

OPERATING INSTRUCTIONS

S300

Safety laser scanner



en

SICK
Sensor Intelligence.

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1 About this document

Please read this chapter carefully before working with this documentation and the S300.

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 S300 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 for the machine, the system or the vehicle.

1.2 Target group

These operating instructions are addressed to *planning engineers, machine designers and the operators* of machines and systems which are to be protected by one or several S300 safety laser scanners. They also address people who integrate the S300 into a machine, a system or a vehicle, initialize its use, or who are in charge of servicing and maintaining the device.

1.3 Scope

These operating instructions are original operating instructions.

These operating instructions are only applicable to the S300 safety laser scanner with one of the following entries on the type label in the field *Operating Instructions*:

- 8010946 AE W284
- 8010946 AE X175
- 8010946 AE XK33
- 8010946 AE YY96

This document is part of SICK part number 8010946 (operating instructions “S300 – Safety laser scanner” in all available languages).

For the configuration and diagnostics of these devices you require a CDS (Configuration & Diagnostic Software) version $\geq 3.6.7$. To determine the version of your software version, select the **Module-Info...** option in the **?** menu.

1.4 Depth of information

These operating instructions contain information on the S300 safety laser scanner. They have the following parts:

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

Planning and using protective devices such as the S300 also require specific technical skills which are not detailed in this documentation.

General information on accident prevention using opto-electronic protective devices can be found in the competence brochure "Guidelines Safe Machinery".

When operating the S300, the national, local and statutory rules and regulations must be observed.

Note Please refer also to the SICK AG homepage on the Internet at www.sick.com

Here you will find information on:

- application examples
- these operating instructions in different languages for viewing and printing

1.5 Abbreviations used

AGV	Automated Guided Vehicle
ANSI	American National Standards Institute
AWG	American Wire Gauge = standardization and classification of wires and cables by type, diameter etc.
CDS	SICK Configuration & Diagnostic Software = software for configuration and diagnostics on the S300
CMS	Contour Measurement & Safety = expanded measured data output as well as detection of reflectors as artificial landmarks
EDM	External device monitoring
EFI	Enhanced function interface = safe SICK device communication
EMC	Electromagnetic compatibility
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

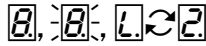
1.6 Symbols used

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 S300:



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 "OSSDs in the OFF state" LED is illuminated continuously.



The "Error/contamination" LED is flashing.



The "Warning field interrupted" LED is off.

➤ 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 warning notices!



Information is displayed in the software indicating to you which settings you can make in the CDS (Configuration & Diagnostic Software).

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 system operators.

➤ Please read this chapter carefully before working with the S300 or with the machine protected by the S300.

2.1 Qualified safety personnel

The S300 safety laser scanner must be installed, connected, commissioned and serviced only by qualified safety personnel. Qualified safety 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

- have been instructed by the responsible machine owner 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 recognized engineering practice (e.g. DIN standards, VDE stipulations, engineering regulations from other EU member states) that they can assess the work safety aspects of the power-driven equipment

and

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

As a rule these are qualified safety 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 organization operating the ESPE.

2.2 Applications of the device

The S300 safety laser scanner is used to protect persons and systems. It is intended to be used to monitor hazardous areas indoors.

It is not allowed to use the S300 outdoors.

The S300 cannot provide protection from parts thrown out of the machine or emitted radiation.

The S300 complies with the requirements in the standard on the radiated emissions as defined for class A (industrial application); the S300 is therefore only suitable for use in an industrial environment.

The device is a *type 3 ESPE* as defined by IEC 61496-1 and IEC 61496-3 and is therefore allowed for use with category 3 PL d controls as per EN ISO 13849-1 or SIL2 as per IEC 61508.

The S300 is suitable for:

- hazardous area protection
- hazardous point protection
- access protection
- vehicle protection (electrically powered industrial trucks)

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

2.3 Correct use

The S300 safety laser scanner must be used only as defined in section 2.2 “Applications of the device” on page 10. It must be used only by qualified personnel and only on the machine where it has been installed and initialized by qualified safety 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 S300 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!

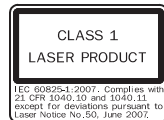
Please observe the following items in order to ensure the correct use of the S300 safety laser scanner.

Repair only by authorized persons!

The improper repair of the protective device can result in the loss of the protective function. The protective device is only allowed to be repaired by the manufacturer or persons authorized by the manufacturer.



The S300 safety laser scanner is of laser safety class 1. Additional measures for screening the laser radiation are not necessary (eye safe).



- 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 S300, 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 14.
- The national/international rules and regulations apply to the installation, commissioning, use and periodic technical inspections of the S300 safety laser scanner, in particular:
 - Machinery Directive
 - Work Equipment Directive
 - the work safety regulations/safety rules
 - other relevant safety regulations
- Manufacturers and operators of the machine on which the S300 is used are responsible for obtaining and observing all applicable safety regulations and rules.

- The notes, in particular the test notes (see chapter 9 “Commissioning” on page 99) in these operating instructions (e.g. on use, mounting, installation or integration into the machine control) 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 authorized persons make changes to the configuration. The SICK service team is available to provide assistance if required.
 - The tests must be carried out by qualified safety personnel or specially qualified and authorized 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 S300 is used. The machine operator is to be instructed in the use of the device by qualified safety personnel and must be instructed to read the operating instructions.
 - To meet the requirements of the relevant product standards (e.g. IEC 61496-1), the external voltage supply for the devices (SELV) must be able to bridge a brief mains failure of 20 ms. Power supplies according to EN 60204-1 satisfy this requirement. Suitable power supplies are available as accessories from SICK (see section 13.3 “Accessories/spare parts” on page 138).
 - In case of data cables more than 30 m long, as per EN 61000 either the device itself must be earthed, or the screen on the data cable must be earthed in the immediate vicinity of the cable entry in the system plugs.
- Enclosed with these operating instructions is a checklist for checking by the manufacturer and OEM (see section 14.2 “Checklist for the manufacturer” on page 140). Use this checklist when checking the system that is protected with the S300.

2.5 Environmental protection

The S300 safety laser scanner is constructed in such a way that it adversely affects the environment as little as possible and uses only a minimum of power and natural resources.

➤ At work, always act in an environmentally responsible manner.

2.5.1 Disposal

Unusable or irreparable devices should always be disposed as per the applicable national regulations on waste disposal (e.g. European waste code 16 02 14).

Notes

- We would be pleased to be of assistance to you on the disposal of these devices. Contact your local SICK representative.
- Information on the individual materials in the S300 is given in chapter 12 “Technical specifications” on page 120.

2.5.2 Separation of materials



WARNING

Only qualified safety personnel are allowed to separate materials!

Caution is required when dismantling devices. There is a risk of injuries.

Before you send the devices for appropriate recycling, it is necessary to separate the different materials in the S300.

- Separate the housing from the rest of the parts (in particular the circuit boards).
- Send the separated parts for recycling as appropriate (see Tab. 1).

Tab. 1: Overview on disposal by components

Components	Disposal
Product	
Housing	Metal recycling (aluminium)
Motor bracket	Metal recycling (zinc die-cast housing)
Optics cover	Plastic recycling
Circuit boards, cables, connectors and electrical connecting pieces	Electronic recycling
Packaging	
Cardboard, paper	Paper/cardboard recycling
Polyethylene packaging	Plastic recycling

2.6 Applicable directives and standards

The most important directives and standards, valid for the use of opto-electronic protective devices in Europe, are listed below. Further regulations may be of importance to you, depending on the application. You can obtain further information of machine-specific standards from national institutions (e.g. DIN, BSI, AFNOR 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 system and the local authorities and obtain information on the regulations and standards applicable there.

Application and installation of protective devices

Machinery Directive, 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 (IEC 60 204/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 (EN 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 13 849-1) as well as part 2: Validation (EN ISO 13 849-2)
- Safety of machinery – electro-sensitive protective equipment – Part 1: General requirements (IEC 61 496-1) as well as part 3: Special requirements for AOPDDR (IEC 61 496-3)
- Safety of machinery – Application of protective equipment to detect the presence of persons (IEC/TS 62 046)

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 S300 safety laser scanner meets this requirement.

Recommendation Please request our competence brochure “Guidelines Safe Machinery” on this subject (part no. 8007988).

3 Product description

This chapter provides information on the special features and properties of the S300 safety laser scanner. It describes the construction and the operating principle of the device.

3.1 Special features

- 270° scan area
- increased dust and particle tolerance due to dazzle and particle algorithms
- variants with scanning ranges up to 2 m or 3 m (maximum protective field radii)
- configuration using PC or notebook with SICK Configuration & Diagnostic Software
- configuration memory in the system plug. In case of device replacement, the existing configuration is automatically transferred to the S300 newly connected. In this way downtimes can be significantly reduced.
- field sets comprising of one protective field and up to two warning fields
- contour monitoring of the protective field if only one warning field is used
- 5 universal I/O connections
- integrated external device monitoring (EDM)
- integrated restart interlock/restart interlock delay for which the parameters can be set
- safe bus interface via enhanced function interface (EFI) for operation in a system with other safety laser scanners, with products of the sens:Control product group or with a Flexi Soft safety controller
- compatibility mode for interoperability with safety laser scanners of an older generation

From S300 Advanced

- up to 4 field sets
- protective field switching via static inputs or EFI

S300 Professional

- up to 8 field sets
- protective field switching via dynamic inputs using incremental encoders
- velocity routing using a Flexi Soft safety controller

S300 Expert

- up to 16 field sets
- CMS function for the detection of reflectors as artificial landmarks

3.2 Function

The S300 safety laser scanner operates correctly as a protective device only 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 system or the vehicle to a safe state at any time using the OSSDs on the S300, i.e. before a person has reached the hazardous point or hazardous area.

Or:

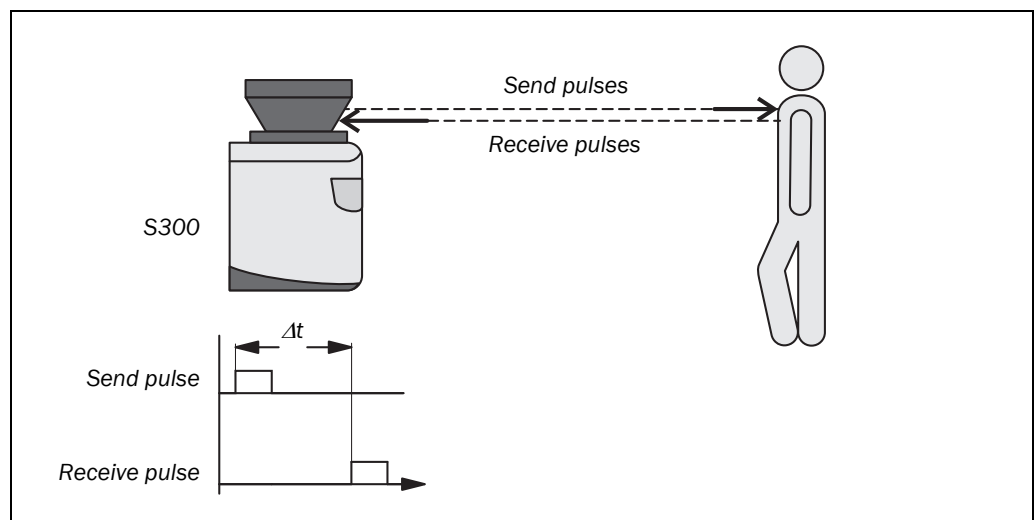
It must be possible to transfer the dangerous state of the machine, the system or the vehicle to a safe state at any time using the OSSDs on a safety controller connected to the S300 or to a further safety laser scanner.

- The S300 must be mounted and configured such that it detects objects as they enter the hazardous area (see chapter 5 “Mounting” on page 56 and chapter 9 “Commissioning” on page 99).
- The safety laser scanner’s optical path must always remain clear and is not allowed to be covered by transparent objects such as protective windows, Plexiglas, lenses etc. The safety laser scanner’s protective function can only be ensured if the contamination measurement function is not bypassed by such measures.

3.2.1 Principle of operation

The S300 is an optical sensor that scans its surroundings in two dimensions using infrared laser beams. It is used to monitor hazardous areas on machines or vehicles.

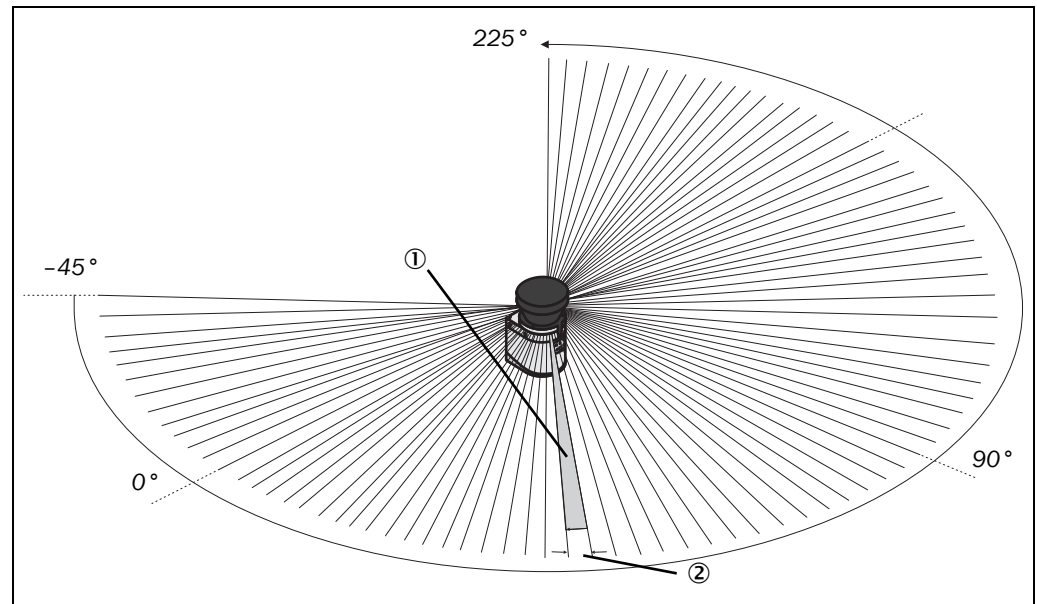
Fig. 1: Principle of operation, time-of-flight measurement by the S300



The S300 works on the principle of time-of-flight measurement. It sends out very short pulses of light (send pulses). At the same time an “electronic stopwatch” is started. When the light hits an object, it is reflected and received by the safety laser scanner (receive pulses). From the time between sending and reception (Δt) the S300 calculates the distance to the object.

S300

Fig. 2: Principle of operation, rotation of the S300



In the S300 there is also a mirror rotating at constant speed that deflects the light pulses such that they cover an arc of 270°. In this way an object can be detected in the protective field within 270°. The first beam of a scan starts at -45° relative to the back of the safety laser scanner.

The S300 sends a pulse of light with an angular resolution of 0.5° ①. As a result resolutions between 30 mm and 150 mm can be achieved ②.

Due to its active scanning principle, the S300 does not require receivers or reflectors. This has the following advantages:

- Your installation effort is lower.
- You can easily adapt the monitored area to the hazardous area on a machine.
- In comparison with contact sensors, electro-sensitive scanning is nearly wear-free.

3.2.2 Field set comprising of protective field and warning field(s)

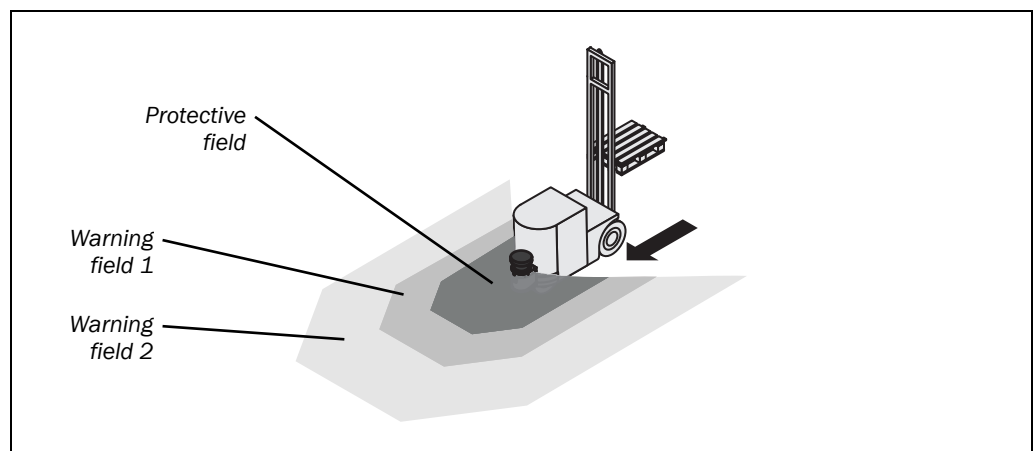
Protective fields and warning fields form the so-called field set. You can configure these field sets with the aid of the CDS. The fields can be configured as circular, rectangular or of arbitrary shape. If the area to be monitored changes, then you can re-configure the S300 in software without additional mounting effort.

Depending on the variant used (see section 3.3.2 “Functions of the S300 variants” on page 20), you can define up to 16 field sets and save these in the safety laser scanner. In this way you can switch to a different field set in case of a change in the monitoring situation (see section 3.2.3 “Monitoring cases” on page 19).

You can configure field sets comprising one protective field and one or two warning fields.

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, the S300 switches the OSSDs to the off status and thus initiates the shutdown of the machine or stop of the vehicle.

Fig. 3: Field set with one protective field and two warning fields



You can define the warning fields such that the safety laser scanner detects an object before the actual hazardous area.

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

Note A **warning field** on all S300 variants is **not** allowed to be used for tasks related to the protection of people.

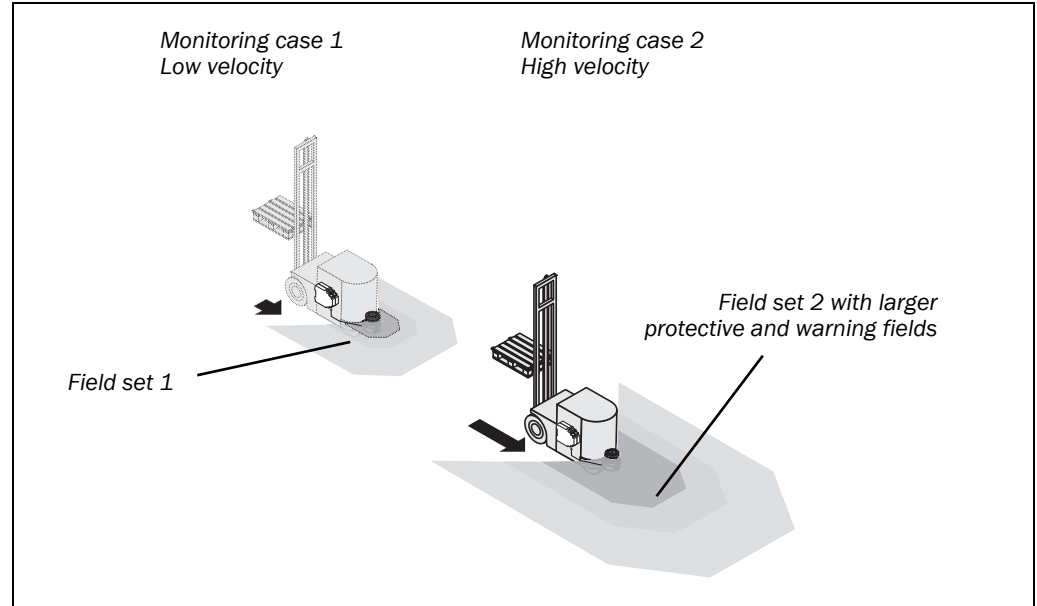
Contour monitoring

In addition to the protective field, the S300 can also monitor a contour (e.g. the floor in vertical applications).

3.2.3 Monitoring cases

Depending on the variant used (see section “Functions of the S300 variants” on page 20) up to 32 monitoring cases can be defined and selected during operation using local static or dynamic control inputs or via EFL. In this way process-dependent hazardous area protection or velocity-dependent vehicle monitoring is possible for example.

Fig. 4: S300 Remote with two monitoring cases on an AGV



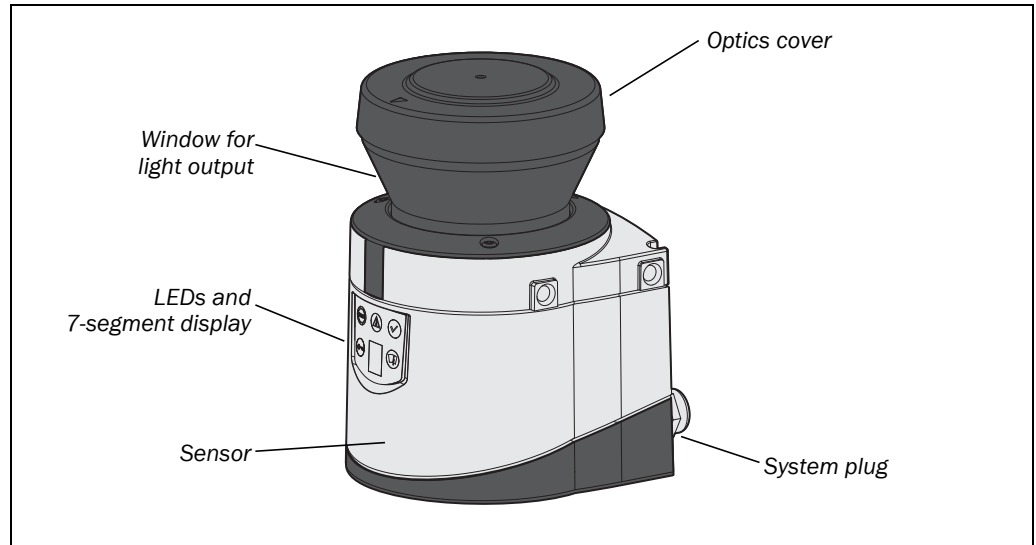
3.3 S300 variants

3.3.1 Device components

The S300 safety laser scanner comprises three components:

- the sensor with the opto-electronic acquisition system, the LEDs and the 7-segment display
- the optics cover with the window for the light output
- the system plug with the configuration memory (the system plug contains all electrical connections with the exception of the configuration interface)

Fig. 5: Device components



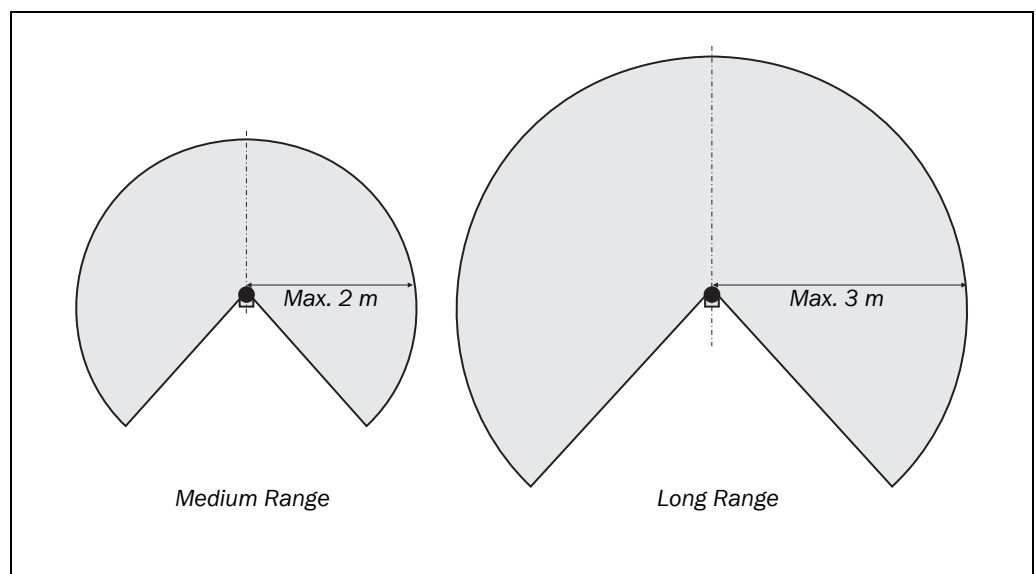
3.3.2 Functions of the S300 variants

So that different applications can be covered, four S300 variants each with two different scanning ranges are available.

Scanning ranges

The S300 variants differ in the maximum scanning range and the resulting size of the protective field.

Fig. 6: Protective field ranges



S300

Tab. 2: Functions of the S300 variants

Variants

Functions	Standard	Advanced	Professional	Expert
Protective field range, radial [m]	2/3	2/3	2/3	2/3
Warning field range, radial ¹⁾ [m]	8	8	8	8
Object resolution [mm]	30/40/50/70/150 ²⁾			
Pairs of output signal switching devices (OSSDs)	1	1	1	1
External device monitoring (EDM)	■ ³⁾	■ ³⁾	■ ³⁾	■ ³⁾
Universal I/Os	5	5	5	5
Restart interlock/delay	■ ³⁾	■ ³⁾	■ ³⁾	■ ³⁾
Field sets comprising of one protective field and two warning fields	1	4	8	16
Programmable monitoring cases in standalone mode	1	4	32	32
Programmable monitoring cases in an EFI system	32	32	32	32
Static control inputs for monitoring case switching	–	2	1	1
Static/dynamic control inputs for monitoring case switching	–	–	2	2
EFI interface (safe SICK device communication)	■	■	■	■
Park mode, activation via monitoring case	–	■	■	■
Stand-by, activation via EFI bit or stand-by input	■	■	■	■
Configuration memory in the system plug	■	■	■	■
Data interface RS-422	■	■	■	■
Extended CMS functions (reflector detection, filter function for the measured values)	–	–	–	■

¹⁾ Warning field range with a remission of 30% (see section 12.1 on page 116).

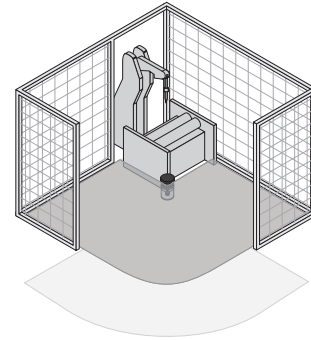
²⁾ 150 mm resolution can only be configured with the Long Range variant with 3 m scanning range.

³⁾ Availability depending on the configuration of the universal I/Os (see section 4.8 on page 42).

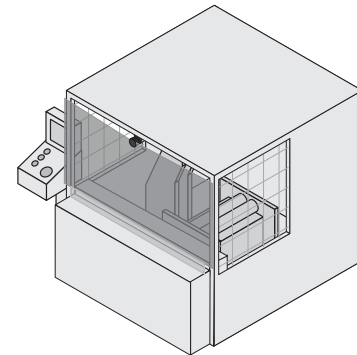
3.3.3 Applications

Tab. 3: Possible applications
for the S300 variants

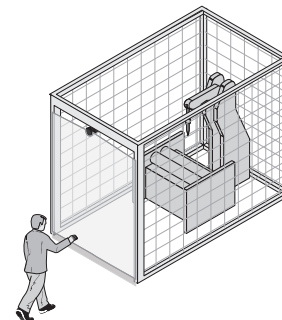
S300 Standard:
Hazardous area protection with
one monitored area



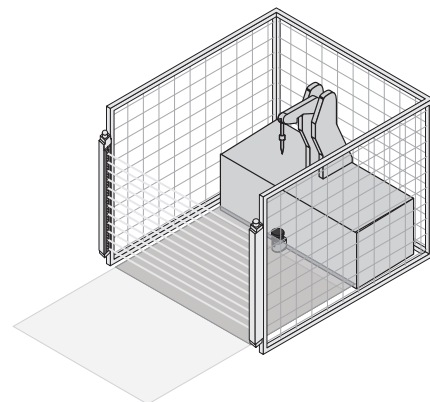
S300 Standard:
Hazardous point protection on
an insertion station



S300 Standard Long Range:
Access protection for high areas
of access

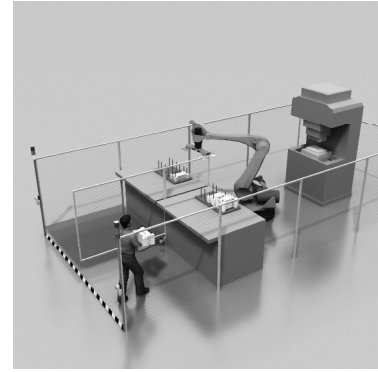


S300 Standard:
Presence detection for a safety
light curtain

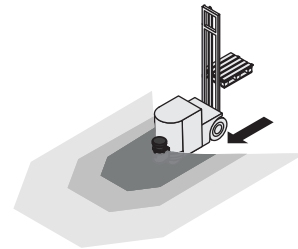


S300

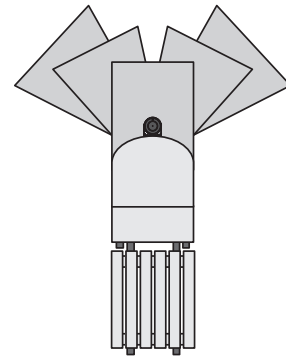
S300 Advanced:
Hazardous area protection with
multiple monitored areas



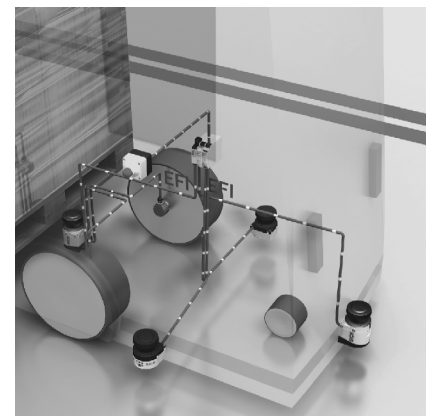
S300 Advanced:
Freely moving vehicle with two
warning fields



S300 Expert:
Protection of an automated
guided vehicle (AGV) with
protective fields for different
vehicle velocities and driving
around bends

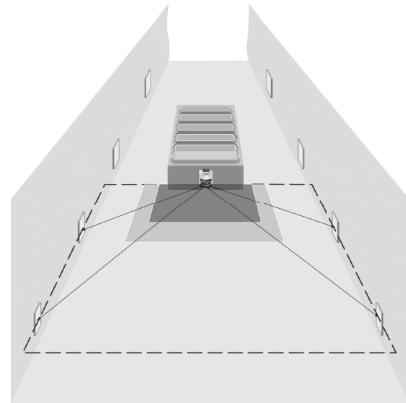


S300 Expert, S300 Professional
in combination with a Flexi Soft
safety controller:
Velocity-dependent protection of
an automated guided vehicle
(AGV). An S300 Expert measures
the velocity and provides the
velocity information to the other
safety laser scanners via EFL.



S300 Expert:

Protection of an automated guided vehicle (AGV) with output of processed measured data (as navigation aid, e.g. during docking maneuvers)

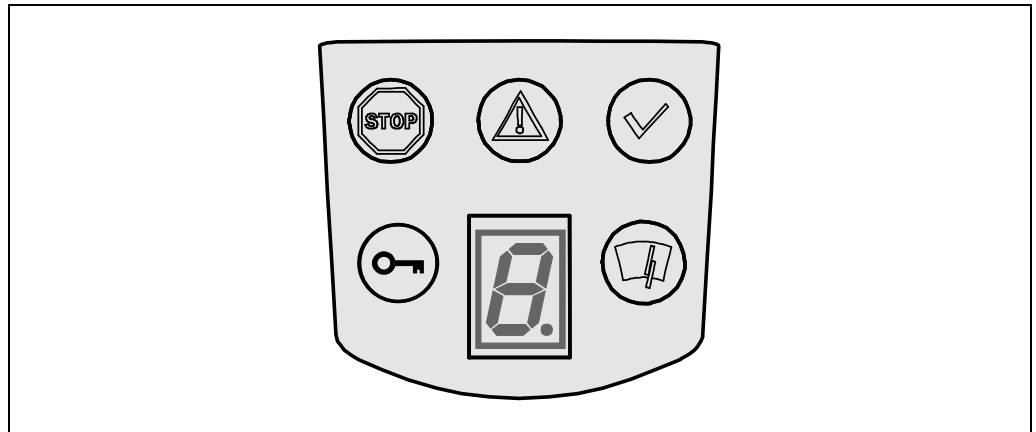


3.4 Status indicators







3.4.1 LEDs and 7-segment display

The LEDs and the 7-segment display indicate the operational status of the S300. They are on the front face of the safety laser scanner.

Fig. 7: Status indicators on the S300



The symbols have the following meaning:

-  OSSDs in the OFF state (e.g. in case of object in the protective field, monitored contour changed, reset required, lock-out)
-  Warning field interrupted (object in warning field)
-  OSSDs in the ON state (no object in the protective field)
-  Reset required
-  Optics cover contaminated
-  7-segment display for the indication of the status and errors

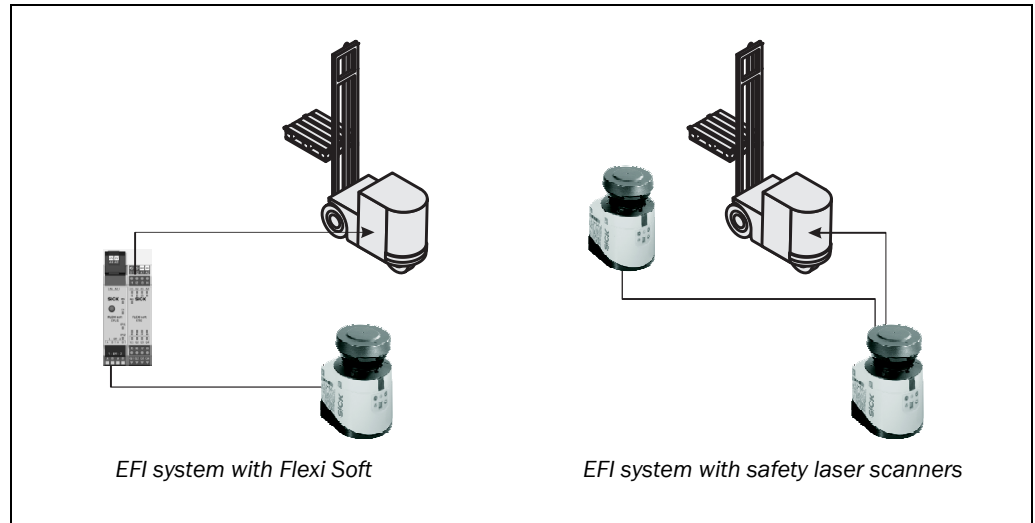
Note

You will find detailed information in section 11.3 “Error and status indications on the LEDs” on page 108 and in section 11.4 “Error and status indications on the 7-segment display” on page 110.

3.5 Interoperability

The S300 safety laser scanner can be integrated in an EFI system. An EFI system can comprise two safety laser scanners, a sens:Control device with one to two safety laser scanners or a safety controller Flexi Soft with up to four safety laser scanners.

Fig. 8: S300 in combination with a Flexi Soft safety controller or with another S300



Addressing of the guest

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

All devices involved can be unambiguously identified by the address and information can be distributed and retrieved using bit assignment (see also Technical Description “EFI – Enhanced Function Interface”, SICK part no. 8012621).





WARNING

In an EFI system with two safety laser scanners, set the address of one of the scanners to guest!

To be able to unambiguously differentiate between the devices in an EFI system, one S300 must be configured as the guest. For this purpose a jumper is wired between the connection terminals 7 and 13 (see section 6.1.1 “Pin assignment on the system plug” on page 82).

The jumper always defines the guest device. This jumper is never allowed to be fitted on the host device.

When the S300 is switched on in an EFI system, the following message appears briefly on the 7-segment display:

-  on the S300 host
-  on the S300 guest

Note

In an EFI system with an S3000 the S300 must be configured as a guest, it is never allowed to be configured as host.

