OPERATING INSTRUCTIONS

S3000 PROFINET IO, S3000 PROFINET IO-OF

Safety laser scanners

SICK
Sensor Intelligence.

Described product

S3000 PROFINET IO, S3000 PROFINET IO-OF

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 Purpose of this document

These operating instructions contain the information needed during the life cycle of the safety laser scanner.

Operating instructions of the safety laser scanner must be made available to all people who work with the device.

► Read these operating instructions carefully.
► Make sure that you have fully understood the contents before working with the safety laser scanner.

1.2 Scope

Product

This document applies to the following products:

- Product code: S3000 PROFINET IO, S3000 PROFINET IO-OF
- “Operating instructions” type label entry:
  - 8013289

Document identification

Document part number:

- This document: 8013291
- Available language versions of this document: 8013289

You can find the current version of all documents at www.sick.com.

1.3 Target groups of these operating instructions

Some sections of these operating instructions are intended for certain target groups. However, the entire operating instructions are relevant for intended use of the product.

Table 1: Target groups and selected sections of these operating instructions

Target group	Sections of these operating instructions
Project developers (planners, developers, designers)	"Project planning", page 25 "Configuration", page 63 "Technical data", page 103 "Accessories", page 122
Installers	"Mounting", page 48
Electricians	"Electrical installation", page 56
Safety experts (such as CE authorized representatives, compliance officers, people who test and approve the application)	"Project planning", page 25 "Configuration", page 63 "Commissioning", page 86 "Technical data", page 103 "Checklist for initial commissioning and commissioning", page 128
Operators	"Troubleshooting", page 97
Maintenance personnel	"Maintenance", page 90 "Troubleshooting", page 97

1.4 Further information

www.sick.com

The following information is available via the Internet:

- Data sheets and application examples
- CAD files and dimensional drawings
- Certificates (such as the EU declaration of conformity)
- Guide for Safe Machinery. Six steps to a safe machine
- CDS (Configuration & Diagnostic Software)

1.5 Symbols and document conventions

The following symbols and conventions are used in this document:

Warnings and other notes

DANGER
Indicates a situation presenting imminent danger, which will lead to death or serious injuries if not prevented.

WARNING
Indicates a situation presenting possible danger, which may lead to death or serious injuries if not prevented.

CAUTION
Indicates a situation presenting possible danger, which may lead to moderate or minor injuries if not prevented.

NOTICE
Indicates a situation presenting possible danger, which may lead to property damage if not prevented.

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

Instructions to action

► The arrow denotes instructions to action.

1. The sequence of instructions for action is numbered.
2. Follow the order in which the numbered instructions are given.

✓ The check mark denotes the result of an instruction.

7-segment display

Display symbols show the status of the 7-segment display of the device:

8 Constant display of characters, e.g., 8
8 Flashing display of characters, e.g., 8
L ↻ 2 Alternating display of characters, e.g., L and 2

LEDs

LED symbols describe the status of an LED:

● The LED lights up permanently.

The LED flashes.
The LED is off.

These symbols describe which LED is involved: , , , ,

The “Error/Contamination” LED flashes.
The “Protective field interrupted” LED lights up permanently.

The term “dangerous state”

The figures in this document always show the dangerous state (standard term) of the machine as movement of a machine part. In practice, there are various types of dangerous state:

- Machine movements
- Vehicle movements
- Live electrical parts
- Visible and invisible beams
- A combination of multiple hazards

2 Safety information

2.1 General safety notes

Overview

This section contains general safety information about the safety laser scanner.

Further safety information regarding specific usage situations is provided in the respective chapters.

Integrating the product

DANGER
The product can not offer the expected protection if it is integrated incorrectly.

- ► Plan the integration of the product in accordance with the machine requirements (project planning).
- ► Implement the integration of the product in accordance with the project planning.

Laser class 1

CAUTION
Optical radiation: Class 1 Laser Product

Caution - if any operating or calibrating equipment other than those specified here are used or other methods are employed, this can lead to dangerous exposure to radiation.

- ► Use only the tools and auxiliary equipment specified in this documentation.
- ► Only carry out the procedures specified in this documentation.
- ► Do not open the housing unless carrying out the mounting and maintenance operations provided in this documentation.

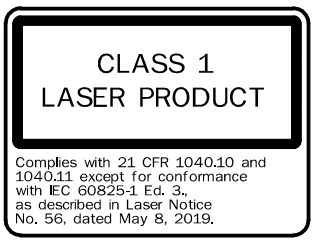


Figure 1: Laser class 1

This device complies with the following standards:

- EN 60825-1:2014 + A11:2021
- IEC 60825-1:2014
- 21 CFR 1040.10 and 1040.11, except compliance with IEC 60825-1:2014, as described in Laser Notice No. 56 dated May 8, 2019

Additional measures to shield the laser beam are not required (eye-safe).

Mounting and electrical installation

DANGER
Death or severe injury due to electrical voltage and/or an unexpected startup of the machine

- ► Make sure that the machine is (and remains) disconnected from the voltage supply during mounting and electrical installation.
- ► Make sure that the dangerous state of the machine is and remains switched off.

2.2 Intended use

The safety laser scanner is an electro-sensitive protective device (ESPE) and is suitable for the following applications:

- Hazardous area protection
- Hazardous point protection
- Access protection
- Mobile hazardous area protection (protection of automated guided vehicles)

The product may be used in safety functions.

The safety laser scanner must only be used within the limits of the prescribed and specified technical data and operating conditions at all times.

Incorrect use, improper modification or manipulation of the safety laser scanner will invalidate any warranty from SICK; in addition, any responsibility and liability of SICK for damage and secondary damage caused by this is excluded.

2.3 Inappropriate use

The safety laser scanner works as an indirect protective measure and cannot provide protection from pieces thrown from the application nor from emitted radiation. Transparent objects are not detected.

The safety laser scanner is not suitable for the following applications, among others:

- Outdoors
- Underwater
- In explosion-hazardous areas

2.4 Applications of the device

The safety laser scanner is used to protect people and systems.

The safety laser scanner is not permitted to be used outdoors.

The safety laser scanner does not offer protection from flying parts or from emitted radiation.

The safety laser scanner is intended exclusively for use in industrial environments. Radio interference may result when used in residential areas.

Stationary applications can be implemented, e.g. for access or hazardous area protection.

The device is a type 3 ESPE in accordance with IEC 61496-1 and IEC 61496-3 and can therefore be used in controllers of category 3 PL d in accordance with ISO 13849-1 or SIL 2 in accordance with IEC 61508.

The safety laser scanner is suitable for:

- Hazardous area protection
- Hazardous point protection

- Access protection
- Vehicle protection (electrically powered industrial trucks)

NOTE
Depending on the application, further protective devices and measures may be required in addition to the safety laser scanner.

2.5 Requirements for the qualification of personnel

The product must be configured, installed, connected, commissioned, and serviced by qualified safety personnel only.

Project planning

You need safety expertise to implement safety functions and select suitable products for that purpose. You need expert knowledge of the applicable standards and regulations.

Mounting, electrical installation and commissioning

You need suitable expertise and experience. You must be able to assess if the machine is operating safely.

Configuration

You need suitable expertise and experience. You must be able to assess if the machine is operating safely.

Operation and maintenance

You need suitable expertise and experience. You must be instructed in machine operation by the machine operator. For maintenance, you must be able to assess if the machine is operating safely.

3 Product description

3.1 Construction and function

The safety laser scanner is an optical sensor that scans its environment in two dimensions with infrared laser beams. It is used to monitor hazardous areas on machines or vehicles.

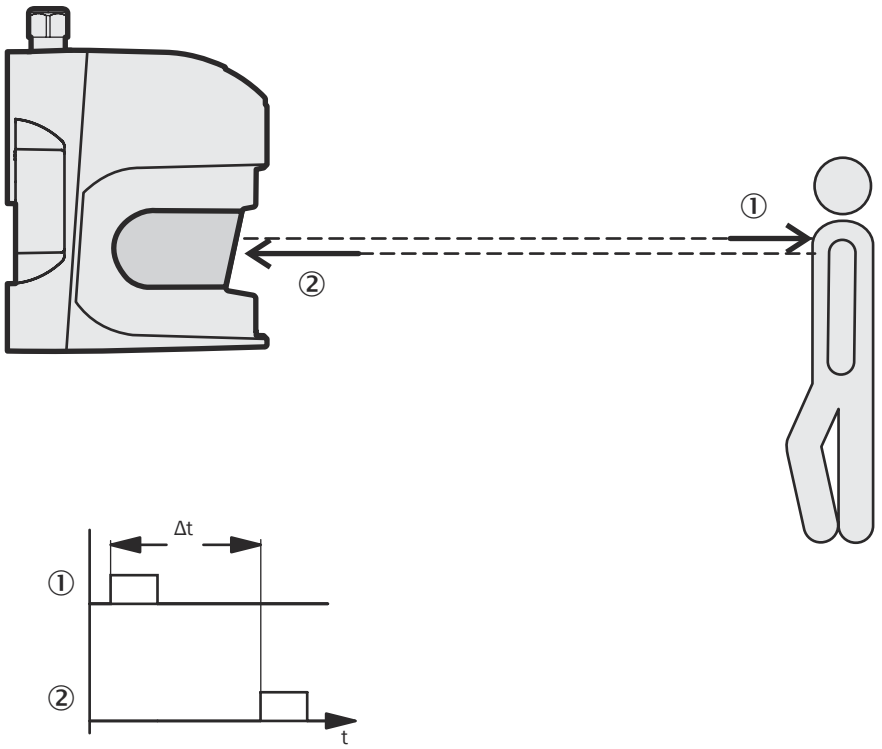


Figure 2: Principle of operation of the safety laser scanner time-of-flight measurement

① Transmitted light pulse

② Reflected light pulse

The device operates according to the time-of-flight measurement principle. The device emits very short light pulses (transmitted light pulse). while an “electronic stopwatch” runs simultaneously. If the light strikes an object, the object reflects the light which is then received by the safety laser scanner (received light pulse). The device calculates the distance to the object based on the time interval between the moment of transmission and moment of receipt (Δt).

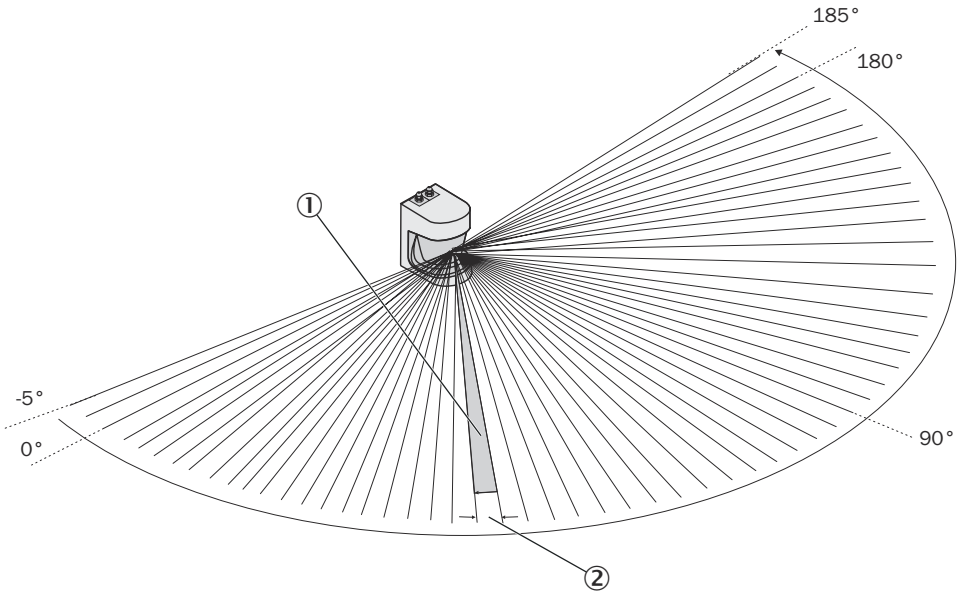


Figure 3: Principle of operation of the safety laser scanner rotation

① Angular resolution

② Object resolution

The device also contains a uniformly rotating mirror. The mirror deflects the light pulses so that they extend over a 190° sector of a circle. This means an object in the protective field can be detected within 190°. The first beam of a scan begins at −5° in relation to the rear side of the safety laser scanner.

The device emits the light pulses with an angular resolution of 0.25 or 0.5° ①. This enables resolutions between 30 mm and 150 mm to be achieved ②.

Thanks to the active scanning principle, the safety laser scanner does not need external receivers or reflectors. This has the following advantages:

- The installation process requires very little time or effort.
- The monitored area can be easily adapt to the hazardous area of the machine.
- In contrast to tactile sensors, non-contact scanning is nearly wear-free.

Contour monitoring

In addition to the protective field, the safety laser scanner can also monitor a contour (e.g., the floor in vertical applications).

Mode of operation

The safety laser scanner can only fulfill its protective function if the following requirements are satisfied:

- It must be possible to influence the machine, system or vehicle control electrically.
- It must be possible to change the dangerous state of the machine, the system or the vehicle into a safe state at any time using the safety laser scanner. That is, before the person reaches the hazardous points or hazardous areas.
- The safety laser scanner must be arranged and configured in such a manner that it can detect objects entering into the hazardous area.
- The optical path of the safety laser scanner must be kept clear at all times and must also not be obscured by transparent objects such as protective screens, plexiglass, lenses, etc. The protective function of the safety laser scanner can only be guaranteed if the contamination measurement function is not circumvented by such measures.

Further topics

- "Mounting", page 48
- "Commissioning", page 86

3.2 Product characteristics

3.2.1 Specific features

- 190° scanning angle
- Increased dust and particle tolerance due to dazzle and particle algorithms
- Sensor heads with a scanning range up to 4 m, 5.5 m or 7 m (maximum radii of the protective field)
- Warning field range: 49 m (20 m at 20% radiance factor)
- Various I/O modules for different fields of applications
- Easy exchange of the I/O module. This makes it easy to extend the functionality.
- Configuration via PC or notebook using the SICK Configuration & Diagnostic software
- Power supply plug with integrated configuration memory
- Dual field mode with field sets comprising a protective field and a warning field (optional simultaneous monitoring of 2 field sets)
- Contour monitoring of a protective field
- Integrated configurable restart interlock/restart delay
- Simultaneous protective fields with separate output information, and ability to reset separately
- Direct safety-related connection to PROFINET IO networks
- Connection options:
  - S3000 PROFINET IO: RJ45 female connectors for RJ45-push-pull male connector
  - S3000 PROFINET IO-OF: SCRJ female connectors for VARIOSUB push-pull SCRJ plug connector
- Monitoring case switching via static inputs

S3000 PROFINET IO/IO-OF Advanced

- Up to 4 field sets

S3000 PROFINET IO/IO-OF Professional

- Up to 8 field sets

The S3000 PROFINET IO/IO-OF has no local inputs or outputs apart from the parameterization interface. All communication occurs via the PROFINET IO network.

3.2.2 Device overview

The safety laser scanner comprises 3 components:

- The sensor head with the opto-electronic detection system
- The I/O module that determines the functionality of the device
- The system plug with configuration memory. The system plug has all the electrical connections except for the configuration interface.

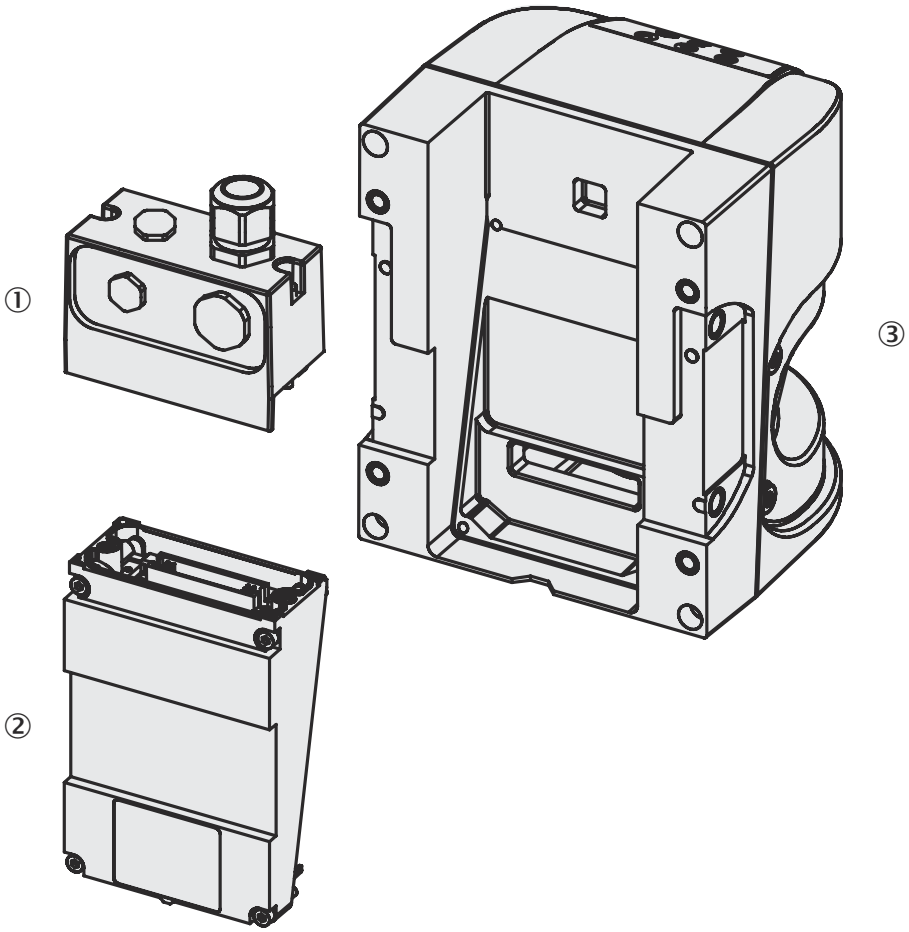


Figure 4: Sensor head, I/O module and system plug

① System plug
② I/O module
③ Sensor head

3.2.3 I/O module

The I/O module determines the available functions and therefore the possible fields of application for the safety laser scanner.

I/O module functions

Table 2: Functions

Function	Advanced	Professional
Object resolution [mm]	30/40/50/70/150	30/40/50/70/150
Restart interlock/delay	✓	✓
Field sets comprise a protective field and a warning field (dual field mode)	4	8
Can be used to simultaneously monitor 2 areas. The areas can be monitored with one protective field and one warning field respectively (dual field mode). This allows up to 2 protective fields to be monitored.	✓	✓
Programmable monitoring cases	4	16
Static control inputs for monitoring case switching	2	4

Function	Advanced	Professional
Output of measurement data (surrounding contour)	✓	✓

3.2.4 Sensor heads

The sensor heads differ with regards to their maximum scanning range and the resultant protective field size.

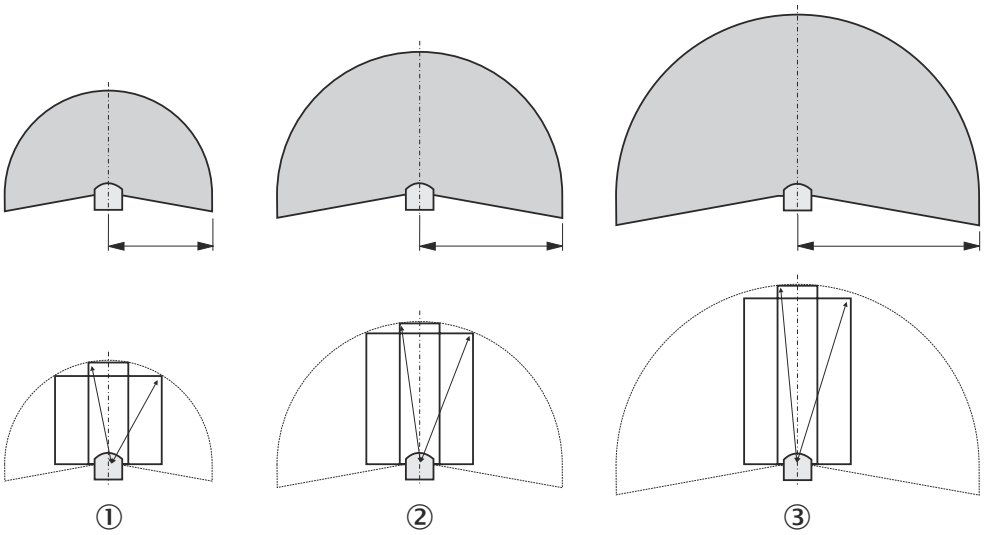


Figure 5: Protective field ranges of the sensor heads

① Short Range sensor head, maximum scanning range 4 m
② Medium Range sensor head, maximum scanning range 5.5 m
③ Long Range sensor head, maximum scanning range 7 m

3.2.5 Status indicators

The LEDs and 7-segment display indicate the operational status of the device. They are located on the front side of the device. Above each of the LEDs is an icon that will be used to describe the LED in these operating instructions.

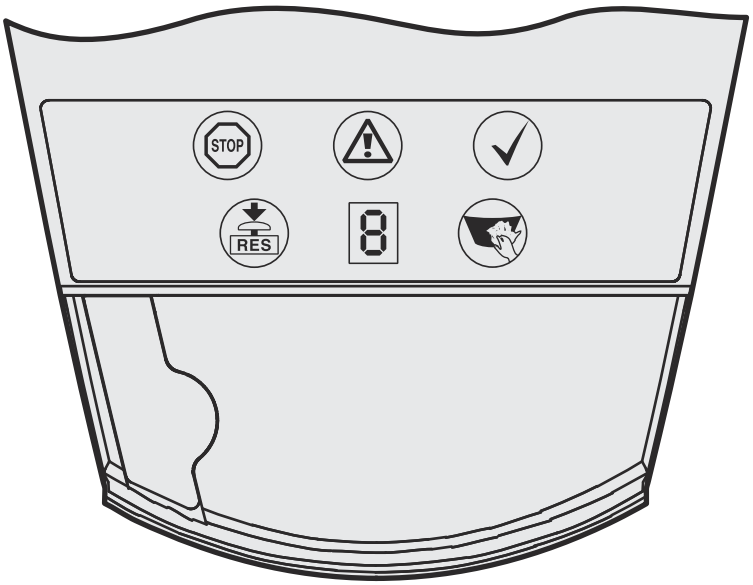


Figure 6: Status indicators of the safety laser scanner

The icons have the following meanings:

Table 3: Status indicators

Symbol	Meaning
	Object in the protective field, Monitored contour has changed, Reset required, Lock-out.
	Warning field interrupted (Object in the warning field)
	No object in the protective field
	Reset required
	Front screen contaminated
	7-segment display to indicate status and errors

Further topics

- "Error and status indications of the LEDs", page 97
- "Error and status indicators on the 7-segment display", page 98

3.2.6 Protective field, warning field and field set

Protective field

The protective field protects the hazardous area of a machine or vehicle. As soon as the safety laser scanner recognizes an object in the protective field, the device signals **Protective field interrupted** thereby causing the machine to be switched off or the vehicle to be stopped.

Warning field

The warning fields can be defined so that the safety laser scanner detects an object even before the actual hazardous area.

Warning field 1 can be used in particular for vehicle protection applications to detect an object before the actual hazardous area and to slowly retard the movement of the vehicle or bring it to a standstill. This can reduce the wear on the brakes of the AGV. Warning field 2 can also be used to trigger a warning signal.

NOTE

A warning field must not be used for tasks relating to the protection of people.

Field set comprising a protective field and warning field(s)

Protective fields and warning fields form the so-called field set. These field sets are configured using the CDS. You can configure the fields to be radial, rectangular or free form. When the area to be monitored changes, you can reconfigure the safety laser scanner via the software without additional mounting work.

Depending on the I/O module used, you can define up to 8 field sets and save them in the safety laser scanner. This allows you to switch to another field set if the monitoring situation changes.

You can configure field sets that comprise one protective field and one warning field.

Further topics

- "I/O module", page 16

3.2.7 Monitoring cases

Up to 16 monitoring cases can be defined and selected during operation. This makes it possible, for example, to perform process-dependent hazardous area protection or speed-dependent vehicle monitoring.

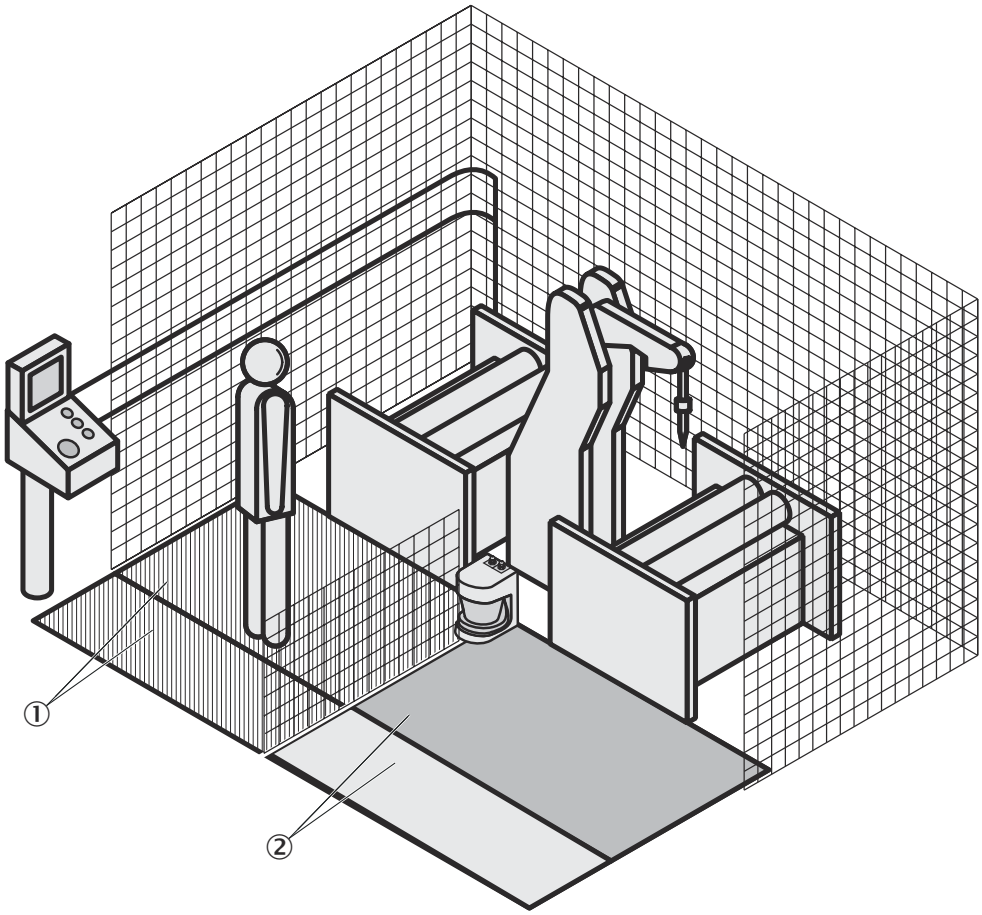


Figure 7: Monitoring cases

① Protective field and warning field of the inactive monitoring case 1

② Protective field and warning field of the active monitoring case 2

3.2.8 Simultaneous monitoring

The following monitoring scenarios are available depending on the field mode selected:

- Simultaneous monitoring of two field sets each with one protective field and one warning field (dual field mode)

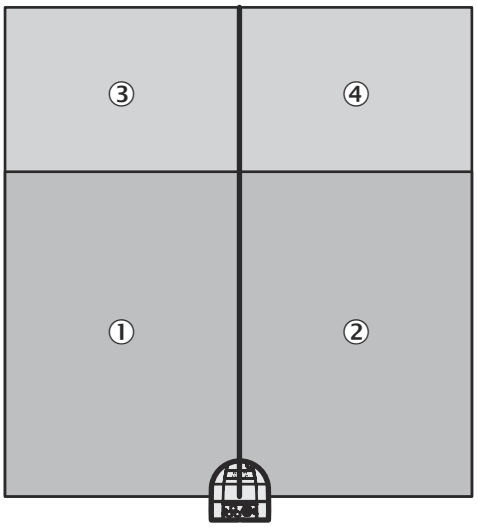


Figure 8: Dual field mode

① Protective field
② Simultaneous protective field
③ Warning field
④ Simultaneous warning field

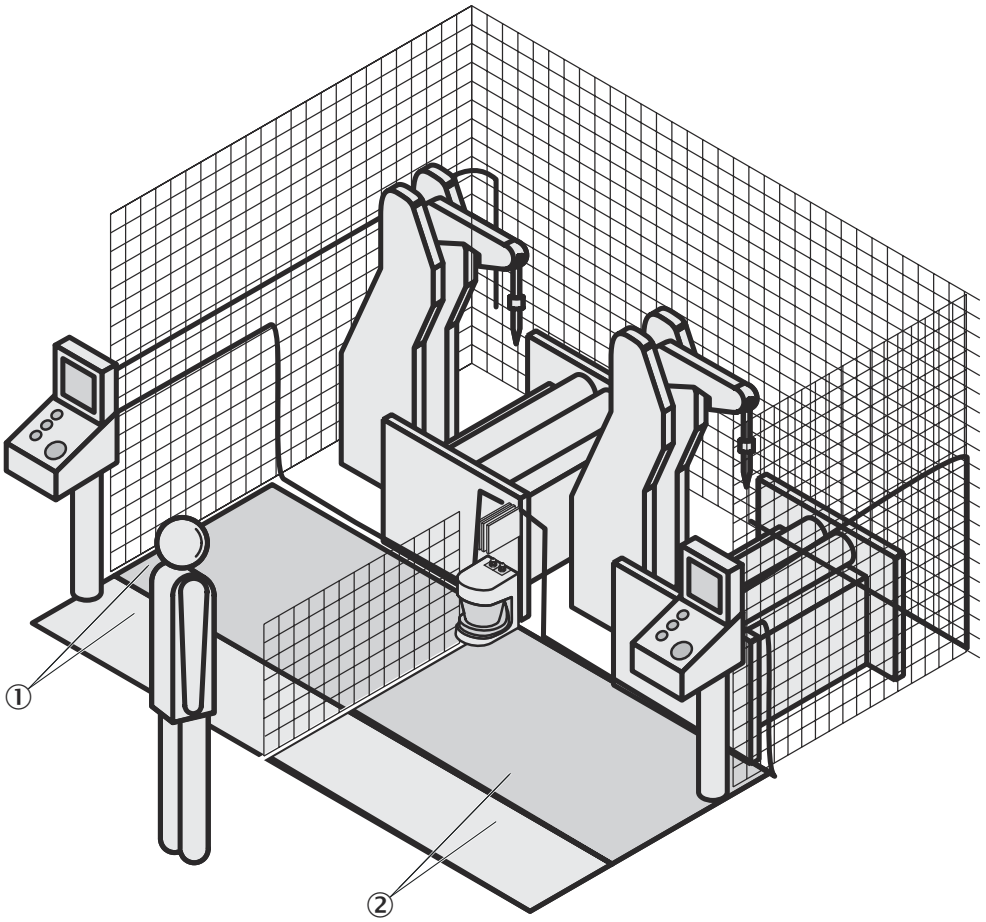


Figure 9: Simultaneous monitoring

① Active field set
② Active simultaneous field set

3.3 Operating principle of the device

PROFINET IO device

The PROFINET IO device is a decentralized, process-oriented field device. The device expects the configuration from an IO controller/supervisor and periodically transmits its process data to the IO controller.

