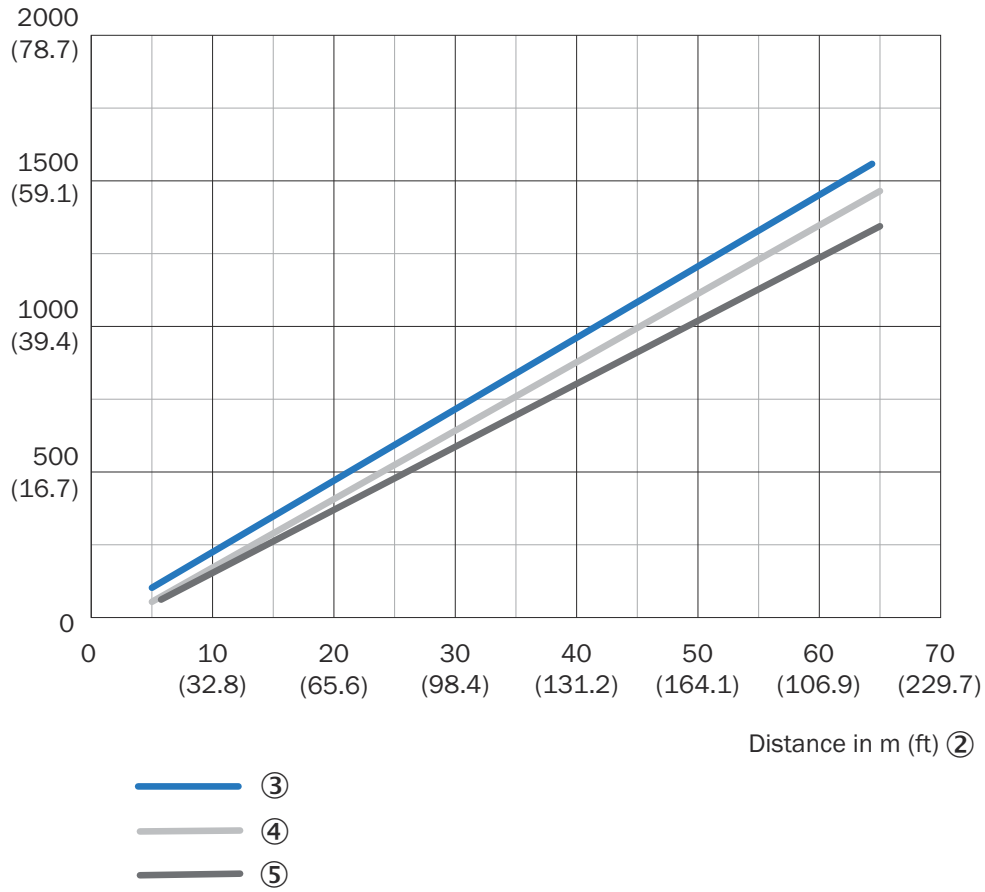


Figure 14: Minimum object size as a function of distance

① Minimum object size in mm (inches)
② Distance in m (ft)
③ Minimum object size
④ Minimum object size (2-fold interlaced mode)
⑤ Minimum object size (4-fold interlaced mode)

NOTE
For reliable measurement, in particular when using the device to output measured values, the laser needs to hit the object several times. Therefore, the object either needs to be larger than the minimum object size, or both the LiDAR sensor and the object must not be moving.

3.6.7 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.

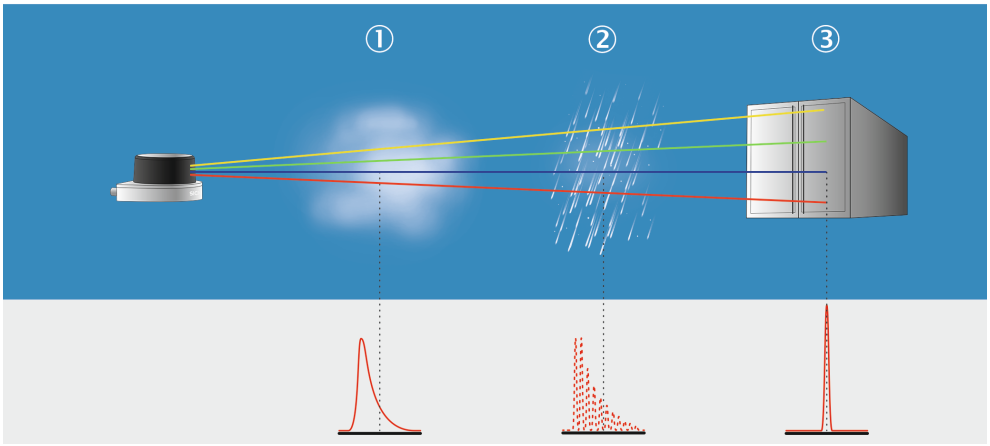


Figure 15: Multi-echo analysis: example industrial application for ports, cranes, and traffic.