3.5.1 Examples for EFI systems

Fig. 9: EFI systems comprising two safety laser scanners

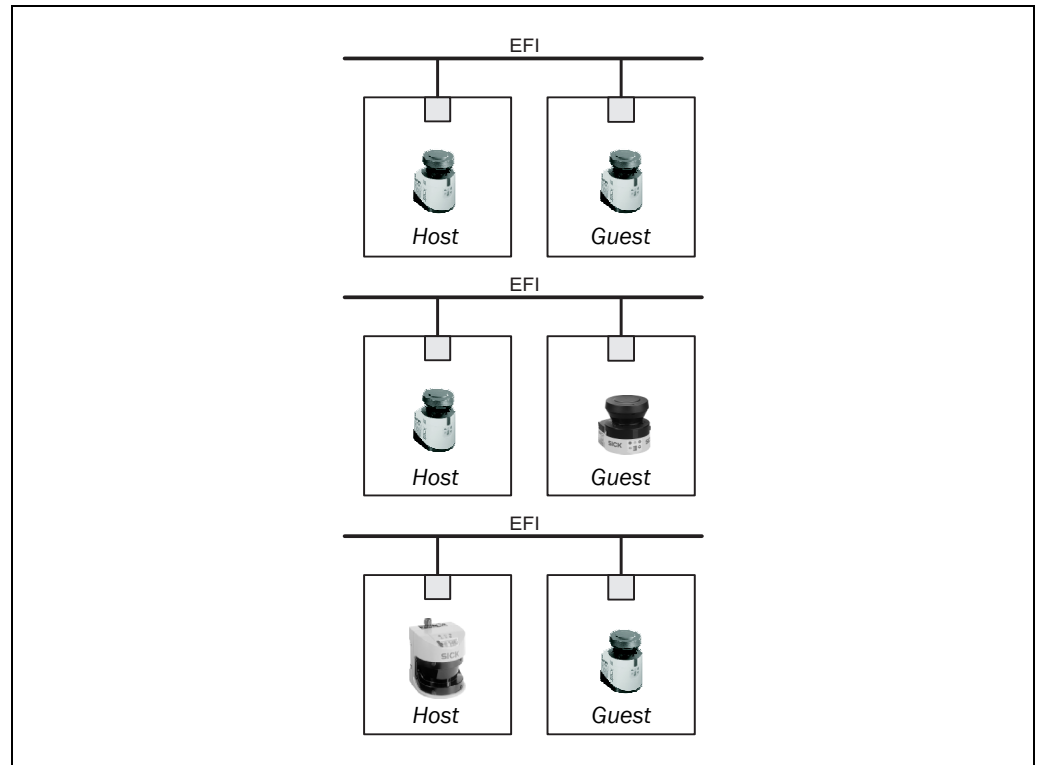


Fig. 10: EFI system with sens:Control device

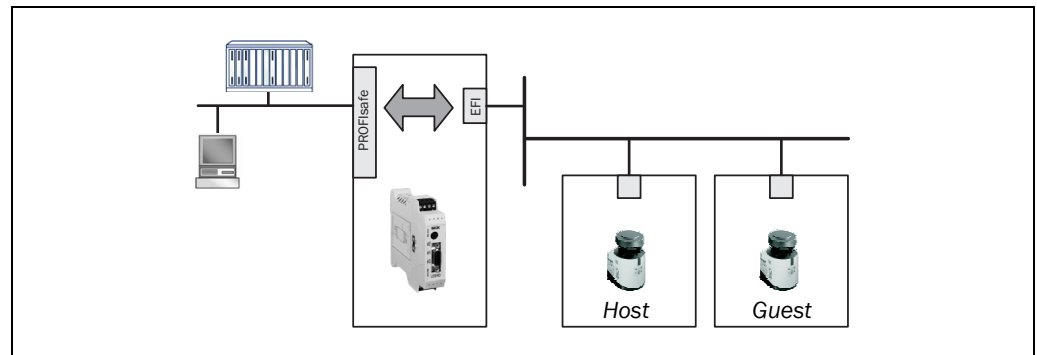
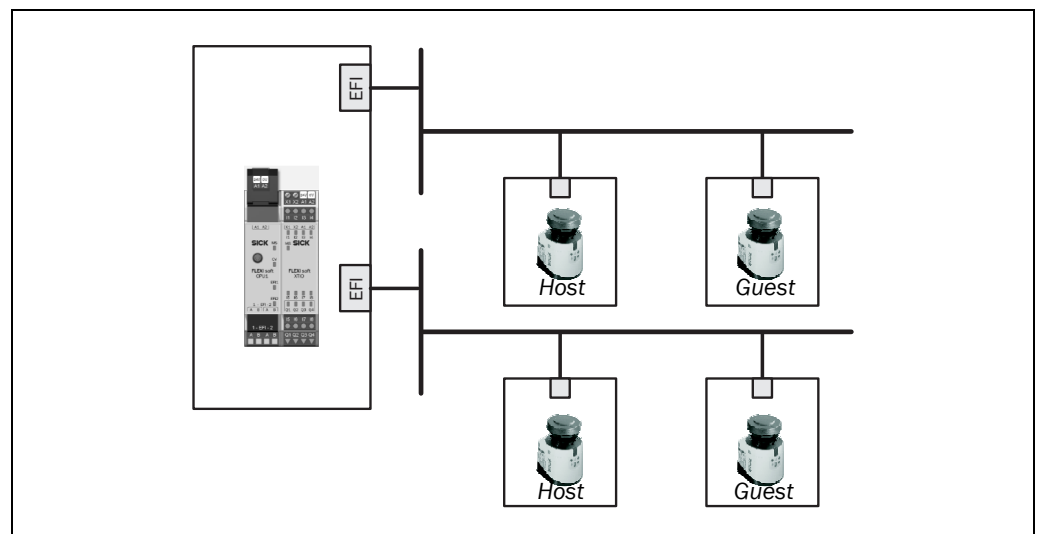


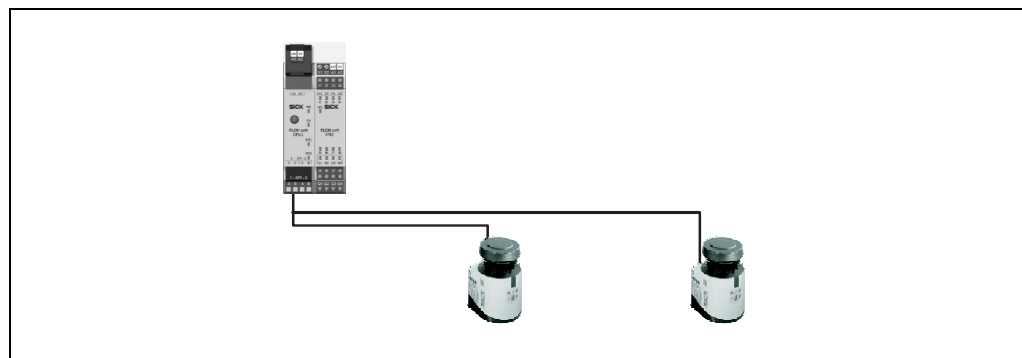
Fig. 11: EFI system with Flexi Soft safety controller



The Flexi Soft safety controller provides two EFI strings; up to two safety laser scanners (S3000, S300, S300 Mini, also mixed) can be connected to each of these strings. It is therefore possible to realize applications with up to four safety laser scanners (see also section 7.2.4 on page 91).

S300

Fig. 12: EFI network topologies



You will find details on the connection of safety laser scanners in section 7.3.8 “Protective field switching with a Flexi Soft safety controller” on page 96.

3.5.2 Interoperability of the variants

Due to the further development of the safety laser scanner, additional functions, e.g. triple field technology, have been implemented in the device. As a result the latest devices are not 100 % compatible with safety laser scanners already in use in the field.

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

Interoperability with safety laser scanners

	S3000 Standard	S3000 Advanced	S3000 Professional	S3000 Remote	S3000 Expert	S300 Standard	S300 Advanced	S300 Professional	S300 Expert	S300 Mini Standard	S300 Mini Remote
S300 Standard	■	■	■	■	■	■	■	■	■	X	■
S300 Advanced	■	■	■	■	■	■	■	■	■	X	■
S300 Professional	■	■	■	■	■	■	■	■	■	X	■
S300 Expert	■	■	■	■	■	■	■	■	■	X	■

Tab. 4: Interoperability with safety laser scanners

■ = EFI system possible

X = EFI system not possible

Interoperability with safety laser scanners in compatibility mode
(see section 4.1 on page 29)

	S3000 Standard	S3000 Advanced	S3000 Professional	S3000 Professional CMS	S3000 Remote	S3000 Expert	S300 Standard	S300 Advanced	S300 Professional	S300 Professional CMS	S300 Expert	S300 Expert CMS	S300 Mini Standard	S300 Mini Remote
S300 Standard	X	X	X	X	X	X	X	X	X	X	X	X	X	X
S300 Advanced	■	■	■	■	■	■	X	■	■	■	■	■	X	X
S300 Professional	■	■	■	■	■	■	X	■	■	■	■	■	X	X
S300 Expert	■	■	■	■	■	■	X	■	■	■	■	■	X	X

Tab. 5: Interoperability with safety laser scanners in compatibility mode

■ = EFI system possible

X = EFI system not possible

3.5.3 Specific features with EFI systems

Input signals

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

Monitoring case switching

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

Example The S300 Advanced is used on an S300 Professional as a guest. Eight monitoring cases are configured for the S300 Professional. On the S300 Advanced there are also eight monitoring cases available in this situation.

Internal or external OSSDs

In an EFI system you define which output signal switching device (OSSD) is switched when there is an object in the protective field (see section 4.6 on page 39).

Restart interlock/delay

The effectiveness of a restart interlock/delay configured in the S300 is dependent on the integration of the EFI status information from the S300 in the logic of the Flexi Soft safety controller (see section 4.7 on page 40).

3.5.4 Interoperability with sens:Control devices

The S300 safety laser scanner can be connected to the following sens:Control devices and in this way integrated into the related bus systems.

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

4 Configurable functions

4.1 Compatibility mode

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



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

Reasons why you must activate the compatibility mode or the compatibility mode is activated automatically by the CDS:

- You are using one of the following devices in an EFI system:
 - S300 Professional CMS
 - S300 Expert CMS
 - S300 with firmware < 02.10 and serial number < 12210000
 - S300 with system plug serial number < 12210000
 - S3000 Professional CMS
 - S3000 with firmware $< B02.41$ and serial number < 12210000
 - S3000 Standard, Advanced, Professional with an I/O module with serial number < 12210000
 - S3000 Remote with an I/O module with serial number < 11240000
- You configure an S300 with firmware < 02.10 and serial number < 12210000 .
- You configure an S300 with system plug serial number < 12210000 .
- You use an S300 with a system plug in which a configuration is saved, ...
 - that only supports the compatibility mode.
 - that has been configured in the compatibility mode.
 - that has been configured with a CDS version $< 3.6.7$.
- You want to ensure newly configured devices can be replaced with old devices.
- You want to replace old devices with new.

The table below shows the differences between the functions of the S300 variants in the compatibility mode.

Tab. 6: Functions of the S300 variants in the compatibility mode

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

- Notes**
- The user interface of the CDS in compatibility mode corresponds to the user interface of CDS version 3.6.6.
 - The related operating instructions delivered with the device are to be used for older devices (see 1.3 "Scope" on page 7).

⁴⁾ 8 field sets at angular resolution 1.0°; 4 field sets at angular resolution 0.5°.

S300

Interoperability in an EFI system depending on the firmware version

	Firmware	S300 Standard	S300 Standard	S300 Advanced	S300 Advanced	S300 Professional	S300 Professional	S300 Professional CMS	S300 Expert	S300 Expert	S300 Expert CMS
Firmware		≥02.10	<02.10	≥02.10	<02.10	≥02.10	<02.10	<02.10 ⁶⁾	≥02.10	<02.10	<02.10 ⁶⁾
S300 Standard	≥02.10	X	-	X	■	X	■	■	X	■	■
S300 Advanced	≥02.10	X	-	X	■	X	■	■	X	■	■
S300 Professional	≥02.10	X	-	X	■	X	■	■	X	■	■
S300 Expert	≥02.10	X	-	X	■	X	■	■	X	■	■

Tab. 7: Required compatibility mode with different firmware versions of the S300 in an EFI system with other S300

■ = Compatibility mode required

X = Compatibility mode not required⁵⁾

- = EFI system not possible

	Firmware	S3000 Standard	S3000 Standard	S3000 Advanced	S3000 Advanced	S3000 Professional	S3000 Professional	S3000 Professional CMS	S3000 Expert	S3000 Remote	S3000 Remote
Firmware		≥B02.41	≤B02.35	≥B02.41	≤B02.35	≥B02.41	≤B02.35	≤B02.35 ⁶⁾	≥B02.41	≥B02.41	≤B02.35
S300 Standard	≥02.10	X	■	X	■	X	■	■	X	X	■
S300 Advanced	≥02.10	X	■	X	■	X	■	■	X	X	■
S300 Professional	≥02.10	X	■	X	■	X	■	■	X	X	■
S300 Expert	≥02.10	X	■	X	■	X	■	■	X	X	■

Tab. 8: Required compatibility mode with different firmware versions of the S300 in an EFI system with other safety laser scanners

■ = Compatibility mode required

X = Compatibility mode not required⁷⁾

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

⁵⁾ Make sure that the serial number of the system plug on both devices is > 12210000.⁶⁾ This variant supports exclusively the compatibility mode.⁷⁾ Make sure that the serial number of the S300 system plug is > 12210000 and that the S3000 I/O module is current (S3000 Standard, Advanced, Professional with I/O module with serial number > 12210000, S3000 Remote with I/O module with serial number > 11240000).

4.2 System parameters

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



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

4.2.1 Application name

Enter a name for your application. You can enter a name with a maximum of 16 characters.

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.

4.2.2 Name of the scanner

Enter a **device name** for each of the safety laser scanners in the system. You can enter names with a maximum of 8 characters.

Recommendation

Use meaningful names, e.g. “front” and “rear” for vehicle monitoring. Unique device names make the subsequent configuration steps easier (for example on allocating the control inputs or the OSSDs).

On a host/guest system with two safety laser scanners, the device names must always be different.

4.2.3 User data

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

4.2.4 Display direction of the 7-segment display

The depiction of numbers on the 7-segment display can be rotated by 180° with the aid of the CDS. This is useful, for example, when the S300 must be rotated by 180° owing to the specific assembly.

If you rotate the numbers of the 7-segment display, the point in the 7-segment display goes out.

How to determine the display direction of the 7-segment display:

- Under **7-segment display**, activate the **Rotated by 180°** option. After the configuration draft has been transferred to the S300, the numbers of the 7-segment display are rotated by 180°.

4.3 Application



With the help of the CDS you can configure the S300 for the required application. Depending on whether you select a stationary or a mobile application, different configuration options are available:

Tab. 9: Comparison of mobile and stationary applications

Mobile applications	Stationary applications
Resolution	
<ul style="list-style-type: none"> • 30 mm (hand detection with smaller protective field size) • 40 mm (hand detection with larger protective field size) • 50 mm (leg detection with smaller protective field size) • 70 mm (leg detection with larger protective field size)⁸⁾ 	<ul style="list-style-type: none"> • 30 mm (hand detection with smaller protective field size) • 40 mm (hand detection with larger protective field size) • 50 mm (leg detection with smaller protective field size) • 70 mm (leg detection with larger protective field size) • 150 mm⁹⁾ (body detection)
Manipulation prevention	
The safety laser scanner checks whether in any 90° segment all measured values correspond to the maximum distance value that can be measured.	
<ul style="list-style-type: none"> • If this is the case, the S300 shuts down after 2 hours and signals . 	<ul style="list-style-type: none"> • If this the case, the S300 shuts down after 5 seconds and signals .

⁸⁾ In mobile applications a resolution of only 70 mm is required for leg detection, as a coarser resolution is adequate for the detection of a human leg due to the movement of the vehicle.

⁹⁾ Can only be configured with the Long Range variant with 3 m scanning range.

4.3.1 Resolution

The maximum protective field range¹⁰⁾ depends on the configured resolution. The following table shows the related maximum protective field range of the two variants at the resolutions that can be set:

Tab. 10: Maximum protective field ranges at different resolutions

	Maximum protective field range
Medium Range variant	
30 mm (hand detection)	1.25 m
40 mm (hand detection)	1.60 m
50 mm (leg detection)	2.00 m
70 mm (leg detection)	2.00 m
Long Range variant	
30 mm (hand detection)	1.25 m
40 mm (hand detection)	1.60 m
50 mm (leg detection)	2.10 m
70 mm (leg detection)	3.00 m
150 mm (body detection)	3.00 m

Note The warning field can be configured to up to 8 m for all variants and resolutions. The detection capability within the warning field is dependent on the remission of the objects to be detected (see Fig. 77 “Diagram scanning range S300 Medium Range” on page 116).

4.3.2 Basic response time

The basic response time of the S300 is 80 ms.

Note You may need to add supplements to the basic response time due to multiple sampling and data transmission over EFI (see section 12.2 “OSSD response times” on page 117).

4.3.3 Maximum protective field range

Depending on the configured resolution and the variant used (see section 4.3.1 “Resolution” on page 34), the maximum protective field range of the safety laser scanner is shown in the CDS.

Note The maximum protective field range of the S300 must be sufficient to cover the calculated protective field size including the necessary supplements (see section 5.1.1 “Protective field size” on page 57).

¹⁰⁾ Radial distance to the safety laser scanner.

4.4 Incremental encoder

The S300 Professional and the S300 Expert have two dual-channel dynamic control inputs using which the possible monitoring cases can be switched as a function of the velocity.

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

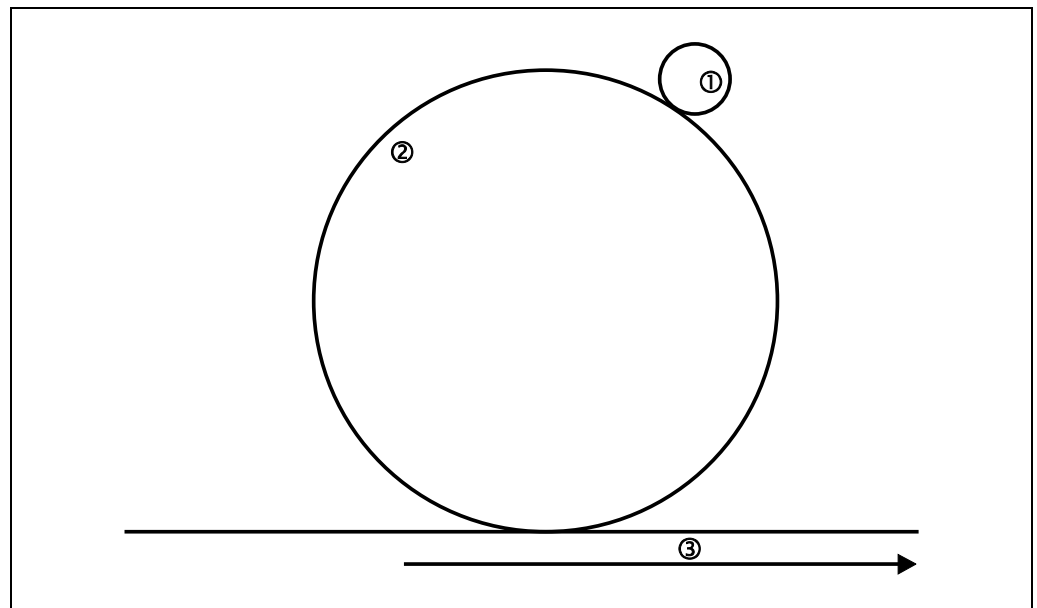
If you want to use the inputs A and B as dynamic control inputs, select the **Indicate velocity** option.

4.4.1 Pulses per cm travel that are output by the incremental encoders

The result is dependent on the number of pulses the incremental encoder supplies per revolution, and on the ratio between the wheel on the vehicle and the friction wheel on which the incremental encoder is mounted.

Fig. 13: Calculation of pulses per cm travel

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



How to calculate the number of pulses per centimeter:

Example:

- The wheel on a forklift truck has a diameter of 35 cm.
- The friction wheel on which the incremental encoder is mounted has a diameter of 3.5 cm.
- The incremental encoder used supplies 1000 pulses per revolution.

Circumference of the forklift truck wheel = $d \times \pi = 35 \text{ cm} \times \pi = 109.96 \text{ cm}$

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

For this information the number of pulses per centimeter of distance covered by the vehicle is:

Pulses/cm = $10,000 : 109.96 = 90.94$

On configuring the incremental encoder in the CDS, you must therefore enter the rounded value "91" in **Pulses per centimeter** in the CDS. The user software calculates from this value the maximum velocity allowed.

4.4.2 Tolerances allowed on the dynamic inputs

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

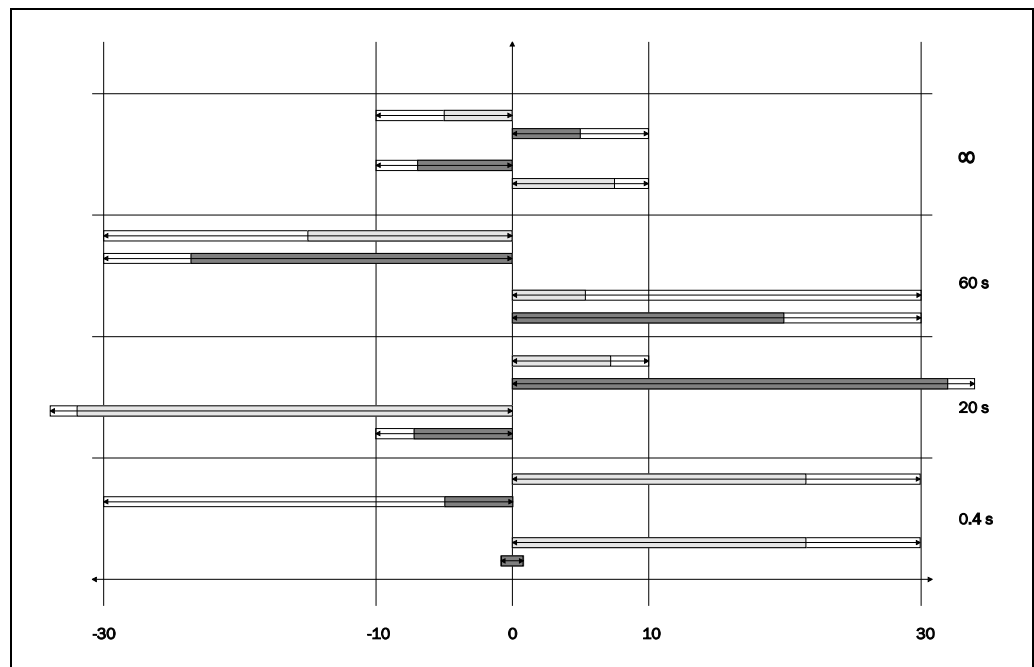
The velocities from the two incremental encoders may only differ from each other by a tolerance that can be configured. Deviations are allowed only for a certain time window (see Fig. 14) depending on the velocity.

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

Exceeding the tolerance is tolerated for a certain period of time. Then the system switches to a safe state (lock-out). The period of time is dependent on the vehicle velocity. Fig. 14 shows the deviations that are tolerated and for how long.

Fig. 14: Tolerances allowed on the dynamic inputs

■ Velocity on input A
□ Velocity on input B

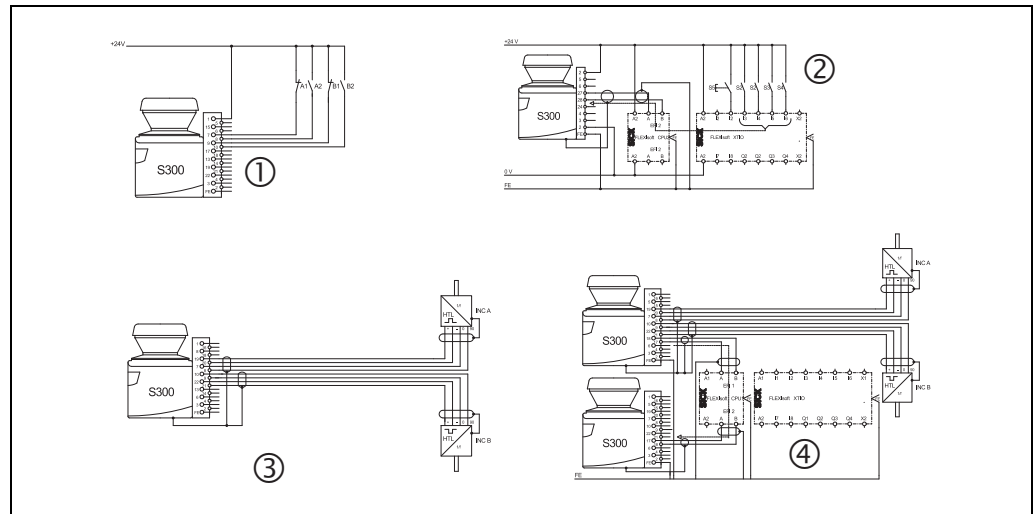


- If the vehicle velocity is in the range between -10 cm/s and $+10 \text{ cm/s}$, then there is no shut down, irrespective of how long the deviation between the incremental encoders is present.
- If the vehicle velocity is between -30 and -10 cm/s or $+10$ and $+30 \text{ cm/s}$, then the maximum period of time for which a deviation is tolerated is 60 s.
- If the vehicle velocity is in the range $\leq -30 \text{ cm/s}$ or $\geq +30 \text{ cm/s}$, then the maximum period of time for which a deviation is tolerated is 20 s.
- If the vehicle velocity is in the range $\leq -10 \text{ cm/s}$ or $\geq +10 \text{ cm/s}$, then different directions of rotation on the incremental encoders are only tolerated for 0.4 s.

4.5 Inputs

It is possible to switch between the monitoring cases of the S300 during operation. There are various ways of achieving this switching:

Fig. 15: Possible ways of monitoring case switching



- ① Local static inputs (S300 Advanced, Professional and Expert)
- ② External static inputs via EFI (all S300 variants)
- ③ Local dynamic inputs (S300 Professional and Expert)
- ④ Velocity information via EFI
 - indicate and use velocity (S300 Professional and Expert)
 - use velocity (all S300 variants)



During the configuration of an EFI system you define in the CDS the device in which the inputs are used.

Standalone operation

In standalone operation of an S300 use the local inputs of the S300.

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

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

The dual-channel control input **C** is formed by the Universal I/O1 and Universal I/O5 connections.

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

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

EFI system

If devices are connected together via EFI, the S300 can receive control commands from other devices, e.g. a second S300 or Flexi Soft safety controller. Tab. 37 on page 131 shows the possible control commands of the S300.

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

If the S300 is connected to a Flexi Soft safety controller, up to five dual-channel control inputs can be configured.

4.5.1 Input delay

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

The following figures, based on experience, give input delays for various methods of switching:

Tab. 11: Figure 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

Note Also pay attention to the notes in section 5.6 “Time for monitoring case switching” on page 71.

4.5.2 Sampling for the static control inputs

If you are using static sampling, decide between complementary or 1-of-n sampling depending on the control features available. Depending on this selection you can define the switching criteria for the monitoring cases (see section 4.10.1 “Monitoring case switching via static input information” on page 48).

Complementary sampling

One control input comprises 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. 12: 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

1-of-n sampling

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

Tab. 13: Truth table for 1-of-n sampling with two input pairs

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

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

4.6 OSSDs



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

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



WARNING

Do not use the OSSD bit for safety relevant functions!

If the local OSSDs on the S300 are not used, the OSSD state is always transferred as active via EFI. In this case the OSSD bit in the Flexi Soft safety controller is not allowed to be used for safety-related functions.

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



WARNING

Pay attention to the logical values for the protective field status information on transfer to the Flexi Soft safety controller!

The status of an evaluated protective field is logical 1 if the protective field is unoccupied, the status is logical 0 if the protective field is infringed (see section 12.5 “EFI status information and control commands” on page 129). The status of a protective field that is **not evaluated** is always logical 1.

4.6.1 External device monitoring (EDM)

The EDM checks if the contactors actually de-energize when the protective device is tripped. If you activate external device monitoring, then the S300 checks the contactors after each interruption of the protective field and prior to the machine restart. The EDM can so identify if one of the contactors has welded, for instance. In this case the external device monitoring places the system in a safe operational state and the OSSDs are not switched back to the ON state.

The table shows how the S300 reacts if the external device monitoring detects a contactor malfunction:

Tab. 14: Behavior of the S300 on a contactor malfunction

Without internal restart interlock or with restart delay	<ul style="list-style-type: none"> • The system locks completely (lock-out). • The error message appears in the 7-segment display.
With restart interlock	<ul style="list-style-type: none"> • The S300 switches its OSSDs to the OFF state. • The LED is illuminated. • The error message appears in the 7-segment display.

**Notes**

You can configure the external device monitoring in the CDS.

- You will find examples on the connection of the external device monitoring in section 7.3 “Connection diagrams” on page 92.
- If you do not use the external device monitoring function, leave the inputs disconnected (see section 6.1.1 “Pin assignment on the system plug” on page 82).

4.7 Restart

You can configure the restart behavior of the S300 as follows:

- without restart interlock
- with restart delay
- with restart interlock

**WARNING**

You can configure the type of restart in the CDS.

It is imperative that you configure the S300 with restart interlock if the protective field can be left to approach the hazardous point or if a person cannot be detected at every point in the hazardous area for the S300!

During the assessment, pay attention to whether the protective field can be left in the direction of the hazardous point, to areas that are unprotected due to the mounting and the unprotected near range of the S300 (see section 5.5 “Methods of preventing unprotected areas” on page 69).

Restart behavior on the integration of the S300 into a Flexi Soft safety controller

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

- The internal restart interlock/delay acts on the OSSD of the S300. If the status information on the OSSDs is used in the Flexi Soft safety controller, then the restart interlock/delay also acts on the Flexi Soft safety controller.
- If the status information on the protective fields is used in the Flexi Soft safety controller, the restart interlock/delay does **not** affect the Flexi Soft safety controller (see section 12.5 “EFI status information and control commands” on page 129). In this case you must realize a restart interlock/delay in the Flexi Soft safety controller.

Configuration of the S300 without restart interlock

After the OSSDs on the S300 have been switched to the OFF state due to an object in the protective field, the OSSDs are re-enabled again immediately when there is no longer an object in the active protective field.

This configuration is only allowed ...

- if an external restart interlock is realized on the machine controller
- or
- if the protective field **cannot** be left in the direction of the hazardous point and if people can be detected by the S300 **at every point in the hazardous area!**

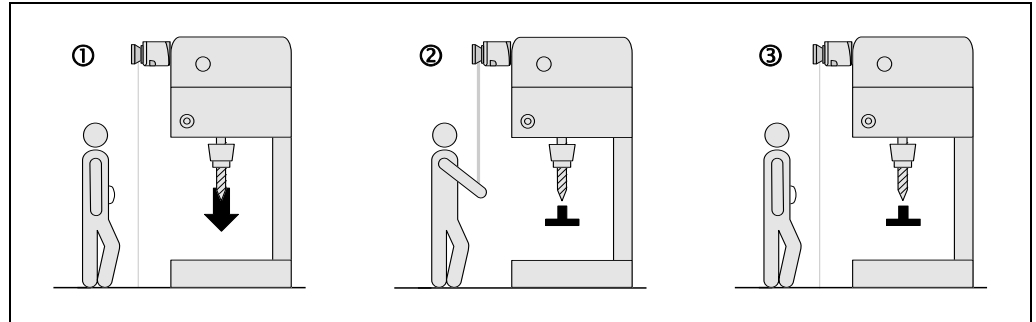
Restart delay for mobile applications

In mobile applications you can configure a restart delay from 2 to 60 seconds on the S300. The OSSDs on the S300 switch to the ON state if there is no object in the protective field for the duration given.

This configuration is only allowed if the protective field **cannot** be left in the direction of the hazardous point and if a person can be detected **at every point in the hazardous area** by the S300!

Configuration of the S300 with restart interlock

Fig. 16: Schematic outline of the operation with restart interlock



Note Do not confuse the restart interlock with the starting interlock on the machine. The starting interlock prevents the machine starting after switching on. The restart interlock prevents the machine starting again after an error or a protective field infringement.

The OSSDs on the S300 switch to the OFF state to initiate a machine ① or vehicle stop as soon as there is an object in the protective field ②. They do not switch to the ON state ③, even if there is no longer an object in the protective field. The OSSDs only switch to the ON state if the operator operates the control switch for restart or reset.



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.

- Notes**
- You will find examples on the connection of the internal restart interlock in section 7.3 "Connection diagrams" on page 92.
 - If you do not use the internal restart interlock, leave the inputs disconnected (see section 6.1.1 "Pin assignment on the system plug" on page 82).

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 S300 (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 S300 switches its OSSDs to the ON state.
- the LED ✓ on the safety laser scanner illuminates green.

The external restart interlock prevents the machine from restarting. After resetting the S300 the operator must press the control switch to restart the machine controller.



WARNING

Ensure that the correct sequence is followed!

The controller must be realized such that the machine only restarts if the S300 is first reset and then the control switch for restarting the machine controller is operated.

4.8 Universal I/O connections



WARNING

You are not allowed to use the universal I/O connections for safety-relevant functions!

You are only allowed to use the universal I/O connections for signaling. You must never use the signals for controlling the application or for safety-relevant functions.

The S300 has five universal I/O connections. You can configure these five connections for one or more of the following functions (OR operator):

As inputs:

- I/O1¹¹⁾ as reset
- I/O2 as EDM or Reset

As outputs:

I/O3, I/O4 and I/O5¹¹⁾

Tab. 15: Configuration options of the universal I/O connections as outputs

In standalone operation	In an EFI system with another safety laser scanner
<ul style="list-style-type: none"> • Error • Contamination error • Contamination warning • Warning field 1 • Warning field 2 • Reset required 	<ul style="list-style-type: none"> • Protective field (host/guest) • Warning field 1 (host/guest) • Warning field 2 (host/guest) • Simultaneous protective field of the host, if the host is an S3000 in dual field mode • Simultaneous warning field of the host, if the host is an S3000 in dual field mode



The universal I/O connections are configured in the CDS in the **Universal I/O** area. Fig. 17 shows a configuration example.

Fig. 17: Configuration example universal I/O connections of the S300

Inputs	I/O 1 Pin 5	I/O 2 Pin 6	
External device monitoring	<input type="radio"/>	<input type="radio"/>	
Reset	<input type="radio"/>	<input checked="" type="radio"/>	
Outputs	I/O 3 Pin 13	I/O 4 Pin 14	I/O 5 Pin 15
Contamination warning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contamination error	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reset required	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Error	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Protective field	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Warning field 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Warning field 2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Note If you operate the S300 in the compatibility mode, then the connections on the universal I/O are used as application diagnostic output, warning field output and application diagnostic output for reset required.

¹¹⁾ Not available if input C is used.

4.8.1 Application diagnostic output in the compatibility mode



The S300 variants have a configurable application diagnostic output in the compatibility mode. For the application diagnostic output you configure in the CDS ...

- whether it is deactivated.
- whether a signal is only output when the optics cover is contaminated.
- whether a signal is only output on errors.
- whether a signal is output both for optics cover contamination and on errors.

4.9 Field sets

The number of field sets that can be configured is dependent on the safety laser scanner variant. The following table shows the number of field sets per variant:

Tab. 16: Number of field sets that can be configured per variant

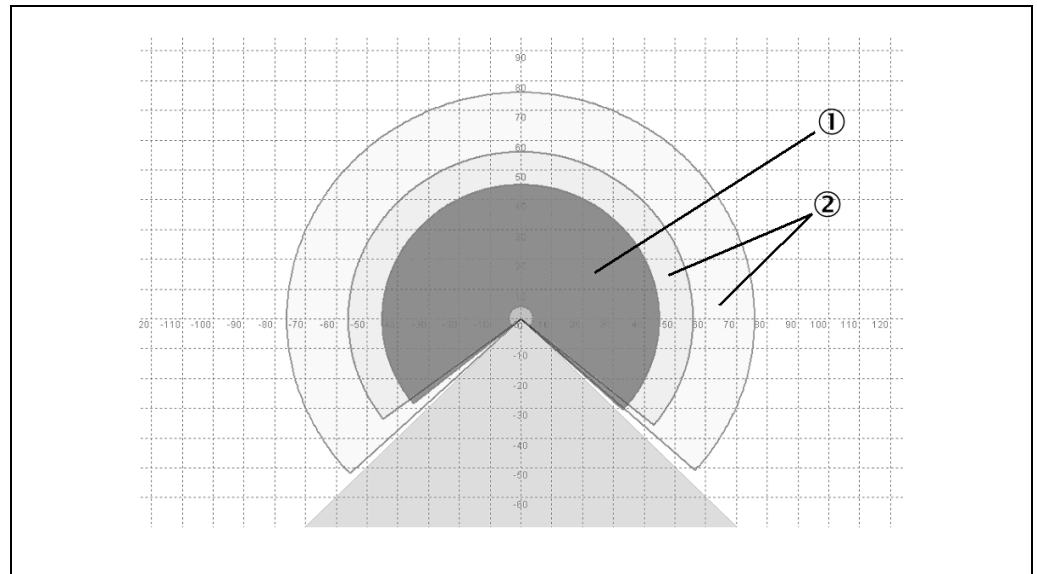
	Standard	Advanced	Professional	Expert
Number of field sets	1	4	8	16

4.9.1 Configuring the protective field and warning field



With the aid of the CDS you can configure the field set, which comprises a protective field ① and two warning fields ②. During this process you configure the shape and size of the protective and warning fields. You can realize any field shape required.

Fig. 18: Creating a field set in the CDS



Note The area to be monitored is scanned radially by the S300. The S300 cannot see through objects during this process. The area behind objects that are in the area to be monitored (pillars, grilles, etc.) can thus not be monitored.

Protective fields and warning field can cover up an angle of up to 270° and have different radial scanning ranges depending on the variant and the resolution configured (see section 4.3.1 “Resolution” on page 34).