PROFIsafe for PROFINET

PROFIsafe specifies how safety-related devices (e.g., S3000 PROFINET IO/IO-OF) can reliably communicate with safety controllers (e.g., FPLC). via a network. PROFIsafe implements this reliable communication by means of a profile, i.e., a specific format of the user data and a special protocol.

Device role

The S3000 PROFINET IO/IO-OF is an IO device.

The device expects the configuration from an IO controller and periodically transmits its process data to the IO controller.

Device model

The S3000 PROFINET IO/IO-OF is available as a compact device.

Services supported

- PROFINET IO conformance class B
- LLDP according to IEEE 802.1 AB
- SNMP
- MIB-II
- Cyclic IO communication
- Acyclic read/write services for communication via TCI interface
- Diagnostic alarms
- TCP/IP communication via port 9000
- MRP client support

3.4 Input signals

3.4.1 Reset signals

If the safety laser scanner is operated with a restart interlock, then the safety laser scanner requests a reset signal from the controller (Reset required) after a protective field interruption and subsequent clear protective field. The safety laser scanner responds to the rising signal edge from Low to High of the reset signal (and not to the signal level).

WARNING
Dangerous state of the machine

If the reset signal is implemented as a single signal, an electromagnetic interference signal could trigger a restart.

► The reset signal must be fail-safe (single failure proof).

3.4.2 Control signals for switching monitoring cases

You can switch between protective fields by switching monitoring cases.

NOTE

The respective control inputs A, B, C, D of the S3000 PROFINET IO/IO-OF Professional, or A, B of the S3000 PROFINET IO/IO-OF Advanced expect complementary signals.

Table 4: Logical state 0 of the control inputs via the process image

Control input	A		B		C		D	
Bits of the output bye 0 in the process image (see table 25, page 104, see table 27, page 107)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Value of the bit	1	0	1	0	1	0	1	0
Logical state	0		0		0		0	

Table 5: Logical state 1 of the control inputs via the process image

Control input	A		B		C		D	
Bits of the output bye 0 in the process image (see table 25, page 104, see table 27, page 107)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Value of the bit	0	1	0	1	0	1	0	1
Logical state	1		1		1		1	

Examples

01011010 = valid value: A = 1, B = 1, C = 0, D = 0

11011010 = invalid value, input A is not set complementarily

3.4.3 Standby

When the S3000 PROFINET IO/IO-OF is in standby mode, the protective field and warning field outputs are deactivated. The S3000 PROFINET IO/IO-OF remains in standby mode as long as the relevant input information is pending (active High) (table 25 and table 27).

3.4.4 Initialization

When the S3000 PROFINET IO/IO-OF is in the lock-out state, e.g. due to an invalid value at the inputs, the safety laser scanner can be initialized. During the initialization, the device executes a boot sequence similar to a warm start.

Once the cause of the error has been eliminated, the device starts regular operation again.

The safety laser scanner responds to the rising signal edge from Low to High (and not to the signal level).

3.5 Example applications

Overview

The examples shown are only intended to help with planning. Additional protective measures for the application may need to be considered.

In the case of the examples with monitoring case switching, bear in mind that a person may already be in the protective field when switching takes place. Only by switching in the correct time frame (i.e., before the hazard occurs at this point for the person) is protection provided.

Hazardous area protection

In hazardous area protection, people are detected if they stay in a defined area. This type of protective device is suitable for machines, where it is possible to see a hazardous area completely from the reset pushbutton. When the hazardous area is entered, a stop signal is triggered and starting is prevented.

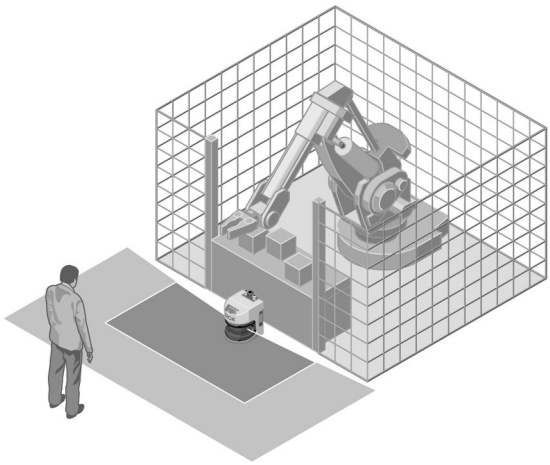


Figure 10: Hazardous area protection: detection of the presence of a person in the hazardous area

Hazardous point protection

In hazardous point protection, the approach is detected very close to the hazardous point. The advantage of this type of protective device is that it is possible to have a short minimum distance and the operator can work more ergonomically.

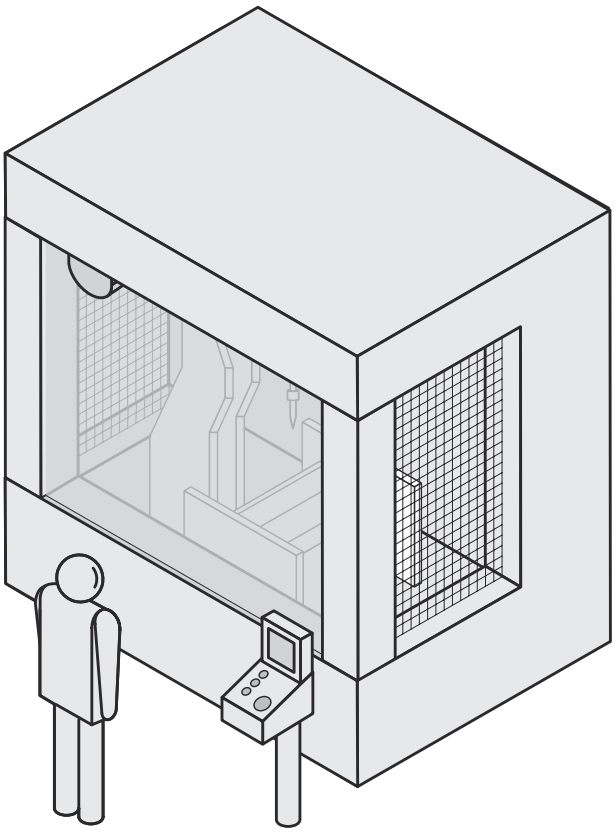


Figure 11: Hazardous point protection: hand detection

Access protection

In access protection, people are detected if their whole body passes through the protective field. This type of protective device is used for the protection of access to hazardous areas. A stop signal is initiated if the hazardous area is entered. A person standing behind the protective device will not be detected by the ESPE.

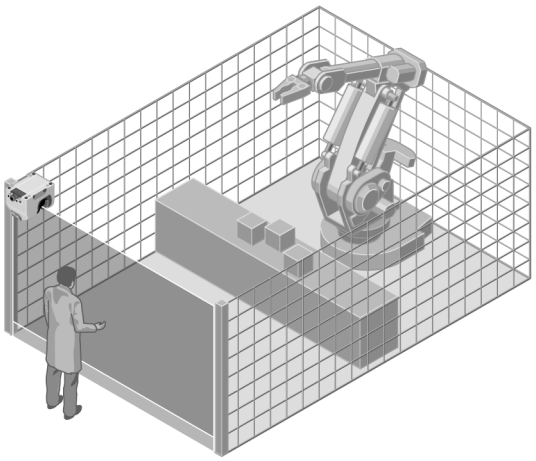


Figure 12: Access protection: detection of a person when accessing a hazardous area

Mobile hazardous area protection

Mobile hazardous area protection is suitable for AGVs (automated guided vehicles), cranes and forklift trucks, to protect people when vehicles are moving or docking at a fixed station.

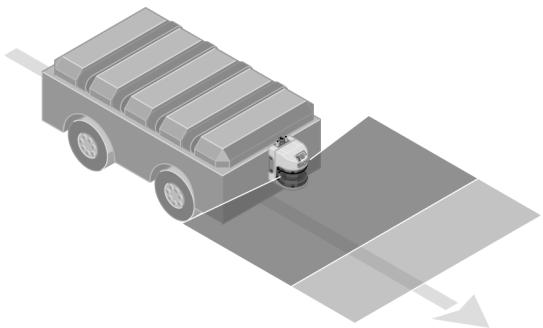


Figure 13: Mobile hazardous area protection: detection of a person when a vehicle approaches

Further topics

- "Timing for monitoring case switching", page 32

4 Project planning

4.1 Manufacturer of the machine

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- Use of the safety laser scanner requires a risk assessment. Check whether additional protective measures are required.
- Comply with the applicable national regulations derived from the application (e.g., work safety regulations, safety rules, or other relevant safety guidelines).
- Apart from the procedures described in this document, the components of the safety laser scanner must not be opened.
- The safety laser scanner must not be tampered with or changed.
- Improper repair of the protective device can lead to a loss of the protective function. The protective device must only be repaired by the manufacturer or by someone authorized by the manufacturer.

4.2 Operator of the machine

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- Changes to the electrical integration of the safety laser scanner in the machine control and changes to the mechanical mounting of the safety laser scanner necessitate a new risk assessment. The results of this risk assessment may require the entity operating the machine to meet the obligations of a manufacturer.
- Changes to the device's configuration may impair the protective function. The effectiveness of the protective device must be checked after any change to the configuration. The person carrying out the change is also responsible for maintaining the protective function of the device.
- Apart from the procedures described in this document, the components of the safety laser scanner must not be opened.
- The safety laser scanner must not be tampered with or changed.
- Improper repair of the protective device can lead to a loss of the protective function. The protective device must only be repaired by the manufacturer or by someone authorized by the manufacturer.

4.3 Design

Important information

WARNING
Ineffectiveness of the protective device

If the distance between the protective device and the hazardous point is too small, a person may reach the hazardous point before the dangerous state of the machine has been completely stopped.

- Design the protective field so that an adequate minimum distance to the hazardous area is created.

WARNING
Dangerous state of the machine

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

- ► Make sure that there are no obstacles in the area to monitored which impair the field of view of the device or could cause movement shadows. The device cannot monitor such shadowed areas. If unavoidable shadowed areas exist, check whether they pose a risk. Implement additional protective measures if necessary.
- ► Keep the area to be monitored free of smoke, fog, vapor and other air impurities. No condensation must be allowed to form at the light emission window. The function of the device may otherwise be impaired, which can lead to unintended shutdowns.
- ► Avoid strongly reflective objects in the scan plane of the device. Example: Retro-reflectors can influence the measurement result of the device. Highly specular objects inside the protective field can blank part of the surface to be monitored in some cases.
- ► Mount the device in such a way that incident sunlight cannot dazzle it. Do not arrange stroboscope and fluorescent lights or other strong light sources directly on the scan plane since they can influence the device under certain circumstances.

WARNING
Ineffectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

- ► Make sure that the field of view of the device is not restricted.

WARNING
Ineffectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

- ► Prevent people from being able to crawl beneath, stand behind, or climb over the protective field by mounting the device appropriately.

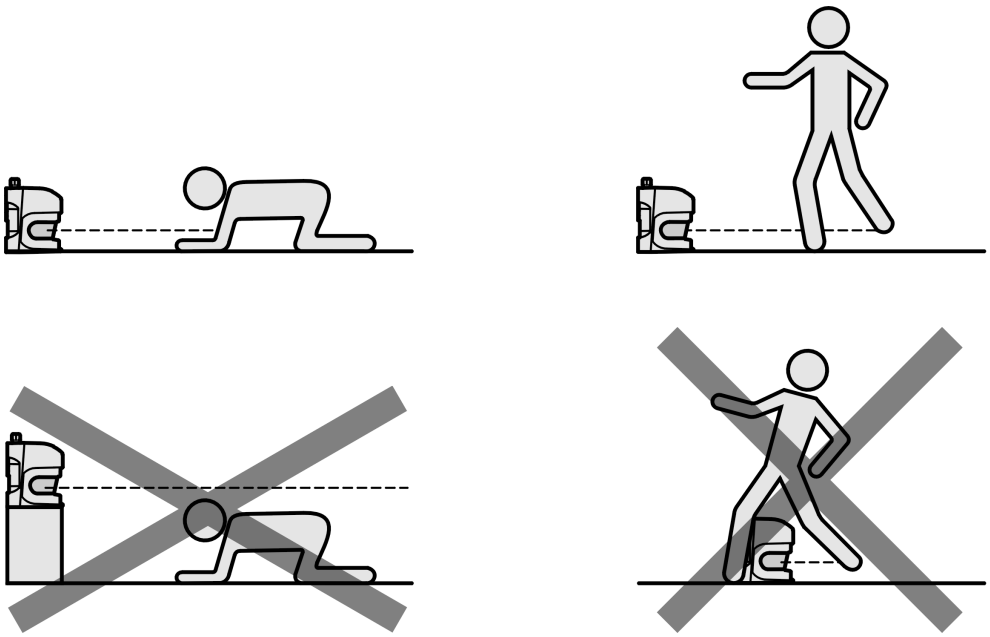


Figure 14: Prevent crawling beneath, standing behind, or climbing over

NOTICE

- Mount the device in a dry location. Protect it from contamination and damage.
- Avoid installing the device near strong electrical fields. These fields can be caused, for example, by nearby welding cables, induction cables, or cell phones.

NOTE

- Mount the device so that it is protected from moisture, dirt, and damage.
- Mount the sensor so that the status indicators can be clearly seen.
- Always mount the device so that there is still enough space for mounting and dismantling the system connector.
- Avoid exposing the device to excessive shock and vibration.
- For systems that vibrate heavily, use shock absorbers to prevent the possibility of fixing screws unintentionally coming loose.
- Regularly check the tightness of the fixing screws.
- Observe the maximum permissible tightening torque for the fixing screws on the device:
  - M6 at the rear = max. 12 Nm
  - M8 on the side = max. 16 Nm

Further topics

- "Mounting", page 48

4.3.1 If several safety laser scanners are used

The device has been designed to minimize the probability of mutual interference with other safety laser scanners. To completely rule out unintended shutdowns, the safety laser scanners must be mounted as shown in the following examples.

NOTE

To calculate the minimum distance for any particular case, refer to ISO 13855.

To adjust the safety laser scanners at different angles, use mounting kits 1 to 3.

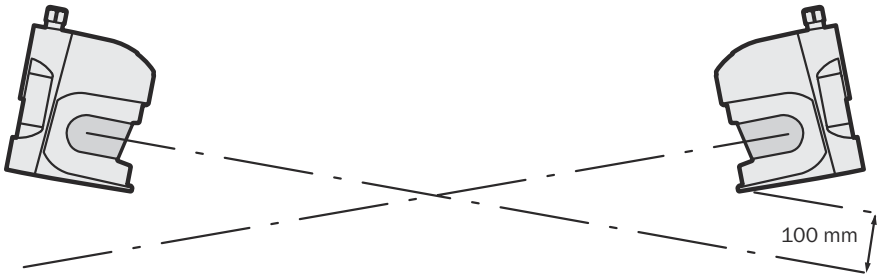


Figure 15: Mounting opposite

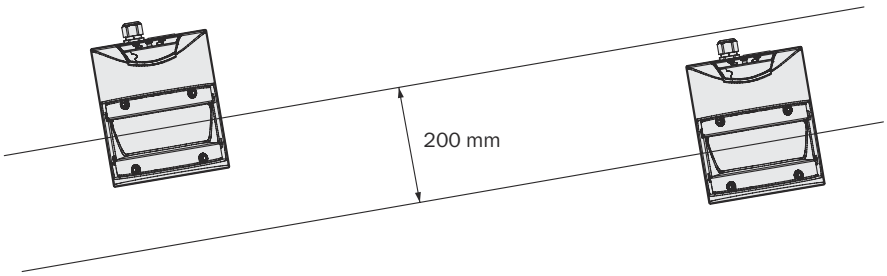


Figure 16: Mounting angled parallel

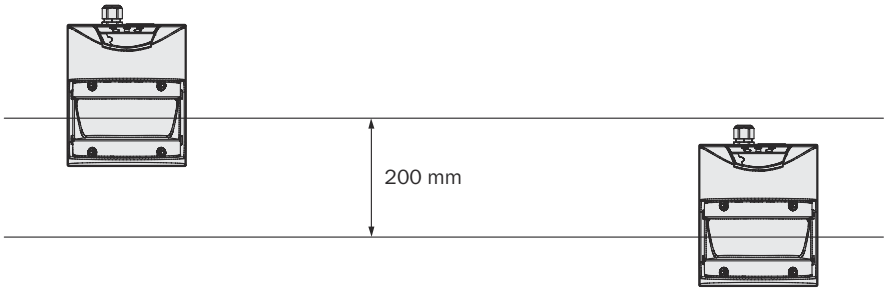


Figure 17: Mounting offset parallel

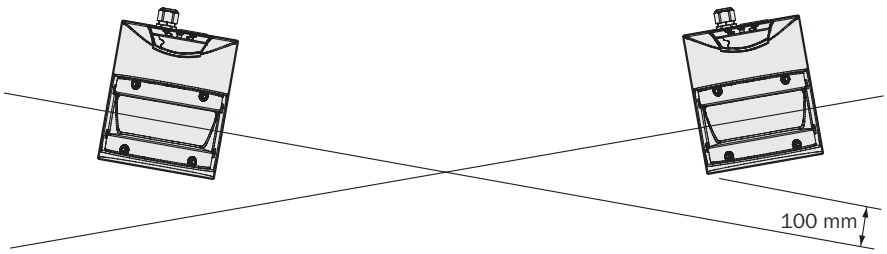


Figure 18: Mounting crosswise

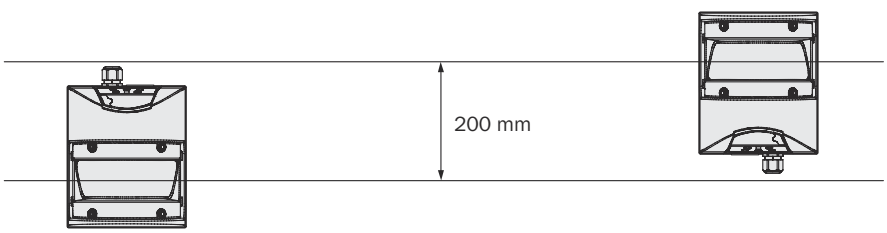


Figure 19: Mounting one device upside down, offset parallel

4.3.2 Measures to prevent unsecured areas

Overview

When mounting the safety laser scanner, there may be areas which it cannot detect (①).

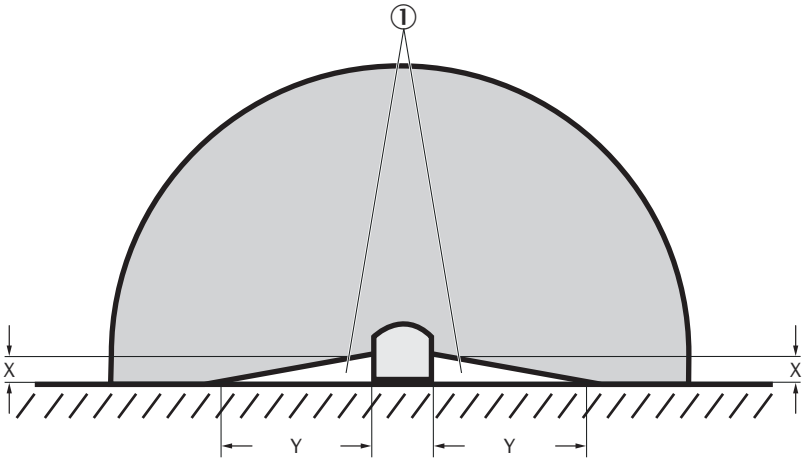


Figure 20: Unsecured areas in stationary applications

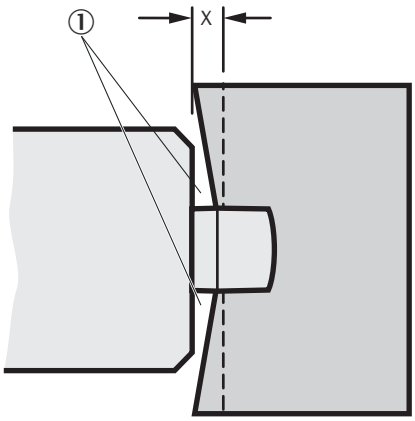


Figure 21: Unsecured areas in mobile applications

These areas become larger if you mount the safety laser scanner using the mounting kits.

Table 6: Size of the unsecured areas

Installation variant	Size of the unsecured areas	
	X	Y
Direct mounting	109 mm	1,245 mm
Using mounting kit 1	112 mm	1,280 mm
Using mounting kits 1 and 2	127 mm	1,452 mm
Using mounting kits 1, 2 and 3	142 mm	1,623 mm

Important information

DANGER
Ineffectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

The safety laser scanner must be mounted so that people cannot enter unsecured areas.

Examples of possible measures:

- ► Attach deflector plates to prevent anyone standing behind.
- ► Mount the safety laser scanner in an undercut.
- ► Mount the safety laser scanner in the paneling of the machine or vehicle.
- ► Mount a frame to prevent access to the area.

DANGER
Ineffectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

If the vehicle takes off very quickly from standstill, the protective field must be sufficiently large to ensure that a person standing in front of it can be detected in time.

- ► Select a sufficiently large protective field.

DANGER
Ineffectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

- When installing the system in a paneling, for example, prevent any interference with the optical beam path.
- Do not apply an additional front screen.
- If a viewing slit is required, make sure that it is adequately dimensioned.

Mounting with deflector plates

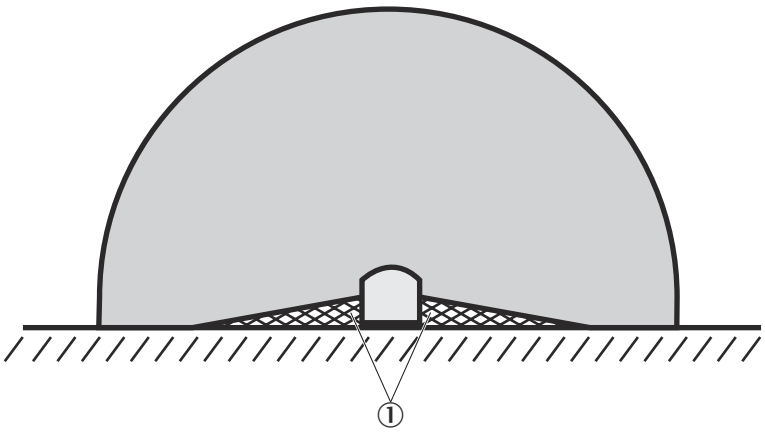


Figure 22: Mounting with deflector plates (example)

- ► Attach the deflector plates ① so that it is not possible to stand behind the unsecured areas of the safety laser scanner.

Mounting in an undercut

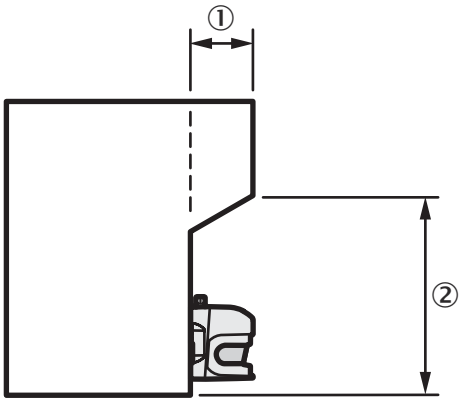


Figure 23: Implementation with an undercut

- ► Make the undercut ① sufficiently deep that it completely covers the area not protected by the safety laser scanner (see figure 22) and so that it is not possible to stand behind the unsecured areas.
- ► Prevent crawling beneath the undercut by making the height of the undercut ② sufficiently small so that no one can crawl under it.

Mounting in the vehicle paneling

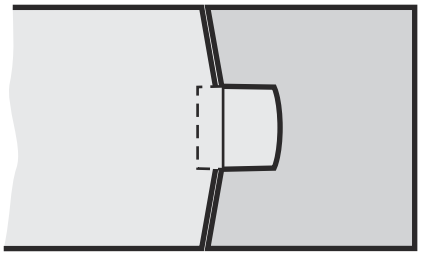


Figure 24: Installing the device in the vehicle paneling

- ► Install the safety laser scanner in the vehicle paneling in such a way that the unsecured areas are ≤ 70 mm in size and the safety laser scanner protrudes no more than 109 mm beyond the front edge of the vehicle. The vehicle can then be accelerated to a speed of 0.3 m/s within one second.

Complementary information

By observing all the necessary safety measures, it may be possible to avoid using a restart interlock and thereby potentially increase the availability of the system.

Further topics

- "Dimensional drawings", page 118

4.3.2.1 Near range

The near range is a 5 cm wide area in front of the optics cover. Use a bracket or undercut to prevent persons from entering the near range or provide additional protection using a close-range scanner with a detection range of 5 cm. The vehicle can then be accelerated at any rate.

4.3.3 Timing for monitoring case switching

Overview

When switching between monitoring cases, it is possible that a person may already be in the newly activated protective field when switching takes place. Only by switching in the correct time frame (i.e., before the hazard occurs at this point for the person) is protection provided.

You must advance the switching time in the following situations:

- You have entered an input delay for the switching method.

The following diagram illustrates the relationships:

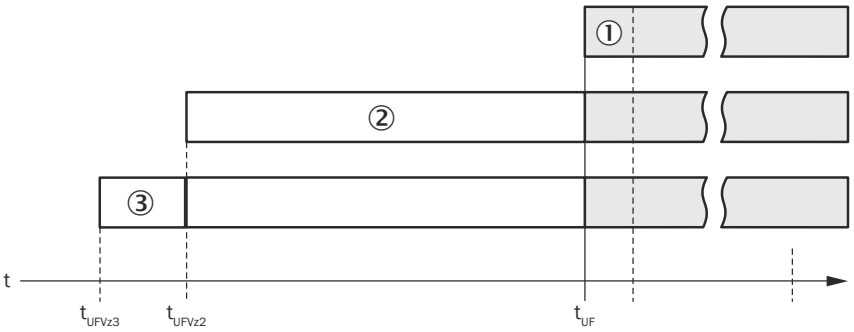


Figure 25: Advancing the switching time

- If the input conditions are present on the control inputs within 10 ms and 20 ms (cf. ①), the switching time (t_{UF}) does not need to be advanced.
- If an input delay for the control inputs needs to be allowed for (cf. ②), the switching time (t_{UFVz2}) must be advanced by the input delay.
- If external OSSDs are used, the switching time (t_{UFVz3}) must be advanced by an additional 20 ms (cf. ③).

Important information

DANGER

Ineffectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

Someone may already be in the protective field at the time of switchover. Only by switching in the correct time frame, i.e., before the hazard occurs at this point for the person, is protection provided.

► Time the switching so that the safety laser scanner detects a person in the protective field at a sufficient minimum distance before the dangerous state occurs.

Example

The following figure shows a gantry robot that is protected by 2 monitoring cases.

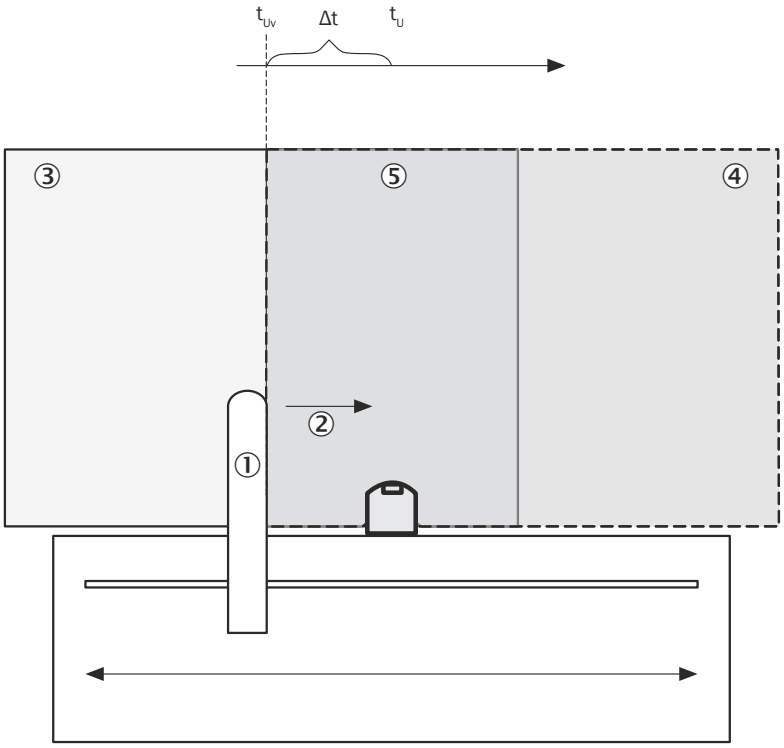


Figure 26: Advancing the switching time (example)

The gantry robot ① moves to the right ②. The dangerous movement is being monitored on the left-hand side by one of the monitoring cases ③. Due to the required advancement of the switching time, it is necessary to already switch the monitoring case when the gantry robot arrives at the point t_{Uv} to ensure that the right monitoring case ④ is active at time t_U.

The same applies for a movement to the left, i.e., for the switchover to monitoring case ③.

The protective fields of the monitoring cases must overlap ⑤ to ensure the protective function is guaranteed at all times.

Time of switching

Calculating the time of switching

- The time of switching is calculated using the following equation:
  $t_{UFVz} = t_{EVz}$

where

- t_{UFVz} = time by which the switching is advanced
- t_{EVz} = input delay for the control inputs

Complementary information

- In the phases before and after switching, only the minimum distances calculated for the individual monitoring cases apply.
- The preceding considerations are provided exclusively for the purposes of selecting the optimum switching time.

- If the timing for the switching cannot be exactly defined, e.g., due to the variable processing speed of the machine, or if advancing of the timing results in premature termination of the monitoring of the initial area, the two protective fields must partially overlap.
  Alternatively, you can use simultaneous monitoring to temporarily monitor both hazardous areas.

4.3.4 Stationary applications in horizontal operation

This type of protective device is suitable for machines and systems where, for example, a hazardous area is not completely surround by a physical guard.

