OPERATING INSTRUCTIONS

microScan3 Core I/O

Safety laser scanner

SICK
Sensor Intelligence.

Described product

microScan3 Core I/O

Manufacturer

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

Legal information

This work is protected by copyright. Any rights derived from the copyright shall be reserved for SICK AG. Reproduction of this document or parts of this document is only permissible within the limits of the legal determination of Copyright Law. Any modification, abridgment or translation of this document is prohibited without the express written permission of SICK AG.

The trademarks stated in this document are the property of their respective owner.

© SICK AG. All rights reserved.

Original document

This document is an original document of SICK AG.

Contents

1 About this document

1.1 Function of this document

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

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

Read the operating instructions carefully and ensure that you have understood the contents completely before you work with the safety laser scanner.

1.2 Scope

The operating instructions apply to the microScan3 safety laser scanner with the following type label entry in the Operating Instructions field:

- 8016344

This document is included with the following SICK part numbers (this document in all available language versions):

- 8016344

1.3 Target groups of these operating instructions

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

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

Target group	Chapter of these operating instructions
Project developers (planners, developers, designers)	"Project planning", page 25 "Configuration", page 75 "Technical data", page 144 "Accessories", page 160
Installers	"Mounting", page 66
Electricians	"Electrical installation", page 72
Safety experts (such as CE authorized representatives, compliance officers, people who test and approve the application)	"Project planning", page 25 "Configuration", page 75 "Commissioning", page 114 "Technical data", page 144 "Checklist for initial commissioning and commissioning", page 170
Operators	"Operation", page 118 "Troubleshooting", page 131
Maintenance personnel	"Maintenance", page 124 "Troubleshooting", page 131

1.4 Further information

www.sick.com

The following information is available via the Internet:

- Further language versions of these operating instructions
- Data sheets and application examples
- CAD data of drawings and dimensional drawings
- Certificates (such as the EU declaration of conformity)

- Guide for Safe Machinery (six steps to a safe machine)
- Safety Designer (software for configuring the safety laser scanner and further safety solutions)

1.5 Symbols and document conventions

The following symbols and conventions are used in this document:

Safety notes and other notes

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

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

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

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

NOTE
Indicates useful tips and recommendations.

Instructions to action

▶ The arrow denotes instructions to action.

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

✓ The check mark denotes the result of an instruction.

LED symbols

These symbols indicate the status of an LED:

○ The LED is off.
☼ The LED is flashing.
● The LED is illuminated continuously.

2 Safety information

2.1 General safety notes

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

Further information about specific product use situations can be found in the relevant chapters.

DANGER
Hazard due to lack of effectiveness of the protective device

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

- ▶ Please read this document carefully and make sure that you understand the content fully before working with the device.
- ▶ Follow all safety notes in this document.

WARNING
Invisible laser radiation

Laser class 1M

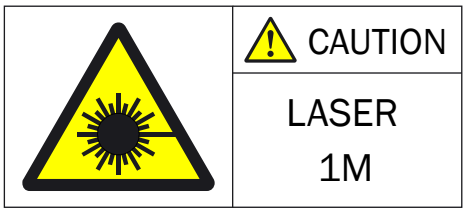


Figure 1: Laser class 1M

This device complies with the following standards:

- IEC 60825-1:2007/EN 60825-1:2007
- IEC 60825-1:2014/EN 60825-1:2014
- 21 CFR 1040.10 and 1040.11, except for changes due to Laser Notice No. 50 of 24/06/2007

The safety laser scanner's accessible laser is not hazardous as long as the beam cross section is not reduced by optical instruments, such as magnifying glasses, lenses, telescopes.

The curved part of the optics cover is the outlet for the laser radiation.

The laser marking is located on the underside of the safety laser scanner.

- ▶ You must comply with the latest version of the applicable laser safety regulations.

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

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

CAUTION
Observing the safety laser scanner through optical instruments (such as magnifying glasses, lenses, telescopes) may be hazardous for the eyes.

▶ Do not look directly at the laser beam source using optical instruments.

2.2 Intended use

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

- Hazardous area protection
- Hazardous point protection
- Access protection
- Mobile hazardous area protection (e.g. protection from automated guided vehicles)

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

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

2.3 Inappropriate use

DANGER
Hazard due to lack of effectiveness of the protective device
Persons and parts of the body to be protected may not be recognized in case of non-observance.
The safety laser scanner works as an indirect protective measure and cannot provide protection from pieces thrown from application nor from emitted radiation. Transparent objects are not detected.

▶ You must only use the safety laser scanner as an indirect protective measure.

The safety laser scanner is not suitable for the following applications, among others:
- Outdoors
- Underwater
- In explosion-hazardous areas

2.4 Requirements for personnel qualifications

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

Project planning

For project planning, a person is considered competent when he/she has expertise and experience in the selection and use of protective devices on machines and is familiar with the relevant technical rules and national work safety regulations.

Mechanical mounting

For mechanical mounting, a person is considered competent when he/she has the expertise and experience in the relevant field and is sufficiently familiar with the application of the protective device on the machine that he/she can assess its operational safety status.

Electrical installation

For electrical installation, a person is considered competent when he/she has the expertise and experience in the relevant field and is sufficiently familiar with the application of the protective device on the machine that he/she can assess its operational safety status.

Configuration

For configuration, a person is considered competent when he/she has the expertise and experience in the relevant field and is sufficiently familiar with the application of the protective device on the machine that he/she can assess its work safety aspects.

Commissioning

For commissioning, a person is considered competent when he/she has the expertise and experience in the relevant field and is sufficiently familiar with the application of the protective device on the machine that he/she can assess its operational safety status.

Operation and maintenance

For operation and maintenance, a person is considered competent when he/she has the expertise and experience in the relevant field and is sufficiently familiar with the application of the protective device on the machine and has been instructed by the machine operator in its operation.

An operator may clean the safety laser scanner and carry out specific thorough checks following instruction. More information for the operator of the machine: see "Regular cleaning", page 124, see "Operation", page 118.

3 Product description

3.1 Setup and function

The safety laser scanner is an electro-sensitive protective device (ESPE), which two-dimensionally scans its environment with infrared laser beams.

The safety laser scanner forms a protective field using the invisible laser beams. This protective field protects the hazardous area and enables hazardous point protection, access protection or hazardous area protection. As soon as an object is situated in the protective field, the safety laser scanner signals the detection by means of a signal change at the safety output (OSSD for example). The machine or its control must safely analyze the signals (for example using a safe control or safety relays) and stop the dangerous state.

The safety laser scanner operates on the principle of time-of-flight measurement. It emits light pulses in regular, very short intervals. If the light strikes an object, it is reflected. The safety laser scanner receives the reflected light. The safety laser scanner calculates the distance to the object based on the time interval between the moment of transmission and moment of receipt (Δt).

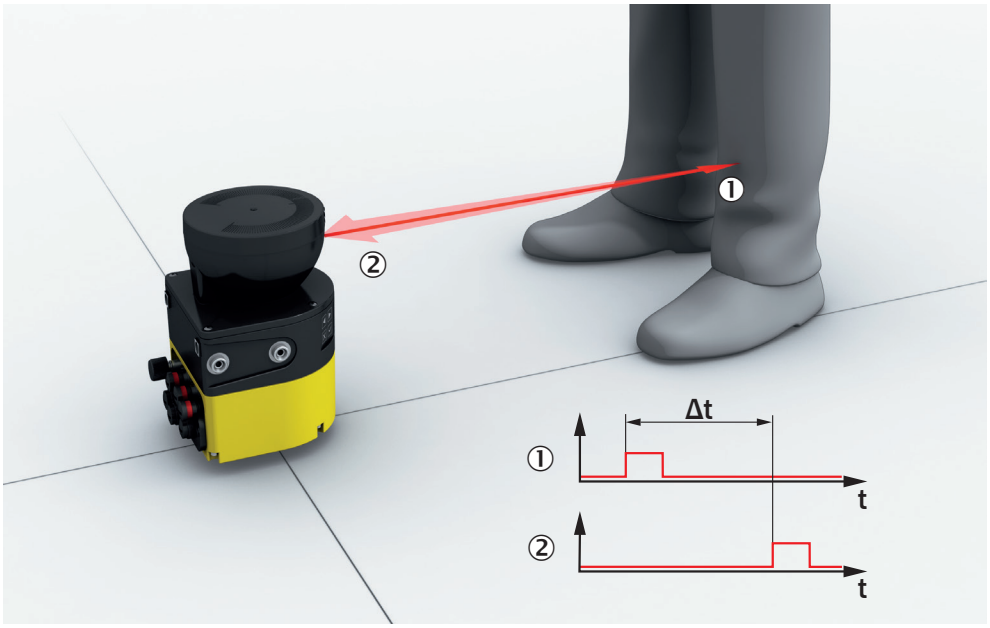


Figure 2: Principle of time-of-flight measurement

① Transmitted light pulse

② Reflected light pulse

A rotating mirror is situated in the safety laser scanner. The mirror deflects the light pulses so that they scan a fan-shaped area.

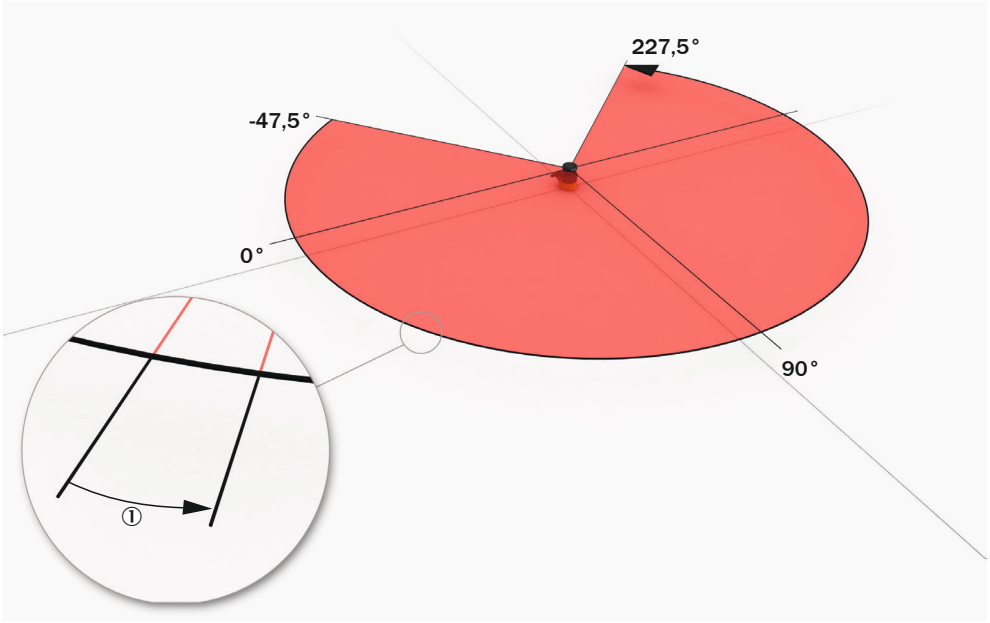


Figure 3: Light pulses scan an area

① Angular resolution: the angular distance (in degrees) between 2 distance measurements

Scan cycle time and resolution

The time that the mirror requires for one rotation is called the scan cycle time. The number of light pulses per unit of time is constant. The scan cycle time and the number of light pulses per unit of time determine the angular resolution. The scanning range for a given object resolution depends on the angular resolution. The object resolution indicates the minimum size that an object must be to allow it to be detected safely. The scan cycle time also influences the response time.

Slightly different scan cycle times can be used to minimize mutual interference in neighboring safety laser scanners.

The resolution in protective fields can be set to various values according to the intended purpose.

Geometry of the scan plane

The laser beams emitted cover a sector of a circle, so an object can be detected in an area of up to 275°.

The sector of a circle covered ranges from –47.5° to 227.5°, where 90° denotes the axis of the safety laser scanner from the back to the front. When viewing the safety laser scanner from above, the direction of rotation of the mirror and the deflected light pulses is counterclockwise, see figure 3.

3.2 Product characteristics

3.2.1 Device overview

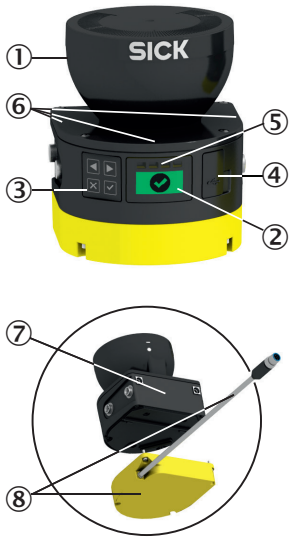


Figure 4: Device overview

① Optics cover
② Display
③ Keypad
④ USB connection
⑤ Status LEDs
⑥ Additional LEDs for ON state and OFF state
⑦ Safety laser scanner without system plug
⑧ System plug

Different variants of the safety laser scanner are available, see "Variants", page 16. Further information about the variants see "Variant overview", page 144.

All variants have an optics cover and the rotating mirror is located below the optics cover. The light pulses are emitted and the reflected light pulses are received through the optics cover.

The display with 4 pushbuttons is located below the optics cover. The safety laser scanner also has a number of light emitting diodes, see "Status indicators", page 16, see "Buttons and display", page 119.

Information about connections: see "Connections", page 17.

The safety laser scanner can be mounted and operated in any alignment. In this document, position and direction information is used as follows with respect to the safety laser scanner, as long as different usage is not indicated separately:

- The top is the side of the safety laser scanner on which the optics cover is located.
- The bottom is the side of the safety laser scanner opposite the optics cover.
- The front is the side of the safety laser scanner on which the display is located. The 90° angle of the sector of a circle scanned by the safety laser scanner points in this direction.
- The back is the side of the safety laser scanner opposite the display. The sector of a circle not scanned by the safety laser scanner lies in this direction.

3.2.2 Variants

The safety laser scanner is delivered in different variants. You will find an overview of important distinguishing features of the variants in the following.

Performance package

The Core performance package is characterized by the number of configurable fields and the number of safety switching functions (OSSD pairs).

- microScan3 core I/O: 8 fields; safety output: 1 OSSD pair

Integration in the control

The safety laser scanner communicates with the machine controller as follows:

- I/O: local inputs and outputs (incl. OSSDs)

Protective field range

The safety laser scanner is available in variants with the following maximum protective field range:

- 4.0 m
- 5.5 m
- 9.0 m

Further topics

- "Variant overview", page 144

3.2.3 Status indicators

The safety laser scanner outputs important status information using a number of light emitting diodes. The safety laser scanner has a graphical display and 4 pushbuttons for additional information.

4 status light emitting diodes are located directly above the display.

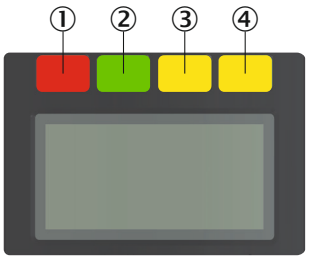


Figure 5: Status LEDs

Table 2: Status LEDs

Number	Function	Color	Meaning
①	OFF state	Red	Lights up red when the OSSD pair is in the OFF state.
②	ON state	Green	Lights up green when the OSSD pair is in the ON state.
③	Warning field	Yellow	Shines yellow if at least one warning field is interrupted.
④	Restart interlock	Yellow	Setup with reset: Flashes if the restart interlock has been triggered. Configuration with automated restart after a time: Lights up while the configured time to restart expires.

The OFF state and ON state light emitting diodes can be found in multiple locations on the safety laser scanner. 3 additional sets are arranged in pairs on the base of the optics cover. So the light emitting diodes can also be seen in many cases when it is not possible to see the display, e.g. due to the mounting situation or because it is hidden from the operator's position.

More information about the meaning of the light emitting diodes see "Diagnostic LEDs", page 131.

Depending on the configuration, the display shows current information about the safety laser scanner's status, see "Buttons and display", page 119.

3.2.4 Connections

- 1 × connecting cable with male connector, M12, A-coded for voltage supply, OSSDs and universal I/Os (can be used as universal input, universal output or in pairs as static control input)
- 1 × female connector, USB 2.0 Mini-B for configuration and diagnosis [1)]

OSSD

An OSSD is a safety switching output. The functionality of each OSSD is tested periodically. OSSDs are always connected in pairs and must undergo dual-channel analysis for safety reasons. An OSSD pair is formed from 2 OSSDs that are connected and analyzed together.

Control input

A control input receives signals, e.g. from the machine or from the control. Use of control inputs is how the protective device receives information about the conditions at the machine, e.g., if there is a change of operating mode. If the protective device is configured appropriately, it will activate a different monitoring case after receiving a new control input.

The control input information must be transmitted reliably. Generally, at least 2 separate channels are used to do this.

A static control input is a dual-channel control input, which evaluates the status of every channel as the value 0 or 1. The signal states of a static control input give a unique signal pattern. This signal pattern activates a monitoring case.

Universal I/O

Universal I/O can be configured as universal input or as universal output.

Universal input

Depending on the device, a universal input can be used for resetting, external device monitoring (EDM), sleep mode, or restarting the protective device, for example. If sleep mode is activated by a universal input, the sleep mode must not be used for safety applications. Certain universal inputs can also be used in pairs as a static control input.

Universal output

A universal output outputs a signal depending on its configuration, e.g. if the reset pushbutton needs to be pushed or if the optical cover is contaminated. A universal output must not be used for safety functions.

3.2.5 System plug

A system plug is required to operate the safety laser scanner.

1) The USB connection may only be used temporarily and only for configuration and diagnostics.

The base plate is the system plug (see figure 4, page 15).

The safety laser scanner's internal configuration memory is integrated in the system plug. The system plug and all connecting cables can remain at the installation site when the safety laser scanner is replaced. The system plug is detached from the defective safety laser scanner and connected to the new safety laser scanner. The new safety laser scanner reads the configuration from the configuration memory when switching on.

3.2.6 Field types

During operation, the safety laser scanner uses its laser beams continuously to check whether people or objects are present in one or more areas. The areas to be checked are called fields. A distinction is made between the following field types, depending on how the safety laser scanner is used:

- Protective field
- Reference contour field
- Contour detection field
- Warning field

Table 3: Field types and their function

	Protective field	Reference contour field	Contour detection field	Warning field
Safe switch off (according to ISO 13849-1)	Yes (PL d)	Yes (PL d)	Yes (PL d)	No
Max. scanning range of the safety laser scanner	Variant-dependent: 4.0 m 5.5 m 9.0 m	Variant-dependent: 4.0 m 5.5 m 9.0 m	Variant-dependent: 4.0 m 5.5 m 9.0 m	Variant-dependent: 40 m 64 m
Purpose	Detection and protection of people	Tamper protection	e.g. door monitoring	Functional use (no safety-relevant use)

Protective field

The protective field protects the hazardous area of a machine or vehicle. As soon as the electro-sensitive protective device detects an object in the protective field, it switches the associated safety outputs to the OFF state. This signal can be passed to controllers resulting in the dangerous state coming to an end, e.g. to stop the machine or the vehicle.

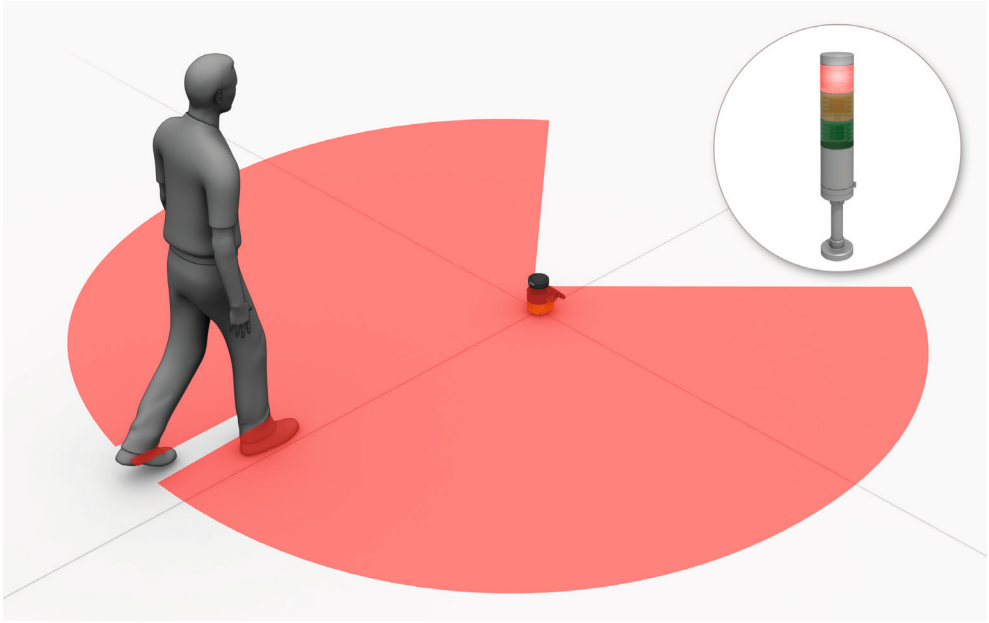


Figure 6: Protective field, shown in red in this document

Reference contour field

The reference contour field monitors a contour of the environment. The safety laser scanner switches all safety outputs to the OFF state if a contour does not match the set parameters, because, for example, the mounting situation of the safety laser scanner were changed.

National and international standards require or recommend that a reference contour is monitored, if the safety laser scanner is used in vertical operation for hazardous point protection or for access protection.

The reference contour field detects unintentional and intentional changes to the position or alignment of the safety laser scanner. Unintentional changes may be caused by vibrations for example. An example of an intentional change is deliberate tampering to disable the safety laser scanner's functionality.

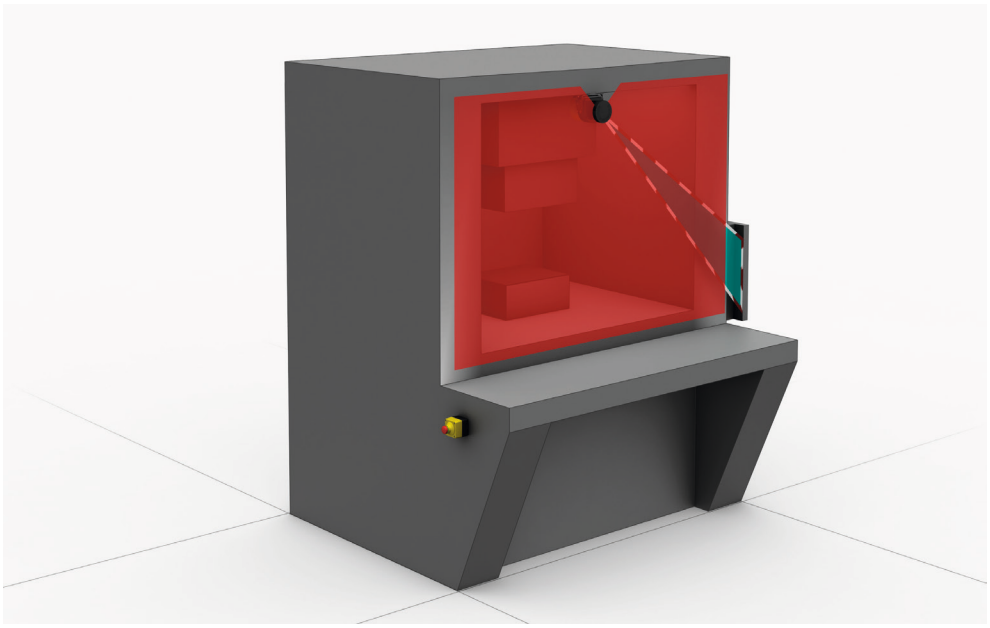


Figure 7: Reference contour field, shown in blue-green in this document

Contour detection field

The contour detection field monitors a contour of the environment. The safety laser scanner switches the associated safety outputs to the OFF state if a contour does not match the set parameters, because, for example, a door or flap is open.

The contour detection field is used for detecting changes in the environment and only switches the outputs in the current monitoring case. By contrast, the reference contour field is used for detecting changes at the safety laser scanner and switches all safety outputs.

Warning field

The warning field monitors larger areas than the protective field. Simple switching functions can be triggered with the warning field, e.g. a warning light or an acoustic signal can be triggered if a person approaches, even before the person enters the protective field.

The warning field must not be used for safety applications.

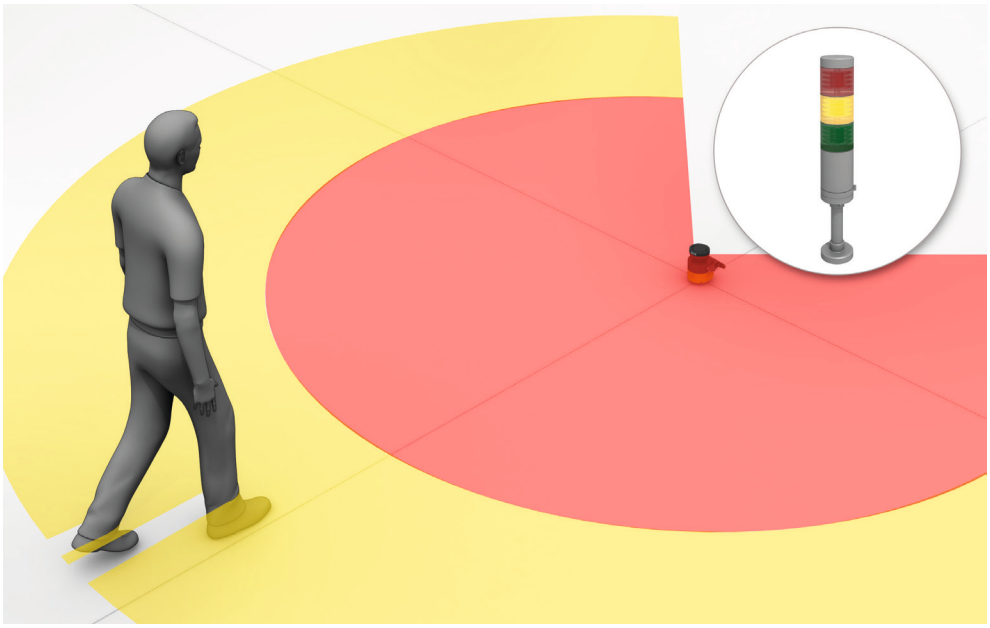


Figure 8: Warning field, shown in yellow or orange in this document

3.2.7 Field set

A field set consists of one or more fields. The fields in a field set are monitored simultaneously.

A field set can contain various types of field.

A typical application is the use of a protective field with one or more warning fields: if a vehicle approaches a person, a warning field triggers an optical or acoustic signal. If the person does not react to this and the vehicle continues to approach, the safety laser scanner detects an object in the protective field and switches the associated safety outputs to the OFF state. The vehicle stops before it reaches the person.

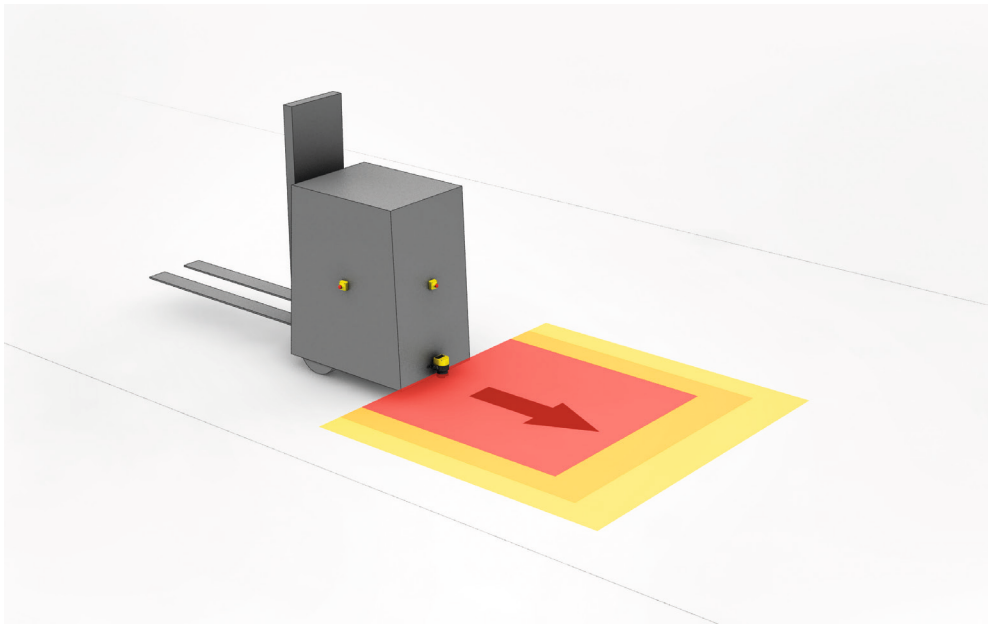


Figure 9: Field set, consisting of one protective field (red) and 2 warning fields (orange and yellow)

3.2.8 Monitoring case

A monitoring case signals the machine status to the safety laser scanner. The safety laser scanner activates the field set, which is assigned to the monitoring case and therefore a particular machine status.

If a machine, e.g., has various operational statuses, a monitoring case can be assigned to each operational status. The safety laser scanner receives a defined signal for the current operational status via the control inputs. If there is a change of signal, the safety laser scanner switches from one monitoring case to the monitoring case that is assigned to the new signal (as well as the new operational status). Generally, one field set is assigned to each monitoring case.

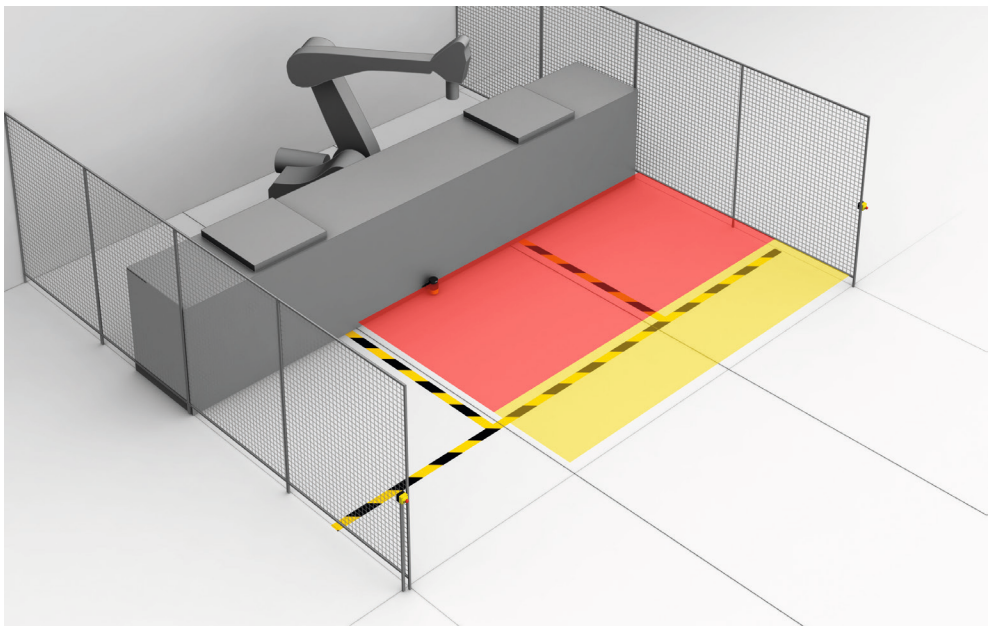


Figure 10: Monitoring case 1 with field set 1

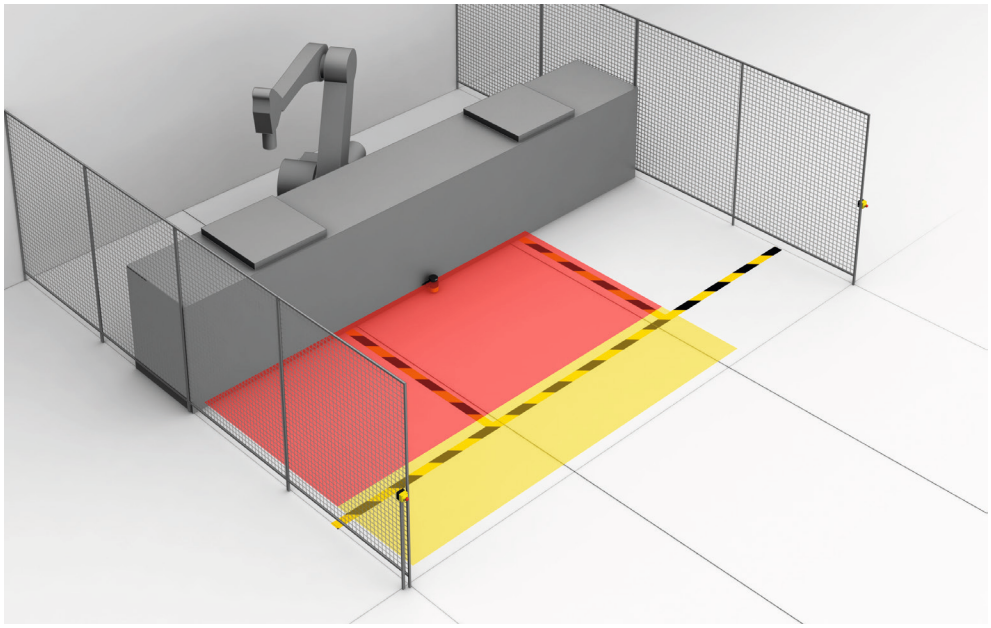


Figure 11: Monitoring case 2 with field set 2

3.3 Example applications

Hazardous area protection

In hazardous area protection, people are detected if they stay in a defined area.

This type of protective device is suitable for machines, where it is possible to see a hazardous area completely from the reset pushbutton. When the hazardous area is entered, a stop signal is triggered and starting is prevented.

