OPERATING INSTRUCTIONS

S3000

Safety laser scanners

SICK
Sensor Intelligence.

Described product

S3000

Manufacturer

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Original document

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Contents

1 About this document

1.1 Purpose of this document

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

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

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

1.2 Scope

Product

This document applies to the following products:

- Product code: S3000
- “Operating instructions” type label entry:
  - 8009791 AE V430
  - 8009791 AE W285
  - 8009791 AE WK81
  - 8009791 AE YY95
  - 8009791 AE ZA18

Document identification

Document part number:

- This document: 8009942
- Available language versions of this document: 8009791

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 32 "Configuration", page 82 "Technical data", page 138 "Accessories", page 158
Installers	"Mounting", page 64
Electricians	"Electrical installation", page 72
Safety experts (such as CE authorized representatives, compliance officers, people who test and approve the application)	"Project planning", page 32 "Configuration", page 82 "Commissioning", page 116 "Technical data", page 138 "Checklist for initial commissioning and commissioning", page 168
Operators	"Troubleshooting", page 129
Maintenance personnel	"Maintenance", page 120 "Troubleshooting", page 129

1.4 Further information

www.sick.com

The following information is available via the Internet:

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

1.5 Symbols and document conventions

The following symbols and conventions are used in this document:

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 LED lights up permanently.
✺ The LED flashes.

○ The LED is off.

These symbols describe which LED is involved: ⊜, ⊜, ⚠, ⚒, ✓

⚒ ● The “Error/Contamination” LED flashes.
⊜ ● The “OSSDs in OFF state” LED lights up permanently.

The term “dangerous state”

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

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

2 Safety information

2.1 General safety notes

Overview

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

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

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.

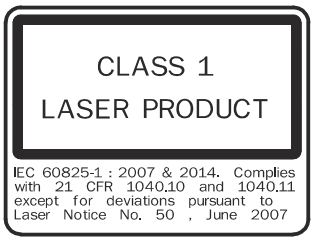


Figure 1: Laser class 1

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

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.

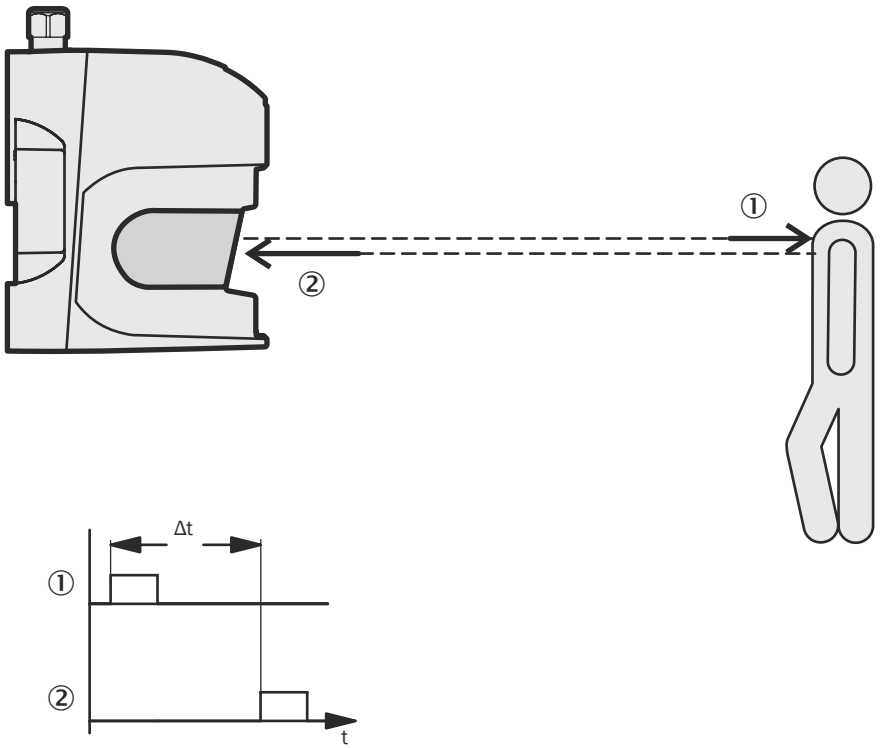


Figure 2: Principle of operation of the safety laser scanner time-of-flight measurement

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).

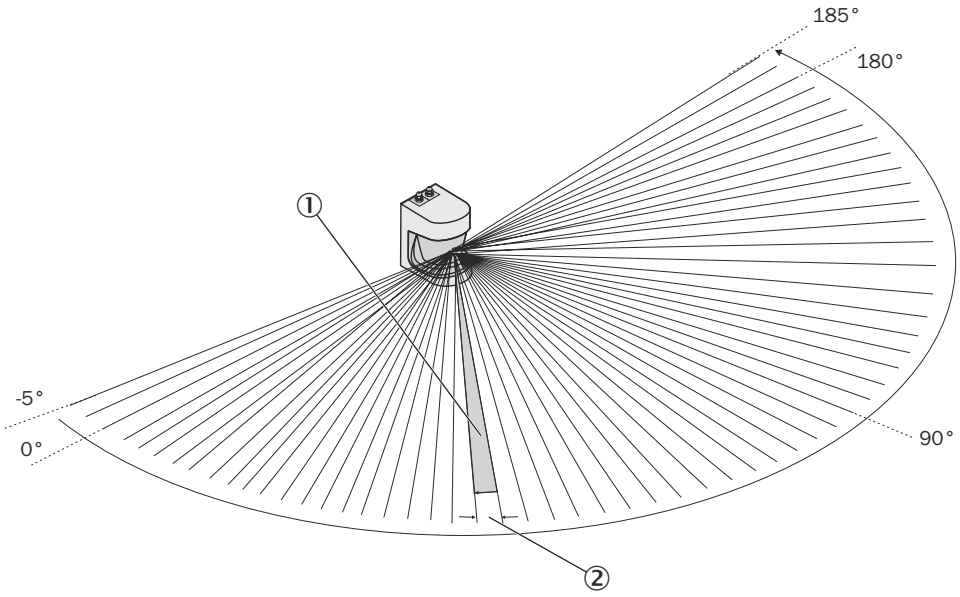


Figure 3: Principle of operation of the safety laser scanner rotation

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 190° sector of a circle. This means an object in the protective field can be detected within 190°. The first beam of a scan begins at −5° in relation to the rear side of the safety laser scanner.

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

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

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

Contour monitoring

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

Mode of operation

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

- It must be possible to influence the machine, system or vehicle control electrically.
- It must be possible to change the dangerous state of the machine, the system or the vehicle into a safe state at any time using the 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 64
- "Commissioning", page 116

3.2 Product characteristics

3.2.1 Specific features

- 190° scanning angle
- Increased dust and particle tolerance due to dazzle and particle algorithms
- Sensor heads with a scanning range up to 4 m, 5.5 m or 7 m (maximum radii of the protective field)
- Various I/O modules for different fields of applications
- Easy exchange of the I/O module. This makes it easy to extend the functionality.
- Configuration via PC or notebook using the SICK Configuration & Diagnostic software
- 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.
- Dual field mode with field sets comprising a protective field and a warning field (optional simultaneous monitoring of 2 field sets)
- Dual protective field mode with field sets comprising 2 protective fields (optional simultaneous monitoring of 2 field sets = 4 protective fields)
- Triple field mode with field sets comprising one protective field and 2 warning fields
- Contour monitoring of a protective field
- 3 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

S3000 Advanced or higher

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

S3000 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

S3000 Expert and Remote [1)]

- Up to 32 field sets (in dual field mode or dual protective field mode)
- Up to 21 field sets (in triple field mode)

S3000 Expert

- CMS feature for detecting reflectors as artificial landmarks

1) Sensor head with firmware ≥ B02.41 and I/O module with serial number > 11240000.

3.2.2 Device overview

The safety laser scanner comprises 3 components:

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

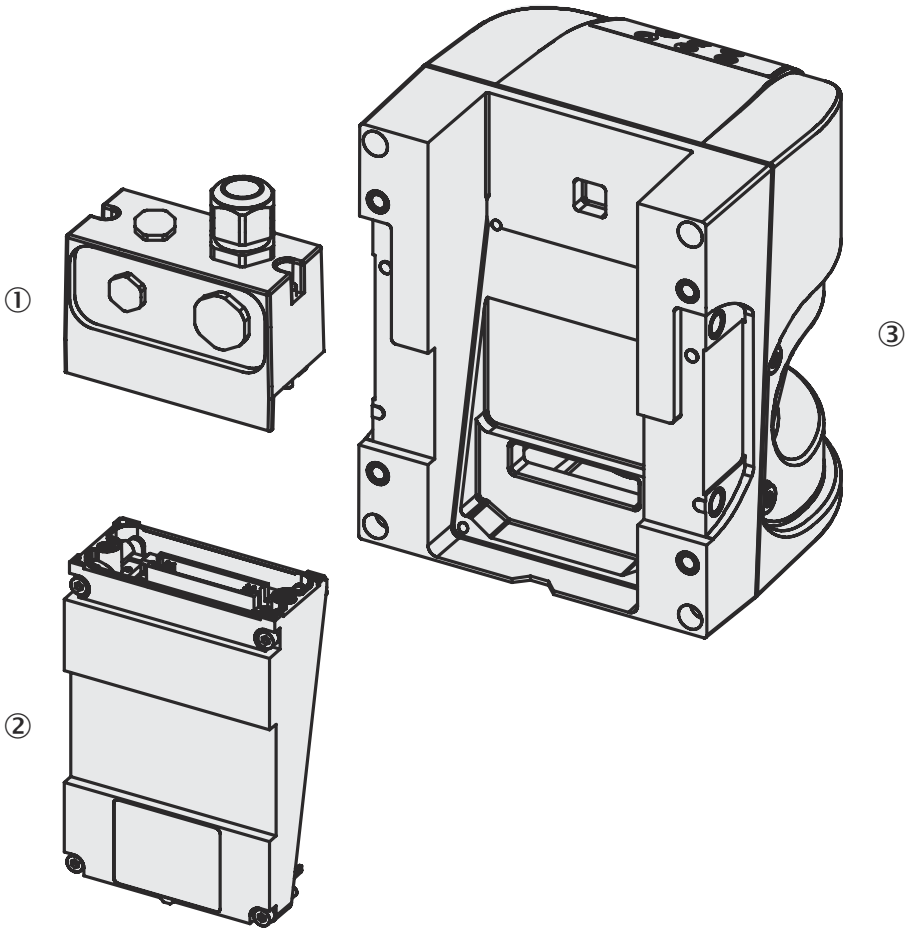


Figure 4: Sensor head, I/O module and system plug

① System plug
② I/O module
③ Sensor head

3.2.3 I/O module

Five I/O modules are available for the safety laser scanner. These I/O modules make the device suitable for a wide variety of fields of application.

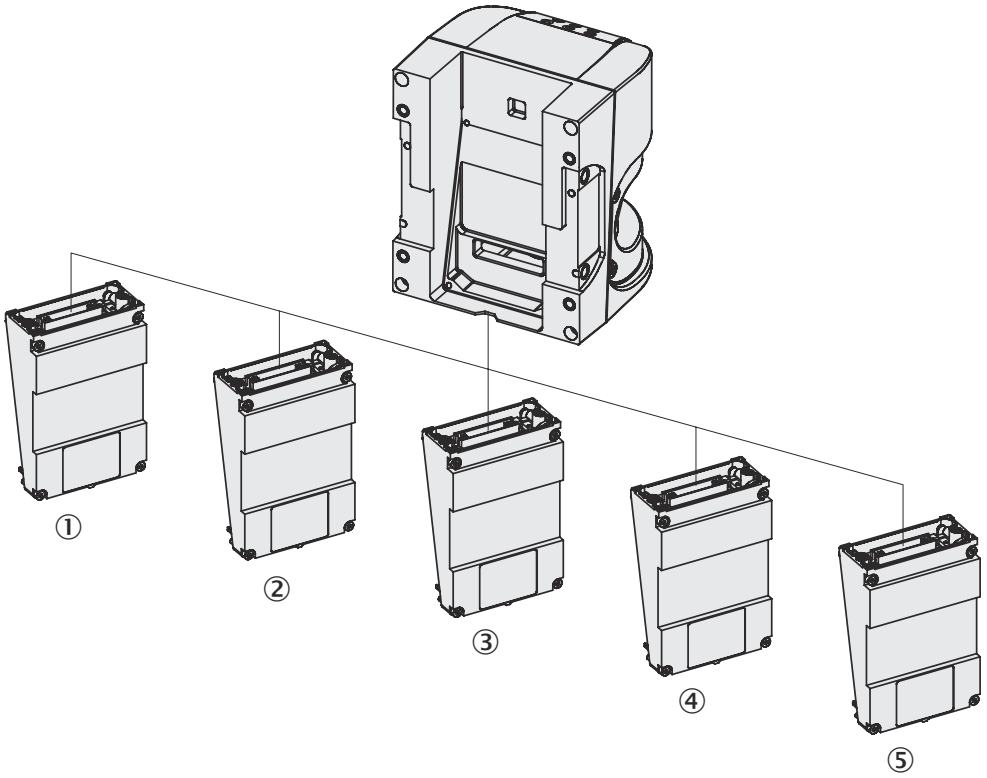


Figure 5: Available I/O modules

① Standard
② Advanced
③ Professional
④ Expert
⑤ Remote

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

I/O module functions

Table 2: Functions

Function	Standard	Advanced	Professional	Expert	Remote [1]
Object resolution [mm]	30/40/50/70/150	30/40/50/70/150	30/40/50/70/150	30/40/50/70/150	30/40/50/70/150
Output signal switching device pairs (OSSDs)	1	1	1	1	1
External device monitoring (EDM)	✓	✓	✓	✓	✓
Universal I/O	3	3	3	3	3
Restart interlock/ delay	✓	✓	✓	✓	✓
Field sets comprising one protective field and one warning field (dual field mode) or 2 protective fields (dual protective field mode)	2 [2]	4	8	32	32 [3]

Function	Standard	Advanced	Professional	Expert	Remote [1]
Can be used to simultaneously monitor 2 areas. The areas can be monitored with one protective field and one warning field respectively (dual field mode) or 2 protective fields [4] (dual protective field mode). This allows up to 4 protective fields to be monitored [5].	✓	✓	✓	✓	✓
Field sets comprising one protective field and 2 warning fields (triple field mode) with an angular resolution of 0.5 °	1	4	8	21	21 [6]
Field sets comprising one protective field and 2 warning fields (triple field mode) with an angular resolution of 0.25 °	1	4	8	10	10
Programmable monitoring cases in standalone operation	1	4	16	32	–
Programmable monitoring cases in an EFI system	32	32	32	32	32
Static control inputs for monitoring case switching	–	2	2	2	–
Static/dynamic control inputs for monitoring case switching	–	–	2	2	–
EFI interface (safe SICK device communication)	✓	✓	✓	✓	✓
Output of measurement data (surrounding contour)	✓	✓	✓	✓	✓
Extended CMS features (reflector detection, filter function for measured values)	–	–	–	✓	–

1) Valid for I/O modules with serial number > 11240000.
2) The second field set on the device can only be used as a simultaneous field set.
3) Maximum possible number of field sets. The actual number is the same as for the S3000 variant to which a safety laser scanner is connected.
4) Function is available for firmware B02.43 or above.
5) If two or four protective fields are being monitored, the cut-off paths must be routed to independent OSSD pairs using a Flexi Soft safety controller.
6) Only in conjunction with S3000 Expert or in standalone operation with a Flexi Soft safety controller.

3.2.4 Sensor heads

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

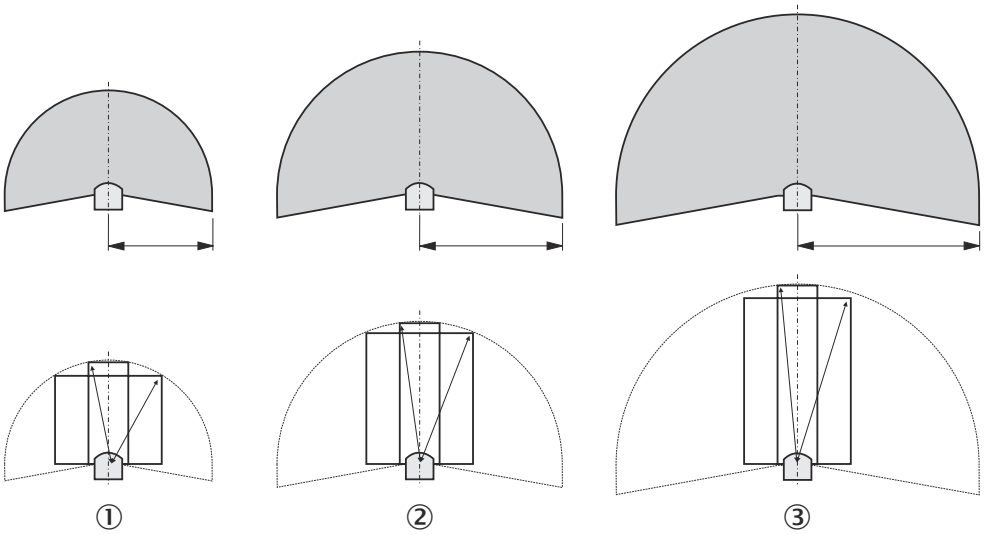


Figure 6: Protective field ranges of the sensor heads

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

3.2.5 Status indicators

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

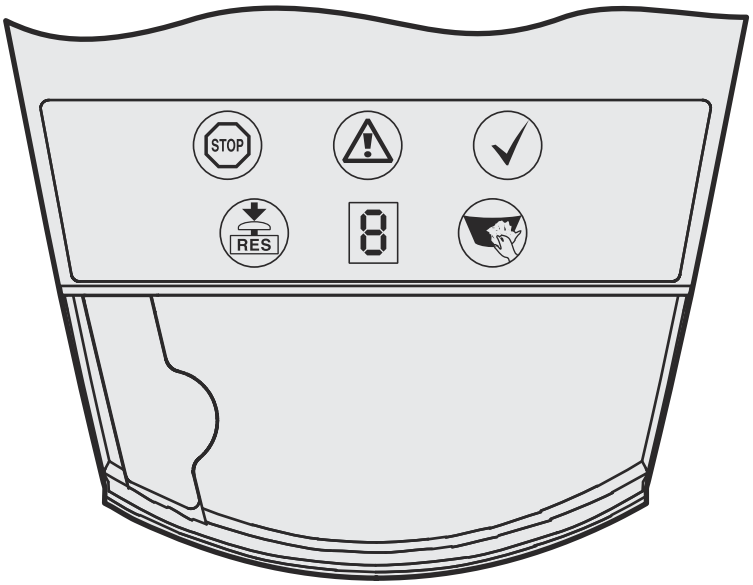


Figure 7: Status indicators of the safety laser scanner

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
	Front screen contaminated
	7-segment display to indicate status and errors

Further topics

- "Error and status indications of the LEDs", page 129
- "Error and status indicators on the 7-segment display", page 131

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.

If 2 protective fields have been configured, the two cut-off paths must be routed to independent OSSD pairs of the Flexi Soft safety controller.

Warning field

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

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

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

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

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

Depending on the I/O module used, you can define up to 32 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 different field sets:

- Field sets that comprise one protective field and one warning field
- Field sets that comprise two protective fields
- Field sets that comprise one protective field and two warning fields

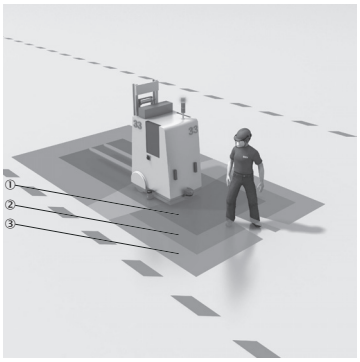


Figure 8: Triple field mode with one protective field and two warning fields

① Protective field
② Warning field 1
③ Warning field 2

Further topics

- "I/O module", page 16

3.2.7 Monitoring cases

Depending on the I/O module used, 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.

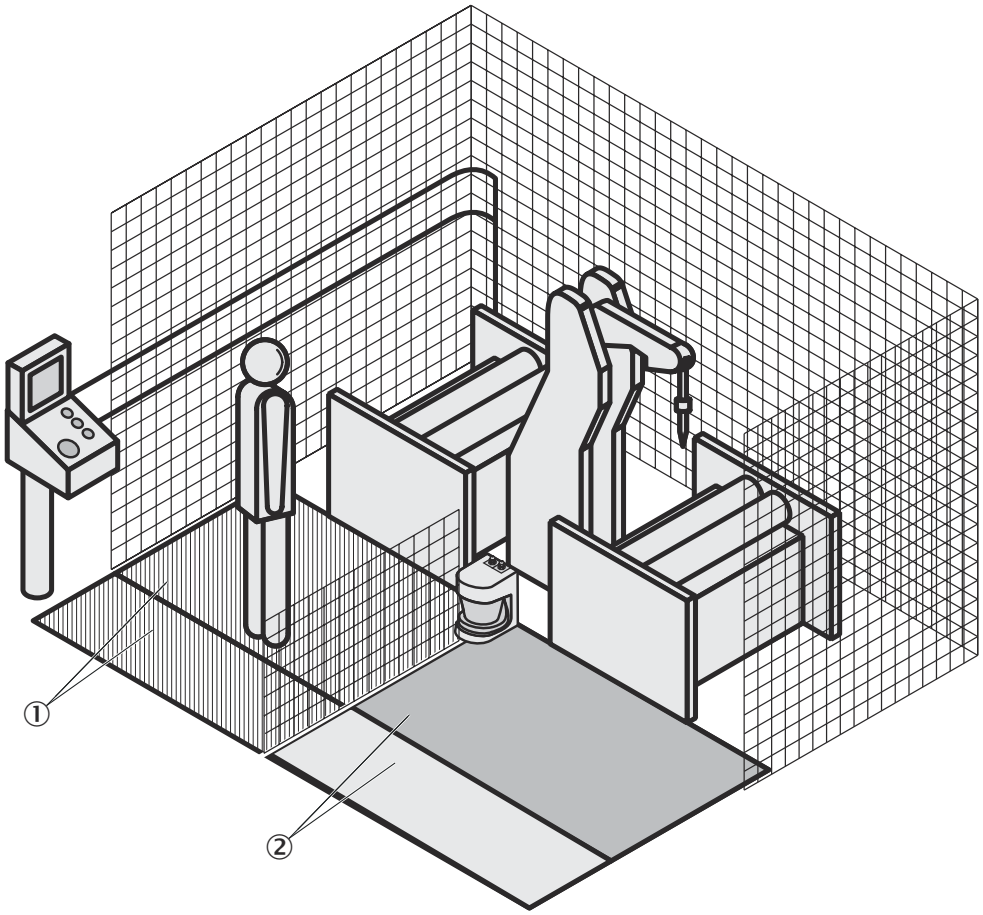


Figure 9: Monitoring cases

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

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

3.2.8 Simultaneous monitoring

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

- Simultaneous monitoring of two field sets each with one protective field and one warning field (dual field mode) or with two protective fields (dual protective field mode)
- Monitoring of one field set with one protective field and two warning fields (triple field mode)

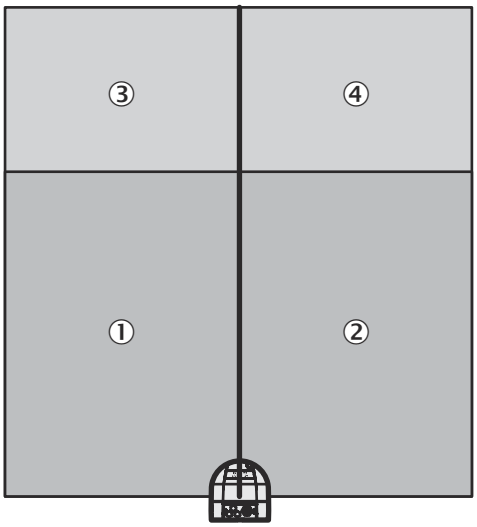


Figure 10: Dual field mode

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

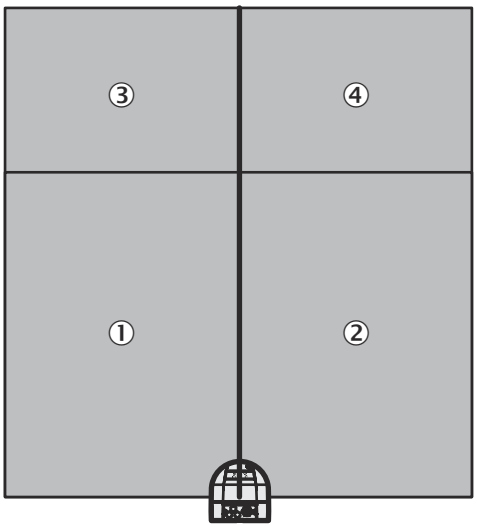


Figure 11: Dual protective field mode

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

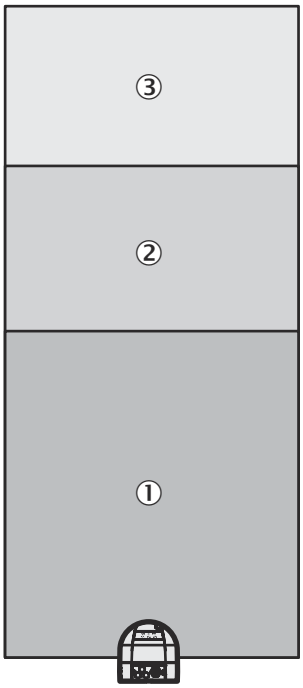


Figure 12: Triple field mode

① Protective field
② Warning field 1
③ Warning field 2

When using simultaneous monitoring, the safety laser scanner can monitor two field sets at the same time (e.g., hazardous area on the left, and hazardous area on the right). When used in conjunction with a Flexi Soft safety controller that provides multiple OSSD pairs, this can be used, for example, to independently protect two machines using only one safety laser scanner.

If two field sets are simultaneously configured with dual protective fields, four protective fields can be monitored at the same time. This, in conjunction with a Flexi Soft safety controller, allows up to four independent hazardous areas to be monitored for safety at the same time.

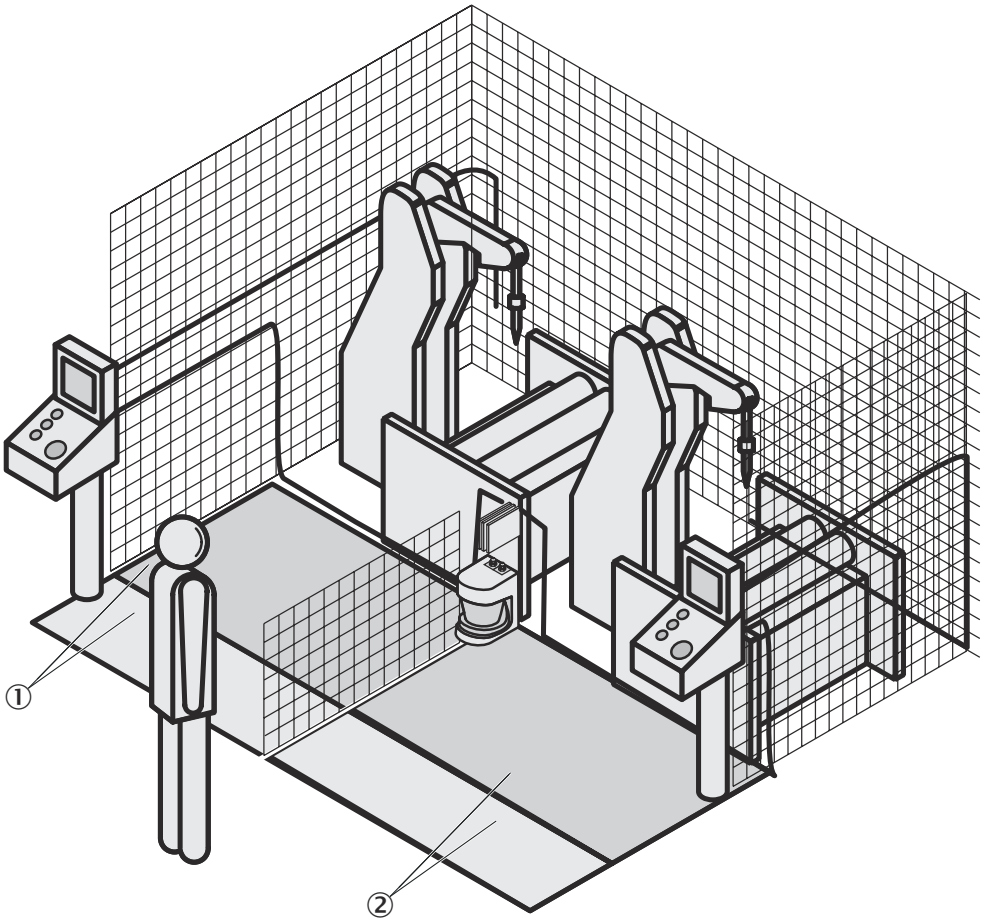


Figure 13: Simultaneous monitoring

① Active field set

② Active simultaneous field set

3.2.9 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.

When using a Flexi Soft safety controller with a S3000 in dual field mode, two protective fields and two warning fields can be monitored simultaneously. In dual protective field mode, four protective fields can be monitored simultaneously. Up to eight protective fields and up to eight warning fields, or up to 16 protective fields can therefore be monitored simultaneously in one application.