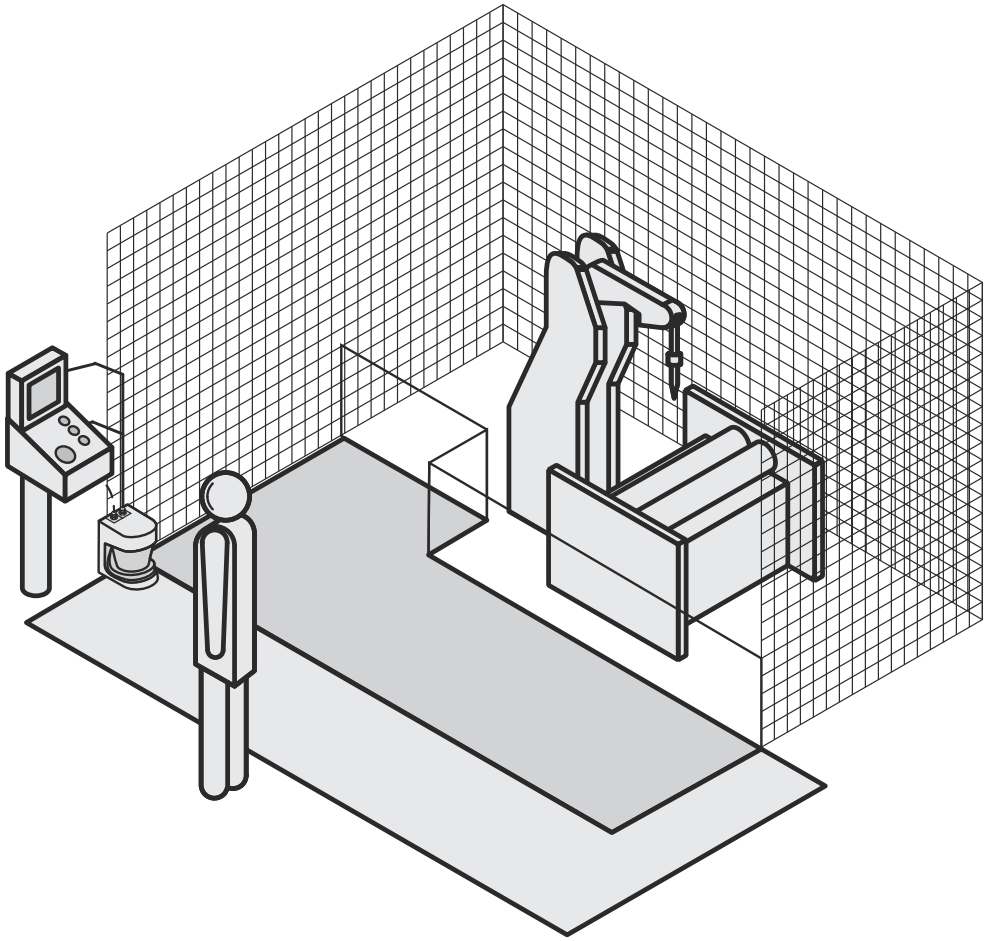


Figure 27: Horizontally mounted stationary application

For a horizontal stationary application, you determine the following:

- The protective field size to maintain the necessary minimum distance
- The height of the scan plane
- The restart behavior
- Measures to protect any areas that are not covered by the safety laser scanner

NOTE

After defining the protective field size, mark the boundaries of the protective field on the floor. By doing this, you enable the operators of the system to see the protective field boundaries, and make it easier to check the protective function at a later date.

4.3.4.1 Protective field size

Overview

The protective field must be configured in such a way that a minimum distance (S) to the hazardous area is maintained. This minimum distance ensures that the hazardous point can only be reached if the dangerous state of the machine has been stopped completely.

You can operate the device in stationary horizontal operation using a 50 mm or 70 mm resolution. For each resolution, you can select between a 60 ms and 120 ms response time. The resolution and response time determine the maximum protective field range[1)] of the device.

- If the 50 mm resolution is selected, the maximum protective field range is less than for the 70 mm resolution, however you can mount the device as low as you wish.
- If the 70 mm resolution is selected, you can configure the largest protective field range but need to position the scan plane of the device at 300 mm.

Important information

WARNING

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

With a 70 mm resolution and low mounting height, it may not be possible to detect a human leg.

► For horizontal stationary applications with a 70 mm resolution, mount the scan plane at a height of at least 300 mm above the floor in accordance with ISO 13855 (see "Height of the scan plane at 70 mm resolution", page 38).

NOTE

If you define several monitoring cases with different protective fields, you must calculate the protective field sizes for all protective fields used.

NOTE

As you can select from two different resolutions and two different response times, it may be necessary to calculate the protective field size several times (iterative calculation).

- First calculate the protective field based on a resolution of 50 mm and a basic response time of 60 ms.
- If the calculated protective field is larger than the maximum protective field range at 50 mm resolution, recalculate the protective field using the same resolution and the faster response time.
- If the calculated protective field is larger than the maximum achievable protective field range, recalculate the protective field using the lower resolution.

Minimum distance S

The minimum distance S depends on the:

- Approach speed of the body or parts of the body
- Stopping time of the machine or system
  The machine stopping/run-down time can be obtained from the machine documentation or must be determined by measurement.
- Response time of the safety laser scanner
- Supplements for general and, possibly, reflection-related measurement errors

1) Radial distance to the safety laser scanner.

- Supplement to prevent reaching over
- Height of the scan plane
- Switching time between monitoring cases, if applicable

Calculate the minimum distance S using the following formula (see ISO 13855):

► $S = (K \times (T_M + T_S)) + Z_G + Z_R + C_{RO}$

where

- K = Approach speed (1,600 mm/s, defined in ISO 13855)
- T_M = Stopping time of the machine or system
- T_S = Response time of the safety laser scanner and the downstream controller
- Z_G = General supplement = 100 mm
- Z_R = Supplement for reflection-related measurement errors
- C_{RO} = Supplement to prevent reaching over

Response time T_S of the safety laser scanner

The response time T_S of the safety laser scanner depends on the:

- Basic response time of the safety laser scanner
- Set multiple sampling

Supplement Z_R for reflection-related measurement errors

DANGER

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

Retro-reflectors at a distance of less than 1 m from the protective field boundary can dazzle the safety laser scanner and impair its detection capability.

► Avoid retro-reflectors at a distance of less than 1 m to the protective field boundary.

► If retro-reflectors are nevertheless mounted at a distance of less than 1 m from the protective field boundary, add a supplement Z_R = 200 mm to the protective field.

Supplement C_{RO} to protect against reaching over

With a protective field installed horizontally, there is a risk of people reaching over the protective field and thereby reaching the hazardous area before the safety laser scanner shuts down the dangerous state. You need to allow for this by incorporating a supplement into the calculation of the minimum distance. This will prevent people from reaching over the protective field and getting into a hazardous situation (see ISO 13857) before the safety laser scanner responds.

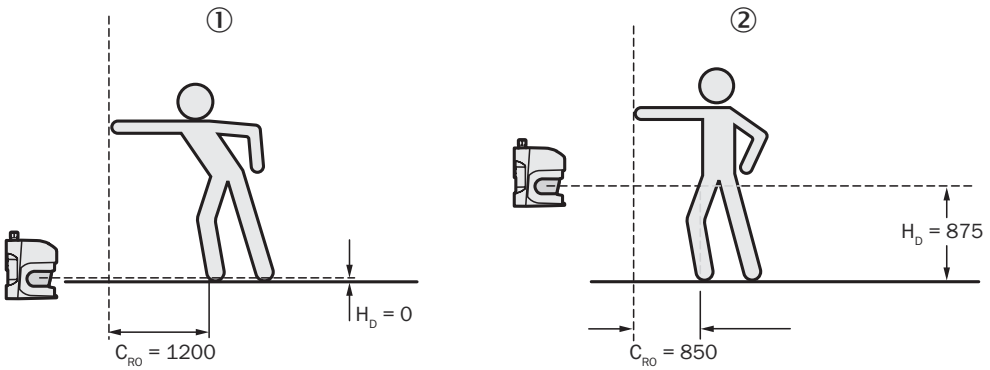


Figure 28: Risk of reaching over (mm)

The necessary supplement to the minimum distance depends on the height of the protective field's scan plane. The supplement is larger for a lower installation height ① than for a higher installation height ②.

In summary, there are three common options for mounting the scan plane of the safety laser scanner. The optimal mounting option depends on the particular application.

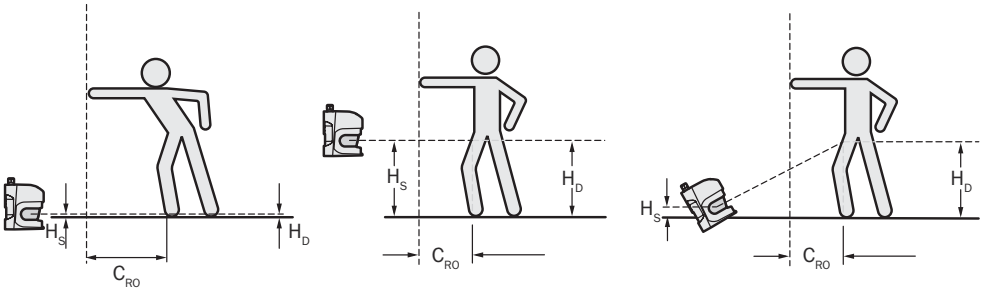


Figure 29: Mounting options for the scan plane

Table 7: Advantages and disadvantages of the mounting options

Installation position	Advantage	Disadvantage
Safety laser scanner low (H_S < 300 mm) Inclination of the scan plane small ($H_D \approx H_S$)	No external influence from dazzling, no crawling beneath possible	Larger supplement C_{RO}
Safety laser scanner high (H_S > 300 mm) Inclination of the scan plane small ($H_D \approx H_S$)	Small protective field supplement C_{RO}	Risk of crawling beneath (front and side)
Safety laser scanner low (H_S < 300 mm) Inclination of the scan plane large ($H_D > H_S$)	Small protective field supplement C_{RO}	Risk of crawling beneath (front), possible external influence from dazzling

H_D = Detection height

H_S = Scanner mounting height

DANGER

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

If the scan plane is higher than 300 mm, it may be possible for people to crawl beneath the protective field and reach the hazardous area.

- ► Prevent people from being able to crawl beneath the protective field by mounting the safety laser scanner appropriately.
- ► If the protective device is mounted higher than 300 mm, additional measures must be taken to prevent people crawling beneath.
  For publicly accessible applications, the mounting height may need to be reduced to 200 mm (see the relevant regulations).

Calculation of supplement C_{RO}

Calculating the supplement C_{RO}

- ► If there is sufficient free space in front of the machine or system, use the value 1,200 mm for the supplement C_{RO}.
- ► If the minimum distance needs to be kept as small as possible, calculate C_{RO} using the following formula: C_{RO} = 1200 mm – (0.4 × H_D)
  where H_D is the mounting height of the protective field.

NOTE

The minimum supplement C_{RO} to prevent reaching over is 850 mm (arm length).

Height of the scan plane at 70 mm resolution

Due to the radial sampling of the protective field, the optical resolution at greater distances from the safety laser scanner is lower than in the near range.

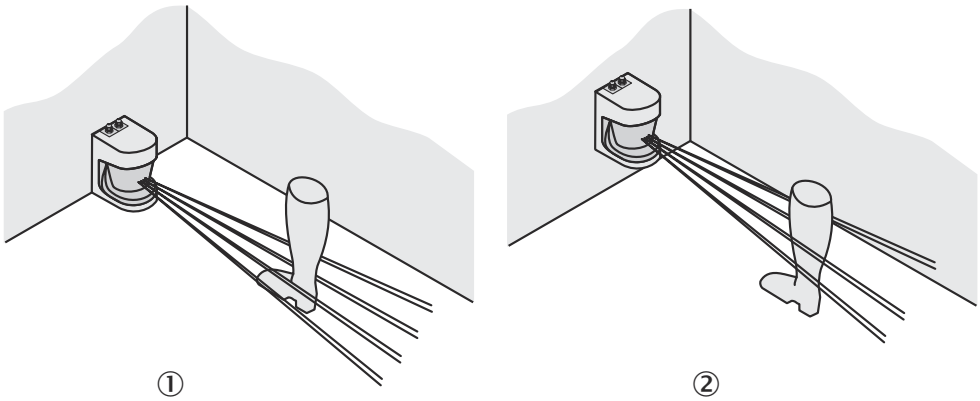


Figure 30: Relationship between resolution and protective field mounting height

If you select a resolution of 70 mm for hazardous area protection in the CDS, it may not be possible to detect a human leg under certain circumstances (e.g. scanning to the left and right of an ankle ①).

If you mount the safety laser scanner higher, the scan plane is at calf height and the leg is also detected when using an object resolution of 70 mm ②.

Further topics

- "Response times", page 116

4.3.5 Stationary vertical operation for access protection

Access protection can be used when access to the machine can be defined by physical means. In access protection applications, the device detects the entry of an entire body.

NOTE

- To ensure adequate access protection, a response time of ≤ 90 ms and a resolution of 150 mm or finer is required.
- To protect the protective device against inadvertent adjustment or manipulation, you must use the contour of the surroundings as a reference for the safety laser scanner.

Further topics

- "Using the contour as a reference", page 80

4.3.5.1 Minimum distance

Overview

For access protection, a minimum distance (S) must be maintained between the protective field and the hazardous area. This minimum distance ensures that the hazardous point can only be reached if the dangerous state of the machine has been stopped completely.

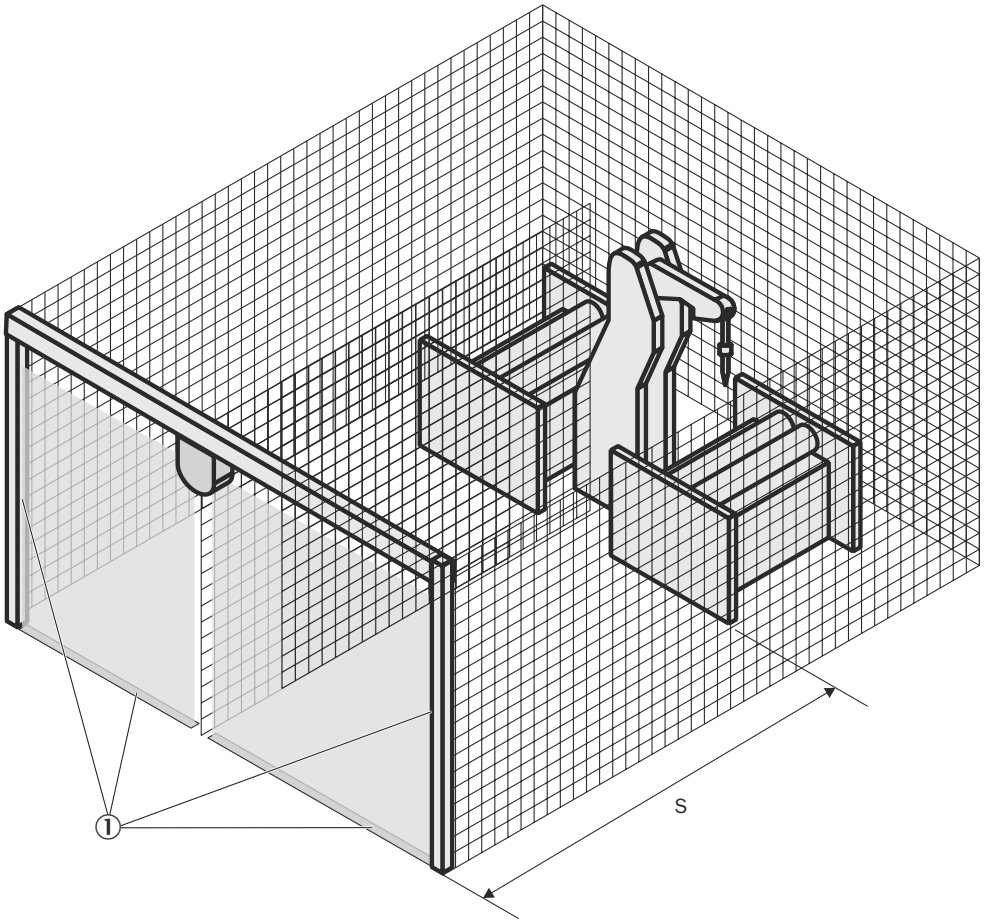


Figure 31: Access protection

① Contour of the floor and side panels as a reference

According to ISO 13855 and ISO 13857, the minimum distance S depends on the:

- Reach or approach speed
- Stopping time of the machine or system
  (The machine stopping/run-down time can be obtained from the machine documentation or must be determined by measurement. SICK Service can carry out a stop time measurement on your system on request.)
- Response time of the safety laser scanner
- Supplement C to prevent reaching through

Minimum distance S

Calculate the minimum distance S using the following formula (see ISO 13855):

► $S = (K \times (T_M + T_S)) + C$

where

- K = Approach speed (1,600 mm/s, defined in ISO 13855)
- T_M = Stopping time of the machine or system

- T_S = Response time of the safety laser scanner
- C = Supplement to prevent reaching over (850 mm)

Response time T_S of the safety laser scanner

DANGER
Ineffectiveness of the protective device

If a critical response time is exceeded (for an object diameter of 150 mm and speed of 1.6 m/s: 90 ms), a person may not be detected under certain circumstances.

The critical response time is exceeded if the basic response time is too high, possibly due to multiple sampling or the use of external OSSDs.

► For access protection, set the total response time of the safety laser scanner to no greater than 90 ms.

Higher response times may be permitted in specific applications if agreed with the responsible authority, e.g., if you increase the available detection time by mounting the safety laser scanner at an angle.

The response time T_S of the safety laser scanner depends on the:

- Basic response time of the safety laser scanner
- Set multiple sampling

Further topics

- "Response times", page 116

4.3.6 Stationary vertical operation for hazardous point protection

Hazardous point protection is necessary if the operator must remain near the dangerous state of the machine. For hazardous point protection, it is necessary to be able to detect hands. To provide hand protection, a resolution of 40 mm or finer is required.

DANGER
Ineffectiveness of the protective device

The device is not suitable for detecting fingers because the finest resolution available is 30 mm.

► Do not use the device for safety applications that require the detection of fingers.

To protect the protective device against inadvertent adjustment or manipulation, you must use the contour of the surroundings as a reference for the safety laser scanner.

Further topics

- "Using the contour as a reference", page 80

4.3.6.1 Minimum distance

Overview

For hazardous point protection, a minimum distance must be maintained between the protective field and the hazardous point. This minimum distance ensures that the hazardous point can only be reached once the dangerous state of the machine has been stopped completely.

For hazardous point protection, you can operate the safety laser scanner using a 30 mm or 40 mm resolution. For each resolution, you can select between a 60 ms and 120 ms response time. Due to the proximity to the hazardous point, it is usually only possible to use the shorter response time. The resolution and response time determine the maximum protective field range and the minimum distance to the hazardous point.

- If you select the 30 mm resolution, smaller objects are detected and the required minimum distance is smaller. The protective field range is smaller.
- If you select the 40 mm resolution, the required minimum distance is larger. The protective field range is larger, which makes this setting suitable for protecting larger hazardous points.

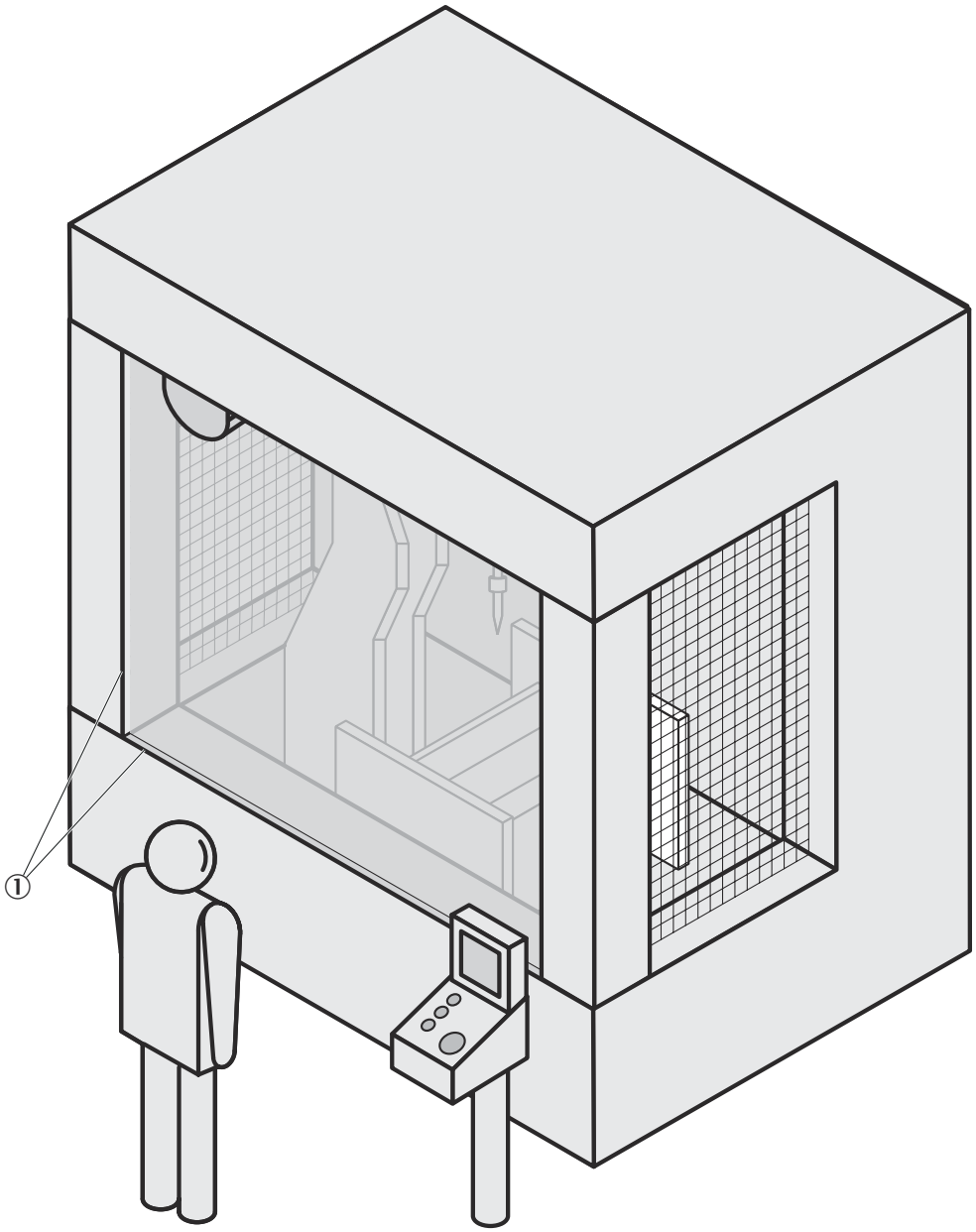


Figure 32: Minimum distance to hazardous area

① Contour of the floor and side panels as a reference

Important information

DANGER
Danger due to reaching around or reaching behind

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ► Mount the safety laser scanner so that it is impossible to reach around or behind.
- ► Take suitable additional measures if necessary.

Minimum distance S

According to ISO 13855 and ISO 13857, the minimum distance S depends on the:

- Stopping time of the machine or system. The machine stopping/run-down time can be obtained from the machine documentation or must be determined by measurement.
- Response time of the safety laser scanner
- Reach or approach speed
- Resolution of the safety laser scanner

Calculate the minimum distance S using the following formula (see ISO 13855):

- $S = 2{,}000 \times (T_M + T_S) + 8 \times (d - 14)$ [mm]

where

- S = Minimum distance [mm]
- T_M = Stopping time of the machine or system
- T_S = Response time of the safety laser scanner
- d = Resolution of the safety laser scanner [mm]

The reach or approach speed is already included in the formula.

- If the result is S ≤ 500 mm, use the calculated value as the minimum distance.
- If the result is S > 500 mm, you may be able to reduce the minimum distance using the following calculation:
  $S = 1{,}600 \times (T_M + T_S) + 8 \times (d - 14)$ [mm]
- If the new value is S > 500 mm, then use the newly calculated value as the minimum distance.
- If the new value is S ≤ 500 mm, then use 500 mm as the minimum distance.

Response time T_S of the safety laser scanner

The response time T_S depends on the:

- Basic response time of the safety laser scanner
- Set multiple sampling

Further topics

- "Response times", page 116

4.3.7 Mobile applications

If the dangerous state is produced by a vehicle (e.g., AGV or fork lift), the hazardous area that is produced by the movement of the vehicle is protected by the safety laser scanner.

NOTE

- The device must only be used to protect vehicles that are powered by an electric motor.
- Because the safety laser scanner itself is moving in a mobile application, a resolution of 70 mm is sufficient for detecting people.
- In the following calculations, only the vehicle speed is taken into account and not the speed of a walking person. This is based on the assumption that the person recognizes the danger and stands still.
- If the application is to protect vehicles from collisions, then it may be necessary to use different assumptions.

For a horizontally mounted mobile application, you determine the following:

- Protective field length
- Protective field width
- Height of the scan plane
- Restart behavior
- Measures to prevent unsecured areas

4.3.7.1 Protective field length

Overview

You must configure the protective field so that a minimum distance to the vehicle is upheld. This minimum distance ensures that a vehicle monitored by the safety laser scanner stops before a person or an object is reached.

NOTE

If you define several monitoring cases with different protective fields, and in particular if you switch between monitoring cases depending on the speed, you must calculate the protective field lengths for all protective fields used.

Protective field length S_L

Calculate the protective field length S_L using the following formula:

- $S_L = S_A + Z_G + Z_R + Z_F + Z_B$

where

- S_A = Stopping distance
- Z_G= General supplement = 100 mm
- Z_R = Supplement for a possible reflection-related measurement error of the safety laser scanner
- Z_F = Supplement for a possible lack of ground clearance of the vehicle
- Z_B = Supplement for the decreasing braking force of the vehicle as specified in the relevant vehicle documentation

Stopping distance S_A

The stopping distance comprises the vehicle's braking distance and the distance covered during the safety laser scanner's response time and the vehicle control's response time.

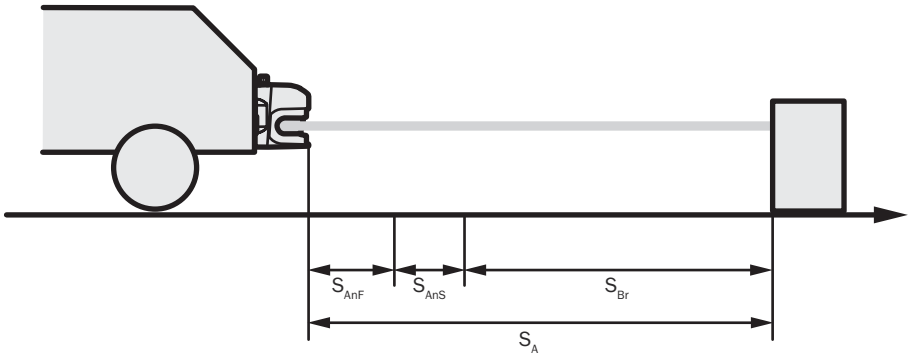


Figure 33: Stopping distance

NOTE

Please note that a vehicle's braking distance does not increase linearly with increasing speed, but rather in a squared relationship. This is particularly important if you switch between protective fields of different sizes depending on the speed determined by incremental encoders.

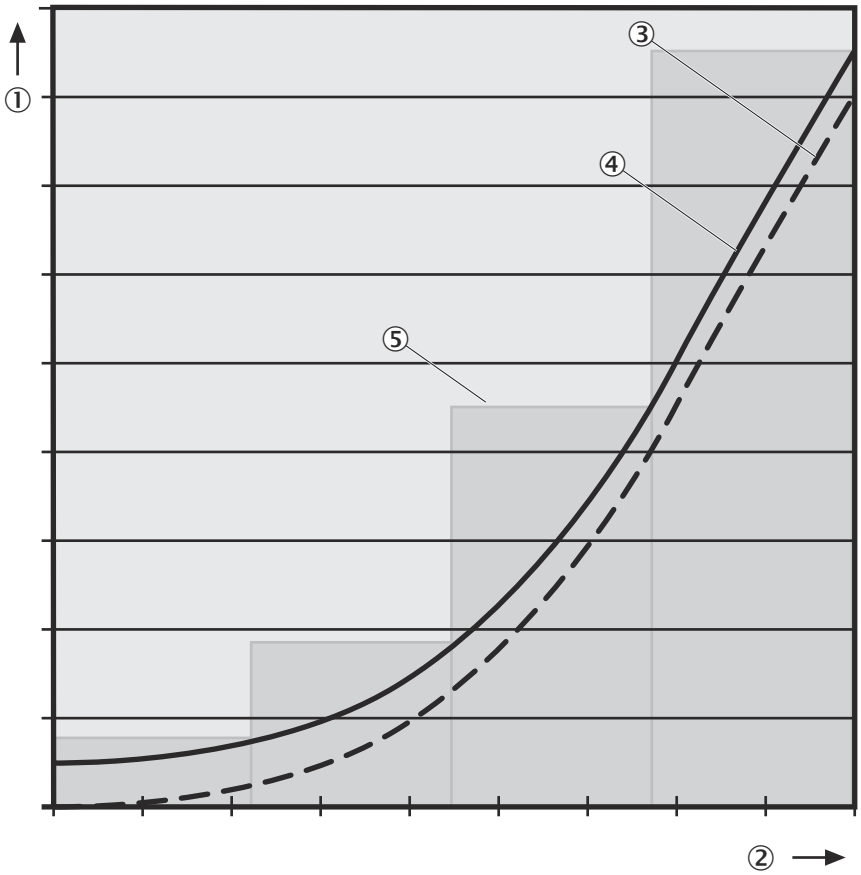


Figure 34: Stopping distance as a function of the vehicle's speed

① Stopping distance
② Speed
③ Stopping distance
④ Stopping distance + supplements
⑤ Required protective field length

Calculate the stopping distance S_A using the following formula:

- $S_A = S_{Br} + S_{AnF} + S_{AnS}$

where

- S_{Br}= Braking distance, which is specified in the vehicle documentation
- S_{AnF} = Distance covered during the response time of the vehicle controller, which is specified in the vehicle documentation
- S_{AnS} = Distance covered during the response time of the safety laser scanner

Distance covered during the response time of the safety laser scanner

The distance covered during the response time of the safety laser scanner depends on the following factors:

- Response time of the safety laser scanner
- Maximum speed of the vehicle in the mobile application

The response time T_S of the safety laser scanner depends on the following factors:

- Basic response time of the safety laser scanner
- Set multiple sampling

Calculate the distance S_{AnS} covered during the response time of the safety laser scanner using the following formula

- $S_{AnS} = T_S \times V_{max}$

where

- T_S = Response time of the safety laser scanner
- V_{max}= Maximum speed of the vehicle as specified in the relevant vehicle documentation

Supplement Z_R for reflection-related measurement errors

For retro-reflectors in the background less than 1 m from the protective field boundary, the supplement Z_R is 200 mm.

Supplement Z_F due to lack of ground clearance

This supplement is necessary, because, generally, a person is detected above the foot and the braking process cannot take account of the length of the foot in front of the point of detection. A person's foot could be injured if a vehicle has no ground clearance.

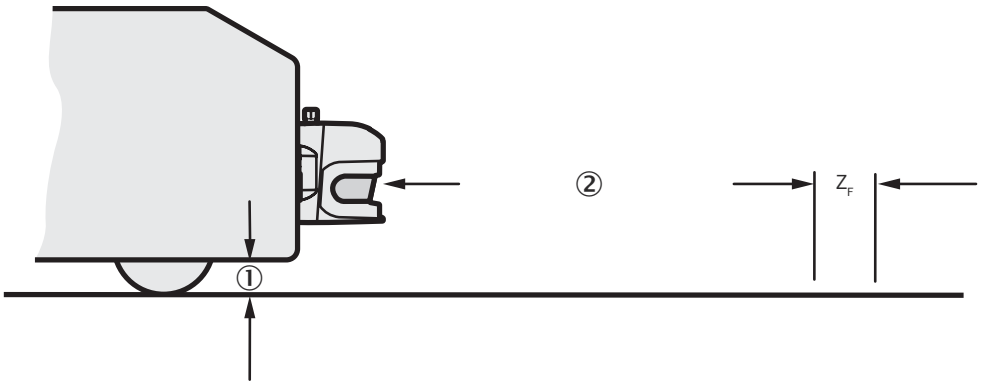


Figure 35: Supplement due to lack of ground clearance

① Ground clearance

② Protective field length

The lump supplement for ground clearance under 120 mm is 150 mm. This supplement may be reduced further in individual cases. The actual supplement required based on the ground clearance of the vehicle can be read from the following graph:

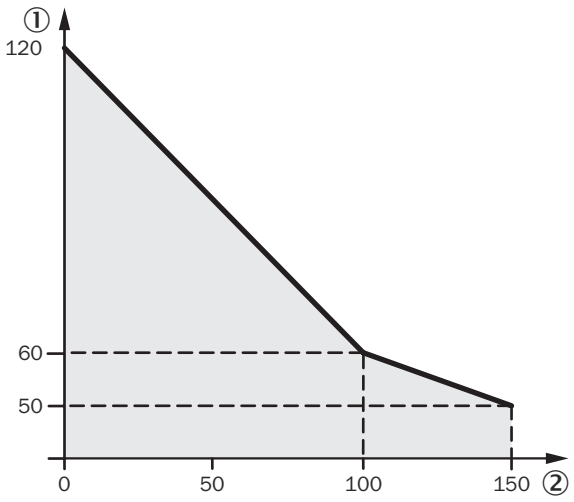


Figure 36: Vehicle ground clearance graph

① Ground clearance of the vehicle in mm

② Supplement Z_F in mm

Further topics

- "Response times", page 116

4.3.7.2 Protective field width

The width of the protective field must cover the width of the vehicle and take into account the supplements for the measurement errors and the lack of ground clearance.