① Fog
② Rain
③ Measuring object

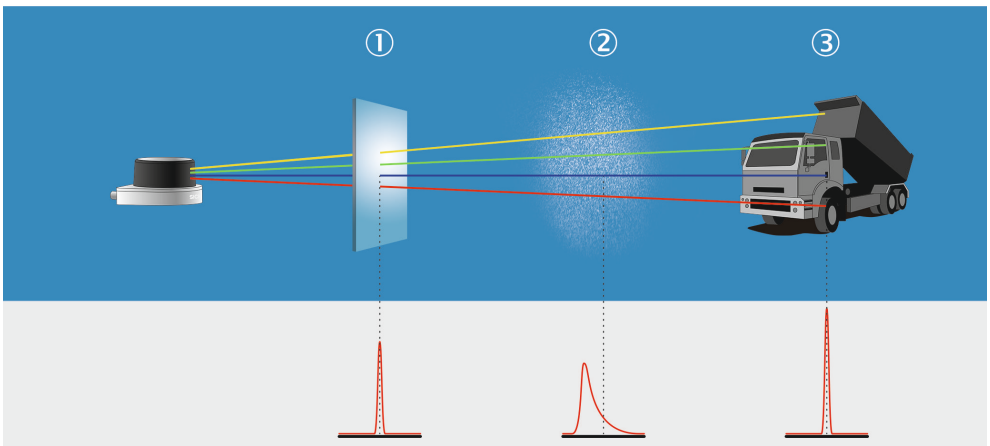


Figure 16: Multi-echo analysis: example industrial application for mining.

① Glass pane
② Dust
③ Measuring object

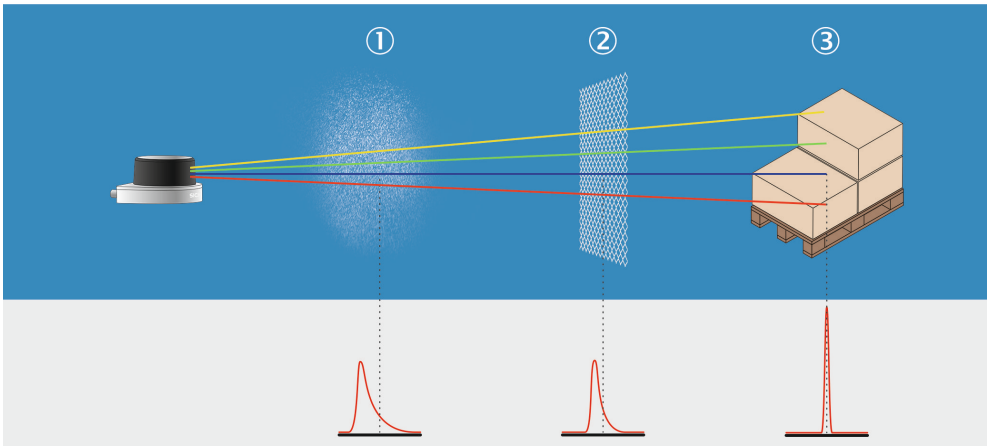


Figure 17: Multi-echo analysis: example industrial application for industrial vehicles.