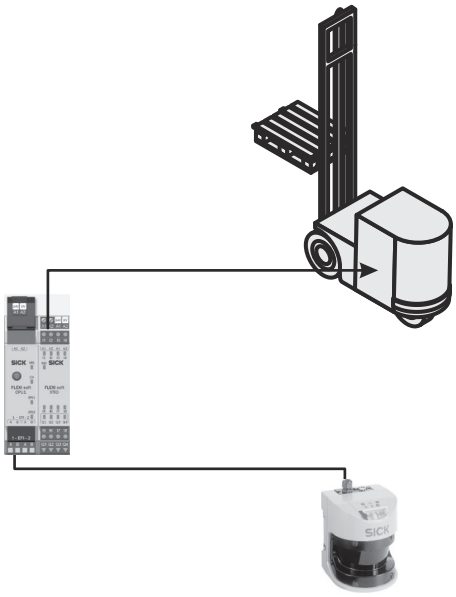


Figure 14: EFI system with Flexi Soft

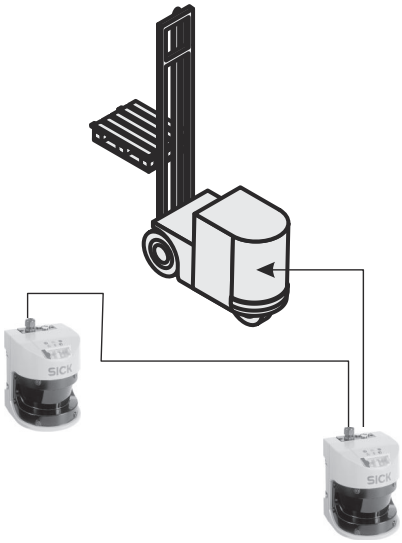


Figure 15: EFI system with safety laser scanners

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 (ERR) and 10 (A1) on the guest (see "Pin assignment", page 75).
- 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:

- H at the host
- G at the guest

3.2.9.1 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, S3000 safety laser scanners with firmware ≥ B02.41 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
S3000 Standard	✔	✔	✔	✔	✔	✔	✔	✔	✔	–	✔
S3000 Advanced	✔	✔	✔	✔	✔	✔	✔	✔	✔	–	✔
S3000 Professional	✔	✔	✔	✔	✔	✔	✔	✔	✔	–	✔
S3000 Remote	✔	✔	✔	✔ [2]	✔	✔	✔	✔	✔	–	✔ [2]
S3000 Expert	✔	✔	✔	✔	✔	✔	✔	✔	✔	–	✔

1) This device does not have an EFI interface so it cannot be used in an EFI system.
2) Only in conjunction with a Flexi Soft safety controller or sens:Control device.

✔ = 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
S3000 Standard	✔	✔	✔	✔	✔	✔	–	✔	✔	✔	✔	✔	–	–
S3000 Advanced	✔	✔	✔	✔	✔	✔	–	✔	✔	✔	✔	✔	–	–
S3000 Professional	✔	✔	✔	✔	✔	✔	–	✔	✔	✔	✔	✔	–	–
S3000 Remote	✔	✔	✔	✔	✔ [2]	✔	–	✔	✔	✔	✔	✔	–	–

	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
S3000 Expert	✔	✔	✔	✔	✔	✔	–	✔	✔	✔	✔	✔	–	–

1) This device does not have an EFI interface so it cannot be used in an EFI system.
2) Only in conjunction with a Flexi Soft safety controller or sens:Control device.

✔ = EFI system supported

– = EFI system not supported

Further topics

- "Compatibility mode", page 83

3.2.9.2 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 S3000 with a higher-level device (S3000 host or sens:Control device) as the guest, more monitoring cases may be available depending on the system configuration.

Example

You are using an S3000 Advanced as a guest for an S3000 Professional. The S3000 Professional has been configured with 8 monitoring cases. In this case 8 monitoring cases will also be available on the S3000 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 S3000 depends on the integration of the EFI status information from the S3000 in the logic of the Flexi Soft safety controller.

Further topics

- "OSSDs", page 95
- "Restart", page 96

3.2.9.3 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.

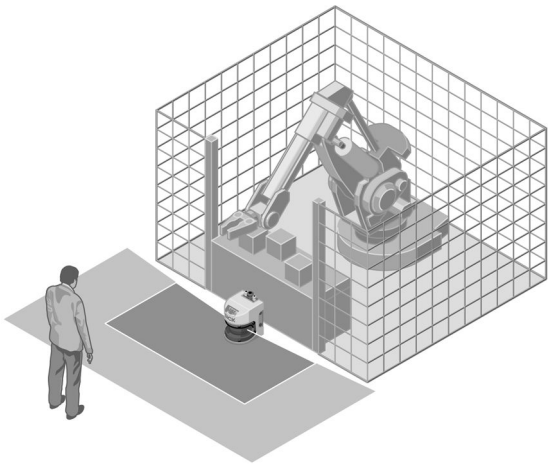


Figure 16: Hazardous area protection: detection of the presence of a person in the hazardous area

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.

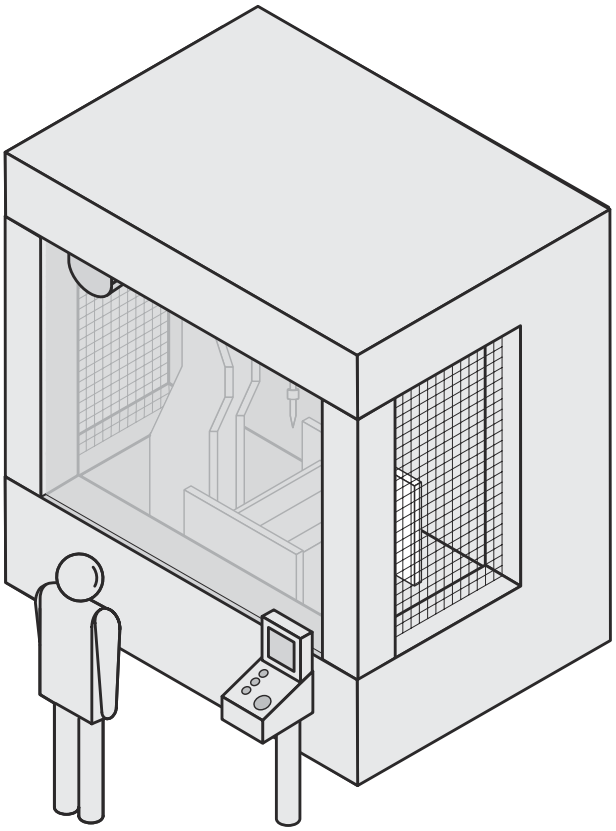


Figure 17: Hazardous point protection: hand detection

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.

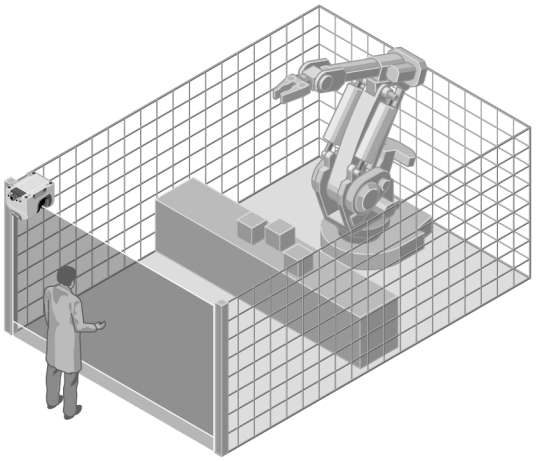


Figure 18: Access protection: detection of a person when accessing a hazardous area

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.

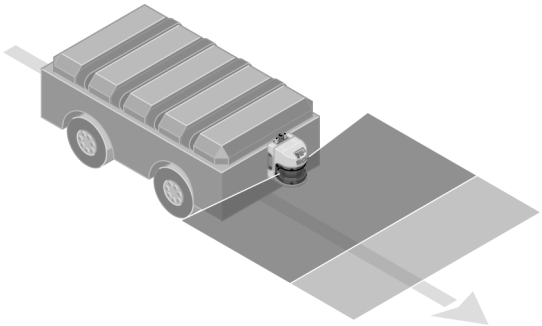


Figure 19: Mobile hazardous area protection: detection of a person when a vehicle approaches

Further topics

- "Timing for monitoring case switching", page 39

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.

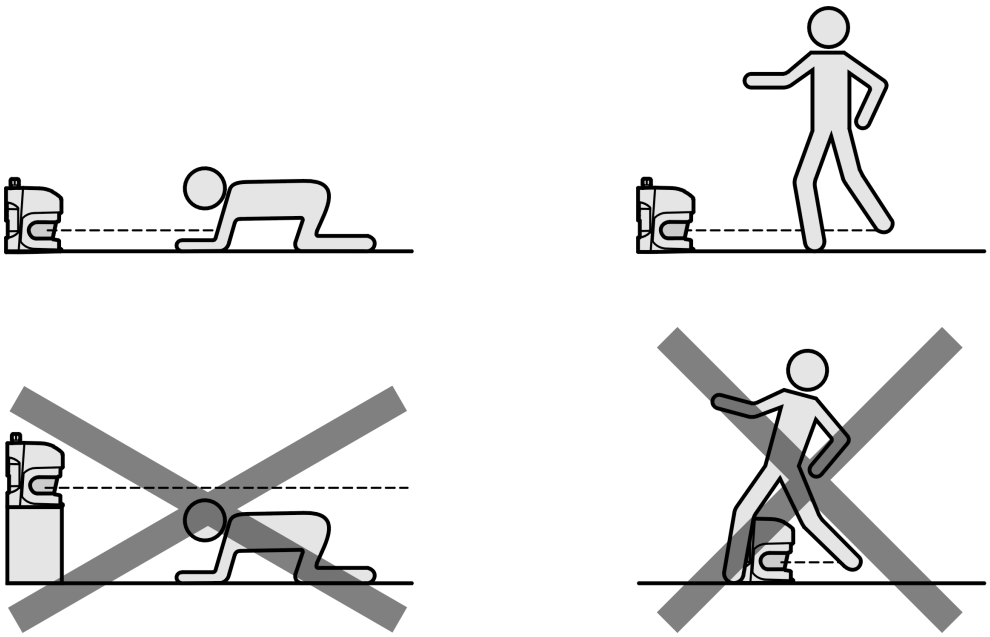


Figure 20: Prevent crawling beneath, standing behind, or climbing over

NOTICE

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

NOTE

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

Further topics

- "Mounting", page 64

4.3.1 If several safety laser scanners are used

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

NOTE

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

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

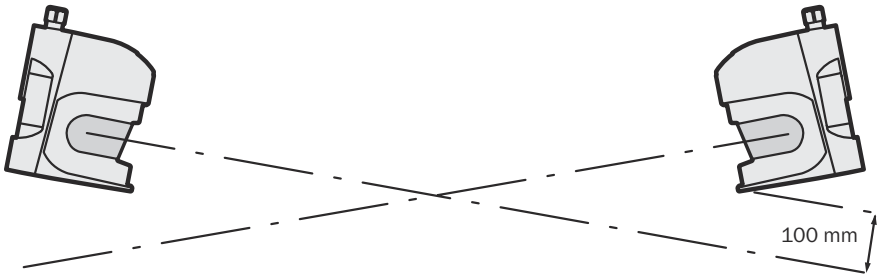


Figure 21: Mounting opposite

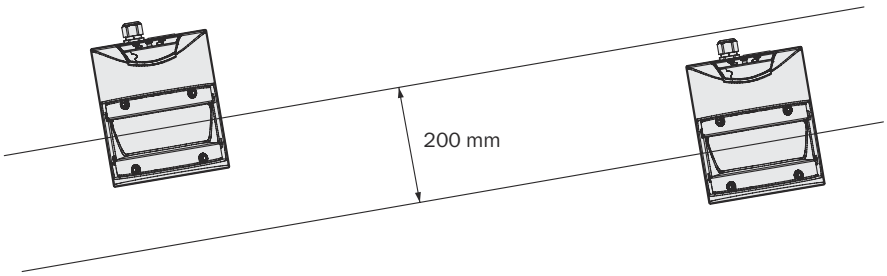


Figure 22: Mounting angled parallel

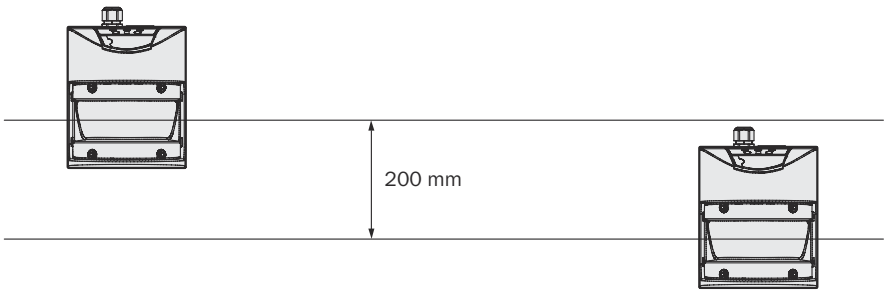


Figure 23: Mounting offset parallel

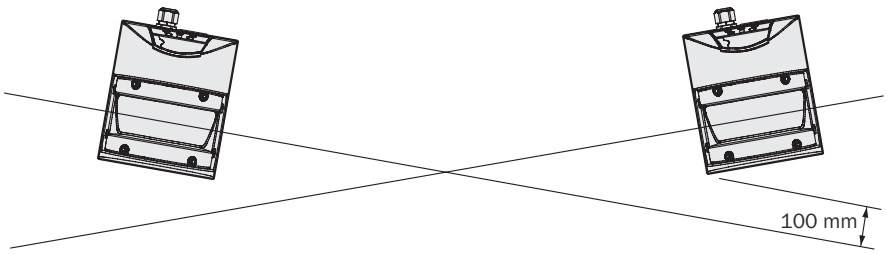


Figure 24: Mounting crosswise

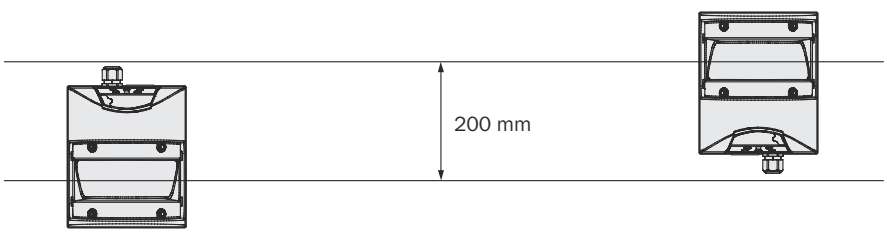


Figure 25: Mounting one device upside down, offset parallel

Further topics

- "Brackets", page 159

4.3.2 Measures to prevent unsecured areas

Overview

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

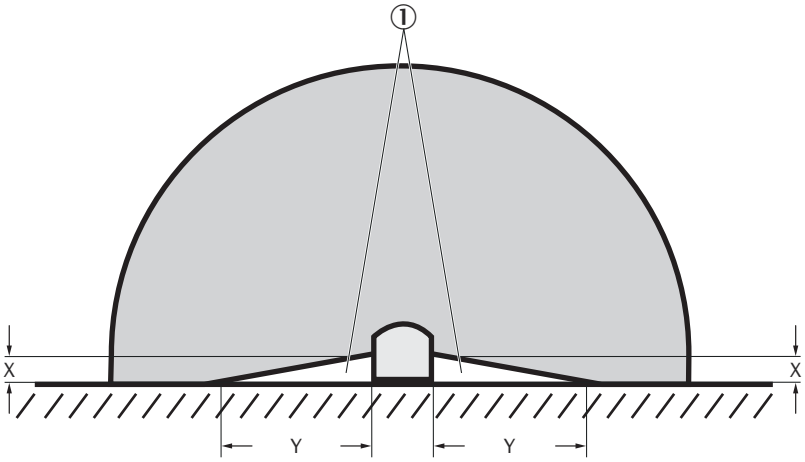


Figure 26: Unsecured areas in stationary applications

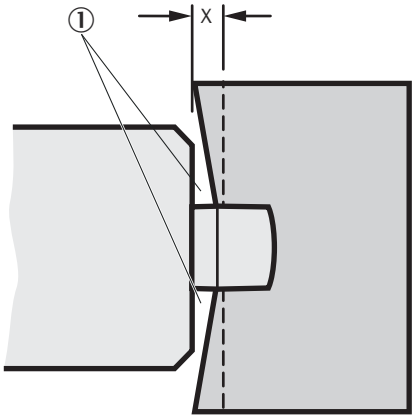


Figure 27: Unsecured areas in mobile applications

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

Table 6: Size of the unsecured areas

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

Important information

DANGER
Ineffectiveness of the protective device

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

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

Examples of possible measures:

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

DANGER
Ineffectiveness of the protective device

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

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

- Select a sufficiently large protective field.

DANGER
Ineffectiveness of the protective device

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

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

Mounting with deflector plates

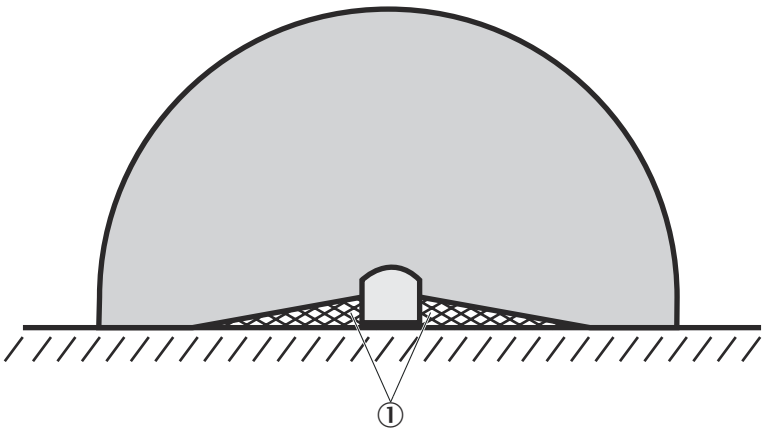


Figure 28: Mounting with deflector plates (example)

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

Mounting in an undercut

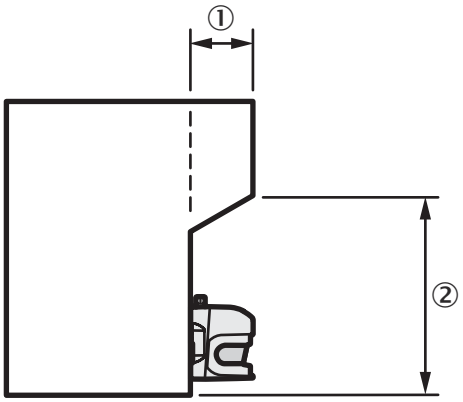


Figure 29: Implementation with an undercut

- Make the undercut ① sufficiently deep that it completely covers the area not protected by the safety laser scanner (see figure 28) and so that it is not possible to stand behind the unsecured areas.
- Prevent crawling beneath the undercut by making the height of the undercut ② sufficiently small so that no one can crawl under it.

Mounting in the vehicle paneling

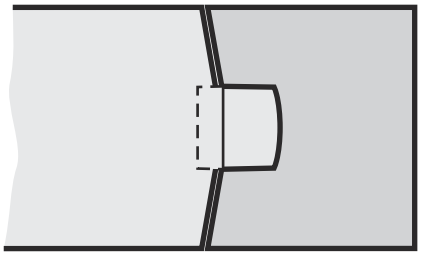


Figure 30: Installing the device in the vehicle paneling

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

Complementary information

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

Further topics

- "Dimensional drawings", page 153

4.3.2.1 Near range

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

4.3.3 Timing for monitoring case switching

Overview

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

You must advance the switching time in the following situations:

- You have entered an input delay for the switching method.
- You are using external inputs (e.g., the inputs of another S3000).
- You are controlling external OSSDs via EFI (e.g., the OSSDs on another S3000) instead of the internal OSSDs.

The following diagram illustrates the relationships:

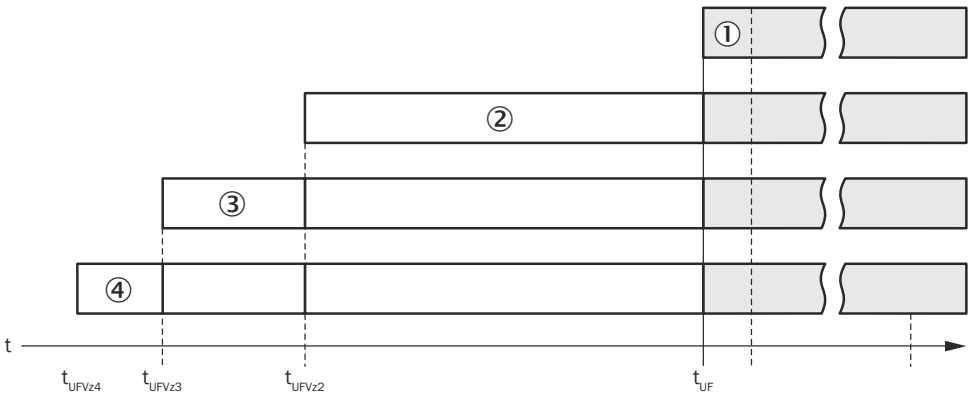


Figure 31: Advancing the switching time

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

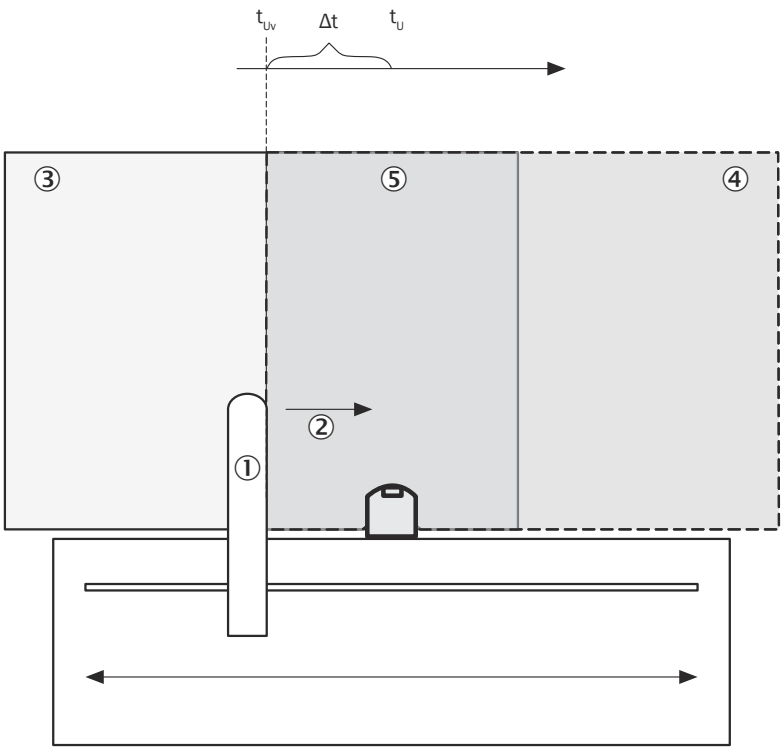


Figure 32: Advancing the switching time (example)

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.
  Alternatively, you can use simultaneous monitoring to temporarily monitor both hazardous areas.

Further topics

- "Input delay", page 94

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.

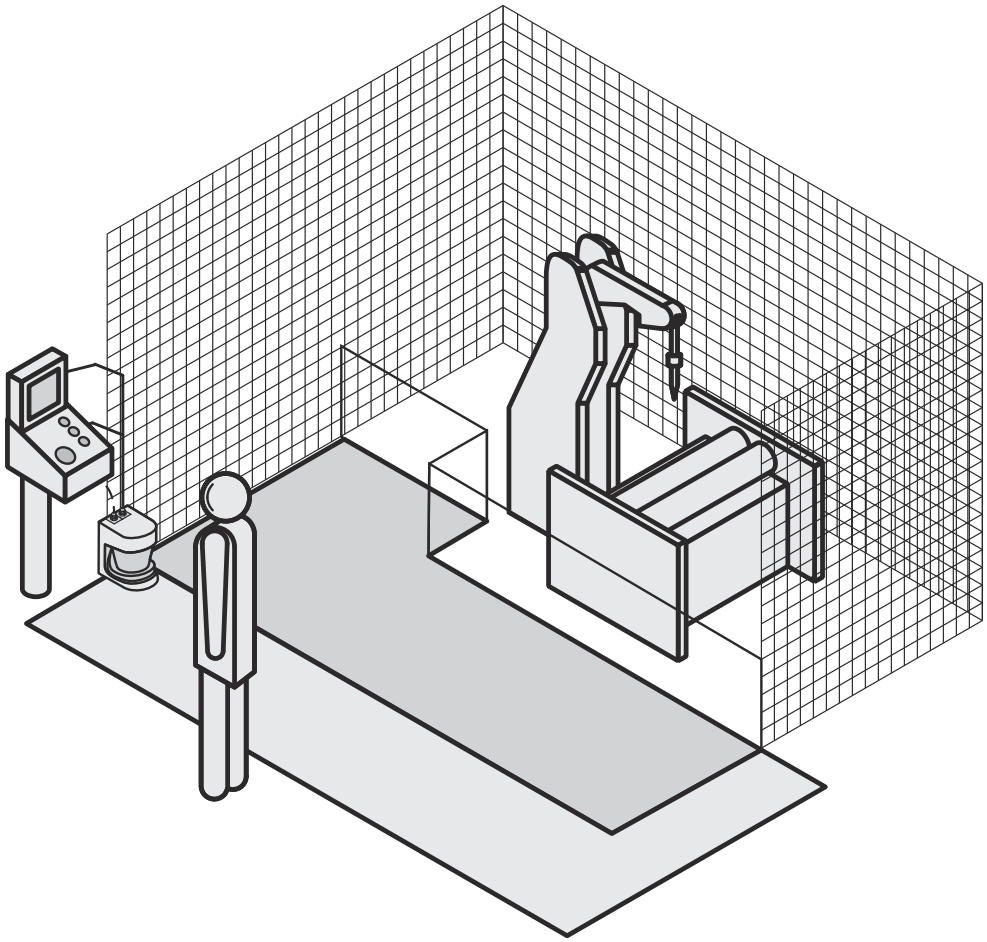


Figure 33: Horizontally mounted stationary application

For a horizontal stationary application, you determine the following:

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

NOTE

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

4.3.4.1 Protective field size

Overview

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

You can operate the device in stationary horizontal operation using a 50 mm or 70 mm resolution. For each resolution, you can select between a 60 ms and 120 ms response time. The resolution and response time determine the maximum protective field range[2)] of the device.

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

Important information

WARNING

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

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

▶ For horizontal stationary applications with a 70 mm resolution, mount the scan plane at a height of at least 300 mm above the floor in accordance with ISO 13855 (see "Height of the scan plane at 70 mm resolution", page 45).

NOTE

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

NOTE

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

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

Minimum distance S

The minimum distance S depends on the:

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

2) Radial distance to the safety laser scanner.

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

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

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

where

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

Response time T_S of the safety laser scanner

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

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

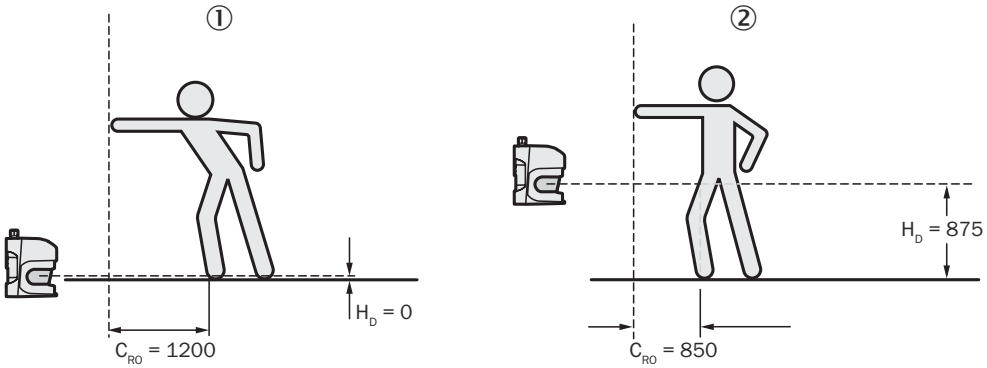


Figure 34: Risk of reaching over (mm)

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

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

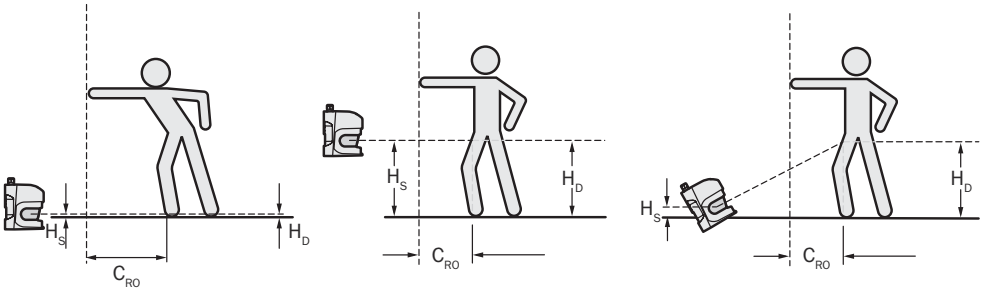


Figure 35: Mounting options for the scan plane

Table 7: Advantages and disadvantages of the mounting options

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

H_D = Detection height

H_S = Scanner mounting height

DANGER

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

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

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

Calculation of supplement C_{RO}

Calculating the supplement C_{RO}

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

NOTE

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

Height of the scan plane at 70 mm resolution

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

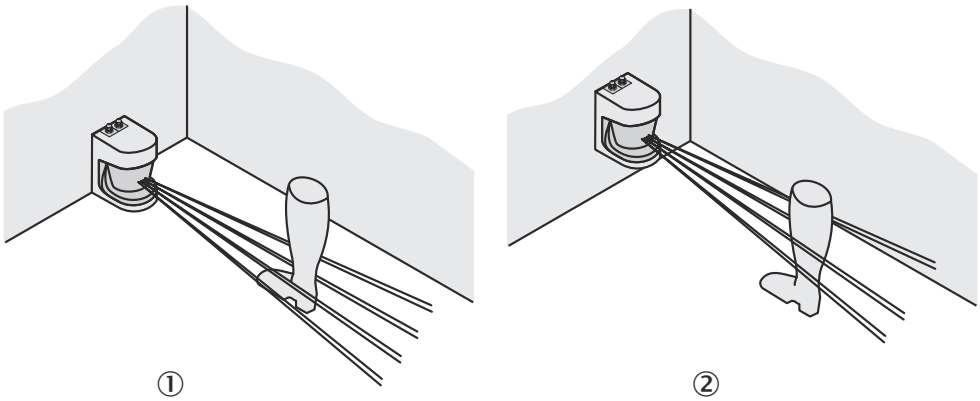


Figure 36: Relationship between resolution and protective field mounting height

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

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

Further topics

- "Response times", page 148

4.3.5 Stationary vertical operation for access protection

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

NOTE

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

Further topics

- "Using the contour as a reference", page 104

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.