Calculate the protective field width S_B using the following formula:

- $S_B = F_B + 2 \times (Z_G + Z_R + Z_F)$

where

- F_B = Vehicle width
- Z_G = General supplement = 100 mm
- Z_R = Supplement for a possible reflection-related measurement error of the safety laser scanner
- Z_F = Supplement for a possible lack of ground clearance of the vehicle

NOTE

The S3000 is normally mounted in the middle of the vehicle. If this is not the case, the protective field must be defined asymmetrically. The CDS displays the fields as they appear in the topview of the safety laser scanner. There must be supplements on the right and left of the vehicle.

4.3.7.3 Height of the scan plane

DANGER

Ineffectiveness of the protective device

Persons lying on the floor may not be detected.

► Mount the safety laser scanner so that the maximum scan plane height is 200 mm.

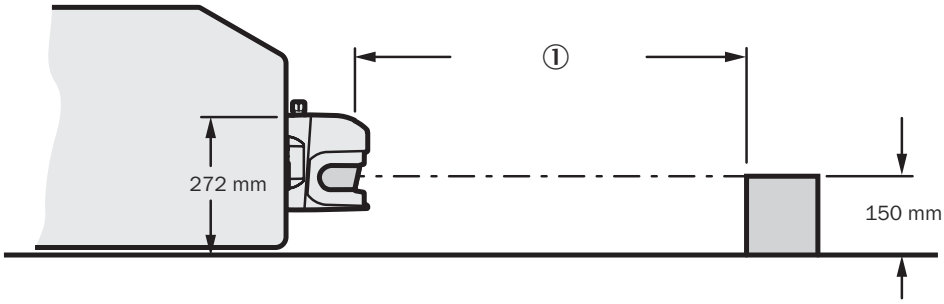


Figure 37: Fitting height

① Set protective field length

5 Mounting

5.1 Safety

Important information

WARNING
Ineffectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ► Do not do repair work on device components.
- ► Do not make changes to or manipulate device components.
- ► Apart from the procedures described in this document, the device components must not be opened.

WARNING
Dangerous state of the machine

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

- ► Make sure that there are no obstacles in the area to monitored which impair the field of view of the device or could cause movement shadows. The device cannot monitor such shadowed areas. If unavoidable shadowed areas exist, check whether they pose a risk. Implement additional protective measures if necessary.
- ► Keep the area to be monitored free of smoke, fog, vapor and other air impurities. No condensation must be allowed to form at the light emission window. The function of the device may otherwise be impaired, which can lead to unintended shutdowns.
- ► Avoid strongly reflective objects in the scan plane of the device. Example: Retro-reflectors can influence the measurement result of the device. Highly specular objects inside the protective field can blank part of the surface to be monitored in some cases.
- ► Mount the device in such a way that incident sunlight cannot dazzle it. Do not arrange stroboscope and fluorescent lights or other strong light sources directly on the scan plane since they can influence the device under certain circumstances.

NOTICE

- ► Mount the device in a dry location. Protect it from contamination and damage.
- ► Avoid installing the device near strong electrical fields. These fields can be caused, for example, by nearby welding cables, induction cables, or cell phones.

NOTE

- ► Mark the protective field on the floor if appropriate for the application.

Further topics

- "Project planning", page 25
- "Electrical installation", page 56
- "Configuration", page 63
- "Commissioning", page 86
- "Test notes", page 87

5.2 Mounting procedure

Overview

The origin of the scan plane is located 63 mm above the bottom edge of the device. When the device is mounted using mounting kit 3, the origin of the scan plane is located 102 mm above the bottom edge of mounting kit 3.

The device can be mounted in the following ways:

- Direct mounting without mounting kit
- Mounting using mounting kit 1
- Mounting using mounting kits 1 and 2
- Mounting using mounting kits 1, 2 and 3

The mounting kits build one on another. To mount the device using mounting kit 2, you will therefore also need mounting kit 1. To mount the device using mounting kit 3, you will also need mounting kits 1 and 2.

The installation orientation of the safety laser scanner is not crucial, i.e., the device can be mounted both at an angle or upside down.

Important information

WARNING
Ineffectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

► Make sure that the field of view of the device is not restricted.

WARNING
Ineffectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

► Prevent people from being able to crawl beneath, stand behind, or climb over the protective field by mounting the device appropriately.

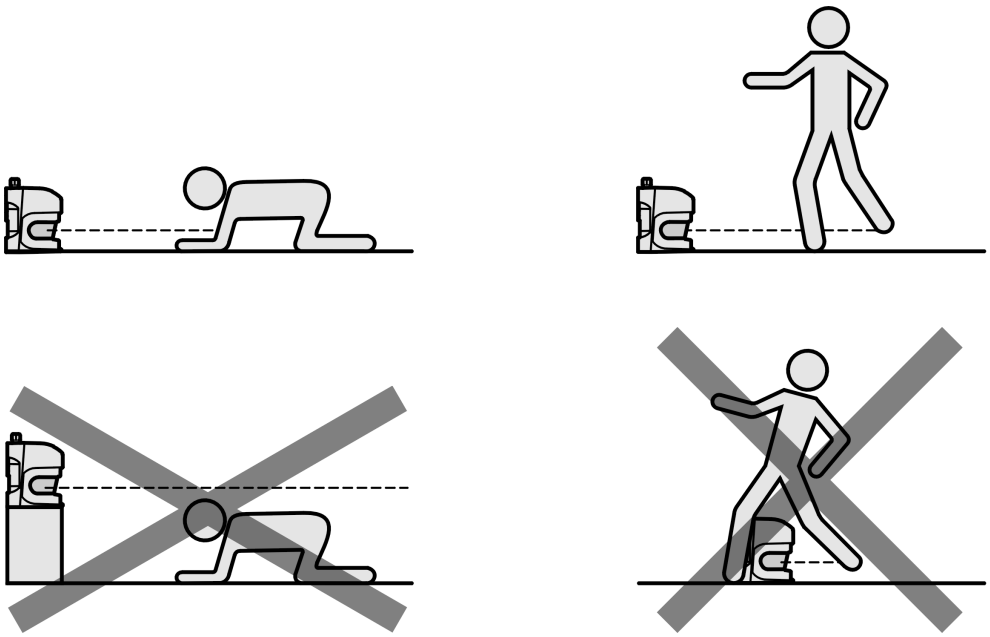


Figure 38: Prevent crawling beneath, standing behind, or climbing over

NOTE

- Mount the device so that it is protected from moisture, dirt, and damage.
- Mount the sensor so that the status indicators can be clearly seen.
- Always mount the device so that there is still enough space for mounting and dismantling the system connector.
- Avoid exposing the device to excessive shock and vibration.
- For systems that vibrate heavily, use shock absorbers to prevent the possibility of fixing screws unintentionally coming loose.
- Regularly check the tightness of the fixing screws.
- Observe the maximum permissible tightening torque for the fixing screws on the device:
  - M6 at the rear = max. 12 Nm
  - M8 side = max. 16 Nm

Further topics

- "Dimensional drawings", page 118

5.2.1 Direct mounting

The device has four M6 × 8 threaded holes on the rear. They can be used to mount the device directly if you are able to drill through the mounting surface from behind.

NOTE

The maximum permissible tightening torque of the threaded holes is 12 Nm.

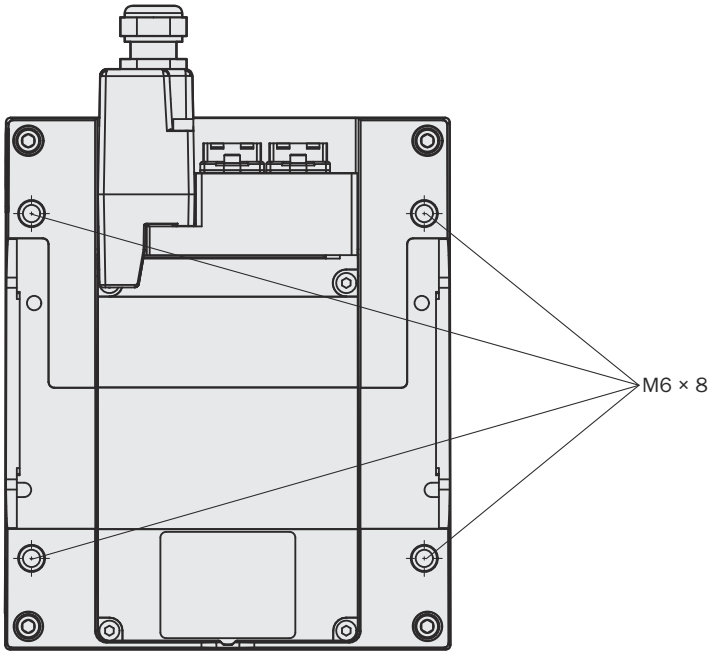


Figure 39: Threaded holes for direct mounting

NOTE
Use at least mounting kit 1. This will make the device easier to remove.

5.2.2 Mounting using mounting kit 1

Overview

You can use mounting kit 1 to mount the device indirectly on the mounting surface. This is always necessary if you cannot drill through the mounting surface from the rear.

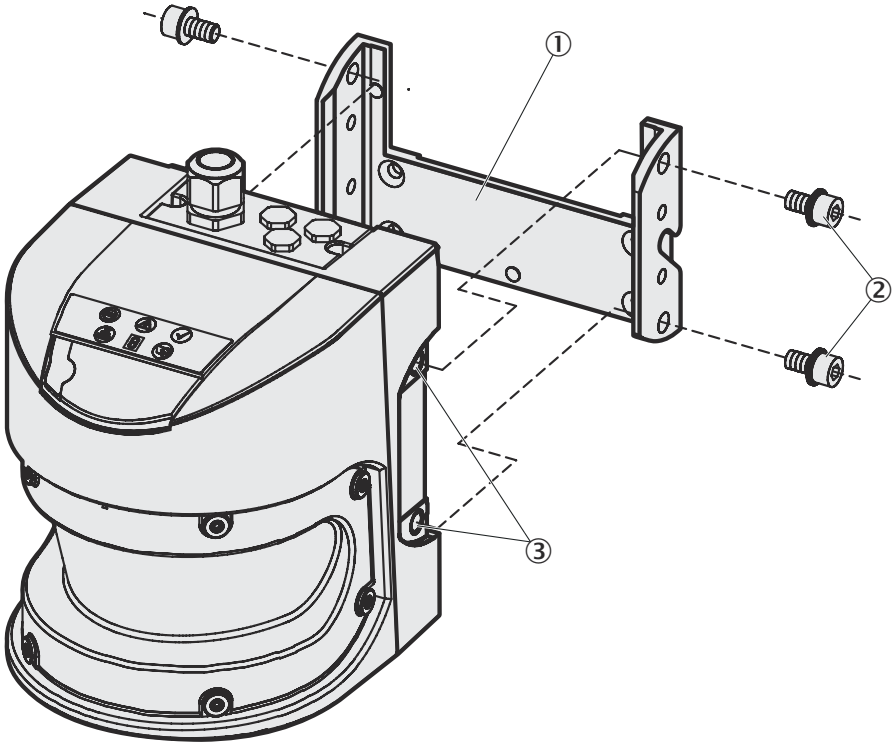


Figure 40: Mounting using mounting kit 1

① Mounting kit 1
② Fixing screws
③ Threaded mounting holes M8×9

Procedure

1. Mount kit 1 on the mounting surface.
2. Mount the safety laser scanner on mounting kit 1.

NOTE
Observe the maximum permissible tightening torque of 16 Nm for the M8 × 9 threaded mounting holes.

5.2.3 Mounting using mounting kit 2

Overview

You can use mounting kit 2 (only in conjunction with mounting kit 1) to align the device in 2 planes. The maximum adjustment angle is ± 11° in both planes.

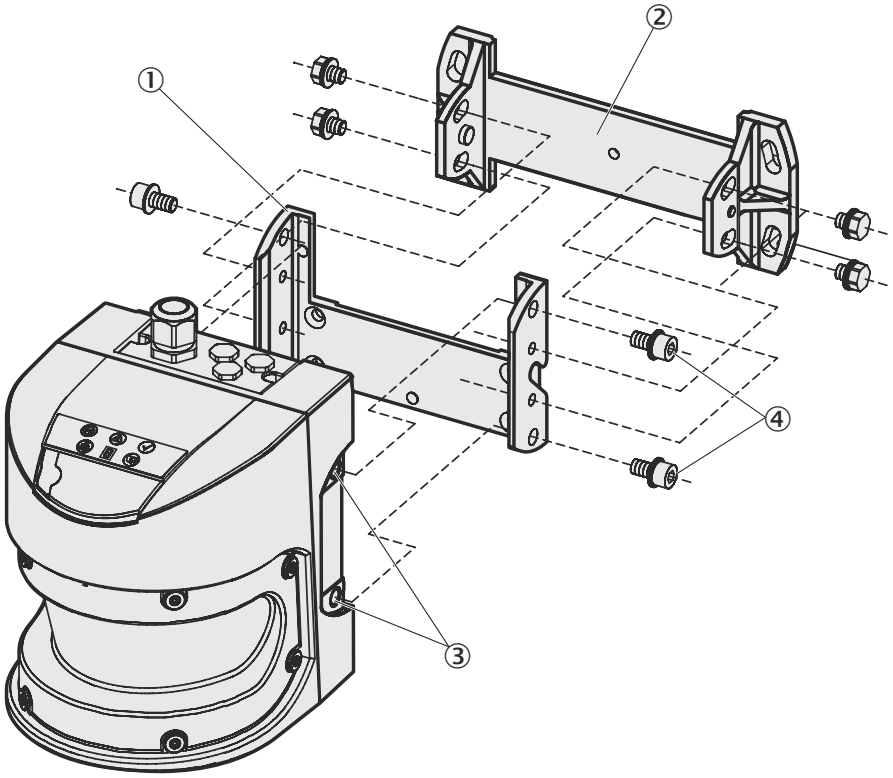


Figure 41: Mounting using mounting kit 2

① Mounting kit 1
② Mounting kit 2
③ Threaded mounting holes M8×9
④ Fixing screws

Procedure

1. Mount kit 2 on the mounting surface.
2. Mount kit 1 on mounting kit 2.
3. Mount the safety laser scanner on mounting kit 1.

NOTE
Observe the maximum permissible tightening torque of 16 Nm for the M8 × 9 threaded mounting holes.

4. Adjust the safety laser scanner along the longitudinal and transverse axis.

5.2.4 Mounting using mounting kit 3

Overview

You can use mounting kit 3 (only in conjunction with mounting kit 1 and 2) to mount the device so that the scan plane is parallel to the mounting surface. This enables, for example, stable floor mounting or ensures that mounting kit 2 remains precisely adjustable crosswise on uneven wall surfaces.

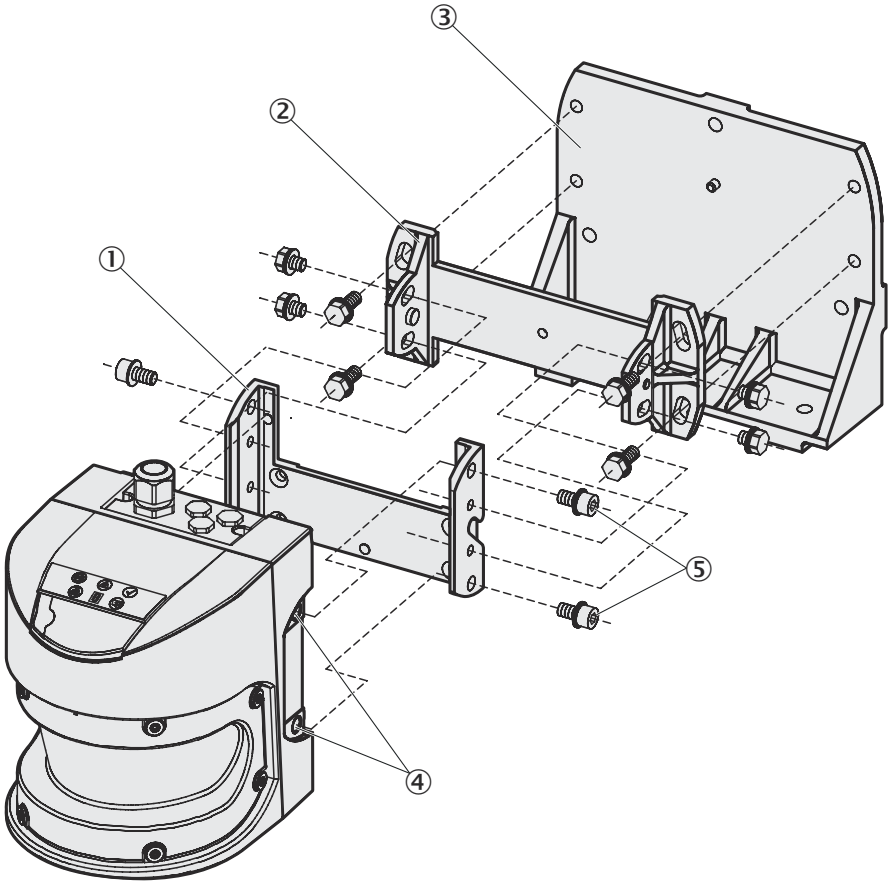


Figure 42: Mounting using mounting kit 3

① Mounting kit 1
② Mounting kit 2
③ Mounting kit 3
④ Threaded mounting holes M8×9
⑤ Fixing screws of the S3000

Procedure

1. Mount kit 3 on the mounting surface.
2. Mount kit 2 on mounting kit 3.
3. Mount kit 1 on mounting kit 2.
4. Mount the safety laser scanner on mounting kit 1.

NOTE
Observe the maximum permissible tightening torque of 16 Nm for the M8 × 9 threaded mounting holes.

5. Adjust the safety laser scanner along the longitudinal and transverse axis.

NOTE
When mounting the device, observe the dimensional drawings.

Further topics

- "Dimensional drawings", page 118

5.2.5 Mounting using the heavy duty mounting adapter

You can use the heavy duty mounting adapter to mount the device so that the scan plane is between 100 mm and 350 mm above the ground. The mounting adapter allows you to align the device in 3 planes. The maximum adjustment angle is ± 5° or ± 9°.

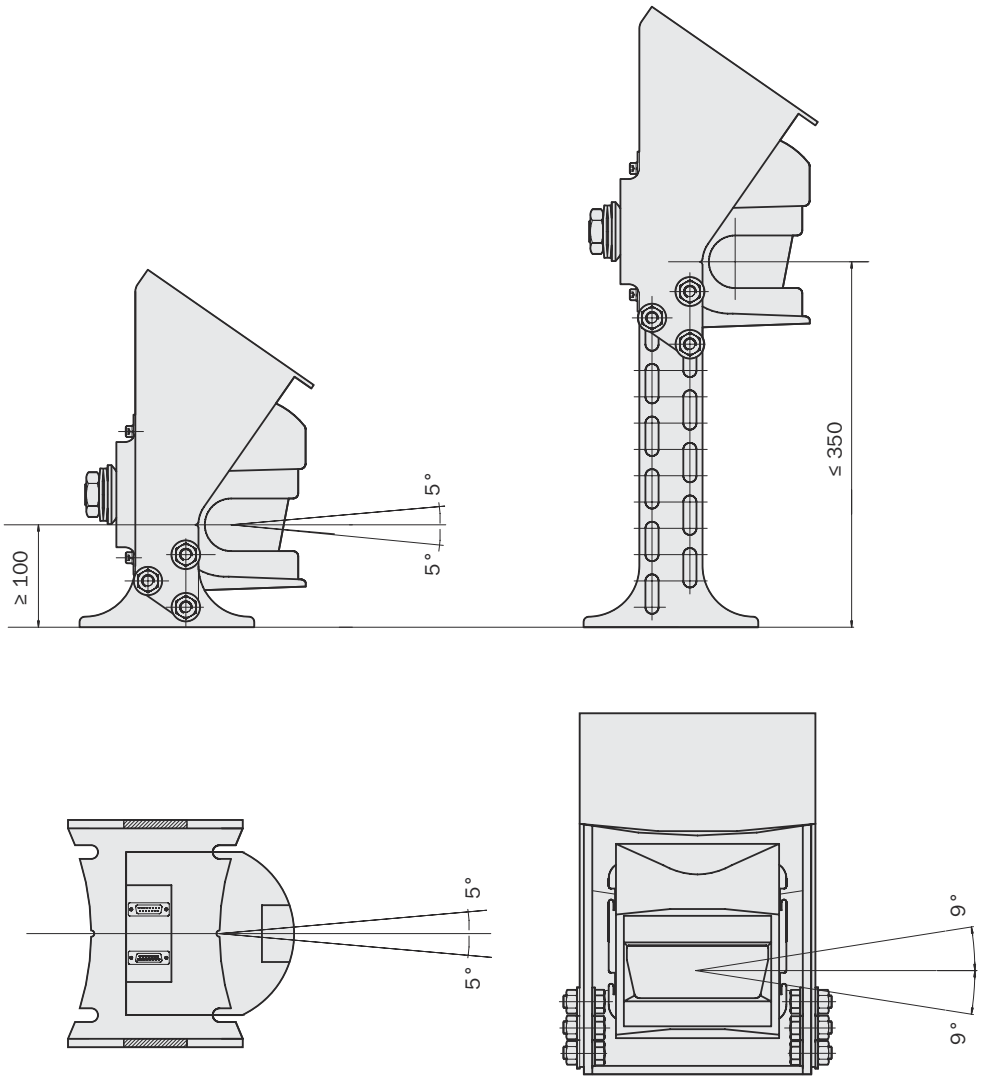


Figure 43: Mounting using heavy duty mounting adapter

5.2.6 Important notes information label

► After mounting the device, affix the supplied self-adhesive **Important notes** information label.

NOTE

- Use only the information label in the language that the operators of the machine can read and understand.
- Affix the information label so that it is clearly visible to all operators during operation of the system. After attaching additional objects and equipment, the information label must not be concealed from view.

6 Electrical installation

6.1 Safety

DANGER
Hazard due to unexpected starting of the machine

- ► Make sure that the entire system is disconnected from the voltage supply during all electrical installation work to prevent an unintentional start-up.

NOTE

- ► Lay all cables and connecting cables so that they are protected from damage.
- ► If you are using the safety laser scanner to protect hazardous areas: Make sure that the connected controller and all devices responsible for safety also comply with the required category according to ISO 138491 and the required performance level according to ISO 13849.
- ► If you are using shielded cables, connect the shield over a large area.
- ► Make sure that the safety laser scanner is provided with appropriate electrical fuse protection.

NOTE

- The power supply unit must be able to bridge a power failure of 20 ms.
- The power supply unit must provide safe isolation (SELV/PELV). Suitable power supply units are available as accessories from SICK.

Further topics

- "Data sheet", page 108

6.2 Pin assignment

Overview

The S3000 PROFINET IO/IO-OF is installed electrically using the power supply plug and using the two RJ45 or SCRJ female connectors.

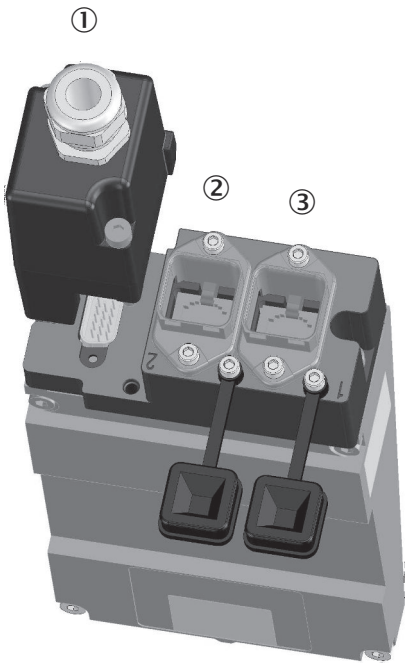


Figure 44: System connection for RJ45

① Power supply plug
② RJ45 female connector 2
③ RJ45 female connector 1

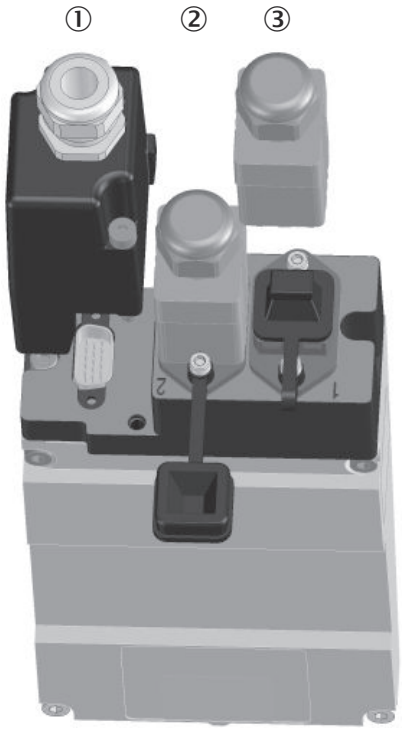


Figure 45: System connection for SCRJ (optical fiber)

① Power supply plug
② SCRJ female connector 2
③ SCRJ female connector 1

NOTE

- All inputs and outputs of the device must be used only in the specified manner.
- With the push-pull plug connected the connection complies with enclosure rating IP65.
  - RJ45: e.g., Phoenix VS-PPC-C1-RJ45-MNNA-PG9-4Q5, part number: 1608100
  - SCRJ: e.g., Phoenix VS-PPC-C1-SCRJ-MNNA-PG9-A4D-C, part number: 1608032
- With the supplied cover, the connection complies with enclosure rating IP65.

Wiring in accordance with EMC regulations

The quality of the shield is essentially dependent on the quality of the connection of the screen. In general, the best shielding effect can only be achieved by applying the screen at both ends using large area connections.

► If it is not possible to connect the screen via threaded fittings (e.g. on bus nodes), connect the screen physically close to the device using a metal clamp, e.g., to a control cabinet chassis.

NOTE

- If there is a protection earth (PE) in an installation, it can be used to connect the functional earth (FE). A functional earth connection (FE) must never be used as a protection earth (PE), however.

Functional earth

To achieve the specified EMC safety, the functional earth (FE) must be connected, e.g., to the central earth star point of the vehicle or system.

Since the safety laser scanner has no separate functional earth connection (FE), the functional earth must, if necessary, be connected to the housing.

6.2.1 Voltage supply

The power is supplied via the power supply plug.

NOTICE

A too high voltage supply may damage the device.

► Make sure that the external 24 V supply voltage does not exceed 40 V (SELV or PELV).

The power supply plug is available in the following variants:

- With terminals
- Pre-assembled, with open cable ends
- Pre-assembled, with cable and external Y-distribution. This power supply plug corresponds to a standardized push-pull power connector (industry standard).

Power supply plug with terminals

► Route the connecting cables through the cable entry into the connector housing.

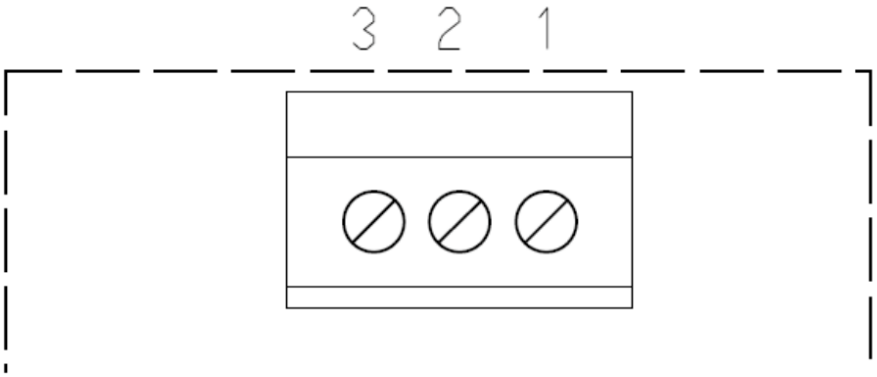


Figure 46: Terminals on the power supply plug

Table 8: Terminal assignment on the power supply plug

Terminal	Signal	Function	Wire color for pre-assembled power supply plug with flying leads
1	24 V DC	Supply voltage	1
2	–	Reserved	–
3	0 V DC	Supply voltage	2

6.2.2 Network connection using a RJ45 push-pull male connector

To connect the device to the network, you need to use push-pull male connectors with a metal housing. With the push-pull plug connected, the connection complies with enclosure rating IP65 (e.g., Phoenix VS-PPC-C1-RJ45-MNNA-PG9-4Q5, part number: 1608100).

With the supplied cover, the connection complies with enclosure rating IP65.

If the network is not connected to a further network subscriber, then a connection using a single male connector is sufficient. It does not matter which of the two female connectors is used. The unused female connector must always be protected with the supplied cover (see figure 44).

Figure 47: RJ45 push-pull male connector (not included with delivery)

Table 9: Pin assignment on the RJ45 female connectors

Pin	Signal	PROFINET IO colors
1	TX+	Yellow
2	TX–	Orange
3	RX+	White
4	–	Do not use
5	–	Do not use
6	RX–	Blue
7	–	Do not use
8	–	Do not use

6.2.3 Network connection using SCRJ push-pull male connector (optical fiber)

To connect the device to the network, you need to use push-pull male connectors with a metal housing. With the push-pull plug connected, the connection complies with enclosure rating IP65 (e.g., Phoenix VS-PPC-C1-SCRJ-MNNA-PG9-A4D-C, part number: 1608032).

With the supplied cover, the connection complies with enclosure rating IP65.

If the network is not connected to a further network subscriber, then a connection using a single male connector is sufficient. It does not matter which of the two female connectors is used. The unused female connector must always be protected with the supplied cover (see figure 45).

Figure 48: SCRJ push-pull male connector (not included with delivery)

NOTE

- If you are not using any optical adapters, the maximum allowed cable length to the next device is 50 meters.
- The maximum allowed line attenuation for the transmission link is 12 dB.

► Observe the mounting and wiring instructions of the manufacturer of the plug connectors and cables, in particular with regard to the number of bending radiuses.
► Minimize the number of plug connectors in a connecting cable, ideally to only two: one at the S3000 PROFINET IO/IO-OF and another one at the FPLC.
► Once the electrical installation is completed, determine the signal reserve of the connection cable using the CDS diagnostic function.
► To obtain a signal reserve of > 4 dB, use low attenuation cables and plug connectors.

6.3 M8 × 4 configuration connection (serial interface)

Configuration is normally performed via PROFINET IO. The S3000 PROFINET IO/IOOF provides a local RS232 configuration connection ① for configuration and diagnostics directly on the device.

