

OPERATING INSTRUCTIONS

S3000

Safety Laser Scanner



GB

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Sensor Intelligence.

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1 About this document

Please read this chapter carefully before working with this documentation and the S3000.

1.1 Function of this document

These operating instructions are designed to address *the technical personnel of the machine manufacturer or the machine operator* in regards to correct mounting, electrical installation, commissioning, operation and maintenance of the S3000 safety laser scanner.

These operating instructions do *not* provide instructions for operating the machine, the system or the vehicle on which the safety laser scanner is, or will be, integrated. Information on this is to be found in the appropriate operating instructions of the machine, the system or the vehicle.

1.2 Target group

These operating instructions are addressed to *planning engineers, developers and the operators* of machines and systems which are to be protected by one or several S3000 safety laser scanners. They also address people who integrate the S3000 into a machine, a system or a vehicle, initialise its use, or who are in charge of servicing and maintaining the device.

1.3 Scope

This document is an original document.

Note These operating instructions are only applicable to the S3000 safety laser scanner with one of the following entries on the type label in the field *Operating Instructions*:

- 8009791
- 8009791 AE N517
- 8009791 AE N702
- 8009791 AE OA34
- 8009791 AE PA46
- 8009791 AE TL59

This document is part of SICK part number 8009791 (operating instructions “S3000 Safety Laser Scanner” in all available languages).

For the configuration and diagnostics of these devices you require CDS (SICK Configuration & Diagnostic Software) version 3.6.1 or higher. To check the version of the software, on the **?** menu select **Module info...**

1.4 Depth of information

These operating instructions contain information on the S3000 safety laser scanner:

- installation and mounting
- electrical installation
- commissioning and configuration
- care and maintenance
- fault, error diagnosis and troubleshooting
- part numbers
- accessories
- conformity and approval

Planning and using protective devices such as the S3000 also requires specific technical skills that are not detailed in this documentation.

General information on accident prevention using opto-electronic protective devices can be found in the brochure “Safe Machines with opto-electronic protective devices”.

When operating the S3000, the national, local and statutory rules and regulations must be observed.

Note We also refer you to the SICK AG homepage on the Internet at www.sick.de/S3000.

Here you will find information on:

- application examples
- a list of frequently asked questions regarding the S3000
- these operating instructions in different languages for viewing and printing

1.5 Abbreviations

AGV	Automated guided vehicle
ANSI	American National Standards Institute
AWG	American Wire Gauge = standardisation and classification of wires and cables by type, diameter etc.
CDS	SICK Configuration & Diagnostic Software
EDM	External device monitoring
EFI	Enhanced function interface = safe SICK device communication
ESD	Electrostatic discharge
ESPE	Electro-sensitive protective equipment
FPLC	Fail-safe programmable logic controller
OSSD	Output signal switching device = signal output of the protective device that is used to stop the dangerous movement
RIA	Robotic Industries Association

1.6 Symbols used

Recommendation

Recommendations are designed to give you some assistance in your decision-making process with respect to a certain function or a technical measure.

Note

Refer to notes for special features of the device.



Display indicators show the status of the 7-segment display on the S3000:



Constant indication of characters, e.g. 8



Flashing indication of characters, e.g. 8



Alternating indication of characters, e.g. L and 2



LED symbols describe the status of an LED:



The LED is constantly illuminated.



The LED is flashing.



The LED is off.



These symbols identify which LED is described.



The "Error/Contamination" LED is flashing.



The "OSSDs deactivated" LED is constantly illuminated.

➤ Take action ...

Instructions for taking action are shown by an arrow. Read carefully and follow the instructions for action.



WARNING

Warning!

A warning indicates an actual or potential risk or health hazard. Observation and implementation of the warning will protect you from accidents.

Read carefully and follow the warnings!



Software notes show the location in the CDS (SICK Configuration & Diagnostic Software) where you can make the appropriate settings and adjustments. In the CDS on the **View** menu, **Dialog box**, select the item **File cards** to go straight to the stated dialog fields. Alternatively, the software wizard will guide you through the appropriate setting.

The term "dangerous state"

The *dangerous state* (standard term) of the machine is always shown in the drawings and diagrams of this document as a movement of a machine part. In practical operation, there may be a number of different dangerous states:

- machine movements
- vehicle movements
- electrical conductors
- visible or invisible radiation
- a combination of several risks and hazards

2 On safety

This chapter deals with your own safety and the safety of the equipment operators.

➤ Please read this chapter carefully before working with the S3000 or with the machine protected by the S3000.

2.1 Specialist personnel

The S3000 safety laser scanner must be installed, connected, commissioned and serviced only by specialist personnel. Specialist personnel are defined as persons who

- due to their specialist training and experience have adequate knowledge of the power-driven equipment to be checked

and

- who have been instructed by the responsible machine operator in the operation of the machine and the current valid safety guidelines

and

- are sufficiently familiar with the applicable official health and safety regulations, directives and generally recognised engineering practice (e.g. DIN standards, VDE stipulations, engineering regulations from other EC member states) that they can assess the work safety aspects of the power-driven equipment

and

- who have access to these operating instructions and who have read them.

As a rule these are specialist personnel from the ESPE manufacturer or also those persons who have been appropriately trained at the ESPE manufacturer, are primarily involved in checking ESPE and are allocated the task by the organisation operating the ESPE.

2.2 Device applications

The S3000 safety laser scanner is used to protect persons and plant. It is intended to be used to monitor hazardous areas indoors.

The S3000 is not intended for outdoor use.

The S3000 cannot provide protection from flying parts or from emitted radiation.

The S3000 is only intended for use in industrial environments. When used in residential areas it can cause radio interferences.

The device is a *Type 3 ESPE* as defined by EN 61496-1 and CLC/TS 61496-2 and is therefore allowed for use with controls in category 3 PL d¹⁾ according to EN ISO 13849-1 and SIL2 according to IEC 61508.

The S3000 is suitable for:

- hazardous area protection
- hazardous point protection
- access protection
- vehicle protection

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

¹⁾ PL e can be achieved using additional devices, e.g. by using special actuators and a safety controller Flexi Soft. However, an exact analysis of the performance levels by a safety specialist with the aid of the SISTEMA software is always necessary.

2.3 Correct use

The S3000 safety laser scanner must only be used as defined in chapter 2.2 “Device applications” on page 10. It must only be used by qualified personnel on the machine where it has been installed and initialised by specialist personnel in accordance with these operating instructions. It is only permitted to be used on machines on which the dangerous state can be stopped immediately by the S3000 and/or it is possible to prevent the machine being placed in operation.

Note If the device is used for any other purposes or modified in any way — also during mounting and installation — any warranty claim against SICK AG shall become void.

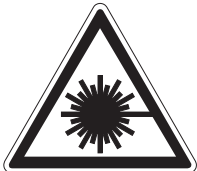
2.4 General safety notes and protective measures



WARNING

Pay attention to the safety notes!

Please observe the following statements in order to ensure the correct use of the S3000 safety laser scanner.



The safety laser scanner S3000 is of laser safety class 1. Additional measures for screening the laser radiation are not necessary (eye safe).

CLASS 1
LASER PRODUCT

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

- This device meets the norms: IEC 60825-1 as well as CDRH 21 CFR 1040.10 and 1040.11; excluded are deviations due to Laser Notice No. 50, dated 24.06.2007. In the standards CDRH 21 CFR 1040.10 and 1040.11 the following note is required: “Caution — use of controls, adjustments or performance of procedures other than those herein specified may result in hazardous radiation exposure!”
- During the mounting, installation and usage of the S3000, observe the standards and directives applicable in your country. You will find an overview of the most important regulations in section 2.6 “Applicable directives and standards” on page 13.
- The national/international rules and regulations apply to the installation, commissioning, use and periodic technical inspections of the S3000 safety laser scanner, in particular
 - Machinery Directive 2006/42/EC
 - Work Equipment Directive 89/655/EEC
 - the work safety regulations/safety rules
 - other relevant health and safety regulations
- Manufacturers and users of the machine on which the S3000 is used are responsible for obtaining and observing all applicable safety regulations and rules.
- The notes, in particular the test notes (see chapter 8 “Commissioning” on page 97) in these operating instructions (e.g. on use, mounting, installation or integration into the machine controller) must be observed.

- Changes to the configuration of the devices can degrade the protective function. After every change to the configuration you must therefore check the effectiveness of the protective device. The person who makes the change is also responsible for the correct protective function of the device. When making configuration changes, please always use the password hierarchy provided by SICK to ensure that only authorised persons make changes to the configuration. The SICK service team is available to provide assistance if required.
 - The tests must be carried out by specialist personnel or specially qualified and authorised personnel and must be recorded and documented to ensure that the tests can be reconstructed and retraced at any time.
 - The operating instructions must be made available to the operator of the machine where the S3000 is used. The machine operator is to be instructed in the use of the device by specialist personnel and must be instructed to read the operating instructions.
 - The external voltage supply of the device must be capable of buffering brief mains voltage failures of 20 ms as specified in EN 60204. Suitable power supplies are available as accessories from SICK (Siemens type series 6 EP 1).
- Enclosed with these operating instructions is a checklist for checking by the manufacturer and OEM (see chapter 13.2 “Manufacturer’s checklist” on page 139). Use this checklist when checking the plant that is protected with the S3000.

2.5 Environmental protection

The S3000 safety laser scanner is constructed in such a way that it adversely affects the environment as little as possible. It uses only a minimum of power and natural resources. At work, always act in an environmentally responsible manner. For this reason please note the following information on disposal.

Disposal

- Always dispose of unserviceable or irreparable devices in compliance with local/national rules and regulations on waste disposal.
- Remove the plastic parts and send the aluminium housing of the safety laser scanner for recycling.
- Dispose of all electronic assemblies as hazardous waste. The electronic assemblies are easy to dismantle.

Note • We would be pleased to be of assistance on the disposal of this device. Contact your local SICK representative.

2.6 Applicable directives and standards

The most important directives and standards, valid for the use of opto-electronic safety systems in Europe, are listed below. Further regulations may be of importance to you, depending on the type of use. You can obtain further information of machine-specific standards from national institutions (e.g. DIN, BSI, ANFOR etc.), the authorities or your trade association.

If you operate the machine or vehicle in a country outside the European Union, please contact the manufacturer of the plant and the local authorities and obtain information on the regulations and standards applicable there.

Application and installation of safety systems

Machinery Directive 2006/42/EC, e.g.:

- Safety of machinery – Basic concepts, general principles for design (EN ISO 12 100)
- Industrial automation systems – Safety of integrated manufacturing systems – Basic requirements (ISO 11 161)
- Safety of machinery – Electrical equipment of machines – Part 1: General requirements (EN 60 204)
- Safety of machinery – Safety distances to prevent hazard zones being reached by the upper and lower limbs (EN ISO 13 857)
- Safety requirements for robots (EN ISO 10 218-1)
- Safety of industrial trucks. Driverless trucks and their systems (EN 1525)
- Safety of machinery – The positioning of protective equipment in respect of approach speeds of parts of the human body (prEN ISO 13 855)
- Safety of machinery – Principles for risk assessment (EN ISO 14 121-1)
- Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design (EN ISO 13 849 part 1 and part 2)
- Safety of machines – Electro-sensitive protective equipment – Part 1: General requirements (EN 61 496-1) as well as part 3: Particular requirements for Active Opto-electronic Protective Devices responsive to Diffuse Reflection (AOPDDR) (CLC/TS 61 496-3)

Foreign standards, for example:

- Performance Criteria for Safeguarding (ANSI B11.19)
- Machine tools for manufacturing systems/cells (ANSI B11.20)
- Safety requirements for Industrial Robots and Robot Systems (ANSI/RIA R15.06)
- Safety Standard for guided industrial vehicles and automated functions of named industrial vehicles (ANSI B56.5)

Note To some extent these standards require the protective device to have the safety level “**Control reliable**”. The S3000 safety laser scanner meets this requirement.

Recommendation Please request our brochure on this subject “Safe Machines with opto-electronic protective devices”.

3 Product description

This chapter provides information on the special features and properties of the S3000 safety laser scanner. It describes the structure and the operating principle of the device, in particular the different operating modes.

➤ Please read this chapter before mounting, installing and commissioning the device.

3.1 Special features

- sensor heads with scanning ranges up to 4 m, 5.5 m or 7 m²⁾
- 190° scanning angle
- up to 8 protective fields and warning fields (dependent on the I/O module)
- the contour of the surrounding can be monitored (contour change e.g. the opening of a door to the outside)
- integrated external device monitoring (EDM)
- integrated restart interlock/restart interlock delay for which parameters can be set
- status display with LEDs and 7-segment display
- various I/O modules for different applications
- simple replacement of the I/O module (in this way the functionality can be easily enhanced)
- dynamic protective field switching using incremental encoder inputs (S3000 Professional)
- minimum response time 60 ms
- configuration using PC or notebook with SICK Configuration & Diagnostic Software
- configuration memory in the system plug. Down times are shortened by the easy replacement of the S3000
- safe bus interfacing using SICK sens:Control products
- increased resilience to ambient light and dust due to highly effective dazzle and particle algorithms

3.2 Function

The S3000 safety laser scanner only operates correctly as a protective device if the following conditions are met:

- The control of the machine, system or vehicle must be electrical.
- It must be possible to transfer the dangerous state of the machine, the plant or the vehicle to a safe state at any time using the OSSDs on the S3000 after integration in the controller.
- The S3000 must be mounted and configured such that it detects objects as they enter the hazardous area (see chapter 4 “Installation and mounting” on page 47).

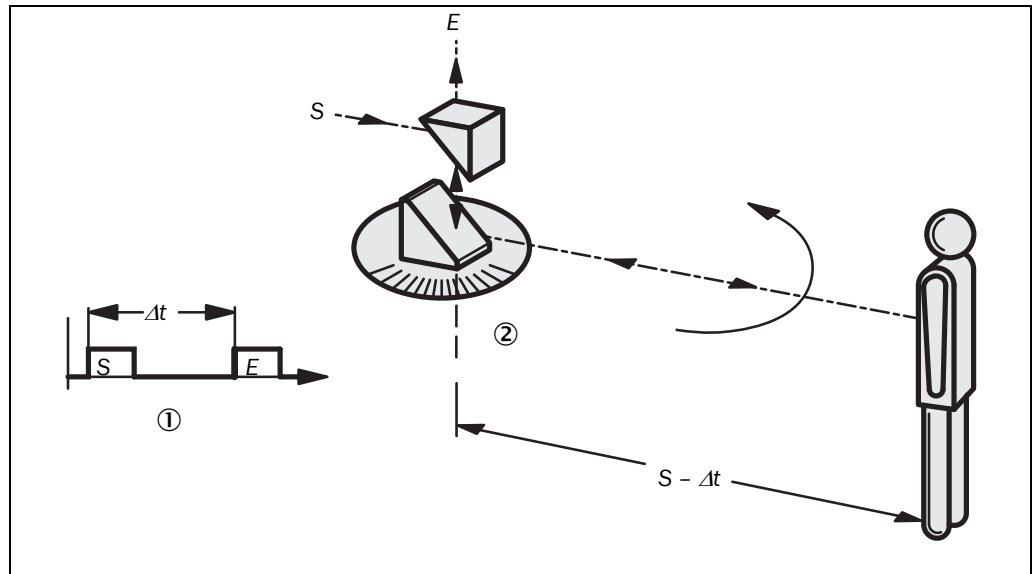
²⁾ Maximum protective field radii.

S3000

3.2.1 Principles of operation

The S3000 is an optical sensor that scans its surroundings in two dimensions using infrared laser beams. It is used to monitor a hazardous area on a machine or a vehicle.

Fig. 1: Principle of operation, time-of-flight measurement by the S3000

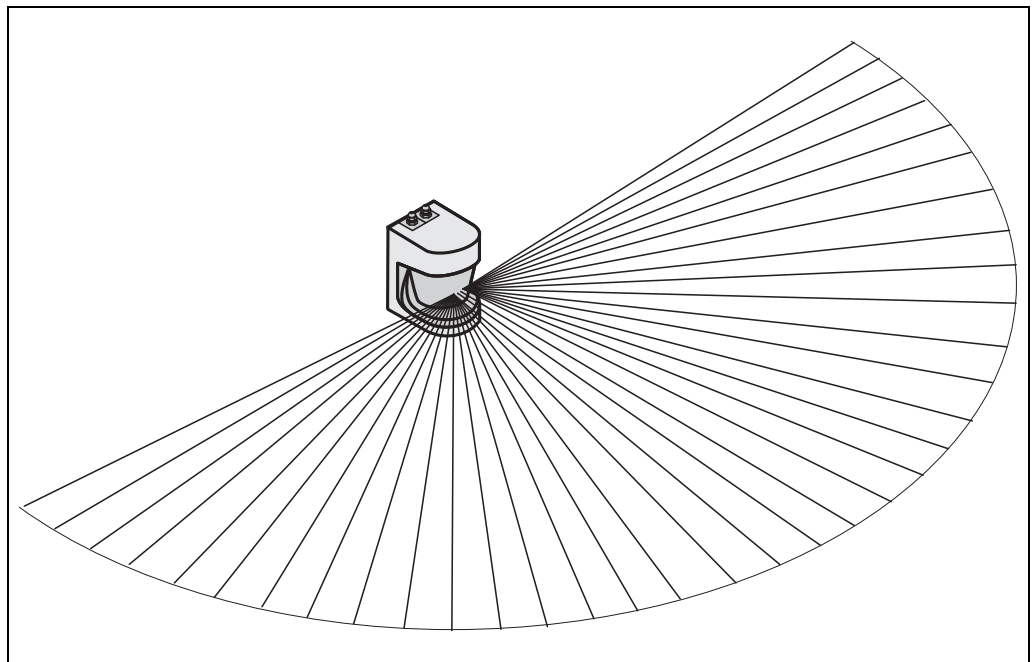


The S3000 works on the principle of time-of-flight measurement ①. It sends out very short pulses of light (S). At the same time an “electronic stopwatch” is started. When the light is incident on an object, it is reflected and received by the safety laser scanner (E). From the time between sending and reception (Δt) the S3000 calculates the distance to the object.

In the S3000 there is also a mirror rotating at constant speed ② that deflects the light pulses such that they cover an arc of 190° . By determining the angle of rotation of the mirror, the S3000 determines the direction of the object.

From the measured distance and the direction of the object, the safety laser scanner determines the exact position of the object.

Fig. 2: Principle of operation of the S3000 – light pulses



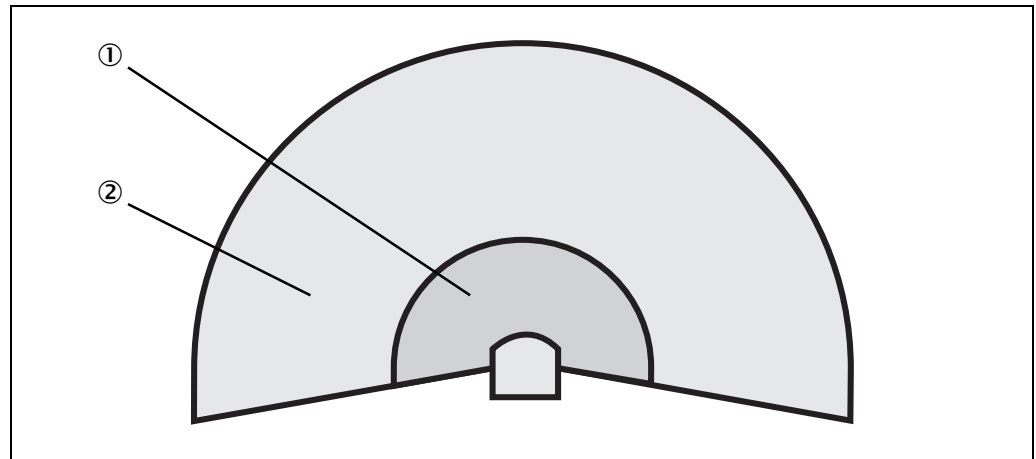
The S3000 uses light pulses precisely radiated in specific directions. Thus the laser scanner does not continuously cover the area to be monitored. In this way resolutions of between 30 mm and 150 mm are achieved.

Due to its active scanning principle, the S3000 does not require receivers or reflectors. This has the following advantages:

- Ease of installation.
- You can easily adapt the monitored area to the hazardous area on a machine.
- In comparison with contact sensors, there is less wear when electro-sensitive scanning is used.

3.2.2 Field set comprising of protective field and warning field

Fig. 3: Protective field and warning field



The protective field ① secures the hazardous area on a machine or vehicle. As soon as the safety laser scanner detects an object in the protective field, the S3000 switches the OSSDs to the off status and thus initiates the shutdown of the machine or stop of the vehicle.

You can define the warning field ② such that the safety laser scanner detects an object before the actual hazardous area and e.g. triggers a warning signal.

The protective field and warning field form a pair, the so-called field set. With the aid of the CDS you can configure these field sets and transfer them to the S3000. If the area to be monitored changes, then you can re-configure the S3000 in software without additional mounting effort.

Depending on the I/O module used (see section “I/O modules” on page 24) you can define up to eight field sets and save these in the safety laser scanner. When using the safety laser scanners S3000 Advanced, S3000 Professional and S3000 Remote this enables you to switch to a different field set if the monitoring situation changes (see section 3.2.3 “Monitoring cases” on page 17).

S3000

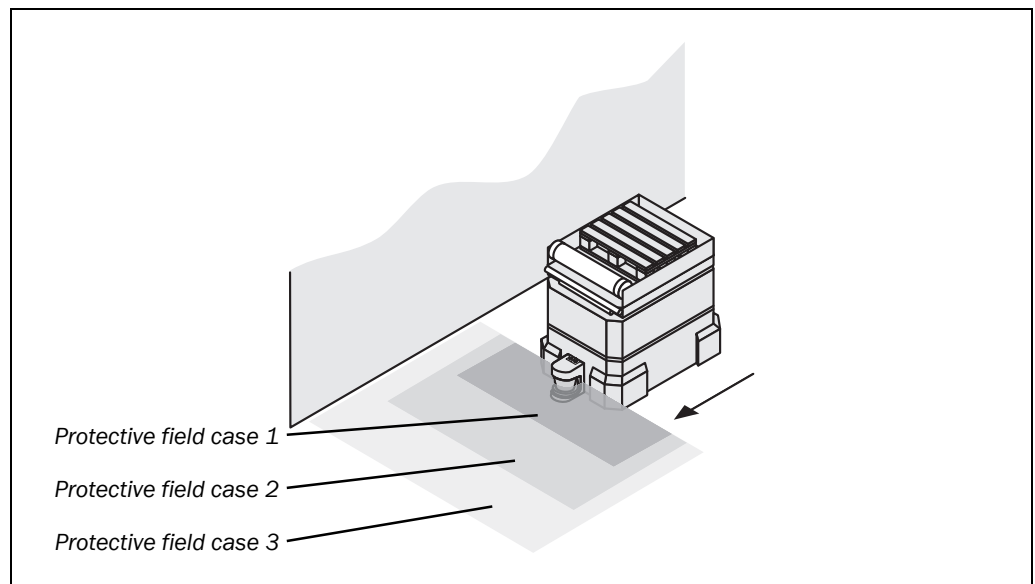
3.2.3 Monitoring cases

Depending on the I/O module used (see section “I/O modules” on page 24) up to 16 monitoring cases can be defined and selected during operation using static or dynamic control inputs. In this way, for instance, it is possible to monitor vehicles as a function of the velocity.

Each monitoring case includes ...

- the input conditions, the so-called control signals, that control the activation of the monitoring case.
- a field set, comprising protective field and warning field.
- if necessary, a simultaneous field set.
- if necessary, a unique follow-on case or two alternative follow-on cases.

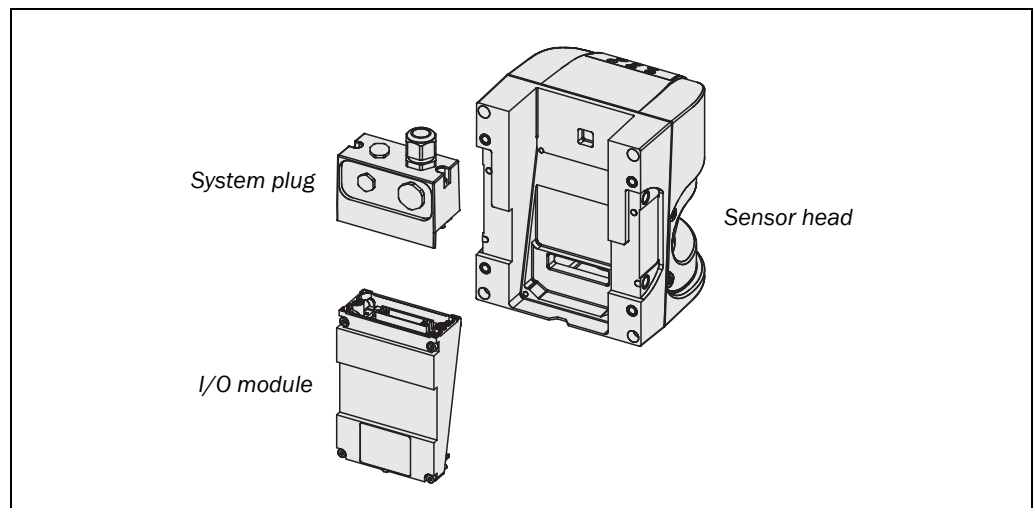
Fig. 4: S3000 with three defined monitoring cases on an AGV

**3.2.4 Device components**

The S3000 safety laser scanner comprises three components:

- the sensor head with the opto-electronic acquisition system
- the I/O module, this defines the functionality of the S3000
- the system plug with the configuration memory (the system plug contains all electrical connections)

Fig. 5: Sensor head, I/O module and system plug



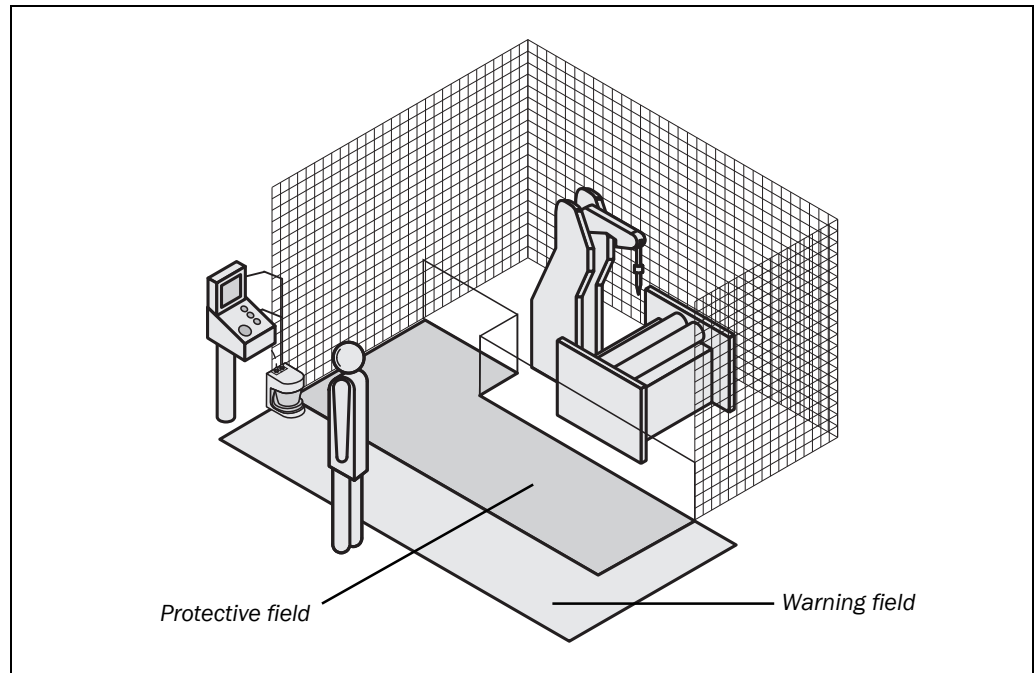
3.3 Applications

3.3.1 Stationary applications

Hazardous area protection

On dangerous stationary machines, the S3000 switches the output signal switching devices (OSSDs) to the off status if the protective field is interrupted. The S3000 initiates the shutdown of the machine or the shutdown of the dangerous state.

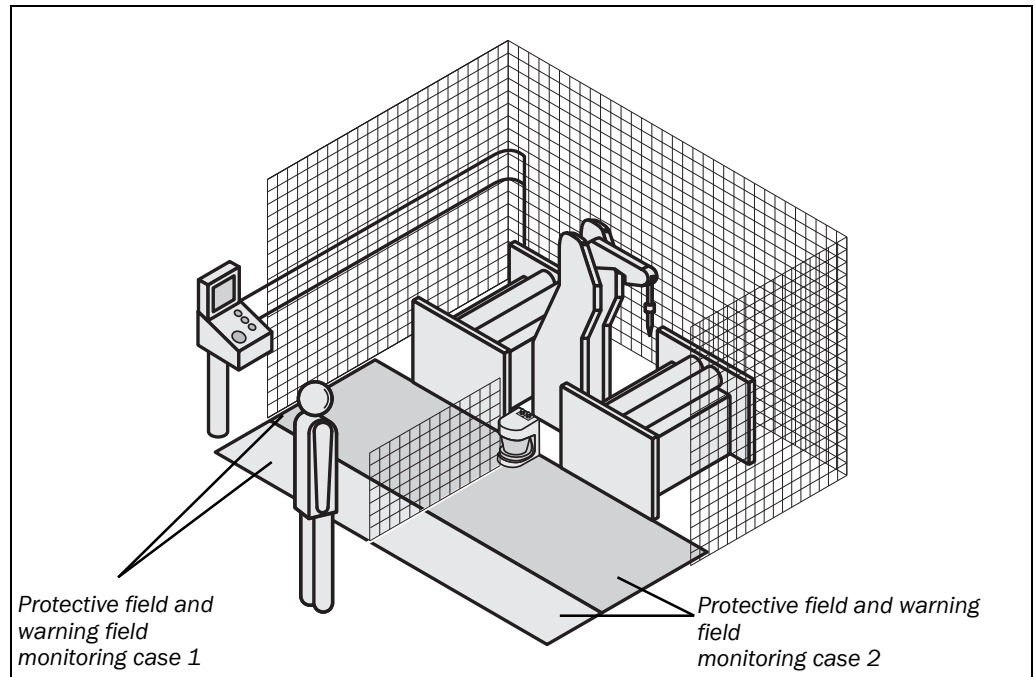
Fig. 6: Hazardous area protection with one monitored area



S3000**Hazardous area protection with multiple monitored areas (position-related protective field switching)**

Using the safety laser scanners S3000 Advanced, Professional and Remote (see chapter 3.4 “S3000 variants” on page 24) you can define various monitoring cases to match the protective field and warning field to the situation on the machine and to monitor changing hazardous areas — e.g. during different machine production phases — depending on the situation.

Fig. 7: Hazardous area protection with multiple monitored areas

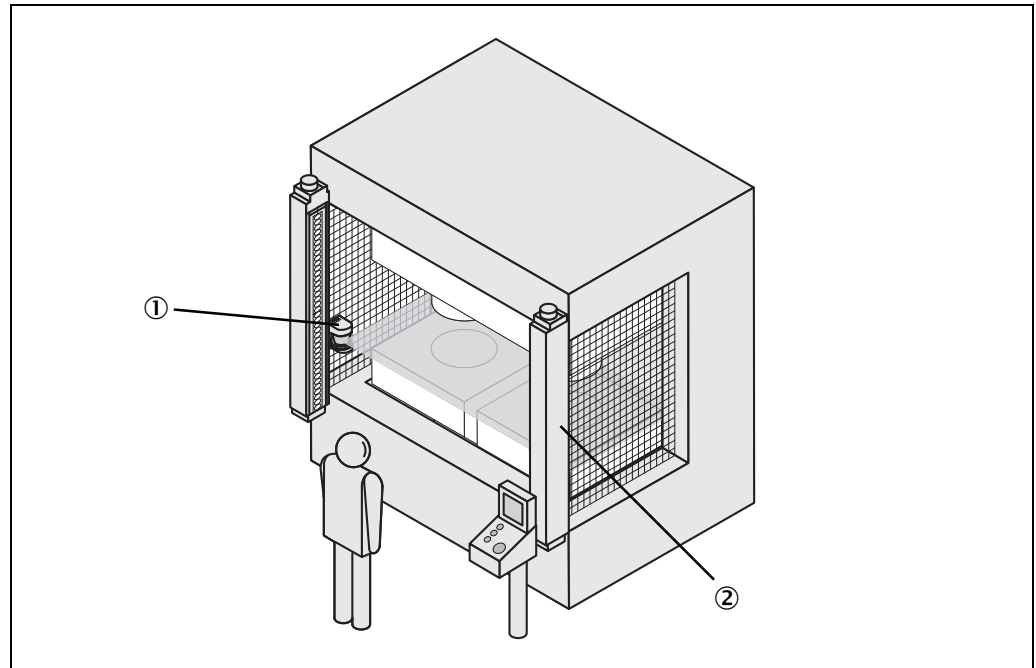


Interior protection

On large machines the S3000 safety laser scanner can be used to protect the interior. The machine can only be restarted if the S3000 does not detect any object in the protective field. This is particularly important for interiors that can only be seen with difficulty from the outside, or cannot be seen at all.

In this application, the S3000 ① only has a secondary protective function. The primary protective function that stops the dangerous movement is provided in the example by a light curtain ②, while the S3000 monitors the restarting of the machine.

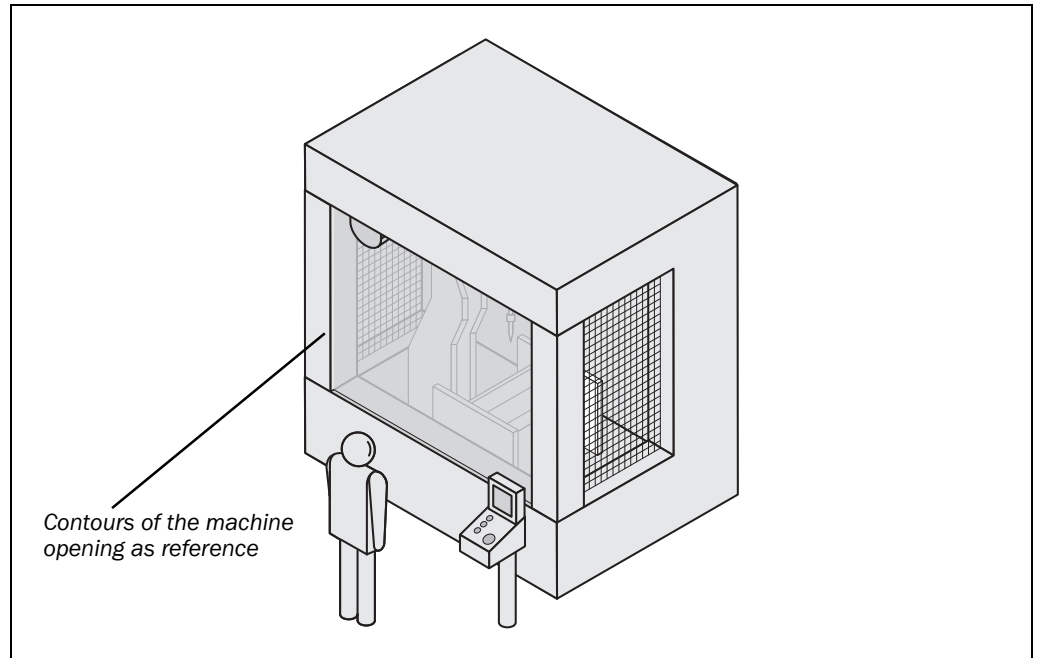
Fig. 8: Interior protection



S3000**Hazardous point protection (vertical protection)**

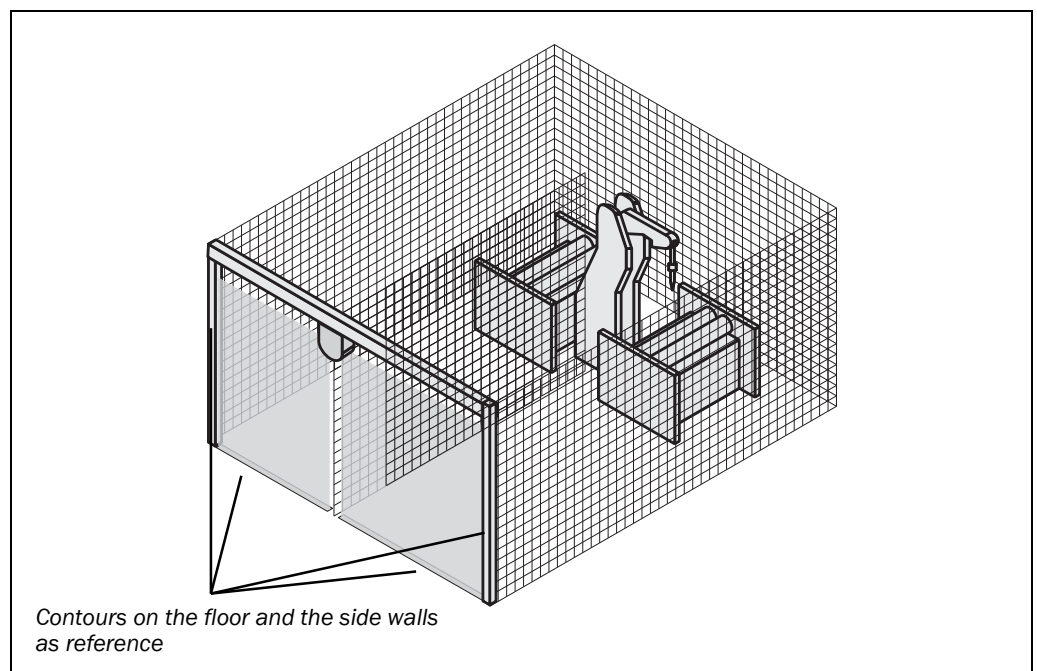
The S3000 can also be used vertically. Mounting in this way requires less space on the machine or plant. Hazardous point protection is necessary if the operator is near the dangerous state of the machine. Hand protection must be realised to protect the hazardous point.

Fig. 9: Protecting hazardous points

**Access protection (vertical protection)**

You can also use the S3000 vertically for access protection. Access protection can be used when the access to the machine can be defined by physical means. With access protection the S3000 detects the entry of a person.

Fig. 10: Access protection



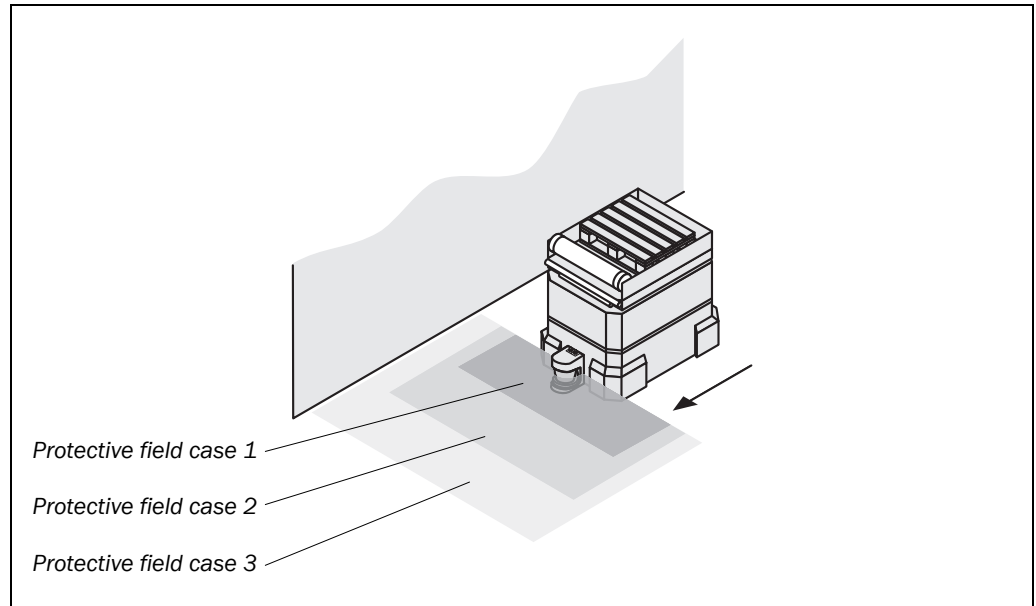
3.3.2 Mobile applications

The S3000 can be used both on manually controlled vehicles, e.g. fork lift trucks, and also on automated guided vehicles (AGV) or trolleys.

Velocity-dependent protective field switching

You can use the S3000 on vehicles, e.g. to protect the route of a vehicle through a factory building. If there is a person or an obstacle in the hazardous area, the S3000 ensures that the vehicle reduces speed and stops if necessary.

Fig. 11: Velocity-dependent protective field switching



Several user defined monitoring cases are used to monitor the hazardous areas differently at varying velocities. You can acquire the velocity of the vehicle using incremental encoders, and using this information dynamically adapt field sets of varying size to the vehicle velocity (see section “Incremental encoder specification” on page 77).