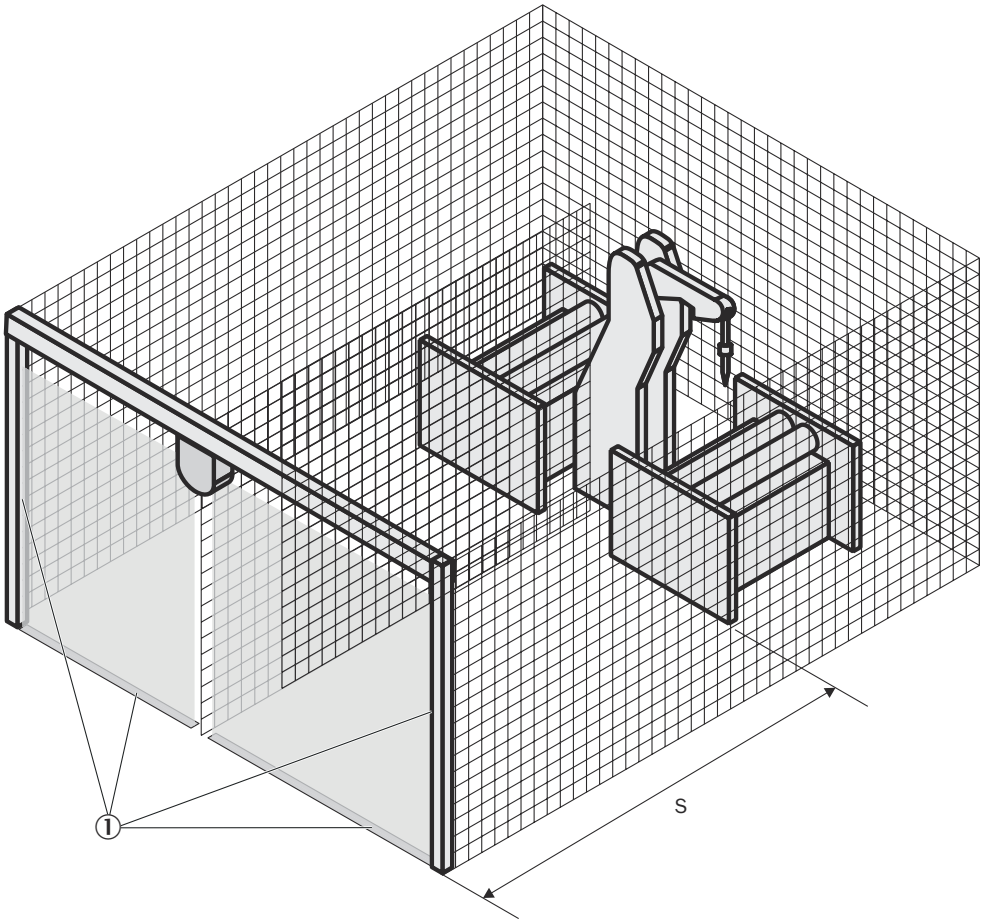


Figure 37: Access protection

① Contour of the floor and side panels as a reference

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

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

Minimum distance S

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

▶ $S = (K \times (T_M + T_S)) + C$

where

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

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

Response time T_S of the safety laser scanner

DANGER
Ineffectiveness of the protective device

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

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

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

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

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

- Basic response time of the safety laser scanner
- Set multiple sampling
- Transmission speed to external OSSDs via EFI

Further topics

- "Response times", page 148

4.3.6 Stationary vertical operation for hazardous point protection

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

DANGER
Ineffectiveness of the protective device

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

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

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

Further topics

- "Using the contour as a reference", page 104

4.3.6.1 Minimum distance

Overview

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

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

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

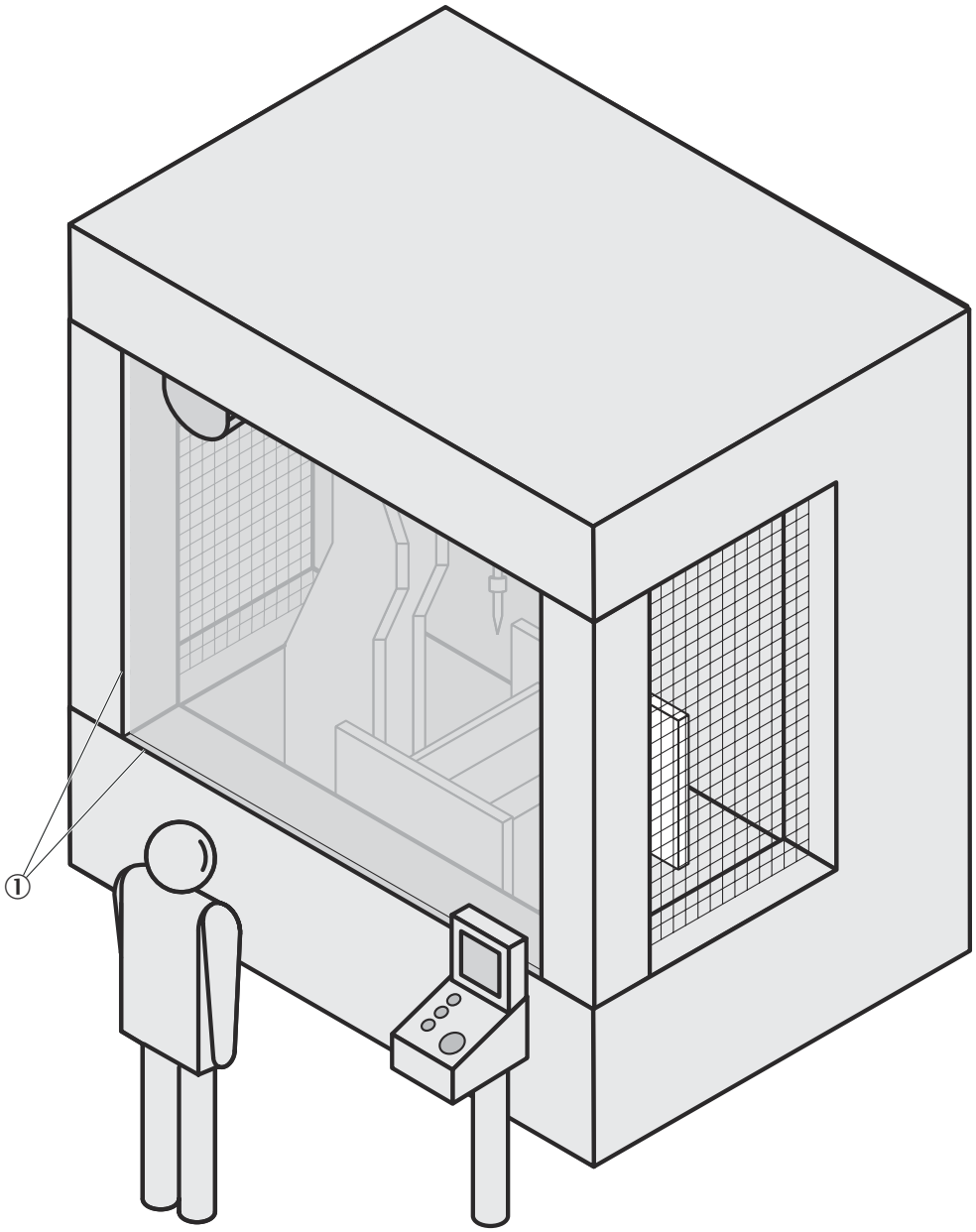


Figure 38: Minimum distance to hazardous area

① Contour of the floor and side panels as a reference

Important information

DANGER
Danger due to reaching around or reaching behind

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

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

Minimum distance S

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

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

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

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

where

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

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

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

Response time T_S of the safety laser scanner

The response time T_S depends on the:

- Basic response time of the safety laser scanner
- Set multiple sampling
- Transmission speed to external OSSDs via EFI

Further topics

- "Response times", page 148

4.3.7 Mobile applications

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

NOTE

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

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

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

4.3.7.1 Protective field length

Overview

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

NOTE

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

Protective field length S_L

Calculate the protective field length S_L using the following formula:

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

where

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

Stopping distance S_A

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

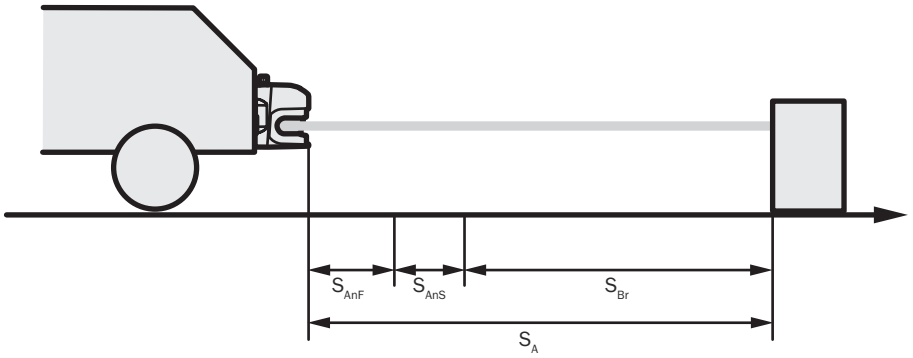


Figure 39: Stopping distance

NOTE

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

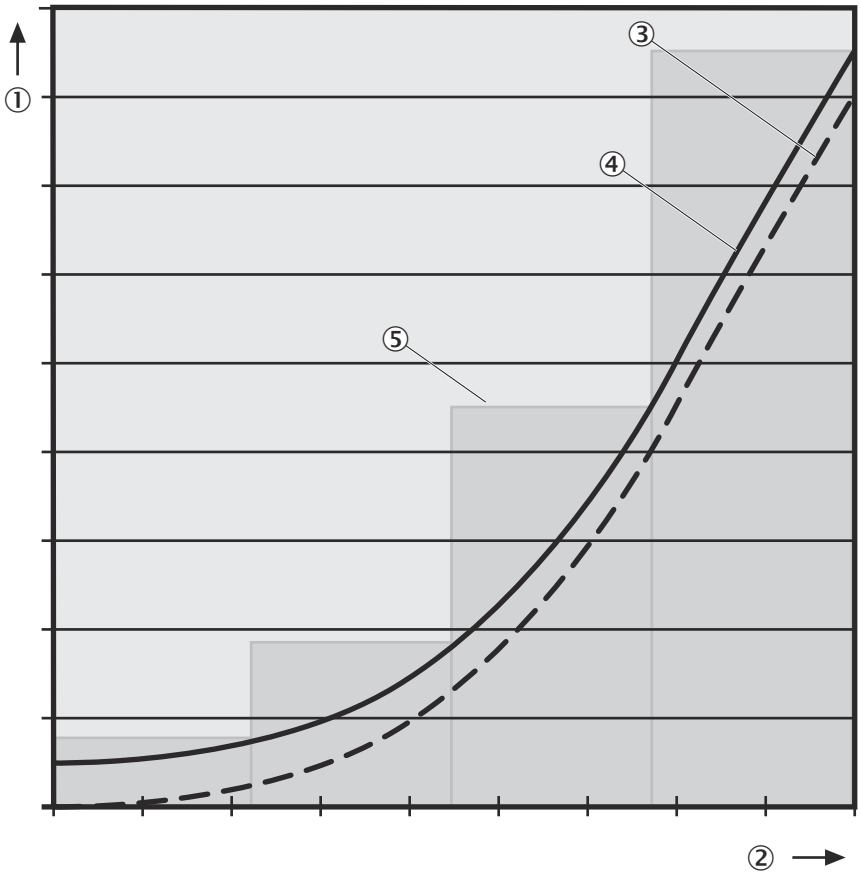


Figure 40: Stopping distance as a function of the vehicle's speed

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.

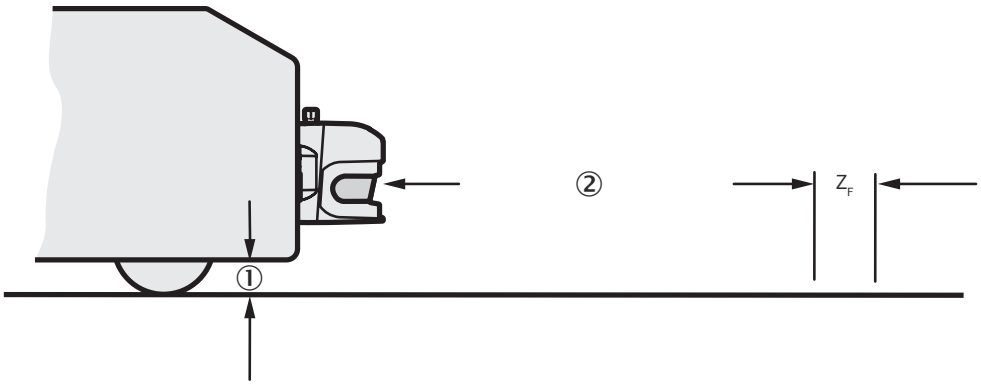


Figure 41: Supplement due to lack of ground clearance

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:

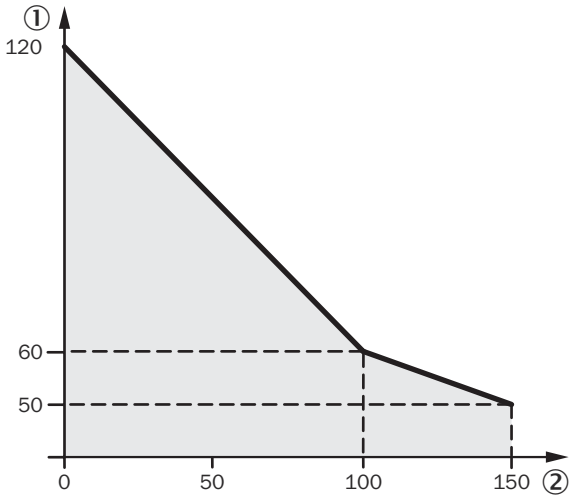


Figure 42: Vehicle ground clearance graph

① Ground clearance of the vehicle in mm

② Supplement Z_F in mm

Further topics

- "Response times", page 148

4.3.7.2 Protective field width

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

Calculate the protective field width S_B using the following formula:

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

where

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

NOTE

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

4.3.7.3 Height of the scan plane

DANGER
Ineffectiveness of the protective device
Persons lying on the floor may not be detected.

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

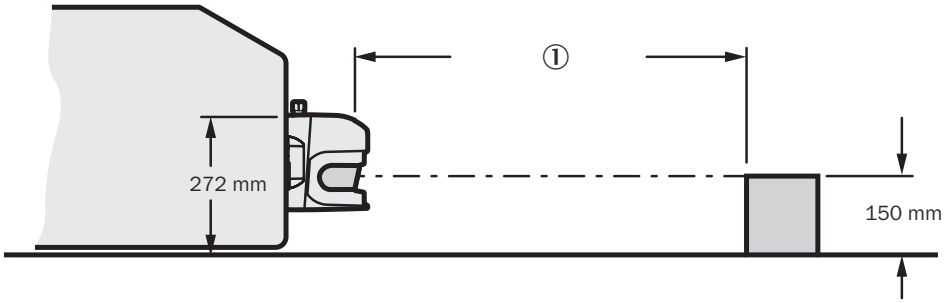


Figure 43: Fitting height

① Set protective field length

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).

NOTE
In the case of the examples with an S3000 Expert or Flexi Soft, the universal I/O connections must be configured in such a way that they display the relevant states.

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 8: 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 138).
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

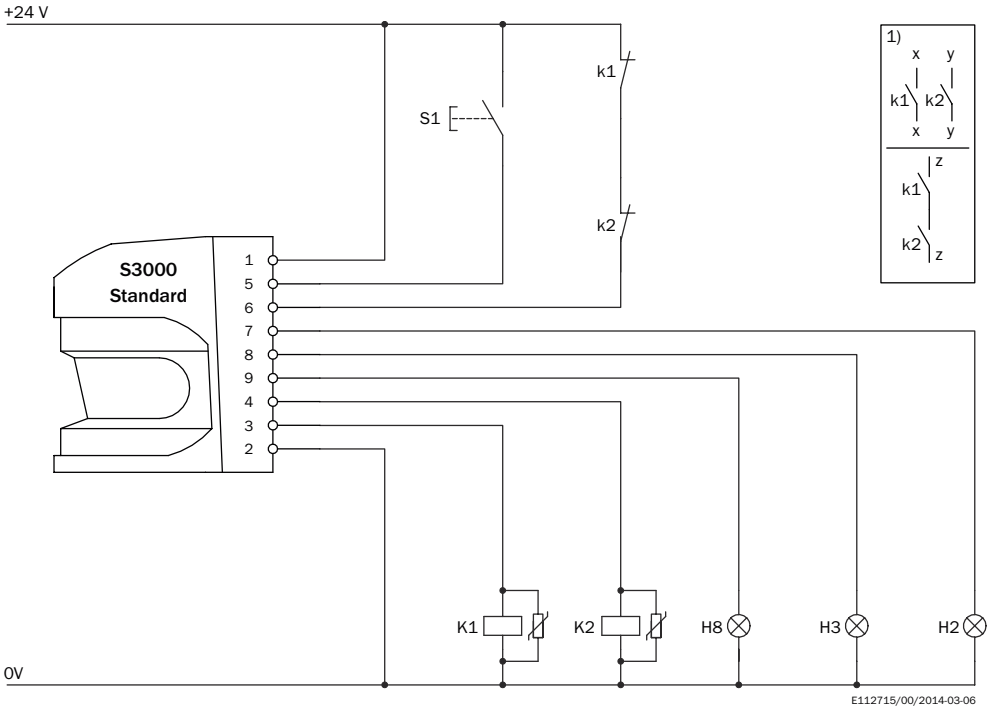


Figure 44: Connection diagram for restart interlock and external device monitoring

S3000 Standard in conjunction with relays (contactors); Operating mode: with restart interlock and external device monitoring.

Restart interlock and external device monitoring in conjunction with a UE10 safety relay

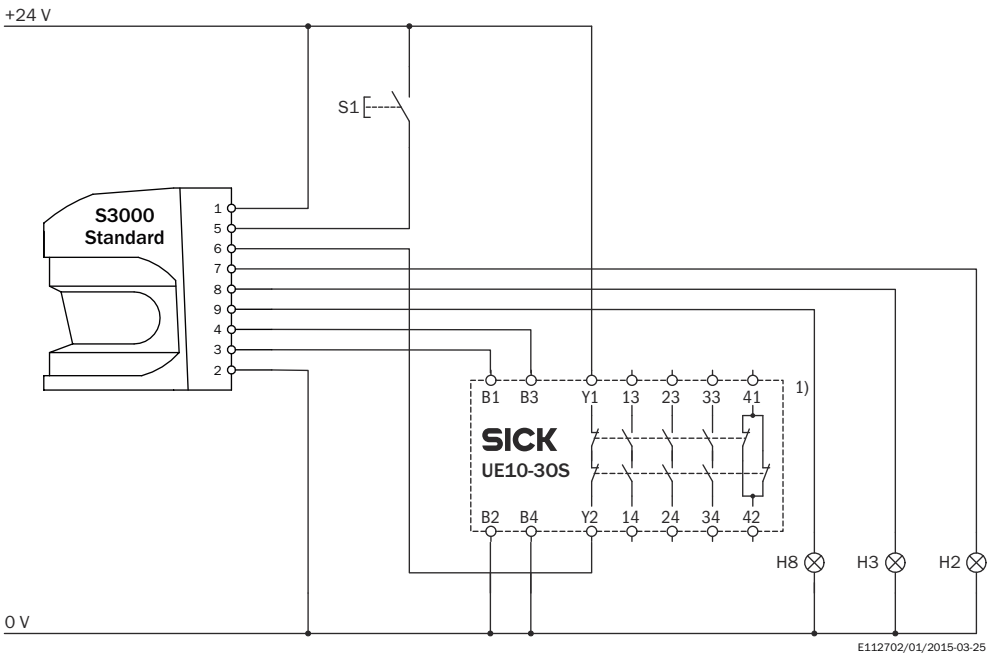


Figure 45: Connection diagram for restart interlock and external device monitoring in conjunction with a UE10 safety relay

S3000 Standard in conjunction with UE10-3OS; Operating mode: with restart interlock and external device monitoring.

Monitoring case switching using two static input pairs

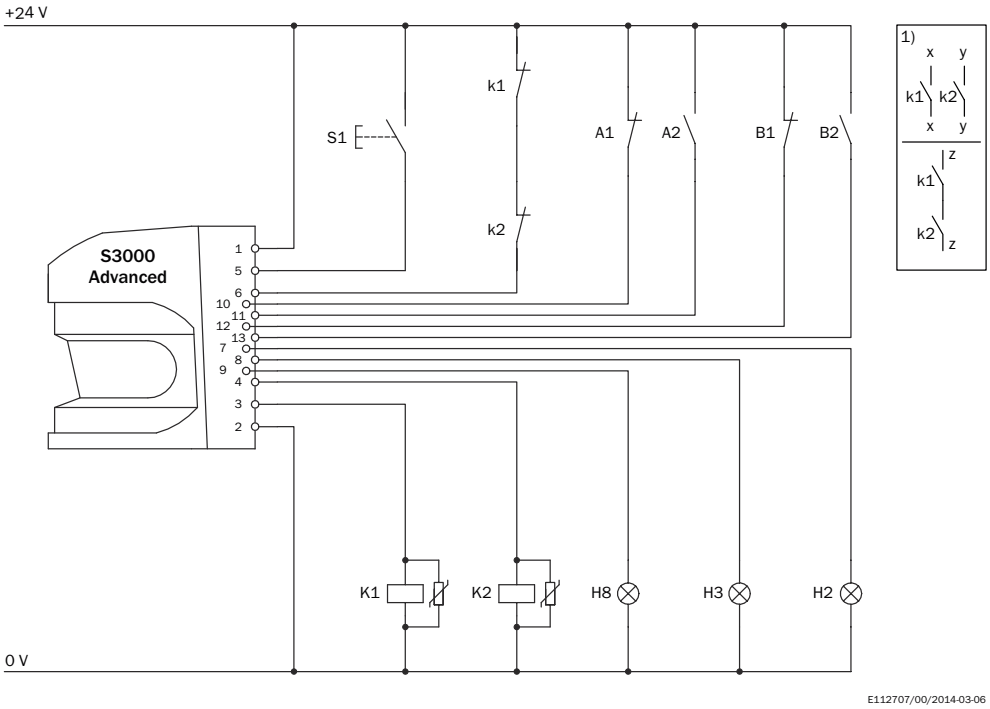


Figure 46: Connection diagram for monitoring case switching using two static input pairs

S3000 Advanced 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 four static input pairs

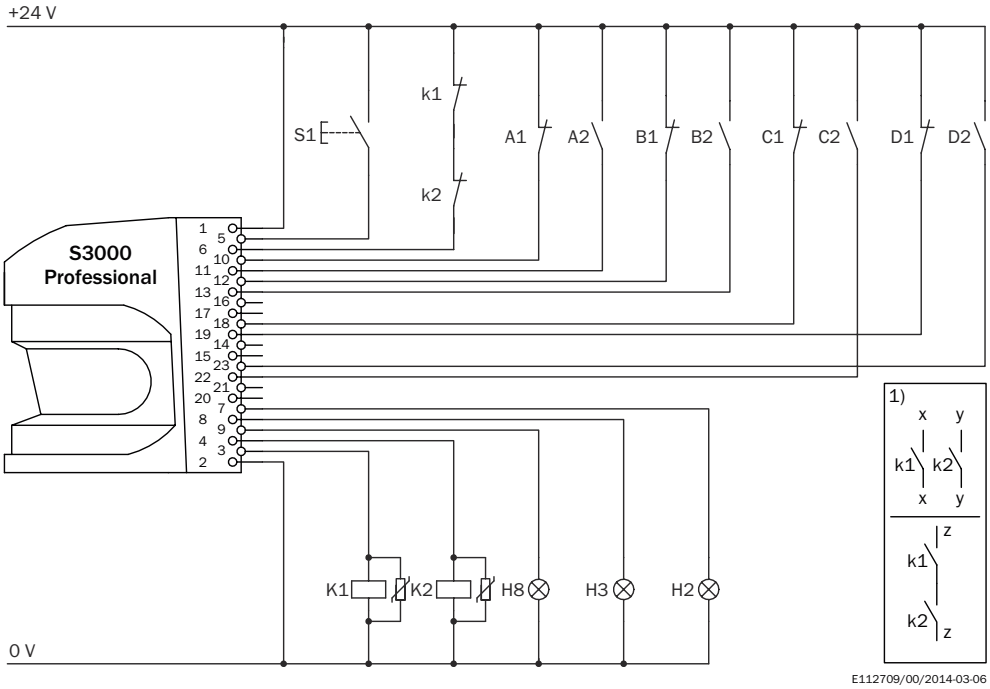


Figure 47: Connection diagram for monitoring case switching using four static input pairs

S3000 Professional in conjunction with relays (contactors); Operating mode: with restart interlock and external device monitoring; Static monitoring case switching by the control inputs A to D.

Monitoring case switching using static and dynamic inputs

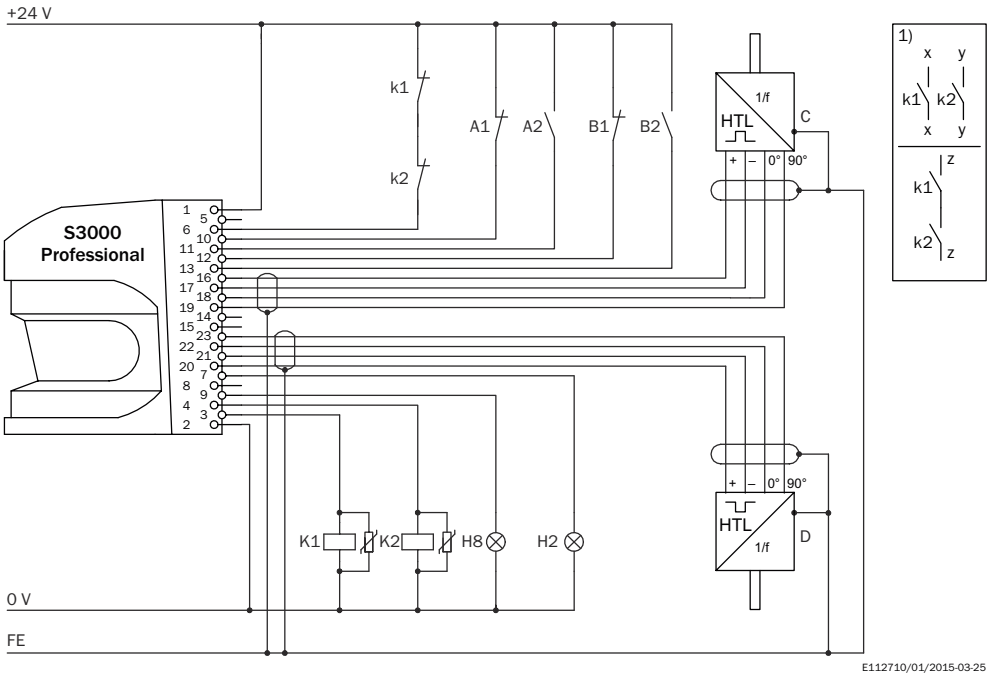


Figure 48: Connection diagram for monitoring case switching using static and dynamic inputs

S3000 Professional 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; Dynamic monitoring case switching by the incremental encoders C and D.

Monitoring case switching between two safety laser scanners with static inputs

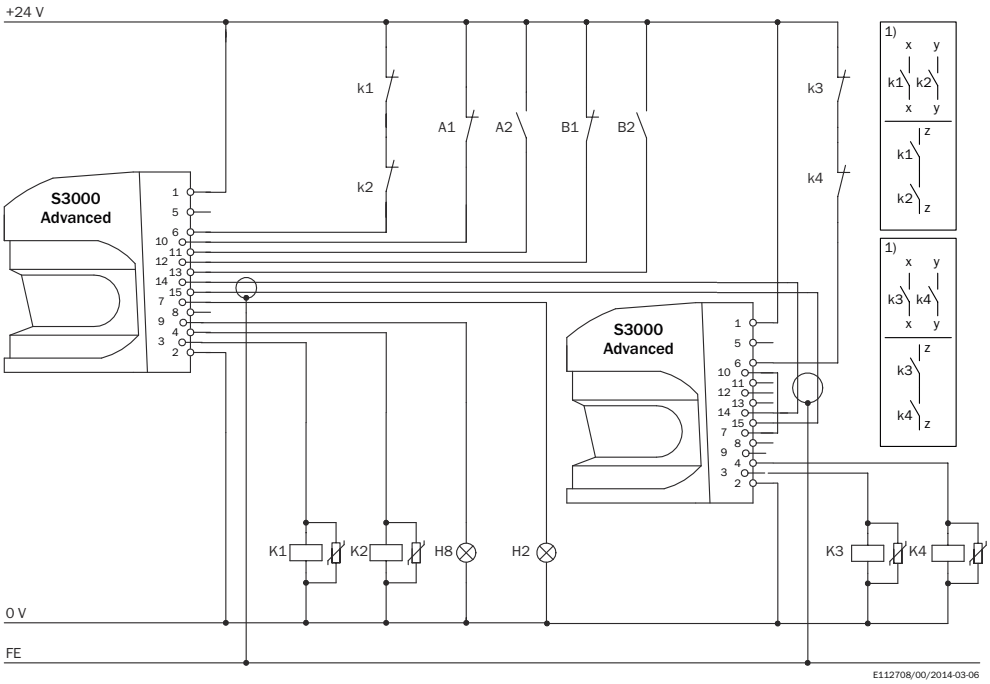


Figure 49: Connection diagram for monitoring case switching between two safety laser scanners with static inputs

Two S3000 Advanced in an EFI system in conjunction with relays (contactors); Operating mode: without restart interlock, with external device monitoring; Monitoring case switching by the control inputs A and B on separate OSSD pairs (simultaneous monitoring).

Monitoring case switching between two safety laser scanners with static and dynamic inputs

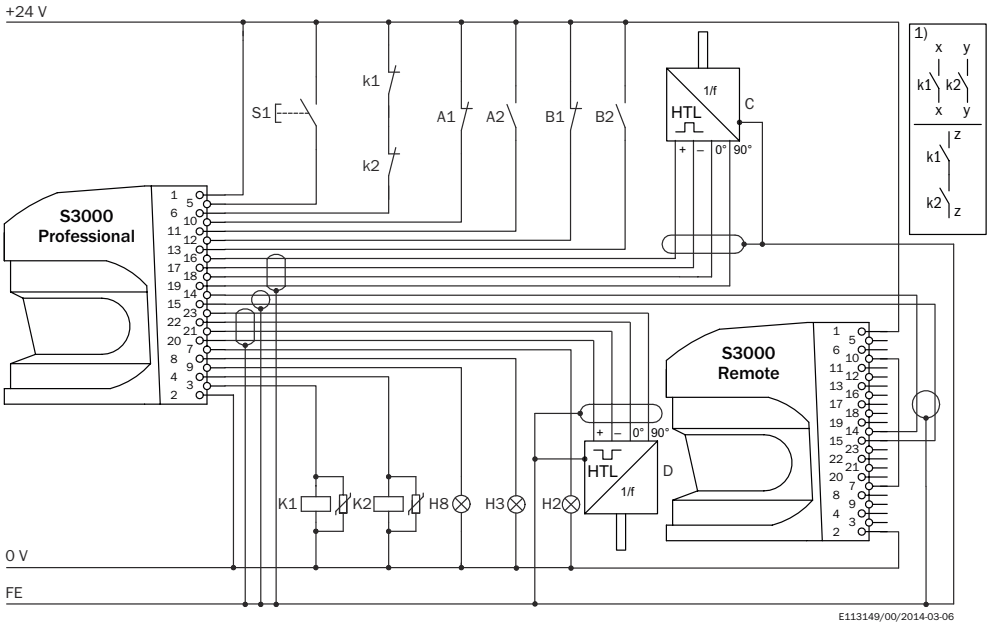


Figure 50: Connection diagram for monitoring case switching between two safety laser scanners with static and dynamic inputs

S3000 Professional and S3000 Remote in an EFI system in conjunction with relays (contactors); Operating mode: with restart interlock and external device monitoring; Static monitoring case switching by the control inputs A and B; Direction of travel-dependent dynamic monitoring case switching by the incremental encoders C and D; Sensor communication via EFI.

