S300

Safety laser scanners

SICK
Sensor Intelligence.

Described product

S300

Manufacturer

SICK AG
Erwin-Sick-Str. 1
79183 Waldkirch
Germany

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: S300
- "Operating instructions" type label entry:
  - 8010946 AE W284
  - 8010946 AE X175
  - 8010946 AE XK33
  - 8010946 AE YY96
  - 8010946 AE ZA21

Document identification

Document part number:
- This document: 8010948
- Available language versions of this document: 8010946

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 27 "Configuration", page 75 "Technical data", page 123 "Accessories", page 140
Installers	"Mounting", page 58
Electricians	"Electrical installation", page 64
Safety experts (such as CE authorized representatives, compliance officers, people who test and approve the application)	"Project planning", page 27 "Configuration", page 75 "Commissioning", page 105 "Technical data", page 123 "Checklist for initial commissioning and commissioning", page 150
Operators	"Troubleshooting", page 115
Maintenance personnel	"Maintenance", page 109 "Troubleshooting", page 115

1.4 Further information

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:

Safety notes 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
Indicates useful tips and recommendations.

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 "OSSDs in OFF state" LED lights up permanently.
    ✹   The "Error/Contamination" LED flashes.

⚠ The "Warning field interrupted" LED is OFF.

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.

Product integration

⚠️ **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**
If any operating or adjusting devices other than those specified in this document are used or other methods are employed, this can lead to dangerous exposure to radiation.

▶ Only use the operating or adjusting devices specified in this document.
▶ Only follow the methods specified in this document.
▶ Do not open the housing, except for the purposes of the installation and maintenance work specified in these operating instructions.

CLASS 1
LASER PRODUCT

IEC 60825-1 : 2007 & 2014. Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50 , June 2007
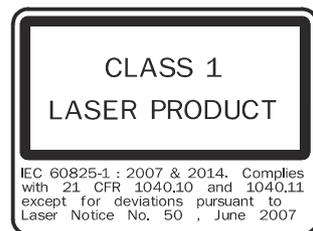
Figure 1: Laser class 1

This device complies with the following standards:
- IEC 60825-1:2007
- IEC 60825-1:2014
- 21 CFR 1040.10 and 1040.11, except for changes due to Laser Notice No. 50 dated 24/06/2007

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 device is intended for monitoring hazardous areas in closed rooms.

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 satisfies the requirements of Class A (industrial environment) of the generic EMC standard; the device is therefore only suitable for use in industrial environments.

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 SIL2 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.
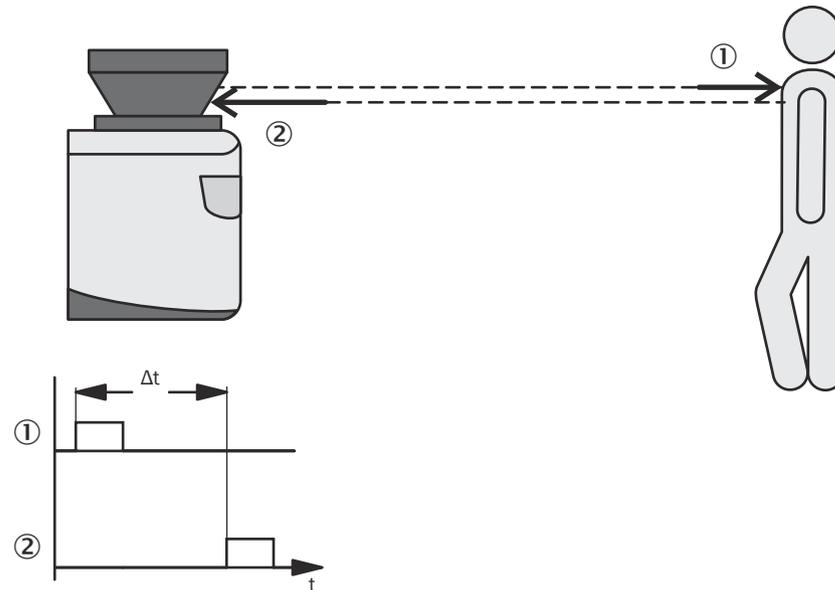
Figure 2: Principle of operation of the safety laser scanner time-of-flight measurement

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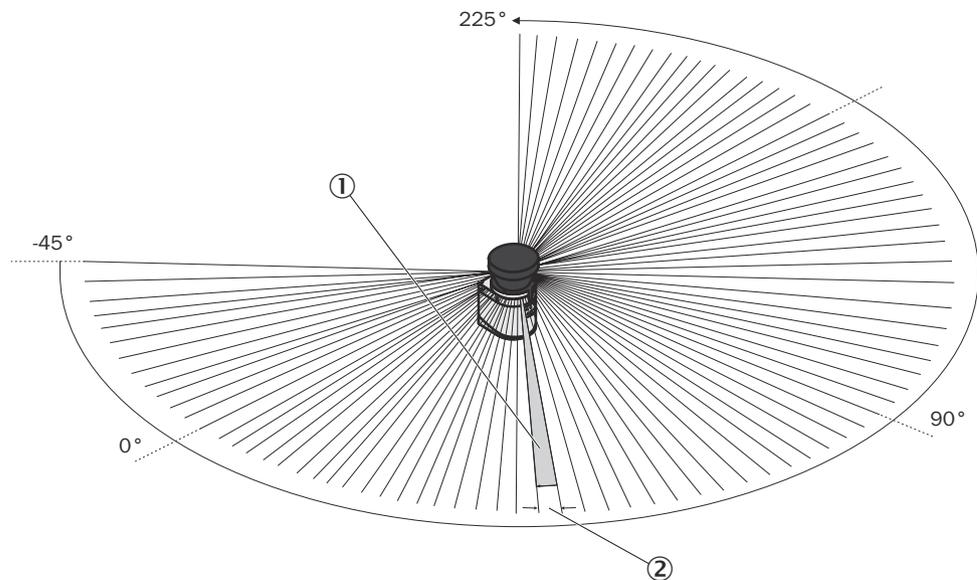
Figure 3: Principle of operation of the safety laser scanner rotation

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 270° sector of a circle. This means an object in the protective field can be detected within 270°. The first beam of a scan begins at −45° in relation to the rear side of the safety laser scanner.

The device emits the light pulses with an angular resolution of 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 OSSDs on the safety laser scanner. That is, before the person reaches the hazardous points or hazardous areas.
  Or:
- It must be possible to change the dangerous state of the machine, the system or the vehicle into a safe state at any time by means of the OSSDs on a safety controller connected to the S300 Mini Standard or another safety laser scanner.

- 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 58
- "Commissioning", page 105

3.2 Product characteristics

3.2.1 Specific features

- 270° scanning angle
- Increased dust and particle tolerance due to dazzle and particle algorithms
- Product variants with a scanning range up to 2 m or 3 m (maximum radii of the protective field)
- Configuration via PC or notebook using the SICK Configuration & Diagnostic software
- Configuration memory in the system plug. If the device is exchanged, the existing configuration is automatically transmitted to the newly-connected safety laser scanner. This considerably reduces downtimes.
- Field sets comprising one protective field and up to 2 warning fields
- Contour monitoring of the protective field if using only one warning field
- 5 universal I/O connections
- Integrated external device monitoring (EDM)
- Integrated configurable restart interlock/restart delay
- Secure bus connection via Enhanced Function Interface (EFI) for operation in a system network with other safety laser scanners, with products in the sens:Control product group, or with a Flexi Soft safety controller
- Compatibility mode for interoperability with older generation safety laser scanners

S300 Advanced or higher
- Up to 4 field sets
- Monitoring case switching via static inputs or EFI

S300 Professional or higher
- Up to 8 field sets
- Monitoring case switching via dynamic inputs using incremental encoder
- Speed routing using a Flexi Soft safety controller

S300 Expert
- Up to 16 field sets
- CMS feature for detecting reflectors as artificial landmarks

3.2.2 Device overview

The safety laser scanner comprises 3 components:
- The sensor with the opto-electronic detection system, the LEDs, and the 7-segment display
- The optics cover with the light emission window
- The system plug with configuration memory. The system plug has all the electrical connections except for the configuration interface.
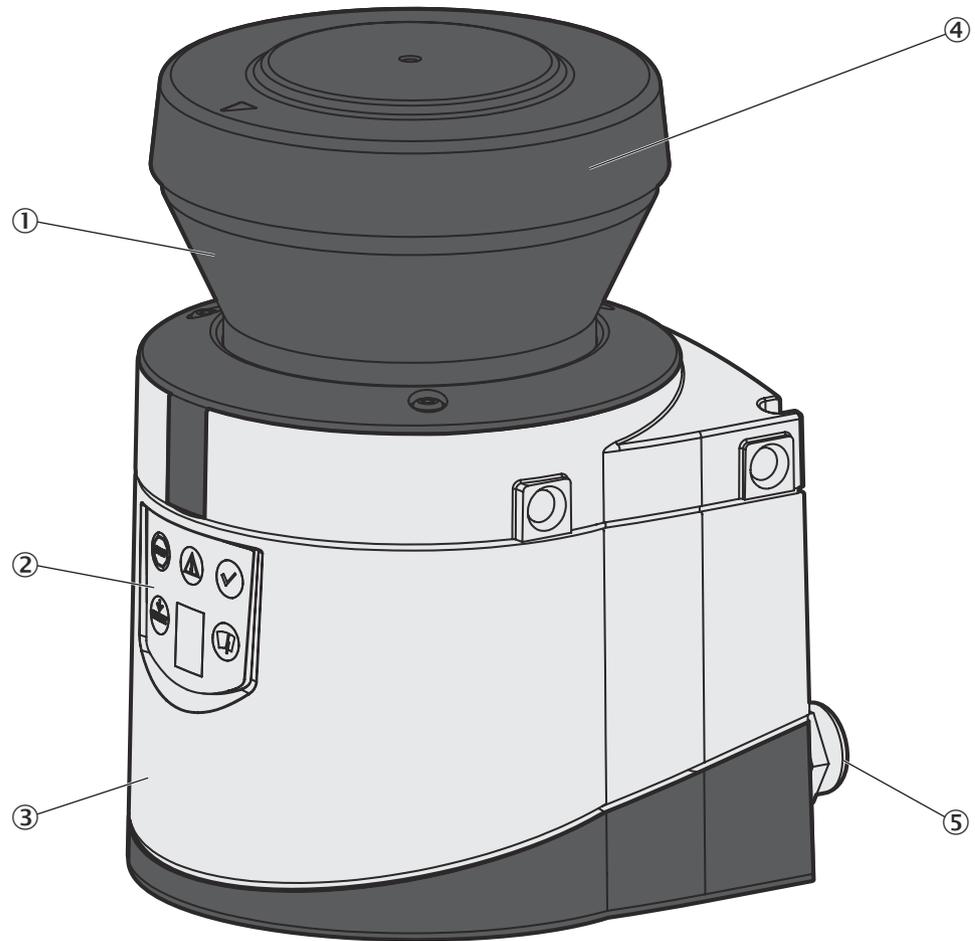
Figure 4: Device components

①   Light emission window
②   LEDs and 7-segment display
③   Sensor
④   Optics cover
⑤   System plug

3.2.3 Functions

Table 2: Functions

Function	Standard	Advanced	Professional	Expert
Protective field range, radial [m]	2/3	2/3	2/3	2/3
Warning field range, radial [m] [1]	8	8	8	8
Object resolution [mm]	30/40/50/ 70/150 [2]	30/40/50/ 70/150 [2]	30/40/50/ 70/150 [2]	30/40/50/ 70/150 [2]
Output signal switching device pairs (OSSDs)	1	1	1	1
External device monitoring (EDM)	✔ [3]	✔ [3]	✔ [3]	✔ [3]
Universal I/O	5	5	5	5
Restart interlock/delay	✔ [3]	✔ [3]	✔ [3]	✔ [3]
Field sets comprising one protective field and 2 warning fields	1	4	8	16

Function	Standard	Advanced	Professio-nal	Expert
Programmable monitoring cases in stand-alone operation	1	4	16	32
Programmable monitoring cases in an EFI system	32	32	32	32
Static control inputs for monitoring case switching	–	2	1	1
Static/dynamic control inputs for monitoring case switching	–	–	2	2
EFI interface (safe SICK device communication)	✔	✔	✔	✔
Park mode, activation by monitoring case	–	✔	✔	✔
Standby, activation by EFI bit or standby input	✔	✔	✔	✔
Configuration memory in the system plug	✔	✔	✔	✔
RS422 data interface	✔	✔	✔	✔
Extended CMS features (reflector detection, filter function for measured values)	–	–	–	✔

[1]   Warning field range for a radiance factor of 30% (see "Characteristic curves", page 130).
[2]   150 mm resolution configurable only for the Long Range variant with a 3 m scanning range.
[3]   Availability depends on the configuration of the universal I/Os (see "Universal I/O connections", page 89).

3.2.4 Scanning ranges

The product variants differ with regards to their maximum scanning range and the resultant protective field size.
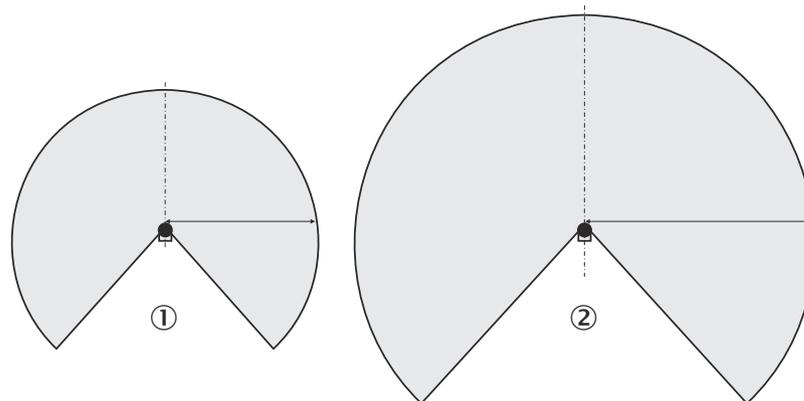
Figure 5: Protective field ranges

①   Medium Range, maximum scanning range 2 m
②   Long Range, maximum scanning range 3 m

3.2.5 Status indicators

The LEDs and 7-segment display indicate the operational status of the device. They are found on the front side of the device.
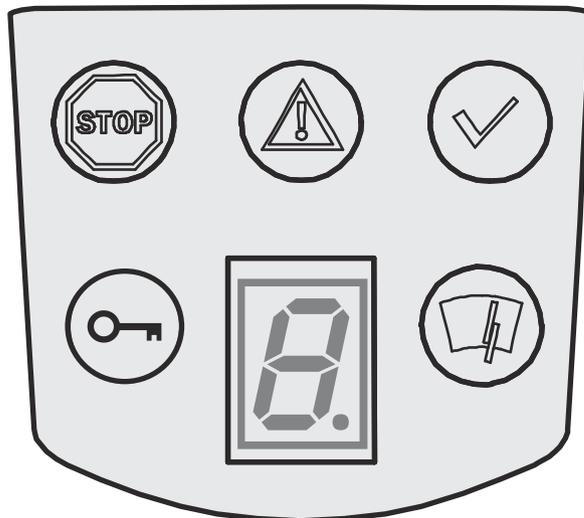
Figure 6: Status indicators of the safety laser scanner

The icons have the following meanings:

Table 3: Status indicators

Symbol	Meaning
⊜	OSSDs in OFF state. For example, Object in the protective field, Monitored contour has changed, Reset required, Lock-out.
⚠	Warning field interrupted (Object in the warning field)
✓	OSSDs in the ON state (No object in the protective field)
⊶	Reset required
▣	Optics cover is dirty
🄰	7-segment display to indicate status and errors

Further topics

- "Error and status indications of the LEDs", page 115
- "Error and status indicators on the 7-segment display", page 117

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 switches the OSSDs to the OFF state 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 product variant, you can define up to 16 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 or two warning fields.
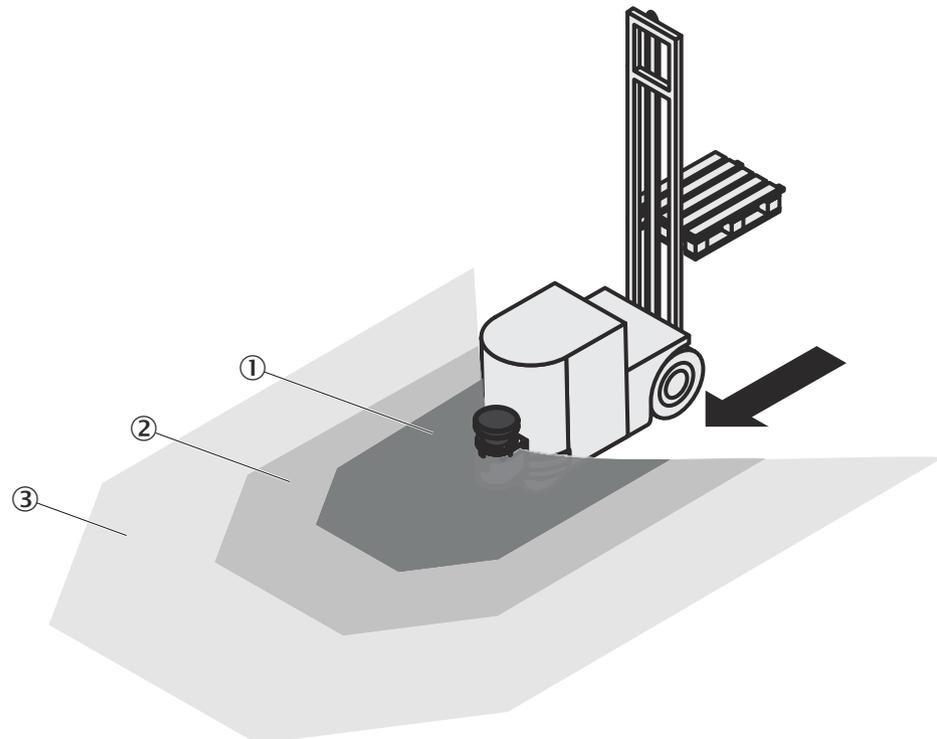
Figure 7: Field set with one protective field and two warning fields

①   Protective field
②   Warning field 1
③   Warning field 2

Further topics

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3.2.7   Monitoring cases

Depending on the product variant, up to 32 monitoring cases can be defined and selected during operation via local static or dynamic control inputs or via EFI. This makes it possible, for example, to perform process-dependent hazardous area protection or speed-dependent vehicle monitoring.
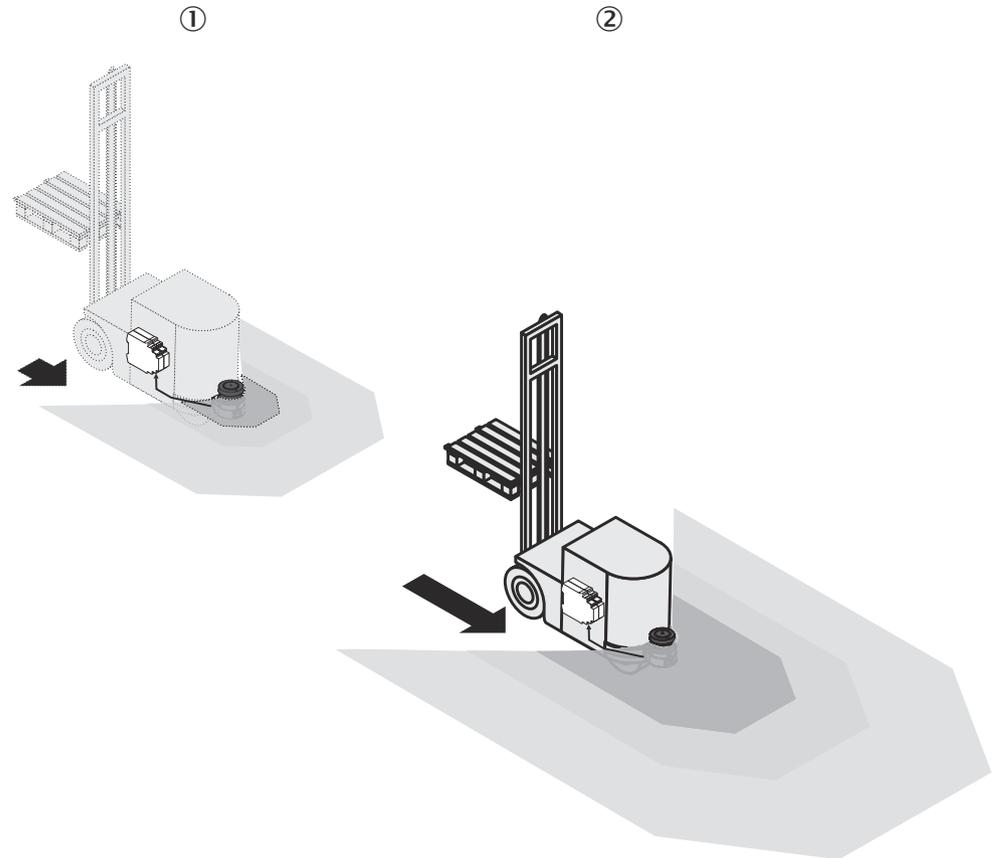
Figure 8: Safety laser scanner with two monitoring cases on one AGV

①   Monitoring case 1, low speed, field set 1

②   Monitoring case 2, high speed, field set 2 with larger protective fields and warning fields

3.2.8 Interoperability

The safety laser scanner can be integrated into an EFI system. An EFI system can comprise two safety laser scanners, one sens:Control device with one or two safety laser scanners, or one Flexi Soft safety controller with up to four safety laser scanners.

The Flexi Soft safety controller supports two EFI strings to which up to two safety laser scanners (S3000, S300, S300 Mini, or mixed) each can be connected. They can therefore be used to implement applications with up to four safety laser scanners.
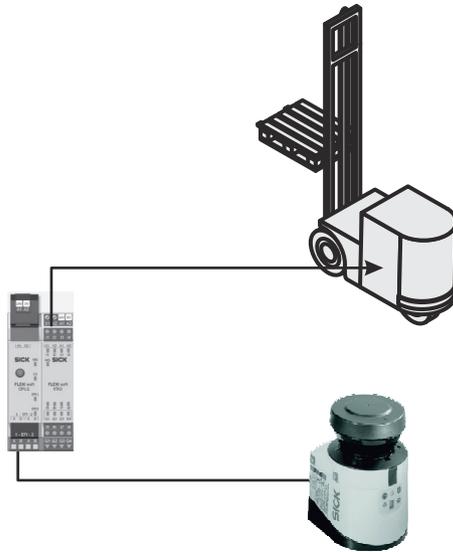
Figure 9: EFI system with Flexi Soft
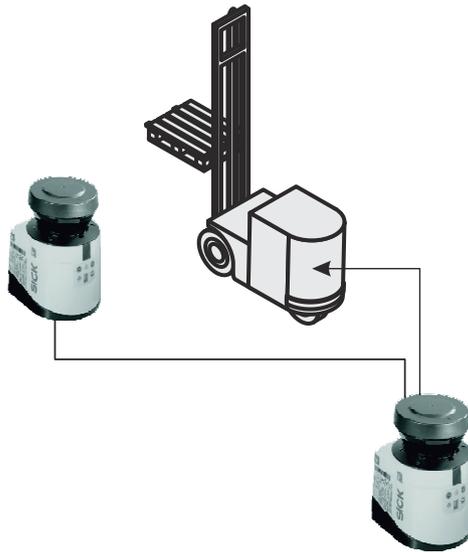
Figure 10: EFI system with safety laser scanner

Addressing the guest

If two safety laser scanners are operated on an EFI string, then one is the host and the other the guest. If only one safety laser scanner is operated on an EFI string, then it is the host.

The addressing enables all devices involved to be uniquely identified, and information to be distributed and accessed via bit assignments (see also the "EFI – Enhanced Function Interface" technical description, SICK part number 8012621).

ⓘ **NOTE**

Addressing the host and guest:
▶ Wire a jumper between terminals 7 and 13 on the guest (see "Pin assignment", page 66).
▶ Do not fit this jumper on the host device. The jumper always defines the guest device.

When switching on the safety laser scanner in an EFI system, the following message appears briefly on the 7-segment display:

- $\boxed{H}$ at the host
- $\boxed{C}$ at the guest

NOTE
In an EFI system with an S3000, the S300 must be configured as the guest. It must not be configured as the host.

3.2.8.1 Interoperability of product variants

In the course of further developing the safety laser scanner, additional functionality such as the triple field technology has been implemented in the devices. The latest devices are therefore not fully compatible with the safety laser scanners already in the field.

To ensure the compatibility of the devices, S300 safety laser scanners with firmware ≥ 02.10 and serial number > 12210000 can be operated in compatibility mode. The following tables show which devices can form an EFI system.

Interoperability with safety laser scanners

Table 4: Interoperability with safety laser scanners

	S3000 Standard	S3000 Advanced	S3000 Professional	S3000 Remote	S3000 Expert	S300 Standard	S300 Advanced	S300 Professional	S300 Expert	S300 Mini Standard [1]	S300 Mini Remote
S300 Standard	✔	✔	✔	✔	✔	✔	✔	✔	✔	–	✔
S300 Advanced	✔	✔	✔	✔	✔	✔	✔	✔	✔	–	✔
S300 Professional	✔	✔	✔	✔	✔	✔	✔	✔	✔	–	✔
S300 Expert	✔	✔	✔	✔	✔	✔	✔	✔	✔	–	✔

[1] This device does not have an EFI interface so it cannot be used in an EFI system.

✔ = EFI system supported

– = EFI system not supported

Interoperability with safety laser scanners in compatibility mode

Table 5: Interoperability with safety laser scanners in compatibility mode

	S3000 Standard	S3000 Advanced	S3000 Professional	S3000 Professional CMS	S3000 Remote	S3000 Expert	S300 Standard [1]	S300 Advanced	S300 Professional	S300 Professional CMS	S300 Expert	S300 Expert CMS	S300 Mini Standard [1]	S300 Mini Remote
S300 Standard	–	–	–	–	–	–	–	–	–	–	–	–	–	–
S300 Advanced	✔	✔	✔	✔	✔	✔	–	✔	✔	✔	✔	✔	–	–
S300 Professional	✔	✔	✔	✔	✔	✔	–	✔	✔	✔	✔	✔	–	–

	S3000 Standard	S3000 Advanced	S3000 Professional	S3000 Professional CMS	S3000 Remote	S3000 Expert	S300 Standard [1]	S300 Advanced	S300 Professional	S300 Professional CMS	S300 Expert	S300 Expert CMS	S300 Mini Standard [1]	S300 Mini Remote
S300 Expert	✔	✔	✔	✔	✔	✔	–	✔	✔	✔	✔	✔	–	–

[1] This device does not have an EFI interface so it cannot be used in an EFI system.

✔ = EFI system supported

– = EFI system not supported

Further topics

- "Compatibility mode", page 76

3.2.8.2 Special considerations for EFI systems

Input signals

In an EFI system, the input signals for monitoring case switching are applied to the inputs of the host or a safety controller. The guest communicates with the host via EFI and receives the input information regarding monitoring case switching from the host.

Monitoring case switching

In an EFI system, the host determines the number of possible monitoring cases. If you have configured an S300 with a higher-level device (S3000 or higher specification S300 or sens:Control device) as the guest, more monitoring cases may be available depending on the system configuration.

Example

You are using an S300 Advanced as a guest for an S300 Professional. The S300 Professional has been configured with 8 monitoring cases. In this case 8 monitoring cases will also be available on the S300 Advanced.

Internal or external OSSDs

In an EFI system, you define which output signal switching device (OSSD) is switched when there is an object in the protective field.

Restart interlock/delay

The effectiveness of a restart interlock/delay configured in the S300 depends on the integration of the EFI status information from the S300 in the logic of the Flexi Soft safety controller.

Further topics

- "OSSDs", page 86
- "Restart", page 87

3.2.8.3 Interoperability with sens:Control devices

The safety laser scanner can be connected to the following sens:Control devices and thereby integrated into the respective bus system.