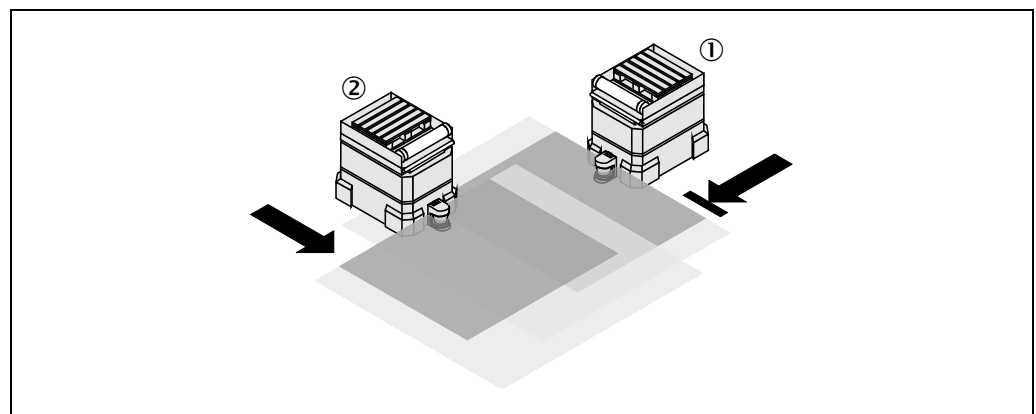
3.3.3 Other applications (not for personnel protection)

Along with safety-related applications, you can also use the S3000 for applications in which people do not need to be protected.

Collision protection

Along with people, you can also, for instance, protect vehicles from colliding with other objects.

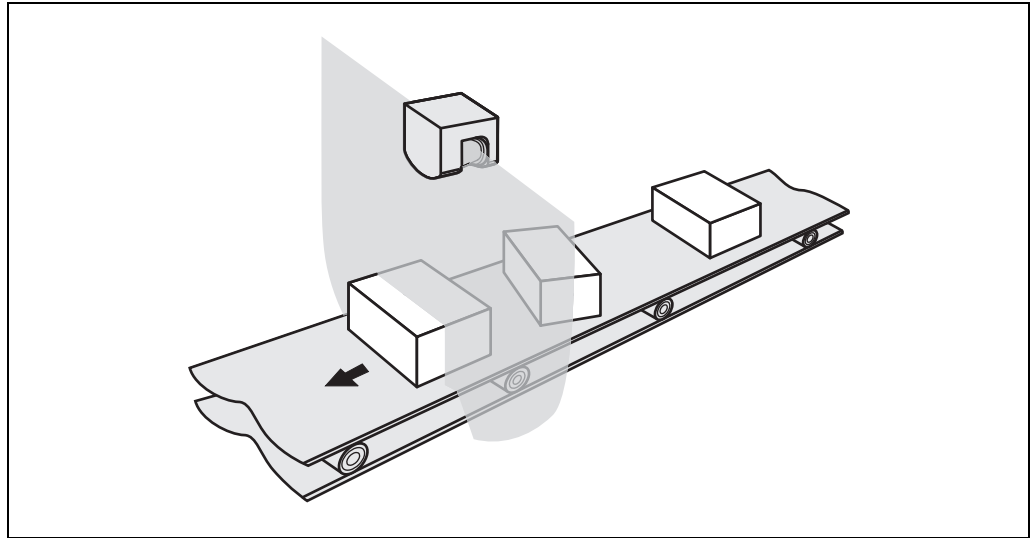
Fig. 12: Collision protection



As soon as vehicle ② reaches the warning field of vehicle ①, vehicle ① slows down. When vehicle ② reaches the protective field of vehicle ①, vehicle ① stops.

S3000

Fig. 13: Measurement application "contour measurement"

Measurement applications

You can use the measuring principle of the S3000 for numerous measurement tasks, e.g. for the

- item size measurement
- item position detection (e.g. pallets)
- cross-sectional measurement in corridors and tunnels
- profile measurement of items or vehicles
- overhang checking for items on shelves
- level measurement for solid bulk material
- length measurement

Notes

- Please note the additional functions of the S3000 I/O modules Professional and Professional CMS; with these modules expanded applications are possible via the measured data interface RS-422. You will find further details on this topic in the documentation on the message lists (part no. 9090807).
- Laser measuring systems (LMS) with specially adapted software are also available from SICK AG for measuring tasks.

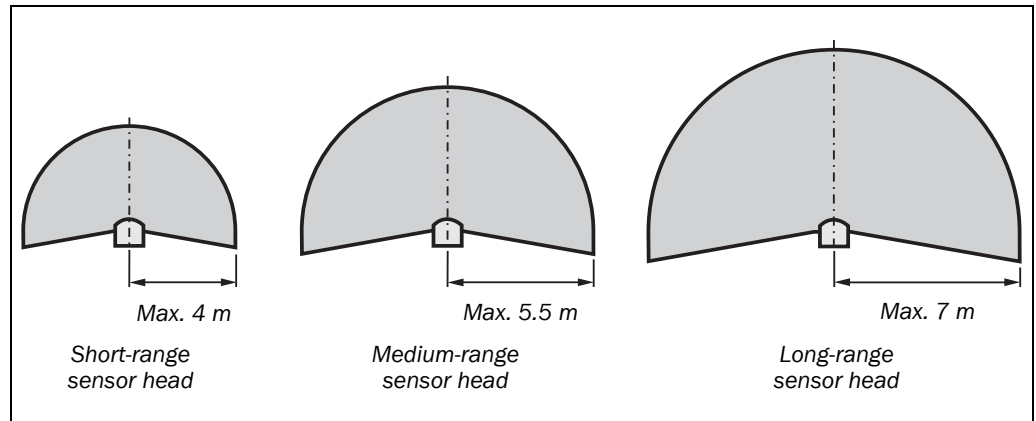
3.4 S3000 variants

To cover the stated applications, there are 15 S3000 variants. These are formed by three sensor heads and five I/O modules.

Sensor heads

The sensor heads differ in the maximum scanning range and the resulting size of the protective field.

Fig. 14: Protective field ranges of the sensor heads

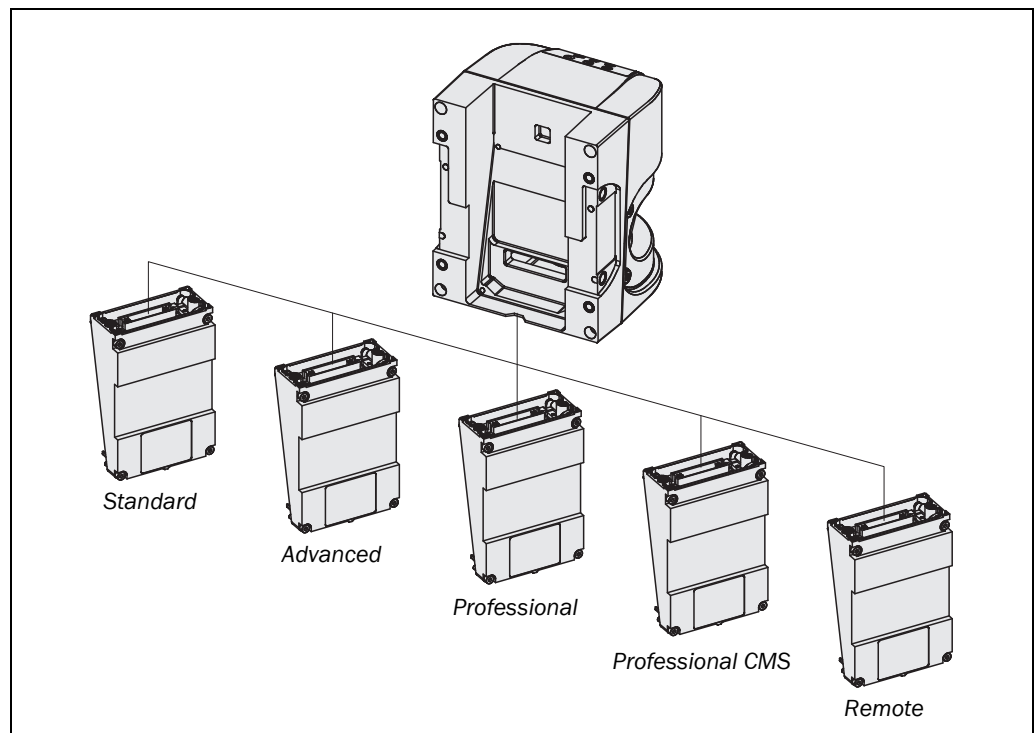


Note The protective field ranges are the maximum achievable radial distances from the safety laser scanner. They are achieved in applications with a resolution of 70 mm and coarser.

I/O modules

Five I/O modules are available for the S3000. With the aid of these I/O modules, the S3000 covers the various application areas.

Fig. 15: Available I/O modules



S3000Tab. 1: Functions
of the I/O modules

Functions	Standard	Advanced	Professional	Professional CMS	Remote
Pairs of output signal switching devices (OSSDs)	1	1	1	1	1
External device monitoring (EDM)	Yes	Yes	Yes	Yes	Yes
Restart interlock/delay	Yes	Yes	Yes	Yes	Yes
Application diagnostic output (warning field interrupted, control switch, restart or reset pressed, error/contamination)	3	3	3	3	3
Field sets for the simultaneous monitoring of two areas	Yes	Yes	Yes	Yes	Yes
Switchable field sets	1	4	8	8	8 ³⁾
Programmable monitoring cases	1	4	16	16	16 ⁴⁾
EFI (safe SICK device communication) for the combination of two S3000 in one system (vehicle monitoring with bi-directional travel) or for a bus interface to devices in the Flexi Soft/Classic, EFI gateways series (function enhancement)	Yes	Yes	Yes	Yes	Yes
Static control inputs for switching between the monitoring cases (complementary or 1-of-n)	–	2	2	2	–
Universal control inputs. The inputs can be used both as static (complementary or 1-of-n) control inputs and as dynamic control inputs for switching between the monitoring cases.	–	–	2	2	–
Output of the measured data (surrounding contour)	Yes	Yes	Yes	Yes	Yes
Filter function for the measured data	–	–	–	Yes	–
Reflector detection	–	–	–	Yes	–
Configurable message structure	–	–	–	Yes	–

Note The CD-ROM “CDS & Manuals” contains additional documentation on the topics of measured data output, filter functions, reflector detection and message structure (PDF file in German and English).

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.

⁴⁾ Maximum possible number of monitoring cases — the actual number is the same as for the S3000 variant to which an S3000 Remote is connected.

3.4.1 Possible applications for the S3000 variants*Tab. 2: Possible applications for the I/O modules*

Typical application	Functionality required	Necessary variant
Protection of a robot insertion station	One field set	S3000 Standard
Protection of a pipe bending machine	Up to four switchable field sets	S3000 Advanced
Protection of a complex material processing system	Up to eight switchable field sets	S3000 Professional
Protection of an automated guided vehicle AGV with bi-directional travel	In each direction of travel up to eight velocity-dependent switchable field sets	S3000 Professional together with S3000 Remote
Protection of an automated guided vehicle (AGV) with output of processed measured data (for assisting control, e.g. during docking manoeuvres)	Up to eight velocity-dependent switchable field sets, separate data interface for the output of room contour and reflector detection	S3000 Professional CMS

3.5 Configurable functions

3.5.1 Field sets

Configuring the protective field and warning field



WARNING

Check the protective fields configured!

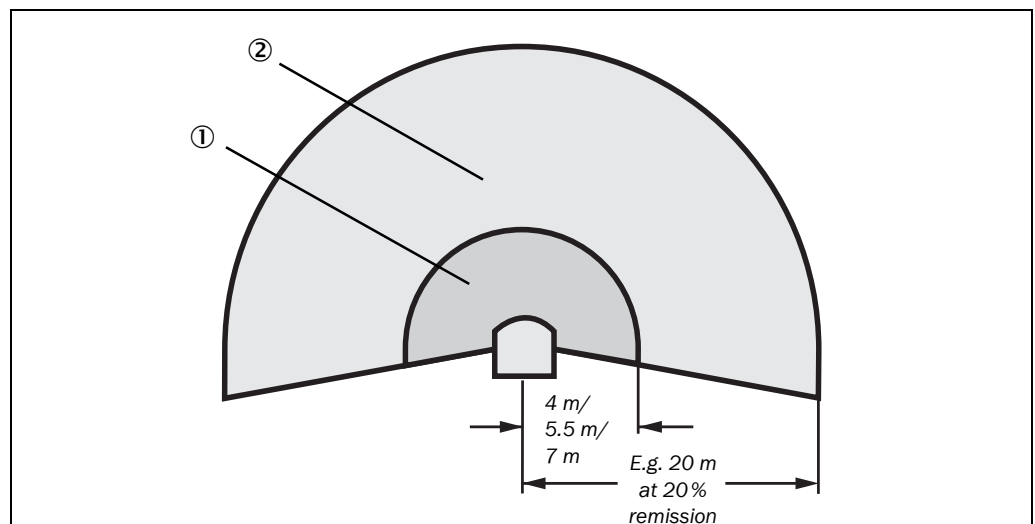
Prior to commissioning the machine or vehicle, check the configuration of the protective fields using the instructions in chapter 8 “Commissioning” on page 97 and using the checklist on page 139.

Note

The area to be monitored is scanned radially by the S3000. The S3000 cannot “see around a corner”. The area behind objects that are in the area to be monitored (pillars, grilles, etc.) can thus not be monitored.

- The protective field (①) can cover up to 190° and, depending on the sensor head, have a radius of up to 4 m, 5.5 m or up to 7 m.
- The warning field (②) can cover up to 190° and have a radius of up to 49 m. The detection is dependent on the remission (e.g. objects with 20% remission can be detected at a radius of up to 20 m).

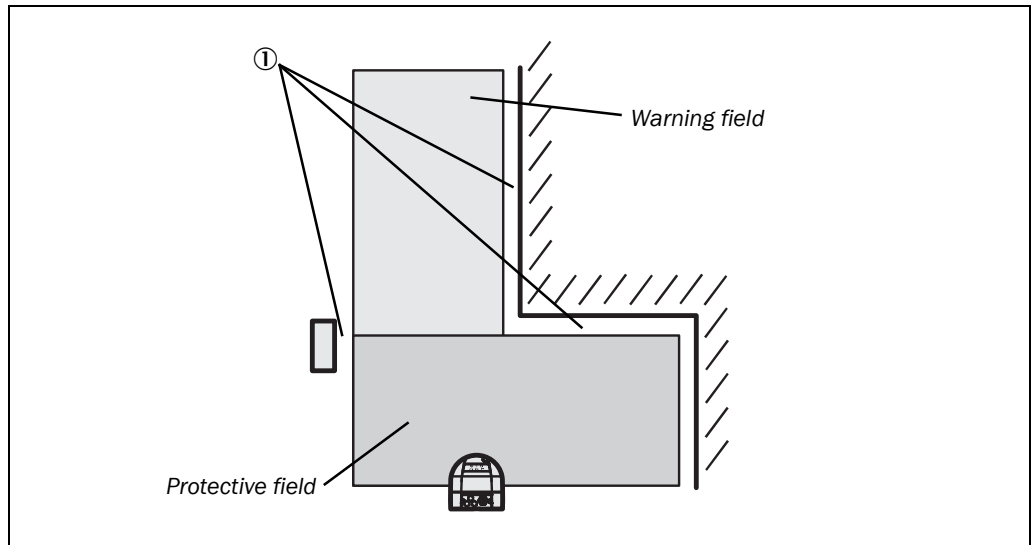
Fig. 16: Radii of protective field and warning field



With the aid of the CDS you can configure the field set, which comprises a protective field and a warning field. During this process you configure the shape and size of the protective field and the warning field. You can realise any field shape required.

Note If the protective field or warning field stretches as far as a wall or another object (pillar, neighbouring machine, shelf), there must be a distance of 100 mm between the protective field or warning field and the object ①.

Fig. 17: Configuring protective field and warning field



WARNING

Secure unprotected areas

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

Protective field suggested by the safety laser scanner

The CDS can suggest a protective field. The safety laser scanner scans the visible room contour several times. During this process possible measurement errors are taken into account. From the data obtained in this way the CDS determines the contour of the surrounding.



You can obtain the suggestion for the protective field in the field set editor in the CDS.

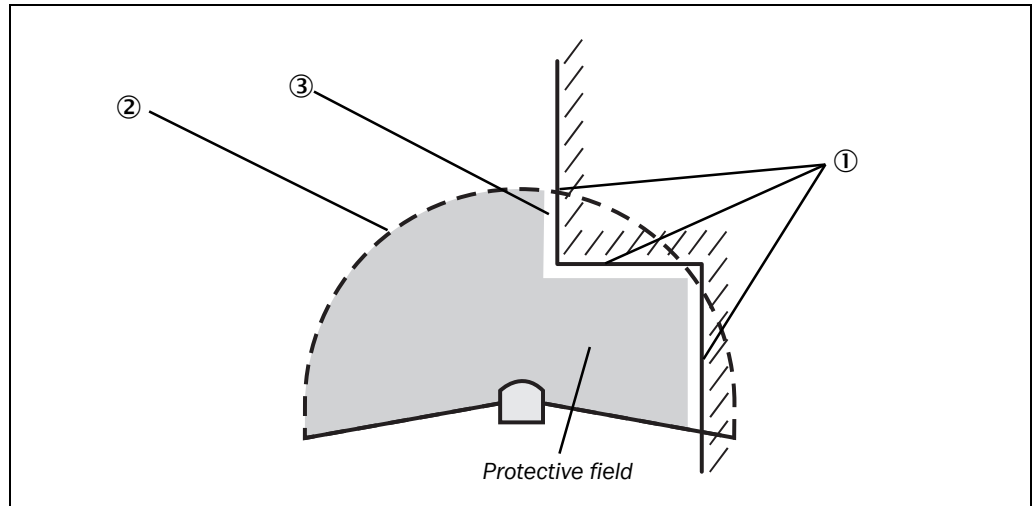
The size determined for the protective field is ...

- as large as the visible room contour ①.
- as large as the maximum scanning range of the safety laser scanner ② in places where there is no room contour within the scanning range.

Note The measurement tolerances of the S3000 are automatically subtracted from the protective field suggested. The protective field is then a distance of 100 mm from walls or objects ③.

S3000

Fig. 18: Reading protective field and warning field



WARNING

Check the protective field suggested!

The safety laser scanner cannot calculate the safety distance necessary for your application. Calculate the safety distance based on the descriptions in chapter 4 “Installation and mounting” on page 47. Prior to commissioning the machine or vehicle, check the configuration of the protective fields using the instructions in chapter 8 “Commissioning” on page 97 and using the checklist on page 139.

3.5.2 Resolution, basic response time and scanning range



With the CDS you can configure the S3000 for the required application. First set the resolution for application. Possible resolutions are:

- 30 mm (hand detection with smaller safety distance)
- 40 mm (hand detection with larger safety distance)
- 50 mm (leg detection with smaller protective field size)
- 70 mm (leg detection with larger protective field size)
- 150 mm (body detection)

Note For mobile applications a resolution of only 70 mm is required for leg detection, as a lower resolution is sufficient for the detection of a human leg due to the movement of the vehicle.

The maximum protective field range depends on the resolution selected⁵⁾ and the basic response time for application depends on the maximum protective field range. The following tables show the values that can be configured:

⁵⁾ Radial distance to the safety laser scanner.

Tab. 3: Maximum protective field range short-range sensor head

Application	60 ms basic response time	120 ms basic response time
Stationary		
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)	4.00 m	4.00 m
Mobile		
70 mm (leg detection)	4.00 m	4.00 m

Tab. 4: Maximum protective field range medium-range sensor head

Application	60 ms basic response time	120 ms basic response time
Stationary		
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)	5.50 m	5.50 m
Mobile		
70 mm (leg detection)	4.70 m	5.50 m

Tab. 5: Maximum protective field range long-range sensor head

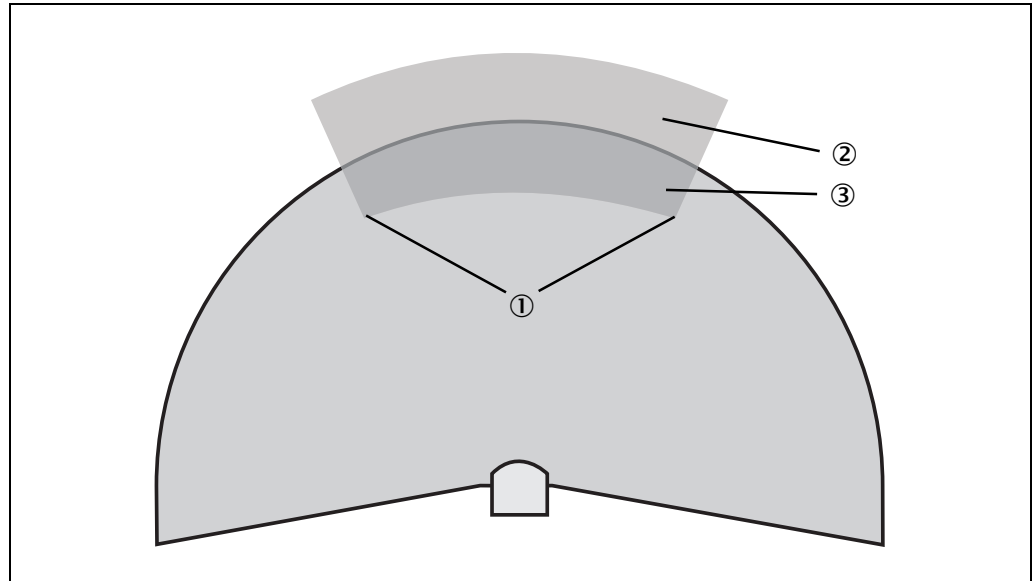
Application	60 ms basic response time	120 ms basic response time
Stationary		
30 mm (hand detection)	1.90 m	2.80 m
40 mm (hand detection)	2.60 m	3.80 m
50 mm (leg detection)	3.30 m	4.80 m
70 mm (leg detection)	4.70 m	7.00 m
150 mm (body detection)	7.00 m	7.00 m
Mobile		
70 mm (leg detection)	4.70 m	7.00 m

Note You may need to add supplements to the basic response time due to multiple sampling and data transmission over EFI (see chapter 11.2 “OSSD response times” on page 115).

3.5.3 Using the contour as a reference

In addition to the protective field, the S3000 can also monitor a contour (e.g. the floor in vertical applications or the walls in horizontal applications).

Fig. 19: Schematic diagram of contour as reference



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

The OSSDs on the S3000 switch to the OFF state if ...

- there is an object in the protective field.
- the room contour changes by more than the tolerance band in the contour segment (e.g. by opening a door or by changing the position of the S3000).

Note You can define any number of contour segments. The contour segments must not be narrower than the configured resolution. At the points where a contour has been configured as a reference you cannot define a warning field.

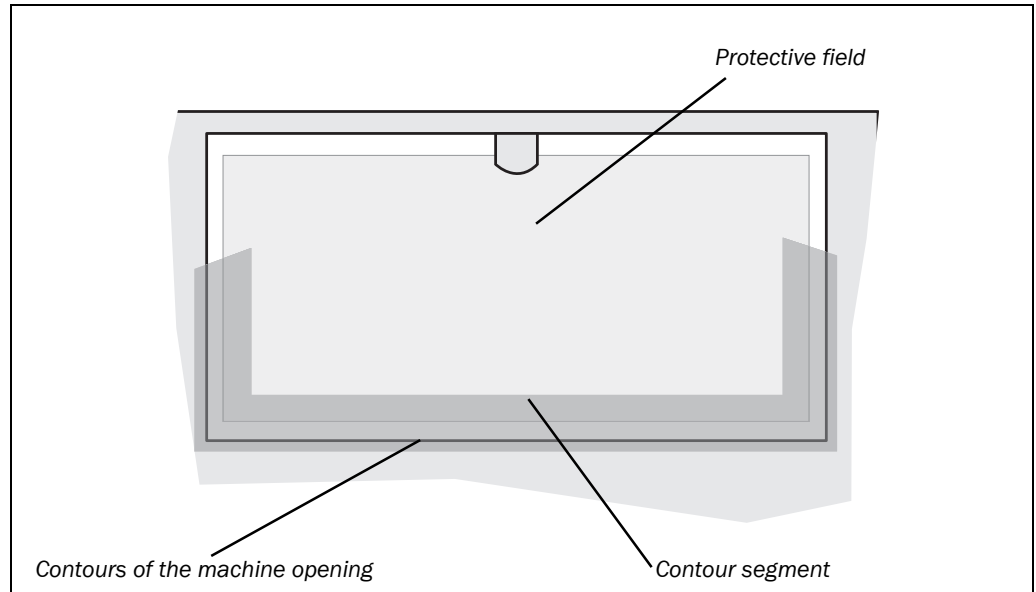


You define the contour as a reference in the CDS field set editor.

Vertical operation

In vertical operation (for access protection and hazardous point protection) according to CLC/TS 61496-3 you **must** always configure the protective fields used with the contour as reference function.

Fig. 20: Contour as reference for vertical operation

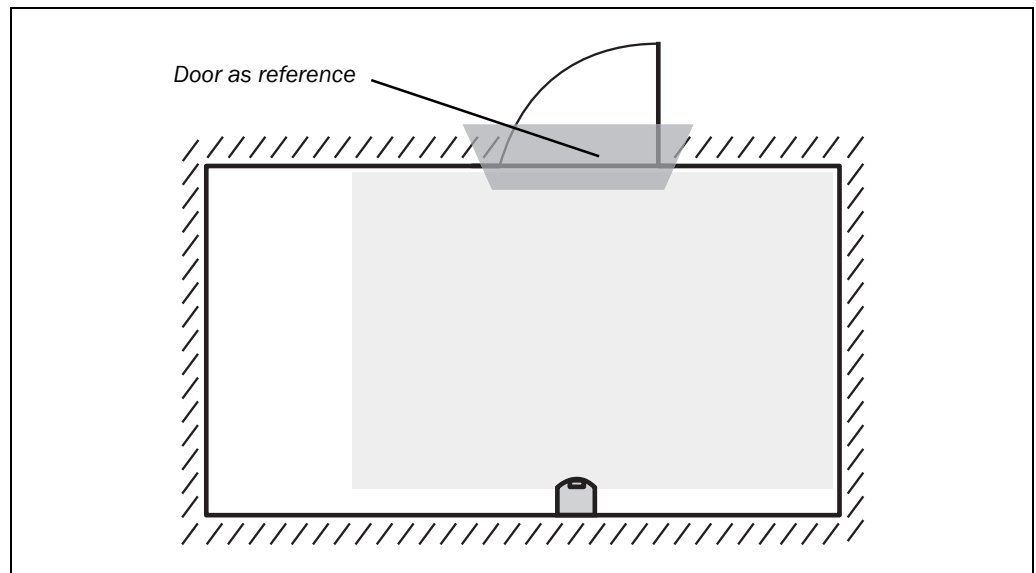
**Recommendation**

Use lateral, vertical boundaries of the opening (e.g. door frames) and the floor as reference. If in this case the position of the S3000 is changed in one or more planes, the distance to the reference changes and the S3000 switches its OSSDs to the OFF state.

Horizontal operation

During horizontal operation, you can also use the contour as reference function, e.g. so that if a door is opened (change to the room contour) the OSSDs on the S3000 are placed in the OFF state.

Fig. 21: Contour as reference for horizontal operation



3.5.4 Internal or external OSSDs



On a system with two safety laser scanners S3000 or on an S3000 that is connected to a switching amplifier or a bus node (series UE100 or UE1000), you can define which output is switched by the protective field or the protective fields.

- Internal OSSDs

Defines that the protective field or the protective fields switch the OSSDs on S3000.

- External OSSDs

The S3000 transmits the status of the field sets (protective field/warning field) over the EFI. The OSSDs on another device connected via the EFI have switched.

- S3000 connected: The OSSDs on the second S3000 are switched.
- Switching amplifier connected (UE100 series): The OSSDs on the switching device are switched.
- Bus node connected (UE1000 series): Using the bus node the information is passed to an FPLC that must shutdown the dangerous state.



WARNING

Only connect the OSSDs to a single subsequent switching element!

Each output signal switching device (OSSD) is only allowed to be connected to one switching element (e.g. relay or contactor). If several switching elements are required, then you must choose a suitable form of contact duplication.

3.5.5 External device monitoring (EDM)

The EDM function monitors the contact elements activated by both the OSSDs (e.g. contactors). The machine is only allowed to start if both contactors are in the de-energised state on reset, that is they are deactivated.

The S3000 monitors the contactors after every interruption of the protective field and before the restart of the machine. The EDM can therefore detect if one of the contacts on the contactor has fused, for instance.



You can configure the external device monitoring in the CDS.

- If **no** internal restart interlock is configured, then ...
 - the system locks completely (lock-out).
 - the error message  appears in the 7-segment display.
- If an internal restart interlock is configured, then ...
 - the S3000 deactivates its OSSDs.
 - the adjacent LED illuminates.
 - the error message  appears in the 7-segment display.
 - with the flashing LED the S3000 signals that the control switch for restarting or resetting the restart must be operated.



Notes

- You will find examples on the connection of the external device monitoring in chapter 6.4 “Connection diagrams” on page 88.
- If you do not use the external device monitoring function, leave the inputs disconnected (see chapter 5.1.1 “Pin assignments of the I/O modules” on page 75).

3.5.6 Application diagnostic output

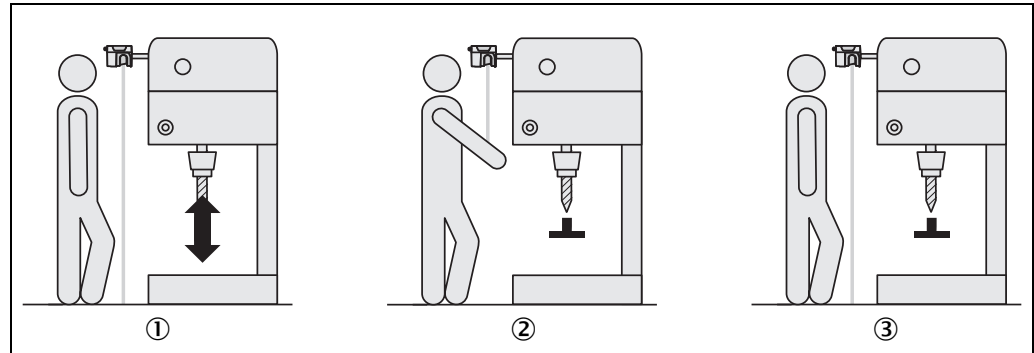


The S3000 has an application diagnostic output that can be configured. For the application diagnostic output you configure in the CDS ...

- whether it 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.

3.5.7 Restart

Fig. 22: Schematic of operation with restart interlock



Restart interlock

The dangerous state of a machine ① or a vehicle is interrupted as soon as there is an object in the protective field ② and is not enabled again ③, even if there is no longer an object in the protective field. The OSSDs are only enabled again when the operator operates the control switch for restarting or resetting.

The restart interlock can be implemented in two different ways:

- with the internal restart interlock of the S3000:
The outputs on the S3000 are enabled after the connected control switch is operated.
- with the restart interlock of the machine controller:
The S3000 has no effect on the restart.



WARNING

Place the control switch for restart or reset outside the hazardous area in a place where it can clearly be seen from the hazardous area!

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. Ensure that the person who operates the control switch has a full view of the hazardous area.

S3000

Restart delay

On the S3000, instead of a restart interlock you can configure a restart delay of 2 to 60 seconds. This enables the machine or the vehicle to start automatically when the protective field becomes clear, and the set time has elapsed. It is not possible to combine restart interlock and restart delay.

**WARNING**

It is imperative that you configure the S3000 with restart interlock if the protective field can be left to approach the hazardous point and if a person cannot be detected at every point in the hazard area for the S3000!

Restart interlock is imperative if the protective field can be left to approach the hazardous point. If this is the case and you deactivate both the restart interlock on the S3000 and the restart interlock on the machine, you will place the operators at serious risk. Check, if necessary, whether it is possible to prevent the protective field from being left to approach the hazard point by design measures (see chapter 4.1.2 “Measures to protect areas not covered by the S3000”).

Note

The S3000 cannot differentiate between a contaminated front screen and an obstacle directly in front of it. To ensure high availability, the S3000 has been designed such that it reliably detects dark black bodies such as wide black cord or shoe leather from a distance of 5 cm in front of the front screen.

Furthermore, due to mounting with or without mounting kits, unprotected areas are produced near the S3000.

**WARNING**

Secure the area close to the S3000 if operated without restart interlock!

Make the area near the device impassible by means of physical measures (bar or recessing) or, in addition to the S3000, use a proximity switch with 5 cm acquisition range. Without this additional protection you will endanger persons who move from the protective field into the area near the device.

Permissible configuration

Restart interlock of the S3000	Restart interlock machine/vehicle	Permissible application
Deactivated	Deactivated	Only if it is not possible to leave the protective field to approach the hazardous point. Ensure that this is prevented by the design of the plant.
Deactivated	Activated	All, if the hazardous area can be completely seen by the operator
Activated	Deactivated	Only if it is not possible to leave the protective field to approach the hazardous point. Ensure that this is prevented by the design of the plant.
Activated	Activated	All, if the hazardous area cannot be completely seen by the operator. The restart interlock of the S3000 takes over the function for resetting the protective device. Restart interlock using the machine controller (see “Reset” on page 36).

Tab. 6: Permissible configuration of the restart interlock

Reset

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

If you want to activate the restart interlock on the S3000 (internal) and also a restart interlock on the machine (external), then each restart interlock has its own control switch.

After operating the control switch for the internal restart interlock (with protective field unoccupied) ...



- the S3000 switches on its OSSDs.

- the adjacent LED on the safety laser scanner illuminates green.

The external restart interlock prevents the machine from restarting. After resetting the S3000 the operator must press the control switch to restart the machine controller.



WARNING

Ensure that the correct sequence is followed!

The controller must be configured such that the machine only restarts if the S3000 is first reset and then the control switch for restarting the machine controller is pressed.

Notes

- You will find examples on the connection of the internal restart interlock in chapter 6.4 “Connection diagrams” on page 88.

If you do not use the restart interlock, leave the inputs disconnected (see chapter 5.1.1 “Pin assignments of the I/O modules” on page 75).



You can configure the type of restart in the CDS.

3.5.8 Multiple sampling

When multiple sampling is set, an object must be scanned several times before the S3000 deactivates its OSSDs. In this way you can reduce the probability that, for instance, welding sparks, dust or slow flying insects can cause the system to stop.

With a multiple sampling configuration of, e.g., 3, an object must be scanned three times in succession before the S3000 switches off the OSSDs.



WARNING

The total response time is increased by the multiple sampling!

With a multiple sampling greater than 2, note that you must add a supplement to the basic response time (see chapter 11.2 “OSSD response times” on page 115)!

On the S3000, a multiple sampling of 2 is the minimum setting. You can set the multiple sampling up to 16 with the aid of the CDS. The response time resulting from your setting is displayed in the CDS.

Tab. 7: Recommended multiple sampling

Recommended multiple sampling	Application
2 times	Stationary under clean ambient conditions
3 times	Vertical applications
4 times	Mobile
8 times	Stationary under dusty ambient conditions

Recommendation

Using multiple sampling you can increase the availability of a plant.

You can configure the multiple sampling in the CDS for each monitoring case. vertical applications

3.5.9 Monitoring cases

If you are using the S3000 Advanced, you can define up to four monitoring cases, if you are using the S3000 Professional, up to 16 monitoring cases (the S3000 Remote offers the same number of monitoring cases as the S3000 variant connected to it). Allocate a field set to each monitoring case (and, if necessary, an additional, simultaneously monitored field set).



WARNING

Ensure that the safety distance to the dangerous state is adequate in any monitoring case to protect the hazardous area!

See chapter 4 “Installation and mounting” on page 47.

It is possible to switch between these monitoring cases during operation:

- on the S3000 Advanced via static control inputs or via the EFI interface (e.g. using a Flexi Soft safety controller)
- on the S3000 Professional using static and/or dynamic control inputs (with incremental encoders) or via the EFI (e.g. using a Flexi Soft safety controller)
- on the S3000 Remote using the EFI (e.g. using a Flexi Soft safety controller)

Park mode

For mobile applications in which vehicles are parked for a time, the safety laser scanners S3000 Advanced, S3000 Professional and S3000 Remote can be switched to park mode. In the park mode the OSSDs are deactivated and the laser in the safety laser scanner shutdown. In this way the power consumption of the device is reduced.

The park mode can be configured for a monitoring case. To switch to the park mode, the inputs must be configured such that the related monitoring case with the park mode is activated.

Recommendation

If you park vehicles beside each other, switch them to the park mode. In this way you prevent the S3000 on the vehicles from dazzling each other and the S3000 from possibly entering an error condition.



You can configure the monitoring cases in the CDS.

3.5.10 Static and dynamic control inputs for incremental encoders

The S3000 Advanced has two two-channel static control inputs via which the four possible monitoring cases can be switched.

The S3000 Professional has four two-channel control inputs via which the 16 possible monitoring cases can be switched. Of these four control inputs, two are static, the other two can be used universally as both static control inputs and also dynamic control inputs.



You can configure the control inputs in the CDS.

If you are using static sampling, decide between complementary or 1-of-n sampling depending on the control features available.



WARNING

When switching the monitoring cases using static and dynamic control inputs, please note the following points:

- Ensure that the control for the monitoring case switching has a sufficiently high level of safety.
- Ensure that the circuit for the control inputs is suitable for the ambient conditions to be expected so that systematic effects and thus errors on the switching of the monitoring cases can be excluded.
- Ensure that the control — using static or dynamic control inputs (incremental encoder inputs) — provides switching between the monitoring cases in the correct time frame. Note that at the time of the switching there may be a person in the protective field. Only by means of switching in the correct time frame (i.e. before the hazard occurs at this point for the person) is protection provided (see chapter 4.5 “Timing for monitoring case switching” on page 65).
- Ensure that only one safety laser scanner is connected to an incremental encoder.

Static complementary sampling

A control input comprises a pair of two connections. For correct switching one connection must be inverted in relation to the other.

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

Tab. 8: Level at the connections for the control inputs for complementary sampling

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

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.

Note If, on the S3000 Professional, you use two of the control input pairs as incremental encoder inputs, the additional static switching is reduced to 4, as there are only two control input pairs still available.

S3000

Static 1-of-n sampling

With 1-of-n sampling you use each of the four (Advanced) or eight (Professional) control input connections. All connections must be used, only one connection is ever allowed to be 1.

Tab. 9: Truth table for 1-of-n sampling

Professional/Professional CMS							
Advanced							
A1	A2	B1	B2	C1	C2	D1	D2
1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0
0	0	1	0	0	0	0	0
0	0	0	1	0	0	0	0
0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0
0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	1

Input delay

If the control device via which you switch the static control inputs cannot switch within 10 ms (for 60 ms basic response time) or 20 ms (for 120 ms basic response time) to the related input condition (e.g. due to switch bounce times), you must choose an input delay. For the input delay choose the time in which your defined control device can switch to a corresponding input condition.

Independent of the basic response time chosen for the S3000, you can increase the input delay in 30-ms steps (for 60 ms basic response time) or 60-ms steps (for 120 ms basic response time).

The following figures, derived from experience, are a guide for the various switching methods given.

Tab. 10: Figures from experience for the necessary 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 using independent sensors	130–480 ms

Dynamic sampling with incremental encoders

With dynamic sampling using incremental encoders, you define for each monitoring case the number of pulses that must be present at the incremental encoder inputs for the related velocity (Fig. 23 on page 40 shows the velocity tolerances that are allowed to be present at the inputs).

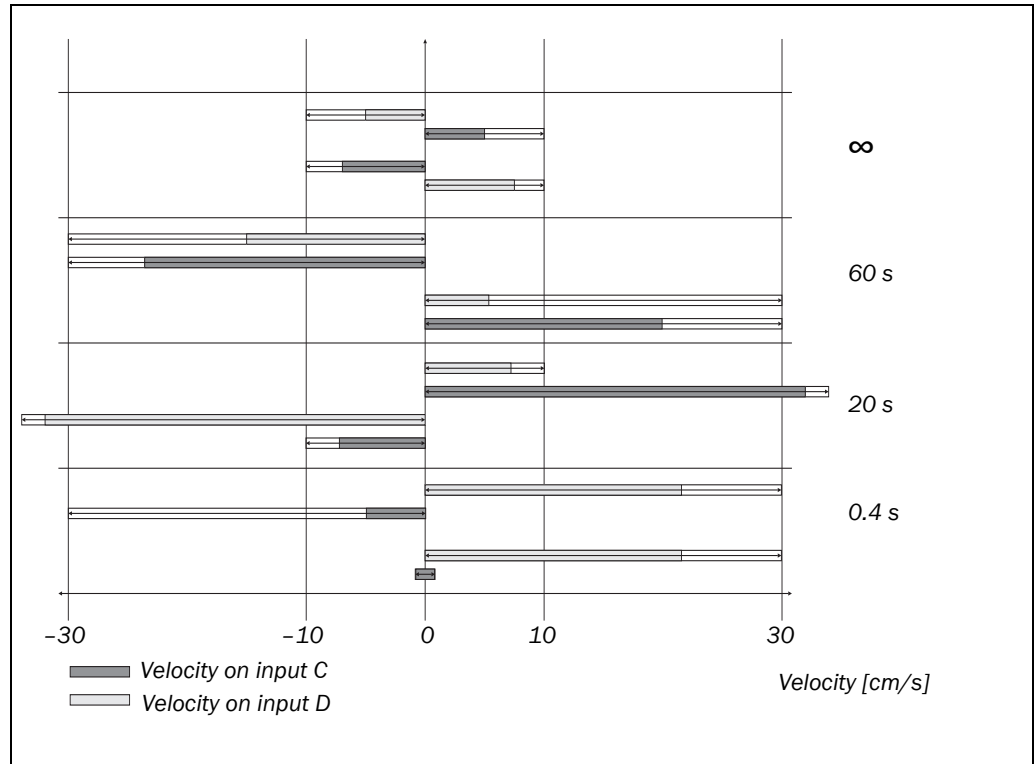
Per incremental encoder, one 0°/90° output is required so that the direction of travel can be determined. Two incremental encoders are necessary to detect a possible fault in one encoder (it is imperative you lay the connecting cables to the incremental encoders separately).