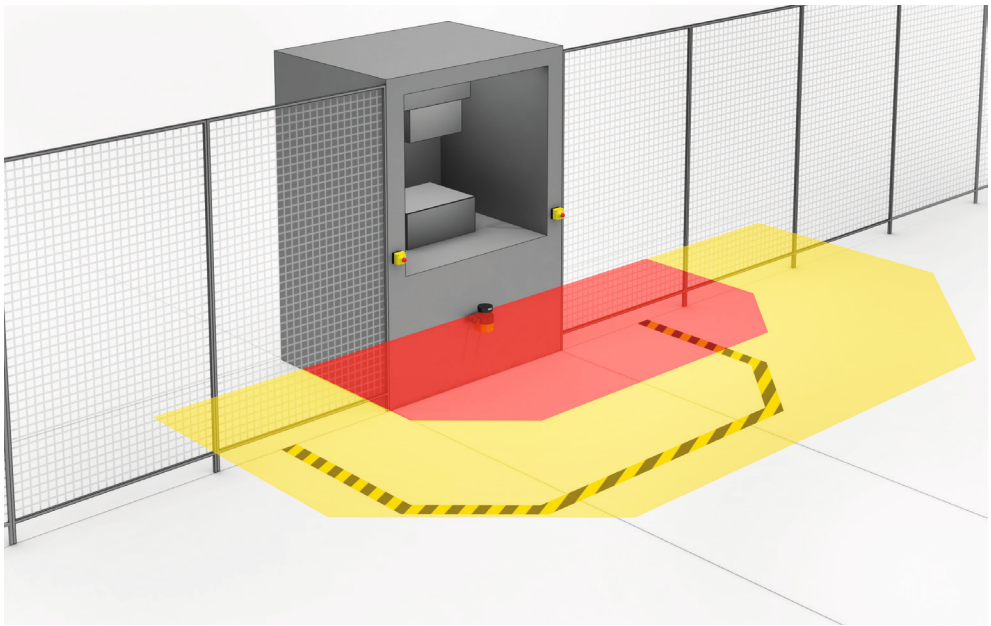


Figure 12: Hazardous area protection: detection of the presence of a person in the hazardous area

Hazardous point protection

In hazardous point protection, the approach is detected very close to the hazardous point.

The advantage of this type of protective device is that it is possible to have a short minimum distance and the operator can work more ergonomically.

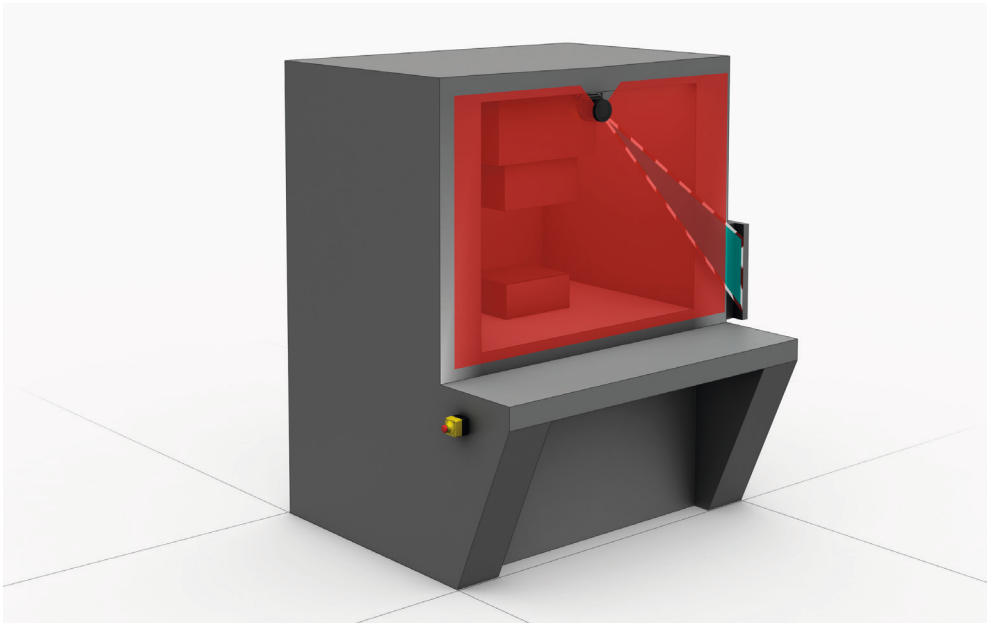


Figure 13: Hazardous point protection: Hand detection

Access protection

In access protection, people are detected if their whole body passes through the protective field.

This type of protective device is used for the protection of access to hazardous areas. When the hazardous area is entered, a stop signal is triggered. A person standing behind the protective device will not be detected by the ESPE.

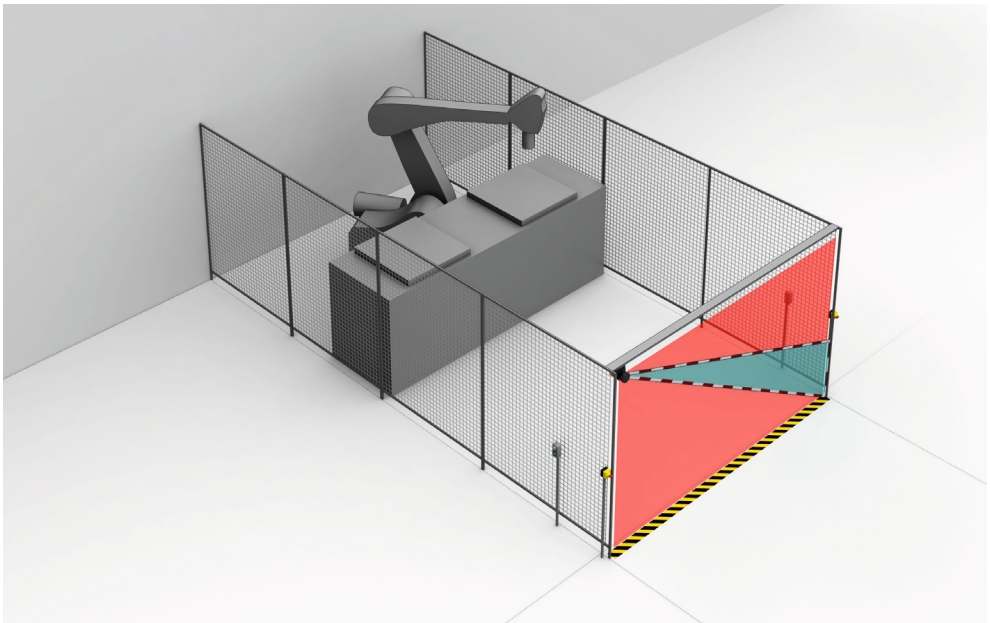


Figure 14: Access protection: detection of a person when accessing a hazardous area

Mobile hazardous area protection

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

The safety laser scanner monitors the area in the direction of travel and stops the vehicle as soon as an object is located in the protective field.

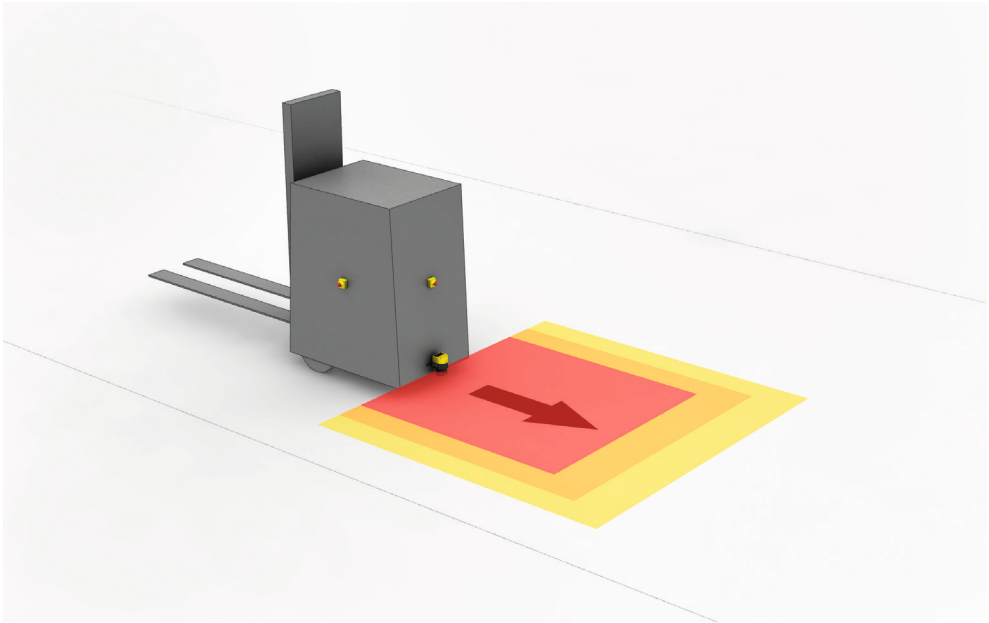


Figure 15: Mobile hazardous area protection: detection of a person when a vehicle approaches

4 Project planning

4.1 Manufacturer of the machine

DANGER
Hazard due to lack of effectiveness of the protective device

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

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

4.2 Operator of the machine

DANGER
Hazard due to lack of effectiveness of the protective device

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

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

4.3 Assembly

This chapter contains important information about the design.

Information about the individual steps for mounting the device: see "Mounting", page 66.

DANGER
Hazard due to lack of effectiveness of the protective device

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

▶ Make sure that the following design requirements are met so that the safety laser scanner can fulfill its protective function.

- The safety laser scanner must be affixed so that people or parts of the body are reliably detected upon entry into the hazardous area.
- The safety laser scanner must be affixed so that no mirrors or other exceedingly reflective objects are in the protective field.
- The safety laser scanner must be affixed so that no small objects (e.g. cables) are in the protective field, even if the safety outputs do not switch to the OFF state as a result.
- The safety laser scanner must be affixed so that no obstacles disrupt the safety laser scanner's field of view. Take additional protective measures if a risk arises due to unavoidable obstacles.
- If people can stay between the protective device and the hazardous point without being detected, check if additional protective measures (e.g. restart interlock) are required.
- Reaching under, over and around, crawling beneath and stepping over the safety laser scanner, as well as moving it, must be prevented.

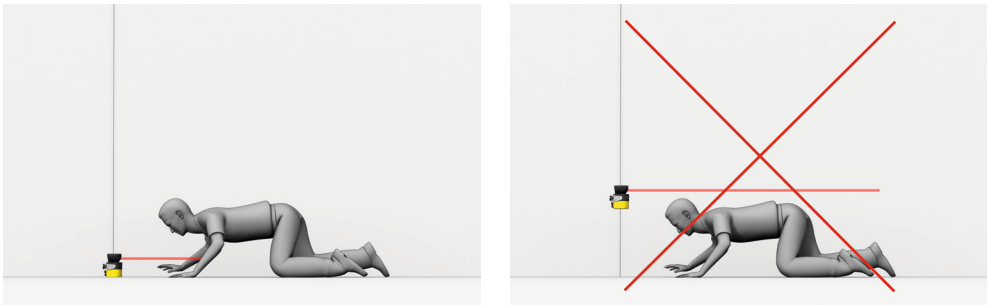


Figure 16: Prevent crawling beneath

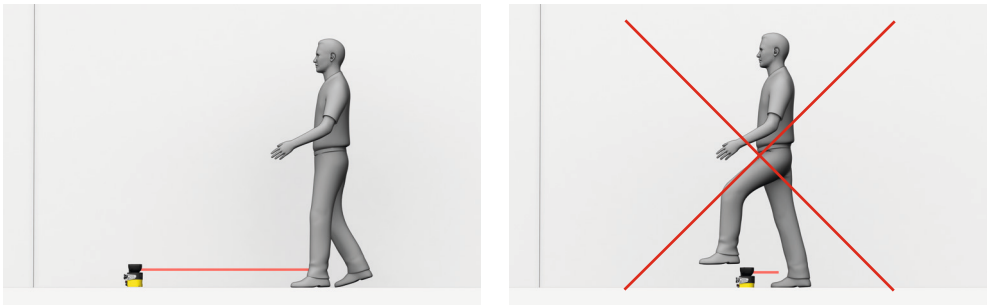


Figure 17: Prevent stepping over

DANGER
Hazard due to lack of effectiveness of the protective device

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

The optical beam path must not be disrupted, e.g. if the system is incorporated into paneling.

- Do not attach an additional front screen.
- If a viewing slit is required, make sure that its size is sufficient, see "Dimensional drawings", page 157.

NOTE
Certain optical and electromagnetic ambient conditions can affect the safety laser scanner. This may impair the machine's availability. That is to say, the safety laser scanner switches the machine off, although no people are located in the protective field.

Take note of the following for a high level of availability:

- Avoid having strong electric fields in the vicinity of the safety laser scanner. These may be caused by nearby welding or induction cables, for example.
- Prevent condensation forming on the optics cover.

4.3.1 Protection from influences

A safety laser scanner can be influenced by the beams from a different laser source in close proximity to it, e.g. by another laser scanner. This may impair the machine's availability. That is to say, the affected safety laser scanner switches the machine off, although no people are situated in the protective field.

A safety laser scanner may be dazzled by a strong external light source in the scan plane. This may impair the machine's availability. That is to say, the safety laser scanner switches the machine off, although no people are located in the protective field.

You can use the following measures to increase the availability:

- The safety laser scanner has a function for interference protection. The scan cycle time is adjusted in small increments. You can increase the availability by choosing different modes for interference protection in adjacent safety laser scanners, see "Additional interference protection", page 88.
- Higher multiple sampling reduces the likelihood of a laser source influencing the safety laser scanner. You can increase the availability by setting multiple sampling to the highest value permitted in your application, while taking minimum distances into account, see "Multiple sampling", page 87.
- You can further increase the availability by choosing a suitable mounting method, see "Mounting methods for protection from interference from systems in close proximity", page 171.
- Avoid external light sources in the scan plane. Mount the safety laser scanner so that it cannot be dazzled by incoming sunlight. Do not position halogen lights, infrared light sources or stroboscopes directly on the scan plane.

You can check the beam path of the safety laser scanner with the LS-80L scan finder (part no. 6020756).

NOTE
You must comply with the standard ISO 13855 when choosing the mounting method.

4.3.2 Preventing unprotected areas

DANGER
Hazard due to lack of effectiveness of the protective device

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

Mount the safety laser scanner so that people cannot enter unsecured areas. Take one or more of the measures described below as required:

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

Unsecured areas behind the safety laser scanner

Depending on the mounting situation, areas may result, which cannot be detected by the safety laser scanner.

The undetected areas become larger if the safety laser scanner is mounted using a mounting kit.

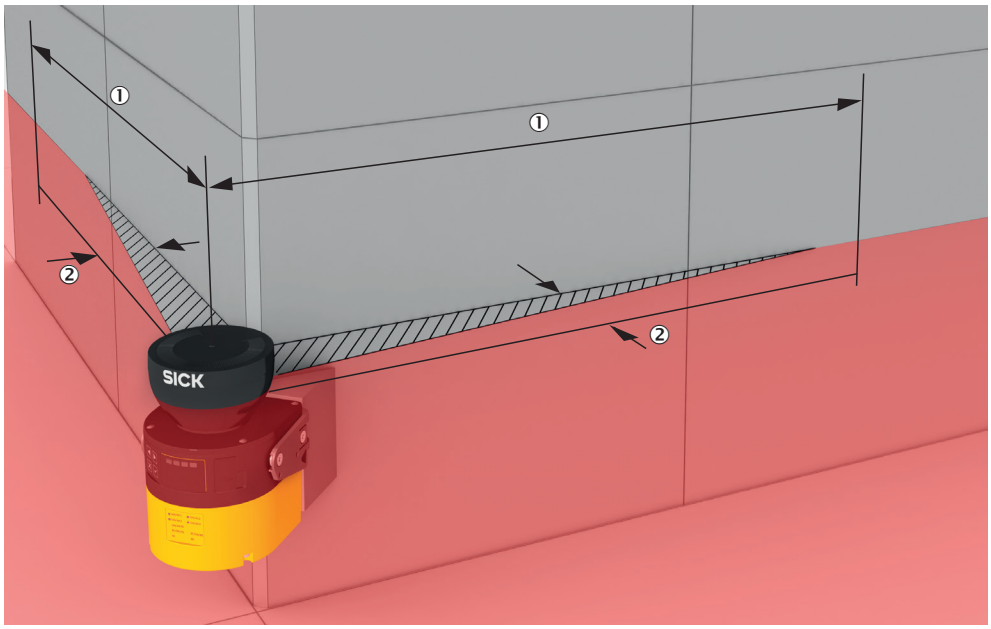


Figure 18: Unsecured areas

① Length of the unsecured area
② Width of the unsecured area

Area where detection capability is restricted

In close proximity (50 mm wide area in front of the optics cover), the detection capability of the safety laser scanner may be restricted. If required, this area must be secured using an undercut or frame, for example.

Mounting with deflector plates

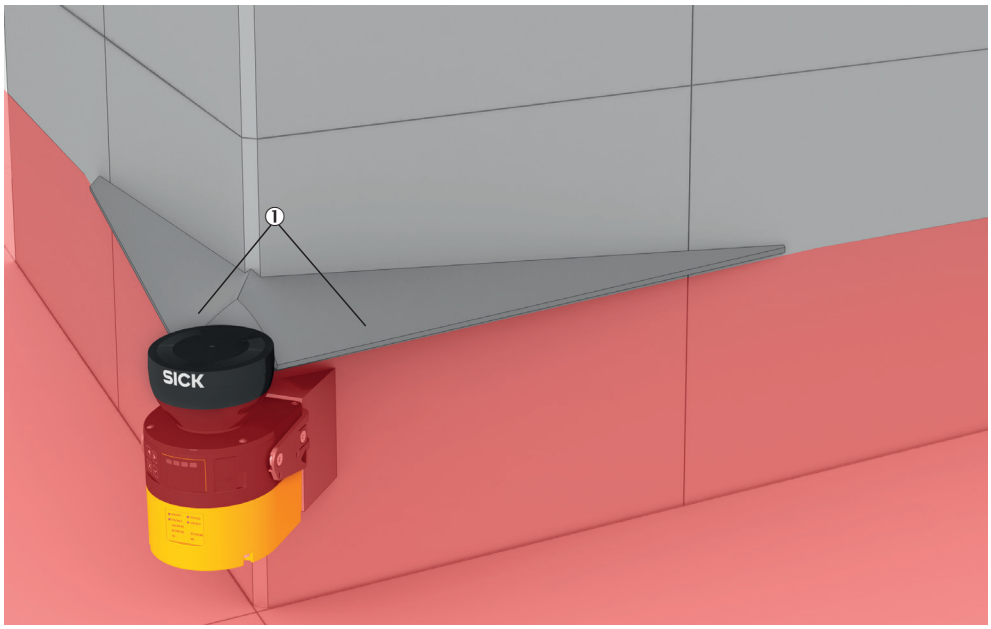


Figure 19: Mounting with deflector plates (example)

- ▶ Attach the deflector plates ① so that it is not possible to step into unsecured areas.
- ▶ Attach the deflector plates so that they lie outside the scan plane.

Mounting in an undercut

Figure 20: Mounting in an undercut (example)

- ▶ Mount the safety laser scanner in an undercut so that no-one can enter the unsecured areas.
- ▶ Make the undercut at least deep enough ①, that it covers the unsecured areas completely and no one can enter the unsecured areas.
- ▶ Prevent crawling beneath the undercut. Design the undercut to be so low ②, that no one can crawl into it.

Mounting in the machine or vehicle's paneling

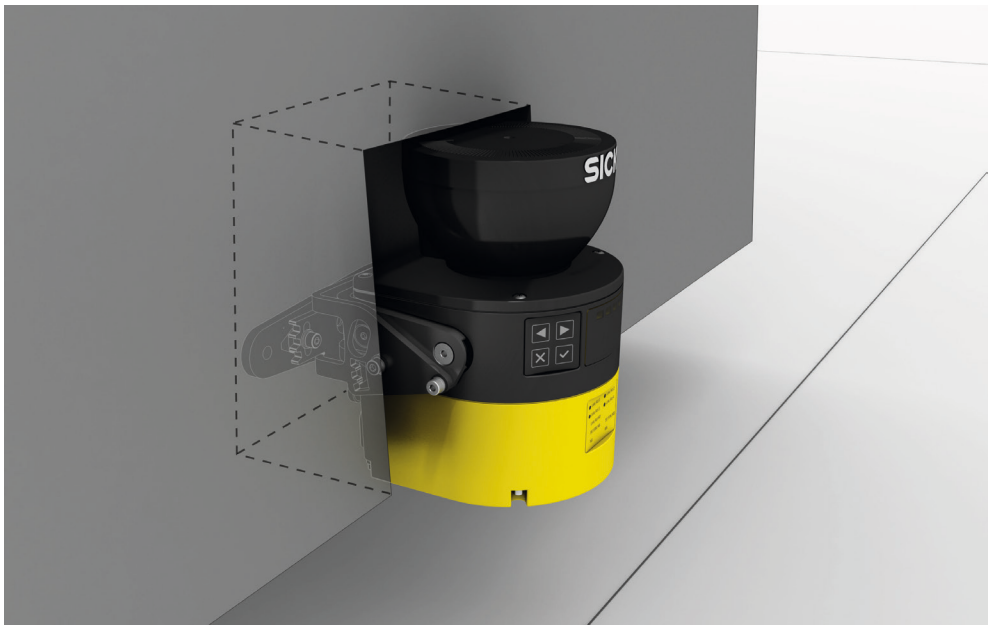


Figure 21: Mounting in vehicle paneling (example)

- If a viewing slit is required, make sure that its size is sufficient, see "Dimensional drawings", page 157.

4.3.3 Response time of the safety laser scanner

The safety laser scanner's response time must be taken into account, among other things, so that the safety laser scanner can be positioned in a suitable location and the protective fields can be sized correctly.

The response times are specified in the technical data, see "Response times", page 150.

The response time of the safety laser scanner resulting from current settings is shown in Safety Designer.

4.3.4 Reference contour monitoring

Reference contour field

The reference contour field monitors a contour of the environment. The safety laser scanner switches all safety outputs to the OFF state if a contour does not match the set parameters, because, for example, the mounting situation of the safety laser scanner were changed.

National and international standards require or recommend that a reference contour is monitored, if the safety laser scanner is used in vertical operation for hazardous point protection or for access protection.

The reference contour field detects unintentional and intentional changes to the position or alignment of the safety laser scanner. Unintentional changes may be caused by vibrations for example. An example of an intentional change is deliberate tampering to disable the safety laser scanner's functionality.

Vertical operation

National and international standards require or recommend that a reference contour is monitored, if the angle between access direction and scan plane exceeds +30°.

DANGER
Hazard due to lack of effectiveness of the protective device

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

▶ Use a contour from the environment as a reference to protect the protective device from inadvertent adjustment or tampering.

Configuring the reference contour field during vertical operation

Note the following points in particular when configuring the reference contour field:

- In many cases, it makes sense to use lateral vertical passage boundaries (e.g. door frames) and the floor as a reference.
- The reference contour field has a tolerance band, which can be set, around the contour. If the safety laser scanner does not detect the contour within the tolerance band, all safety outputs switch to the OFF state.
  - For high availability, setting both the positive tolerance band (far) and the negative tolerance band (near) to the TZ value is recommended. (TZ = tolerance range of the safety laser scanner, see "Data sheet", page 145.)
  - Make sure that the tolerance band is not too wide. The reference contour field must detect a change in the position or alignment of the safety laser scanner before a dangerous gap is created between the protective field and mechanical limit.
- The following requirements apply to the protective field with respect to the reference contour field:
  - Access protection:
    - If the reference contour represents the edge of the protected opening, the distance between the edge of the protected opening and the protective field must be no more than 100 mm wide. A distance equal to the TZ value is recommended for high availability and sufficient protection. (TZ = tolerance range of the safety laser scanner, see "Data sheet", page 145.)
    - If the reference contour does not represent the edge of the protected opening, the protective field must be larger than the protected opening. The required overrun (o) is calculated using the same formula as for hazardous point protection.
  - Hazardous point protection: the protective field must be larger than the protected opening. The required overrun (o) is calculated using the following formula:
    $o \geq (2 \times TZ) - d$
    where:
    - o = overrun of the protective field over the opening
    - TZ = tolerance range of the safety laser scanner, see "Data sheet", page 145
    - d = set resolution
- You can define a number of contours in the reference contour field and so monitor various areas in the environment.

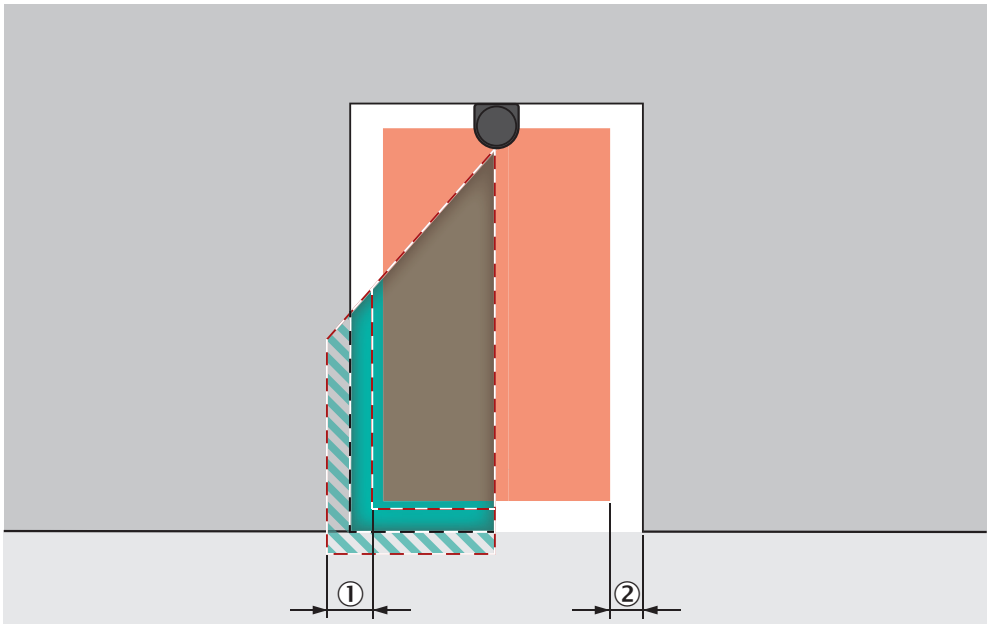


Figure 22: Tolerance band of the reference contour field (protective field within the protected opening, edge of the protected opening = reference contour)

① Tolerance band of the reference contour field

② Distance of the protective field from the reference contour, to ensure availability

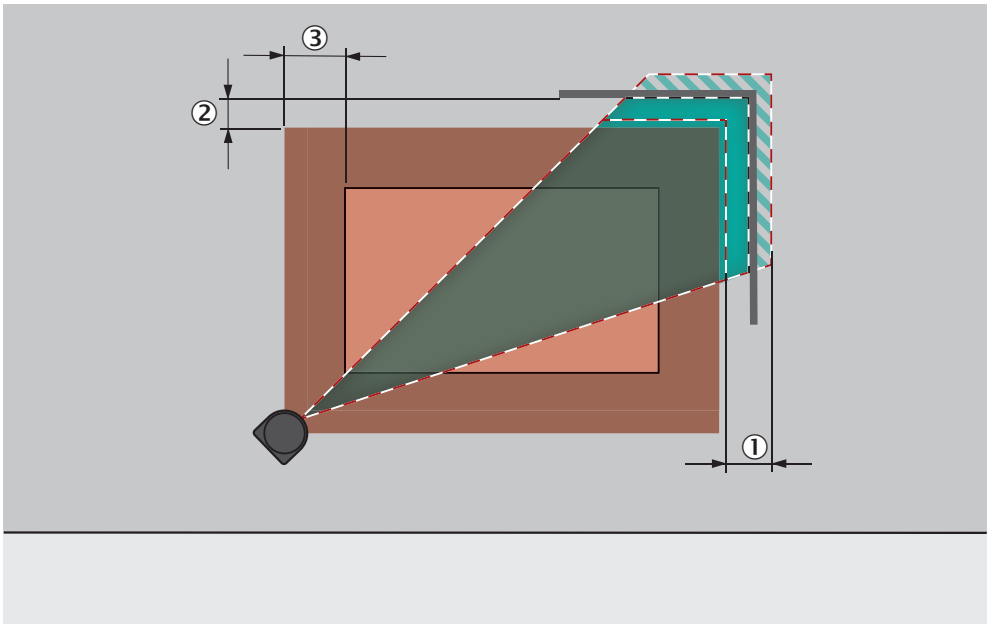


Figure 23: Overrun of the protective field in front of an opening

① Tolerance band of the reference contour field

② Distance of the protective field from the contour, to ensure availability

③ o = overrun of the protective field over the opening

4.3.5 Monitoring case switching time

When switching between monitoring cases, it is possible that a person may already be in the newly activated protective field when switching takes place. Only switching in time (namely before the danger arises for the person at this location) ensures protection.

DANGER
Hazard due to lack of effectiveness of the protective device

- Switching of the monitoring case should be timed so that the safety laser scanner detects a person in the protective field with a sufficient minimum distance, before the dangerous state occurs.

DANGER
Hazard due to lack of effectiveness of the protective device

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

In addition to the parameters considered below, the switching signal's propagation delay time up to the protective device also influences the switching duration. This includes the controls processing time, for example.

- Take account of the switching signal's propagation delay time up to the protective device.

In some cases, the process of switching between monitoring cases takes so long that the new monitoring case is not available inside the response time provided. This means that it may not be possible to detect a person in the protective field in time. In cases like this, you must start switching between monitoring cases earlier.

The following parameters influence the duration of the process:

- The set input delay (see "Input delay ", page 106).
- The processing time for the chosen input.

You calculate when to switch between monitoring cases as follows

1. First calculate how long it takes to switch between monitoring cases:
   $t_{CSR} = t_{ID} + t_I$
   where:
   - t_{CSR} = time required for switching between monitoring cases in milliseconds (ms)
   - t_{ID}=input delay for the control inputs in milliseconds (ms)
   - t_I = processing time for the selected switching type in milliseconds (ms)
     - Local static control input: t_I = 12 ms
2. Then calculate how much time is available in the response time for switching between monitoring cases:
   $t_{CSA} = (n - 1) \times t_S$
   where:
   - t_{CSA} = time available for switching between monitoring cases in milliseconds (ms)
   - n = set multiple sampling (default: n = 2)
   - t_S = scan cycle time (poss. incl. supplement due to interference protection) in milliseconds (ms)
3. Then check whether there is enough time available for switching between monitoring cases:
   - If $t_{CSA} \geq t_{CSR}$: earlier start is not necessary.
   - If $t_{CSA} < t_{CSR}$: you must start switching between monitoring cases earlier. The time advance t_{CSP} required is: $t_{CSP} = t_{CSR} - t_{CSA}$

NOTE

In some cases, it is not possible to define when to switch (for example because processing times of the machine vary) or the time advance means that the monitoring of an area finishes too early. Follow one of the following recommendations in these cases:

- Allow the two protective fields to partially overlap.

4.3.6 Hazardous area protection

The safety laser scanner is mounted with a horizontal scan plane in a stationary application, for example on a machine where the hazardous area is not completely surrounded by a physical guard. During hazardous area protection, the safety laser scanner detects a person's legs. The protective field is parallel to the person's direction of approach.

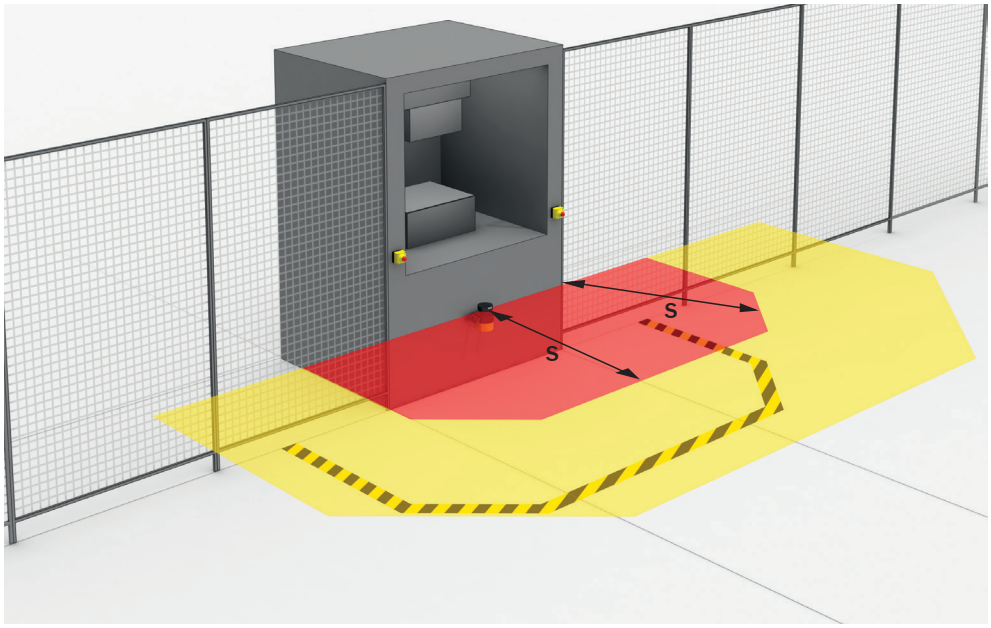


Figure 24: Stationary application with horizontal scan plane for hazardous area protection

NOTE

Mark the outline of the protective field boundaries on the floor after you have worked out the protective field size. By doing this, you allow machine operators to see the protective field boundaries and make it easier to thoroughly check the protective function at a later date.

4.3.6.1 Protective field

Overview

The protective field must be designed so that it detects a person at a minimum distance from the hazardous point. This distance is required to prevent a person or part of their body from reaching the hazardous area before the end of the machine's dangerous state.

In hazardous area protection, the minimum distance typically defines the protective field size required.

If you define a number of monitoring cases with different protective fields, you must calculate the protective field size separately for each protective field used.

In many cases, a resolution of 50 mm to 70 mm is suitable for hazardous area protection.

Important information

DANGER
Hazard due to lack of effectiveness of the protective device
In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

1. Calculate the required minimum distance for your machine using the following formulas and examples.
2. Take this calculation and the specifications in these instructions into account when mounting the safety laser scanner.
3. Take this calculation and the specifications in these instructions into account when configuring the safety laser scanner.