Monitoring case switching between two safety laser scanners using a Flexi Soft safety controller

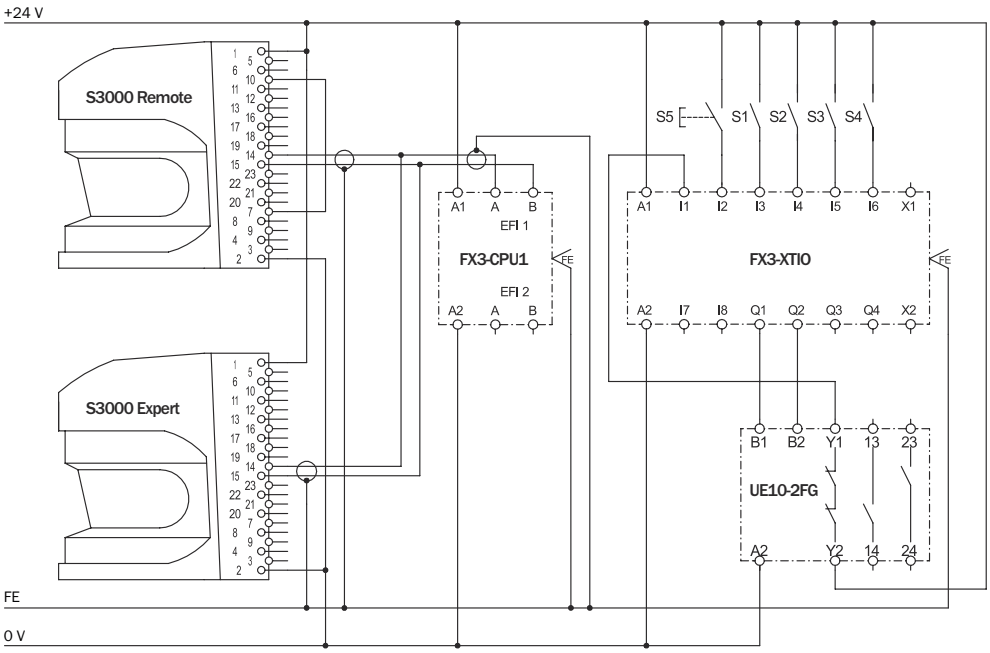


Figure 51: Connection diagram for monitoring case switching between two safety laser scanners using a Flexi Soft safety controller

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

Monitoring case switching between an S3000 Expert and an S300 Mini Remote using static inputs

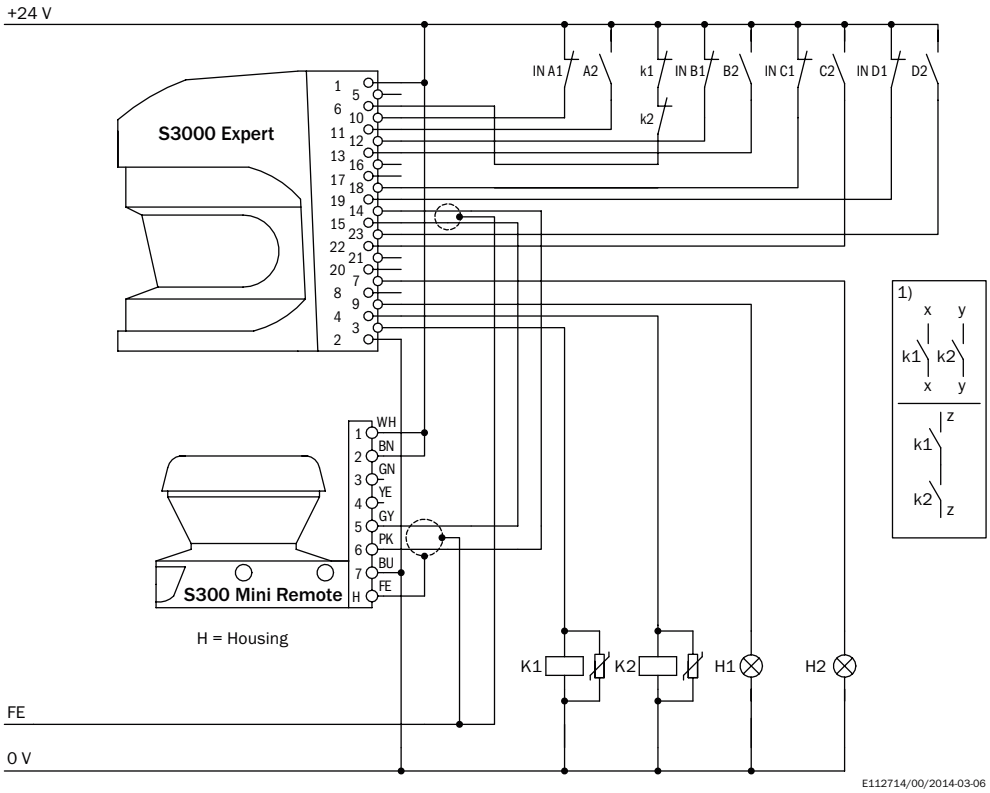


Figure 52: Connection diagram for monitoring case switching between an S3000 Expert and an S300 Mini Remote using static inputs

S3000 Expert and S300 Mini Remote 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 to D of the S3000. The protective fields act on the OSSDs on the S3000 Expert.

Monitoring case switching between an S3000 Expert and an S300 Mini Remote using static and dynamic inputs

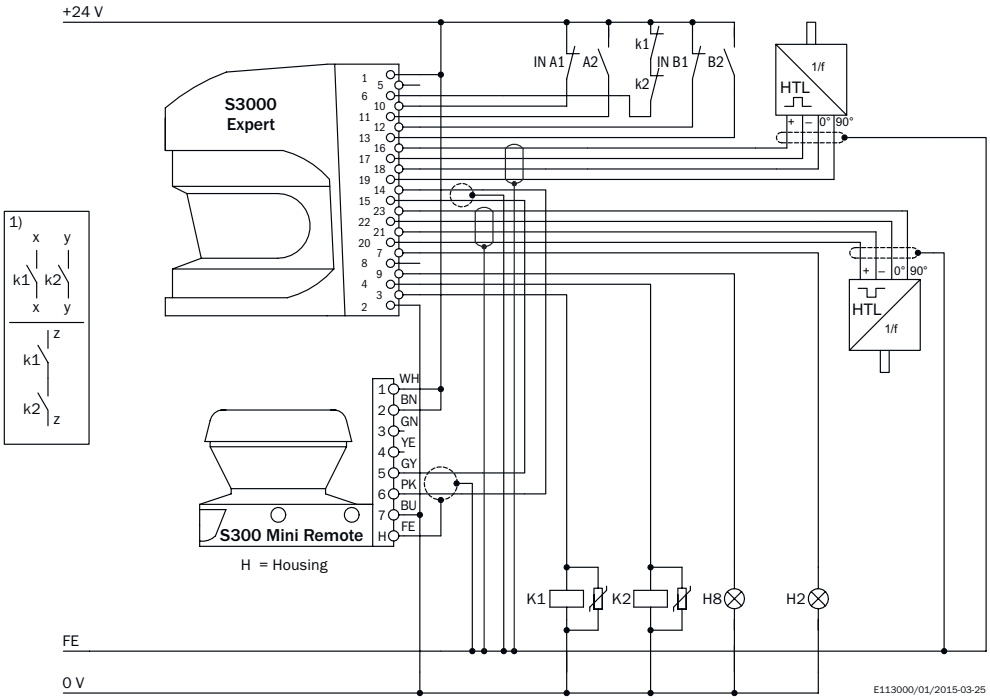


Figure 53: Connection diagram for monitoring case switching between an S3000 Expert and an S300 Mini Remote using static and dynamic inputs

S3000 Expert and S300 Mini Remote 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 an S3000 and an S300 using static and dynamic inputs

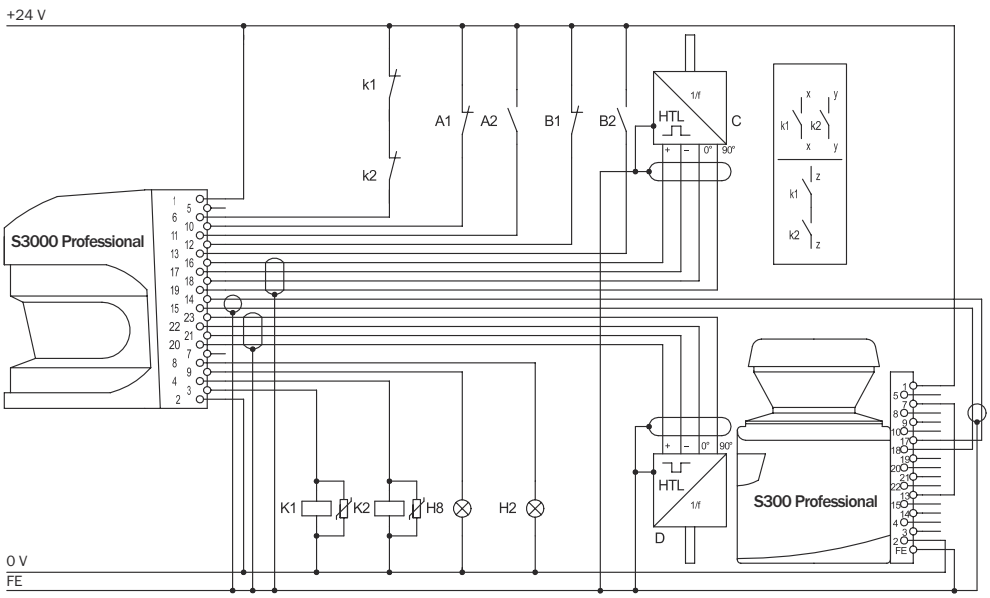


Figure 54: Connection diagram for monitoring case switching between an S3000 and an S300 using static and dynamic inputs

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

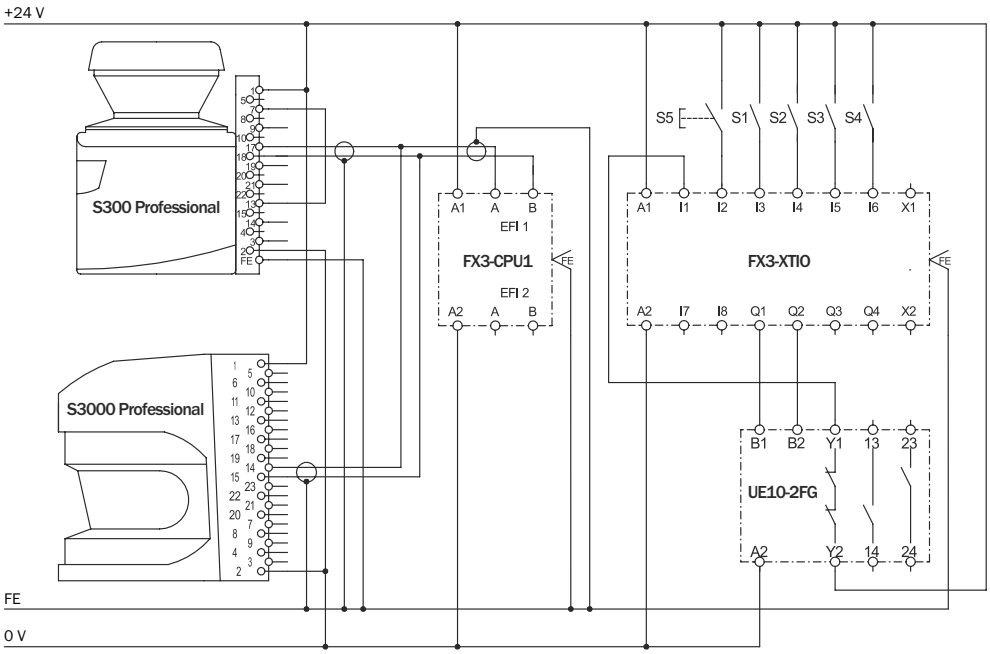


Figure 55: Connection diagram for monitoring case switching between S3000 and S300 usin a Flexi Soft safety controller

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 32
- "Electrical installation", page 72
- "Configuration", page 82
- "Commissioning", page 116
- "Test notes", page 117

5.2 Mounting procedure

Overview

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

The device can be mounted in the following ways:

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

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

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

Important information

WARNING
Ineffectiveness of the protective device

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

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

WARNING
Ineffectiveness of the protective device

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

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

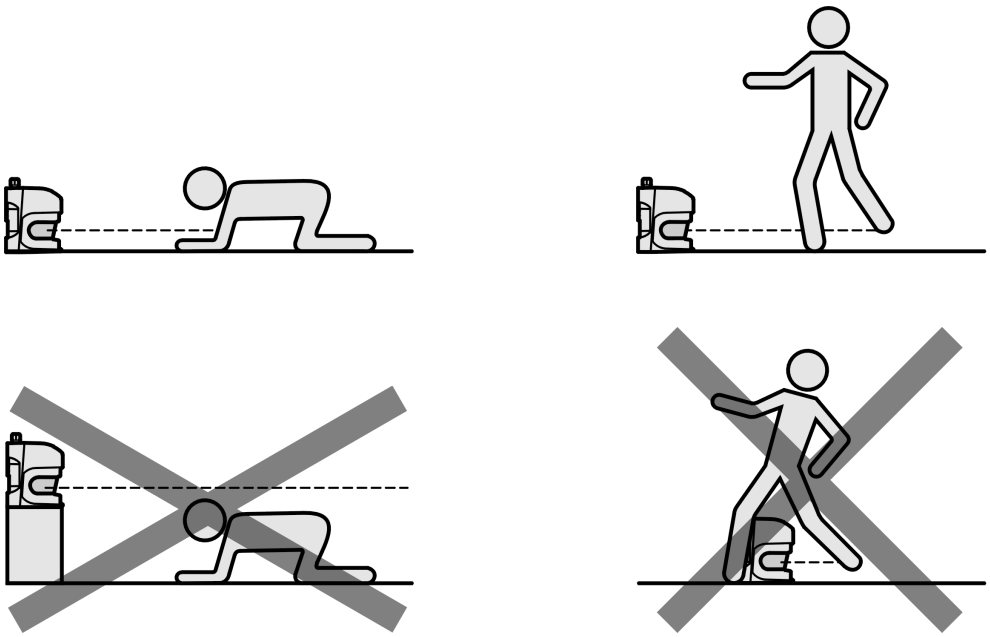


Figure 56: Prevent crawling beneath, standing behind, or climbing over

NOTE

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

Further topics

- "Dimensional drawings", page 153
- "Brackets", page 159

5.2.1 Direct mounting

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

NOTE

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

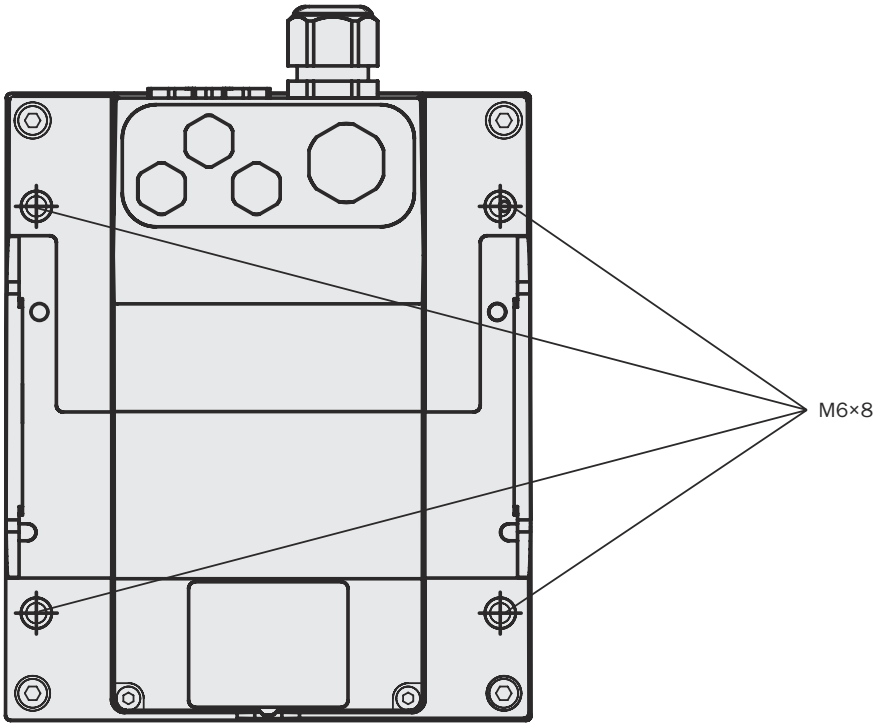


Figure 57: Threaded holes for direct mounting

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

5.2.2 Mounting using mounting kit 1

Overview

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

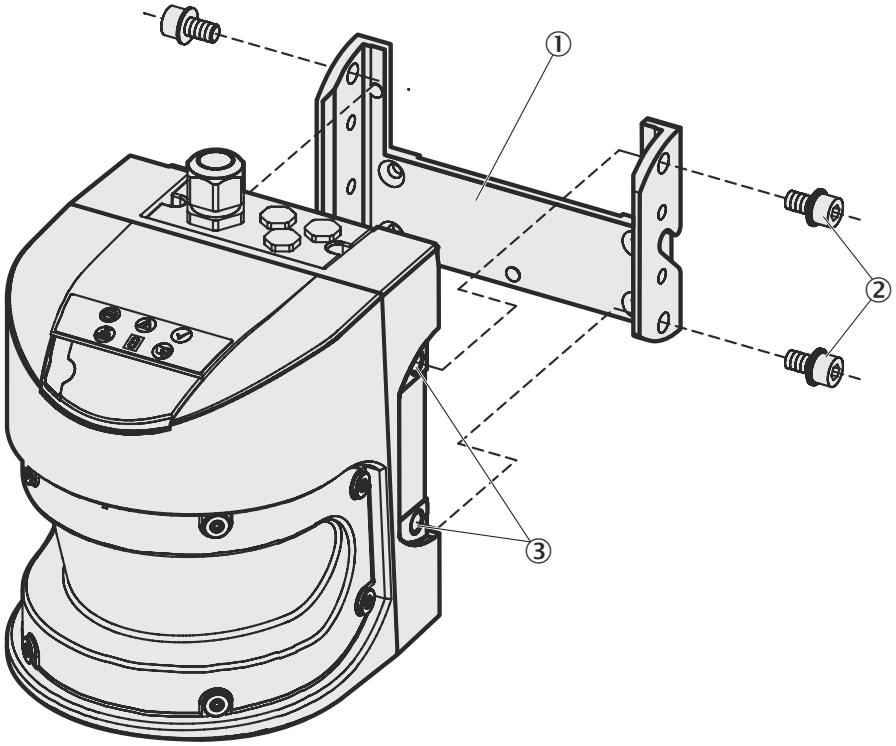


Figure 58: Mounting using mounting kit 1

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

Approach

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

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

5.2.3 Mounting using mounting kit 2

Overview

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

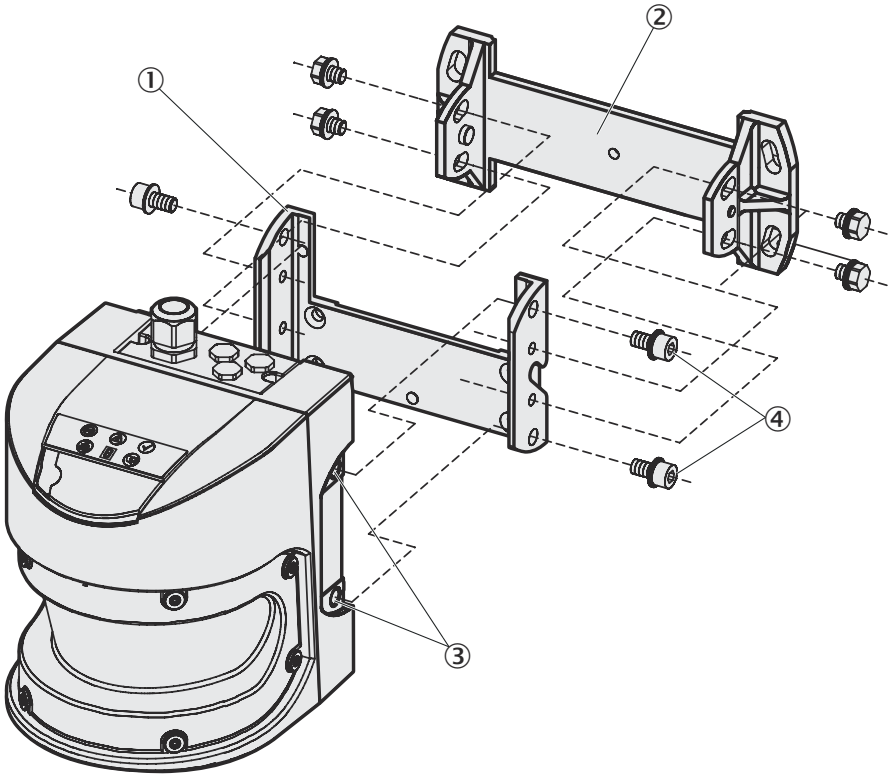


Figure 59: Mounting using mounting kit 2

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

Approach

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

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

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

5.2.4 Mounting using mounting kit 3

Overview

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

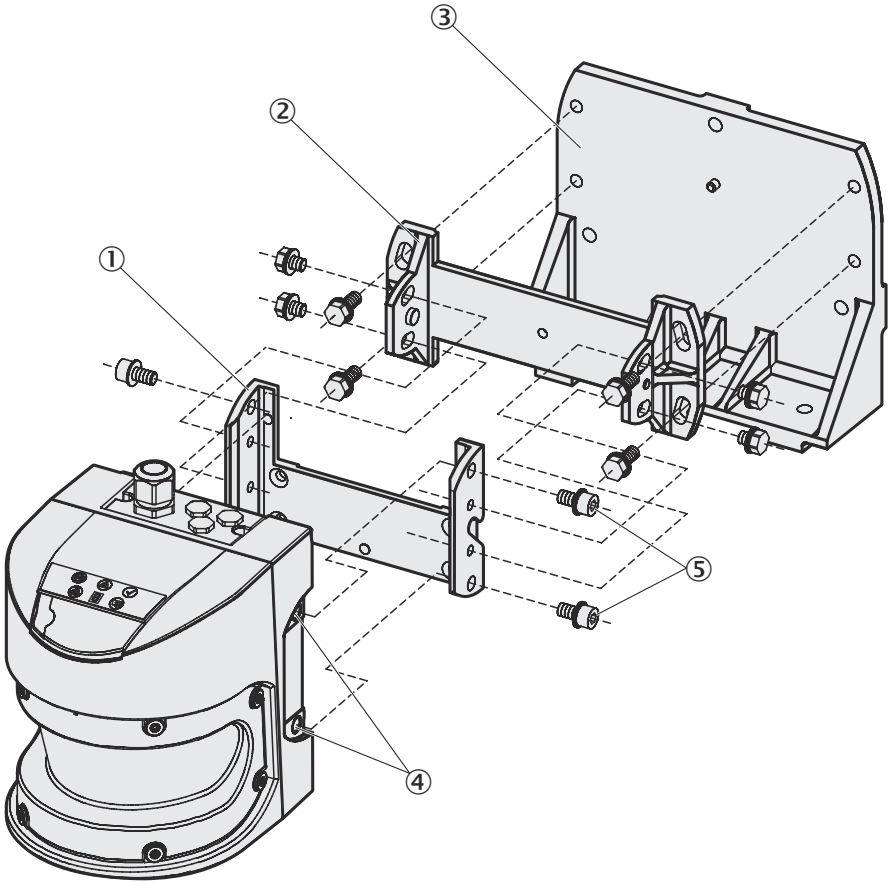


Figure 60: Mounting using mounting kit 3

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

Approach

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

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

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

NOTE
When mounting the device, observe the dimensional drawings.

Further topics

- "Dimensional drawings", page 153

5.2.5 Mounting using the heavy duty mounting adapter

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

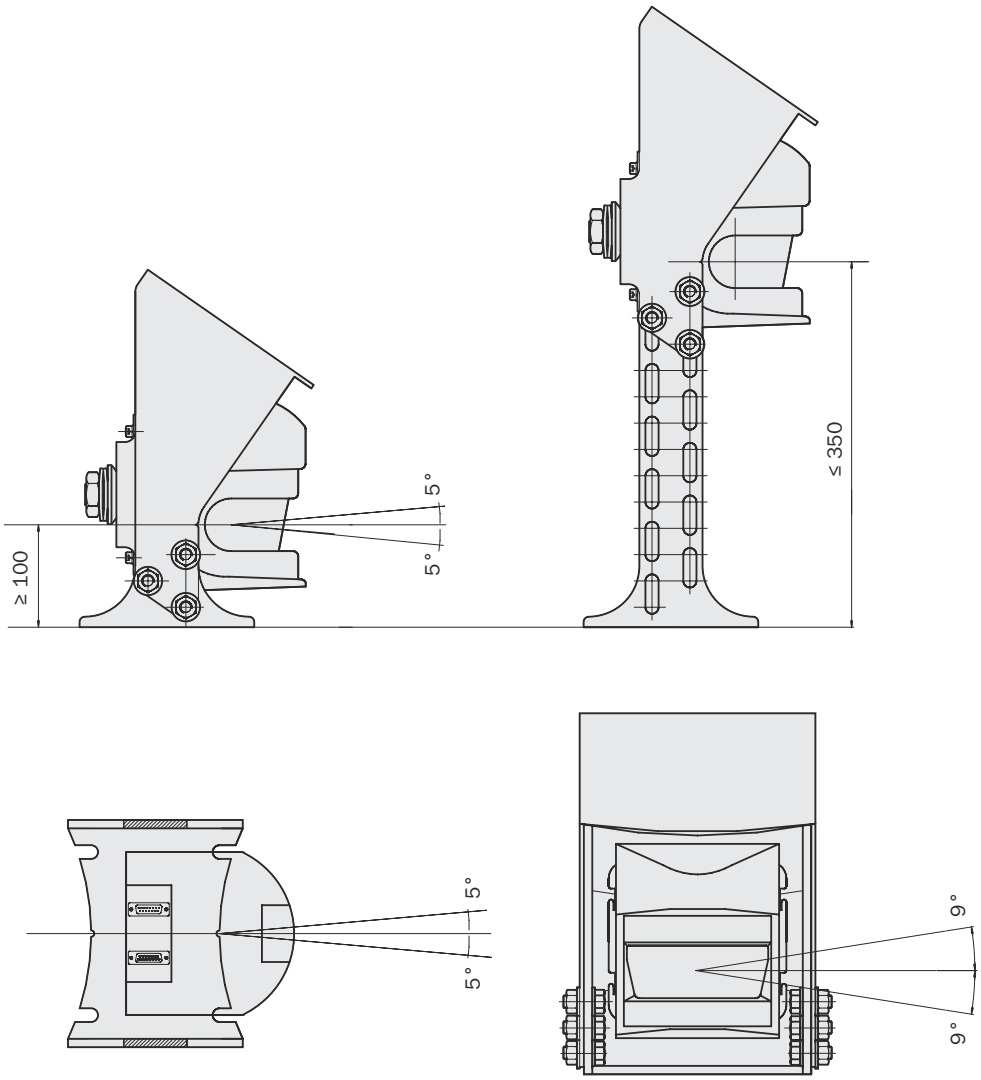


Figure 61: Mounting using heavy duty mounting adapter

5.2.6 Important notes information label

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

NOTE

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

6 Electrical installation

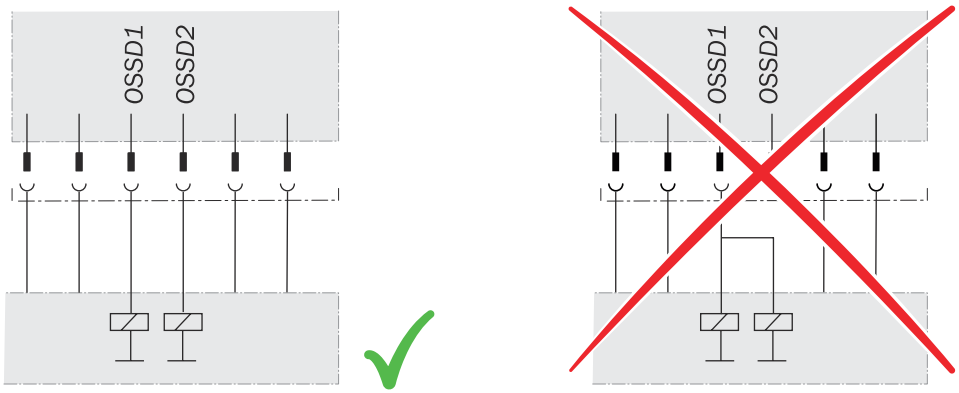
6.1 Safety

DANGER
Hazard due to unexpected starting of the machine

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

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.