① Dust
② Fences
③ Measuring object

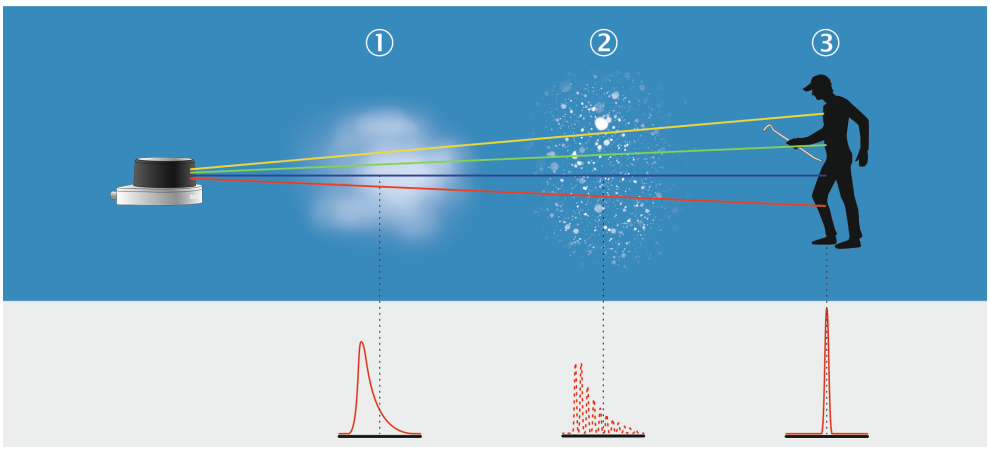


Figure 18: Multi-echo analysis: example industrial application for building management.

① Fog
② Snow
③ Measuring object

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.
- To avoid ingress of dust and water, only remove the protective elements, e.g. protective caps of the electrical connections just before attaching the connecting cable.

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.

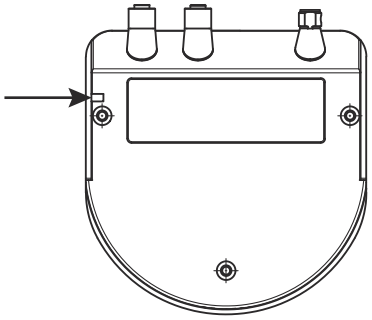
4.4 Storage

- 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 34.
- Relative humidity: see "Technical data", page 34.
- 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.
- The device can be mounted in any position.
- When mounting the device upside down, make sure that the ventilation duct of the ventilation element remains free of water and contamination.



- 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 40.
- Regularly check the tightness of the fixing screws.
- For indoor mounting, use a protection hood if necessary, for outdoor installation use a weather protection hood if necessary (both optional accessories), see "Accessories", page 40.
- Do not mount the device on or directly in front of a bright metallic surface or other reflective surface, since reflections can falsify the measurements.
- Do not place magnetic objects on the optics cover, since they can disturb the angular measurement.
- 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.
- When mounting the device up high, and in particular to secure the device during mounting, a retaining cable for fastening is available as an accessory.

5.2 Mounting device

1. Mount the device in a suitably prepared bracket using the fixing holes provided (see "Dimensional drawing", page 37). Mounting brackets are available as accessories, see "Accessories", page 40.
2. Make the electrical connection. Attach and tighten a voltage-free cable, see "Connecting the device electrically", page 30.
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.
4. Switch on the supply voltage.

5.3 Mounting multiple devices

NOTICE RISK OF INTERFERENCE FROM OTHER DEVICES!
Radiation sources with a wavelength of 850 nm can cause interference if they affect the device directly.

The device has been designed to minimize the probability of mutual interference, including between different LiDAR sensors. To rule out even the slightest effects on the measurement accuracy, the devices should be arranged such the laser beams are not received by another device.

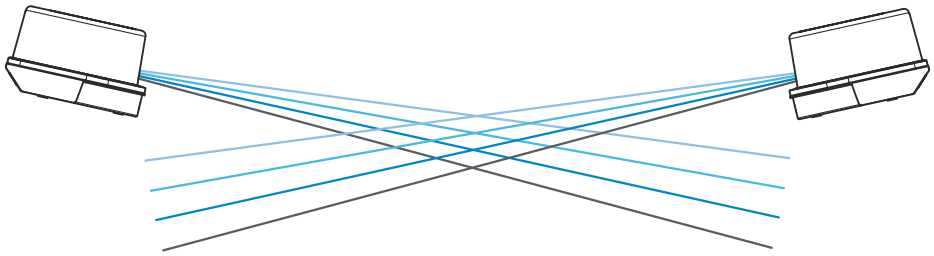


Figure 19: Arrangement for 2 devices

6 Electrical installation

6.1 Wiring instructions

NOTE

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

The 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.