DANGER
Hazard due to lack of effectiveness of the protective device
Persons and parts of the body to be protected may not be recognized in case of non-observance.
Body parts to be protected may not be detected under coarse resolution.

- Use a resolution of 70 mm or finer for hazardous area protection.
- For hazardous area protection with a resolution of 70 mm: make sure that it is possible to detect a human leg.
- For hazardous area protection with a resolution of 70 mm: mount the safety laser scanner at a height of at least 300 mm (height of the scan plane).
- If it is not possible to mount the safety laser scanner at a height of at least 300 mm, use a finer resolution see "Calculating required resolution", page 39.

NOTE
If the protective field needs to be as small as possible, you may have to calculate the minimum distance multiple times with different scan cycle times (iterative calculation) because of various dependencies. [2)]
Always take the actual response time into account when calculating the minimum distance, see "Response times", page 150.

1. First calculate the minimum distance on the basis of the response time for a small scan cycle time.
2. If the calculated minimum distance is larger than the resulting protective field range (see "Protective field range", page 152), recalculate the minimum distance on the basis of the response time for a large scan cycle time.

4.3.6.2 Calculating minimum distance

Overview

The calculation of the minimum distance is based on international or national standards and statutory requirements applicable at the place of installation of the machine.

If the minimum distance is calculated according to ISO 13855, then it depends on the following points:

2) The required minimum distance depends on the response time, among other things, and therefore on the scan cycle time. The protective field range likewise depends on the scan cycle time: the protective field range is shorter for a faster scan cycle time.

- Machine stopping time (time interval between triggering the sensor function and the end of the machine's dangerous state)
- Response time of the protective device, see "Response times", page 150
- Reach or approach speed of the person
- Resolution (detection capability) of the safety laser scanner
- Type of approach: parallel
- Parameters specified based on the application
- Supplements for general and, possibly, reflection-based measurement errors
- Supplement to protect against reaching over
- Height of the scan plane
- Switching time between monitoring cases

Important information

NOTE
More information is available in the ISO 13855 standard and in the Guide for Safe Machinery.

NOTE
SICK offers a stopping/run-down time measurement service in many countries.

Calculation example of the minimum distance S according to ISO 13855

The example shows the calculation of the minimum distance for parallel approach to the protective field. Depending on the application and the ambient conditions a different calculation may be required. (e.g., a protective field or at an arbitrary angle to the direction of approach or an indirect approach)

▶ Calculate S using the following formula:
$S = 1600\ mm/s \times T + TZ + Z_R + C$
where:
  - S = minimum distance in millimeters (mm)
  - T = stopping/run-down time for the entire system in seconds (s) (Response time of the safety laser scanner + machine's stopping/run-down time, incl. response time of the machine's control system and signal propagation time)
  - TZ = tolerance range of the safety laser scanner, see "Data sheet", page 145
  - Z_R = supplement for reflection-based measurement errors in millimeters (mm)
  - C = supplement to protect against reaching over in millimeters (mm)

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

Supplement Z_R for reflection-based measurement errors

All devices: If there is a retroreflector in the vicinity of the protective device (distance of the retroreflector from protective field ≤ 6 m), you must take the supplement Z_R = 350 mm into account.

Devices with max. protective field range of 9 m for stationary applications: Strongly reflective surfaces (e.g. shiny metal, tile) with a distance from the protective field ≤ 6 m can behave similarly to a retroreflector if the laser beam hits the surface vertically. If the protective field is larger than 50% of the protective field range in the direction of the laser beam which is hitting the surface vertically, you must take supplement Z_R = 350 mm into account in this direction. [3] Supplement Z_R must be upheld at least at a width of 3 × d (d = set object resolution) around the laser beam which hits the surface vertically.

3) The protective field range depends on the set scan cycle time and resolution.

Supplement C to protect against reaching over

Under certain circumstances, a person can reach the hazardous area by reaching over, before the protective device stops the dangerous state. Supplement C prevents this.

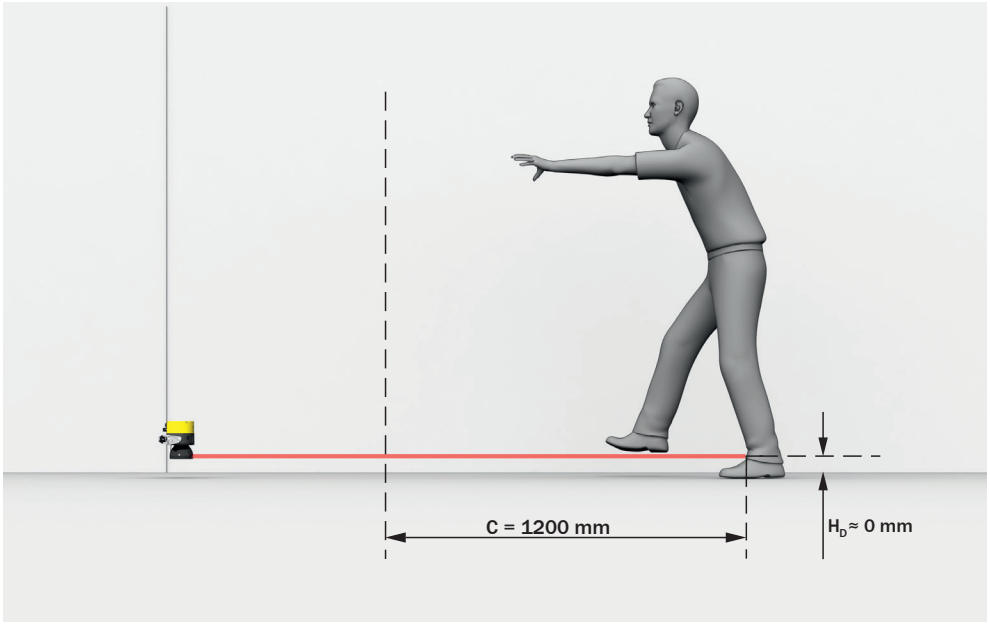


Figure 25: Protection against reaching over when mounted low (dimensions in mm)

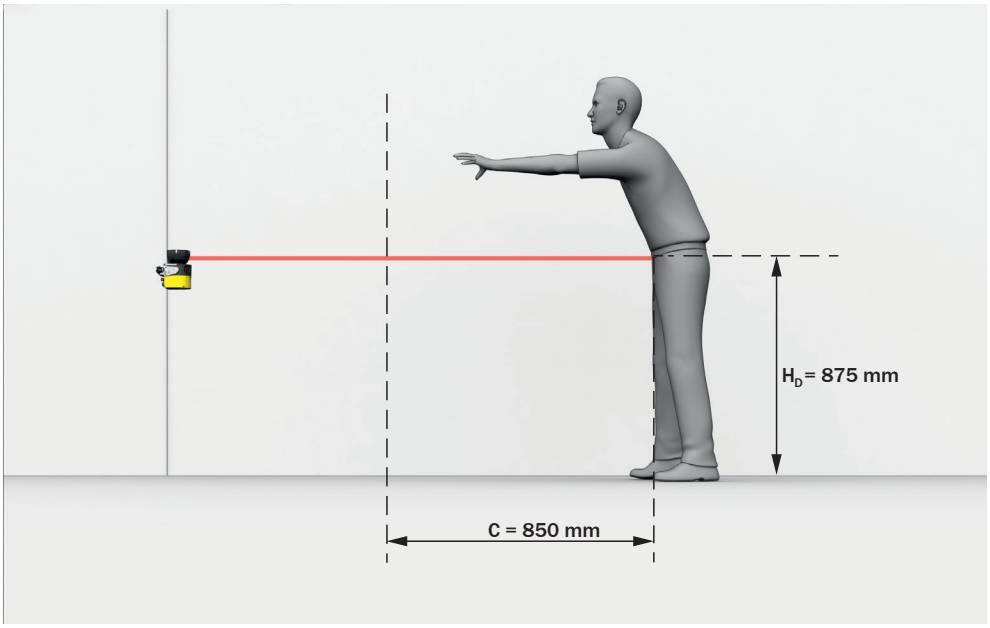


Figure 26: Protection against reaching over when mounted high (dimensions in mm)

The necessary supplement to the minimum distance depends on the height of the protective field's scan plane. The supplement is larger if the safety laser scanner is affixed low-down than if it is affixed high-up.

Calculating the supplement C

- ▶ If you have sufficient free space in front of your machine, use value 1200 mm as the supplement C.
- ▶ If you want to keep the minimum distance as low as possible, use the following formula to calculate C:
  $C = 1200\ mm - (0.4 \times H_D)$
  where:
  - H_D = height of the protective field above the floor in millimeters (mm).
- ✓ If the result is C ≥ 850 mm, then use the calculated value as supplement C.
- ✓ If the result is C < 850 mm, then use C = 850 mm (this value corresponds to an arm's length and is valid as a minimum supplement to protect against reaching over).

4.3.6.3 Height of the scan plane

Overview

If you choose a resolution of 70 mm for hazardous area protection, it is not possible to detect a human leg under certain circumstances. This is because a beam does not hit the leg. Rather, the beams pass by the sides of the ankle (see figure 27, page 38). If you mount the safety laser scanner at a height of at least 300 mm (height of the scan plane), the scan plane is at calf height and the leg is detected even at a resolution of 70 mm (see figure 28, page 39).

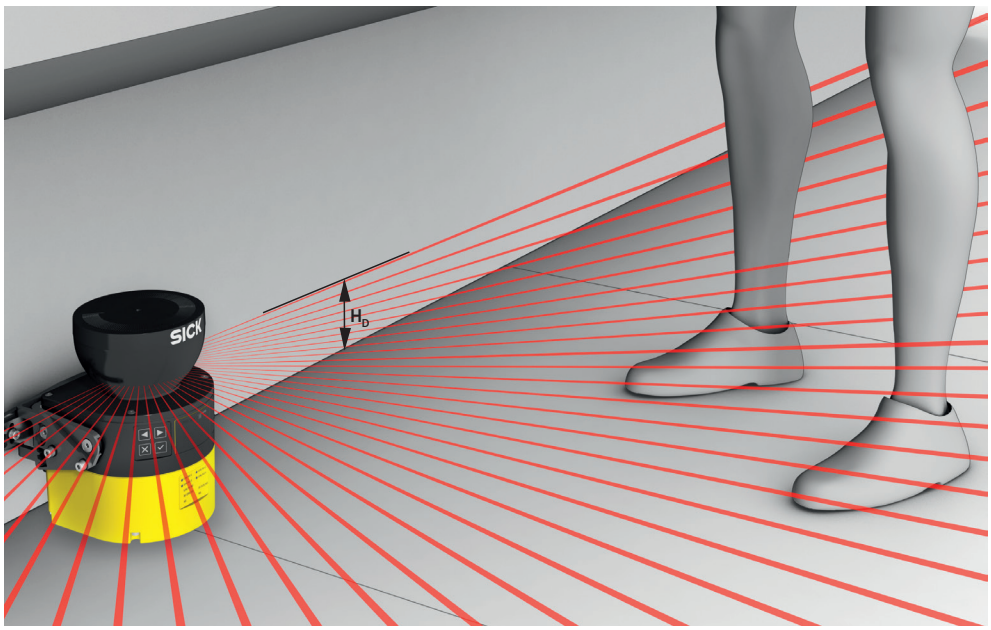


Figure 27: Scan plane at ankle height

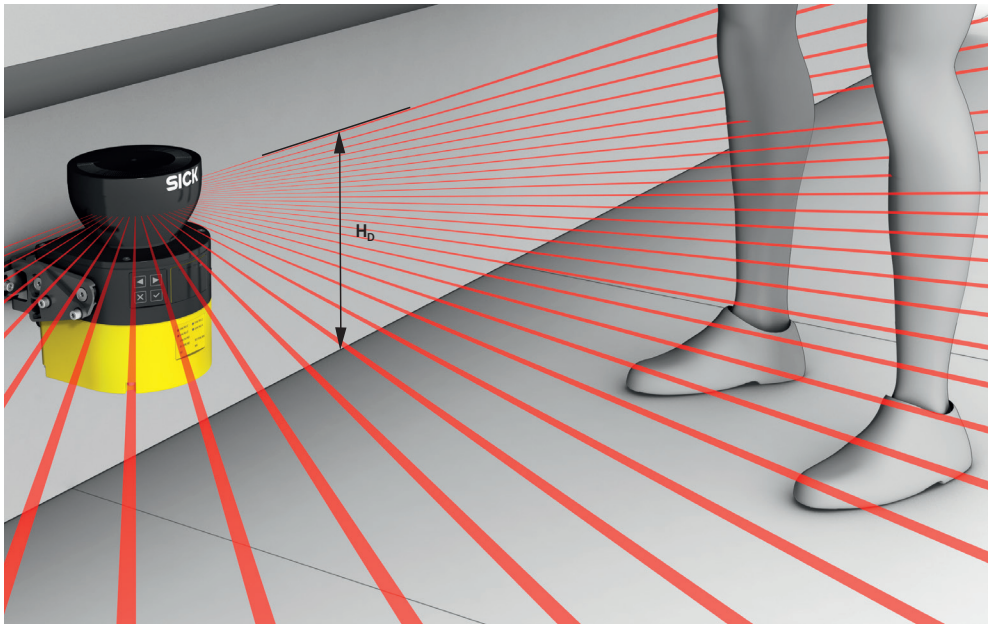


Figure 28: Scan plane at calf height

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

It is possible to get around the protective device by crawling beneath.

- Prevent people from being able to crawl beneath the protective field by mounting the safety laser scanner appropriately.
- If you mount the protective device higher than 300 mm, you must use additional measures to prevent crawling beneath.

DANGER
Hazard due to lack of effectiveness of the protective device

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

Body parts to be protected may not be detected under coarse resolution.

- Use a resolution of 70 mm or finer for hazardous area protection.
- For hazardous area protection with a resolution of 70 mm: make sure that it is possible to detect a human leg.
- For hazardous area protection with a resolution of 70 mm: mount the safety laser scanner at a height of at least 300 mm (height of the scan plane).
- If it is not possible to mount the safety laser scanner at a height of at least 300 mm, use a finer resolution see "Calculating required resolution", page 39.

Calculating required resolution

If the height of the protective field (scan plane) is predefined and is less than 300 mm, you can calculate the required resolution using the following formula:

$d_r = H_D/15 + 50$ mm

where:

- d_r = coarsest permissible resolution of the safety laser scanner in millimeters (mm)
- H_D = height of the protective field above the floor in millimeters (mm)

▶ The safety laser scanner's resolution can be set to the predefined value d. If the result d_r does not match any of these values, choose a finer resolution ($d \leq d_r$).

4.3.6.4 Distance from walls

Overview

The availability may be impaired if the protective field stretches as far as a wall or a different object. So, plan to have a space between the protective field and the object. A distance of the TZ value is recommended to ensure availability. (TZ = tolerance range of the safety laser scanner, see "Data sheet", page 145.)

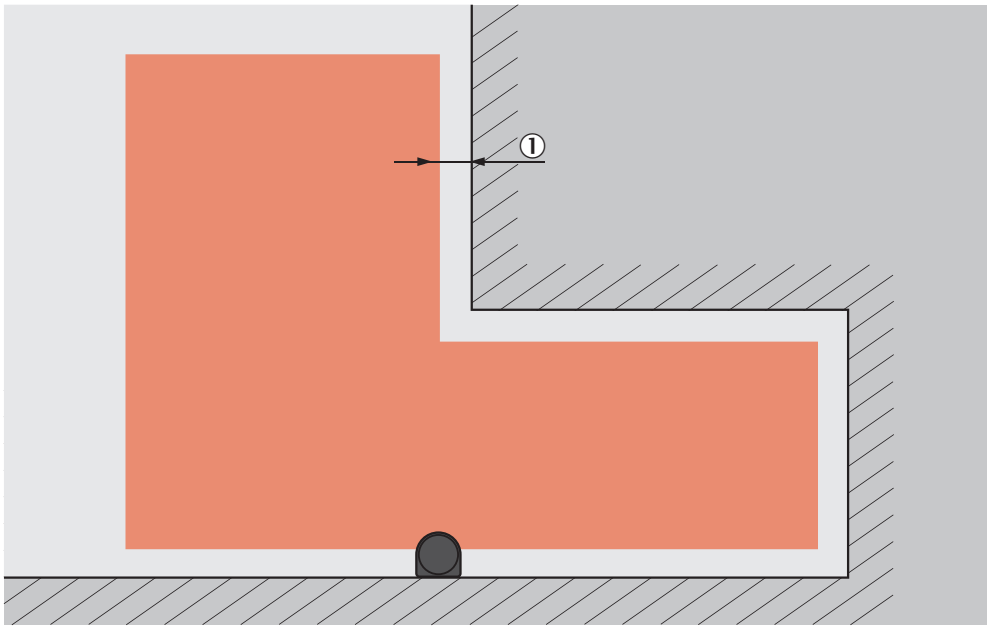


Figure 29: Distance of the protective field from the wall

① Recommended distance of the protective field from the wall.

Important information

DANGER

Hazard due to lack of effectiveness of the protective device

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

If the distance between the protective field and the wall is so large that a person can stand in it, this person might not be detected. If needed, take suitable measures to prevent this such as:

▶ Attaching deflector plates
▶ Attaching fence

4.3.7 Hazardous point protection

Overview

The safety laser scanner is mounted with a vertical scan plane in a stationary application, for example on a machine where the operator must stay close to the hazardous point. A fixed barrier with a height of at least 1200 mm is located in front of the hazardous point. The operator can reach over the barrier and through the scan plane into the hazardous point. But the operator cannot climb over the barrier. If there is no such barrier available, access protection may be required.

During hazardous point protection, the safety laser scanner detects a person's hand or other part of their body. The protective field is orthogonal to the direction of approach of the body part. A resolution of 40 mm or finer is required to ensure detection of the hand during hazardous point protection.

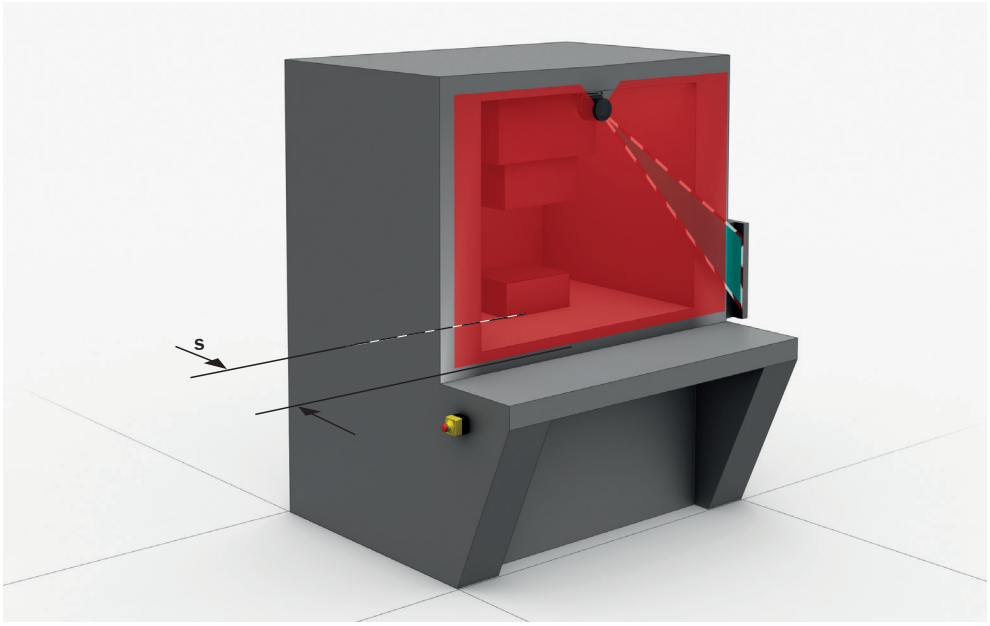


Figure 30: Stationary application in vertical operation for hazardous point protection

Important information

DANGER

Hazard due to lack of effectiveness of the protective device

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

The safety laser scanner is not suitable for finger detection, because the finest resolution is 30 mm.

- Never use the safety laser scanner for applications in which finger detection has to be realized.
- Use the contour of the environment as a reference to protect the protective device from inadvertent adjustment or tampering (see "Reference contour monitoring", page 30).

DANGER
Hazard due to lack of effectiveness of the protective device

If there is a retroreflector in the protective field level (distance of the retroreflector from protective field ≤ 6 m), it may not be possible detect people and parts of the body that are to be protected, or it may not be possible to detect them on time.

- Avoid retroreflectors in the protective field level if possible.
- With retroreflectors at the protective field level: Increase overrun of the protective field over the opening to be protected by supplement Z_R = 350 mm.

DANGER
Hazard due to lack of effectiveness of the protective device

Devices with max. protective field range of 9 m: Strongly reflective surfaces (e.g. shiny metal, tile) with a distance from the protective field ≤ 6 m can behave similarly to a retroreflector if the laser beam hits the surface vertically. If the protective field is larger than 50% of the effective protective field range in the direction of the laser beam which is hitting the surface vertically, it is possible that persons and parts of the body that are to be protected will not be detected or not be detected on time.

- Avoid strongly reflective surfaces in the protective field level if possible.
- With strongly reflective surfaces in the protective field level: Increase overrun of the protective field over the opening to be protected by supplement Z_R = 350 mm.

Protective field

The protective field must be designed so that it detects access by a person at a minimum distance from the hazardous point. This distance is required to prevent a person or part of their body from reaching the hazardous area before the end of the machine's dangerous state.

In hazardous area protection, the minimum distance typically defines the position at which the safety laser scanner is mounted.

In many cases, a resolution of 30 mm or 40 mm is suitable for hazardous point protection.

DANGER
Hazard due to lack of effectiveness of the protective device

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

1. Calculate the required minimum distance for your machine using the following formulas and examples.
2. Take this calculation and the specifications in these instructions into account when mounting the safety laser scanner.
3. Take this calculation and the specifications in these instructions into account when configuring the safety laser scanner.

DANGER
Hazard due to lack of effectiveness of the protective device

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

- Always mount the safety laser scanner so that it is impossible to reach around or behind.
- Provide suitable additional measures if necessary.

NOTE

The required minimum distance depends on the safety laser scanner's set resolution. Take account of the following notes when choosing the resolution:

- If you choose a fine resolution, the protective field range is smaller and so the protective field is only suitable for smaller hazardous points. But the required minimum distance is smaller, so you can mount the safety laser scanner closer to the hazardous point.
- If you choose a coarser resolution, the protective field range is larger and so the protective field is also suitable for larger hazardous points. But the required minimum distance is larger, so you must mount the safety laser scanner further away from the hazardous point.

Calculating minimum distance

The calculation of the minimum distance is based on international or national standards and statutory requirements applicable at the place of installation of the machine.

If the minimum distance is calculated according to ISO 13855, then it depends on the following points:

- Machine stopping time (time interval between triggering the sensor function and the end of the machine's dangerous state)
- Response time of the protective device, see "Response times", page 150
- Reach or approach speed of the person
- Resolution (detection capability) of the safety laser scanner
- Type of approach: orthogonal
- Parameters specified based on the application

NOTE

Additional information is available in the ISO 13855 standard and in the Guidelines Safe Machinery.

NOTE

SICK offers a stopping/run-down time measurement service in many countries.

Calculation example of the minimum distance S according to ISO 13855

The example shows the calculation of the minimum distance for an orthogonal approach to the protective field. A different calculation may be required depending on the application and the ambient conditions (for example, for a protective field parallel to or at any angle to the direction of approach or an indirect approach).

▶ First, calculate S using the following formula:
S = 2000 mm/s × T + 8 × (d – 14 mm)
where:
  - S = minimum distance in millimeters (mm)
  - T=stopping/run-down time for the entire system in seconds (s)
(Response time of the safety laser scanner + machine's stopping/run-down time, incl. response time of the machine's control system and signal propagation time)
  - d = resolution of the safety laser scanner in millimeters (mm)

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

✓ If the result S is ≤ 100 mm, use S = 100 mm.

✓ If the result 100 mm < S ≤ 500 mm, use the calculated value as the minimum distance.

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

S = 1600 mm/s × T + 8 ×(d – 14 mm)

✓ If the new value is S > 500 mm, 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.

4.3.8 Access protection

Overview

The safety laser scanner is mounted with a vertical scan plane in a stationary application, for example on a machine, for which access to the hazardous area may be defined structurally. For access protection, the safety laser scanner detects an intrusion by a whole body. The protective field is orthogonal to the person's direction of approach.

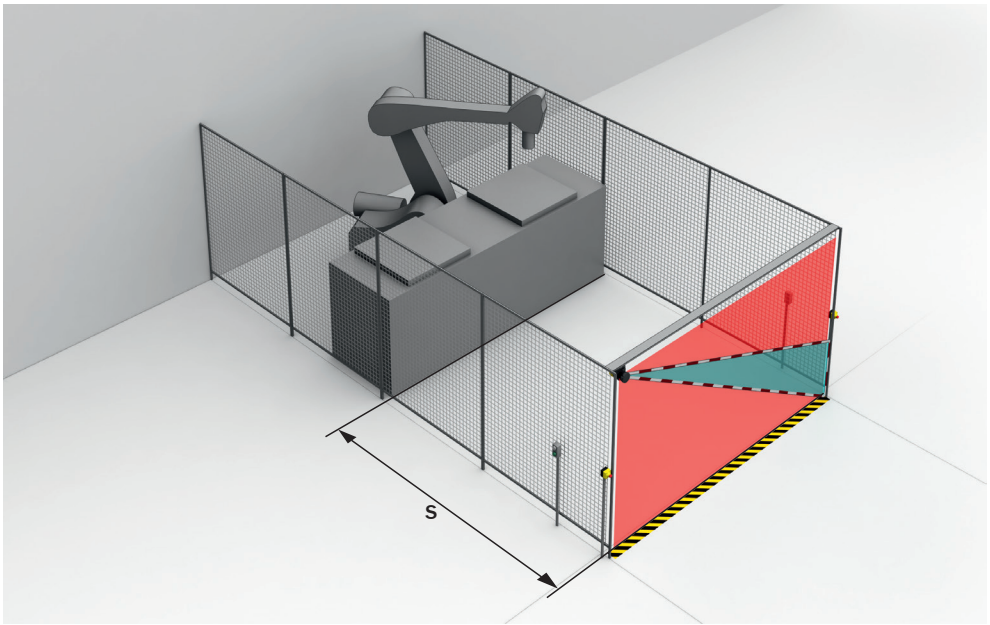


Figure 31: Stationary application in vertical operation for access protection

Important information

DANGER

Hazard due to lack of effectiveness of the protective device

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

- Use a resolution of 200 mm or finer. Otherwise, protection will not be ensured during access protection.
- Use double sampling during access protection. Under certain circumstances, a person could pass through the protective field without being detected when using higher multiple sampling.
- Use the contour of the environment as a reference to protect the protective device from inadvertent adjustment or tampering (see "Reference contour monitoring", page 30).

DANGER
Hazard due to lack of effectiveness of the protective device

If there is a retroreflector in the protective field level (distance of the retroreflector from protective field ≤ 6 m), it may not be possible detect people and parts of the body that are to be protected, or it may not be possible to detect them on time.

- Avoid retroreflectors in the protective field level if possible.
- With retroreflectors at the protective field level: Increase overrun of the protective field over the opening to be protected by supplement Z_R = 350 mm.

DANGER
Hazard due to lack of effectiveness of the protective device

Devices with max. protective field range of 9 m: Strongly reflective surfaces (e.g. shiny metal, tile) with a distance from the protective field ≤ 6 m can behave similarly to a retroreflector if the laser beam hits the surface vertically. If the protective field is larger than 50% of the effective protective field range in the direction of the laser beam which is hitting the surface vertically, it is possible that persons and parts of the body that are to be protected will not be detected or not be detected on time.

- Avoid strongly reflective surfaces in the protective field level if possible.
- With strongly reflective surfaces in the protective field level: Increase overrun of the protective field over the opening to be protected by supplement Z_R = 350 mm.

Protective field

The protective field must be designed so that it detects a person at a minimum distance from the hazardous point. This distance is required to prevent a person or part of their body from reaching the hazardous area before the end of the machine's dangerous state.

In access protection, the minimum distance typically defines the position at which the safety laser scanner is mounted.

The protective field must be at least 900 mm high so that it is not possible to climb over it.

Devices with max. protective field range of 9 m: The protective field must cover a minimum area so that the safety laser scanner reliably detects a moving person. The lower edges of the protective field must be no more than max. 300 mm above the floor and the upper edges of the protective field must be at least min. 1,400 mm above the floor.

DANGER
Hazard due to lack of effectiveness of the protective device

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

1. Calculate the required minimum distance for your machine using the following formulas and examples.
2. Take this calculation and the specifications in these instructions into account when mounting the safety laser scanner.
3. Take this calculation and the specifications in these instructions into account when configuring the safety laser scanner.

Calculating minimum distance

The calculation of the minimum distance is based on international or national standards and statutory requirements applicable at the place of installation of the machine.

If the minimum distance is calculated according to ISO 13855, then it depends on the following points:

- Machine stopping time (time interval between triggering the sensor function and the end of the machine's dangerous state)
- Response time of the protective device, see "Response times", page 150
- Reach or approach speed of the person
- Resolution (detection capability) of the safety laser scanner
- Type of approach: orthogonal
- Parameters specified based on the application
- Supplement to prevent reaching through

NOTE
Additional information is available in the ISO 13855 standard and in the Guidelines Safe Machinery.

NOTE
SICK offers a stopping/run-down time measurement service in many countries.

Calculation example of the minimum distance S according to ISO 13855

The example shows the calculation of the minimum distance for an orthogonal approach to the protective field. A different calculation may be required depending on the application and the ambient conditions (for example, for a protective field parallel to or at any angle to the direction of approach or an indirect approach).

▶ Calculate S using the following formula:
S = 1600 mm/s × T + 850 mm
where:
  - S = minimum distance in millimeters (mm)
  - T=stopping/run-down time for the entire system in seconds (s)
(Response time of the safety laser scanner + machine's stopping/run-down time, incl. response time of the machine's control system and signal propagation time)

The approach speed is already included in the formula.

4.3.9 Mobile hazardous area protection

The safety laser scanner is mounted with a horizontal scan plane in a mobile application, for example on an automated guided vehicle. In mobile hazardous area protection, the safety laser scanner protects the hazardous area created by the vehicle's movement. The safety laser scanner detects a person's legs. The protective field is parallel to the direction of approach.

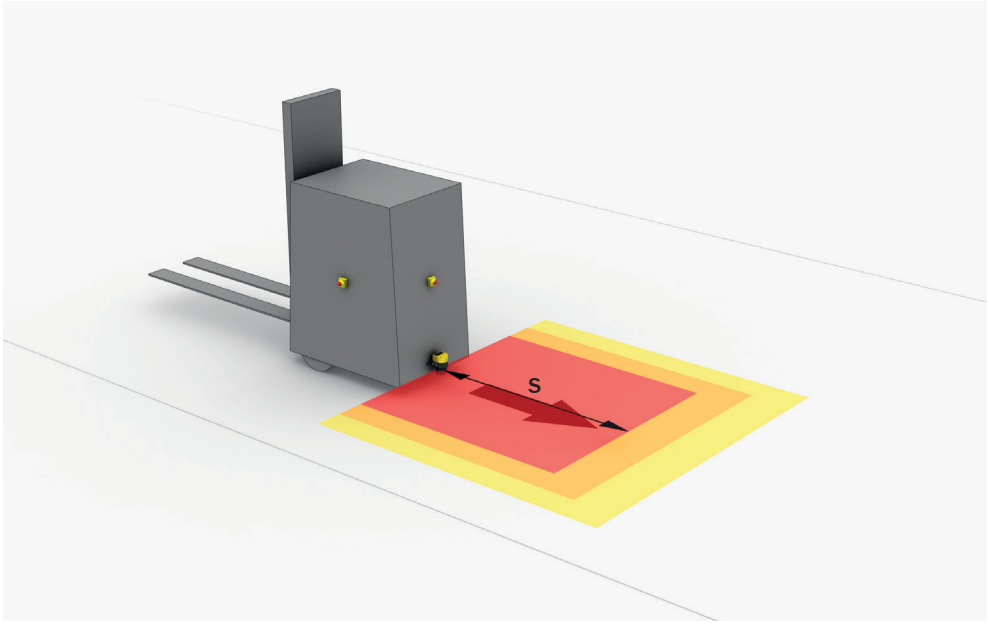


Figure 32: Mobile application in horizontal operation for hazardous area protection

DANGER

Hazard due to lack of effectiveness of the protective device

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

1. Calculate the minimum dimensions required for the protective field taking into account the supplements described in the following text along with the specific requirements imposed by your application.
2. Take this calculation and the specifications in these instructions into account when mounting the safety laser scanner.
3. Take this calculation and the specifications in these instructions into account when configuring the safety laser scanner.

NOTE

- In a mobile application, a resolution of 70 mm (leg detection) is sufficient for detecting people. By contrast with stationary hazardous point protection, this is also true for a low mounting height, as the safety laser scanner moves together with the vehicle.
- In the following calculation examples, only the vehicle speed is taken into account, not the speed of a walking person. This is based on the assumption that the person recognizes the danger and stands still.

4.3.9.1 Protective field length

The protective field must be designed so that it detects a person at a minimum distance from the hazardous point. This distance is required to ensure that the vehicle comes to a stop before it reaches a person or an object.

In mobile hazardous area protection, the minimum distance typically defines the protective field length required. When calculating the protective field length, the impact of turning must be considered separately.

If you define a number of monitoring cases with different protective fields, you must calculate the protective field size separately for each protective field used.

Supplement Z_R for reflection-based measurement errors

All devices: If there is a retroreflector in the vicinity of the protective device (distance of the retroreflector from protective field ≤ 6 m), you must take the supplement Z_R = 350 mm into account.