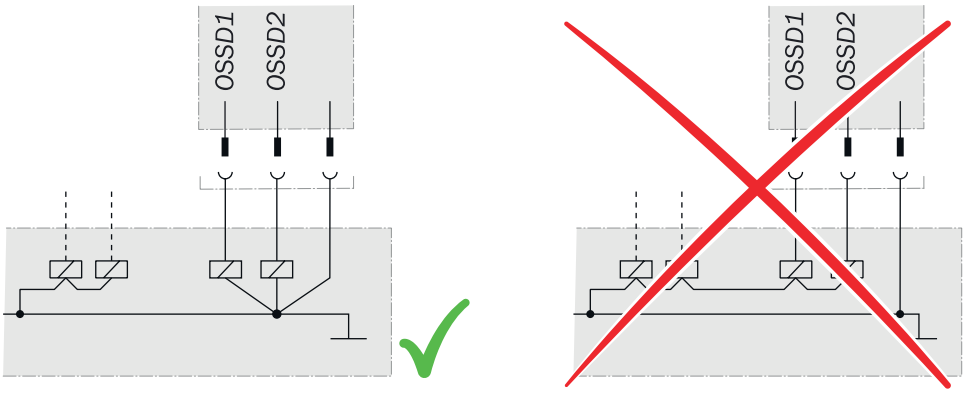


DANGER
Dangerous state of the machine
The dangerous state may not be stopped in the event of non-compliance.

- 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 158).

Further topics

- "Data sheet", page 138

6.2 Pin assignment

Overview

All inputs and outputs of the device are located on the 30-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.

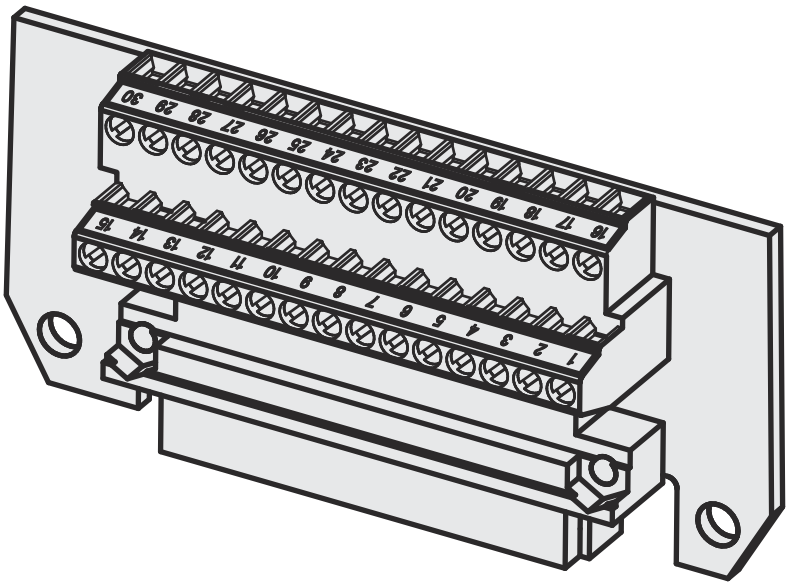


Figure 62: Screw terminal block of the system plug

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 51, page 158).
- ▶ 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.

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

Further topics

- "Pre-assembled system plug", page 80

6.2.1 Pin assignment

Table 9: Pin assignment on the I/O module

Pin	Signal	Function	Standard	Advanced	Professional	Expert	Remote
1	24 V DC	Supply voltage S3000	■	■	■	■	■
2	0 V DC	Supply voltage S3000	■	■	■	■	■
3	OSSD1	Output signal switching device	■	■	■	■	■
4	OSSD2	Output signal switching device	■	■	■	■	■
5	RESET	Input, reset	■	■	■	■	■
6	EDM	Input, external device monitoring	■	■	■	■	■
7	UNI-I/O1 / ERR	Universal I/O or application diagnostic output or connection for a jumper for addressing as a guest [1]	■	■	■	■	■
8	UNI-I/O2 / RES_REQ	Universal I/O or output for reset required	■	■	■	■	■
9	UNI-I/O3 / WF	Universal I/O or output for object in the warning field	■	■	■	■	■
10	A1	Static control input A or connection for a jumper for addressing as guest [1]	■ [2]	■	■	■	■ [2]
11	A2	Static control input A		■	■	■	
12	B1	Static control input B		■	■	■	
13	B2	Static control input B		■	■	■	
14	EFI_A	Enhanced function interface = safe SICK device communication	■	■	■	■	■
15	EFI_B		■	■	■	■	■
16	24 V DC	Supply voltage for the incremental encoder 1			■	■	
17	GND				■	■	
18	C1 or INC1_0	Static control input C or dynamic control input (input for incremental encoder) 1			■	■	
19	D1 or INC1_90	Static control input D or dynamic control input (input for incremental encoder) 1			■	■	
20	24 V DC	Supply voltage for the incremental encoder 2			■	■	
21	GND				■	■	
22	C2 or INC2_0	Static control input C or dynamic control input (input for incremental encoder) 2			■	■	
23	D2 or INC2_90	Static control input D or dynamic control input (input for incremental encoder) 2			■	■	
24	Reserved, do not use.						
25	RxD–	RS-422 interface to measurement data output	■	■	■	■	■
26	RxD+		■	■	■	■	■
27	TxD+		■	■	■	■	■
28	TxD–		■	■	■	■	■
29	Reserved, do not use.						

Pin	Signal	Function	Standard	Advanced	Professional	Expert	Remote
30		Reserved, do not use.					

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 10. This is also required if several safety laser scanners are connected to one EFI string on a Flexi Soft safety controller.
2) No control input A.

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: 16 and 17, as well as 20 and 21.
- ▶ Connect each output of an incremental encoder (for 0° or 90°) to one control input (C1 / D1 or C2 / D2) 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

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.

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.

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 (ERR) and 10 (A1).

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

RS-422 interface

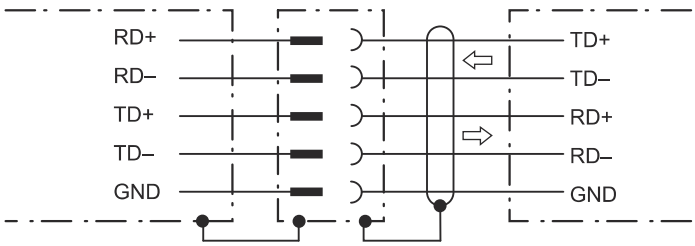


Figure 63: Connection diagram for the RS-422 interface

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 holes on the top and rear. Suitable cable entries for these holes are included with the device. The number of cable entries differs depending on the variant.

SX0A-A0000B system plug:

- 1 cable entry without M12 cable gland (blind plug)
- 1 cable entry with M20 cable gland
- 2 blind plugs for the second exit side

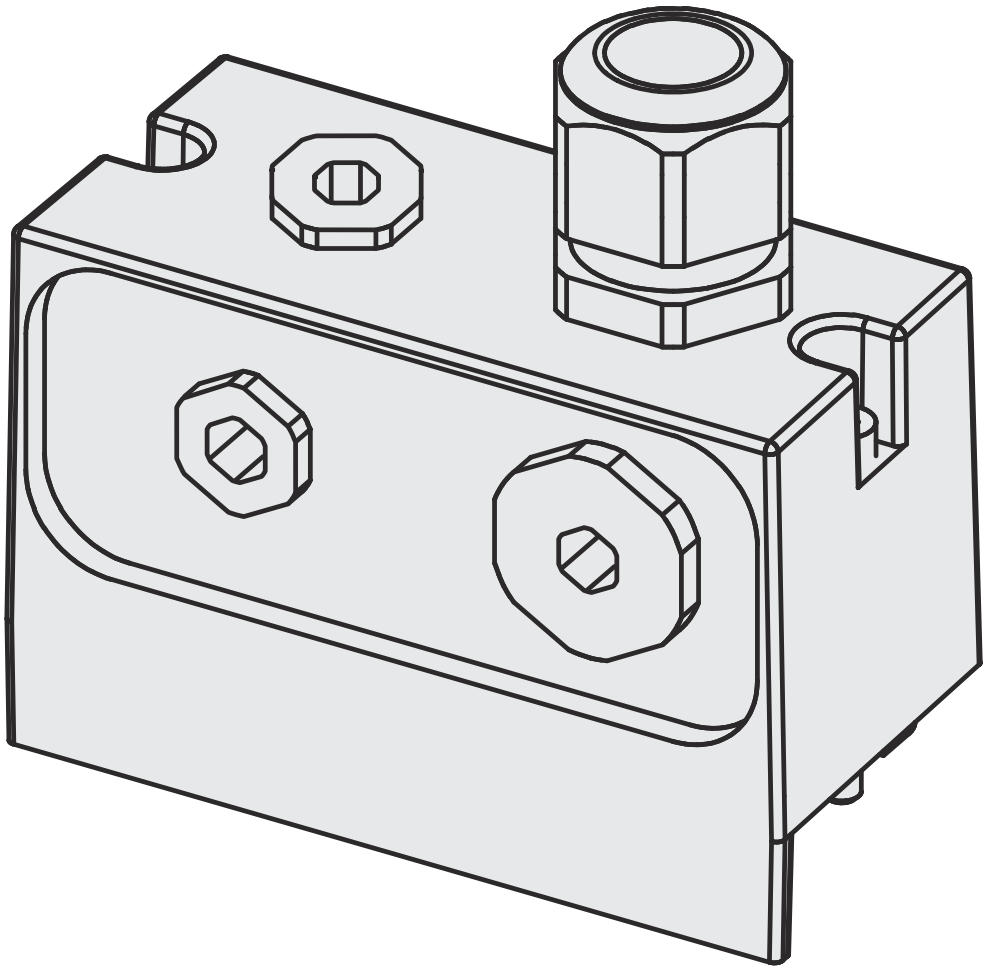


Figure 64: SX0A-A0000B system plug

SX0A-A0000D:

- 3 cable entries without M12 cable gland (blind plug)
- 1 cable entry with M20 cable gland
- 4 blind plugs for the second exit side

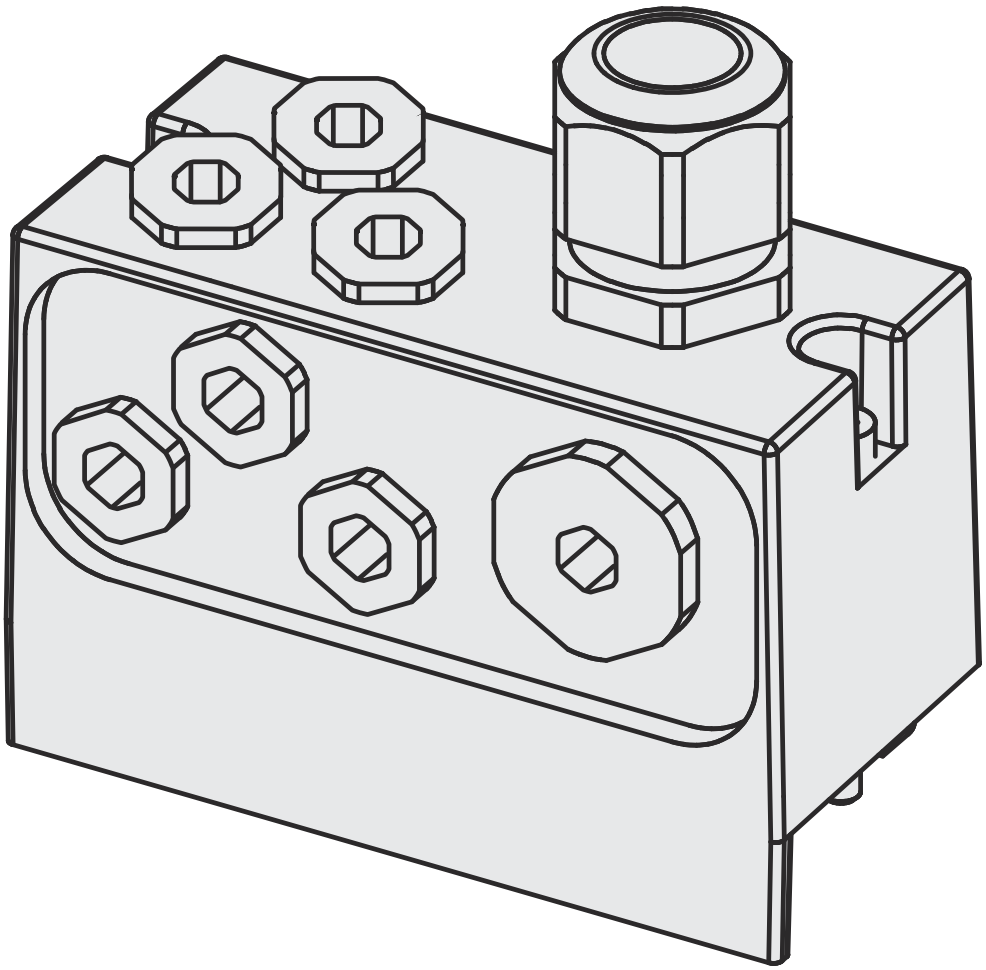


Figure 65: SX0A-A0000D system plug

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

Table 10: Use of the supplied cable entries

Cable entry	Cable diameter	Use
M20	6 mm ... 12 mm	• System cables (supply voltage, outputs, static inputs)
M12 (only if supplied)	3 mm to 6.5 mm	• Universal I/O • Incremental encoder • RS422 data cables • EFI

Table 11: Recommended wire cross-sections

Cable	Recommended wire cross-sections	Shielded
System cables (supply voltage, outputs, static inputs)	0.5 mm^2 ... 1 mm^2, 9 ... 17 wires	No
Incremental encoder	4 × 0.25 mm^2	Yes
EFI	1 × 2 × 0.22 mm^2	Yes
Universal I/O	2 × 0.25 mm^2	No
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

- "Pre-assembled system plug", page 80
- "System plug", page 156
- "Connecting cables for self-assembly", page 158

6.4 Pre-assembled system plug

SX0A-B0905G

- For S3000 Standard and Remote
- With 9 unshielded wires
- Cable connection at the rear
- 5 m long

SX0A-B0905B, SX0A-B0910B, SX0A-B0920B

- For S3000 Standard and Remote
- With 9 unshielded wires
- Cable connection at the top
- 5, 10 or 20 m long

SX0A-B1305B, SX0A-B1310B, SX0A-B1320B

- For S3000 Advanced
- With 13 unshielded wires
- Cable connection at the top
- 5, 10 or 20 m long

SX0A-B1305D, SX0A-B1310D

- For S3000 Professional and S3000 Expert with static and dynamic inputs
- With 13 unshielded wires
- With 3 M12 cable entries for incremental encoders
- Cable connection at the top
- 5 or 10 m long

SX0A-B1705B, SX0A-B1710B, SX0A-B1720B

- For S3000 Professional and S3000 Expert with static inputs
- With 17 unshielded wires
- Cable connection at the top
- 5, 10 or 20 m long

Table 12: Pin assignment on pre-assembled system plugs

Pin	Signal	Wire color	SX0A-B0905G	SX0A-B0905B SX0A-B0910B SX0A-B0920B	SX0A-B1305B SX0A-B1310B SX0A-B1320B	SX0A-B1305D SX0A-B1310D	SX0A-B1705B SX0A-B1710B SX0A-B1720B
1	24 V DC	Brown	■	■	■	■	■
2	0 V DC	Blue	■	■	■	■	■
3	OSSD1	Gray	■	■	■	■	■
4	OSSD2	Pink	■	■	■	■	■
5	RESET	Red	■	■	■	■	■
6	EDM	Yellow	■	■	■	■	■
7	UNI-I/O1 / ERR	White/black	■	■	■	■	■
8	UNI-I/O2 / RES_REQ	Red/blue	■	■	■	■	■
9	UNI-I/O3 / WF	White/brown	■	■	■	■	■
10	A1	White/red			■	■	■
11	A2	White/orange			■	■	■

Pin	Signal	Wire color	SX0A-B0905G	SX0A-B0905B SX0A-B0910B SX0A-B0920B	SX0A-B1305B SX0A-B1310B SX0A-B1320B	SX0A-B1305D SX0A-B1310D	SX0A-B1705B SX0A-B1710B SX0A-B1720B
12	B1	White/yellow			■	■	■
13	B2	White/green			■	■	■
18	C1 or INC1_0	White/blue					■
19	D1 or INC1_90	White/gray					■
22	C2 or INC2_0	White/violet					■
23	D2 or INC2_90	White					■
Number of top mounted cable glands (cable entries to the rear sealed with blind plugs)			2	2	2	4	2

NOTE

- To prevent possible interference, disconnect all wires from the system plug that are not required for the particular application.

Further topics

- "System plug", page 156

6.5 M8 × 4 configuration connection (serial interface)

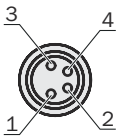


Figure 66: Pin assignment on the M8 × 4 configuration connection

Table 13: Pin assignment on the M8 × 4 configuration connection

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

NOTE

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

7 Configuration

7.1 Delivery state

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

- The operational status of the safety laser scanner is **Waiting for configuration**.
- The 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.

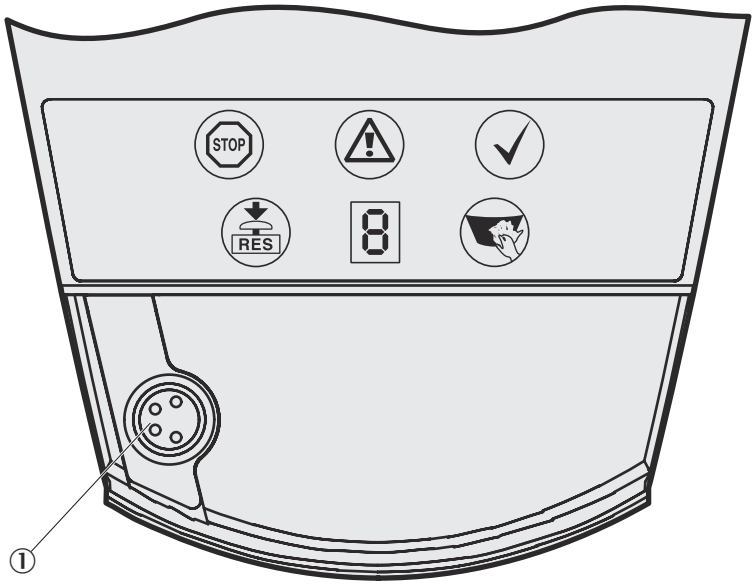


Figure 67: Configuration connection

Complementary information

NOTE

- Two service cables of different lengths are available for connecting the PC or notebook to the safety laser scanner (see "Service cables", page 158).
- Make sure that the service cable is not laid close to powerful electrical drives or cables carrying high currents. This will avoid EMC effects on the service cable.
- The service cable must only be connected for configuration and diagnostics. The service cable must be plugged in and the protective cap attached during operation.

NOTE

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

7.4 Compatibility mode

Overview

To ensure compatibility, the S3000 safety laser scanners with firmware ≥ B02.41 can be operated in compatibility mode.

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

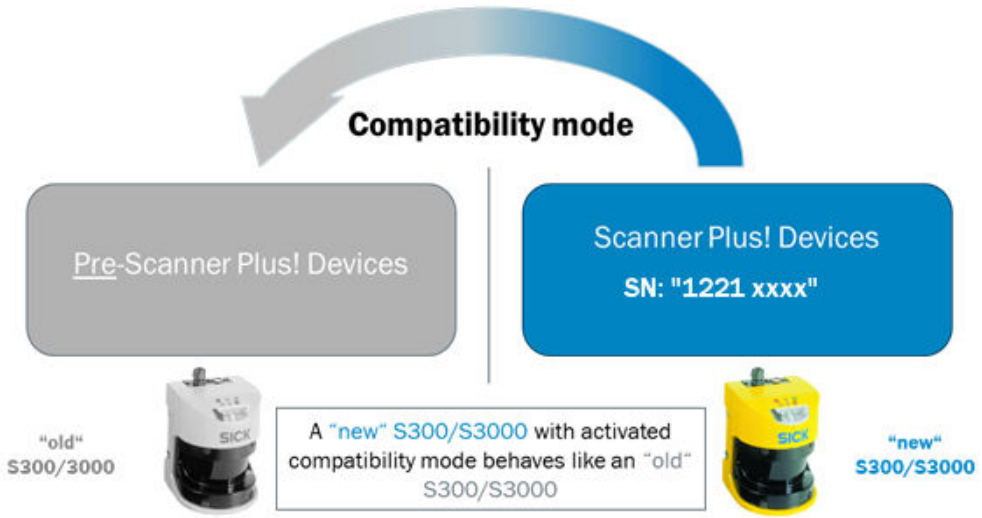


Figure 68: Compatibility mode

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:
  - S3000 Professional CMS
  - S3000 with firmware < B02.41 and serial number < 12210000
  - S3000 Standard, Advanced, Professional with an I/O module with serial number < 12210000
  - S3000 Remote with an I/O module with serial number < 11240000
  - S300 Professional CMS
  - S300 Expert CMS
  - S300 with firmware < 02.10 and serial number < 12210000
  - S300 with system plug serial number < 12210000
- You are configuring an S3000 with firmware < B02.41 and serial number < 12210000.
- You are configuring an S3000 Standard, Advanced, Professional with an I/O module with serial number < 12210000.
- You are configuring an S3000 Remote with an I/O module with serial number < 11240000.
- 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 14: Functions in the compatibility mode

Functions	Standard	Advanced	Professional	Expert	Remote [1)]
Application diagnostic output, warning field output and application diagnostic output for reset instead of universal I/Os	■	■	■	■	■

Functions	Standard	Advanced	Professional	Expert	Remote [1]
Field sets comprising one protective field and one warning field (dual field mode) or two protective fields (dual protective field mode)	2 [2]	4	8	8	8 [3]
Programmable monitoring cases in standalone operation	1	4	16	16	–
Programmable monitoring cases in an EFI system	1	4	16	16	16
Speed routing using a Flexi Soft safety controller	–	–	–	–	–

1) Valid for I/O modules with serial number > 11240000.
2) The second field set on the S3000 Standard can only be used as a simultaneous field set.
3) Maximum possible number of field sets – the actual number is the same as for the S3000 variant to which an S3000 Remote is connected.

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 15: Required compatibility mode with different firmware versions of the S3000 in an EFI system with other S3000

	Firmware	S3000 Standard	S3000 Standard	S3000 Advanced	S3000 Advanced	S3000 Professional	S3000 Professional	S3000 Professional CMS	S3000 Expert	S3000 Remote	S3000 Remote
Firmware		≥B02.41	≤B2.35	≥B02.41	≤B02.35	≥B02.41	≤B02.35	≤B02.35 [1]	≥B02.41	≥B02.41	≤B02.35
S3000 Standard	≥B02.41	X	■	X	■	X	■	■	X	X	■
S3000 Advanced	≥B02.41	X	■	X	■	X	■	■	X	X	■
S3000 Professional	≥B02.41	X	■	X	■	X	■	■	X	X	■
S3000 Expert	≥B02.41	X	■	X	■	X	■	■	X	X	■
S3000 Remote	≥B02.41	X	■	X	■	X	■	■	X	X	■

1) This product variant only supports compatibility mode.

■ = Compatibility mode required

X = Compatibility mode not required [3)]

Table 16: Required compatibility mode with different firmware versions of the S3000 in an EFI system with other safety laser scanners

	Firmware	S300 Standard	S300 Standard	S300 Advanced	S300 Advanced	S300 Professional	S300 Professional	S300 Professional CMS	S300 Expert	S300 Expert	S300 Expert CMS
Firmware		≥ 02.10	< 02.10	≥ 02.10	< 02.10	≥ 02.10	< 02.10	< 02.35 [1)]	≥ 02.10	< 02.10	< 02.10 [1)]
S3000 Standard	≥B02.41	X	–	X	■	X	■	■	X	■	■
S3000 Advanced	≥B02.41	X	–	X	■	X	■	■	X	■	■
S3000 Professional	≥B02.41	X	–	X	■	X	■	■	X	■	■
S3000 Expert	≥B02.41	X	–	X	■	X	■	■	X	■	■
S3000 Remote	≥B02.41	X	–	X	■	X	■	■	X	■	■

1) This product variant only supports compatibility mode

■ = Compatibility mode required

X = Compatibility mode not required [4)]

– = EFI system not supported

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.

3) Make sure that you have the latest S3000 I/O module (S3000 Standard, Advanced, Professional with I/O module with serial number > 12210000, S3000 Remote with I/O module with serial number > 11240000).

4) 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).

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 17: Comparison of mobile and stationary applications

Mobile applications	Stationary applications
Resolution	

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

7.6.1 Resolution

Maximum protective field ranges

The maximum protective field range [6] depends on the configured resolution and angular resolution. The table shows the configurable resolutions:

Table 18: Maximum protective field ranges at different resolutions

	Maximum protective field range	
Short Range sensor head	At 0.5° angular resolution (60 ms basic response time)	At 0.25° angular resolution (120 ms basic response time)
30 mm (hand detection)	1.90 m	2.80 m
40 mm (hand detection)	2.60 m	3.80 m
50 mm (leg detection)	3.30 m	4.00 m
70 mm (leg detection)	4.00 m	4.00 m
150 mm (body detection) [1]	4.00 m	4.00 m
Medium Range variant		
30 mm (hand detection)	1.90 m	2.80 m
40 mm (hand detection)	2.60 m	3.80 m
50 mm (leg detection)	3.30 m	4.80 m
70 mm (leg detection)	4.70 m	5.50 m
150 mm (body detection) [1]	5.50 m	5.50 m
Long Range variant		
30 mm (hand detection)	1.90 m	2.80 m
40 mm (hand detection)	2.60 m	3.80 m
50 mm (leg detection)	3.30 m	4.80 m
70 mm (leg detection)	4.70 m	7.00 m
150 mm (body detection) [1]	7.00 m	7.00 m

[1] Cannot be configured for mobile applications.

[5] 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.

[6] Radial distance to the safety laser scanner.

Complementary information

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

Further topics

- "Characteristic curves", page 145

7.6.2 Basic response time

The basic response time depends on the angular resolution selected and is:

- 60 ms basic response time at 0.5° angular resolution
- 120 ms basic response time at 0.25° angular resolution

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 148

7.6.3 Angular resolution and maximum protective field range

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

Two angular resolutions can be configured:

- At 0.5° angular resolution the basic response time is 60 ms.
- At 0.25° angular resolution the basic response time is 120 ms.

NOTE

- The maximum protective field range of the safety laser scanner must be sufficient to cover the calculated protective field size including the necessary supplements.
- On the S3000 Expert and S3000 Remote, the number of field sets that can be configured depends on the angular resolution selected.

Further topics

- "Resolution", page 88
- "Basic response time", page 89
- "Protective field size", page 42
- "Field Sets", page 100

7.6.4 Field mode

Dual

If you select the **Dual** option, you can configure field sets that comprise two fields: one protective field and one warning field.

If you select the **Dual** option, simultaneous monitoring is available. This enables two protective fields and two warning fields to be evaluated.

Dual protective fields

If you select the **Dual protective fields** option, you can configure field sets that comprise two protective fields. Here both fields are evaluated as safe fields.

If you select the **Dual protective fields** option, simultaneous monitoring is available. This enables four protective fields to be evaluated.

NOTE
This function can only be used in conjunction with a Flexi Soft safety controller that is connected via EFI.

Triple

If you select the **Triple** option, you can configure field sets with three fields. These field sets comprise one protective field and two warning fields.

NOTE
On the S3000 Expert and S3000 Remote, the number of field sets that can be configured depends on the field mode selected.

Further topics

- "Simultaneous monitoring", page 113
- "Field Sets", page 100

7.6.5 Exchange of field results via EFI

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.

If you evaluate the status of the protective fields using Flexi Soft, then on the **Resolution/ field mode** tab first select the **Transfer unallocated fields as interrupted** option.

If you have selected the **Dual protective fields** field mode, then the **Transfer unallocated fields as interrupted** option is selected automatically.

Further topics

- "EFI status information and control commands", page 150

7.7 Incremental encoder

The S3000 Professional and the S3000 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.

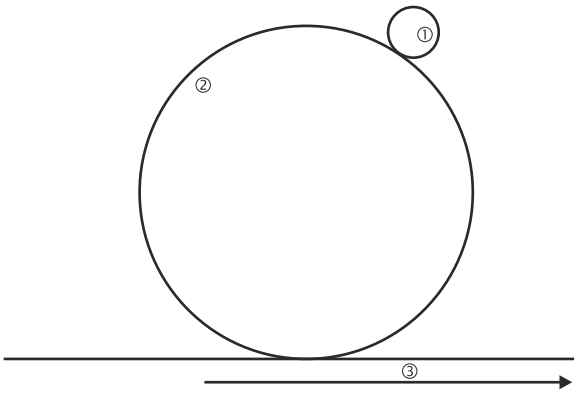


Figure 69: Calculation of pulses per cm travel

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, see figure 70, page 92.

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 70, page 92.

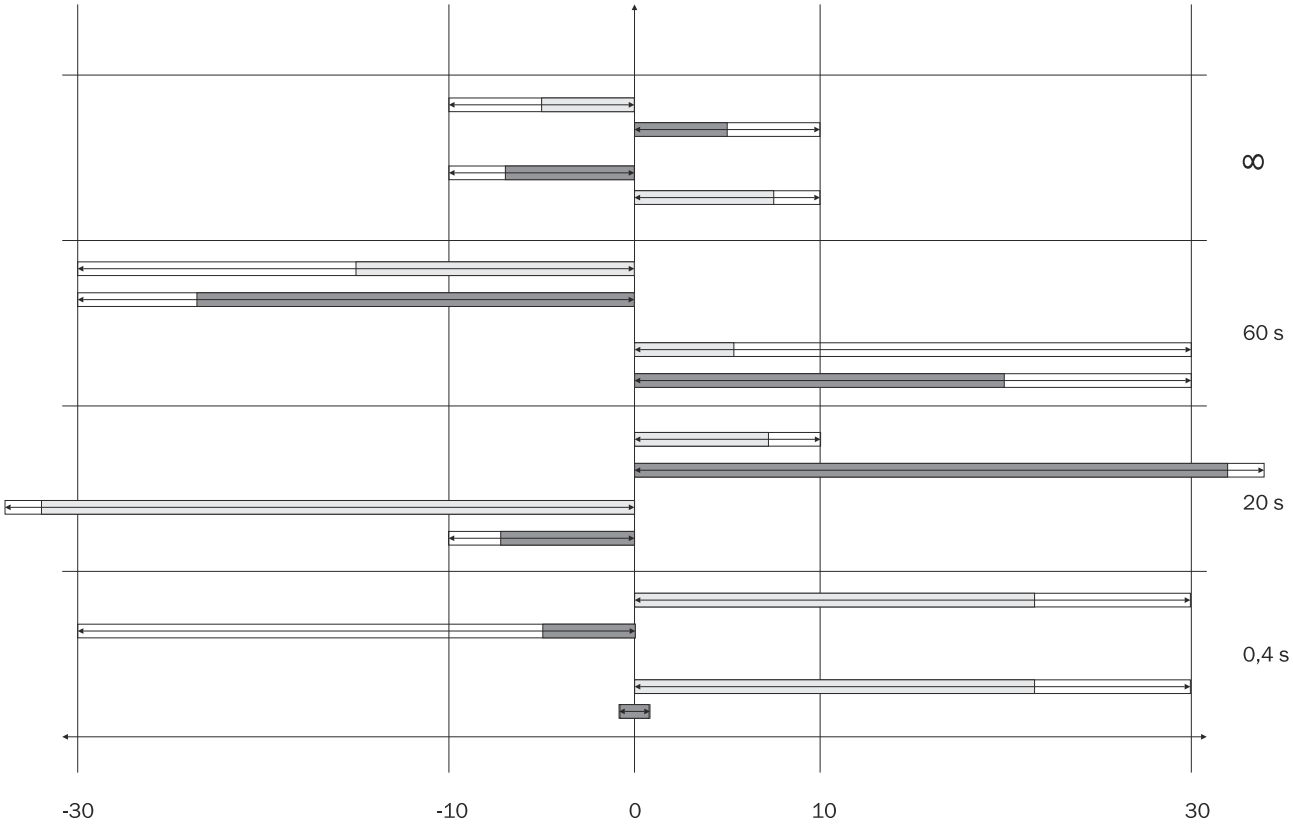


Figure 70: Tolerances allowed on the dynamic inputs

Speed on input C
Speed on input D

- 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.
- You can disable the tolerance ranges by switching to a monitoring case in which a speed threshold is monitored.