- The UE4140-22I0000 PROFIsafe gateway
- The UE1140-22I0000 PROFIBUS gateway
- The UE1840-22H0000 Ethernet gateway
- The UE1940-22I0000 CANopen gateway
- The UE4740-20H0000 PROFINET IO gateway

3.3 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.
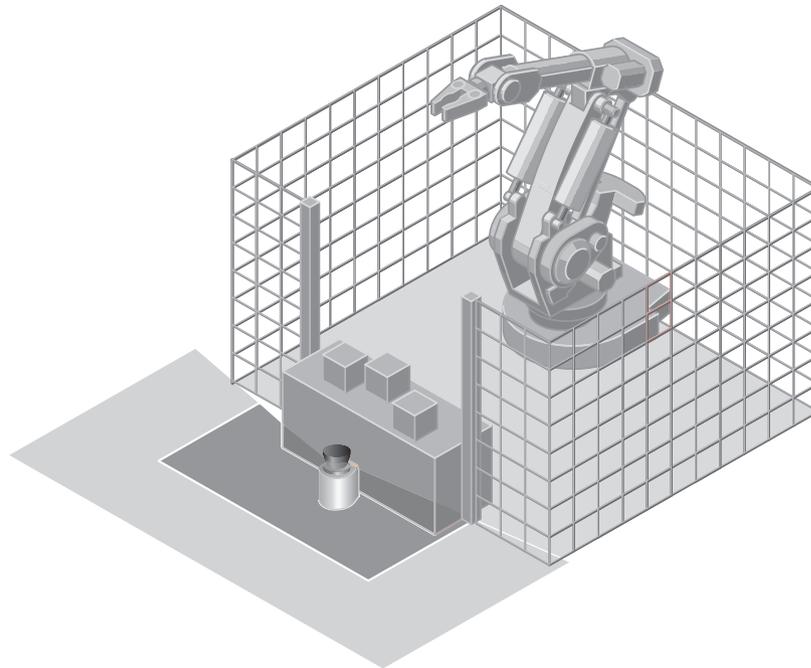
Figure 11: Hazardous area protection: detection of the presence of a person in the hazardous area

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.
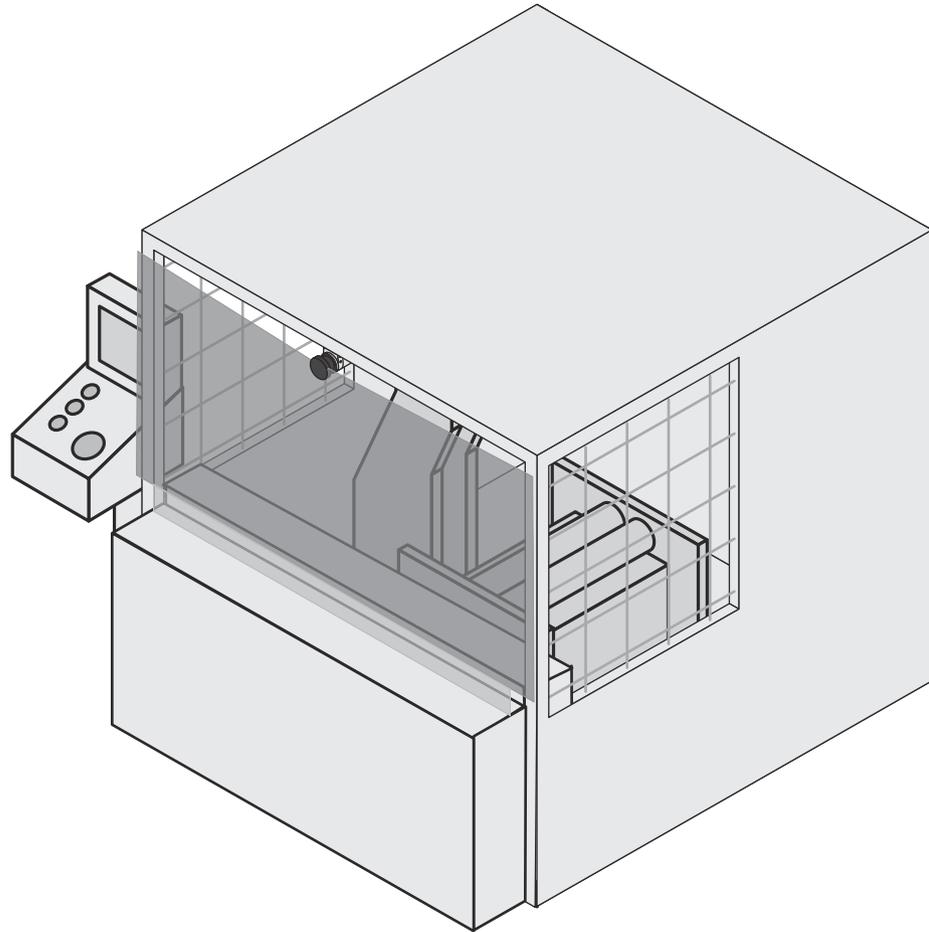
Figure 12: Hazardous point protection: hand detection

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.
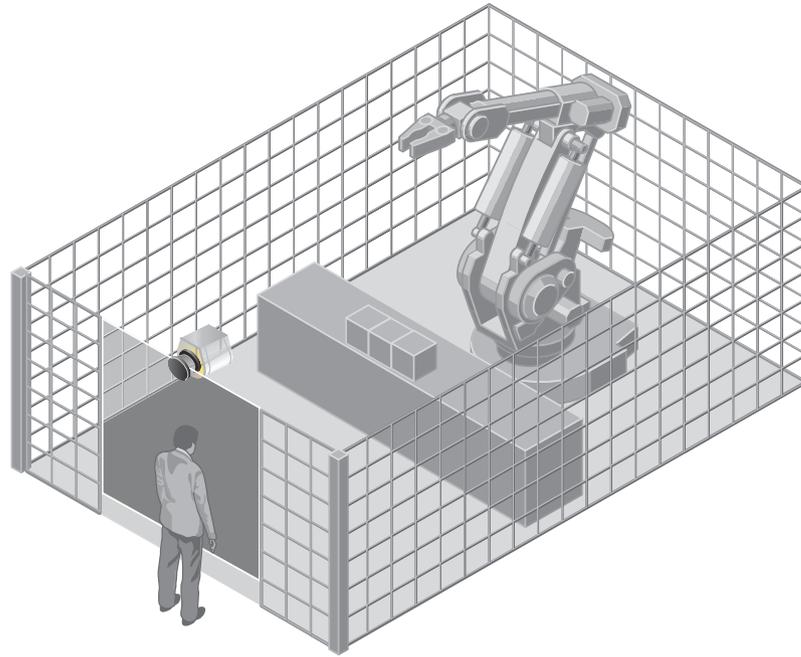
Figure 13: Access protection: detection of a person when accessing a hazardous area

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.
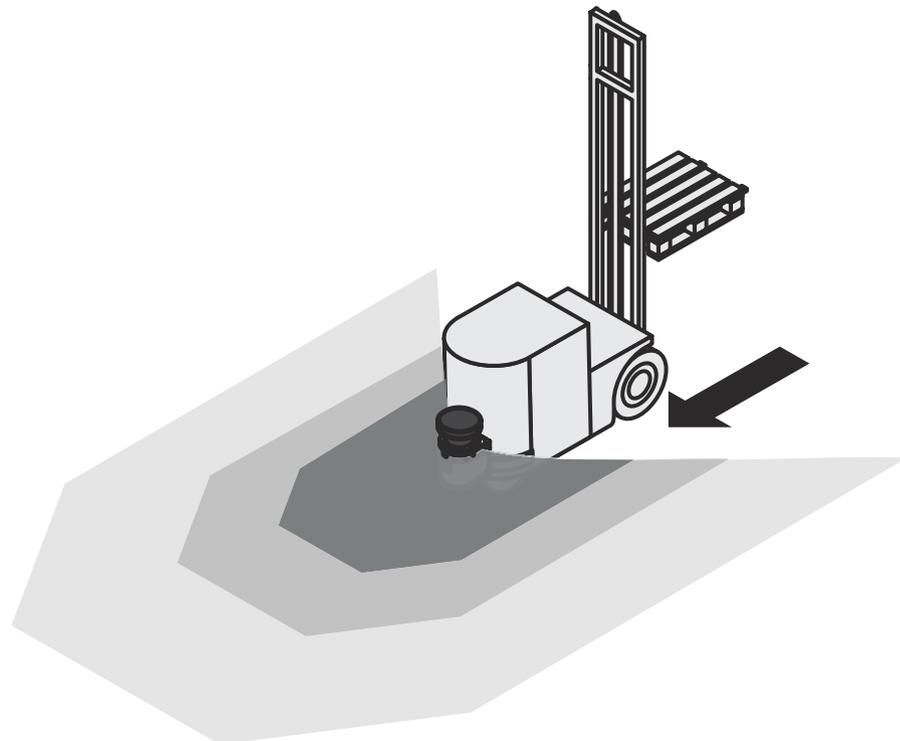
Figure 14: Mobile hazardous area protection: detection of a person when a vehicle approaches

Further topics

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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 operator of the machine to meet a manufacturer's obligations.
> ▶ 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.
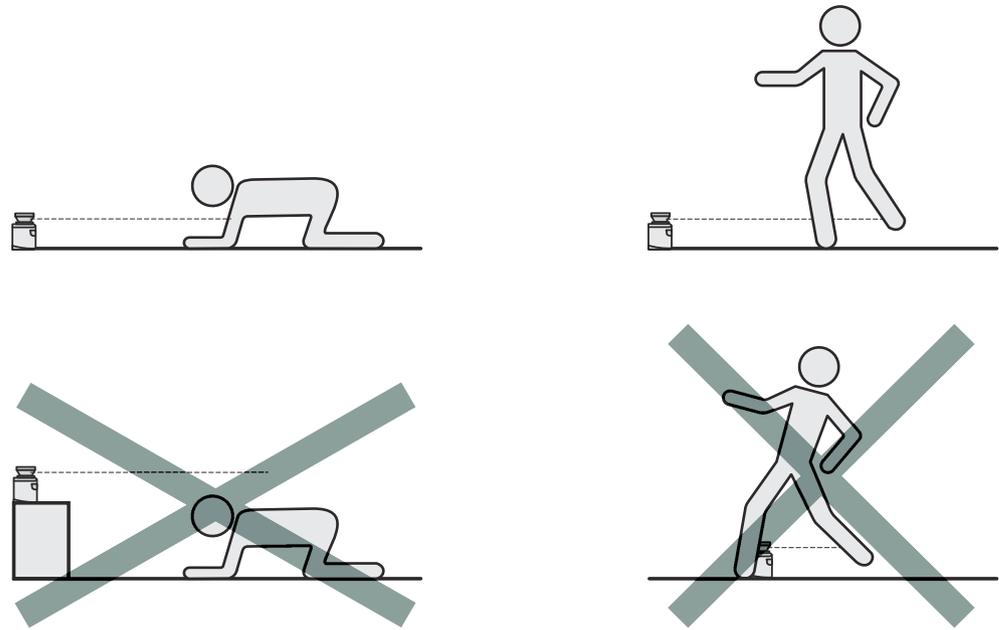
Figure 15: Prevent crawling beneath, standing behind, or climbing over

---

! **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.

---

i **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 of 5.9 Nm for the M5 fixing screws on the device.

Further topics

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.

---

i **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 and 2.
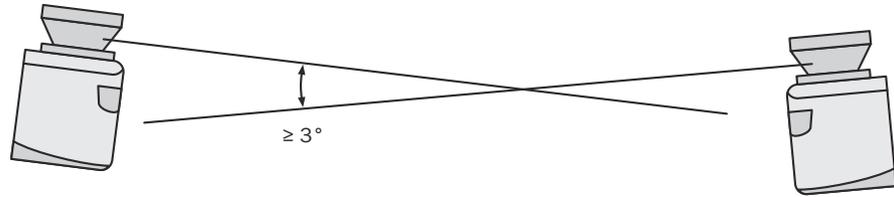
Figure 16: Mounting opposite
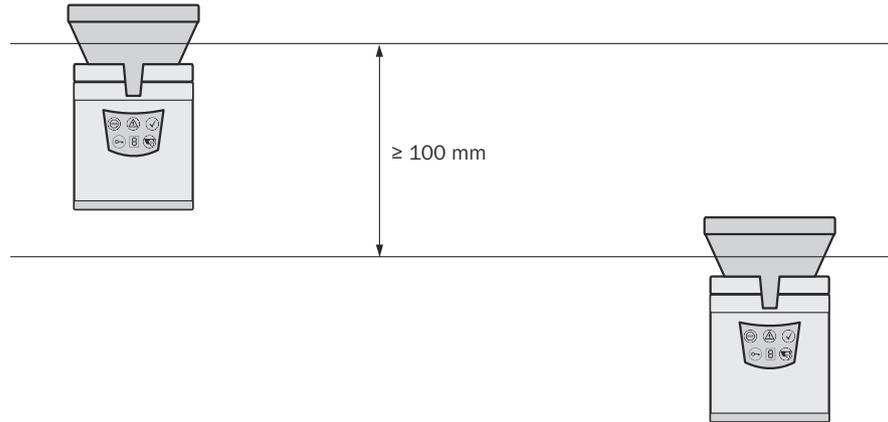
Figure 17: Mounting offset parallel
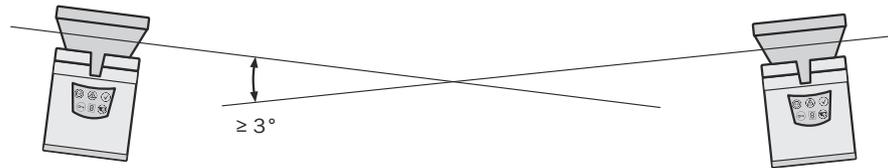
Figure 18: Mounting crosswise
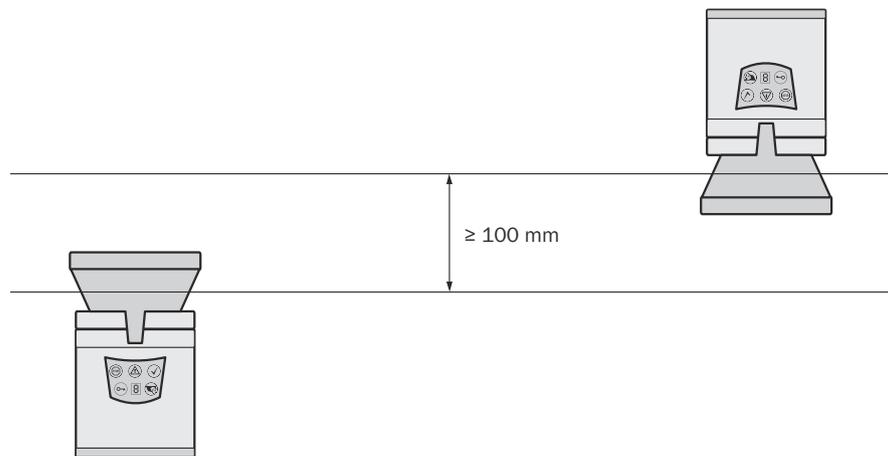
Figure 19: Mounting upside down, offset parallel
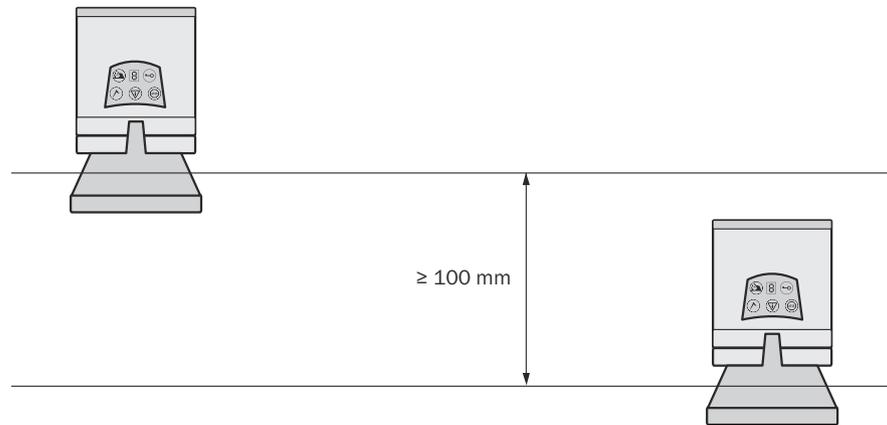
Figure 20: Mounting both devices upside down, offset parallel
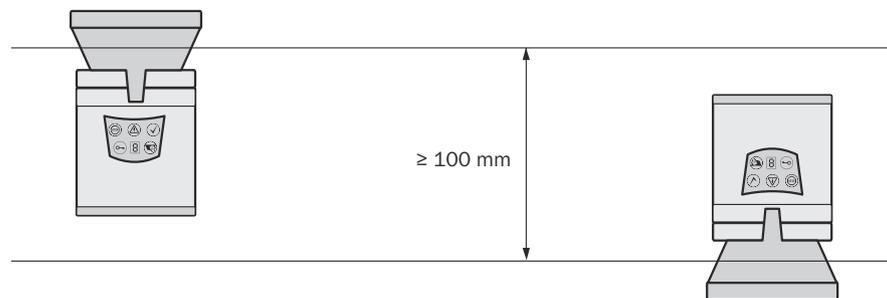
Figure 21: Mounting one device upside down, offset parallel

Further topics

- "Brackets", page 140

4.3.2 Measures to prevent unsecured areas

Overview

When mounting the safety laser scanner, there may be areas which it cannot detect (①).
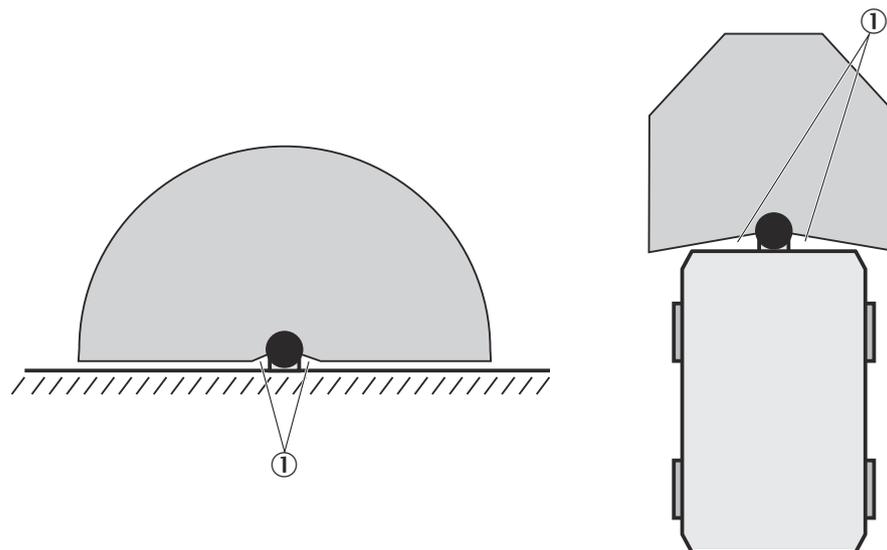
Figure 22: Unsecured areas

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 in a corner
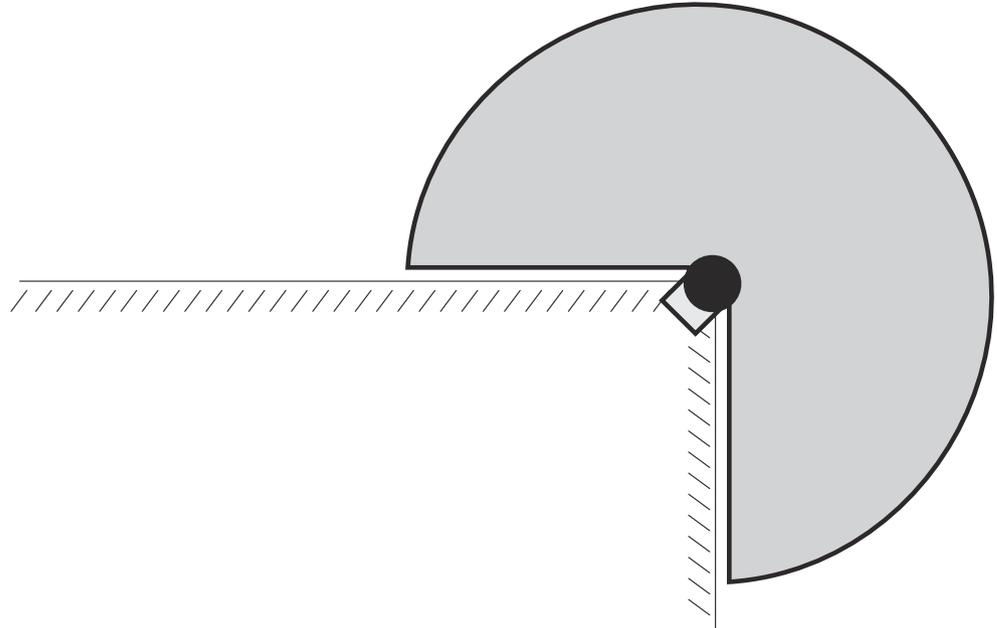
Figure 23: Avoid unsecured areas

To avoid unsecured areas, the device can, for example, be mounted in a corner.
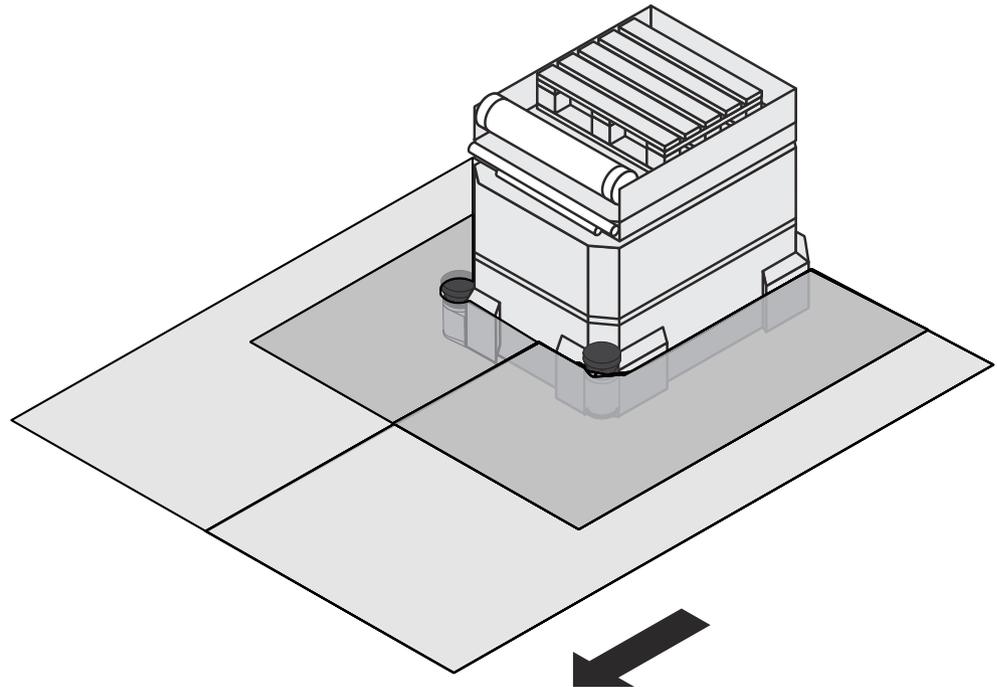
Figure 24: Mounting example for front and side protection in one direction of travel

If two safety laser scanners are mounted at a 45° angle on the front corners of a vehicle, you can configure the protective field in such a way that no unsecured areas are created and the hazardous areas on narrow tracks can also be protected.
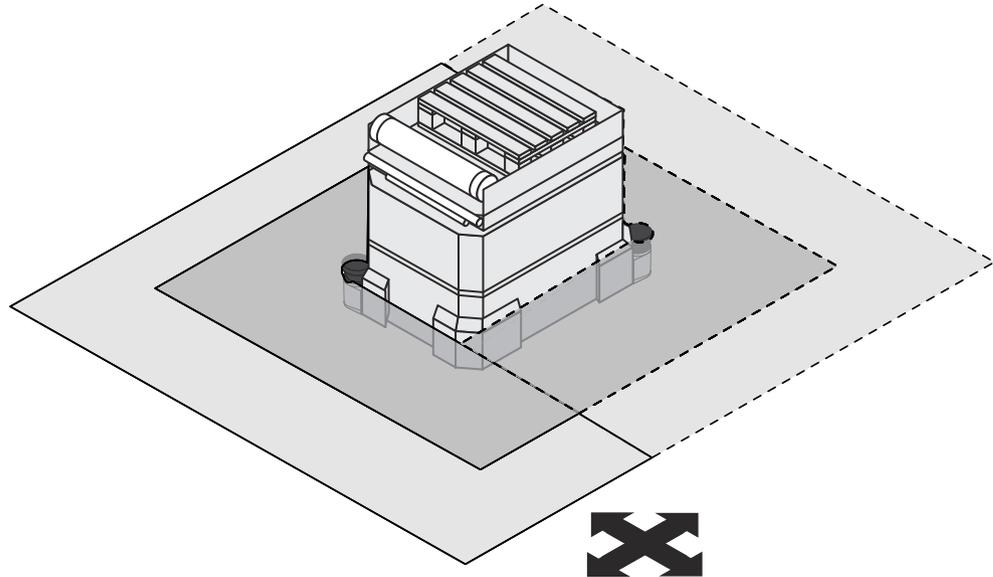
Figure 25: Mounting example for all round protection in any direction of travel

Using two safety laser scanners mounted diagonally opposite one another, it is possible to implement protective fields on the vehicle that provide all round protection in any direction of travel.

Further topics

- "Dimensional drawings", page 137

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 under-cut 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.
- You are using external inputs (e.g., the inputs of another S300).
- You are controlling external OSSDs via EFI (e.g., the OSSDs on another S300) instead of the internal OSSDs.

The following diagram illustrates the relationships:
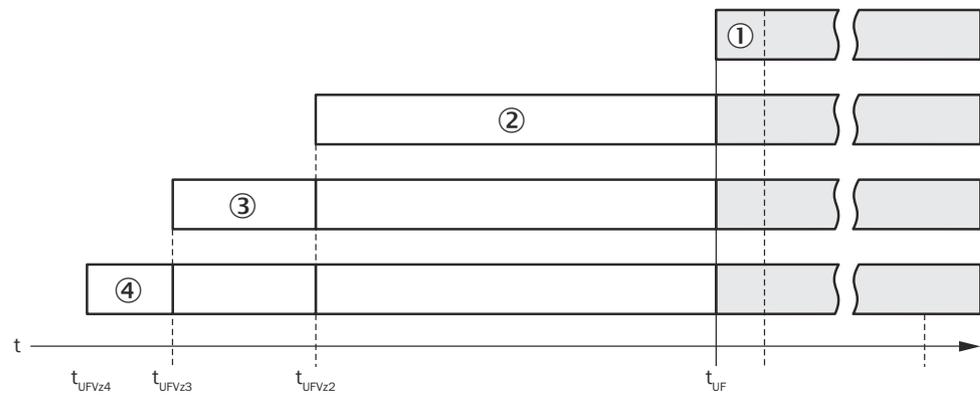
Figure 26: Advancing the switching time

- If the input conditions are present at the control inputs within 10 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 the inputs of another device are used via EFI, the switching time (t_{UFVz3}) must be advanced by an additional 0.5 times the basic response time of the slowest system in the EFI system (cf. ③).
- If external OSSDs are used, the switching time (t_{UFVz4}) must be advanced by an additional 20 ms (cf. ④).

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.
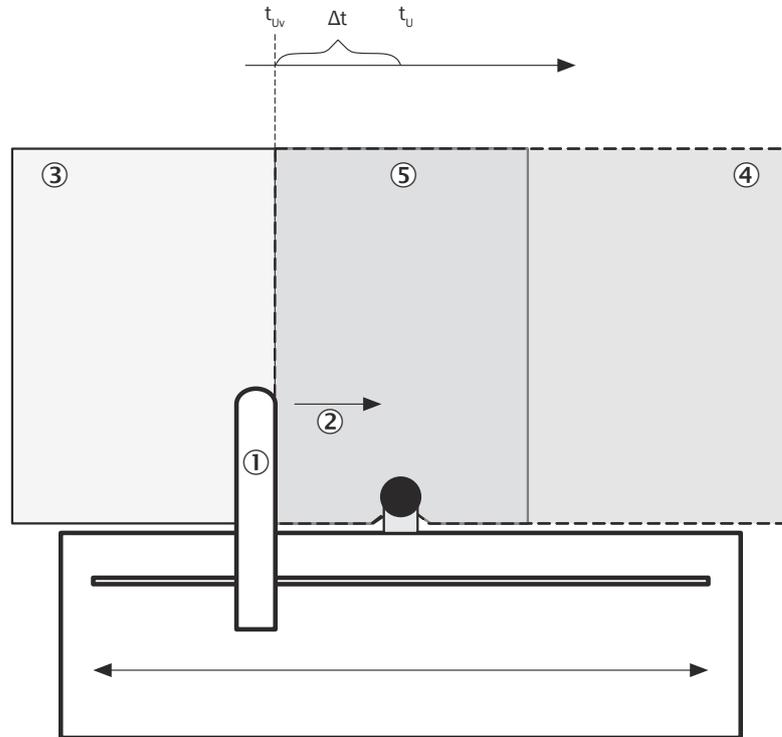
Figure 27: Advancing the switching time (example)

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:
  $$t_{UFVz} = t_{EVz} + t_{exOVz} + t_{StVz}$$

where
- t_{UFVz} = time by which the switching is advanced
- t_{EVz} = input delay for the control inputs
- t_{exOVz} = delay time due to external OSSDs via EFI = 20 ms
- t_{StVz} = delay time due to external control inputs via EFI (0.5 × basic response time of the slowest system in the EFI system)

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.

Further topics

- "Input delay", page 85

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.
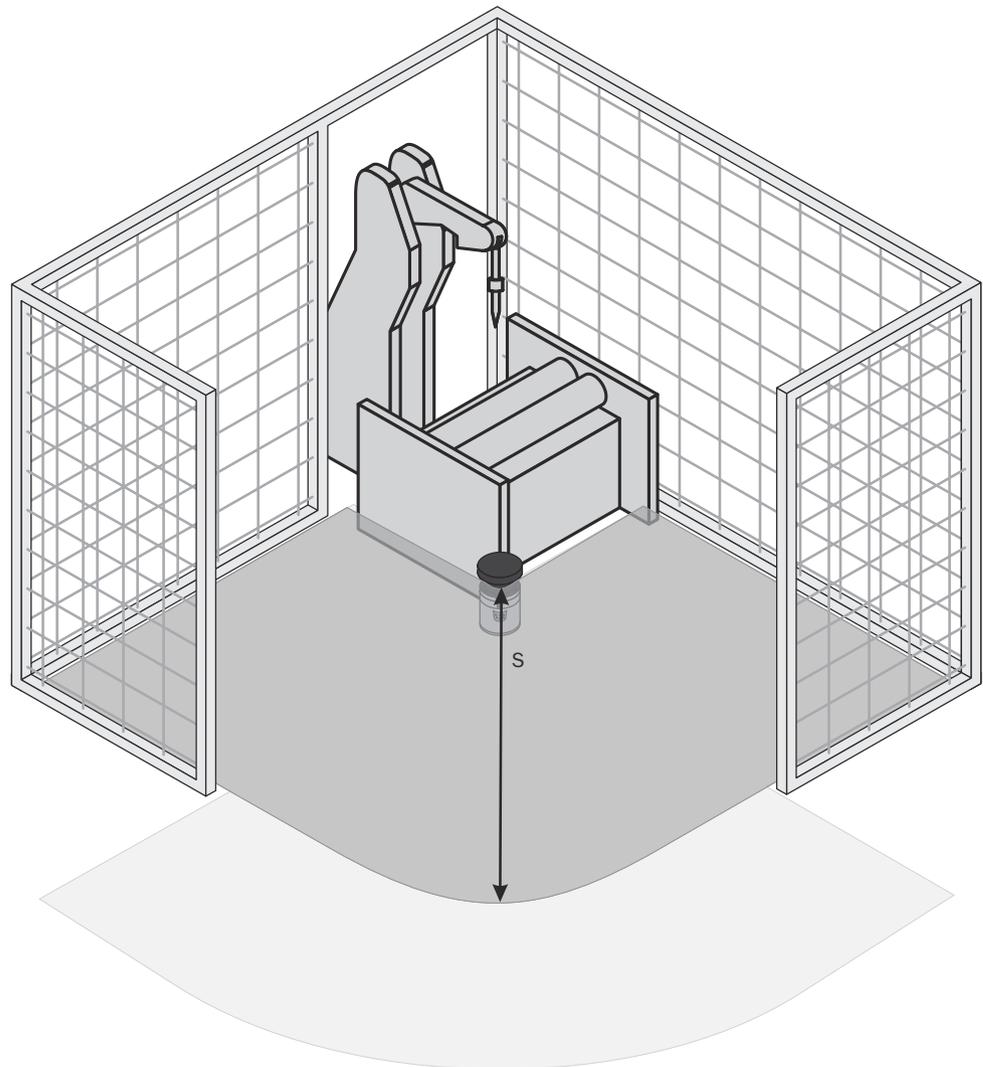
Figure 28: Horizontally mounted stationary application

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 30, 40, 50 or 70 mm resolution. The resolution determines the maximum protective field range of the device.

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 41).

> **NOTE**
>
> If you use a S300 Advanced, Professional or Expert, you can define several monitoring cases with different protective fields. In this case you must calculate the protective field sizes for all protective fields used.