During the configuration of the monitoring cases in the CDS, you must cover all possible or allowed velocities of the vehicle. An undefined velocity will result in the shutdown of the OSSDs (useful e.g. for safe maximum velocity monitoring on vehicles).

Tolerances 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. the vehicle's tyres, the values at the two inputs may, however, vary. Fig. 23 shows the deviations that are tolerated and for how long.

Fig. 23: Tolerances on the dynamic inputs



- Velocity deviations of ± 10 cm/s are always tolerated.
- Velocity deviations of ± 30 cm/s are tolerated for 60 seconds, if velocity deviations in the same direction are present at both inputs.
- Velocity deviations of more than ± 30 cm/s are tolerated for 20 seconds, if velocity deviations in the same direction are present at both inputs.
- If velocity deviations in different directions are present at the inputs, velocity deviations of more than + or -10 cm/s are only tolerated for 0.4 seconds.

Modern applications for autonomous vehicles require additional configuration features for driving around tight bends. The S3000 offers the following additional functions:

- For a duration of max. 20 seconds or 60 seconds the velocity signals from the two encoders are allowed to vary by max. 45 %. Reference velocity is always the larger of the two encoder velocities present.
- The tolerance ranges shown in Fig. 23 can be disabled if the vehicle is to drive around tight bends and as a result the standard tolerances will result in unintentional shut downs.

➤ Choose the function **Activated speed threshold monitoring** on the CDS **Inputs** tab.

➤ On the CDS **Cases** tab you can select three different settings:

- Ignoring velocity ranges: Usage of static input signals for monitoring case activation
- Using velocity ranges: The minimum and maximum velocity set is used for monitoring case switching.
- Using velocity thresholds: If a defined threshold is exceeded, the safety laser scanner shuts down. Velocity differences larger than 45 % are tolerated for 60 seconds. Only if the threshold is exceeded does a shut down occur.

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

- Notes**
- Warning — The redundant velocity monitoring by the safety laser scanner is deactivated for max. 60 seconds. Ensure 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 off its OSSDs, i.e. tight bends are not allowed to last more than 60 seconds.

3.5.11 Checking of the monitoring case switching

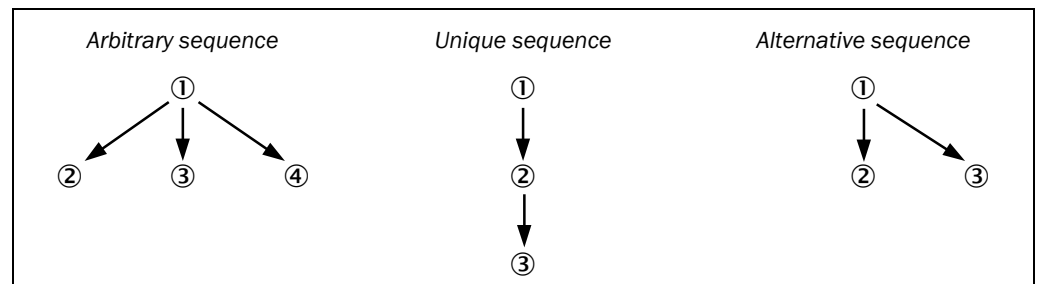
To check the switching between monitoring cases, configure a series of monitoring cases. Here you can define either an arbitrary sequence, a unique sequence, or two alternative sequences.

- 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.

Recommendation

Use the checking of the monitoring cases as an additional medium to exclude risks. For example, deviations of a vehicle from a corridor or a plant from the stipulated production process can be detected.

Fig. 24: Schematic layout of the monitoring case switching



3.5.12 Simultaneous monitoring

Within a monitoring case, the S3000 can monitor two field sets simultaneously (e.g. hazardous area on the left and hazardous area on the right). For this purpose choose any further field set with the related monitoring case as the simultaneous field set.

On a system with one S3000 both field sets act on the internal OSSDs in the S3000. In addition, the device signals protective field infringements in both field sets to an external device (e.g. the UE100 series) via EFI

On a system with two S3000, the switching signals for the two field sets can be allocated to the OSSDs on the first or second device.



You configure a monitoring case with simultaneous field set in the CDS.

3.5.13 Naming applications and laser scanners

A name can be assigned to the application configured and to the laser scanner(s). The names are saved in the devices after the configuration is transferred. The name chosen may, for example, be the identifier for the system or the machine.

If you assign unique application names, you may “reserve” the devices for certain duties. 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. He may then exchange these devices for those with the correct application name.



You enter the application name and the name of the scanner used in the CDS.

3.6 S3000 in master/slave operation

The S3000 safety laser scanner can be incorporated in a master/slave system using an EFI connection.

- Two S3000 can form the master/slave system in which one of the safety laser scanners is the master, the other the slave.
- One S3000 together with an S300 can form the master/slave system in which the S3000 is the master and the S300 is the slave.
- An S3000 can be connected to a higher-level device (S3000, series UE100 switching amplifier or series UE1000 bus node). In this case the S3000 is the slave.
- It is possible to connect up to four safety laser scanners to a safety controller Flexi Soft; one safety laser scanner in each pair is the master, the other the slave (see also 3.7 further unten).

When the S3000 is switched on in a configured master/slave system, the following message appears briefly on the 7-segment display (see section 8.3 on page 100):

-  for host on the S3000 master
-  for guest on the S3000 slave

3.6.1 Addressing the slave

To unambiguously differentiate between the master device and slave device in a master/slave system, it is possible to define a S3000 as a slave. For this purpose a jumper is wired between the connection terminals 7 (ERR) and 10 (A1) (see section 5.1.1 “Pin assignments of the I/O modules” on page 75).

Note Connect this connection terminal only for a slave device that is connected to a master over EFI and that as a result uses the master’s control inputs and its application diagnostic output.

3.6.2 Control inputs

In a master/slave system, the control signals for monitoring case switching are applied to the inputs on the master. The slave is connected to the master via EFI and receives from the master the input information for monitoring case switching.

Note You can only connect the input signals to **one** safety laser scanner. Distributed connection of the input signals to two safety laser scanners is not possible.



You can configure the control inputs of the master in the CDS.

3.6.3 Internal or external OSSDs



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

- Internal OSSDs

Defines that the protective field or the protective fields switch the OSSDs on S3000.

- External OSSDs

The S3000 transmits the status of the field sets (protective field/warning field) over the EFI. The OSSDs on another device connected via the EFI have switched.

- Connected S3000 or S300: The OSSDs on the second safety laser scanner are switched.
- Connected switching amplifier (UE100 series): The OSSDs on the UE100 are switched depending on its configuration.
- Connected bus node (UE1000 series): The information is passed to an FPLC, which further processes the information, depending on the configuration of the UE1000.

3.6.4 Monitoring case switching

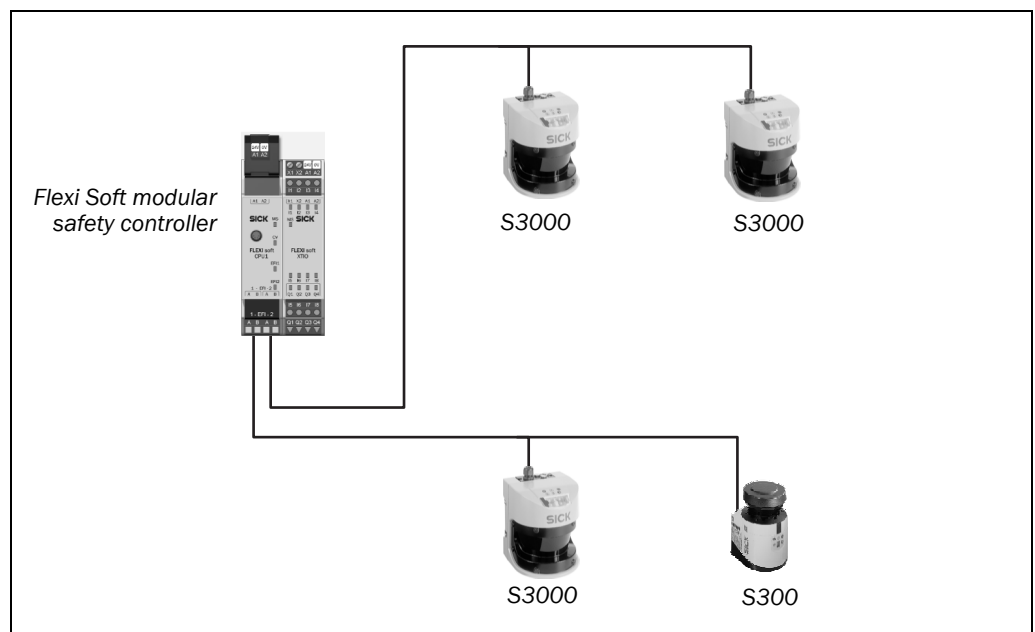
In a master/slave system, the simplest device defines the number of possible monitoring cases. If, for example, a S3000 Professional and an S3000 Advanced are connected together, only four monitoring cases are available to the two S3000.

A field set and the input conditions that activate the monitoring case must be allocated to each monitoring case.

3.7 S3000 in combination with a Flexi Soft safety controller

The safety controller Flexi Soft provides two EFI strings; up to two safety laser scanners (S3000, S300, also mixed) can be connected to each of these strings. It is therefore possible to realise applications with up to four safety laser scanners (see also section 6.2.5 on page 87 and section 6.4.9 on page 95).

Fig. 25: S3000 and S300 in combination with a Flexi Soft modular safety controller



Using the safety controller Flexi Soft it is possible to monitor two protective fields simultaneously on one safety laser scanner. In one application it is therefore possible to configure up to eight protective fields and up to eight warning fields.



The entire application is configured using the Flexi Soft Designer, from this user interface it is possible to start the CDS to configure the safety laser scanners.

The status of the protective and warning fields is transmitted using EFI and can be combined in the safety controller Flexi Soft as required. During this process it does not matter whether the devices are connected using one or various EFI strings. The signal on the safety outputs on the safety controller Flexi Soft is transferred, e.g., to a machine or vehicle control.

The monitoring cases that have been configured in the safety laser scanners can be switched with the aid of the programmed logic blocks in the safety controller Flexi Soft.

Monitoring case switching is, however, also still possible at the local inputs if, e.g., incremental encoders are used. The incremental encoders must always be connected to the master. Signals from the safety controller Flexi Soft can then not be processed in this arrangement. For this reason the simultaneous combination of local inputs on the safety laser scanners and inputs on the safety controller is not possible.

3.7.1 Addressing the slave

To be able to unambiguously differentiate between the master device and the slave device in a master/slave system, you must define one safety laser scanner on each EFI string as the slave. For this purpose a jumper is wired between the connection terminals 7 (ERR) and 10 (A1) (see section 5.1.1 “Pin assignments of the I/O modules” on page 75).

The safety controller Flexi Soft can then unambiguously identify all safety laser scanners involved and distribute and retrieve information using bit assignment (see also Technical Description “EFI – Enhanced Function Interface”, SICK part no. 8012621).

3.7.2 EFI network topologies

To connect two safety laser scanners to one of the EFI strings on a safety controller Flexi Soft there are two possibilities:

Series connection

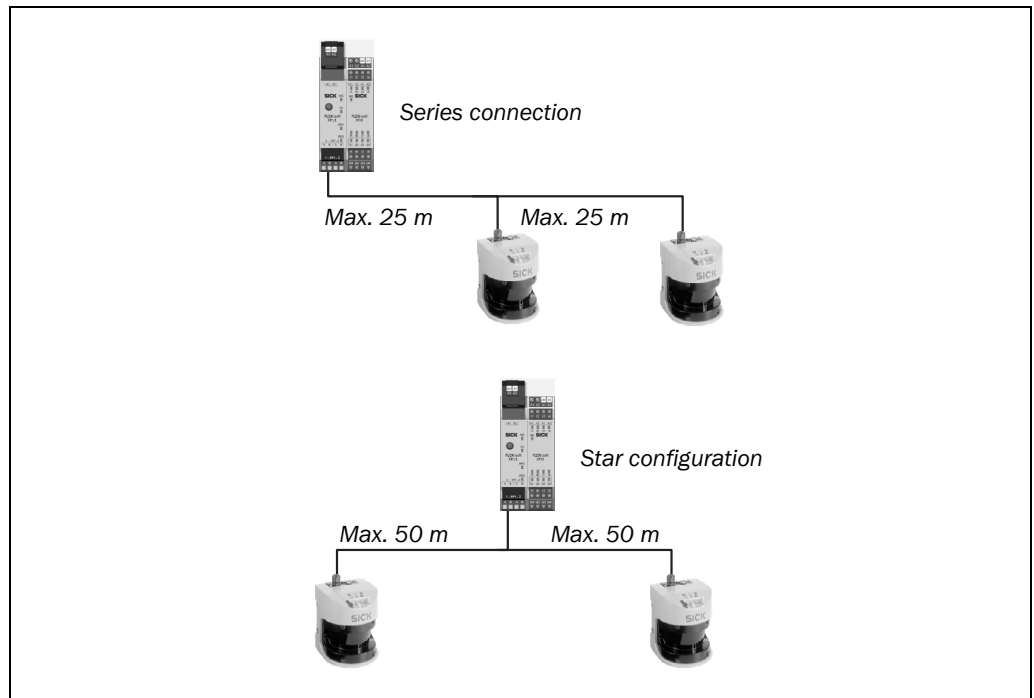
The two safety laser scanners are connected one after the other. The signals and the voltage supply for the second safety laser scanner are routed via the first safety laser scanner in the EFI string.

Star configuration

The two safety laser scanners are connected to the same Flexi Soft input for the EFI string. It is possible to differentiate between the safety laser scanners using the addressing in the EFI protocol.

S3000

Fig. 26: EFI network topologies



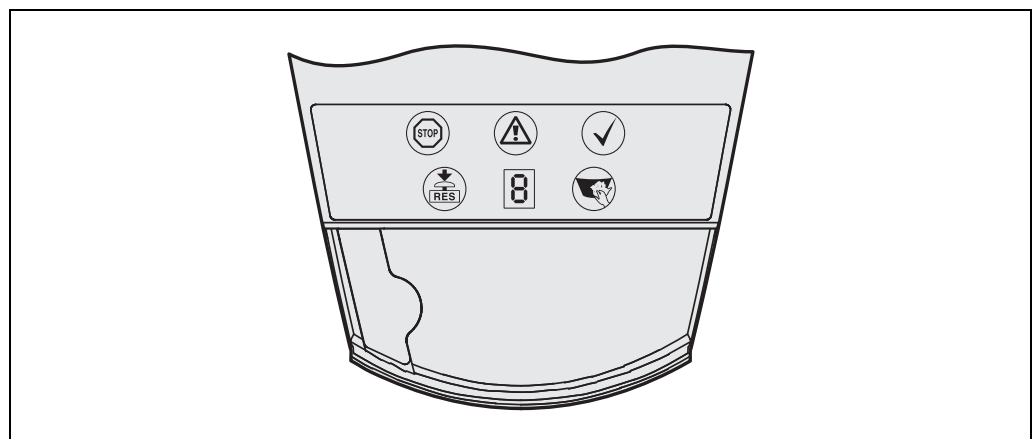
You will find details on the connection of safety laser scanners in section 6.4.9 “Protective field switching with a Flexi Soft safety controller” on page 95.

3.8 Indicators and outputs

3.8.1 LEDs and 7-segment display

The LEDs and the 7-segment display indicate the operational status of the S3000. They are on the front face of the safety laser scanner. Above the LEDs there are symbols that are used in the remainder of these operating instructions to describe the LEDs.

Fig. 27: Operational status indicators on the S3000



The symbols have the following meaning:

-  OSSDs deactivated (e.g. if object in the protective field, reset necessary, lock-out)
-  Reset required
-  Warning field interrupted (object in warning field)
-  Front screen contaminated
-  OSSDs activated (no object in protective field)

3.8.2 Outputs

Using the outputs on the S3000 you shutdown the dangerous state on a machine, a plant or a vehicle and evaluate the operational status of the S3000. The S3000 has the following outputs:

- OSSDs
- warning field
- application diagnostic output (contamination of the front screen/error)
- reset required

The outputs are brought out at the system plug (see chapter 5.1 “System connection” on page 75).

Note All outputs are only allowed to be used for the purpose specified. Note that the signals at the application diagnostic outputs for “warning field”, “contamination of the front screen/error” and “reset necessary” are not safe. For this reason the warning field is not allowed to be used for tasks related to personnel protection.

4 Installation and mounting

This chapter describes the preparation and completion of the mounting of the S3000 safety laser scanner.

Mounting requires four steps:

- definition of the application and the necessary mounting location for the laser scanner
- calculation of the protective field sizes
You can enter the calculated protective field sizes with the aid of the CDS. Or leave the S3000 to suggest the protective fields. In the latter case it is necessary to check whether the suggested sizes correspond to those calculated. Thus in any circumstance you must calculate the protective field size.
- definition of the switching point between monitoring cases
- mounting the safety laser scanner with or without mounting kits



WARNING

No protective function without sufficient safety distance!

The S3000's safety function depends on the system being mounted with the correct safety distance from the hazardous area.

Notes

- Mount the S3000 in a dry place and protect the device from dirt and damage.
- Avoid strong electrical fields. These can, e.g., be produced by welding cables, induction cables in the immediate vicinity and also by mobile telephones operated in close physical proximity.
- Ensure that there are no obstacles in the area to be monitored in the field of view of the S3000 that could cause interference or shadowing. Such shadowed areas cannot be monitored by the S3000. If there are unavoidable shadowed areas, check whether there is a risk. Take additional safety precautions as necessary.
- Keep the area to be monitored free of smoke, fog, steam or other forms of air impurities. Otherwise the function of the S3000 may be impaired and incorrect switching may occur.
- Avoid placing highly reflective objects in the scan plane of the S3000. Examples: Retroreflectors can affect the measurement results of the S3000. Mirrored objects can hide part of the area to be monitored.
- Mount the S3000 such that it is not dazzled by incident sunlight. Do not position stroboscopic and fluorescent lights directly in the scan plane as these may affect the S3000 in specific circumstances.
- Mark the protective field on the floor, if this is reasonable for the application (see EN 61496, part 1, chapter 7).

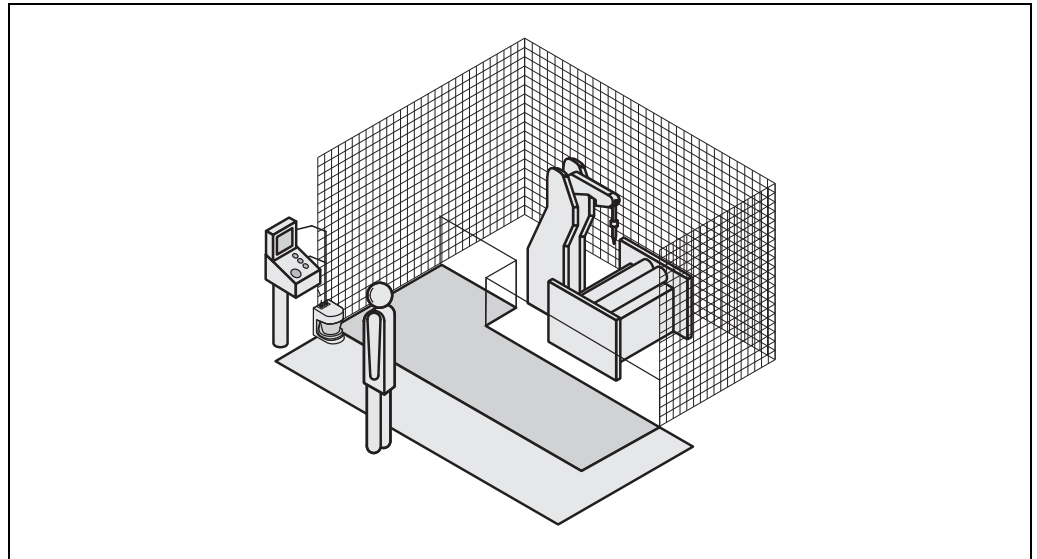
The following steps are necessary after mounting and installation:

- completing the electrical connections (chapter 5 "Electrical installation")
- configuration of the protective field (chapter 7 "Configuration")
- commissioning and checking of the installation (chapter 8 "Commissioning")
- checking of the S3000 functionality and safe shutdown of the machine, vehicle or plant (chapter 8.2 "Test notes")

4.1 Stationary application in horizontal operation

This type of protective device is suitable for machines and plant on which, e.g., a hazardous area is not enclosed by a fixed protective device.

Fig. 28: Horizontally mounted stationary application



For a horizontally mounted stationary application determine ...

- the protective field size to observe the necessary safety distance.
- the height of the scan plane.
- the restart behaviour.
- measures to protect areas not covered by the S3000.

Note Once you have defined the protective field size, mark the boundaries of the protective field on the floor. This avoids inadvertent entrance into the protective field and makes it possible to subsequently check the shape of the protective field.

4.1.1 Protective field size

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

Note If you are using an S3000 Advanced, Professional or Remote, you can define several monitoring cases with different protective fields. In such a case you must calculate the protective field size for all protective fields used.

You can operate the S3000 in stationary horizontal operation with 50 mm or with 70 mm resolution. For each resolution you can choose between 60 ms and 120 ms response time. The maximum protective field range⁶⁾ for the S3000 is given by the resolution and the response time.

- If you choose a 50 mm resolution, the maximum protective field range is less than for a 70 mm resolution, however you can mount the S3000 as low as required.
- If you choose a 70 mm resolution, you can configure the largest protective field range but must position the scan plane of the S3000 at 300 mm.



WARNING

Ensure that a human leg can be detected in horizontal stationary applications with 70 mm resolution!

Mount the scan planes for horizontal stationary applications with 70 mm resolution at a height of at least 300 mm (see “Height of the scan plane at 70 mm resolution” on page 53).

Recommendation

Due to the choice of two resolutions and two response times, it may be necessary to repeatedly calculate the protective field size (iterative calculation).

- Perform your protective field calculation initially 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, calculate it again using the same resolution and the higher response time.
- If the protective field calculated is larger than the maximum protective field range achievable, then re-calculate the protective field with the lower resolution.

⁶⁾ Radial distance to the safety laser scanner.

The safety distance S depends on:

- approach speed of the body or parts of the body
- stopping/run-down time of the machine or system
(The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- response time of the S3000
- supplements for general measurement errors and any measurement errors related to reflection
- supplement for prevention of reaching over
- height of the scan plane
- possibly the time for switching between the monitoring cases

Calculation of the safety distance S:

➤ First, calculate S using the following formula:

$$S = (K \times (T_M + T_S)) + Z_G + Z_R + C$$

Where ...

K = Approach speed (1600 mm/s, defined in prEN ISO 13855)

T_M = Stopping/run-down time of the machine or system

T_S = Response time of the S3000 combined with the downstream controller

Z_G = General safety supplement = 100 mm

Z_R = Supplement for measurement error related to reflection

C = Supplement for prevention of reaching over

Response time T_S of the S3000

The response time T_S of the S3000 depends on ...

- the resolution used.
- the multiple sampling used.
- the transmission speed to external OSSDs over EFI.

See chapter 11.2 "OSSD response times" on page 115.

Supplement Z_R for measurement error related to reflection

WARNING

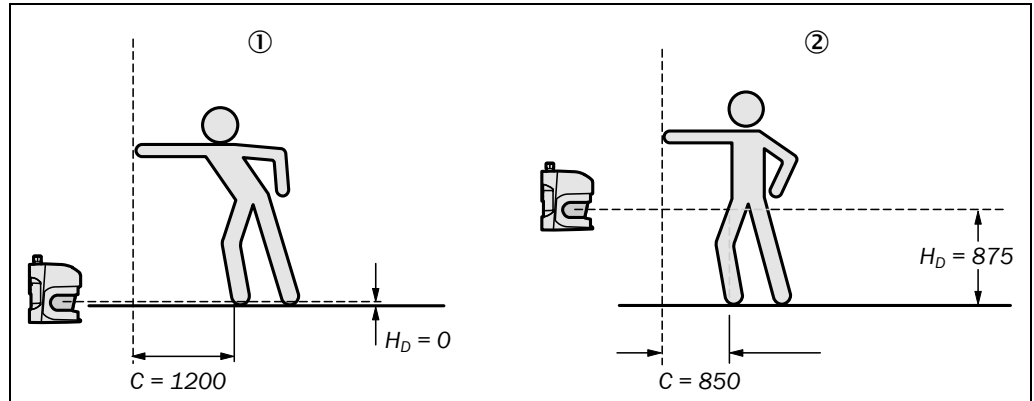
Avoid mounting retroreflectors at a distance of less than one meter from the boundary of the protective field!

With retroreflectors positioned at a distance of less than 1 m from the boundary of the protective field a supplement, Z_R, of 200 mm must be added to the protective field.

S3000**Supplement C for protection against reaching over**

With a protective field installed horizontally, there is a risk that people may reach over the protective field and in this way reach the hazardous area before the S3000 shuts down the dangerous state. For this reason the calculation of the safety distance must take into account a supplement to prevent persons from finding themselves in a hazardous situation by reaching over the protective field (see EN ISO 13857, table 1) before the S3000 triggers.

Fig. 29: Risk of reaching over (mm)



The necessary supplement for the safety distance is dependent on the height of the scan plane for the protective field. At low heights ① the supplement is larger than at greater heights ②.

**WARNING**

Prevent the possibility of crawling beneath the protective device if you mount it higher than 300 mm!

Prevent people from being able to crawl beneath the protective field by means of appropriate mounting of the S3000. If you mount the protective device higher than 300 mm, you must prevent crawling beneath by means of additional measures. For applications that are accessible to the public, the mounting height may need to be reduced to 200 mm (on this subject see the appropriate regulations).

How to calculate the supplement C:

➤ If there is enough empty space in front of your machine or plant, use 1200 mm for the supplement C.

➤ If the safety distance is to be kept as small as possible, calculate C using the following formula:

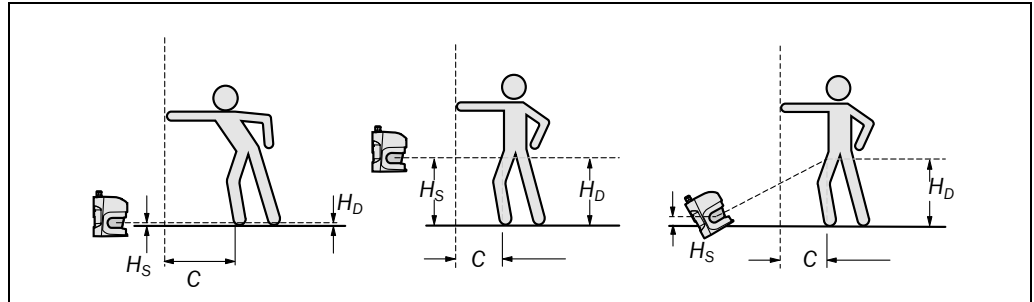
$$C = 1200 \text{ mm} - (0.4 \times H_D)$$

Here H_D is the height at which the protective field is mounted.

Note The minimum supplement to prevent reaching over is 850 mm (arm length).

In summary there are three practical methods of mounting the scan plane for the S3000. The optimal method depends on the related application.

Fig. 30: Mounting methods for the scan plane



Tab. 11 provides assistance in making the selection.

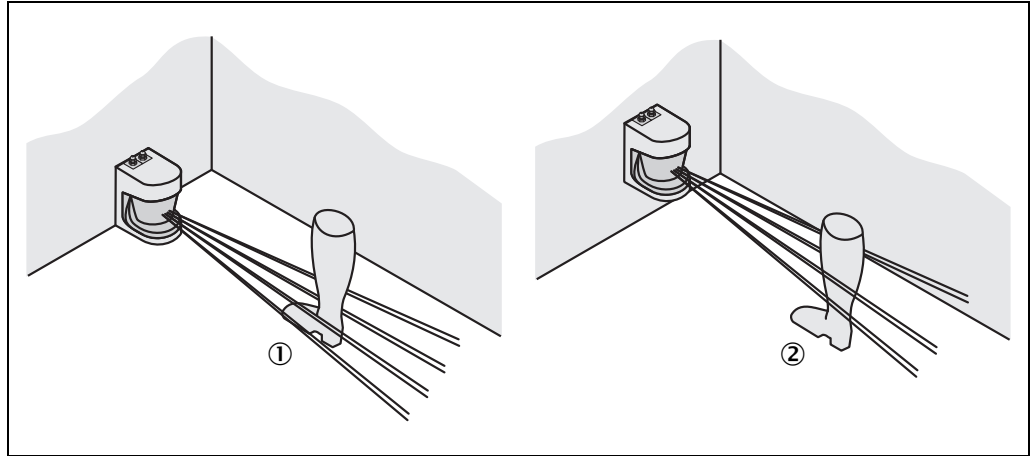
Tab. 11: Advantages and disadvantages of mounting methods

Mounting orientation	Benefit	Disadvantage
Scanner low ($H_S < 300 \text{ mm}$) Inclination of the scanner plane low ($H_D \approx H_S$)	No external effects due to dazzle, crawling beneath not possible	Larger supplement C
Scanner high ($H_S > 300 \text{ mm}$) Inclination of the scanner plane low ($H_D \approx H_S$)	Lower protective field supplement C	Danger of crawling beneath (at the front and side)
Scanner low ($H_S < 300 \text{ mm}$) Inclination of the scanner plane high ($H_D > H_S$)	Lower protective field supplement C	Danger of crawling beneath (at the front), external effect due to dazzle possible
H_D = Detection height H_S = Scanner mounting height		

S3000**Height of the scan plane at 70 mm resolution**

Due to the radial sampling of the protective field, the optical resolution will be lower the further away you get from the scanner.

Fig. 31: Relationship between resolution and protective field mounting height



If you choose a resolution of 70 mm in the CDS for hazardous area protection, a human leg may, in certain circumstances, not be detected. The reason in this case would be that the beams miss the ankle on the left and right ①.

If you mount the S3000 higher, the scan plane is at fibula height and the leg is also detected with an object resolution of 70 mm ②.

**WARNING**

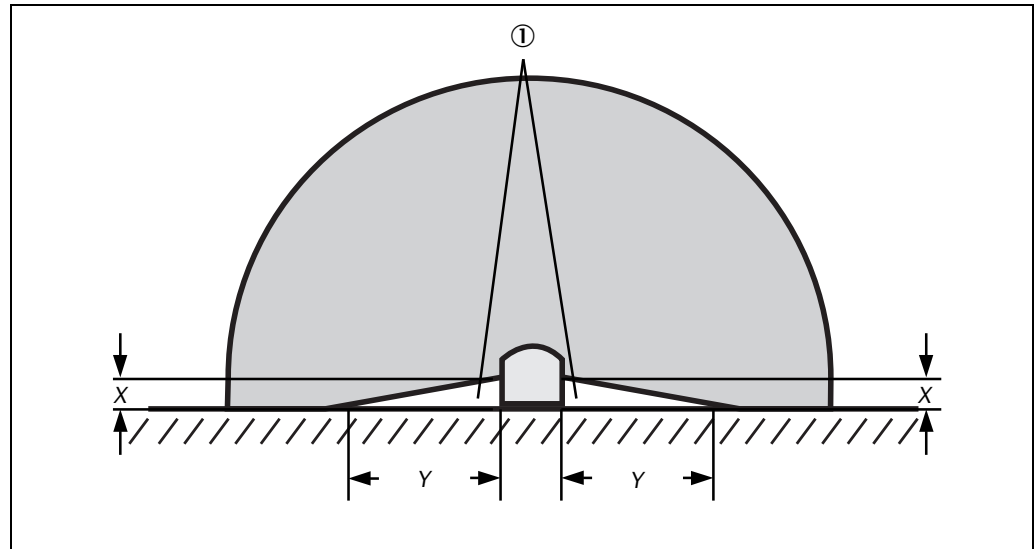
Prevent the possibility of crawling beneath the protective device if you mount it higher than 300 mm!

Prevent people from being able to crawl beneath the protective field by means of appropriate mounting of the S3000. If you mount the protective device higher than 300 mm, you must prevent crawling beneath the protective field by means of additional measures. For applications that are accessible to the public, the mounting height may need to be reduced to 200 mm (on this subject see the appropriate regulations).

4.1.2 Measures to protect areas not covered by the S3000

During mounting, areas may be found that are not covered by the safety laser scanner.

Fig. 32: Unprotected areas for stationary applications



These areas ① become larger if the S3000 is mounted using the mounting kits.

Tab. 12: Size of the unprotected areas

Mounting method	Size of the unprotected areas	
	X	Y
Direct mounting	109 mm	618 mm
With mounting kit 1	112 mm	635 mm
With mounting kit 1 and 2	127 mm	720 mm
With mounting kit 1, 2 and 3	142 mm	805 mm



WARNING

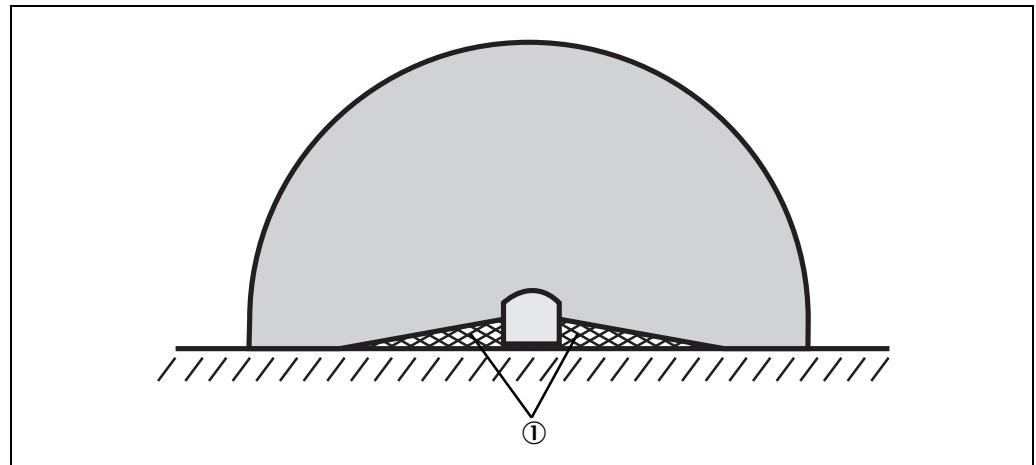
Prevent unprotected areas!

Mount the S3000 such that there are no unprotected areas. Take one of the precautions given in the following:

- Fit cover plates to prevent standing behind.
- Fit the S3000 in a recess.

Mounting with cover plates

Fig. 33: Example of mounting with cover plates

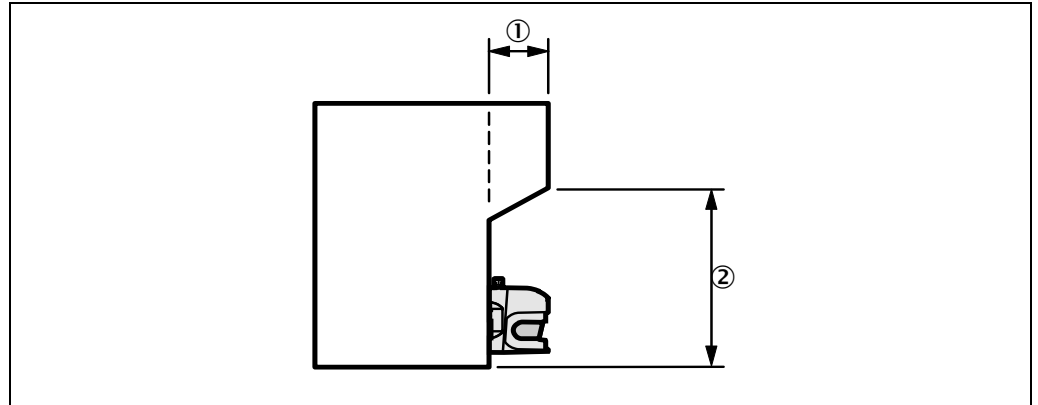


- Fit the cover plates such ① that the areas not covered by the safety laser scanner are completely protected against personnel standing in them.

S3000

Fig. 34: Form of the recess

Mounting in a recess



- Design the recess ① to be sufficiently deep enough that it completely covers the area not protected by the safety laser scanner (Fig. 33) and such that standing in an unscanned area is not possible.

Important

- Prevent crawling beneath the recess by limiting the height of the recess ② such that nobody can crawl beneath.

4.2 Stationary vertical operation for access protection

Access protection can be used when the access to the machine can be defined by physical means. For access protection the S3000 detects the entry of an entire body.

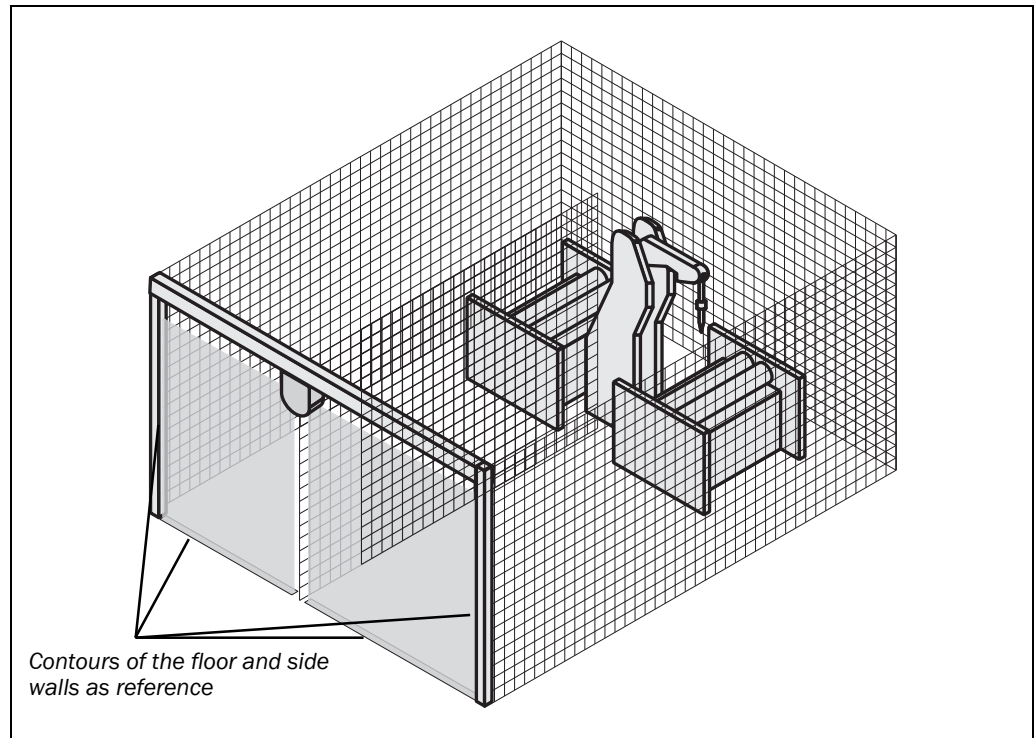
Notes

- 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 surrounding area as a reference for the S3000 (see chapter 3.5.3 “Using the contour as a reference” on page 31).

4.2.1 Safety distance

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

Fig. 35: Access protection



The safety distance S as defined in prEN ISO 13 855 and EN ISO 13 857 depends on:

- reach or approach speed
- stopping/run-down time of the machine or system
(The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement. — On request SICK service can perform a detailed stopping/run-down measurement on your plant.)
- response time of the S3000
- supplement C against reaching through

Calculation of the safety distance S:

➤ First, calculate S using the following formula:

$$S = (K \times (T_M + T_S)) + C$$

Where ...

K = Approach speed (1600 mm/s, defined in prEN ISO 13 855)

T_M = Stopping/run-down time of the machine or system

T_S = Response time of the S3000

C = Supplement against reaching through (850 mm)

Response time T_s of the S3000**WARNING**

The overall response time of the S3000 must not be more than 90 ms for access protection!

If a critical response time is exceeded (for an object diameter of 150 mm and a speed of 1.6 m/s that is 90 ms) a person may no longer 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 due to the usage of external OSSDs.

In specific cases agreed with the responsible authorities higher response times may be allowed (for example by increasing the detection time available by positioning the scanner at an angle). In this case ensure that the areas the scanner cannot see are protected by additional measures.

The response time T_s of the S3000 depends on ...

- the multiple sampling used.
- the transmission speed to external OSSDs over EFI.

See chapter 11.2 “OSSD response times” on page 115.

4.3 Stationary vertical operation for hazardous point protection

Hazardous point protection is necessary if the operator must remain near the dangerous state of the machine. Hand protection must be realised for hazardous point protection.

Notes

- To provide hand protection with hazardous point protection a resolution of at least 40 mm is required. The S3000 provides a maximum resolution of 30 mm.

**WARNING**

Never use the S3000 for applications in which finger protection is required!

Due to the maximum resolution of 30 mm, the S3000 is not suitable for finger protection.

- To protect the protective device against inadvertent adjustment or manipulation, you must use the contour of the surroundings as a reference for the S3000 (see chapter 3.5.3 “Using the contour as a reference” on page 31).