Observe the following notes to ensure safe and trouble-free operation:

- Connect the connecting cables in a de-energized state. Do not switch on the supply voltage until installation is complete and all connecting cables have been connected to the device and control.
- Wire cross-sections in the supply cable from the customer's power system should be designed in accordance with the applicable standards. Protect the device with an external slow-blow fuse of 5 A at the beginning of the supply cable, viewed from the voltage supply.
- The specified enclosure rating of the device when mounted is reached only if suitable mating connectors or protective caps are used.
- Do not open the screwed housing of the device, since the warranty will then become void.
- Turn the rotatable electrical connections max 270° from end position to end position.
- Prior to connecting the I/O line, check the device configuration for the inputs/outputs.
- Avoid tensile loads to the connecting cables.
- Maximum cable lengths for the voltage supply depending on the power supply voltage used (conditions: cable cross-section 0.34 mm^2, 20 °C cable temperature, 10 V applied to the device, max. power consumption as per type label): 6.5 m at 12 V; 46.5 m at 24 V; 66.5 m at 30 V.

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

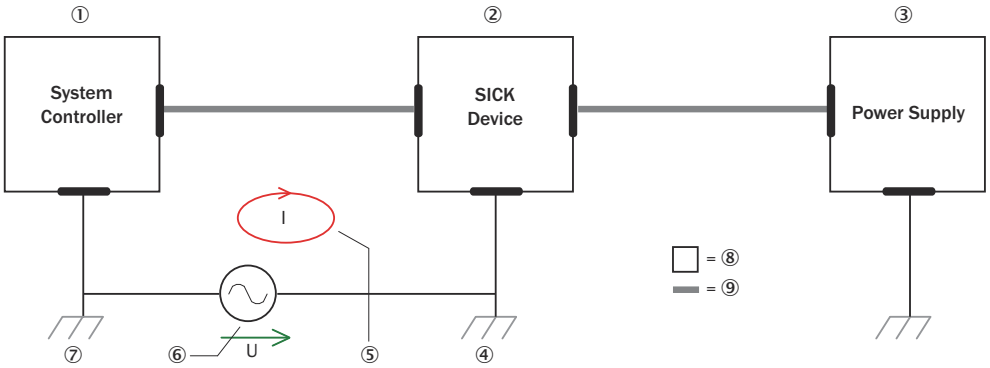


Figure 20: Example: Occurrence of equipotential bonding currents in the system configuration

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.

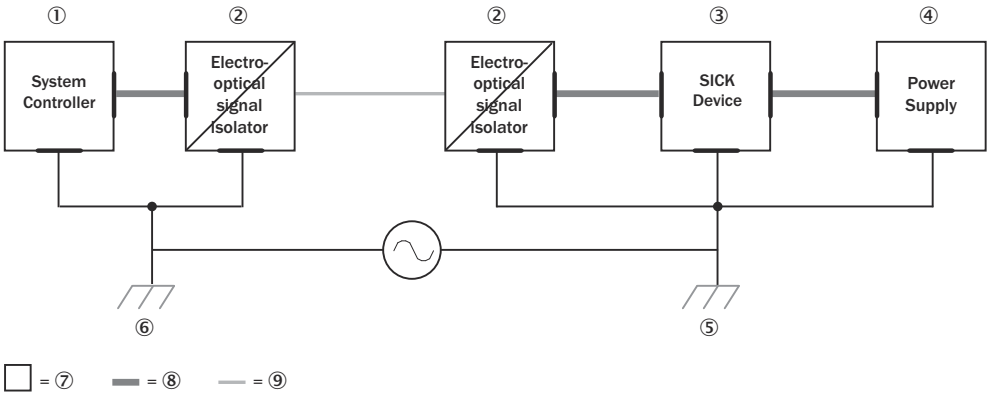


Figure 21: Example: Prevention of equipotential bonding currents in the system configuration by the use of electro-optical signal isolators

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.