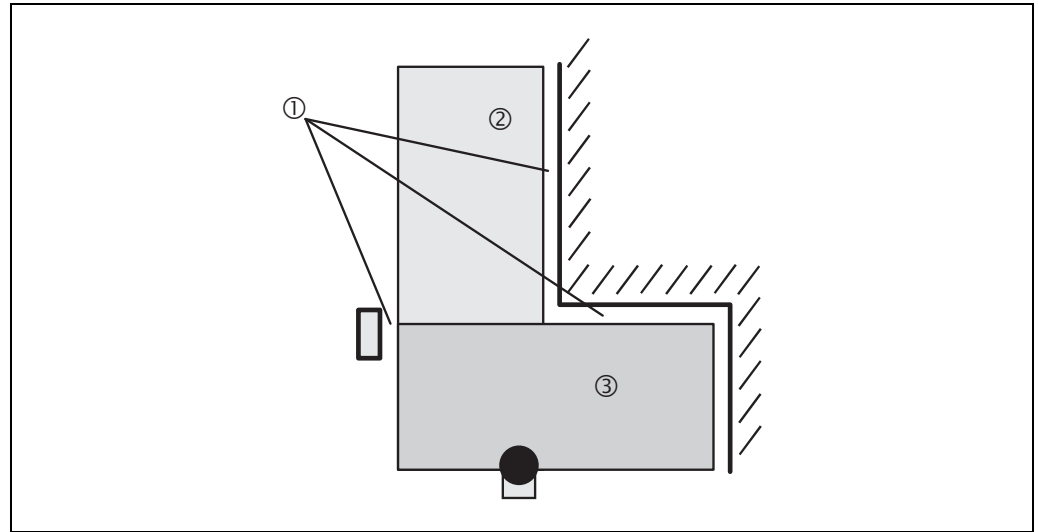
WARNING

Check the protective fields configured!

Prior to commissioning the machine or vehicle, check the configuration of the protective fields. Please observe the notes in chapter 9 “Commissioning” on page 99 and in the checklist on page 140

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

Fig. 19: Configuring protective field and warning field



WARNING

Secure unprotected areas!

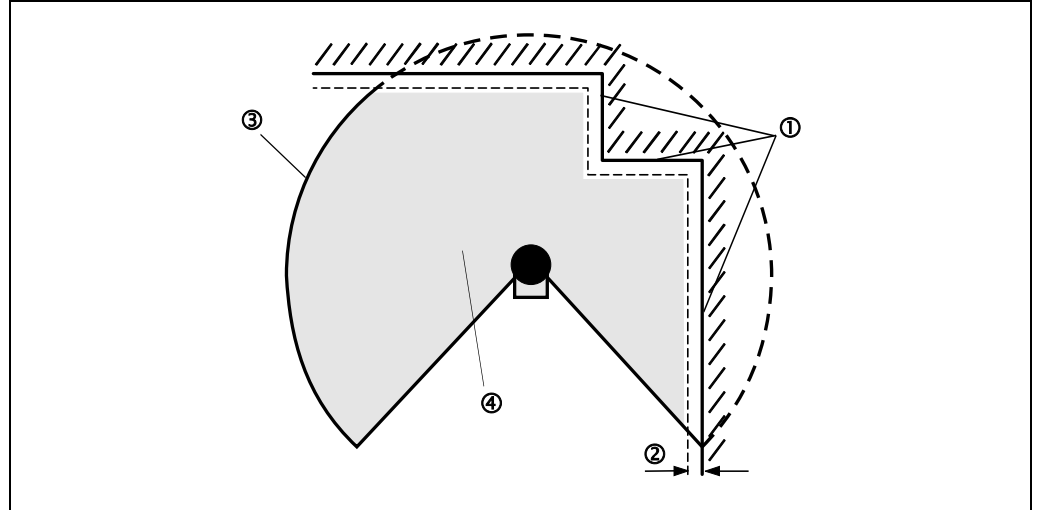
If it is possible to access a narrow strip between the protective field and a wall or another object, you must protect this strip using additional measures (e.g. fence or floor protection).

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



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

Fig. 20: Reading the protective field



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

Note The measuring error tolerances for the S300 are automatically subtracted from the protective field size. As a result the protective field is slightly smaller than the surface covered ②. In those places where the surrounding contour is larger than the protective field range ③, the protective field corresponds to the possible scanning range.



WARNING

Check the protective field suggested!

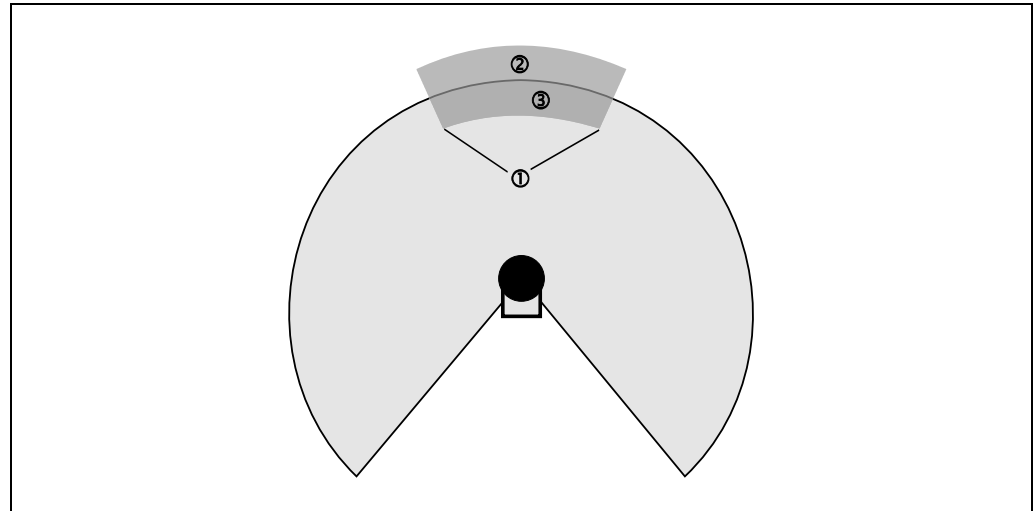
The protective field suggested by the CDS is not a replacement for the calculation of the minimum distance. Calculate the minimum distance and check the effectiveness of the protective fields prior to commissioning the application!

Pay attention to the descriptions in chapter 5 “Mounting” on page 56, the notes in chapter 9 “Commissioning” on page 99 and the checklist on page 140.

4.9.3 Using the contour as a reference

In addition to the protective field, the S300 can also monitor a contour (e.g. the floor in vertical applications or the wall in horizontal applications).

Fig. 21: 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 S300 switch to the OFF state if ...

- there is an object in the protective field.
- the monitored surrounding contour is no longer in the tolerance band (e.g. if a door is opened or if the position of the S300 is changed).

Notes

- 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 warning fields. If, for example, you use the floor as a reference for access protection, you cannot configure a warning field there. However, you can, e.g., configure a warning field to the left and right of the contour segment to control a warning signal on approach from the side.
- The contour as reference function and the warning field 2 function are mutually exclusive.



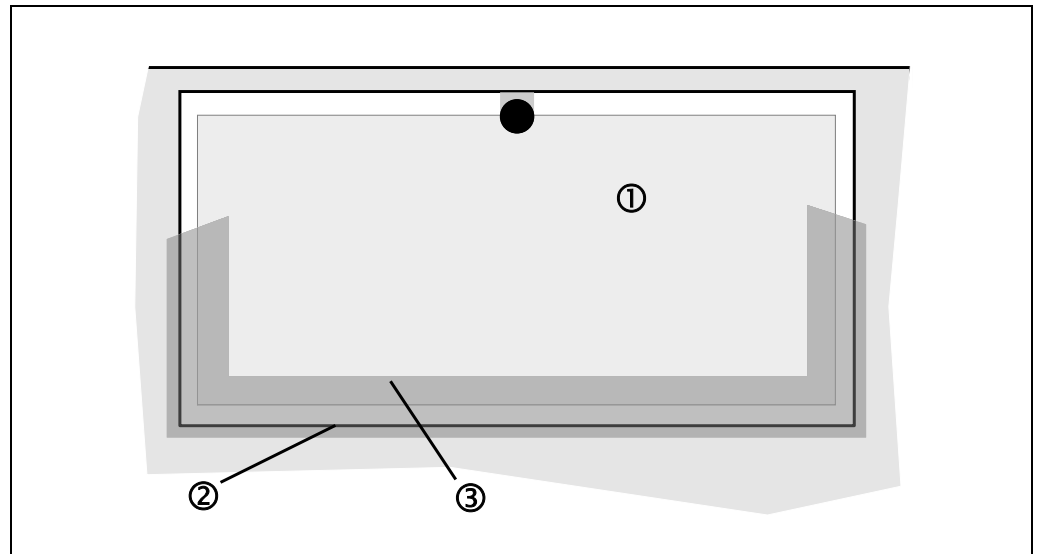
You define the contour as a reference in the CDS field set editor.

Vertical operation

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

Fig. 22: Contour as reference for vertical operation

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



Recommendation

Use lateral, vertical boundaries of the opening (e.g. door frame) and the floor as reference. If in this case the position of the S300 is changed in one or more planes, the distance to the reference changes and the S300 switches its OSSDs to the OFF state.

4.10 Monitoring cases

The S300 supports a configuration with multiple monitoring cases. By switching the monitoring case you can switch to different monitoring conditions in the case of a change to the monitoring situation.



WARNING

Ensure for each monitoring case that the minimum distance to the hazardous area is maintained!

See chapter 5 "Mounting" on page 56.

Tab. 17: Number of monitoring cases per variant and application

Standard	Advanced	Professional	Expert
Applications with local static control inputs on the S300			
1	4	8	8
Applications with static control inputs via EFI (e.g. on a Flexi Soft)			
32	32	32	32
Applications with dynamic control inputs on the S300 or via EFI			
–	–	32	32
Applications with dynamic control inputs via EFI			
32	32	32	32



You can configure the monitoring cases in the CDS.

Each monitoring case includes ...

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

Monitoring cases can be switched with the following input information:

- static information
- velocity information
- a combination of both

4.10.1 Monitoring case switching via static input information

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



WARNING

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

- Ensure that the control for the monitoring case switching has the required level of safety.
- Ensure that the circuit for the control inputs is suitable for the ambient conditions to be expected so that systematic and design-related effects and resulting errors on the switching of the monitoring cases can be excluded.
- Ensure that the control — using static control 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 section 5.6 “Time for monitoring case switching” on page 71).

Static complementary sampling

Using the two control input pairs on the S300 Advanced $2^2 = 4$ monitoring cases can be switched, using the three control input pairs on the S300 Professional and Expert $2^3 = 8$ monitoring cases can be switched.

Using external inputs (e.g. those of a Flexi Soft safety controller, see section 4.5 “Inputs” on page 37), $2^5 = 32$ monitoring cases can be switched via maximally five control input pairs.

Tab. 18: Truth table with complementary evaluation

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

Note Undefined input information will result in the S300 switching the OSSDs to the OFF state or signaling **Protective field infringed** via EFl.

Static 1-of-n sampling

With 1-of-n sampling you use the single connections of the control input pairs. In this way the S300 Advanced provides four and the S300 Professional/Expert six input connections.

- Notes**
- Using external inputs, maximally ten input connections can be used (e.g. those of a Flexi Soft safety controller, see section 4.5 “Inputs” on page 37).
 - All connections must be connected!
 - One connection must be 1!
 - Only one connection is ever allowed to be 1!

Tab. 19: Truth table for 1-of-n sampling

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

4.10.2 Monitoring case switching via velocity information



WARNING

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

- Ensure that the control — using 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 section 5.6 “Time for monitoring case switching” on page 71).
- Ensure that only one safety laser scanner is connected to an incremental encoder.
 - 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.

Prerequisites

For dynamic sampling using incremental encoders, configure ...

- the **Use velocity** option (see section 4.4 “Incremental encoder” on page 35).
- for each monitoring case the velocity range for switching to the monitoring case.

Example:

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

Note 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 switching of the OSSDs to the OFF state (useful e.g. for safe maximum velocity monitoring on vehicles).

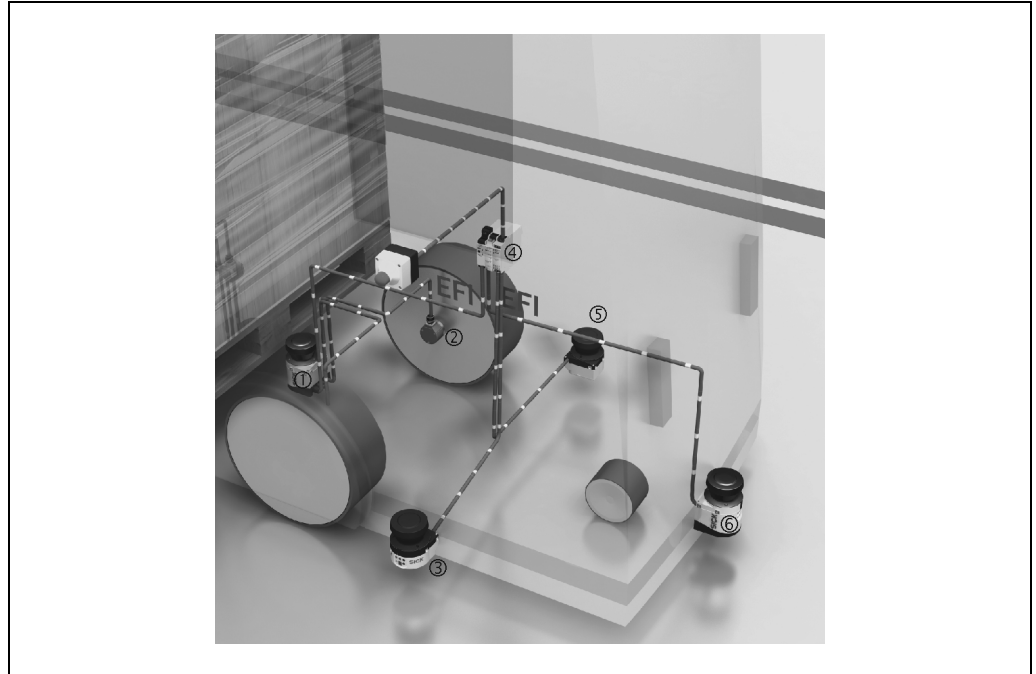
4.10.3 Velocity routing via EFI

If several safety laser scanners are connected to a Flexi Soft safety controller, then a velocity routing can be configured. In this way the velocity information that is determined by an S300 Professional or Expert with the aid of incremental encoders is distributed to all safety laser scanners.

Note The velocity routing is not available in the compatibility mode.

Fig. 23: Example for velocity routing on an AGV

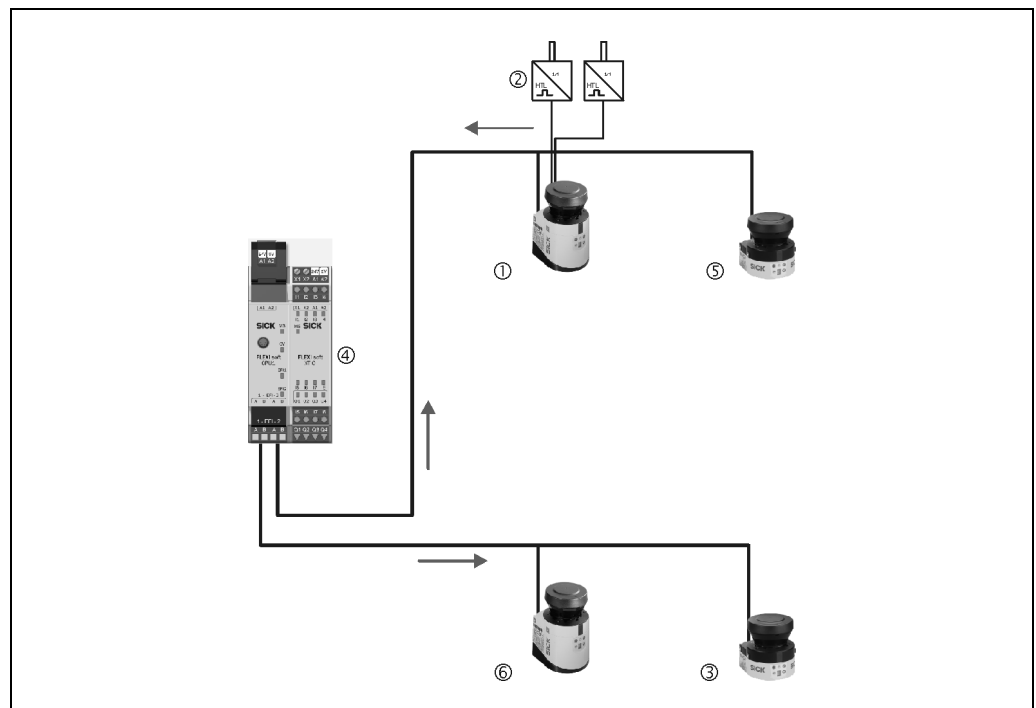
- ① S300 Expert on EFI1.1
- ② Incremental encoder
- ③ S300 Mini on EFI2.2
- ④ Flexi Soft
- ⑤ S300 Mini on EFI1.2
- ⑥ S300 on EFI2.1



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

Fig. 24: Connection diagram for velocity routing

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

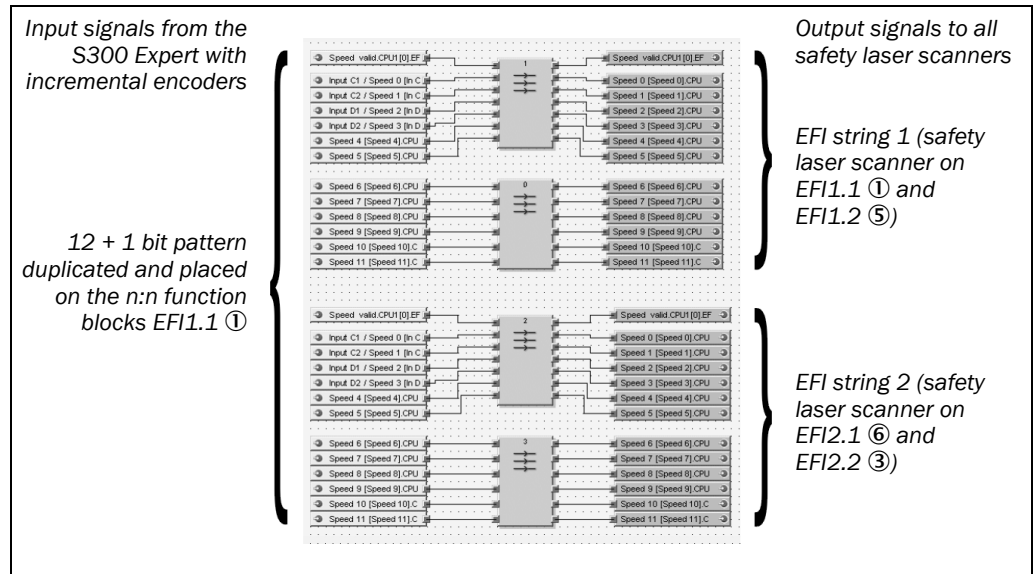


S300

Fig. 25: Example for velocity routing in the Flexi Soft Designer

How to configure a velocity routing in the Flexi Soft Designer:

- Configure the velocity routing in the Flexi Soft Designer for instance as in the following figure.



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

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



The “Speed valid” status information is relevant for safety!

Ensure that the **Speed valid** input signal is connected to the **Speed valid** output signal.



How to configure the safety laser scanners in the CDS:

- On the **Incremental encoder** tab for the S300 Expert to which the incremental encoders are connected, select the **Indicate velocity** option.
- All safety laser scanners, also the sending devices, must use these velocity signals via EFI.
- For this reason activate **on all** safety laser scanners on the **Inputs** tab the option **Use Flexi Soft CPU1**.
- Then, select **on all** safety laser scanners on the **Inputs** tab the **Use velocity** option.

4.10.4 Multiple sampling

If multiple sampling is set, an object must be scanned several times before the S300 switches its OSSDs to the OFF state. In this way you can reduce the probability that insects, welding sparks or other particles result in the shutdown of the system.

If a multiple sampling of 3 is configured, for instance, an object must be detected in the protective field three times in succession before the S300 switches the OSSDs to the OFF state.



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 section 12.2 “OSSD response times” on page 117)!

On the S300, a multiple sampling of 2 is the minimum setting. You can set the multiple sampling to up to 16 with the aid of the CDS. The supplement to the basic response time resulting from your setting is displayed in the CDS.

Tab. 20: Recommended multiple sampling

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

Recommendation



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

You can configure the multiple sampling in the CDS. You can set individual multiple sampling for each monitoring case.

4.10.5 Checking of the monitoring case switching

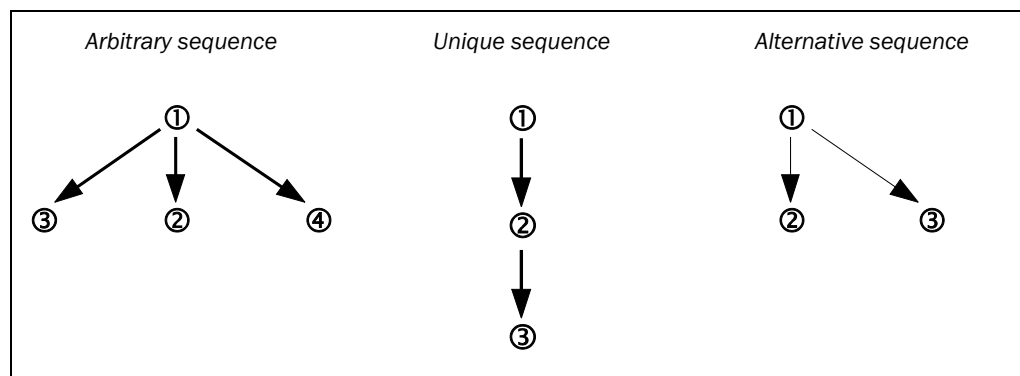
To check the switching between monitoring cases, configure a series of monitoring cases. Here you can define either an arbitrary sequence, a unique sequence, or two alternative sequences.

- 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 monitoring of the monitoring case switching as an additional check on your control. For example, in this way deviations of a vehicle from a corridor or a system from the stipulated production process can be detected.

Fig. 26: Schematic layout of the monitoring case switching



You can configure the sequence of monitoring cases in the CDS.

4.10.6 Park/stand-by mode

If, in mobile applications, vehicles are not moved for a time (e.g. for battery charging), the OSSDs can be switched to the OFF state and the laser on the S300 can be switched off. In this way the power consumption of the device is reduced.

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

The function can be realized with the aid of the park mode or the stand-by mode.

Note If, in an EFI system, you only use the OSSDs on one safety laser scanner (common OSSDs), then the OSSDs on this safety laser scanner will switch to the OFF state as soon as either of the two safety laser scanners is switched to the park/stand-by mode. If, on the other hand, you use the OSSDs on both safety laser scanners (separate OSSDs), then only the OSSDs on the safety laser scanner that is switched to park/stand-by mode will switch to the OFF state.

Park mode



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

The S300 needs the response time resulting from the configuration to switch from the park mode to another monitoring case.

Stand-by mode

A dedicated *STBY* single-channel input is provided for switching to the stand-by mode (see section 6.1.1 “Pin assignment on the system plug” on page 82).

Alternatively it is also possible to switch to the stand-by mode via EFI (see section 12.5 “EFI status information and control commands” on page 129).

Note A monitoring case is not occupied by the stand-by mode.

4.11 Measured data output

For the measured data output configure the baud rate of the interface.

You configure whether the **Silent time** is set automatically to 5000 ms or you configure an individual shorter **Silent time** between 60 and 4980 ms. The silent time defines the time, after sending the silent byte, for which the continuous output of data can be interrupted to make it possible to access to the interface. In the default delivery status, the Silent time is set to 5000 ms.

With the aid of the **Send mode** option you can configure whether the measured data output is to be triggered as a **Continuous data output** or **Data output only on request**.

You will find further details on this topic in the “Telegram Listing Standard” documentation (part no. 9090807).

CMS functionality on the S300 Expert

On the S300 Expert you can configure additional parameters for the CMS functionality.

With the aid of the **Send mode** option you can configure whether the measured data output is to be triggered as a **Continuous data output**, **Data output only on request** or by an **Internal event**.

If you have selected **Internal event**, then you must define this event.

With **Continuous data output** you must select which data are to be output.

If you also activate **Measured data output**, then you can select whether the measured data are to be output together with the I/O data in **one telegram** or in **two separate telegrams**.

For the measured data output you define one to five segments (which are defined by start and end angles).

You will find further details on this topic in the “Telegram Listing CMS” documentation (part no. 9090806).

5 Mounting

This chapter describes the preparation and completion of the mounting of the S300 safety laser scanner.

Mounting requires four steps:

- definition of the application and the necessary mounting location for the safety laser scanner
- calculation of the protective field sizes and minimum distances (see EN ISO 13855)
- definition of the switching point between monitoring cases
- mounting the safety laser scanner with or without mounting kits



WARNING

No protective function without sufficient minimum distance!

Only if you configure the protective field such that there is an adequate minimum distance to the hazardous area, is protection by the S300 ensured.

Notes

- Mount the S300 in a dry place and protect the device from dirt and damage.
- Avoid the installation of the S300 in the vicinity of strong electric fields. These can, e.g., be produced by welding cables, induction cables in the immediate vicinity and also by mobile telephones operated nearby.
- Ensure that there are no obstacles in the area to be monitored in the field of view of the S300 that could cause interference or shadowing. Such shadowed areas cannot be monitored by the S300. 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. There must not be any condensation on the light output window. Otherwise the function of the S300 may be impaired and incorrect switching may occur.
- Avoid placing highly reflective objects in the scan plane of the S300. Examples: Retro-reflectors can affect the measurement results of the S300. Highly reflective objects within the protective field can blank part of the area to be monitored in certain circumstances.
- Mount the S300 such that it is not dazzled by incident sunlight. Do not position stroboscopic and fluorescent lights or other strong light sources directly in the scan plane as these may affect the S300 in specific circumstances.
- Mark the protective field on the floor, if this is reasonable for the application (see IEC 61496-1, chapter 7).

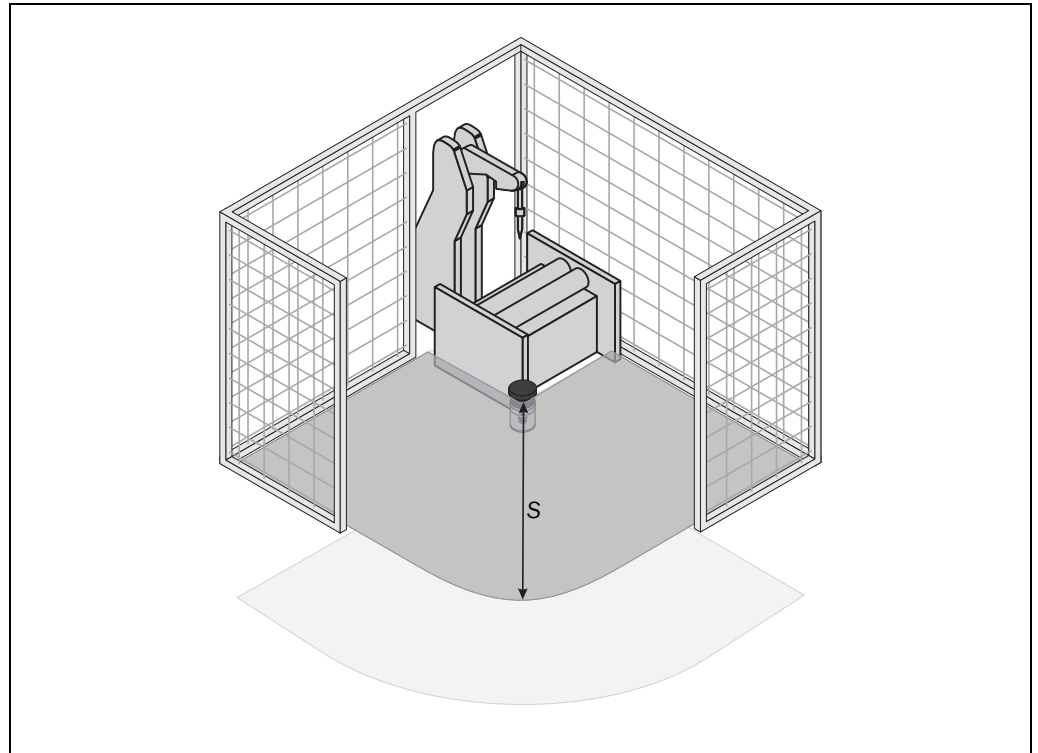
The following steps are necessary after mounting:

- completing the electrical connections (chapter 6 “Electrical installation”)
- configuration of the protective field (chapter 8 “Configuration”)
- commissioning and checking of the installation (chapter 9 “Commissioning”)
- checking the function and safe shutdown (section 9.2 “Test notes”)

5.1 Stationary application in horizontal operation

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

Fig. 27: Horizontal stationary application



For a horizontal stationary application determine ...

- the protective field size to observe the necessary minimum distance.
- the height of the scan plane.
- the restart behavior.
- measures to protect any areas not covered by the S300.

Note Once you have defined the protective field size, mark the boundaries of the protective field on the floor. In this way you will make the protective field boundaries visible for the operator and ease subsequent testing of the protective function.

5.1.1 Protective field size

The protective field must be so configured that a minimum 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 S300 Advanced, Professional or Expert, 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 S300 in stationary horizontal operation with 30, 40, 50 or 70 mm resolution. The maximum protective field range for the S300 is given by the resolution.

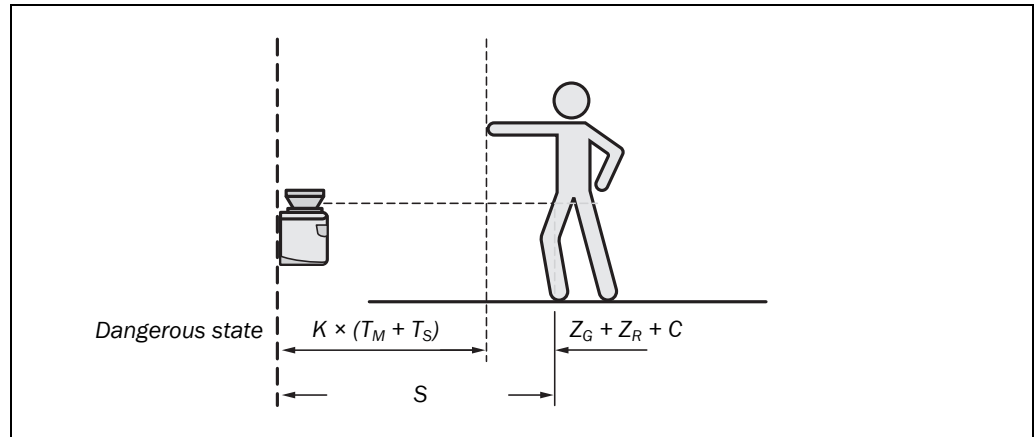


WARNING

Ensure that a human leg can be detected with 70 mm resolution!

As per EN ISO 13855, mount the scan planes for horizontal stationary applications with 70 mm resolution at least 300 mm above the floor (see “Height of the scan plane at 70 mm resolution” on page 60).

Fig. 28: Minimum distance S

**The minimum 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 S300
- 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

How to calculate the minimum distance S (see EN ISO 13855):

➤ 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 EN ISO 13855)

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

T_S = Response time of the S300 and the downstream controller

Z_G = General safety supplement of the S300 = 100 mm

Z_R = Supplement for measurement error related to reflection

C = Supplement for prevention of reaching over

Response time T_S of the S300

The response time T_S of the S300 depends on ...

- the basic response time of the S300,
- the multiple sampling set,
- the transmission speed to external OSSDs via EFI.

See section 12.2 "OSSD response times" on page 117.

Supplement Z_R for measurement errors caused by reflection

WARNING

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

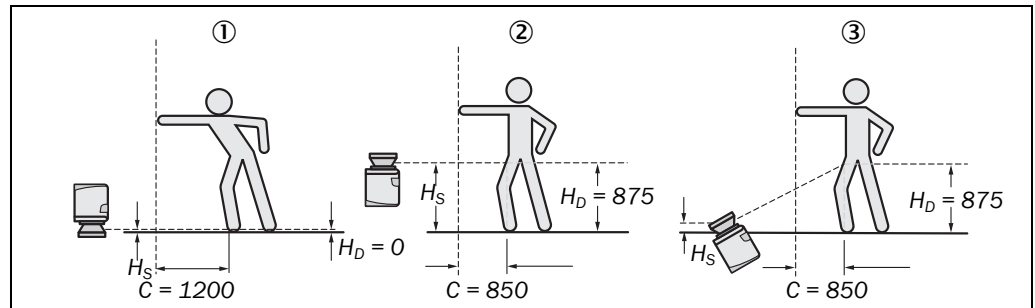
With retroreflectors positioned at a distance of less than 1 m from the boundary of the protective field a supplement, Z_R, of 200 mm must be added to the protective field.

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 S300 shuts down the dangerous state. For this reason the calculation of the minimum distance must take into account a supplement to prevent persons from finding themselves in a hazardous situation by reaching over (see EN ISO 13 857) before the S300 triggers.

The necessary supplement for the minimum 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 and ③.

Fig. 29: Mounting variations for the scan plane



In summary there are three usual variations of mounting the scan plane for the S300. The optimal variation depends on the related application. Tab. 21 provides assistance making the selection.

Tab. 21: Advantages and disadvantages of mounting variations

H_D = Detection height
 H_S = Scanner mounting height

Mounting orientation	Benefit	Disadvantage
Safety laser scanner low ($H_S < 300$ mm) Low inclination of the scan plane ($H_D \approx H_S$)	Low external effects due to dazzle, crawling beneath not possible	Higher supplement C
Safety laser scanner high ($H_S > 300$ mm) Low inclination of the scan plane ($H_D \approx H_S$)	Lower protective field supplement C	Danger of crawling beneath (at the front and side)
Safety laser scanner low ($H_S < 300$ mm) High inclination of the scan plane ($H_D > H_S$)	Lower protective field supplement C	Danger of crawling beneath (at the front), external effect due to dazzle possible



WARNING

In case of scan planes at a height of more than 300 mm ensure that people cannot reach the hazardous area by crawling underneath the scan plane!

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 system, use 1200 mm for the supplement C.

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

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

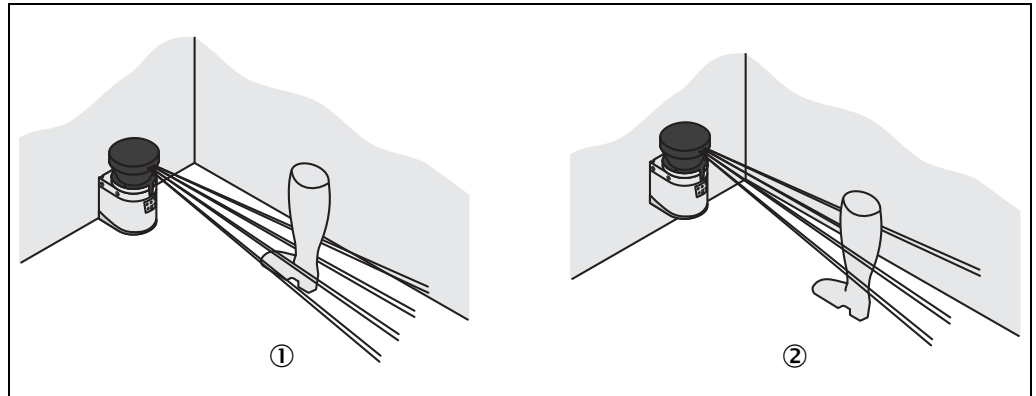
Here H_D is the height at which the protective field is mounted.

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

Height of the scan plane at 70 mm resolution

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

Fig. 30: 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 (e.g. scan to left and right of the bone ①).

If you mount the S300 higher, the scan plane is at fibula height and the leg is also detected with an object resolution of 70 mm ②.

5.2 Stationary vertical operation for access protection

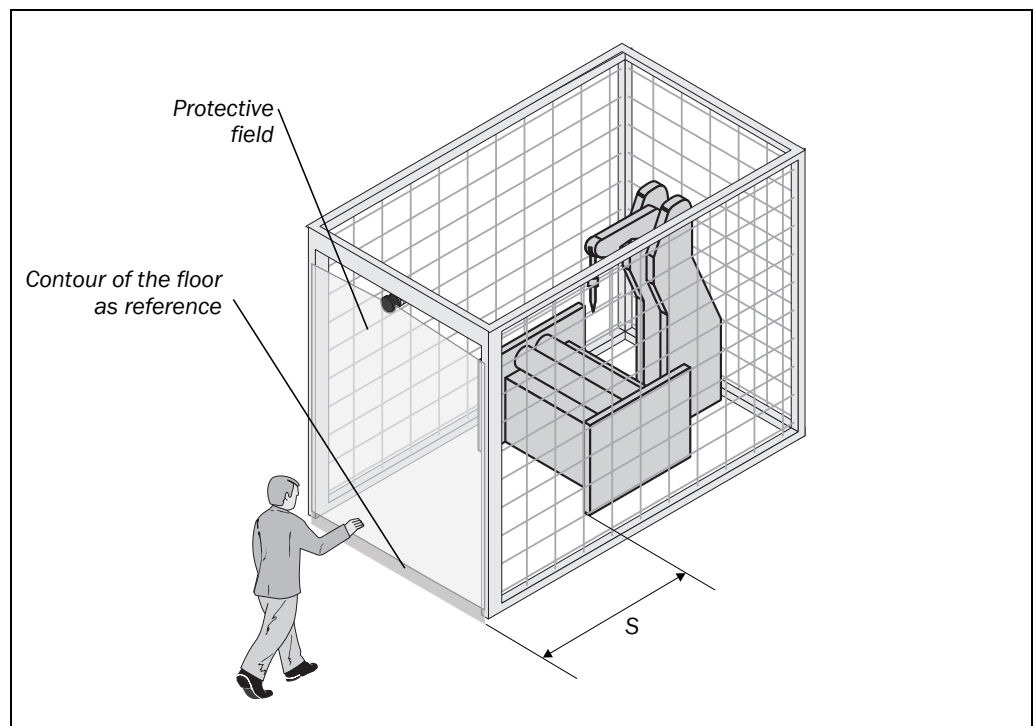
Access protection can be used when the access to the machine can be defined by physical means. For access protection the S300 detects the entry of an entire body.