Supplement Z_F for lack of ground clearance

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

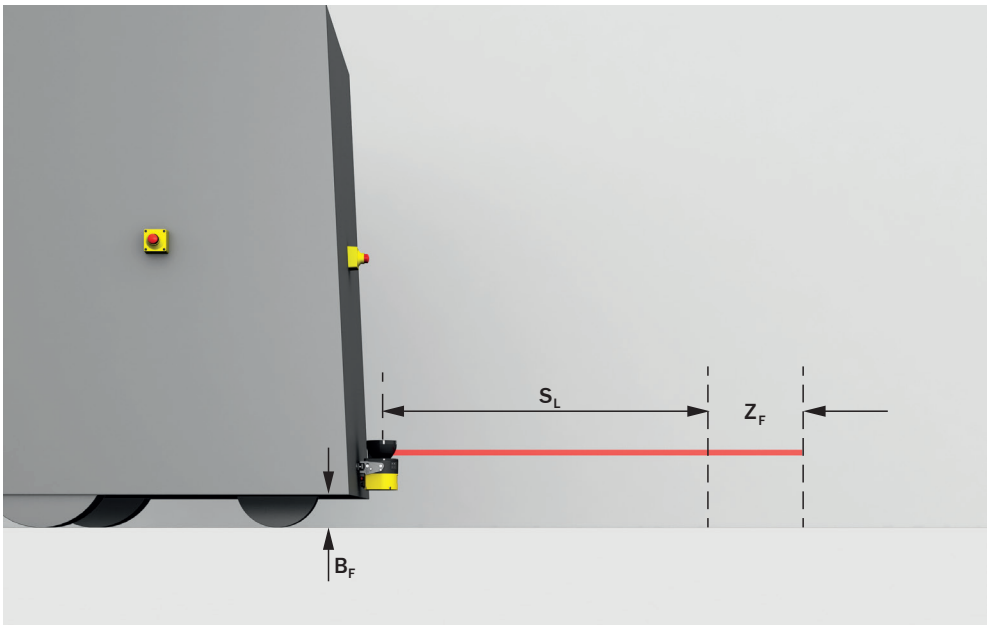


Figure 33: flat-rate supplement ZF for lack of ground clearance

B_F ground clearance

S_L protective field length without a supplement for lack of ground clearance

Z_F supplement for lack of ground clearance

The flat-rate supplement for a ground clearance below 120 mm is 150 mm. This supplement may be reduced further in individual cases. Read the supplement actually required for your vehicle's ground clearance from the following graph.

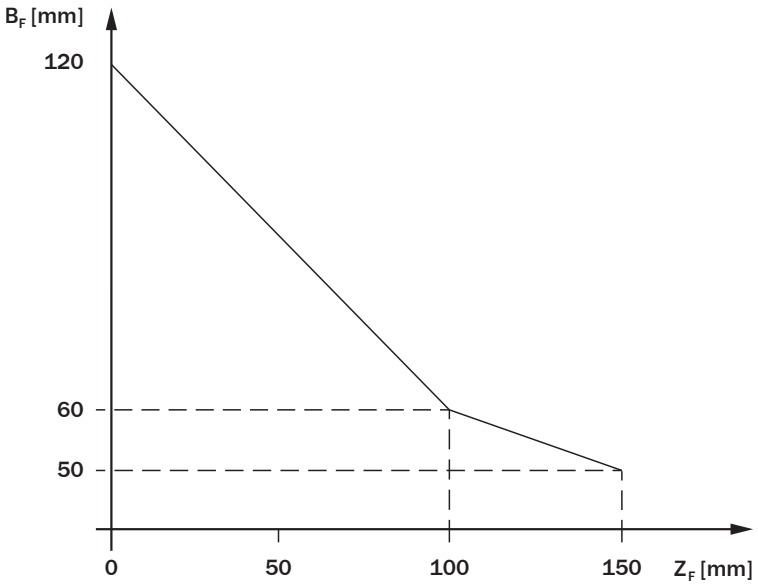


Figure 34: Minimum supplement for lack of ground clearance

B_F ground clearance in mm

Z_F supplement for lack of ground clearance in mm

Calculation example for the protective field length S_L

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

where:

- S_L = protective field length in millimeters (mm)
- S_A = stopping distance in millimeters (mm)
- TZ = tolerance range of the safety laser scanner, see "Data sheet", page 145
- Z_R = supplement for reflection-based measurement errors in millimeters (mm)
- Z_F = supplement for lack of ground clearance of the vehicle in millimeters (mm)
- Z_B = supplement for the decreasing braking force of the vehicle, from the vehicle documentation, in millimeters (mm)

Stopping distance S_A

The stopping distance comprises the vehicle's braking distance and the distance covered during the safety laser scanner's response time and the vehicle control's response time (including signal propagation time).

NOTE

A vehicle's braking distance does not increase linearly with increasing speed, but rather in a squared relationship.

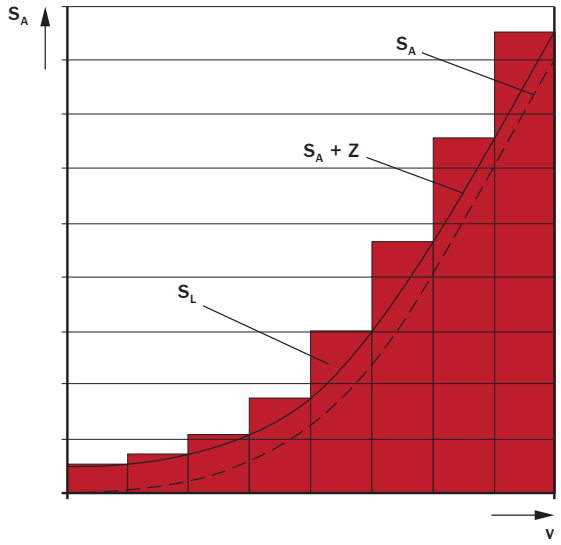


Figure 35: Stopping distance as a function of the vehicle's speed

v speed
S_A stopping distance
Z supplements
S_L protective field length for the relevant range of speeds

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

where:

- S_A = stopping distance in millimeters (mm)
- S_{Br} = braking distance, from the vehicle documentation, in millimeters (mm)
- S_{AnF} = distance covered during the vehicle control's response time (including signal propagation time), from the vehicle documentation, in millimeters (mm)
- S_{AnS} = distance covered during the safety laser scanner's response time in millimeters (mm)
  The distance S_{AnS} depends on the safety laser scanner's response time and the vehicle's speed. The distance S_{AnS} is calculated using the following formula:
  $S_{AnS} = t_R \times V_{max}$
  where:
  - t_R = safety laser scanner's response time in seconds (s) (see "Response times", page 150)
  - V_{max} = maximum speed of the vehicle, from the vehicle documentation, in millimeters per second (mm/s) (If you define a number of monitoring cases with different protective fields: V_{max} = maximum speed of the vehicle in the current monitoring case)

4.3.9.2 Protective field width

The protective field must be wide enough to cover the width of the loaded vehicle with supplements for measurement error and the lack of ground clearance. When calculating the protective field width, the impact of turning must be considered separately.

Supplement Z_R for reflection-based measurement errors

All devices: If there is a retroreflector in the vicinity of the protective device (distance of the retroreflector from protective field ≤ 6 m), you must take the supplement Z_R = 350 mm into account.

Supplement Z_F for lack of ground clearance

This supplement is necessary, because, generally, a person is detected above the foot and so the braking process cannot take account of the length of the foot in front of the point of detection. A person's foot could be injured if a vehicle has no ground clearance, see "Supplement Z_F for lack of ground clearance", page 48.

Calculation example for the protective field width S_B

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

where:

- S_B = protective field width in millimeters (mm)
- F_B = vehicle width in millimeters (mm)
- TZ = tolerance range of the safety laser scanner, see "Data sheet", page 145
- Z_R = supplement for reflection-based measurement errors in millimeters (mm)
- Z_F = supplement for lack of ground clearance of the vehicle in millimeters (mm)

NOTE

In many cases, the safety laser scanner is mounted in the center of the vehicle. If this is not the case, you must define the protective field asymmetrically. Make sure that the supplements are located on the right and left of the vehicle.

4.3.9.3 Height of the scan plane

DANGER

Hazard due to lack of effectiveness of the protective device

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

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

People who are lying down are reliably detected if the scan plane is at a height of no more than 200 mm.

In many cases, a mounting height of 150 mm above the floor (height of the scan plane) is suitable.

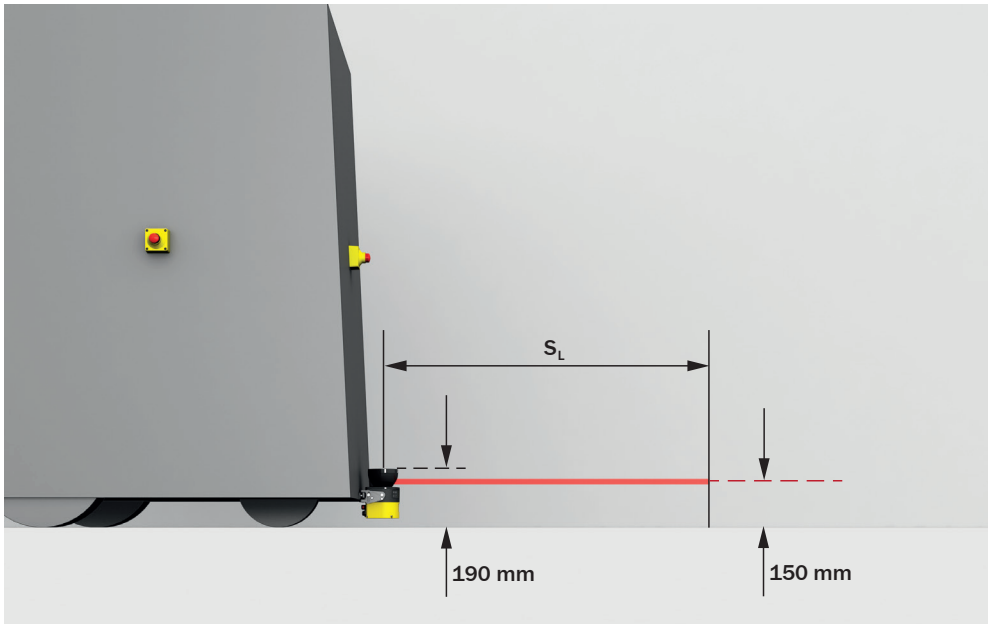


Figure 36: Recommended fitting height

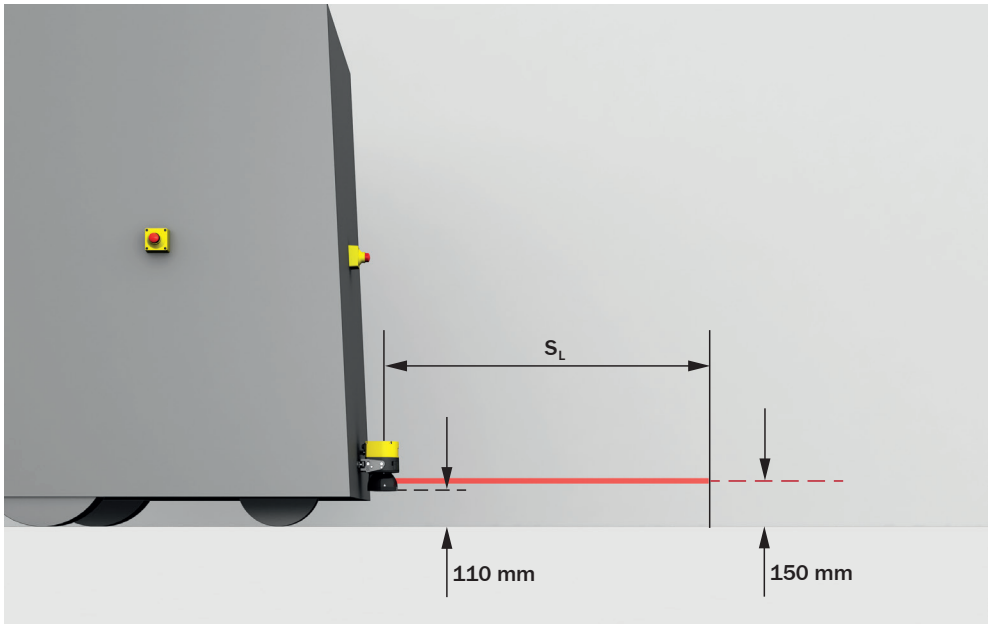


Figure 37: Recommended fitting height for inverted mounting

4.4 Integrating the equipment into the electrical control

This chapter contains important information about integration in the electrical control. Information about the individual steps for electrical installation of the device: see "Electrical installation", page 72.

Information about pin assignment: see "Pin assignment", page 74.

Requirements for use

The output signals of the protective device must be analyzed by downstream controllers in such a way that the dangerous state of the machine is ended safely. Depending on the safety concept, the signal is analyzed by safety relays or a safety controller, for example.

DANGER

Hazard due to lack of effectiveness of the protective device

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

▶ Make sure that the following control and electrical requirements are met so the safety laser scanner can fulfill its protective function.

- It must be possible to electrically influence the control of the machine.
- Use the same earthing method for all devices that are electrically connected to the safety laser scanner.
- All earthing points must be connected with the same ground potential.
- Voltage supply must be supplied in accordance with SELV/PELV (IEC 60204-1) for all devices that are electrically connected to the safety laser scanner.
- All devices that are electrically connected to the safety laser scanner must be supplied by the same voltage supply.
- The control that is connected and all devices responsible for safety must comply with the required performance level and the required category (for example according to ISO 13849-1).
- When using a safety controller, different signal levels of both OSSDs in an OSSD pair must be detected depending on applicable national regulations or required reliability of the safety function. The maximum discrepancy time tolerated by the control must be selected according to the application.
- A restart interlock must be implemented depending on applicable national regulations or required reliability of the safety function. Each OSSD pair in the safety laser scanner is equipped with a configurable internal restart interlock. For safety laser scanners which do not have OSSDs, if a restart interlock is required, it must be provided in the external control.

DANGER

Hazard due to lack of effectiveness of the protective device

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

Downstream contactors must be positively guided and monitored depending on applicable national regulations or required reliability of the safety function.

▶ Make sure that downstream contactors are monitored (external device monitoring, EDM).

- Each OSSD pair in the safety laser scanner is equipped with a configurable internal EDM.

The safety laser scanner complies with the regulations for electromagnetic compatibility (EMC) for the industrial sector (Radio Safety Class A).

4.4.1 Voltage supply

DANGER
Hazard due to lack of effectiveness of the protective device

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

▶ Make sure that the following control and electrical requirements are met so the safety laser scanner can fulfill its protective function.

- The power supply unit must be able to jumper a brief power failure of 20 ms as specified in IEC 60204-1.
- The safety laser scanner requires a supply voltage of 24 V. Details about tolerances and further connected loads, see "Data sheet", page 145.
- The power supply unit must provide safe isolation according to IEC 61140 (SELV/PELV as per IEC 60204-1). Suitable power supply units are available as accessories from SICK, see "Connection technology", page 162.
- Make sure that the safety laser scanner is provided with appropriate electrical fuse protection. Electrical data for calculating what fuse is required, see "Data sheet", page 145.
- Use the same earthing method for all devices that are electrically connected to the safety laser scanner.
- Voltage supply must be supplied in accordance with SELV/PELV (IEC 60204-1) for all devices that are electrically connected to the safety laser scanner.
- All devices that are electrically connected to the safety laser scanner must be supplied by the same voltage supply.

4.4.2 USB connection

The safety laser scanner has a USB connection for configuration and diagnostics. The USB connection complies with the USB 2.0 mini-B standard (female connector). The USB connection may only be used temporarily and only for configuration and diagnostics. More information: see "Configuration", page 75 and see "Troubleshooting", page 131.

4.4.3 OSSDs

Safety laser scanners with local outputs can be directly integrated into the machine controller.

DANGER
Hazard due to lack of effectiveness of the protective device

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

▶ Make sure that the following control and electrical requirements are met so the safety laser scanner can fulfill its protective function.

- A restart interlock must be implemented depending on applicable national regulations or required reliability of the safety function. Each OSSD pair in the safety laser scanner is equipped with an internal restart interlock.
- When using a safety controller, different signal levels of both OSSDs in an OSSD pair must be detected depending on applicable national regulations or required reliability of the safety function. The maximum discrepancy time tolerated by the control must be selected according to the application.
- The output signals from an OSSD pair must not be connected to each other.
- In the machine controller, both signals from an OSSD pair must be processed separately.

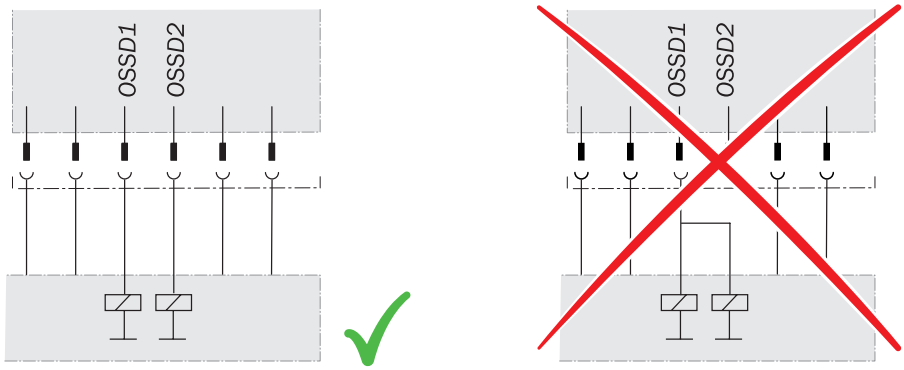


Figure 38: Dual-channel and isolated connection of OSSD1 and OSSD2

- The machine must switch to the safe state if, at any time, at least one OSSD in an OSSD pair switches to the OFF state.
- Prevent the formation of a potential difference between the load and the protective device. If you connect loads to the OSSDs (safety outputs) that then also switch if controlled with negative voltage (e.g., electro-mechanical contactor without reverse polarity protection diode), 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. In the event of a fault, this is the only way to ensure that there can be no potential difference between the 0 V connections of the loads and those of the corresponding protective device.

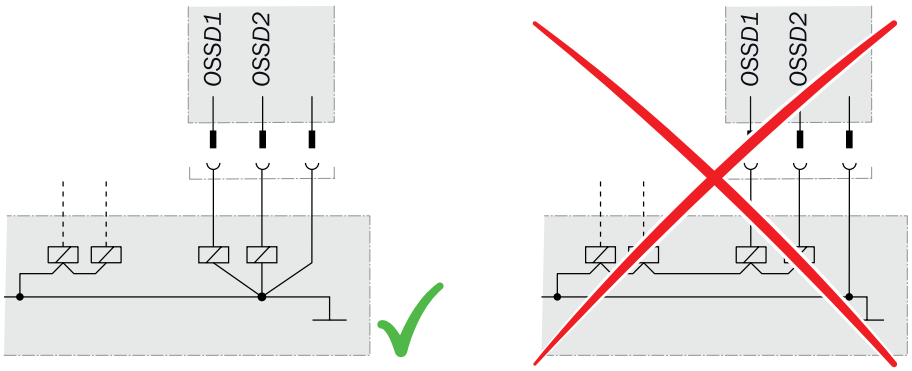


Figure 39: No potential difference between load and protective device

DANGER

Hazard due to lack of effectiveness of the protective device

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

Downstream contactors must be positively guided and monitored depending on applicable national regulations or required reliability of the safety function.

▶ Make sure that downstream contactors are monitored (external device monitoring, EDM).

- Each OSSD pair in the safety laser scanner is equipped with an internal EDM.

Requirements for the electrical control of the machine

The OSSDs are short-circuit protected to 24 V DC and 0 V. When the protective field is clear, the OSSDs signal the ON state with the HIGH signal level (non-isolated). If there are objects in the protective field or there is a device fault, the OSSDs signal the OFF state with the LOW signal level.

4.4.4 Control inputs

The safety laser scanner is equipped with control inputs.

It is possible during continuous operation to switch between various monitoring cases of the safety laser scanner via the control inputs.

Static control inputs are used for information about machine status.

When switching between monitoring cases, bear in mind that a person may already be in the protective field when switching takes place. So, you must make sure that the monitoring case is switched at the right time. Only switching in time (namely before the danger arises for the person at this location) ensures protection, see "Monitoring case switching time", page 32.

DANGER
Hazard due to lack of effectiveness of the protective device

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

The same safety level is required for the safety-related parts of the control which switch the active protective field as for the safety function. In many cases, this is PL d as per ISO 13849-1 or SIL2 as per IEC 62061.

- Position-dependent switching must be carried out by 2 independently wired signal sources, such as 2 independent position switches.
- Manual switching that depends on the operating mode must be carried out using a suitable manual control switch.
- Use the same earthing method for all devices that are electrically connected to the safety laser scanner.
- Voltage must be supplied in accordance with SELV/PELV (IEC 60204-1) for all devices that are electrically connected to the safety laser scanner.
- All devices that are electrically connected to the safety laser scanner must be supplied by the same voltage supply.

Information about electrical properties: see "Data sheet", page 145

Information about pin assignment: see "Electrical installation", page 72

Information about the configuration of the control inputs: see "Inputs and outputs, local", page 101

4.4.4.1 Static control inputs

The static control input supports the following analysis method:

- Complementary analysis

You can define the switching criteria for the monitoring cases (see "Monitoring cases", page 105).

Complementary analysis

A static control input consists of 2 channels. To switch correctly, one channel must be switched inversely to the other. The following table shows which status the static control input's channels must have to define logical input condition 1 and 0 at the relevant control input.

Table 4: Status of the channels of the control inputs with complementary evaluation

A1	A2	Logical input status (input A)
1	0	0
0	1	1
1	1	Fault
0	0	Fault

In antivalent evaluation, the 2 channels of each static control input must always be inverted, even if the status of a control input in a monitoring case is random. If it is not inverted, all safety outputs switch to the OFF state and the device displays a fault.

4.4.5 Universal inputs, universal outputs, universal I/Os

The safety laser scanner is equipped with universal I/Os.

Universal I/O can be configured as universal input or as universal output.

Depending on the device, a universal input can be used for resetting, external device monitoring (EDM), sleep mode, or restarting the protective device, for example. If sleep mode is activated by a universal input, the sleep mode must not be used for safety applications. Certain universal inputs can also be used in pairs as a static control input.

A universal output outputs a signal depending on its configuration, e.g. if the reset pushbutton needs to be pushed or if the optical cover is contaminated. A universal output must not be used for safety functions.

- Use the same earthing method for all devices that are electrically connected to the safety laser scanner.
- Voltage must be supplied in accordance with SELV/PELV (IEC 60204-1) for all devices that are electrically connected to the safety laser scanner.
- All devices that are electrically connected to the safety laser scanner must be supplied by the same voltage supply.

Information about electrical properties: see "Technical data", page 144

Information about pin assignment: see "Electrical installation", page 72

4.4.6 Restart interlock

Depending on the regulations which apply at the place of installation, a restart interlock may be required.

The restart interlock prevents the machine from automatically starting up, for example after a protective device has responded while the machine is operating or after changing the machine's operating mode.

First, the operator must press a reset pushbutton to return the protective device to monitoring status. Then, in a second step, the operator can restart the machine.

Depending on applicable national regulations, a restart interlock must be available if it is possible to stand behind the protective field.

Reset

The reset brings the protective device back to the monitoring state after it has sent a stop command. The reset also quits the start-up or restart interlock of a protective device, so that the machine can be restarted in a second step.

The reset must only be possible, when all safety functions and protective devices are functional.

The reset of the protective device must not introduce any movement or dangerous situations itself. The machine is only permitted to start after the reset once a separate start command has been sent.

- Manual resets are performed using a separate, manually operated device, such as a reset pushbutton.
- Automatic resets by the protective device are only permitted in special cases, if one of the following conditions is met:
  - It must not be possible for people to be in the hazardous area without triggering the protective device.
  - It must be ensured that no people are in the hazardous area during or after the reset.

Internal restart interlock

Each safety output of the safety laser scanner is equipped with a configurable internal restart interlock.

When the internal restart interlock is used, the following sequence is the result for the machine operator:

1 A safety output of the safety laser scanner switches to the OFF state if there is an interruption in the protective field.
2 The safety output remains in the OFF state when there is no longer an object in the protective field.
3 The safety output only switches back to the ON state when the operator presses the reset pushbutton, which is outside the hazardous area. If there is an object in the protective field when the reset pushbutton is pressed, the safety output stays in the OFF state.
4 After the reset, the operator can restart the machine in a second step.

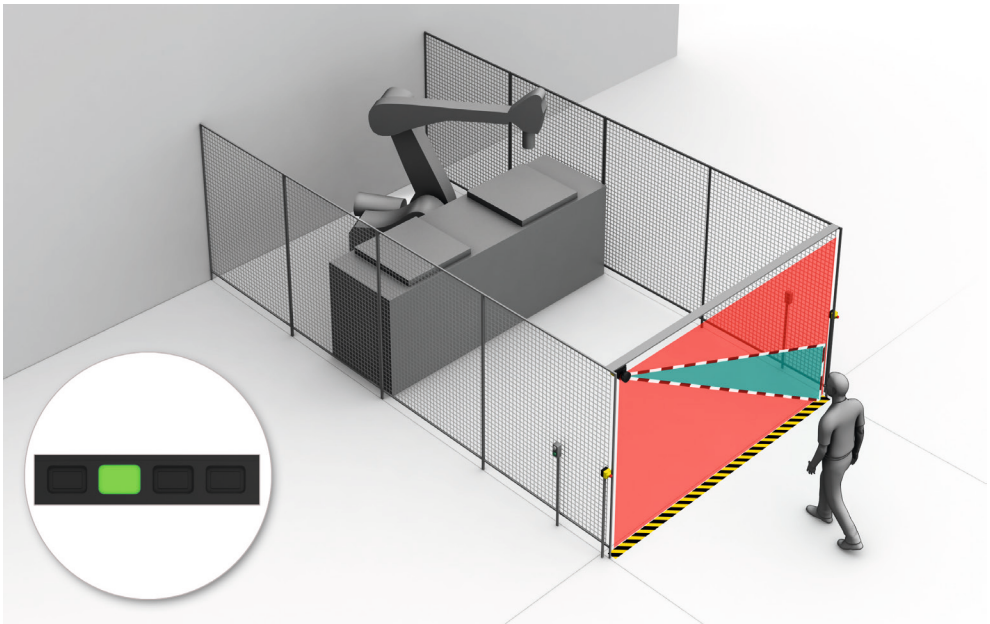


Figure 40: How the restart interlock works (1): no one in protective field, machine operates

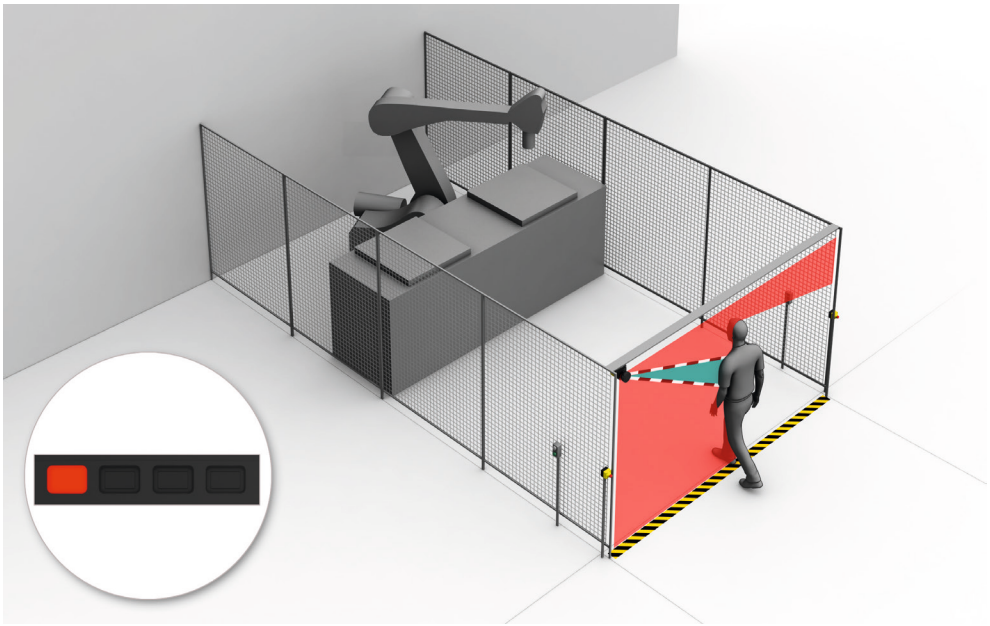


Figure 41: How the restart interlock works (2): person detected in protective field, safety output in OFF state

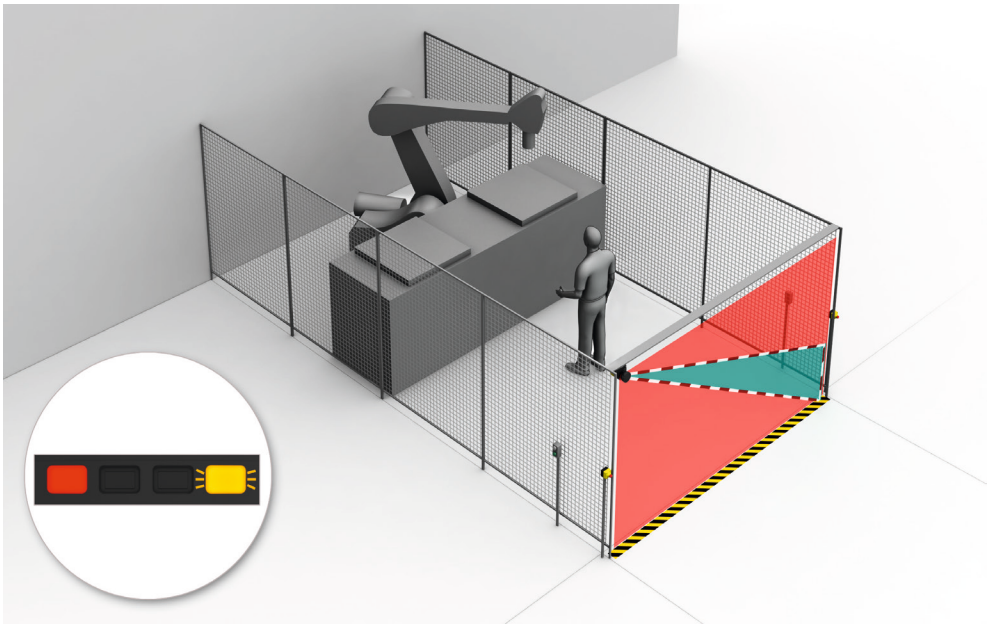


Figure 42: How the restart interlock works (3): person in hazardous area, no detection in protective field, safety output still in OFF state

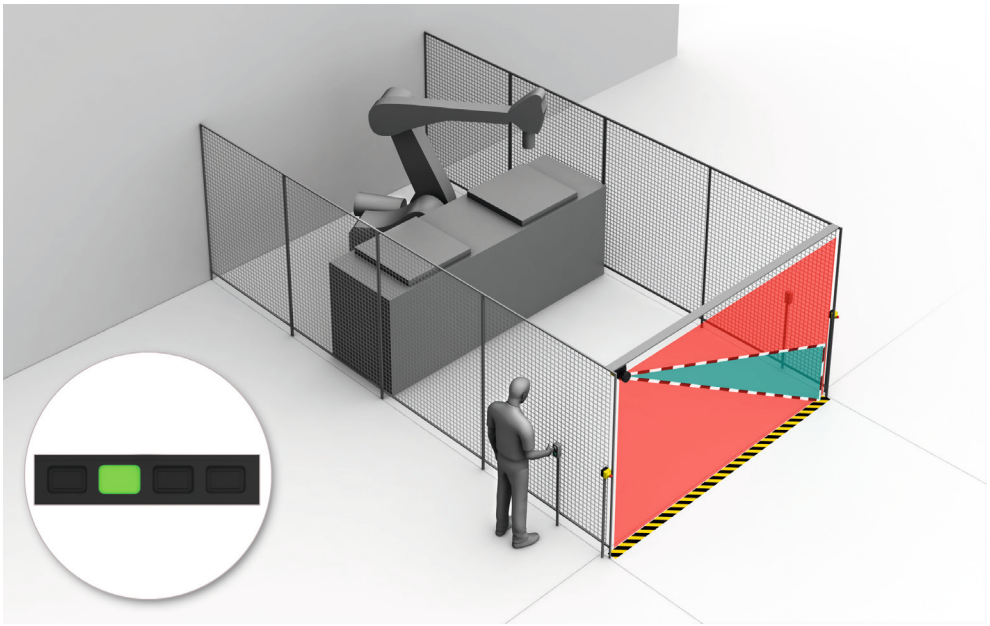


Figure 43: How the restart interlock works (4): the reset pushbutton must be pressed before restarting the machine.

DANGER
Hazard due to unexpected starting of the machine

- Affix the control switch for resetting the restart interlock outside the hazardous area.
- Make sure that the control switch cannot be activated by a person who is in the hazardous area.
- Also make sure that the person activating the control switch has a complete view of the hazardous area.

4.4.7 External device monitoring (EDM)

The external switching elements (external device monitoring, EDM) must be inspected in line with the regulations which apply at the place of installation or the required reliability of the safety function.

The external device monitoring (EDM) monitors the status of downstream contactors.

In order to use external device monitoring, positively guided contactors must be used to switch off the machine. If the auxiliary contacts of the positively guided contactors are connected to the external device monitoring, the external device monitoring checks whether the contactors switch correctly when the OSSDs are switched off.

NOTE
Each OSSD pair in the safety laser scanner is equipped with a configurable internal EDM.

4.4.8 Connection diagrams

Restart interlock and external device monitoring (EDM)

The safety laser scanner can be connected directly to relays/contactors. It is operated with restart interlock and external device monitoring.