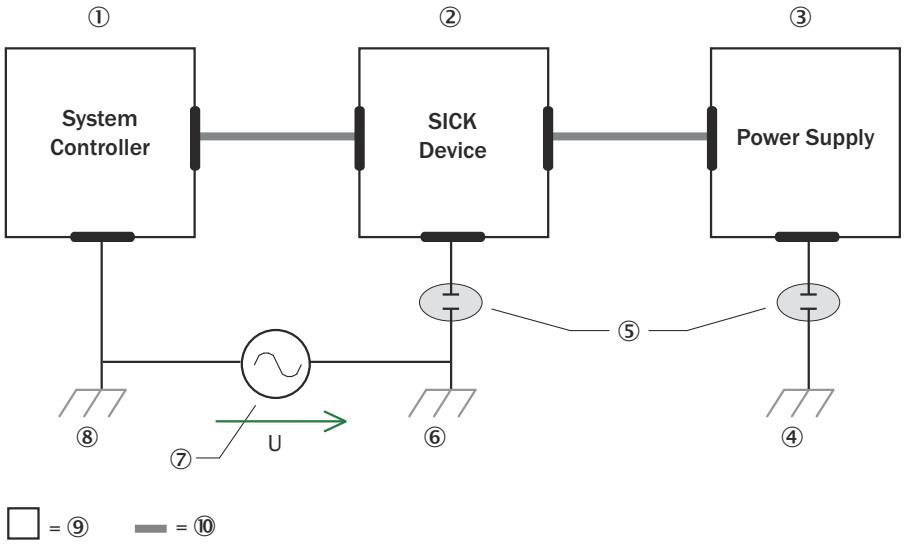


Figure 22: Example: Prevention of equipotential bonding currents in the system configuration by the insulated mounting of the device

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 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

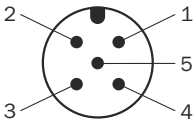


Figure 23: Male connector M12, 5-pin, A-coded

Table 3: 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

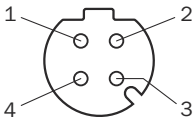


Figure 24: M12 female connector, 4-pin, D-coded

Table 4: Pin assignment for Ethernet connection

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

Connection I/O

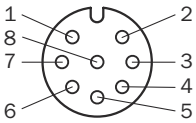


Figure 25: Female connector, M12, 8-pin, A-coded

Table 5: Pin assignment for I/O connection

Pin	Identification	Description	Wire color, part number 2134055 1)
1	IN1 / OUT1	Digital input 1 / Digital output 1	White
2	IN2 / OUT2	Digital input 2 / digital output 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 the device electrically

NOTICE

Observe the wiring instructions (see "Wiring instructions", page 24) and prerequisites for safe operation (see "Prerequisites for safe operation of the device", page 25).

1. Ensure the voltage supply is not connected.
2. Connect the device according to the connection diagram, see "Connection diagram", page 28.

7 Commissioning

7.1 Programming the device using SICK AppStudio

Programming of the device for the specific application is undertaken by default using the **SICK AppStudio** development environment.

Installing and starting the development environment

1. Download and install the latest version of SICK AppStudio from the online product page for the software by following the instructions provided there (supportportal.sick.com).
   Administrator rights may be required on the computer to install the software.
2. Enter your personal license key to complete installation.
3. Start program. Path: **Start** > **All programs** > **SICK** > **SICK AppStudio**
4. Select the directory (workspace) where all data and changes are to be automatically saved.
5. Establish a connection between the software and the device via Ethernet.
   The IP address **192.168.0.1** is configured by default on the device.

First steps with the device

There are various sensor apps available which can be used to demonstrate certain device properties and as a starting point for programming.

Depending on the version of the **SICK AppStudio** development environment used, the steps described below may differ.

1. Transfer the app currently located on the connected device to the created workspace using the **Transfer to working directory** context menu.
2. Activate the desired app and transfer it to and activate it on the sensor using **Run all apps** in the bar at the top.
3. Start the Internet browser (recommendation: Chrome, Firefox or Safari) and enter the IP address of the device.
4. Get to know the operating principle of the app and change parameters as needed.
5. In AppExplorer, adjust UI elements in the app under **pages** or change the operating principle of the app under **scripts** (programming in LUA).
6. Transfer the changes to the device using **Run all apps** and update the browser for visualization.

For more information, visit supportportal.sick.com.

8 Maintenance

8.1 Maintenance plan

During operation, the device works maintenance-free.

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

Table 6: 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 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 errors and corrective actions are described in the table below. In the case of errors 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 telephone processing.

Table 7: Troubleshooting questions and replies

Question / status	Response / remedial actions
Measurement data show anomalies.	Optics cover contaminated: Clean the optics cover.
Other fault, warning or error arises.	Call up the diagnostic information in SOPAS ET.