Further topics

- "Monitoring case switching via speed information", page 109

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:

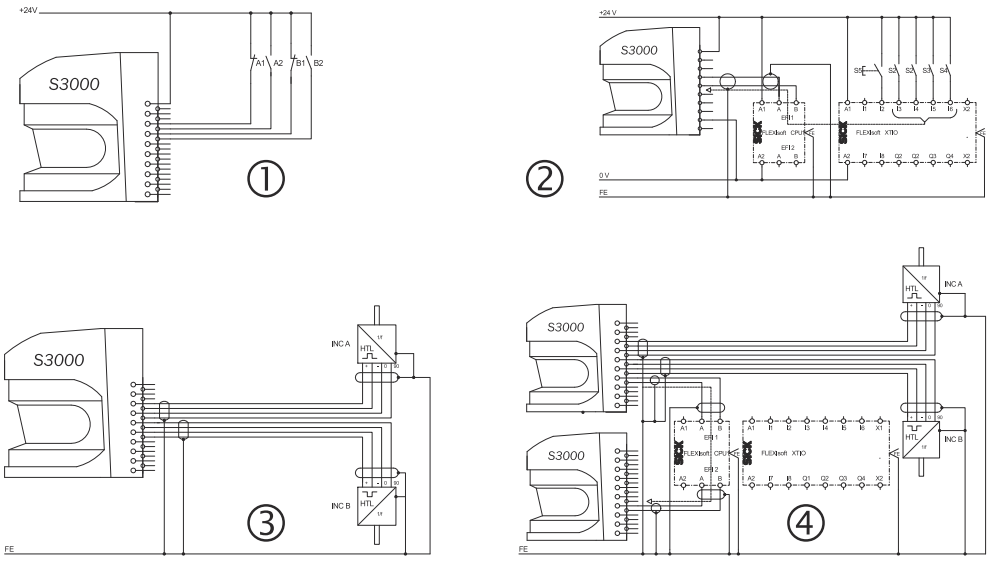


Figure 71: Possible ways of monitoring case switching

① Local static inputs
② External static inputs via EFI
③ Local dynamic inputs
④ Speed information via EFI

Static control inputs on the S3000 Advanced, Professional and Expert

- Locally on the S3000
- Externally via EFI (e.g., using a Flexi Soft safety controller)

Dynamic control inputs for connecting incremental encoders on the S3000 Professional and Expert

- Locally on the S3000
- Externally via EFI (e.g., using another S3000)

Static and dynamic control inputs for connecting incremental encoders on the S3000 Expert and Remote

- Externally via EFI (e.g., using another S3000)

Stand-alone operation

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

The S3000 Advanced has two dual-channel static control inputs.

The S3000 Professional and the S3000 Expert have four dual-channel control inputs. Of these four control inputs, two are static (A and B), the other two (C and D) can be used as both static control inputs and also dynamic control inputs.

▶ 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 152.

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 60 ms basic response time) or 20 ms (for 120 ms basic response time) (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.

Depending on the basic response time selected for the S3000, you can increase the input delay in 30 ms increments (for 60 ms basic response time) or 60 ms increments (for 120 ms basic response time).

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

Table 19: 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

- "Timing for monitoring case switching", page 39

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 20: 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 21: 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

A1	A2	B1	B2	Result (e.g., monitoring case no.)
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 106

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 1 and/or the simultaneous protective field 1 switches the internal OSSDs on the safety laser scanner.

DANGER
No switching of the OSSDs by the protective field 2 and the simultaneous protective field 2

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

If you have selected the **Dual protective fields** field mode, then protective field 2 and the simultaneous protective field 2 do not switch the OSSDs.

▶ You must therefore route the cut-off signals for protective field 2 and simultaneous protective field 2 via the EFI interface to the external OSSDs on a Flexi Soft safety controller.

- 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.

If you evaluate the status of the protective fields using Flexi Soft, then on the **Resolution/ field mode** tab first select the **Transfer unallocated fields as interrupted** option.

Further topics

- "EFI status information and control commands", page 150

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 22: 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 8 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 8 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

- "Connection diagrams", page 54
- "Pin assignment", page 75

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

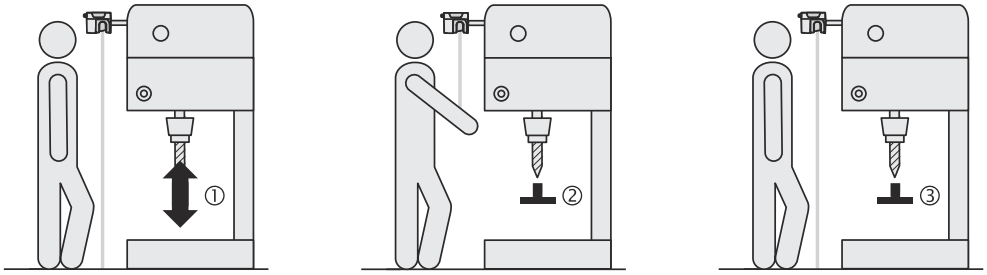


Figure 72: Schematic representation of operation with restart interlock

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.

NOTE

- For examples on connecting the internal restart interlock, see "Connection diagrams", page 54.
- If you do not use the internal restart interlock, leave the inputs disconnected.

Reset

NOTE

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

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

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

- 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 36
- "EFI status information and control commands", page 150
- "Pin assignment", page 75

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 S3000 has three universal I/O connections. You can configure these three connections for one or more of the following functions (linked by the operator OR):

- Contamination warning
- Contamination error
- Reset required
- Error
- Protective field
- Protective field 2 (if the **Dual protective fields** field mode and the **Simultaneous field evaluation** function have been selected)
- Warning field
- Simultaneous protective field
- Simultaneous protective field 2 (if the **Dual protective fields** field mode and the **Simultaneous field evaluation** function have been selected)
- Simultaneous warning field or 2nd warning field (depending on the configured field mode)
- Protective field of a connected guest
- Protective field 2 of a connected guest (if the **Dual protective fields** field mode and the **Simultaneous field evaluation** function have been selected)
- Simultaneous protective field of a connected guest
- Warning field of a connected guest
- Simultaneous warning field or 2nd warning field of a connected guest (depending on the configured field mode)

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

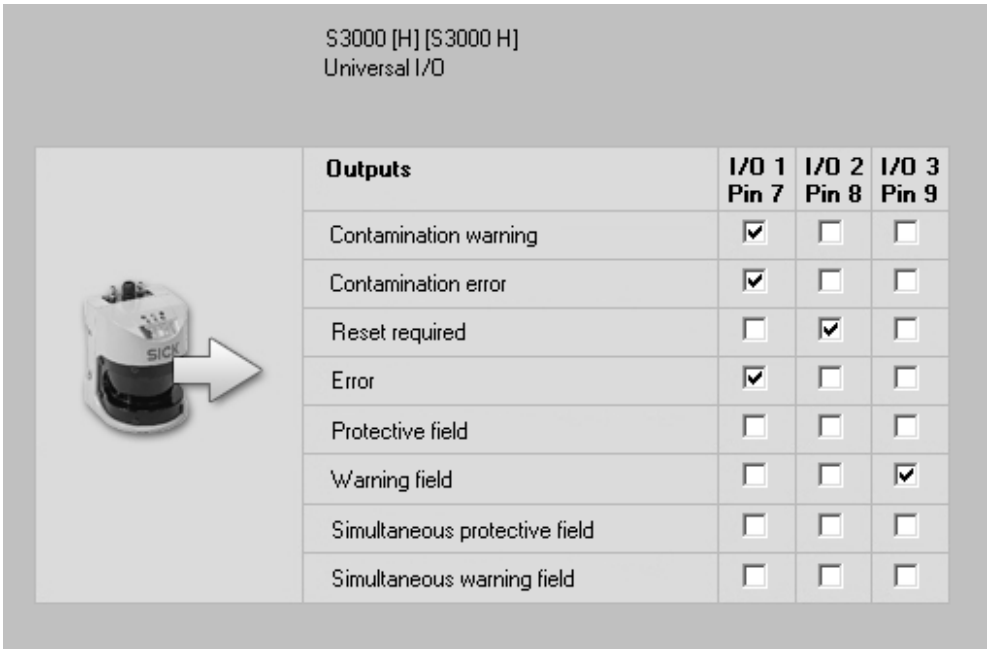


Figure 73: Configuration example for the universal I/O connections of the S3000

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.
- 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.

On the S3000 Expert and S3000 Remote, the number of field sets that can be configured also depends on the field mode selected (dual field mode/dual protective field mode/ triple field mode) and the angular resolution configured. The following table shows the number of field sets per product variant and application:

Table 23: Number of field sets that can be configured per use

Angular resolution	Standard	Advanced	Professional	Expert	Remote
Dual field mode/dual protective field mode					
Configured angular resolution 0.5°	1	4	8	32	32
Configured angular resolution 0.25°	1	4	8	16	16
Triple field mode					
Configured angular resolution 0.5°	1	4	8	21	21

Angular resolution	Standard	Advanced	Professional	Expert	Remote
Configured angular resolution 0.25°	1	4	8	10	10

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.

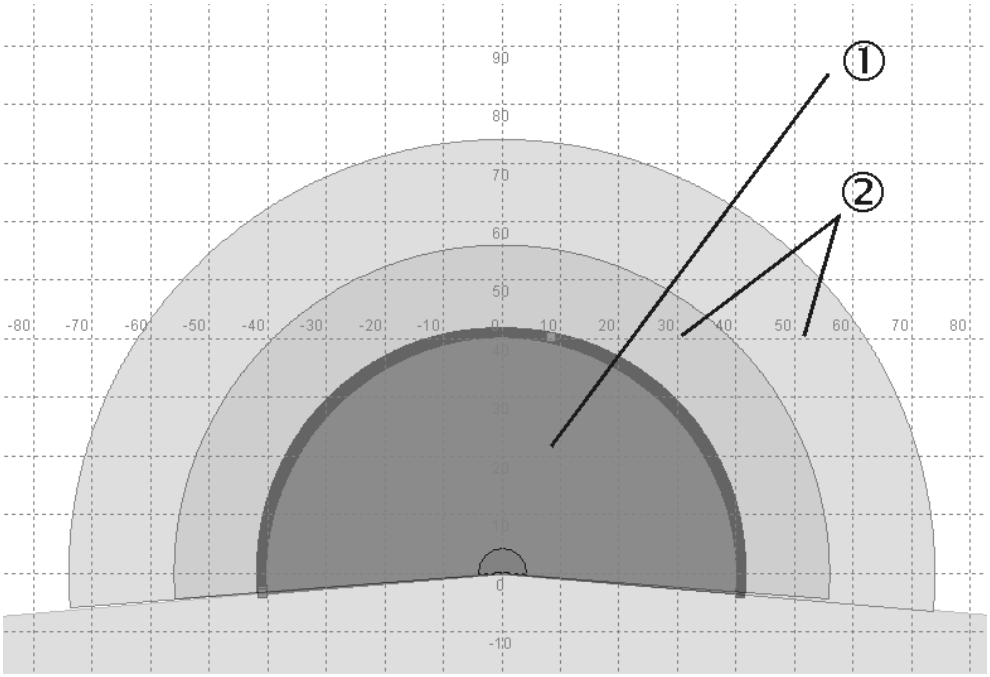


Figure 74: Creating a field set in the CDS

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

WARNING

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

Before commissioning the machine or vehicle, check the configuration of the protective fields, see "Commissioning", page 116, see "Checklist for initial commissioning and commissioning", page 168.

▶ Check the configured protective fields.

NOTE

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

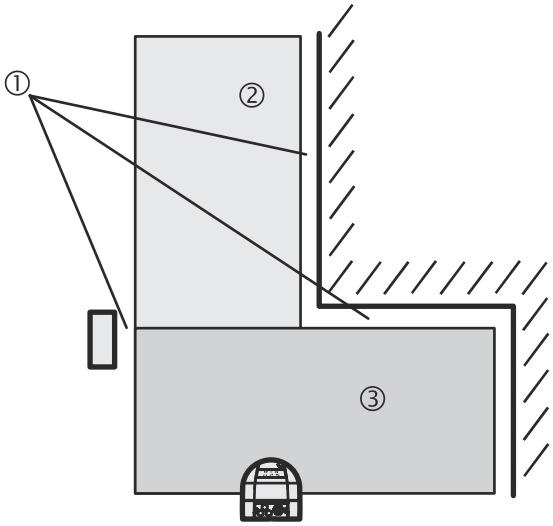


Figure 75: Configuring the protective field and warning field

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 88

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:

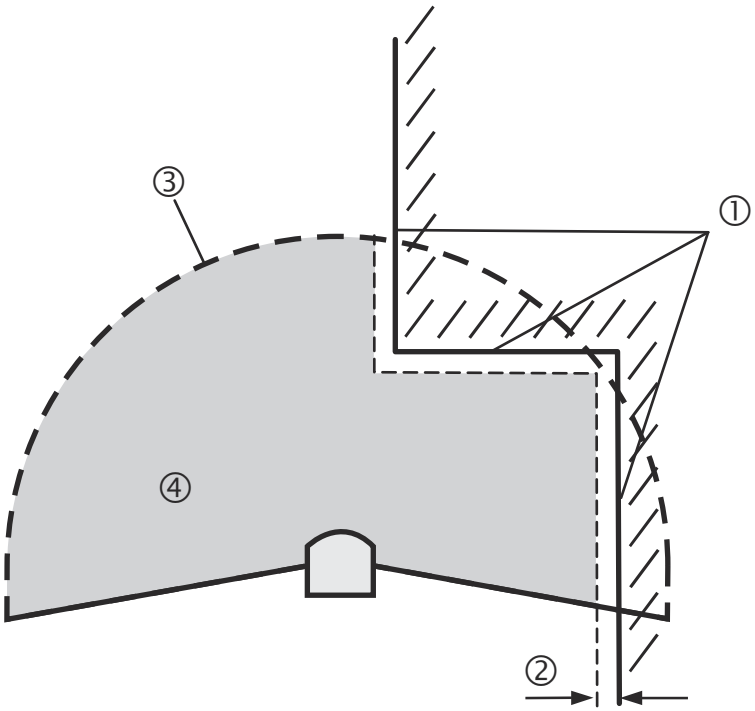


Figure 76: Reading the protective field

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

NOTE

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

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

WARNING

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

The protective field suggested by the CDS is not a replacement for the calculation of the minimum distance, see "Mounting", page 64.

Before commissioning the machine or vehicle, check the configuration of the protective fields, see "Commissioning", page 116, see "Checklist for initial commissioning and commissioning", page 168.

- 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).

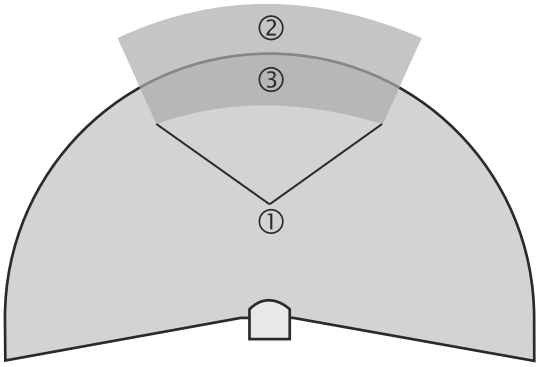


Figure 77: Schematic diagram of contour as reference

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.

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.

CAUTION
Restricted field evaluation in the dual protective field mode

In the **Dual protective fields** field mode, protective field 2 is not evaluated in the areas in which a contour is configured as reference.

▶ Monitor the contour outside the area of protective field 2.

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

Vertical operation

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

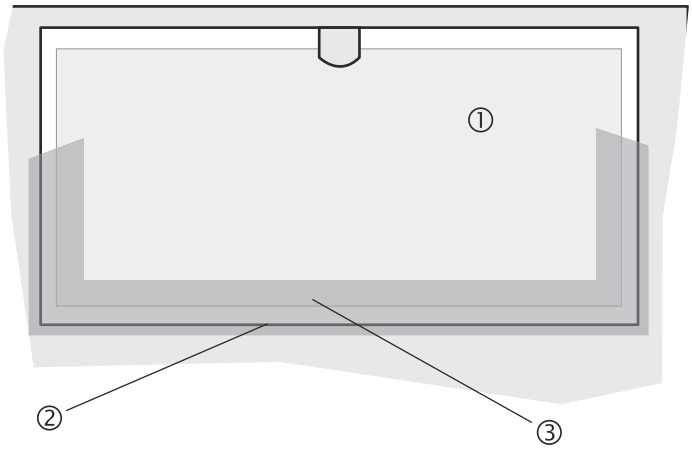


Figure 78: Contour as reference for vertical operation

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 24: Number of monitoring cases

Application	Standard	Advanced	Professional	Expert	Remote
Applications with local static control inputs on the S3000	1	4	16	16	–
Applications with static control inputs via EFI (e.g., on a Flexi Soft)	32	32	32	32	32
Applications with dynamic control inputs on the S3000	–	–	16	32	–
Applications with dynamic control inputs via EFI	32	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 simultaneous field set.
- If necessary, a unique follow-on case or two alternative follow-on cases.
- The multiple sampling for the field set.
- The multiple sampling for the simultaneous field set.

Monitoring cases can be switched with the following input information:

- Static information
- Speed information
- A combination of the two

Further topics

- "Field Sets", page 100
- "Mounting", page 64

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 39).

- 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 S3000 Advanced, $2^2 = 4$ monitoring cases can be switched.

Using the four control input pairs on the S3000 Professional, $2^4 = 16$ monitoring cases can be switched.

Using the four control input pairs on the S3000 Expert, $2^4 = 16$ 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 25: 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 S3000 Advanced provides four input connections.

With 1-of-n sampling, you use the single connections of the control input pairs. In this way, the S3000 Professional provides eight input connections.

With 1-of-n sampling, you use the single connections of the control input pairs. In this way, the S3000 Expert provides eight input connections.

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 26: 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 92

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 39).

- ▶ 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.

Disabling tolerance ranges, monitoring speed thresholds

Modern applications for autonomous vehicles require additional configuration features for driving around tight bends.

The S3000 offers the following additional functions:

- The tolerance ranges (see "Tolerances allowed on the dynamic inputs", page 91) can be disabled if the vehicle is to drive around tight bends and as a result the standard tolerances will result in unintentional shutdowns.

- ▶ On the **Cases** tab in the CDS, select the **Monitor speed thresholds** function.

If a defined threshold is exceeded, the safety laser scanner shuts down. Speed differences larger than 45% are tolerated for 60 seconds. Only if the threshold is exceeded does a shutdown occur.

The information on the minimum and maximum speed is determined for the threshold and in this case is not used for the speed-dependent monitoring case activation.

NOTE

- The redundant speed monitoring by the safety laser scanner is deactivated for max. 60 seconds. You must ensure that the safety requirements for the application are met.
- For safety reasons, the 60 seconds criterion must never be exceeded. The safety laser scanner then switches its OSSDs to the OFF state, i.e., tight bends are not allowed to last more than 60 seconds.

Further topics

- "Timing for monitoring case switching", page 39
- "Inputs", page 92

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 S3000 Professional or Expert to be distributed to all safety laser scanners.

NOTE

Speed routing is not available in the compatibility mode.

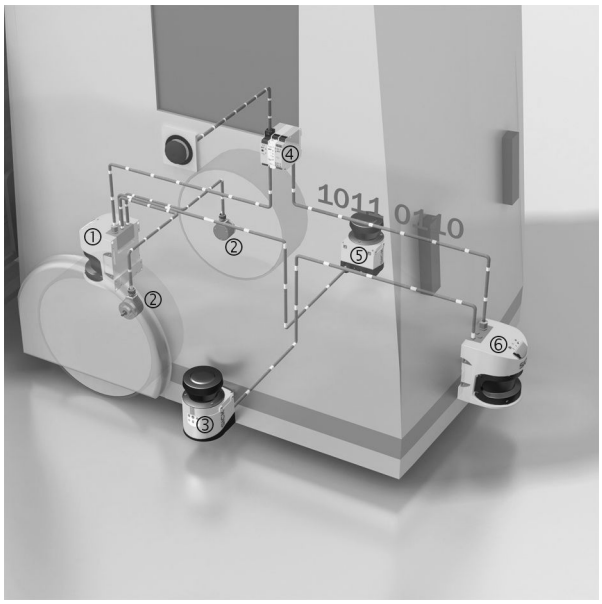


Figure 79: Example for speed routing on an AGV

① S3000 Expert on EFI1.1
② Incremental encoder
③ S300 on EFI2.2
④ Flexi Soft
⑤ S300 on EFI1.2
⑥ S3000 on EFI2.1

Incremental encoders ② are connected to the S3000 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.

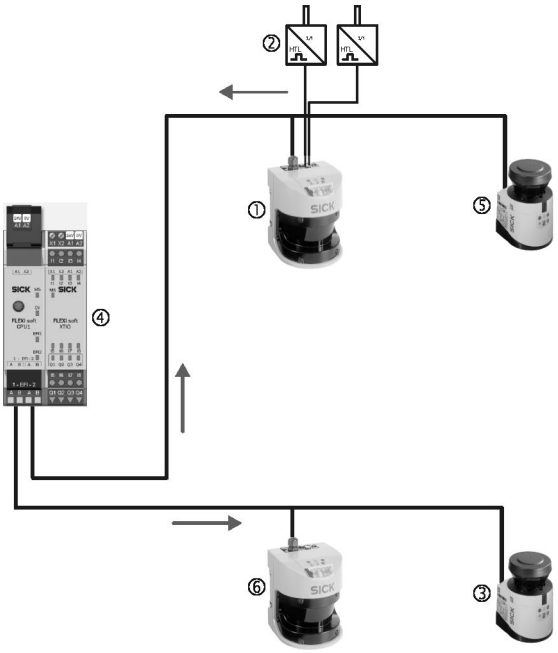


Figure 80: Connection diagram for speed routing

① S3000 Expert on EFI1.1
② Incremental encoder
③ S300 on EFI2.2
④ Flexi Soft
⑤ S300 on EFI1.2
⑥ S3000 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.

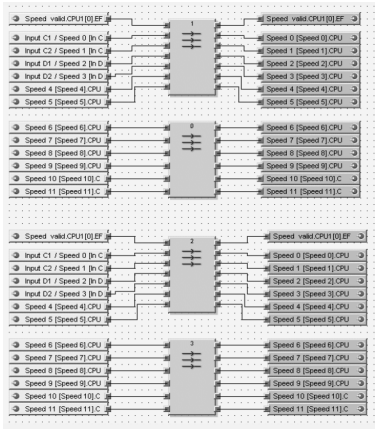


Figure 81: Example for speed routing in the Flexi Soft Designer

- 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 S3000 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 27: Recommended multiple sampling

	Recommended multiple sampling	
Application	**Basic response time 60 ms**	**Basic response time 120 ms**
Stationary under clean ambient conditions	2×	2×

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

NOTE

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

Further topics

- "Response times", page 148

7.13.5 Simultaneous monitoring

Overview

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

Important information

NOTE

On the S3000, simultaneous monitoring can only be configured in the dual field mode or in the dual protective field mode (see "Monitoring cases", page 21).

Approach

1. On the **Resolution/field mode** tab, select either the **Dual** or **Dual protective fields** field mode.
2. On the **Resolution/field mode** tab, select the **Simultaneous field evaluation** option.
3. If you evaluate the status of the protective fields using Flexi Soft, then on the **Resolution/field mode** tab first select the **Transfer unallocated fields as interrupted** option. If the **Dual protective fields** field mode was selected, then the **Transfer unallocated fields as interrupted** option is selected automatically.
4. On the **Cases** tab, select a further field set as a simultaneous field set within the relevant monitoring case.

On a system with one S3000, the first protective field in both field sets acts on the internal OSSDs on the S3000. In a system with several devices connected via EFI, the two field sets can act on different OSSDs.

Further topics

- "Field mode", page 89
- "OSSDs", page 95

7.13.6 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.

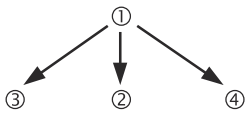


Figure 82: Schematic representation of monitoring case switching - arbitrary sequence

Figure 83: Schematic representation of monitoring case switching - unique sequence

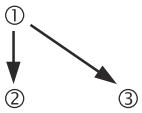


Figure 84: Schematic representation of monitoring case switching - alternative sequence

7.13.7 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

The S3000 can be switched to the standby mode via EFI. This requires an external safety controller (e.g., Flexi Soft).

NOTE
The standby mode is not available in compatibility mode.
The standby mode does not take up a monitoring case.

Further topics

- "EFI status information and control commands", page 150

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 S3000 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

- "Safety information", page 10
- "Test notes", page 117

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 28: 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	 or 	Device addressed as host or guest
3		Power-up cycle, during initial commissioning: Device in configuration mode
	Other display	Safety interlock activated. Malfunction in the external conditions or in the device itself.

Table 29: Display of LEDs after the power up sequence

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

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

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

Further topics

- "Error and status indicators on the 7-segment display", page 131
- "Error and status indications of the LEDs", page 129

8.3 Test notes

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

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

These checks must therefore always be performed.

8.3.1 Tests before initial commissioning

Overview

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

Important information

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

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

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 168.
- ▶ 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 120.
- ▶ Make sure that the operating personnel of the machine protected by the safety laser scanner are correctly instructed by qualified safety personnel before being allowed to operate the machine. Instructing the operating personnel is the responsibility of the machine owner.
- ▶ Ensure that the **Important notes** information label is affixed to the machine in a place where it is clearly visible for the operators. The information label is included

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

- ▶ The annex to this document includes a checklist for review by the manufacturer and installer. Use this checklist as a reference before commissioning the system for the first time.
- ▶ Document in a clear manner the settings for the safety laser scanner, and the results of the testing during initial commissioning. For this purpose also print out the complete configuration of the safety laser scanner (including protective field shapes) and include these with the documentation.

NOTE

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

Further topics

- "Checklist for initial commissioning and commissioning", page 168

8.4 Recommissioning

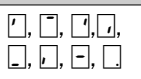
Overview

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 30: 7segment display during and after the power up sequence during recommissioning

Step	Display	Meaning
1		Power-up cycle, test of the 7-segment display. All segments are activated consecutively.
2		Saved configuration invalid: Devices in the configuration mode, no further steps taken
		Waiting for partner device on the EFI
3	 or 	Device addressed as host or guest (only in an EFI system)
4		Device in dual field mode or dual protective field mode
		Device in triple field mode
5		Waiting for valid inputs
		A device connected via EFI reports a malfunction.
6		Waiting for Reset
		Waiting for EDM
7	No display	Device is ready for operation
		Device ready for operation but object in the first or second protective field of the field set (in dual protective field mode)

Step	Display	Meaning
		Device ready for operation but object in the first or second simultaneous protective field (in dual protective field mode)
		Device ready for operation but object in the protective field (in triple field mode)
		Device ready for operation but object in the first or second warning field (in triple field mode)
		Device ready for operation but object in the protective field or in the simultaneous protective field (in dual field mode)
	Other display	Safety interlock activated. Malfunction in the external conditions or in the device itself.

Table 31: Display of LEDs after the power up sequence

Display					Meaning
●	○	●	○	○	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. Control switch for restart or reset must be operated.
Other display					Safety interlock activated. Malfunction in the external conditions or in the device itself

Complementary information

NOTE

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

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 (ERR) and 10 (A1).

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

Further topics

- "Replacing the I/O module", page 125
- "Monthly check of the protective device by authorized and specialist personnel", page 120
- "Error and status indicators on the 7-segment display", page 131
- "Error and status indications of the LEDs", page 129
- "Safety", page 116
- "Pin assignment", page 73

9 Maintenance

9.1 Safety

WARNING
Ineffectiveness of the protective device

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

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

DANGER
Hazard due to unexpected starting of the machine

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

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

9.2 Regular inspection

9.2.1 Regular inspection of the protective device by qualified safety personnel

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

Further topics

- "Checklist for initial commissioning and commissioning", page 168

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:
    - Move the test object along the inner edge of the tolerance band of the reference contour. The safety laser scanner must detect the test object at each position and indicate the detection.
    - If several reference contours are used, test all reference contours.

Further topics

- "Regular inspection of the protective device by qualified safety personnel", page 120
- "OSSDs", page 95

9.3 Cleaning the front screen

Overview

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

Important information

NOTICE

- Do not use aggressive cleaning agents.
- Do not use any abrasive cleaning agents.

NOTE

Static charges cause dust particles to stick to the front screen. This effect can be diminished by using the anti-static plastic cleaner (SICK part no. 5600006) and the SICK lens cloth (part no. 4003353).

Approach

To clean the front screen:

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

Further topics

- "Accessories", page 158

9.4 Replacing the front screen

Overview

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

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

Important information

WARNING

Incorrect reference value of optical properties

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

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

NOTE

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

Prerequisites

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

Approach

To replace the front screen:

1. Disconnect the system plug and remove the safety laser scanner.
2. Move the safety laser scanner to a clean location (office, maintenance 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 ⑧ of the front screen.