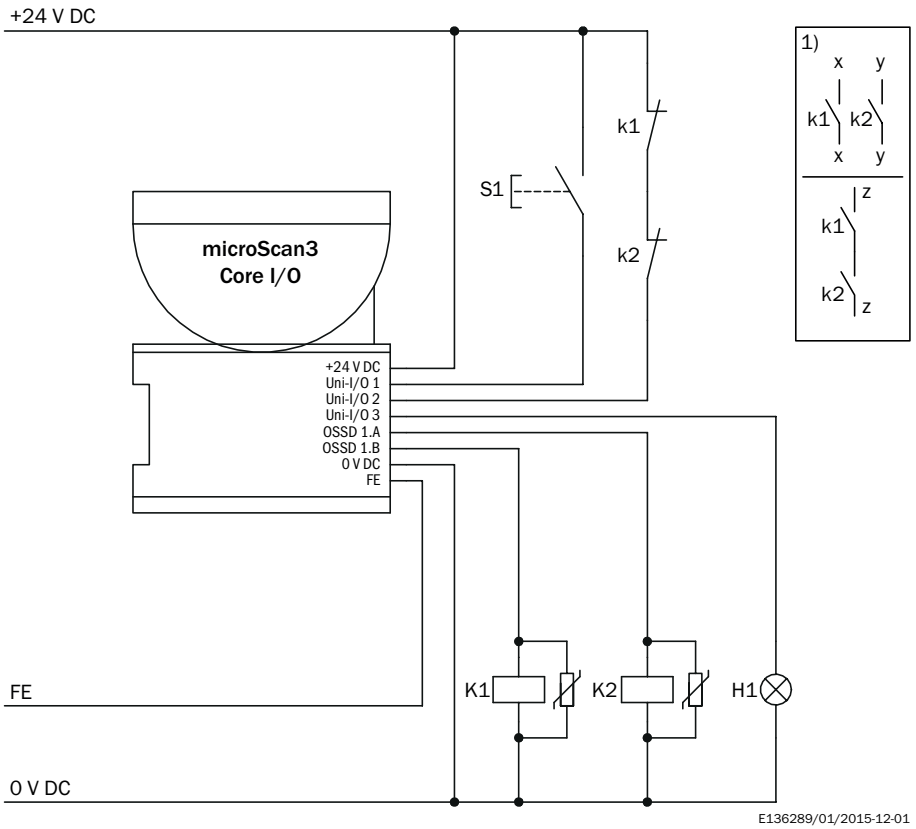


Figure 44: Connection diagram with restart interlock and external device monitoring (EDM)

Uni-I/O 1	configured as input **reset**
Uni-I/O 2	configured as input **external device monitoring (EDM)**
Uni-I/O 3	configured as output **reset required**

Restart interlock and external device monitoring (EDM) via safety relay

The safety laser scanner can be integrated by means of a safety controller or a safety relay, for example the safety relay UE10-2FG. It is operated with restart interlock and external device monitoring.

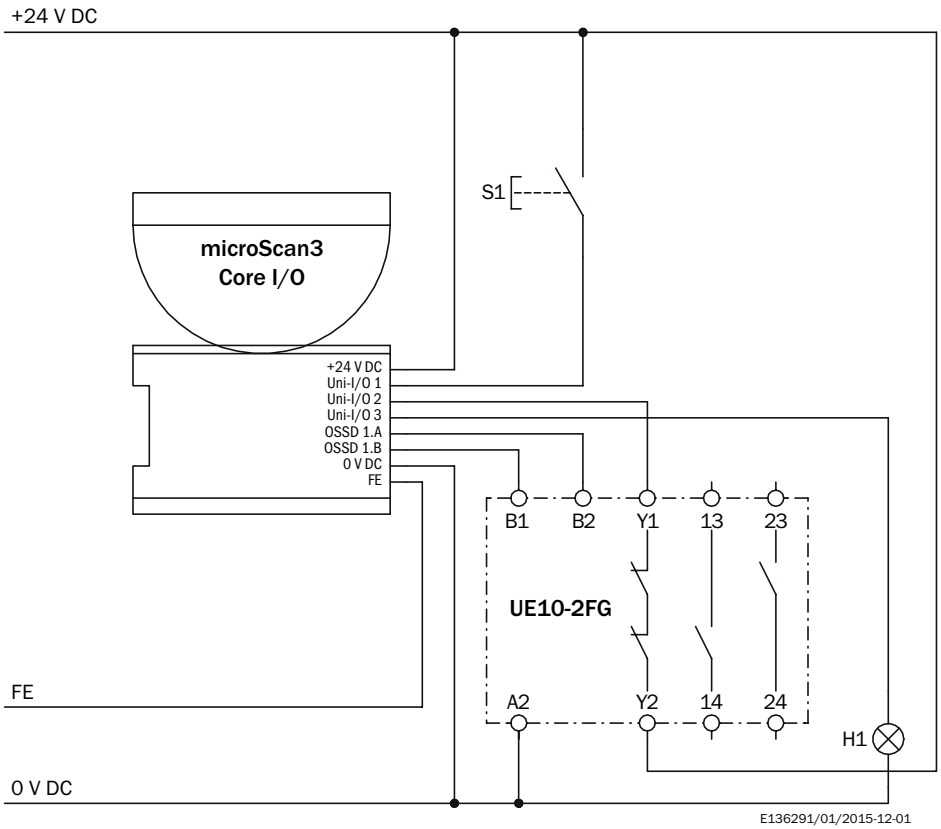


Figure 45: Connection diagram with restart interlock and external device monitoring (EDM) via safety relay

Uni-I/O 1	configured as input **reset**
Uni-I/O 2	configured as input **external device monitoring (EDM)**
Uni-I/O 3	configured as output **reset required**

4.5 Testing plan

The protective device must be tested by appropriately qualified safety personnel when commissioning, after modifications and at regular intervals.

The regular thorough checks serve to verify the effectiveness of the protective device and discover defects due to modifications or external influences (such as damage or manipulation).

The manufacturer and user must define the type and frequency of the thorough checks of the machine on the basis of the application conditions and the risk assessment. Determination of the thorough checks must be documented in a traceable manner.

- A thorough check must be carried out during commissioning and following modifications, see "Thorough check", page 116
- The regular thorough checks on the safety laser scanner must fulfill certain minimum requirements, see "Minimum requirements for the regular thorough check", page 63
- In many cases, depending on the application conditions, the risk assessment determines that further thorough checks are required, see "Recommendations for further thorough checks", page 63

A test object is required for some thorough checks. An optically opaque cylinder with a black surface can be used as a suitable test object. The diameter must match the configured resolution.

4.5.1 Minimum requirements for the regular thorough check

DANGER
Hazard due to lack of effectiveness of the protective device

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

- ▶ The thorough checks must be carried out at least annually.
- ▶ The thorough checks must be carried out by qualified safety personnel or specially qualified and authorized personnel and must be documented in a traceable manner.

The following thorough checks must be carried out at least once a year:

- "Thorough check of the principal function of the protective device", page 63
- Thorough check of the detection capability (resolution) in the context of the "Thorough check of the area to be protected", page 64

If a thorough check reveals a fault, the machine should be shut down immediately. In this case, the mounting and electrical installation of the safety laser scanner must be checked by appropriately qualified safety personnel.

4.5.2 Recommendations for further thorough checks

In many cases, depending on the application conditions, the risk assessment of the machine determines that further thorough checks are required or that some thorough checks must take place more frequently.

In many cases, it makes sense to carry out the following thorough checks together with the regular thorough check:

- "Thorough visual check of the machine and the protective device", page 65
- "Test of the contour detection field", page 65
- Thorough check of the relevant points on the checklist, see "Checklist for initial commissioning and commissioning", page 170

In many cases, it makes sense to carry out the following thorough checks daily:

- "Thorough visual check of the machine and the protective device", page 65
- "Thorough check of the principal function of the protective device", page 63

If a thorough check reveals a fault, the machine should be shut down immediately. In this case, the mounting and electrical installation of the safety laser scanner must be checked by appropriately qualified safety personnel.

4.5.3 Carrying out thorough checks

Thorough check of the principal function of the protective device

SICK recommends the following procedure:

- ▶ Watch the display and the status LEDs above the safety laser scanner's display. If, when the machine is switched on, at least one LED above the safety laser scanner's display does not light up permanently, you must assume that there is a fault.
- ▶ Test the function of the protective device by triggering the protective function once and observing the safety output's reaction using the reaction of the machine, for example.
  - All applications: during the thorough check, observe whether the safety laser scanner displays the interruption of the protective field using the LEDs and/or the display.
  - Stationary application (hazardous area protection, access protection, hazardous point protection):
    - Interrupt the protective field using the supplied test object and observe whether the machine stops.

- Mobile application (mobile hazardous area protection):
  - Place the supplied test object in the path of the vehicle and observe whether the vehicle stops.
    OR
  - Activate a protective field, which is interrupted by at least one test object and check the expected reaction (for example by an automatic thorough check in the safety controller).

If the thorough check reveals a fault, the machine should be shut down immediately. In this case, the mounting and electrical installation of the safety laser scanner must be checked by appropriately qualified safety personnel.

Thorough check of the area to be protected

The area to be protected and the detection capability are checked during this thorough check.

The thorough check covers the following points:

- Changes in the detection capability (thorough check of all configured fields)
- Modifications, tampering and damage to the protective device or the machine, which lead to changes in the area to be protected or the position of the protective field

SICK recommends the following procedure:

Hazardous area protection

- ▶ Position the supplied test object at a number of points at the edges of the area to be protected. The safety laser scanner must detect the test object at each position and indicate the detection. How it is indicated depends on the configuration. The number and position of sites where the thorough check is carried out must be chosen so that undetected access to the hazardous area is impossible.
- ▶ If a number of protective fields are used (in different monitoring cases for example), check the edges of all protective fields.

Access protection and hazardous point protection

- ▶ Move the supplied test object along the edges of the area to be protected. The safety laser scanner must detect the test object at each position and indicate the detection. How it is indicated depends on the configuration. The protective field must be dimensioned such that reaching around or going around it is impossible.
- ▶ If a number of protective fields are used (in different monitoring cases for example), check the edges of all protective fields.
- ▶ If the reference contour monitoring feature is used, check the areas with the reference contour:
  - Move the test object along the inner edge of the tolerance band of the reference contour. The safety laser scanner must detect the test object at each position and indicate the detection.
  - If a number of reference contours are used, check all reference contours.

Mobile hazardous area protection

- ▶ Place the supplied test object in the path of the vehicle and check whether the vehicle comes to a stop in time.
- ▶ If a number of protective fields are used (in different monitoring cases for example), check whether the vehicle comes to a stop in time in all of the protective fields.

- ▶ If necessary, change the position of the test object so that a thorough check is carried out for each monitoring case to determine whether the protective field is active over the whole of the required width.
- ▶ Check the height of the scan plane. The scan plane must be at a height of at least 200 mm so that people lying down can be reliably detected. For this purpose, position the supplied test object at a number of points at the edges of the area largest protective field. The safety laser scanner must detect the test object at each position and indicate the detection. How it is indicated depends on the configuration.

If the thorough check reveals a fault, the machine should be shut down immediately. In this case, the mounting and electrical installation of the safety laser scanner must be checked by appropriately qualified safety personnel.

Test of the contour detection field

If you use contour detection fields, you must test whether each contour detection field fulfills the intended function.

Notes on planning the test

- Which contour should be detected at which position? What is the desired result?
- What is the desired result if the contour is not at the position?
- What is the desired result if only one part of the contour is at the position?
- Is it possible for there to be another object at the intended position instead of the expected object, so that the safety laser scanner still recognizes the contour? What is the desired result?

If the thorough check reveals a fault, the machine should be shut down immediately. In this case, the mounting and electrical installation of the safety laser scanner must be checked by appropriately qualified safety personnel.

Thorough visual check of the machine and the protective device

SICK recommends the following procedure:

- ▶ Check whether the machine or the protective device has been modified or manipulated so that the effectiveness of the protective device may be impaired.
- ▶ Check the following points in particular.
  - Has the machine been retrofitted?
  - Have machine parts been removed?
  - Have modifications been made to the machine's surroundings?
  - Are there any defective cables or open cable ends?
  - Have the protective device or its parts been dismantled?
  - Is the protective device damaged?
  - Is the protective device severely contaminated?
  - Is the optics cover contaminated, scratched or destructed?
  - Has the protective device's alignment been changed?
  - Are there any objects (e.g. cables, reflective surfaces) in the protective field?

If one of the points applies, the machine should be shut down immediately. In this case, the machine and the protective device must be checked by appropriately qualified safety personnel.

5 Mounting

5.1 Safety

Information about the requirements for properly mounting the safety laser scanner, see "Assembly", page 25.

DANGER
Dangerous state of the machine

- Make sure that the dangerous state of the machine is (and remains) switched off during mounting, electrical installation, and commissioning.
- Make sure that the safety laser scanner's outputs do not affect the machine during mounting, electrical installation, and commissioning.

DANGER
Hazard due to lack of effectiveness of the protective device

If unsuitable brackets are used or if subjected to excessive vibrations, the device may become detached or damaged.

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

- Only use SICK-approved brackets for mounting.
- Take appropriate measures for vibration damping if vibration and shock specifications exceed the values and test conditions specified in the data sheet, see "Data sheet", page 145.

DANGER
Hazard due to lack of effectiveness of the protective device

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

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

NOTE
Mount the device in the following order.

5.2 Unpacking

- The safety laser scanner's optics cover is an optical component. Make sure that the optics cover does not become dirty or scratched during unpacking and mounting. Prevent fingerprints on the optics cover.
- Check the components for completeness and the integrity of all parts, see "Scope of delivery", page 158.
- Please contact your respective SICK subsidiary should you have any complaints.

5.3 Mounting procedure

The following options for mounting the safety laser scanner are available:

- mounting directly without a mounting kit
- mounting using mounting kit 1
- mounting using mounting kits 1 and 2

The mounting kits 1 and 2 are built upon one another. This means that for mounting using mounting kit 2, you also need mounting kit 1.

Each mounting kit consists of a bracket, and the screws needed to mount the safety laser scanner on the bracket.

DANGER

Hazard due to lack of effectiveness of the protective device

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

- ▶ You must take account of the minimum distances calculated for your machine, see "Assembly", page 25.
- ▶ Mount the safety laser scanner so that crawling beneath, climbing over and standing behind the protective fields is impossible.

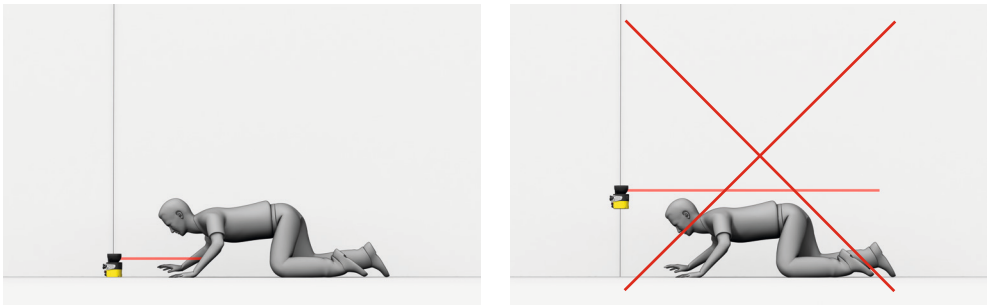


Figure 46: Prevent crawling beneath

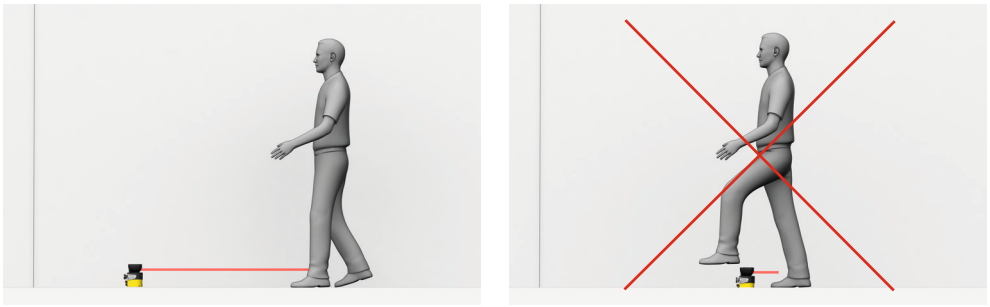


Figure 47: Prevent stepping over

NOTE

- ▶ Read this section completely before mounting the safety laser scanner.

Mounting instructions

- ▶ The safety laser scanner's optics cover is an optical component. Make sure that the optics cover does not become dirty or scratched during unpacking and mounting. Prevent fingerprints on the optics cover.
- ▶ Mount the safety laser scanner so that it is protected from moisture, dirt and damage.
- ▶ Make sure that the safety laser scanner's field of view is not restricted.
- ▶ Make sure that there are not mirrors or other very reflective objects in the protective field.

- Make sure that no small objects (e.g. cables) are in the protective field, even if the safety outputs do not switch to the OFF state as a result.
- Mount the safety laser scanner so that the status indicators are clearly visible.
- Mount the safety laser scanner so that you can plug in and pull out the system plug.
- Take appropriate measures for vibration damping if vibration and shock specifications exceed the values and test conditions specified in the data sheet, see "Data sheet", page 145.
- For machines that vibrate heavily, use thread-locking compounds to prevent the possibility of fixing screws coming loose unintentionally.
- Make sure that the safety laser scanner is aligned correctly, even during mounting: if the safety laser scanner is intended to monitor an area of 270° on a corner, the safety laser scanner may be mounted rotated by a maximum of 2.5° about the vertical axis.
- Location of the scan plane: see "Dimensional drawings", page 157.
- Take account of the tightening torque for the fixing screws:
  - M5 at rear/at side = 4.5 Nm ... 5.0 Nm
  - M4 at rear/at side = 2.2 Nm ... 2.5 Nm

  Higher tightening torques may damage the thread. Lower tightening torques do not offer sufficient protection against slipping of the safety laser scanner due to vibrations, for example.

5.3.1 Direct mounting

The safety laser scanner has 4 M5 threaded holes on the back. If you are able to drill through the mounting surface from the rear, you can mount the safety laser scanner directly using these threaded holes.

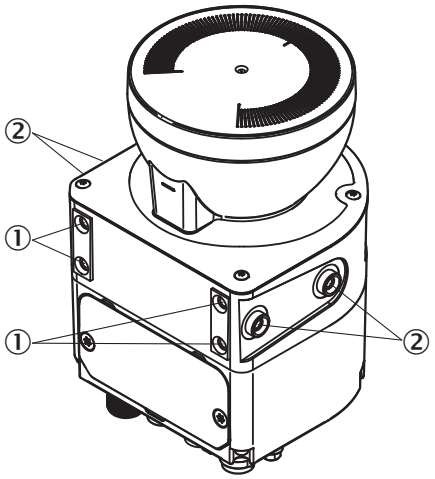


Figure 48: Mounting the safety laser scanner directly

① Rear M5 threaded hole

② Side M5 threaded hole

- Use either the rear or the side M5 threaded holes for direct mounting, see figure 48, page 68.
- Use all four rear or all 4 side M5 threaded holes for direct mounting, so that the values given in the data sheet for vibration and shock resistance are achieved.
- Maximum depth of thread engagement: 7.5 mm (see "Dimensional drawings", page 157).
- Tightening torque: 4.5 Nm to 5.0 Nm.

5.3.2 Mounting using mounting kit 1

If you are not able to drill through the mounting surface from behind, you can use the mounting kit 1 to mount the safety laser scanner. Mounting kit 1 makes it possible to replace the safety laser scanner easily.

The mounting kit is available as mounting kit 1a without protection for the optics cover and as mounting kit 1b with protection for the optics cover, see "Accessories", page 160.

Tool required:

- TX20 Torx wrench

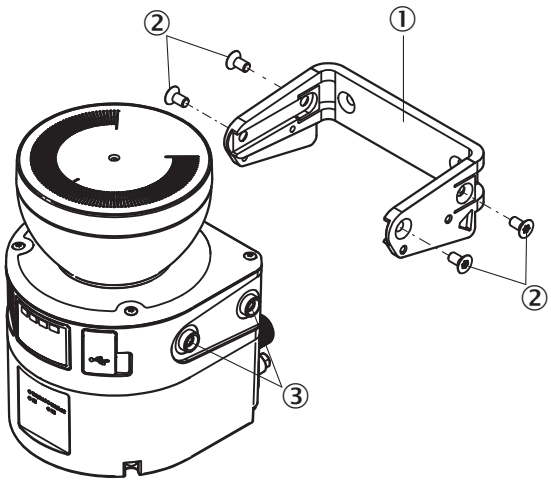


Figure 49: Mounting using mounting kit 1a

① Mounting bracket
② Screws for mounting bracket
③ Threaded holes for mounting bracket

1. Make sure that the mounting bracket is oriented correctly. See the symbol on the mounting bracket.
2. Mount the mounting bracket on the mounting surface.
3. Push the safety laser scanner onto the mounted mounting bracket.
4. Use all 4 supplied M5 screws to fix the safety laser scanner on the mounting bracket.
5. Tighten the M5 screws. Tightening torque: 4.5 Nm ± 5.0 Nm.

5.3.3 Mounting using mounting kit 2

You can use mounting kit 2 to align the safety laser scanner in 2 planes (rotation around the transverse axis and around the depth axis). The maximum alignment angle is ±5° in each plane. You will also need mounting kit 1a or 1b for mounting using mounting kit 2.

Mounting kit 2 consists of 2 parts: holding plate and alignment bracket.

The mounting kit is available as mounting kit 2a with shallower depth and as mounting kit 2b with greater depth.

Tool required:

- TX20 Torx wrench

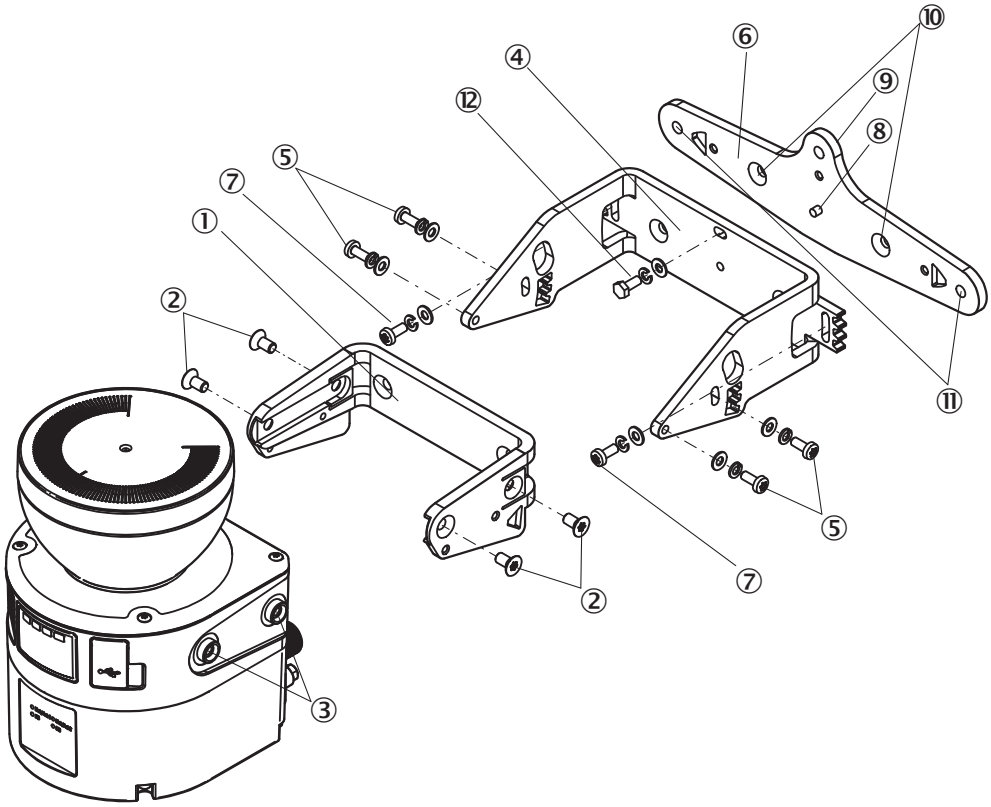


Figure 50: Mounting using mounting kit 2

① Mounting bracket
② Screws for mounting bracket
③ Threaded holes for mounting bracket
④ Alignment bracket
⑤ Screws for alignment bracket
⑥ Holding plate
⑦ Screws for holding plate
⑧ Centering pin
⑨ Holding tab
⑩ Drill holes with countersink
⑪ Outer drill holes
⑫ Stabilization screw (only bracket 2b)

1. Make sure that the holding plate is oriented correctly. See the symbol on the holding plate.
2. Mount the holding plate on the mounting surface. Either use the two outer drill holes (⑪) or the two drill holes with countersink (⑩). Also use the drill hole in the holding tab.
   Procedure when using the drill holes with countersink (⑩):
   - ▷ Loosen the screws (⑦) and remove the alignment bracket from the holding plate.
   - ▷ Mount the holding plate on the mounting surface.
   - ▷ Make sure that the alignment bracket is oriented correctly. See the symbol on the alignment bracket.
   - ▷ Push the alignment bracket back onto the centering pin (⑧) and fix it on the holding plate using the M4 screws, washers and spring rings (⑦).
3. Make sure that the mounting bracket 1a or 1b is oriented correctly. See the symbol on the mounting bracket.

4. Use the supplied M4 screws, washers and spring rings to fix mounting bracket 1a or 1b on the alignment bracket.
5. Only with mounting kit 2b: an additional stabilization screw is needed if there are stricter requirements on vibration/shock resistance. Turn the stabilization screw with washer and spring ring (⑫) into the thread hole of the holding plate through the slot of the alignment bracket.
6. Push the safety laser scanner onto the mounted mounting bracket.
7. Use all 4 supplied M5 screws to fix the safety laser scanner on the mounting bracket.
8. Tighten the M5 screws. Tightening torque: 4.5 Nm to 5.0 Nm.
9. Align the safety laser scanner. You can use a slotted screwdriver (blade width 8 mm) for fine alignment, see "Alignment", page 114.
10. Tighten the M4 screws. Tightening torque: 2.2 Nm to 2.5 Nm.

6 Electrical installation

6.1 Safety

Information on the requirements that must be met for safe integration of the safety laser scanner into the control and electronics of the machine: see "Integrating the equipment into the electrical control", page 52.

Mounting should be completed before electrical installation.

DANGER
Hazard due to electrical voltage

Hazard due to unexpected starting of the machine

- Make sure that the machine is (and remains) disconnected from the power supply during the electrical installation.
- Make sure that the dangerous state of the machine is (and remains) switched off.
- Make sure that the outputs of the safety laser scanner have no effect on the machine during the electrical installation.

DANGER
Hazard due to lack of effectiveness of the protective device

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

- Make sure that the following control and electrical requirements are met so the safety laser scanner can fulfill its protective function.

- Use suitable power supply.
- Use the same earthing method for all devices that are electrically connected to the safety laser scanner.
- Check that all earthing points are connected with the same ground potential.
- Voltage supply must be supplied in accordance with SELV/PELV (IEC 60204-1) for all devices that are electrically connected to the safety laser scanner.
- All devices that are electrically connected to the safety laser scanner must be supplied by the same voltage supply
- Connect functional earth correctly.

DANGER
Hazard due to lack of effectiveness of the protective device

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

- Always connect the two OSSDs in an OSSD pair separately from one another. The two OSSDs must not be connected to each other.
- Connect the OSSDs such that the machine controller processes both signals separately.

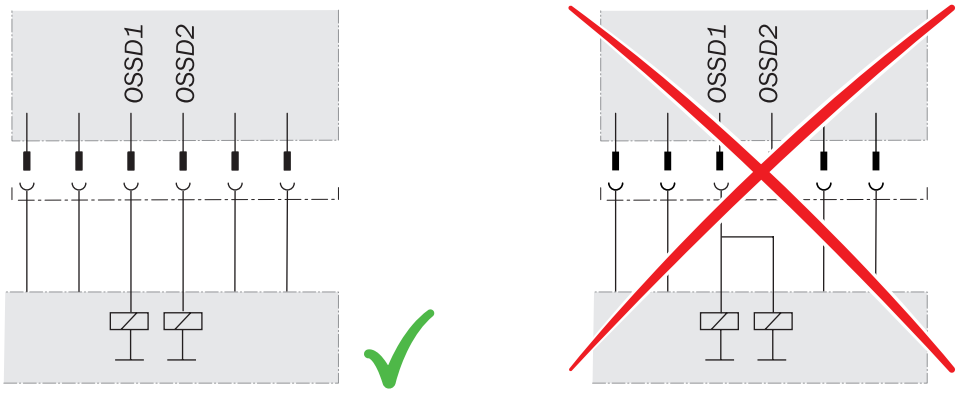


Figure 51: Connecting OSSD1 and OSSD2

DANGER

Hazard due to lack of effectiveness of the protective device

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

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

- If you connect loads to the OSSDs (safety outputs) that then also switch if controlled with negative voltage (e.g., electro-mechanical contactor without reverse polarity protection diode), 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. In the event of a fault, this is the only way to ensure that there can be no potential difference between the 0 V connections of the loads and those of the corresponding protective device.

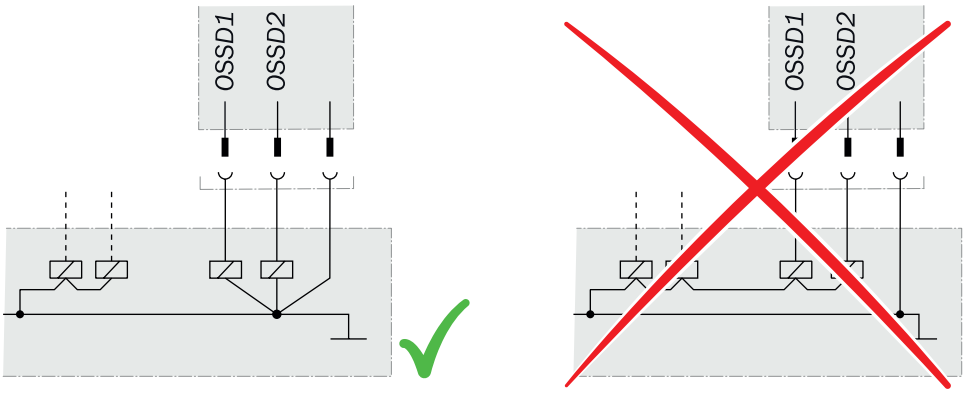


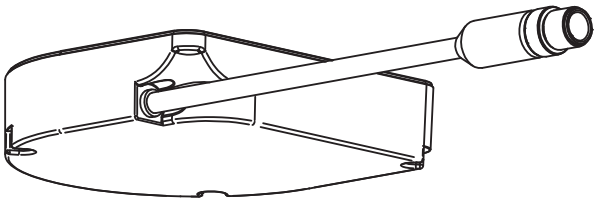
Figure 52: No potential difference between load and protective device

6.2 Connection overview

The USB connection may only be used temporarily and only for configuration and diagnostics. The permanent connections are contacted via M12 plug connectors.

6.2.1 microScan3 Core

Table 5: System plug and connections: microScan3 Core

Safety laser scanner	Suitable system plug	Plug connector
microScan3 Core I/O	 MICSX-ABIZZZZZ1 (part number: 2073156)	• Connecting cable with M12 plug connector, see page 74

6.3 Pin assignment

You will find the pin assignment for the individual plug connectors in the following.

6.3.1 Connecting cable with M12 plug connector

Voltage is supplied and local inputs and outputs are connected via the connecting cable with an 8-pin, A-coded M12 male connector.

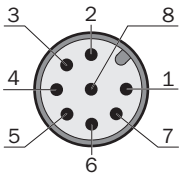


Figure 53: Pin assignment of the connecting cable (male connector, M12, 8-pin, A-coded)

Table 6: Pin assignment of the connecting cable with M12 plug connector

Pin	Marking	Function	Wire color [1]
1	+24 V DC	Supply voltage (+24 V DC)	Brown
2	OSSD 1.A	OSSD pair 1, OSSD A	White
3	0 V DC	Supply voltage (0 V DC)	Blue
4	OSSD 1.B	OSSD pair 1, OSSD B	Black
5	Uni-I/O 1	Universal I/O 1, configurable: • Universal input: resetting, EDM (external device monitoring), sleep mode, restarting the device • Universal output: contamination, fault, reset required, monitoring result (warning field)	Gray
6	Uni-I/O 2	Universal I/O 2, configurable: • Control input A1 (together with pin 7) • Universal input: resetting, EDM (external device monitoring), sleep mode, restarting the device • Universal output: contamination, fault, reset required, monitoring result (warning field)	Pink
7	Uni-I/O 3	Universal I/O 3, configurable: • Control input A2 (together with pin 6) • Universal input: resetting, EDM (external device monitoring), sleep mode, restarting the device • Universal output: contamination, fault, reset required, monitoring result (warning field)	Violet
8	FE	Functional earth/shield	Orange

[1] Applies to the extension cables recommended as accessories, see "Accessories", page 160.

7 Configuration

7.1 General requirements

This chapter describes the delivery state and the preparations necessary for configuration.

7.1.1 Delivery state

The safety laser scanner is not configured in the delivery state.

7.2 Safety Designer

The safety laser scanner is configured with Safety Designer.

This chapter describes the basics of using Safety Designer. More information regarding Safety Designer can be found in the operating instructions for the Safety Designer item no. 8018178.

7.2.1 Installation assistant

An installation assistant will help you to install Safety Designer.

1. Call up the download web page and enter **Safety Designer** in the search field on www.sick.com.
2. Take note of the system requirements on the download page.
3. Download the installation file from the download page. Extract it and run it.
4. Follow the notes from the setup assistant.

7.2.2 Projects

Using Safety Designer, you can configure one or more devices in a project. You can save the configuration data in a project file on the computer.

Creating a project

▶ Click on **New project**.
✓ This creates and opens an empty project.

Configuring a device online (device connected to computer)

The following interfaces are suitable for configuration:

- USB [4)]

If a device is connected to the computer, Safety Designer can establish a connection to the device.

You will then configure the device online. In this case, you can transfer the configuration to the devices directly and use diagnostic functions.

▶ Click on **Connect**.
✓ Safety Designer searches for connected devices, with which it can establish a connection.

Configuring a device offline (device not connected to computer)

If the device is not connected to the computer, select it from the device catalog.