Minimum distance S
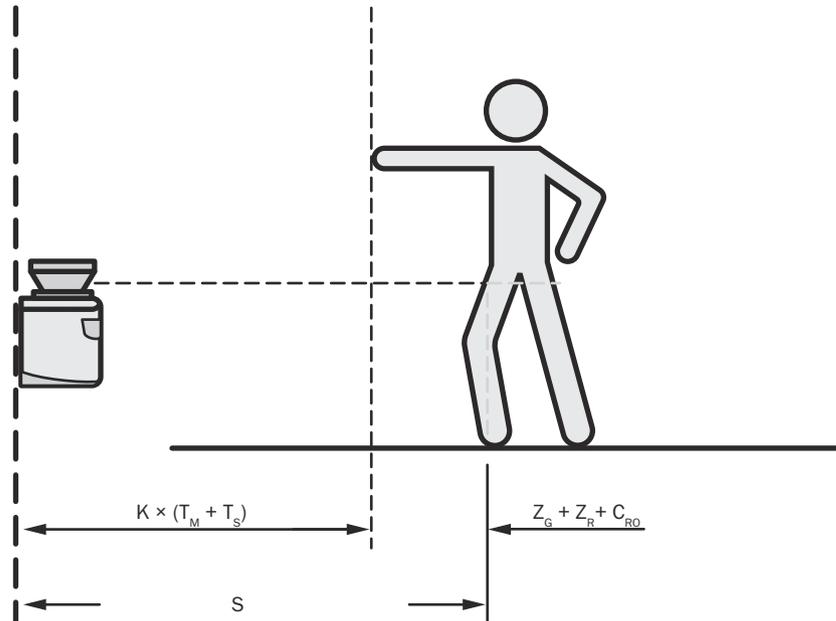
Figure 29: Minimum distance S

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
- 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
- Transmission speed to external OSSDs via EFI

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.

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 and ③.
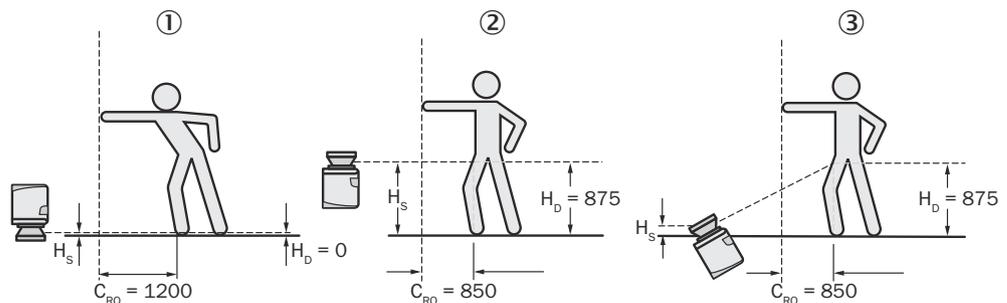
Figure 30: Mounting options for the scan plane

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.

Table 6: 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 ($H_D \approx H_S$)	Low 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: $C_{RO} = 1200 \text{ mm} - (0.4 \times H_D)$
   where H_D is the mounting height of the protective field.

ℹ️ **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.
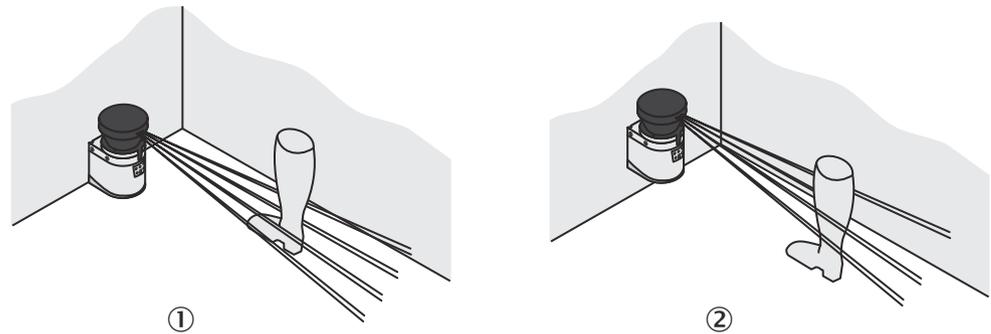
Figure 31: Relationship between resolution and protective field mounting height

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

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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.

ℹ **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

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.
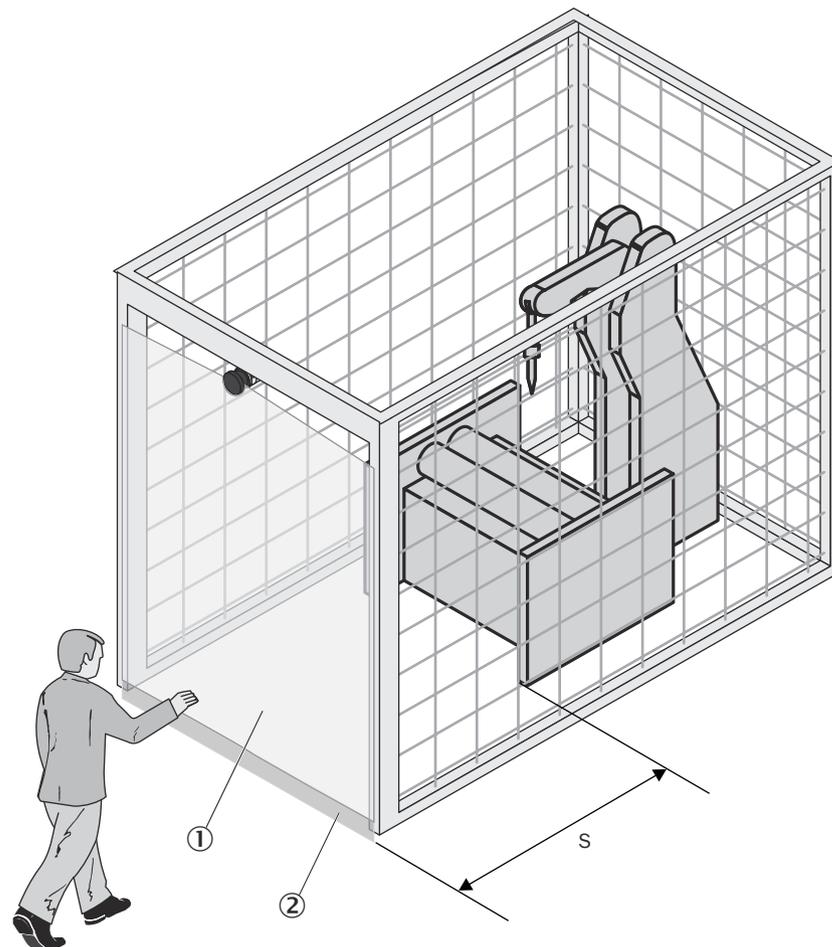
Figure 32: Access protection

① Protective field

②   Contour of the floor as 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.

▶   For access protection, set the total response time of the safety laser scanner to no greater than 80 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
* Transmission speed to external OSSDs via EFI

Further topics

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

-

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.
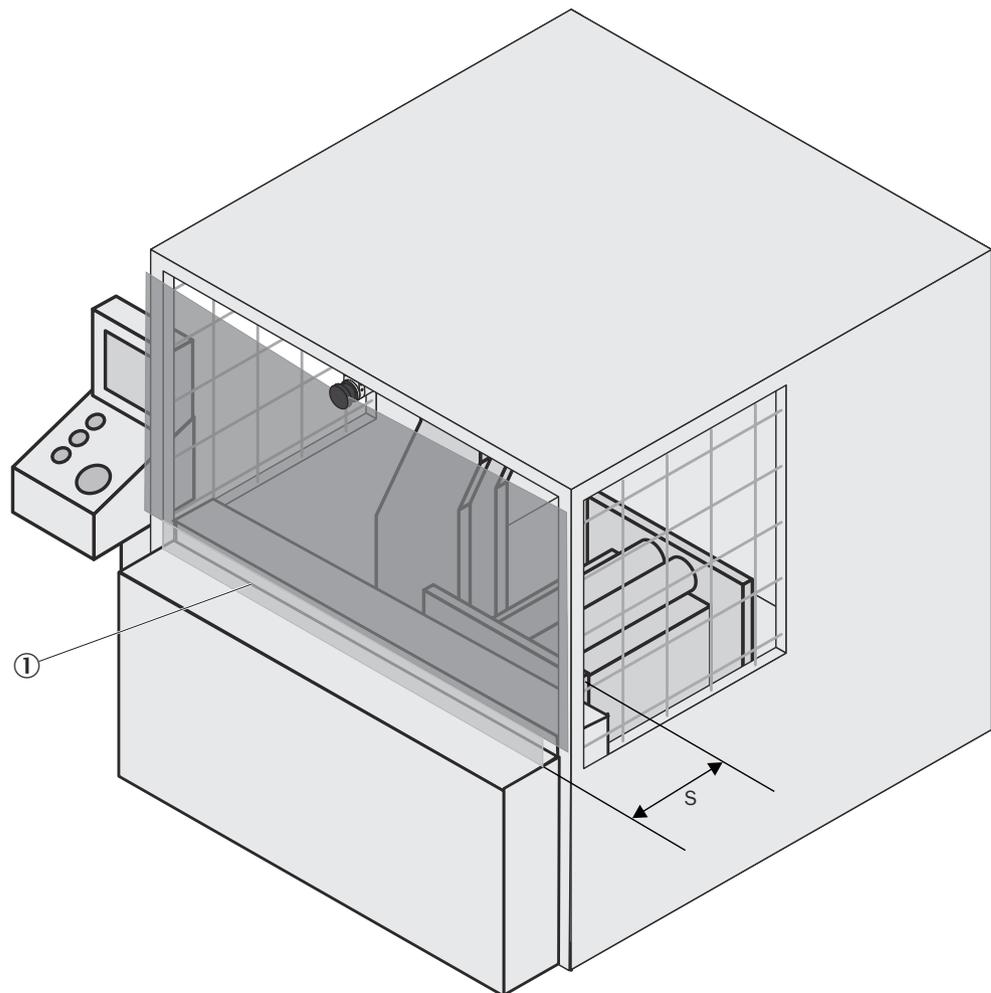
Figure 33: Minimum distance to hazardous area

①   Contours as 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
- Transmission speed to external OSSDs via EFI

Further topics

-

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.

If you use a S300 Advanced, Professional or Expert, you can define several monitoring cases with different protective fields. These monitoring cases can be switching using static control inputs or, in the case of the S300 Professional and Expert product variants, also dynamically.

In the case of dynamic switching, the S300 Professional and Expert use the incremental encoders connected to them to determine the speed of the vehicle. The S300 Professional and Expert can therefore switch the protective field depending on the speed. In such an application, you must calculate the protective field sizes (especially the protective field lengths) for all speeds.

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.
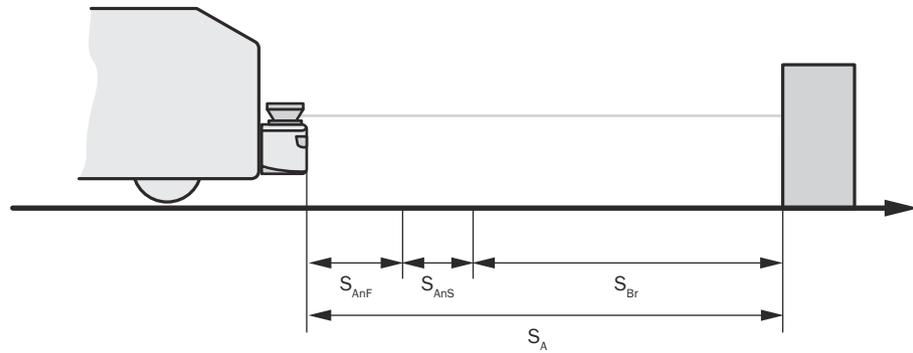
Figure 34: Stopping distance

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i **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.
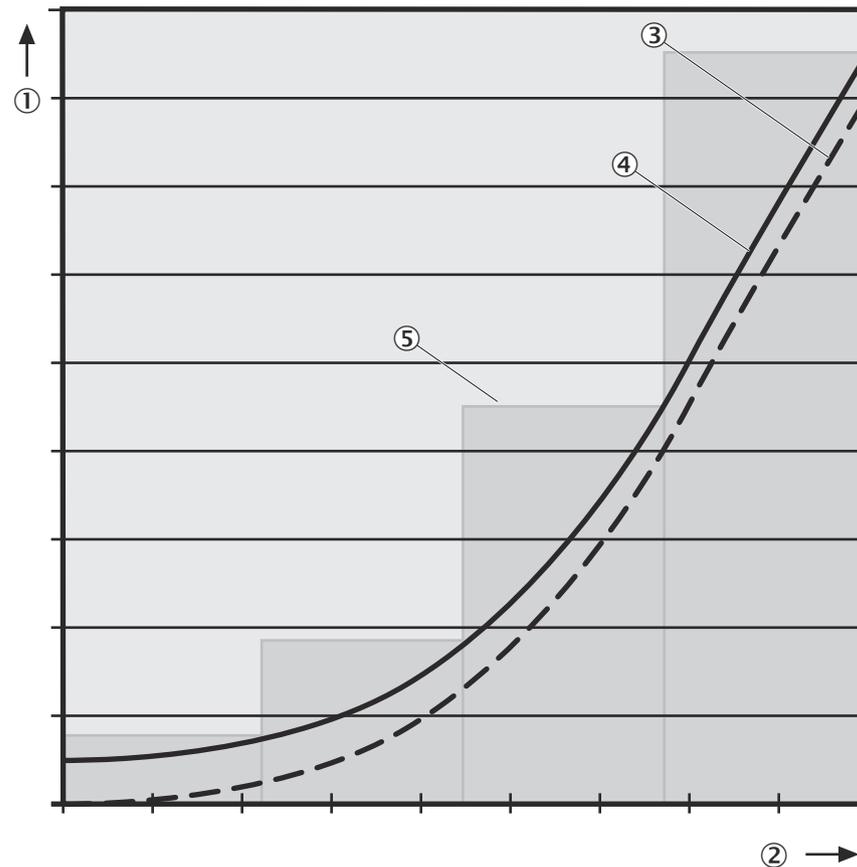
Figure 35: Stopping distance as a function of the vehicle's speed

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
- Transmission speed to external OSSDs via EFI

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.
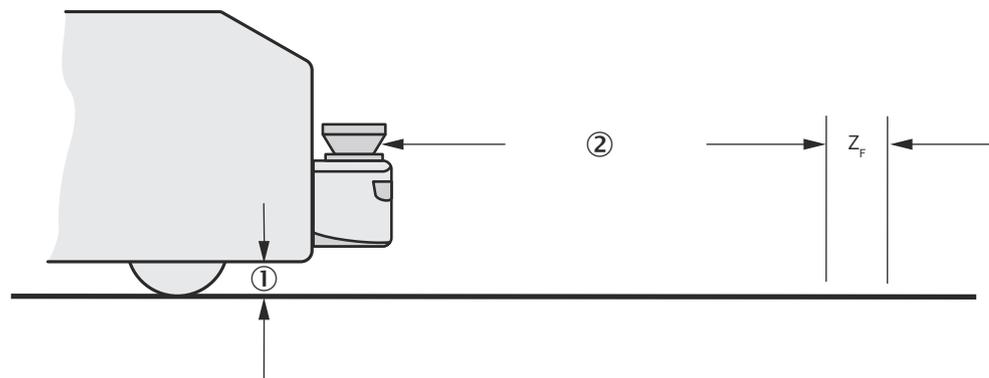
Figure 36: Supplement due to lack of ground clearance

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:
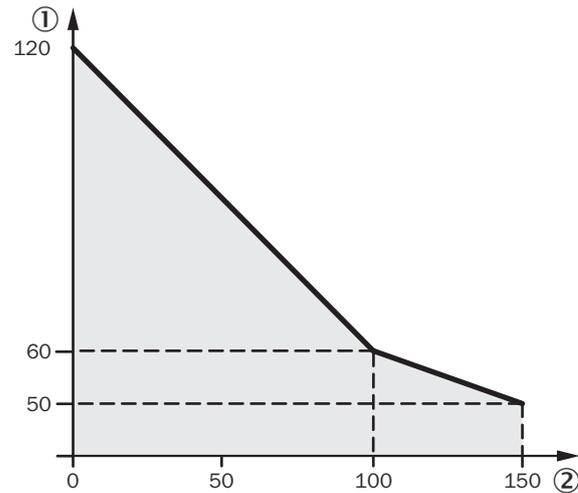
Figure 37: Vehicle ground clearance graph

①   Ground clearance of the vehicle in mm

②   Supplement Z_F in mm

Further topics

*   "Response times", page 131

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:

* $S_B = F_B + 2 × (Z_G + Z_R + Z_F)$

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

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.
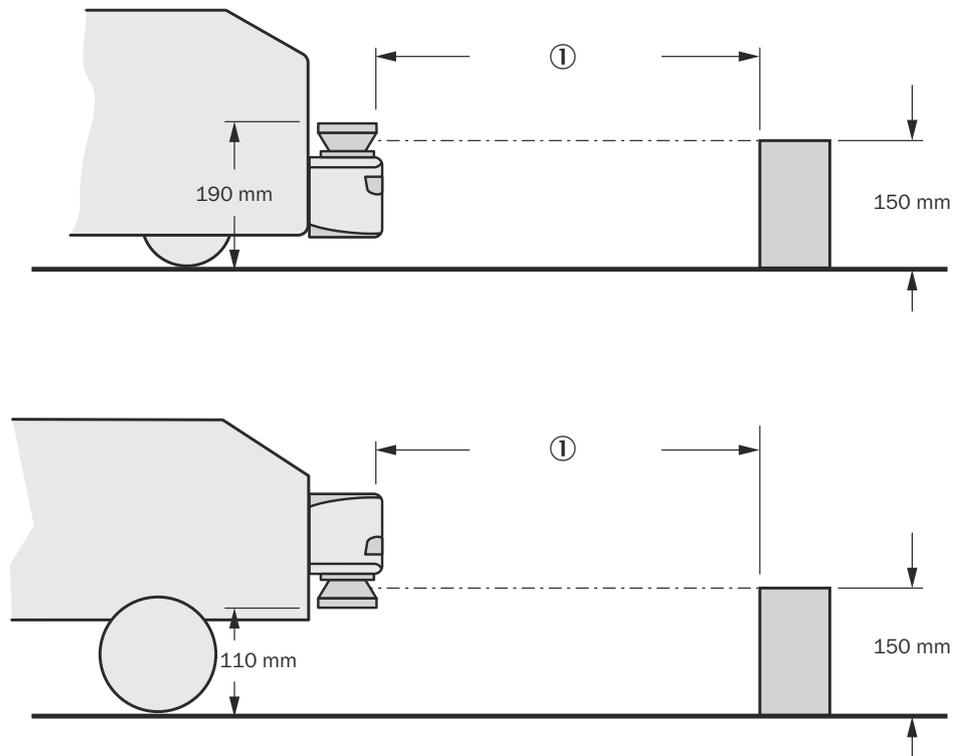
Figure 38: Fitting height

①   Set protective field length

> **NOTE**
> You can also mount the device upside down in order to achieve the optimal scan plane.

4.4 Integration in electrical control

4.4.1 Connection diagrams

Important information

> ⚠ **WARNING**
> **Ineffectiveness of the protective device**
>
> 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.
>
> Downstream contactors must be positively guided and monitored depending on regulations applicable at the operation site or required reliability of the safety function.
>
> ▶   Make sure that downstream contactors are monitored (external device monitoring, EDM).

⚠️ **WARNING**

Ineffectiveness of the protective device

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 same safety level is required for the safety-related parts of the control which switch the active protective field as for the safety function.

In many cases, this is safety level PL d as per ISO 13849-1 or SIL2 as per IEC 62061.

▶ For position-dependent switching, use two independently wired signal sources, for example two independent position switches.
▶ For speed-dependent switching, use two independently wired signal sources, for example two independent incremental encoders.
▶ For manual operating mode-dependent switching, use a suitable manual control switch.

⚠️ **WARNING**

Ineffectiveness of the protective device

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.

▶ When operating two safety laser scanners in a system network (communication via EFI), use the same earthing method for both safety laser scanners.

❗ **NOTICE**

▶ Ensure adequate arc suppression at the relays (contactors). Keep in mind that arc-suppressors can extend the response time.
▶ Lay the arc-suppressors parallel to the relays (contactors) (not over the contacts).

ℹ️ **NOTE**

When using two safety laser scanners connected via EFI in an application, the input signals must be connected to just one safety laser scanner. It is not possible to distribute the input signal connections across two safety laser scanners.

Schematic legend

Table 7: Schematic legend for connection diagrams

	Meaning
k1 and k2 or k3 and k4	Output circuits Incorporate these contacts into the controller in such a way that the dangerous state is brought to an end if the output circuit is open. For categories 3 and 4, they must be incorporated on dual-channels (x, y paths) in accordance with EN 13849-1. Observe the maximum values when loading the outputs (see "Data sheet", page 123).
FE	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.
H2	Signaling device for error or contamination
H3	Signaling device for Reset required
H8	Signaling device for warning field interruption

Restart interlock and external device monitoring
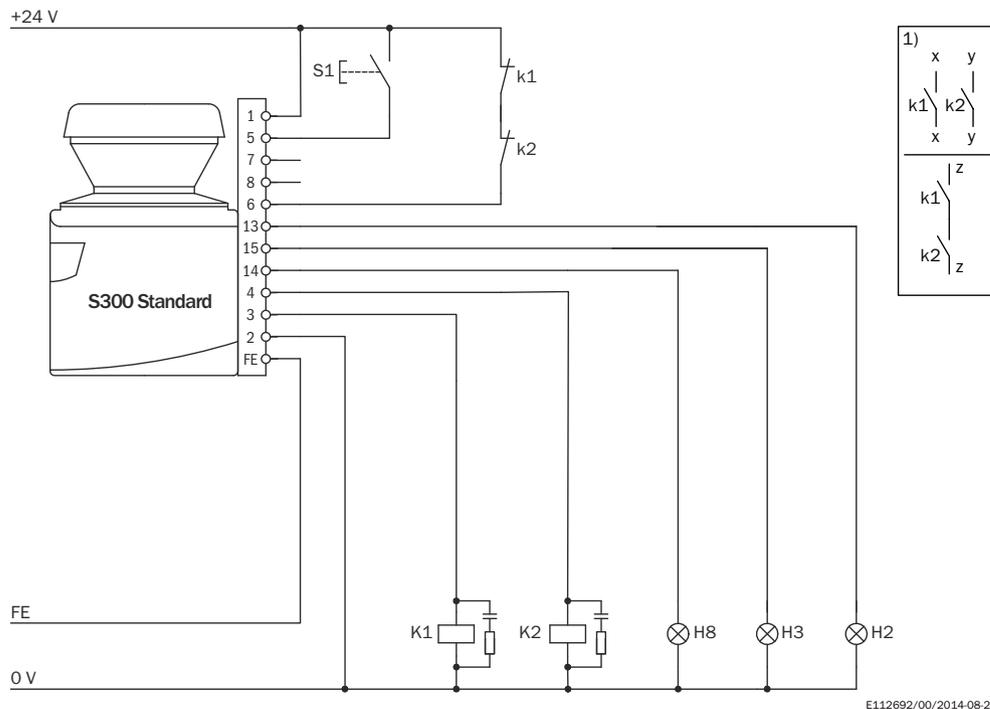
Figure 39: Connection diagram for restart interlock and external device monitoring

S300 Standard in conjunction with relays (contactors); Operating mode: with restart interlock and external device monitoring.

Monitoring case switching using one static input pair
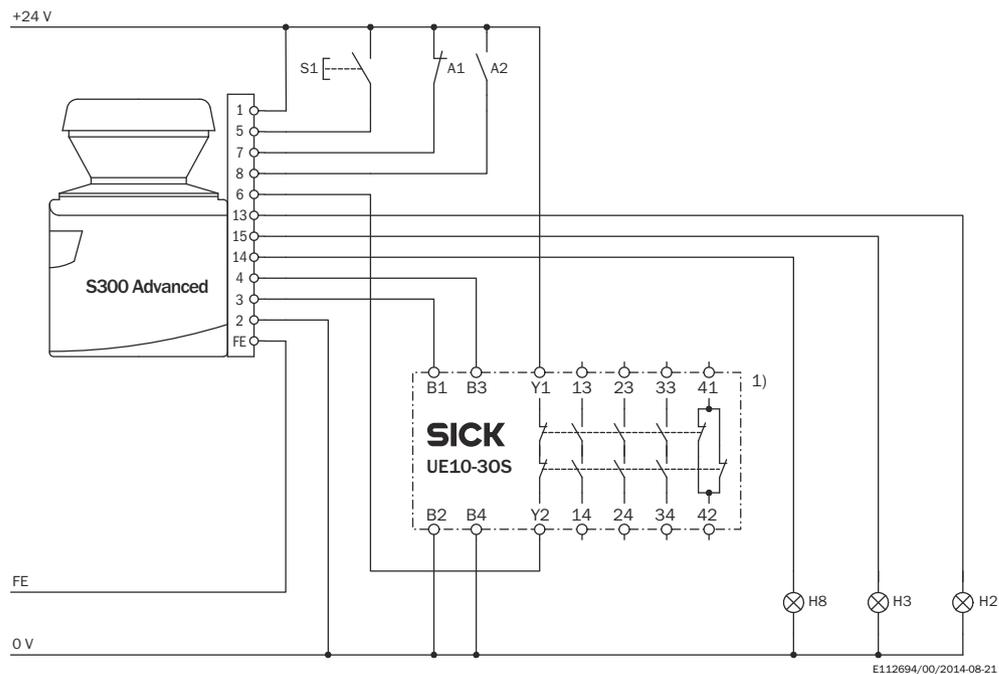
Figure 40: Connection diagram for monitoring case switching using one static input pair

S300 Advanced in conjunction with UE10-3OS; Operating mode: with restart interlock and external device monitoring; Monitoring case switching by the control input A.

Monitoring case switching using two static input pairs
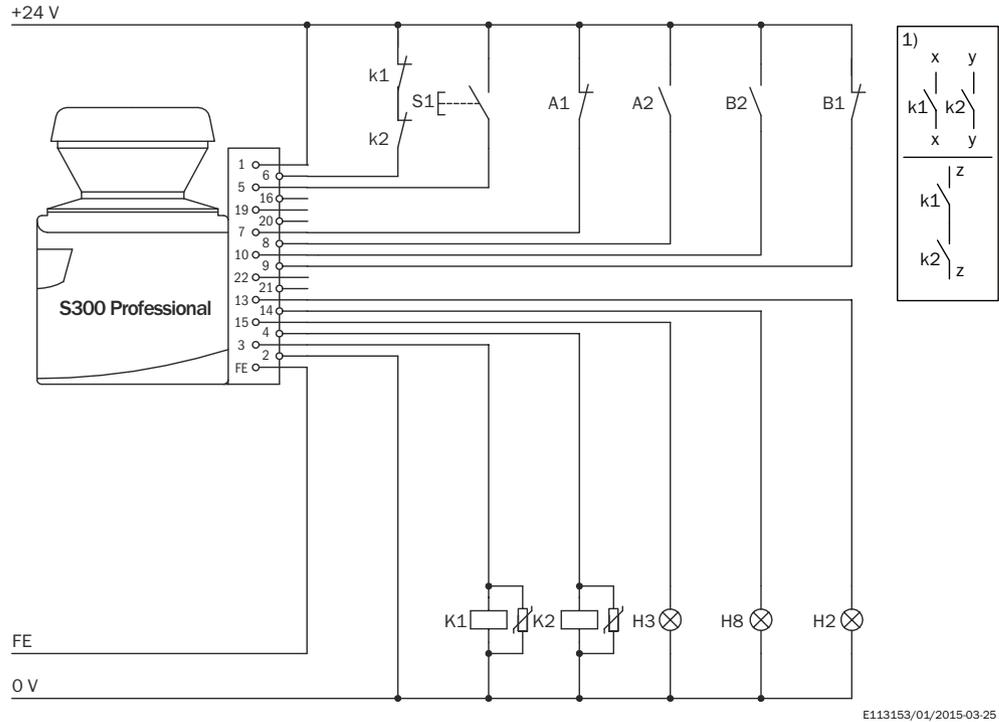
Figure 41: Connection diagram for monitoring case switching using two static input pairs

S300 Professional in conjunction with relays (contactors); Operating mode: with restart interlock and external device monitoring; Monitoring case switching by the control inputs A and B.

Monitoring case switching using static and dynamic inputs
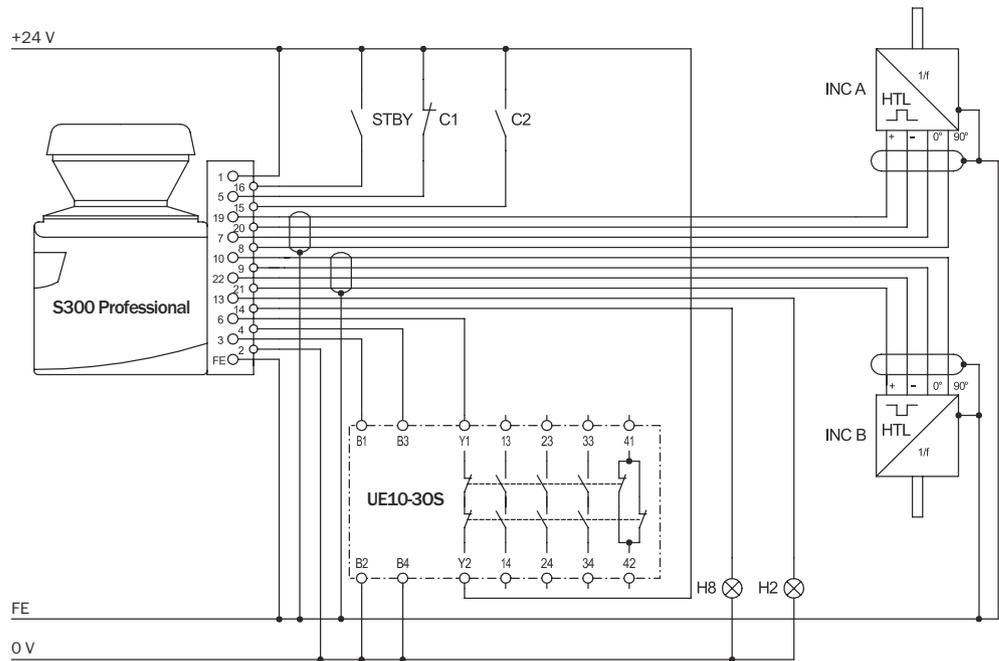
Figure 42: Connection diagram for monitoring case switching using static and dynamic inputs

S300 Professional in conjunction with UE10-3OS; Operating mode: without restart interlock, with external device monitoring; Static monitoring case switching by the control input C; Dynamic monitoring case switching by the incremental encoders A and B.