4.3.1 Safety distance

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

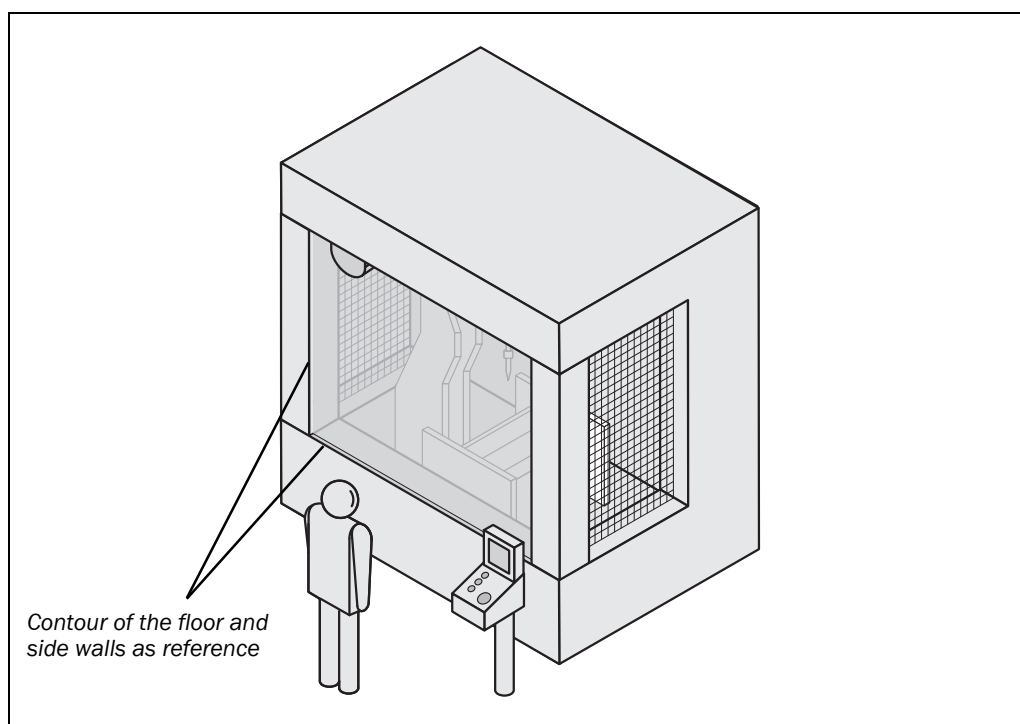
You can operate the S3000 with 30 mm or 40 mm resolution for hazardous point protection. At each resolution you can choose a response time between 60 ms and 120 ms (due to the proximity of the hazardous point in the majority of cases only the shorter response time can be used). The maximum protective field range and the minimum distance to the hazardous point is given by the resolution and the response time.

- If you choose 30 mm resolution, the protective field that can be configured is smaller (for smaller hazardous points to be protected), however you can mount the S3000 nearer to the hazardous point.
- If you choose 40 mm resolution, the protective field that can be configured is larger (thus for larger hazardous points to be protected), however you must mount the S3000 further away from the hazardous point.

**WARNING****Danger due reaching around or reaching behind!**

Always mount the scanner such that reaching around and behind is impossible. Provide suitable additional precautions as necessary.

Fig. 36: Safety distance to the hazardous area

**The safety distance as defined in prEN ISO 13 855 and EN ISO 13 857 depends on:**

- stopping/run-down time of the machine or system
(The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- response time of the S3000
- reach or approach speed
- resolution of the S3000

Calculation of the safety distance S:

➤ First, calculate S using the following formula:

$$S = 2000 \times (T_M + T_S) + 8 \times (d - 14 \text{ mm}) [\text{mm}]$$

Where ...

S = Safety distance [mm]

T_M = Stopping/run-down time of the machine or system

T_S = Response time of the S3000

d = Resolution of the S3000 [mm]

Note The reach/approach speed is already included in the formula.

➤ If the result S is ≤ 500 mm, then use the determined value as the safety distance.

➤ If the result S > 500 mm, you may be able to reduce the safety distance using the following calculation:

$$S = 1600 \times (T_M + T_S) + 8 \times (d - 14 \text{ mm}) [\text{mm}]$$

➤ If the new value S is > 500 mm, then use the newly calculated value as the minimum safety distance.

➤ If the new value S is ≤ 500 mm, then use 500 mm as the minimum safety distance.

Response time of the S3000

The response time T_S of the S3000 depends on ...

- the resolution used.
- the multiple sampling used.
- the transmission speed to external OSSDs over EFL.

See chapter 11.2 “OSSD response times” on page 115.

4.4 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 S3000.

- Notes**
- The S3000 may only be used to protect vehicles powered by electric motor.
 - Due to the movement of the S3000 in a mobile application, a resolution of 70 mm is sufficient for the detection of people.
 - In the following calculations only take into account the velocity of the vehicle, not the speed of the person walking. This is based on the assumption that the person will recognise the danger and stand still.
 - If the application is to protect vehicles from collisions, then you may need to make different assumptions. These are very specific and can therefore not be described within this manual. Contact the relevant authorities and clarify the assumptions that must be taken into account with regard to your application.

For a horizontally mounted mobile application, determine:

- protective field length
- protective field width
- height of the scan plane
- restart behaviour
- methods of preventing unprotected areas

4.4.1 Protective field length

You must configure the protective field such that a safety distance to the vehicle is maintained. This ensures that a vehicle monitored by the S3000 comes to a stop before a person or object is reached.

If you are using an S3000 Advanced, Professional or Remote, you can define several monitoring cases with different protective fields. You can switch these using static control inputs or on the S3000 Professional and S3000 Remote also dynamically.

For dynamic switching, the vehicle velocity is determined by means of incremental encoders connected to the S3000 Professional. The protective fields in the S3000 Professional and in the S3000 Remote (via EFI to an S3000 Professional connected) can be switched as a function of the velocity. In such an application, the protective field sizes (in particular the protective field length) must be calculated for all velocities.

Calculation of the protective field length:

➤ Calculate the necessary protective field length using the formula:

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

Where ...

S_A = Stopping distance

Z_G = General safety supplement = 100 mm

Z_R = Supplement for any measurement error of the S3000 related to reflection

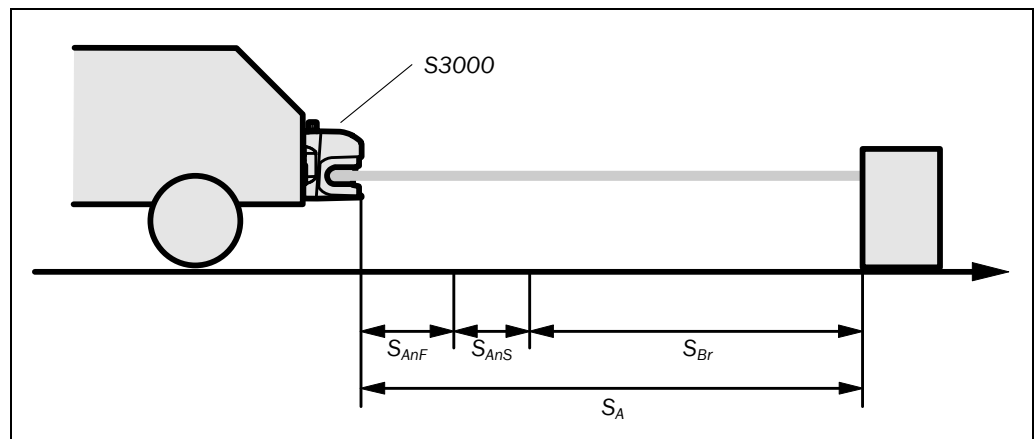
Z_F = Supplement for any lack of ground clearance of the vehicle

Z_B = Supplement for the reduction in the braking performance of the vehicle as defined in the related vehicle documentation

Stopping distance

The stopping distance comprises the braking distance for the vehicle, the distance covered during the response time of the safety laser scanner and the response time of the vehicle controller.

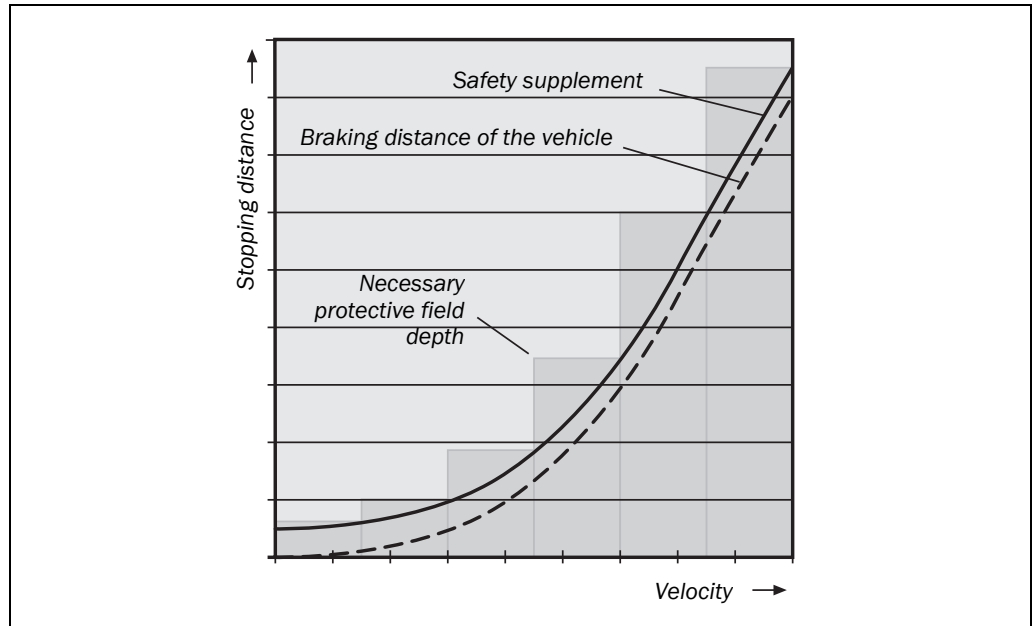
Fig. 37: Stopping distance



Note Take into account that the braking distance for a vehicle is not linear with increasing velocity, but increases in a square function. This is particularly important if you switch the protective field length as a function of the velocity using incremental encoders.

S3000

Fig. 38: Braking distance as a function of the vehicle velocity

**Calculation of the stopping distance:**

➤ Calculate the stopping distance using the formula:

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

Where ...

S_{Br} = Braking distance from the vehicle documentation

S_{AnF} = Distance covered during the response time of the vehicle controller from 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 response time of the safety laser scanner.
- the maximum velocity of the vehicle in your mobile application.

The response time T_S of the S3000 depends on ...

- the multiple sampling used.
- the transmission speed to external OSSDs via EFI.

See chapter 11.2 "OSSD response times" on page 115.

Calculation of the distance covered during the response time of the safety laser scanner:

➤ Calculate the distance using the formula:

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

Where ...

T_S = Response time of the safety laser scanner

V_{max} = Maximum velocity of the vehicle from the related vehicle documentation

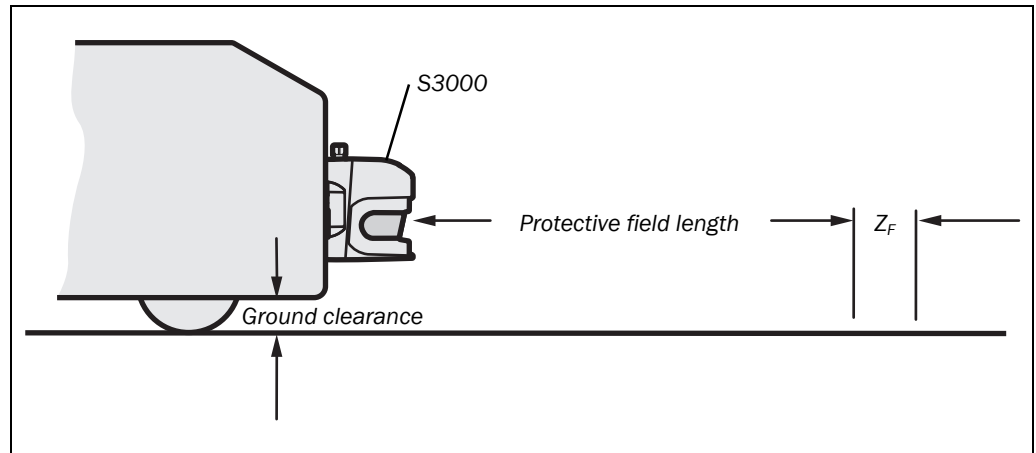
Supplement Z_R for measurement error related to reflection

With retroreflectors in the background at a distance of less than 1 m from the boundary of the protective field, the supplement Z_R is 200 mm.

Supplement due to lack of ground clearance

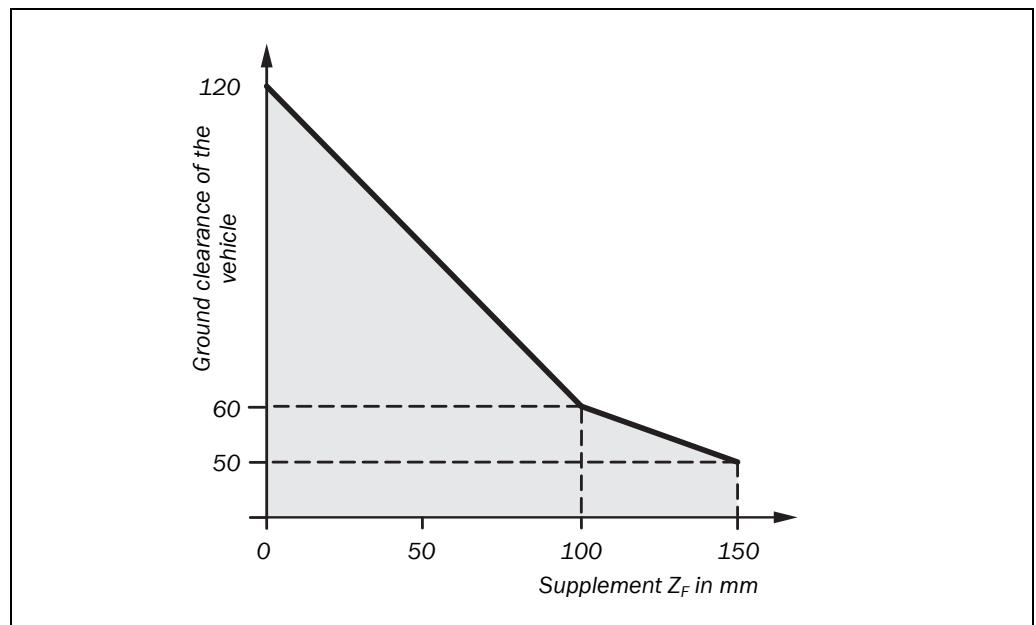
This supplement is necessary because a person is generally detected above the foot and the braking action can therefore not take into account the length of the foot in front of the detection point. If a vehicle has no ground clearance, a person may receive foot injuries.

Fig. 39: Supplement due to lack of ground clearance



➤ The supplement for foot space below 120 mm is 150 mm. If you wish to further reduce this supplement, read the supplement necessary from the following diagram:

Fig. 40: Diagram of ground clearance of the vehicle



4.4.2 Protective field width

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

Calculation of the protective field width:

➤ Calculate the protective field width S_B using the formula:

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

Where ...

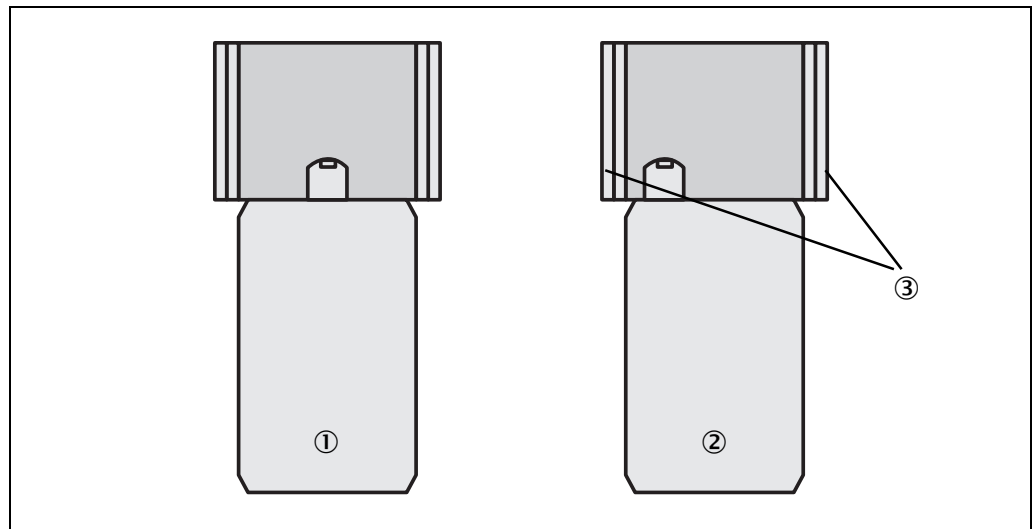
F_B = Vehicle width

Z_G = General safety supplement = 100 mm

Z_R = Supplement for any measurement error of the S3000 related to reflection

Z_F = Supplement for any lack of ground clearance of the vehicle

Fig. 41: Protective field width



Note Normally you will mount the S3000 in the middle of the vehicle ①. If this is not the case, then you must define the protective field asymmetrically ②. (The CDS represents the fields as they appear in the top view on the scanner.) Ensure that there are supplements on the right and left of the vehicle ③.

4.4.3 Height of the scan plane

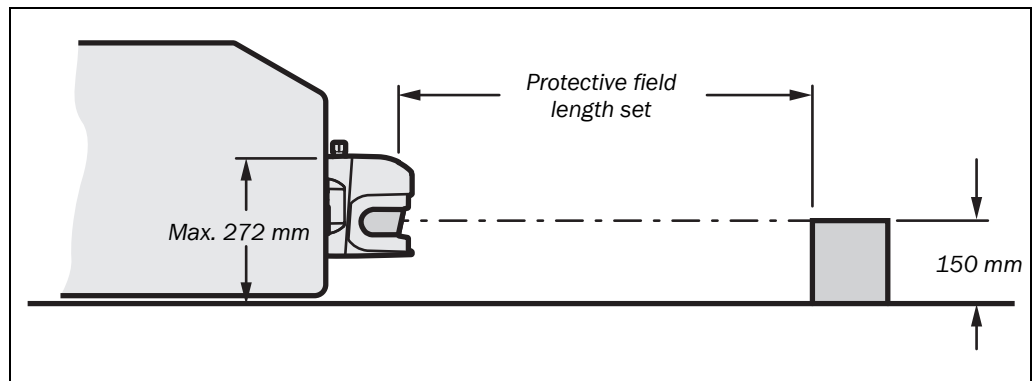


WARNING

Mount the S3000 such that the scan plane is at a maximum height of 200 mm!

Any body lying flat on the floor will be reliably detected. Tilting the protective field, which will result in objects with a diameter of 200 mm not being detected, is not allowed. We recommend aligning the scan plane at 150 mm.

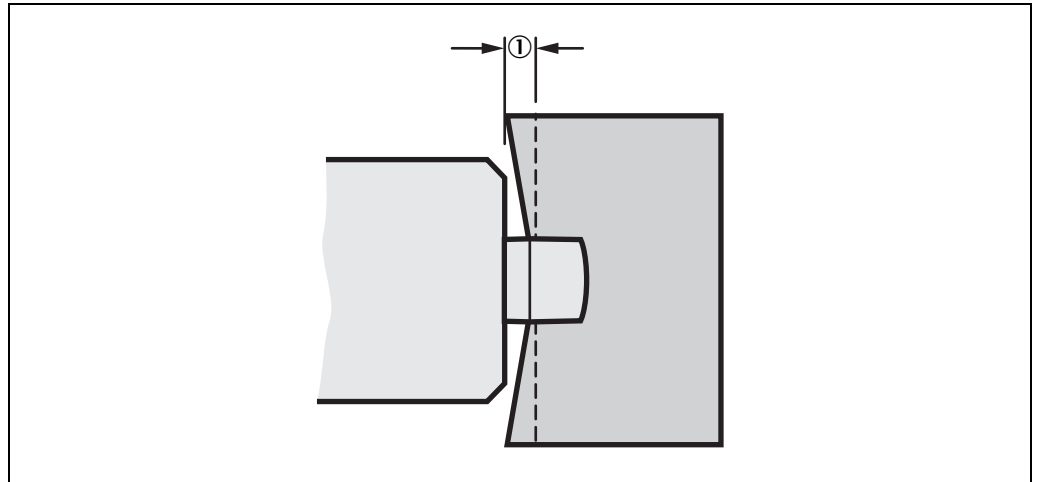
Fig. 42: Mounting height



4.4.4 Methods of preventing unprotected areas

When the S3000 is mounted on a plane surface, there are areas in front of the mounting surface that are not covered by the safety laser scanner.

Fig. 43: Unprotected areas for mobile applications



These unprotected areas ① become larger if you mount the S3000 using mounting kits.

Tab. 13: Unprotected areas

Mounting method	Size of the unprotected areas
Direct mounting	109 mm
With mounting kit 1	112 mm
With mounting kit 1 and 2	127 mm
With mounting kit 1, 2 and 3	142 mm



WARNING

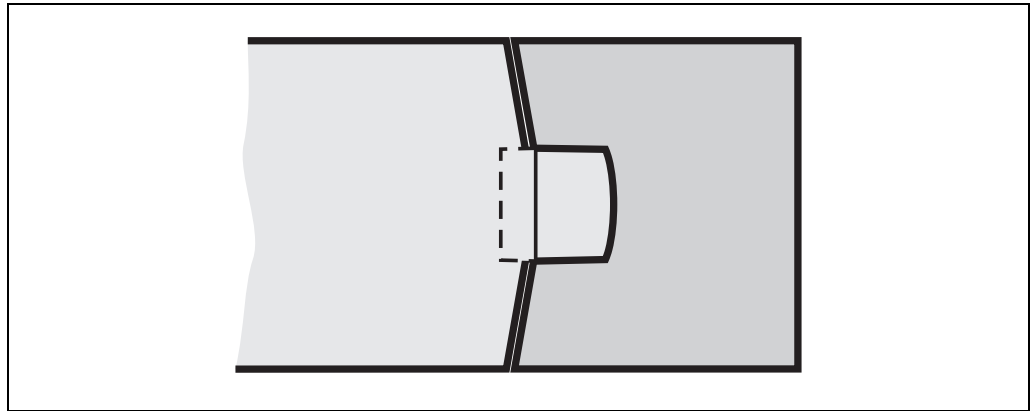
Secure the unprotected areas!

If the vehicle is accelerated to a maximum velocity of 0.3 m/s in less than three seconds when in operation, you must prevent personnel from entering the unprotected areas by means of mechanical trim panels, switch strips or fitting the S3000 in the vehicle trim panels.

S3000**Fitting in the vehicle trim**

Build the S3000 into the vehicle trim such that the unprotected areas are ≤ 70 mm and the S3000 projects a maximum of 109 mm beyond the front of the vehicle. The vehicle may then be accelerated to a velocity of 0.3 m/s within a second.

Fig. 44: Fitting the S3000 in the vehicle trim



Additionally, protect the area near to the scanner (5 cm wide area in front of the front screen) using a proximity switch with 5 cm acquisition range. Otherwise make the area near the scanner impassable with a bar or a recess. The vehicle may then be accelerated as required.

Note Note that the system must be fitted e.g. in a trim panel without impairing the optical beam path. The attachment of an additional front screen is thus not permitted. Any slot for the field of view must be adequately sized (see Fig. 92 in chapter 11.6 “Dimensional drawings” on page 129).

Recommendation If, when observing all necessary safety precautions, you are able to avoid the use of a re-start interlock, you will increase the availability of your vehicle.

4.5 Timing for monitoring case switching

If you switch between several monitoring cases, along with the safety distance to the dangerous state there is a further safety-relevant aspect that you must address.

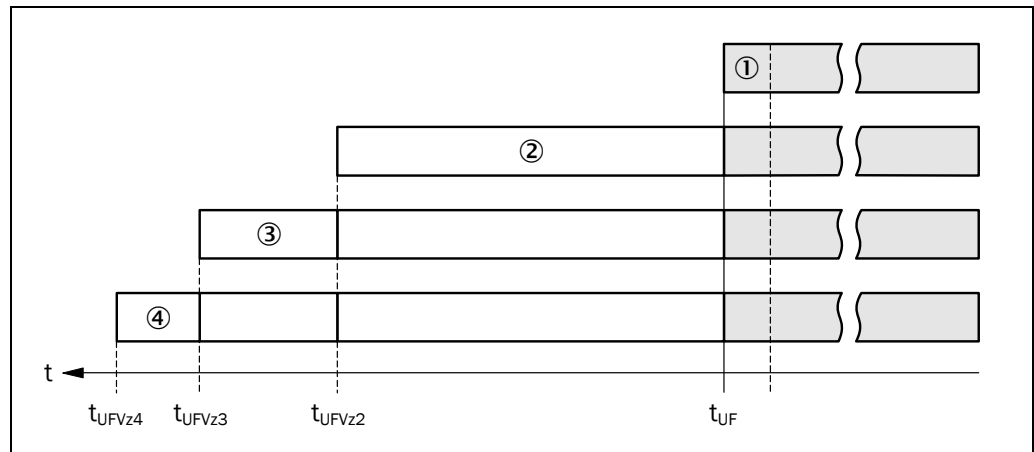
If you can switch within 10 or 20 ms, the chosen protective field is available within the response time of the S3000. For this reason you can initiate the switching at the time at which you actually want to switch from one monitoring case to the other.

However, you must advance the timing of the switching if you ...

- have entered an input delay for your switching method (see section “Input delay” on page 39).
- use external inputs (e.g. the inputs on another S3000).
- control external OSSDs instead of the internal OSSDs (e.g. the OSSDs on another S3000) via EFI.

Fig. 45: Advancement for the switch timing

The following diagram shows the relationships:



- If the input conditions are present at the control inputs within 10 or 20 ms (cf. ①), the timing for the switching (t_{UF}) does not need to be advanced.
- If an input delay for the control inputs needs to be taken into account (cf. ②), the timing for the switching (t_{UFVz2}) must be advanced by the input delay.
- If the inputs on a different device are used via EFI, the timing for the switching (t_{UFVz3}) must be further advanced by 0.5 times the basic response time (= 30 or 60 ms) (cf. ③). On a system with two S3000 use the scanner with the higher response time for the basis for the calculation.
- If external OSSDs are used, the timing for the switching (t_{UFVz4}) must be further advanced by 20 ms (cf. ④).



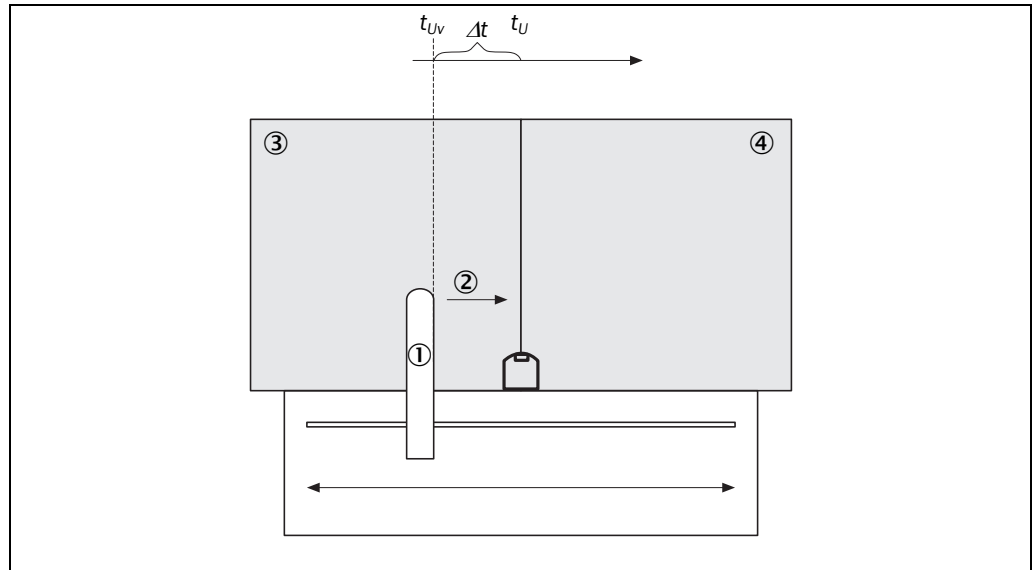
WARNING

Define the timing for the switching such that the S3000 already detects a person in the protective field before the dangerous state occurs!

At the time of the switching there may be personnel in the protective field. Only by means of switching in the correct time frame (i.e. before the hazard occurs at this point for the person) is protection provided.

- Note**
- In the phases before and after the switching, the safety distances calculated for the individual monitoring cases apply on their own.
 - The considerations above serve only for the selection of the optimal timing of the switching.
 - 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, you must ...
 - allow the two protective fields to partially overlap.
 - have both hazardous areas monitored temporarily using simultaneous monitoring.

Fig. 46: Example of advancing the timing for the switching



The gantry robot ① moves to the right ②. On the left hand side the dangerous movement is monitored by a monitoring case ③. When the gantry robot arrives at the point t_{UV} , switching must have already been performed due to the advancing of the switching necessary so that at time t_U the right monitoring case ④ is active.

Note For the movement to the left, that is for the switching to the monitoring case ③, the same applies.

How far you must advance the timing for the switching depends on ...

- the input delay your switching method requires to provide the input condition for case switching (see section “Input delay” on page 39).
- whether you switch external OSSDs via EFI.
- whether you use external control inputs (e.g. on another S3000).

Calculation of the timing for the switching:

➤ Calculate the timing for the switching using the following formula:

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

Where ...

t_{UFVz} = Timing advance for the switching

t_{EVz} = Input delay for the control inputs

t_{exOVz} = Delay due to external OSSDs over EFI = 20 ms

t_{StVz} = Delay due to external control inputs over EFI ($0.5 \times$ basic response time)

4.6 Mounting steps

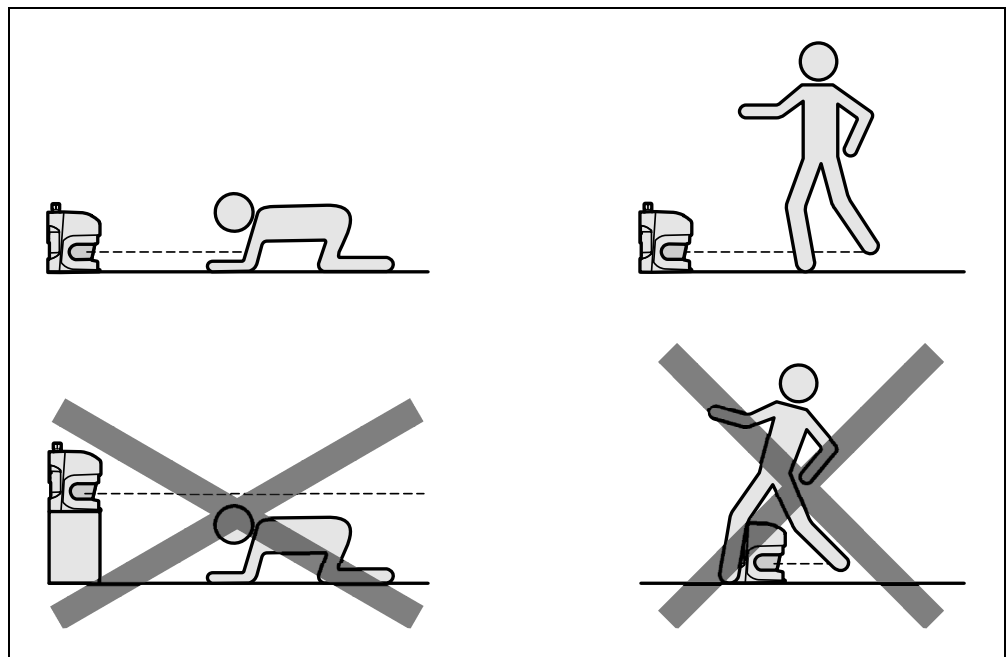


WARNING

Special features to note during mounting:

- Mount the S3000 such that it is protected from moisture, dirt and damage.
- Ensure that the front screen field of view is not restricted.
- Mount the scanner such that the indicators are easy to see.
- Always mount the S3000 such that you can plug in and remove the system plug.
- Avoid excessive shock and vibration loading on the safety laser scanner.
- On applications that suffer from heavy vibration, prevent the fixing screws from coming loose using screw locking devices.
- Regularly check the tightness of the fixing screws.
- Prevent personnel from being able to crawl beneath, stand behind or climb over the protective field by means of appropriate mounting of the S3000.

Fig. 47: Prevent crawling beneath, standing behind, climbing over



The origin of the scan plane is 63 mm above the bottom edge of the S3000. If you mount the S3000 using mounting kit 3, then the origin of the scan plane is 102 mm above the bottom edge of mounting kit 3 (see chapter 11.6.3 “Scan plane origin” on page 131).

There are four possible ways of fixing the S3000:

- direct mounting without mounting kit
- mounting with mounting kit 1
- mounting with mounting kit 1 and 2
- mounting with mounting kit 1, 2, and 3

The mounting kits build one on another. For fixing with mounting kit 2 you will therefore also need mounting kit 1. For fixing with mounting kit 3 you will therefore also need mounting kits 1 and 2. You will find the part numbers for the mounting kits in chapter 12.3.3 “Mounting kits” on page 133.

S3000

Note Observe the maximum torque for the fastening screws on the S3000:

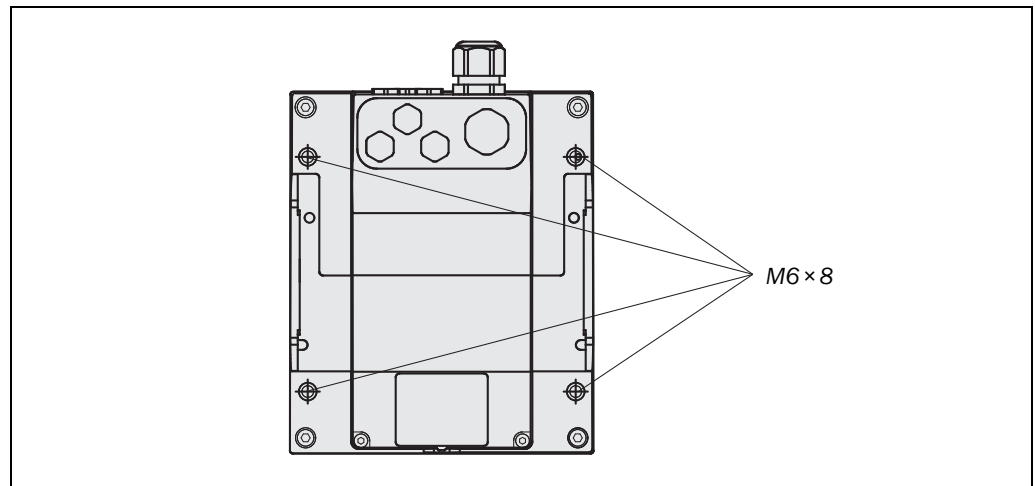
- M6 on rear = max. 12 Nm
- M8 on side = max. 16 Nm

The orientation in which the safety laser scanner is mounted is not relevant, i.e. you can mount the S3000 both at an angle and upside down.

4.6.1 Direct mounting

The S3000 has four threaded holes M6 × 8 on its rear face. Using these holes you can directly mount the S3000 by drilling through the mounting surface from the rear.

Fig. 48: Threaded holes for direct mounting

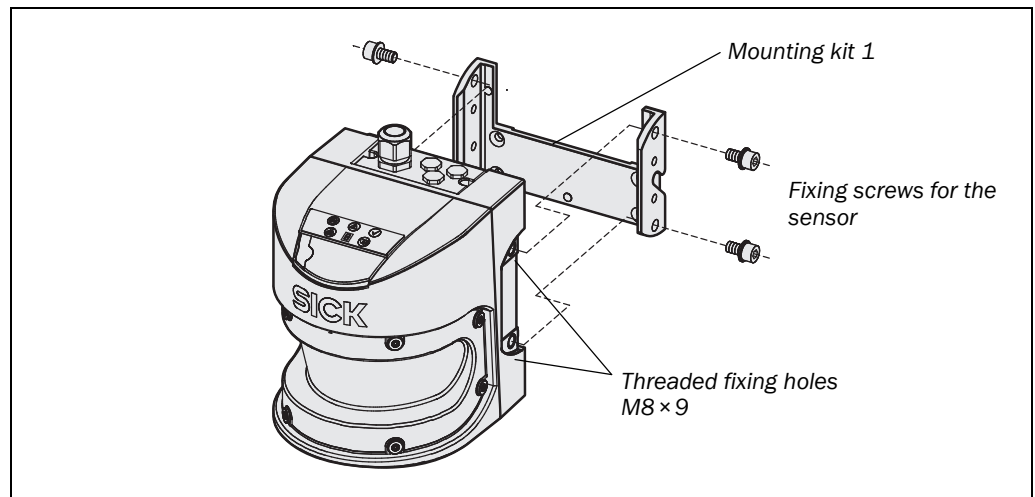


Recommendation Use at least mounting kit 1. This will make the device easier to remove.

4.6.2 Mounting with mounting kit 1

With the aid of mounting kit 1 you can mount the S3000 indirectly on the mounting surface. This is always necessary if you cannot drill through the mounting surface from the rear.

Fig. 49: Mounting with mounting kit 1

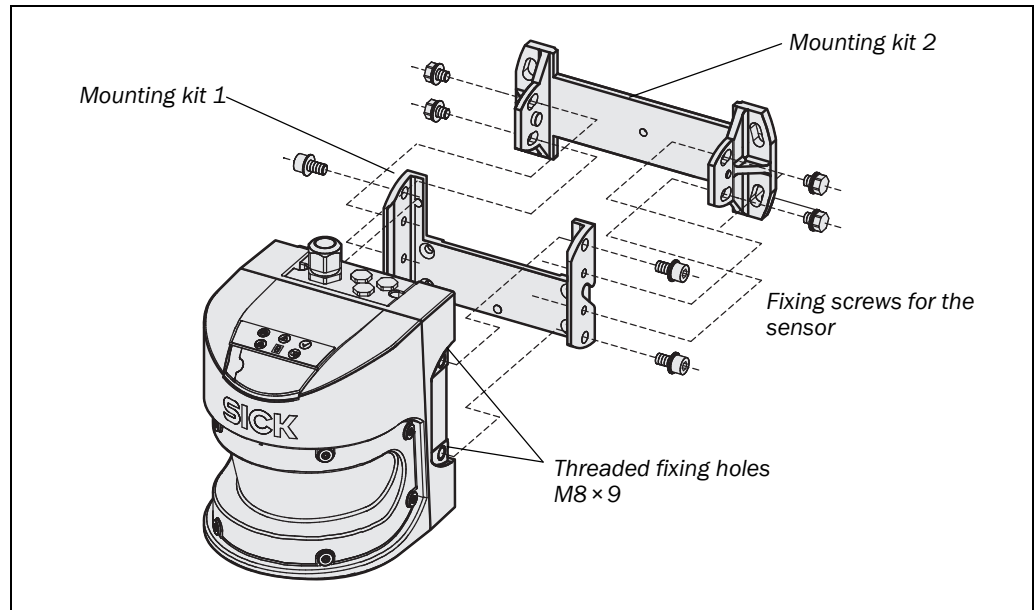


- Mount the mounting kit 1 on the mounting surface.
- Then mount the S3000 on the mounting kit 1.

4.6.3 Mounting with mounting kit 2

With the aid of mounting kit 2 (only in conjunction with mounting kit 1) you can align the S3000 in two planes. The maximum adjustment angle is $\pm 11^\circ$ in both planes.

Fig. 50: Mounting with mounting kit 2

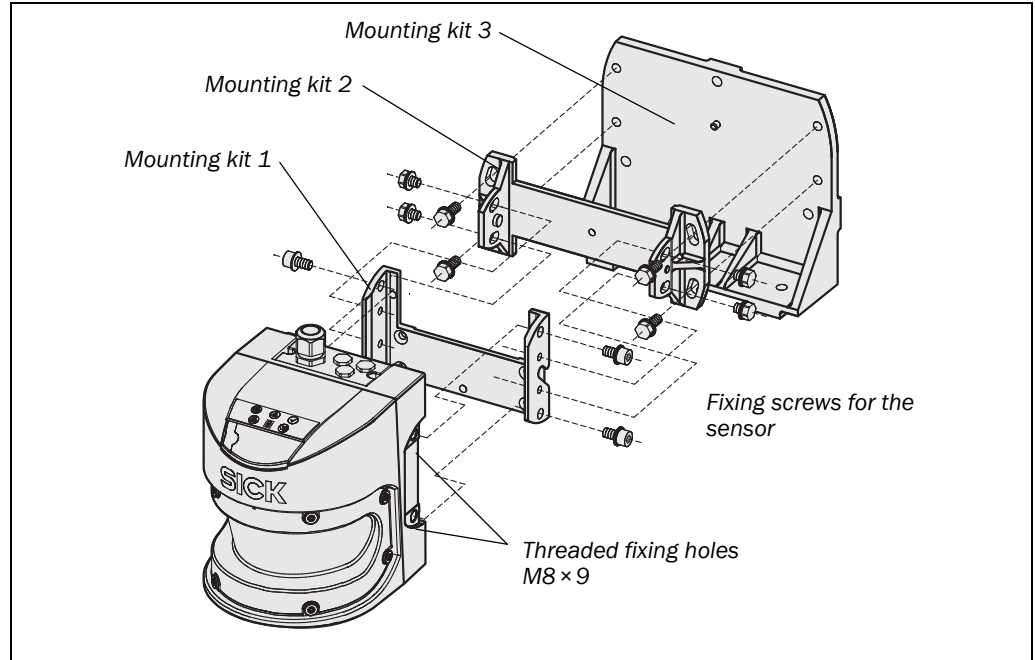


- Mount the mounting kit 2 on the mounting surface.
- Then mount mounting kit 1 on mounting kit 2.
- Then mount the S3000 on mounting kit 1.
- Adjust the S3000 longitudinally and cross-wise.