You will then configure the device offline. Diagnostics functions are not available.

4) The USB connection may only be used temporarily and only for configuration and diagnostics.

You can connect the computer to the device later, assign a device to the device tile, and transfer the configuration to the device.

7.2.3 User interface

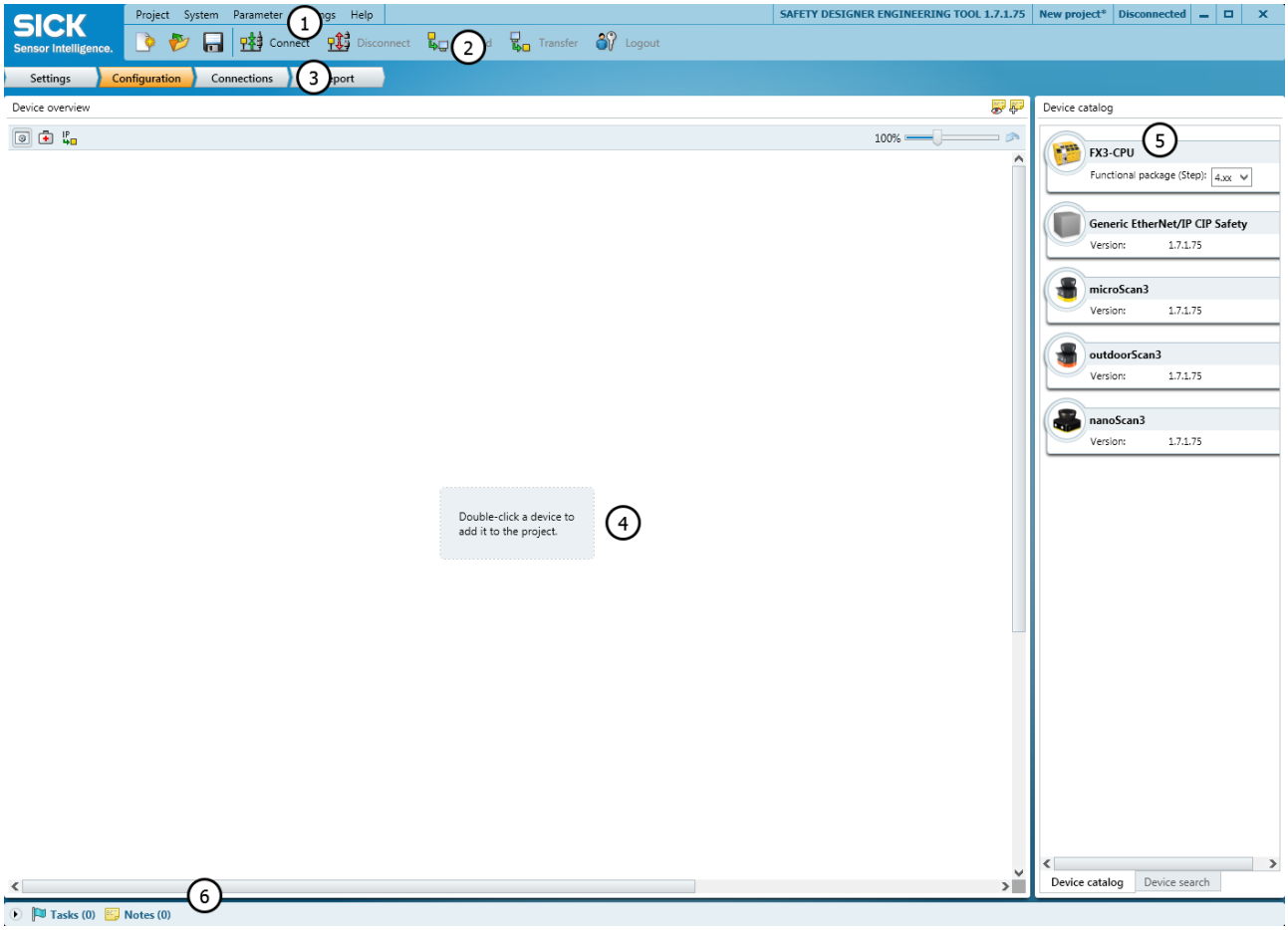


Figure 54: Software controls

① Menu bar
② Toolbar
③ Main navigation
④ Working range
⑤ Device catalog
⑥ Task list and notes

7.2.4 User groups

The devices contain a hierarchy of user groups that regulate access to the devices.

The user groups' settings and passwords are part of the configuration stored in the device.

For certain actions (e.g., transferring a configuration to the device), you are requested to log onto the device with the respective user group.

Table 7: User groups

User group	Password	Authorization
Machine operator	Does not need a password (anyone can log in as a machine operator).	May read configuration from the device (if not blocked).

User group	Password	Authorization
Maintenance technician	Does not have a factory-set password. The password is created by the authorized client (namely, it is not possible initially to log in as a maintenance technician).	May read configuration from the device. May transfer verified configuration to the device.
Authorized client	The password SICKSAFE is created at the factory. Change this password to protect the device against unauthorized access.	May read configuration from the device. May transfer verified and unverified configuration to the device. May verify configuration. Can set a password for maintenance technicians.

If a device's configuration is saved in its system plug, the passwords are preserved if the device is replaced.

NOTICE

If you leave a computer unattended, which is connected to devices, you must log out of the **maintenance technician** or **authorized client** user groups and change to the **machine operator** user group, so that unauthorized people cannot transfer configurations to the devices.

7.2.4.1 Changing user group

1. Establish a connection to the device.
2. In the toolbar, click on the **User** button.

✓ The **Log in** dialog box is opened.

3. Select the desired user group.
4. Enter the password and click on **Log in**.

7.2.5 Settings

Project information

Under **Project information** you can enter a project name, a user name and a short description of the project. The information is saved in the project.

Network

You can define network presettings here for network-compatible devices which use these settings.

The following items are configured under **Presettings for IP addresses:**

- The range of IP addresses used for automatic IP address generation.
- Automatic IP address generation and their device assignment. Automatic IP address generation ensures that IP addresses are not used more than once.

▶ Enter the lowest and highest IP addresses which are to be assigned in the **IP address range** fields.
▶ If applicable, enter a deviating **subnet mask**.
▶ If applicable, enter the IP address of a **router**.
▶ Activate the **Automatically assign an IP address from this IP range to every new project device** option.

✓ Every device which is added to the project from the device catalog is assigned an IP address from the configured IP address range with the configured subnet mask and the configured router.

The safety network number (SNN) for a project is assigned under **Presettings for the SNN**. The safety network number should be identical for all devices in a safety-related EtherNet/IP network.

You can take the following actions:

- Directly enter an SNN (to do so, you must know the correct SNN format).
- Paste an SNN from the clipboard with the **Paste** button.
- Copy an SNN to the clipboard with the **Copy** button.
- Generate an SNN.

▶ Activate the **Automatically assign this Safety Network Number to every new project device** option.
✓ Every device which is added to the project from the device catalog is assigned the configured SNN.

Generate an SNN

▶ Click on **Generate**.
✓ The **Safety Network Number** dialog box opens.
▶ Click on **Time-based**.
✓ An SNN which contains the current time stamp is generated and displayed in the **Result** field.
▶ In the **Manual** field, enter a number between 1 and 9999 and click on **Generate**.
✓ An SNN based on manual entry is generated and displayed in the **Result** field.
▶ Click on **OK**.
✓ The **Safety Network Number** dialog box closes and the SNN is adopted.

Data recorder

The data recorder saves records in a file.

▶ Enter the storage location and file location for the record file of the data recorder under **Data recorder**.
✓ The storage location and file name of the record file are adopted.

7.2.6 Configuration

In the **Configuration**, area you can compile the devices for a project. The available devices can be found in the Device Catalog. The devices are displayed as Device tiles in the working area.

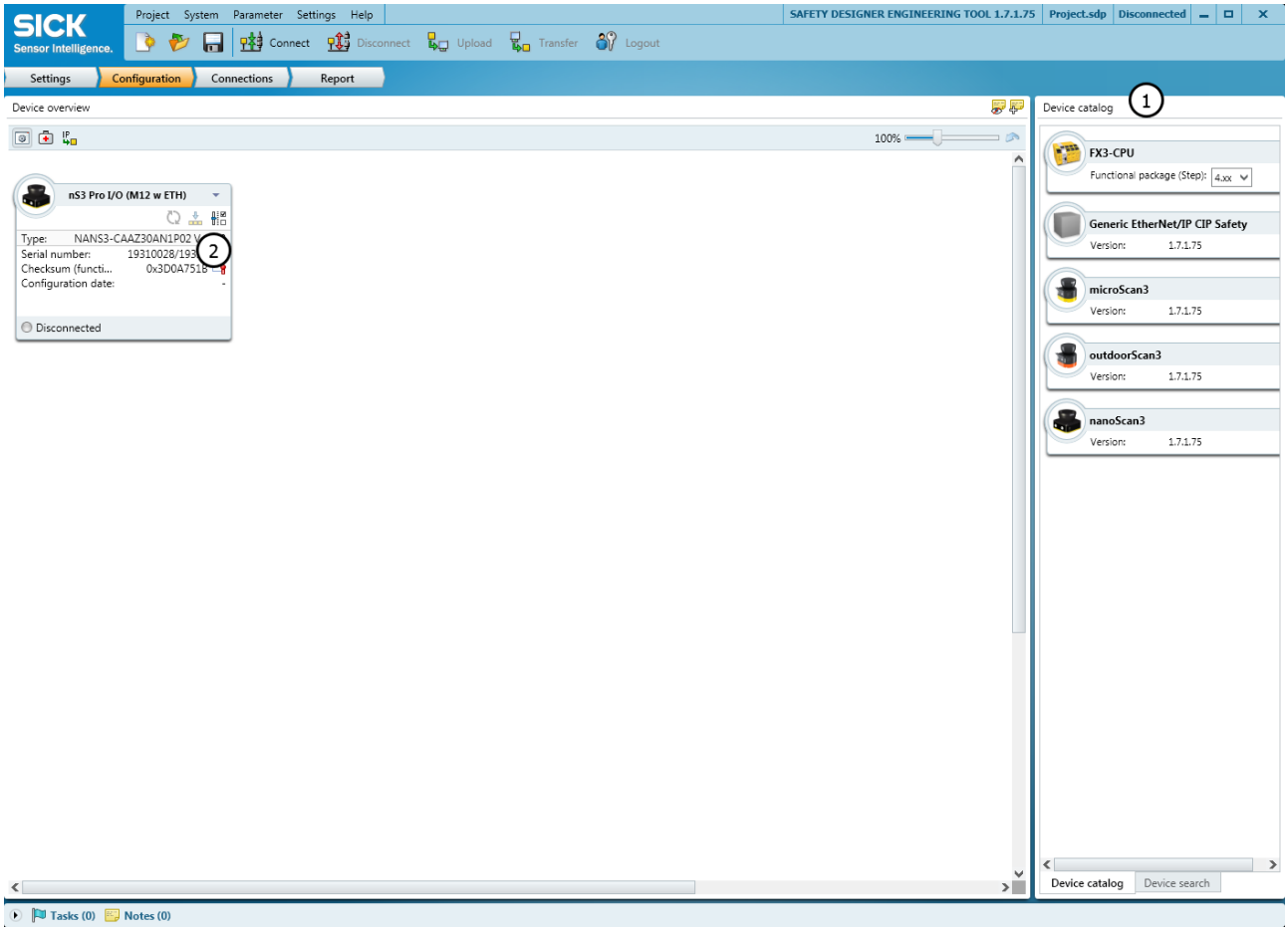


Figure 55: Configuration

① Device Catalog

② Device tile

7.2.6.1 Device Catalog

The Device Catalog contains all available devices.

- The **Device catalog** tab contains the devices installed in Safety Designer.
- The **Device search** tab contains the devices found during a device search.

The devices from the device catalog can be compiled in a project in the working area.

▶ Drag a device into the working area using drag and drop.
Or:
▶ Double-click on a device in the device catalog. [5]
✓ The device is shown as a tile in the working area.

7.2.6.2 Open the device window – configure devices

Open a device window to configure a device, perform diagnostics, or create reports. You have the following options:

▶ Click on the Device tile.
Or:
▶ Open the tile menu and choose **Configure**.
✓ The device window opens. [5]

5) When a device is configured offline for the first time, the device selection assistant opens. This is where you select the type of device to be configured.

7.3 Overview

The **Overview** dialog box contains information about the safety laser scanner.

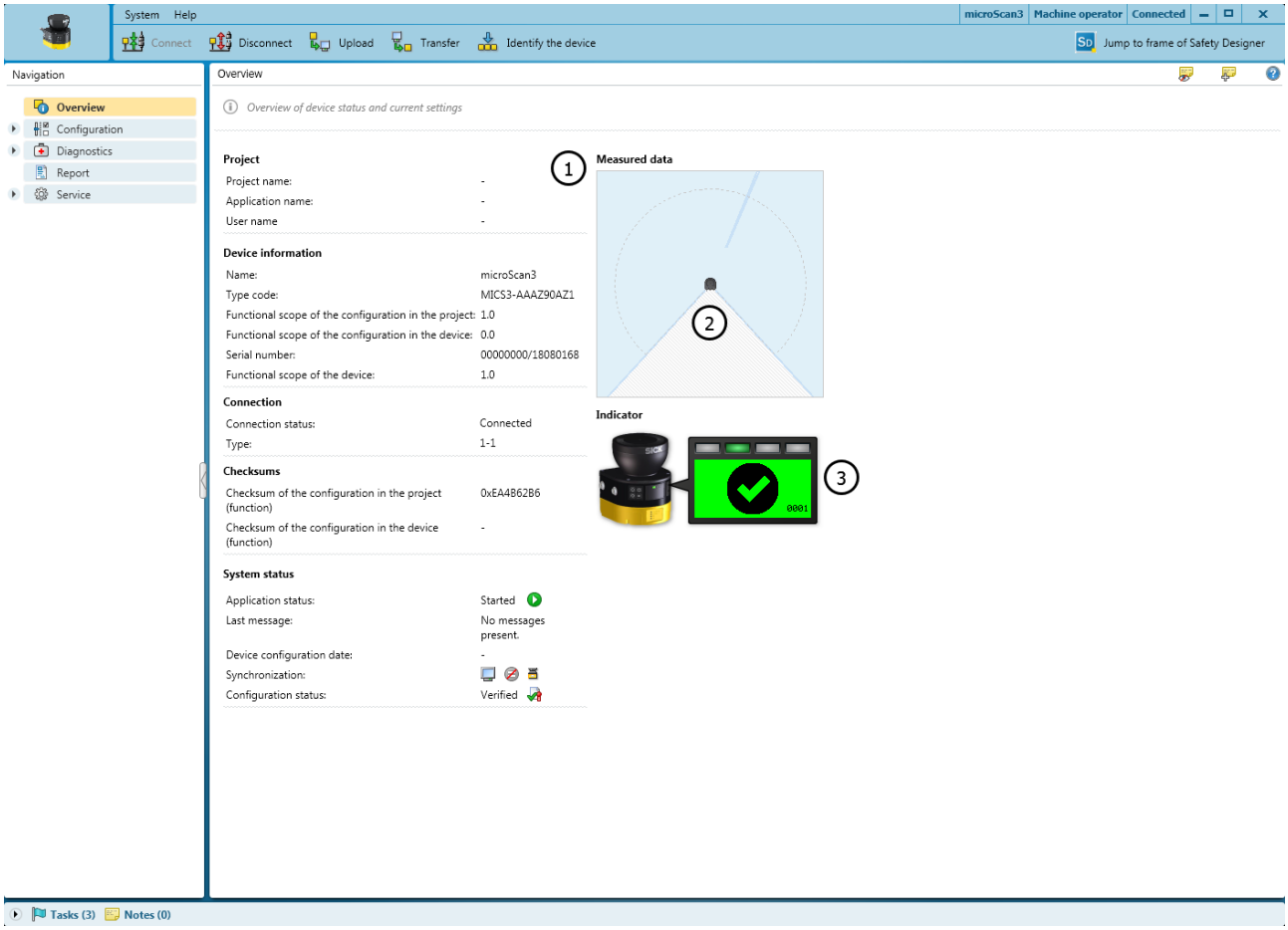


Figure 56: Overview

① Device information
② Current measurement data
③ Display with device status

Project

- Project name: the same name should be chosen for all devices in the project
- Application name: this name can be the same for a number of devices in the project. It highlights that these devices realize an application together, by responding to one another for example.

Device information

- Name, identifies the specific device
- Type code of the safety laser scanner
- Functional scope of the configuration in the project
- Functional scope of the configuration in the device
- Serial number of the safety laser scanner
- Functionality of the device

Connection

- Connection status
- Type of connection

Checksums

A checksum is used as a unique identification for a configuration. Using the checksum, it is possible to work out whether a setup was changed or whether two devices have the same configuration.

The checksum of the configuration in the project may not match the checksum in the device, for example if a field geometry has been modified, but not yet transmitted to the device.

System status

- Application status
- Current notification from the safety laser scanner
- Configuration date for the configuration in the device
- Synchronization: shows whether the configuration in Safety Designer and the configuration in the device are identical
- Configuration status

Measurement data

Shows the measurement data when a device is connected.

Display

Shows the status of the display and LEDs when a device is connected.

Establishing connection

1. Check whether the safety laser scanner is connected correctly.
2. Click on **Connect** in the toolbar.

✓ Safety Designer creates the connection to the safety laser scanner.

7.3.1 Functional scope

Older versions of the Safety Designer potentially do not support the full functionality of the latest devices. Vice versa, older devices might not support the full functionality of the latest Safety Designer.

To identify the different levels of the functionality, we use a 3-digit version number. The version number is marked with the letter V on the device.

In order for a configuration to be transmitted from the Safety Designer to the device, the functional scope of the configuration and the functional scope of the device must match one another:

- The 1st digit of both version numbers must be identical
- The 2nd digit of the version numbers on the device must be at least as large as that of the configuration in the Safety Designer
- The 3rd digit is not relevant for compatibility

The functional scope of the device can be read at the following locations:

- Label on the device
- Display, entry in the menu **Device information** under **Hardware**
- Safety Designer, **Overview** dialog box (only with connected devices)
- Safety Designer, report

Figure 57: Functional scope

① Functional scope of the device

If you configure a device offline, you must define the functional scope of the configuration when adding the device in the device selection wizard in the Safety Designer.

If you add a device to the project via the device search, the functionality of the device will be carried over. If the device has already been configured, the functional scope of the configuration is adopted in the device.

Further topics

- "Version numbers and functional scope", page 144

7.4 Reading configuration

At the left, you see the values configured in the project for the device. If the device is connected, you see the values saved in the device at the right.

If the values in the project and the values in the device differ, you can read the values out from the device and adopt them in the project.

▶ Click on **Read from the device.**
✓ The values are read from the device and adopted in the project.

Configuration

- Name
  If a number of safety laser scanners are used in an application or in a project, a unique device name helps to tell the individual devices apart.
- Checksums
  A checksum is used as a unique identification for a configuration. Using the checksum, it is possible to work out whether a setup was changed or whether two devices have the same configuration.
  The checksum of the configuration in the project may not match the checksum in the device, for example if a field geometry has been modified, but not yet transmitted to the device.

7.5 Identification

Overview

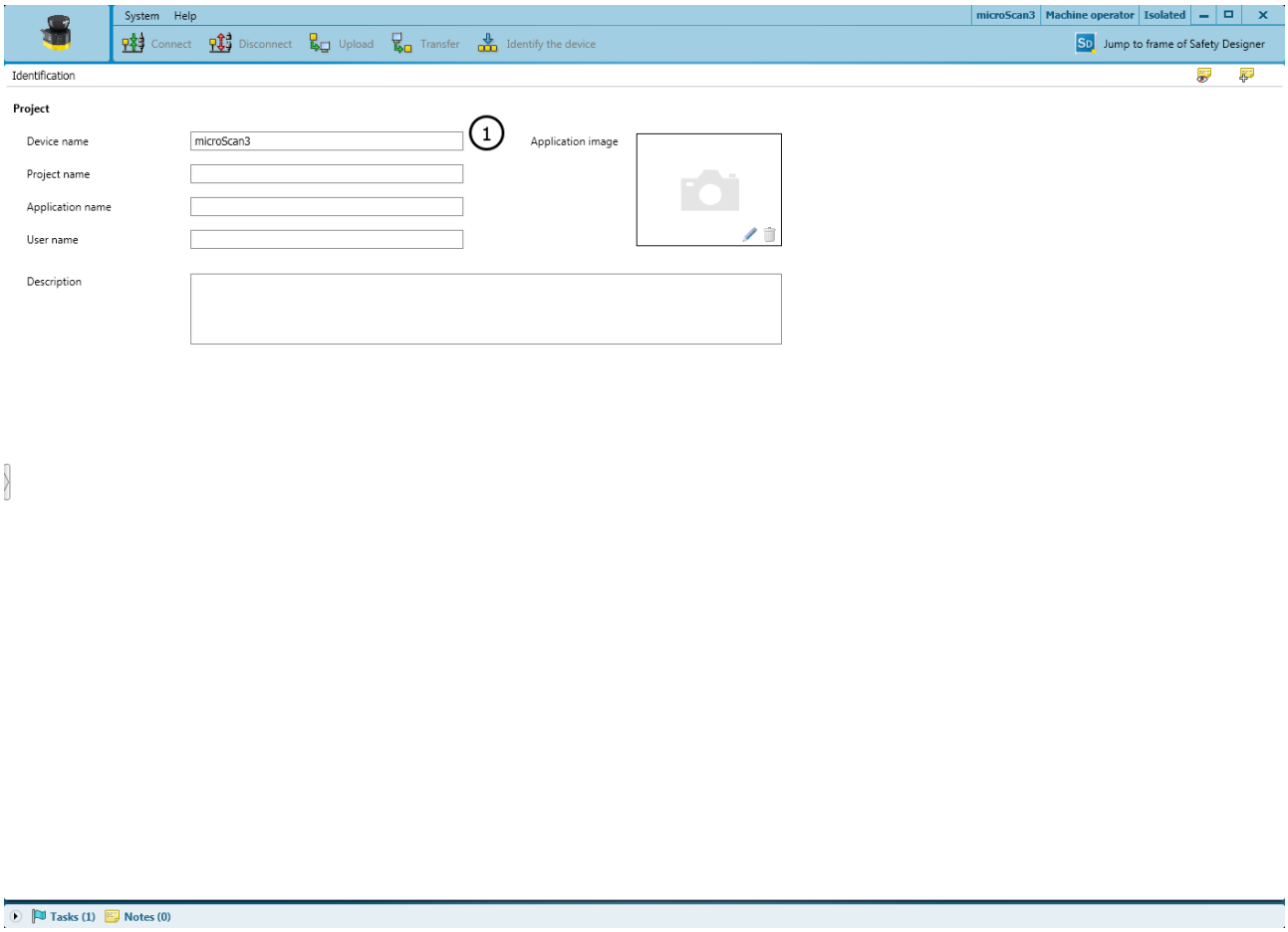


Figure 58: Identification

① Parameters for the project and the device

In the **Identification** dialog box, you can assign names and information to uniquely identify the application, project, and devices.

Device name

If a number of safety laser scanners are used in an application or in a project, a unique device name helps to tell the individual devices apart.

▶ Give each device a unique device name.

Project name

The project name is used to identify an entire project. The same project name should be chosen for all devices in the project.

▶ Enter a project name.

Application name

The application name can be the same for a number of devices in the project. It highlights that these devices realize an application together, by responding to one another for example.

▶ Enter an application name.

User name

The user name helps later users to find a contact for the application.

▶ Enter a user name.

Application image

An image helps to identify the application more quickly. The application image is saved in the project file on the PC and transmitted to the device. The Safety Designer supports the following file formats: BMP, GIF, JPG, PNG, TIF.

1. Click on the pencil icon.
2. Select an image file for the application.

✓ The image is incorporated as a thumbnail.

Description

A description makes it easier to understand an application's context more quickly.

▶ Enter a description with a maximum of 1000 characters.

7.6 Application

Overview

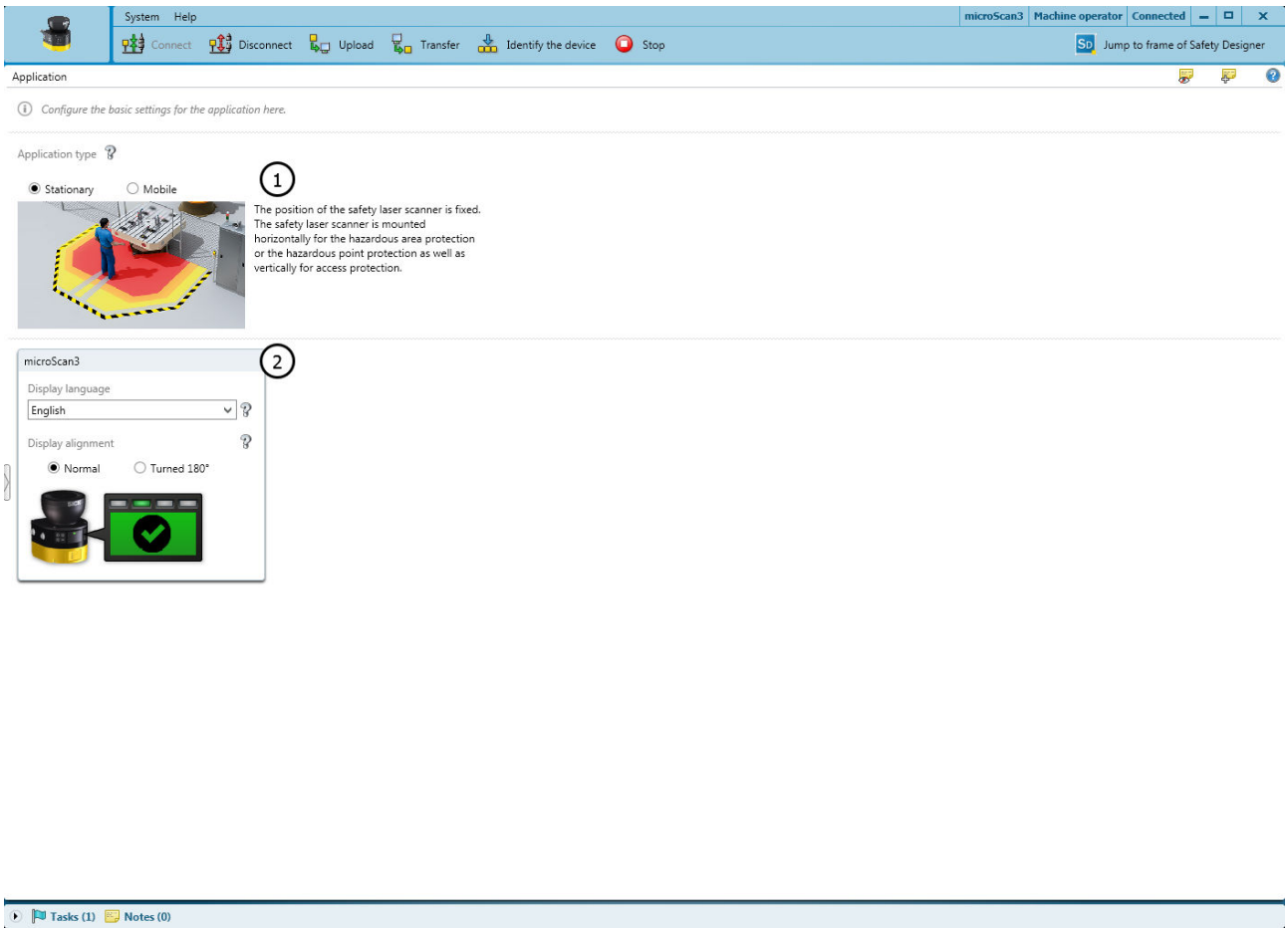


Figure 59: Application

① Basic settings for the application

② Settings for the device, which relate to the application

Application type

The type of application depends on the application of the safety laser scanner:

▶ Select application type.
✓ Mobile
Mobile hazardous area protection is suitable for AGVs (automated guided vehicles), cranes and forklifts, to protect people when vehicles are moving or docking. The safety laser scanner monitors the area in the direction of travel and stops the vehicle as soon as an object is located in the protective field.
✓ Stationary
The safety laser scanner's position is fixed. The safety laser scanner is mounted horizontally (for hazardous area protection) or vertically (for hazardous point protection and access protection).

Display language

The safety laser scanner's display outputs notifications and statuses (see "Buttons and display", page 119). Multiple languages are available for the display.

▶ Select a language that the operator understands.
✓ The safety laser scanner outputs the notifications in the set language.

Display orientation

If you mount the safety laser scanner upside down, you can rotate the orientation of the display through 180°.

▶ Choose the option **Normal** or **Upside down** for display orientation.
✓ The preview shows the display's orientation.

7.7 Monitoring plane

A safety laser scanner's scan plane forms its monitoring plane.

Define the following parameters:

- Parameters for the monitoring plane
- Parameters for the safety laser scanner

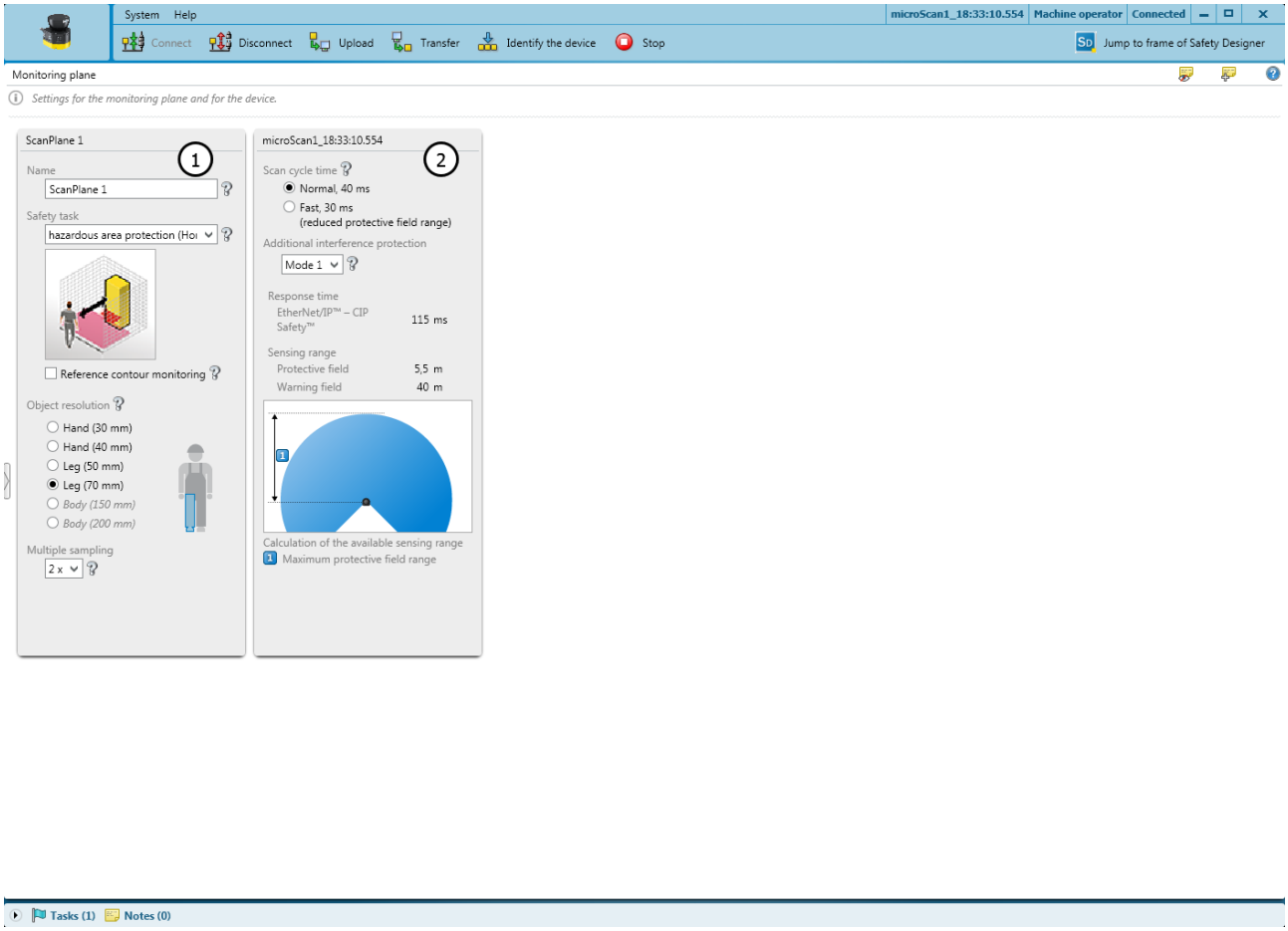


Figure 60: Monitoring plane

① Parameters for the monitoring plane

② Parameters for the safety laser scanner

7.7.1 Parameters for the monitoring plane

Overview

Configure a name, the protection task, object resolution, and multiple sampling setting for the monitoring plane.

At first, the object resolution and multiple sampling configured for the monitoring plane apply for all fields. If necessary, make changes to each individually at a later date. If you do this, Safety Designer will indicate this in the settings for the monitoring plane.

Name of the monitoring plane

You can use the name to identify monitoring planes when creating fields and monitoring cases and also in reports.

▶ Enter a descriptive name for the monitoring plane (e.g., “Hazardous area on the right hand side”).

✓ The name is used to identify the monitoring planes.

Protection task

People approach the monitoring plane parallel or orthogonally, depending on the orientation of the protective field in your application (see "Project planning", page 25).

- Hazardous area protection (horizontal)

Typically, for a horizontal approach, the requirement is to detect the leg. The typical object resolution is leg (70 mm).

- Access protection (vertical)
  Typically, for access protection, the requirement is to detect a person. The typical object resolution is body (200 mm).
- Hazardous point protection (vertical)
  Typically, for hazardous point protection, the requirement is to detect a hand. The typical object resolution is hand (40 mm).