Monitoring case switching between two safety laser scanners with static inputs
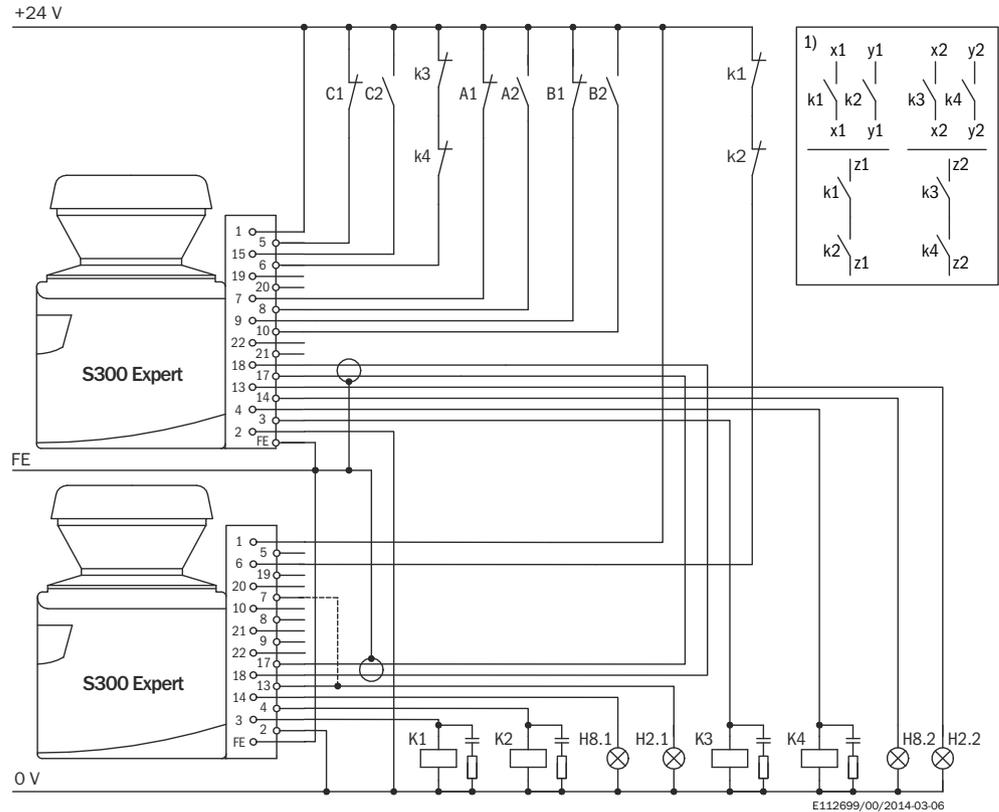
Figure 43: Connection diagram for monitoring case switching between two safety laser scanners with static inputs

S300 Expert and S300 Expert in an EFI system in conjunction with relays (contactors); Operating mode: without restart interlock, with external device monitoring; Static monitoring case switching by the control inputs A, B and C. The protective fields affect the respective OSSDs on the host and guest.

Monitoring case switching between two safety laser scanners with static and dynamic inputs
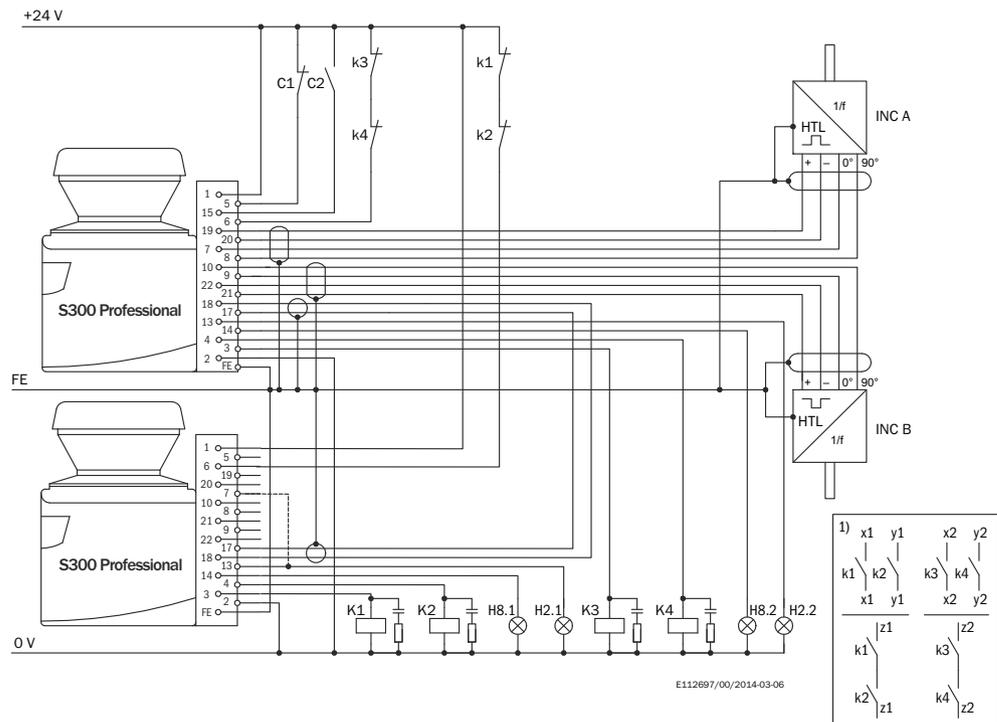
Figure 44: Connection diagram for monitoring case switching between two safety laser scanners with static and dynamic inputs

Two S300 Professional in an EFI system in conjunction with relays (contactors); Operating mode: without restart interlock, with external device monitoring; Static monitoring case switching by the control input C of the host; Dynamic monitoring case switching by the incremental encoders A and B of the host. The protective fields affect the respective OSSDs on the host and guest.

Monitoring case switching between an S3000 and an S300 using static and dynamic inputs
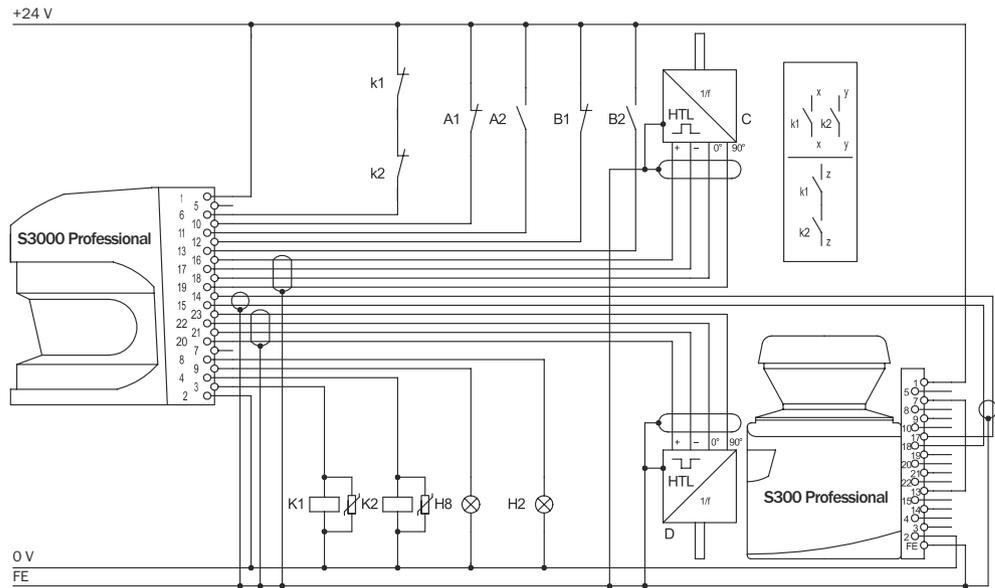
Figure 45: Connection diagram for monitoring case switching between an S3000 and an S300 using static and dynamic inputs

S3000 Professional and S300 Professional in an EFI system in conjunction with relays (contactors); Operating mode: without restart interlock, with external device monitoring; Static monitoring case switching by the control inputs A and B of the S3000; Direction of travel-dependent dynamic monitoring case switching by the incremental encoders C and D of the S3000. The protective fields act on the OSSDs on the S3000.

Monitoring case switching between S3000 and S300 using a Flexi Soft safety controller
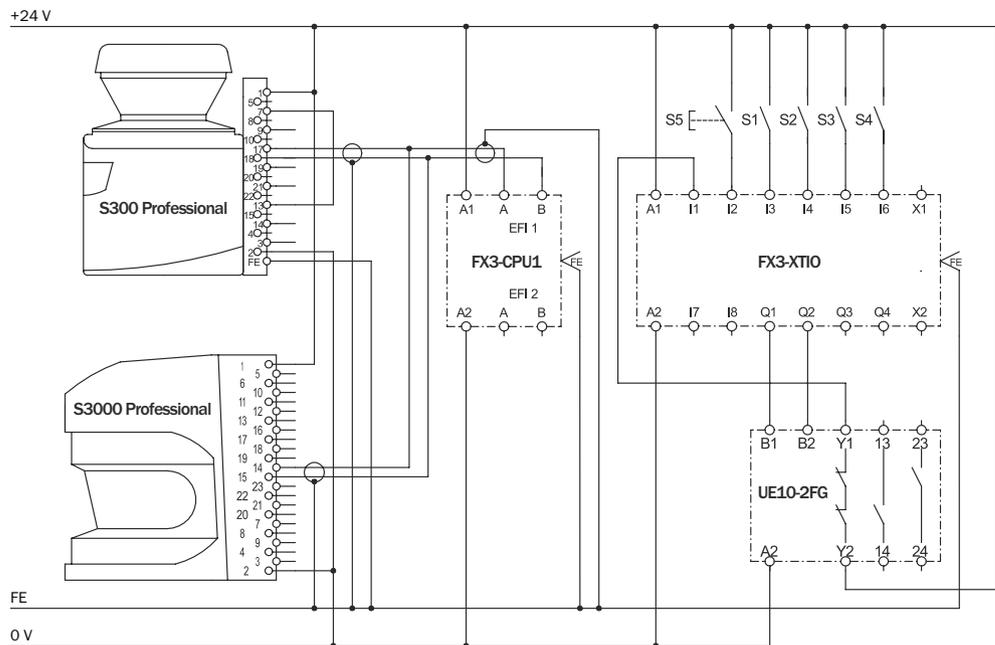
Figure 46: Connection diagram for monitoring case switching between S3000 and S300 usin a Flexi Soft safety controller

S3000 Professional and S300 Professional in an EFI system; Protective field evaluation, restart interlock and EDM via EFI using a Flexi Soft safety controller; Static monitoring case switching via EFI by the control inputs S1 to S4 of the Flexi Soft safety controller.

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 27
- "Electrical installation", page 64
- "Configuration", page 75
- "Commissioning", page 105
- "Test notes", page 106

5.2 Mounting procedure

Overview

The origin of the scan plane is located 116 mm above the bottom edge of the device.

The device can be mounted in the following ways:
- Direct mounting without mounting kit
- Mounting using mounting kit 1a or 1b
- Mounting using mounting kit 2 (only in conjunction with mounting kit 1a or 1b)

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.
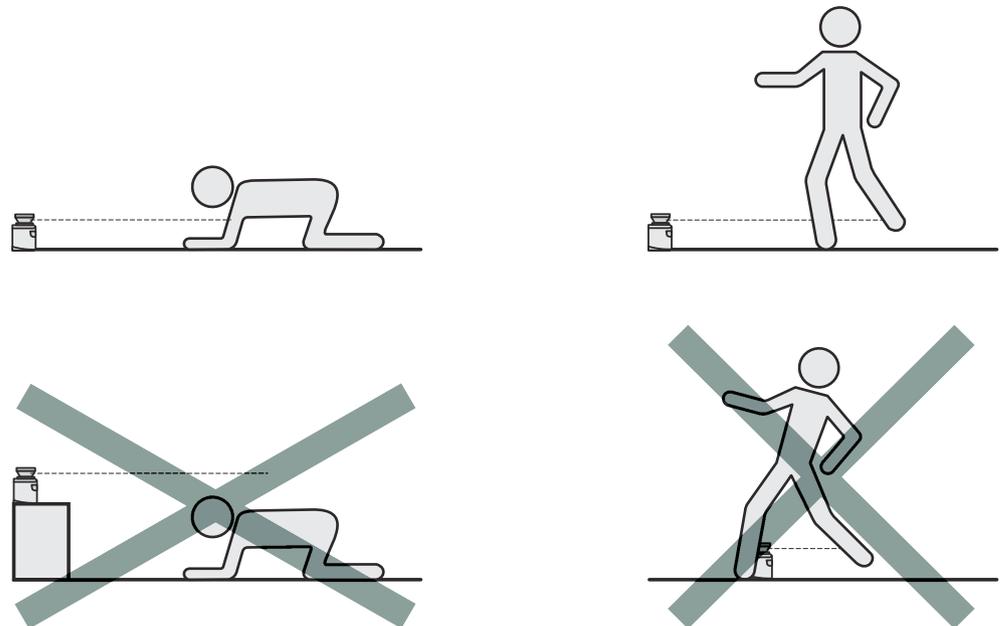
Figure 47: Prevent crawling beneath, standing behind, or climbing over

---

ⓘ **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 of 5.9 Nm for the M5 fixing screws on the device.

Further topics

-
-

5.2.1   Direct mounting

The device has two M5 × 8 threaded holes on the rear. They can be used to mount the device directly on the intended mounting surface. To avoid a possible tendency to vibrate, the reference surface located on the rear can be used as a third support point if necessary ①.
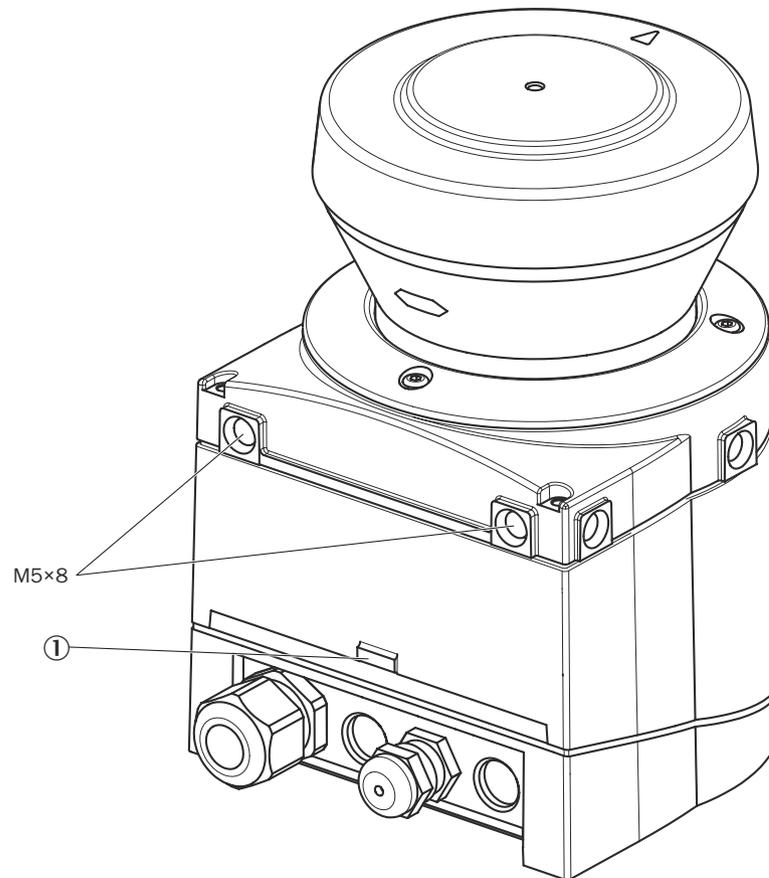
Figure 48: Direct mounting

ⓘ **NOTE**
When mounting the device, observe the dimensional drawings.

Further topics

5.2.2   Mounting using mounting kit 1a or 1b

Overview

You can use mounting kit 1 to mount the device indirectly on the mounting surface. The mounting kit is available as mounting kit 1a without a protective device for the optics cover and as mounting kit 1b with a protective device for the optics cover.
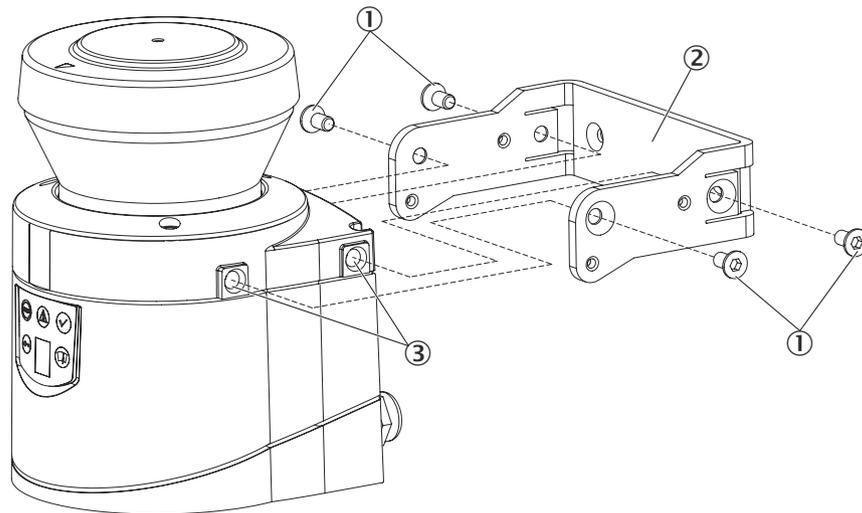
Figure 49: Mounting using mounting kit 1a

①   Fixing screws
②   Mounting kit 1a
③   Threaded holes M5×8
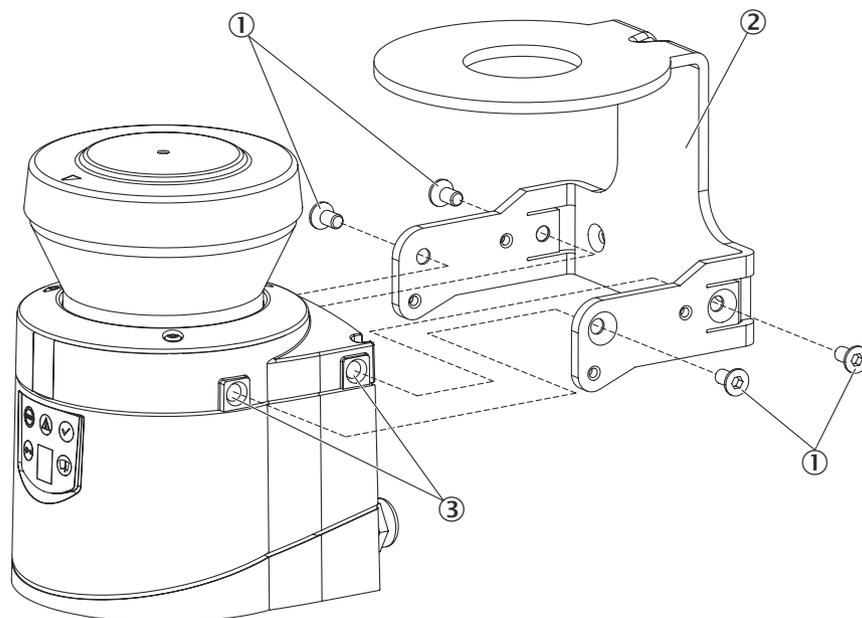
Figure 50: Mounting using mounting kit 1b including optics cover protection

①   Fixing screws
②   Mounting kit 1b
③   Threaded holes M5×8

Approach

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

> **i** **NOTE**
> When mounting the device, observe the dimensional drawings.

Further topics

*   "Dimensional drawings", page 137

5.2.3 Mounting using mounting kits 2 and 3

Overview

You can use mounting kits 2 and 3 (only in conjunction with mounting kit 1a or 1b) to align the device in 2 planes. The maximum adjustment angle is ± 11° in both planes.
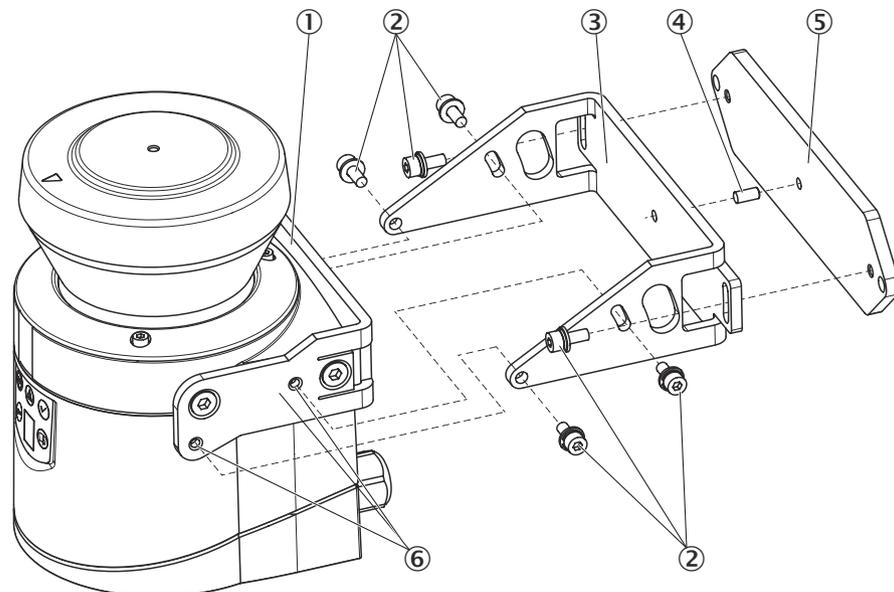
Figure 51: Mounting using mounting kit 2

①   Mounting kit 1a
②   Fixing screws
③   Mounting kit 2
④   Centring pin
⑤   Mounting kit 3
⑥   Threaded holes M4

Approach

1. Mount kit 1a or 1b on the safety laser scanner.
2. Mount kit 3 on the mounting surface.
3. Insert the centering pin (4 mm) into the center hole of mounting kit 3.
4. Fit the mounting kit 2 onto mounting kit 3 and mount using two M4×10 fixing screws.
5. Mount the safety laser scanner on mounting kit 2 using the threaded holes in mounting kit 1a.
6. Adjust the safety laser scanner along the longitudinal and transverse axis then tighten the six fixing screws on the mounting kits.

> **(i) NOTE**
> When mounting the device, observe the dimensional drawings.

Further topics

5.2.4 Important notes information label

▶ After mounting the device, affix the supplied self-adhesive **Important notes** infor‐
mation label.

> **(i) 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.

⚠️ **DANGER**
Dangerous state of the machine

The dangerous state may not be stopped in the event of non-compliance.

▶ Always connect OSSD1 and OSSD2 separately. The two OSSDs must not be connected to each other.
▶ Connect the OSSDs such that the machine controller processes both signals separately.
Contactors connected in series must be positively guided and monitored.
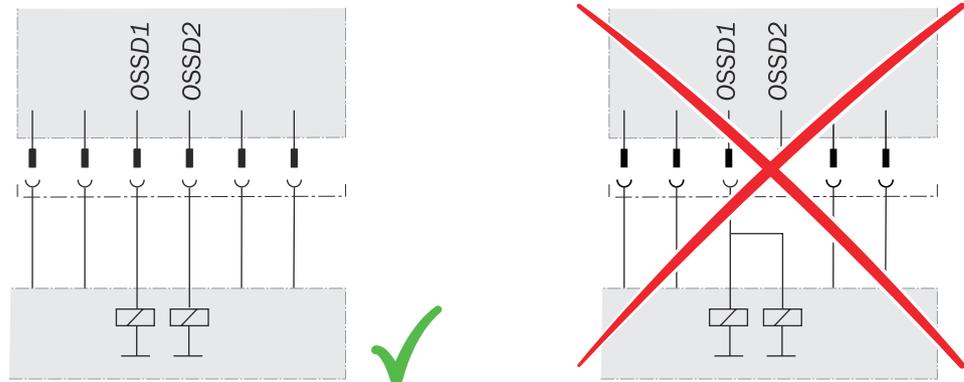
⚠️ **DANGER**
Dangerous state of the machine

The dangerous state may not be stopped in the event of non-compliance.

▶ Each OSSD must only be connected to one downstream switching element.
▶ If more than one switching element is required, use a suitable contact multiplier.

⚠️ **DANGER**
Ineffectiveness of the protective device

If loads are connected to the OSSDs that do not have reverse polarity protection, a potential difference between the 0 V connections of the loads and those of the associated protective device could prevent the machine from being switched off in the event of an error.

▶ Prevent the formation of a potential difference between the load and the protective device.
▶ Connect the 0 V connections of the loads and those of the associated protective device individually and directly to the same 0 V terminal strip.
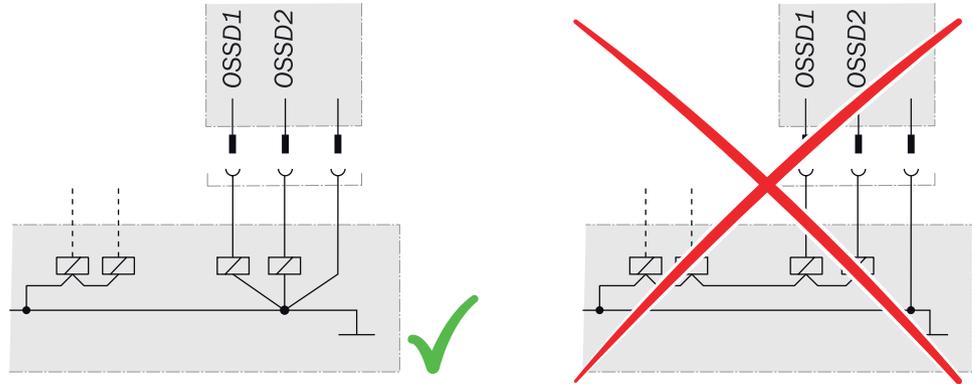
> **NOTE**
> ▶ Lay all cables and connecting cables so that they are protected from damage.
> ▶ If you are using the safety laser scanner to protect hazardous areas: Make sure that the connected controller and all devices responsible for safety also comply with the required category according to ISO 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 (see "Accessories", page 140).
> • For data cables over 30 m in length, either the device itself or the screen of the data cable must be grounded in the immediate vicinity of the cable entry into the system plug.

Further topics

• "Data sheet", page 123

6.2 Pin assignment

Overview

All inputs and outputs of the device are located on the 24-pin screw connection + FE in the system plug. You can either connect cables directly to the screw terminal or use a pre-assembled system plug from SICK.
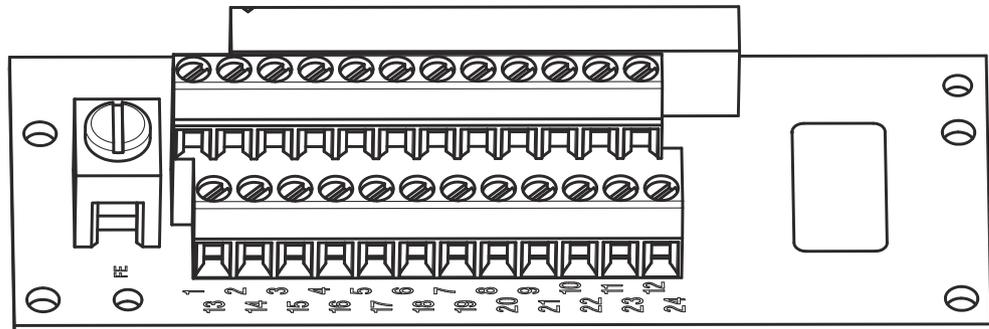
Figure 52: Screw terminal block of the system plug

The system plug has different pin assignments depending on the product variant.

NOTE

- All inputs and outputs of the device must be used only in the specified manner.
- Enclosure rating IP65 cannot be guaranteed if the cable gland/blind plug are missing or not fastened, or the fixing screws of the system plug are missing or not fastened.

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.

▶ To connect the screen on the safety laser scanner, use the M12 EMC cable gland (see table 48, page 140).
▶ Use similar cable glands on the incremental encoders.
▶ 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 you want to operate two safety laser scanners in a system (communication via EFI), then the same earthing method must be used for both safety laser scanners.
- 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.

Further topics

- "Pre-assembled system plug", page 71

6.2.1 Pin assignment

Table 8: Pin assignment on the system plug

Pin	Signal	Function	Standard	Advanced	Professional	Expert
FE	Functional earth		■	■	■	■
1	24 V DC	Supply voltage S300	■	■	■	■
2	0 V DC	Supply voltage S300	■	■	■	■
3	OSSD1	Output signal switching device	■	■	■	■
4	OSSD2	Output signal switching device	■	■	■	■
5	UNI-I/O1 / RESET /C1	Universal I/O or input, reset, or (for the S300 Professional and Expert) static control input C	■	■	■	■
6	UNI-I/O2 / EDM	Universal I/O or input, external device monitoring	■	■	■	■

Pin	Signal	Function	Standard	Advanced	Professional	Expert
7	A1 or INC1_0	Static control input A or dynamic control input (incremental encoder) 1 or connection for a jumper for addressing as guest [1]	■	■	■	■
8	A2 or INC1_90	Static control input A or dynamic control input (input for incremental encoder) 1		■	■	■
9	B1 or INC2_0	Static control input B or dynamic control input (input for incremental encoder) 2		■ [2]	■	■
10	B2 or INC2_90	Static control input B or dynamic control input (input for incremental encoder) 2		■ [2]	■	■
11	RxD–	RS-422 interface to measurement data output	■	■	■	■
12	RxD+		■	■	■	■
13	UNI-I/O3 / ERR/WEAK	Universal I/O or application diagnostic output for error or contamination or connection for a jumper for addressing as guest [1]	■	■	■	■
14	UNI-I/O4 / WF	Universal I/O or application diagnostic output for object in the warning field	■	■	■	■
15	UNI-I/O5 / RES_REQ/C2	Universal I/O or application diagnostic output, reset required, or (for the S300 Professional and Expert) static control input C	■	■	■	■
16	STBY	Control input for standby mode	■	■	■	■
17	EFI$_A$	Enhanced function interface = safe SICK device communication	■	■	■	■
18	EFI$_B$		■	■	■	■
19	24 V DC	Supply voltage for incremental encoder 1			■	■
20	GND				■	■
21	24 V DC	Supply voltage for incremental encoder 2			■	■
22	GND				■	■
23	TxD–	RS-422 interface to measurement data output	■	■	■	■
24	TxD+		■	■	■	■

[1] In order to operate 2 safety laser scanners in an EFI system, you must define a device as a guest using a bridge between pin 7 and pin 13.

[2] No dynamic control input.

Requirements for incremental encoders

⚠️ **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 connecting cables of the incremental encoders are laid together, a cable break could cause an error that could remain undetected.

▶   Route the connecting cable for each incremental encoder in its own plastic-sheathed cable.
▶   Each incremental encoder must have a separate voltage supply. To do so, use the terminals that have been provided for this purpose: 19 and 20, as well as 21 and 22.
▶   Connect each output of an incremental encoder (for 0° or 90°) to one control input (A1 / B1 or A2 / B2) only.

The two incremental encoders must meet the following requirements:
*   Dual-channel rotary encoder with 90° phase shift
*   Supply voltage: 24 V DC
*   Outputs: push/pull outputs
*   Enclosure rating IP54 or higher
*   Shielded cable
*   Max pulse rate: 100 kHz
*   Minimum number of pulses: 50 pulses per cm

ℹ️ **NOTE**

You can obtain suitable incremental encoders at **www.sick.com** or from your SICK subsidiary.

Control inputs

The input signals can be connected to one safety laser scanner only. It is not possible to distribute the input signal connections across two safety laser scanners.