4.6.4 Mounting with mounting kit 3

With the aid of mounting kit 3 (only in conjunction with mounting kits 1 and 2) you can mount the S3000 such that the scan plane is parallel to the mounting surface. This enables stable floor mounting or ensures that mounting kit 2 remains precisely adjustable cross-wise on uneven wall surfaces.

Fig. 51: Mounting with mounting kit 3



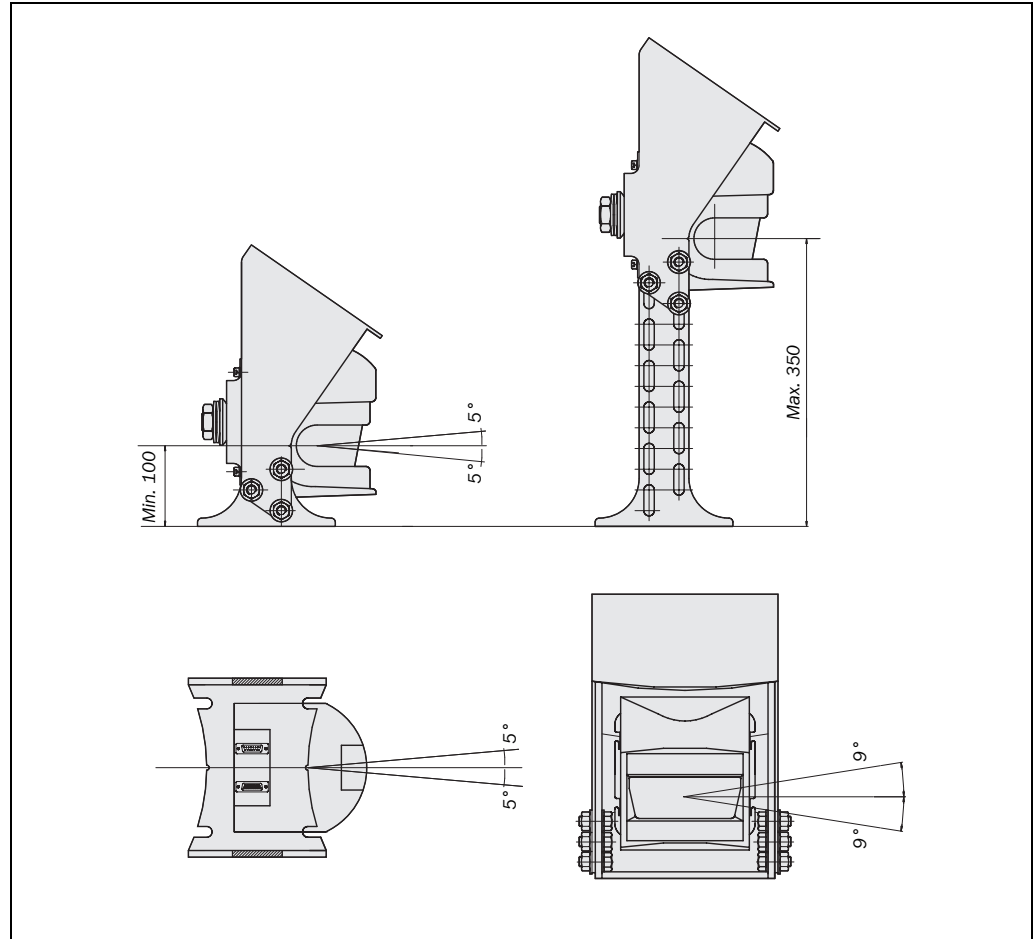
- Mount mounting kit 3 on the mounting surface.
- Then mount mounting kit 2 on mounting kit 3.
- Then mount mounting kit 1 on mounting kit 2.
- Finally mount the S3000 on mounting kit 1.
- Adjust the S3000 longitudinally and cross-wise.

Note During mounting, please observe the dimensional drawings in chapter “Technical specifications” (see section 11.6 “Dimensional drawings” on page 129).

4.6.5 Mounting with the Heavy Duty mounting bracket

With the aid of the Heavy Duty mounting bracket you can mount the S3000 such that the scan plane is between 100 mm and 350 mm above the floor. With the aid of the mounting bracket you can align the S3000 in three planes. The maximum adjustment angle is $\pm 5^\circ$ or $\pm 9^\circ$.

Fig. 52: Mounting with the Heavy Duty mounting bracket



4.6.6 Adhesive label Important information

- On completion of mounting, you must affix the self-adhesive label **Important information** supplied with the S3000:
 - Use only the information label in the language which the operators of the machine understand.
 - Affix the information label such that it is clearly visible for the users/operators during operation. The information label must not be covered even after additional items have been mounted.

4.6.7 Using multiple safety laser scanners S3000

The S3000 is so designed that mutual interference between several scanners is unlikely. To completely exclude erroneous switching, you must mount the scanners as shown in the following examples.

Note In any circumstance observe prEN ISO 13855.

Use mounting kits 1 to 3 to adjust the scanners to different angles (see chapter 12.3.3 “Mounting kits” on page 133). The beam path for the safety laser scanners can be checked using the Scanfinder LS70b (part no. 6020756).

S3000

Fig. 53: Opposite mounting

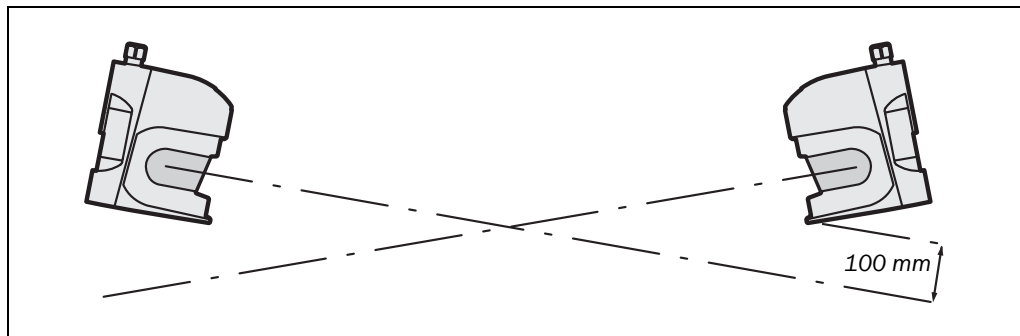


Fig. 54: Inclined, parallel mounting

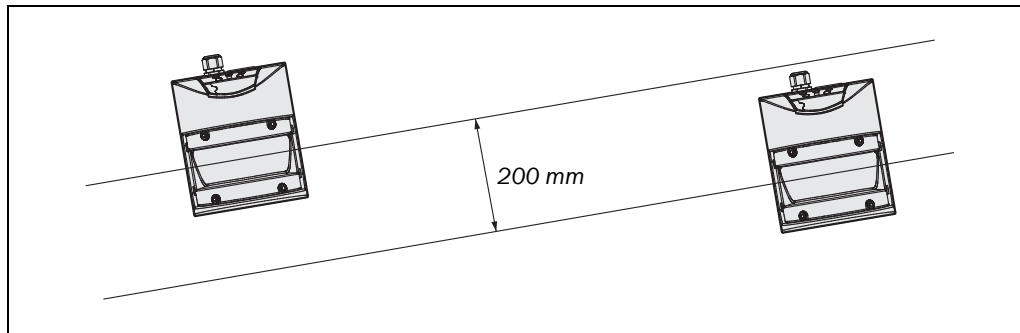


Fig. 55: Offset parallel mounting

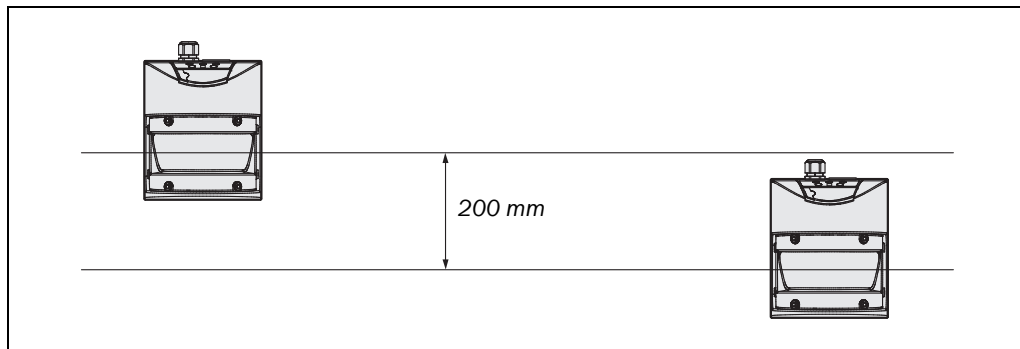


Fig. 56: Mounting on a cross

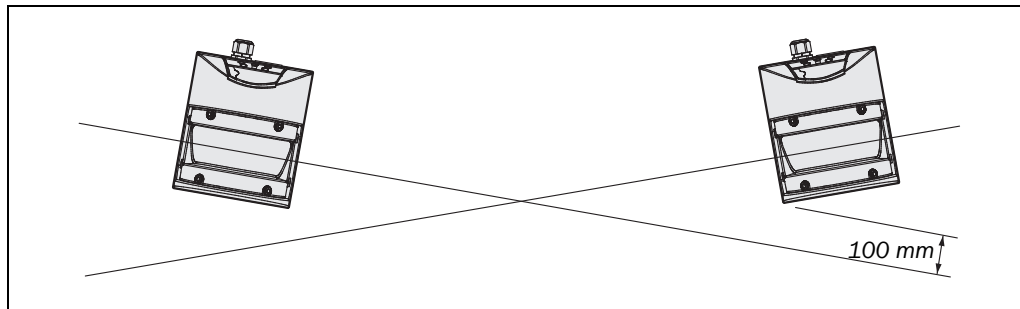
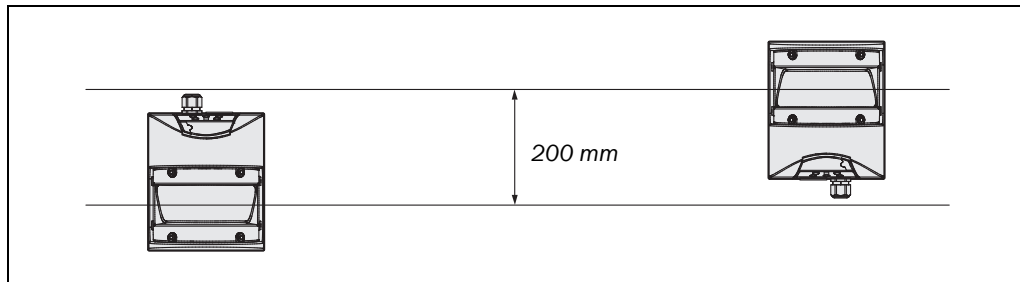


Fig. 57: Reverse mounting, parallel



5 Electrical installation



WARNING

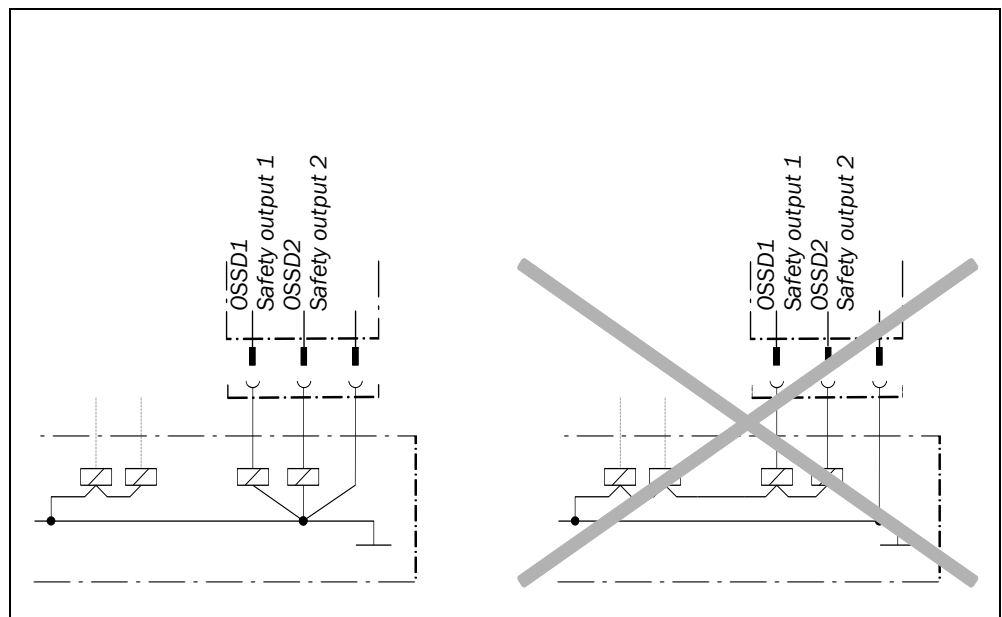
Switch the entire machine/system off line!

The machine/system could inadvertently start up while you are connecting the devices.

- Ensure that the entire machine/system is disconnected during the electrical installation.

Prevent the formation of a potential difference between the load and the protective device!

- If you connect loads that are not reverse-polarity protected to the OSSDs or the safety outputs, you must connect the 0 V connections of these loads and those of the corresponding protective device individually and directly to the same 0 V terminal strip. This is the only way to ensure that, in the event of a defect, there can be no potential difference between the 0 V connections of the loads and those of the corresponding protective device.



Notes

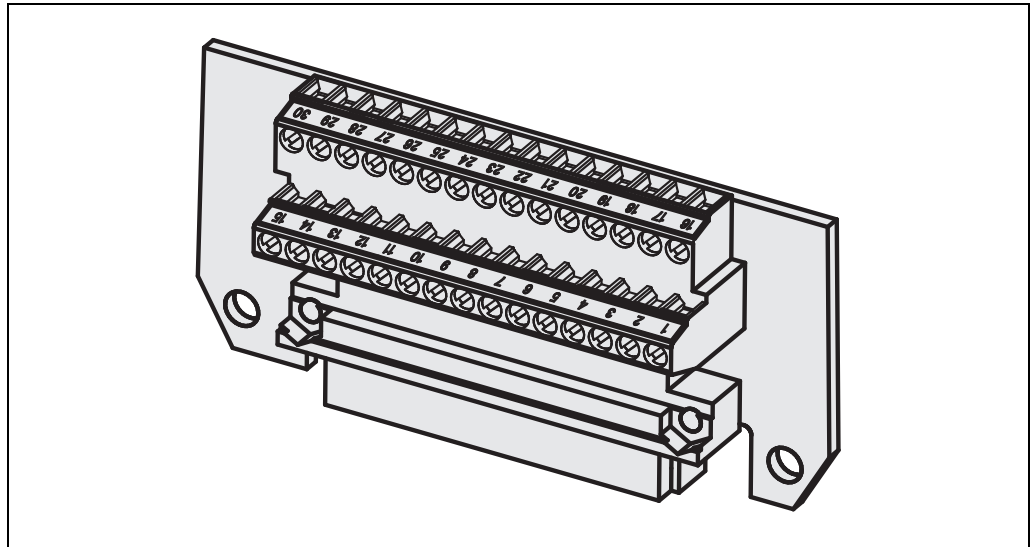
- Route all cables and connection cables such that they are protected from damage.
- If you use the S3000 for the protection of hazardous areas: Ensure that any control systems or other devices forming part of the safety installation meet the stipulated category according to EN ISO 13 849-1!
- If you use screened cable, lay the shield evenly around the cable gland.
- Ensure that the S3000 is adequately protected electrically. You will find the electrical data necessary for determining the correct fuse in chapter 11.4 "Data sheet" on page 119.

The electrical connections for the S3000 are made at the system plug. It contains connections for the inputs, outputs and the supply voltage. You can either make connections directly to the terminal strip on the system plug or use a pre-assembled system plug from SICK (see chapter 5.3 "Pre-assembled system plugs" on page 80).

5.1 System connection

All inputs and output connections for the S3000 are located on the system connector. This comprises of a 30-pin screw terminal connector and is located in the system plug.

Fig. 58: Screw terminal strip on the system plug



The system connection pin assignments vary depending on the S3000 variant.

Note

- If the cable gland is missing or not tightened, or if fixing screws are missing or not tightened on the system plug, the IP 65 enclosure rating is not met.
- All inputs and outputs for the S3000 are to be used only in the context specified.
- If you want to operate two scanners in a group (communication via EFI), then the same earthing method must be used for both scanners.

5.1.1 Pin assignments of the I/O modules

Tab. 14: Pin assignments of the I/O modules

Pin	Signal	Function	Standard	Advanced	Professional	Professional CMS	Remote
1	+24V DC	Supply voltage S3000	x	x	x	x	x
2	0V DC	Supply voltage S3000	x	x	x	x	x
3	OSSD1	Output signal switching device	x	x	x	x	x
4	OSSD2	Output signal switching device	x	x	x	x	x
5	RESET	Input, reset	x	x	x	x	x
6	EDM	Input, external device monitoring	x	x	x	x	x
7	ERR	Application diagnostic output — error/contamination or connection for a jumper for slave addressing ⁷⁾	x	x	x	x	x
8	RES_REQ	Output, reset required	x	x	x	x	x
9	WF	Output, object in warning field	x	x	x	x	x

⁷⁾ In master/slave operation, a device can be defined as a slave using a jumper between pin 7 and pin 10. This action is also necessary if several safety laser scanners are connected to one EFI string on a safety controller Flexi Soft.

Pin	Signal	Function	Standard	Advanced	Professional	Professional CMS	Remote
10	A1	Static control input A or connection for a jumper for slave addressing ⁷⁾	X ⁸⁾	X	X	X	X ⁸⁾
11	A2	Static control input A		X	X	X	
12	B1	Static control input B		X	X	X	
13	B2	Static control input B		X	X	X	
14	EFI _A	Enhanced function interface = safe SICK device communication	X	X	X	X	X
15	EFI _B		X	X	X	X	X
16	+24V DC	Supply voltage incremental encoder 1			X	X	
17	GND				X	X	
18	C1 or INC1_0	Static control input C or dynamic control input (incremental encoder input) 1			X	X	
19	D1 or INC1_90	Static control input D or dynamic control input (incremental encoder input) 1			X	X	
20	+24V DC	Supply voltage incremental encoder 2			X	X	
21	GND				X	X	
22	C2 or INC2_0	Static control input C or dynamic control input (incremental encoder input) 2			X	X	
23	D2 or INC2_90	Static control input D or dynamic control input (incremental encoder input) 2			X	X	
24	Reserved, do not use!						
25	RxD-	RS-422 interface for output of measured data	X	X	X	X	X
26	RxD+		X	X	X	X	X
27	TxD+		X	X	X	X	X
28	TxD-		X	X	X	X	X
29	EFI _A	Enhanced function interface = safe SICK device communication	X	X	X	X	X
30	EFI _B		X	X	X	X	X

⁸⁾ No control input A on S3000 Standard and Remote.

**WARNING****Incremental encoder specification****Never supply both incremental encoders using one supply cable!**

The connection cables for the incremental encoders must each be in a separate plastic-sheathed cable as otherwise a cable break could cause an error that could remain undetected.

The incremental encoders must meet the following specifications:

- two-channel rotary encoder with 90° phase offset
- supply voltage: 24 V DC
- outputs: push/pull outputs
- enclosure rating IP 54 or better
- screened cable
- max. pulse frequency: 100 kHz
- min. number of pulses: 50 pulses per cm

Recommendation

You can procure suitable incremental encoders, e.g., from SICK-Stegmann GmbH, Duerrheimer Strasse 36, 78166 Donaueschingen, www.sick.de/de/products/categories/industrial/encoder/en.html. Recommended series: DGS60-G, DGS65-G or DGS66-G.

EFI connection

Connect EFI-A on the first device with EFI-A on the second device and EFI-B on the first device with EFI-B on the second device.

Notes

- Always use screened twisted pair cables!
- If the length of the cable to the safety laser scanner is more than 30 m, the shield is to be connected as close as possible to the safety laser scanner.

5.2 System plug assembly

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 varies depending on the variant:

- system plug SX0A-A0000B for S3000 Standard, S3000 Advanced and S3000 Remote:
 - 1 cable entry without M12 cable gland (blanking plug)
 - 1 cable entry with M20 cable gland
 - 2 blanking plugs for the unused outlets
- system plug SX0A-A0000D for S3000 Professional:
 - 3 cable entries without M12 cable gland (blanking plugs)
 - 1 cable entry with M20 cable gland
 - 4 blanking plugs for the unused outlets

Note You can also purchase the S3000 with pre-assembled system plug with various cable lengths (see chapter 5.3 “Pre-assembled system plugs” on page 80 and chapter 12.3.4 “System plug” on page 134).

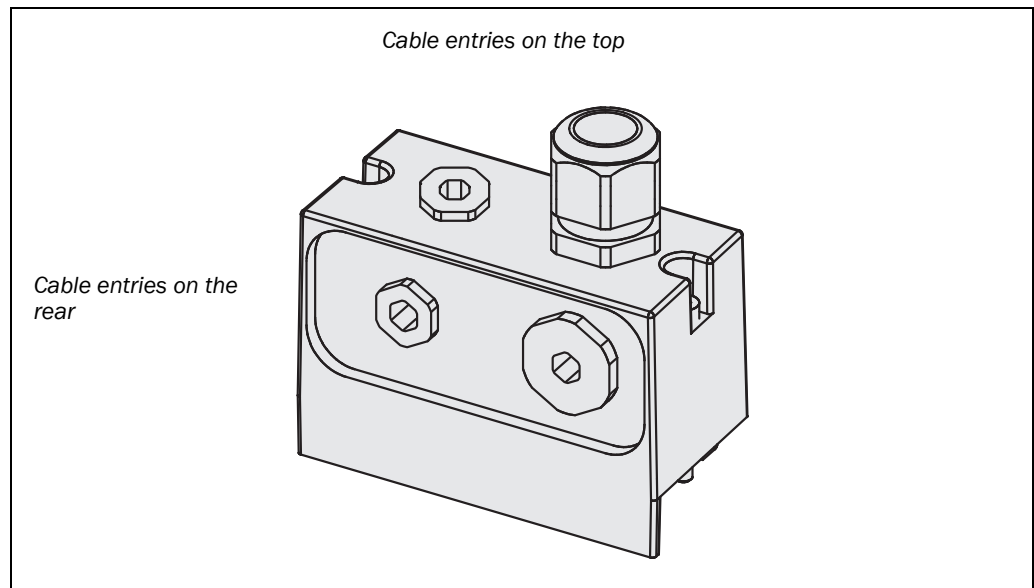


WARNING

The length of the spare cable should be such that the system plug cannot inadvertently be plugged into a neighbouring S3000!

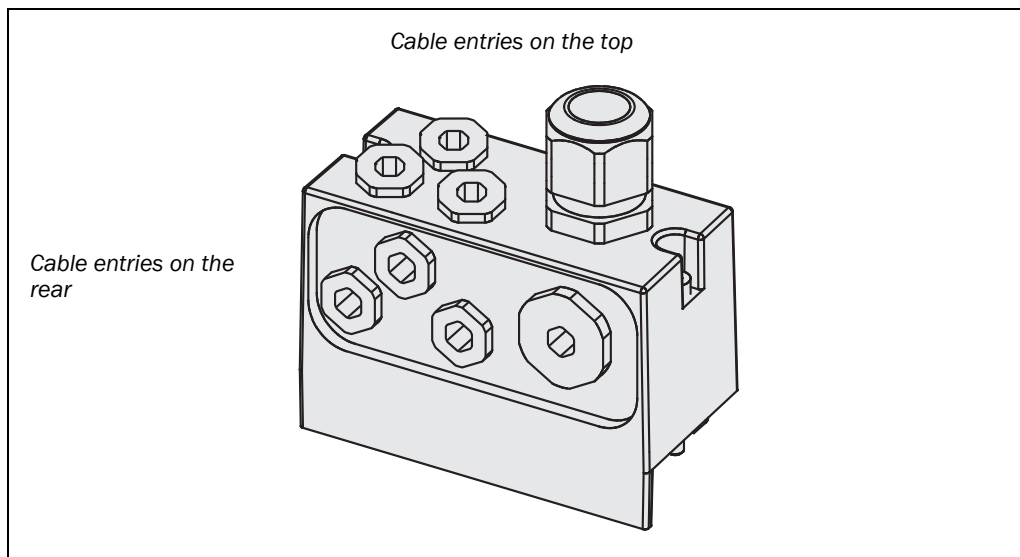
From experience 20 to 30 cm spare cable at the scanner have proven to adequate. In this way you avoid the inadvertent connection of the system plug to a neighbouring S3000 and operation of an S3000 with an incorrect configuration. The spare cable enables you to change the S3000 with ease if necessary.

Fig. 59: System plug SX0A-A0000B for S3000 Standard, S3000 Advanced and S3000 Remote



S3000

Fig. 60: System plug SX0A-A0000D for S3000 Professional



Depending on the application use suitable cable entries on the top or rear. For the EFI cables you must choose EMC-proof cable glands (see 12.3.6 “Self assembly connecting cables” on page 135).

Tab. 15: Use the cable entries supplied

Cable entry	Cable diameter	Usage
M20	6–12 mm	System cables (supply voltage, outputs, static inputs)
M12 (only if supplied)	3–6.5 mm	- Control switch for restart or reset - Incremental encoder - RS-422 data cables - EFI

Use the following wire cross-sections for the individual connections:

Tab. 16: Recommended wire cross-sections

Cable	Recommended cable	Screened
System cables (supply voltage, outputs, static inputs)	9–17 cores, 0.5–1 mm ²	No
Incremental encoder	4 × 0.25 mm ²	Yes
EFI	1 × 2 × 0.22 mm ²	Yes
Control switch for restart or reset	2 × 0.25 mm ²	No
RS-422 data cables	4 × 0.25 mm ²	Yes

Recommendation

If you do not want to assemble the system plug yourself, you will find suitable cables in the ordering information (see chapter 12.3.6 “Self assembly connecting cables” on page 135).

5.3 Pre-assembled system plugs

5.3.1 Pre-assembled system plugs with flying leads

To connect the S3000 variants, the following pre-assembled system plugs are available (see also chapter 12.3.4 “System plug” on page 134):

- **SX0A-B0905G**
 - for S3000 Standard and S3000 Remote
 - with 9 unscreened cores
 - 5 m long
 - cable outlet on the bottom
- **SX0A-B0905B, SX0A-B0910B and SX0A-B0920B**
 - for S3000 Standard and S3000 Remote
 - with 9 unscreened cores
 - 5, 10 or 20 m long
 - cable outlet on the top
- **SX0A-B1305B, SX0A-B1310B and SX0A-B1320B**
 - for S3000 Advanced
 - with 13 unscreened cores
 - 5, 10 or 20 m long
 - cable outlet on the top
- **SX0A-B1305D and SX0A-B1310D**
 - for S3000 Professional with static and dynamic inputs
 - with 13 unscreened cores
 - 5 or 10 m long
 - with 3 M12 cable entries for incremental encoders
 - cable outlet on the top
- **SX0A-B1705B, SX0A-B1710B and SX0A-B1720B**
 - for S3000 Professional mit static inputs
 - with 17 unscreened cores
 - 5, 10 or 20 m long
 - cable outlet on the top

S3000

Tab. 17: Pin assignment: pre-assembled system plug

Pin	Signal	Wire colour	SX0A-B0905B SX0A-B0910B SX0A-B0920B	SX0A-B1305B SX0A-B1310B SX0A-B1320B	SX0A-B1305D SX0A-B1310D	SX0A-B1705B SX0A-B1710B SX0A-B1720B
1	+24V DC	Brown	x	x	x	x
2	0V DC	Blue	x	x	x	x
3	OSSD1	Grey	x	x	x	x
4	OSSD2	Pink	x	x	x	x
5	RESET	Red	x	x	x	x
6	EDM	Yellow	x	x	x	x
7	ERR	White/black	x	x	x	x
8	RES_REQ	Red/blue	x	x	x	x
9	WF	White/brown	x	x	x	x
10	A1	White/red		x	x	x
11	A2	White/orange		x	x	x
12	B1	White/yellow		x	x	x
13	B2	White/green		x	x	x
18	C1 or INC1_0	White/blue				x
19	D1 or INC1_90	White/grey				x
22	C2 or INC2_0	White/purple				x
23	D2 or INC2_90	White				x
Number of top mounted cable glands (cable entries to the rear sealed with blanking plugs)			2	2	4	2

Note **Disconnect all cores from the system plug that are not necessary for the related application (In this way you will prevent possible interference.)!**

6 Application and connection diagrams

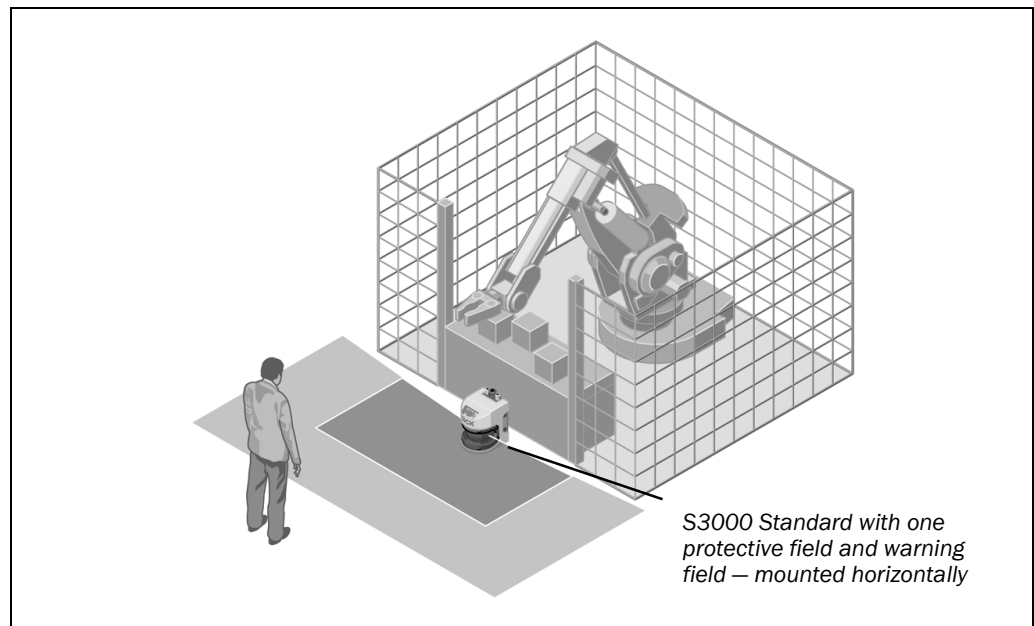
The examples shown are only provided as an aid for your planning. You may need to consider additional protection measures for your application.

In the examples with protective field switching, note that at the time of the switching there may already be a person in the protective field. Only by means of switching in the correct time frame (i.e. before the danger occurs at this point) is reliable protection provided (see chapter 4.5 “Timing for monitoring case switching” on page 65).

6.1 Stationary applications

6.1.1 Applications with one monitored area (S3000 Standard)

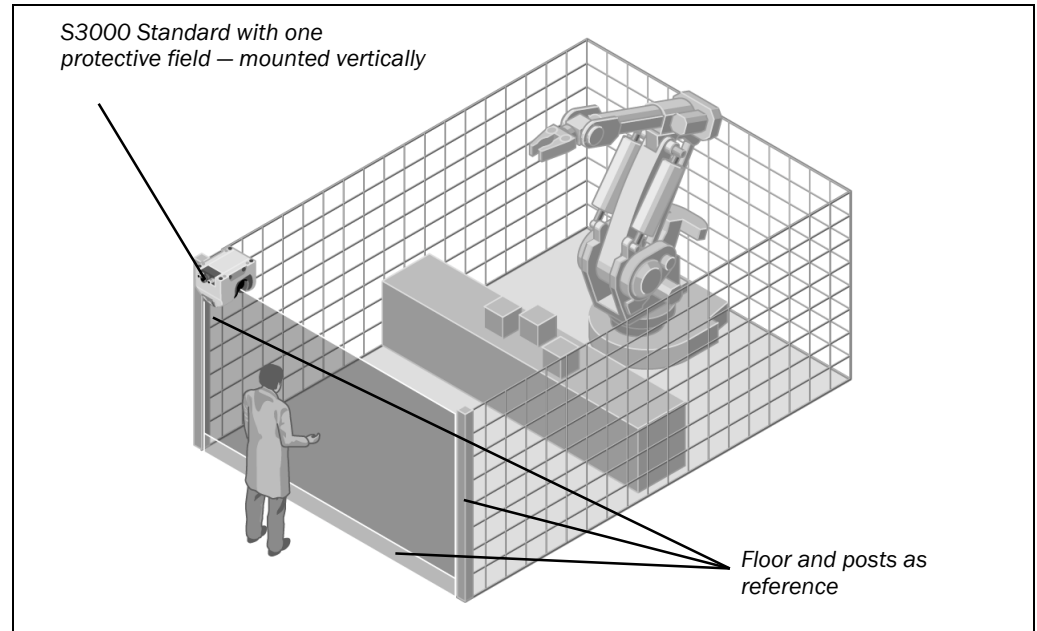
Fig. 61: Hazardous area protection with S3000 Standard



The area is permanently monitored by the S3000.

S3000

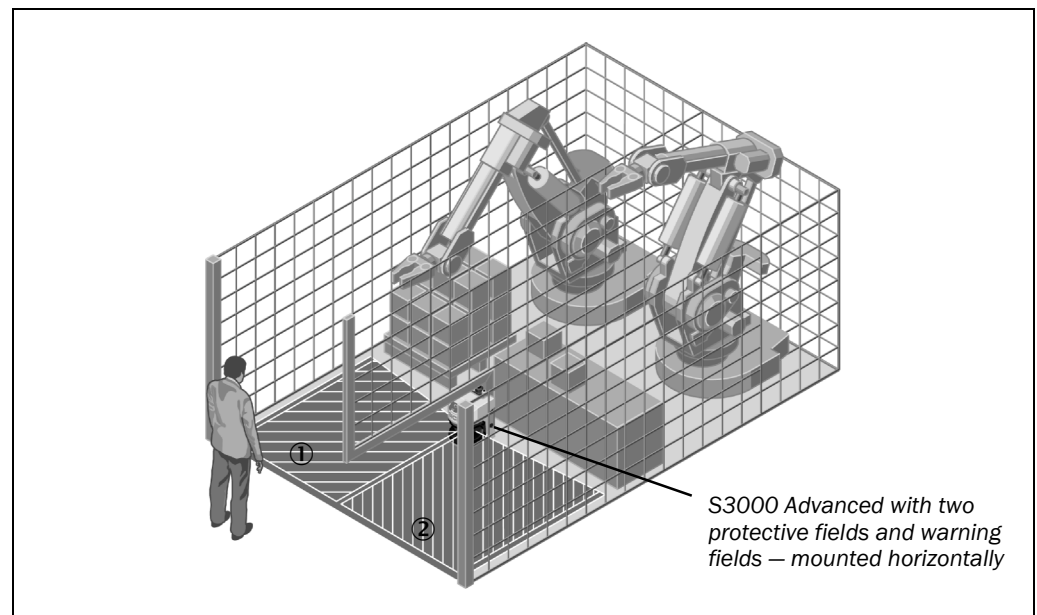
Fig. 62: Access protection with S3000 Standard



The access is monitored permanently. For safety against manipulation on the S3000, e.g. the floor is used as a reference. If the alignment of the S3000 changes (e.g. due to change to the mounting), the S3000 shuts down.

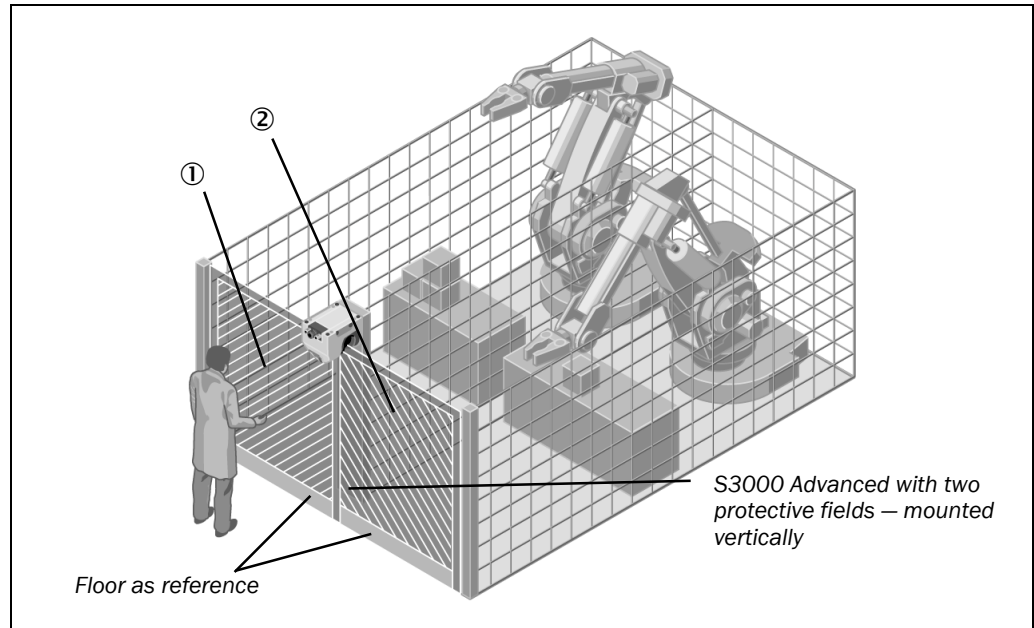
6.1.2 Applications with multiple monitored areas (S3000 Advanced)

Fig. 63: Hazardous area protection with S3000 Advanced



The two areas to be monitored are switched using the static control inputs depending on the phase of the process on the machine. For example the area ① or the area ② can be monitored, both areas can be monitored or none.

Fig. 64: Access protection with S3000 Advanced

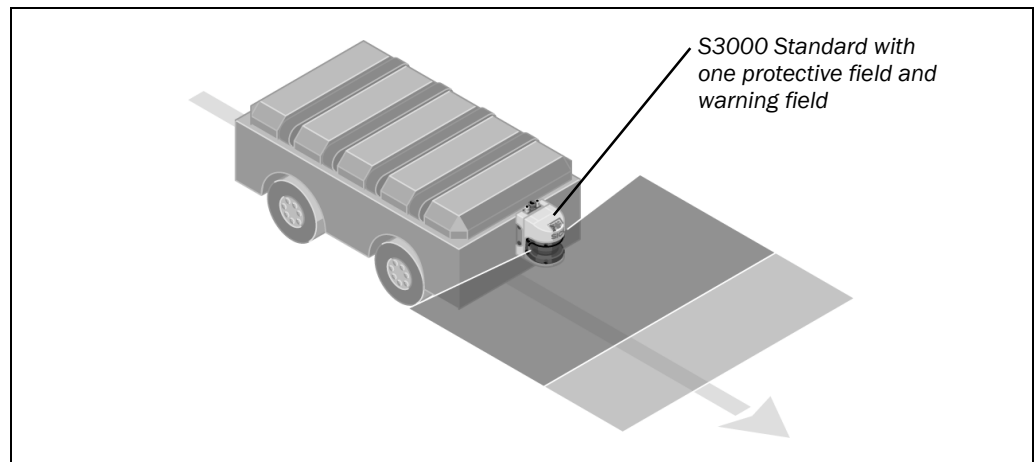


The two areas to be monitored are switched using the static control inputs depending on the process phase. For example the area ① or the area ② can be monitored, both areas can be monitored or none. For safety against manipulation on the S3000, e.g. the floor is used as a reference in each case. If the alignment of the S3000 changes (e.g. due to change to the mounting), the S3000 shuts down.

6.2 Mobile applications

6.2.1 Vehicle monitoring for unidirectional travel (S3000 Standard)

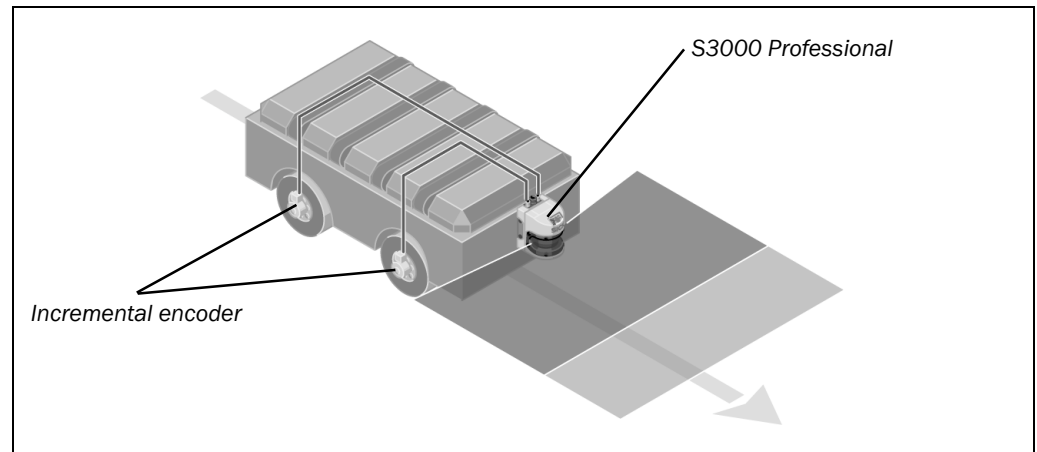
Fig. 65: Vehicle monitoring with S3000 Standard



The S3000 monitors the area in one direction of travel and stops the vehicle as soon as there is an object in the protective field.