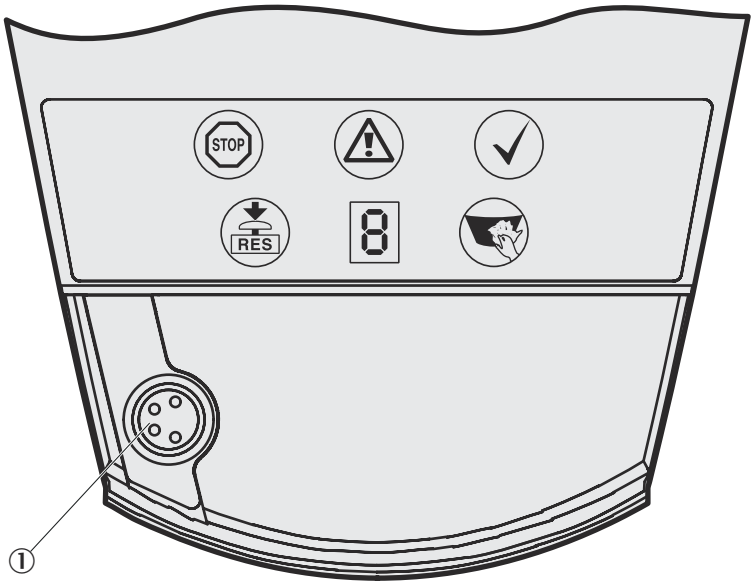


Figure 49: Local configuration connection

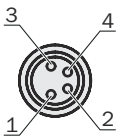


Figure 50: Pin assignment on the M8 × 4 configuration connection

Table 10: Pin assignment on the M8 × 4 configuration connection

Pin	Safety laser scanner	PC-side RS232 DSub
1	Reserved	Not assigned
2	RxD	Pin 3
3	0 V DC input (power supply)	Pin 5
4	TxD	Pin 2

NOTE

- ► Pull the connection cable out of the configuration connection after configuration.
- ► After the device has been configured, plug the protective cap fastened to the device back into the configuration connection.

7 Configuration

7.1 Delivery state

On delivery, the safety laser scanner is in a safe state.

- The operational status of the safety laser scanner is **Waiting for configuration**.
- The 7-segment display shows 6.

7.2 CDS

You will require a CDS (Configuration & Diagnostic Software) to configure and diagnose these devices.

Procedure

1. Open the download web page by entering **CDS** in the search field on www.sick.com.
2. Take note of the system requirements on the download page.
3. Download the installation file from the download page. Extract it and run it.
4. Follow the notes from the setup assistant.

7.3 Preparing the configuration

Overview

All available parameters can be configured using the CDS (Configuration & Diagnostic Software). The field geometries for the protective fields and warning fields can also be defined in the CDS.

There are two options for connecting the CDS to the device:

- Local device connection
- Network

The connection to the local configuration and diagnostics connection is made using a service cable that is available as an accessory.

Configuration via the network is only possible after the PROFINET configuration. The CDS is opened using TCI in the hardware configuration in the network engineering tool.

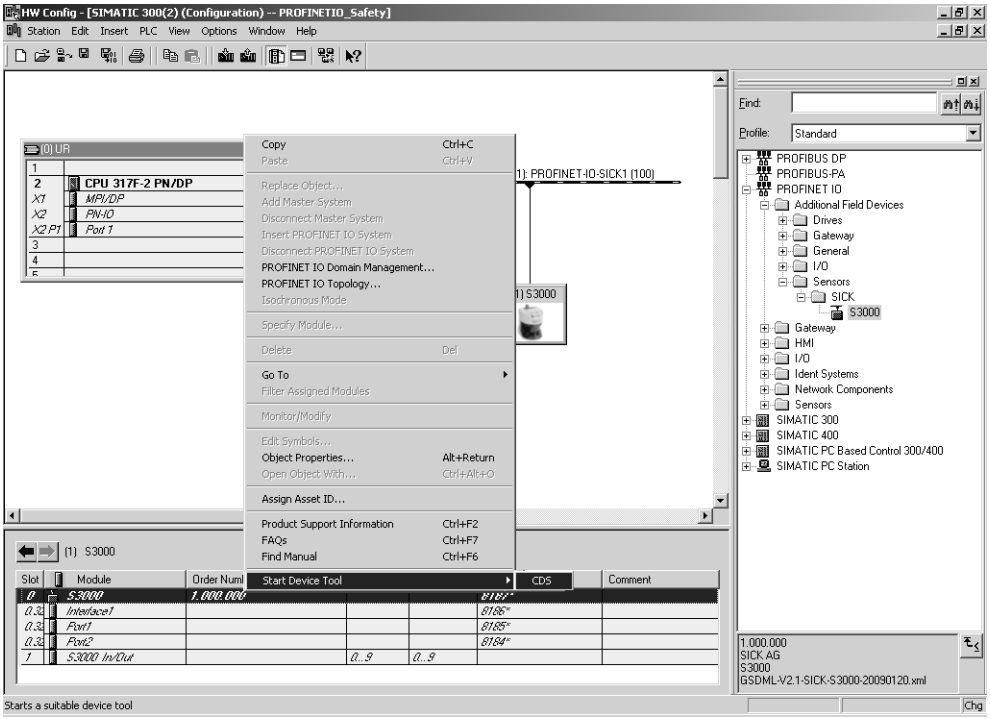


Figure 51: Example for opening the CDS using TCI

NOTE

How to prepare the configuration using a local device connection is described below.

Prerequisites

- The safety laser scanner has been correctly mounted and the electrical connections are in place.
- The necessary tools are at hand.
- Current version of the CDS
- Service cable for connecting the PC and safety laser scanner (not included with delivery)

Procedure

► To configure and diagnose the device using the CDS, connect the PC to the configuration connection of the safety laser scanner ①.

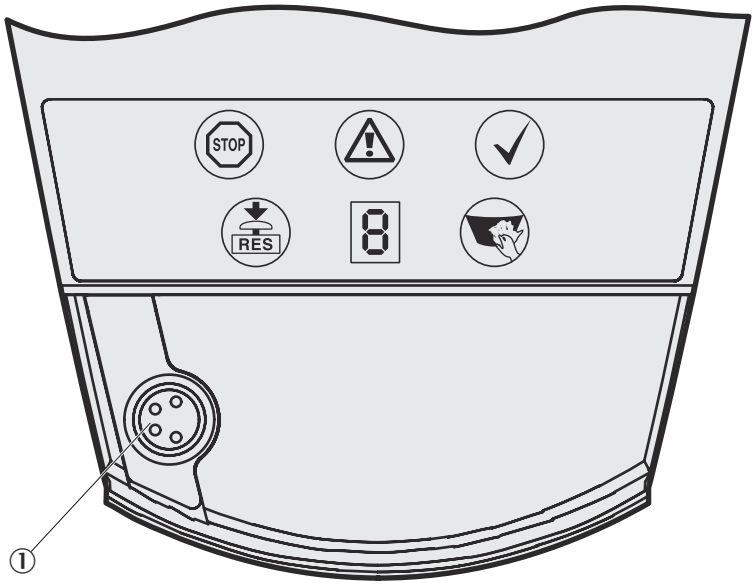


Figure 52: Configuration connection

Complementary information

NOTE

- Two service cables of different lengths are available for connecting the PC or notebook to the safety laser scanner (accessory available from SICK).
- Make sure that the service cable is not laid close to powerful electrical drives or cables carrying high currents. This will avoid EMC effects on the service cable.
- The service cable must only be connected for configuration and diagnostics. The service cable must be plugged in and the protective cap attached during operation.

NOTE

- For more information on configuration, see the online help of the CDS (Configuration & Diagnostic Software).
- You can use the password function in the CDS to protect the configuration settings from unauthorized access if you store the passwords in such a way that they too are protected from unauthorized access.

7.4 PROFINET IO network

An MRP domain and a NameOfStation must be named as per the PNO specification V2.3.

You should therefore observe the following naming convention when configuring your PROFINET IO network:

- The identifier comprises one or more words. These words are separated using a [.].
- The total length of the identifier is 1 to 240 characters.
- The word length is 1 to 63 characters.

- The identifier uses the following syntax:
  - Words comprise [a-z0-9-].
  - Words do not start with [-].
  - Words do not end with [-].
  - The first word must not have the form port-xyz or port-xyz-abcde (a, b, c, d, e and x, y, z = 0 ... 9).
  - Identifiers must not have the form n.n.n.n (n = 0 ... 999).

Additionally, you should observe the following when naming an MRP domain:

- The total length of the identifier must be 3, 7, 11, 15, 19, ... characters.

7.5 Configuring PROFINET IO

You can find an application and programming example for configuring the S3000 PROFINET IO/IO-OF and an FPLC under the respective part number in the download area at www.sick.com.

7.5.1 Reading the generic station description (GSDML)

Overview

Before you can configure PROFINET IO for the first time for the S3000 PROFINET IO/IO-OF, you must add the generic station description (GSDML [2)]) for the S3000 PROFINET IO/IO-OF to the hardware catalog in the network engineering tool, e.g., the SIMATIC Manager (Siemens) for PROFINET IO.

Procedure

1. On the web page www.sick.com, enter the part number in the search field and download the GSDML file.
2. To load the generic station description file, follow the instructions in the online help or in the user manual of the network engineering tool.

✓ The S3000 PROFINET IO/IOOF now appears in the hardware catalog in the network engineering tool under **PROFINET IO** > **Additional Field Devices** > **Sensors** > **SICK**.

2) GSDML = Generic station description based on XML.

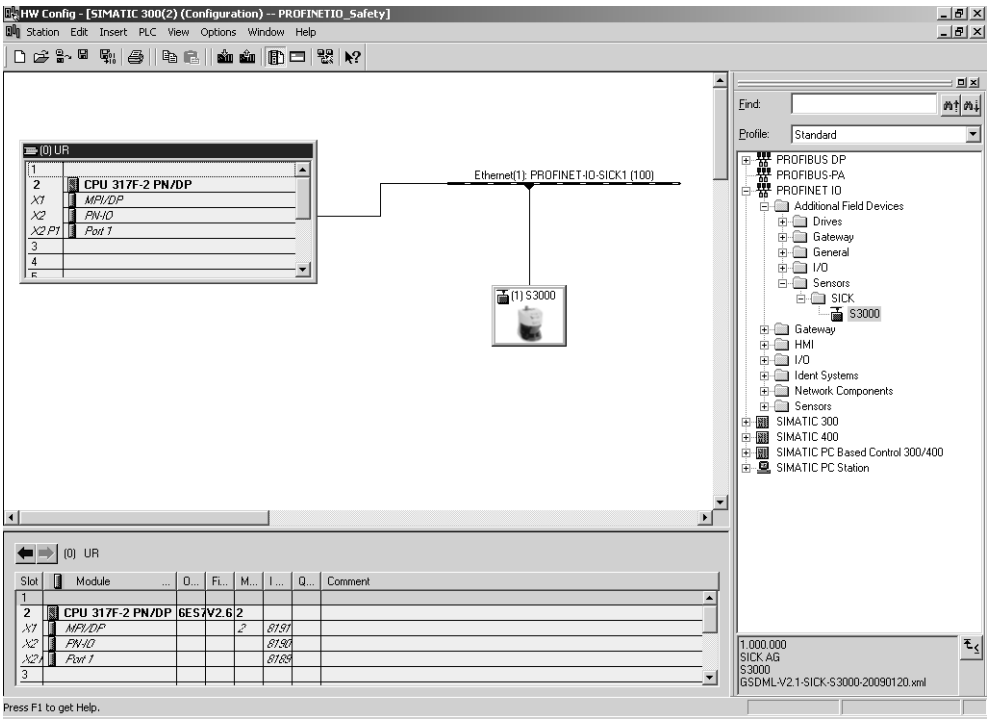


Figure 53: S3000 PROFINET IO/IO-OF in the hardware catalog

7.5.2 Configuring users

Overview

Every PROFINET IO field device, e.g., the S3000 PROFINET IO/IO-OF has a dedicated MAC address. You will find the MAC address for the S3000 PROFINET IO/IO-OF on the sticker on the rear of the I/O module (e.g., 00:06:77:02:00:A7).

In addition, a PROFINET IO field device requires a unique, system-specific device name. The IO controller uses the device name to determine the IP address of the field device.

The IP address is defined in two steps:

- You use the device name assigned to the S3000 PROFINET IO/IO-OF by the network engineering tool, or you configure a unique system-specific device name using the network engineering tool (e.g., SIEMENS SIMATIC Manager).
- The IO controller assigns the IP address based on the device name.

Procedure

To define the name of the S3000 PROFINET IO/IO-OF if necessary:

1. Double-click the symbol for S3000 PROFINET IO/IO-OF in the network engineering tool.

✓ The **Properties** dialog box opens.

2. Select the **General** tab.
3. Enter the device name for the S3000 PROFINET IO/IO-OF.
4. Assign a new IP address.

NOTE

The device name and IP address must match the settings in the CDS.

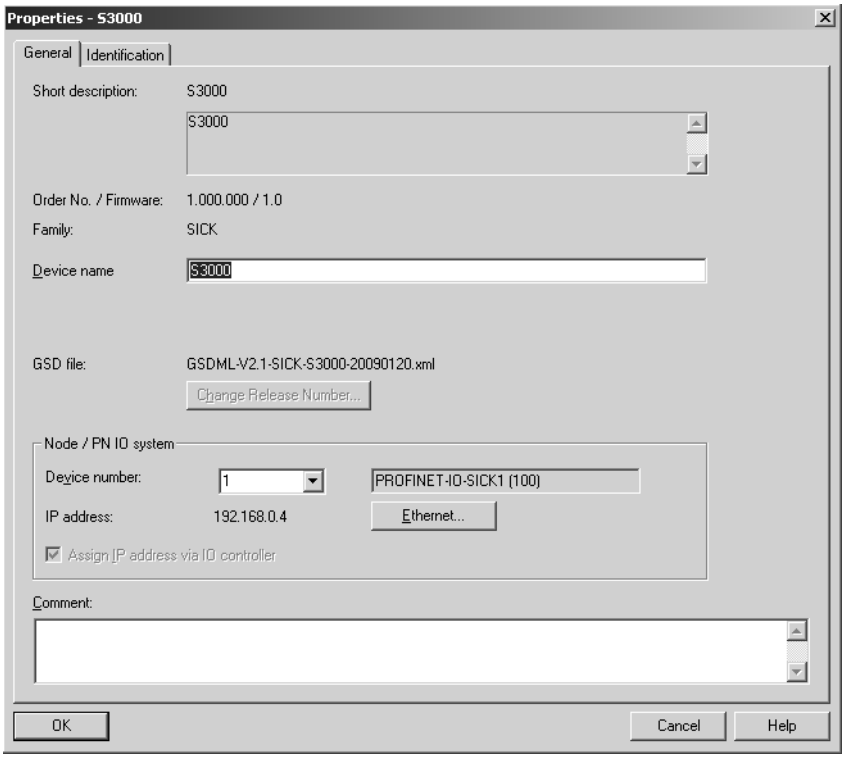


Figure 54: Properties of the S3000 PROFINET IO/IO-OF

7.6 Configuring PROFIsafe

Procedure

1. In the slots area in the network engineering tool, select the **Object properties** command in the context menu.

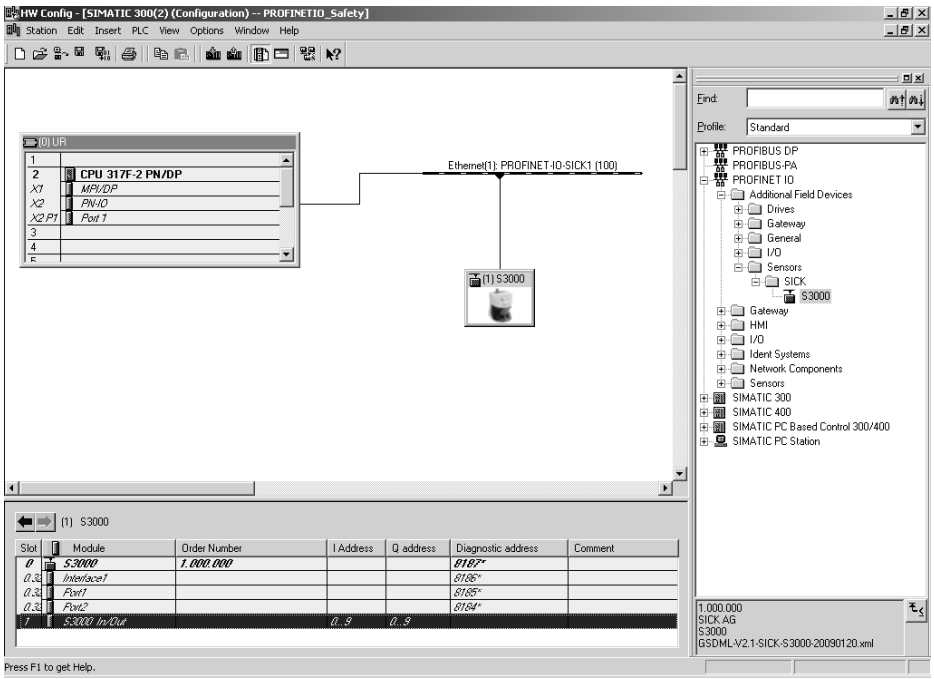


Figure 55: PROFIsafe configuration, step 1

2. On the **PROFIsafe** tab, configure the parameters for the S3000 PROFINET IO/IO-OF.

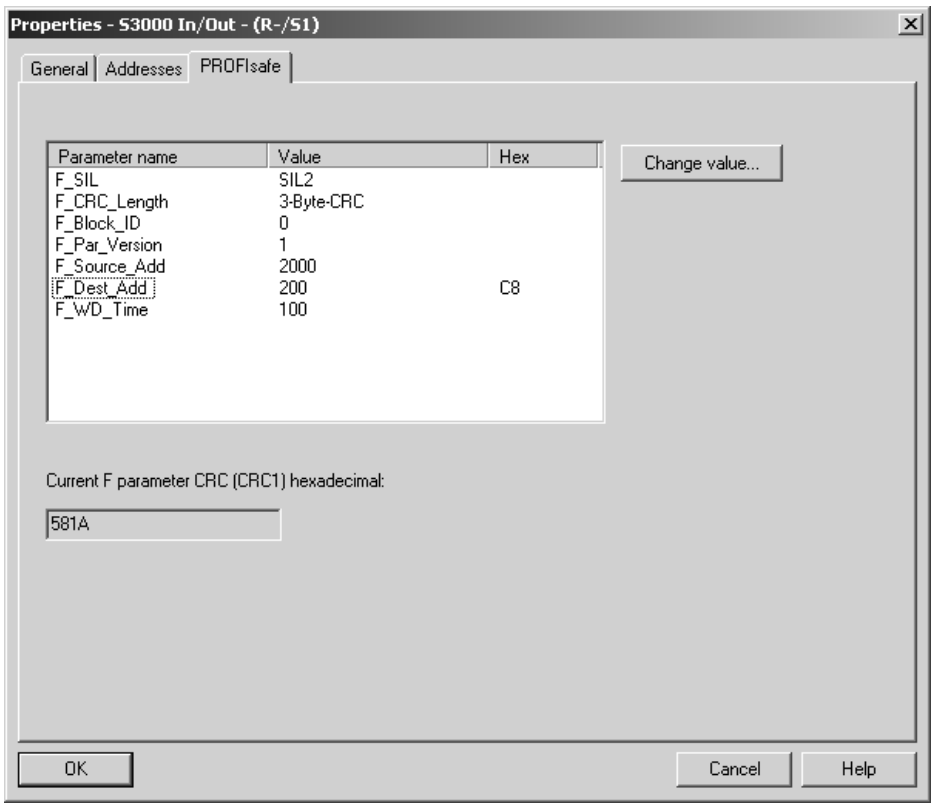


Figure 56: PROFIsafe configuration, step 2

NOTE
The parameters are described in table 11.

Complementary information

Table 11: PROFIsafe parameters for the S3000 PROFINET IO/IOOF

Parameter	Meaning	Setting
F_SIL	Safety integrity level (NoSIL, SIL1 or SIL2) of the S3000 PROFINET IO/IO-OF	Depends on the application
F_CRC_Length	Expected length of the CRC checksum in the PROFIsafe telegram	3-byte CRC [1)]
F_Block_ID	This parameter is set to 1 to indicate that the data set for the value of F_iPar_CRC is extended by 4 bytes. You must not change this parameter.	0
F_Par_Version	Implemented PROFIsafe version. You cannot change this parameter.	1
F_Source_Add	PROFIsafe source address. Must be unique in combination with the PROFIsafe destination address and is assigned automatically.	1 to 65,534
F_Dest_Add	PROFIsafe destination address. Must be unique in combination with the PROFIsafe source address and is assigned automatically. • The PROFIsafe address for the S3000 PROFINET IO/IO-OF must match this value. ► Enter the default value for the F_Dest_Add parameter using CDS (see figure 57, page 71).	1 to 65,534

Parameter	Meaning	Setting
F_WD_Time	Monitoring time (“Watchdog time”) for the cyclic service. If no valid PROFIsafe telegram is exchanged between the S3000 PROFINET IO/IO-OF and the FPLC within the set monitoring time, both will proceed to the safe status, i.e., they assign themselves failsafe values. The monitoring time should be sufficiently long to tolerate minor delays in communication. In the event of an error however, it must not unnecessarily delay the system response of the S3000 PROFINET IO/IO-OF or that of the FPLC.	From 1 to 65,535 ms, depending on the application

1) Cannot be changed.

Further topics

- "Setting the PROFIsafe address on the S3000 PROFINET IO/IO-OF", page 70

7.6.1 Setting the PROFIsafe address on the S3000 PROFINET IO/IO-OF

Overview

To be able to operate the device as a PROFIsafe user, it must have a PROFIsafe address. The PROFIsafe address must match the corresponding setting in the FPLC network engineering tool.

Procedure

1. Open the PROFIBUS configuration for the bus node in the network engineering tool.
2. Read the value of the **F_Dest_Add** parameter.
3. In the CDS, navigate through the following path: device symbol **S3000 PROFINET IO**, in the context menu **Configuration draft**, **Edit**, **General** tab, **PROFIsafe address (F_Dest_Add)** option.
4. Use the CDS to set the value read as the PROFIsafe address in the configuration for the S3000.

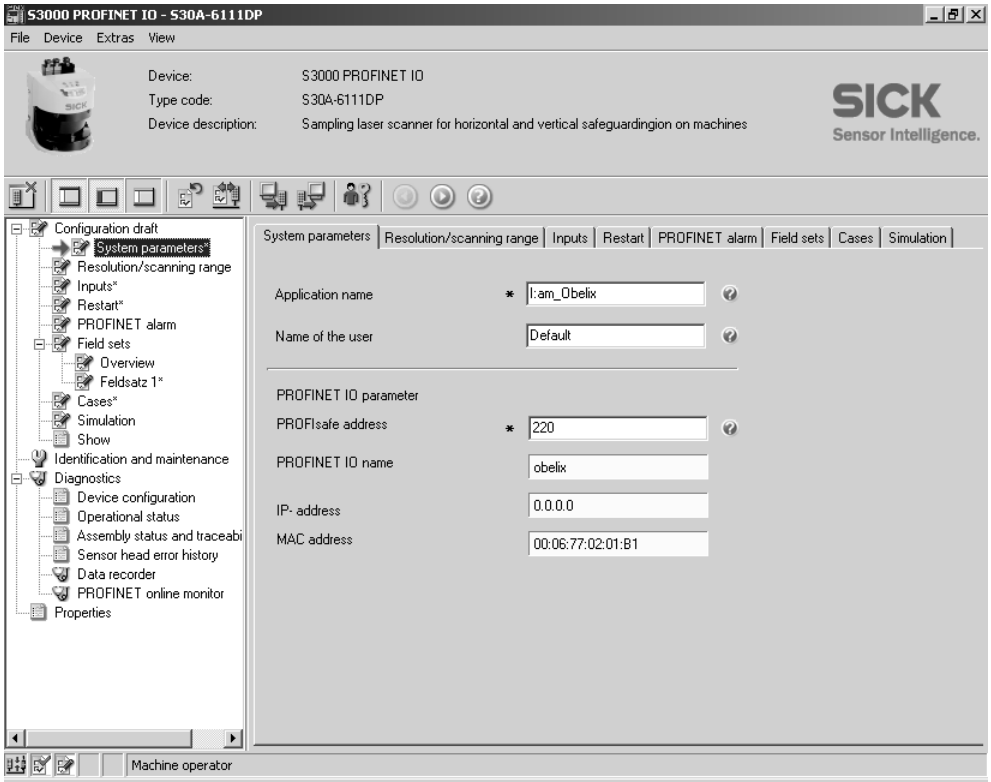


Figure 57: Corresponding parameter in the CDS

7.6.2 Passivation and reintegration of the S3000 PROFINET IO/IO-OF

Passivation

After establishing the communication link from the S3000 PROFINET IO/IO-OF to the fail-safe control, the S3000 PROFINET IO/IO-OF is in the passive state.

The safety laser scanner is also placed in this state after the following events:

- In case of errors in the safety-related communication (communication error) between F-CPU and S3000 PROFINET IO/IO-OF via the safety protocol as per PROFIsafe
- In case of F peripheral/channel errors (e.g., wire break, short-circuit)
- If the F peripheral has been rendered passive in the fail-safe control

If the S3000 PROFINET IO/IO-OF is in the passive state, then the S3000 PROFINET IO/IO-OF must be reintegrated.

Reintegration of the S3000 PROFINET IO/IO-OF

The reintegration of a S3000 PROFINET IO/IO-OF into the fail-safe control system, i.e., the provision of process values, is generally automatic. Depending on the cycle time for the F process group and the PROFINET IO, the reintegration may take a few cycles of the F process group in certain circumstances.

If the establishment of the communication between F-CPU and F peripheral takes longer than the monitoring time set, automatic reintegration is not performed.

In this case the reintegration must be undertaken in the F program in accordance with the information from the manufacturer of the control. For more information, refer to the operating instructions for the fail-safe control system.

7.7 System parameters

You can assign a name to the configured application as well as to the safety laser scanner(s). The names are saved in the devices after the configuration is transferred. The name chosen may be, for example, the identifier for the vehicle, system or the machine.

You enter the application name and the names of the safety laser scanners used in the CDS.

7.7.1 Application name

Overview

Devices with unique application names can be “reserved” for specific tasks. A machine maintenance person comparing exchanged devices with the configuration data saved in the CDS will be notified that the application name does not match. The machine maintenance person can then exchange these devices for those with the correct application name.

Procedure

► Enter a name for the application. The name can be a maximum of 16 characters long.

7.7.2 Name of the scanner

► Enter a **device name** for each of the safety laser scanners in the system. The name can be a maximum of 8 characters long.

NOTE

- Use meaningful names, e.g., “front” and “rear” for vehicle monitoring. Unique device names make the subsequent configuration steps easier.
- On a host/guest system with two safety laser scanners, the device names must always be different.

7.7.3 User data

You can optionally enter a user name in the **Name of the user** field. The name can be a maximum of 22 characters long. This is then added to the configuration protocol and in the diagnostics report.

7.7.4 Display direction of the 7-segment display

Overview

You can rotate the numbers shown on the 7-segment display by 180° using the CDS. This is useful, for example, if the device needs to be rotated by 180° on account of the mounting method.

Procedure

► Under **7-segment display**, activate the **Rotated by 180°** option.
✓ After the draft configuration has been transferred to the device, the numbers of the 7-segment display are rotated by 180°.

Complementary information

When the numbers shown on the 7-segment display are rotated, the dot on the 7-segment display goes out.

7.8 Application

You can configure the safety laser scanner for the required application using the CDS. Depending on whether you select a stationary or a mobile application, different configuration options are available:

Table 12: Comparison of mobile and stationary applications

Mobile applications	Stationary applications
Resolution	
• 30 mm (hand detection with smaller protective field size) • 40 mm (hand detection with larger protective field size) • 50 mm (leg detection with smaller protective field size) • 70 mm (leg detection with larger protective field size) [3]	• 30 mm (hand detection with smaller protective field size) • 40 mm (hand detection with larger protective field size) • 50 mm (leg detection with smaller protective field size) • 70 mm (leg detection with larger protective field size) • 150 mm (body detection)
Manipulation prevention	
The safety laser scanner checks whether in any 90° segment all measured values correspond to the maximum distance value that can be measured.	
• If this is the case, the device shuts down after **2 hours** and signals .	• If this is the case, the device shuts down after **5 seconds** and signals .

7.8.1 Resolution

Maximum protective field ranges

The maximum protective field range [4] depends on the configured resolution and angular resolution. The table shows the configurable resolutions:

Table 13: Maximum protective field ranges at different resolutions

	Maximum protective field range	
Short Range sensor head	At 0.5° angular resolution (60 ms basic response time)	At 0.25° angular resolution (120 ms basic response time)
30 mm (hand detection)	1.90 m	2.80 m
40 mm (hand detection)	2.60 m	3.80 m
50 mm (leg detection)	3.30 m	4.00 m
70 mm (leg detection)	4.00 m	4.00 m
150 mm (body detection) [1]	4.00 m	4.00 m
Medium Range variant		
30 mm (hand detection)	1.90 m	2.80 m
40 mm (hand detection)	2.60 m	3.80 m
50 mm (leg detection)	3.30 m	4.80 m
70 mm (leg detection)	4.70 m	5.50 m
150 mm (body detection) [1]	5.50 m	5.50 m
Long Range variant		
30 mm (hand detection)	1.90 m	2.80 m
40 mm (hand detection)	2.60 m	3.80 m

3) IIn mobile applications a resolution of only 70 mm is required for leg detection, as a coarser resolution is adequate for the detection of a human leg due to the movement of the vehicle.

4) Radial distance to the safety laser scanner.

	Maximum protective field range	
50 mm (leg detection)	3.30 m	4.80 m
70 mm (leg detection)	4.70 m	7.00 m
150 mm (body detection) [1]	7.00 m	7.00 m

[1] Cannot be configured for mobile applications.

Complementary information

NOTE
You can configure the warning field up to 49 m for all resolutions. The detection capability within the warning field depends on the radiance factor of the objects to be detected.

Further topics

- "Characteristic curves", page 114

7.8.2 Basic response time

The basic response time depends on the angular resolution selected and is:
- 60 ms basic response time at 0.5° angular resolution
- 120 ms basic response time at 0.25° angular resolution

7.8.3 Angular resolution and maximum protective field range

The angular resolution affects the maximum protective field range and the basic response time.

Two angular resolutions can be configured:
- At 0.5° angular resolution the basic response time is 60 ms.
- At 0.25° angular resolution the basic response time is 120 ms.

NOTE
- The maximum protective field range of the safety laser scanner must be sufficient to cover the calculated protective field size including the necessary supplements.

Further topics

- "Resolution", page 73
- "Basic response time", page 74
- "Protective field size", page 35

7.9 Restart

Overview

You can configure the restart behavior as follows:

- Without restart interlock
- With restart delay
- With restart interlock

The type of restart can be configured in the CDS.

Important information

DANGER

Hazard due to unexpected starting of the machine

If the protective field can be exited in the direction of the hazardous point, e.g., to areas that are unprotected due to the method of mounting or the near range of the safety laser scanner, the machine could restart while a person is in the hazardous area.

► It is imperative that you configure the safety laser scanner with restart interlock if the protective field can be exited in the direction of the hazardous point or if a person cannot be detected by the safety laser scanner at every point in the hazardous area.

Configuration of the safety laser scanner without restart interlock

If there is an object in the protective field, the safety laser scanner signals **Protective field interrupted**. This state is canceled again when there is no longer an object in the active protective field.