Reference contour monitoring

NOTE
If the monitoring plane has a vertical alignment, a contour (such as the floor, a part of the machine bed, or an access threshold) must typically be defined and monitored as a reference contour. A reference contour field is used for this, see "Reference contour field", page 89.

▶ Activate the **Reference contour monitoring** option.
✓ The **Reference contour field** point is shown in the navigation. Here you can configure the reference contour field required for your application.

Object resolution

The object resolution defines the size that an object must be to allow it to be reliably detected. The following object resolutions are available:

- 30 mm = hand detection
- 40 mm = hand detection
- 50 mm = leg detection/arm detection
- 60 mm = leg detection/arm detection (depends on variant)
- 70 mm = leg detection/arm detection
- 150 mm = body detection
- 200 mm = body detection

▶ Choose the object resolution.
✓ Objects the same size as or larger than the chosen object resolution are reliably detected.

NOTE
The configurable object resolution has an influence on the protective field range available. The finer the object resolution configured for the safety laser scanner, the shorter the available protective field range.

The protective field range is shown to you, see "Parameters for the safety laser scanner", page 88.

Multiple sampling

DANGER
Hazard due to lack of effectiveness of the protective device

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

A higher multiple sampling increases the response time.

▶ Make a note of the safety laser scanner's new response time in Safety Designer.
▶ Adjust the minimum distance from the hazardous point to the new response time.

Multiple sampling indicates how often an object has to be scanned before the safety laser scanner reacts. A higher multiple sampling reduces the possibility that insects, weld sparks or other particles cause the machine to be shut down. You will increase the machine's availability.

A multiple sampling of 2 is the minimum setting.

▶ Increase the multiple sampling up to 16.
✓ An object must be this many times.

Table 8: Recommended multiple sampling

Application	Recommended multiple sampling
Stationary application: such as horizontal hazardous area protection or vertical hazardous point protection under clean ambient conditions	2×
Stationary application: such as vertical access protection Only 2-time multiple sampling may be used for vertical access protection.	2×
Mobile application	4×
Stationary application: such as horizontal hazardous area protection under dusty ambient conditions	8×

7.7.2 Parameters for the safety laser scanner

Overview

Configure the parameters for the safety laser scanner here.

Additional interference protection

If you mount several safety laser scanners in close proximity to each other, this can lead to mutual interference. You will prevent mutual interference in neighboring safety laser scanners if you choose different settings for interference protection.

Modes 1 to 4 are available. Interference protection influences the scan cycle time and therefore the response time.

- Mode 1 = + 0 ms per scan cycle
- Mode 2 = + 1 ms per scan cycle
- Mode 3 = + 2 ms per scan cycle
- Mode 4 = + 3 ms per scan cycle

▶ Configure a different mode for each safety laser scanner that is mounted in close proximity.
✓ The resulting response time is shown.

Scan cycle time

You can configure the scan cycle time. The safety laser scanner's scan cycle time influences the response time and the protective field range.

Devices with a max. protective field range of 4.0 m and devices with max. protective field range of 5.5 m:

- 40 ms: Full protective field range, increased availability in dusty conditions, for example
- 30 ms: Smaller protective field range with shorter response time

Devices with a max. protective field range of 9.0 m:

- 50 ms: Full protective field range, increased availability in dusty conditions, for example
- 40 ms: Smaller protective field range with shorter response time

▶ Select scan cycle time.

✓ The resulting response time and the range of the fields are shown.

Complementary information

NOTE

The safety laser scanner's response time depends on the scan cycle time, interference protection and multiple sampling, see "Response times", page 150. In addition to the safety laser scanner's response time, further signal transmission and processing also influence the time up until the end of the dangerous state.

A graphic shows how the configuration affects the available ranges.

7.8 Reference contour field

Overview

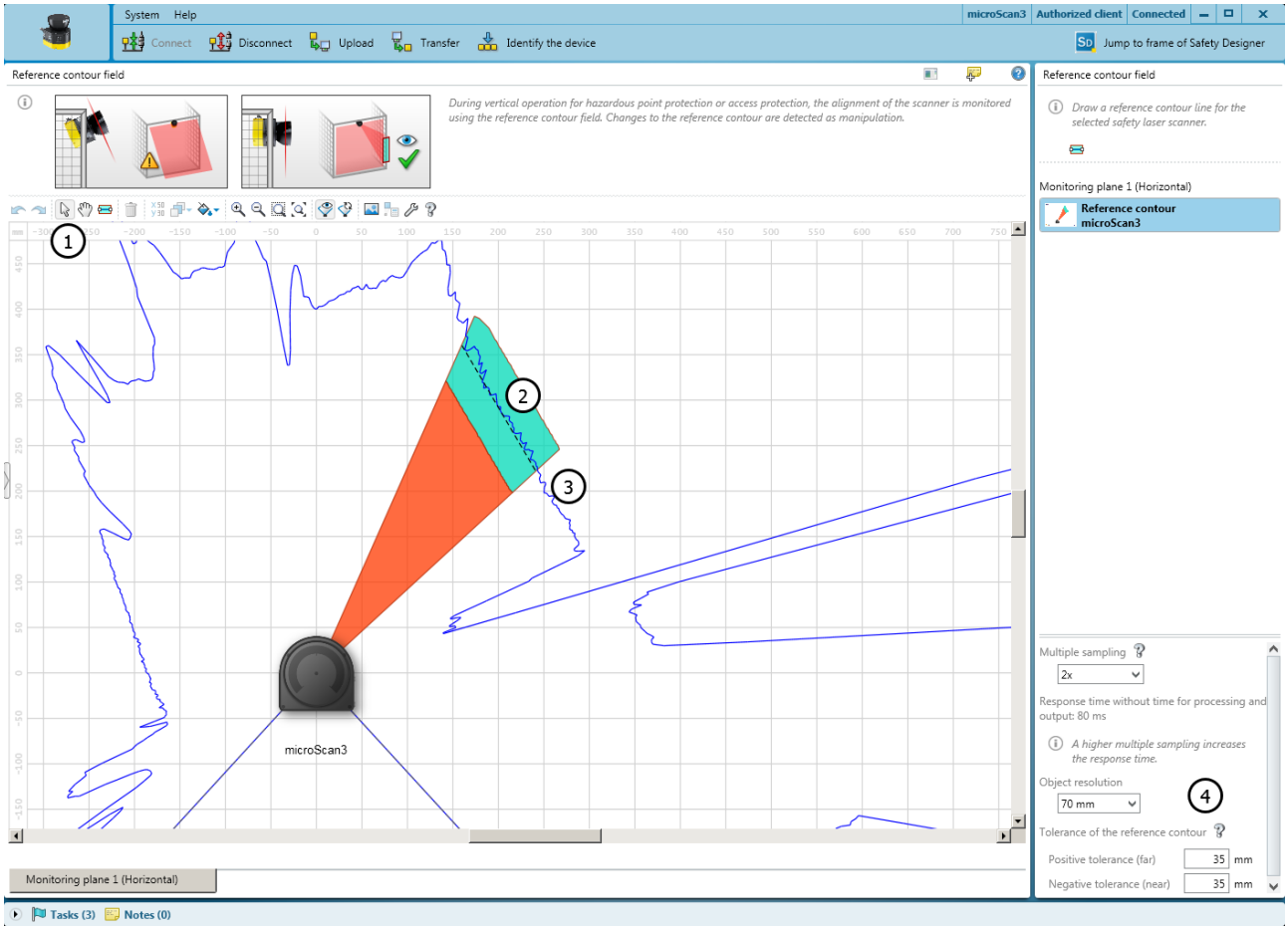


Figure 61: Reference contour field

① Tool for drawing reference contour fields

② Drawn contour with tolerance band

③ Reference contour field

④ Configure the field

If you have activated the **Reference contour monitoring** option for a monitoring plane, the **Reference contour field** dialog box is shown. Draw the reference contour field on the basis of the values determined during project planning (see "Reference contour monitoring", page 30).

The reference contour field monitors a contour of the environment. The safety laser scanner switches all safety outputs to the OFF state if a contour does not match the set parameters, because, for example, the mounting situation of the safety laser scanner were changed.

Drawing a reference contour field

1. Select the tool for drawing reference contour fields.
2. Draw a line along the spatial contour as a reference.
   - ▷ First, use the mouse to click the desired contour.
   - ▷ Click to add the corners of the contour.
   - ▷ Finally, double-click the contour.

✓ The reference contour field is displayed.

Multiple sampling and object resolution

DANGER
Hazard due to lack of effectiveness of the protective device

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

A higher multiple sampling increases the response time.

- ▶ Make a note of the safety laser scanner's new response time in Safety Designer.
- ▶ Adjust the minimum distance from the hazardous point to the new response time.

Safety Designer initially uses multiple sampling and the object resolution of the monitoring plane for the fields.

If necessary, define multiple sampling and the object resolution for each field individually.

1. Select multiple sampling.

✓ Multiple sampling indicates how often an object has to be scanned before the safety laser scanner reacts.

2. Select object resolution.

✓ The object resolution defines the size that an object must be to allow it to be reliably detected.

Tolerance band

A contour has a positive and a negative tolerance band. The cut-off path goes to the OFF state if the safety laser scanner does not detect the contour inside the tolerance band.

- ▶ Enter the **Positive tolerance (far)**.

✓ The tolerance away from the safety laser scanner is defined.

- ▶ Enter the **Negative tolerance (near)**.

✓ The tolerance toward the safety laser scanner is defined.

7.9 Fields

Using the field editor, you can configure the safety laser scanner's field sets in a graphical user interface. The number of configurable fields depends on the safety laser scanner variant, see "Variants", page 16.

The edge length or the diameter of each field must be at least as large as the selected object resolution.

7.9.1 Using the field editor

Overview

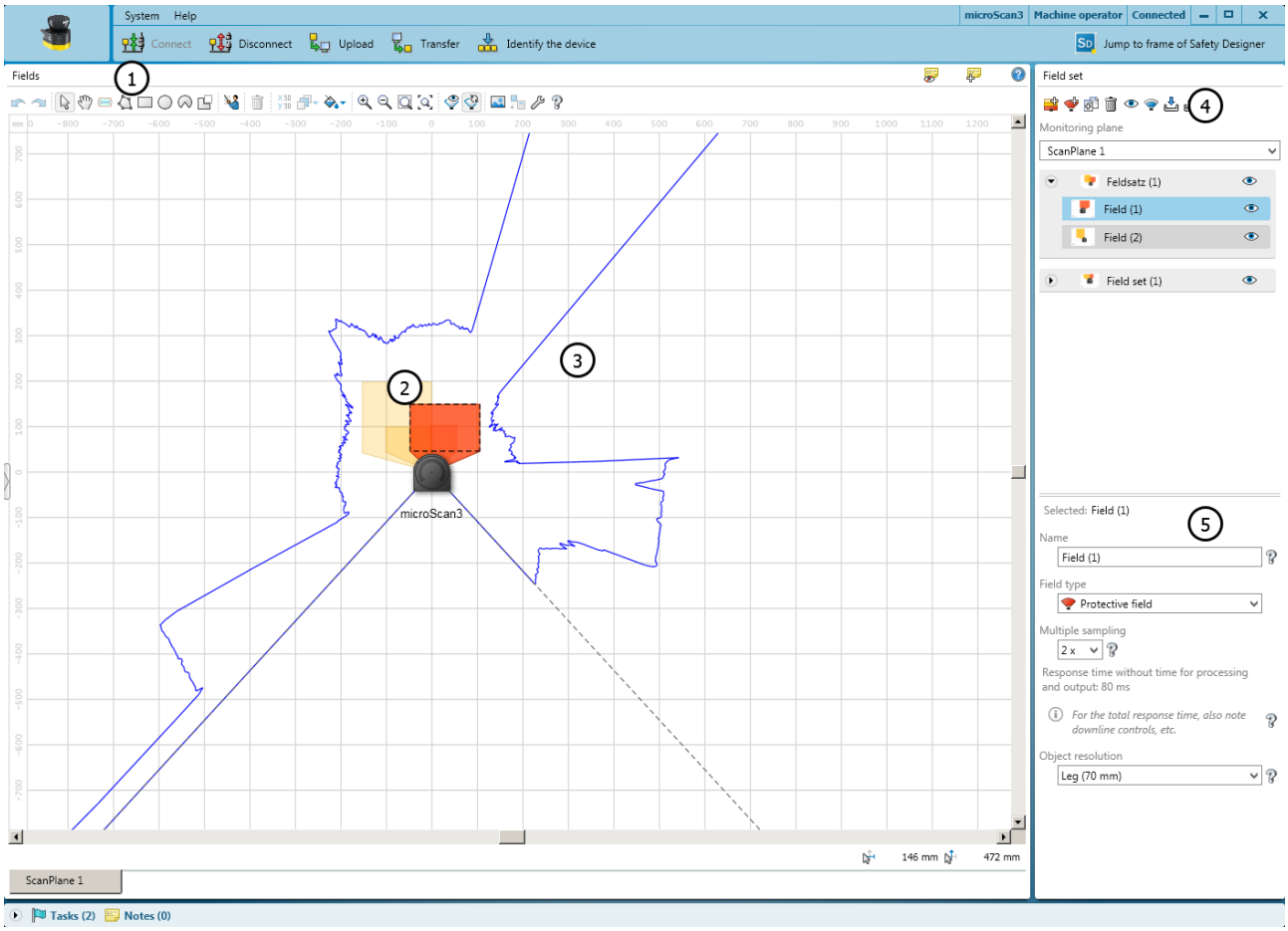


Figure 62: Field editor

① Toolbar
② Protective field (red) and warning field (yellow) created
③ Visible spatial contour
④ Create, copy, delete field set and fields
⑤ Define field type, name field, configure field

In the **Fields** area, you can draw the fields in a field set using the tools in the toolbar. You can create field sets and fields in the **Field set** area. In the area below, you can define the field type, enter the name and, configure multiple sampling and the object resolution, if necessary.

Toolbar

Using the tools in the field editor, you can draw the fields in a field set or masked areas inside the fields.

Table 9: Buttons on the toolbar

	Arrow tool, for marking objects
	Hand tool, for moving the work space


Draw reference contour field or contour detection field


Draw field using points


Draw rectangle


Draw circle


Draw circle segment


Mask areas (see "Drawing in points that cannot be monitored", page 98). Use the drawing functions for fields to draw the masked areas. The buttons are crosshatched.


Enable propose field

Edit a field using coordinates (see "Editing fields using coordinates", page 97)


Push the object into the foreground or background


Select field design


Calculate field


Zoom in


Zoom out


Zoom to area


Zoom to work space


Show snapshot of the spatial contour. Clicking again clears the spatial contour shown.


Show live spatial contour


Paste background image (see "Background image", page 95)


Open field editor settings

Field display

Safety Designer displays the field types in different colors.

Table 10: Colors of the field types

Protective field	Warning field	Reference contour field and contour detection field
Red	Yellow	Turquoise

Create fields and field sets

NOTE

You can only create the number of fields and field sets allowed in the safety laser scanner's performance package. If the maximum number of fields and field sets has already been used, it is not possible to create any more fields or field sets.

Create the fields in a field set in the same order that you need them in the monitoring case table (see "Cut-off paths", page 106).

If you choose, e.g., protective field, warning field, the protective field acts on cut-off path 1 and the warning field acts on cut-off path 2.

Table 11: Buttons for field sets

	Add field set
	Add field to field set
	Duplicate field set
	Delete field or field set
	Hide or show field sets and fields
	Manage field set templates (see "Creating field set templates", page 94)
	Import field sets and fields
	Export field sets and fields

Add field set:

The menu contains a simple field set template and may contain user-defined field set templates.

1. Choose **Simple field set.**
✓ A field set containing one field is created.
2. Enter a unique name for the field set under **Name.**
3. Add further fields to the field set, if necessary.

Add field:

1. Select the field set to which you would like to add a field.
2. Click on **Add field to field set.**
✓ Another field is added to the selected field set.

Duplicate field set:

1. Select the field set which you would like to duplicate.
2. Click on **Duplicate field set.**
✓ The field set is duplicated and pasted in as a copy.

Manage field set templates:

1. Click on **Manage field set templates.**
✓ The available templates are shown.
2. Edit the field set template or create a new field set template (see "Creating field set templates", page 94).

Field name and field type

Assign a unique name and select a field type for each field. Change the multiple sampling or the object resolution of a field, if required.

1. Select the field to be edited.
2. Enter the name of the field.
3. Select the field type see "Field types", page 18.

Multiple sampling and object resolution

DANGER
Hazard due to lack of effectiveness of the protective device

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

A higher multiple sampling increases the response time.

- ▶ Make a note of the safety laser scanner's new response time in Safety Designer.
- ▶ Adjust the minimum distance from the hazardous point to the new response time.

Safety Designer initially uses multiple sampling and the object resolution of the monitoring plane for the fields.

If necessary, define multiple sampling and the object resolution for each field individually.

1. Select multiple sampling.
✓ Multiple sampling indicates how often an object has to be scanned before the safety laser scanner reacts.
2. Select object resolution.
✓ The object resolution defines the size that an object must be to allow it to be reliably detected.

Tolerance band

A contour has a positive and a negative tolerance band. The cut-off path goes to the OFF state if the safety laser scanner does not detect the contour inside the tolerance band.

- ▶ Enter the **Positive tolerance (far)**.
✓ The tolerance away from the safety laser scanner is defined.
- ▶ Enter the **Negative tolerance (near)**.
✓ The tolerance toward the safety laser scanner is defined.

Field set name

Assign a unique name for each field set.

1. Select the field set to be edited.
2. Enter the name of the field set.

7.9.2 Creating field set templates

If you require the same combination of fields a number of times, you can create a field set template.

You can edit field set templates using the **Manage field sets** tool.

Example: you define a field set template with protective field, warning field1 and warning field2.

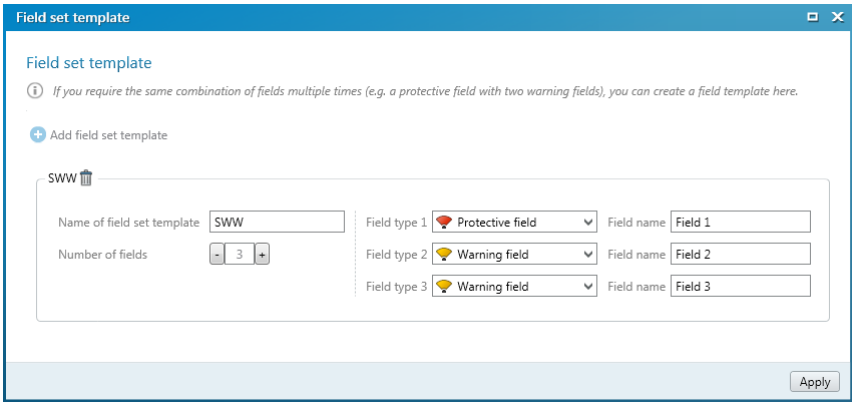


Figure 63: Field set template

Creating a field set template

1. Click on **Add field set template**.
2. Enter the name for the template.
3. Define the number of fields.

✓ A selection field is shown for each field.

4. Select the **Field types** for the fields.
5. Enter the **Field names**.
6. Click on **Apply**.

✓ The field set template is saved.

7.9.3 Importing and exporting field sets and fields

Overview

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

Importing field sets and fields

1. Click on **Import fields**.
2. Select exported file with field set information.

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

3. Select the required field sets and fields.
4. Start the import.

✓ The field sets and fields will be imported.

Exporting field sets and fields

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

✓ The field sets and fields will be exported.

7.9.4 Background image

You can select a background image for the field editor. For example, the plan view of the machine to be protected can be used as a sample.

The background image is saved in the project file on the PC. It is not transferred to the device.

You can use the **Edit background image** tool to choose a background image.

The Safety Designer supports the following file formats: BMP, JPG, PNG.

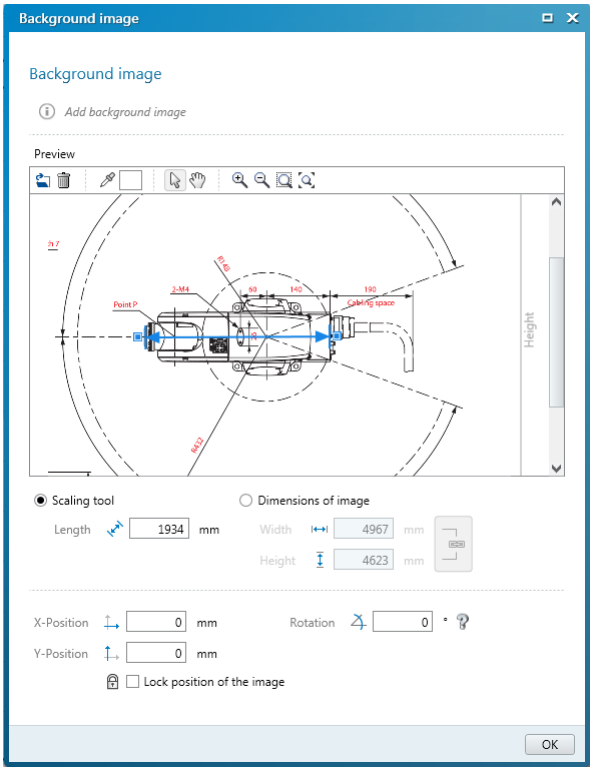


Figure 64: Background image

1. Click on **Edit background image** in the toolbar.
✓ The **Background image** dialog box opens.
2. Click on **Search...**.
3. Select the file for the background image.
✓ Safety Designer displays the background image.
4. If necessary, use the pipette icon to select a color of the image to make this color transparent.
5. Adjust the size of the image with the scaling tool or by directly entering the dimensions. Use the scaling tool to move the tips of the blue arrow to two known points and then enter the distance between the points in the **Length** field.
6. Enter the **X position**, **Y position** and **rotation** in the field editor's coordinates system. You can then freely move or rotate the background image in the field editor.
7. If required, click the option **Lock position of background image**.
✓ It is no longer possible to change the background image in the field editor.

7.9.5 Settings for the field editor

You can edit settings for the field editor.

You can open the settings using the tool **Edit field editor settings**.

Field calculation

You specify whether the fields are calculated manually or automatically after drawing.

If you select the **Manual** option, first draw the areas to be monitored. Then click on **Calculate field** so that the Safety Designer calculates the field that the safety laser scanner actually monitors.

If you select the **Automatic** option, the drawn areas are immediately converted into fields.

Display Reference Contour Field

You determine whether the reference contour field is displayed.

Drawing area

You can use a Cartesian or a polar coordinates system and select the colors for the grid and the drawing area.

- ▶ Choose the option **Cartesian**.
- ✓ The coordinates system is shown as a Cartesian coordinates system.
- ▶ Choose the option **Polar**.
- ✓ The coordinates system is shown as a polar coordinates system.
- ▶ Select **Color of grid**.
- ✓ The field editor's grid is displayed in the chosen color.
- ▶ Select **Color of drawing area**.
- ✓ The field editor's drawing area is displayed in the chosen color.

7.9.6 Editing fields using coordinates

You can use coordinates to edit fields. Depending on the form on which a field is based, the appropriate input fields are displayed. The example shows a dialog box for a rectangle.

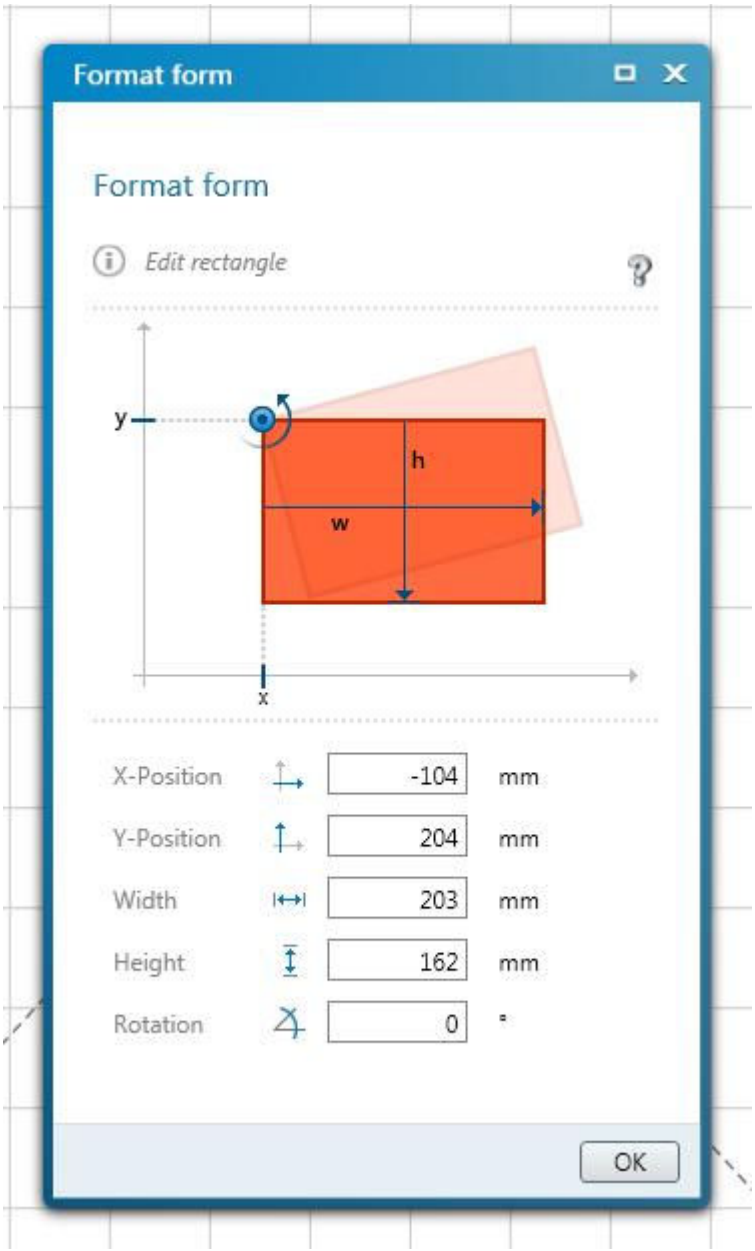


Figure 65: Editing fields using coordinates

The reference points for the X and Y values are as follows:

- Rectangle: top left corner
- Circle: center point
- Circle sector: center point
- Polygon: each point individually
- Contour line: each point individually

7.9.7 Drawing in points that cannot be monitored

The area to be monitored is scanned radially ①. For this reason, shadows ③ are formed by objects in the room ② (support columns, separator grids, etc.). The safety laser scanner cannot monitor these areas.

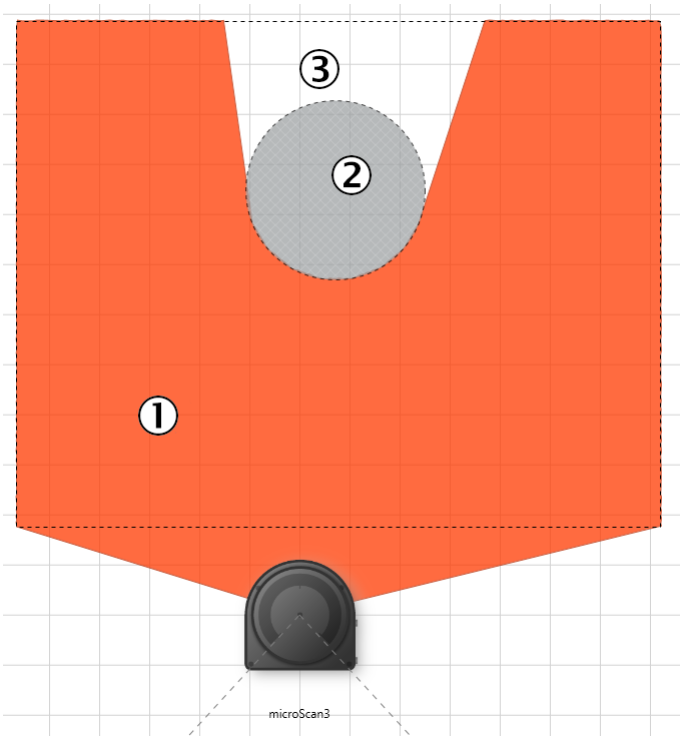


Figure 66: Area that cannot be monitored

① Protective field
② Marked column
③ Area that cannot be monitored

Drawing masked areas

You can draw in objects, which limit the safety laser scanner's field of view, as masked areas. The masked area casts a shadow, so unmonitored areas may be created. The field editor shows the shadowing of the masked area ③.

1. Click on the tool **Mask areas**.
✓ The tools you can use to draw fields are shown crosshatched.

2. Choose a drawing tool.
3. Draw the masked area.
✓ The masked area is crosshatched in gray.
✓ The field editor shows the shadowing of the masked area.

7.9.8 Enable propose field

Overview

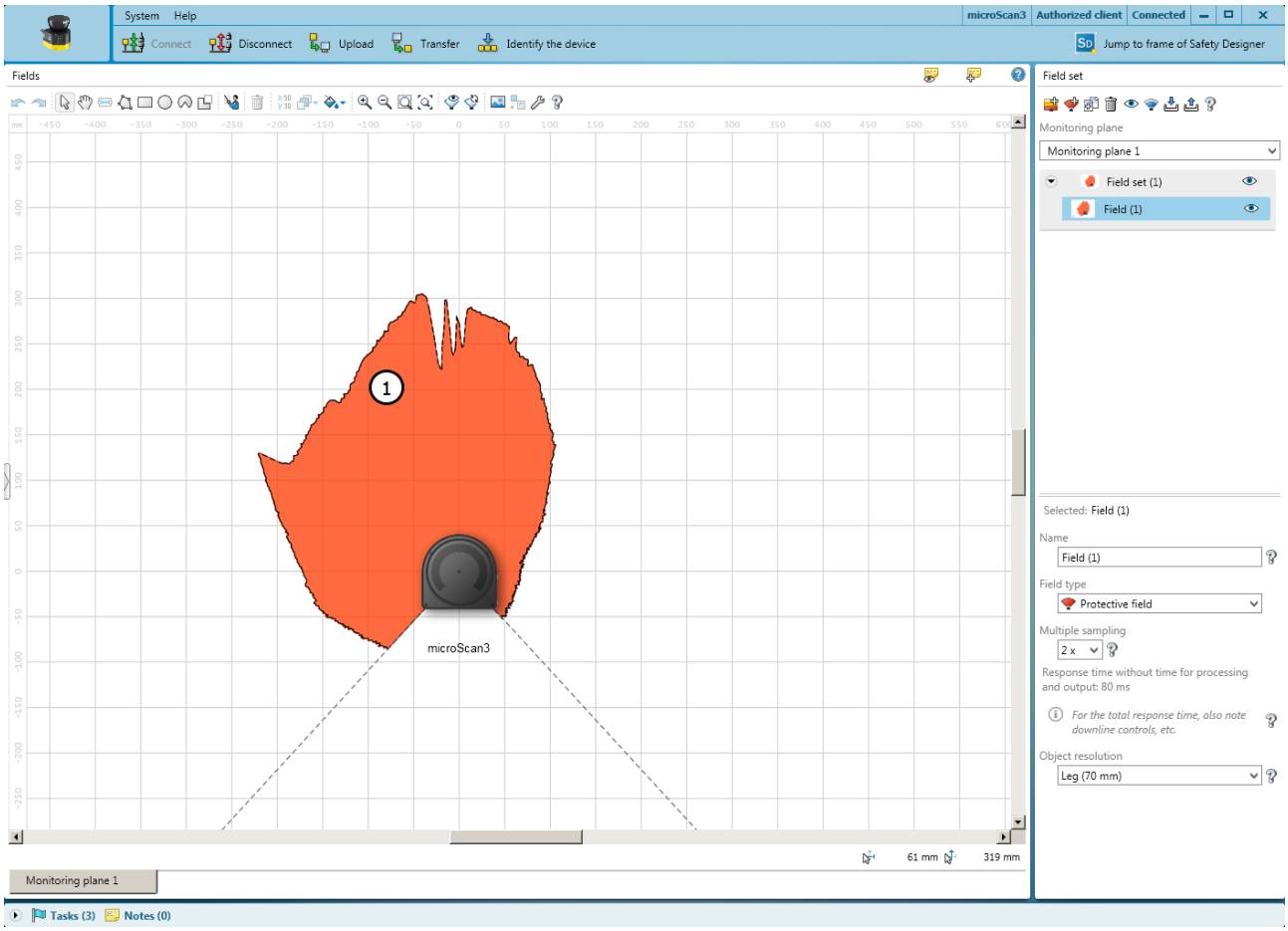


Figure 67: Enable propose field

① Proposal for a protective field

You can have a protective field or warning field suggested by Safety Designer.

For this purpose, the safety laser scanner scans the visible surrounding contour several times. Based on the data obtained, the Safety Designer suggests the contour and size of the field.

You can create a field using the **Propose field** tool.

Important information

NOTE

If you propose a protective field, the proposal does not replace the calculation of the minimum distance. You must calculate the minimum distance and check whether the size of the proposed protective field is sufficient. You must also take into account the measurement tolerances of the safety laser scanner

Decrease the suggested field

If you walk the imaginary field on its borders and, e.g. hold a board or cardboard into the laser beam, the surrounding contour is thereby limited. As long as the **Propose field** function is active, the proposed field is reduced to the respectively measured surrounding contour.

Approach

1. Select field type.
2. Click on **Propose field**.
✓ The safety laser scanner scans the contour of the room.
3. If necessary, reduce the size of the suggested field.
4. Click on **Propose field** again.
✓ The Safety Designer displays the proposed field.