6.2.2 Velocity-dependent vehicle monitoring for unidirectional travel (S3000 Professional)

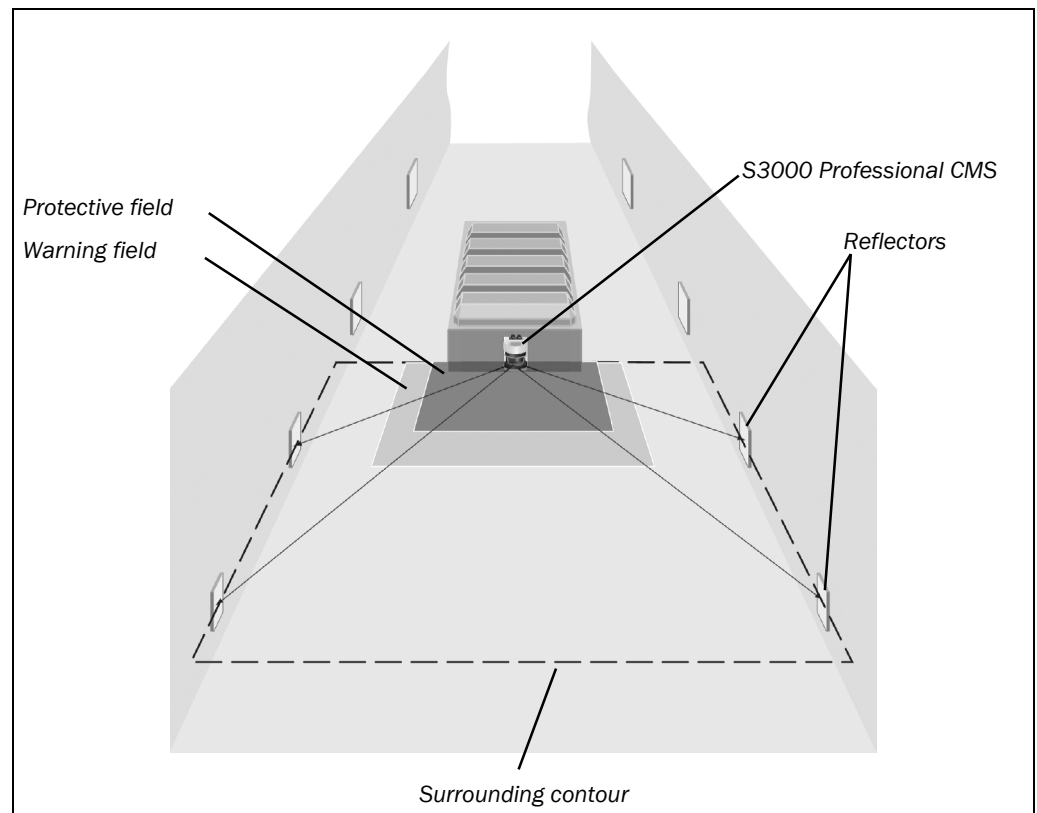
Fig. 66: Velocity-dependent vehicle monitoring with S3000 Professional



Using incremental encoders the S3000 Professional acquires the velocity of the vehicle via its dynamic control inputs. For different velocities, various field sets with protective fields and warning fields of varying sizes are configured in the S3000. The field sets are switched dynamically using the vehicle velocity.

6.2.3 Vehicle monitoring with determination of the surrounding contour and reflector detection (S3000 Professional CMS)

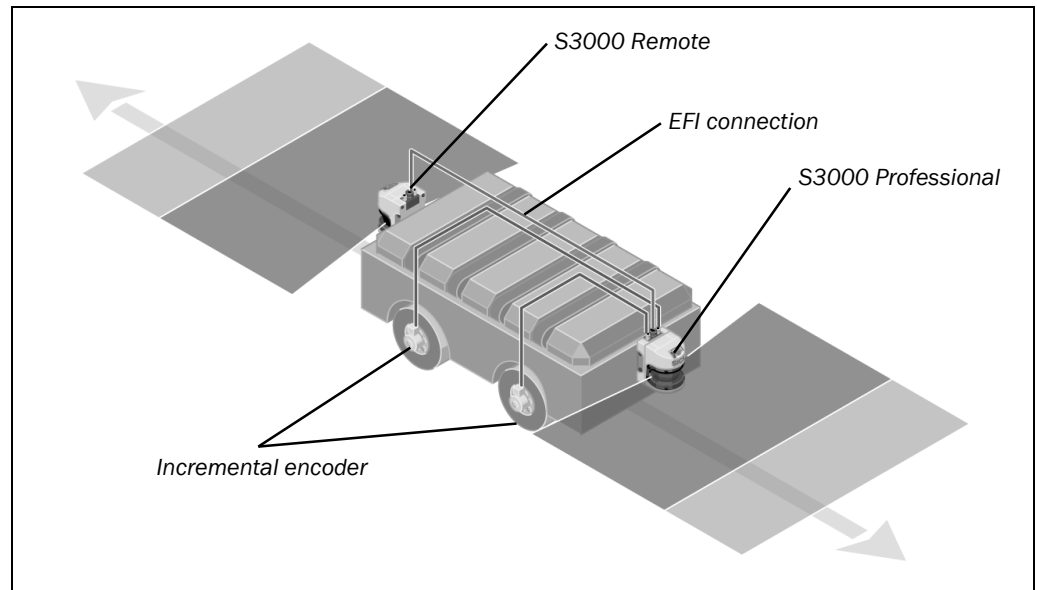
Fig. 67: Mobile application with S3000 Professional CMS



The S3000 monitors the area in one direction of travel and stops the vehicle as soon as there is an object in the protective field. In addition, the surrounding contour is measured and reflectors fitted to the walls detected. Surrounding contour and reflector detection are output via the RS-422 interface using configurable messages.

6.2.4 Velocity-dependent vehicle monitoring for bi-directional travel (S3000 Professional with S3000 Remote)

Fig. 68: Mobile application with S3000 Professional

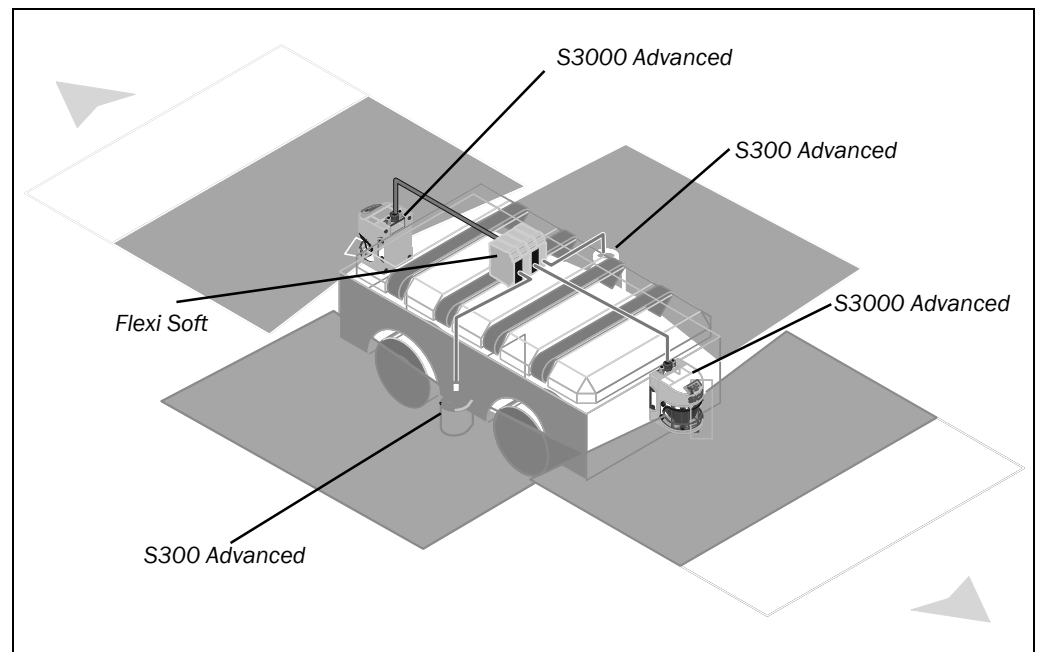


Using incremental encoders the S3000 Professional acquires the velocity of the vehicle via its dynamic control inputs. Various field sets of different sizes are configured in the S3000 for the different velocities. The field sets are switched dynamically using the vehicle velocity.

The S3000 Remote receives the values from the incremental encoders from the S3000 Professional via the EFI. It monitors the areas for the second direction of travel as a function of the velocity. As soon as there is an object in the protective field, the S3000 Remote deactivates the OSSDs on the S3000 Professional using the EFI.

6.2.5 Vehicle monitoring with four safety laser scanners and the Flexi Soft modular safety controller

Fig. 69: Mobile application with S3000 and S300 Advanced



The protective fields on the two S3000 monitor in the related direction of travel on forward or reverse movement. The protective fields on the S300 monitor the area to the side of the vehicle. The information on the protective fields is passed via EFI to the safety controller Flexi Soft and there combined using logic modules.

The signal on the safety outputs on the safety controller Flexi Soft is passed to the vehicle control.

6.3 Applications with sens:Control

With sens:Control, the safe control solutions, SICK provides you with an entire range of interface products that were specially developed for interfacing safety products and machines.

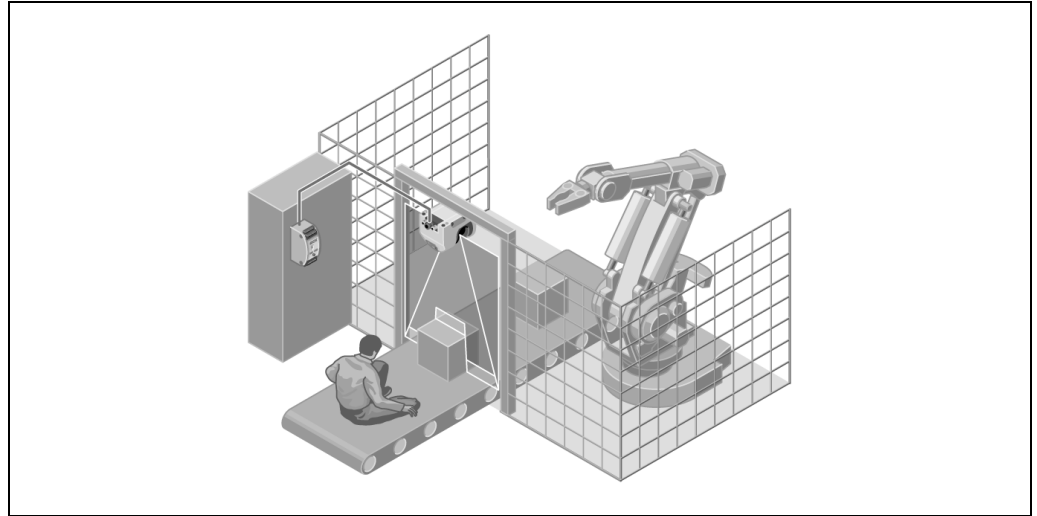
For complex applications the S3000 can be integrated into sens:Control family safety systems. In this way the functions of the laser scanner can be enhanced and corresponding applications realised.

Note Please observe the related operating instructions for the sens:Control products.

6.3.1 Complex system enhancements series UE100

Protection of two separate working areas with one S3000 Standard and UE100 sens:Control series.

Fig. 70: S3000 with UE100 series

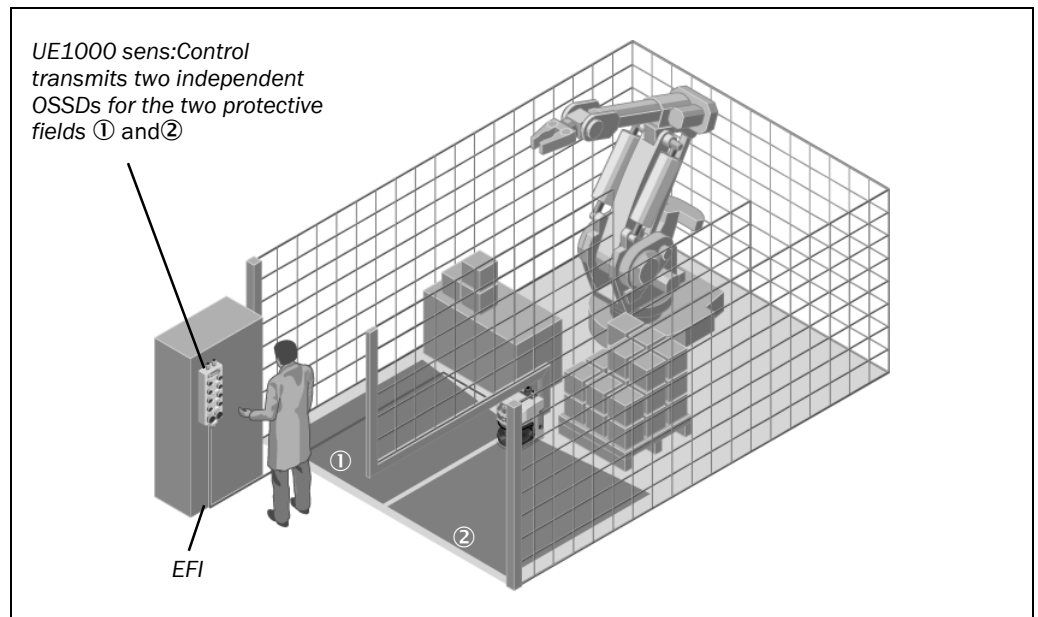


Note You will find connection diagrams in the operating instructions for the UE100 series.

6.3.2 Bus interfaces UE1000 series

All S3000 variants are equipped with an EFI (safe SICK device communication). All safety-relevant signals are transmitted using this interface. A bus interface to a safe fieldbus is possible using the UE1000 series sens:Control device family.

Fig. 71: S3000 with UE1000 series



Note You will find connection diagrams in the operating instructions for the UE1000 series.

6.4 Connection diagrams

Note Only use relays with positively-driven contacts. The protection elements connected in parallel with the contactors are used for arc-suppression. Ensure that there is adequate arc-suppression at the relay contacts. Take into account that arc-suppressors may lengthen the response time.

S3000

If you require to operate two scanners in a group (communication via EFI), then the same earthing method must be used for both scanners.

Sketch key

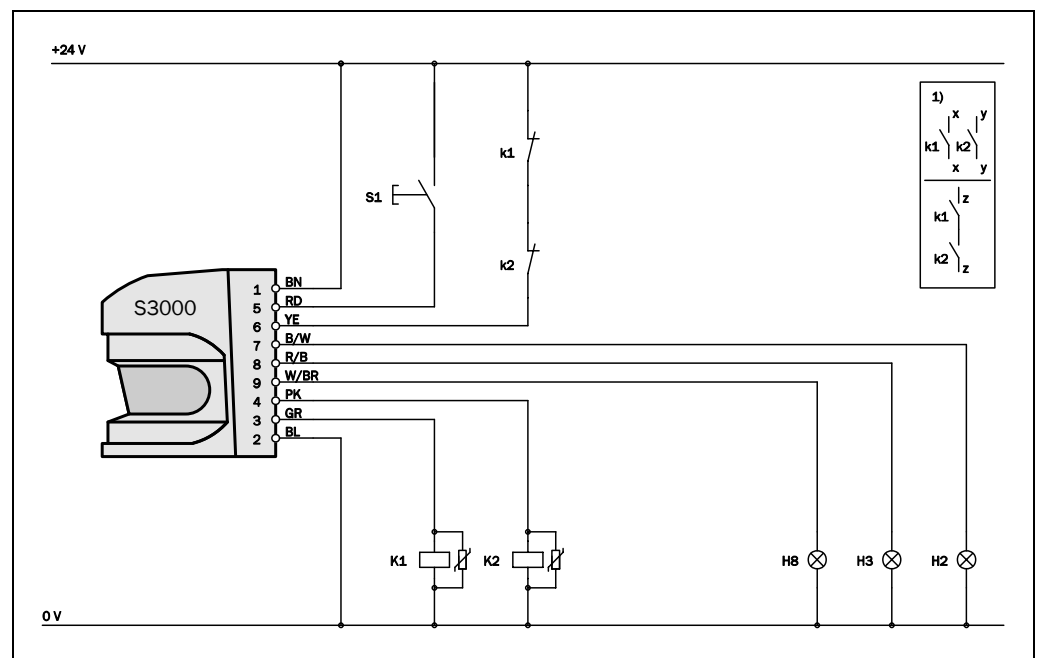
- 1) = output circuits

These contacts are to be connected to the controller such that, with the output circuit open, the dangerous state is disabled. For categories 3 and 4 in compliance with EN ISO 13849-1, the interfacing must be two-channel (x-/y paths). Observe the maximum values for the loading of the outputs (see chapter 11.4 "Data sheet" on page 119).

- H2 = sensor for error/contamination
- H3 = sensor for waiting for restart
- H8 = sensor for warning field interruption

6.4.1 Restart interlock and external device monitoring

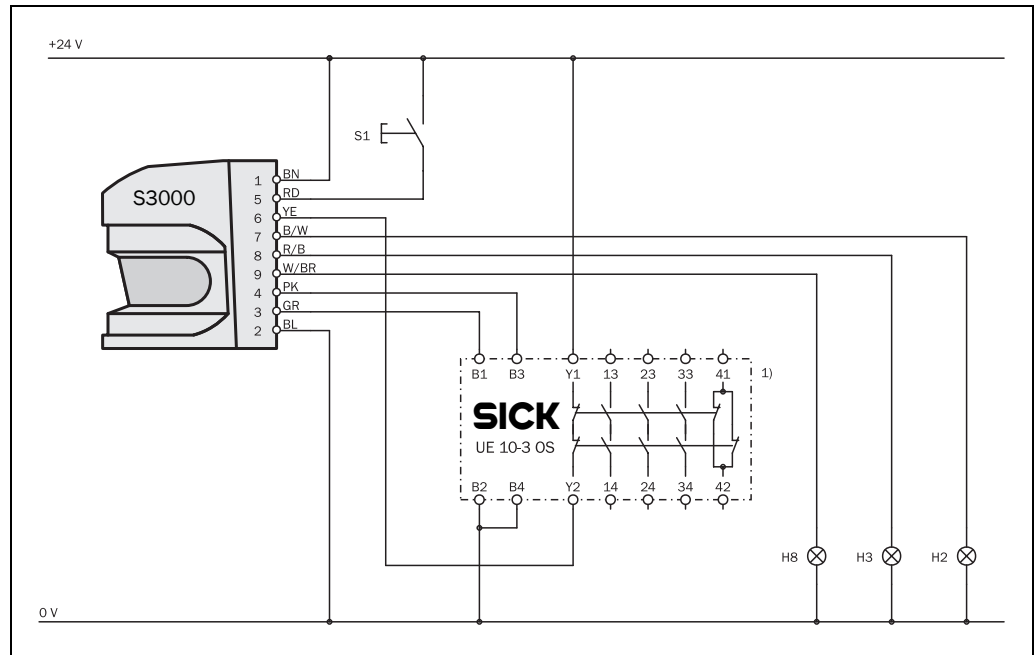
Fig. 72: Connection diagrams for restart interlock and external device monitoring



S3000 Standard in conjunction with relays/contactors; operating mode: with restart interlock and external device monitoring.

6.4.2 Restart interlock and external device monitoring with UE10 series

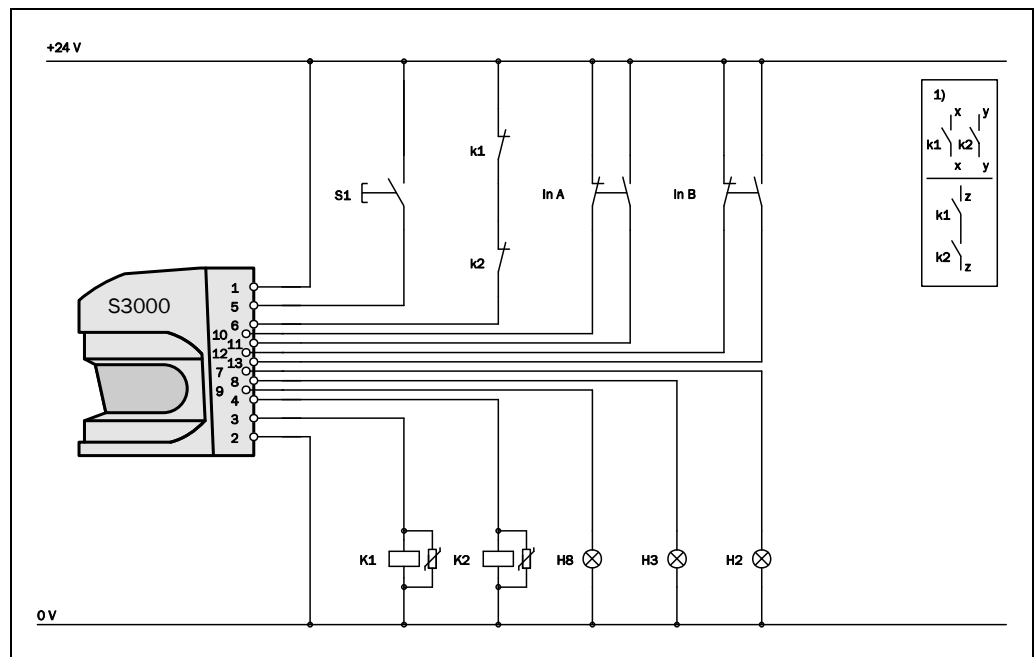
Fig. 73: Connection diagram for restart interlock and external device monitoring with series UE10



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

6.4.3 Protective field switching with two static inputs

Fig. 74: Connection diagram for protective field switching using two static inputs

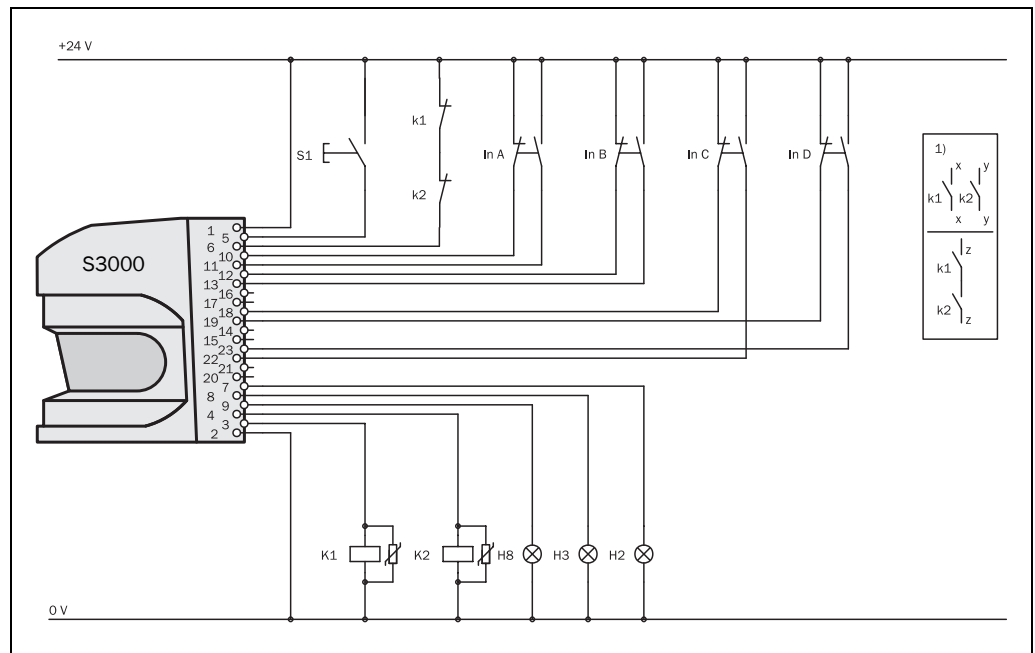


S3000 Advanced in conjunction with relays/contactors; operating mode: with restart interlock and external device monitoring; protective field switching by means of control inputs A (In A) and B (In B).

S3000

Fig. 75: Connection diagram for protective field switching with four static inputs

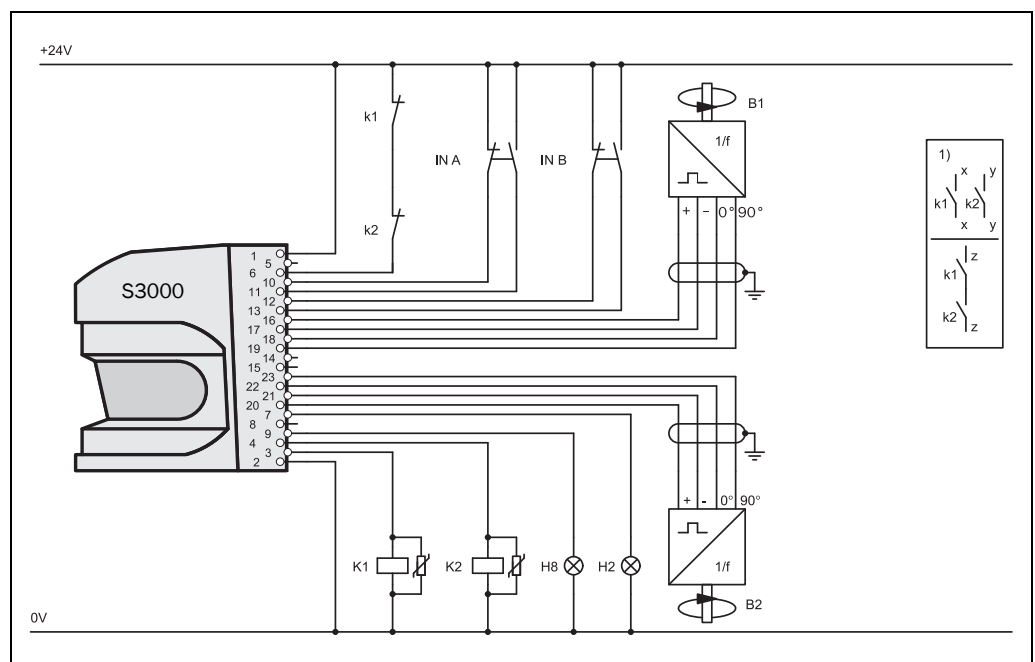
6.4.4 Protective field switching with four static inputs



S3000 Professional in conjunction with relays/contactors; operating mode: with restart interlock and external device monitoring; static protective field switching by means of the control inputs A (In A), B (In B), C (In C) and D (In D).

Fig. 76: Connection diagram for protective field switching with static and dynamic inputs

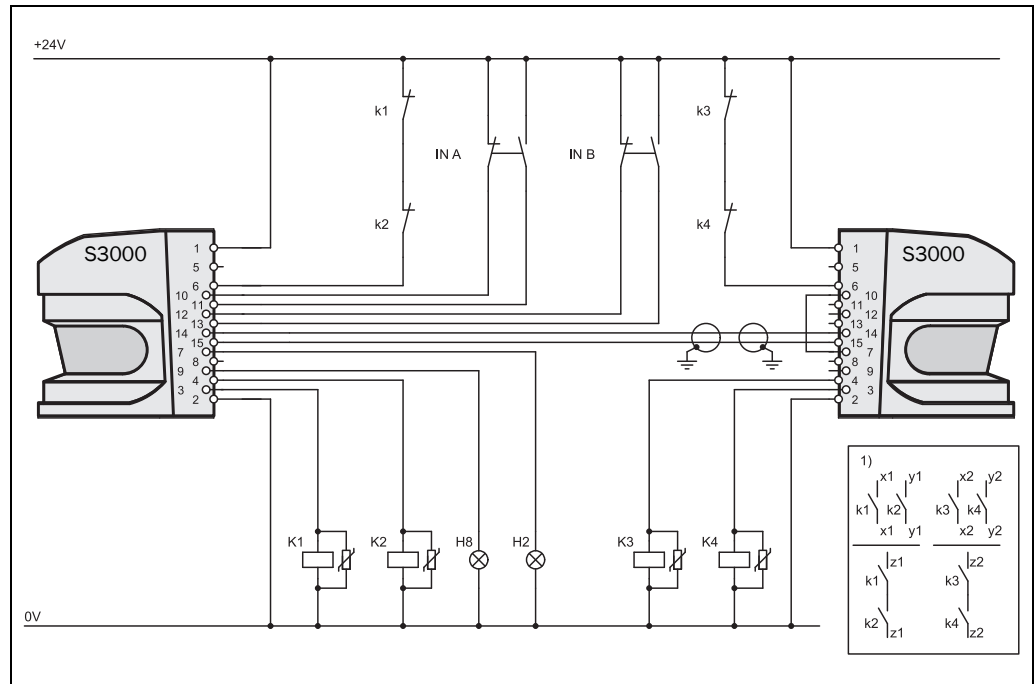
6.4.5 Protective field switching with static and dynamic inputs



S3000 Professional in conjunction with relays/contactors; operating mode: without restart interlock with external device monitoring, dynamic protective field switching by means of B1 and B2 as well as static protective field switching by means of control inputs A (In A) and B (In B).

6.4.6 Protective field switching between two S3000 with static inputs

Fig. 77: Connection diagram for protective field switching between two S3000 with static inputs



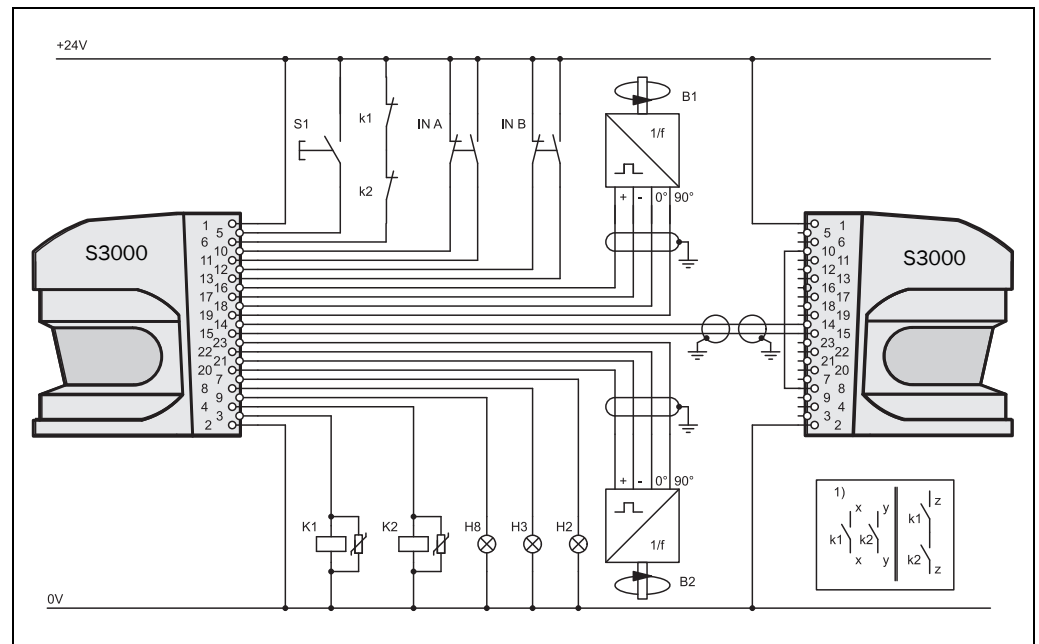
S3000 Advanced with S3000 Advanced in master/slave conjunction with relays/contactors; operating mode: without restart interlock with external device monitoring; protective field switching by means of control input A (In A) and control input B (In B) on separate OSSD pairs (simultaneous monitoring).

Note If you use two S3000 Advanced or two S3000 Professional in one application, then you can only connect the input signals to one safety laser scanner. Distributed connection of the input signals to two safety laser scanners is not possible.

S3000

Fig. 78: Connection diagram for protective field switching between two S3000 with static and dynamic inputs

6.4.7 Protective field switching between two S3000 with static and dynamic inputs

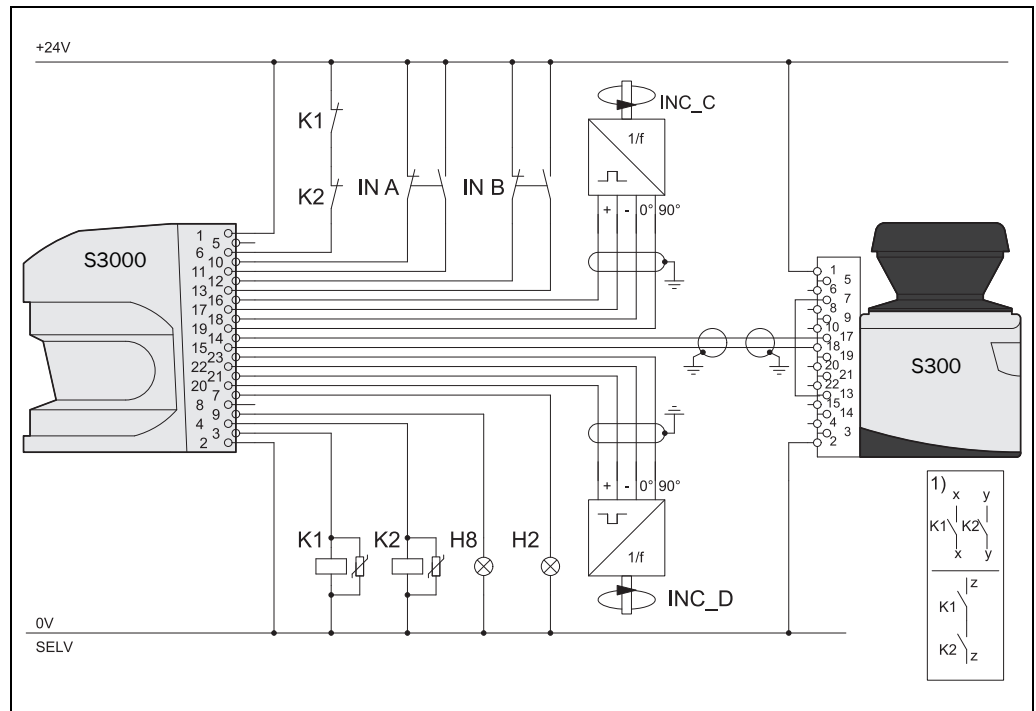


S3000 Professional and Remote in master/slave conjunction with relays/contactors, operating mode: without restart interlock with external device monitoring, direction of travel-dependent dynamic protective field switching by means of B1 and B2 as well as static protective field switching by means of the control inputs A (In A) and B (In B) with sensor communication via EFI.

Note If, in a master/slave system, you only use the OSSDs on one safety laser scanner (common OSSDs), then switch off the OSSDs on this safety laser scanner as soon as either of the two safety laser scanners is switched to the park mode. If, on the other hand, you use the OSSDs on both safety laser scanners (separate OSSDs), then only switch off the OSSDs on the safety laser scanner that is switched to park mode.

6.4.8 Protective field switching between an S3000 and an S300 with static and dynamic inputs

Fig. 79: Connection diagram: protective field switching between an S3000 and an S300 with static and dynamic inputs

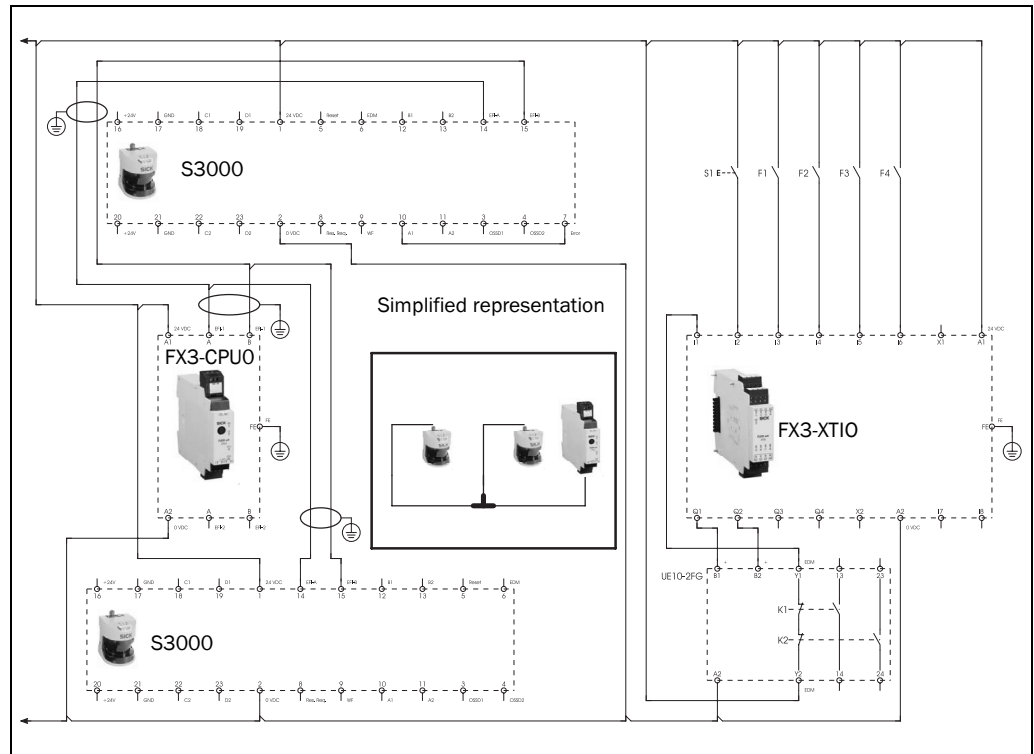


S3000 Professional with S300 Professional in master/slave conjunction with relays/contactors; Operating mode: without restart interlock, with external device monitoring, direction of travel dependent dynamic protective field switching by the incremental encoders C and D as well as static protective field switching by the control inputs IN A and IN B on the S3000. The protective fields affect the OSSDs on the master.

S3000

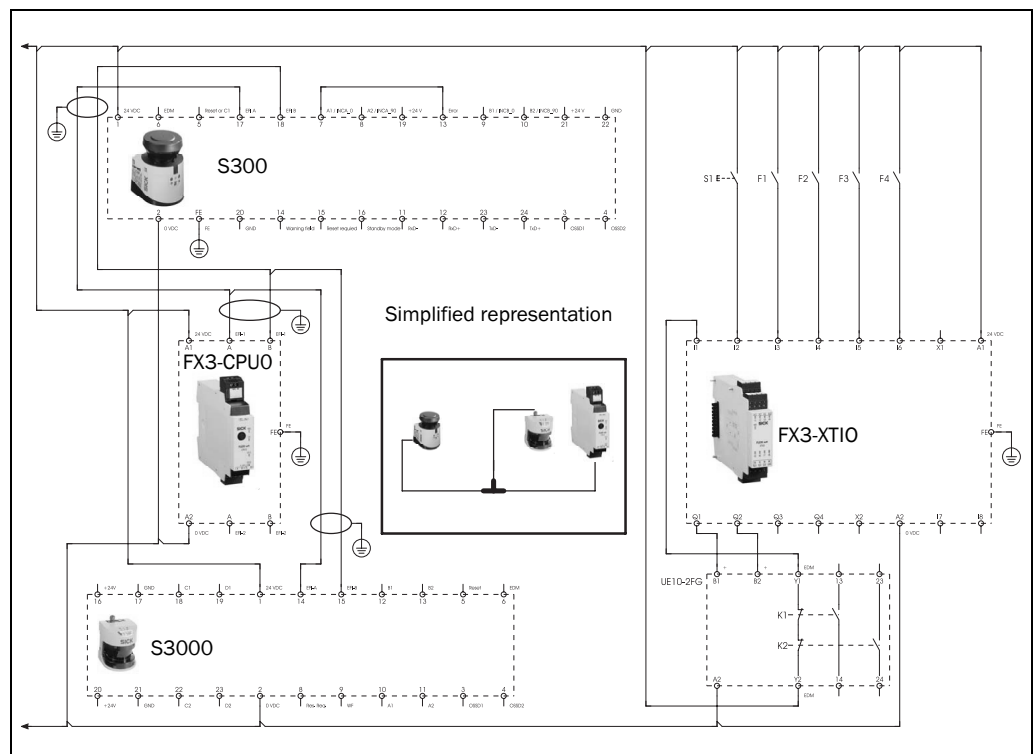
6.4.9 Protective field switching with a Flexi Soft safety controller

Fig. 80: Connection diagram: protective field switching between two S3000 using a Flexi Soft safety controller



Two S3000 Professional with one S300 Professional in master/slave combination. Protective field evaluation and switching via EFI using a Flexi Soft safety controller.

Fig. 81: Connection diagram: protective field switching between S3000 and S300 using a Flexi Soft safety controller



One S3000 Professional with one S300 Professional in master/slave combination. Protective field evaluation and switching via EFI using a Flexi Soft safety controller.

7 Configuration

7.1 Default delivery status

The S3000 is delivered in a safe default status.

- The device status is **Waiting for configuration**.
- Thus the switching outputs (OSSDs) are deactivated (the red LED illuminates: ☹ ●).
- The 7-segment display indicates .

7.2 Preparation of the configuration

How to prepare the configuration:

- Make sure that the safety laser scanner has been correctly mounted and that the electrical connections are correct and in place.
- Have the necessary tools at hand.