EFI systems

Connect EFI_A of the first device to EFI_A of the second device, and EFI_B of the first device with EFI_B of the second device.

ℹ️ **NOTE**

*   Use only shielded twisted pair cables.
*   If the length of cable to the safety laser scanner is more than 30 m, the shield must be connected as close as possible to the device.

ℹ️ **NOTE**

To be able to unambiguously differentiate between the host device and the guest device in an EFI system, one safety laser scanner must be configured as the guest.

▶   To define the guest device, wire a jumper between terminals 7 (A1 / INC1_0) and 13 (UNI-I/O3 / ERR/WEAK).

The jumper always defines the guest device. This jumper must not be fitted on the host device.

RS-422 interface
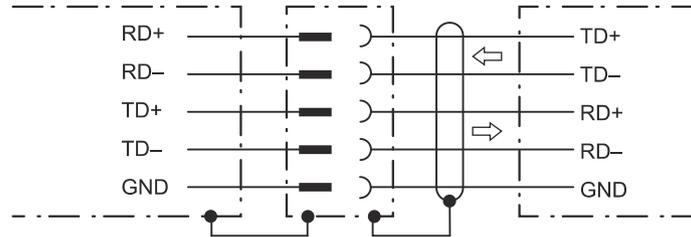
Figure 53: Connection diagram for the RS-422 interface

6.3 Unassembled system plug

Important information

ⓘ **NOTE**
Experience has shown that 20 to 30 cm of cable reserve on the safety laser scanner is ideal. This prevents the system plug from accidentally being plugged into an adjacent safety laser scanner and putting a safety laser scanner with an incorrect configuration into operation. You can easily exchange the safety laser scanner with the cable reserve if needed.

▶   Keep the cable reserve short enough that the system plug cannot accidentally be plugged into an adjacent safety laser scanner.

ⓘ **NOTE**
You can also purchase the safety laser scanner with pre-assembled system plugs with various lengths of cable.

System plug

The system plug has cable entries for cable glands on the base and top. The number of cable entries and cable glands differs depending on the variant.

SX0B-A0000G system plug:
- For S300 Standard and S300 Advanced
- 1 cable entry with M16 cable gland
- 1 cable entry without M16 cable gland (blind plug)
- 2 cable entries without M12 cable gland (blind plug)
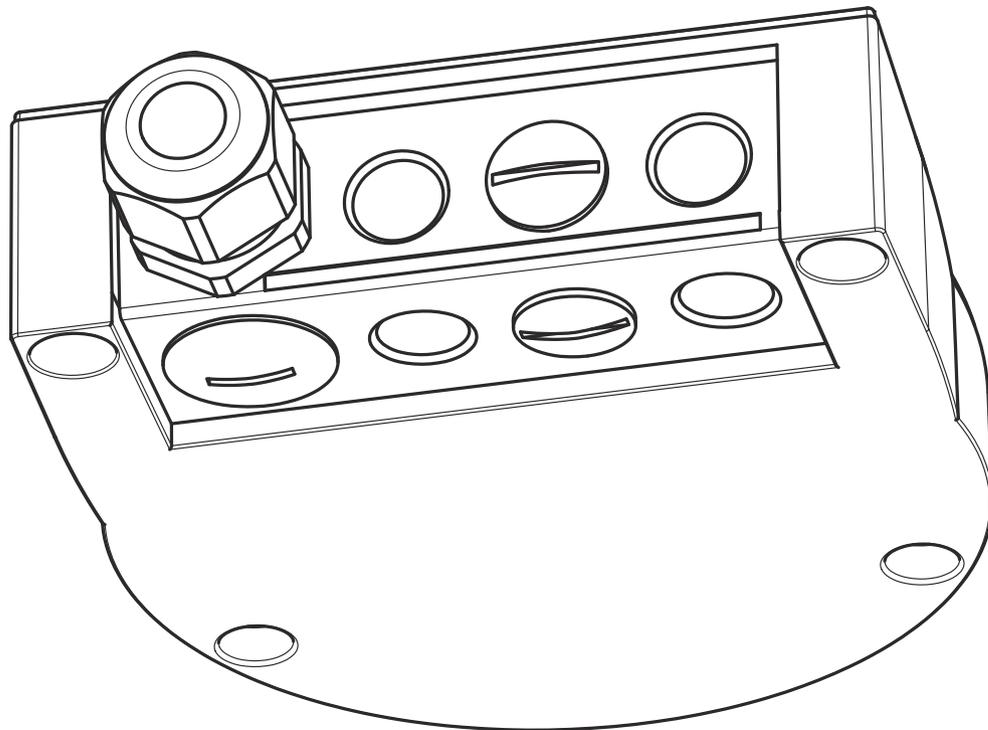
Figure 54: SX0B-A0000G system plug

SX0B-A0000J system plug:
- For S300 Professional and Expert
- 1 cable entry with M16 cable gland
- 1 cable entry without M16 cable gland (blind plug)
- 6 cable entries without M12 cable gland (blind plug)
- 2 M12 cable glands, enclosed loosely
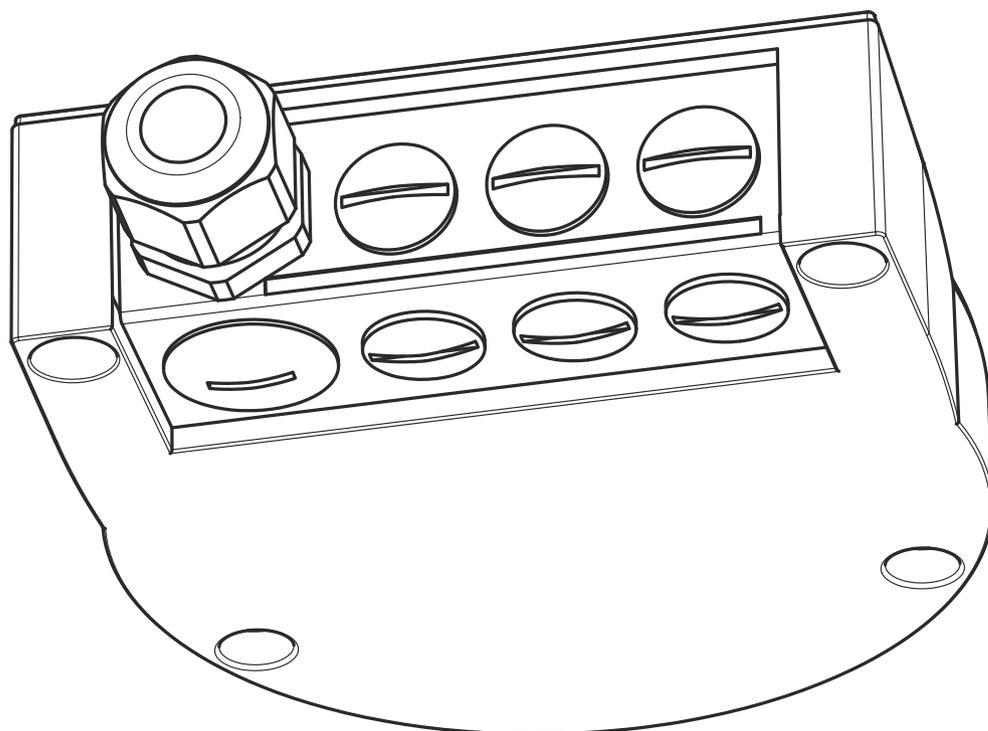
Figure 55: SX0B-A0000J system plug

▶ Depending on the application, use suitable cable glands on the bottom or rear.
▶ Use EMC compliant cable glands for the EFI cables.

Table 9: Use of the supplied cable glands

Cable gland	Cable diameter	Use
M16	5 mm … 9 mm	• System cables (supply voltage, outputs, static inputs, universal I/Os)
M12, EMC	3 mm … 6.5 mm	• EFI • Incremental encoder • RS422 data cables

Table 10: Recommended wire cross-sections

Cable	Recommended wire cross-sections	Shielded
System cables (supply voltage, outputs, static inputs, universal I/Os)	0.5 mm^2 … 1 mm^2, 9 … 15 wires	No [1]
EFI	2 × 0.22 mm^2	Yes
Incremental encoder	4 × 0.25 mm^2	Yes
RS422 data cables	4 × 0.25 mm^2	Yes

[1]   A shield is recommended if there are high EMC charges in the surroundings.

Further topics

6.4   Pre-assembled system plug

Pre-assembled system plug with flying leads

SX0B-B1105G, SX0B-B1110G, SX0B-B1114G, SX0B-B1120G
- For S300 Standard
- With 11 wires, unshielded (M16 cable gland)
- 5, 10, 14 or 20 m long

SX0B-B1105J, SX0B-B1110J
- For S300 Professional and Expert with dynamic inputs
- With 11 wires, unshielded (M16 cable gland)
- With 2 M12 cable glands (for incremental encoders), enclosed loosely
- 5 or 10 m long

SX0B-B1505G, SX0B-B1510G
- For S300 Advanced, Professional and Expert with static inputs
- With 15 wires, unshielded (M16 cable gland)
- 5 or 10 m long

Table 11: Pin assignment on pre-assembled system plugs

Pin	Signal	Wire color	SX0B-B1105G SX0B-B1110G SX0B-B1114G SX0B-B1120G	SX0B-B1105J SX0B-B1110J	SX0B-B1505G SX0B-B1510G
FE	Functional earth	Green	■	■	■
1	24 V DC	Brown	■	■	■
2	0 V DC	Blue	■	■	■

Pin	Signal	Wire color	SX0B-B1105G SX0B-B1110G SX0B-B1114G SX0B-B1120G	SX0B-B1105J SX0B-B1110J	SX0B-B1505G SX0B-B1510G
3	OSSD1	Gray	■	■	■
4	OSSD2	Pink	■	■	■
5	UNI-I/O1 / RESET/ C1	Red	■	■	■
6	UNI-I/O2 / EDM	Yellow	■	■	■
7	A1 or INC1_0	White/blue			■
8	A2 or INC1_90	White/gray			■
9	B1 or INC2_0	White/violet			■
10	B2 or INC2_90	White			■
13	UNI-I/O3 / ERR	White/black	■	■	■
14	UNI-I/O4 / WF	White/brown	■	■	■
15	UNI-I/O5 / RES_REQ/C2	Red/blue	■	■	■
16	STBY	White/green	■	■	■

SX0B-X0000XS06: Pre-assembled system plug with plug connectors
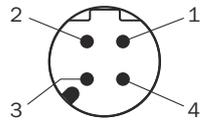
Figure 56: Voltage supply and EFI: Male connector, M12, 4-pin, D-coded

Table 12: Voltage supply and EFI: Male connector, M12, 4-pin, D-coded

PIN	Designation	Function
1	EFI$_A$	Enhanced function interface (safe SICK device communication)
2	EFI$_B$	
3	24 V DC	S300 supply voltage
4	0 V DC	S300 supply voltage
Thread	FE	Functional earth/shield
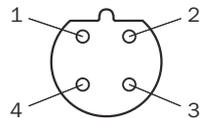
Figure 57: Dynamic input 1: Female connector, M12, 4-pin, B-coded

Table 13: Dynamic input 1: Female connector, M12, 4-pin, B-coded

PIN	Designation	Function
1	24 V DC	Supply voltage for incremental encoder 1
2	GND	
3	A1 / INC1_0	Static control input A or dynamic control input (input for incremental encoder) 1
4	A2 / INC1_90	
Thread	FE	Functional earth/shield
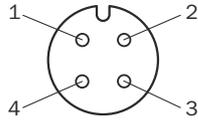
Figure 58: Dynamic input 2: Female connector, M12, 4-pin, A-coded

Table 14: Dynamic input 2: Female connector, M12, 4-pin, A-coded

PIN	Designation	Function
1	24 V DC	Supply voltage for the incremental encoder 2
2	GND	
3	B1 / INC2_0	Static control input B or dynamic control input (input for incremental encoder) 2
4	B2 / INC2_90	
Thread	FE	Functional earth/shield
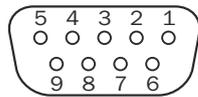
Figure 59: Measurement data output: Female connector, D-Sub, 9-pin

Table 15: Measurement data output: Female connector, D-Sub, 9-pin

PIN	Designation	Function
1	RxD−	RS-422 interface to measurement data output
2	RxD+	
3	TxD+	
4	TxD−	
5	nc	Not connected
6		
7		
8		
9		
Housing	FE	Functional earth/shield

Further topics

-

6.5 M8 × 4 configuration connection (serial interface)
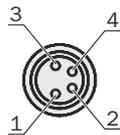
Figure 60: Pin assignment on the M8 × 4 configuration connection

Table 16: 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

> **(i)** **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 not configured.

- The operational status of the safety laser scanner is **Waiting for configuration**.
- The output signal switching devices (OSSDs) are in the OFF state, the red LED is illuminated: ◎.
- The 7-segment display shows ⑥.

7.2 CDS

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

Approach

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

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 the safety laser scanner (not included with delivery)

Approach

▶   To configure and diagnose the device using the CDS, connect the PC to the configuration connection of the safety laser scanner ①.
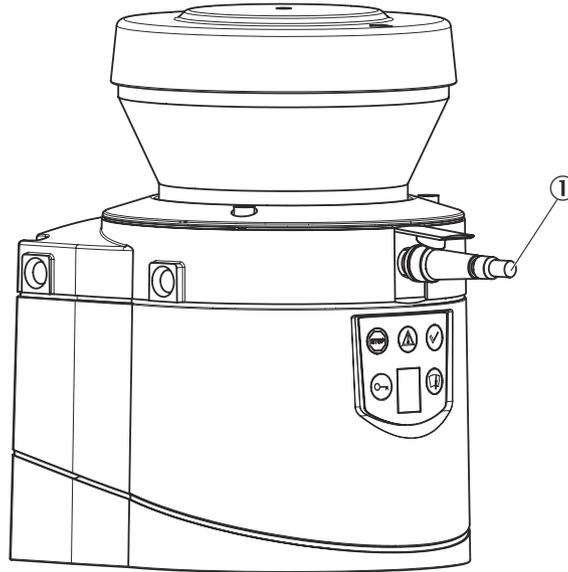
Figure 61: Configuration connection

Complementary information

> ℹ️ **NOTE**
> - Two service cables of different lengths are available for connecting the PC or notebook to the safety laser scanner (see "Service cables", page 140).
> - 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.

> ℹ️ **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 Compatibility mode

Overview

To ensure compatibility, the S300 safety laser scanners with firmware ≥ 02.10 can be operated in compatibility mode.

Activate the compatibility mode in the device selection wizard in the CDS.

Reasons why you must activate the compatibility mode or the compatibility mode is activated automatically by the CDS:
- You are using one of the following devices in an EFI system:
    - ○   S300 Professional CMS
    - ○   S300 Expert CMS

  o S300 with firmware < 02.10 and serial number < 12210000
  o S300 with system plug serial number < 12210000
  o S3000 Professional CMS
  o S3000 with firmware < B02.41 and serial number < 12210000
  o S3000 Standard, Advanced, Professional with an I/O module with serial number < 12210000
  o S3000 Remote with an I/O module with serial number < 11240000
- You are configuring an S300 with firmware < 02.10 and serial number < 12210000.
- You are configuring an S300 with system plug serial number < 12210000.
- You are using a safety laser scanner with a system plug in which a configuration is saved that:
  - only supports the compatibility mode.
  - was configured in the compatibility mode.
  - was configured with a CDS version < 3.6.7.
- You want to ensure newly configured devices can be replaced with old devices.
- You want to replace old devices with new.

The table below shows the differences between the functions of the product variants in the compatibility mode.

Table 17: Functions in the compatibility mode

Functions	Standard	Advanced	Professional	Expert
Application diagnostic output "Warning field interrupted"	■	■	■	■
Application diagnostic output "Error/contamination"	■	■	■	■
Application diagnostic output "Reset required"	■	■	■	■
External device monitoring (EDM)	■	■	■	■
Restart interlock/delay	■	■	■	■
Field sets comprising a protective field and one warning field	1	2	4	8/4 [1]
Programmable monitoring cases in stand-alone operation	1	2	4	8
Speed routing using a Flexi Soft safety controller	–	–	–	–

[1] Eight field sets at 1.0° angular resolution; four field sets at 0.5° angular resolution.

NOTE
- The user interface of the CDS in compatibility mode corresponds to the user interface of CDS version 3.6.6.
- The related operating instructions delivered with the device are to be used for older devices.

Interoperability in an EFI system depending on the firmware version

Table 18: Required compatibility mode with different firmware versions of the S300 in an EFI system with other S300

Firmware	Firmware	S300 Standard ≥ 02.10	S300 Standard < 02.10	S300 Advanced ≥ 02.10	S300 Advanced < 02.10	S300 Professional ≥ 02.10	S300 Professional < 02.10	S300 Professional CMS < 02.10 [1]	S300 Expert ≥ 02.10	S300 Expert < 02.10	S300 Expert CMS < 02.10 [1]
S300 Standard	≥ 02.10	X	–	X	■	X	■	■	X	■	■
S300 Advanced	≥ 02.10	X	–	X	■	X	■	■	X	■	■
S300 Professional	≥ 02.10	X	–	X	■	X	■	■	X	■	■
S300 Expert	≥ 02.10	X	–	X	■	X	■	■	X	■	■

[1]   This product variant only supports compatibility mode.

■ = Compatibility mode required

X = Compatibility mode not required [1]

– = EFI system not supported

Table 19: Required compatibility mode with different firmware versions of the S300 in an EFI system with other safety laser scanners

Firmware	Firmware	S3000 Standard ≥B02.41	S3000 Standard ≤B02.35	S3000 Advanced ≥B02.41	S3000 Advanced ≤B02.35	S3000 Professional ≥B02.41	S3000 Professional ≤B02.35	S3000 Professional CMS ≤B02.35 [1]	S3000 Expert ≥B02.41	S3000 Remote ≥B02.41	S3000 Remote ≤B02.35
S300 Standard	≥ 02.10	X	■	X	■	X	■	■	X	X	■
S300 Advanced	≥ 02.10	X	■	X	■	X	■	■	X	X	■
S300 Professional	≥ 02.10	X	■	X	■	X	■	■	X	X	■
S300 Expert	≥ 02.10	X	■	X	■	X	■	■	X	X	■

[1]   This product variant only supports compatibility mode

■ = Compatibility mode required

X = Compatibility mode not required [2]

[1]   Make sure that the serial number of the system plug of both devices is > 12210000.
[2]   Make sure that the serial number of the S300 system plug is > 12210000 and that the S3000 I/O module is current (S3000 Standard, Advanced, Professional with I/O module with serial number > 12210000, S3000 Remote with I/O module with serial number > 11240000).

Complementary information

> **NOTE**
> The S300 Mini does not support the compatibility mode. For EFI systems with the S300 Mini safety laser scanner, a device must be used that is not operated in the compatibility mode.

Further topics

- "Scope", page 7

7.5   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.

7.5.1   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.

Approach

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

7.5.2   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.

7.5.3   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.

7.5.4   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.

Approach

▶ 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.

7.6 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 20: 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 [4] (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 ⌷ ↻ ⌷.

7.6.1 Resolution

Maximum protective field ranges

The maximum protective field range [5] depends on the configured resolution. The following table shows the respective maximum protective field range of the product variants at the resolutions that can be set:

Table 21: Maximum protective field ranges at different resolutions

	Maximum protective field range
Medium Range variant	
30 mm (hand detection)	1.25 m
40 mm (hand detection)	1.60 m
50 mm (leg detection)	2.00 m
70 mm (leg detection)	2.00 m
Long Range variant	
30 mm (hand detection)	1.25 m
40 mm (hand detection)	1.60 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] Configurable only for the Long Range variant with a 3 m scanning range.
[5] Radial distance to the safety laser scanner.

	Maximum protective field range
50 mm (leg detection)	2.10 m
70 mm (leg detection)	3.00 m
150 mm (body detection)	3.00 m

Complementary information

NOTE
You can configure the warning field up to 8 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 130

7.6.2　Basic response time

The basic response time of the safety laser scanner is 80 ms.

NOTE
You may need to add supplements to the basic response time due to multiple sampling and data transmission over EFI.

Further topics

- "Response times", page 131

7.6.3　Maximum protective field range

The maximum protective field range of the safety laser scanner, which depends on the configured resolution and the product variant used, is shown in the CDS.

NOTE
The maximum protective field range of the device must be sufficient to cover the calculated protective field size including the necessary supplements.

Further topics

- "Resolution", page 80
- "Protective field size", page 38

7.7　Incremental encoder

The S300 Professional and the S300 Expert have two dual-channel dynamic control inputs using which the possible monitoring cases can be switched depending on the speed.

Incremental encoders must be connected to the dynamic control inputs for this purpose. Per incremental encoder, one 0°/90° output is required so that the direction of travel can be determined.

To use the inputs A and B as dynamic control inputs, select the **Indicate velocity** option.

7.7.1 **Pulses per cm travel that are output by the incremental encoders**

Overview

The result depends on the number of pulses the incremental encoder supplies per revolution. It also depends on the ratio between the wheel on the vehicle and the friction wheel on which the incremental encoder is mounted.
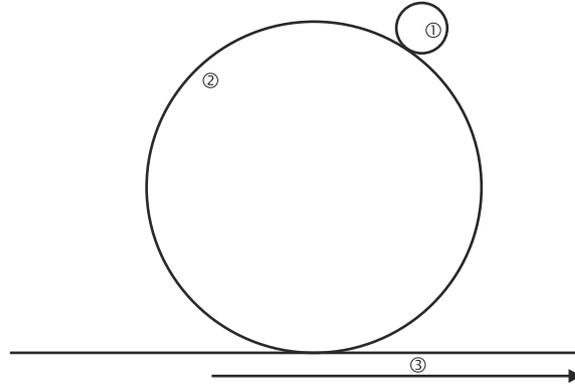
Figure 62: Calculation of pulses per cm travel

① Friction wheel ø 3.5 cm
② Forklift truck ø 35 cm
③ Distance covered by the AGV

Calculating the number of pulses per centimeter

Example:
• The wheel on a forklift truck has a diameter of 35 cm.
• The friction wheel on which the incremental encoder is mounted has a diameter of 3.5 cm.
• The incremental encoder used supplies 1,000 pulses per revolution.

Circumference of the forklift truck wheel = d × π = 35 cm × π = 109.96 cm

One revolution of the forklift truck wheel corresponds to ten revolutions of the friction wheel and therefore 10,000 pulses from the incremental encoder.

The number of pulses of the incremental encoder per centimeter of distance covered by the vehicle is therefore:

pulses/cm = 10,000 : 109.96 = 90.94

When configuring the incremental encoder in the CDS, you therefore need to enter the rounded value "91" in the **Pulses per centimeter** field. The user software uses this value to calculate the maximum permissible speed of the vehicle.

7.7.2 **Tolerances allowed on the dynamic inputs**

As a rule, the same pulse frequency is present at the dynamic inputs when a vehicle moves in a straight line. On driving around bends or in case of wear e.g., of the vehicle's tires, the values at the two inputs may, however, vary.

The speed values from the two incremental encoders may only differ from each other by a tolerance that can be configured. Deviations are allowed only for a certain time window depending on the speed, .

The maximum percentage deviation between the two encoder speeds that can be configured is 45%. During this process the higher of the two speeds (irrespective of whether with positive or negative sign) is used as the reference for this calculation as well as the vehicle speed.

The tolerance is allowed to be exceeded for a certain period of time. After that the system switches to a safe state (lock-out). The period of time depends on the vehicle speed, see figure 63, page 83.
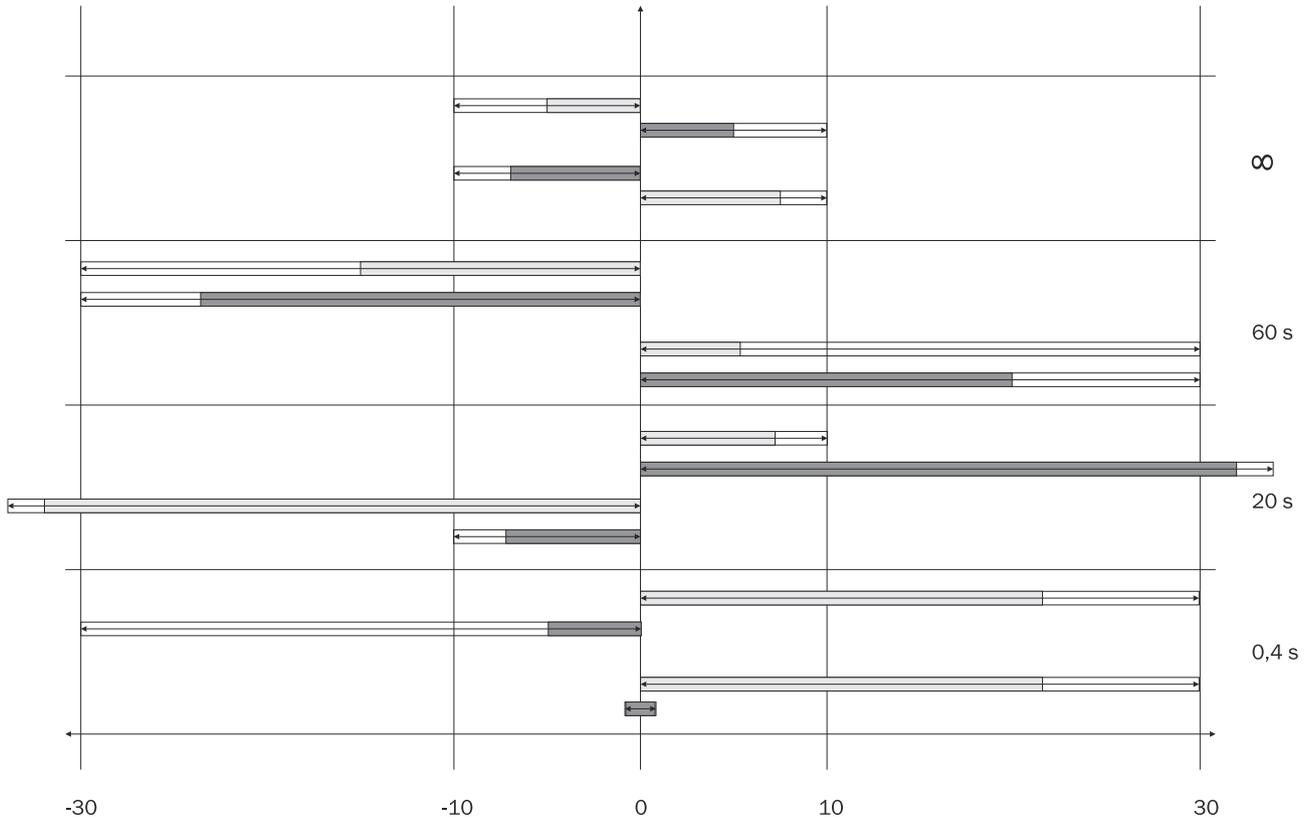
Figure 63: Tolerances allowed on the dynamic inputs

| ▬▬▬ | Speed on input A |
| ▭▭▭ | Speed on input B |

- If the vehicle speed is in the range between –10 cm/s and +10 cm/s, then no shut down occurs, irrespective of how long the deviation between the incremental encoders is present.
- If the vehicle speed is between –30 and –10 cm/s or +10 and +30 cm/s, then the maximum period of time for which a deviation is tolerated is 60 s.
- If the vehicle speed is in the range ≤–30 cm/s or ≥+30 cm/s, then the maximum period of time for which a deviation is tolerated is 20 s.
- If the vehicle speed is in the range ≤–10 cm/s or ≥+10 cm/s, then different directions of rotation on the incremental encoders are only tolerated for 0.4 s.

7.8 Inputs

Overview

It is possible to switch between the monitoring cases of the safety laser scanner during operation. The following options are available for doing this:
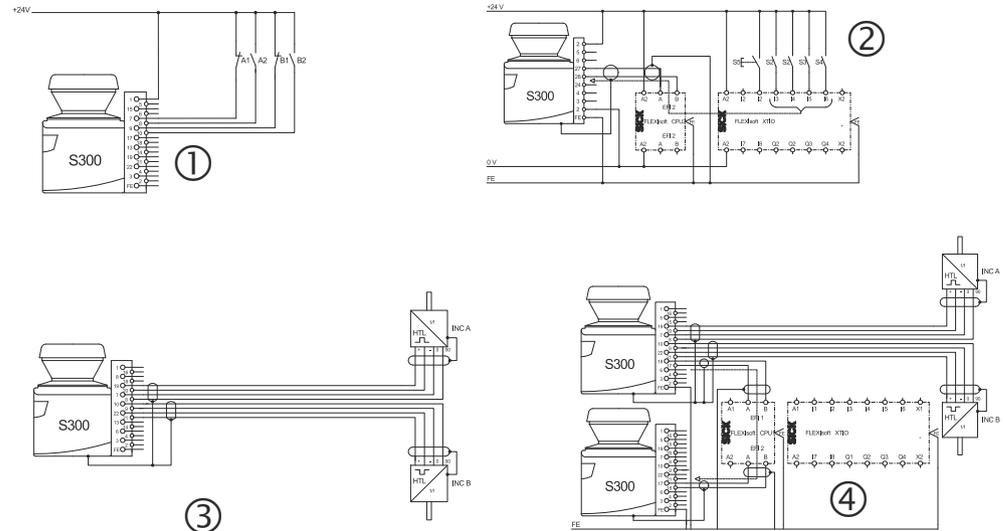
Figure 64: Possible ways of monitoring case switching

① Local static inputs (S300 Advanced, Professional and Expert)

② External static inputs via EFI (all S300 variants)

③ Local dynamic inputs (S300 Professional and Expert)

④ Speed information via EFI

- Indicate and use velocity (S300 Professional and Expert)
- Use velocity (all S300 variants)

When configuring an EFI system, you define in the CDS the device in which the inputs are used.

Stand-alone operation

In stand-alone operation of a device, you use the local inputs of the device.

The S300 Advanced has two dual-channel static control inputs A and B.

The S300 Professional and the S300 Expert have three dual-channel control inputs. Of these control inputs, you can use the inputs A and B as both static control inputs and also dynamic control inputs.

The dual-channel control input C is formed by the universal I/O 1 and universal I/O 5 connections.

▶ Activate the inputs you want to use for monitoring case switching.

If you activate the **Use speed** option, you can use speed ranges for monitoring case switching.

EFI system

If devices are connected together via EFI, the safety laser scanner can receive control commands from other devices, e.g., a second safety laser scanner or Flexi Soft safety controller. For the supported control commands of the safety laser scanner, see "Control features", page 135.

In an EFI system, you configure which device you want to use for obtaining the input information.

If the safety laser scanner is connected to a Flexi Soft safety controller, up to five dual-channel control inputs can be configured.

7.8.1 Input delay

If the control device that you use to switch the static control inputs cannot switch to the appropriate input condition within 10 ms (for example because of the switch's bounce times), you must configure an input delay. For the input delay, select a time in which the control device can switch in a defined way to a corresponding input condition.