This configuration is only allowed under one of the following conditions:

- If an external restart interlock is implemented on the machine controller.
- If the protective field cannot be exited in the direction of the hazardous point and if people can be detected by the safety laser scanner at every point in the hazardous area.

Restart delay for mobile application

In mobile applications, you can configure a restart delay from 2 to 60 seconds on the device. The **Protective field interrupted** signal is canceled if there is no object in the protective field for the specified period of time.

This configuration is only allowed If the protective field cannot be exited in the direction of the hazardous point and if a person can be detected by the safety laser scanner at every point in the hazardous area.

Configuration of the safety laser scanner with restart interlock

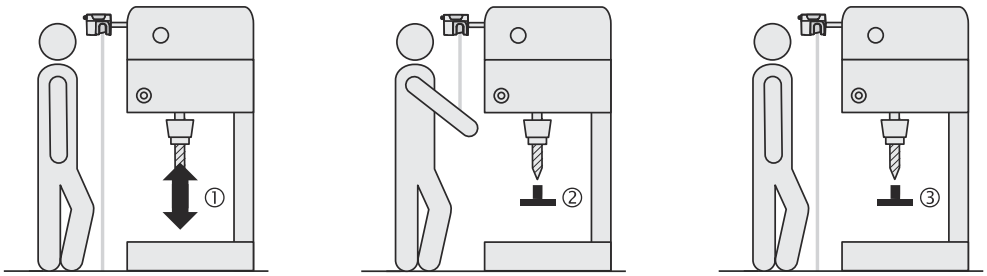


Figure 58: Schematic representation of operation with restart interlock

NOTE

Do not confuse the restart interlock with the start interlock on the machine. The start interlock prevents the machine from starting after switching on. The restart interlock prevents the machine from starting again after an error or an interruption in the protective field.

The safety laser scanner signals **Protective field interrupted** to initiate a machine ① or vehicle stop as soon as there is an object in the protective field ②. The signal remains active ③, even if there is no longer an object in the protective field. The signal is only canceled once the operator activates the control switch for restart or reset.

WARNING
Dangerous state of the machine

If the control switch for restart or reset is operated while a person is in the hazardous area, the machine could restart.

- ► Place the control switch for restart or reset outside the hazardous area such that it cannot be operated by a person in the hazardous area.
- ► Place the control switch for restart or reset outside the hazardous area such that the person who operates the control switch has a full view of the hazardous area.

Reset

NOTE
The reset function is often also called “preparation for restart”. In these operating instructions the term **reset** is used.

If the restart interlock on the safety laser scanner (internal) is activated, and also a restart interlock on the machine (external) is implemented, then each restart interlock has its own control switch.

After operating the control switch for the internal restart interlock (with the protective field clear), the safety laser scanner responds as follows:

- The **Protective field interrupted** signal is canceled.
- The LED ✓ on the safety laser scanner illuminates green.

The external restart interlock prevents the machine from restarting. After resetting the safety laser scanner, the operator must activate the control switch to restart the machine controller.

The controller must be implemented such that the machine only restarts if the safety laser scanner is first reset and then the control switch for restarting the machine controller is activated.

Reset signals

If you operate the safety laser scanner using the “With restart interlock” function, then after a protective field interruption and subsequent clearing of the protective field, it requests a reset signal from the controller (Reset required). The safety laser scanner responds to the rising signal edge from Low to High of the reset signal (and not to the signal level).

WARNING
Dangerous state of the machine

If the reset signal is implemented as a single signal, an electromagnetic interference signal could trigger a restart.

- ► The reset signal must be fail-safe (single failure proof).

Further topics

- "Measures to prevent unsecured areas", page 29

7.10 Field Sets

The number of field sets that can be configured depends on the product variant.

Table 14: Number of field sets that can be configured per use

Angular resolution	Advanced	Professional
Dual field mode		
Configured angular resolution 0.5°	4	8
Configured angular resolution 0.25°	4	8

7.10.1 Configuring the protective field and warning field

The field set, which comprises a protective field ① and two warning fields ② is configured using the CDS. This involves configuring the shape and size of the protective field and warning field. Any field shape can be created.

The area to be monitored is scanned radially by the device. The device cannot see through objects, however. The surface behind objects which are located in the area to be monitored (support columns, separator grids, etc.) can therefore not be monitored.

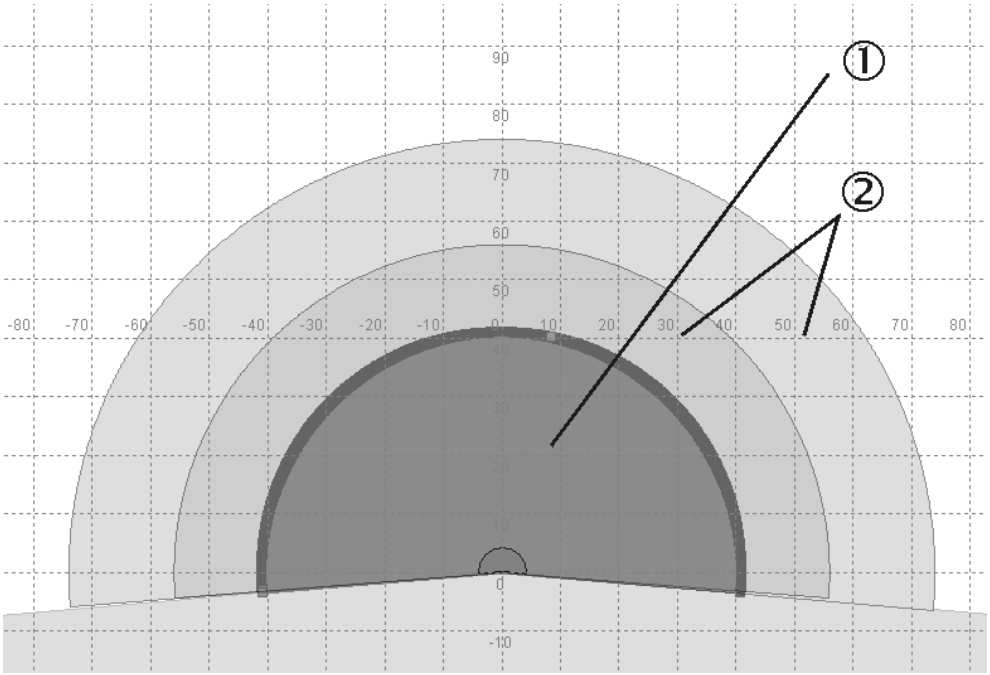


Figure 59: Creating a field set in the CDS

Protective fields and warning fields can cover an angle of up to 190° and have different radial scanning ranges depending on the sensor head and the resolution configured.

WARNING

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

Before commissioning the machine or vehicle, check the configuration of the protective fields, see "Commissioning", page 86, see "Checklist for initial commissioning and commissioning", page 128.

► Check the configured protective fields.

NOTE

If the protective field ③ or the warning fields ② extend all the way to a wall or another object (pillar, neighboring machine, shelf), there should be a distance of 100 mm between the protective field or warning field and the object to prevent false triggering ①.

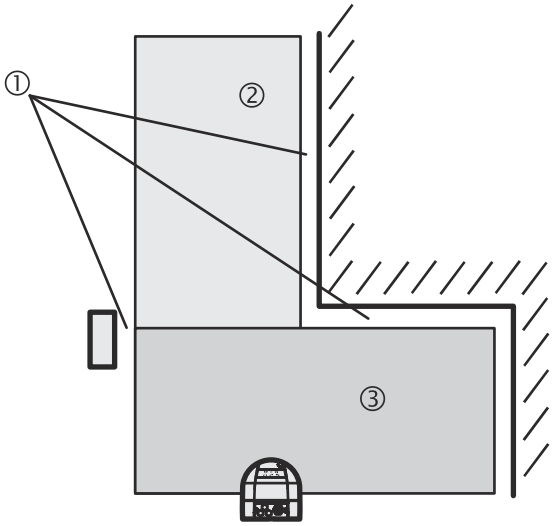


Figure 60: Configuring the protective field and warning field

DANGER

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

If it is possible to access a narrow strip between the protective field and a wall or another object, this strip must be protected using additional measures (e.g., fence or floor protection).

► Secure unprotected areas.

Further topics

- "Resolution", page 73

7.10.2 Importing and exporting field sets and fields

Overview

If you need identical field sets or fields across different projects, you can export entire field sets or individual fields out of one project and import them into another project.

Importing field sets and fields

1. Click on **Import field sets from XML file**.
2. Select exported file with field set information.

✓ A preview of the field sets and fields saved in the file will be shown.

3. Select the required field sets and import fully.
4. Drag individual fields into the required field set.

✓ The field sets and fields will be imported.

Exporting field sets and fields

1. Click on **Export field sets to XML file**.
2. Select the relevant folder and enter a file name for storing the field set information.
3. Start the export.

✓ The field sets and fields will be exported.

7.10.3 Protective field or warning field suggested by the safety laser scanner

The CDS can suggest the protective field or warning field in the field set editor. For this purpose, the safety laser scanner scans the visible surrounding contour several times. From the data obtained, the CDS suggests the contour and size of the field. The following figure shows an example for the reading of a protective field:

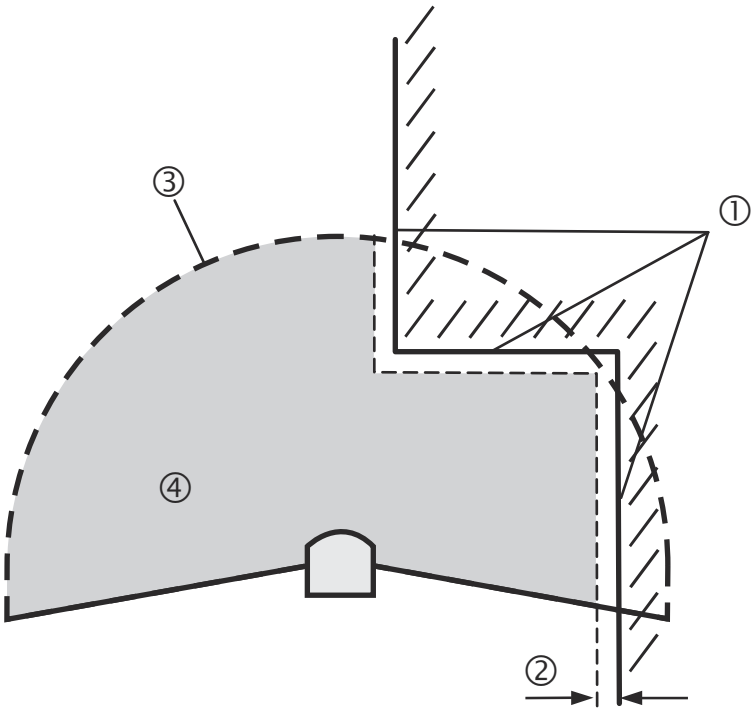


Figure 61: Reading the protective field

In those places at which the surrounding contour is smaller than the maximum protective field range (e.g., at ①), the protective field ④ corresponds to the surrounding contour.

NOTE

The measuring error tolerances for the device are automatically subtracted from the protective field size. As a result the protective field is slightly smaller than the surface covered ②.

In those places where the surrounding contour is larger than the protective field range ③, the protective field corresponds to the possible scanning range.

WARNING

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

The protective field suggested by the CDS is not a replacement for the calculation of the minimum distance, see "Mounting", page 48.

Before commissioning the machine or vehicle, check the configuration of the protective fields, see "Commissioning", page 86, see "Checklist for initial commissioning and commissioning", page 128.

- ► Calculate the minimum distance.
- ► Check the configured protective fields.

7.10.4 Using the contour as a reference

In addition to the protective field, the device can also monitor a contour (e.g., the floor in vertical applications).

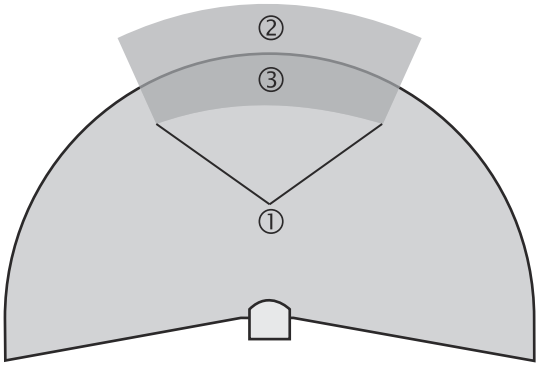


Figure 62: Schematic diagram of contour as reference

WARNING
Dangerous state of the machine

If a contour segment is smaller than the configured resolution, a change in the contour or a change in the position of the device may not be detected.

► Define contour segments that are larger than the configured resolution.

For contour monitoring you define a contour segment ①. The contour segment comprises a positive ② and a negative ③ tolerance band.

The device signals **Protective field interrupted** in the following situations:

- There is an object in the protective field.
- The monitored surrounding contour is no longer in the tolerance band, e.g., if a door is opened or the position of the safety laser scanner is changed.

NOTE

- You can define any number of contour segments.
- You cannot define warning fields at the points where a contour has been configured as a reference. If, for example, you use the floor as a reference for access protection, you cannot configure a warning field there. However, you can for example configure a warning field to the left and right of the contour segment to control a warning signal on approach from the side.
- The contour as reference function and the warning field 2 function are mutually exclusive.

You define the contour as a reference in the CDS field set editor.

Vertical operation

In vertical operation (for access protection and hazardous point protection), the protective fields must, in accordance with IEC 61496-3, be configured using the contour as reference function. In addition, the total response time of the device is not allowed to exceed 90 ms.

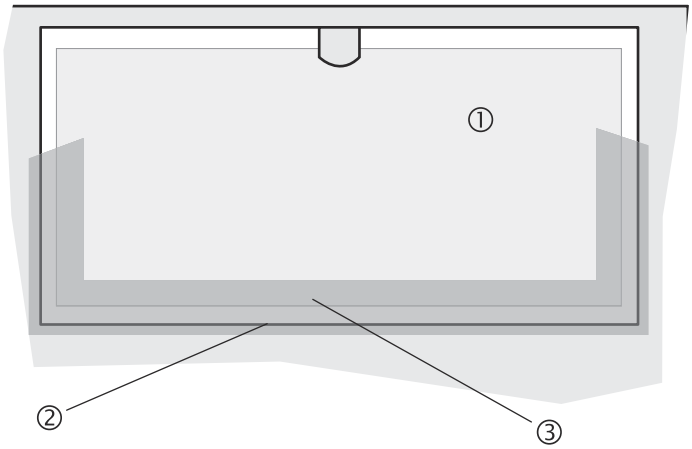


Figure 63: Contour as reference for vertical operation

① Protective field
② Contours of the machine opening
③ Contour segment

NOTE
Lateral, vertical boundaries of the opening (e.g., door frame) together with the floor are particularly suitable as a reference. If the position of the safety laser scanner is changed in one or more planes, the distance to the reference changes. The device then switches its safety outputs to the OFF state or signals **Protective field interrupted**.

7.11 Monitoring cases

Overview

The device supports a configuration with multiple monitoring cases. By switching the monitoring case you can switch to different monitoring conditions in the case of a change to the monitoring situation.

Important information

DANGER
In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.
The minimum distance to the hazardous area depends on the monitoring situation.

► Make sure that the minimum distance to the hazardous area is maintained for each monitoring case.

Configurable monitoring cases

The number of monitoring cases that can be configured depends on the product variant and the control. The following table shows the number of monitoring cases:

Table 15: Number of monitoring cases

Advanced	Professional
4	16

Complementary information

You can configure the monitoring cases in the CDS.

The number of available field sets depends on the safety laser scanner variant and is independent of the number of available monitoring cases. A suitable field set may therefore not be available for every monitoring case.

Each monitoring case includes the following information:

- The input conditions, the so-called control signals that control the activation of the monitoring case.
- A field set comprising a protective field and warning field(s).
- If necessary, a simultaneous field set.
- If necessary, a unique follow-on case or two alternative follow-on cases.
- The multiple sampling for the field set.
- The multiple sampling for the simultaneous field set.

Monitoring cases can be switched with static input information.

Further topics

- "Field Sets", page 76
- "Mounting", page 48

7.11.1 Monitoring case switching via static input information

Overview

For monitoring case switching via static input information, you configure for each monitoring case the input condition to be used to switch to this monitoring case.

Important information

WARNING

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

Someone may already be in the protective field at the time of switchover. Only by switching in the correct time frame, i.e., before the hazard occurs at this point for the person, is protection provided (see "Timing for monitoring case switching", page 32).

► Make sure that the control – using static control inputs – provides switching between the monitoring cases in the correct time frame.

NOTE

The control for the monitoring case switching must meet the required safety level.

The circuit for the control inputs must be suitable for the ambient conditions to be expected so that systematic and design-related effects and resulting errors on the switching of the monitoring cases can be excluded.

Static complementary sampling

Using external inputs (e.g., those of a PROFIsafe safety controller), $2^4 = 16$ monitoring cases can be switched via a maximum of four control input pairs.

Table 16: Truth table for complementary sampling

A	B	C	D	E.g. case
0	0	0	0	1
1	0	0	0	2
0	1	0	0	3

A	B	C	D	E.g. case
1	1	0	0	4
0	0	1	0	5
1	0	1	0	6
0	1	1	0	7
1	1	1	0	8
...				...
0	1	1	1	15
1	1	1	1	16

NOTE

An undefined input information will result in the device switching the safety outputs to the OFF state or signaling **Protective field interrupted**.

7.11.2 Multiple sampling

If multiple sampling is set, an object must be scanned several times before the S3000 transmits a protective field interruption. In this way you can reduce the probability that insects, welding sparks or other particles result in the shutdown of the system.

If a multiple sampling of 3 is configured, for example, an object must be detected in the protective field three times in succession before the S3000 signals **Protective field interrupted**.

DANGER

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

The total response time is increased by the multiple sampling.

► With a multiple sampling greater than 2, note that a supplement must be added to the basic response time.

A multiple sampling of 2 is the minimum setting. The multiple sampling can be set to a value up to 16 using the CDS. The supplement to the basic response time resulting from this setting is displayed in the CDS.

Table 17: Recommended multiple sampling

	Recommended multiple sampling	
Application	**Basic response time 60 ms**	**Basic response time 120 ms**
Stationary under clean ambient conditions	2×	2×
Vertical applications	3 times	–
Mobile	4 times	4 times
Stationary under dusty ambient conditions	8 times	8 times

NOTE

- Using multiple sampling you can increase the availability of a system.
- The multiple sampling can be configured in the CDS. A specific multiple sampling value can be set both for the configured field set and for the simultaneous field set in each monitoring case.

Further topics

- "Response times", page 116

7.11.3 Simultaneous monitoring

Overview

Using simultaneous monitoring, the S3000 can monitor two field sets at the same time (e.g., a hazardous area on the left and a hazardous area on the right) within a monitoring case.

Procedure

1. On the **Cases** tab, select a further field set as a simultaneous field set within the relevant monitoring case.

7.11.4 Checking the monitoring case switching

To check the switching between monitoring cases, configure a series of monitoring cases. Either an arbitrary sequence, a unique sequence, or two alternative sequences can be defined.

- Arbitrary sequence: It is allowed to switch from one monitoring case to any other defined monitoring case.
- Unique sequence: It is only allowed to switch from a monitoring case to another specifically defined monitoring case.
- Alternative sequence: It is allowed to switch from a monitoring case to one of two specifically defined monitoring cases.

NOTE
Use the monitoring case switching check as an additional check on the control. For example, to detect deviations of a vehicle from a corridor, or deviations of a system from the prescribed production process.

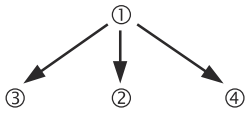


Figure 64: Schematic representation of monitoring case switching - arbitrary sequence

Figure 65: Schematic representation of monitoring case switching - unique sequence

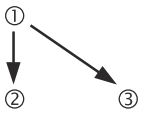


Figure 66: Schematic representation of monitoring case switching - alternative sequence

7.11.5 Park/standby mode

Overview

If, in mobile applications, vehicles are not moved for a time (e.g., for battery charging), the OSSDs can be switched to the OFF state and the laser on the device can be switched off. In this way the power consumption of the device is reduced.

In this way you also prevent the safety laser scanners from dazzling each other and entering an error condition.

The function can be implemented using either the park mode or the standby mode.

Park mode

To switch to the park mode, configure a monitoring case for which the park mode is defined in the CDS.

The device needs the response time resulting from the configuration to switch from the park mode to another monitoring case.

Standby mode

The S3000 can be switched to the standby mode via PROFINET.

NOTE
The standby mode does not take up a monitoring case.

7.12 Measurement data output

For measurement data output, the baud rate of the interface needs to be configured.

The **Silent time** defines the time, after sending the silent byte, for which the continuous output of data can be interrupted to make it possible to access to the interface. The factory default setting for the silent time is 5,000 ms.

Possible configurations for the Silent time:

- 5,000 ms (default).
- Custom silent time between 60 ms and 4,980 ms.

The **Send mode** option is used to configure whether the measurement data output is to be triggered as a **Continuous data output** or **Data output only on request**.

For further details on this topic, see the “Telegram Listing Standard” documentation (part no. 9090807).

8 Commissioning

8.1 Safety

DANGER
Ineffectiveness of the protective device

Before a machine that is protected by a safety laser scanner is commissioned for the first time, the machine or protective device may not yet behave as planned. The system must be tested and approved by qualified safety personnel. The results of the test must be documented.

- ► Before approving the machine, test whether the protective device is fully monitoring access to the hazardous area or hazardous point.
- ► After approving the machine, check at regular intervals (e.g., in the morning before beginning work) whether the safety laser scanner is properly switching the safety outputs to the OFF state as soon as there is an object in the protective field. Perform this test along all protective field boundaries in accordance with the application-specific requirements.

Further topics

- "Safety information", page 10
- "Test notes", page 87

8.2 Power up sequence

After the device is switched on, it goes through a power-up cycle. During the power-up cycle, the 7-segment display indicates the device status.

The following indications are possible during initial commissioning of the safety laser scanner:

Table 18: 7segment display during and after the power up sequence during initial commissioning

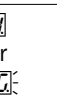
Step	Display	Meaning
1		Power-up cycle, test of the 7-segment display. All segments are activated consecutively.
2		Device addressed as host or guest
3		Power-up cycle, during initial commissioning: Device in configuration mode
	Other display	Safety interlock activated. Malfunction in the external conditions or in the device itself.

Table 19: Display of LEDs after the power up sequence

Display					Meaning
●	●	●	●	○	Power-up cycle, step 1
●	○	○	○	○	Power-up cycle, step 2
●	○	○	○	○	Power-up cycle, step 3 Device status: Waiting for configuration or object in the protective field

Display					Meaning
Other display					Safety interlock activated. Malfunction in the external conditions or in the device itself

NOTE
The switch-on time depends on the extent of the configuration data and can take up to 20 seconds.

Further topics

- "Error and status indicators on the 7-segment display", page 98
- "Error and status indications of the LEDs", page 97

8.3 Test notes

Check the protective device as described below and in accordance with the applicable standards and regulations.

These tests are also used to identify if the protection is affected by external light sources or other unusual environmental conditions.

These checks must therefore always be performed.

8.3.1 Tests before initial commissioning

Overview

Before commissioning the machine and after making changes, you must check whether the safety functions are fulfilling their planned purpose and whether persons are being adequately protected.

Important information

WARNING
Hazard due to unexpected starting of the machine
Until all the tests have been successfully completed, it is possible that the machine, system or the protective device does not yet behave as planned.

► Make sure that nobody is put at risk during initial commissioning of the machine.

Procedure

► Make sure that there are no persons in the hazardous area during initial commissioning.
► Check the effectiveness of the protective device mounted to the machine, using all selectable operating modes as specified in the checklist in the annex, see "Checklist for initial commissioning and commissioning", page 128.
► Check the effectiveness of the protective device as per the monthly check, see "Monthly check of the protective device by authorized and specialist personnel", page 90.
► Make sure that the operating personnel of the machine protected by the safety laser scanner are correctly instructed by qualified safety personnel before being allowed to operate the machine. Instructing the operating personnel is the responsibility of the machine owner.
► Ensure that the **Important notes** information label is affixed to the machine in a place where it is clearly visible for the operators. The information label is included

with the safety laser scanner on delivery. Ensure that the operators are given the opportunity to properly perform this monthly check.

► The annex to this document includes a checklist for review by the manufacturer and installer. Use this checklist as a reference before commissioning the system for the first time.

► Document in a clear manner the settings for the safety laser scanner, and the results of the testing during initial commissioning. For this purpose also print out the complete configuration of the safety laser scanner (including protective field shapes) and include these with the documentation.

NOTE

- Use the **Create diagnostic dump...** function in the CDS (right click on the COM interface to which the safety laser scanner is connected). You can keep these data as a backup and in this way document the state during initial commissioning at any time.
- Your SICK representative will be pleased to provide you with advice on initial commissioning.

Further topics

- "Checklist for initial commissioning and commissioning", page 128

8.4 Recommissioning

Overview

If the device has already been put into operation but has been replaced or exchanged since then, the device automatically reads the saved configuration from the system plug remaining on the machine.

No acceptance by qualified safety personnel is required after the configuration is read from the system plug. The check as per the requirements for monthly checking must, however, be carried out.

7-segment display and LEDs after the power up sequence

Table 20: 7segment display during and after the power up sequence during recommissioning

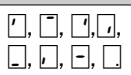
Step	Display	Meaning
1		Power-up cycle, test of the 7-segment display. All segments are activated consecutively.
2		Saved configuration invalid: Devices in the configuration mode, no further steps taken
3		Device in dual field mode
4		Waiting for valid inputs
5		Waiting for Reset
6	No display	Device is ready for operation
		Device ready for operation but object in the protective field or in the simultaneous protective field (in dual field mode)
	Other display	Safety interlock activated. Malfunction in the external conditions or in the device itself.

Table 21: Display of LEDs after the power up sequence

Display					Meaning
●	○	●	○	○	The device is ready for operation, object in the protective field and warning field.

Display					Meaning
○	○	●	○	●	The device is ready for operation, object in the warning field.
○	○	○	○	●	The device is ready for operation, no object in the protective field or warning field.
●	☀	○	○	○	The device is ready for operation, no object in the protective field or warning field. Control switch for restart or reset must be operated.
Other display					Safety interlock activated. Malfunction in the external conditions or in the device itself

Complementary information

NOTE

If the system plug has also been replaced, then the configuration must be transferred to the safety laser scanner using the CDS. Acceptance by qualified safety personnel is required in this case.

Further topics

- "Replacing the I/O module", page 95
- "Monthly check of the protective device by authorized and specialist personnel", page 90
- "Error and status indicators on the 7-segment display", page 98
- "Error and status indications of the LEDs", page 97
- "Safety", page 86
- "Pin assignment", page 56

9 Maintenance

9.1 Safety

WARNING
Ineffectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ► Do not do repair work on device components.
- ► Do not make changes to or manipulate device components.
- ► Apart from the procedures described in this document, the device components must not be opened.

DANGER
Hazard due to unexpected starting of the machine

The system could inadvertently start up while the front screen is being replaced.

- ► Always isolate the machine from the power supply during all work on the machine and safety laser scanner

9.2 Regular inspection

9.2.1 Regular inspection of the protective device by qualified safety personnel

- ► Check the system at the inspection intervals specified in the national rules and regulations. If any changes are made to the machine or someone tampers with the protective device after initial commissioning, this will ensure that any such issues are detected.
- ► If major changes have been made to the machine or the protective device, or if the safety laser scanner has been modified or repaired, check the system again as per the checklist in the annex.

Further topics

- "Checklist for initial commissioning and commissioning", page 128

9.2.2 Monthly check of the protective device by authorized and specialist personnel

Overview

The effectiveness of the protective device must be checked monthly by authorized and specialist personnel. The test must also be performed if the operating mode is changed.

Important information

DANGER
Ineffectiveness of the protective device

If any one of the following test points is not met, it is not permitted to continue to work on the machine or operate the vehicle. In this case the installation of the safety laser scanner must be checked by qualified safety personnel.

- ► Shut down the machine.
- ► Check the installation of the safety laser scanner.

Procedure

1. Carry out the test for the relevant preset monitoring case.
2. Check the mechanical installation to ensure that all fixing screws are secure and that the safety laser scanner is properly aligned.
3. Check each safety laser scanner device for visible changes such as damage, manipulation etc.
4. Switch on the machine/system.
5. Watch the LEDs on each safety laser scanner.
6. If not at least one LED of each safety laser scanner is permanently illuminated when the machine/system is switched on, it is to be assumed that there is an error in the machine or system. In this case the machine must be shut down immediately and checked by qualified safety personnel.
7. To test the protective function for the entire system, deliberately interrupt the protective field while the machine is running.
   The LEDs of the safety laser scanner must change from green to red and the dangerous movement must stop immediately.
8. Repeat this test at different points in the hazardous area and on all safety laser scanners.
   If any non-conformance of this function is discovered while doing so, the machine/system must be shut down immediately and checked by qualified safety personnel.
9. For stationary applications, check that the hazardous areas marked out on the floor match the shapes of the protective fields stored in the safety laser scanner and that any gaps are protected by additional protective measures.
   In the case of mobile applications, check that the moving vehicle actually stops at the protective field boundaries which are set in the safety laser scanner and listed on the information label in the vehicle or in the configuration protocol. If any non-conformance of this function is discovered while doing so, the machine/system must be shut down immediately and checked by qualified safety personnel.
10. If the reference contour monitoring feature is used, check the areas with the reference contour:
    - Move the test object along the inner edge of the tolerance band of the reference contour. The safety laser scanner must detect the test object at each position and indicate the detection.
    - If several reference contours are used, test all reference contours.

Further topics

- "Regular inspection of the protective device by qualified safety personnel", page 90

9.3 Cleaning the front screen

Overview

The safety laser scanner is largely maintenance-free. The front screen on the safety laser scanner should however be cleaned regularly and also if contaminated.

Important information

NOTICE

- ► Do not use aggressive or abrasive cleaning agents.
- ► Recommendation: Use lens cleaner and lens cloths from SICK.

Procedure

To clean the front screen:

- ► Use a clean and soft brush to remove dust from the front screen.
- ► Moisten the SICK lens cloth with lens cleaner, then use the cloth to wipe off the light emission window on the front screen.

9.4 Replacing the front screen

Overview

If the front screen is scratched or damaged, it must be replaced. Order the replacement front screen from SICK.

After replacing the front screen, the measurement system of the safety laser scanner must be calibrated to the new front screen. During front screen calibration, the reference for the contamination measurement of the front screen is defined (status = not contaminated).

Important information

WARNING

Incorrect reference value of optical properties

If the front screen calibration is not done correctly, persons and parts of the body to be protected may not be detected.

- ► Perform a front screen calibration every time the front screen is replaced.
- ► Perform the front screen calibration at room temperature (10 °C to 30 °C).
- ► Only perform the front screen calibration using a new front screen.
- ► Make sure that the new front screen is free of contamination when carrying out the calibration.

NOTE

- The front screen on the device is an optical component which must not be contaminated or scratched during replacement.
- The front screen may only be replaced by qualified safety personnel in a clean, dust- and dirt-free environment.
- Never replace the front screen during operation as dust particles could enter the device.
- Avoid contamination on the inside of the front screen, for example due to fingerprints.
- Do not use any additional sealant for sealing the front screen, e.g., silicon, as the vapors produced may damage the optics.
- Mount the front screen as per the following instructions to ensure that the housing is sealed to IP65.