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 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

Measurement principle	HDDM+
Application	MRSxxxxx-0xxxxx: Indoor MRSxxxxx-1xxxxx: Outdoor
Light source	Infrared (wavelength 850 nm; max. output power 1.26 W; pulse duration 3.5 ns; average power 4.0 mW)
Laser class	Laser class 1 (EN 60825-1:2014+A11:2021, IEC 60825-1:2014, EN/IEC 60825-1:2007) Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.
Horizontal aperture angle	275°
Vertical aperture angle	7.5° (over 4 measurement levels)
Scan field flatness	Conical error: ± 0.6° Tilt: ± 0.6°
Scanning frequency	50 Hz, 4x 12.5 Hz
Angular resolution	Horizontal: 0.25°, 0.125° (interlaced mode), 0.0625° (interlaced mode) Vertical: 2.5°
Heating	Self-heating
Working range	0.2 m ... 64 m
Scanning range with 10% remission	16 m
Scanning range with 90% remission	30 m
Spot divergence	10.4 mrad x 8.7 mrad
Light spot size at front screen	7 mm rounded
Number of echoes evaluated	3

Working range diagram

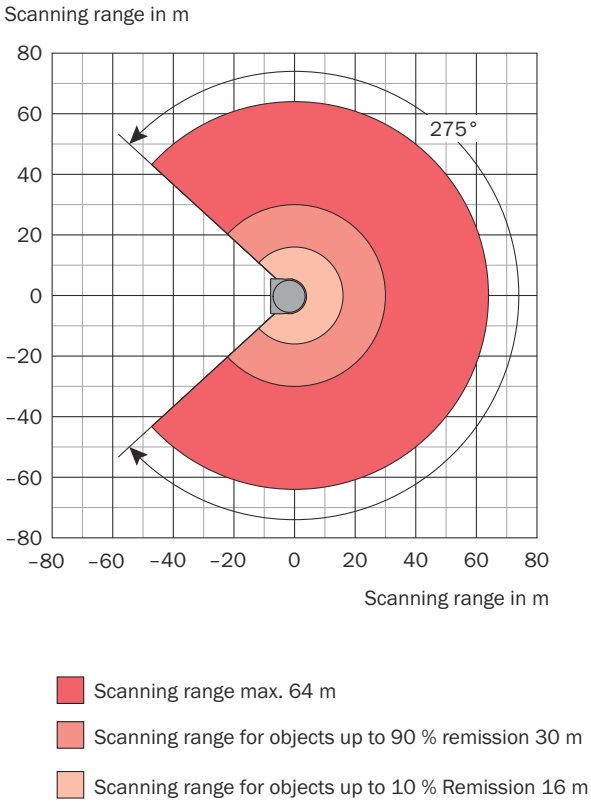


Figure 26: Working area diagram, top view

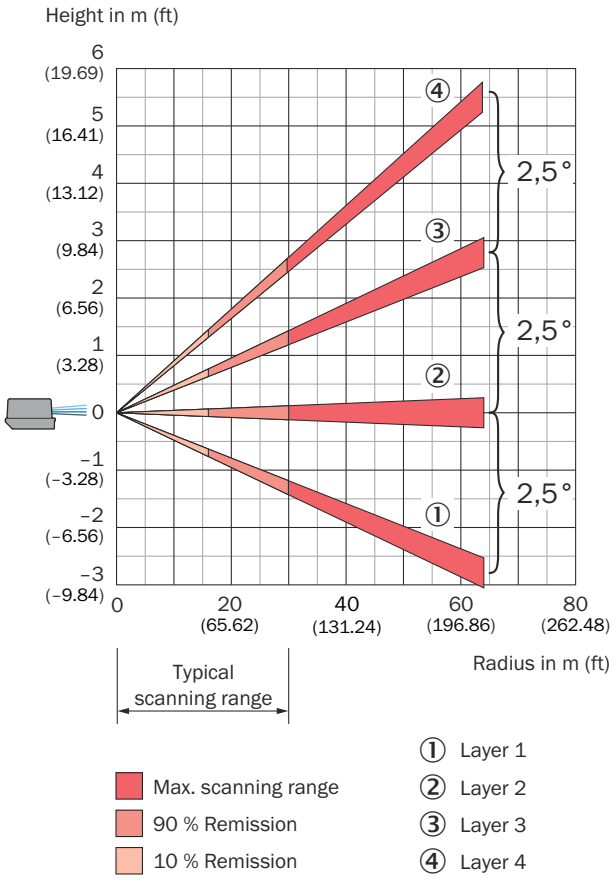


Figure 27: Working area diagram, side view

10.2 Mechanics/electronics

Connection type	3 x M12 round connectors with swivel connector
Supply voltage	10 V DC ... 30 V DC
Permissible residual ripple	±5%
Power consumption	P_{typ} = 13 W P_{start} = 30 W for 1 s (motor start-up) P_{max} = 37 W (with full specified current at all outputs)
Housing	ALSi12 Optics cover: PC
Housing color	MRSxxxxx-xxxxx0: Light blue(RAL 5012) MRSxxxxx-xxxxx1: Gray (RAL 7042)
Enclosure rating	IP65 (IEC 60529:1989+AMD1:1999+AMD2:2013) IP67 (IEC 60529:1989+AMD1:1999+AMD2:2013)
Protection class	III (IEC 61140:2016-11)
Electrical safety	IEC 61010-1:2010-06
Weight	1.2 kg
Dimensions (L x W x H)	151.9 mm x 150 mm x 92.5 mm
Encoder input frequency	not available
Maximum output current	max. 100 mA per output