- Notes**
- To ensure adequate access protection, a response time of ≤ 90 ms and a resolution of 150 mm or finer are required.
 - To protect the protective device against inadvertent adjustment or manipulation, you must use the contour of the surroundings as a reference for the S300 (see section 4.9.3 “Using the contour as a reference” on page 46).

5.2.1 Minimum distance

For access protection, a minimum 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. 31: Access protection



The minimum distance S as defined in EN 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 stoptime measurement on your system.)
- response time of the S300
- supplement C against reaching through

How to calculate the minimum distance S (see EN ISO 13855):

➤ First, calculate S using the following formula:

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

Where ...

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

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

T_S = Response time of the S300

C = Supplement against reaching through (850 mm)

Response time T_S of the S300**WARNING****The total response time of the S300 must not be more than 80 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.

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 safety laser scanner at an angle). In this case ensure that the areas the safety laser scanner cannot see are protected by additional measures.

The response time T_S of the S300 depends on ...

- the basic response time of the S300,
- the multiple sampling set,
- the transmission speed to external OSSDs via EFI.

See section 12.2 “OSSD response times” on page 117.

5.3 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 is required for hazardous point protection.

Note

The S300 must therefore be configured with a resolution of at least 40 mm.



WARNING

Never use the S300 for safety applications in which finger protection is required!

Due to the finest possible resolution of 30 mm, the S300 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 S300 (see section 4.9.3 “Using the contour as a reference” on page 46).

5.3.1 Minimum distance

For hazardous point protection, a minimum 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.

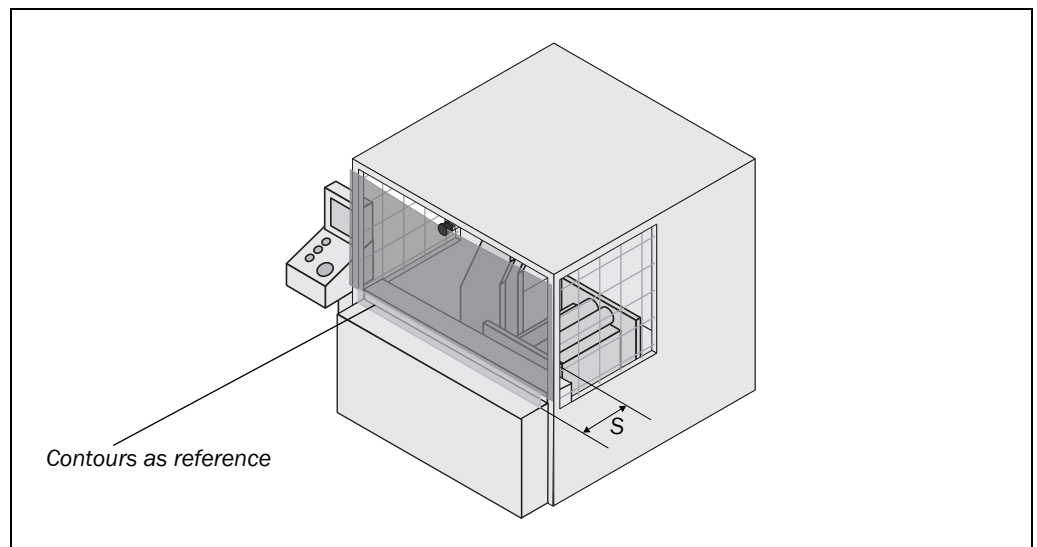


WARNING

Prevent reaching around or reaching behind the protective field!

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

Fig. 32: Minimum distance to the hazardous area



The minimum distance S as defined in EN ISO 13855 and EN ISO 13857 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 S300
- reach or approach speed
- resolution of the S300

How to calculate the minimum distance S (see EN ISO 13855):

➤ First, calculate S using the following formula:

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

Where ...

S = Minimum distance [mm]

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

T_S = Response time of the S300

d = Resolution of the S300 [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 minimum distance.

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

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

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

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

Response time T_S of the S300

The response time T_S of the S300 depends on ...

- the basic response time of the S300,
- the multiple sampling set,
- the transmission speed to external OSSDs via EFI.

See section 12.2 "OSSD response times" on page 117.

5.4 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 S300.

- Notes**
- The S300 may only be used to protect vehicles powered by electric motor.
 - 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 recognize the danger and stand still.
 - For vehicle protection, observe EN 1525 "Safety of industrial trucks. Driverless trucks and their systems".
 - If the application is to protect vehicles from collisions, then you may need to use different assumptions.

For a horizontally mounted mobile application, determine:

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

5.4.1 Protective field length

You must configure the protective field such that a minimum distance to the vehicle is maintained. This ensures that a vehicle monitored by the S300 comes to a stop before a person or object is reached.

If you are using an S300 Advanced, Professional or Expert, you can define several monitoring cases with different protective fields. You can switch these using static control inputs or on the S300 Professional and Expert variants also dynamically.

For dynamic switching, the vehicle velocity is determined by means of incremental encoders connected to the S300 Professional or Expert. S300 Professional and Expert can therefore switch the protective fields 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.

How to calculate the protective field length S_L (see EN ISO 13855):

➤ Calculate the necessary protective field length S_L 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 of the S300 = 100 mm

Z_R = Supplement for any reflection related measurement error of the S300

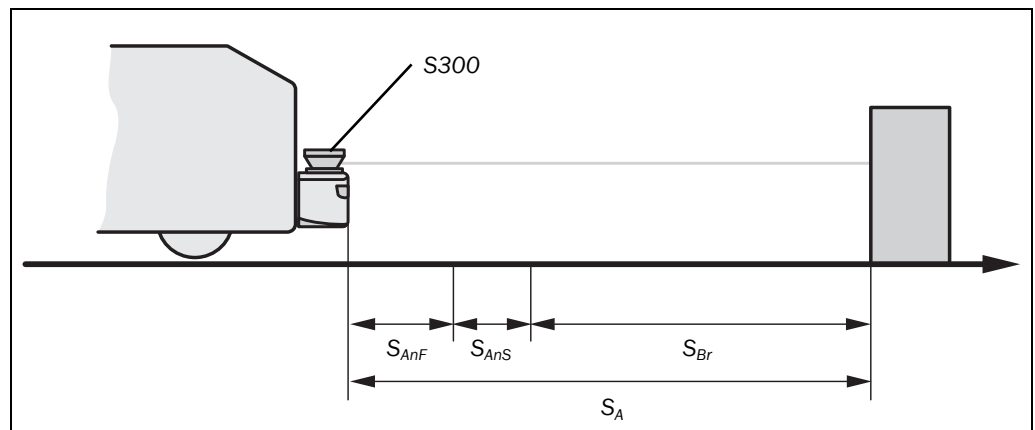
Z_F = Supplement for any lack of ground clearance of the vehicle

Z_B = Supplement for the reduction in the braking performance of the vehicle to be found in the related vehicle documentation

Stopping distance S_A

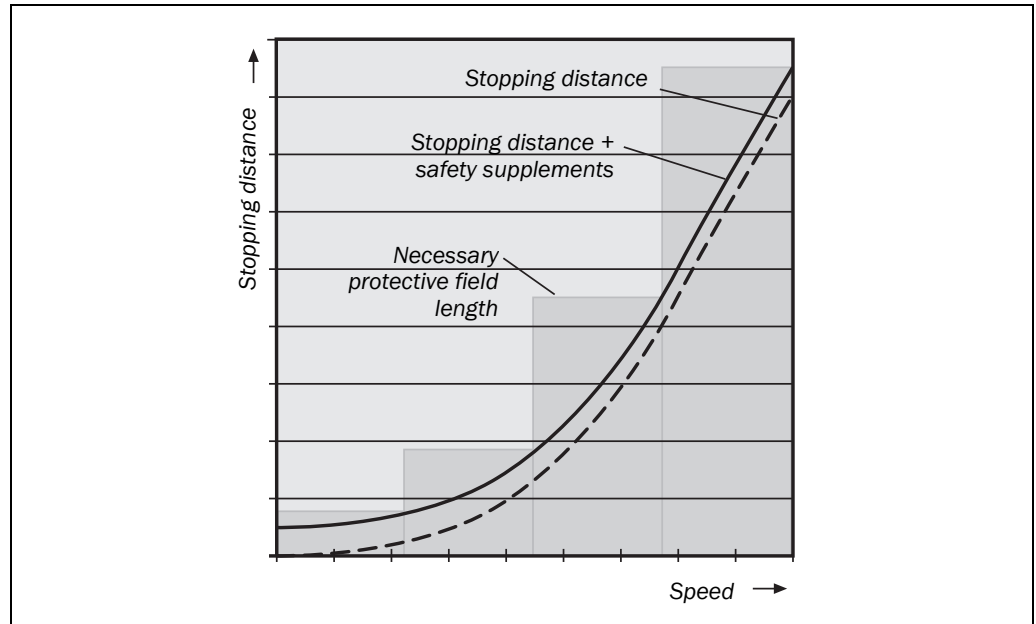
The stopping distance comprises the braking distance for the vehicle, the distance covered during the response time of the safety laser scanner and the response time of the vehicle controller.

Fig. 33: 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 between protective fields with different sizes dependant on the velocity monitored by use of incremental encoders.

Fig. 34: Stopping distance as a function of the vehicle velocity



How to calculate the stopping distance S_A :

➤ Calculate the stopping distance S_A using the formula:

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

Where ...

S_{Br} = Braking distance, to be found in the vehicle documentation

S_{AnF} = Distance covered during the response time of the vehicle controller, to be found in the vehicle documentation

S_{AnS} = Distance covered during the response time of the safety laser scanner

Distance covered during the response time of the safety laser scanner

The distance covered during the response time of the safety laser scanner depends on ...

- the response time of the safety laser scanner.
- the maximum velocity of the vehicle in your mobile application.

The response time T_S of the S300 depends on ...

- the basic response time of the S300,
- the multiple sampling set,
- the transmission speed to external OSSDs via EFI.

See section 12.2 "OSSD response times" on page 117.

How to calculate the distance S_{AnS} covered during the response time of the safety laser scanner:

➤ Calculate the distance S_{AnS} 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

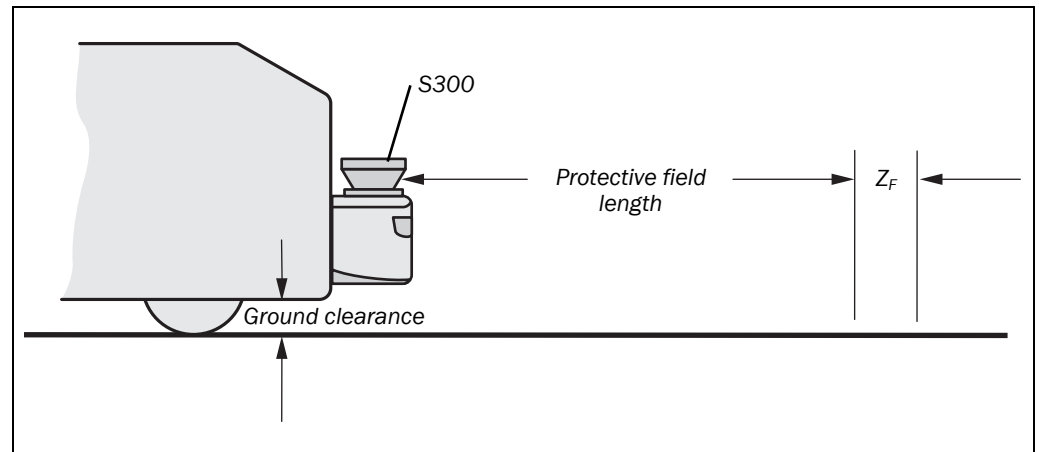
Supplement Z_R for measurement errors caused by reflection

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 Z_F due to lack of ground clearance

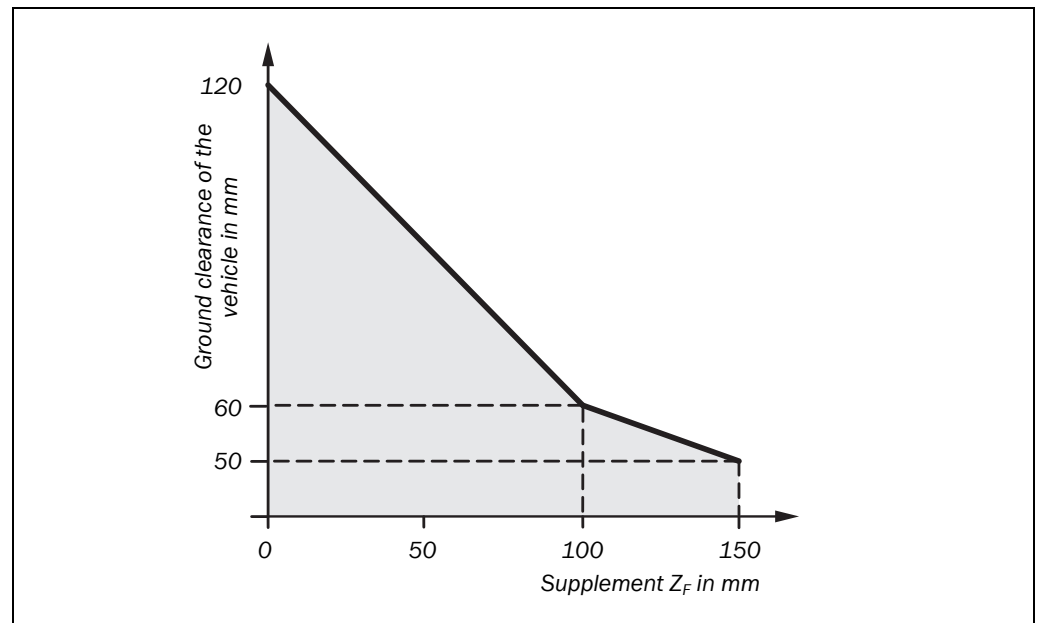
This supplement is necessary because a person is generally detected above the foot and the braking action can therefore not take into account the length of the foot in front of the detection point. If a vehicle has no ground clearance, a person may receive foot injuries.

Fig. 35: Supplement due to lack of ground clearance



- The flat rate supplement for ground clearance below 120 mm is 150 mm. This supplement can be further reduced in specific cases. For this purpose read off the actual supplement necessary for the ground clearance of your vehicle from the diagram below:

Fig. 36: Diagram of ground clearance of the vehicle



5.4.2 Protective field width

The width of the protective field must cover the width of the vehicle and the supplements for the measurement error and the lack of ground clearance.

How to calculate the protective field width S_B (see EN ISO 13 855):

➤ 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 of the S300 = 100 mm

Z_R = Supplement for any reflection related measurement error of the S300

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

5.4.3 Height of the scan plane

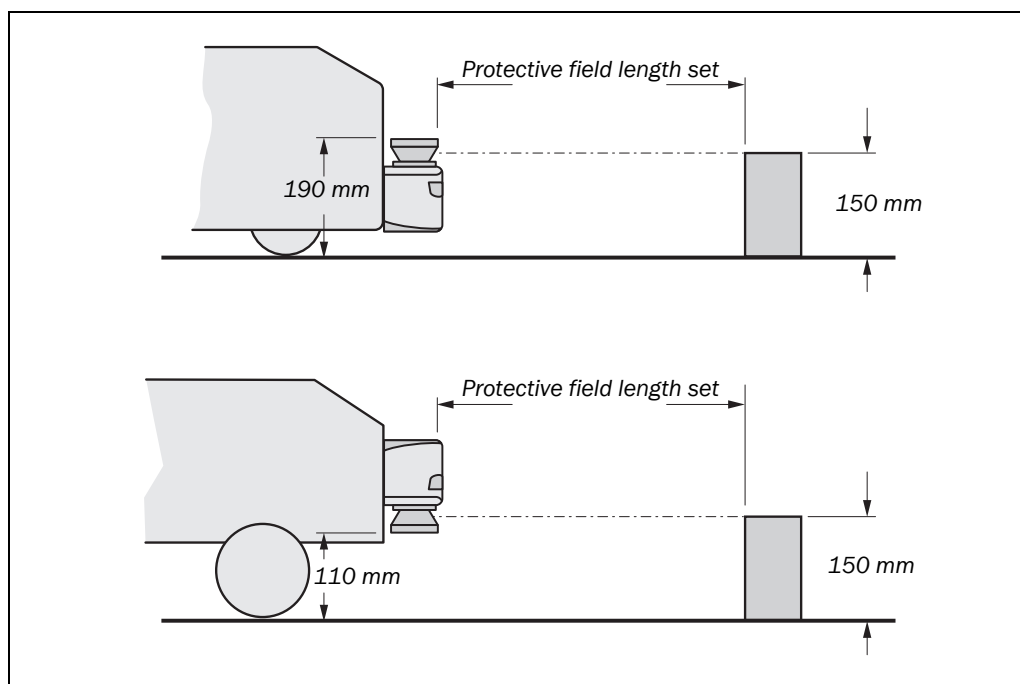


WARNING

Mount the S300 such that the scan plane is at a maximum height of 200 mm!

In this way also persons lying down will be reliably detected. Tilting the protective field so that objects with a diameter of 200 mm are not detected, is not allowed. We recommend aligning the scan plane horizontally at 150 mm.

Fig. 37: Mounting height

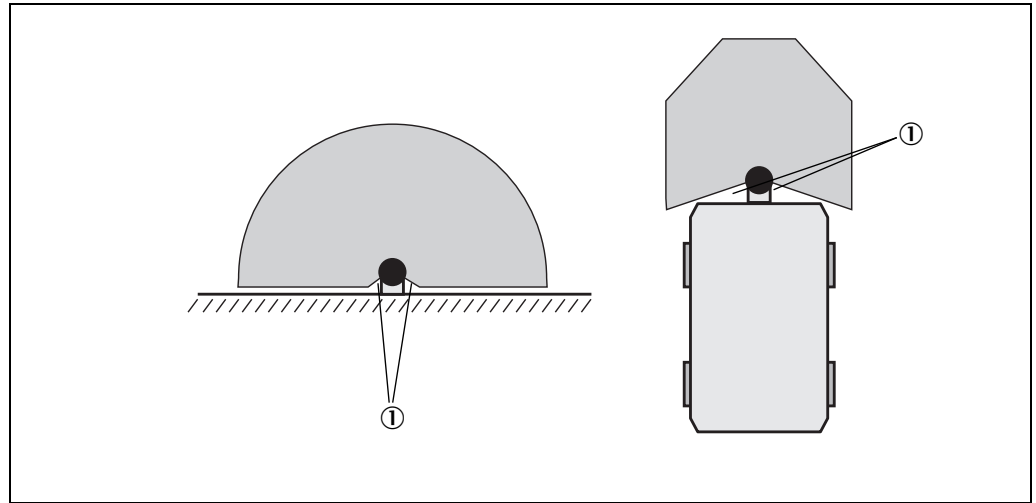


Note To produce the optimal scan plane, you can also mount the S300 reversed.

5.5 Methods of preventing unprotected areas

During mounting the S300, areas may be found that are not covered by the safety laser scanner (①).

Fig. 38: Unprotected areas



WARNING

Prevent unprotected areas!

Mount the S300 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 S300 in a recess.

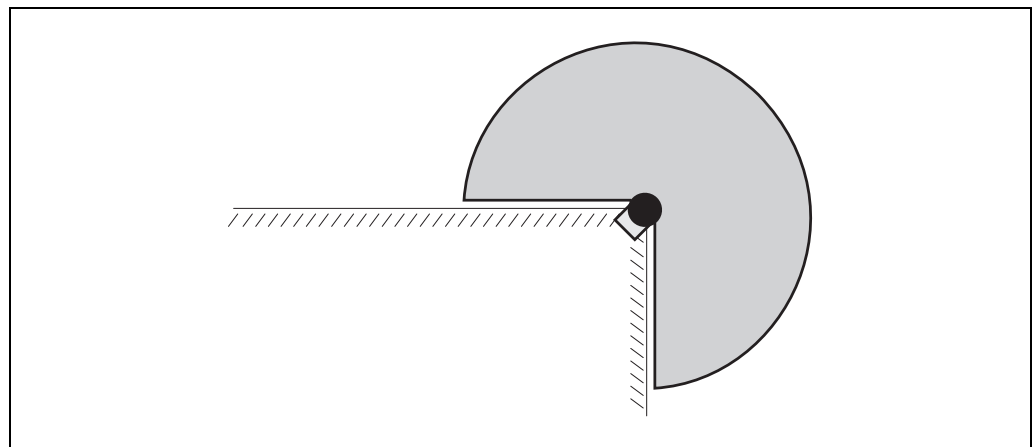
Mobile applications: Secure any unsecured areas!

Areas not visible to safety laser scanners must be secured using appropriate measures, such as mechanical casings, switch rails or bumpers. Bumpers must be designed in such a way that they still trigger quickly enough at maximum acceleration.

Mobile applications: Ensure the protective field selected is large enough!

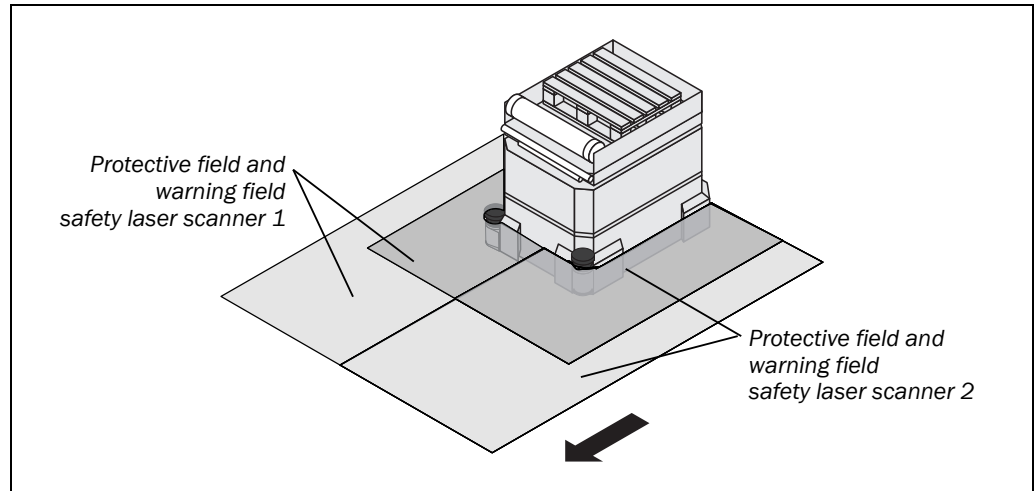
When starting very quickly from standstill, the protective field selected needs to be large enough to suffice even at maximum acceleration.

Fig. 39: Preventing unprotected areas



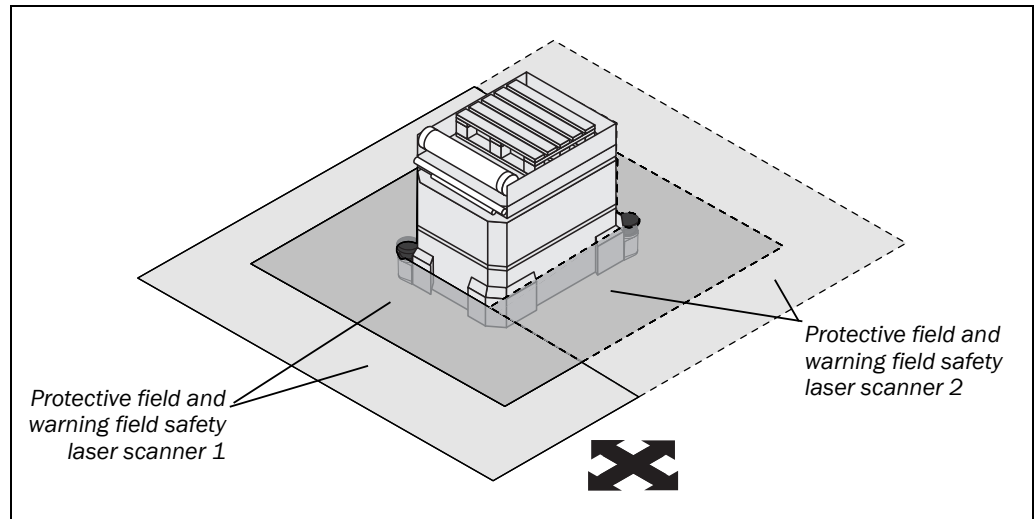
Mount the S300 for example on a corner to prevent unprotected areas.

Fig. 40: Mounting example for front and side protection in a direction of travel



With two S300 mounted at an angle of 45° on the front corners of a vehicle, you can configure the protective fields so that there are no unprotected areas and the hazardous areas in narrow aisles can also be protected.

Fig. 41: Mounting example for all-round protection in all directions of travel



With two S300 mounted diagonally opposite, you can implement protective fields on the vehicle for all-round protection in all directions of travel.

5.5.1 Near range

Make the near range impassible using a bar or a recess, or additionally protect the near range (5 cm wide area in front of the optics cover) using a proximity switch with 5 cm acquisition range. The vehicle may then be accelerated as required.

5.6 Time for monitoring case switching

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



WARNING

Set the timing for the switching such that the S300 already detects a person in the protective field with an adequate minimum distance before the dangerous state occurs!

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.

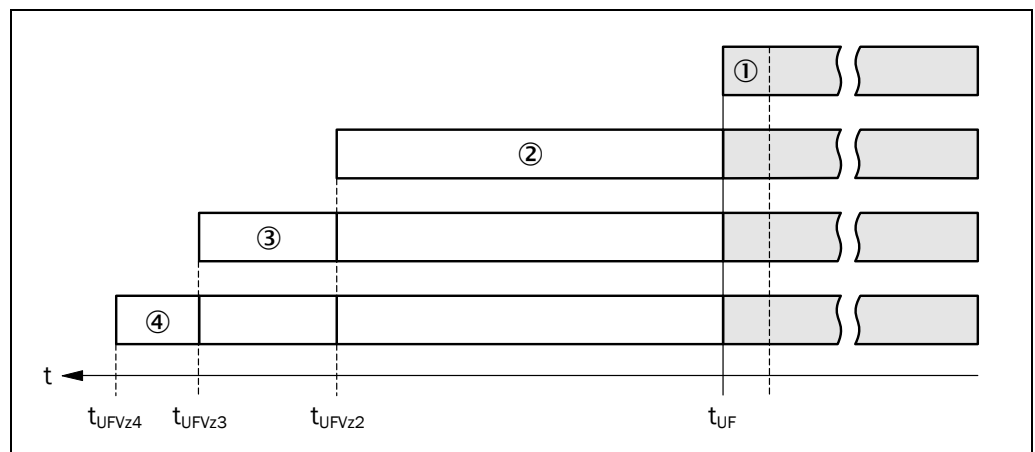
If you switch the controller within 10 ms, the protective field selected is available within the basic response time of the S300. For this reason you can initiate the switching at the time at which you actually want to switch from one monitoring case to the other.

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 38).
- use external inputs (e.g. the inputs on another S300).
- control external OSSDs instead of the internal OSSDs (e.g. the OSSDs on another S300) via EFI.

The following diagram shows the relationships:

Fig. 42: Advancement for the switch timing



- If the input conditions are present at the control inputs within 10 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 of the slowest system in the EFI system (cf. ③).
- If external OSSDs are used, the timing for the switching (t_{UFVz4}) must be further advanced by 20 ms (cf. ④).

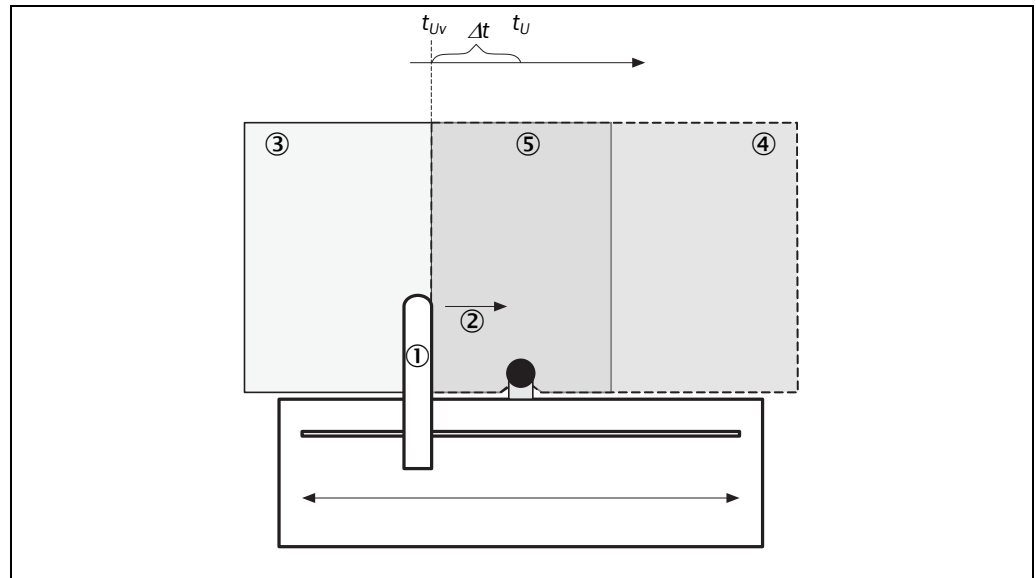
Notes

- In the phases before and after the switching, the minimum 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 advancing the timing results in premature termination of the monitoring of the initial area, you must allow the two protective fields to partially overlap.

The following figure shows an example for a gantry robot that is protected using two monitoring cases.

Fig. 43: 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.

- Notes**
- For the movement to the left, that is for the switching to the monitoring case ③, the same applies.
 - The protective fields for the monitoring cases must overlap here ⑤, so that a protective function is always provided.

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

- the input delay required for the used switching method to provide the input condition for case switching (see section 4.5.1 “Input delay” on page 38).
- whether you use external OSSDs via EFI.
- whether you use external control inputs (e.g. on another S300).

How to calculate 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

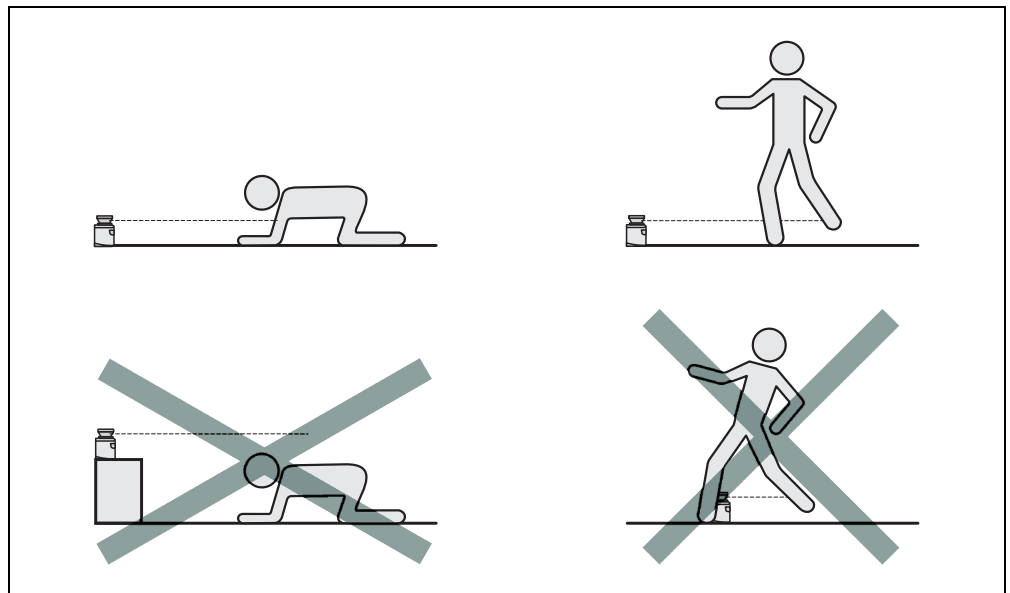
t_{exOVz} = Delay due to external OSSDs over EFI = 20 ms

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

5.7 Mounting steps**WARNING****Special features to note during mounting:**

- Mount the S300 such that it is protected from moisture, dirt and damage.
- Ensure that the entire field of view of the S300 is not restricted.
- Mount the safety laser scanner such that the indicators are easy to see.
- Always mount the S300 so that there is still enough space for mounting and removing the system plug.
- Avoid excessive shock and vibration loading on the safety laser scanner.
- On systems 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 S300.

Fig. 44: Prevent crawling beneath, standing behind, climbing over



The origin of the scan plane is 116 mm above the bottom edge of the S300 (see section 12.6.3 “Scan plane origin” on page 134).

There are three possible ways of fixing the S300:

- direct mounting without mounting kit
- mounting with mounting kit 1a or 1b
- mounting with mounting kit 2 (only in conjunction with mounting kit 1a or 1b)

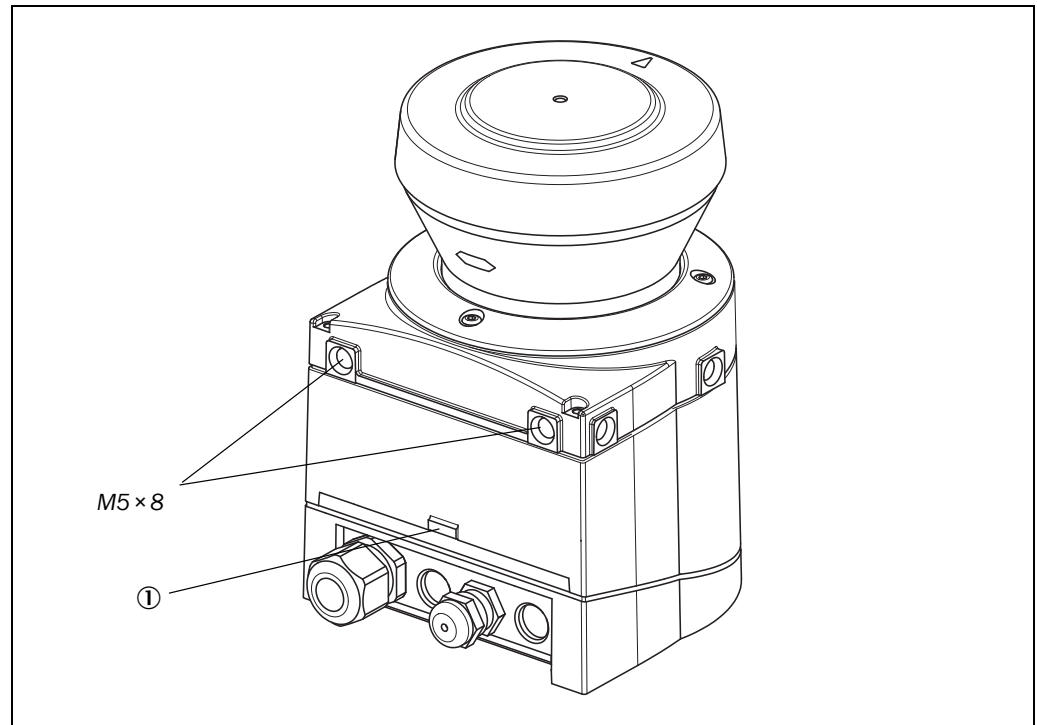
You will find the part numbers for the mounting kits in section 13.3.1 “Mounting kits” on page 135.

Note Pay attention to the maximum tightening torque of the M5 fixing screws on the S300 of max. 5.9 Nm.

5.7.1 Direct mounting

The S300 has two threaded holes M5 × 8 on the rear. Using them you can mount the S300 directly on the intended mounting surface. To avoid a possible tendency to vibrate, if necessary the reference surface on the rear can be used as the third mounting point ①.

Fig. 45: Direct mounting



Note During mounting, please observe the dimensional drawings (see section 12.6 “Dimensional drawings” on page 132).

5.7.2 Mounting with mounting kit 1a or 1b

With the aid of mounting kit 1 you can mount the S300 indirectly on the mounting surface. The mounting kit is available as mounting kit 1a without protection device for the optics cover and as mounting kit 1b with protection device for the optics cover.