The following empirical values exist for the switchover time using various methods:

Table 22: Empirical values for the required input delay

Switching method	Input delay required
Electronic switching using controller or complementary electronic outputs with 0 to 10 ms bounce time	10 ms
Contact (relay) controls	30–150 ms
Control via independent sensors	130–480 ms

Further topics

7.8.2 Sampling for the static control inputs

Overview

If you are using static sampling, you can choose between complementary sampling or 1-of-n sampling depending on the control features available. Depending on this selection, you can define the switching criteria for the monitoring cases.

Complementary evaluation

A control input consists of 2 channels. To switch correctly, one channel must be switched inversely to the other.

The following table shows the levels that must be present at the channels for the control input to define the logical input state 1 and 0 at the related control input.

Table 23: Level at the channels for the control inputs for complementary sampling

A1	A2	Logical input state
1	0	0
0	1	1
1	1	Error
0	0	Error

1-of-n evaluation

With 1-of-n sampling, you use the single connections of the control input pairs.

Table 24: Truth table for 1-of-n sampling with two input pairs

A1	A2	B1	B2	Result (e.g., monitoring case no.)
1	0	0	0	1
0	1	0	0	2
0	0	1	0	3
0	0	0	1	4
0	0	0	0	Error
1	1	0	0	Error

NOTE
- All connections must be connected.
- Only one connection is ever allowed to be 1.

Further topics

- "Monitoring case switching via static input information", page 96

7.9 OSSDs

In an EFI system, you define in the CDS which output signal switching device (OSSD) is switched when there is an object in the protective field.

- Internal OSSDs
  Defines that the protective field or the protective fields switch the OSSDs on the safety laser scanner.
- External OSSDs
  The device transmits the status of the field sets (protective field/warning fields) via the EFI interface. The OSSDs on another device connected via the EFI interface are switched.
  - Connected S300 or S3000: The OSSDs on the second safety laser scanner are switched.
  - Connected safety controller (e.g., Flexi Soft): The OSSDs on the safety controller are switched depending on its configuration.
  - Connected network solution (e.g., safety remote I/O): The information is passed via the network e.g., to an FPLC that must shutdown the dangerous state.

⚠️ **DANGER**
Incorrect use of the OSSD bit

The dangerous state may not be stopped in the event of non-compliance.

If the local OSSDs on the device are not used, the OSSD state is always transferred as active via EFI. In this case, the OSSD bit in the Flexi Soft safety controller must not be used for safety-related functions.

▶ Do not use the OSSD bit for safety-related functions.

Use the status information from the protective fields instead.

The status of the protective fields is transmitted using EFI and can be combined in the Flexi Soft safety controller as required. The signal of the Flexi Soft safety controller safety outputs is transmitted, for example, to a machine or vehicle controller.

⚠️ **DANGER**
Incorrect signal evaluation

The dangerous state may not be stopped in the event of non-compliance.

▶ Note the logical values of the status information of the protective fields when transferred to the Flexi Soft safety controller.

- The status of an evaluated protective field is logical 1 if the protective field is clear.
- The status is logical 0 if the protective field is interrupted.
- The status of an unallocated protective field defaults initially to logical 1.

Further topics

- "EFI status information and control commands", page 134

7.9.1 External device monitoring (EDM)

The EDM checks if the contactors actually de-energize when the protective device is tripped. If you activate external device monitoring, then the safety laser scanner checks the contactors after each interruption of the protective field and prior to the machine restart. External device monitoring is then able to detect if one of the contactor's contacts is welded, for instance. In this case the external device monitoring places the system in a safe operational status and the OSSDs are not switched back to the ON state.

The table shows how the device reacts if the external device monitoring detects a contactor malfunction:

Table 25: Behavior of the device on a contactor malfunction

Without internal restart interlock or with restart delay	• The system locks completely (lock-out). • The error message 🄱 appears in the 7-segment display.
With restart interlock	• The safety laser scanner switches its OSSDs to the OFF state. • The LED ◎ is illuminated. • The error message 🄱 appears in the 7-segment display.

External device monitoring can be configured in the CDS.

ⓘ **NOTE**

▶ If the external device monitoring function is not being used, leave the inputs disconnected.

Further topics

7.10 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.

Restart behavior when the safety laser scanner is integrated into a Flexi Soft safety controller

The effectiveness of a restart interlock/delay configured in the safety laser scanner depends on the integration of the EFI status information from the safety laser scanner in the logic of the Flexi Soft safety controller.

- The internal restart interlock/delay acts on the OSSDs on the safety laser scanner. If the status information on the OSSDs is used in the Flexi Soft safety controller, the restart interlock/delay also acts on the Flexi Soft safety controller.
- If the status information on the protective fields is used in the Flexi Soft safety controller, the restart interlock/delay does not affect the Flexi Soft safety controller. In this case, a restart interlock/delay must be implemented in the Flexi Soft safety controller.

Configuration of the safety laser scanner without restart interlock

If there is an object in the protective field, the OSSDs on the safety laser scanner switch to the OFF state. The OSSDs are re-enabled again immediately 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 OSSDs on the device switch to the ON state 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
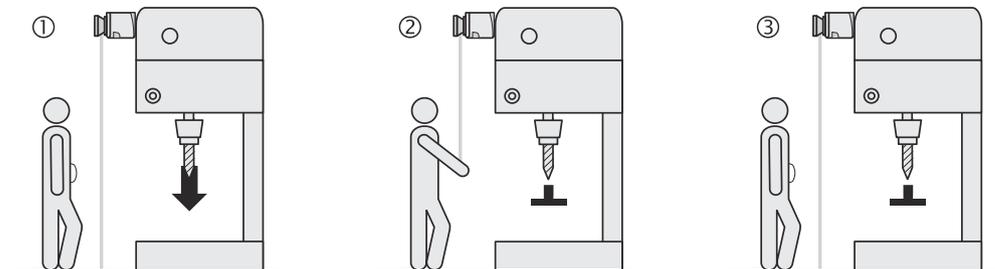
Figure 65: Schematic representation of operation with restart interlock

> **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 OSSDs on the safety laser scanner switch to the OFF state to initiate a machine ① or vehicle stop as soon as there is an object in the protective field ②. They do not switch to the ON state ③, even if there is no longer an object in the protective field. The OSSDs only switch to the ON state 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.

> ℹ️ **NOTE**
> - For examples on connecting the internal restart interlock, see "Connection diagrams", page 50.
> - If you do not use the internal restart interlock, leave the inputs disconnected.

Reset

> ℹ️ **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:
- It switches its OSSDs to the ON state.
- 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.

Further topics

- "Measures to prevent unsecured areas", page 31
- "EFI status information and control commands", page 134
- "Pin assignment", page 66

7.11 Universal I/O connections

Important information

> ⚠️ **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.
>
> The universal I/O connections supply non-safe signals. The signals are not suitable for controlling an application or for safety-relevant functions.
>
> ▶ Do not use universal I/O connections for safety-related functions.

The safety laser scanner has five universal I/O connections. You can configure these five connections for one or more of the following functions (linked by the operator OR):

As inputs:
- I/O1 [6] as Reset
- I/O2 as EDM or Reset

As outputs:
- I/O3, I/O4 and I/O5 [6]

Table 26: Configuration options of the universal I/O connections as outputs

In stand-alone operation	In an EFI system with another safety laser scanner
• Error • Contamination error • Contamination warning • Warning field 1 • Warning field 2 • Reset required	• Protective field (host/guest) • Warning field 1 (host/guest) • Warning field 2 (host/guest) • Simultaneous protective field of the host, if the host is an S3000 in dual field mode • Simultaneous warning field of the host, if the host is an S3000 in dual field mode

You can configure the universal I/O connections in the **Universal I/O** area in the CDS.

Figure 66: Configuration example for universal I/O connections

> **NOTE**
> If you operate the device in the compatibility mode, then the connections on the universal I/O are used as an application diagnostic output, warning field output, and application diagnostic output for Reset required.

7.11.1 Application diagnostic output in the compatibility mode

The device has a configurable application diagnostic output in the compatibility mode. You can configure the following for the application diagnostic output in the CDS:

- Whether the application diagnostic output is deactivated.
- Whether a signal is only output when the front screen is contaminated.

---

[6] Not available if input C is used.

- Whether a signal is only output on errors.
- Whether a signal is output both for front screen contamination and on errors.

7.12 Field Sets

The number of field sets that can be configured depends on the product variant. The following table shows the number of field sets per product variant:

Table 27: Number of field sets that can be configured per product variant

	Standard	Advanced	Professional	Expert
Number of field sets	1	4	8	16

7.12.1 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.
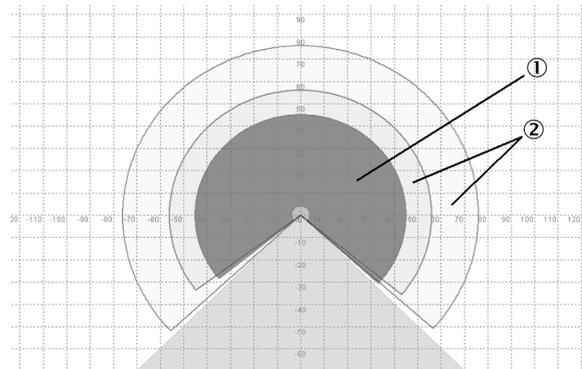

Figure 67: Creating a field set in the CDS

Protective fields and warning fields can cover an angle of up to 270° and have different radial scanning ranges depending on the product variant 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 105, see "Checklist for initial commissioning and commissioning", page 150.

▶ Check the configured protective fields.

ℹ️ **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.
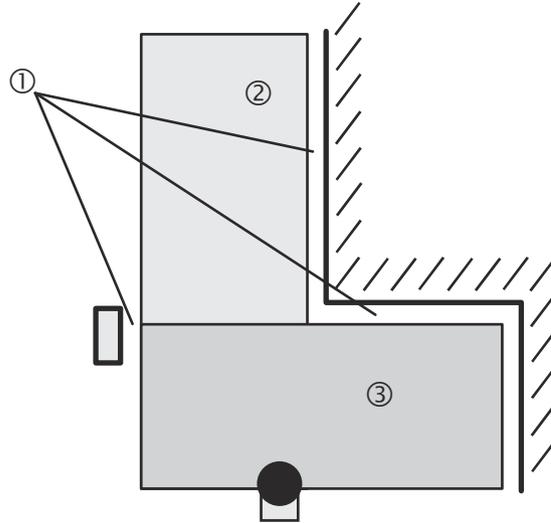
Figure 68: Configuring the protective field and warning field

⚠ **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 80

7.12.2   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.

7.12.3   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:
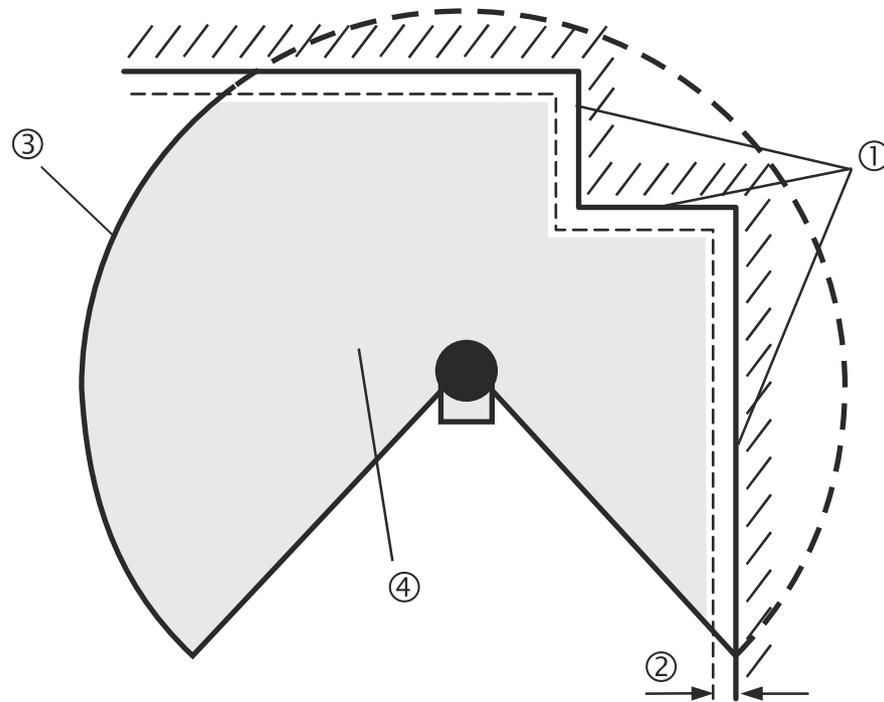
Figure 69: Reading the protective field

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.

i 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 58.

Before commissioning the machine or vehicle, check the configuration of the protective fields, see "Commissioning", page 105, see "Checklist for initial commissioning and commissioning", page 150.

▶   Calculate the minimum distance.
▶   Check the configured protective fields.

7.12.4 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).
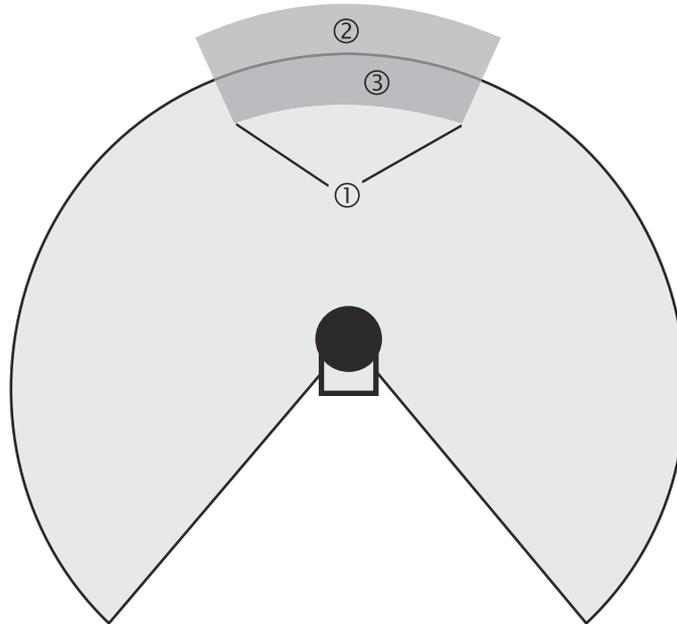

Figure 70: Schematic diagram of contour as reference

⚠️ **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 OSSDs of the device swiched to the OFF state 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.

ℹ️ **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), you must, in accordance with IEC 61496-3, configure the protective fields using the contour as reference function.
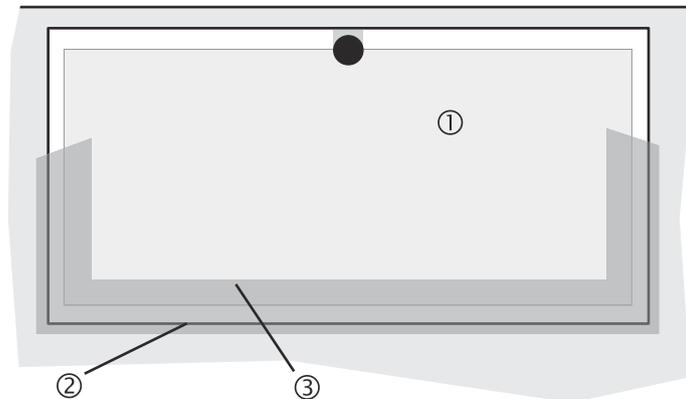

Figure 71: Contour as reference for vertical operation

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**.

7.13   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 28: Number of monitoring cases

Application	Standard	Advanced	Professional	Expert
Applications with local static control inputs on the safety laser scanner	1	4	8	8
Applications with static control inputs via EFI (e.g., on a Flexi Soft)	32	32	32	32
Applications with dynamic control inputs on the safety laser scanner	–	–	16	32
Applications with dynamic control inputs via EFI	32	32	32	32

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 unique follow-on case or two alternative follow-on cases.
- The multiple sampling for the field set.

Monitoring cases can be switched with the following input information:
- Static information
- Speed information
- A combination of the two

Further topics
- "Field Sets", page 91
- "Mounting", page 58

7.13.1 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 34).

▶ 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 the two control input pairs on the S300 Advanced, 2^2 = 4 monitoring cases can be switched.

Using the three control input pairs on the S300 Professional, 2^3 = 8 monitoring cases can be switched.

Using the three control input pairs on the S300 Expert, 2^3 = 8 monitoring cases can be switched.

Using external inputs (e.g., those of a Flexi Soft safety controller), 2^5 = 32 monitoring cases can be switched via a maximum of five control input pairs.

Table 29: Truth table for complementary sampling

A	B	C	D	E	E.g. case
0	0	0	0	0	1
1	0	0	0	0	2
0	1	0	0	0	3
1	1	0	0	0	4
0	0	1	0	0	5
1	0	1	0	0	6
0	1	1	0	0	7
1	1	1	0	0	8
...					...
0	1	1	1	0	15
1	1	1	1	0	16
0	0	0	0	1	17
...					...
0	1	1	1	1	31
1	1	1	1	1	32

NOTE

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

Static 1-of-n sampling

With 1-of-n sampling, you use the single connections of the control input pairs. In this way, the S300 Advanced provides four input connections.

With 1-of-n sampling, you use the single connections of the control input pairs. In this way, the S300 Professional provides six input connections.

With 1-of-n sampling, you use the single connections of the control input pairs. In this way, the S300 Expert provides six input connections.

i NOTE
- Using external inputs (e.g., those of a Flexi Soft safety controller), a maximum of ten input connections can be used.
- All connections must be connected.
- Once connection must be 1.
- Only one connection is ever allowed to be 1.

Table 30: Truth table for 1-of-n sampling

A1	A2	B1	B2	C1	C2	D1	D2	E1	E2	E.g. case
1	0	0	0	0	0	0	0	0	0	1
0	1	0	0	0	0	0	0	0	0	2
0	0	1	0	0	0	0	0	0	0	3
0	0	0	1	0	0	0	0	0	0	4
0	0	0	0	1	0	0	0	0	0	5
0	0	0	0	0	1	0	0	0	0	6
0	0	0	0	0	0	1	0	0	0	7
0	0	0	0	0	0	0	1	0	0	8
0	0	0	0	0	0	0	0	1	0	9
0	0	0	0	0	0	0	0	0	1	10
1	1	0	0	0	0	0	0	0	0	Error
0	0	0	1	1	0	0	0	0	0	Error
0	0	0	0	0	0	0	0	0	0	Error
And all other combinations										Error

Further topics

- "Inputs", page 83

7.13.2 Monitoring case switching via speed information

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 34).

▶ Make sure that the control – using dynamic control inputs (incremental encoders) – provides switching between the monitoring cases in the correct time frame.
▶ Make sure that only one safety laser scanner is connected to an incremental encoder.
▶ Use two incremental encoders so that a possible fault in one encoder can be detected.
▶ Lay the connecting cables to the incremental encoders separately.

Prerequisites

For dynamic sampling using incremental encoders, configure the following:
- The **Use speed** option
- For each monitoring case, the range of speeds for switching to the monitoring case

Example

• Monitoring case 1 (standstill)	–10 … +10 cm/s
• Monitoring case 2 (forward movement 1)	11 … 50 cm/s
• Monitoring case 3 (forward movement 2)	51 … 100 cm/s
• Monitoring case 4 (forward movement 3)	101 … 200 cm/s

NOTE

When configuring the monitoring cases in the CDS, you must cover all possible or allowed speeds of the vehicle. An undefined speed will result in the safety outputs being switched to the OFF state or the device signaling **Protective field interrupted**. You can use this function, for example, for safe maximum speed monitoring on vehicles.

Further topics

7.13.3 Speed routing via EFI

Overview

If several safety laser scanners are connected to a Flexi Soft safety controller, then a speed routing can be configured. This enables the speed information determined using the incremental encoders on an S300 Professional or Expert to be distributed to all safety laser scanners.

NOTE

Speed routing is not available in the compatibility mode.
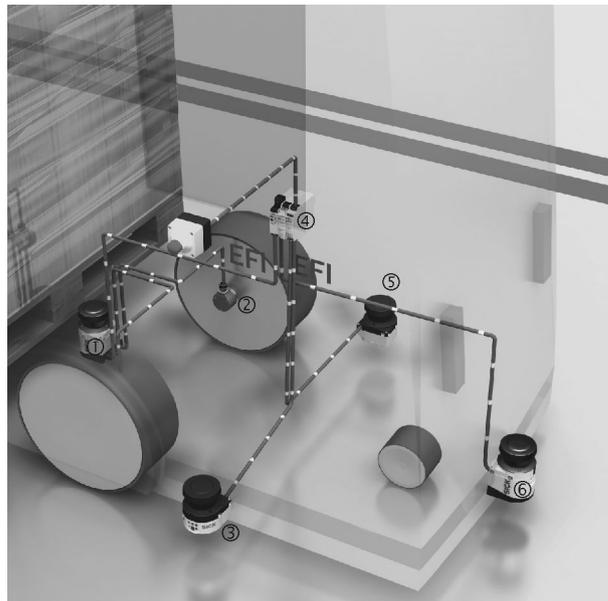
Figure 72: Example for speed routing on an AGV

①   S300 Expert on EFI1.1
②   Incremental encoder
③   S300 Mini on EFI2.2
④   Flexi Soft
⑤   S300 Mini on EFI1.2

⑥   S300 on EFI2.1

Incremental encoders ② are connected to the S300 Expert on EFI1.1 ①. These incremental encoders generate the necessary speed signals. The Flexi Soft safety controller ④ distributes the signals to all four safety laser scanners (① and ⑤ as well as ③ and ⑥). The signals are available on all four safety laser scanners for monitoring case switching.
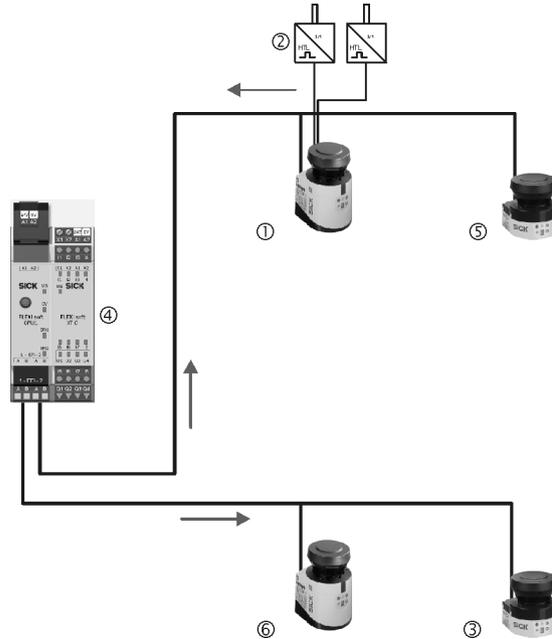

Figure 73: Connection diagram for speed routing

①   S300 Expert on EFI1.1
②   Incremental encoder
③   S300 Mini on EFI2.2
④   Flexi Soft
⑤   S300 Mini on EFI1.2
⑥   S300 on EFI2.1

Configuring speed routing in the Flexi Soft Designer

▶   Configure the speed routing in the Flexi Soft Designer, for example as shown in the following figure.
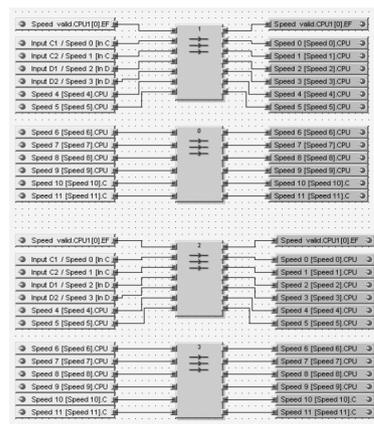

Figure 74: Example for speed routing in the Flexi Soft Designer

- Left: Input signals from the device with incremental encoders
    - 12 + 1 bit pattern duplicated and placed on the n:n function blocks EFI1.1 ①
- Right: Output signals to all safety laser scanners
    - EFI string 1 (safety laser scanner on EFI1.1 ① and EFI1.2 ⑤)
    - EFI string 2 (safety laser scanner on EFI2.1 ⑥ and EFI2.2 ③)

The speed signals of the S300 Expert are broken down into a 12 + 1 bit pattern: 12 speed bits and one bit for validation. These signals are available as input signals, are duplicated and placed twice on the n:n function blocks (0 and 1 as well as 2 and 3).

The outputs of the function blocks are placed on EFI string 1 or on EFI string 2. As a result they are available to all four safety laser scanners.

⚠ **DANGER**

Dangerous state of the machine

The "Speed valid" status information is relevant for safety.

▶ Make sure that the "Speed valid" input signal is connected to the "Speed valid" output signal.

Configuring the safety laser scanners in the CDS

▶ In the CDS, on the **Incremental encoder** tab for the device to which the incremental encoders are connected, select the **Indicate velocity** option.

All safety laser scanners, also the sending devices, must use these speed signals via EFI.

▶ For this reason activate the **Use Flexi Soft CPU1** option on the **Inputs** tab for all safety laser scanners.
▶ Then select the **Use velocity** option on the **Inputs** tab for all safety laser scanners.

7.13.4 Multiple sampling

If multiple sampling is set, an object must be scanned several times before the safety laser scanner switches its OSSDs to the OFF state. 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 safety laser scanner switches the OSSDs to the OFF state.

⚠ **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 31: Recommended multiple sampling

Application	Recommended multiple sampling
Stationary under clean ambient conditions	2 times
Vertical applications	2 times

Application	Recommended multiple sampling
Mobile	4 times
Stationary under dusty ambient conditions	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 for each monitoring case.

Further topics

-

7.13.5   **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.
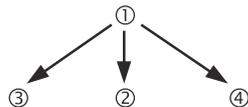
Figure 75: Schematic representation of monitoring case switching - arbitrary sequence

Figure 76: Schematic representation of monitoring case switching - unique sequence
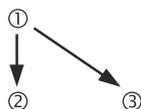
Figure 77: Schematic representation of monitoring case switching - alternative sequence

7.13.6   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.

> **NOTE**
> If, in an EFI system, only the OSSDs on one safety laser scanner are used (common OSSDs), then the OSSDs on this safety laser scanner will switch to the OFF state as soon as either of the two safety laser scanners is switched to the park/standby mode. If, on the other hand, the OSSDs on both safety laser scanners are used (separate OSSDs), then only the OSSDs on the safety laser scanner that is switched to park/standby mode will switch to the OFF state.

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

A dedicated STBY single-channel input is provided for switching to the standby mode.

Alternatively, it is also possible to switch to the standby mode via EFI.

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

Further topics

7.14   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).

CMS functionality

On the S300 Expert, further parameters, in addition to those described above, can be configured for the CMS functionality.

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

If **Internal event** is selected, this event must be defined.

With **Continuous data output**, the data to output must be selected.

If **Measurement data output** is also enabled, it is necessary to select whether the measurement data are to be output together with the I/O data in **one telegram** or in **two separate telegrams**.

For the measurement data output, one to five segments, which are defined by start and end angles, need to be specified.

For further details on this topic, see the "Telegram Listing CMS" documentation (part no. 9090806).

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

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 32: 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	6	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 33: Display of LEDs after the power up sequence

Step	Display					Meaning
1	◎	⊶	⚠	🖳	✓	Device self-test
2	◎	⊶	⚠	🖳	✓	Device self-test
3	◎	⊶	⚠	🖳	✓	Device status: Waiting for configuration or object in the protective field, OSSDs in the OFF state
	Other display					Safety interlock activated. Malfunction

> ℹ️ **NOTE**
> The switch-on time depends on the extent of the configuration data and can take up to 25 seconds.

Further topics

8.3 Test notes

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.

Approach

▶ 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 150.
▶ 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 109.
▶ 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.

ℹ️ **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

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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 34: 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	2	Waiting for device on the EFI (only possible for S300 Advanced and Professional)
3 [1]	H or G	Device addressed as host Device addressed as guest
4	4	Waiting for valid inputs
5	No display or ⌐ or ⌐, ⌐ or i	Device ready for operation Device ready for operation but object in the protective field Device ready for operation but object in the warning field Device ready for operation but object in the protective field (in compatibility mode)
	Other display	Safety interlock activated. Malfunction.

[1] Only in an EFI system.

Table 35: Display of LEDs after the power up sequence

Display					Meaning
⊚	⊶	⚠	🔧	✓	Power-up cycle, step 1
⊚	⊶	⚠	🔧	✓	Power-up cycle, step 2
⊚	⊶	⚠	🔧	✓	The device is ready for operation, object in the protective field and warning field.
⊚	⊶	⚠	🔧	✓	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. Reset required
Other display					Safety interlock activated. Malfunction

Complementary information

ℹ **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.

ℹ **NOTE**
To be able to unambiguously differentiate between the host device and the guest device in an EFI system, one safety laser scanner must be configured as the guest.

If the system plug on a guest device has been replaced, the jumper must be rewired on the guest device.

▶ To define the guest device, wire a jumper between terminals 7 (A1 / INC1_0) and 13 (UNI-I/O3 / ERR/WEAK).

The jumper always defines the guest device. This jumper must not be fitted on the host device.

Further topics

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 optics cover 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 150

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.

Approach

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.
   If the safety laser scanner with the protective field that you are interrupting switches the OSSDs on another safety laser scanner or the OSSDs on a sens:Control series via EFI, then on this device the LEDs must change from green to red and the dangerous movement on the machine or system connected must come to an immediate stop.
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:
    o 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.
    o If several reference contours are used, test all reference contours.

Further topics

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9.3 Cleaning the optics cover

Overview

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

Important information

> **!** **NOTICE**
> ▶ Do not use aggressive cleaning agents.
> ▶ Do not use abrasive cleaning agents.

> **i** **NOTE**
> Static charges cause dust particles to be attracted to the optics cover. This effect can be diminished by using the anti-static plastic cleaner (part number 5600006) and the SICK lens cloth (part number 4003353).

Approach

To clean the optics cover:
▶ Use a clean and soft brush to remove dust from the optics cover.
▶ Moisten the SICK lens cloth with the anti-static plastic cleaner, then use the cloth to wipe off the light emission window on the optics cover.

Further topics

• "Accessories", page 140

9.4 Replacing the optics cover

Overview

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

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

Important information

> ⚠ **WARNING**
> Incorrect reference value of optical properties
>
> If optics cover calibration is not done correctly, persons and parts of the body to be protected may not be detected.
>
> ▶ Carry out an optics cover calibration every time the optics cover is replaced.
> ▶ Perform the optics cover calibration at room temperature (10 °C to 30 °C).
> ▶ Only perform the optics cover calibration using a new optics cover.
> ▶ Make sure that the new optics cover is free of contamination when carrying out the calibration.