1) E.g. 30 V*100 mA = 3 W

10.3 Dimensional drawing

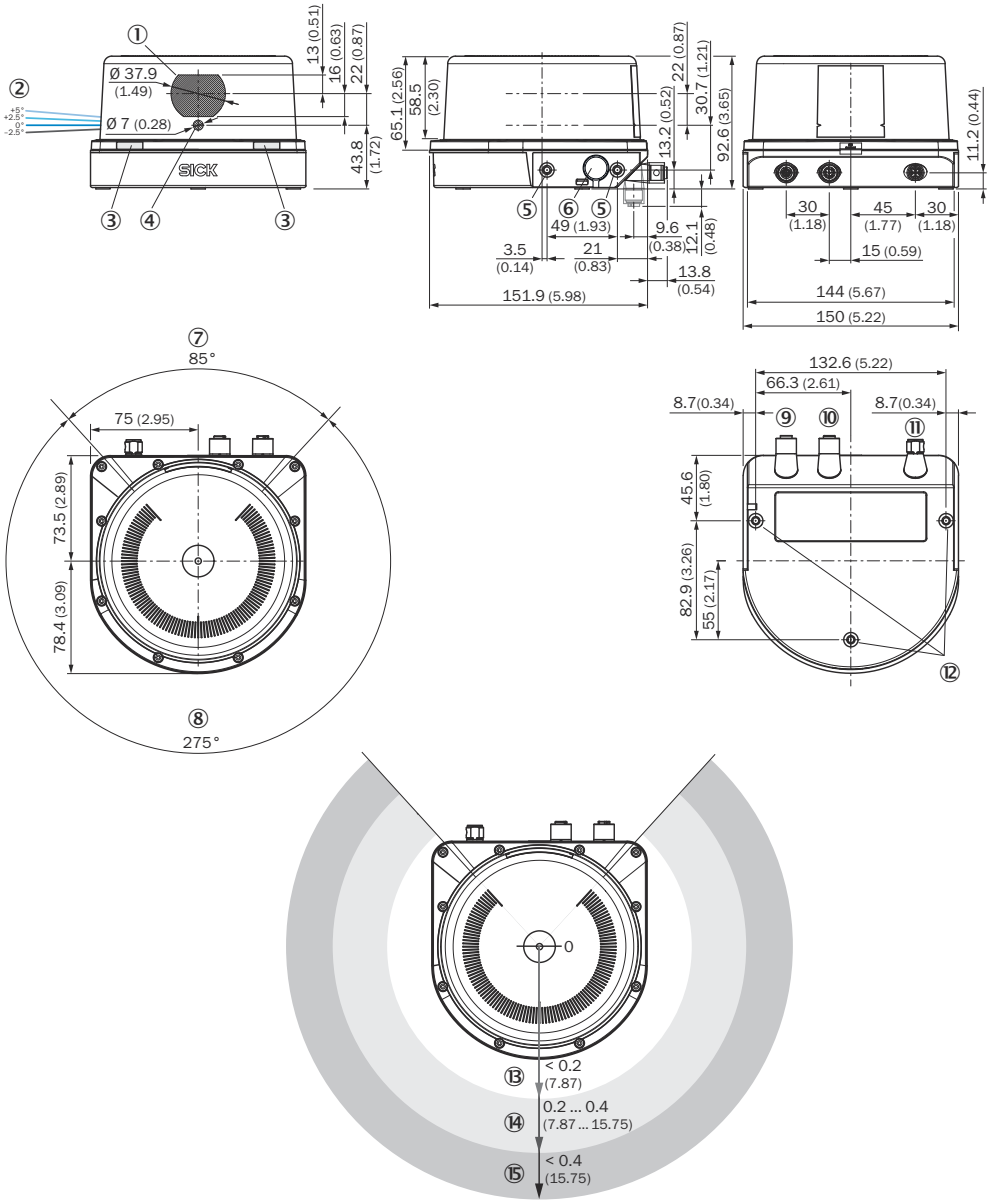


Figure 28: MRS1000 device structure and dimensions, dimensions in mm

① Receiver
② Laser aperture angle scan layers 1 to 4
③ Status LEDs
④ Sender
⑤ M5x7.5 fixing holes
⑥ Ventilation element
⑦ Blind spot
⑧ Field of view
⑨ Ethernet connection
⑩ I/O connection
⑪ PWR connection (supply voltage)
⑫ M5x7.5 fixing holes
⑬ Close range (no detection or measurement possible)