Fig. 46: Mounting with mounting kit 1a

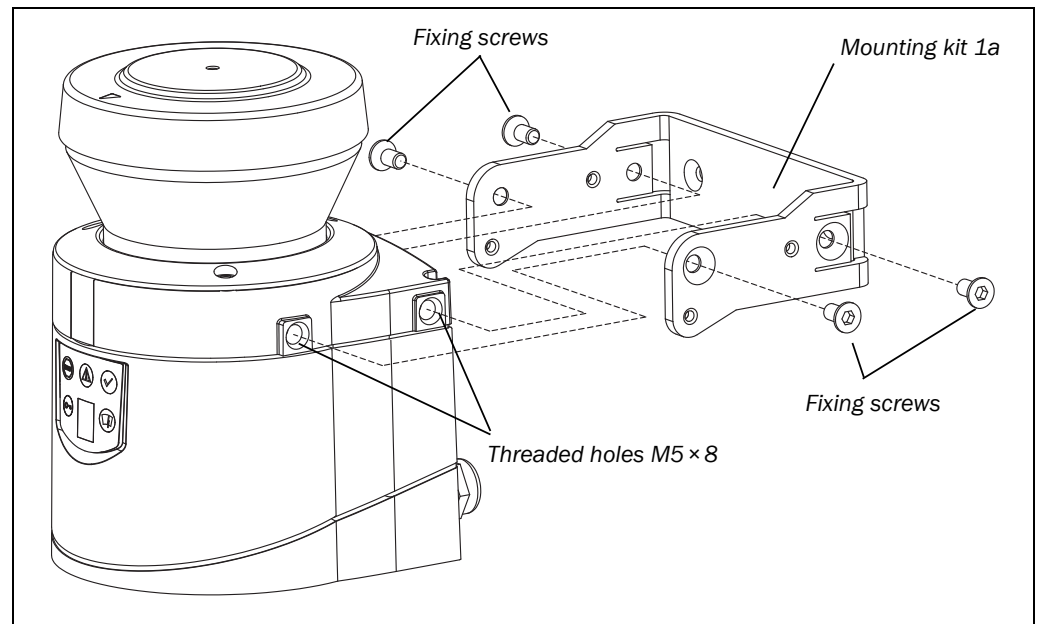
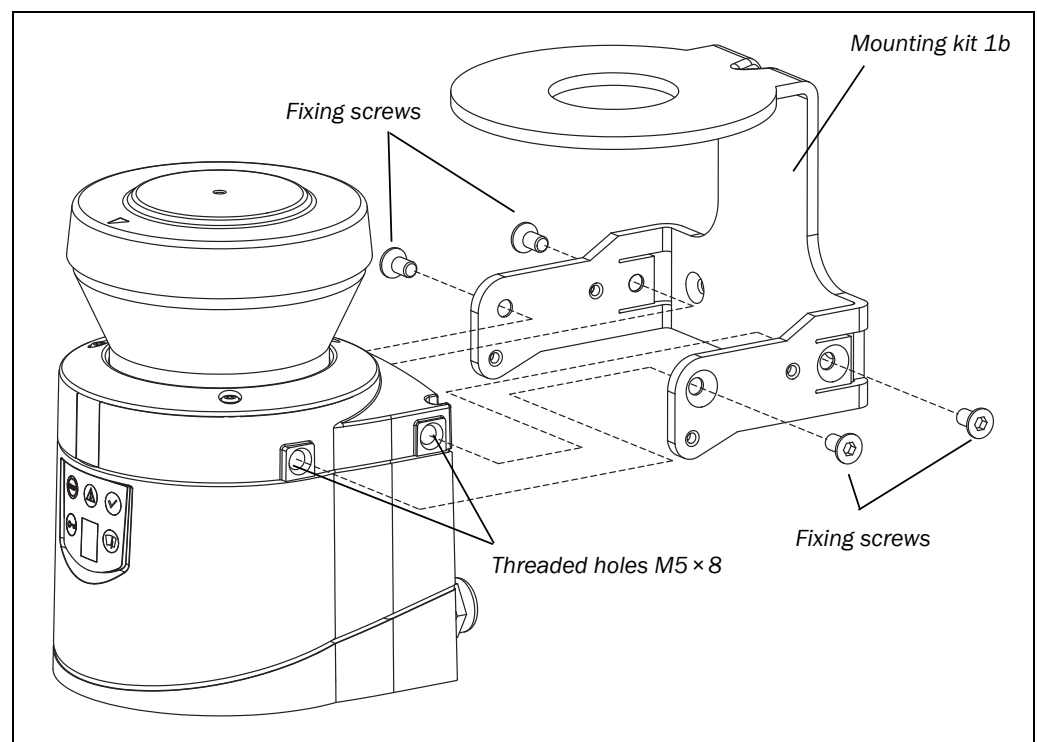


Fig. 47: Mounting with mounting kit 1b incl. protection for the optics cover



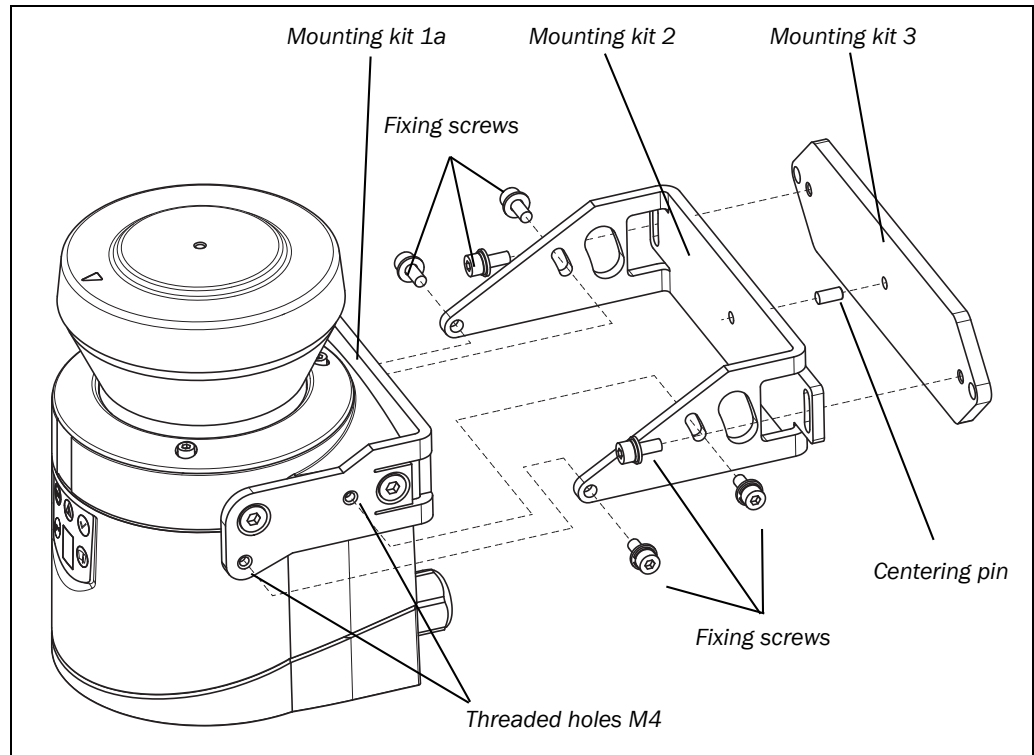
- Mount mounting kit 1a or 1b on the mounting surface.
- Then mount the S300 on the mounting kit 1a or 1b.

Note During mounting, please observe the dimensional drawings (see section 12.6 “Dimensional drawings” on page 132).

5.7.3 Mounting with mounting kit 2 and 3

With the aid of mounting kits 2 and 3 (only in conjunction with mounting kit 1a or 1b) you can align the S300 in two planes. The maximum adjustment angle is $\pm 11^\circ$ in both planes.

Fig. 48: Mounting with mounting kit 2



- Mount mounting kit 1a or 1b to the S300.
- Mount the mounting kit 3 on the mounting surface.
- Fit the centering pin (4 mm) in the central hole on mounting bracket 3.
- Fit mounting kit 2 to mounting kit 3 and mount it using two fixing screws M4 × 10.
- Then mount the S300 on mounting kit 2 with the aid of the threaded holes in mounting kit 1a.
- Adjust the S300 longitudinally and transversely and then tighten the six fixing screws on the mounting kits.

Note During mounting, please observe the dimensional drawings (see section 12.6 “Dimensional drawings” on page 132).

5.7.4 Information label Important information

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

5.7.5 Using multiple S300 safety laser scanners

The S300 is so designed that mutual interference between several safety laser scanners is unlikely. To completely exclude erroneous switching, you must mount the safety laser scanners as shown in the following examples.

Note In any circumstance observe EN ISO 13855 when calculating the minimum distance. Use mounting kits 1 and 2 to adjust the safety laser scanners to different angles (see section 13.3.1 “Mounting kits” on page 135).

Fig. 49: Opposite mounting

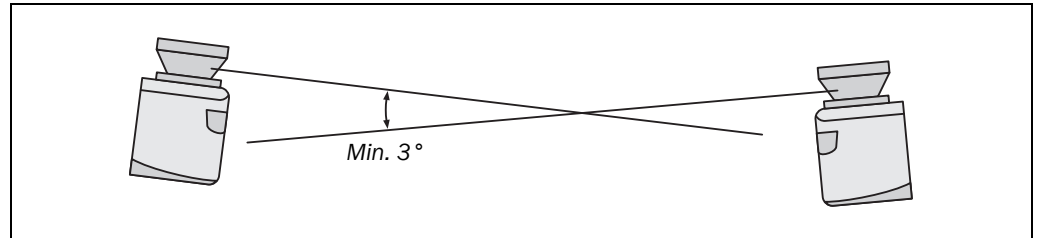


Fig. 50: Offset parallel mounting

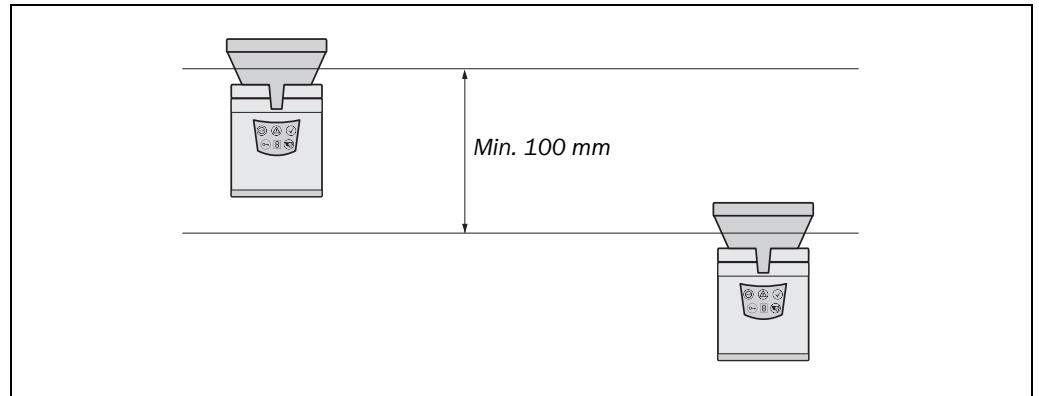


Fig. 51: Mounting on a cross

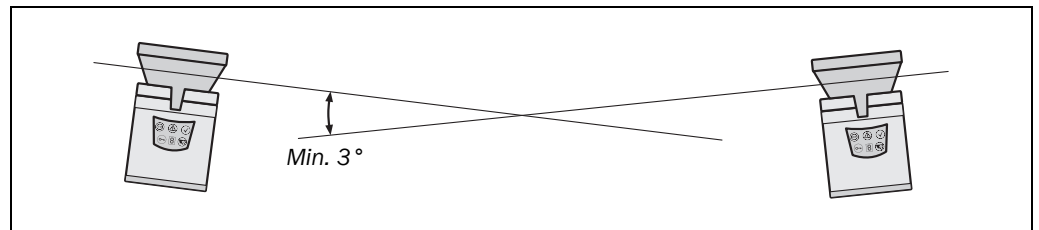


Fig. 52: Reverse mounting, parallel offset

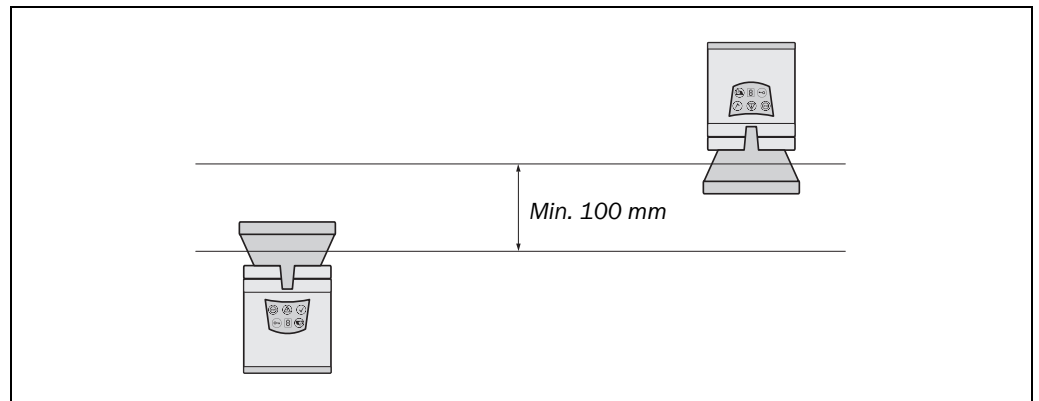


Fig. 53: Reverse mounting of two S300, with parallel offset

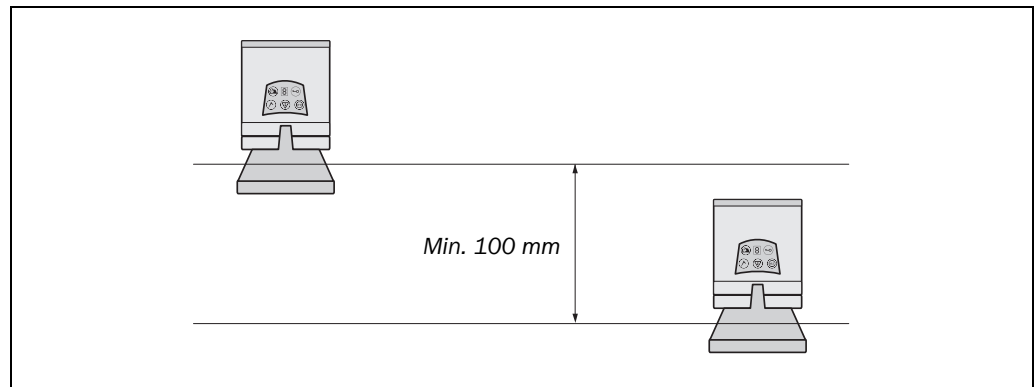
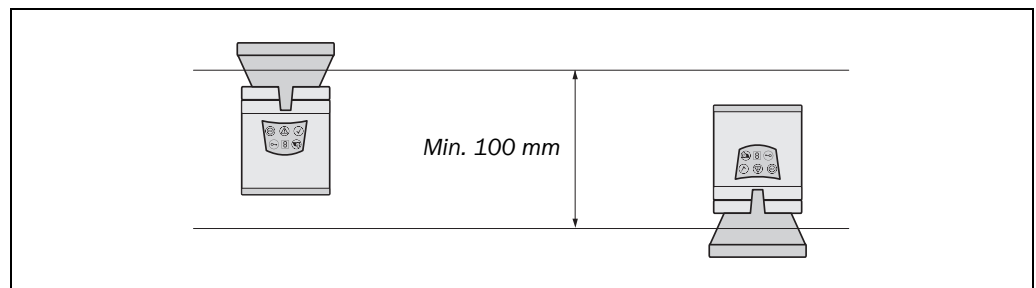


Fig. 54: Reverse mounting of an S300, with parallel offset



6 Electrical installation



WARNING

Switch the entire machine/system off line!

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

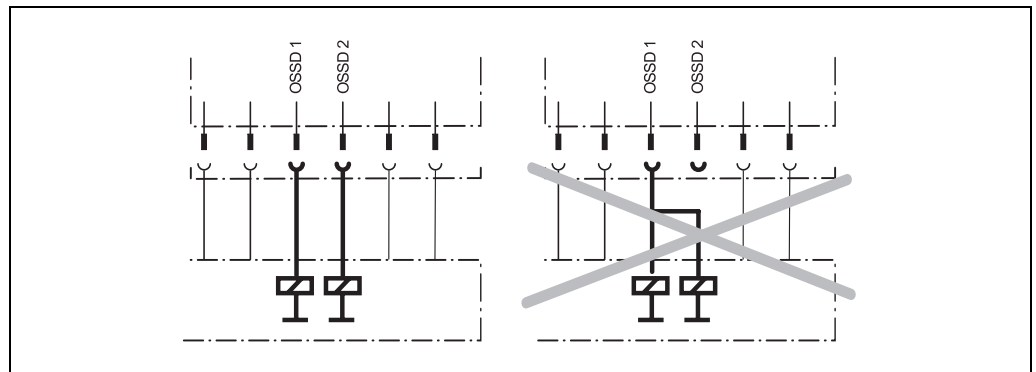
- To prevent an unintentional start, ensure that the entire machine/system is disconnected during the electrical installation.

Connect OSSD1 and OSSD2 separately!

You are not allowed to connect OSSD1 and OSSD2 together, otherwise signal safety will not be ensured.

- Ensure that the machine controller processes the two signals separately.

Downstream contactors must be positively guided and monitored.

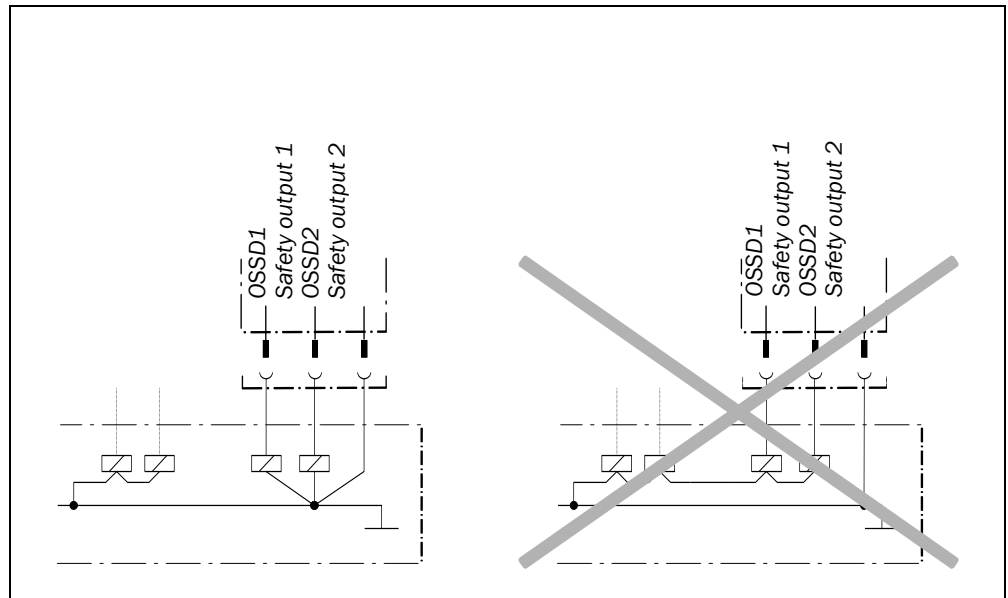


Only ever connect one downstream switching element to an OSSD!

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, you must choose a suitable form of contact duplication.

Prevent the occurrence 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.



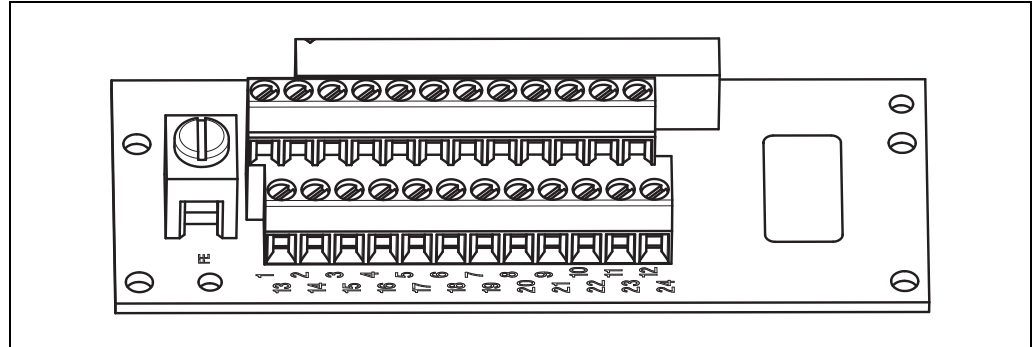
- Notes**
- Route all cables and connection cables such that they are protected from damage.
 - Ensure that also the controller connected and all devices related to safety have the required category as per EN ISO 13849-1 or the required performance level as per EN ISO 13849!
 - If you use screened cables, lay the screen evenly around the cable gland.
 - Ensure that the S300 is adequately protected electrically. You will find the electrical data necessary for determining the correct fuse in section 12.4 “Data sheet” on page 120.

6.1 System connection

You will find all inputs and outputs of the S300 on the 24-pin screw terminal connection + FE in the system plug.

You can either make connections directly to the terminal strip on the system plug or use a pre-assembled system plug from SICK (see section 6.3 on page 86).

Fig. 55: Screw terminal strip on the system plug



The system plug pin assignments vary depending on the S300 variant.

- Notes**
- If the cable gland/blanking plug 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 on the S300 are to be used only in the context specified.

Wiring in accordance with EMC regulations

The quality of the shield is essentially dependent on the quality of the connection of the screen. In principle the best screening action can only be achieved with the connection of the screen at both ends using large area connections.

- To connect the screen on the S300 use the EMC cable gland M12 (part no. 5308757).
- Use similar cable glands on the incremental encoders.
- If it is not possible to connect the screen via threaded fittings (e.g. on bus nodes), connect the screen physically close, e.g. to a control cabinet chassis using a metal clamp.

- Notes**
- If you want to operate two safety laser scanners in a system (communication via EFI), then the same earthing method must be used for both safety laser scanners.
 - If there is a PE in an installation, it can be used for the connection of the FE. However a functional earth connection (FE) is never allowed to be used as a PE!

Functional earth

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

6.1.1 Pin assignment on the system plug

Tab. 22: Pin assignment on the system plug

Pin	Signal	Function	Standard	Advanced	Professional	Expert
FE	Functional earth		■	■	■	■
1	+24 V DC	Supply voltage S300	■	■	■	■
2	0 V DC	Supply voltage S300	■	■	■	■
3	OSSD1	Output signal switching device	■	■	■	■
4	OSSD2	Output signal switching device	■	■	■	■
5	UNI-I/01/ RESET/C1	Universal I/O or input, Reset or (on the S300 Professional and Expert) static control input C	■	■	■	■
6	UNI-I/02/EDM	Universal I/O or input, External device monitoring	■	■	■	■
7	A1 or INC1_0	Static control input A or dynamic control input (incremental encoder) 1 or connection for a jumper for guest addressing ¹²⁾	■	■	■	■
8	A2 or INC1_90	Static control input A or dynamic control input (incremental encoder input) 1		■	■	■
9	B1 or INC2_0	Static control input B or dynamic control input (incremental encoder input) 2		■ ¹³⁾	■	■
10	B2 or INC2_90	Static control input B or dynamic control input (incremental encoder input) 2		■ ¹³⁾	■	■
11	RxD-	RS-422 interface for output of measured data	■	■	■	■
12	RxD+		■	■	■	■
13	UNI-I/03/ ERR/WEAK	Universal I/O or application diagnostic output – Error/contamination or connection for a jumper for addressing as guest ¹²⁾	■	■	■	■
14	UNI-I/04/WF	Universal I/O or application diagnostic output, Object in warning field	■	■	■	■
15	UNI-I/05/ RES_REQ/C2	Universal I/O or application diagnostic output, Reset required or (on the S300 Professional and Expert) static control input C	■	■	■	■
16	STBY	Control input for stand-by mode	■	■	■	■
17	EFI _A	Enhanced function interface = safe SICK device communication	■	■	■	■
18	EFI _B		■	■	■	■
19	+24 V DC	Supply voltage incremental encoder 1			■	■
20	GND				■	■
21	+24 V DC	Supply voltage incremental encoder 2			■	■
22	GND				■	■
23	TxD-	RS-422 interface for output of measured data	■	■	■	■
24	TxD+		■	■	■	■

¹²⁾ In an EFI system, a device must be defined as a guest using a jumper between pin 7 and pin 13.¹³⁾ No dynamic control input on the S300 Advanced.



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 power supply to the two incremental encoders must be independent. For this purpose use the connection terminals provided, 19 and 20 as well as 21 and 22.
- Each incremental encoder output (for 0° or 90°) is only allowed to be connected to one control input, e.g. A1/B1 or A2/B2.

Both 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 from SICK AG, tel.: +49 211/5301-250 or at www.sick.com. Or contact your local SICK representative.

Control inputs

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.

EFI systems

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 device.



WARNING

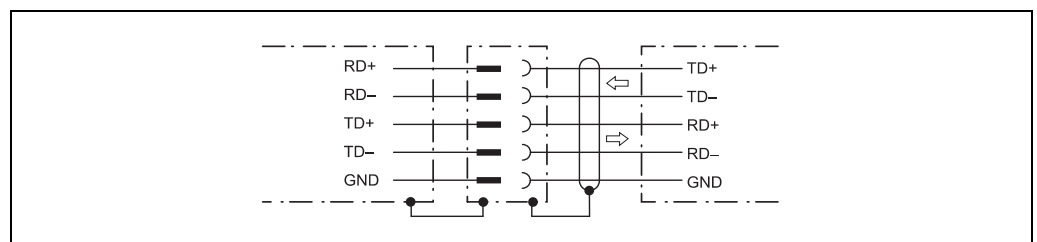
In an EFI system with two safety laser scanners, set the address of one of the scanners to guest!

To differentiate unambiguously between the host and guest device in an EFI system, one S300 must be configured as the guest. For this purpose a jumper is wired between the connection terminals 7 (A1/INC1_0) and 13 (UNI-I/O3/ERR/WEAK).

The jumper always defines the guest device. This jumper is never allowed to be fitted on the host device.

RS-422 interface

Fig. 56: Connection sketch RS-422 interface



6.2 System plug assembly

The system plug has cable entries for cable glands on the underside and on the rear. The number of cable entries and cable glands varies depending on the variant:

- system plug SX0B-A0000G for S300 Standard and S300 Advanced:
 - 1 cable entry with M16 cable gland
 - 1 cable entry without M16 cable gland (blanking plug)
 - 2 cable entries without M12 cable gland (blanking plugs)
- system plug SX0B-A0000J for S300 Professional and Expert:
 - 1 cable entry with M16 cable gland
 - 1 cable entry without M16 cable gland (blanking plug)
 - 6 cable entries without M12 cable gland (blanking plugs)
 - 2 M12 cable glands, enclosed loose

Note You can also procure the S300 with pre-assembled system plug with varying cable lengths (see section 6.3 “Pre-assembled system plugs” on page 86 and section 13.3.2 “System plug S300” on page 136).



WARNING

The length of the spare cable should be such that the system plug cannot inadvertently be plugged into a neighboring S300!

From experience 20 to 30 cm spare cable at the safety laser scanner have proven to be adequate. In this way you avoid the inadvertent connection of the system plug to a neighboring S300 and operation of an S300 with an incorrect configuration. The spare cable enables you to change the S300 with ease if necessary.

Fig. 57: System plug SX0B-A0000G for S300 Standard and S300 Advanced

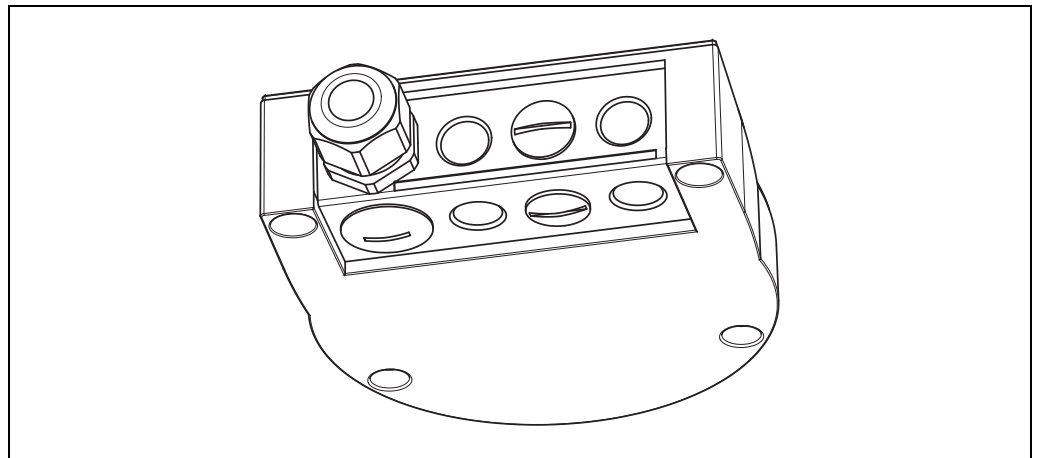
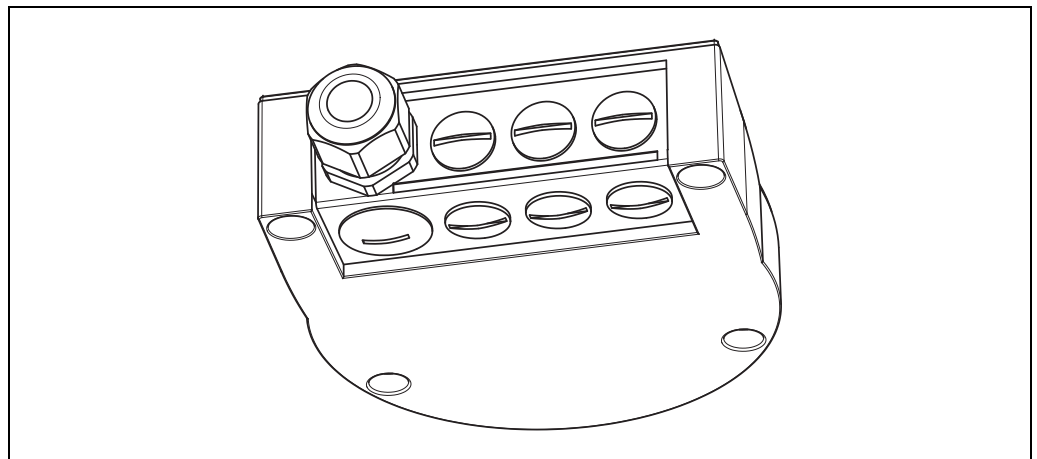


Fig. 58: System plug SX0B-A0000J for S300 Professional and Expert



Depending on the application use suitable cable glands on the bottom or rear. For the EFI cables you must choose EMC-proof cable glands.

Tab. 23: Use the cable glands supplied

Cable gland	Cable diameter	Usage
M16	5-9 mm	<ul style="list-style-type: none"> System cables (supply voltage, outputs, static inputs, universal I/Os)
M12, EMC proof	3-6.5 mm	<ul style="list-style-type: none"> EFI Incremental encoder RS-422 data cables

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

Tab. 24: Recommended wire cross-sections

Cable	Recommended wire cross-sections	Screened
System cables (supply voltage, outputs, static inputs, universal I/Os)	9-15 cores, 0.5-1 mm ²	No ¹⁴⁾
EFI	2 × 0.22 mm ²	Yes
Incremental encoder	4 × 0.25 mm ²	Yes
RS-422 data cables	4 × 0.25 mm ²	Yes

Recommendation

If you want to assemble the system plug yourself, you will find suitable cables in the ordering information (see section 13.3.4 “Self assembly connecting cables” on page 137).

¹⁴⁾ A shield is recommended if there is a significant EMC interference in the area.

6.3 Pre-assembled system plugs

To connect the S300 variants, the following pre-assembled system plugs are available (see also section 13.3.2 "System plug S300" on page 136):

For S300 Standard

- SX0B-B1105G, SX0B-B1110G, SX0B-B1114G and SX0B-B1120G
 - with 11 cores, unscreened (M16 cable gland)
 - 5, 10, 14 or 20 m long

For S300 Professional and Expert with dynamic inputs

- SX0B-B1105J and SX0B-B1110J
 - with 11 cores, unscreened (M16 cable gland)
 - 5 or 10 m long
 - with 2 M12 cable glands (for incremental encoders), enclosed loose

For S300 Advanced, Professional and Expert with static inputs

- SX0B-B1505G and SX0B-B1510G
 - with 15 cores, unscreened (M16 cable gland)
 - 5 or 10 m long

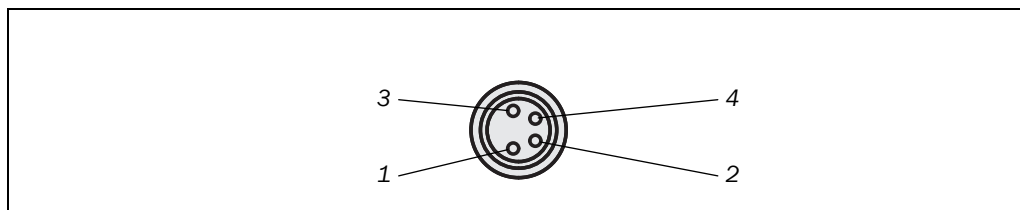
Tab. 25: Pin assignment
pre-assembled system plug

Pin	Signal	Wire color	SX0B-B1105G SX0B-B1110G SX0B-B1120G	SX0B-B1105J SX0B-B1110J	SX0B-B1505G SX0B-B1510G
FE	Functional earth	Green	■	■	■
1	+24 V DC	Brown	■	■	■
2	0 V DC	Blue	■	■	■
3	OSSD1	Gray	■	■	■
4	OSSD2	Pink	■	■	■
5	UNI-I/O1/RESET/ C1	Red	■	■	■
6	UNI-I/O2/EDM	Yellow	■	■	■
7	A1 or INC1_0	White/blue			■
8	A2 or INC1_90	White/gray			■
9	B1 or INC2_0	White/purple			■
10	B2 or INC2_90	White			■
13	UNI-I/O3/ERR	White/black	■	■	■
14	UNI-I/O4/WF	White/brown	■	■	■
15	UNI-I/O5/ RES_REQ/C2	Red/blue	■	■	■
16	STBY	White/green	■	■	■

S300

6.4 Configuration connection M8 × 4 (serial interface)

Fig. 59: Pin assignment
configuration connection
M8 × 4



Tab. 26: Pin assignment
configuration connection
M8 × 4

Pin	S300	PC-side RS-232-D-Sub
1	Reserved	Not assigned
2	RxD	Pin 3
3	0 V DC (voltage supply)	Pin 5
4	TxD	Pin 2

- Notes**
- After configuration always remove the connecting cable from the configuration connection!
 - After the configuration of the device has been completed, locate the attached protection cap to cover the configuration connection.

7 Application examples and connection diagrams

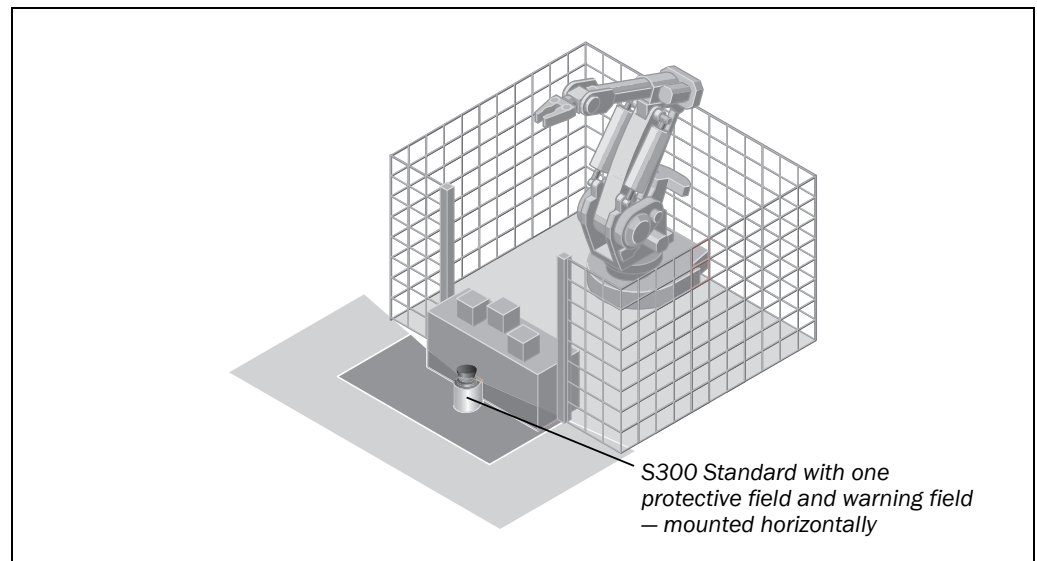
The examples shown are only provided as an aid for your planning. You may need to consider additional protection measures for your application.

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 section 5.6 “Time for monitoring case switching” on page 71).

7.1 Stationary applications

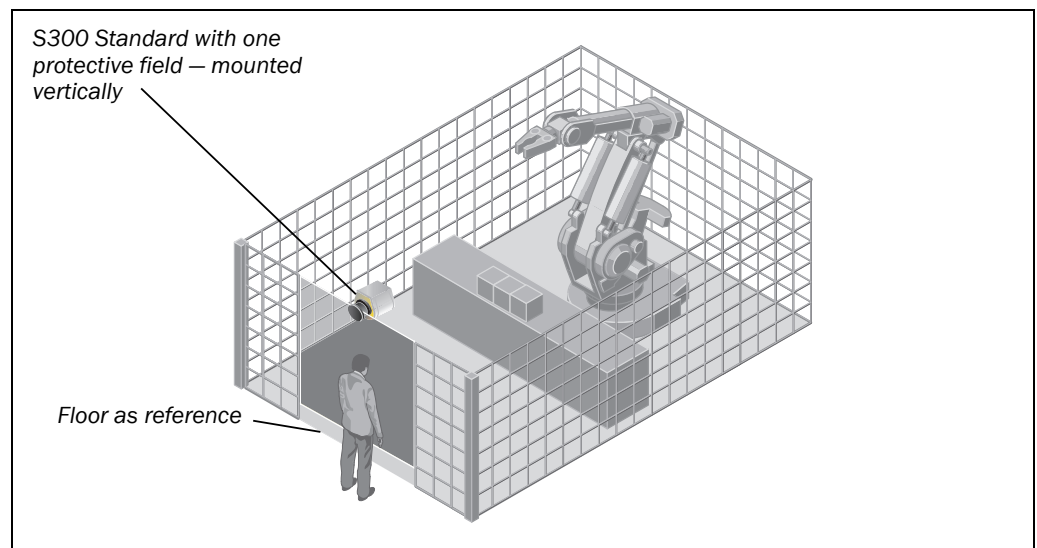
7.1.1 Applications with one monitored area (S300 Standard)

Fig. 60: Hazardous area protection with S300 Standard



The area is permanently monitored by the S300.