Prerequisites

- Only use a new front screen.
- When replacing the front screen, take ESD protection measures.
- Set a torque wrench to 1.2 Nm (hand-tight) and have this at hand.

Procedure

To replace the front screen:

1. Disconnect the system plug and remove the safety laser scanner.
2. Move the safety laser scanner to a clean location (office, maintenance rooms or similar).

3. First clean the outside of the safety laser scanner. This prevents foreign bodies entering the device when it is opened.
4. Remove the fixing screws ① to ⑧ of the front screen.

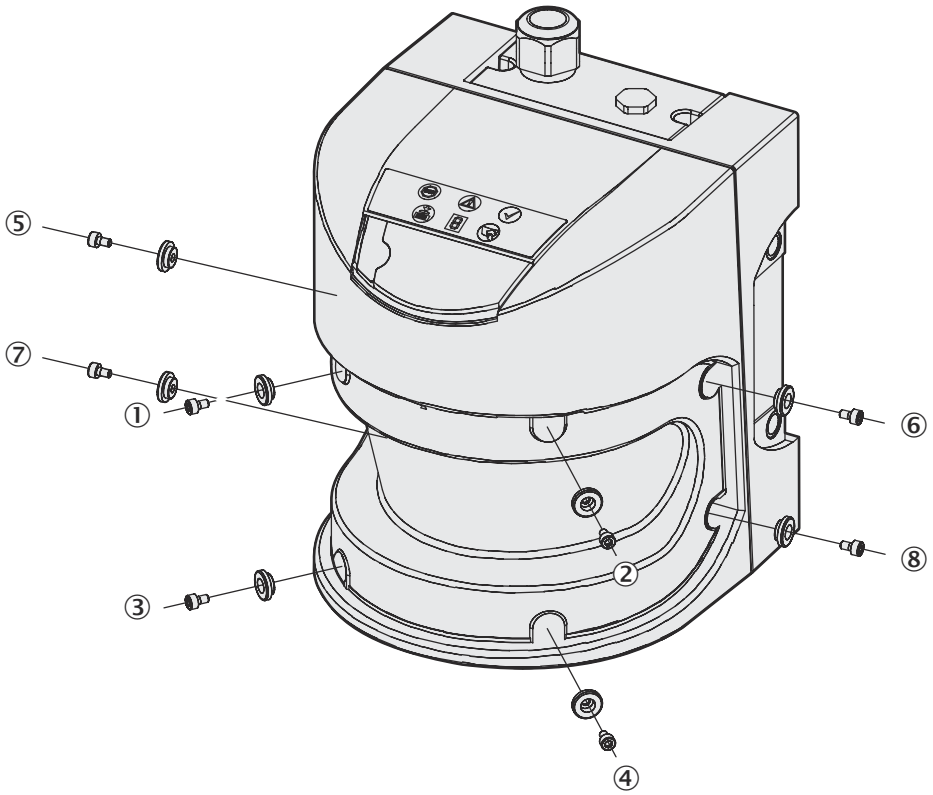


Figure 67: Remove the fixing screws of the front screen

5. Remove the front screen and the old rubber seal.
6. Remove any contamination from the seal groove and the mating surface for the sensor head. If possible use a plastic cleaner that does not leave residues.

NOTE

If necessary smear a thin coating of Vaseline in the seal groove of the front screen. This makes mounting easier.

7. Insert the new seal ①, starting in the middle. During this process first align the centre markings on the sensor head (② and ③) and seal (④ and ⑤).

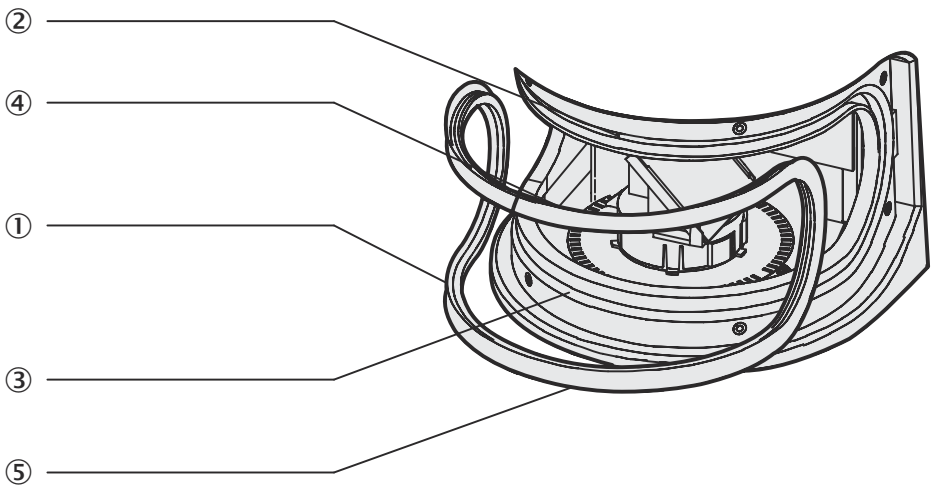


Figure 68: Inserting the rubber seal

NOTICE

If the front seal is not inserted correctly, the front screen may be damaged.

► Do not use any pointed or sharp tools.

8. First place the seal only lightly in the rounded sections of the seal groove. This will avoid stretching the seal.
9. Only then press the seal home. Do not rotate the seal while inserting it.

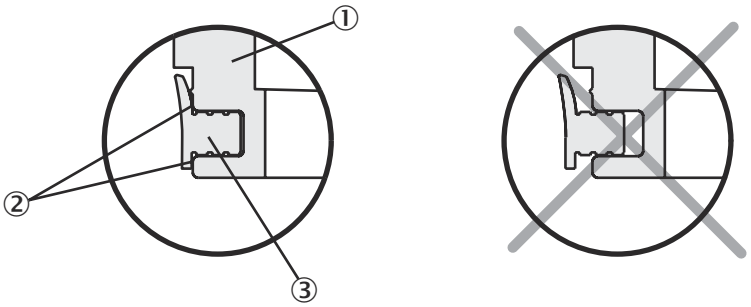


Figure 69: Depth for pressing in the seal

① Housing
② Seal edge flush with housing edge
③ Seal

The seal is pressed in far enough when the edge of the seal and the sensor head are flush.

10. It is imperative to check that the seal is seated evenly all the way around the groove.
11. Check whether the mirror is contaminated. Remove any contamination with an optic brush.
12. If you cannot remove the contamination with the optic brush, contact your local SICK subsidiary.
13. Take the new front screen from the packaging.
14. If necessary, remove any remnants of packaging.
15. Place the front screen on the rubber seal and insert the new fixing screws ① to ④ with distance bushes (see figure 67).
16. Press the front screen on the front of the cover. During this process tighten the front screws ① to ④ to the tightening torque set.
17. Now insert the rest of the screws ⑤ to ⑧ with distance bushes (see figure 67) and tighten using the torque wrench.

Putting the safety laser scanner back into operation:

► Properly remount the safety laser scanner.
► Connect the system plug of the safety laser scanner.
After power up, the safety laser scanner automatically reads the saved configuration from the system plug.
► Now perform a front screen calibration using the CDS.

Further topics

- "Mounting", page 48
- "Recommissioning", page 88

9.5 Replacing the I/O module

Overview

In the case of an error or a change in the functionality of the S3000, you can replace the I/O module. After re-commissioning, the I/O module reads the saved configuration from the system plug.

Important information

DANGER
Hazard due to unexpected starting of the machine
While the I/O module is being replaced, the system may start inadvertently.

- ► Always isolate the machine from the power supply during all work on the machine and safety laser scanner

NOTE

- The saved configuration must correspond to the properties of the device used. You can, for example, replace an S3000 PROFINET IO/IO-OF Advanced with an S3000 PROFINET IO/IO-OF Professional, the new device is downward compatible. You cannot, however, replace an S3000 PROFINET IO/IO-OF Professional with an S3000 PROFINET IO/IO-OF Advanced, as there is no upward compatibility.
- If compatibility is not ensured, the 7-segment display indicates E. The device enters a safe operational status.

Further topics

- "Recommissioning", page 88

9.5.1 Steps for replacing the I/O module

Important information

NOTICE
When the I/O module is dismantled, advanced electronic components are accessible.
No liability can be accepted for damage caused by electrostatic discharge.

- ► Protect the components from electrostatic discharge, contamination and moisture.
- ► If possible use anti-static floor mats and workbench covers.
- ► When working on the device, touch a bare metal surface from time to time to discharge static charging of your body.
- ► Only remove the components of the device from their anti-static packing immediately prior to installation.

NOTICE

- The I/O module is only allowed to be replaced by qualified safety personnel in a clean environment.
- Mount the I/O module as per the following instructions to ensure that the housing is sealed to IP65.

Procedure

1. Disconnect the system plug and remove the safety laser scanner.
2. Move the safety laser scanner to a clean location (office, maintenance rooms or similar).

3. First clean the outside of the safety laser scanner. This prevents foreign bodies entering the device when it is opened.
4. Remove the fixing screws for the I/O module.
5. Take hold of the I/O module with one hand at the recess for the connector to the system plug.
6. With the other hand take hold of the I/O module at the dismantling aid on the underside of the device.
7. Pull out the I/O module parallel to the mounting shaft.
8. Remove any contamination from the sealing surface and the mating surface for the sensor head. If possible use a plastic cleaner that does not leave residues.
9. Remove the I/O module from the packaging and take adequate ESD protection measures during this process.
10. Check the surfaces for cleanliness and the seal for correct seating.
11. Insert the I/O module in the mounting shaft parallel to the rear of the sensor head. During this process use the three surrounding sides of the shaft for orientation.
12. Guide the I/O module along these surfaces to the plug connector. During this process slide the I/O module parallel to the rear of the sensor head, avoid tilting. The I/O module can be connected without the need to apply force.
13. When the I/O module is flat against the rear of the sensor head (distance approx. 1 mm), tighten the screws in stages, diagonally, to 10 to 12 Nm.

Putting the safety laser scanner back into operation

1. Properly remount the safety laser scanner.
2. Connect the system plug of the safety laser scanner.

✓ If you have replaced the I/O module for the same I/O module variant, after power up the safety laser scanner automatically reads the saved configuration from the system plug.

✓ If you have replaced the I/O module with a different I/O module variant (e.g., Advanced with Professional), you must perform an initial commissioning.

Further topics

- "Mounting", page 48
- "Recommissioning", page 88
- "Safety", page 86

10 Troubleshooting

10.1 Response to errors

DANGER
Ineffectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ► Immediately shut the machine down if the behavior of the machine cannot be clearly identified.
- ► Immediately put the machine out of operation if you cannot clearly identify or allocate the error and if you cannot safely remedy the error.
- ► Secure the machine so that it cannot switch on unintentionally.

WARNING
Ineffectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ► Do not do repair work on device components.
- ► Do not make changes to or manipulate device components.
- ► Apart from the procedures described in this document, the device components must not be opened.

NOTE
Additional information on troubleshooting is available from your SICK subsidiary.

10.2 Diagnostics

The following diagnostic options are available:

- 7-segment display
- LED indicators
- CDS (Configuration & Diagnostic Software)
- Alarms (PROFINET diagnostic messages)

The following signals indicate fault-free operation:

- The green LED is illuminated
- The dot on the 7-segment display is flashing

10.3 Error and status indications of the LEDs

Overview

This section describes the meaning of the error and status indications of the LEDs and how you can respond.

Meaning of the LEDs

Table 22: Meaning of the LEDs

LED	Meaning
✓	LED illuminated = PROFIsafe communication active, no fault LED flashing at 0.5 Hertz = Operator acknowledge requested by the FPLC
SF	LED illuminated = Device passive or has an error
BF	Reset required

LED	Meaning
⚠	LED off = Warning field(s) clear LED illuminated = Warning field(s) interrupted
	LED illuminated = Contamination

Further topics

- "Status indicators", page 17

10.4 Error and status indicators on the 7-segment display

This section explains the meaning of the error and status indications of the 7-segment display and how you can respond.

Table 23: Error and status indicators on the 7-segment display

Display	Possible cause	Remedy
0, 1, 2, 3, 4, 5, 6, 7, 8, 9	Power-up cycle - all segments are activated consecutively.	Not an error
	PROFINET IO communication in progress.	Not an error
a	Standby mode active, the laser is switched off.	Not an error
1.	Object in the protective field	Not an error. This status indication makes system testing easier when using simultaneous protective fields.
1	Object in the simultaneous protective field or the contour as reference function has triggered	
3	Initialization of the device	The display automatically goes out when the safety laser scanner is initialized. If the display does not go out: ► Check the system configuration using the CDS. ► Transfer the corrected configuration to the safety laser scanner again.
4	Waiting for valid input signals	The display goes out automatically if an input signal is pending which corresponds to a configured monitoring case. If the display does not go out: ► Check the system configuration using the CDS.
6	Wait for configuration or configuration not complete	The display goes out automatically once the configuration has been successfully transferred. If the display does not go out: ► Check the system configuration using the CDS. ► Transfer the corrected configuration to the safety laser scanner again.
E ↻ 1	Sensor head faulty	► Send the sensor head to the manufacturer for repair.
E ↻ 2	I/O module faulty	► Send the I/O module to the manufacturer for repair.

Display	Possible cause	Remedy
E 3	Configuration memory in the system plug defective	► Send the system plug to the manufacturer for repair.
1 1	The safety laser scanner is receiving no measured values within a range of least 90° (maximum measuring range 49 m). The device is therefore not detecting any obstacles present there, for example building walls.	► For correct functioning of the safety laser scanner, always ensure that measured values are received within a range of 90°; this range can be moved as required within the scan range.
H	PROFINET IO module identification (is initiated by the FPLC)	Not an error
1 2	Device is dazzled.	► Check whether the safety laser scanner is being dazzled by an external light source, e.g., headlight, infrared light source, stroboscopic light, sun etc. If necessary, re-mount the device.
1 3	Error temperature The operating temperature of the S3000 is above the permitted range.	► Check whether the S3000 is being operated as per the permissible ambient conditions.
n 1	Input signal for a non-defined monitoring case	► Check the operating process of the monitored machine or system. ► If necessary, check the configuration of the monitoring cases using the CDS.
n 2	Incorrect sequence when switching the monitoring cases	
n 3	Incorrect operation of the control inputs	► Check the operation of the control inputs.
STOP ● With field switching P	No PROFINET IO communication, no PROFIsafe active	► Check the configuration of PROFINET IO and the configuration of the safety laser scanner.
STOP ● Without field switching □		
STOP ● With field switching P (with flashing dot)	PROFINET IO communication in progress, no PROFIsafe active	► Check the PROFIsafe configuration. ► Read the device diagnostics in the safety laser scanner using the network engineering tool or using the CDS. Typical PROFIsafe configuration errors are indicated.
STOP ● Without field switching □ (with flashing dot)		

Display	Possible cause	Remedy
With field switching (with flashing dot)	PROFINET IO communication active, waiting for reintegration in PROFIsafe	The safety laser scanner is waiting for reintegration by the fail-safe control. ► If this action cannot be performed, check the monitoring time (**F_WD_Time**) of the safety laser scanner and the cycle with which the fail-safe program is started (for example F_WD_Time on SIMATIC, see table 11, page 69).
Without field switching (with flashing dot)		
1 ... 6	Channel 1 to 6 of the contamination measurement contaminated	► Clean the front screen.
7	No front screen fitted or dazzling of the contamination measurement.	► Fit the new front screen (then carry out a front screen calibration). If a front screen was fitted at the time of the error: ► Check whether the safety laser scanner is being dazzled by an external light source, e.g., headlight, infrared light source, stroboscopic light, sun etc.
8 9	Traceability data incorrect or front screen calibration failed	► Carry out a front screen calibration or replace the safety laser scanner if necessary.
1	Sensor head internal error	► Replace the sensor head of the safety laser scanner.
2	I/O module internal error	► Replace the I/O module of the safety laser scanner.
3	Combination of I/O module and sensor head invalid	► Check whether the correct I/O module has been used and replace if necessary.

Further topics

- "Status indicators", page 17
- "Configuring PROFINET IO", page 66
- "Configuring PROFIsafe", page 68
- "Passivation and reintegration of the S3000 PROFINET IO/IO-OF", page 71
- "Configuration", page 63

10.4.1 The lock-out operational status

In case of certain errors or an erroneous configuration, the device can go into the lock-out operational status.

To place the device back in operation, proceed as follows:

► Rectify the cause of the error, see "Error and status indicators on the 7-segment display", page 98.

► Switch off the voltage supply for the device for at least 2 seconds and then switch it back on.

Or:

► Restart the device using the CDS.

10.5 Advanced diagnostics

Detailed diagnostics can be undertaken using CDS locally (RS-232 on the front) as well as via the network or the higher level FPLC (TCI integration of the diagnostic device in the FPLC).

10.6 Alarms

Overview

Alarms can be output acyclically. As soon as an error occurs in the safety laser scanner, the safety laser scanner passes it on to the network.

The device-specific help can be read using the IO controller. The help is saved in the GSDML [5] of the safety laser scanner.

I&M function (Identification & Maintenance function)

The following data are loaded and displayed during the online device diagnostics from, for example, Step 7.

- IM0 = Device identification (serial number, version number, part number, manufacturer, etc.)
- IM1 = User can enter system code and location code
- IM2 = Installation date
- IM3 = Description of the function
- IM4 = Signature (config CRC)

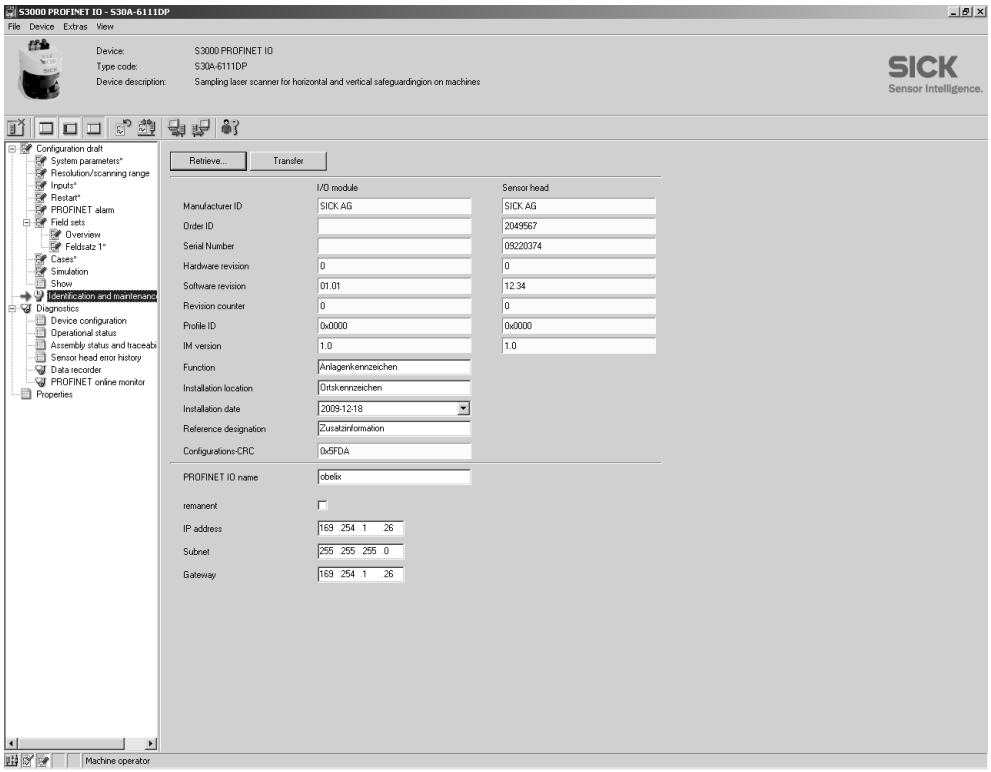


Figure 70: I&M function in the CDS

5) See “PROFIBUS Profile Guidelines Part1: I&M Functions V1.1.1”

11 Decommissioning

11.1 Disposal

Procedure

► Always dispose of unusable devices in accordance with national waste disposal regulations.

Complementary information

SICK will be glad to help you dispose of these devices on request.

12 Technical data

12.1 Process image S3000 PROFINET IO/IO-OF Advanced

The process contains data on four monitoring cases and four field sets.

INPUT

Table 24: Process image for S3000 PROFINET IO/IO-OF Advanced INPUT

	Bit	Description
Byte 0	0.0	Protective field clear
	0.1	Warning field clear
	0.2	Simultaneous protective field clear
	0.3	Simultaneous warning field clear
	0.4	Reset required (protective field)
	0.5	Reserved
	0.6	Reset required (simultaneous protective field)
	0.7	Reserved
Byte 1	1.0	Contamination
	1.1	Monitoring case valid
	1.2	Monitoring case number – Bit 0
	1.3	Monitoring case number – Bit 1
	1.4	Reserved
	1.5	Reserved
	1.6	Reserved
	1.7	Reserved
Byte 2	2.0	Reserved
	2.1	Reserved
	2.2	Reserved
	2.3	Reserved
	2.4	Reserved
	2.5	Reserved
	2.6	Reserved
	2.7	Reserved
Byte 3	3.0	Reserved
	3.1	Reserved
	3.2	Reserved
	3.3	Reserved
	3.4	Reserved
	3.5	Reserved
	3.6	Reserved
	3.7	Reserved

	Bit	Description
Byte 4	4.0	Reserved
	4.1	Reserved
	4.2	Reserved
	4.3	Reserved
	4.4	Reserved
	4.5	Reserved
	4.6	Reserved
	4.7	Reserved
Byte 5	5.0	Reserved
	5.1	Reserved
	5.2	Reserved
	5.3	Reserved
	5.4	Reserved
	5.5	Reserved
	5.6	Reserved
	5.7	Reserved

OUTPUT

Table 25: Process image for S3000 PROFINET IO/IO-OF Advanced OUTPUT

	Bit	Description
Byte 0	0.0	Monitoring case switching A1
	0.1	Monitoring case switching A2
	0.2	Monitoring case switching B1
	0.3	Monitoring case switching B2
	0.4	Reserved
	0.5	Reserved
	0.6	Reserved
	0.7	Reserved
Byte 1	1.0	Reset the protective field
	1.1	Reserved
	1.2	Reset the simultaneous protective field
	1.3	Reserved
	1.4	Standby
	1.5	Initialization
	1.6	Reserved
	1.7	Reserved
Byte 2	2.0	Reserved
	2.1	Reserved
	2.2	Reserved
	2.3	Reserved
	2.4	Reserved
	2.5	Reserved
	2.6	Reserved
	2.7	Reserved

	Bit	Description
Byte 3	3.0	Reserved
	3.1	Reserved
	3.2	Reserved
	3.3	Reserved
	3.4	Reserved
	3.5	Reserved
	3.6	Reserved
	3.7	Reserved
Byte 4	4.0	Reserved
	4.1	Reserved
	4.2	Reserved
	4.3	Reserved
	4.4	Reserved
	4.5	Reserved
	4.6	Reserved
	4.7	Reserved
Byte 5	5.0	Reserved
	5.1	Reserved
	5.2	Reserved
	5.3	Reserved
	5.4	Reserved
	5.5	Reserved
	5.6	Reserved
	5.7	Reserved

12.2 Process image S3000 PROFINET IO/IO-OF Professional

The process contains data on eight monitoring cases and eight field sets.

INPUT

Table 26: Process image for S3000 PROFINET IO/IO-OF Professional INPUT

	Bit	Description
Byte 0	0.0	Protective field clear
	0.1	Warning field clear
	0.2	Simultaneous protective field clear
	0.3	Simultaneous warning field clear
	0.4	Reset required (protective field)
	0.5	Reserved
	0.6	Reset required (simultaneous protective field)
	0.7	Reserved

	Bit	Description
Byte 1	1.0	Contamination
	1.1	Monitoring case valid
	1.2	Monitoring case number – Bit 0
	1.3	Monitoring case number – Bit 1
	1.4	Monitoring case number – Bit 2
	1.5	Monitoring case number – Bit 3
	1.6	Reserved
	1.7	Reserved
Byte 2	2.0	Reserved
	2.1	Reserved
	2.2	Reserved
	2.3	Reserved
	2.4	Reserved
	2.5	Reserved
	2.6	Reserved
	2.7	Reserved
Byte 3	3.0	Reserved
	3.1	Reserved
	3.2	Reserved
	3.3	Reserved
	3.4	Reserved
	3.5	Reserved
	3.6	Reserved
	3.7	Reserved
Byte 4	4.0	Reserved
	4.1	Reserved
	4.2	Reserved
	4.3	Reserved
	4.4	Reserved
	4.5	Reserved
	4.6	Reserved
	4.7	Reserved
Byte 5	5.0	Reserved
	5.1	Reserved
	5.2	Reserved
	5.3	Reserved
	5.4	Reserved
	5.5	Reserved
	5.6	Reserved
	5.7	Reserved

OUTPUT

Table 27: Process image for S3000 PROFINET IO/IO-OF Professional OUTPUT

	Bit	Description
Byte 0	0.0	Monitoring case switching A1
	0.1	Monitoring case switching A2
	0.2	Monitoring case switching B1
	0.3	Monitoring case switching B2
	0.4	Monitoring case switching C1
	0.5	Monitoring case switching C2
	0.6	Monitoring case switching D1
	0.7	Monitoring case switching D2
Byte 1	1.0	Reset the protective field
	1.1	Reserved
	1.2	Reset the simultaneous protective field
	1.3	Reserved
	1.4	Standby
	1.5	Initialization
	1.6	Reserved
	1.7	Reserved
Byte 2	2.0	Reserved
	2.1	Reserved
	2.2	Reserved
	2.3	Reserved
	2.4	Reserved
	2.5	Reserved
	2.6	Reserved
	2.7	Reserved
Byte 3	3.0	Reserved
	3.1	Reserved
	3.2	Reserved
	3.3	Reserved
	3.4	Reserved
	3.5	Reserved
	3.6	Reserved
	3.7	Reserved
Byte 4	4.0	Reserved
	4.1	Reserved
	4.2	Reserved
	4.3	Reserved
	4.4	Reserved
	4.5	Reserved
	4.6	Reserved
	4.7	Reserved

	Bit	Description
Byte 5	5.0	Reserved
	5.1	Reserved
	5.2	Reserved
	5.3	Reserved
	5.4	Reserved
	5.5	Reserved
	5.6	Reserved
	5.7	Reserved

12.3 PROFINET diagnostic messages

Operational statuses:

- Waiting for configuration
- Lock-out
- Device error
- Error in the sensor head
- Error in the I/O module
- Error in the system plug
- Measured value error in a 90° segment
- Dazzle
- Temperature error
- Undefined monitoring case
- Sequence error in field set switching
- Invalid input state
- Contamination error or contamination measurement
- PROFIsafe communication error

12.4 Data sheet

General details

Table 28: General details

	Minimum	Typical	Maximum
Typ (IEC 61496)	Type 3		
Safety integrity level (IEC 61508) [1]	SIL 2		
Safety integrity level (IEC 62061) [1]	SIL 2		
Category (ISO 13849)	Category 3		
Performance level (ISO 13849)	PL d		
PFH (T_{amb} = 25 °C) (average frequency of a dangerous failure per hour)			8×10^{-8} h^{-1}
T_M (mission time) (ISO 13849)	20 years		
Laser class	Laser class 1 (according to IEC 60825-1 as well as CDRH 21 CFR 1040.10 and 1040.11, except compliance with IEC 60825-1:2014, as described in Laser Notice No. 56 dated May 8, 2019)		
Enclosure rating (IEC 60529)	IP65		
Ambient operating temperature	–10 °C		+50 °C

	Minimum	Typical	Maximum
Storage temperature	–25 °C		+50 °C +70 °C (≤ 24 h)
Humidity (taking into account the ambient operating temperature)	IEC 61496-1, section 5.1.2 and 5.4.2 IEC 61496-3, section 5.4.2		
Height above sea level during operation			2,300 m
Protective field range			
Short Range			4.00 m
Medium Range			5.50 m
Long Range			7.00 m
Range of services			
Advanced	4 protective fields and warning fields (field sets)		
Professional	8 protective fields and warning fields (field sets)		
Vibration resistance [2]			
Standards	• IEC 60068-2-6 • IEC 60068-2-64 • IEC 60721-3-5 • IEC TR 60721-4-5 • IEC 61496-3		
Class	5M1 (IEC 60721-3-5)		
Sinusoidal vibrations	• 0.35 mm, 50 m/s^2, 10 Hz ... 150 Hz • 1.5 mm, 0.5 g, 5 Hz ... 200 Hz		
Noise vibrations	• 0.5 m^2/s^3, 5 Hz ... 200 Hz • 0.1 m^2/s^3, 200 Hz ... 500 Hz • 50 m/s^2, 10 Hz ... 500 Hz		
Shock resistance [2]			
Standards	• IEC 60068-2-27 • IEC 60721-3-5 • IEC TR 60721-4-5 • IEC 61496-3		
Class	5M1 (IEC 60721-3-5)		
Single shock	150 m/s^2, 11 ms		
Continuous shock	• 50 m/s^2, 11 ms • 100 m/s^2, 16 ms		
Sender	Pulsed laser diode		
Wavelength	880 nm	905 nm	935 nm
Divergence of collimated beam		2.5 mrad	
Pulse duration			3.1 ns
Average output power			562 µW
Light spot size at front screen		12 mm	
Light spot size at 4.0 m scanning range		23 mm	
Light spot size at 5.5 m scanning range		27 mm	
Light spot size at 7.0 m scanning range		32 mm	
Housing			
Material	Die-cast aluminum		

	Minimum	Typical	Maximum
Color	RAL 1021 (colza yellow)		
Front screen			
Material	Polycarbonate		
Interface	Outside with scratch-resistant coating		
System plug	ESD-protected		
Dimensions [3]			
Height			224 mm
Width			155 mm
Depth			160 mm
Overall weight		3.3 kg	

1) For detailed information on the safety configuration of the machine/system, please consult your SICK subsidiary.
2) For direct mounting.
3) Without cable glands.