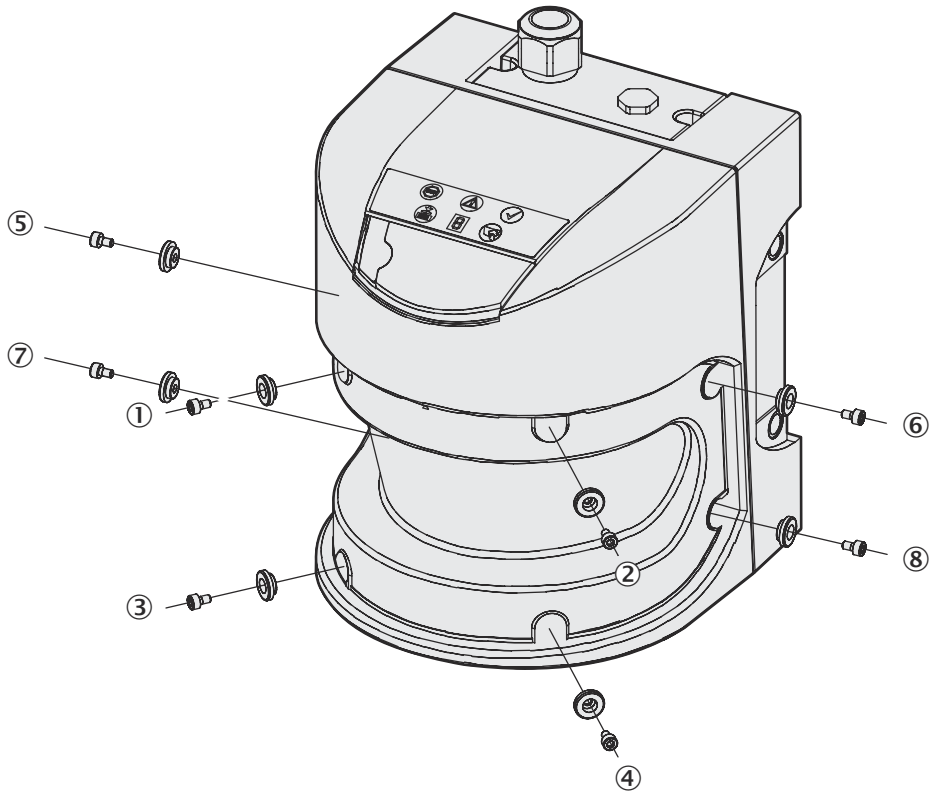


Figure 85: Remove the fixing screws of the front screen

5. Remove the front screen and the old rubber seal.

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

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

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

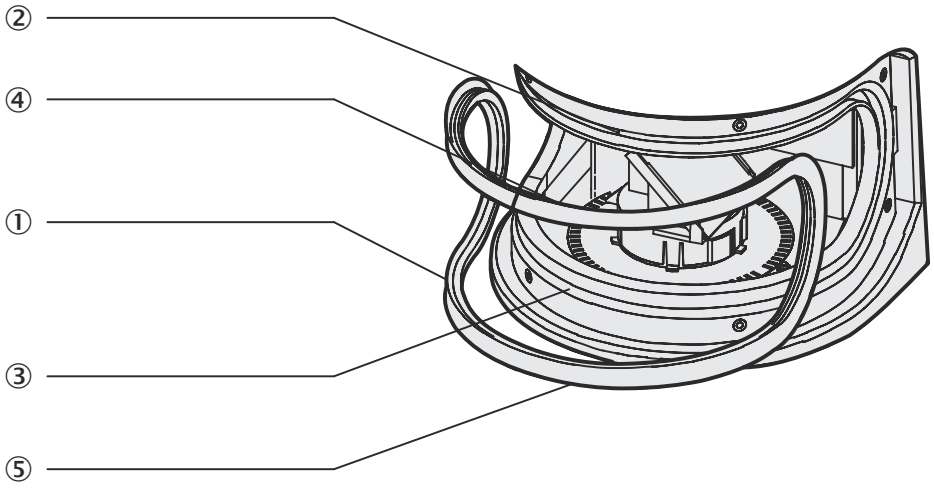


Figure 86: Inserting the rubber seal

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

▶ Do not use any pointed or sharp tools.

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

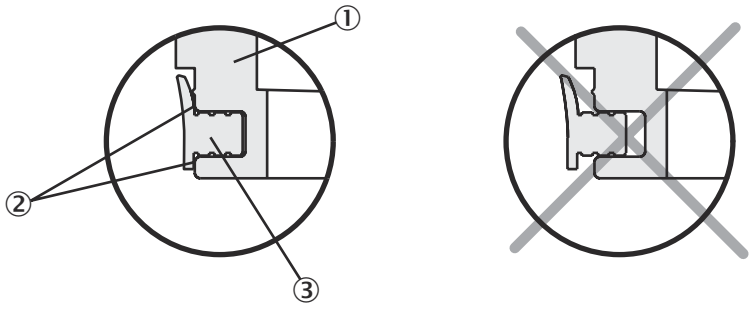


Figure 87: Depth for pressing in the seal

① Housing
② Seal edge flush with housing edge
③ Seal

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

10. It is imperative to check that the seal is seated evenly all the way around the groove.
11. Check whether the mirror on the motor is dirty and, if necessary, remove any contamination using an optic brush.
12. Take the new front screen from the packaging.

13. If necessary, remove any remnants of packaging.
14. Place the front screen on the rubber seal and insert the new fixing screws ① to ④ with distance bushes (see figure 85).
15. Press the front screen on the front of the cover. During this process tighten the front screws ① to ④ to the tightening torque set.
16. Now insert the rest of the screws ⑤ to ⑧ with distance bushes (see figure 85) and tighten using the torque wrench.

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 a front screen calibration using the CDS.

Further topics

- "Accessories", page 158
- "Additional accessories", page 160
- "Mounting", page 64
- "Recommissioning", page 118

9.5 Replacing the I/O module

Overview

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

Important information

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

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

NOTE

- The saved configuration must correspond to the properties of the device used. You can, for example, replace an S3000 Professional with an S3000 Expert, the new device is downward compatible. You cannot, however, replace an S3000 Expert with an S3000 Professional, as there is no upward compatibility.
- If compatibility is not ensured, the 7-segment display indicates 6. The device enters a safe operational status.

Compatibility of the I/O modules with configurations in the compatibility mode

Due to the compatibility mode, there are special features in relation to the compatibility of the configurations saved in the system plug. The following tables show which sensor heads are compatible with which I/O modules and which configurations.

Table 32: Compatibility of the Standard I/O module

I/O modules	Compatibility mode (configuration in the system plug)	Compatible	Display
Serial number < 12210000	Enabled	■	None
Serial number < 12210000	Not enabled	X	6

I/O modules	Compatibility mode (configuration in the system plug)	Compatible	Display
Serial number > 12210000	Enabled	■	None
Serial number > 12210000	Not enabled	■	None

■ = I/O module is compatible with the configuration in the system plug

X = I/O module is not compatible with the configuration in the system plug

Table 33: Compatibility of the Advanced I/O module

I/O modules	Compatibility mode (configuration in the system plug)	Compatible	Display
Serial number < 12210000	Enabled	■	None
Serial number < 12210000	Not enabled	X	6.
Serial number > 12210000	Enabled	■	None
Serial number > 12210000	Not enabled	■	None

■ = I/O module is compatible with the configuration in the system plug

X = I/O module is not compatible with the configuration in the system plug

Table 34: Compatibility of the Professional I/O module

I/O modules	Compatibility mode (configuration in the system plug)	Compatible	Display
Serial number < 12210000	Enabled	■	None
Serial number < 12210000	Not enabled	X	6.
Serial number > 12210000	Enabled	■	None
Serial number > 12210000	Not enabled	■	None

■ = I/O module is compatible with the configuration in the system plug

X = I/O module is not compatible with the configuration in the system plug

Table 35: Compatibility of the Remote I/O module

I/O modules	Compatibility mode (configuration in the system plug)	Compatible	Display
Serial number < 11240000	Enabled	■	None
Serial number < 11240000	Not enabled	X	6.
Serial number > 11240000	Enabled	■	None
Serial number > 11240000	Not enabled	■	None

■ = I/O module is compatible with the configuration in the system plug

X = I/O module is not compatible with the configuration in the system plug

Table 36: Compatibility of the Expert I/O module

I/O modules	Compatibility mode (configuration in the system plug)	Compatible	Display
All modules	Enabled	■	None
All modules	Not enabled	■	None

■ = I/O module is compatible with the configuration in the system plug

X = I/O module is not compatible with the configuration in the system plug

Further topics

- "Recommissioning", page 118

9.5.1 Steps for replacing the I/O module

Important information

NOTICE

When the I/O module is dismantled, advanced electronic components are accessible.

No liability can be accepted for damage caused by electrostatic discharge.

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

NOTICE

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

Approach

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

Recommissioning the safety laser scanner

1. Correctly re-mount the safety laser scanner.
2. Connect the system plug of the safety laser scanner.

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

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

Further topics

- "Accessories", page 158
- "Mounting", page 64
- "Recommissioning", page 118
- "Safety", page 116

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.

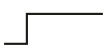
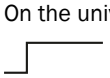
10.2 Error and status indications of the LEDs

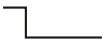
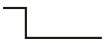
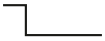
Overview

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

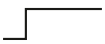
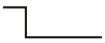
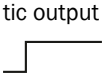
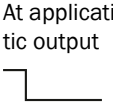
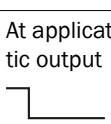
Table 37: Error and status indications of the LEDs

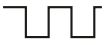
Display	Output level	Possible cause	Rectification of the error
⏻●	At the OSSDs 	Object in the protective field, OSSDs in the OFF state	Not an error
✓●	At the OSSDs 	Protective field clear, OSSDs in the ON state	Not an error
⚠●	On the respective universal I/O [1] 	Object in the warning field [2]	Not an error
⏻○✓○	OSSDs 	Supply voltage missing or too low	▶ Check the voltage supply and activate, if necessary.
☜○	On the universal I/O [3] 	Not an error	

Display	Output level	Possible cause	Rectification of the error
☜○	On the universal I/O [3] 	No supply voltage	▶ Check the voltage supply and activate, if necessary.
☜●	On the universal I/O [3] 	Front screen contaminated, operation is not guaranteed	▶ Cleaning the front screen
☜●	On the universal I/O [3] 	Front screen contaminated, operation is not guaranteed	▶ Cleaning the front screen
☜●	On the universal I/O [3] 	System error	▶ Note the error indicated on the 7-segment display or run diagnostics using the CDS. ▶ Switch off the voltage supply for the S3000 for at least 2 seconds and then switch it back on.
RES●	On the universal I/O [4] 	Reset required	▶ Operate the control switch for restart or reset.
RES●	No level change	Restart delay is counting down	▶ No action is required

1) If this is configured as a warning field output.
2) On the S3000 in the triple field mode, the 7-segment display shows which warning field contains an object.
3) If this is configured as the output for a contamination error/warning.
4) If this is configured as the output for “Reset required”.

Table 38: Error and status indications of the LEDs in the compatibility mode

Display	Output level	Possible cause	Rectification of the error
OSSD●	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
⚠●	At warning field output 	Object in the warning field	Not an error
OSSD○✓○	At the OSSDs 	Supply voltage missing or too low	▶ Check the voltage supply and activate, if necessary.
☜○	At application diagnostic output 	Not an error	
☜○	At application diagnostic output 	No supply voltage	▶ Check the voltage supply and activate, if necessary.
☜●	At application diagnostic output 	Front screen contaminated, operation is not guaranteed	▶ Clean the front screen.

Display	Output level	Possible cause	Rectification of the error
	At application diagnostic output  (1 Hz)	Front screen is contaminated, operation is still guaranteed	▶ Clean the front screen.
	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 voltage supply for the S3000 for at least 2 seconds and then switch it back on.
	At Res_Req output  (1 Hz)	Reset required	▶ Operate the control switch for restart or reset.
	No level change	Restart delay is counting down	▶ No action is required

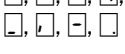
Further topics

- "Status indicators", page 19
- "Pin assignment", page 73

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 39: Error and status indicators on the 7-segment display

Display	Possible cause	Remedy
	Power-up cycle - all segments are activated consecutively.	Not an error
Indication of detections in the protective field and changes in the monitored contour in dual field mode		
	Object in the protective field or Surrounding contour [1] changed	Not an error. This status indication makes system testing easier when using simultaneous protective fields or in an EFI system. As required in the standard, if the OSSDs on the guest are not used, a detection in the protective field is not signaled via the red LED on the guest.
	Object in the simultaneous protective field or Surrounding contour [1] changed	
Indication of detections in the protective field and changes in the monitored contour in dual protective field mode		
	Object in the first protective field of the field set or Surrounding contour [1] changed	Not an error

Display	Possible cause	Remedy
,	Object in the second protective field of the field set or Surrounding contour [1] changed	Not an error
'	Object in the first protective field of the simultaneous field set or Surrounding contour [1] changed	Not an error
,	Object in the second protective field of the simultaneous field set or Surrounding contour [1] changed	Not an error
Indication of detections in the protective field or warning field in triple field mode		
¯	Object in the protective field	Not an error
-	Object in warning field 1	Not an error
_	Object in warning field 2	Not an error
Indications for all field modes		
3	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 3 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 152). ▶ 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. ▶ Additionally if 8 is displayed: Switch off the device, wait at least 3 seconds, then switch the voltage supply 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 or The monitored speed threshold has been 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. ▶ Check the speed threshold configured in the related monitoring cases.
E 1	Sensor head faulty	▶ Switch off the voltage supply for the device for at least 2 seconds and then switch it back on. If the display does not go out: ▶ Send the sensor head, I/O module or system plug to the manufacturer for repair.
E 2	I/O module faulty	
E 3	Configuration memory in the system plug defective	
E 4	A second device which is connected via EFI is in the error state.	▶ Check the connected device and the connection.

Display	Possible cause	Remedy
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.
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 49 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.

Display	Possible cause	Remedy
L.9.	There is a short-circuit between the reset input and another input or output, or the reset pulse does not fulfill the requirements.	▶ Check the wiring for cross-circuits. Or: ▶ Check whether the reset pulse fulfills the requirements (see figure 91, page 147).
n.1.	Input signal for a non-defined monitoring case	▶ Check the path of the vehicle. Or: ▶ Check the operating process of the monitored machine or system. ▶ If necessary, check the configuration of the monitoring cases using the CDS.
n.2.	Incorrect sequence when switching the monitoring cases	
n.3.	Incorrect operation of the control inputs	▶ Check the operation of the digital control inputs.
n.4.	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.
n.5.	Short-circuit on control inputs B1/2 or incorrect operation of B1/2 via EFI	
n.6.	Short-circuit on control inputs C1/2 or incorrect operation of C1/2 via EFI	
n.7.	Short-circuit on control inputs D1/2 or incorrect operation of D1/2 via EFI	
n.8.	Incorrect operation of E1/2 via EFI	
o.	Park/standby mode, the OSSDs are in the OFF state; the laser is switched off.	Not an error. Operational readiness is restored by switching to a different monitoring case or withdrawing the standby bit via EFI.
P.	A device connected via EFI reports a malfunction.	▶ Carry out an error diagnosis of the device connected to the affected device.
u.	Front screen calibration active	Not an error
u.1...6.	Channel 1 to 6 of the contamination measurement contaminated	▶ Clean the front screen.
u.7.	No front screen fitted or dazzling of the contamination measurement	▶ Fit the new front screen (then carry out a front screen calibration). If a front screen was fitted at the time of the error: ▶ Check whether the device is being dazzled by an external light source, e.g., headlight, infrared light source, stroboscopic light, sun etc.
u.8. and u.9.	Traceability data incorrect or front screen calibration failed	▶ Carry out a front screen calibration or replace the device if necessary.

Display	Possible cause	Remedy
	Device internal error	▶ Replace the device.
	I/O module internal error	▶ Replace the I/O module.
	Combination of I/O module and sensor head invalid	▶ Check whether the correct I/O module has been used and replace if necessary.

1) If the contour as reference function is configured.

Further topics

- "Status indicators", page 19
- "Pin assignment", page 75
- "Park/standby mode", page 114

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 131.

▶ 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 40: General details

	Minimum	Typical	Maximum
Type	Type 3 (IEC 61496-1)		
Safety Integrity Level [1]	SIL2 (IEC 61508)		
SIL claim limit [1]	SILCL2 (EN 62061)		
Category	Category 3 (ISO 13849-1)		
Performance level	PL d (ISO 13849-1)		
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	II (IEC 61140) [2]		
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 [3]			
Standards	• IEC 60068-2-6 • IEC 60068-2-64 • IEC 60721-3-5 • IEC TR 60721-4-5 • IEC 61496-3		
Class	5M1 (IEC 60721-3-5)		
Sinusoidal vibrations	• 0.35 mm, 50 m/s^2, 10 Hz ... 150 Hz • 1.5 mm, 0.5 g, 5 Hz ... 200 Hz		
Noise vibrations	• 0.5 m^2/s^3, 5 Hz ... 200 Hz • 0.1 m^2/s^3, 200 Hz ... 500 Hz • 50 m/s^2, 10 Hz ... 500 Hz		
Shock resistance [3]			
Standards	• IEC 60068-2-27 • IEC 60721-3-5 • IEC TR 60721-4-5 • IEC 61496-3		
Class	5M1 (IEC 60721-3-5)		
Single shock	150 m/s^2, 11 ms		

	Minimum	Typical	Maximum
Continuous shock	• 50 m/s², 11 ms • 100 m/s², 16 ms		
Sender	Pulsed laser diode		
Wavelength	880 nm	905 nm	935 nm
Divergence of collimated beam		2.5 mrad	
Pulse duration			3.1 ns
Average output power			562 µW
Light spot size at front screen		12 mm	
Light spot size at 4.0 m scanning range		23 mm	
Light spot size at 5.5 m scanning range		27 mm	
Light spot size at 7.0 m scanning range		32 mm	
Housing			
Material	Die-cast aluminum		
Color	RAL 1021 (colza yellow)		
Front screen			
Material	Polycarbonate		
Interface	Outside with scratch-resistant coating		
System plug	ESD-protected		
Dimensions [4]			
Height			185 mm
Width			155 mm
Depth			160 mm
Overall weight		3.3 kg	

1) For detailed information on the safety configuration of the machine/system, please consult your SICK subsidiary.
2) SELV/PELV safety extra-low voltage.
3) For direct mounting.
4) Without cable glands.

Functional information

Table 41: Functional information

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

	Minimum	Typical	Maximum
Protective field of the sensor head with 5.5 m scanning range at 120 ms response time			
At 30 mm resolution			2.80 m
At 40 mm resolution			3.80 m
At 50 mm resolution			4.80 m
At 70 mm resolution			5.50 m
At 150 mm resolution			5.50 m
Protective field of the sensor head with 5.5 m scanning range at 60 ms response time			
At 30 mm resolution			1.90 m
At 40 mm resolution			2.60 m
At 50 mm resolution			3.30 m
At 70 mm resolution			4.70 m
At 150 mm resolution			5.50 m
Protective field of the sensor head with 7 m scanning range at 120 ms response time			
At 30 mm resolution			2.80 m
At 40 mm resolution			3.80 m
At 50 mm resolution			4.80 m
At 70 mm resolution			7.00 m
At 150 mm resolution			7.00 m
Protective field of the sensor head with 7 m scanning range at 60 ms response time			
At 30 mm resolution			1.90 m
At 40 mm resolution			2.60 m
At 50 mm resolution			3.30 m
At 70 mm resolution			4.70 m
At 150 mm resolution			7.00 m
Scanning angle			190° (–5° to +185°)
Radiance factor	1.8%		Several 1,000% (reflectors)
Angular resolution	0.5°		0.25°
Generally necessary protective field supplement			100 mm
Supplement for retro-reflectors on scan plane with distance of less than 1 m to protective field boundary			200 mm
Measurement error for measurement data output up to 5.5 m and 1.8% radiance factor			
Systematic error		± 5 mm	
Statistical including systematic error			
At 1 σ		± 24 mm	
At 2 σ		± 43 mm	
At 3 σ		± 62 mm	
At 4 σ		± 80 mm	
At 5 σ		± 99 mm	
Flatness of the scan field at 5.5 m			± 70 mm
Flatness of the scan field at 7 m			± 88 mm

	Minimum	Typical	Maximum
Distance of mirror rotational axis (zero point of X- and Y-axis) to rear side of device	93 mm		
Distance between center point of scan plane and bottom edge of the housing	63 mm		
Warning field range (radial)		Approx. 20 m [2]	49 m
Distance measurement range			49 m
Number of multiple samplings (can be configured via CDS)	2		16
Power-up delay		9 s	20 s
Restart after (can be configured)	2 s		60 s

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

Electric

Table 42: Electric

	Minimum	Typical	Maximum
Supply voltage (SELV) [1] [2]	16.8 V	24 V	28.8 V
Permissible residual ripple [3]			± 5%
Start-up current [4]			2 A
Operating current without output load [5]		0.6 A	0.8 A
Operating current with maximum output load, without load due to incremental encoders [5]		2.2 A	2.3 A
Operating current with maximum output load, with maximum load allowed due to incremental encoders [5]		2.4 A	2.6 A
Power consumption without output load [5]		14 W	19 W
Power consumption with maximum output load, without load due to incremental encoders [5]		53 W	55 W
Power consumption with maximum output load, with maximum load allowed due to incremental encoders [5]		58 W	62 W
Power consumption in standby mode or park mode without output load		14 W	19 W
Electrical connection	Plug-in terminal housing with screw terminal connections		
Screw terminal technical data			
Rigid wire cross-circuit	0.14 mm^2		1.5 mm^2
Flexible wire cross-circuit [6]	0.14 mm^2		1.0 mm^2
American wire gage (AWG)	26		16
Wire stripping length		5 mm	
Screw tightening torque	0.22 Nm		0.25 Nm
Cable length for power supply tolerance ± 10%			
At wire cross-section 1 mm^2			50 m
with a wire cross-section of 0.5 mm^2			25 m
with a wire cross-section of 0.25 mm^2			12 m
Cable length for power supply tolerance ± 5%			

	Minimum	Typical	Maximum
At wire cross-section 1 mm^2			60 m
with a wire cross-section of 0.5 mm^2			30 m
with a wire cross-section of 0.25 mm^2			15 m
Cable length for power supply tolerance ± 1%			
At wire cross-section 1 mm^2			70 m
with a wire cross-section of 0.5 mm^2			35 m
with a wire cross-section of 0.25 mm^2			17 m
Input for control switch for restarting or resetting			
Input resistance at HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	28.8 V
Voltage for LOW	–3 V	0 V	5 V
Input capacitance		15 nF	
Static input current	6 mA		15 mA
Actuating time of the control switch	120 ms		
EDM input			
Input resistance at HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	28.8 V
Voltage for LOW	–3 V	0 V	5 V
Input capacitance		15 nF	
Static input current	6 mA		15 mA
Response time at EDM after switching on the OSSDs			300 ms
Static control inputs			
Input resistance at HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	28.8 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	28.8 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 HIGH	U_V – 3 V		U_V
Current load		50 mA	100 mA
OSSDs			

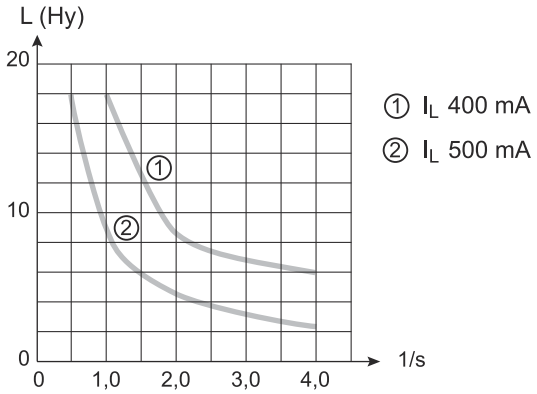
	Minimum	Typical	Maximum
Output signal switching device pair	2 PNP semiconductors, short-circuit protected [7], cross-circuit monitored		
Safe status when an error occurs	At least one OSSD is in the OFF state.		
Switching voltage HIGH at 500 mA	U_V – 2.7 V		U_V
Switching voltage LOW	0 V	0 V	3.5 V
Source switching current	6 mA	0.2 A	0.5 A
Leakage current [8]			250 µA
Load inductance [9]			2.2 H
Load capacity			2.2 µF at 50 Ω
Switching sequence (no toggling and no simultaneous monitoring)	Depending on the load inductance		
Permissible cable resistance [10]			2.5 Ω
Test pulse width [11]		230 µs	300 µs
Test frequency			
At 0.5° angular resolution		120 ms	
At 0.25° angular resolution		240 ms	
Power-up delay of the OSSDs from red to green		120 ms	
Time offset on switching the OSSDs between OSSD2 and OSSD1		1.3 ms	2 ms
UNI-I/O1, 2 and 3			
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 the warning field output or UNI-I/O1, 2 and 3 on configuration as warning field output	Corresponds to the resulting response time of the OSSDs plus supplement		
Supplement for 0.25° angular resolution		50 ms	
Supplement for 0.5° angular resolution		25 ms	
Incremental encoders that can be evaluated			
Type	Dual-channel rotary encoder with 90° phase shift		
Enclosure rating	IP54		
Supply voltage		24 V	
Necessary outputs for incremental encoders	Push-pull		
Pulse frequency			100 kHz
Number of pulses per cm	50		1000
Length of cable (shielded)			10 m
Configuration and diagnostic interface			
Communication protocol	RS232 (proprietary)		
Transmission rate	9,600 Baud 19,200 Baud 38,400 Baud		

	Minimum	Typical	Maximum
Cable length for 9,600 Baud and 0.25 mm^2 cables			15 m
Galvanic separation	No		
Output TxD HIGH	5 V		15 V
Output TxD LOW	–15 V		–5 V
Voltage range RxD	–15 V		15 V
Switching threshold RxD LOW	–15 V		0.4 V
Switching threshold RxD HIGH	2.4 V		15 V
Short-circuit current at TxD	–60 mA		60 mA
Maximum voltage level at RxD	–15 V		15 V
Maximum voltage level at TxD	–11 V		11 V
Data interface			
Communication protocol	RS422 (proprietary)		
Transmission speed (selectable)	9,600 Baud 19,200 Baud 38,400 Baud 125 kBaud 250 kBaud 500 kBaud		
Cable length for 500 kBaud and 0.25 mm^2 cables			100 m
Galvanic separation	Yes		
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–	–29 V		29 V
Maximum voltage level at RxD+, RxD–	–29 V		29 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 mm^2		0.6 mm^2
Safe SICK device communication via EFI/SDL			
Cable length for 500 kBaud and 1 × 2 × 0.22 mm^2 cables			50 m
Galvanic separation	Yes		
Cable type to be connected	Twisted pairs with copper braid screen, cable diameter ≤ 6.8 mm		
Wire cross-section of the cable to be connected	1 × 2 × 0.22 mm^2		

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 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) Applies to the voltage range between U_s and 0 V.

8) 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 state as LOW. An FSPLC (fail-safe programmable logic controller) must detect this state.

9) If the switching sequence is low, the maximum permissible load inductance is higher.



10) 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.)

11) 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

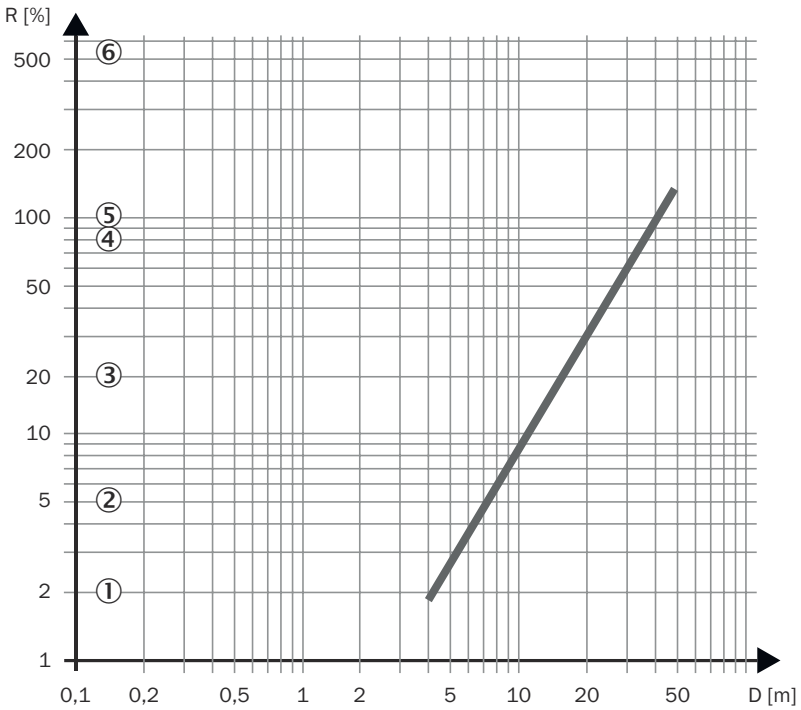


Figure 88: Diagram scanning range with Short Range sensor head

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%

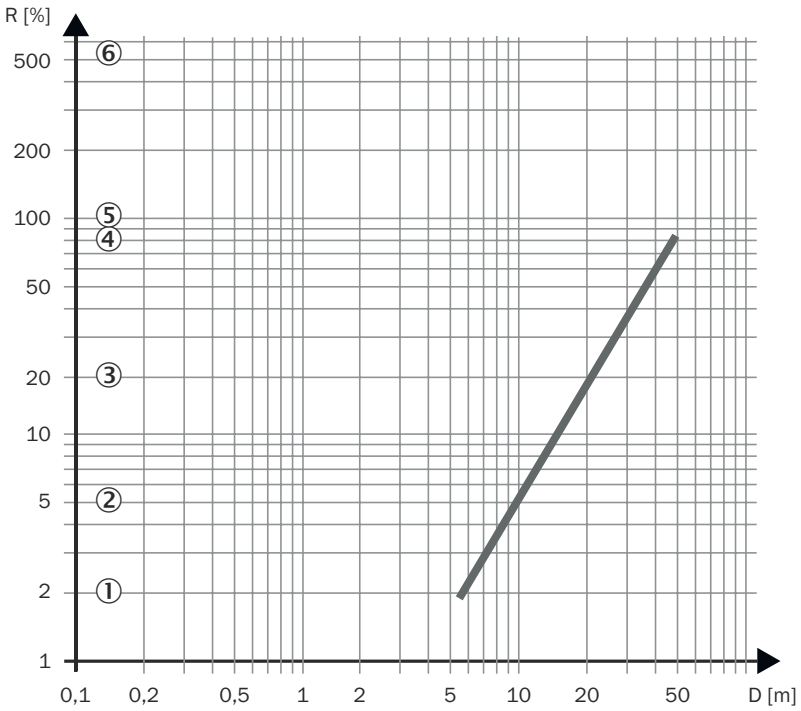


Figure 89: Diagram scanning range with Medium Range sensor head

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%

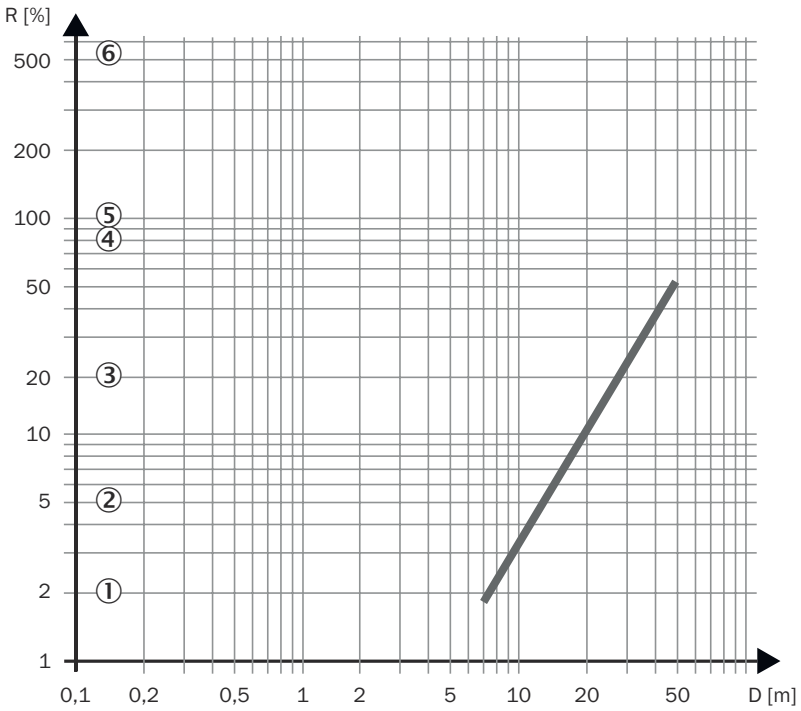


Figure 90: Diagram scanning range with Long Range sensor head

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%

Reset pulse

If the reset pulse on the “Reset” input is, for example, provided by an (F)PLC, then the pulse must be of a specific length.