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

Prerequisites

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

Approach

To replace the optics cover:
1. Disconnect the system plug and remove the safety laser scanner.
2. Move the safety laser scanner to a clean location (office, maintenance shops 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 ③ of the optics cover.
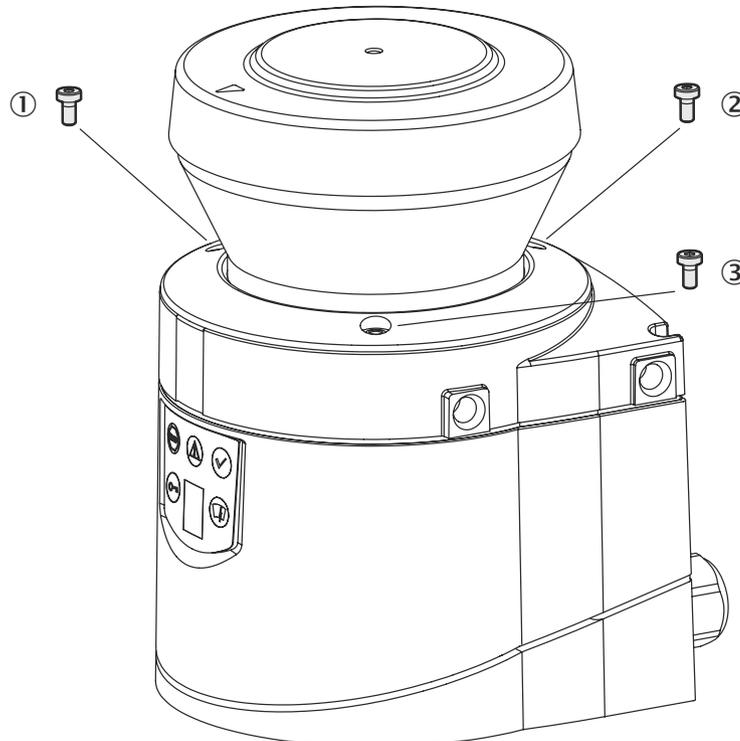
Figure 78: Remove the fixing screws of the optics cover

5. Remove the optics cover.
6. Check whether the mirror on the motor is dirty and, if necessary, remove any contamination using an optic brush.

7. Take the new optics cover out of the packaging and remove the protective cap for the seal.
8. If necessary, remove any remnants of packaging.
9. Place the optics cover on the safety laser scanner and fit the new fixing screws ① to ③.
10. When fitting the new optics cover, ensure the arrow on the top of the cover points to the front and that the optics cover is fully in contact without a gap.
11. Tighten the screws using the set tightening torque.
12. Make sure that the optics cover is clear of dirt and damage.

Recommissioning the safety laser scanner:

▶ Correctly re-mount 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 an optics cover calibration using the CDS.

Further topics

- "Accessories", page 140
- "Additional accessories", page 142
- "Mounting", page 58
- "Recommissioning", page 107

9.5 Replacing the device

Overview

The device has a configuration memory in the system plug. In case of device replacement, the existing configuration is automatically transferred to the newly connected device.

Approach

1. Remove the system plug.
2. Remove the safety laser scanner.
3. Correctly mount the new safety laser scanner.
4. 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.
5. Carry out the check as per the requirements for monthly checking.

Compatibility mode

If a new device is connected to an older system plug, the new device will operate automatically in compatibility mode.

Reasons for activating the compatibility mode
- System plug serial number < 12210000
- System plug in which the following configuration is saved:
  - A configuration that only supports the compatibility mode.
  - A configuration that has been configured in the compatibility mode.
  - A configuration that has been configured with a CDS version < 3.6.7.

ⓘ NOTE
If compatibility cannot be established, e.g., if an S300 Professional is replaced with an S300 Advanced, the device switches to the "Waiting for configuration" state. In this case the 7-segment display indicates *6*.

Further topics

- "Mounting", page 58
- "Recommissioning", page 107
- "Monthly check of the protective device by authorized and specialist personnel", page 109
- "Compatibility mode", page 76

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 fault and if you cannot safely remedy the fault.
- ▶ 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 can be found at the responsible SICK subsidiary.

10.2 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.

Error and status indications of the LEDs

Table 36: Error and status indications of the LEDs

Display	Output level	Possible cause	Rectification of the error
◉ ✓	At the OSSDs	Object in the protective field, OSSDs in the OFF state	Not an error
◉ ✓	At the OSSDs	Protective field clear, OSSDs in the ON state	Not an error
⚠	On the respective universal I/O [1]	Object in one of the warning fields	Not an error
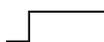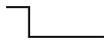
Display	Output level	Possible cause	Rectification of the error
◎ ✓ 🐞	At the OSSDs On all universal I/Os	Supply voltage missing or too low	▶ Check the voltage supply and activate, if necessary.
☀	On the universal I/O [2]	Reset required	▶ Operate the control switch for restart or reset.
⊞	On the universal I/O [3]	Not an error	
🐞	On the universal I/O [4]	Optics cover is dirty, operation is not guaranteed	▶ Clean the optics cover.
☀🐞	On the universal I/O [5]	Optics cover is dirty, operation is still guaranteed	▶ Clean the optics cover.

[1] Depending on which is configured for warning field 1 or 2.
[2] If one of the universal I/Os is configured as the output for "Reset required".
[3] If one of the universal I/Os is configured as the output for a contamination error/warning.
[4] If one of the universal I/Os is configured as the output for a contamination error.
[5] If one of the universal I/Os is configured as the output for a contamination warning.

Table 37: Error and status indications of the LEDs in the compatibility mode

Display	Output level	Possible cause	Rectification of the error
◎ ✓ 🐞	At the OSSDs At application diagnostic output	Supply voltage missing or too low	▶ Check the voltage supply and activate, if necessary.
☀	At Res_Req output (1 Hz)	Reset required	▶ Operate the control switch for restart or reset.
⊞	At error/contamination output	Not an error	
⊞	At application diagnostic output	Optics cover is dirty, operation is not guaranteed	▶ Clean the optics cover.
☀	At application diagnostic output (1 Hz)	Optics cover is dirty, operation is still guaranteed	▶ Clean the optics cover.
☀	At application diagnostic output (4 Hz)	System error	▶ Note the error indicated on the 7-segment display or run diagnostics using the CDS. ▶ Switch off the device and turn it on again, if necessary.

Further topics

10.3 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 38: Error and status indicators on the 7-segment display

Display	Possible cause	Remedy
⌐, ⌐, ⌐, ⌐, ⌐, ⌐, ⊏, ⌐	Power-up cycle - all segments are activated consecutively.	Not an error
⌐	Object in the protective field	Not an error
⊟	Object in warning field 1	Not an error
⊡	Object in warning field 2	Not an error
⌐	Object in the protective field (in compatibility mode)	Not an error
∃	Initialization of the device or Waiting for the end of the initialization of a second device connected to the EFI interface	▶ The display goes out automatically when the device has been initialized and/or the connection to the second device has been made. If the ∃ display does not go out: ▶ Check whether the partner device is in operation. ▶ Check the wiring. If no partner device is connected: ▶ Check the system configuration using the CDS. Transfer the corrected configuration to the device again.
4	Waiting for valid input signals	▶ The display goes out automatically if an input signal is present that corresponds to the configured evaluation type (1-of-n or complementary). If the 4 display does not go out: ▶ Check the wiring. ▶ Check the control signals for correct switching behavior. ▶ If speed ranges are used for monitoring case switching, check whether the EFI status information **Speed valid** is transferred (see "Control features", page 135). ▶ Check the system configuration using the CDS. Transfer the corrected configuration to the device again.

Display	Possible cause	Remedy
6	Waiting for configuration or configuration not completed	▶ The display goes out automatically once the configuration has been successfully transferred. If the 6 display does not go out: ▶ Check the system configuration using the CDS. Transfer the corrected configuration to the device again. ▶ Check whether the configuration saved in the system plug is compatible with the safety laser scanner.
6	Waiting for restart of the device	▶ Switch off the voltage supply for the safety laser scanner for at least 2 seconds and then switch it back on.
8 or 8	Error in the external device monitoring (EDM)	▶ Check whether the contactors are working correctly or have been wired incorrectly and rectify any error. ▶ If 8 is displayed: Also switch off the voltage supply for the device for at least 2 seconds and then switch it back on.
9	Error in the control switch for restart or reset	▶ Check the functionality of the control switch. The pushbutton may be defective or stuck. ▶ Check the wiring of the control switch for short-circuit to 24 V.
d⟲1	Speed tolerance exceeded: The difference between the speeds measured by the incremental encoders is too large.	▶ Check the incremental encoders. ▶ Check the configuration of the incremental encoder inputs using the CDS.
d⟲2	Direction of movement output by the incremental encoders is different	▶ Check the wiring of the incremental encoder inputs, e.g., for incorrect pin assignments.
d⟲3	Maximum frequency at INC1 input exceeded	▶ Check the function of the incremental encoders. ▶ Check the configuration of the incremental encoder inputs using the CDS. ▶ Check whether the maximum allowed speed of the vehicle is exceeded.
d⟲4	Maximum frequency at INC2 input exceeded	▶ Check the function of the incremental encoders. ▶ Check the configuration of the incremental encoder inputs using the CDS. ▶ Check whether the maximum allowed speed of the vehicle is exceeded.
E⟲1	Safety laser scanner defective	▶ Switch off the voltage supply for the device for at least 2 seconds and then switch it back on.
E⟲3	Configuration memory in the system plug defective	If the display does not go out: ▶ Send the device or system plug to the manufacturer for repair.
E⟲4	A second device which is connected via EFI is in the error state.	▶ Check the connected device and the connection.
F⟲1	Overcurrent at OSSD connection 1	▶ Check the connected switching element (contactor, relay) and replace if necessary. ▶ Check the wiring for short-circuit to 0 V.

Display	Possible cause	Remedy
F⊃2	Short-circuit to 24 V at OSSD connection 1	▸ Check the wiring for short-circuit to 24 V.
F⊃3	Short-circuit to 0 V at OSSD connection 1	▸ Check the wiring for short-circuit to 0 V.
F⊃4	Overcurrent at OSSD connection 2	▸ Check the connected switching element (contactor, relay) and replace if necessary. ▸ Check the wiring for short-circuit to 0 V.
F⊃5	Short-circuit to 24 V at OSSD connection 2	▸ Check the wiring for short-circuit to 24 V.
F⊃6	Short-circuit to 0 V at OSSD connection 2	▸ Check the wiring for short-circuit to 0 V.
F⊃7	Short-circuit between OSSD connection 1 and 2	▸ Check the wiring and rectify the error.
F⊃9	General OSSD wiring error	▸ Check the complete wiring of the OSSDs.
G	Device is addressed as guest	Not an error. The symbol is displayed for approx. 2 seconds when a device that is addressed as a guest is switched on.
H	Device is addressed as host	Not an error. The symbol is displayed for approx. 2 seconds when a device that is addressed as a host is switched on.
I⊃1	The device is receiving no measured values within a range of at least 90° (maximum measuring range of 29.9 m) and 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.
I⊃2	Device is dazzled	▸ Check whether the device is being dazzled by an external light source, e.g., headlight, infrared light sources, stroboscopic light, sun etc. ▸ If necessary, re-mount the device.
I⊃3	Temperature error. The operating temperature of the device is outside the permitted range.	▸ Check whether the device is being operated as per the permissible ambient conditions.
L⊃2	Invalid configuration of the EDM	▸ Check that the machine-side EDM is connected correctly.
L⊃4	The addresses of both the host device and the guest device may have been set to guest. A device connected via EFI or the connection to the device is defective or disrupted.	▸ Remove the jumper on the host device. ▸ Check the connected device and the connection to this device.
L⊃8	Undervoltage of the supply voltage	▸ Check the power supply unit and the connecting cables.

Display	Possible cause	Remedy
`Lc9`	There is a short-circuit between the input for the control switch for restart or reset and another input or output.	► Check the wiring for cross-circuits.
`nc1`	Input signal for a non-defined monitoring case	► Check the path of the vehicle. Or:
`nc2`	Incorrect sequence when switching the monitoring cases	► Check the operating process of the monitored machine or system. ► If necessary, check the configuration of the monitoring cases using the CDS.
`nc3`	Incorrect operation of the control inputs	► Check the operation of the digital control inputs.
`nc4`	Short-circuit on control inputs A1/2 or incorrect operation of A1/2 via EFI	► Check the wiring, the digital control inputs or the wiring to the devices connected via EFI.
`nc5`	Short-circuit on control inputs B1/2 or incorrect operation of B1/2 via EFI	
`nc6`	Short-circuit on control inputs C1/2 or incorrect operation of C1/2 via EFI	
`nc7`	Incorrect operation of D1/2 via EFI	
`nc8`	Incorrect operation of E1/2 via EFI	
`a`	Park/standby mode, the OSSDs are in the OFF state; the laser is switched off.	Not an error. Operational readiness is restored when the criteria for the park mode or standby mode are withdrawn. If the `a` display does not go out: ► Test the level(s) at the STBY input and at the control inputs that switch to the monitoring case with park mode.
`P`	A device connected via EFI reports a malfunction.	► Carry out an error diagnosis of the device connected to the affected device.
`u`	Optics cover calibration active	Not an error
`uc1`	Light emission window on the optics cover contaminated	► Clean the light emission window on the optics cover.
`uc8` and `uc9`	Dazzling of the contamination measurement (there may not be an optics cover fitted)	► Check whether the device is being dazzled by an external light source, e.g., headlight, infra-red light source, stroboscopic light, sun etc. Or: ► Fit the new optics cover (then carry out an optics cover calibration).

Further topics

- "Status indicators", page 17
- "Replacing the device", page 113
- "Pin assignment", page 66
- "Park/standby mode", page 103

10.3.1 The lock-out operational status

In case of certain faults 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 fault, see "Error and status indicators on the 7-segment display", page 117.

▶ 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.

10.4 Advanced diagnostics

The supplied CDS (Configuration & Diagnostic Software) contains extended diagnostic options. The CDS enables you to isolate the problem if the error situation is unclear or there are availability issues.

For detailed information, see the online help of the CDS (Configuration & Diagnostic Software).

11 Decommissioning

11.1 Disposal

Approach

▶ 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 Data sheet

General details

Table 39: General details

	Minimum	Typical	Maximum
Type	3 (IEC 61496-1)		
Safety Integrity Level [1]	SIL2 (IEC 61508)		
SIL claim limit [1]	SILCL2 (EN 62061)		
Category	Category 3 (EN ISO 13849-1)		
Performance Level [1]	PL d (ISO 13849)		
PFHd (T_{amb} = 25 °C) (mean probability of a dangerous failure per hour)			8×10^{-8}
T_M (mission time)	20 years (ISO 13849)		
Laser class	Laser class 1 (according to IEC 60825-1 as well as CDRH 21 CFR 1040.10 and 1040.11; excluded are deviations due to Laser Notice No. 50 dated June 24, 2007)		
Enclosure rating	IP65 (EN 60529)		
Protection class S300 Medium Range	II (IEC 61140)		
Protection class S300 Long Range	III (IEC 61140)		
Ambient operating temperature	–10 °C		+50 °C
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
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/s², 10 Hz … 150 Hz • 1.5 mm, 0.5 g, 5 Hz … 200 Hz		
Noise vibrations	• 0.5 m²/s³, 5 Hz … 200 Hz • 0.1 m²/s³, 200 Hz … 500 Hz • 50 m/s², 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/s², 11 ms		

	Minimum	Typical	Maximum
Continuous shock	• 50 m/s², 11 ms • 100 m/s², 16 ms		
Sender	Pulsed laser diode		
Wavelength	895 nm	905 nm	915 nm
Divergence of collimated beam (full angle)		14 mrad	
Pulse duration			5.5 ns
Average output power			3.42 mW
Light spot size on the optics cover		8 mm	
Light spot size at 2.0 m scanning range		28 mm	
Housing			
Material	Die-cast aluminum		
Color	RAL 1021 (colza yellow)		
Optics cover			
Material	Polycarbonate		
Interface	Outside with scratch-resistant coating		
System plug	ESD-protected		
Material	Die-cast aluminum		
Color	RAL 9005 (black)		
Device dimensions [3]			
Height			152 mm
Width			102 mm
Depth			105 mm
Total weight (without connecting cables)		1.2 kg	

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

Functional information

Table 40: Functional information

	Minimum	Typical	Maximum
Resolution of the S300 Medium Range	30 mm, 40 mm, 50 mm, 70 mm		
Protective field of the S300 Medium Range			
At 30 mm resolution			1.25 m
At 40 mm resolution			1.60 m
At 50 mm resolution			2.00 m
At 70 mm resolution			2.00 m
Resolution of the S300 Long Range	30 mm, 40 mm, 50 mm, 70 mm, 150 mm		
Protective field of the S300 Long Range			
At 30 mm resolution			1.25 m
At 40 mm resolution			1.60 m
At 50 mm resolution			2.10 m
At 70 mm resolution			3.00 m
At 150 mm resolution			3.00 m

	Minimum	Typical	Maximum
Scanning angle			270°
Radiance factor	1.8%		Several 1,000% (reflectors [1])
Angular resolution		0.5°	
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 on data output via RS-422 (S300 Medium Range up to 2 m in the specified radiance factor range)			
Systematic error		± 20 mm	
Statistical including systematic error			
At 1 σ		± 28 mm	
At 2 σ		± 36 mm	
At 3 σ		± 44 mm	
At 4 σ		± 52 mm	
At 5 σ		± 60 mm	
Measurement error on data output via RS-422 (S300 Long Range up to 3 m in the specified radiance factor range)			
Systematic error		± 20 mm	
Statistical including systematic error			
At 1 σ		± 29 mm	
At 2 σ		± 38 mm	
At 3 σ		± 47 mm	
At 4 σ		± 56 mm	
At 5 σ		± 65 mm	
Flatness of the scan field at 2 m			± 50 mm
Distance of mirror rotational axis (zero point of X- and Y-axis) to rear side of device		55 mm	
Distance between center point of scan plane and bottom edge of the housing		116 mm	
Warning field [2]		8 m	
Distance measurement range			30 m
Number of multiple samplings (can be configured via CDS)	2		16
Power-up delay			
Configured device		15 s	
When the configuration is read out of the system plug			25 s
Restart after (can be configured)	2 s		60 s
Basic response time	80 ms		

[1] Complies with Diamond Grade 3000X™ (approx. 1,250 cd/lx × m²).
[2] The detection capability of the warning field depends on the radiance factor of the objects to be detected (see "Characteristic curves", page 130).

Electric

Table 41: Electric

	Minimum	Typical	Maximum
Supply voltage (SELV) [1] [2]	16.8 V	24 V	30 V
Permissible residual ripple [3]			± 5%
Start-up current [4]			2 A
Operating current without output load [5]		0.25 A	0.33 A
Operating current with maximum output load [5]			1.7 A
Power consumption without output load [5]		6 W	8 W
Power consumption with maximum output load [5]			41 W
Power consumption in standby mode or park mode without output load [5]		6 W	8 W
Electrical connection	System plug with screw connections		
FE screw terminal technical data			
Rigid wire cross-circuit	0.3 mm²		1.6 mm²
Flexible wire cross-circuit [6]	0.3 mm²		1.6 mm²
American wire gage (AWG)	22		14
Wire stripping length		5 mm	
Screw tightening torque			0.5 Nm
Screw terminal technical data			
Rigid wire cross-circuit	0.14 mm²		1.5 mm²
Flexible wire cross-circuit [7]	0.14 mm²		1.0 mm²
American wire gage (AWG)	26		16
Wire stripping length		5 mm	
Screw tightening torque	0.22 Nm		0.3 Nm
Cable length for power supply tolerance ± 10%			
At wire cross-section 1 mm²			50 m
At wire cross-section 0.5 mm²			25 m
At wire cross-section 0.25 mm²			12 m
Cable length for power supply tolerance ± 5%			
At wire cross-section 1 mm²			60 m
with a wire cross-section of 0.5 mm²			30 m
with a wire cross-section of 0.25 mm²			15 m
Cable length for power supply tolerance ± 1%			
At wire cross-section 1 mm²			70 m
with a wire cross-section of 0.5 mm²			35 m
with a wire cross-section of 0.25 mm²			17 m
UNI-I/O1 and UNI-I/O2			
Input resistance at HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	30 V
Voltage for LOW	−3 V	0 V	5 V
Input capacitance		15 nF	
Static input current	6 mA		15 mA
When used for Reset			
Actuating time of the control switch	200 ms		

	Minimum	Typical	Maximum
When used for EDM			
Permissible contactor dropout time			300 ms
Permissible contactor pull in time			300 ms
UNI-I/O3, UNI-I/O4 and UNI-I/O5			
Switching voltage HIGH at 200 mA	U_V – 3.3 V		U_V
Source switching current		100 mA	200 mA
Current limiting (after 5 ms at 25 °C)	600 mA		920 mA
Switch-on delay		1.4 ms	2 ms
Switch-off delay		0.7 ms	2 ms
Response time of UNI-I/O3, UNI-I/O4 and UNI-I/O5 when configured as a warning field output	Corresponds to the resulting response time of the OSSDs plus 50 ms		
Standby mode input			
Input resistance at HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	30 V
Voltage for LOW	–3 V	0 V	5 V
Input capacitance		15 nF	
Static input current	6 mA		15 mA
Standby mode activation			80 ms
Standby mode deactivation	200 ms		250 ms
Static control inputs			
Input resistance at HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	30 V
Voltage for LOW	–3 V	0 V	5 V
Input capacitance		15 nF	
Static input current	6 mA		15 mA
Input frequency (max. switching sequence or frequency)	$1/t_{UFVz}$ + half basic response time (t_{UFVz} = time set for advancing the timing for the switching)		
Dynamic control inputs			
Input resistance at HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	30 V
Voltage for LOW	–3 V	0 V	5 V
Input capacitance		1 nF	
Static input current	6 mA		15 mA
Duty cycle (Ti/T)		0.5	
Input frequency			100 kHz
Voltage supply for incremental encoders			
24 V voltage output	U_V – 3 V		U_V
Current load per incremental encoder		50 mA	100 mA
Speed range that can be sampled			
Forward	From +10 cm/s to +2,000 cm/s		
Backward	From –10 cm/s to –2,000 cm/s		
Speed tolerance with same direction information			45%

	Minimum	Typical	Maximum
Tolerance time for exceeding speed with same direction information from the incremental encoders			
At < 30 cm/s			60 s
At ≥ 30 cm/s			20 s
Tolerance time for different direction information or signal failure from an incremental encoder			
At > 10 cm/s			0.4 s
Incremental encoders that can be evaluated			
Type	Dual-channel rotary encoder with 90° phase shift		
Enclosure rating	IP54		
Supply voltage	U_V – 3 V		U_V
Outputs required on the incremental encoders	Push-pull		
Pulse frequency			100 kHz
Number of pulses per cm	50		
Length of cable (shielded)			10 m
OSSDs			
Output signal switching device pair	2 PNP semiconductors, short-circuit protected [8], cross-circuit monitored		
Safe status when an error occurs	At least one OSSD is in the OFF state.		
Switching voltage HIGH at 250 mA	U_V – 2.7 V		U_V
Switching voltage LOW S300 Medium Range	0 V	0 V	3.5 V
Switching voltage LOW S300 Long Range	0 V	0 V	2.0 V
Source switching current [9]	6 mA		0.25 A
Leakage current [10]			250 µA
Load inductance			2.2 H
Load capacity			2.2 µF at 50 Ω
Switching sequence (without switchover)			5 ^{1}/s
Permissible cable resistance [11]			2.5 Ω
Test pulse width [12]		230 µs	300 µs
Test frequency		120 ms	
Power-up delay of the OSSDs from red to green		120 ms	
Time offset on switching the OSSDs between OSSD2 and OSSD1			2 ms
Configuration and diagnostic interface			
Communication protocol	RS232 (proprietary)		
Transmission rate	38,400 Baud		
Cable length for 38,400 Baud and 0.25 mm² 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

	Minimum	Typical	Maximum
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
Data interface			
Communication protocol	RS422 (proprietary)		
Transmission speed (selectable)	9,600 Baud 19,200 Baud 38,400 Baud 115.2 kBaud 125 kBaud 230.4 kBaud 250 kBaud 460.8 kBaud 500 kBaud		
Cable length for 500 kBaud and 0.25 mm² cables			100 m
Galvanic separation			
S300 Medium Range	Yes		
S300 Long Range	No		
Differential output voltage at the sender (between TxD+ and TxD–) with 50 Ω load	± 2 V		± 5 V
Differential input threshold at the receiver (between RxD+ and RxD–)	± 0.2 V		
Short-circuit current at TxD+, TxD–	–250 mA		250 mA
Maximum voltage level at TxD+, TxD–	–30 V		30 V
Maximum voltage level at RxD+, RxD–	–30 V		30 V
Terminator	115 Ω	120 Ω	125 Ω
Cable type to be connected	Twisted pairs with copper braid screen		
Impedance of the cable to be connected	80 Ω	100 Ω	115 Ω
Wire cross-section of the cable to be connected			0.25 mm²
Safe SICK device communication via EFI/SDL			
Cable length for 500 kBaud and 0.22 mm² cables			50 m
Galvanic separation			
S300 Medium Range	Yes		
S300 Long Range	No		
Cable type to be connected	Twisted pairs with copper braid screen		
Impedance of the cable to be connected	108 Ω	120 Ω	132 Ω
Wire cross-section of the cable to be connected			0.22 mm²

[1]   Operation only in a short-circuit protected system with max. 8 A.
[2]   To meet the requirements of the relevant product standards (e.g., IEC 61496-1), the external voltage supply for the devices (SELV) 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.
[3]   The absolute voltage level must not drop below the specified minimum voltage.
[4]   The load currents for the input capacitors are not taken into account.
[5]   With a typical supply voltage of 24 V.
[6]   Ferrules are not needed.
[7]   Ferrules are not needed.

8) Applies to the voltage range between U_s and 0 V.
9) Switching currents up to 500 mA are allowed briefly (≤ 100 ms).
10) In the case of an error (0 V cable open circuit), no more than the specified leakage current flows in the OSSD cable. The downstream control element must detect this status as LOW. An FSPLC (fail-safe programmable logic controller) must be able to identify this status.
11) Make sure to limit the individual conductor resistances to the downstream controller to this value to ensure that a cross-circuit between the outputs is safely detected. (Also note EN 60204-1.)
12) When active, the outputs are tested cyclically (brief LOW). When selecting the downstream controllers, make sure that the test pulses do not result in deactivation.

12.2 Characteristic curves

Scanning range for warning fields
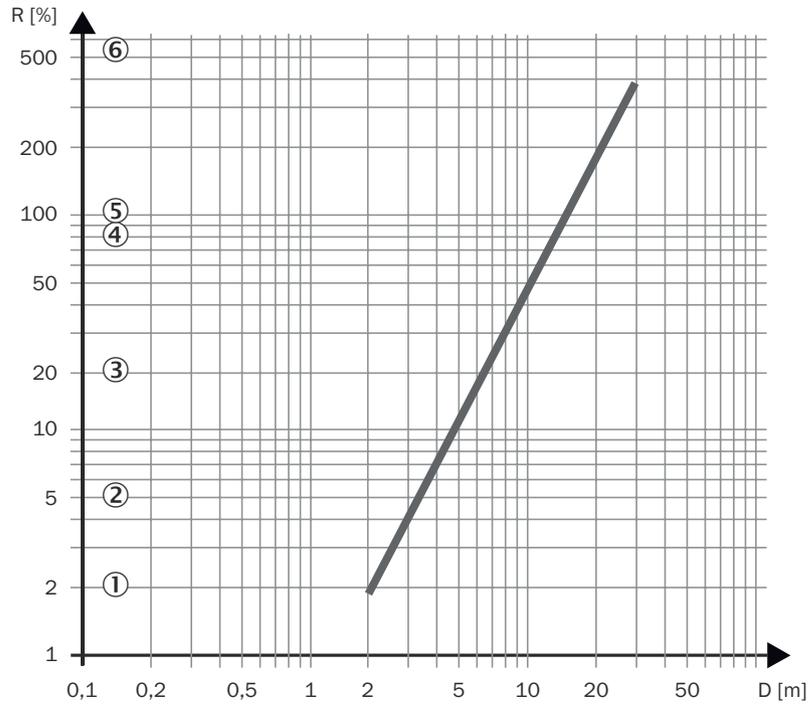
Figure 79: Diagram scanning range with Medium Range

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%
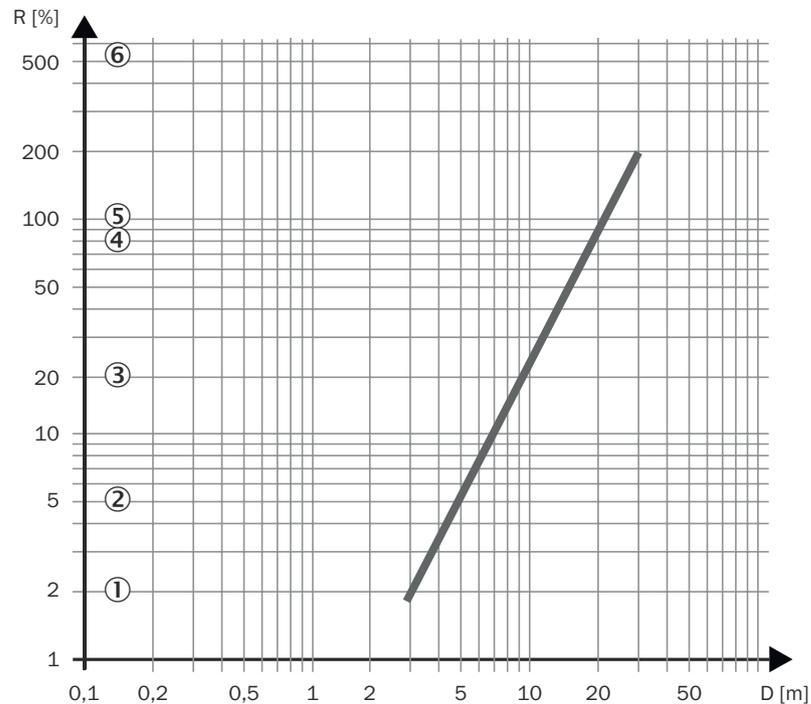
Figure 80: Diagram scanning range with Long Range

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%

12.3 Response times

Overview

The total response time of the application depends on the:
- Basic response time of the safety laser scanner
- Set multiple sampling
- OSSDs used

Total response time T_S

Calculating the total response time T_S

▶ The total response time T_S is calculated using the following equation:

$$T_S = t_B + T_{MFA} + T_{EFIO}$$

where
- t_B = Basic response time = 80 ms
- T_{MFA} = Supplement due to multiple sampling > 2
- T_{EFIO} = Supplement for the usage of external OSSDs via EFI

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 basic response time of 80 ms.

Table 42: Supplements for multiple sampling

Multiple sampling	Supplement	Basic response time and supplement
2 times (default)	0 ms	80 ms
3 times	40 ms	120 ms
4 times	80 ms	160 ms
5 times	120 ms	200 ms
6 times	160 ms	240 ms
7 times	200 ms	280 ms
8 times	240 ms	320 ms
9 times	280 ms	360 ms
10 times	320 ms	400 ms
11 times	360 ms	440 ms
12 times	400 ms	480 ms
13 times	440 ms	520 ms
14 times	480 ms	560 ms
15 times	520 ms	600 ms
16 times	560 ms	640 ms

External OSSDs

If the OSSDs on another device are used via EFI interface as external output signal switching devices (for example with two safety laser scanners connected together), the response time increases by 20 ms in each case.