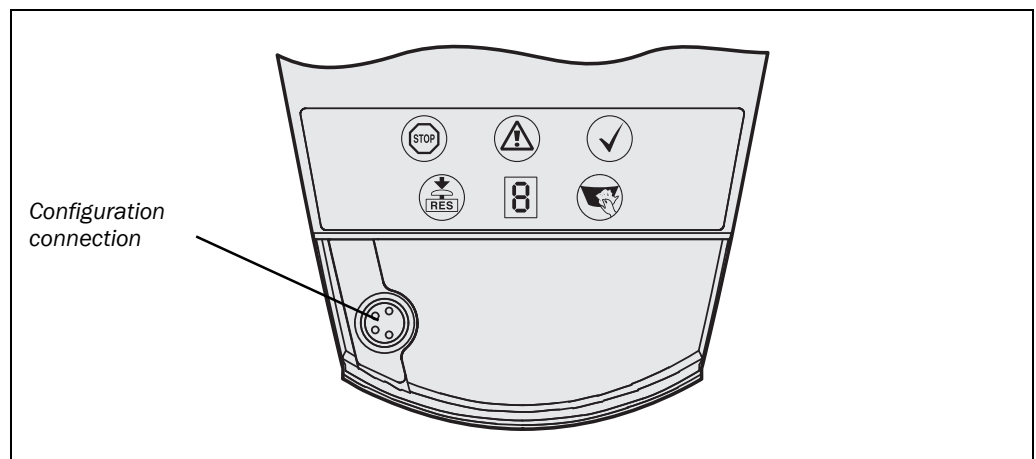
To configure the safety laser scanner you need:

- CDS (SICK Configuration & Diagnostic Software) on CD-ROM
- user manual for CDS on CD-ROM
- PC/notebook with Windows NT 4/2000 Professional/ME/XP/Vista and an serial RS-232 interface (PC/notebook not included)
- connection cable for connecting PC and S3000 (not included)

Configuring the S3000 with the aid of the CDS:

For configuration and diagnostics using the CDS, connect the PC to the configuration connection.

Fig. 82: Configuration connection



Two connection cables of different length are available for the connection of the PC/notebook to the S3000 (see chapter 12.3 “Accessories/spare parts” on page 133).

Note Ensure that the configuration cable is not laid in close proximity to high power electrical drives or cables carrying high power. This will avoid EMC effects on the configuration cable. To configure the device, please read the user manual for the CDS (SICK Configuration & Diagnostic Software) and use the online help function of the programme.

8 Commissioning

8.1 Initial commissioning



WARNING

Commissioning requires a thorough check by qualified personnel!

Before you operate a system protected by the S3000 safety laser scanner for the first time, make sure that the system is first checked and approved by qualified personnel. Please read the notes in chapter 2 “On safety” on page 10.

- Prior to approving the machine, check whether the access to the hazardous area is completely monitored by the protective devices. Check also at regular intervals after approval of the machine (e.g. in the morning at the start of work) as to whether the S3000 correctly switches the OSSDs as soon as there is an object in the protective field. This test should be performed along all protective field boundaries as per the specific regulations for the application (see chapter 8.2 “Test notes” on page 98).

8.1.1 Power up sequence

After power up the S3000 runs through the power up cycle. During the power up cycle, the 7-segment display indicates the device status.

During the initial commissioning of an S3000 the following indications are possible:

Tab. 18: 7-segment display during and after the power up sequence on initial commissioning

Step	Display	Meaning
1		Power-up cycle, testing the 7-segment display. All segments are activated sequentially.
2		Power up cycle, during initial commissioning: device in configuration mode
	Other display	Safety lock activated. Malfunction in external conditions or in the device itself. See chapter 10.4 “Errors displayed by the 7-segment display” on page 108.

Tab. 19: LED indication 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 deactivated
Other display					Safety lock activated. Malfunction in the external conditions or in the device itself (see chapter 10.3 “Indications and error messages” on page 107)

Note The duration of power up depends on the volume of the configuration data and can take up to 20 seconds.

8.2 Test notes

The purpose of the tests described in the following is to confirm the safety requirements specified in the national/international rules and regulations, especially the safety requirements in the Machine and Work Equipment Directive (EC Conformity).

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

These tests must therefore always be performed.

8.2.1 Pre-commissioning tests

The purpose of the pre-commissioning tests is to confirm the safety requirements specified in the national/international rules and regulations (EC Conformity). This applies particularly to the safety requirements in the machinery directive or work equipment directive.



WARNING

Ensure that you do not place anybody at risk during initial commissioning of the machine!

Always expect that the machine, plant or the protective device does not yet behave as you have planned.

- Ensure 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 section 13.2 “Manufacturer’s checklistManufacturer’s checklist” on page 139).
- Make sure that the operating personnel of the machine protected by the safety laser scanner are properly instructed by specialist personnel before being allowed to operate the machine. Instructing the operating personnel is the responsibility of the machine owner.
- Ensure that the adhesive label **Important information**, which is included with the scanner on delivery, is affixed to the machine in a place where it is clearly visible for the operators. Ensure that the operators have the possibility to perform this daily check correctly.
- The annex to this document includes a checklist for review by the manufacturer and OEM. Use this checklist as a reference prior to commissioning for the first time (see section 13.2 “Manufacturer’s checklistManufacturer’s checklist” on page 139).
- Document the adjustment of the scanner and the results of the testing during initial commissioning in a traceable manner. For this purpose also print out the complete configuration of the scanner (including protective field shapes) and include these with the documentation.

Note SICK AG can perform the testing prior to initial commissioning for you.

8.2.2 Regular inspection of the protective device by qualified personnel

- Check the system following the inspection intervals specified in the national rules and regulations. This procedure ensures that any changes on the machine or manipulations of the protective device after the first commissioning 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 plant again as per the checklist in the annex (see section 13.2 “Manufacturer’s checklistManufacturer’s checklist” on page 139).

8.2.3 Daily testing of the protective device by a specialist or authorised personnel

The effectiveness of the protective device must be checked daily by a specialist or by authorised personnel. The test must also be performed if the operating mode is changed.

**WARNING****No further operation if errors occur during the test!**

If any one of the following 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 S3000 must be checked by specialised personnel (see section 8.2.2 “Regular inspection of the protective device by qualified personnel” on page 98).

- The test must be carried out for the relevant preset monitoring case.
- Check the mechanical installation to ensure that all mounting screws are secure and that the S3000 is properly aligned.
- Check each S3000 device for visible changes such as damage, manipulation etc.
- Switch on the machine/plant.
- Watch the LEDs on each S3000.
- If at least one LED is not permanently lit when the machine/plant is switched on, it is to be assumed that there is a fault in the machine or plant. In this case the machine must be shut down immediately and checked by a specialist.
- Deliberately obstruct the protective field without risk to any personnel while the machine is running in order to test the effectiveness of the entire system.

The LEDs of the S3000 device must change from green to red and the hazardous movement must stop immediately. If the S3000, with the protective field that you are interrupting, switches the OSSDs on another S3000 or the OSSDs on an interface of the 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 plant connected must come to an immediate stop.

Repeat this test at different points in the danger area and on all S3000 devices. If you discover any non-conformance of this function, the machine/plant must be shut down immediately and checked by a specialist.

- For stationary applications, check that the danger area marked out on the floor matches the shape of the protective field stored in the S3000 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 field limits which are set in the S3000 and listed on the information label in the vehicle or in the configuration protocol. If you discover any non-conformance of this function, the machine/plant/vehicle must be stopped immediately and checked by a specialist.

8.3 Re-commissioning

If the S3000 has previously been commissioned, but the device replaced, the S3000 automatically reads the saved configuration from the system plug. In this way acceptance by a specialist is not necessary. However the test in accordance with the regulations for the daily test must be performed (see section 8.2.3 “Daily testing of the protective device by a specialist or authorised personnel” on page 99).

When you place a configured S3000 (e.g. after replacement of the sensor head) back into operation, the following indications are possible:

Tab. 20: 7-segment display during and after the power up sequence on re-commissioning

Step	Display	Meaning
1		Power-up cycle, testing the 7-segment display. All segments are activated sequentially.
2		Power up cycle, during initial commissioning: device in configuration mode
3		Waiting for partner device on the EFI
4	 or 	Device addressed as master or slave
5		Waiting for valid inputs
6	No display	The device is operational.
	Other display	Safety lock activated. Malfunction in external conditions or in the device itself. See chapter 10.4 “Errors displayed by the 7-segment display” on page 108.

S3000

Tab. 21: LED indication after the power up sequence

Display					Meaning
					
●	○	○	○	○	Power-up cycle, step 1
●	●	●	●	○	Power-up cycle, step 2
●	○	●	○	○	The device is operational, object in protective field and warning field.
○	○	●	○	●	Or: The device is operational, object in warning field.
○	○	○	○	●	Or: The device is operational, no object in protective field and warning field.
●	☼	○	○	○	Or: The device is operational, no object in protective field and warning field. Control switch for restart interlock or reset must be operated.
Other display					Safety lock activated. Malfunction in the external conditions or in the device itself (see chapter 10.3 "Indications and error messages" on page 107)

9 Care and maintenance



WARNING

Do not make any repairs to the device!

The S3000 does not contain any repairable components. For this reason do not open the S3000 components and only replace the parts that are described in the following chapters as replaceable.

Switch the entire machine/system off line!

The machine/system could inadvertently start up while you are changing the front screen. As a matter of principle, always isolate the machine from the power supply during all work on the machine and safety laser scanner.

9.1 Cleaning the front screen

The safety laser scanner S3000 is largely maintenance-free. The front screen on the safety laser scanner should however be regularly cleaned and also if contaminated.

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

Note Static charges cause dust particles to be attracted to the front screen. You can diminish this effect by using the anti-static plastic cleaner (SICK Part No. 5600006) and the SICK lens cloth (Part No. 4003353) (see section 12.3 “Accessories/spare parts” on page 133).

Cleaning the front screen:

- Use a clean and soft brush to remove dust from the front screen.
- Now wipe the front screen with a clean and damp cloth.

9.2 Replacing the front screen



WARNING

Always perform a front screen calibration after the replacement of the front screen!

After the replacement of the front screen with a new front screen you must perform a front screen calibration with the aid of the CDS. In this way the new front screen on the S3000 is measured and the device made functional. Perform the front screen calibration at room temperature.

- Notes**
- The front screen on the S3000 is an optical part that must not be contaminated or scratched.
 - The front screen is only allowed to be replaced by specialist personnel in a dust- and dirt-free environment.
 - Never replace the front screen during operation as dust particles could enter the device.
 - It is imperative that you avoid contamination of the inside of the front screen, e.g. with fingerprints.

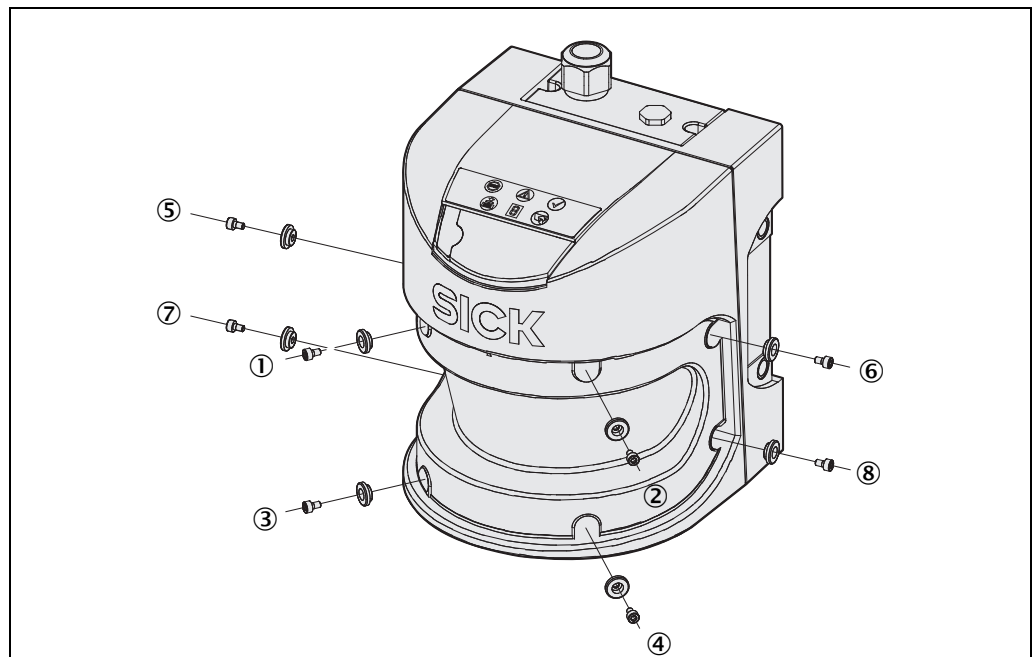
S3000

- Do not use any additional sealant for sealing the front screen, e.g. silicon, as the vapours produced may damage the optics.
- Mount the front screen as per the following instructions to ensure that the housing is sealed to IP 65.

Replacement of the front screen:

- Disconnect the system plug and remove the S3000.
- Take the S3000 to a clean place (office, repair shop or similar).
- First clean the outside of the S3000. This prevents foreign bodies entering the device when it is opened.
- Undo the fixing screws ① to ⑧ for the front screen.

Fig. 83: Removing the fixing screws for the front screen



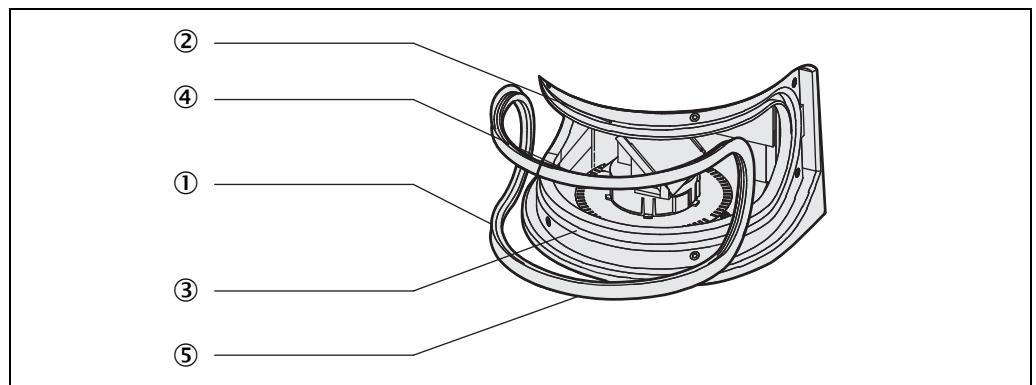
- Now remove the old front screen and the old rubber seal.
- Remove any dirt from the seal groove and the mating face on the sensor head. For this purpose if possible use a plastic cleaner that does not leave residues (see section 12.3 “Accessories/spare parts” on page 133).

Recommendation

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

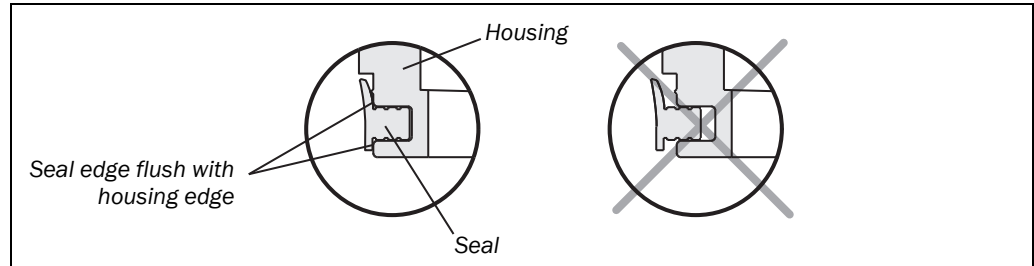
- Insert the new seal ① — starting in the middle —. During this process first align the centre markings on the sensor head (② and ③) and seal (④ and ⑤).

Fig. 84: Inserting the rubber seal



- Note** If the front seal is not inserted correctly, the front screen may be damaged. Do not use any pointed or sharp tools.
- First place the seal only lightly in the rounded sections of the seal groove. In this way you will avoid stretching the seal.
 - Only then press the seal home. The seal should not be stretched on insertion.

Fig. 85: Depth for pressing in the seal



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

- It is imperative that you check that the seal is seated evenly all the way around the groove.
- Check whether the mirror on the motor is clean and remove any contamination with an optic brush.
- Set a torque wrench to 0.7 Nm (hand-tight) and have this at hand.
- Take the new front screen from the packaging.
- Remove any remnants of packaging.
- Place the front screen on the rubber seal and insert the new fixing screws ① to ④ with spacers (see Fig. 84).
- Press the front screen on the front of the cover. During this process tighten the front screws ① to ④ to the torque set.
- Then insert the rest of the screws ⑤ to ⑧ with spacers (see Fig. 84), and tighten using the torque wrench.

Re-commissioning the S3000:

- Re-mount the S3000 correctly (see chapter 4 "Installation and mounting" on page 47).
- Connect the S3000 system plug.
After power up the S3000 automatically reads the saved configuration from the system plug (see chapter 8.3 "Re-commissioning" on page 100).



WARNING

Always perform a front screen calibration with the aid of the CDS after the replacement of the front screen!

The level of contamination is measured continuously during the operation of the S3000. For this purpose the front screen calibration must first be performed; this then serves as a reference for the contamination measurement (status = not contaminated).

The front screen calibration may only be performed immediately after the replacement of the front screen!

The new front screen must be free of contamination at the time of the front screen calibration. The front screen calibration should be performed at room temperature (10-30 °C)!

9.3 Replacing the I/O module



WARNING

Switch the entire machine/system off line!

While you are replacing the I/O module, the plant may start inadvertently.

- As a matter of principle, always isolate the machine from the power supply during all work on the machine and safety laser scanner.

Note

When the I/O module is dismantled, advanced electronic components are accessible. Protect these from electrostatic discharge, contamination and moisture.

- If possible use anti-static floor mats and workbench covers.
- When working on the S3000, touch a bare metal surface from time to time to discharge static charging of your body.
- Only remove the components for the S3000 from their anti-static packing immediately prior to installation.
- Note that no liability can be accepted for damage caused by electrostatic discharge.

Notes

- The I/O module is only allowed to be replaced by specialist personnel in a clean environment.
- Mount the I/O module as per the following instructions to ensure that the housing is sealed to IP 65.

Replacing the I/O module:

- Disconnect the system plug and remove the S3000.
- Take the S3000 to a clean place (office, repair shop or similar).
- First clean the outside of the S3000.
This prevents foreign bodies entering the device when it is opened.
- Undo the fixing screws for the I/O module.
- Take hold of the I/O module with one hand at the recess for the connector to the system plug.
- With the other hand take hold of the I/O module at the dismantling aid on the underside of the device.
- Pull out the I/O module parallel to the mounting shaft.
- Remove any contamination from the sealing surface and the mating surface for the sensor head. For this purpose if possible use a plastic cleaner that does not leave residues (see section 12.3 “Accessories/spare parts” on page 133).
- Remove the I/O module from the packaging, ensure that you take adequate ESD protection measures during this process.
- Check the surfaces for cleanliness and the seal for correct seating.
- 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.
- Guide the I/O module along these surfaces to the connector. During this process slide the I/O module parallel to the rear of the sensor, avoid tilting. The I/O module can be connected without the need to apply force.
- 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.

Re-commissioning the S3000:

- Correctly re-mount the S3000 (see chapter 4 “Installation and mounting” on page 47).
- Connect the S3000 system plug.
 - If you have replaced the I/O module for the same I/O module variant, after power up the S3000 automatically reads the saved configuration from the system plug (see chapter 8.3 “Re-commissioning” on page 100).
 - If you have replaced the I/O module with a different I/O module variant (e.g. Standard with Advanced), you must perform initial commissioning (see chapter 8.1 “Initial commissioning” on page 97).

10 Diagnostics

This chapter describes how to identify and remedy errors and malfunctions during the operation of the safety laser scanner.

10.1 In the event of faults or errors



WARNING

Cease operation if the cause of the malfunction has not been clearly identified!

Stop the machine, the system or the vehicle if you cannot clearly identify or allocate the error and if you cannot safely remedy the malfunction.

10.2 SICK Support

If you cannot remedy an error with the help of the information provided in this chapter, please contact your local SICK representative.

Make a note of the telephone number of your SICK subsidiary so that you or other users have this number easily at hand. You will find the telephone number on the rear of these operating instructions.

Telephone number of your SICK subsidiary

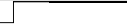
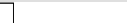
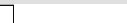
10.3 Indications and error messages

This section describes the meaning of the indications and error messages and how you can respond. You will find a description of the indicators in section 3.8 “Indicators and outputs” on page 45, the connections for the outputs in section 5.1 “System connection” on page 75.

Tab. 22: Operational status indicators during operation

Display	Output level	Possible cause
●	At the OSSDs 	Object in the protective field, OSSDs deactivated
●	At the OSSDs 	Protective field unoccupied, OSSDs activated
●	At the warning field output 	Object in warning field

Tab. 23: LED error messages

Display	Output level	Possible cause	Remedying the error
   	OSSDs 	No operating voltage, or voltage too low	➤ Check the voltage supply and activate, if necessary.
 	Error/contamination 	No error	
 	Application diagnostic output 	No supply voltage	➤ Check the voltage supply and activate, if necessary.
 	Application diagnostic output 	Front screen contaminated, operation not guaranteed	➤ Clean the front screen.
 	Application diagnostic output  1 Hz	Front screen contaminated, still in operation	➤ Clean the front screen.
 	Application diagnostic output  4 Hz	System error	➤ Pay attention to the error display of the 7-segment display or carry out a diagnostics with the aid of the CDS. ➤ If necessary, switch the device off and back on again.
 	At the Res_Req output  1 Hz	Reset required	➤ Operate the control switch for restarting or resetting.

10.4 Errors displayed by the 7-segment display

This section explains the meaning of the error displays on the 7-segment display and how to respond to the messages. You will find a description of the positions and symbols on the S3000 in section 3.8 “Indicators and outputs” on page 45.

The lock-out operational status

In case of certain faults or an erroneous configuration, the system can go into the lock-out status. The 7-segment display on the safety laser scanner then indicates , , , , , , , , , , ,  or . To place the device back in operation, proceed as follows:

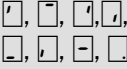
- Rectify the cause of the fault as per Tab. 24.
- Switch off the power supply for the S3000, wait at least 3 seconds and then switch back on the power supply.

Or:

- Restart the safety laser scanner with the aid of the CDS.

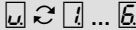
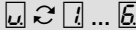
S3000

Tab. 24: Error displays on the 7-segment display

Display	Possible cause	Remedying the error
	Power-up cycle — all segments are activated sequentially.	No error
	Park mode (see chapter “Park mode” on page 37); the OSSDs are deactivated, the laser is shutdown.	No error. Readiness for operation is restored by switching to another monitoring case.
	Object in protective field	No error. Status indication eases system testing on the use of simultaneous protective fields or in master/slave operation (if the OSSDs on the slave are not used in master/slave operation, then as required in the standard, a protective field infringement is not signalled via the red LED on the slave).
	Object in the simultaneous protective field or the contour as reference function has triggered	
	Initialising the device or Waiting for the end of the initialisation of a second device connected to the EFI	➤ The display goes off automatically when the S3000 is initialised and/or the connection to the second device has been established. If display  does not go off: ➤ Check whether the partner device is in operation. ➤ Check the cabling. If there is no partner device connected: ➤ Check the system configuration with the aid of the CDS. Re-transfer the corrected configuration to the S3000.
	Waiting for valid input signal	➤ The display goes off automatically when an input signal is present that corresponds to a configured monitoring case. If display  does not go off: ➤ Check the cabling. ➤ Check the configuration of the system using the CDS (SICK Configuration & Diagnostic Software). Re-transfer the corrected configuration to the S3000.
	Waiting for configuration or configuration not completed	➤ The display goes off automatically once the configuration has been successfully transferred. If display  does not go off: ➤ Check the configuration of the system using the CDS (SICK Configuration & Diagnostic Software). Re-transfer the corrected configuration to the S3000.

Display	Possible cause	Remedying the error
 or 	EDM error (EDM)	➤ Check whether the contactors are stuck or incorrectly wired and rectify any error. ➤ Additionally, when  is displayed: Switch off the device and wait at least 3 seconds, then switch back on the power supply.
	Error in control switch for restarting or resetting	➤ Check the functionality of the control switch. The button may be defective or stuck. ➤ Check the wiring of the control switch for short-circuit to 24 V.
	Velocity tolerance exceeded: The difference between the velocities measured by the incremental encoders is too large.	➤ Check the incremental encoders. ➤ Check the configuration of the incremental encoder inputs with the aid of the CDS.
	Direction of movement output by the incremental encoders is different	➤ Check the wiring of the incremental encoder inputs, e.g. for incorrect pin assignments.
	Maximum frequency at input C exceeded	➤ Check the incremental encoders. ➤ Check the configuration of the incremental encoder inputs with the aid of the CDS.
	The monitored maximum velocity has been exceeded.	➤ Check the incremental encoders. ➤ Check the configuration of the incremental encoder inputs with the aid of the CDS. ➤ Check the velocity thresholds for the maximum velocity configured in the related monitoring cases
	Sensor head faulty	➤ Send the sensor head to the manufacturer for repair.
	I/O module faulty	➤ Send the I/O module to the manufacturer for repair.
	Configuration memory in the system plug faulty	➤ Send the system plug to the manufacturer for repair.
	A second device connected via EFI has a malfunction.	➤ Check the device connected and the connection.
	Overcurrent on OSSD connection 1	➤ Check the switching element connected. Replace, if necessary. ➤ Check the wiring for short-circuit to 0 V.
	Short-circuit to 24 V at OSSD connection 1	➤ Check the wiring for short-circuit to 24 V.
	Short-circuit to 0 V at OSSD connection 1	➤ Check the wiring for short-circuit to 0 V.

Display	Possible cause	Remedying the error
	Overcurrent on OSSD connection 2	➤ Check the switching element connected. Replace, if necessary. ➤ Check the wiring for short-circuit to 0 V.
	Short-circuit to 24 V at OSSD connection 2	➤ Check the wiring for short-circuit to 24 V.
	Short-circuit to 0 V at OSSD connection 2	➤ Check the wiring for short-circuit to 0 V.
	Short-circuit between OSSD connection 1 and 2	➤ Check the wiring and rectify the error.
	General OSSD wiring error	➤ Check the complete wiring of the OSSDs.
	Device is addressed as slave	No error. The symbol is displayed for approx. 2 seconds on switching on a device that is addressed as a slave.
	Device is addressed as master	No error. The symbol is displayed for approx. 2 seconds on switching on a device that is addressed as a master.
	The S3000 is receiving no measured values within a range of at least 90° (measuring range maximum 49 m), it thus is not detecting any obstacles such as e.g. building walls.	➤ For the correct function 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.
	Device is dazzled	➤ Check whether the S3000 is being dazzled by an external light source, e.g. headlight, infrared light sources, stroboscopic light, sun etc. ➤ If necessary, re-mount the device.
	Temperature error. The operating temperature of the S3000 has exceeded the permissible range.	➤ Check whether the S3000 is operated as per the permissible ambient conditions.
	Invalid configuration of the EDM	➤ Verify that the machine-side EDM is connected correctly.
	A device connected via EFL is faulty or the connection has a malfunction.	➤ Check the device connected and the connection to this device.

Display	Possible cause	Remedying the error
 	There is a short-circuit between the reset input and another input or output, or the reset pulse does not comply with the requirements.	➤ Check the cabling for cross-circuits. Or: ➤ Check whether the reset pulse complies with the requirements (see Fig. 87 on page 115).
 	Input signal for an undefined monitoring case	➤ Check the path of the vehicle. Or: ➤ Check the work process on the machine or plant monitored.
 	Incorrect sequence on switching the monitoring cases	➤ If necessary, check the configuration of the monitoring cases with the aid of the CDS.
 	Incorrect operation of the control inputs	➤ Check the operation of the digital control inputs.
	A device connected via EFI reports a malfunction.	➤ Carry out a fault diagnosis of the device connected with the S3000.
  ... 	Channel 1 to 6 of the contamination measurement soiled	➤ Clean the front screen.
 	No front screen fitted or dazzling of the contamination measurement	➤ Re-fit the new front screen (then perform front screen calibration). If at the time of the error a front screen was fitted: ➤ Check whether the S3000 is being dazzled by an external light source, e.g. headlight, infrared light source, stroboscopic light, sun etc.
   	Traceability data incorrect or front screen calibration failed	➤ Carry out a front screen calibration or replace the S3000, if necessary.
 	Internal error	➤ Replace the S3000.
 	I/O module/sensor head device combination invalid	➤ Check whether the correct I/O module has been used, and replace if necessary.

Note If you have problems during troubleshooting, contact SICK support. Keep a copy of the print out of the results of the diagnostics at hand.

10.5 Extended diagnostics

The CDS software supplied with the device (SICK Configuration & Diagnostic Software) includes extended diagnostic options. It allows you to narrow down the problem if the error is non-specific or if you experience usage downtime problems. Detailed information to be found ...

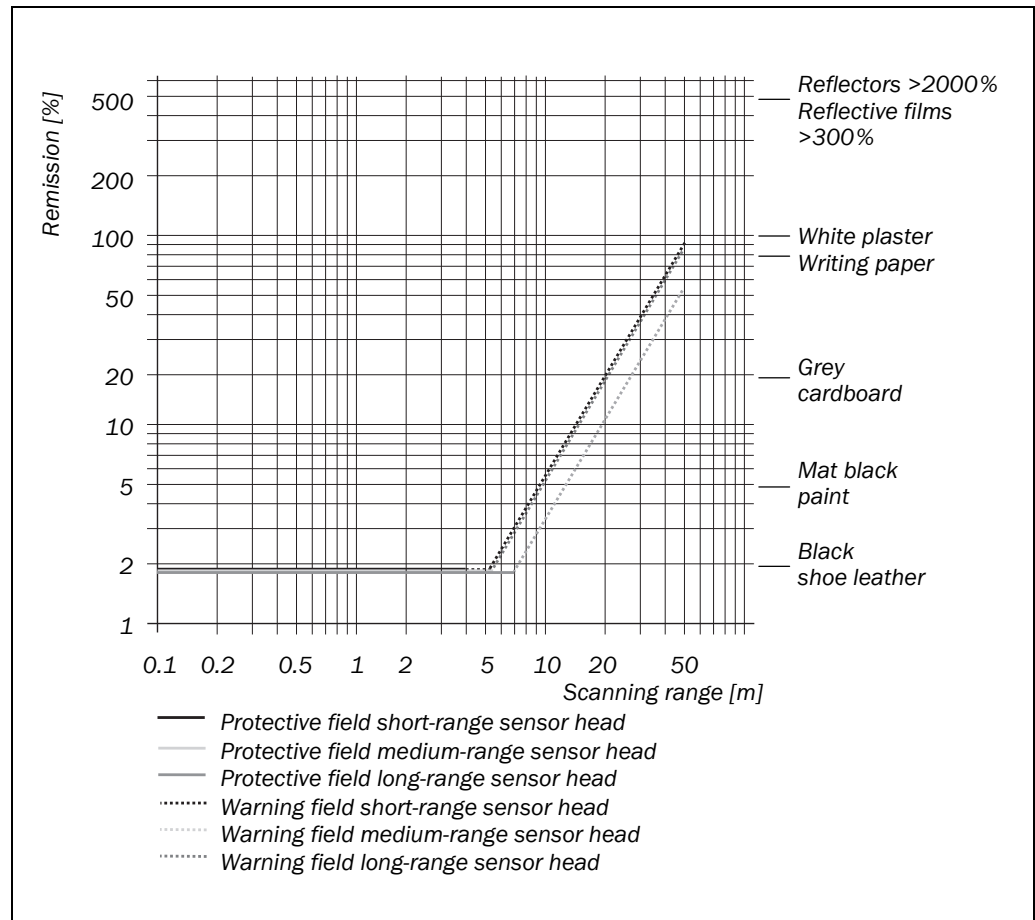
- in the online help function of the CDS (SICK Configuration & Diagnostic Software).
- in the user manual for the CDS.

11 Technical specifications

11.1 Characteristics

11.1.1 Scanning range

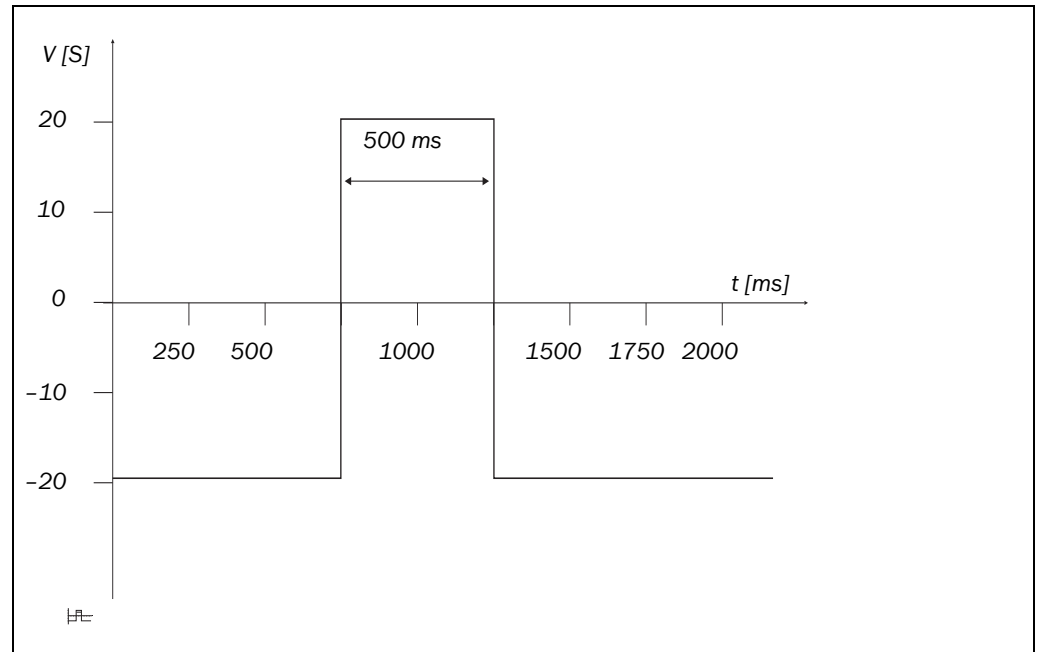
Fig. 86: Diagram of scanning ranges for various reflectances



11.1.2 Reset pulse

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

Fig. 87: Reset pulse requirements



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

11.2 OSSD response times

The total response time of your application is dependent on ...

- the basic response time at the related resolution and the maximum protective field range.
- the multiple sampling used.
- the OSSDs used.

Calculation of the total response time T_S :

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

Where ...

t_B = Basic response time (60 ms or 120 ms)

T_{MFA} = Supplement due to multiple sampling > 2

T_{EFI} = Supplement for the usage of external OSSDs via EFI

Multiple sampling

The S3000 is always set to a minimum of 2 times multiple sampling. From a multiple sampling of 3 you must add a supplement to the response time. The related supplement is dependent on the basic response time and the multiple sampling.

Tab. 25: 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

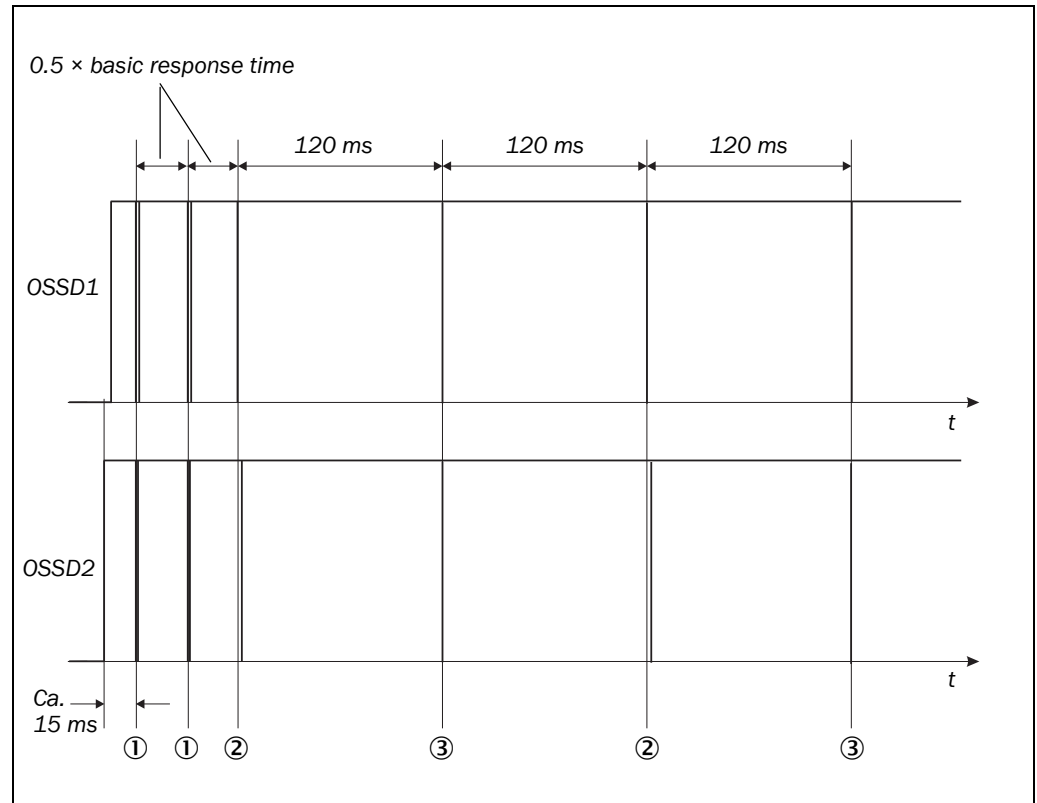
Note If you use the OSSDs on another device via the EFl as external switching outputs (for example with two S3000 connected together), the response time increases by 20 ms in each case.

11.3 Timing behaviour of the OSSDs

The S3000 tests the OSSDs immediately after switch on and then at regular intervals. For this purpose the S3000 briefly switches off both OSSDs (for 300 μ s) and checks whether the channels are electrically isolated during this period.

Note Ensure that the input electronics on your machine or plant do not react to this test pulse and therefore shut down the machine or plant.

Fig. 88: Diagram of the test pulse at the OSSDs



Approx. 15 ms after the switch on of the OSSDs, the S3000 performs the first voltage test ① and then after a half basic response time performs a second voltage test ①.

After a further half basic response time of the S3000 there is a shut-down test ②, 120 ms later a further voltage test ③. Then the S3000 performs a shut-down test and a voltage test alternately at an interval of 120 ms. Fig. 89, Fig. 90 and Fig. 91 show the pulse durations for the individual tests.

Fig. 89: Voltage test after switching on the OSSDs

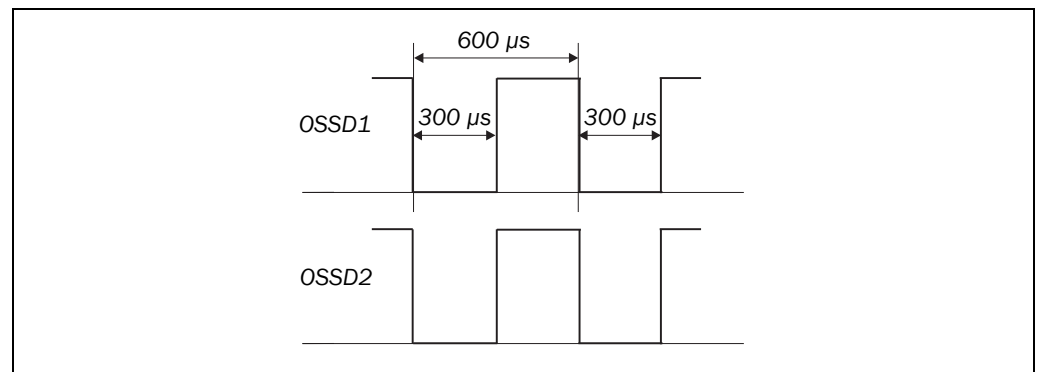


Fig. 90: Shut-down test

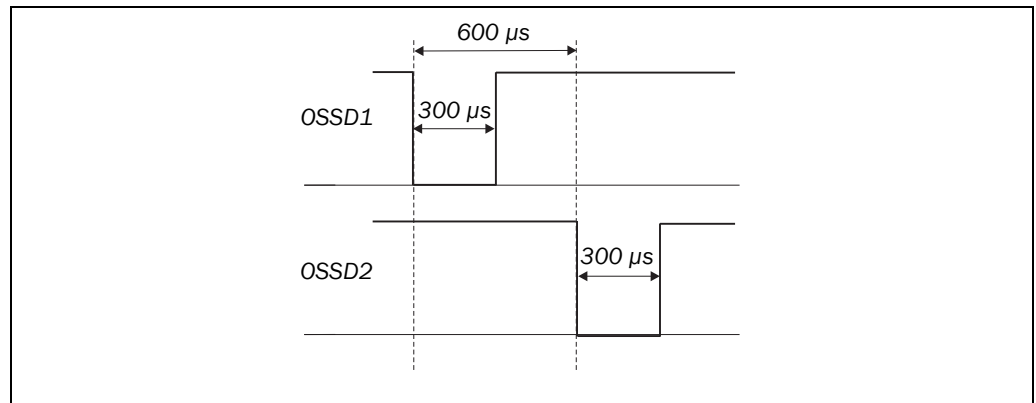
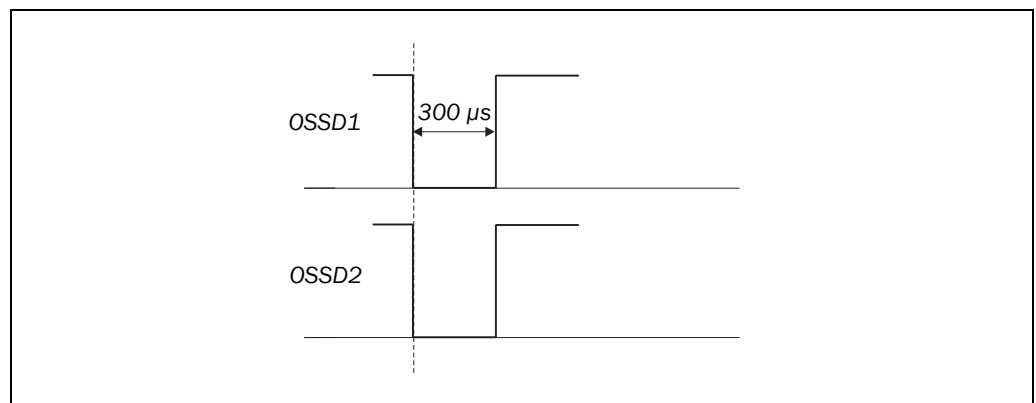


Fig. 91: Voltage test



11.4 Data sheet

Tab. 26: Data sheet S3000

	Minimum	Typical	Maximum
General data			
Laser protection 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 24.06.2007)		
Enclosure rating	IP 65 (EN 60529)		
Protection class	II (EN 50178) ⁹⁾		
Type	Type 3 (EN 61496-1)		
Safety integrity level ¹⁰⁾	SIL2 (IEC 61508) SILCL2 (EN 62061)		
Category	Category 3 (EN ISO 13849-1)		
Performance Level	PL d ¹¹⁾ (EN ISO 13849)		
PFHd (mean probability of a dangerous failure per hour)	$76,7 \times 10^{-9}$		
T _M (mission time)	20 years (EN ISO 13849)		
Operating temperature range	-10 °C		+50 °C
Storage temperature range	-25 °C		+70 °C max. 24 h
Humidity (taking into account the operating temperature range)	EN 61496-1, section 5.1.2 and 5.4.2, as well as CLC/TS 61496-3, section 5.4.2		
Vibration	EN 61496-1, section 5.1.2 and 5.4.4.1, as well as CLC/TS 61496-3, section 5.4.4.2		
Frequency range	10 Hz		150 Hz
Amplitude	0.35 mm or 5 g		
Shock resistance			
Single shock	15 g, 11 ms (EN 60068-2-27)		
Continuous shock	10 g, 16 ms (EN 61496-1, section 5.1.2 and 5.4.4.2, as well as CLC/TS 61496-3, section 5.4.4.2)		

⁹⁾ Safety extra-low voltage SELV/PELV.