⑭ Detection area
⑮ Measuring range

10.4 Performance

Scan/frame rate	55000 ... 165000 measuring points/second
Response time	Typ. 20 ms (4 scan layers), typically 80 ms (1 scan layer) Min. 7 ms, max. 84 ms + 1 scan
Systematic error	± 60 mm Temperature drift: typically ± 0.5 mm/K
Statistical error	≤ 30 mm

1) Depends on the object size

10.5 Interfaces

Ethernet	✓, TCP/ IP Measurement data output (distance, RSSI, supplementary data) Data transmission rate: 10/100 Mbit/s
digital inputs/outputs	I/O (8 (multiport))
Digital inputs	Input voltage: V_s- 30 V ... +30 V (V_s: device supply voltage) **Static input current** • Logical “Active HIGH” (PNP compatible): Typ. 0.3 mA, Max. 1 mA • Logical “Active LOW” (NPN compatible): Typ. -0.3 mA, Max. -1 mA **Level for HIGH** • V_s ≥ 18 V: +12.5 V ... +30 V • V_s < 18 V: 0.75*Vs ... +30 V (at 12 V this means: 0.75*12=9 V → 9 V ... 30 V) **Level for LOW** • Vs ≥ 18 V: Vs-30 V ... +10.5 V (at 24 V this means: 24 V - 30 V= -20 V → -20 V ... +10.5 V • V_s < 18 V: V_s-30 V ... 0.4 * V_s Input capacity: 2.5 nF
Digital outputs	**Typ. Output voltage** • LOW: <= 1 V DC • HIGH: >= V_s- 1 V (V_s= device supply voltage) **Max. switching current per pin under continuous load/current limiting (after 5 ms)** • Max. switching current: 100 mA • Current limiting: 200 mA • Internal resistance: 2.3 Ohm ... 4.6 Ohm • Max. power loss: 1.5 W (total for digital inputs/outputs)
Output data	Contamination indication, IMU (secondary sensor data)
Optical indicators	2 LEDs

10.6 Ambient data

Remission factor	2% ... > 1,000% (reflector)
Electromagnetic compatibility (EMC)	EN 61000-6-2:2005 EN 61000-6-3:2007+A1:2011

Vibration resistance	According to IEC 60068-2-6:2007-12: 10 Hz ... 150 Hz: amplitude 0.35 mm to 5 g, 20 cycles
Shock resistance	Single shock according to IEC 60068-2-27:2008-02: 15 g, 11 ms, 6 shocks per axis Continuous shock according to IEC 60068-2-27:2008-02: 10 g, 16 ms, 1000 shocks per axis
Harmful gas resistance	Test for determining the resistance to flowing mixed gas according to DIN EN 60068–2–60:2016–06, Ke test, method 1
Chemical resistance	Salt spray test: DIN EN IEC 60068-2-52 (2018/08), test method 4
Ambient operating temperature	MRSxxxx-0xxxxx: -10 °C ... +50 °C MRSxxxx-1xxxxx: -30 °C ... +50 °C
Storage temperature	-40 °C ... +75 °C
Operating and storage air humidity	Max 90% air humidity (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 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).

Support Portal

NOTE

In the SICK Support Portal (supportportal.sick.com, registration required) you will find, besides useful service and support information for your product, further detailed information on the available accessories and their use.

12 Annex

12.1 Declarations of conformity and certificates

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

The 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).

12.2 Licenses

SICK uses open source software which is published by the rights holders under a free license. Among others, the following license types are used: GNU General Public License (GPL version 2, GPL version 3), GNU Lesser General Public License (LGPL), MIT license, zlib license and licenses derived from the BSD license.

This program is provided for general use without warranty of any kind. This warranty disclaimer also extends to the implicit assurance of marketability or suitability of the program for a particular purpose.

More details can be found in the GNU General Public License.

For license texts see www.sick.com/licensetexts.

Printed copies of the license texts are also available on request.

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