Fig. 61: Access protection with S300 Standard

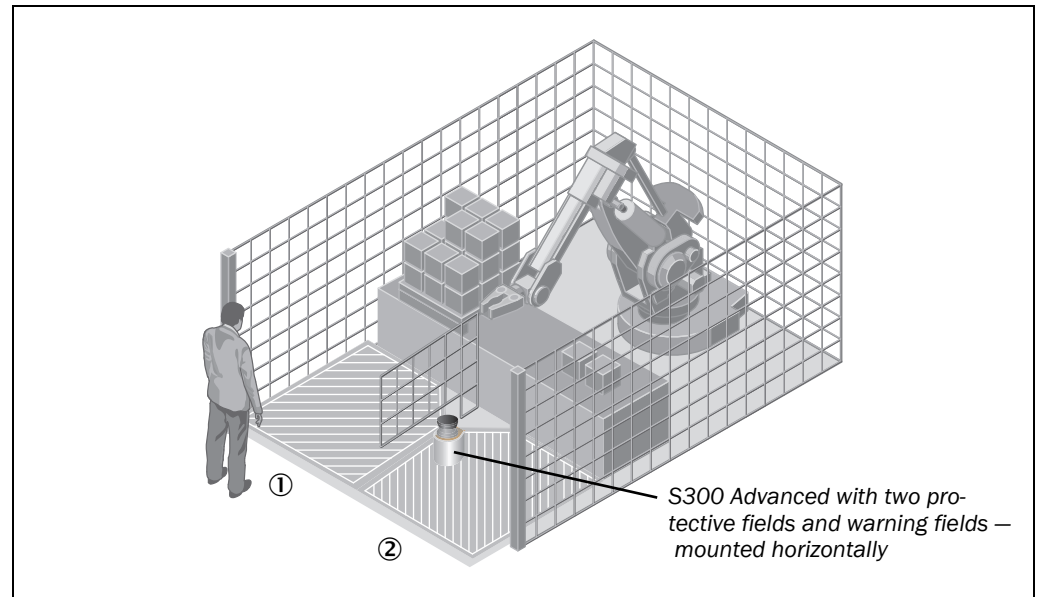


The access is monitored permanently. For safety against manipulation on the S300, e.g. the floor is used as a reference. If the alignment of the S300 changes (e.g. due to changes to the bracket), the S300 switches its OSSDs to the OFF state.

S300

Fig. 62: Hazardous area protection with S300 Advanced

7.1.2 Applications with multiple monitored areas (S300 Advanced)

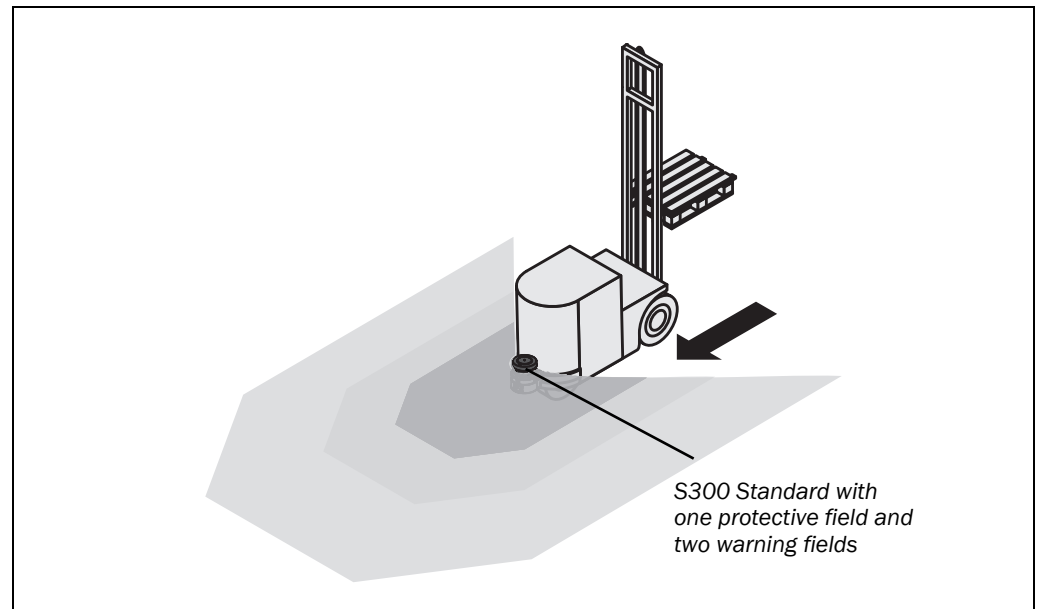


The two areas to be monitored are switched using the static control inputs depending on the phase of the process on the machine. For example the area ① or the area ② can be monitored.

7.2 Mobile applications

7.2.1 Vehicle monitoring for unidirectional travel (S300 Standard)

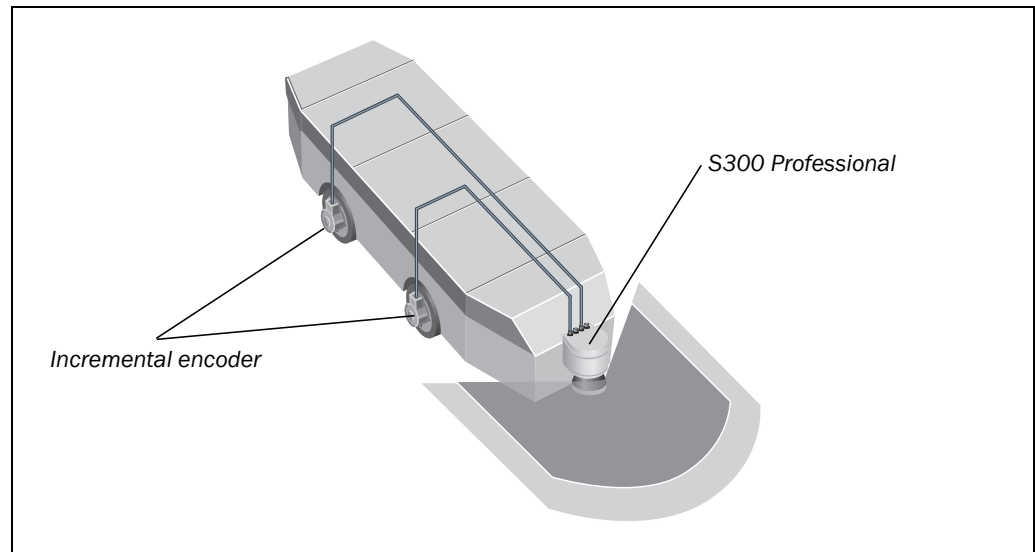
Fig. 63: Vehicle monitoring with S300 Standard



The S300 monitors the area in the direction of travel and switches its OSSDs to the OFF state to stop the vehicle as soon as there is an object in the protective field.

7.2.2 Velocity-dependent vehicle monitoring for unidirectional travel (S300 Professional)

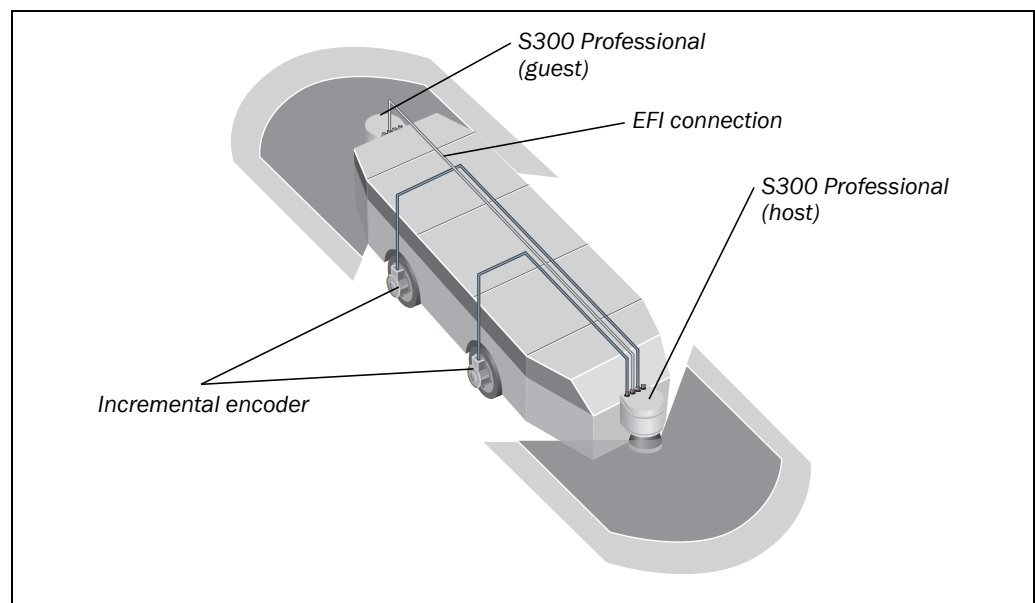
Fig. 64: Velocity-dependent
vehicle monitoring with
S300 Professional



Using incremental encoders the S300 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 S300. The field sets are switched dynamically using the vehicle velocity.

7.2.3 Velocity-dependent vehicle monitoring for bi-directional travel (2 × S300 Professional in host/guest operation)

Fig. 65: Mobile application
with S300 Professional

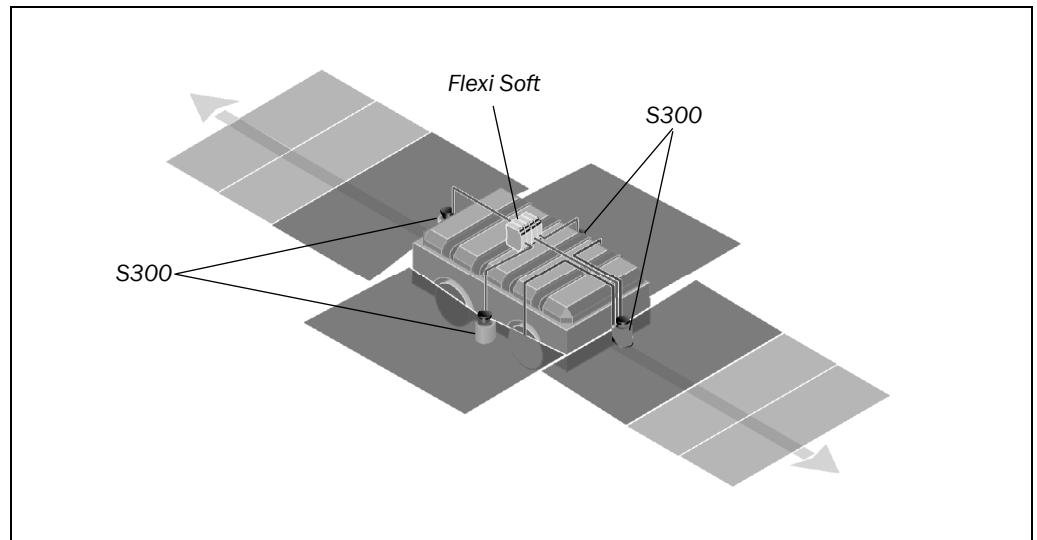


Using incremental encoders the host acquires the velocity and the direction of the vehicle via its dynamic control inputs. Various field sets of different sizes are configured in the S300 for the different velocities. The field sets are switched dynamically using the vehicle velocity.

The guest receives the incremental encoder values from the host over the EFI interface. 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, it switches the OSSDs on the host to the OFF state over the EFI.

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

Fig. 66: Mobile application with S300 Professional and S300 Advanced



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

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

7.3 Connection diagrams

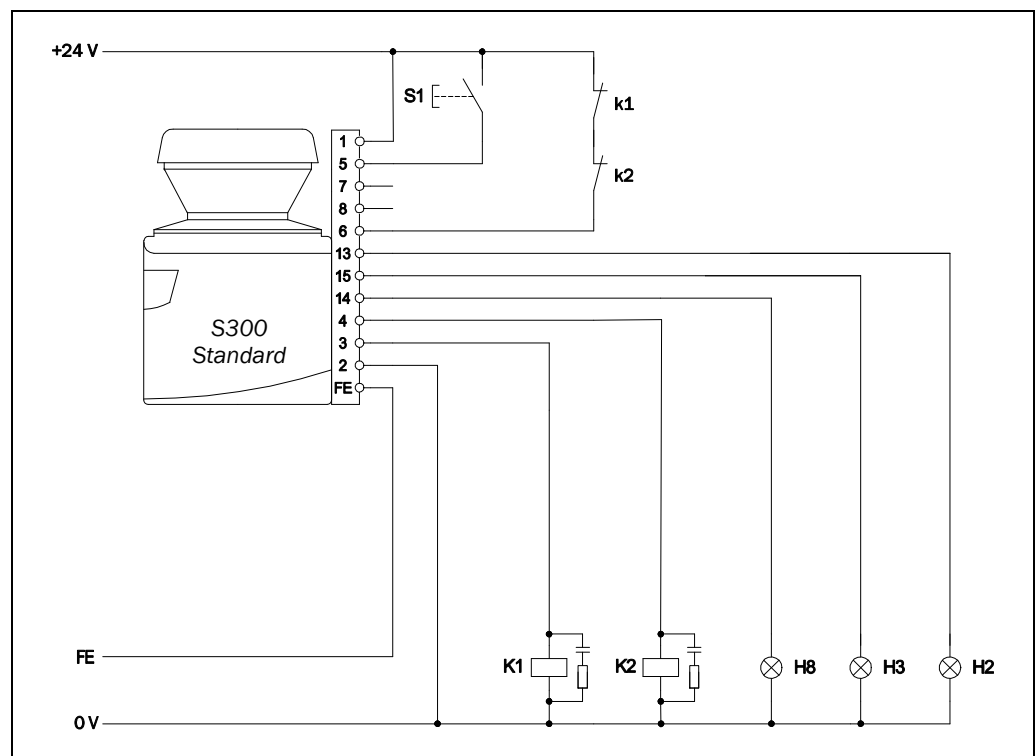
- Notes**
- Only use relays/contacts with positively guided contacts. The protection elements connected in parallel with the relays/contactors are used for arc-suppression.
 - Ensure that there is adequate arc-suppression at the relays/contactors. Take into account that arc-suppressors may lengthen the response time.
 - The arc-suppressors must be in parallel with the relays/contactors (not across the contacts).
 - If you want to operate two safety laser scanners in a system (communication via EFI), then the same earthing method must be used for both safety laser scanners.

Sketch key

- k1 and k2 or k3 and k4 = 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 according to EN ISO 13849-1, the integration must be dual-channel (x/y paths). Observe the maximum values for the loading of the outputs (see section 12.4 “Data sheet” on page 120).
- FE = functional earth
To achieve the specified EMC safety, the functional earth (FE) must be connected (e.g. to the vehicle's or system's central earth star point).
- H2 = sensor for Error/contamination
- H3 = sensor for Reset required
- H8 = sensor for Warning field interruption

7.3.1 Restart interlock and external device monitoring

Fig. 67: Connection diagram for restart interlock and external device monitoring

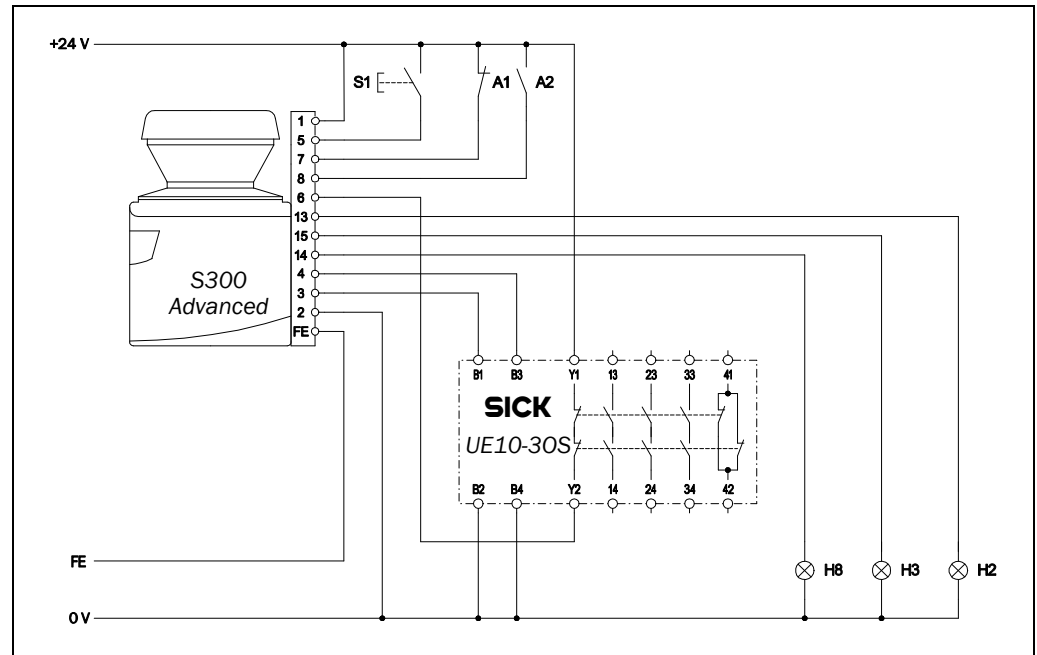


S300 Standard in conjunction with relays/contactors; operating mode: with restart interlock and external device monitoring.

S300

Fig. 68: Connection diagram for protective field switching with a static input pair

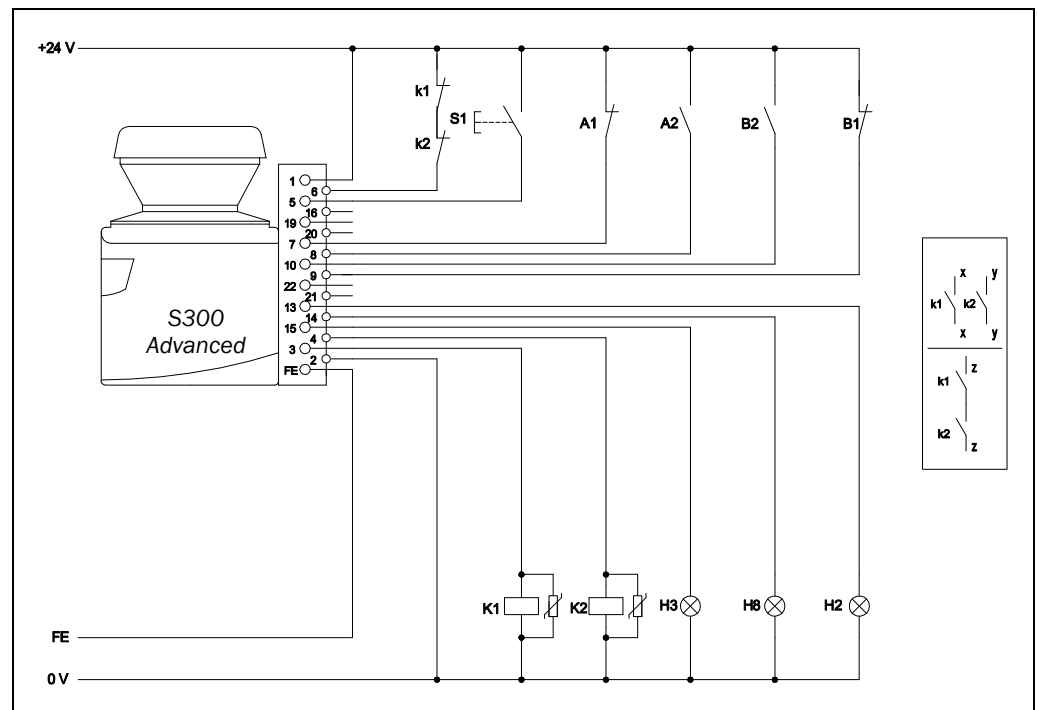
7.3.2 Protective field switching with a static input pair



S300 Advanced in conjunction with UE10-30S; operating mode: with restart interlock and external device monitoring; protective field switching by means of control input IN A. You will find more detailed information in the data sheet on the UE10 series.

Fig. 69: Connection diagram for protective field switching using two static input pairs

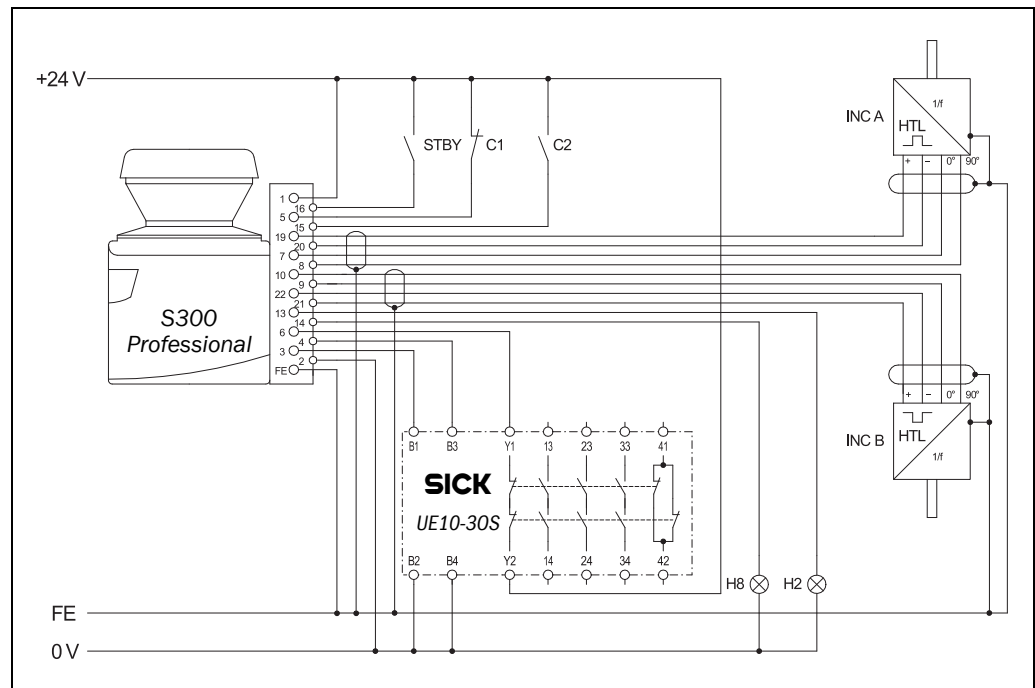
7.3.3 Protective field switching with two static input pairs



S300 Advanced in conjunction with relays/contactors; operating mode: with restart interlock and external device monitoring; protective field switching by means of control inputs IN A and IN B.

7.3.4 Protective field switching with static and dynamic inputs

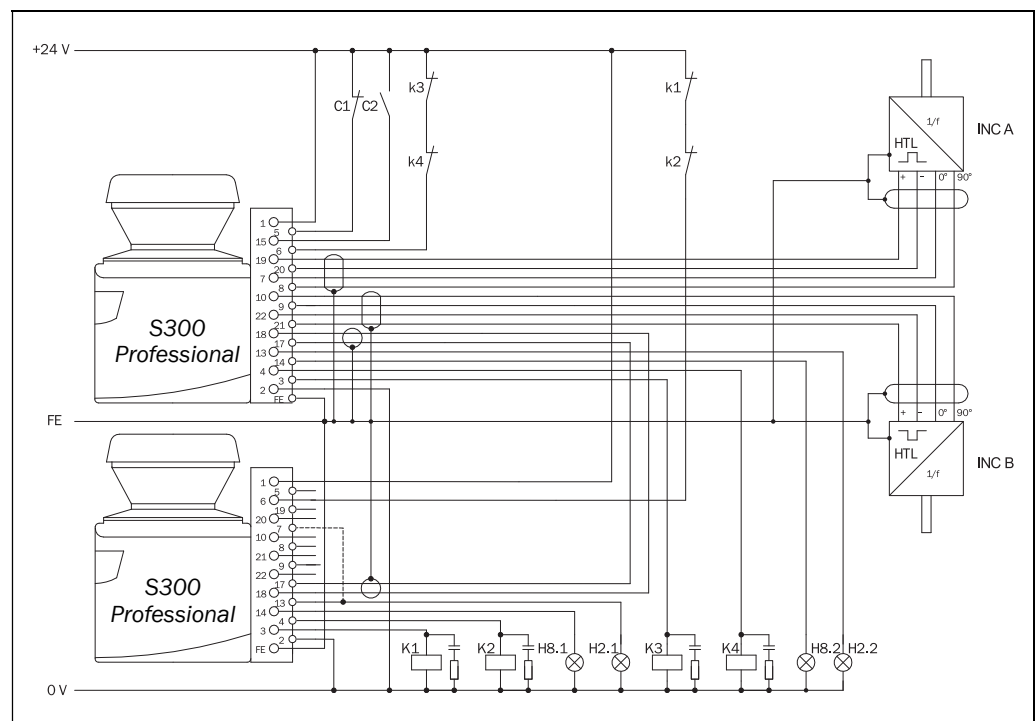
Fig. 70: Connection diagram for protective field switching using static and dynamic inputs



S300 Professional in conjunction with UE10-30S; operating mode: without restart interlock with external device monitoring; dynamic protective field switching by the incremental encoders A and B as well as static protective field switching by the control input IN C.

7.3.5 Protective field switching between two S300 with dynamic and static inputs

Fig. 71: Connection diagram for protective field switching between two S300 with dynamic and static inputs

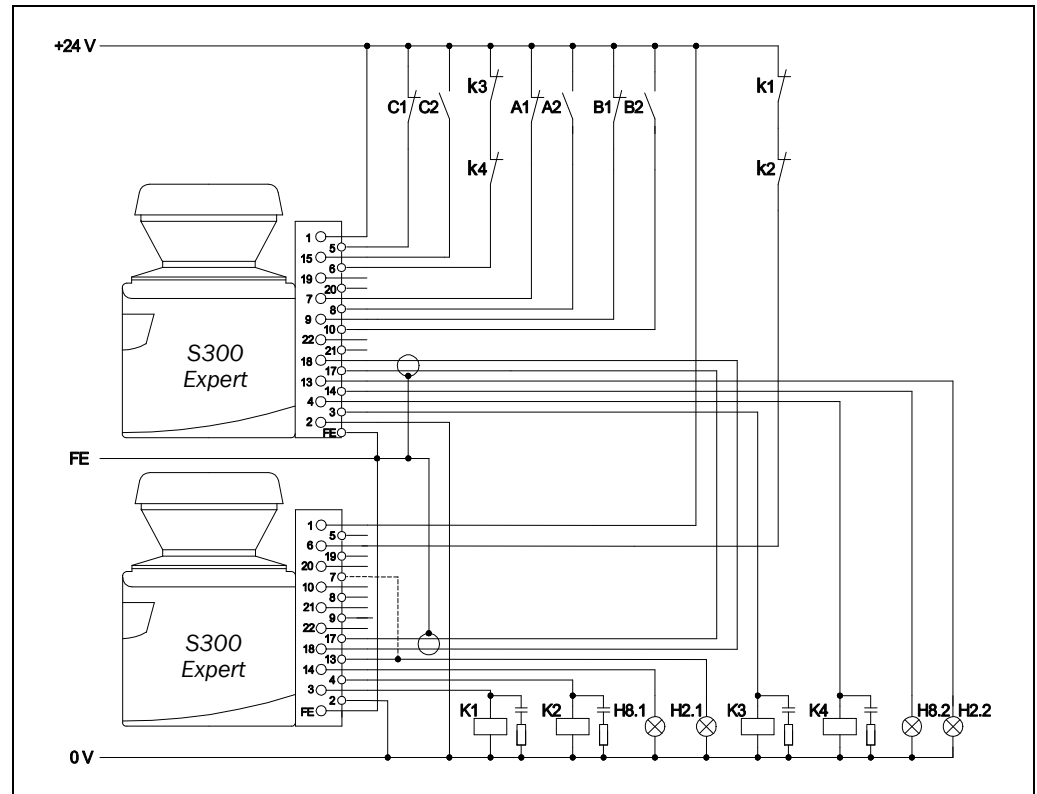


S300 Professional with S300 Professional in host/guest conjunction with relays/contactors; operating mode: without restart interlock with external device monitoring; dynamic protective field switching by the incremental encoders A and B on the host; static protective field switching using the control input IN C on the host. The protective fields affect the related OSSDs on host or guest.

S300

Fig. 72: Connection diagram for protective field switching between two S300 using static inputs

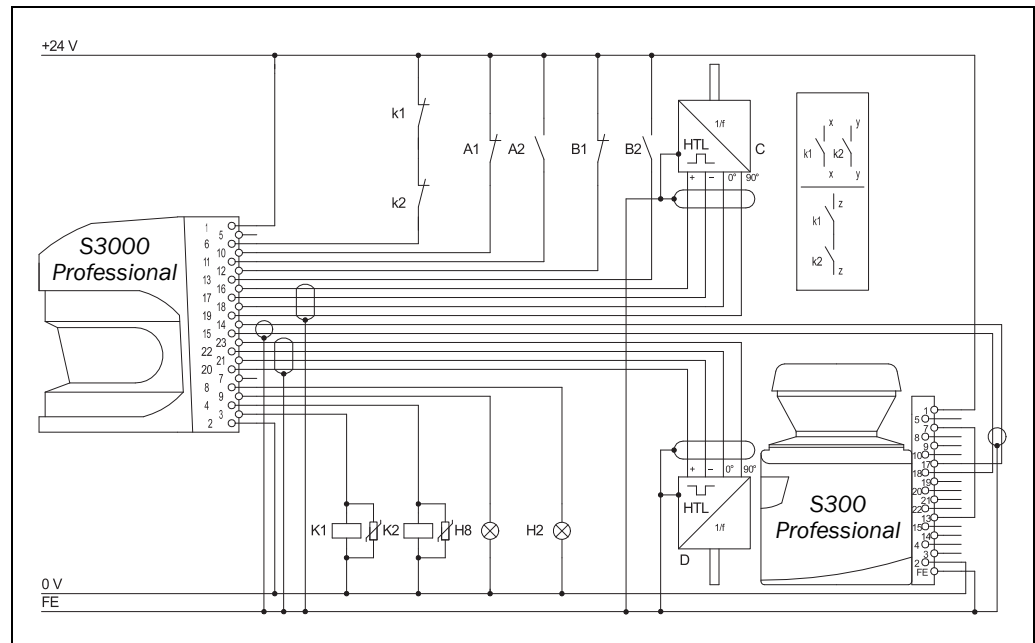
7.3.6 Protective field switching between two S300 with static inputs



S300 Expert with S300 Expert in host/guest conjunction with relays/contactors; operating mode: without restart interlock with external device monitoring; static protective field switching via inputs A, B and C. The protective fields affect the related OSSDs on host or guest.

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

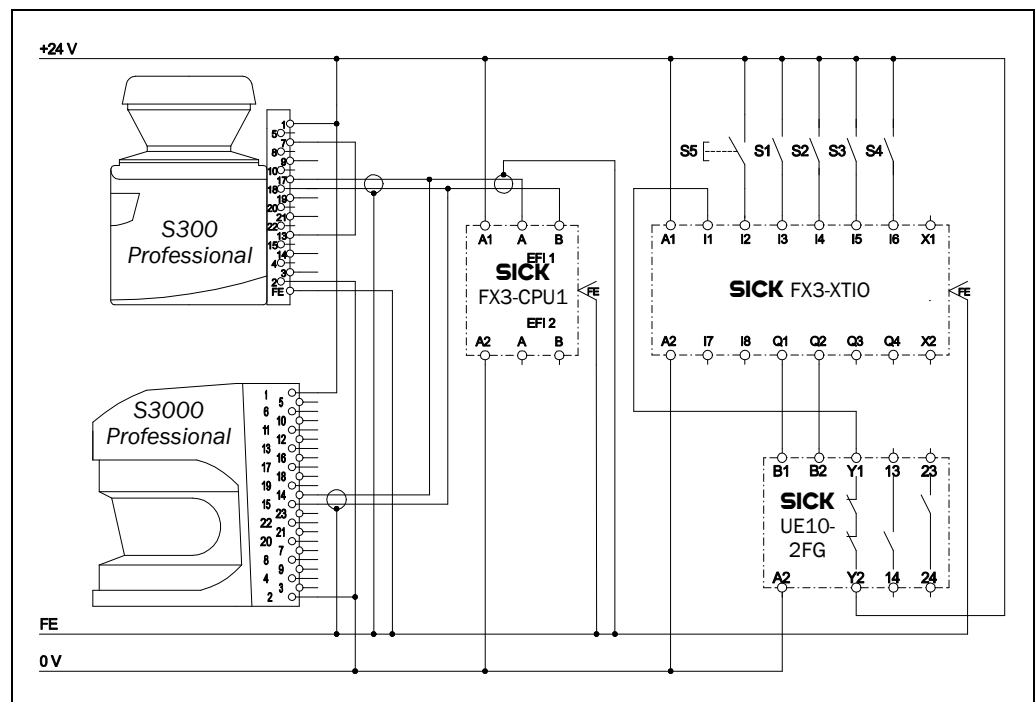
Fig. 73: Connection diagram for protective field switching between an S3000 and an S300 using static and dynamic inputs



S3000 Professional with S300 Professional in host/guest 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 host

7.3.8 Protective field switching with a Flexi Soft safety controller

Fig. 74: Connection diagram protective field switching between S3000 and S300 using a Flexi Soft safety controller





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

8 Configuration

8.1 Default delivery status

The S300 is delivered in a non-configured default state.

- The operational status is **Waiting for configuration**.
- The output signal switching devices (OSSDs) are in the OFF state, the red LED illuminates: .
- The 7-segment display indicates .

8.2 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.

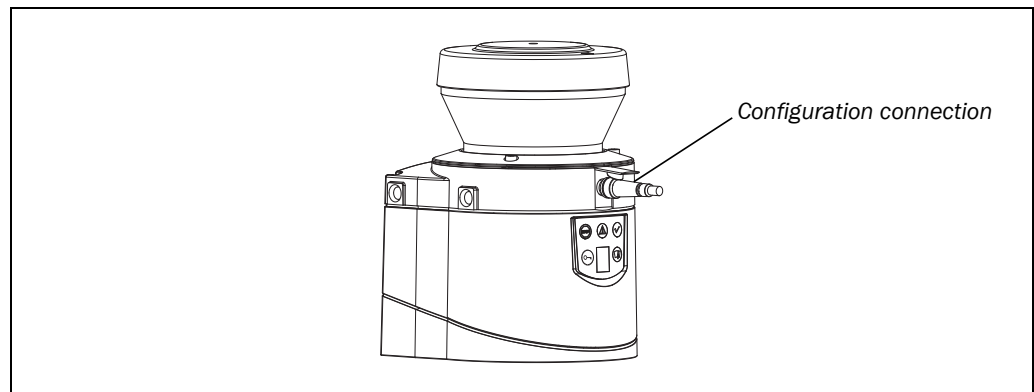
To configure the safety laser scanner you need:

- CDS (Configuration & Diagnostic Software) on CD-ROM, version $\geq 3.6.7$
- user manual for CDS on CD-ROM
- PC/Notebook with Windows NT 4/2000 Professional/XP/Vista/7 (32 Bit) and a serial RS-232 interface (PC/notebook not included)
- service cable for connecting PC and S300 (not included)

How to configure the S300 with the aid of the CDS:

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

Fig. 75: Configuration connection



Two service cables of different length are available for the connection of the PC/notebook to the S300 (see 13.3 on page 135).

- Notes**
- Ensure that the service cable is not laid in close proximity to high power electrical drives or cables carrying high power. In this way you will avoid EMC effects on the service cable.
 - The service cable is only allowed to be connected for configuration and diagnostics. The service cable must be disconnected and the protective cap fitted in operation.

To configure the device, please read the user manual for the CDS (Configuration & Diagnostic Software) and use the online help function of the program.

- Note**
- Use the password function in the CDS and protect the configuration settings from unauthorized access. Also ensure that the passwords are stored protected from unauthorized access.

9 Commissioning

9.1 Initial commissioning



WARNING

Commissioning requires a thorough check by qualified safety personnel!

Before you operate a system protected by the S300 safety laser scanner for the first time, make sure that the system is first checked and released by qualified safety personnel. The result of the test must be documented. Please pay attention to the notes in chapter 2 “On safety” on page 10.

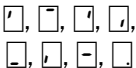

- Prior to releasing the machine, check whether the access to the hazardous area or the hazardous point is completely monitored by the protective devices. Following approval of the machine also check at regular intervals (e.g. in the morning at the start of work) whether the S300 correctly switches the OSSDs to the OFF state 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 section 9.2 “Test notes” on page 100).

9.1.1 Power-up sequence
















After power up the S300 runs through a power up cycle. During the power up cycle, the 7-segment display indicates the device status.