¹⁰⁾ For detailed information on the exact design of your machine/system, please contact your local SICK representative.

¹¹⁾ PL e can be achieved using additional devices, e.g. by using special actuators and a safety controller Flexi Soft. However, an exact analysis of the performance levels by a safety specialist with the aid of the SISTEMA software is always necessary.

	Minimum	Typical	Maximum
Sender	Pulsed laser diode		
Wavelength	880 nm	905 nm	935 nm
Divergence of the collimated beam		2.5 mrad	
Pulse duration			3.1 ns
Average output power			562 µW
Size of light spot at the front screen		12 mm	
Size of light spot at 4,0 m scanning range		23 mm	
Size of light spot at 5.5 m scanning range		27 mm	
Size of light spot at 7.0 m scanning range		32 mm	
Housing			
Material	Aluminium die-cast		
Colour	RAL 1021 (rape yellow)		
Front screen			
Material	Polycarbonate		
Surface finish	Outside with scratch-resistant coating		
System plug	ESD protected		
Dimensions S3000 ¹²⁾			
Height			185 mm
Width			155 mm
Depth			160 mm
Total weight		3.3 kg	

Functional data

Protective field of the sensor head with 4.0 m scanning range ¹³⁾ at 120 ms response time			
At 30 mm resolution			2.80 m
At 40 mm resolution			3.80 m
At 50 mm resolution			4.00 m
At 70 mm resolution			4.00 m
At 150 mm resolution			4.00 m
Protective field of the sensor head with 4,0 m scanning range at 60 ms response time			
At 30 mm resolution			1.90 m
At 40 mm resolution			2.60 m
At 50 mm resolution			3.30 m
At 70 mm resolution			4.00 m
At 150 mm resolution			4.00 m
Protective field of the sensor head with 5.5 m scanning range at 120 ms response time			
At 30 mm resolution			2.80 m
At 40 mm resolution			3.80 m
At 50 mm resolution			4.80 m
At 70 mm resolution			5.50 m
At 150 mm resolution			5.50 m

¹²⁾ Without projection of cable glands with system plug mounted.¹³⁾ Radial distance to the safety laser scanner.

	Minimum	Typical	Maximum
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
Scan angle			190° (-5° to 185°)
Reflectivity	1.8 %		Several 1000 % (Reflectors)
Resolution	30, 40, 50, 70, 150 mm		
Angular resolution	0.50°		0.25°
Protective field supplement generally necessary			100 mm
Supplement for retroreflectors in scan plane at a distance of less than 1 m to the protective field boundary			200 mm
Measurement error for measured data output up to 5.5 m and 1.8 % reflectivity			
Systematic error		±5 mm	
Statistical incl. systematic errors			
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	
Evenness of the scan field at 5.5 m			±70 mm
Evenness of the scan field at 7 m			±88 mm

	Minimum	Typical	Maximum
Distance from mirror axis of rotation (zero point on the X and Y axis) to the rear of the device	93 mm		
Distance between centre of the scan plane and the bottom edge of the housing	63 mm		
Warning field range (radial)		Approx. 20 m ¹⁴⁾	49 m
Distance measuring range			49 m
Number of multiple samplings (configurable via CDS)	2		16
Power up time		9 s	20 s
Restart after (configurable)	2 s		60 s

Electrical data

Electrical connection	Plug-in connection housing with screw terminal connections		
Technical specifications, screw terminals			
Cross-section of rigid cores	0.14 mm ²		1.5 mm ²
Cross-section of flexible cores ¹⁵⁾	0.14 mm ²		1.0 mm ²
American Wire Gauge (AWG)	26		16
Insulation stripping length for the cores		5 mm	
Screw tightening torque	0.22 Nm		0.25 Nm
Cable length for power supply tolerance $\pm 10\%$			
For wire cross-section 1 mm ²			50 m
For wire cross-section 0.5 mm ²			25 m
For wire cross-section 0.25 mm ²			12 m
Cable length for power supply tolerance $\pm 5\%$			
For wire cross-section 1 mm ²			60 m
For wire cross-section 0.5 mm ²			30 m
For wire cross-section 0.25 mm ²			15 m
Cable length for power supply tolerance $\pm 1\%$			
For wire cross-section 1 mm ²			70 m
For wire cross-section 0.5 mm ²			35 m
For wire cross-section 0.25 mm ²			17 m
Supply voltage (SELV)	16.8 V	24 V	28.8 V
The voltage supply must be capable of buffering brief mains voltage failures of 20 ms as specified in EN 60 204. Suitable power supplies are available as accessories from SICK (Siemens type series 6 EP 1)			
Permissible residual ripple ¹⁶⁾			$\pm 5\%$
Switch on current ¹⁷⁾			2 A
Operating current at 24 V without output load			0.8 A

¹⁴⁾ For objects with 20 % reflectivity.¹⁵⁾ Core terminating sleeves are not required.¹⁶⁾ The absolute voltage level must not drop below the specified minimum voltage.¹⁷⁾ The load currents for the input capacitors are not taken into account.

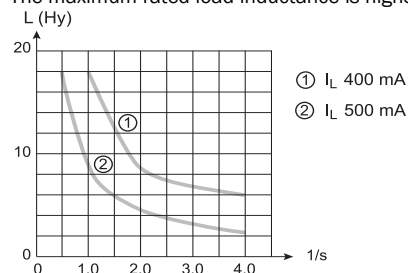
	Minimum	Typical	Maximum
Operating current with max. output load			2.3 A
Power consumption without output load			19 W
Power consumption with maximum output load			55 W
Input for control switch for restarting or resetting			
Input resistance when HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	28.8 V
Voltage for LOW	-3 V	0 V	5 V
Input capacitance		15 nF	
Static input current	6 mA		15 mA
Duration of actuation of the control switch	120 ms		
Input EDM			
Input resistance when 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 when 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 (switching sequence, max. or frequency)	$1/(\text{multiple sampling} + 1) \times \text{scan time} \times 2$		
Dynamic control inputs			
Input resistance when 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
Power supply for incremental encoders			
24 V voltage output HIGH	$U_V - 3 \text{ V}$		U_V
Current load		50 mA	100 mA

	Minimum	Typical	Maximum
OSSDs	2 PNP semiconductors, short-circuit protected ¹⁸⁾ , cross-circuit monitored		
Output signal switching device pair			
HIGH switching voltage at 500 mA	$U_V - 2.7 \text{ V}$		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 ¹⁹⁾			250 μA
Load inductance ²⁰⁾			2.2 H
Load capacity			2.2 μF at 50 Ω
Switching sequence (without switching and without simultaneous monitoring)	Depending on load inductance		
Permissible cable resistance ²¹⁾			2.5 Ω
Test pulse width ²²⁾		230 μs	300 μs
Test frequency		120 ms	
Switching time of the OSSDs from red to green		120 ms	
Time offset on switching the OSSDs between OSSD2 and OSSD1		1.3 ms	2 ms
Application diagnostic outputs warning field, contamination of the front screen/error, reset necessary			
HIGH switching voltage at 200 mA	$U_V - 3.3 \text{ V}$		U_V
Source switching current		100 mA	200 mA
Current limiting (after 5 ms at 25 °C)	600 mA		920 mA
Power up delay		1.4 ms	2 ms
Switch off delay		0.7 ms	2 ms

¹⁸⁾ Applies to the voltage range between U_V and 0 V.

¹⁹⁾ In the case of a fault (the 0-V cable is open circuit) the leakage current flows through the OSSD cable as a maximum. The downstream controller must detect this status as LOW. An FPLC (fail-safe programmable logic controller) must detect this status.

²⁰⁾ The maximum rated load inductance is higher with lower switching sequence.



²¹⁾ Make sure to limit the individual line core resistance to the downstream controller to this value to ensure that a short-circuit between the outputs is safely detected. (Also note EN 60204-1.)

²²⁾ 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.

	Minimum	Typical	Maximum
Incremental encoders that can be evaluated	Two-channel rotary encoder with 90° phase offset		
Type			
Enclosure rating	IP 54		
Supply voltage		24 V	
Outputs required on the incremental encoders	Push/pull		
Pulse frequency			100 kHz
Number of pulses per cm	50		
Cable length (screened)			10 m
Configuration and diagnostics interface			
Communication protocol	RS-232 (proprietary)		
Transmission speed	9600 baud 19 200 baud 38 400 baud		
Cable length at 9600 baud and 0.25-mm ² cables			15 m
Galvanic de-coupling	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
Max. voltage level at RxD	–15 V		15 V
Max. voltage level at TxD	–11 V		11 V

	Minimum	Typical	Maximum
Data interface			
Communication protocol	RS-422 (proprietary)		
Transmission speed (selectable)	9600 baud 19 200 baud 38 400 baud 125 kbaud 250 kbaud 500 kbaud		
Cable length at 500 kbaud and 0.25-mm ² cables			100 m
Galvanic de-coupling	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
Max. voltage level at TxD+, TxD-	-29 V		29 V
Max. voltage level at RxD+, RxD-	-29 V		29 V
Terminating resistance	115 Ω	120 Ω	125 Ω
Type of connecting cable	Twisted pairs with copper braid screen		
Characteristic impedance of the connecting cable	80 Ω	100 Ω	115 Ω
Wire cross-section of the connecting cable	0.25 mm ²		0.6 mm ²
EFI – safe SICK device communication			
Cable length at 500 kbaud and 1 × 2 × 0,22 mm ² -cables			50 m
Galvanic de-coupling	Yes		
Type of connecting cable	Twisted pairs with copper braid screen, cable diameter $\leq 6,8$ mm		
Wire cross-section of the connecting cable	1 × 2 × 0,22 mm ²		

11.5 EFI status information and control commands

If devices are connected together via EFI, EFI status information and control commands are exchanged. Tab. 27 and Tab. 28 shows the status information that can be retrieved and the possible control commands for the S3000.

Note The information in square brackets reflects the names used in the CDS and in the Flexi Soft Designer.

Tab. 27: Status information of the S3000 (Data from the S3000)

Status information	Meaning/effect
1. OSSD on [OSSD]	• Logical 1, if the internal OSSD of the S3000 is switched on (green) • Logical 0, if the OSSD of the S3000 is switched off (red)
Warning field unoccupied [WF LED]	• Logical 1, if the warning field for the is S3000 unoccupied
Contamination [Weak]	• Logical 1, on contamination of the front screen
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 Note: The control inputs on the S3000 are used to switch the monitoring cases on the S3000.
Control input A2 [In A2]	• Logical 1, if the connection of control input A2 is HIGH
Control input B1 [In B1]	• Logical 1, if the connection of control input B1 is HIGH
Control input B2 [In B2]	• Logical 1, if the connection of control input B2 is HIGH
Control input C1 [In C1]	• Logical 1, if the connection of control input C1 is HIGH
Control input C2 [In C2]	• Logical 1, if the connection of control input C2 is HIGH
Control input D1 [In D1]	• Logical 1, if the connection of control input D1 is HIGH
Control input D2 [In D2]	• Logical 1, if the connection of control input D2 is HIGH
Allocated protective field unoccupied [PF]	• Logical 1, if the active allocated protective field is unoccupied
Allocated warning field unoccupied [WF]	• Logical 1, if the active allocated warning field is unoccupied
Simultaneous protective field unoccupied [Sim. PF]	• Logical 1, if the simultaneously monitored protective field is unoccupied
Simultaneous warning field unoccupied [Sim. WF]	• Logical 1, if the simultaneously monitored warning field is unoccupied

Tab. 28: Control features on the S3000 (Data to the S3000)

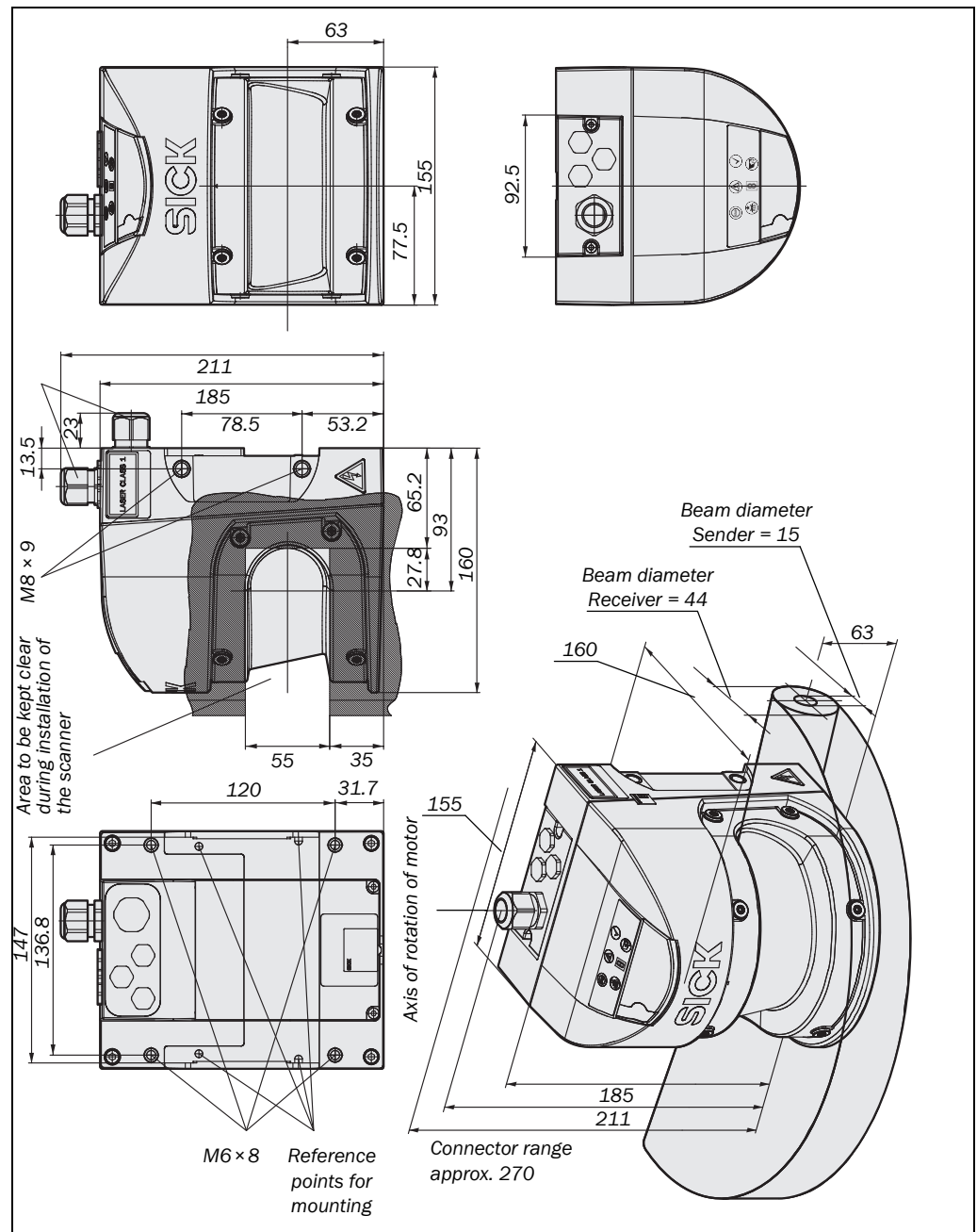
Control feature	Meaning/effect
Control input A1 [In A1]	• Logical 1, stimulates control input A1 of the S3000
Control input A2 [In A2]	• Logical 1, stimulates control input A2 of the S3000
Control input B1 [In B1]	• Logical 1, stimulates control input B1 of the S3000
Control input B2 [In B2]	• Logical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

S3000

11.6 Dimensional drawings

11.6.1 S3000

Fig. 92: Dimensional drawing S3000 (mm)



11.6.2 Mounting kits

Fig. 93: Dimensional drawing, mounting kit 1, 2 and 3 (mm)

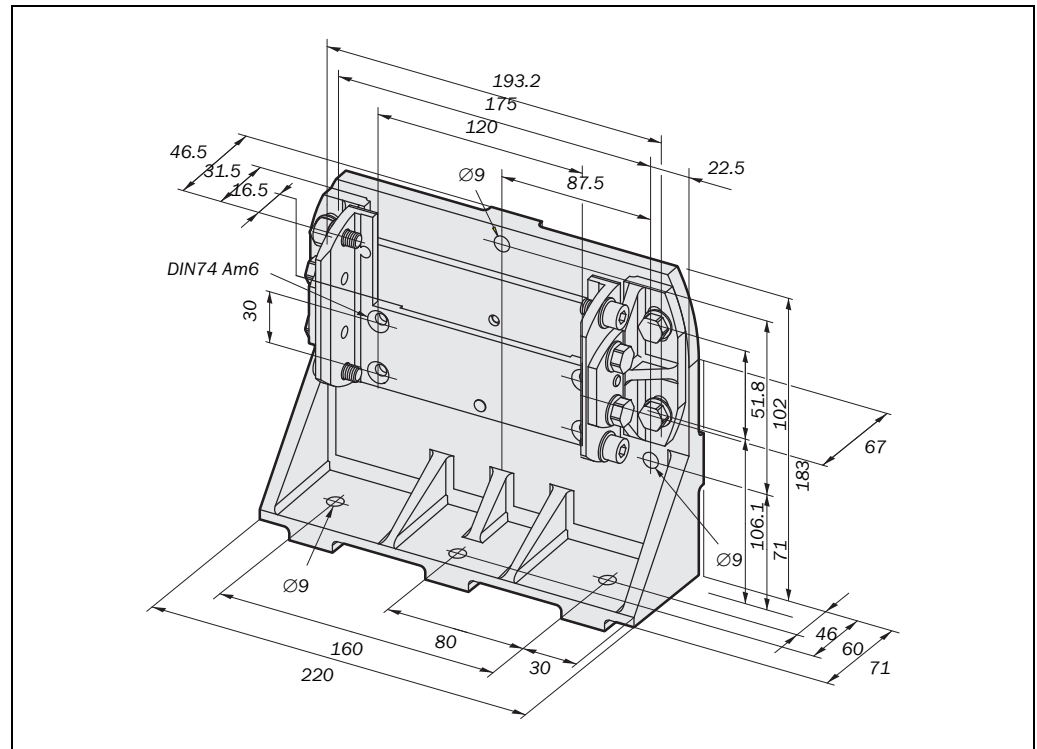
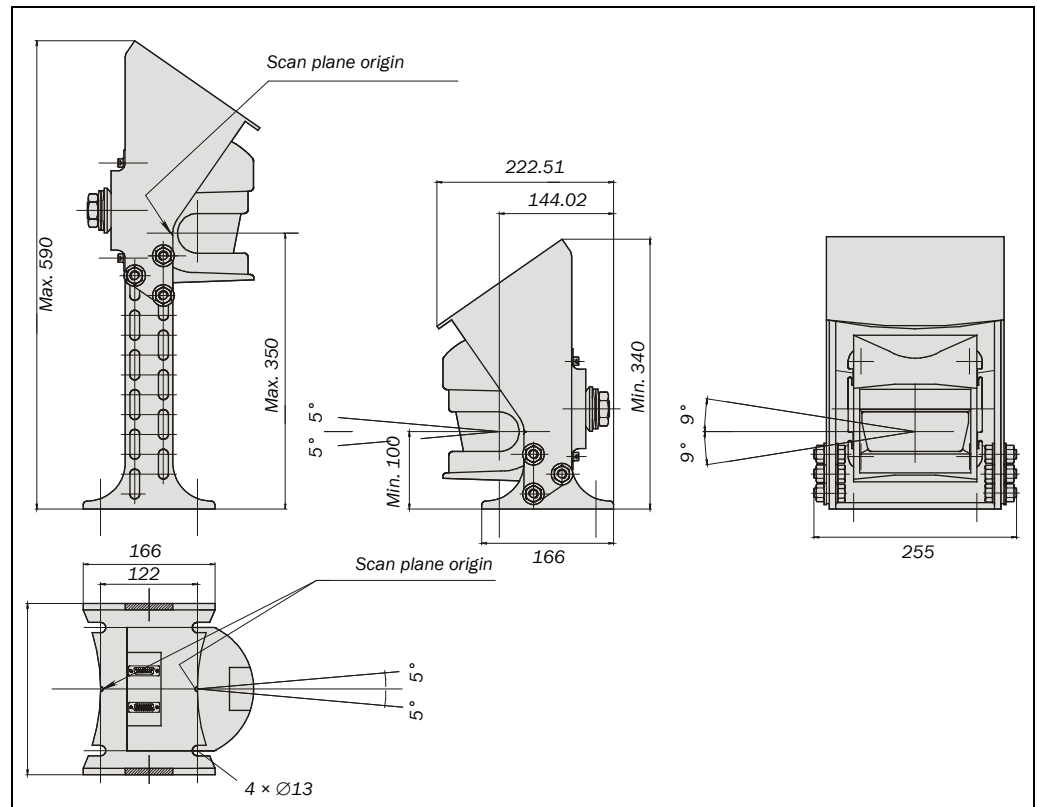


Fig. 94: Dimensional drawing Heavy Duty mounting bracket



S3000**11.6.3 Scan plane origin**

Fig. 95: Dimensional drawing of the scan plane (mm)

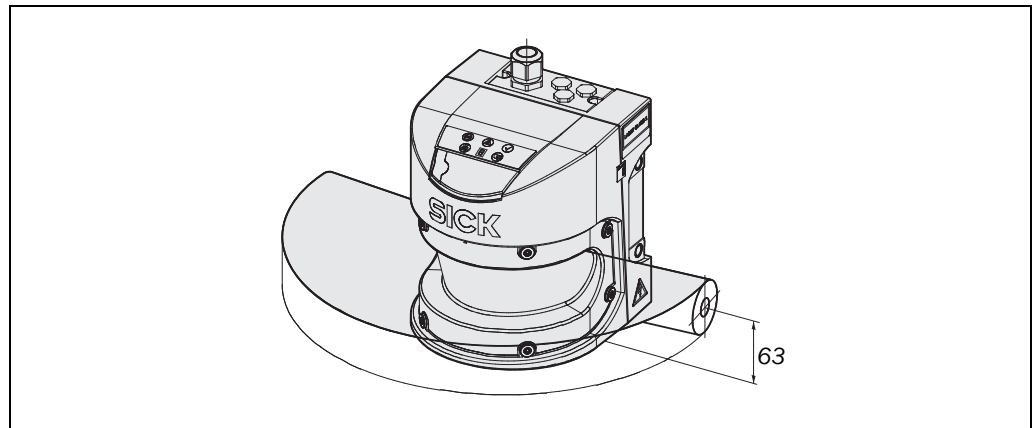
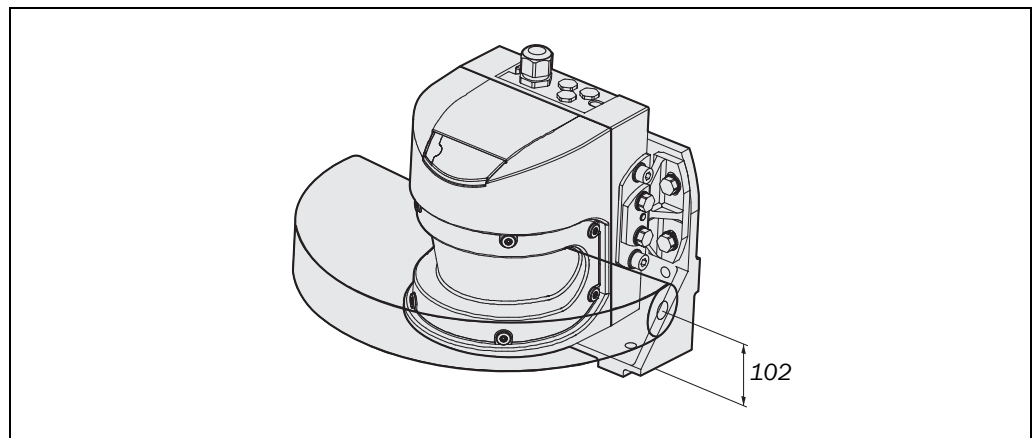


Fig. 96: Dimensional drawing of the scan plane with mounting kit 3 (mm)



12 Ordering information

12.1 Items supplied

- sensor head with I/O module mounted
- operating instructions and CDS (SICK Configuration & Diagnostic Software) on CD-ROM
- adhesive label **Important information**

Note • System plug not included.

System plugs without cable and pre-assembled system plugs are available from SICK AG (see section “System plug” on page 134). For more details see section 5.2 “System plug assembly” on page 78 and 5.3 “Pre-assembled system plugs” on page 80.

12.2 Available systems

Tab. 29: Part numbers systems

Device type	Part	Part number
S30A-4011BA	S3000 Standard with short-range sensor head	1028934
S30A-6011BA	S3000 Standard with medium-range sensor head	1023546
S30A-7011BA	S3000 Standard with long-range sensor head	1023890
S30A-4011CA	S3000 Advanced with short-range sensor head	1028935
S30A-6011CA	S3000 Advanced with medium-range sensor head	1023547
S30A-7011CA	S3000 Advanced with long-range sensor head	1023891
S30A-4011DA	S3000 Professional with short-range sensor head	1028936
S30A-6011DA	S3000 Professional with medium-range sensor head	1019600
S30A-7011DA	S3000 Professional with long-range sensor head	1023892
S30A-4011DB	S3000 Professional CMS with short-range sensor head	1028939
S30A-6011DB	S3000 Professional CMS with medium-range sensor head	1026401
S30A-7011DB	S3000 Professional CMS with long-range sensor head	1026402
S30A-4011EA	S3000 Remote with short-range sensor head	1028938
S30A-6011EA	S3000 Remote with medium-range sensor head	1023548
S30A-7011EA	S3000 Remote with long-range sensor head	1023893

12.3 Accessories/spare parts

12.3.1 Sensor heads

Tab. 30: Part numbers sensor heads

Part	Description	Part number
Short-range	Sensor head with up to 4 m scanning range	2034999
Medium-range	Sensor head with up to 5.5 m scanning range	2022972
Long-range	Sensor head with up to 7 m scanning range	2026747

12.3.2 I/O modules

Tab. 31: Part numbers I/O modules

I/O module	Part number
Standard	2026801
Advanced	2026802
Professional	2022827
Professional CMS	2030915
Remote	2026803

12.3.3 Mounting kits

Tab. 32: Part numbers mounting kit

Mounting kit	Description	Part number
1	Mounting bracket for direct mounting at the rear on wall or machine. No adjustment facility	2015623
2	Bracket only in conjunction with mounting kit 1. Mounting at the rear on wall or machine. Longitudinal and cross-wise adjustment possible	2015624
3	Bracket only in conjunction with mounting kit 1 and 2. Mounting at the rear or below on wall, floor or machine. Longitudinal and cross-wise adjustment possible	2015625
Heavy Duty mounting bracket	Mounting bracket, Heavy Duty version, with protective cover, steel, painted, for floor mounting, height adjustment possible	7087514

12.3.4 System plug

Tab. 33: Part numbers system plugs

System plug	Description	Suitable for					Part number
		Standard	Advanced	Professional	Professional CMS	Remote	
SX0A-A0000B	Without cable, for on-site assembly, one M20 cable gland and one M13 blanking plug	x	x	x	x	x	2023797
SX0A-A0000D	Without cable, for on-site assembly, cable outlet at the rear, one M20 cable gland and one M13 blanking plug	x	x	x	x	x	2023310
SX0A-B0905B	Pre-assembled, 5 m cable length, 9 cores, one M20 cable gland and one M13 blanking plug	x				x	2027170
SX0A-B0905G	Pre-assembled, 5 m cable length, 9 cores, cable outlet at rear, one M20 cable gland and one M13 blanking plug	x				x	2049222
SX0A-B0910B	Pre-assembled, 10 m cable length, 9 cores, one M20 cable gland and one M13 blanking plug	x				x	2027171
SX0A-B0920B	Pre-assembled, 20 m cable length, 9 cores, one M20 cable gland and one M13 blanking plug	x				x	2027814
SX0A-B1305B	Pre-assembled, 5 m cable length, 13 cores, one M20 cable gland and one M13 blanking plug		x				2027172
SX0A-B1310B	Pre-assembled, 10 m cable length, 13 cores, one M20 cable gland and one M13 blanking plug		x				2027173
SX0A-B1320B	Pre-assembled, 20 m cable length, 13 cores, one M20 cable gland and one M13 blanking plug		x				2027815
SX0A-B1705B	Pre-assembled, 5 m cable length, 17 cores, one M20 cable gland and one M13 blanking plug			x	x		2027174
SX0A-B1710B	Pre-assembled, 10 m cable length, 17 cores, one M20 cable gland and one M13 blanking plug			x	x		2027175
SX0A-B1720B	Pre-assembled, 20 m cable length, 17 cores, one M20 cable gland and one M13 blanking plug			x	x		2027816
SX0A-B1305D	Pre-assembled, 5 m cable length, 13 cores, one M20 cable gland, three M12 blanking plugs, 2 EMC-proof cable glands		x				2027176
SX0A-B1310D	Pre-assembled, 10 m cable length, 13 cores, one M20 cable gland, three M12 blanking plugs, 2 EMC-proof cable glands		x				2027177

12.3.5 Service cable

Tab. 34: Part numbers service cables

Part	Description	Part number
Service cable 2 m	Connection cable between the serial interface of the PC and the configuration interface M8 × 4-pin/D-Sub 9-pin approx. 2 m	6021195
Service cable 10 m	Connection cable between the serial interface of the PC and the configuration interface M8 × 4-pin/D-Sub 9-pin approx. 10 m	2027649

S3000

Tab. 35: Part numbers connecting cables

12.3.6 Self assembly connecting cables

Part	Part number
9-cores, cross section 0.56 mm ² (AWG 20), by the meter	6022651
13-cores, cross section 0.56 mm ² (AWG 20), by the meter	6025729
17-cores, cross section 0.56 mm ² (AWG 20), by the meter	6025730
EFI cable, per meter (1 × 2 × 0.22 mm ²)	6029448
DeviceNet connecting cable, PVC, cable diameter 12.2 mm, by the meter	6030756
DeviceNet connecting cable, PVC, cable diameter 6.9 mm, by the meter	6030921
M12 EMC-proof cable gland for EFI connections and incremental encoders, permissible cable diameter 3-6.5 mm, height 19 mm	5308757
M12 EMC-proof cable gland for EFI connections and incremental encoders, permissible cable diameter 3-6.5 mm, height 25 mm	5314772
M20 EMC-proof cable gland for supply cables and signal cables, permissible cable diameter 7-12 mm, height 23 mm	5308762
M20 EMC-proof cable gland for supply cables and signal cables, permissible cable diameter 10-14 mm, height 23 mm	5318531
M20 EMC-proof cable gland for supply cables and signal cables, permissible cable diameter 6-12 mm, height 32.5 mm	5323688
M20 EMC-proof cable gland for supply cables and signal cables, permissible cable diameter 10-14 mm, height 33 mm	5314774

12.3.7 Documentation

Tab. 36: Part numbers documentation

Part	Part number
CDS (SICK Configuration & Diagnostic Software) on CD-ROM including online documentation and operating instructions in all available languages	2032314

12.3.8 Safety relays/compact safety controller

Tab. 37: Part numbers safety relays/compact safety controller

Part	Description	Part number
UE10-2FG3	Safety relay UE10-2FG3	1043916
UE12-2FG3	Safety relay UE12-2FG3	1043918
UE10-3OS2	Safety relay UE10-3OS with screw type terminals	6024917
UE10-3OS3	Safety relay UE10-3OS with plug-in terminals	6024918
UE440	Compact safety controller for multifunctional applications	1023859

12.3.9 Safety controllers

Tab. 38: Part numbers safety controllers

Part	Description	Part number
UE410-MU3T5	Flexi Classic main unit	6026136
UE410-XU3T5	Flexi Classic extension unit	6032470
UE410-8DI3	Flexi Classic input expansion unit	6026139
FX3-CPU000000	Flexi Soft CPU0 main unit Double-layer spring terminals	1043783
FX3-CPU130002	Flexi Soft CPU1 main unit 2 EFI connections Double-layer spring terminals	1043784
FX3-XTIO84002	Flexi Soft XTIO extension unit 8 inputs/4 outputs Double-layer spring terminals	1044125
FX3-XTDI80002	Flexi Soft XTDI input expansion unit 8 inputs, double-layer spring terminals	1044124
FX3-MPL000001	Flexi Soft system plug	1043700

12.3.10 Network solutions

Tab. 39: Part numbers network solutions

Part	Description	Part number
UE4140	EFI gateway PROFIsafe	1029098
UE1140	EFI gateway PROFIBUS	1029099
UE1840	EFI gateway Ethernet TCP/IP	1029100
UE1940	EFI gateway CANopen	1040397
UE4740	EFI gateway PROFINET IO PROFIsafe	1046978
UE4155	PROFIBUS bus node	1024057
UE4455	DeviceNet bus node	1028306
UE4457	Safety remote controller	1028307
UE4215	ASi Safety at Work bus node	1025687

12.3.11 SDL connecting cables

Tab. 40: Part numbers SDL connecting cables

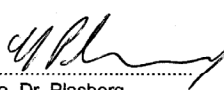
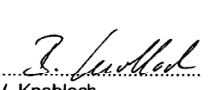
Part	Description	Part number
SDL connection cable 2.5 m	Screened connecting cable, for the connection of the S3000 safety laser scanner, wire cross-section $6 \times 0.75 \text{ mm}^2$, plug straight, stripped	2029337
SDL connection cable 5 m		2029338
SDL connection cable 10 m		2029339
SDL connection cable 15 m		2029340

S3000Tab. 41: Part numbers
miscellaneous**12.3.12 Miscellaneous**

Part	Description	Part number
Front screen	Spare parts set for front screen with replacement seal and screws	2027180
Plastic cleaner	Plastic cleaner and care product, anti-static, 1 litre	5600006
Lens cloth	Cloth for cleaning the front screen	4003353
Power supply, 2.1 A	Power supply, 24 V DC, 2.1 A, 100/240 V AC, 50 W	7028789
Power supply 3.9 A	Power supply, 24 V DC, 3.9 A, 120/240 V AC, 95 W	7028790
Quatech interface card	Serial PC interface card with two RS-422 interfaces, up to 500 kBaud	6022515
LS70b	Scan finder	6020756

13 Annex

13.1 EC Declaration of conformity

	
EC Declaration of conformity	
en	Ident-No. : 9068273/O541
The undersigned, representing the following manufacturer	
SICK AG Industrial Safety Systems Sebastian-Kneipp-Straße 1 79183 Waldkirch Deutschland	
herewith declares that the product	
S3000	
is in conformity with the provisions of the following EC directive(s) (including all applicable amendments), and that the standards and/or technical specifications referenced overleaf have been applied.	
Waldkirch, <u>9. Juni 2009</u>  ppa. Dr. Plasberg (Manager Research and Development)  i.V. Knobloch (Manager Production)	

Note You can obtain the complete EC declaration of conformity via the SICK homepage on the Internet at: www.sick.com

13.2 Manufacturer's checklist

SICK

Checklist for the manufacturer/installer for installing electro-sensitive protective equipment (ESPE)

Details about the points listed below must be present at least during initial commissioning — they are, however, dependent on the respective application, the specifications of which are to be controlled by the manufacturer/installer. This checklist should be retained and kept with the machine documentation to serve as reference during recurring tests.

- | | |
|---|--|
| Have the safety rules and regulations been observed in compliance with the directives/ 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 comply with the required PL/SILCL and PFHd according to EN ISO 13849-1/EN 62061 and the type according to EN 61496-1? | Yes ☐ No ☐ |
| Is the access to the hazardous area/hazardous point only possible through the protective field of the ESPE? | Yes ☐ No ☐ |
| Have appropriate measures been taken to prevent (mechanical protection) or monitor unprotected presence in the hazardous area when protecting a hazardous area/hazardous point and have these been secured against removal? | Yes ☐ No ☐ |
| Are additional mechanical protective measures fitted and secured against manipulation which prevent reaching under, over or around the ESPE? | Yes ☐ No ☐ |
| Has the maximum stopping and/or run-down 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 safety distance from the nearest hazardous point has been achieved? | Yes ☐ No ☐ |
| Are the ESPE devices correctly 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 device (ESPE) or restarting the machine present and correctly installed? | Yes ☐ No ☐ |
| Are the outputs of the ESPE (OSSDs, AS-Interface Safety at Work) integrated in compliance with the required PL/SILCL according to EN ISO 13-849/EN 62061 and does the integration comply with the circuit diagrams? | Yes ☐ No ☐ |
| Has the protective function been checked in compliance with the test notes of this documentation? | Yes ☐ No ☐ |
| Are the given protective functions effective at every setting of the operating mode selector switch? | 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 ☐ |
| Has the information label "Important Information" for the daily check been attached so that it is easily visible for the operator? | Yes ☐ No ☐ |

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

13.3 Glossary

AOPDDR	Active opto-electronic protective device responsive to diffuse reflection (e.g. S3000, see also CLC/TS 61 496-3)
Control input, dynamic, static, universal	The monitoring cases are switched using the control inputs. The S3000 Advanced has two static control inputs, the S3000 Professional two static control inputs and two universal control inputs. The universal control inputs can be used both statically and dynamically (for incremental encoders).
External device monitoring (EDM)	A means by which the electro-sensitive protective equipment (ESPE) monitors the state of control devices which are external to the ESPE.
Field set	Protective field and warning field form a pair, the so-called field set.
I/O module	Defines the functionality of the S3000. Five I/O modules (Standard, Advanced, Professional, Professional CMS and Remote) are available.
Incremental encoder	A component that produces electrical pulses in proportion to a movement. For these pulses, various physical parameters can be derived, e.g. velocity, distance, etc.
Master/slave	Two S3000 that are configured to form a master/slave system using an EFI connection with the aid of the CDS. The control signals for monitoring case switching are applied to the inputs on the master. The slave is connected to the master via EFI and receives from the master the input information for local monitoring case switching.
Monitoring case	A field set (if necessary a simultaneous field set) is allocated to a monitoring case. Monitoring case switching is performed using the control inputs. In this way the S3000 can be adapted to the operating mode of the machine or plant that it monitors.
OSSD	The OSSD output is the switching output on the S3000. This is a semiconductor output and is periodically tested for correct function. The S3000 has two OSSD outputs that operate in parallel; for safety reasons these must be evaluated using two channels.
Protective field	The protective field secures the hazardous area on a machine or vehicle. As soon as the safety laser scanner detects an object in the protective field, it switches the OSSDs to the off status and thus initiates the shutdown of the machine or stop of the vehicle.
Reflectivity	Reflection of luminance. A measure of the reflectivity is the reflectance defined as the ratio of the luminance reflected from a surface in the measuring direction and the luminance of a completely matt white surface (white standard).
Resolution	The minimum size of an object that is acquired by the protective device and is guaranteed by the manufacturer
Restart interlock	The restart interlock is a protective device. In certain situations it prevents the machine from automatically restarting. This applies, e.g., after the scanner function has triggered during a dangerous machine state, after a change to the operating mode or the method of activation of the machine, or after the change to the start control device on the machine.
Sensor head	Contains the opto-electronic acquisition system. Three sensor heads are available (short-range with 4 m, medium-range with 5.5 m and long-range with 7 m scanning range).
System plug	Contains the configuration memory and all electrical connections. In this way the S3000 can be easily replaced. After re-commissioning the configuration is loaded from the system plug; the S3000 is then, normally, ready for use.
Warning field	The warning field is a field with a radius of 49 m. Using this field larger areas can be controlled and simple switching functions (e.g. warning functions) triggered. The warning field is not allowed to be used for tasks related to the protection of people.

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