Further topics

- "Basic response time", page 81

12.4 Timing behavior of the OSSDs

The safety laser scanner tests the OSSDs immediately after switch on and then at regular intervals. For this purpose the device briefly switches off both OSSDs (for 300 μs) and checks whether the OSSDs switch to the OFF state during this time.

i **NOTE**
The controller must not respond to this test pulse. It must not shut down the machine due to the test pulse.
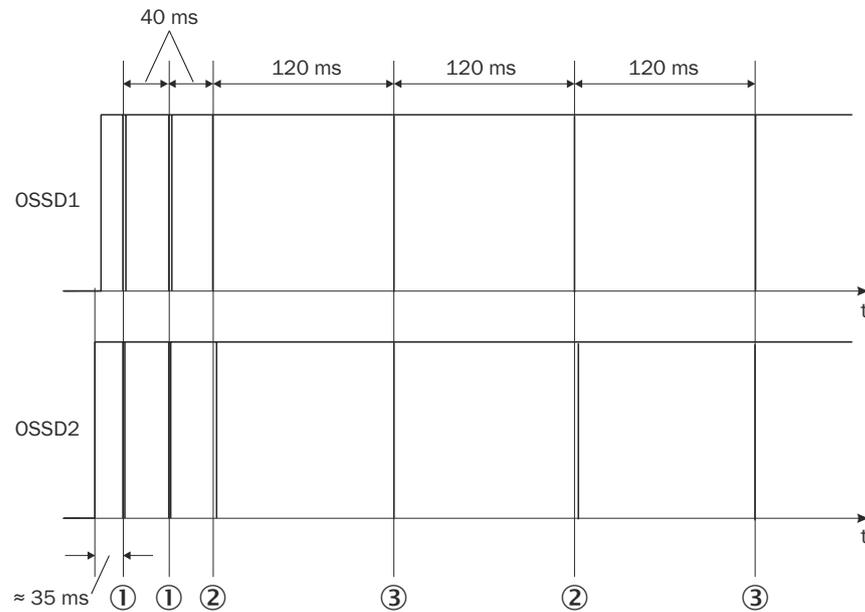
Figure 81: Diagram of the test pulse at the OSSDs

Approx. 35 ms after the OSSDs are switched on, the device performs the first voltage test ①. Then, after a half basic response time (40 ms), it performs a second voltage test ①.

After a further half basic response time of the device there is a shut-down test ②, 120 ms later a further voltage test ③. Then the device performs a shut-down test and a voltage test alternately at an interval of 120 ms. Pulse duration for the individual tests, see figure 82, page 133, see figure 83, page 134, see figure 84, page 134.
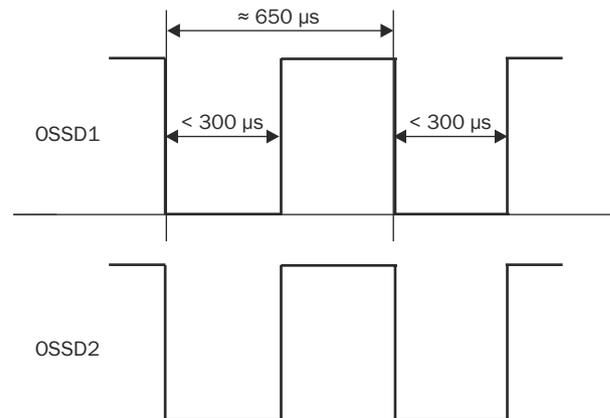
Figure 82: Voltage test after switching on the OSSDs
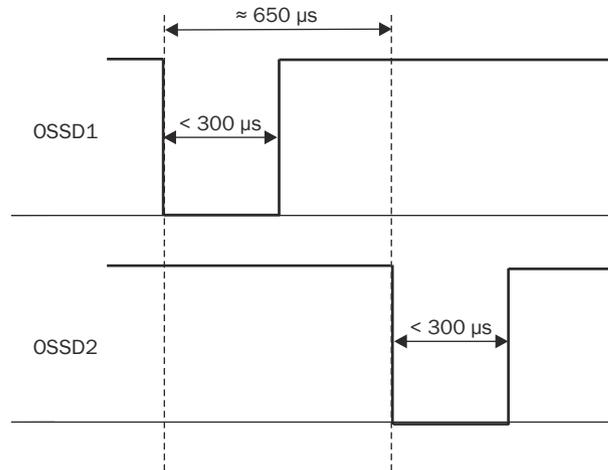
Figure 83: Shut-down test
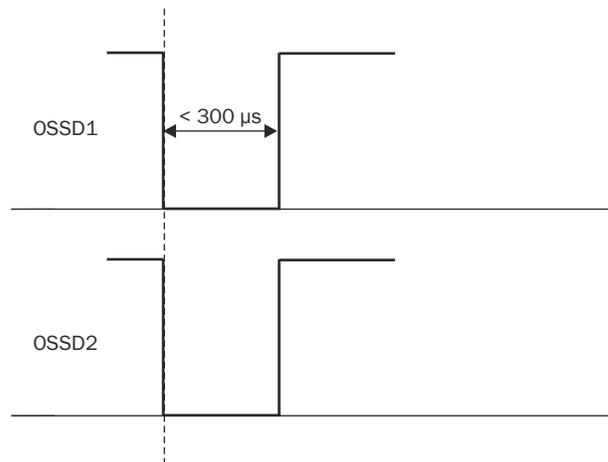
Figure 84: Voltage test

12.5 EFI status information and control commands

Overview

If devices are connected together via EFI, EFI status information and control commands are exchanged. The following two tables show the status information that can be retrieved and the possible control commands for the device.

> **NOTE**
> - The information in square brackets reflects the names used in the CDS and in the Flexi Soft Designer.
> - If the devices are operated in the compatibility mode, then restricted EFI status information and control commands are available.

Status information

Table 43: Status information (data from the safety laser scanner)

Status information	Meaning/effect
OSSD on [OSSD]	• Logical 1, if the internal OSSD of the device is in the ON state (green) • Logical 0, if the OSSD of the device is in the OFF state (red)

Status information	Meaning/effect
Warning field bit [WF]	• Logical 1, if both warning fields of the device are clear • Logical 0, if an object is detected in one of the warning fields of the S300 Mini
Contamination [Weak]	• Logical 1, if the optics cover is contaminated
Reset required [Res. Req]	• Logical 1, if reset required
Reset button pressed [Res. Pressed]	• Logical 1, if the reset button is pressed on the device
I/O error [I/O Error]	• Logical 0, if there is no error on the device • Logical 1, if there is an error on the device
Control input A1 [In A1]	• Logical 1, if the connection of control input A1 is HIGH The control inputs on the device are used to switch the monitoring cases on the device.
Control input A2 [In A2]	• Logical 1, if the connection of control input A2 is HIGH
Control input B1 [In B1]	• Logical 1, if the connection of control input B1 is HIGH
Control input B2 [In B2]	• Logical 1, if the connection of control input B2 is HIGH
Control input C1 [In C1]	• Logical 1, if the connection of control input C1 is HIGH
Control input C2 [In C2]	• Logical 1, if the connection of control input C2 is HIGH
Protective field [PF]	• Logical 1 if the protective field is clear
Warning field 1 [WF1]	• Logical 1, if the active allocated warning field is clear
Warning field 2 [WF2]	• Logical 1, if the active allocated warning field is clear
Speed valid [1]	• Logical 1, if a valid speed is present on the incremental encoder inputs • Logical 0, if an invalid speed is present on the incremental encoder inputs
Speed [1]	• 12 bits for transmitting the speed 100000110000 = –2,000 cm/s 000000000000 = 0 cm/s 011111010000 = +2,000 cm/s

[1]   Not in the compatibility mode.

Control features

Table 44: Control features (data to the safety laser scanner)

Control feature	Meaning/effect
Static input information A1 [In A1]	• Logical 1, stimulates control input A1 of the device
Static input information A2 [In A2]	• Logical 1, stimulates control input A2 of the device
Static input information B1 [In B1]	• Logical 1, stimulates control input B1 of the device
Static input information B2 [In B2]	• Logical 1, stimulates control input B2 of the device
Static input information C1 [In C1]	• Logical 1, stimulates control input C1 of the device

Control feature	Meaning/effect
Static input information C2 [In C2]	• Logical 1, stimulates control input C2 of the device
Static input information D1 [In D1] [1]	• Logical 1, stimulates control input D1 of the device
Static input information D2 [In D2] [1]	• Logical 1, stimulates control input D2 of the device
Static input information E1 [In E1] [1]	• Logical 1, stimulates control input E1 of the device
Static input information E2 [In E2] [1]	• Logical 1, stimulates control input E2 of the device
Standby [1]	• Logical 1, stimulates operational status Standby (individually for host and guest)
Speed valid [1]	• Logical 1, valid speed is present on the incremental encoder inputs • Logical 0, invalid speed is present on the incremental encoder inputs
Speed [1]	• 12 bits for transmitting the speed 100000110000 = –2,000 cm/s 000000000000 = 0 cm/s 011111010000 = +2,000 cm/s
I/O error [I/O Error]	• Logical 0, if there is no error on the connected partner device • Logical 1, if there is an error on the connected partner device

[1] Not in the compatibility mode.

12.6 Dimensional drawings

Safety laser scanner
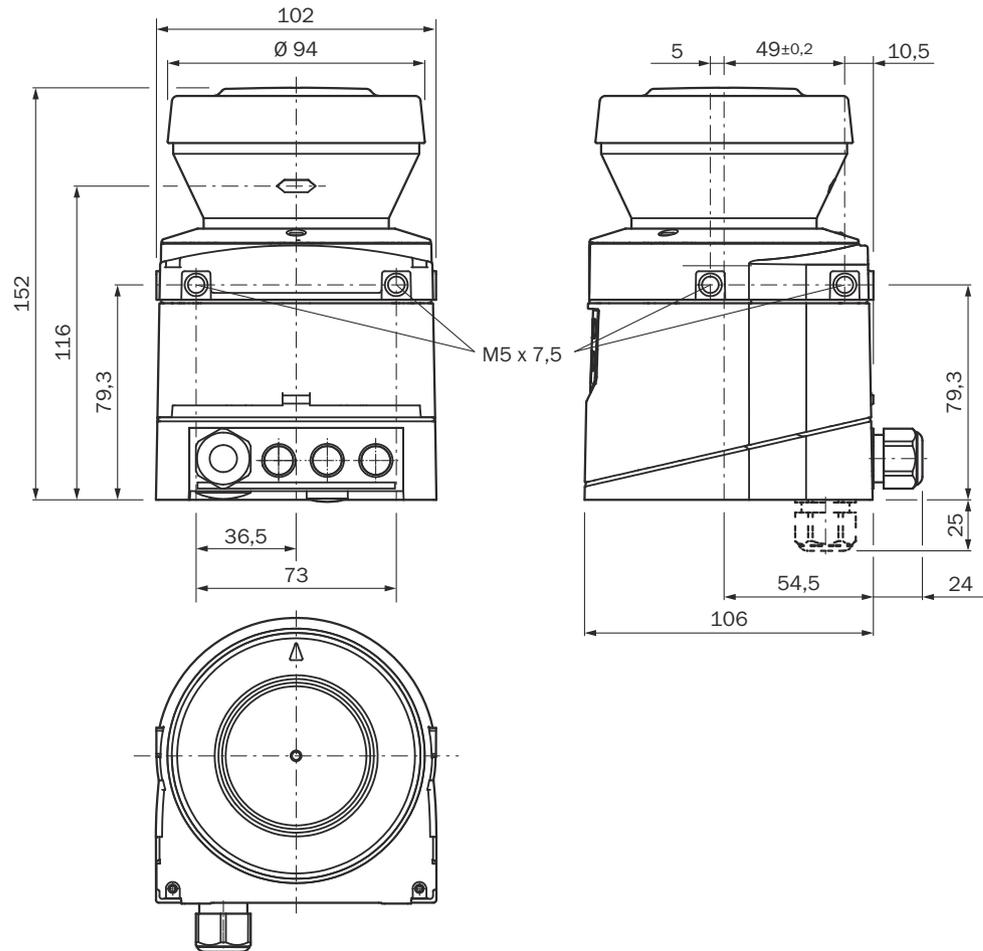
Figure 85: Dimensional drawing safety laser scanner (mm)

Scan plane origin
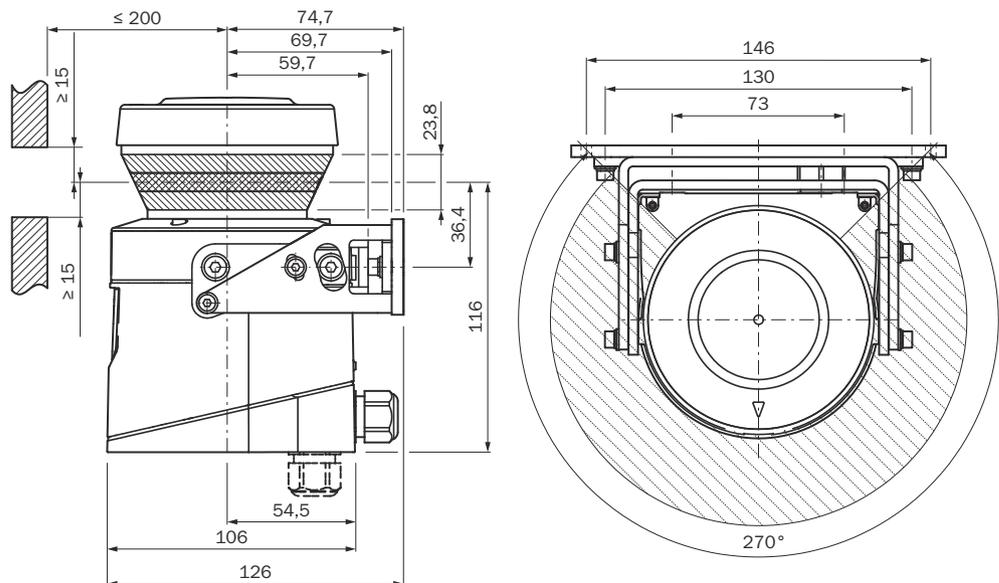
Figure 86: Dimensional drawing scan plane origin with mounting kit 1a, 2 and 3 (mm)

13 Ordering information

13.1 Scope of delivery

- Safety laser scanner
- Safety note
- Mounting instructions
- "Important notes" adhesive label
- Operating instructions and CDS (Configuration & Diagnostic Software) available for downloading at: **www.sick.com**

(i) NOTE
System plug not included with delivery.

System plug without cable and pre-assembled system plug are available from SICK AG.

Further topics

13.2 Ordering information

Table 45: Part numbers, systems

Part	Type code	Part number
S300 Standard, Medium Range (2 m scanning range)	S30B-2011BA	1026820
S300 Advanced, Medium Range (2 m scanning range)	S30B-2011CA	1026821
S300 Professional, Medium Range (2 m scanning range)	S30B-2011DA	1026822
S300 Expert, Medium Range (2 m scanning range)	S30B-2011GB	1050193
S300 Standard, Long Range (3 m scanning range)	S30B-3011BA	1056427
S300 Advanced, Long Range (3 m scanning range)	S30B-3011CA	1056428
S300 Professional, Long Range (3 m scanning range)	S30B-3011DA	1056429
S300 Expert, Long Range (3 m scanning range)	S30B-3011GB	1057641

14 Spare parts

14.1 System plug

Table 46: Part numbers, system plugs

Type code	Equipment	Description	Part number
SX0B-A0000G	One M16 cable gland and one M12 blind plug on the rear	Without cable	2032807
SX0B-B1105G		Pre-assembled, 5 m length of cable, 11 wires	2032859
SX0B-B1110G		Pre-assembled, 10 m length of cable, 11 wires	2032860
SX0B-B1114G		Pre-assembled, 14 m length of cable, 11 wires	2047875
SX0B-B1120G		Pre-assembled, 20 m length of cable, 11 wires	2032861
SX0B-A0000J	One M16 cable gland, three M12 blind plugs on the rear as well as two M12 EMC cable glands, loose	Without cable	2032856
SX0B-B1105J		Pre-assembled, 5 m length of cable, 11 wires	2032857
SX0B-B1110J		Pre-assembled, 10 m length of cable, 11 wires	2032858
SX0B-B1505G	One M16 cable gland and one M12 blind plug on the rear	Pre-assembled, 5 m length of cable, 15 wires	2034264
SX0B-B1510G		Pre-assembled, 10 m length of cable, 15 wires	2034265
SX0B-X0000XS06	One M16 cable gland, 3 M12 cable glands, bottom	**Pre-assembled with connecting cables and plug connectors:** • 1 × female connector, M12, 4-pin, A-coded, for incremental encoder • 1 × female connector, M12, 4-pin, B-coded, for incremental encoder • 1 × male connector, M12, 4-pin, D-coded, for EFI and voltage supply • 1 × female connector, D-Sub, for measurement data output	2100518

15 Accessories

15.1 Connectivity

Service cables

Table 47: Ordering information, service cables

Part	Description	Part number
Service cable, 2 m	For connecting the configuration connection to the serial interface on the PC M8 × 4-pin to DSub 9-pin, approx. 2 m	6021195
Service cable, 10 m	For connecting the configuration connection to the serial interface on the PC M8 × 4-pin to DSub 9-pin, approx. 10 m	2027649
USB Service cable, 2 m	For connecting the configuration connection to the USB interface on the PC M8 × 4-pin to USB-A male connector, approx. 2 m	6034574
USB Service cable, 10 m	For connecting the configuration connection to the USB interface on the PC M8 × 4-pin to USB-A male connector, approx. 10 m	6034575
RS-232 to USB adapter	USB-A male connector to D-Sub male connector, 9-pin	6035396

Connecting cables for self-assembly

Table 48: Connecting cable ordering information

Part	Part number
15-wire, cross-section 0.56 mm^2 (AWG 20), sold by the meter	6030795
EFI cable, sold by the meter (1 × 2 × 0.22 mm^{2}2)	6029448
M12 EMC cable gland for EFI connections, permissible cable diameter 3–6.5 mm	5308757
DeviceNet connecting cable, PVC, cable diameter 12.2 mm, sold by the meter	6030756
DeviceNet connecting cable, PVC, cable diameter 6.9 mm, sold by the meter	6030921
Interconnectron male connector, can be used for DeviceNet connecting cable 6.9 mm (6030921).	6024742

15.2 Brackets

Table 49: Ordering information, mounting kits

Mounting kit	Description	Part number
1a	Mounting bracket for direct mounting at the rear on the wall or machine	2034324
1b	Mounting bracket for direct mounting at the rear on the wall or machine, with optics cover protection	2034325
2	Mounting bracket only in conjunction with mounting brackets 1a or 1b, lateral axis adjustment possible	2039302
3	Holding plate only in conjunction with mounting bracket 2, longitudinal axis adjustment possible	2039303

Dimensional drawings
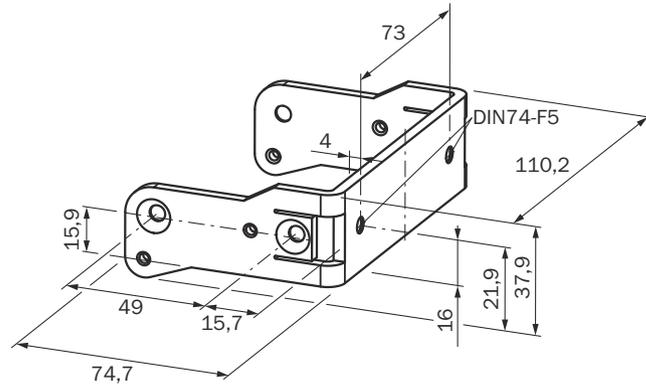
Figure 87: Dimensional drawing mounting kit 1a (mm)
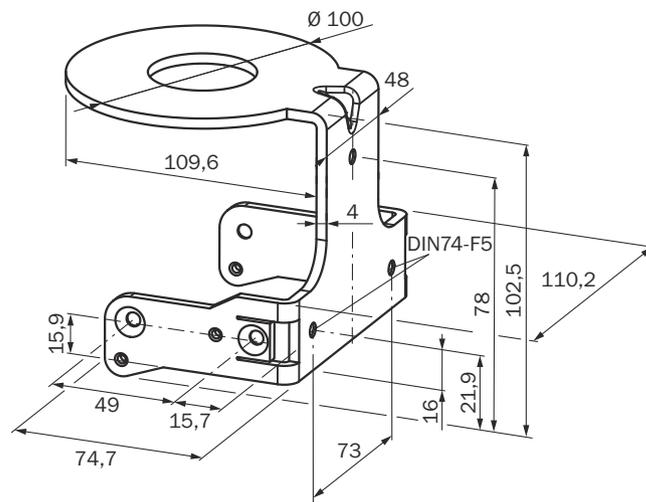
Figure 88: Dimensional drawing mounting kit 1b (mm)
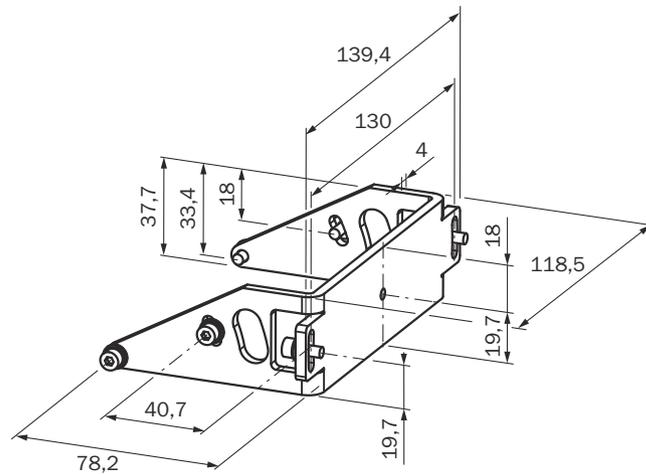
Figure 89: Dimensional drawing mounting kit 2 (mm)
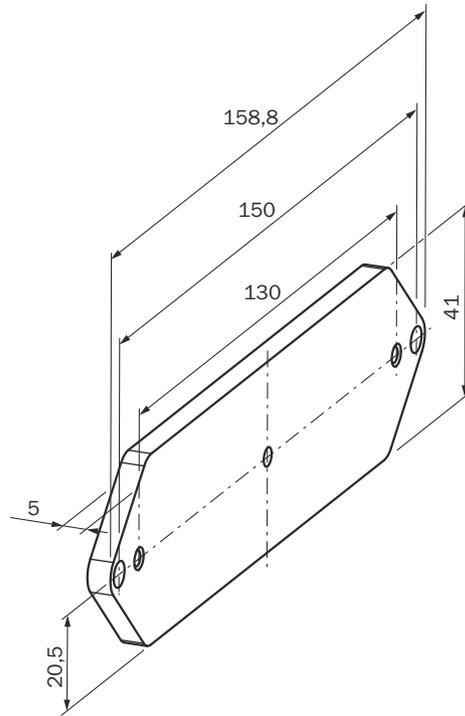
Figure 90: Dimensional drawing mounting kit 3 (mm)

15.3   Additional accessories

Safety relays/compact safety controller

Table 50: Ordering information safety relays/compact safety controller

Part	Type code	Part number
Safety relay UE10-2FG3	UE10-2FG3	1043916
Safety relay UE12-2FG3	UE12-2FG3	1043918
Safety relay UE10-3OS with screw terminals	UE10-3OS2	6024917
Safety relay UE10-3OS with removable terminals	UE10-3OS3	6024918

Safety controllers

Table 51: Safety controller ordering information

Part	Type code	Part number
Flexi Soft CPU0 main module Dual level spring terminals	FX3-CPU000000	1043783
Flexi Soft CPU1 main module 2 EFI connections Dual level spring terminals	FX3-CPU130002	1043784
Flexi Soft XTIO expansion module 8 inputs/4 outputs Dual level spring terminals	FX3-XTIO84002	1044125
Flexi Soft XTDI input expansion module 8 inputs, dual level spring terminals	FX3-XTDI80002	1044124
Flexi Soft system plug	FX3-MPL000001	1043700
Flexi Classic main module	UE410-MU3T5	6026136
Flexi Classic expansion module	UE410-XU3T5	6032470

Part	Type code	Part number
Flexi Classic input expansion module	UE410-8DI3	6026139

Network solutions

Table 52: Ordering information, network solutions

Part	Type code	Part number
EFI gateway PROFIsafe	UE4140	1029098
EFI gateway PROFIBUS	UE1140	1029099
EFI gateway Ethernet TCP/IP	UE1840	1029100
EFI gateway CANopen	UE1940	1040397
EFI gateway PROFINET IO PROFIsafe	UE4740	1046978
Profibus bus node	UE4155	1024057
Safety remote controller	UE4457	1028307

Miscellaneous accessories

Table 53: Ordering information, miscellaneous

Part	Description	Part number
Optics cover	Spare part set for optics cover with replacement seal and screws	2039248
Plastic cleaner	Plastic cleaner and polish, anti-static	5600006
Lens cloth	Cloth for cleaning the optics cover	4003353
Power supply unit 2.1 A	Power supply unit 24 V DC, 2.1 A, 50 W	7028789
Power supply unit 3.9 A	Power supply unit 24 V DC, 3.9 A, 95 W	7028790
Alignment aid		2101720

16 Glossary

AGV	Automated guided vehicle
AWG	American Wire Gage: standardization and classification of wires and cables according to type, diameter, etc.
CMS	Contour Measurement & Safety: extended measurement data output and detection of reflectors as artificial landmarks
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
Dynamic control input	A dynamic control input is a single-channel control input that evaluates a number of pulses per time. An incremental encoder can be connected to a dynamic control input. The incremental encoder reports, for example, the speed of an AGV. In conjunction with a second control input, a dynamic control input is used to switch between different monitoring cases depending on the speed.
EDM	External device monitoring
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
External device monitoring	The external device monitoring (EDM) monitors the status of downstream contactors. In order to use external device monitoring, positively guided contactors must be used to switch off the machine. If the auxiliary contacts of the positively guided contactors are connected to the external device monitoring, the external device monitoring checks whether the contactors switch correctly when the OSSDs are switched off.

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)
Incremental encoder	An incremental encoder generates electrical pulses proportional to a movement. Various physical quantities can be derived from these pulses, e.g. speed and distance covered.
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).
ON state	The ON state is the status of the outputs of the ESPE, where the controlled machine is permitted to operate (e.g., the voltage at the OSSDs is HIGH so that the machine can run).
OSSD	Output signal switching device: signal output for the protective device, which is used for stopping the dangerous movement. An OSSD is a safety switching output. The functionality of each OSSD is tested periodically. OSSDs are always connected in pairs and must undergo dual-channel analysis for safety reasons. An OSSD pair is formed from 2 OSSDs that are connected and analyzed together.
PFH$_D$	Probability of dangerous failure per hour
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:
	  ○ It must not be possible for people to be in the hazardous area without triggering the protective device.
	  ○ 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.
Safety function	Function of a machine whose failure can result in an immediate increase of the risk(s). (ISO 12100)
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.
Static control input	A static control input is a dual-channel control input, which evaluates the status of every channel as the value 0 or 1. The signal states of one or more static control inputs give a unique signal pattern. This signal pattern activates a monitoring case.
Universal I/O	Universal I/O can be configured as universal input or as universal output.
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 54: 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 PFHd 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 adjustment?	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

Australia
Phone +61 (3) 9457 0600
　　　　1800 33 48 02 – tollfree
E-Mail sales@sick.com.au

Austria
Phone +43 (0) 2236 62288-0
E-Mail office@sick.at

Belgium/Luxembourg
Phone +32 (0) 2 466 55 66
E-Mail info@sick.be

Brazil
Phone +55 11 3215-4900
E-Mail comercial@sick.com.br

Canada
Phone +1 905.771.1444
E-Mail cs.canada@sick.com

Czech Republic
Phone +420 234 719 500
E-Mail sick@sick.cz

Chile
Phone +56 (2) 2274 7430
E-Mail chile@sick.com

China
Phone +86 20 2882 3600
E-Mail info.china@sick.net.cn

Denmark
Phone +45 45 82 64 00
E-Mail sick@sick.dk

Finland
Phone +358-9-25 15 800
E-Mail sick@sick.fi

France
Phone +33 1 64 62 35 00
E-Mail info@sick.fr

Germany
Phone +49 (0) 2 11 53 010
E-Mail info@sick.de

Greece
Phone +30 210 6825100
E-Mail office@sick.com.gr

Hong Kong
Phone +852 2153 6300
E-Mail ghk@sick.com.hk

Hungary
Phone +36 1 371 2680
E-Mail ertekesites@sick.hu

India
Phone +91-22-6119 8900
E-Mail info@sick-india.com

Israel
Phone +972 97110 11
E-Mail info@sick-sensors.com

Italy
Phone +39 02 27 43 41
E-Mail info@sick.it

Japan
Phone +81 3 5309 2112
E-Mail support@sick.jp

Malaysia
Phone +603-8080 7425
E-Mail enquiry.my@sick.com

Mexico
Phone +52 (472) 748 9451
E-Mail mexico@sick.com

Netherlands
Phone +31 (0) 30 229 25 44
E-Mail info@sick.nl

New Zealand
Phone +64 9 415 0459
　　　　0800 222 278 – tollfree
E-Mail sales@sick.co.nz

Norway
Phone +47 67 81 50 00
E-Mail sick@sick.no

Poland
Phone +48 22 539 41 00
E-Mail info@sick.pl

Romania
Phone +40 356-17 11 20
E-Mail office@sick.ro

Russia
Phone +7 495 283 09 90
E-Mail info@sick.ru

Singapore
Phone +65 6744 3732
E-Mail sales.gsg@sick.com

Slovakia
Phone +421 482 901 201
E-Mail mail@sick-sk.sk

Slovenia
Phone +386 591 78849
E-Mail office@sick.si

South Africa
Phone +27 10 060 0550
E-Mail info@sickautomation.co.za

South Korea
Phone +82 2 786 6321/4
E-Mail infokorea@sick.com

Spain
Phone +34 93 480 31 00
E-Mail info@sick.es

Sweden
Phone +46 10 110 10 00
E-Mail info@sick.se

Switzerland
Phone +41 41 619 29 39
E-Mail contact@sick.ch

Taiwan
Phone +886-2-2375-6288
E-Mail sales@sick.com.tw

Thailand
Phone +66 2 645 0009
E-Mail marcom.th@sick.com

Turkey
Phone +90 (216) 528 50 00
E-Mail info@sick.com.tr

United Arab Emirates
Phone +971 (0) 4 88 65 878
E-Mail contact@sick.ae

United Kingdom
Phone +44 (0)17278 31121
E-Mail info@sick.co.uk

USA
Phone +1 800.325.7425
E-Mail info@sick.com

Vietnam
Phone +65 6744 3732
E-Mail sales.gsg@sick.com

Detailed addresses and further locations at **www.sick.com**

SICK
Sensor Intelligence.

SICK AG　|　Waldkirch　|　Germany　|　www.sick.com