During the initial commissioning of an S300 the following indications are possible:

Tab. 27: 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 section 11.4 “Error and status indications on the 7-segment display” on page 110.

Tab. 28: LED indication after the power up sequence

Step	Display					Meaning
1						Device self-test
2						Device self-test
3						Device status waiting for configuration or object in the protective field, OSSDs in the OFF state
	Other display					Safety lock activated. Malfunction (see section 11.3 “Error and status indications on the LEDs” on page 108)

Note The duration of power up depends on the volume of the configuration data and can take up to 25 seconds.

9.2 Test notes

9.2.1 Pre-commissioning tests

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



WARNING

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

Always expect that the machine, system 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 14.2 “Checklist for the manufacturer” on page 140).
- Ensure that the operating personnel of the machine protected by the safety laser scanner are correctly instructed by qualified safety personnel before being allowed to operate the machine. Instructing the operating personnel is the responsibility of the machine owner.
- Ensure that the information label **Important information**, which is included with the safety laser 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 before commissioning the system for the first time (see section 14.2 “Checklist for the manufacturer” on page 140).
- Document the adjustment of the safety laser 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 safety laser scanner (including protective field shapes) and include these with the documentation.

Recommendation ➤ Use the **Create development dump...** function in the CDS (right click on the COM interface to which the safety laser scanner is connected). You can keep these data as a backup and in this way document the state during initial commissioning at any time.

Note Your SICK representative will be pleased to provide you with advice on initial commissioning.

9.2.2 Regular inspection of the protective device by qualified safety 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 initial 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 system again as per the checklist in the annex (see section 14.2 “Checklist for the manufacturer” on page 140).

9.2.3 Daily testing of the protective device by a specialist or authorized personnel

The effectiveness of the protective device must be checked daily by a specialist or by authorized 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 S300 must be checked by qualified safety personnel (see section 9.2.2 “Regular inspection of the protective device by qualified safety personnel” on page 100).

- 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 is properly aligned S300.
- Check each S300 device for visible changes such as damage, manipulation etc.
- Switch on the machine/system.
- Watch the LEDs on each S300.
- If not at least one LED of each S300 is permanently lit when the machine/system is switched on, it is to be assumed that there is a fault in the machine or system. In this case the machine must be shut down immediately and checked by qualified safety personnel.
- Deliberately infringe the protective field without risk to any personnel while the machine is running in order to test the protective function for the entire system. The LEDs of the S300 must change from green to red and the dangerous movement must stop immediately. If the S300, with the protective field that you are interrupting, switches the OSSDs on another device (see 4.6 “OSSDs” on page 39), then on this device the LEDs must change from green to red and the dangerous movement on the machine or system connected must come to an immediate stop.
- Repeat this test at different points in the hazardous area and on all S300 devices. If you discover any non-conformance of this function, the machine/system must be shut down immediately and checked by qualified safety personnel.
- For stationary applications, check that the hazardous areas marked out on the floor match the shapes of the protective fields stored in the S300 and that any gaps are protected by additional safety measures. In the case of mobile applications, check that the moving vehicle actually stops in a timely manner at the protective field boundaries which are set in the S300 and listed on the information label on the vehicle or in the configuration protocol. If you discover any non-conformance of this function, the machine/system/vehicle must be stopped immediately and checked by qualified safety personnel.

9.3 Re-commissioning

If the S300 has already been placed in operation once, however the device has been temporarily replaced in the meantime, the S300 reads the configuration saved from the system connector remaining on the machine or system. In this case acceptance by qualified safety personnel is not necessary. However, the test in accordance with the regulations for the daily test must be performed (see section 9.2.3 “Daily testing of the protective device by a specialist or authorized personnel” on page 101).

The following indications are possible:

Tab. 29: 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		Waiting for device on the EFI (only possible with S300 Advanced and Professional)
3 ¹⁵⁾	 or 	Device addressed as host Device addressed as guest
4		Waiting for valid inputs
5	No display or or or 	Device ready for operation Device ready for operation but object in the protective field Device ready for operation but object in the warning field Device ready for operation but object in the protective field (in compatibility mode)
	Other display	Safety lock activated. Malfunction (see section 11.3 “Error and status indications on the LEDs” on page 108).

Tab. 30: 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.
					The device is operational, object in warning field.
					The device is operational, no object in protective field and warning field.
					The device is operational, no object in protective field and warning field. Reset required
Other display					Safety lock activated. Malfunction (see section 11.3 “Error and status indications on the LEDs” on page 108)

¹⁵⁾ Only in an EFI system.

10 Maintenance and care

**WARNING****Do not make any repairs to the device!**

The S300 does not contain any repairable components. For this reason do not open the S300 components and only replace the parts that are described in the following chapters as replaceable.

Switch the entire machine/system off line!

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

10.1 Cleaning optics cover

The S300 safety laser scanner is largely maintenance-free. The optics cover on the safety laser scanner should however be cleaned regularly and if it is contaminated.

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

Note Static charges cause dust particles to be attracted to the optics cover. 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 13.3 “Accessories/spare parts” on page 135).

How to clean the optics cover:

- Use a clean and soft brush to remove dust from the optics cover.
- Moisten the SICK optics cloth with the anti-static plastic cleaner and wipe off the window for light output on the optics cover with the cloth.

10.2 Replacing the optics cover



WARNING

Perform an optics cover calibration with the aid of the CDS after the replacement of the optics cover!

The level of contamination is measured continuously during the operation of the S300. For this purpose the optics cover calibration must first be performed; this then serves as a reference for the contamination measurement (status = not contaminated).

The optics cover calibration is only allowed to be performed with a new optics cover! The new optics cover must be free of contamination at the time of the optics cover calibration. The optics cover calibration must be performed at room temperature (10-30 °C)!

If the optics cover is scratched or damaged, you must replace the optics cover. Order the replacement optics cover from SICK (see section 13.3 “Accessories/spare parts” on page 135).

Notes

- The optics cover on the S300 is an optical part that must not be soiled or scratched on replacement.
- The optics cover is only allowed to be replaced by specialist personnel in a dust and dirt-free environment.
- Never replace the optics cover during ongoing operation, as internal parts may be irreparably damaged in certain circumstances and dust particles may enter the device.
- It is imperative that you avoid contamination of the inside, e.g. with fingerprints.
- Do not use any additional sealant for sealing the optics cover, e.g. silicon, as these substances may affect the optics.
- Mount the optics cover as per the following instructions to ensure that the housing is sealed to IP 65.

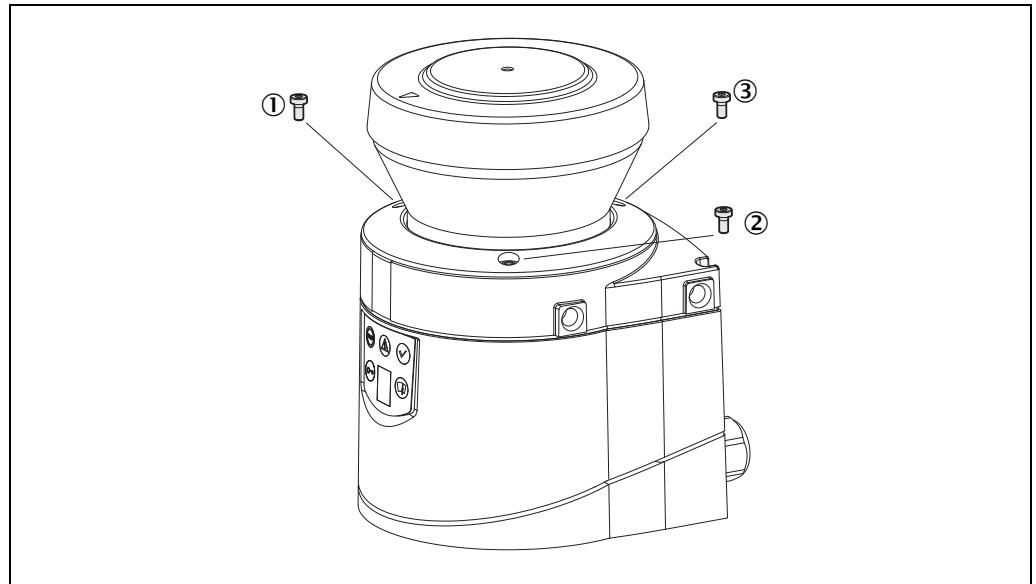
How to replace the optics cover:

Notes

- Only use a **new** optics cover (see 13.3.9 on page 138).
- When replacing the optics cover, take ESD protection measures.
- Set a torque wrench to 1.2 Nm (hand-tight) and have this at hand.
- Disconnect the system plug and remove the S300.
- Take the S300 to a clean place (office, repair shop or similar).
- First clean the outside of the S300. This prevents foreign bodies entering the device when it is opened.
- Undo the fixing screws ① to ③ for the optics cover.

S300

Fig. 76: Undo the fixing screws for the optics cover



- Then remove the optics cover.
- Check whether the mirror on the motor is clean and remove any contamination with an optic brush.
- Take the new optics cover out of the packaging and remove the protection for the seal.
- Remove any remnants of packaging.
- Place the optics cover on the safety laser scanner and fit the new fixing screws ① to ③.
- When fitting the new cover, ensure the arrow on the top of the cover points to the front and that the optics cover is fully in contact **without** a gap.
- Then tighten the screws with the tightening torque set.
- Make sure the optics cover is free of dirt and that it is not damaged.

Re-commissioning the S300:

- Correctly re-mount the S300 (see chapter 5 “Mounting” on page 56).
- Connect the S300 system plug.
After power up the S300 automatically reads the saved configuration from the system plug (see section 9.3 “Re-commissioning” on page 102).
- Then perform an optics cover calibration with the aid of the CDS.



10.3 Replacing the device

The S300 has a configuration memory in the system plug. In case of device replacement, the existing configuration is automatically transferred to the S300 newly connected.

How to replace the S300:


- Remove the system plug.
- Remove the S300.
- Correctly re-mount the new S300 (see chapter 5 “Mounting” on page 56).
- Connect the S300 system plug.
After power up the S300 automatically reads the saved configuration from the system plug (see section 9.3 “Re-commissioning” on page 102).
- Carry out the thorough check as per the regulations to the daily check (see section 9.2.3 “Daily testing of the protective device by a specialist or authorized personnel” on page 101).

Compatibility mode

If a new device is connected to an older system plug, the new device will operate automatically in compatibility mode (see section 4.1 on page 29).

Reasons for the activation of the compatibility mode

- System plug serial number < 12210000
- System plug, in which a configuration is saved, ...
 - that only supports the compatibility mode.
 - that has been configured in the compatibility mode.
 - that has been configured with a CDS version < 3.6.7.

Note If compatibility cannot be established, e.g. if you replace an S300 Professional with an S300 Advanced, the device switches to the “Waiting for configuration” state. In this case the 7-segment display indicates .

11 Diagnostics

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

11.1 In the event of faults or errors



WARNING

Do not operate if behavior is unclear!

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

Repair only by authorized persons!

The improper repair of the protective device can result in the loss of the protective function. The protective device is only allowed to be repaired by the manufacturer or persons authorized by the manufacturer.

11.2 SICK support

If you cannot rectify 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 representative 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 representative

11.3 Error and status indications on the LEDs

This section describes the meaning of the error and status indications of the LEDs and how you can respond. You will find a description of the indicators in section 3.4 “Status indicators” on page 24, the connections for the outputs in section 6.1 “System connection” on page 81.

Tab. 31: Error and status indications on the LEDs

Display	Output level	Possible cause	Rectification of the error
	At the OSSDs 	Object in the protective field, OSSDs in the OFF state	No error
	At the OSSDs 	Protective field unoccupied, OSSDs in ON state	No error
	On the respective universal I/O ¹⁶⁾ 	Object in one of the warning fields	No error
	At the OSSDs On all universal I/Os 	No operating voltage, or voltage too low	➤ Check the voltage supply and activate, if necessary.
	On the universal I/O ¹⁷⁾ 	Reset required	➤ Operate the control switch for restart or reset.
	On the universal I/O ¹⁸⁾ 	No error	
	On the universal I/O ¹⁹⁾ 	Optics cover contaminated, no operation	➤ Clean the optics cover.
	On the universal I/O ²⁰⁾ 	Optics cover contaminated, still in operation	➤ Clean the optics cover.

¹⁶⁾ Depending on which is configured for warning field 1 or 2.

¹⁷⁾ If one of the universal I/Os is configured as output for “Reset required”.


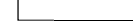
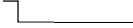



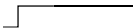






¹⁸⁾ If one of the universal I/Os is configured as output for a contamination error/warning.

¹⁹⁾ If one of the universal I/Os is configured as output for a contamination error.

²⁰⁾ If one of the universal I/Os is configured as output for a contamination error.

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Tab. 32: Error and status indications of the LEDs in the compatibility mode

Display	Output level	Possible cause	Rectification of the error
	At the OSSDs  On the application diagnostic output 	No operating voltage, or voltage too low	➤ Check the voltage supply and activate, if necessary.
	At the Res_Req output  1 Hz	Reset required	➤ Operate the control switch for restart or reset.
	On the Error/contamination output 	No error	
	On the application diagnostic output 	Optics cover contaminated, no operation	➤ Clean the optics cover.
	On the application diagnostic output  1 Hz	Optics cover contaminated, still in operation	➤ Clean the optics cover.
	On the 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.

11.4 Error and status indications on the 7-segment display

This section explains the meaning of the error indications on the 7-segment display and how to respond to the messages. You will find a description of the positions and symbols on the S300 in section 3.4 "Status indicators" on page 24.

The lock-out operational status

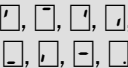






In case of certain faults or an erroneous configuration, the device can go into the lock-out operational status. To place the device back in operation, proceed as follows:











- Rectify the cause of the fault as per Tab. 33.
- Switch off the power supply for the S300, 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.













Tab. 33: Error and status indications on the 7-segment display

Display	Possible cause	Rectification of the error
	Power-up cycle — all segments are activated sequentially.	No error
	Object in protective field	No error
	Object in warning field 1	No error
	Object in warning field 2	No error
	Object in protective field (in compatibility mode)	No error
	Initialization of the device or Waiting for the end of the initialization of a second device connected to the EFI	<ul style="list-style-type: none"> ➤ The display goes out automatically when the S300 has been initialized and/or the connection to the second device has been made. If the display  does not go off: <ul style="list-style-type: none"> ➤ Check whether the partner device is in operation. ➤ Check the wiring. If no partner device is connected: <ul style="list-style-type: none"> ➤ Check the system configuration with the aid of the CDS. Transfer the corrected configuration to the S300 again.

Display	Possible cause	Rectification of the error
	Waiting for valid input signals	<p>➤ The indication extinguishes automatically if an input signal is present that corresponds to the configured evaluation type (1-of-n or complementary).</p> <p>If the display  does not go off:</p> <p>➤ Check the wiring.</p> <p>➤ Check the control signals for correct switching behavior.</p> <p>➤ Check, if velocity ranges are used for monitoring case switching, whether the EFI status information Speed valid is transferred (see Tab. 37 on page 131).</p> <p>➤ Check the system configuration with the aid of the CDS. Transfer the corrected configuration to the S300 again.</p>
	Waiting for configuration or configuration not completed	<p>➤ The display goes off automatically once the configuration has been successfully transferred.</p> <p>If the display  does not go off:</p> <p>➤ Check the system configuration with the aid of the CDS. Transfer the corrected configuration to the S300 again.</p> <p>➤ Check whether the configuration saved in the system plug is compatible with the S300 (see 10.3 on page 106).</p>
	Waiting for restart of the device	<p>➤ Switch off the voltage supply for the S300 for at least 2 seconds and then switch it back on.</p>
 or 	Error of the external device monitoring (EDM)	<p>➤ Check whether the contactors are working correctly or if they are wired incorrectly and rectify any error.</p> <p>➤ If  is displayed: also switch off the voltage supply for the S300 for at least 2 seconds and switch it back on.</p>
	Error in the control switch for restart or reset	<p>➤ Check the functionality of the control switch. The button may be defective or permanently operated.</p> <p>➤ Check the wiring of the control switch for short-circuit to 24 V.</p>
	Velocity tolerance exceeded: The difference between the velocities measured by the incremental encoders is too large.	<p>➤ Check the incremental encoders.</p> <p>➤ Check the configuration of the incremental encoder inputs with the aid of the CDS.</p>

Display	Possible cause	Rectification of the error
	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 INC1 exceeded	➤ Check the function of the incremental encoders.
	Maximum frequency at input INC2 exceeded	➤ Check the configuration of the incremental encoder inputs with the aid of the CDS. ➤ Check whether the permitted maximum velocity of the vehicle is exceeded!
	S300 faulty	➤ Switch off the voltage supply for the S300 for at least 2 seconds and then switch it back on.
	Configuration memory in the system plug faulty	If the display does not go off: ➤ Send the S300 or the system plug to the manufacturer for repair.
	A second device which is connected via EFI is faulty.	➤ Check the connected device and the connection.
	Overcurrent on OSSD connection 1	➤ Check the switching element connected (contactor, relay). 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.
	Overcurrent on OSSD connection 2	➤ Check the switching element connected (contactor, relay). 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 guest	No error. The symbol is displayed for approx. 2 seconds on switching on a device that is addressed as a guest.
	Device is addressed as host	No error. The symbol is displayed for approx. 2 seconds on switching on a device that is addressed as a host.

Display	Possible cause	Rectification of the error
  	The S300 is receiving no measured values within a range of at least 90° (measuring range maximum 29.9 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 S300 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 S300 has exceeded the permissible range.	➤ Check whether the S300 is operated as per the permissible ambient conditions.
  	Invalid configuration of the EDM	➤ Verify that the machine-side EDM is connected correctly.
  	The addresses of both the host device and the guest device may have been set to guest. A device connected via EFI or the connection to the device is defective or disrupted.	➤ Disconnect the connection to the host device (see section 6.1.1 on page 82). ➤ Check the connected device and the connection to this device.
  	Undervoltage of the supply voltage	➤ Check the power supply or the connecting cables.
  	There is a short-circuit between the input for the control switch for restart or reset and another input or output.	➤ Check the wiring for cross-circuits.
  	Input signal for an undefined monitoring case	➤ Check the path of the vehicle. Or: ➤ Check the operating process of the monitored machine or system.
  	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.

Display	Possible cause	Rectification of the error
	Short-circuit on control inputs A1/2 or incorrect operation of A1/2 via EFI	➤ Check the wiring, the digital control inputs or the wiring to the devices connected via EFI.
	Short-circuit on control inputs B1/2 or incorrect operation of B1/2 via EFI	
	Short-circuit on control inputs C1/2 or incorrect operation of C1/2 via EFI	
	Incorrect operation of D1/2 via EFI	
	Incorrect operation of E1/2 via EFI	
	Park/stand-by mode, the OSSDs are in the OFF state; the laser is deactivated.	No error. If the criteria for the park mode or the stand-by mode are withdrawn, readiness for operation is re-established. If the display  does not go off: ➤ Test the level(s) at the STBY input and at the control inputs that switch to the monitoring case with park mode.
	A device connected via EFI reports a malfunction.	➤ Carry out a fault diagnosis of the device connected with the S300.
	Optics cover calibration active	No error
	Window for light output on the optics cover contaminated	➤ Clean the window for the light output on the optics cover.
 and 	Dazzling of the contamination measurement (there may not be an optics cover fitted)	➤ Check whether the S300 is being dazzled by an external light source, e.g. headlight, infrared light source, stroboscopic light, sun etc. Or: ➤ Fit the new optics cover (then perform optics cover calibration).

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.

11.5 Extended diagnostics

The CDS software supplied with the device (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 for the CDS (Configuration & Diagnostic Software).
- in the user manual for the CDS.

12 Technical specifications

12.1 Characteristics

Fig. 77: Diagram scanning range S300 Medium Range

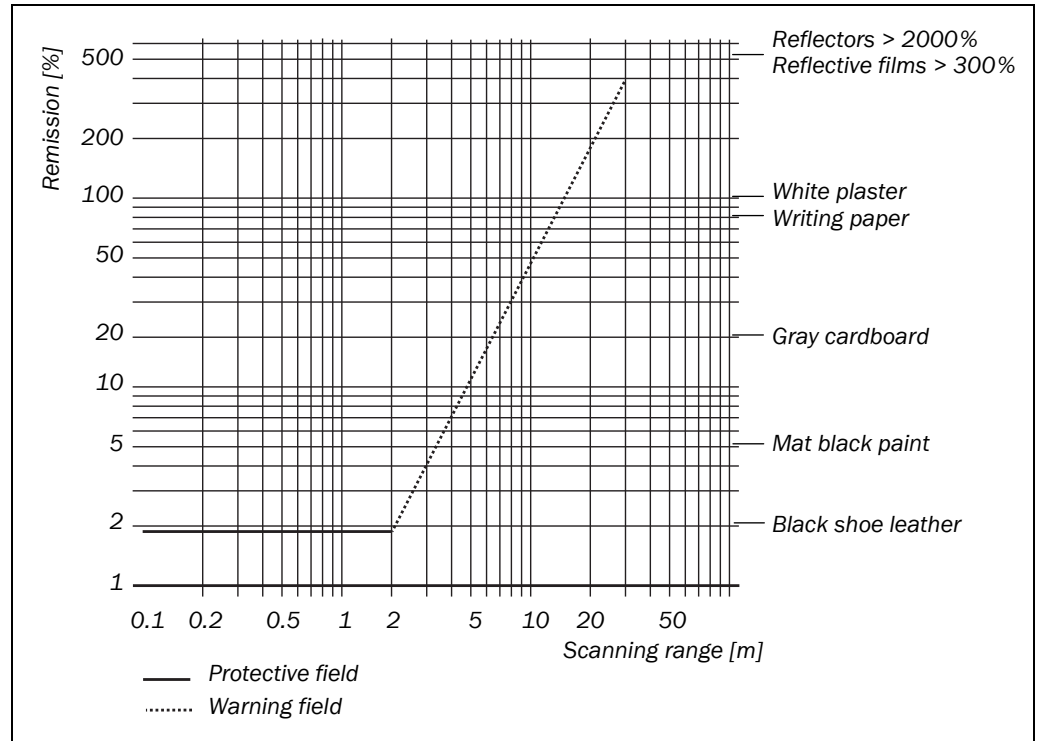
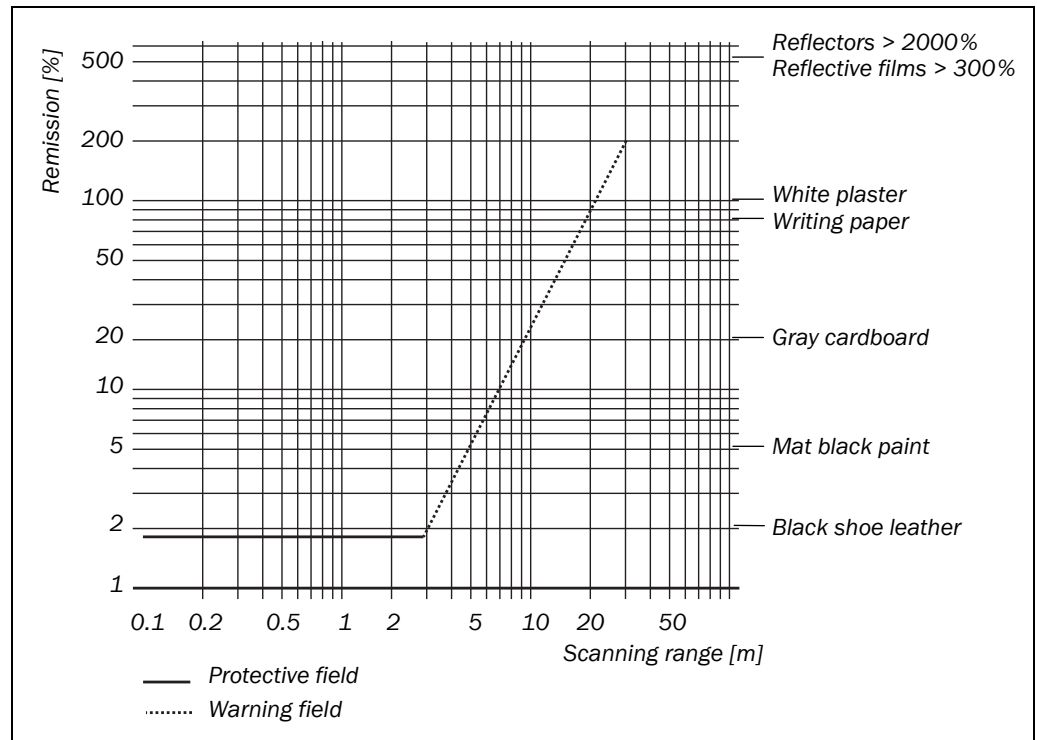


Fig. 78: Diagram scanning range S300 Long Range



12.2 OSSD response times

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

- the basic response time of the S300.
- the multiple sampling set.
- the OSSDs used.

How to calculate the total response time T_S :

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

Where ...

t_B = Basic response time = 80 ms

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

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

Multiple sampling

On the S300 at least double multiple sampling is always set. For a multiple sampling of 3 or higher you must add a supplement of 80 ms to the basic response time.

Tab. 34: Supplements for multiple sampling

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

External OSSDs

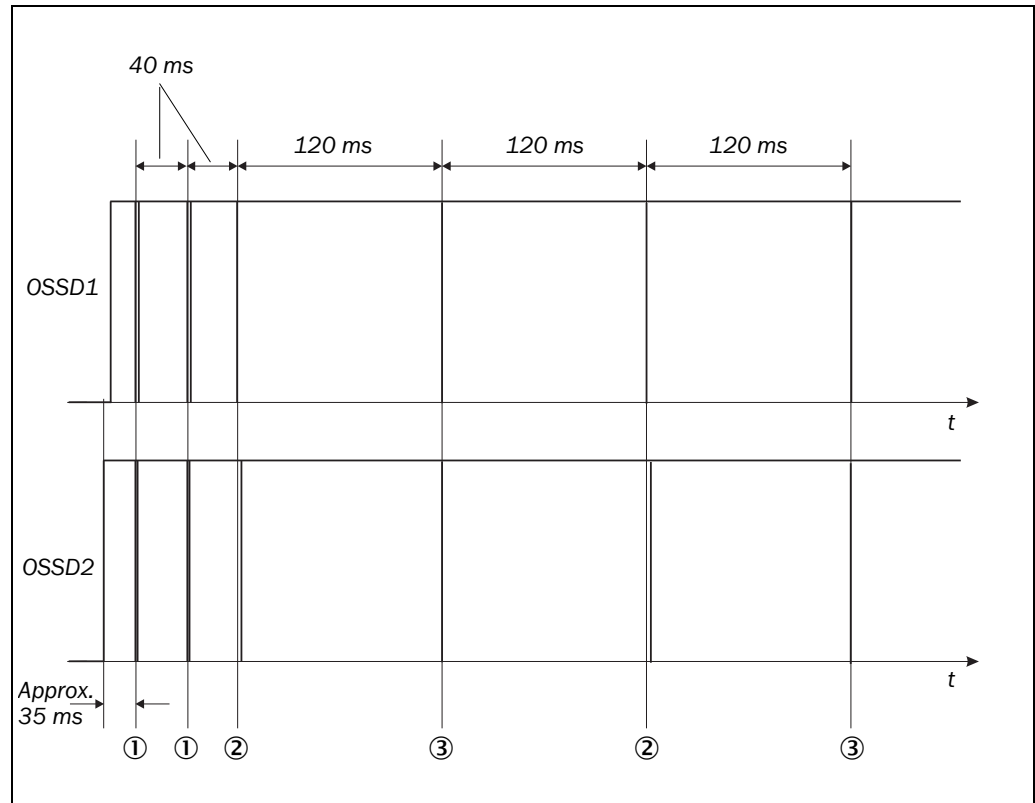
If you use the OSSDs on another device via EFI as external output signal switching devices (for example with two S300 connected together), the response time increases by 20 ms in each case.

12.3 Timing behavior of the OSSDs

The S300 tests the OSSDs immediately after switch on and then at regular intervals. For this purpose the S300 briefly switches off both OSSDs (for 300 µs) and checks whether the OSSDs switch to the OFF state during this time.

Note Ensure that the safety inputs on the controller used do not respond to these test pulses and as a result cause the machine or system to unintentionally shutdown!

Fig. 79: Diagram of the test pulses at the OSSDs



Approx. 35 ms after the switch on of the OSSDs, the S300 performs the first voltage test and then after a half basic response time (40 ms) performs a second voltage test.

After a further half basic response time of the S300 there is a shut-down test ②, 120 ms later a further voltage test ③. Then the S300 performs a shut-down test and a voltage test alternately at an interval of 120 ms. Fig. 80, Fig. 81 and Fig. 82 show the pulse duration for the individual tests.

S300

Fig. 80: Voltage test after switching on the OSSDs

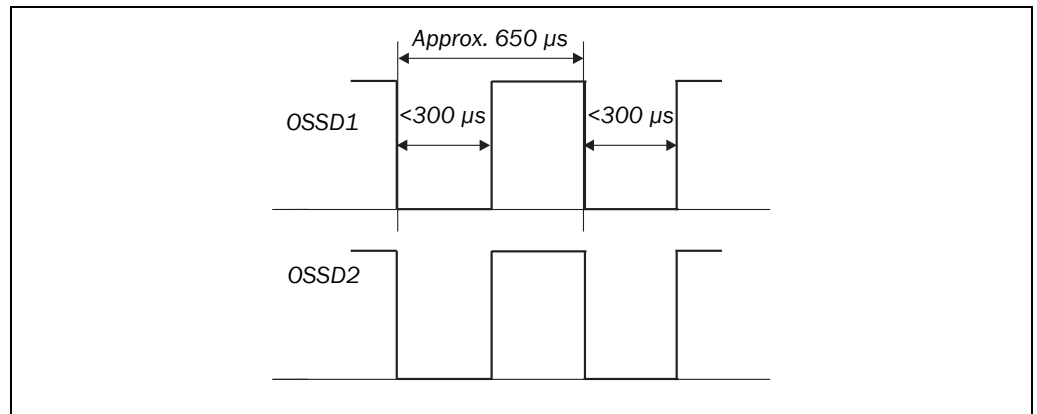


Fig. 81: Shut-down test

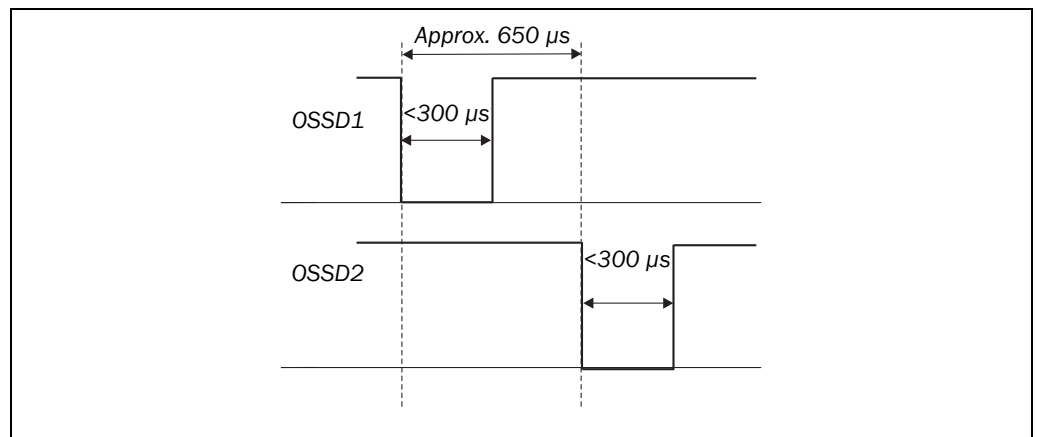
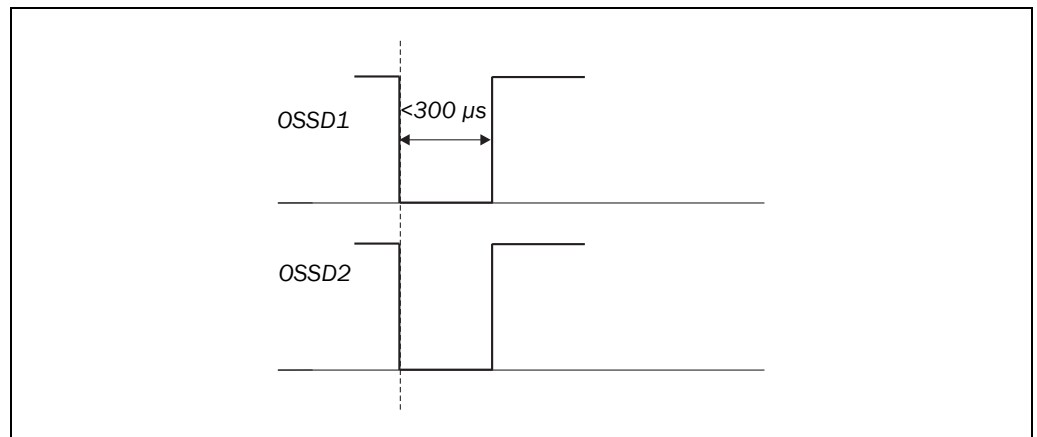


Fig. 82: Voltage test



12.4 Data sheet

Tab. 35: Data sheet S300

	Minimum	Typical	Maximum
General data			
Type	3 (IEC 61496-1)		
Safety Integrity Level ²¹⁾	SIL2 (IEC 61508)		
SIL claim limit ²¹⁾	SILCL2 (EN 62061)		
Category	Category 3 (EN ISO 13849-1)		
Performance Level ²¹⁾	PL d (EN ISO 13849)		
PFHd ($T_{amb} = 25\text{ °C}$) (mean probability of a dangerous failure per hour)			8×10^{-8}
T_M (mission time)	20 years (EN ISO 13849)		
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 S300 Medium Range	II (EN 50178)		
Protection class S300 Long Range	III (EN 50178 and EN 60950)		
Ambient operating temperature	-10 °C		+50 °C
Storage temperature range	-25 °C -25 °C		+50 °C +70 °C (≤24 h)
Humidity (taking into account the ambient operating temperature)	IEC 61496-1, section 5.1.2 and 5.4.2, as well as IEC 61496-3, section 5.4.2		
Vibration	IEC 61496-1 as well as IEC 61496-3		
Frequency range	10 Hz		150 Hz
Amplitude	0.35 mm or 5 g		
Shock resistance	IEC 61496-1, section 5.1 and 5.4.4 as well as IEC 61496-3, section 5.4.4		
Single shock	15 g, 11 ms		
Continuous shock	10 g, 16 ms		

²¹⁾ For detailed information on the safety design of your machine/system, please contact your local SICK representative.

S300

	Minimum	Typical	Maximum
Sender	Pulsed laser diode		
Wavelength	895 nm	905 nm	915 nm
Divergence of the collimated beam (solid angle)		14 mrad	
Pulse duration			5.5 ns
Average output power			3.42 mW
Light spot size at optics cover		8 mm	
Size of light spot at 2.0 m scanning range		28 mm	
Housing			
Material	Aluminium die-cast		
Color	RAL 1021 (rapeseed yellow)		
Optics cover			
Material	Polycarbonate		
Surface finish	Outside with scratch-resistant coating		
System plug	ESD protected		
Material	Aluminium die-cast		
Color	RAL 9005 (black)		
Dimensions S300 ²²⁾			
Height			152 mm
Width			102 mm
Depth			105 mm
Total weight (without connecting cables)		1.2 kg	

²²⁾ Without fixing screws and projection of cable glands with system plug mounted.

Minimum	Typical	Maximum
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Functional data

Resolution of the S300 Medium Range	30, 40, 50, 70 mm		
Protective field of the S300 Medium Range			
At 30 mm resolution			1.25 m
At 40 mm resolution			1.60 m
At 50 mm resolution			2.00 m
At 70 mm resolution			2.00 m
Resolution of the S300 Long Range	30, 40, 50, 70, 150 mm		
Protective field of the S300 Long Range			
at 30 mm resolution			1.25 m
at 40 mm resolution			1.60 m
at 50 mm resolution			2.10 m
at 70 mm resolution			3.00 m
at 150 mm resolution			3.00 m
Scan angle			270°
Remission	1.8 %		Several 1000 % (re-flectors ²³⁾)
Angular resolution		0.5°	
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 on data output via RS-422 (S300 Medium Range up to 2 m in the specified remission range)			
Systematic error		±20 mm	
Statistical incl. systematic errors			
at 1 σ		±28 mm	
at 2 σ		±36 mm	
at 3 σ		±44 mm	
at 4 σ		±52 mm	
at 5 σ		±60 mm	

²³⁾ Complies with Diamond Grade 3000X™ (approx. 1250 cd/lx × m²).

	Minimum	Typical	Maximum
Measurement error on data output via RS-422 (S300 Long Range up to 3 m in the specified remission range)			
Systematic error		±20 mm	
Statistical incl. systematic errors			
at 1 σ		±29 mm	
at 2 σ		±38 mm	
at 3 σ		±47 mm	
at 4 σ		±56 mm	
at 5 σ		±65 mm	
Evenness of the scan field at 2 m			±50 mm
Distance from mirror axis of rotation (zero point on the X and Y axis) to the rear of the device		55 mm	
Distance between centre of the scan plane and the bottom edge of the housing		116 mm	
Warning field ²⁴⁾		8 m	
Distance measuring range			30 m
Number of multiple samplings (configurable via CDS)	2		16
Power-up delay			
Of a configured device		15 s	
If the configuration is read from the system plug			25 s
Restart after (configurable)	2 s		60 s
Basic response time	80 ms		

²⁴⁾ The detection capability of the warning field is dependent on the remission of the objects to be detected (see section 12.1 on page 116).