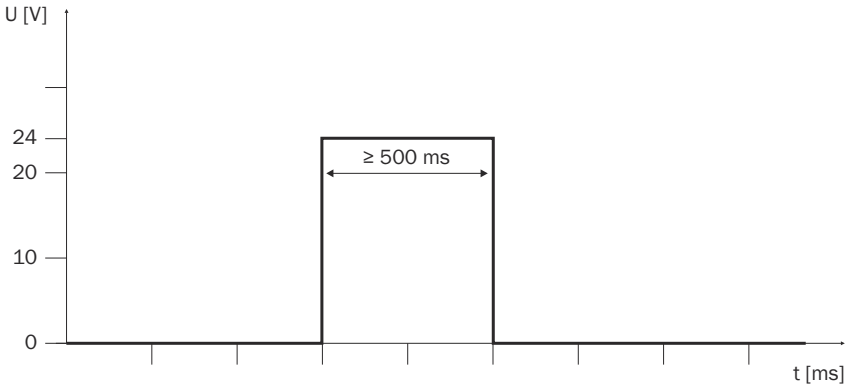


Figure 91: Reset pulse requirements

Make sure that pulses do not have a frequency of 1 Hz or 4 Hz, as otherwise there may be overlaps with the output signals for “Front screen contaminated” or “System error”. This overlap will result in an error on the safety laser scanner.

12.3 Response times

Overview

The total response time of the application depends on the:

- Basic response time at the related resolution and the maximum protective field range
- Set multiple sampling
- 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 (60 ms or 120 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 response time. The related supplement is dependent on the basic response time and the multiple sampling.

Table 43: Supplements for multiple sampling

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

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 89

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.

NOTE
The controller must not respond to this test pulse. It must not shut down the machine due to the test pulse.

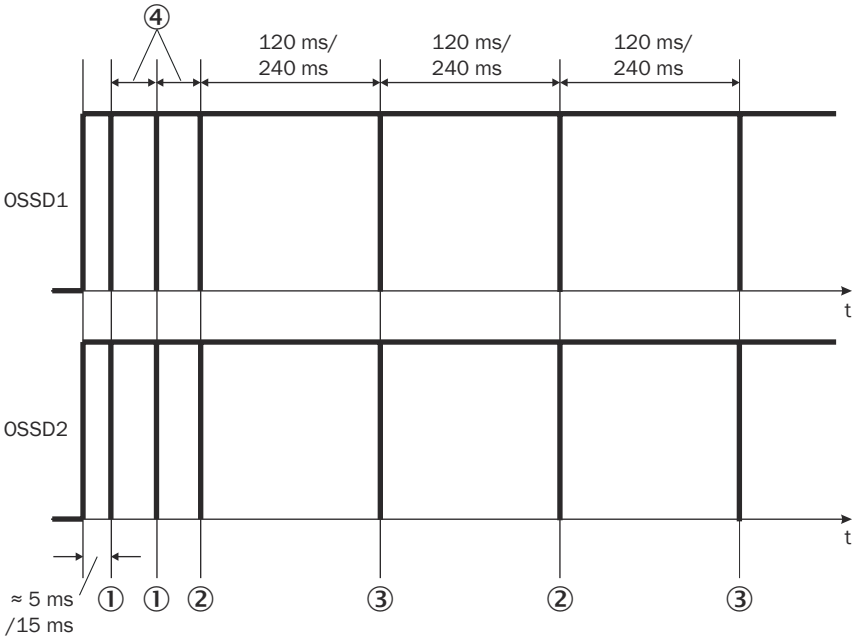


Figure 92: Diagram of the test pulse at the OSSDs

④ 0.5 × basic response time

Approx. 5 or 15 ms [7] after the OSSDs are switched on, the device performs the first voltage test ① and then after a half basic response time a second voltage test ①.

After a further half basic response time of the device there is a shut-down test ②, 120 or 240 ms[7] later a further voltage test ③. Then the device performs a shut-down test and a voltage test alternately at an interval of 120 or 240 ms[7] Pulse duration for the individual tests, see figure 93, page 150, see figure 94, page 150, see figure 95, page 150.

7) At 0.5° or 0.25° angular resolution.

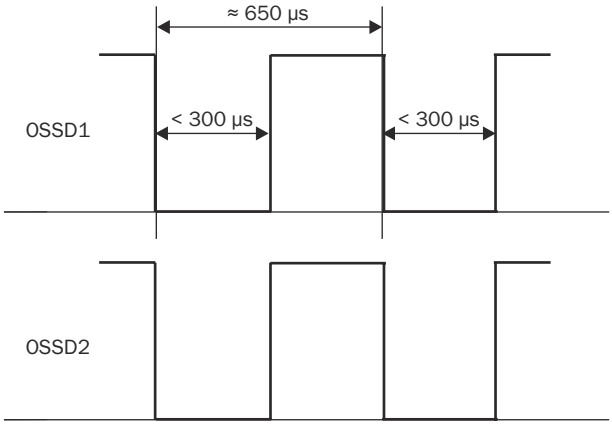


Figure 93: Voltage test after switching on the OSSDs

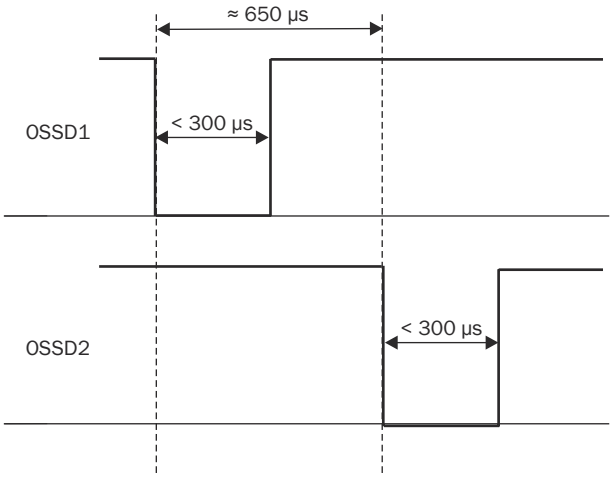


Figure 94: Shut-down test

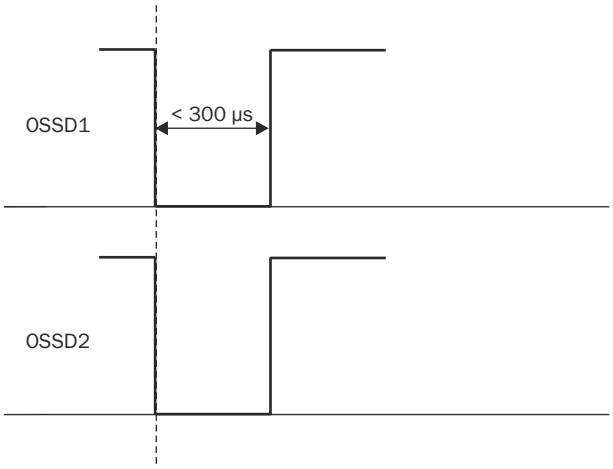


Figure 95: Voltage test

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 44: Status information of the S3000 (data from the S3000)

Status information	Meaning/effect
OSSD on [OSSD]	• Logical 1, if the internal OSSDs of the S3000 are in the ON state (green) • Logical 0, if the OSSDs of the S3000 are in the OFF state (red)
Warning field bit [WF LED]	• Logical 1, if warning field 1 and warning field 2 of the S3000 are clear or not used
Contamination [Weak]	• Logical 1, if the front screen 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 S3000
I/O error [I/O Error]	• Logical 0, if there is no error on the S3000 • Logical 1, if there is an error on the S3000
Control input A1 [In A1]	• Logical 1, if the connection of control input A1 is HIGH [1)]
Control input A2 [In A2]	• Logical 1, if the connection of control input A2 is HIGH [1)]
Control input B1 [In B1]	• Logical 1, if the connection of control input B1 is HIGH [1)]
Control input B2 [In B2]	• Logical 1, if the connection of control input B2 is HIGH [1)]
Control input C1 [In C1]	• Logical 1, if the connection of control input C1 is HIGH [1)]
Control input C2 [In C2]	• Logical 1, if the connection of control input C2 is HIGH [1)]
Control input D1 [In D1]	• Logical 1, if the connection of control input D1 is HIGH [1)]
Control input D2 [In D2]	• Logical 1, if the connection of control input D2 is HIGH [1)]
Allocated protective field clear [PF]	• In dual field mode, in dual protective field mode and in triple field mode: Logical 1, if the active allocated protective field is clear
Allocated warning field clear [WF] or Allocated protective field 2 clear [PF2]	• In dual field mode: Logical 1, if the active allocated warning field is clear • In dual protective field mode: Logical 1, if the active allocated protective field 2 is clear • In triple field mode: Logical 1, if the active allocated warning field is clear
Simultaneous protective field clear [Sim. SF]	• In dual field mode and in dual protective field mode: Logical 1, if the simultaneously monitored protective field is clear • In triple field mode: no function

Status information	Meaning/effect
Simultaneous warning field clear [Sim. WF] or Simultaneous protective field 2 clear [Sim. SF2] or Allocated warning field 2 clear [WF2]	• In dual field mode: Logical 1, if the simultaneously monitored warning field is clear • In dual protective field mode: Logical 1, if the simultaneously monitored protective field 2 is clear • In triple field mode: Logical 1, if the active allocated warning field 2 is clear
Speed valid [2]	• 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 [2]	• 12 bits for transmitting the speed 100000110000 = –2,000 cm/s 000000000000 = 0 cm/s 011111010000 = +2,000 cm/s

1) Only if the inputs are activated in the CDS.
2) Not in the compatibility mode.

Control features

Table 45: Control features on the S3000 (data to the S3000)

Control feature	Meaning/effect
Static input information A1 [In A1]	• Logical 1, stimulates control input A1 of the S3000
Static input information A2 [In A2]	• Logical 1, stimulates control input A2 of the S3000
Static input information B1 [In B1]	• Logical 1, stimulates control input B1 of the S3000
Static input information B2 [In B2]	• Logical 1, stimulates control input B2 of the S3000
Static input information C1 [In C1]	• Logical 1, stimulates control input C1 of the S3000
Static input information C2 [In C2]	• Logical 1, stimulates control input C2 of the S3000
Static input information D1 [In D1]	• Logical 1, stimulates control input D1 of the S3000
Static input information D2 [In D2]	• Logical 1, stimulates control input D2 of the S3000
Static input information E1 [In E1] [1]	• Logical 1, stimulates control input E1 of the S3000
Static input information E2 [In E2] [1]	• Logical 1, stimulates control input E2 of the S3000
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

Control feature	Meaning/effect
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

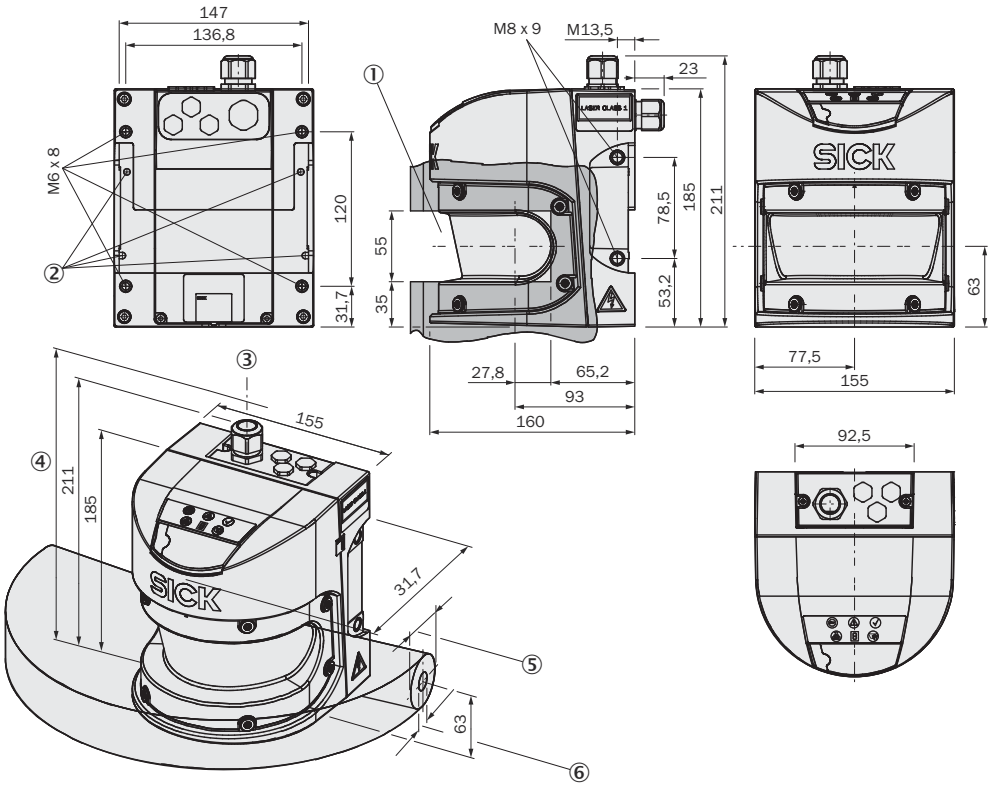


Figure 96: Dimensional drawing safety laser scanner (mm)

① Area to be kept clear during installation of the scanner
② Reference points for mounting
③ Axis of rotation of motor
④ Connector range approx. 270
⑤ Beam diameter Receiver = 44
⑥ Beam diameter Sender = 15

Scan plane origin

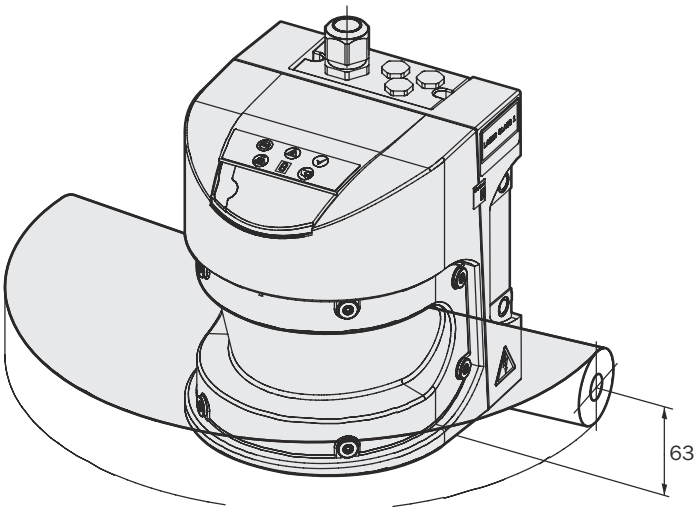


Figure 97: Dimensional drawing scan plane origin (mm)

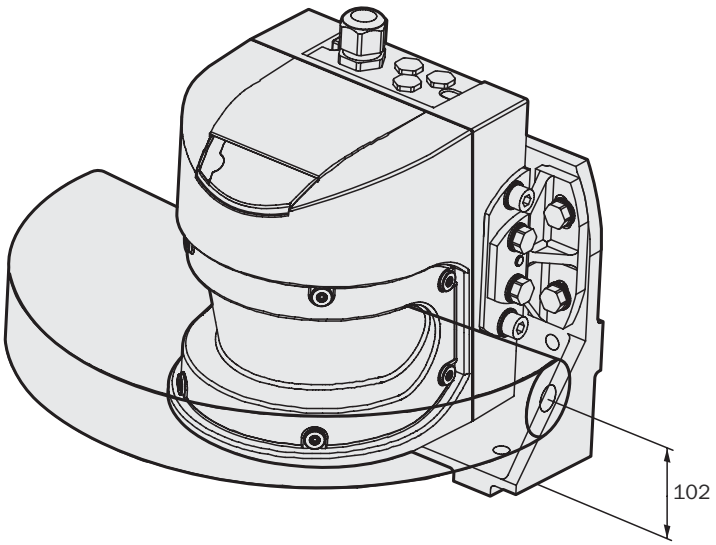


Figure 98: Dimensional drawing scan plane origin with mounting kit 3 (mm)

13 Ordering information

13.1 Scope of delivery

- Sensor head with I/O module mounted
- Safety note
- Mounting instructions
- “Important notes” adhesive label
- Operating instructions and CDS (Configuration & Diagnostic Software) available for downloading at: www.sick.com

NOTE
System plug not included with delivery.

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

Further topics

- "System plug", page 156
- "Unassembled system plug", page 77
- "Pre-assembled system plug", page 80

13.2 Ordering information

Table 46: Part numbers, systems

Part	Type code	Part number
S3000 Standard with Short Range sensor head	S30A-4011BA	1028934
S3000 Standard with Medium Range sensor head	S30A-6011BA	1023546
S3000 Standard with Long Range sensor head	S30A-7011BA	1023890
S3000 Advanced with Short Range sensor head	S30A-4011CA	1028935
S3000 Advanced with Medium Range sensor head	S30A-6011CA	1023547
S3000 Advanced with Long Range sensor head	S30A-7011CA	1023891
S3000 Professional with Short Range sensor head	S30A-4011DA	1028936
S3000 Professional with Medium Range sensor head	S30A-6011DA	1019600
S3000 Professional with Long Range sensor head	S30A-7011DA	1023892
S3000 Expert with Short Range sensor head	S30A-4011GB	1052107
S3000 Expert with Medium Range sensor head	S30A-6011GB	1052108
S3000 Expert with Long Range sensor head	S30A-7011GB	1052109
S3000 Remote with Short -Range sensor head	S30A-4011EA	1028938
S3000 Remote with Medium Range sensor head	S30A-6011EA	1023548
S3000 Remote with Long Range sensor head	S30A-7011EA	1023893

14 Spare parts

14.1 Sensor heads

Table 47: Part numbers, sensor heads

Part	Part number
Short Range sensor head (up to 4 m scanning range)	2034999
Medium Range sensor head (up to 5.5 m scanning range)	2022972
Long Range sensor head (up to 7 m scanning range)	2026747

14.2 I/O modules

Table 48: Part numbers, I/O modules

Part	Part number
I/O module Standard	2026801
I/O module Advanced	2026802
I/O module Professional	2022827
I/O module Professional CMS (only for service purposes)	2030915
I/O module Expert [1)]	2057645
I/O module Remote	2026803

1) Not compatible with sensor head with firmware < B02.40.

14.3 System plug

Table 49: Part numbers, system plugs

Type code	Description	Suitable for					Part number
		Standard	Advanced	Professional	Expert	Remote	
SX0A-A0000B	Without cable, for on-site assembly, one M20 cable gland and one M12 blind plug	✓	✓	✓	✓	✓	2023797
SX0A-A0000D	Without cable, for on-site assembly, one M20 cable gland, three M12 blind plugs, two EMC cable glands	✓	✓	✓	✓	✓	2023310
SX0A-B0905B	Pre-assembled, 5 m length of cable, 9 wires, one M20 cable gland, and one M12 blind plug	✓				✓	2027170
SX0A-B0905G	Pre-assembled, 5 m length of cable, 9 wires, cable connection at the rear, one M20 cable gland, and one M12 blind plug	✓				✓	2049222

Type code	Description	Suitable for					Part number
		Standard	Advanced	Professional	Expert	Remote	
SX0A-B0910B	Pre-assembled, 10 m length of cable, 9 wires, one M20 cable gland, and one M12 blind plug	✓				✓	2027171
SX0A-B0920B	Pre-assembled, 20 m length of cable, 9 wires, one M20 cable gland, and one M12 blind plug	✓				✓	2027814
SX0A-B1305B	Pre-assembled, 5 m length of cable, 13 wires, one M20 cable gland, and one M12 blind plug		✓				2027172
SX0A-B1310B	Pre-assembled, 10 m length of cable, 13 wires, one M20 cable gland, and one M12 blind plug		✓				2027173
SX0A-B1320B	Pre-assembled, 20 m length of cable, 13 wires, one M20 cable gland, and one M12 blind plug		✓				2027815
SX0A-B1705B	Pre-assembled, 5 m length of cable, 17 wires, one M20 cable gland, and one M12 blind plug			✓	✓		2027174
SX0A-B1710B	Pre-assembled, 10 m length of cable, 17 wires, one M20 cable gland, and one M12 blind plug			✓	✓		2027175
SX0A-B1720B	Pre-assembled, 20 m length of cable, 17 wires, one M20 cable gland, and one M12 blind plug			✓	✓		2027816
SX0A-B1305D	Pre-assembled, 5 m length of cable, 13 wires, one M20 cable gland, three M12 blind plugs, two EMC cable glands			✓	✓		2027176
SX0A-B1310D	Pre-assembled, 10 m length of cable, 13 wires, one M20 cable gland, three M12 blind plugs, two EMC cable glands			✓	✓		2027177

15 Accessories

15.1 Connectivity

Service cables

Table 50: 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 51: Connecting cable ordering information

Part	Part number
9-wire, cross-section 0.56 mm^2 (AWG 20), sold by the meter	6022651
13-wire, cross-section 0.56 mm^2 (AWG 20), sold by the meter	6025729
17-wire, cross-section 0.56 mm^2 (AWG 20), sold by the meter	6025730
EFI cable, sold by the meter (1 × 2 × 0.22 mm^2)	6029448
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
EMC M12 cable gland for EFI connections and incremental encoders, permissible cable diameter 3–6.5 mm, height 19 mm	5308757
EMC M12 cable gland for EFI connections and incremental encoders, permissible cable diameter 3–6.5 mm, height 25 mm	5314772
EMC M20 cable gland for supply cables and signal cables, permissible cable diameter 7–12 mm, height 23 mm	5308762
EMC M20 cable gland for supply cables and signal cables, permissible cable diameter 10–14 mm, height 23 mm	5318531
EMC M20 cable gland for supply cables and signal cables, permissible cable diameter 6–12 mm, height 32.5 mm	5323688
EMC M20 cable gland for supply cables and signal cables, permissible cable diameter 10–14 mm, height 33 mm	5314774

15.2 Brackets

Table 52: Ordering information, mounting kits

Mounting kit	Description	Part number
1	Mounting bracket for direct mounting at the rear on the wall or machine. No adjustment possibility	2015623
2	Bracket only in conjunction with mounting kit 1. Mounting at the rear on the wall or machine. Longitudinal and lateral adjustment possible	2015624
3	Bracket only in conjunction with mounting kit 1 and 2. Mounting at the rear or below on the wall, floor or machine. Longitudinal and lateral adjustment possible	2015625
Heavy duty mounting bracket	Mounting bracket, heavy-duty version, with protective hood, steel, lacquered, for floor mounting, height adjustment possible	7087514

Dimensional drawings

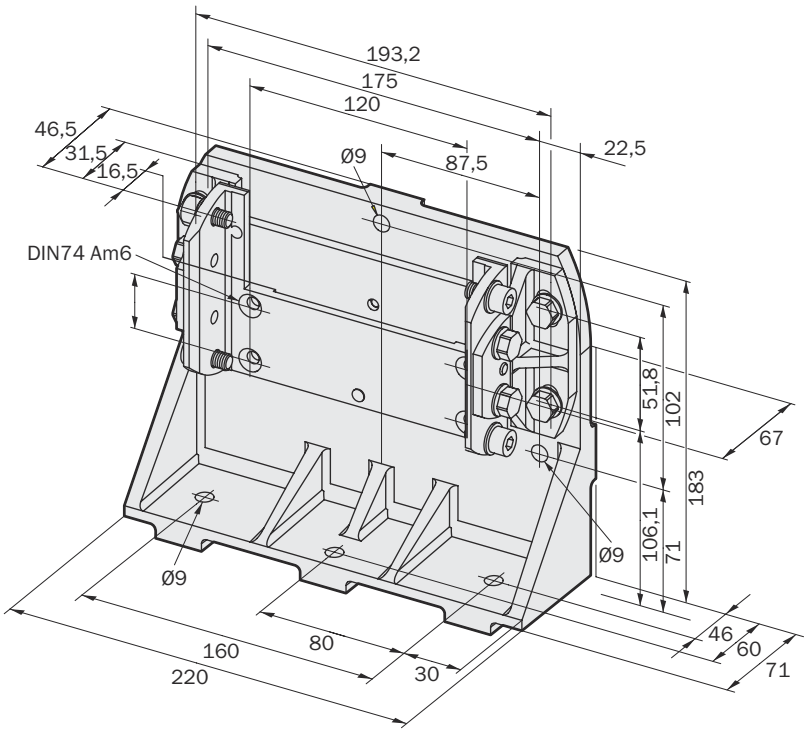


Figure 99: Dimensional drawing mounting kit 1, 2 and 3 (mm)

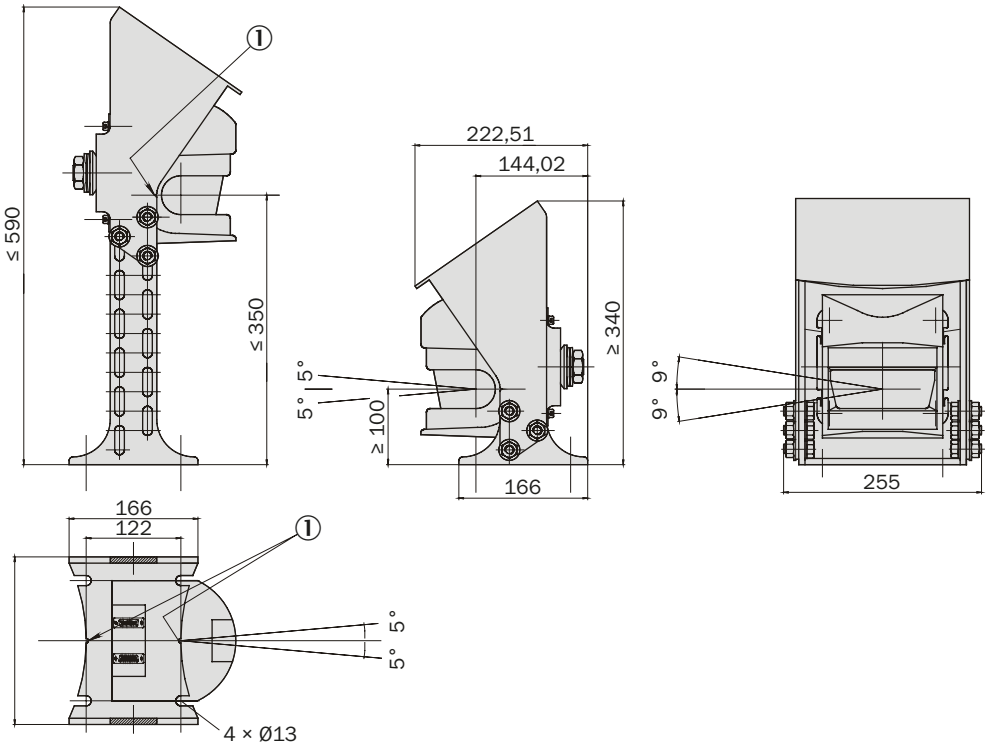


Figure 100: Dimensional drawing heavy duty mounting bracket (mm)

① Scan plane origin

15.3 Additional accessories

Safety relays/compact safety controller

Table 53: 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 54: 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

Part	Type code	Part number
Flexi Classic expansion module	UE410-XU3T5	6032470
Flexi Classic input expansion module	UE410-8DI3	6026139

Network solutions

Table 55: 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

Miscellaneous accessories

Table 56: Ordering information, miscellaneous

Part	Description	Part number
Front screen	Spare part set for front screen with replacement seal and screws	2027180
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
Quatech interface card	Serial PC interface card with two RS-422 interfaces, up to 500 kBaud	6022515
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: o It must not be possible for people to be in the hazardous area without triggering the protective device. o It must be ensured that no people are in the hazardous area during or after the reset.
Resolution	The resolution of an active opto-electronic protective device (also known as the sensor detection capability) is the minimum size of an object for it to be reliably detected.
Response time	The protective device's response time is the maximum time between the occurrence of the event leading to the sensor's response and supply of the switch-off signal to the protective device's interface (for example OFF state of the OSSD pair).
Restart interlock	The restart interlock prevents the machine from automatically starting up, for example after a protective device has responded while the machine is operating or after changing the machine's operating mode. The restart interlock can be implemented in the protective device or in the safety controller. A command to reset the protective device must be given, for example using a reset pushbutton, before the machine can be restarted.
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 57: 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

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