Functional information

Table 29: Functional information

	Minimum	Typical	Maximum
Resolution	30 mm, 40 mm, 50 mm, 70 mm, 150 mm		
Protective field of the sensor head with 4.0 m scanning range [1] at 120 ms response time			
At 30 mm resolution			2.80 m
At 40 mm resolution			3.80 m
At 50 mm resolution			4.00 m
At 70 mm resolution			4.00 m
At 150 mm resolution			4.00 m
Protective field of the sensor head with 4.0 m scanning range at 60 ms response time			
At 30 mm resolution			1.90 m
At 40 mm resolution			2.60 m
At 50 mm resolution			3.30 m
At 70 mm resolution			4.00 m
At 150 mm resolution			4.00 m
Protective field of the sensor head with 5.5 m scanning range at 120 ms response time			
At 30 mm resolution			2.80 m
At 40 mm resolution			3.80 m
At 50 mm resolution			4.80 m
At 70 mm resolution			5.50 m
At 150 mm resolution			5.50 m
Protective field of the sensor head with 5.5 m scanning range at 60 ms response time			
At 30 mm resolution			1.90 m
At 40 mm resolution			2.60 m
At 50 mm resolution			3.30 m
At 70 mm resolution			4.70 m
At 150 mm resolution			5.50 m
Protective field of the sensor head with 7 m scanning range at 120 ms response time			

	Minimum	Typical	Maximum
At 30 mm resolution			2.80 m
At 40 mm resolution			3.80 m
At 50 mm resolution			4.80 m
At 70 mm resolution			7.00 m
At 150 mm resolution			7.00 m
Protective field of the sensor head with 7 m scanning range at 60 ms response time			
At 30 mm resolution			1.90 m
At 40 mm resolution			2.60 m
At 50 mm resolution			3.30 m
At 70 mm resolution			4.70 m
At 150 mm resolution			7.00 m
Scanning angle			190° (–5° to +185°)
Radiance factor	1.8%		Several 1,000% (reflectors)
Angular resolution	0.5°		0.25°
Generally necessary protective field supplement			100 mm
Supplement for retro-reflectors on scan plane with distance of less than 1 m to protective field boundary			200 mm
Measurement error for measurement data output up to 5.5 m and 1.8% radiance factor			
Systematic error		± 5 mm	
Statistical including systematic error			
At 1 σ		± 24 mm	
At 2 σ		± 43 mm	
At 3 σ		± 62 mm	
At 4 σ		± 80 mm	
At 5 σ		± 99 mm	
Flatness of the scan field at 5.5 m			± 70 mm
Flatness of the scan field at 7 m			± 88 mm
Distance of mirror rotational axis (zero point of X- and Y-axis) to rear side of device	93 mm		
Distance between center point of scan plane and bottom edge of the housing	63 mm		
Warning field range (radial)		Approx. 20 m [2]	49 m
Distance measurement range			49 m
Number of multiple samplings (can be configured via CDS)	2		16
Power-up delay		9 s	20 s
Restart after (can be configured)	2 s		60 s

1) Radial distance to the safety laser scanner.
2) For objects with 20% radiance factor.

Electric

Table 30: Electric

	Minimum	Typical	Maximum
Electrical protection class	III (VDE 0106, EN 60950)		
Bus connection	2 standard PROFINET IO female connectors for push-pull plug connectors with metal housing (RJ45 or SCRJ)		
Levels for input information			
Restart [1]	Activated on low-high transition		
Initialization	Activated on low-high transition		
Standby	Activated on permanently high		
Monitoring case switching [1]	Static (complementary)		
Supply voltage (SELV) [2] [3]	16.8 V	24 V	28.8 V
Permissible residual ripple [4]			± 5%
Start-up current [5]			2 A
Operating current without output load [6]		0.6 A	0.8 A
Operating current with maximum output load [6]		2.2 A	2.3 A
Power consumption without output load [6]		14 W	19 W
Power consumption with maximum output load [6]		53 W	55 W
Power consumption in standby mode or park mode without output load		14 W	19 W
Electrical connection	**Plug-in device connection plug:** • Cable gland for cable diameter of 5 mm ... 10 mm • Screw terminal connection for maximum wire cross-section 1.5 mm^2 • Integrated configuration memory		
Screw terminal technical data			
Rigid wire cross-circuit	0.14 mm^2		1.5 mm^2
Flexible wire cross-circuit [7]	0.14 mm^2		1.0 mm^2
American wire gage (AWG)	26		16
Wire stripping length		5 mm	
Screw tightening torque	0.22 Nm		0.25 Nm
Cable length for power supply tolerance ± 10%			
At wire cross-section 1 mm^2			50 m
with a wire cross-section of 0.5 mm^2			25 m
with a wire cross-section of 0.25 mm^2			12 m
Cable length for power supply tolerance ± 5%			
At wire cross-section 1 mm^2			60 m
with a wire cross-section of 0.5 mm^2			30 m
with a wire cross-section of 0.25 mm^2			15 m
Cable length for power supply tolerance ± 1%			
At wire cross-section 1 mm^2			70 m
with a wire cross-section of 0.5 mm^2			35 m
with a wire cross-section of 0.25 mm^2			17 m
Configuration and diagnostic interface			
Communication protocol	RS232 (proprietary)		

	Minimum	Typical	Maximum
Transmission rate	9,600 Baud 19,200 Baud 38,400 Baud		
Cable length for 9,600 Baud and 0.25 mm^2 cables			15 m
Galvanic separation	No		
Output TxD HIGH	5 V		15 V
Output TxD LOW	–15 V		–5 V
Voltage range RxD	–15 V		15 V
Switching threshold RxD LOW	–15 V		0.4 V
Switching threshold RxD HIGH	2.4 V		15 V
Short-circuit current at TxD	–60 mA		60 mA
Maximum voltage level at RxD	–15 V		15 V
Maximum voltage level at TxD	–11 V		11 V

1) Fail-safe input signals are required.
2) Operation only in a short-circuit protected system with max. 8 A.
3) To meet the requirements of the relevant product standards (e.g., IEC 61496-1), the external voltage supply for the devices must be able to bridge a brief mains failure of 20 ms. Power supply units according to EN 60204-1 fulfill this prerequisite. Suitable power supply units are available as accessories from SICK.
4) The absolute voltage level must not drop below the specified minimum voltage.
5) The load currents for the input capacitors are not taken into account.
6) With a typical supply voltage of 24 V.
7) Ferrules are not needed.

Optical fiber

Table 31: Optical fiber

	Minimum	Typical	Maximum
Wavelength of the transmitter (EN 72471)		650 nm	
Diameter of the fiber-optic cable of the POF cables	980 µm	1,000 µm	
Length of cable			50 m
Line attenuation [1]			12 dB

1) Observe the mounting and wiring instructions of the manufacturer of the plug connectors and cables, in particular with regard to the number of bending radiuses.

12.5 Services supported

- PROFINET IO Conformance Class B
- LLDP according to IEEE 802.1 AB
- SNMP
- MIB-II
- Cyclic IO communication
- Acyclic read/write services for communication via TCI interface
- Diagnostic alarms
- TCP/IP communication via port 9000
- MRP client support

12.6 Characteristic curves

Scanning range for warning fields

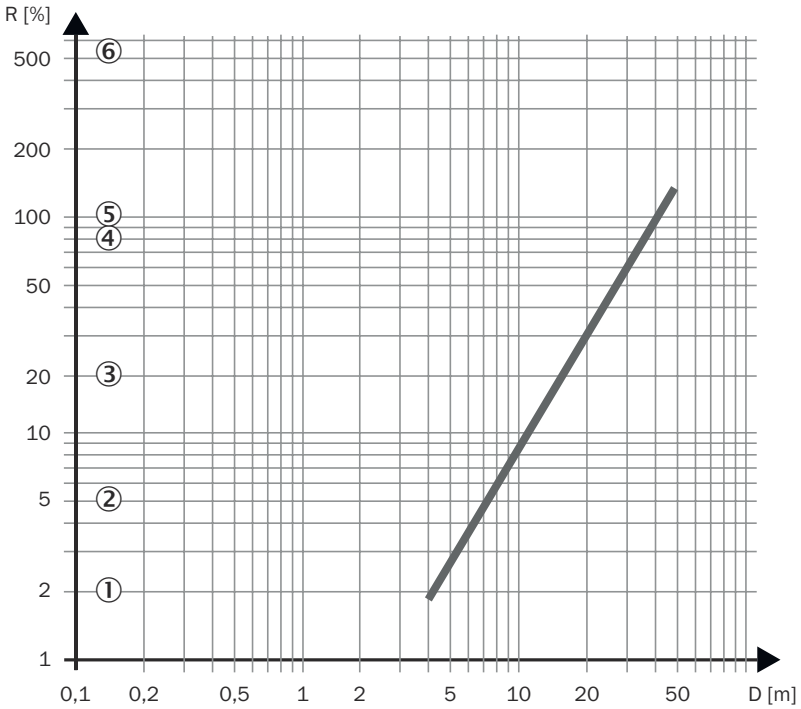


Figure 71: Diagram for scanning range of Short Range sensor head (maximum scanning range 4 m)

R Necessary minimum radiance factor in %
D Scanning range in m
① Black shoe leather
② Matt black paint
③ Gray cardboard
④ Writing paper
⑤ White plaster
⑥ Reflectors > 2,000%, reflective tapes > 300%

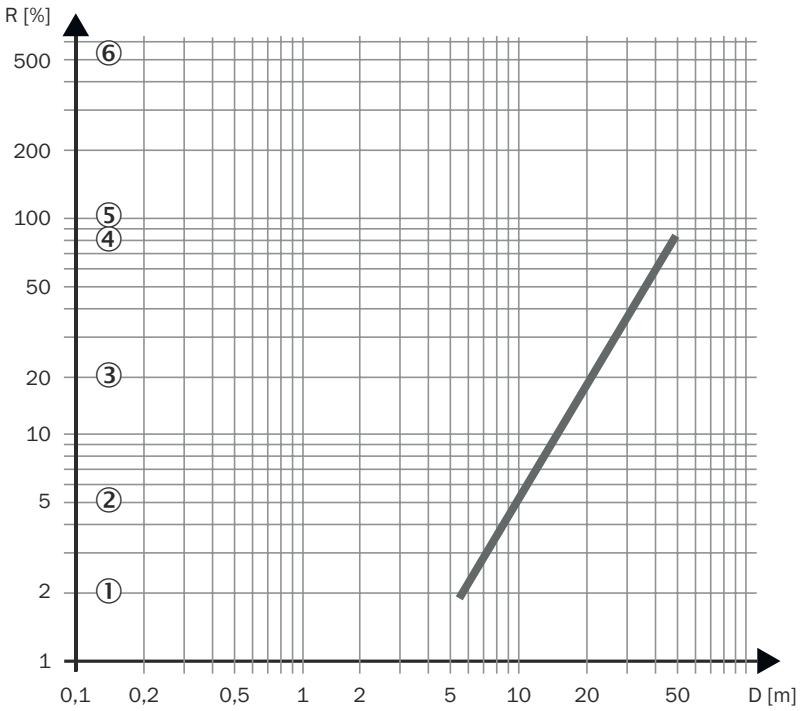


Figure 72: Diagram for scanning range of Medium Range sensor head (maximum scanning range 5.5 m)

R Necessary minimum radiance factor in %
D Scanning range in m
① Black shoe leather
② Matt black paint
③ Gray cardboard
④ Writing paper
⑤ White plaster
⑥ Reflectors > 2,000%, reflective tapes > 300%

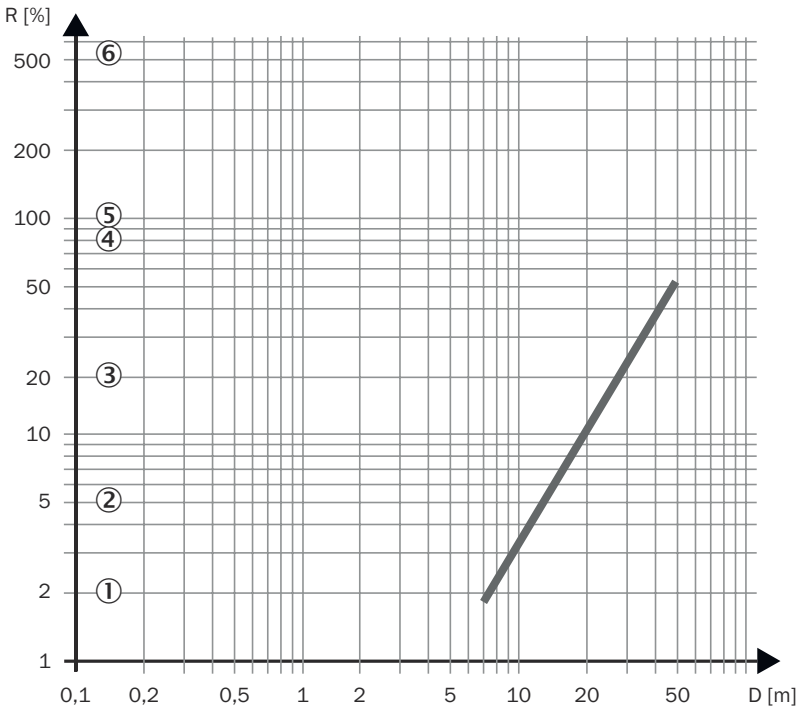


Figure 73: Diagram for scanning range of Long Range sensor head (maximum scanning range 7 m)

R Necessary minimum radiance factor in %
D Scanning range in m
① Black shoe leather
② Matt black paint
③ Gray cardboard
④ Writing paper
⑤ White plaster
⑥ Reflectors > 2,000%, reflective tapes > 300%

12.7 Response times

Overview

The total response time of the application depends on the:

- Basic response time at the related resolution and the maximum protective field range
- Set multiple sampling
- Response time of the I/O module
- Transfer and cycle time for the bus information
- Response time of the controller and actuators

Total response time T_S

Response time on protective field or warning field interruption

- S3000 basic response time
- + resulting response time supplement due to multiple sampling
- + response time of the I/O module (8 ms)
- + response time of the FPLC

Table 32: Calculating the response time, example

60 ms basic response time (resolution = 0.5°)
\+ 90 ms (multiple sampling = 5)

\+ 8 ms response time of the I/O module
= 158 ms (+ response time of the FPLC)

Multiple sampling

Multiple sampling is always set to at least 2 on the device. For a multiple sampling of 3 or above, a supplement must be added to the response time. The related supplement is dependent on the basic response time and the multiple sampling.

Table 33: Supplements for multiple sampling

Multiple sampling	Supplement for basic response time 60 ms	Supplement for basic response time 120 ms
3 times	30 ms	60 ms
4 times	60 ms	120 ms
5 times	90 ms	180 ms
6 times	120 ms	240 ms
7 times	150 ms	300 ms
8 times	180 ms	360 ms
9 times	210 ms	420 ms
10 times	240 ms	480 ms
11 times	270 ms	540 ms
12 times	300 ms	600 ms
13 times	330 ms	660 ms
14 times	360 ms	720 ms
15 times	390 ms	780 ms
16 times	420 ms	840 ms

Response to input information

In the case of monitoring case switching, the advancement of the timing of the switching must be taken into consideration.

The response time of the safety laser scanner to input information comprises:

- S3000 basic response time
- + configured input delay
- + response time of the I/O module (2 × 8 ms = 16 ms)
- + response time of the FPLC

Table 34: Calculating the response time to input information, example

60 ms basic response time (resolution = 0.5°)
\+ 30 ms (configured input delay)
\+ 16 ms
= 106 ms (+ response time of the FPLC)

Further topics

- "Basic response time", page 74

12.8 Dimensional drawings

Safety laser scanner

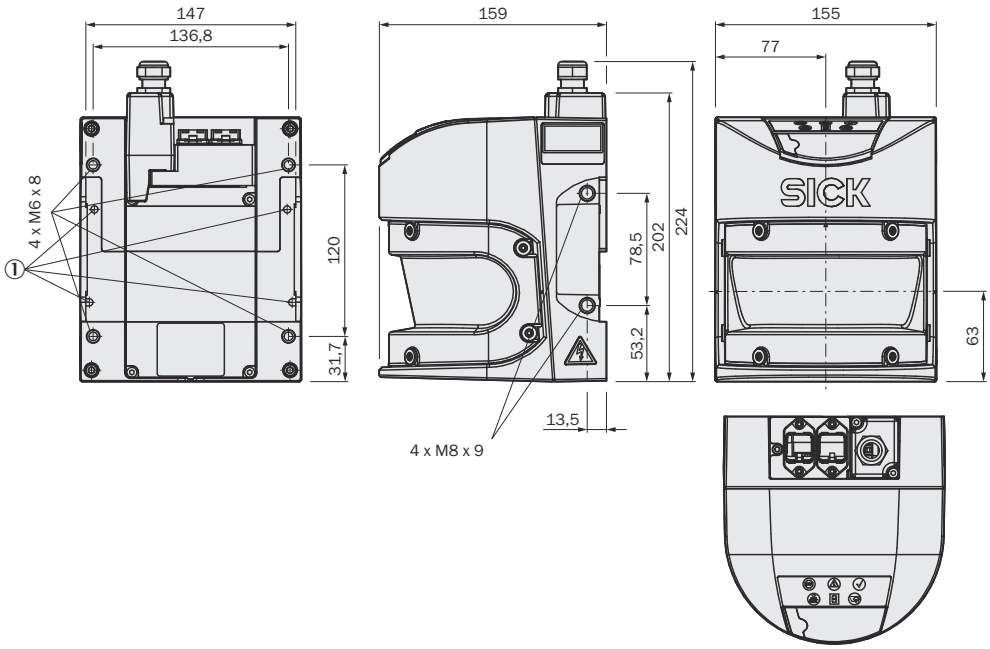


Figure 74: Dimensional drawing safety laser scanner (mm)

① 4 reference points for mounting

Scan plane origin

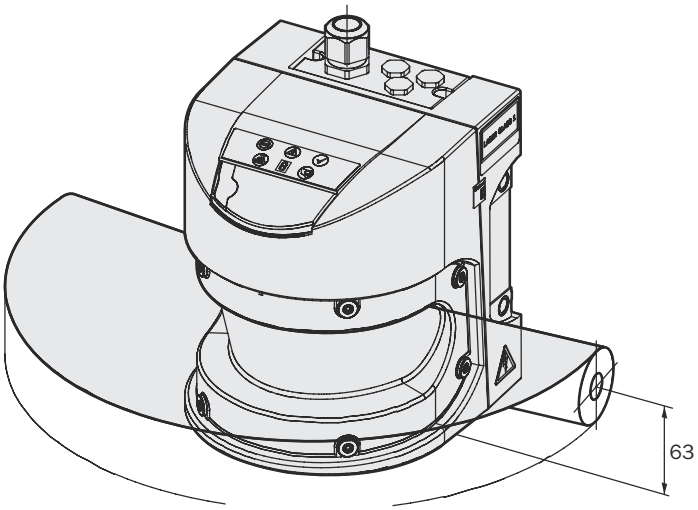


Figure 75: Dimensional drawing scan plane origin (mm)

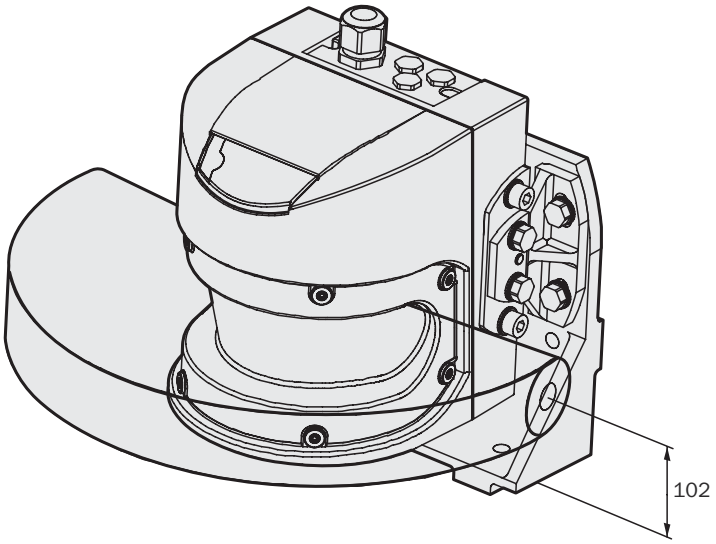


Figure 76: Dimensional drawing scan plane origin with mounting kit 3 (mm)

13 Ordering information

13.1 Scope of delivery

- S3000 PROFINET IO/IO-OF
- Safety note
- Mounting instructions
- “Important notes” adhesive label
- Operating instructions and CDS (Configuration & Diagnostic Software) available for downloading at: www.sick.com

13.2 Ordering information

Table 35: Part number, system with RJ45 female connectors

Part	Type code	Part number
S3000 PROFINET IO Advanced with Short Range sensor head (4 m)	S30A-4111CP	1045650
S3000 PROFINET IO Professional with Short Range sensor head (4 m)	S30A-4111DP	1045651
S3000 PROFINET IO Advanced with Medium Range sensor head (5.5 m)	S30A-6111CP	1045652
S3000 PROFINET IO Professional with Medium Range sensor head (5.5 m)	S30A-6111DP	1045653
S3000 PROFINET IO Advanced with Long Range sensor head (7 m)	S30A-7111CP	1045654
S3000 PROFINET IO Professional with Long Range sensor head (7 m)	S30A-7111DP	1045655

Table 36: Part number, system with SCRJ female connectors (optical fiber)

Part	Type code	Part number
S3000 PROFINET IO-OF Advanced with Short Range sensor head (4 m)	S30A-4111CL	1052591
S3000 PROFINET IO-OF Professional with Short Range sensor head (4 m)	S30A-4111DL	1052592
S3000 PROFINET IO-OF Advanced with Medium Range sensor head (5.5 m)	S30A-6111CL	1052593
S3000 PROFINET IO-OF Professional with Medium Range sensor head (5.5 m)	S30A-6111DL	1052594
S3000 PROFINET IO-OF Advanced with Long Range sensor head (7 m)	S30A-7111CL	1052595
S3000 PROFINET IO-OF Professional with Long Range sensor head (7 m)	S30A-7111DL	1052596

14 Spare parts

14.1 Sensor heads

Table 37: Part numbers, sensor heads

Part	Type code	Part number
Sensor head 4 m	S30A-411	2049566
Sensor head 5.5 m	S30A-611	2049567
Sensor head 7 m	S30A-711	2049568

14.2 I/O modules

Table 38: Part numbers, I/O modules

Part	Type code	Part number
I/O module S3000 PROFINET IO Advanced	S30A-xxxxCP	2047737
I/O module S3000 PROFINET IOOF Advanced	S30A-xxxxCL	2057800

Table 39: Part numbers, I/O modules

Part	Type code	Part number
I/O module S3000 PROFINET IO Professional	S30A-xxxxDP	2047169
I/O module S3000 PROFINET IOOF Professional	S30A-xxxxDL	2057801

14.3 Power supply plug

Table 40: Part numbers, supply connectors

Part	Type code	Part number
Power supply plug	Sx1A, A0000L	2047286
Power supply plug with 1 m cable	Sx1A, B0201L	2049575
Power Y-distribution with supply connector (available on request)	SX1A-B0201M	2049857

For additional accessories related to PROFINET connector technology, e.g., RJ45 push-pull connection plugs, see www.phoenixcontact.com.

15 Accessories

Suitable accessories are available at www.sick.com. Enter the product part number in the search field (part number: see the type label entry in the “Ident. no.” field or in the “P/N” field). All suitable accessories are listed on the Accessories tab of the product page.

16 Glossary

AGV	Automatic Guided Vehicle: driverless vehicle used for transport.
AWG	American Wire Gage: standardization and classification of wires and cables according to type, diameter, etc.
Control input	A control input receives signals, e.g. from the machine or from the control. Use of control inputs is how the protective device receives information about the conditions at the machine, e.g., if there is a change of operating mode. If the protective device is configured appropriately, it will activate a different monitoring case after receiving a new control input. The control input information must be transmitted reliably. Generally, at least 2 separate channels are used to do this. Depending on the device, a control input can be realized as a static control input or a dynamic control input.
Dangerous state	A dangerous state is a status of the machine or facility, where people may be injured. Protective devices prevent this risk if the machine is operated within its intended use. The figures in this document always show the dangerous state of the machine as movement of a machine part. In practice, there are different dangerous states, such as: • Machine movements • Electrical parts • Visible and invisible beam • A combination of multiple hazards
Electro-sensitive protective device	An electro-sensitive protective device is a device or system of devices for safety-related detection of people or parts of the body. It is used to protect people from machines and facilities that pose a risk of injury. It triggers the machine or facility to adopt a safe state before a person is exposed to a hazardous situation. Examples: Safety light curtain, safety laser scanner.
ESD	Electrostatic discharge
ESPE	Electro-sensitive protective device
Field set	A field set consists of one or more fields. The fields in a field set are monitored simultaneously. A field set can contain different field types, e.g., a protective field and a warning field.
FPLC	Fail-safe programmable logic controller
Hazardous area	Hazardous area is any space within and/or around machinery in which a person can be exposed to a hazard. (ISO 12100)
Light spot	The light spot is the projection of the light beam on a plane perpendicular to the light beam. The light beam size depends on the distance between the light source and the surface on which the light beam strikes.
Monitoring case	A monitoring case indicates the machine status to the sensor. Generally, one field set is assigned to each monitoring case. The sensor receives a defined signal for the current machine status. When a signal change occurs, the sensor activates the monitoring case and thereby the field set that is associated with the new machine status.

OFF state	The OFF state is the status of the outputs of the protective device, where the controlled machine is triggered to quit its dangerous state and the start-up of the machine is prevented (e.g., the voltage at the OSSDs is LOW, so that the machine is switched off and remains still).
PL	Performance level (ISO 13849)
PROFINET	PROFINET (Process Field Protocol) is an Ethernet-based network used in industrial automation. With PROFIsafe , PROFINET is also suitable for safety-oriented data communication.
Protective field	The protective field is the area in which the test object specified by the manufacturer is detected by the electro-sensitive protective equipment (ESPE). As soon as the electro-sensitive protective device detects an object in the protective field, it switches the associated safety outputs to the OFF state. This signal can be passed to controllers resulting in the dangerous state coming to an end, e.g. to stop the machine or the vehicle.
Reset	When a protective device has sent a stop command, the stopped state must be maintained until a reset device is activated and the machine can be restarted in a second step. The reset brings the protective device back to the monitoring state after it has sent a stop command. The reset also quits the start-up or restart interlock of a protective device, so that the machine can be restarted in a second step. The reset must only be possible, when all safety functions and protective devices are functional. The reset of the protective device must not introduce any movement or dangerous situations itself. The machine is only permitted to start after the reset once a separate start command has been sent. • Manual resets are performed using a separate, manually operated device, such as a reset pushbutton. • Automatic resets by the protective device are only permitted in special cases, if one of the following conditions is met: o It must not be possible for people to be in the hazardous area without triggering the protective device. o It must be ensured that no people are in the hazardous area during or after the reset.
Resolution	The resolution of an active opto-electronic protective device (also known as the sensor detection capability) is the minimum size of an object for it to be reliably detected.
Response time	The protective device's response time is the maximum time between the occurrence of the event leading to the sensor's response and supply of the switch-off signal to the protective device's interface (for example OFF state of the OSSD pair).
Restart interlock	The restart interlock prevents the machine from automatically starting up, for example after a protective device has responded while the machine is operating or after changing the machine's operating mode. The restart interlock can be implemented in the protective device or in the safety controller. A command to reset the protective device must be given, for example using a reset pushbutton, before the machine can be restarted.

Scan plane	The scan plane is the geometric plane in which the 2D laser scanner captures its environment. A scan layer is created by deflecting a laser beam using a rotating mirror. In practice, the area scanned is not precisely flat. Deviations from the ideal plane are specified as a conical error. Deviations from the ideal alignment are specified as a tilt error.
SIL	Safety integrity level
Start interlock	The start interlock prevents the machine from automatically starting up, for example after if the voltage supply of the electro-sensitive protective device (BWS) is switched on or is restored after an interruption.
Warning field	The warning field monitors larger areas than the protective field. Simple switching functions can be triggered with the warning field, e.g. a warning light or an acoustic signal can be triggered if a person approaches, even before the person enters the protective field. The warning field must not be used for safety applications.

17 Annex

17.1 Conformities and certificates

You can obtain declarations of conformity, certificates, and the current operating instructions for the product at www.sick.com. To do so, enter the product part number in the search field (part number: see the entry in the “P/N” or “Ident. no.” field on the type label).

17.1.1 EU declaration of conformity

Excerpt

The undersigned, representing the manufacturer, herewith declares that the product is in conformity with the provisions of the following EU directive(s) (including all applicable amendments), and that the standards and/or technical specifications stated in the EU declaration of conformity have been used as a basis for this.

- ROHS DIRECTIVE 2011/65/EU
- EMC DIRECTIVE 2014/30/EU
- MACHINERY DIRECTIVE 2006/42/EC

17.1.2 UK declaration of conformity

Excerpt

The undersigned, representing the following manufacturer herewith declares that this declaration of conformity is issued under the sole responsibility of the manufacturer. The product of this declaration is in conformity with the provisions of the following relevant UK Statutory Instruments (including all applicable amendments), and the respective standards and/or technical specifications have been used as a basis.

- Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
- Electromagnetic Compatibility Regulations 2016
- Supply of Machinery (Safety) Regulations 2008

17.2 Note on standards

Standards are specified in the information provided by SICK. The table shows regional standards with similar or identical contents. Not every standard applies to all products.

Table 41: Note on standards

Standard	Standard (regional)
	China
IEC 60068-2-6	GB/T 2423.10
IEC 60068-2-27	GB/T 2423.5
IEC 60204-1	GB/T 5226.1
IEC 60529	GB/T 4208
IEC 60825-1	GB 7247.1
IEC 61131-2	GB/T 15969.2
IEC 61140	GB/T 17045
IEC 61496-1	GB/T 19436.1
IEC 61496-2	GB/T 19436.2
IEC 61496-3	GB 19436.3
IEC 61508	GB/T 20438

Standard	Standard (regional)
	China
IEC 62061	GB 28526
ISO 13849-1	GB/T 16855.1
ISO 13855	GB/T 19876

17.3 Checklist for initial commissioning and commissioning

Checklist for manufacturers or installers for installing electro-sensitive protective device (ESPE)

The details relating to the items listed below must be available no later than when the system is commissioned for the first time. However, these depend on the specific application (the requirements of which must be reviewed by the manufacturer or installer).

This checklist should be retained and kept with the machine documentation to serve as reference during recurring tests.

This checklist does not replace the initial commissioning, nor the regular inspection by qualified safety personnel.

Have the safety rules and regulations been observed in compliance with the directives and standards applicable to the machine?	Yes ☐ No ☐
Are the applied directives and standards listed in the declaration of conformity?	Yes ☐ No ☐
Does the protective device correspond to the required PL/SIL and PFH in accordance with ISO 13849-1/IEC 62061 and the required type in accordance with IEC 61496-1?	Yes ☐ No ☐
Is access to the hazardous area or hazardous point only possible through the protective field of the ESPE?	Yes ☐ No ☐
Have appropriate measures been taken to protect (mechanical protection) or monitor (protective devices) any persons or objects in the hazardous area when protecting a hazardous area or hazardous point, and have these devices been secured or locked to prevent their removal?	Yes ☐ No ☐
Are additional mechanical protective measures fitted and secured against manipulation which prevent reaching below, above or around the ESPE?	Yes ☐ No ☐
Has the maximum shutdown and/or stopping time of the machine been measured, specified and documented (at the machine and/or in the machine documentation)?	Yes ☐ No ☐
Has the ESPE been mounted such that the required minimum distance from the nearest hazardous point has been achieved?	Yes ☐ No ☐
Are the ESPE devices properly mounted and secured against manipulation after alignment?	Yes ☐ No ☐
Are the required protective measures against electric shock in effect (protection class)?	Yes ☐ No ☐
Is the control switch for resetting the protective devices (ESPE) or restarting the machine present and correctly installed?	Yes ☐ No ☐
Are the outputs of the ESPE (OSSDs or safety outputs via the network) integrated according to the required PL/SIL in accordance with ISO 13849-1 / IEC 62061 and does the integration correspond to the circuit diagrams?	Yes ☐ No ☐
Has the protective function been checked in compliance with the test notes of this documentation?	Yes ☐ No ☐
Are the specified protective functions effective at every operating mode that can be set?	Yes ☐ No ☐
Are the switching elements activated by the ESPE, e.g. contactors, valves, monitored?	Yes ☐ No ☐
Is the ESPE effective over the entire period of the dangerous state?	Yes ☐ No ☐
Once initiated, will a dangerous state be stopped when switching the ESPE on or off and when changing the operating mode, or when switching to another protective device?	Yes ☐ No ☐

18 List of figures

19 List of tables

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