Minimum	Typical	Maximum
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Electrical data

Supply voltage (SELV) ²⁵⁾²⁶⁾	16.8 V	24 V	30 V
Permissible residual ripple ²⁷⁾			±5 %
Switch on current ²⁸⁾			2 A
Operating current without output load ²⁹⁾		0.25 A	0.33 A
Operating current with max. output load ²⁹⁾			1.7 A
Power consumption without output load ²⁹⁾		6 W	8 W
Power consumption with maximum output load ²⁹⁾			41 W
Power consumption in the stand-by mode or park mode without output load ²⁹⁾		6 W	8 W
Electrical connection	System plug with screw terminal connections		
Technical specifications, screw type terminal FE			
Cross-section of rigid cores	0.3 mm ²		1.6 mm ²
Cross-section of flexible cores ³⁰⁾	0.3 mm ²		1.6 mm ²
American Wire Gauge (AWG)	22		14
Insulation stripping length for the cores		5 mm	
Screw tightening torque			0.5 Nm
Technical specifications, screw terminals			
Cross-section of rigid cores	0.14 mm ²		1.5 mm ²
Cross-section of flexible cores ³¹⁾	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		0.3 Nm
Cable length for power supply tolerance ±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 ±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

²⁵⁾ Operation only in a short-circuit protected system with max. 8 A.

²⁶⁾ To meet the requirements of the relevant product standards (e.g. IEC 61496-1), the external voltage supply for the devices (SELV) must be able to bridge a brief mains failure of 20 ms. Power supplies according to EN 60204-1 satisfy this requirement. Suitable power supplies are available as accessories from SICK.

²⁷⁾ The absolute voltage level must not drop below the specified minimum voltage.

²⁸⁾ The load currents for the input capacitors are not taken into account.

²⁹⁾ With a typical supply voltage of 24 V.

³⁰⁾ Core terminating sleeves are not required.

³¹⁾ Core terminating sleeves are not required.

	Minimum	Typical	Maximum
Cable length for power supply tolerance $\pm 1\%$ For wire cross-section 1 mm ² For wire cross-section 0.5 mm ² For wire cross-section 0.25 mm ²			70 m 35 m 17 m
UNI-I/O1 and UNI-I/O2 Input resistance when HIGH Voltage for HIGH Voltage for LOW Input capacitance Static input current When used for Reset Actuating time of the control switch	11 V -3 V 6 mA 200 ms	2 k Ω 24 V 0 V 15 nF 	30 V 5 V 15 mA
When used for EDM Permissible contactor dropout time Permissible contactor pull in time			300 ms 300 ms
UNI-I/O3, UNI-I/O4 und UNI-I/O5 HIGH switching voltage at 200 mA Source switching current Current limiting (after 5 ms at 25 °C) Power up delay Switch off delay	$V_S - 3.3\text{ V}$ 600 mA	100 mA 1.4 ms 0.7 ms	V_S 200 mA 920 mA 2 ms 2 ms
Response time UNI-I/O3, UNI-I/O4 and UNI-I/O5 on configuration as warning field output	Corresponds to the resulting response time of the OSSDs plus 50 ms		
Stand-by mode input Input resistance when HIGH Voltage for HIGH Voltage for LOW Input capacitance Static input current Stand-by mode activation Stand-by mode deactivation	11 V -3 V 6 mA 200 ms	2 k Ω 24 V 0 V 15 nF 	30 V 5 V 15 mA 80 ms 250 ms
Static control inputs Input resistance when HIGH Voltage for HIGH Voltage for LOW Input capacitance Static input current Input frequency (max. switching sequence or frequency)	11 V -3 V 6 mA	2 k Ω 24 V 0 V 15 nF 	30 V 5 V 15 mA
	$1/t_{UFVZ}$ + half basic response time (t_{UFVZ} = time set for advancing the timing for the switching)		

	Minimum	Typical	Maximum
Dynamic control inputs			
Input resistance when HIGH		2 kΩ	
Voltage for HIGH	11 V	24 V	30 V
Voltage for LOW	-3 V	0 V	5 V
Input capacitance		1 nF	
Static input current	6 mA		15 mA
Duty cycle (Ti/T)		0.5	
Input frequency			100 kHz
Voltage supply for incremental encoders			
24 V voltage output	$V_S - 3 \text{ V}$		V_S
Current load per incremental encoder		50 mA	100 mA
Velocity range that can be sampled			
Forward	From +10 cm/s to +2000 cm/s		
Backward	From -10 cm/s to -2000 cm/s		
Velocity tolerance with same direction information			45 %
Tolerance time for exceeding velocity with same direction information from the incremental encoders			
at < 30 cm/s			60 s
at ≥ 30 cm/s			20 s
Tolerance time for different direction information or signal failure from an incremental encoder			
at > 10 cm/s			0.4 s
Incremental encoders that can be evaluated			
Type	Two-channel rotary encoder with 90° phase offset		
Enclosure rating	IP 54		
Supply voltage	$V_S - 3 \text{ V}$		V_S
Outputs required on the incremental encoders	Push/pull		
Pulse frequency			100 kHz
Number of pulses per cm	50		
Cable length (screened)			10 m

	Minimum	Typical	Maximum
OSSDs			
Output signal switching device pair	2 PNP semiconductors, short-circuit protected ³²⁾ , cross-circuit monitored		
Safe state in case of an error	At least one OSSD is in the OFF state.		
HIGH switching voltage at 250 mA	$V_S - 2.7 \text{ V}$		V_S
Switching voltage LOW S300 Medium Range	0 V	0 V	3.5 V
Switching voltage LOW S300 Long Range	0 V	0 V	2.0 V
Source switching current ³³⁾	6 mA		0.25 A
Leakage current ³⁴⁾			250 μA
Load inductance			2.2 H
Load capacity			2.2 μF at 50 Ω
Switching sequence (without switching)			5 $1/\text{s}$
Permissible cable resistance ³⁵⁾			2.5 Ω
Test pulse width ³⁶⁾		230 μs	300 μs
Test frequency		120 ms	
Power-up delay of the OSSDs from red to green		120 ms	
Time offset on switching the OSSDs between OSSD2 and OSSD1			2 ms
Configuration and diagnostics interface			
Communication protocol	RS-232 (proprietary)		
Transmission speed	38 400 Baud		
Cable length at 38 400 Baud and 0.25 mm ² cables			15 m
Galvanic isolation	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

³²⁾ Applies to the voltage range between V_S and 0 V.

³³⁾ Switching currents up to 500 mA are allowed briefly ($\leq 100 \text{ ms}$).

³⁴⁾ In the case of a fault (0 V cable open circuit) maximally the leakage current flows in the OSSD cable. The downstream controller must detect this status as LOW. A FPLC (fail-safe programmable logic controller) must be able to identify this status.

³⁵⁾ Make sure to limit the individual line core resistance to the downstream controller to this value to ensure that a cross-circuit between the outputs is safely detected. (Also note EN 60 204-1.)

³⁶⁾ When active, the outputs are tested cyclically (brief LOW). When selecting the downstream controllers, make sure that the test signals do not result in deactivation.

	Minimum	Typical	Maximum
Data interface			
Communication protocol	RS-422 (proprietary)		
Transmission speed (selectable)	9600 Baud 19 200 Baud 38 400 Baud 115.2 kBaud 125 kBaud 230.4 kBaud 250 kBaud 460.8 kBaud 500 kBaud		
Cable length at 500 kBaud and 0.25 mm ² cables			100 m
Galvanic isolation S300 Medium Range S300 Long Range	Yes No		
Differential output voltage at the sender (between TxD+ and TxD-) with 50 Ω load	±2 V		±5 V
Differential input threshold at the receiver (between RxD+ and RxD-)	±0.2 V		
Short-circuit current at TxD+, TxD-	-250 mA		250 mA
Max. voltage level at TxD+, TxD-	-30 V		30 V
Max. voltage level at RxD+, RxD-	-30 V		30 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
EFI — safe SICK device communication			
Cable length at 500 kBaud and 0.22 mm ² cables			50 m
Galvanic isolation S300 Medium Range S300 Long Range	Yes No		
Type of connecting cable	Twisted pairs with copper braid screen		
Characteristic impedance of the connecting cable	108 Ω	120 Ω	132 Ω
Wire cross-section of the connecting cable			0.22 mm ²

12.5 EFI status information and control commands

If devices are connected together via EFI, EFI status information and control commands are exchanged. Tab. 36 and Tab. 37 shows the status information that can be retrieved and the possible control commands for the S300.

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

Tab. 36: Status information of the S300 (data from the S300)

Status information	Meaning/effect
OSSD on [OSSD]	<ul style="list-style-type: none"> • Logical 1, if the internal OSSD of the S300 is in the ON state (green) • Logical 0, if the OSSD of the S300 is in the OFF state (red)
Warning field bit [WF]	<ul style="list-style-type: none"> • Logical 1, if both warning fields of the S300 are unoccupied • Logical 0, if one of the warning fields of the S300 is infringed
Contamination [Weak]	<ul style="list-style-type: none"> • Logical 1, if the optics cover is contaminated
Reset required [Res. Req]	<ul style="list-style-type: none"> • Logical 1, if reset required
Reset button pressed [Res. Pressed]	<ul style="list-style-type: none"> • Logical 1, if the reset button is pressed on the S300
I/O error [I/O Error]	<ul style="list-style-type: none"> • Logical 0, if there is no error on the S300 • Logical 1, if there is an error on the S300
Control input A1 [In A1]	<ul style="list-style-type: none"> • Logical 1, if the connection of control input A1 is HIGH <p>Note: The control inputs on the S300 are used to switch the monitoring cases on the S300.</p>
Control input A2 [In A2]	<ul style="list-style-type: none"> • Logical 1, if the connection of control input A2 is HIGH
Control input B1 [In B1]	<ul style="list-style-type: none"> • Logical 1, if the connection of control input B1 is HIGH
Control input B2 [In B2]	<ul style="list-style-type: none"> • Logical 1, if the connection of control input B2 is HIGH
Control input C1 [In C1]	<ul style="list-style-type: none"> • Logical 1, if the connection of control input C1 is HIGH
Control input C2 [In C2]	<ul style="list-style-type: none"> • Logical 1, if the connection of control input C2 is HIGH
Protective field [PF]	<ul style="list-style-type: none"> • Logical 1, if the protective field is unoccupied
Warning field [WF1]	<ul style="list-style-type: none"> • Logical 1, if the active allocated warning field is unoccupied
Warning field 2 [WF2]	<ul style="list-style-type: none"> • Logical 1, if the active allocated warning field is unoccupied

Status information	Meaning/effect
Speed valid ³⁷⁾	<ul style="list-style-type: none"> • Logical 1, if a valid velocity is present on the incremental encoder inputs • Logical 0, if an invalid velocity is present on the incremental encoder inputs
Speed ³⁷⁾	<ul style="list-style-type: none"> • 12 bits for the transmission of the velocity 100000110000 = -2000 cm/s 000000000000 = 0 cm/s 011111010000 = +2000 cm/s

³⁷⁾ Not in the compatibility mode.

S300

Tab. 37: Control features on the S300 (data to the S300)

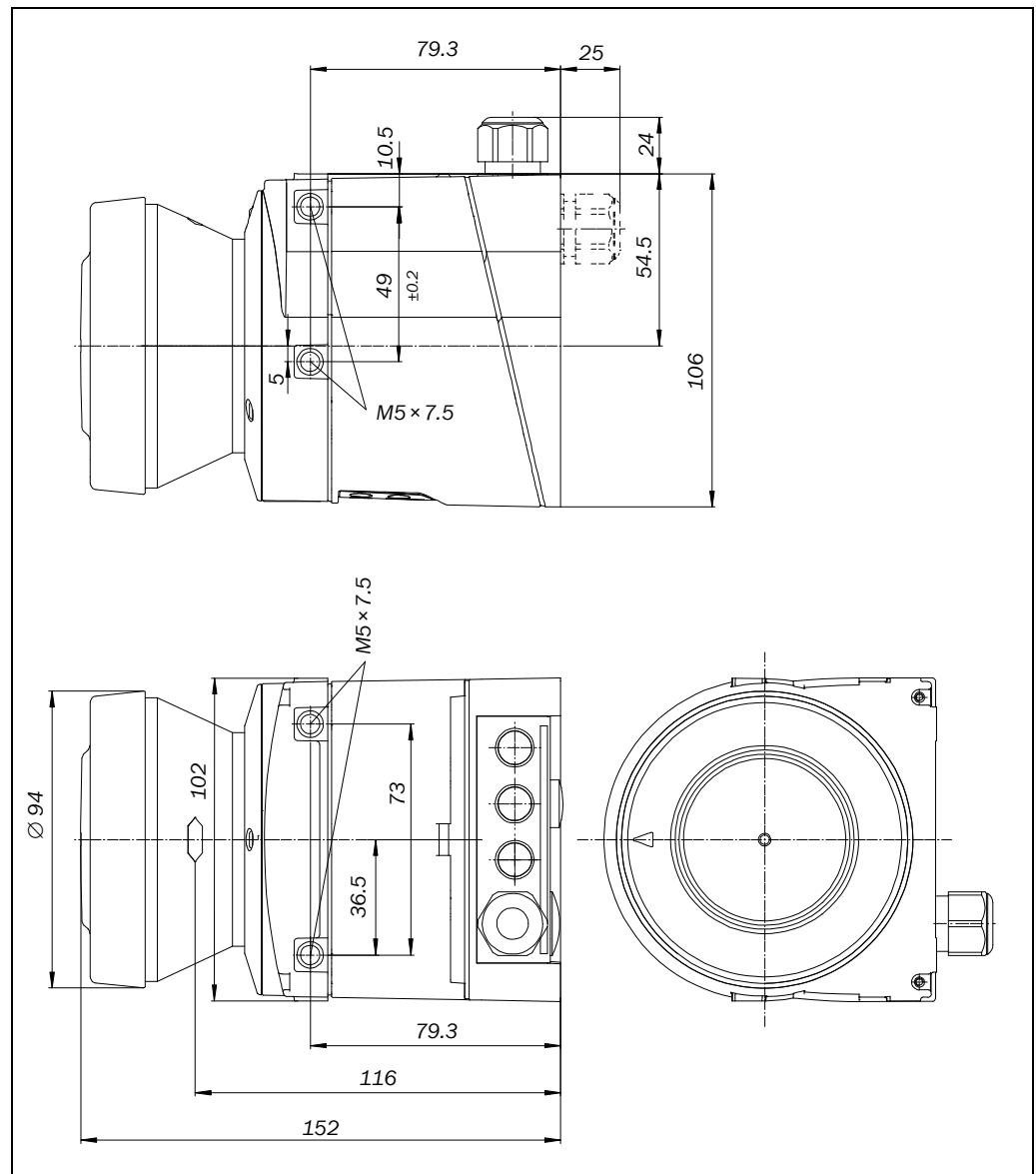
Control feature	Meaning/effect
Static input information A1 [In A1]	<ul style="list-style-type: none"> Logical 1, stimulates control input A1 of the S300
Static input information A2 [In A2]	<ul style="list-style-type: none"> Logical 1, stimulates control input A2 of the S300
Static input information B1 [In B1]	<ul style="list-style-type: none"> Logical 1, stimulates control input B1 of the S300
Static input information B2 [In B2]	<ul style="list-style-type: none"> Logical 1, stimulates control input B2 of the S300
Static input information C1 [In C1]	<ul style="list-style-type: none"> Logical 1, stimulates control input C1 of the S300
Static input information C2 [In C2]	<ul style="list-style-type: none"> Logical 1, stimulates control input C2 of the S300
Static input information D1 [In D1] ³⁸⁾	<ul style="list-style-type: none"> Logical 1, stimulates control input D1 of the S300
Static input information D2 [In D2] ³⁸⁾	<ul style="list-style-type: none"> Logical 1, stimulates control input D2 of the S300
Static input information E1 [In E1] ³⁸⁾	<ul style="list-style-type: none"> Logical 1, stimulates control input E1 of the S300
Static input information E2 [In E2] ³⁸⁾	<ul style="list-style-type: none"> Logical 1, stimulates control input E2 of the S300
Stand-by ³⁸⁾	<ul style="list-style-type: none"> Logical 1, stimulates operational status Stand-by (individually for host and guest)
Speed valid ³⁸⁾	<ul style="list-style-type: none"> Logical 1, valid velocity is present on the incremental encoder inputs Logical 0, invalid velocity is present on the incremental encoder inputs
Speed ³⁸⁾	<ul style="list-style-type: none"> 12 bits for the transmission of the velocity 100000110000 = -2000 cm/s 000000000000 = 0 cm/s 011111010000 = +2000 cm/s
I/O error [I/O Error]	<ul style="list-style-type: none"> Logical 0, if there is no error on the connected partner device Logical 1, if there is an error on the connected partner device

³⁸⁾ Not in the compatibility mode.

12.6 Dimensional drawings

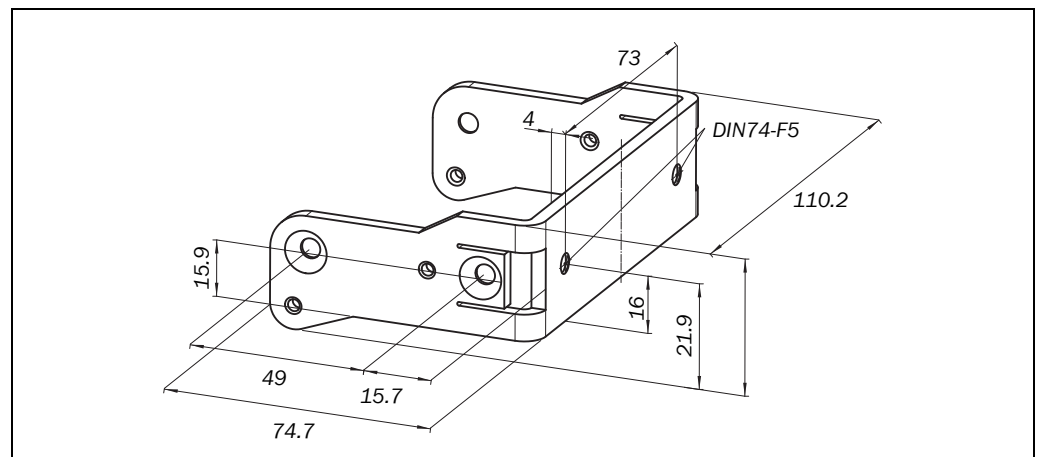
12.6.1 S300

Fig. 83: Dimensional drawing
S300 (mm)



12.6.2 Mounting kits

Fig. 84: Dimensional drawing,
mounting kit 1a (mm)



S300

Fig. 85: Dimensional drawing,
mounting kit 1b (mm)

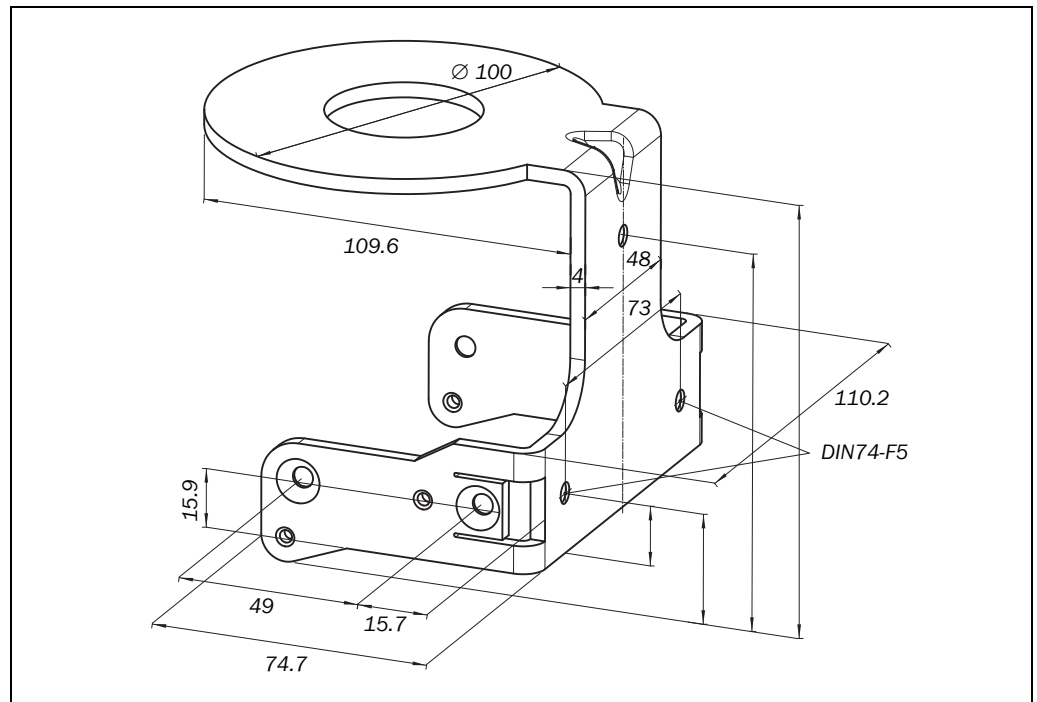


Fig. 86: Dimensional drawing,
mounting kit 2 (mm)

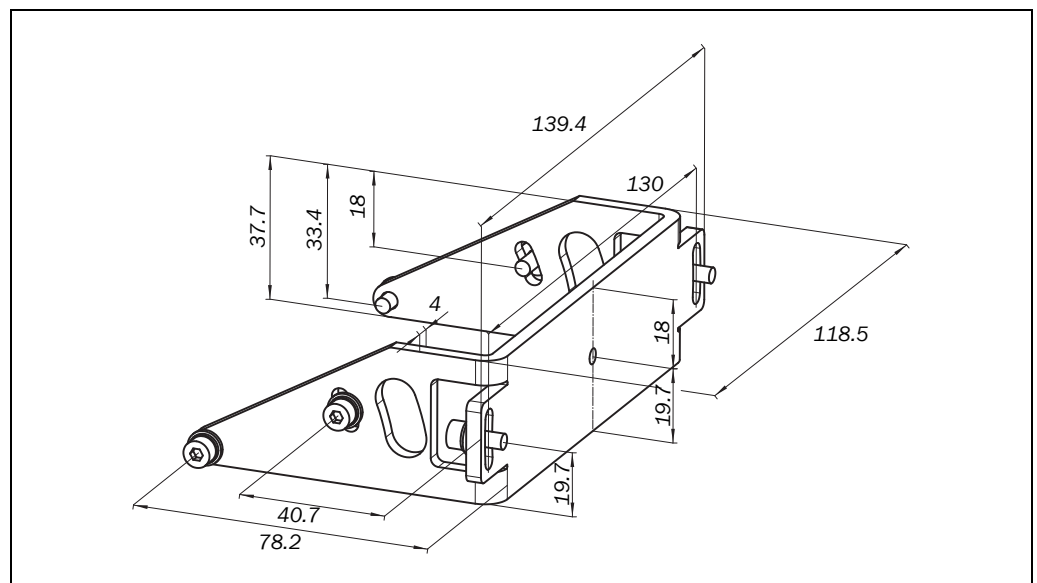
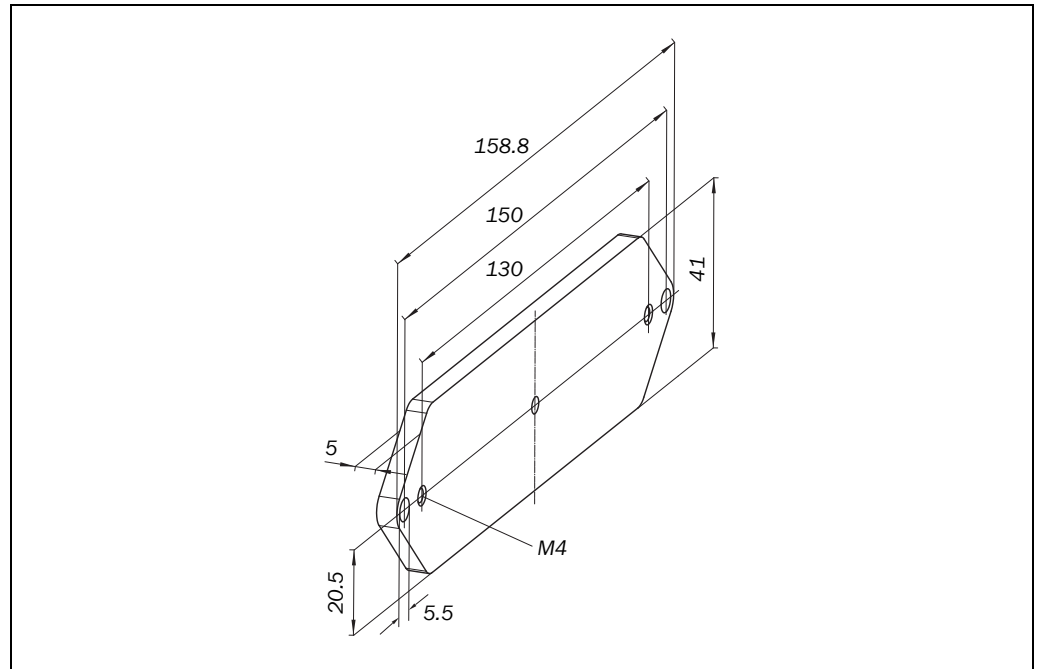
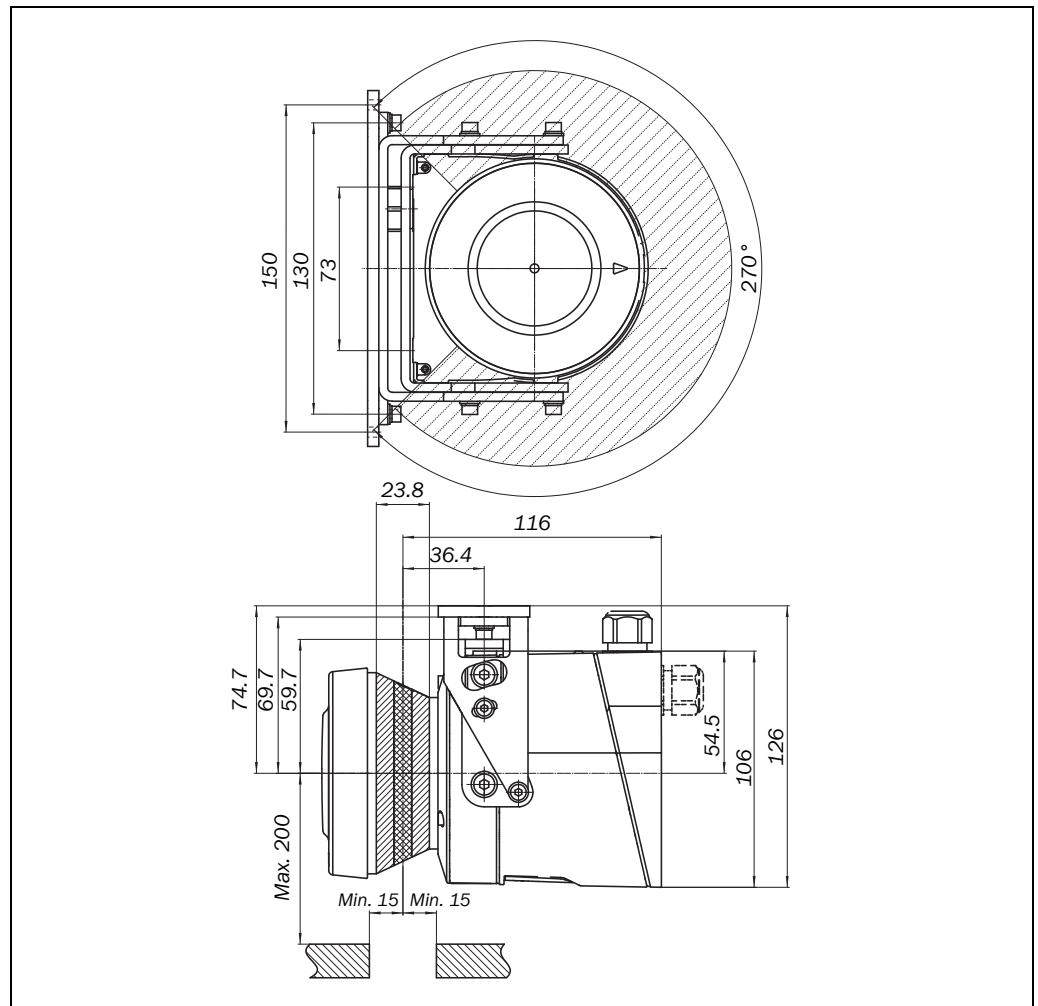


Fig. 87: Dimensional drawing, mounting kit 3 (mm)



12.6.3 Scan plane origin

Fig. 88: Dimensional drawing of the scan plane with mounting kit 1a, 2 and 3 (mm)



13 Ordering information

13.1 Items supplied S300

- safety laser scanner
- operating instructions and CDS (Configuration & Diagnostic Software) on CD-ROM
- adhesive label **Important information**

Note System plugs not included.

System plugs without cable and pre-assembled system plugs are available from SICK AG (see section 13.3.2 “System plug S300” on page 136). For further information see section 6.2 “System plug assembly” on page 84 and section 6.3 “Pre-assembled system plugs” on page 86.

13.2 Available systems

Tab. 38: Part numbers systems

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

13.3 Accessories/spare parts

13.3.1 Mounting kits

Tab. 39: Part numbers mounting kit

Mounting kit	Description	Part number
1a	Mounting bracket for direct mounting at the rear on wall or machine	2034324
1b	Mounting bracket for direct mounting at the rear on wall or machine, with protection for the optics cover	2034325
2	Mounting bracket only in conjunction with mounting bracket 1a or 1b. Cross-wise adjustment possible	2039302
3	Mounting plate only in conjunction with mounting bracket 2. Length-wise adjustment possible	2039303

13.3.2 System plug S300

Tab. 40: Part numbers system plugs S300

System plug	Equipment	Description	Part number
SX0B-A0000G	One M16 cable gland and one M12 blanking plug, on the rear	Without cable	2032807
SX0B-B1105G		Pre-assembled, 5 m long cable, 11 cores	2032859
SX0B-B1110G		Pre-assembled, 10 m long cable, 11 cores	2032860
SX0B-B1114G		Pre-assembled, 14 m long cable, 11 cores	2047875
SX0B-B1120G		Pre-assembled, 20 m long cable, 11 cores	2032861
SX0B-A0000J	One M16 cable gland, three M12 blanking plugs, on the rear as well as 2 M12 EMC-proof cable glands, loose	Without cable	2032856
SX0B-B1105J		Pre-assembled, 5 m long cable, 11 cores	2032857
SX0B-B1110J		Pre-assembled, 10 m long cable, 11 cores	2032858
SX0B-B1505G	One M16 cable gland and one M12 blanking plug, on the rear	Pre-assembled, 5 m long cable, 15 cores	2034264
SX0B-B1510G		Pre-assembled, 10 m long cable, 15 cores	2034265

13.3.3 Service cables

Tab. 41: Part numbers service cables

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

S300

Tab. 42: Part numbers connecting cables

13.3.4 Self assembly connecting cables

Part	Part number
15-cores, cross-section 0.56 mm ² (AWG 20), by the meter	6030795
EFI cable, per meter (1 × 2 × 0.22 mm ²)	6029448
M12 EMC-proof cable gland for EFI connections, permissible cable diameter 3-6.5 mm	5308757
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
Interconnectron plug, can be used for DeviceNet connecting cable 6.9 mm (6030921).	6024742

13.3.5 Documentation

Tab. 43: Part numbers documentation

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

13.3.6 Safety relays/compact safety controller

Tab. 44: 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
UE10-30S2	Safety relay UE10-30S with screw type terminals	6024917
UE10-30S3	Safety relay UE10-30S with removable terminals	6024918

13.3.7 Safety controllers

Tab. 45: Part numbers safety controllers

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

13.3.8 Network solutionsTab. 46: 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
UE4457	Safety remote controller	1028307

13.3.9 MiscellaneousTab. 47: Part numbers
miscellaneous

Part	Description	Part number
Optics cover	Spare parts set for optics cover with replacement seal and screws	2039248
Plastic cleaner	Plastic cleaner and care product, anti-static	5600006
Lens cloth	Cloth for cleaning the optics cover	4003353
Power supply, 2.1 A	Power supply, 24 V DC, 2.1 A, 50 W	7028789
Power supply, 3.9 A	Power supply, 24 V DC, 3.9 A, 95 W	7028790
LS70b	Scan finder	6020756

14 Annex

14.1 Compliance with EU directives

EU declaration of conformity (excerpt)

The undersigned, representing the following manufacturer herewith declares that the product is in conformity with the provisions of the following EU directive(s) (including all applicable amendments), and that the respective standards and/or technical specifications are taken as the basis.

Complete EU declaration of conformity for download: www.sick.com

14.2 Checklist for the manufacturer

SICK

Checklist for the manufacturer/installer for the installation of 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.

- | | |
|--|--|
| 1. Have the safety rules and regulations been observed in compliance with the directives/standards applicable to the machine? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 2. Are the applied directives and standards listed in the declaration of conformity? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 3. Does the protective device comply with the required PL/SIL claim limit and PFHd in accordance with EN ISO 13849-1/EN 62061 and the required type in accordance with IEC 61496-1? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 4. Is the access to the hazardous area/hazardous point only possible through the protective field of the ESPE? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 5. Have appropriate measures been taken to protect (mechanical protection) or monitor (protective devices) any persons or objects in the hazardous area when protecting a hazardous area or hazardous point, and have these devices been secured or locked to prevent their removal? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 6. Are additional mechanical protective measures fitted and secured against manipulation which prevent reaching under, over or around the ESPE? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 7. Has the maximum stopping and/or stopping/run-down time of the machine been measured, specified and documented (at the machine and/or in the machine documentation)? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 8. Has the ESPE been mounted such that the required minimum distance from the nearest hazardous point has been achieved? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 9. Are the ESPE devices properly mounted and secured against manipulation after adjustment? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 10. Are the required protective measures against electric shock in effect (protection class)? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 11. Is the control switch for resetting the protective device (ESPE) or restarting the machine present and correctly installed? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 12. Are the outputs of the ESPE (OSSD) integrated according to required PL/SILCL compliant with EN ISO 13849-1/EN 62061 and does the integration correspond to the comply with the circuit diagrams? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 13. Has the protective function been checked in compliance with the test notes of this documentation? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 14. Are the specified protective functions effective at every operating mode that can be set? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 15. Are the switching elements activated by the ESPE, e.g. contactors, valves, monitored? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 16. Is the ESPE effective over the entire period of the dangerous state? | Yes <input type="checkbox"/> No <input type="checkbox"/> |
| 17. 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 <input type="checkbox"/> No <input type="checkbox"/> |
| 18. Has the information label for the daily check been attached so that it is easily visible for the operator? | Yes <input type="checkbox"/> No <input type="checkbox"/> |

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

14.3 Glossary

AOPDDR	Active opto-electronic protective device responsive to diffuse reflection (e.g. S300, see also IEC 61496-3)
Control input: dynamic, static	The monitoring cases are switched using the control inputs. The S300 Advanced has one static, the S300 Professional and the S300 Expert have two static or dynamic control inputs (for incremental encoders) as well as an optional static control input.
EFI	Enhanced function interface = safe SICK device communication
External device monitoring (EDM)	A device that electronically monitors the relay or contactor operated by the protective device prior to each new start.
Field set	Protective fields and warning fields form the so-called field set.
Host/guest	Two safety laser scanners in an EFI system. The control signals for monitoring case switching are applied to the inputs on the host. The guest is connected to the host via EFI and receives from the host the input information for local monitoring case switching.
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, direction of travel, etc.
Monitoring case	A field set is allocated to a monitoring case. Monitoring case switching is performed using the control inputs. In this way the S300 can be adapted to the operating mode of the machine or system that it monitors.
Optics cover	Plastic part with window for light output. The optics cover is available as a spare part.
OSSD	Output signal switching device = The OSSD output is the switching output on the S300. This is a semiconductor output and is periodically tested for correct function. The S300 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 state and thus initiates the shutdown of the machine or stop of the vehicle.
Remission	Reflection of luminance. A measure of the remission is the level of remission 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/object 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.
Safe state in case of an error	<p>If the internal error detection detects an error that prevents the correct operation of the safety component, the SICK safety component adopts a defined, safe state. The safety component remains in this state until the error or the cause of the error has been rectified. Error cases in which the safety component adopts a safe state include:</p> <ul style="list-style-type: none"> • safety-related internal errors, • invalid input signal conditions, • supply voltage loss, • loss of the assured detection capability.
System plug	Contains the configuration memory and all electrical connections. In this way the S300 can be easily replaced. After re-commissioning the configuration is read from the system plug; the S300 is then, normally, ready for use.

- Universal I/O** The S300 has five universal I/O connections. These connections can be configured as inputs (e.g. for stand-by, EDM or reset) or as outputs (e.g. for device error, contamination or second warning field).
- Warning field** The warning field is a field with a radius of up to 8 m (see section 12.1 “Characteristics” on page 116). 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 personnel protection.

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