7.10 Inputs and outputs, local

Overview

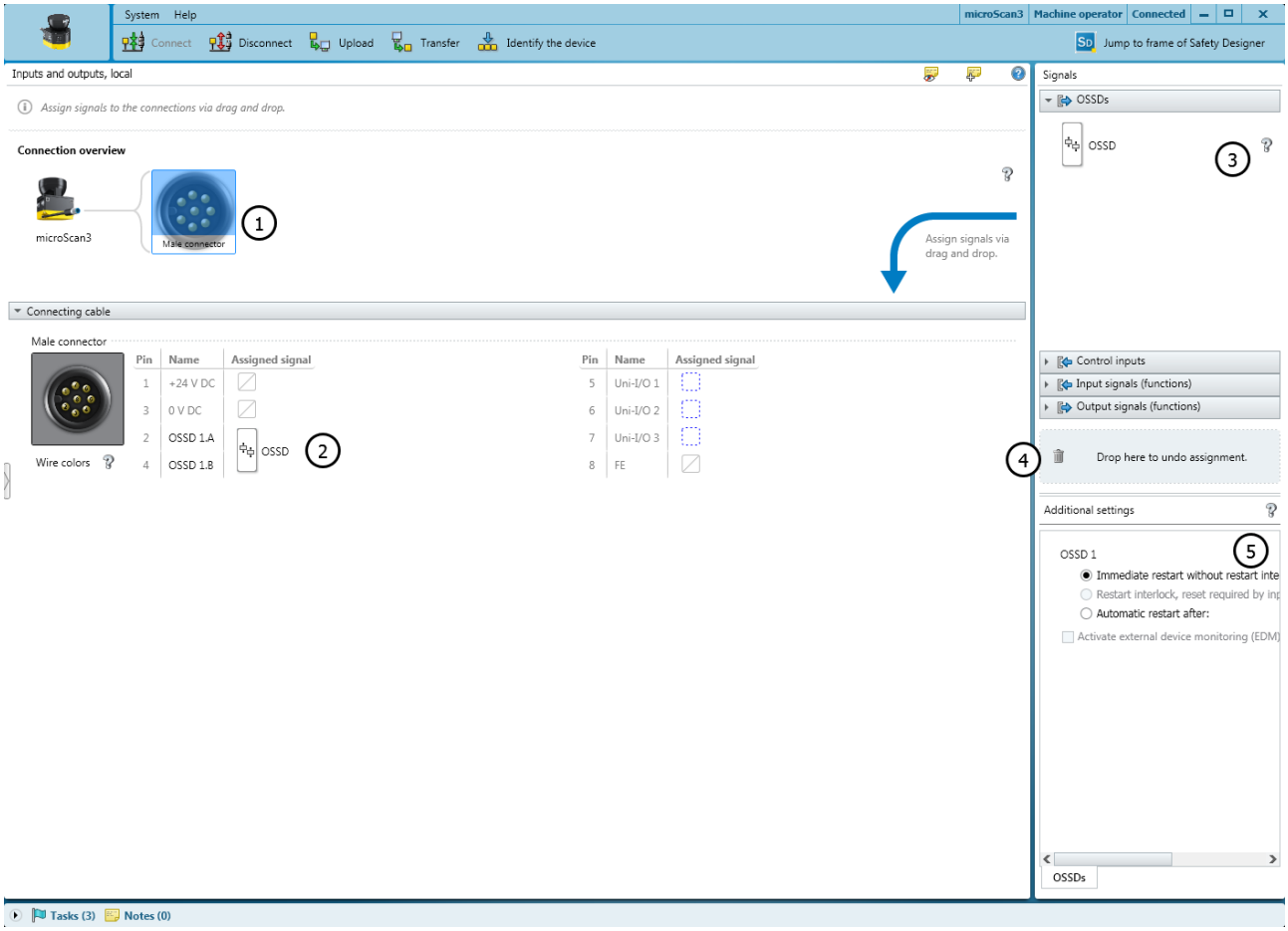


Figure 68: Inputs and outputs, local

① Overview: plug connector of the safety laser scanner
② Pin assignment
③ Available signals
④ Remove signal from connection
⑤ Further settings for some signals

Assign the required signals to the safety laser scanner's connections in the **Inputs and outputs, local** dialog box.

Connection overview

Safety Designer shows the safety laser scanner's plug connector in the center of the dialog box.

Pin assignment

Safety Designer shows the plug connector with the individual pins.

Assigning signals to the pins

Safety Designer shows the available signals on the right under **Signals**.

- ▶ Click on the desired signal type (for example on **Control inputs**).
- ✓ The menu shows the possible control inputs.
- ▶ Drag the signal towards the pins.
- ✓ Possible pins for the connection are highlighted.
  Safety Designer checks for any restrictions that may apply. For example, an OSSD cannot be placed on an input.
- ▶ Drop the signal on the pin.
- ✓ The signal name is shown on the right next to the pins.

Removing signals

- ▶ Click on the signal.
- ▶ Drag the signal on to the trash-can symbol.
- ✓ The pins are free again.

7.10.1 Input signals

External device monitoring (EDM)

Signal from the auxiliary contacts of the positively guided contactors for external device monitoring (EDM).

Reset

Signal from the reset pushbutton to manually reset the internal restart interlock.

Sleep mode

Signal from a pushbutton to activate sleep mode.

Restart device

Signal from a pushbutton to completely restart the device.

Further topics

- "External device monitoring (EDM)", page 60
- "Restart interlock", page 57
- "Device restart", page 111

7.10.2 Output signals

Contamination

Signals that the optics cover is contaminated.

- **Contamination warning** setting: The optics cover should be cleaned soon.
- **Contamination error** setting: All safety outputs in the OFF state. The optics cover is severely contaminated and must be cleaned immediately.

Error

Signals an error.

- **Device error** setting: Device errors are serious errors where all safety outputs switch to the OFF state and the device switches to the locking state. Once the cause of the error has been rectified, the device must be completely restarted.
- **Application error** setting: In the event of an application error, all safety outputs switch to the OFF state. Once the cause of the error has been rectified, the safety function must be restarted.

Reset required

Signals that a reset is possible. A connected lamp lights up if the restart interlock has been triggered and the protective field is then clear again.

Monitoring result

Signals the status of the active field. A connected lamp lights up if the currently monitored field in the cut-off path is interrupted.

Reset required (flashing)

Signals that a reset is possible. A connected lamp flashes if the restart interlock has been triggered and the protective field is then clear again.

Further topics

- "Status display", page 132

7.10.3 Further settings for some signals

Safety Designer shows the setting options for some signals under **Further settings** at bottom right.

DANGER
Hazard due to lack of effectiveness of the protective device

Hazard due to unexpected starting of the machine

By configuring the restart interlock for an OSSD pair, you can influence the restart interlock behavior for the application.

▶ Take account of the notes in the project planning chapter.

Restart interlock for the OSSD pair

The safety laser scanner has the following options for the restart behavior of the OSSD pair (see "Restart interlock", page 57):

- Instant restart without restart interlock: if there is no longer an object in the protective field, the safety laser scanner immediately switches the OSSDs to the ON state.
- Restart interlock, reset required: if the operator activates the restart or reset control switch, the safety laser scanner switches the OSSDs to the ON state.
- Automatic restart after ...: if there is no longer an object in the protective field, the safety laser scanner switches the OSSDs to the ON state after the configured delay.

External device monitoring (EDM)

An input must be configured for external device monitoring (EDM). This input must be correctly connected to the electric control (see "External device monitoring (EDM)", page 60).

If external device monitoring is activated, the safety laser scanner checks whether voltage is applied at the external device monitoring (EDM) input after the OSSDs have been switched off.

If no voltage is applied at the input after the OSSDs have been switched off, the safety laser scanner changes to the locking state and does not switch the OSSDs back to the ON state.

Configuring the restart interlock

- ▶ Select the option **Immediate restart without restart interlock.**
- ✓ The OSSDs switch to the ON state if there is no longer an object in the protective field.
- ▶ Choose the option **Restart interlock, reset required.**
- ✓ The OSSDs only switch to the ON state if the operator activates the reset control switch.
- ▶ Choose the option **Automatic restart after ...** and enter the delay time.
- ✓ The OSSDs switch to the ON state if there is no longer an object in the protective field for the specified duration.

Configuring external device monitoring (EDM)

- ▶ Activate **External device monitoring (EDM).**
- ✓ The OSSDs only switch to the ON state if the external device monitoring was successful.

7.11 Monitoring cases

Overview

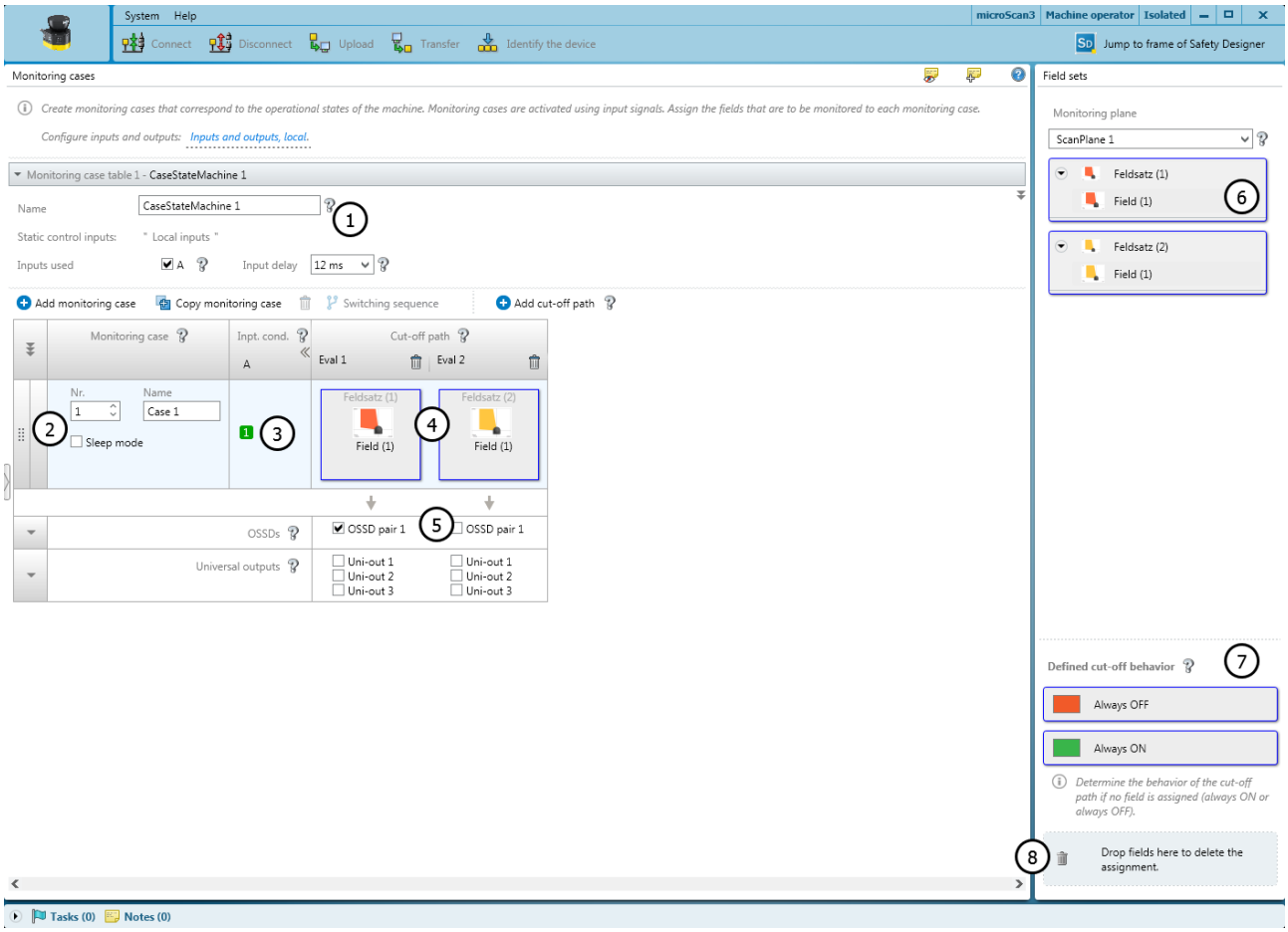


Figure 69: Monitoring cases

① Settings for the whole monitoring case table
② Settings for the individual monitoring case
③ Input conditions for a monitoring case
④ Cut-off paths
⑤ Field set in the monitoring case and in the cut-off path
⑥ Configured field sets
⑦ Areas for defined cut-off behavior
⑧ Remove field set from a monitoring case

You can create monitoring case tables and possible switching criteria for the monitoring cases in the monitoring case editor. You can also define the monitoring cases and their input conditions and assign the field sets.

Further topics

- "Monitoring case", page 21

7.11.1 Settings for monitoring case tables

Name

Enter a name which is as descriptive as possible for the monitoring case table in the **Name** field.

Inputs used

Choose the inputs that you would like to use for switching between monitoring cases in the monitoring case table.

In antivalent evaluation, the 2 channels of each static control input must always be inverted, even if the status of a control input in a monitoring case is random. If it is not inverted, all safety outputs switch to the OFF state and the device displays a fault.

Input delay

If appropriate, select a delay for the inputs in the field **Input delay**.

If your control device, which you use to switch the static control inputs, cannot switch to the appropriate input condition within 12 ms (for example because of the switch's bounce times), you must configure an input delay. For the input delay, select a time in which your control device can switch in a defined way to a corresponding input condition. You can increase the delay time incrementally.

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

Table 12: Empirical values for the required input delay

Switching method	Required input delay
Electronic switching via control, complementary electronic outputs with 0 ms to 12 ms bounce time	12 ms
Tactile controls (relays)	30 ms to 150 ms
Control via independent sensors	130 ms to 480 ms

Also, take account of the notes relating to when to switch between monitoring cases (see "Monitoring case switching time", page 32).

7.11.2 Settings for monitoring cases

Name

Enter a name which is as descriptive as possible for the monitoring case in the Name field. If you create a lot of monitoring cases, you should consider a naming concept that makes it possible to identify the monitoring cases easily (for example right cornering, left cornering).

Sleep mode

If you activate this option, the safety laser scanner changes to the sleep mode as soon as the input conditions for this monitoring case exist.

7.11.3 Input conditions

For each monitoring case, choose the input conditions for which the monitoring case will be activated.

- ▶ Activate the combination of inputs for each monitoring case.
- ✓ The relevant monitoring case is activated for exactly this combination.
- ✓ Combinations which are invalid or already assigned are marked.

7.11.4 Cut-off paths

You can create cut-off paths and define the outputs switched by the cut-off paths. (Example: the protective fields switch the OSSD pair, the warning fields switch a universal output.)

You need a cut-off path for every field in a field set. If the field sets have different sizes, use the field set with the most fields as a guide.

Creating and entering a name

1. Create a cut-off path for every field in the largest field set.
2. Enter a descriptive name for each cut-off path.

Assigning an OSSD pair

▶ Place a check in the box for the OSSD pair.
✓ The OSSD pair is assigned to the cut-off path.

Assigning unsafe outputs

▶ Place a check in the box for the universal output(s).
✓ The universal output is assigned to the cut-off path.

7.11.5 Assigning field sets

Assigning a field set to a monitoring case

The field sets that have been created are shown in the area **Field sets** on the right.

1. Create cut-off paths, see "Cut-off paths", page 106.
2. Drag the field set onto the monitoring case.
✓ The fields in a field set are arranged as they were drawn in the field editor (for example protective field, warning field, warning field).

Deleting the assignment of a field set from the monitoring case

▶ Drag the field set from the monitoring case table onto the trash-can icon.
✓ The field set is removed from the relevant monitoring case.

Defined cut-off behavior

DANGER
Hazard due to lack of effectiveness of the protective device

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

The function **Always ON** has the same effect as a field which is always clear. In a monitoring case with the **Always ON** function, the cut-off path containing this function is permanently in the ON state.

▶ Drag the **Always OFF** function onto the cut-off path.
✓ The field is viewed as being permanently interrupted.
If the monitoring case becomes active, the cut-off path is always in the OFF state.
▶ Drag the **Always ON** function onto the cut-off path.
✓ The field is viewed as being permanently clear.
If the monitoring case becomes active, the cut-off path is always in the ON state.

If fields have not been assigned to certain cells in a monitoring case table, Safety Designer assigns the **Always OFF** function to these cells.

7.12 Simulation

Overview

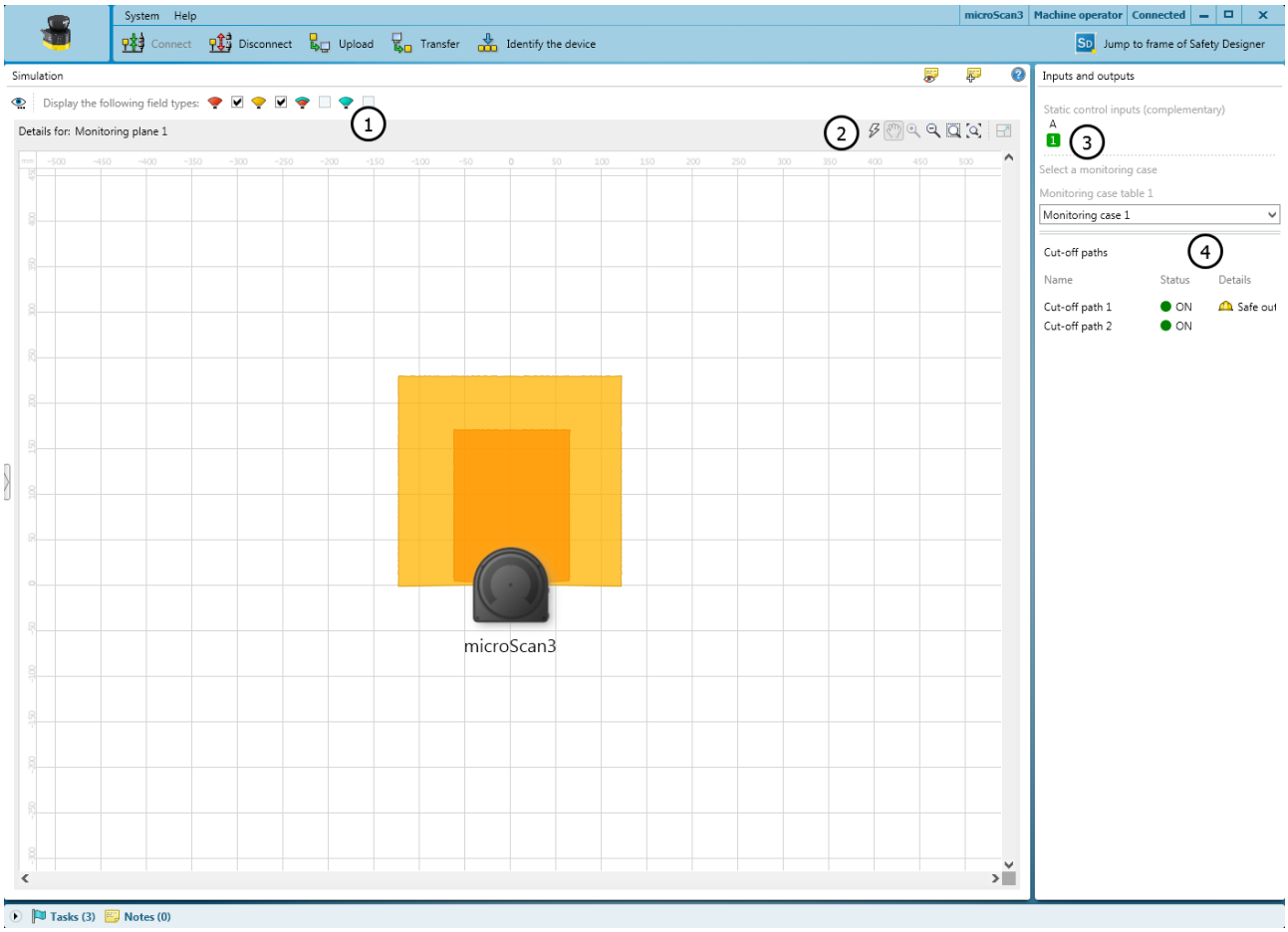


Figure 70: Simulation

① Show or hide field types
② Simulation tools
③ Select input conditions
④ Display the cut-off paths

You can visualize the result of the set configuration in the simulation.

Simulation components and options

- Display the status of the OSSD pairs
- Display the status of the cut-off paths
- Get feedback about which monitoring case is active for the selected input sample (default: monitoring case 1 is active)
- You can switch inputs, monitoring cases, etc. virtually using symbols and observe the result
- You can mark a field in the simulation as interrupted and check which result is triggered by an object in the relevant field
- You can move fields to the foreground or to the background using the context menu (right mouse button)

7.13 Transfer

Transferring configuration

DANGER
Hazard due to lack of effectiveness of the protective device

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

When transferring the configuration, the protective device's existing configuration may be overwritten.

- Check the configuration carefully before transfer.
- Make sure that the desired device is connected during transfer.

At first, the configuration only exists as a project, namely as a configuration file. The configuration must be transmitted to the device.

At the left, you see the values configured in the project for the device. If the device is connected, you see the values saved in the device at the right.

The compatibility of the configuration is checked during transfer.

Checking the configuration

DANGER
Hazard due to lack of effectiveness of the protective device

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

If the configuration is verified, the device automatically starts the safety function after switching on the voltage supply.

If the configuration is not verified, the safety laser scanner may not be operated as a protective device. You can start the safety function manually to test the safety laser scanner and the configuration. The test operation has a time limit.

- Only operate the safety laser scanner as a protective device if the configuration is verified.

You can start the safety function manually to test the safety laser scanner with the new configuration see "Starting and stopping safety function", page 110.

Verifying configuration

DANGER
Hazard due to lack of effectiveness of the protective device

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

By verifying the configuration, you can confirm that the configuration complies with the planned safety function and fulfills the requirements in the risk assessment.

- Check the verification report carefully before confirming verification.
- If the configuration deviates from the planned safety function or does not fulfill the requirements in the risk assessment, verification must not be confirmed.

The configuration must be verified to ensure that the safety function is implemented correctly.

During verification, Safety Designer reads back the transmitted configuration from the safety laser scanner. It compares the configuration with the configuration saved in Safety Designer. If both configurations are identical, Safety Designer displays the verification report. If the user confirms that this is correct, the system is considered to be verified.

Transferring and verifying the configuration of an individual safety laser scanner

1. Click on **Identification** to ensure that the desired device is connected.
✓ The display of the connected device flashes blue.
2. If the checksums on the PC and the device differ, click on **Transmit to device**.
✓ The transfer process is shown in Safety Designer and on the device.
✓ Safety Designer will notify you as soon as the transfer process is complete.
3. Then click on **Verify**.
✓ Safety Designer displays the verification report.
4. Check the verification report and if appropriate, click on **Confirm**.
✓ Device configuration is shown as verified.

7.14 Starting and stopping safety function

In some situations, it is possible to start or stop the safety function manually.

Table 13: Starting and stopping safety function

	Start	starts the safety function.
	Stop	stops the safety function.

DANGER
Hazard due to lack of effectiveness of the protective device

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

If the configuration is verified, the device automatically starts the safety function after switching on the voltage supply.

If the configuration is not verified, the safety laser scanner may not be operated as a protective device. You can start the safety function manually to test the safety laser scanner and the configuration. The test operation has a time limit.

▶ Only operate the safety laser scanner as a protective device if the configuration is verified.

7.15 Reports

You can show a device's data with a report. You have the option of saving and archiving these data as a PDF.

Safety Designer creates a report as soon as you click on **Report** in the navigation. If after configuration changes you click on **Update**, you will receive an updated report.

National and international standards promote or recommend specific data and the person responsible for it. The required data is included in the report.

1. Print the report.
2. Write down the responsible person on the report.
3. Archive the report.

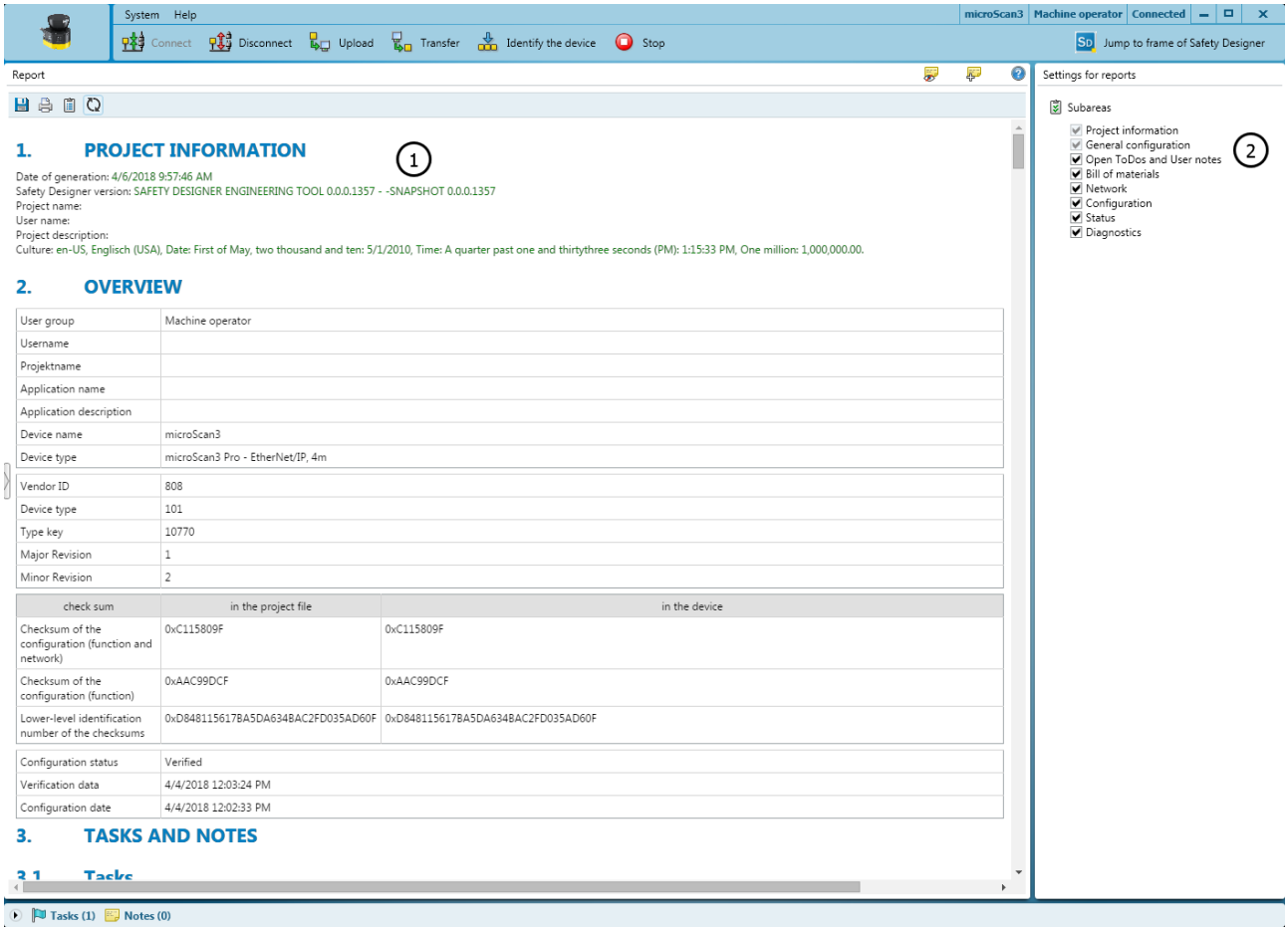


Figure 71: Report

① Contents of the report

② Composition of the report

You compose the contents of a report individually:

1. Select the contents of the report under **Settings for reports**.

✓ Safety Designer creates a report with the selected contents.

7.16 Service

This section describes service options you have with Safety Designer on the safety laser scanner.

7.16.1 Device restart

If you have problems with the device, you can restart the device or subsections of the device (safety function, connections, additional functions).

Restarting safety function

- The fastest type of restart
- Serious faults remain, even if the cause has been rectified (for example a locking state because of a supply voltage which is too low).
- Communication with the device remains intact (connections for configuration, safety function and data not relating to safety).
- Communication beyond the device is not impaired.

Restarting safety function and connections

- The device's function is also re-established after serious faults if the cause has been rectified.
- Communication with the device is interrupted (connections for configuration, safety function and data not relating to safety). The device sets up communication again automatically after restarting.
- Communication beyond the device is not impaired.

Restarting device completely

- The device behaves exactly as it does when the voltage supply is switched off and back on again.
- The device's function is also re-established after serious faults if the cause has been rectified.
- Communication with the device is interrupted (connections for configuration, safety function and data not relating to safety).
- Communication beyond the device is interrupted. This may also affect devices which communicate beyond the device.

7.16.2 Factory settings

Before reconfiguring the device, you can reset all settings to factory settings.

Reseting safety function to factory settings

- The configuration for the safety function is reset to factory settings.
- Communication beyond the device is not impaired.

Reseting whole device to factory settings

- The configuration for the safety function is reset to factory settings.
- The configuration of device communication is reset to factory settings (connections for configuration, safety function and data not relating to safety).

7.16.3 Managing passwords

Assigning or changing passwords

1. Establish a connection to the device.
2. In the device window, under **Service**, choose the entry **User password**.
3. Choose the user group in the **User password** dialog box.
4. Enter the new password twice and use **Accept** to confirm.
5. If you are requested to log in, log in as an **Authorized customer**.

✓ The new password is valid for the user group immediately.

Resetting a password

If you have forgotten a password, you can reset it.

1. Request the form for resetting your password from SICK support.
2. Connect to the device in Safety Designer.
3. In the device window, under **Service**, choose the entry **User password**.
4. Choose the **Reset password** option in the **User password** dialog box.
5. Transmit the serial number shown and the device counter together with the product number and the type code on the form to SICK support.

✓ You will then receive a reset code.

6. Enter the reset code under **Password reset** and use **Accept** to confirm.

✓ The passwords are reset to factory settings (SICKSAFE for an **authorized client**, no password for **machine operators**. It is not possible for **maintenance technicians** to log in). The configuration is not changed.

7.16.4 Optics cover calibration

Overview

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

Important information

WARNING

Incorrect reference value of optical properties

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

- Carry out an optics cover calibration with the Safety Designer every time the optics cover is replaced.
- Carry out the optics cover calibration at room temperature (10 °C to 30 °C).
- Only carry out the optics cover calibration using a new optics cover.
- Make sure that the entire system is clear of contamination when the adjustment is carried out.

Approach

1. Click on **Yes** in the **Replacement** column.
2. Check that the front screen is clean.
3. Click on **Confirm** in the **Cleanliness check** column.
4. Click on **Optics cover calibration** in the **Execute optics cover calibration** column.

✓ The calibration process starts. Typically, this process can take up to a minute. A progress bar shows the progress.

5. Do not switch off the safety laser scanner and do not break the connection between the computer and the safety laser scanner during the adjustment.

✓ The end of the calibration is shown.

8 Commissioning

8.1 Safety

WARNING
Hazard due to lack of effectiveness of the protective device

- ▶ Before commissioning the machine, make sure that the machine is first checked and released by qualified safety personnel.
- ▶ Only operate the machine with a perfectly functioning protective device.

DANGER
Dangerous state of the machine

During commissioning, the machine or the protective device may not yet behave as you have planned.

- ▶ Make sure that there is no-one in the hazardous area during commissioning.

DANGER
Hazard due to lack of effectiveness of the protective device

When changes are made to the machine, the effectiveness of the protective device may be affected unintentionally.

- ▶ After every change to the machine and changes to the integration or operational and secondary conditions of the safety laser scanner, check the protective device for effectiveness and recommission as specified in this chapter.

Before initial commissioning, project planning, mounting, electrical installation and configuration must be completed in accordance with the following chapters:

- "Project planning", page 25
- "Mounting", page 66
- "Electrical installation", page 72
- "Configuration", page 75

8.2 Alignment

The following options are available to you for precisely aligning the safety laser scanner using mounting kit 2a or 2b:

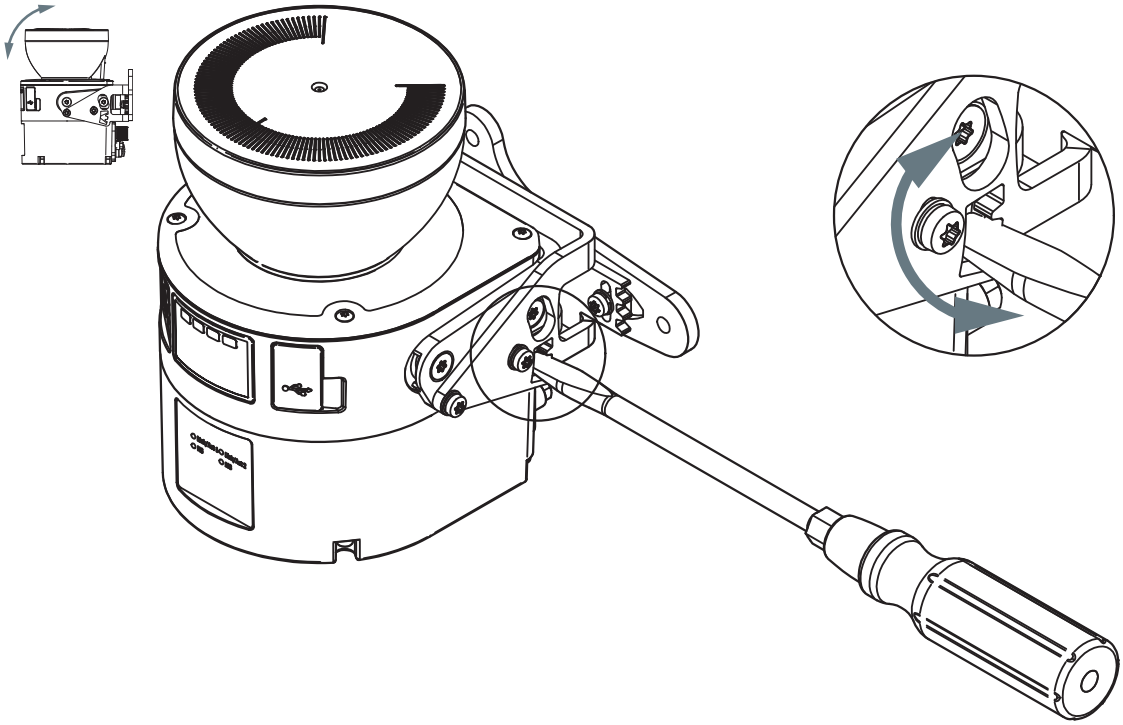


Figure 72: Alignment about the transverse axis

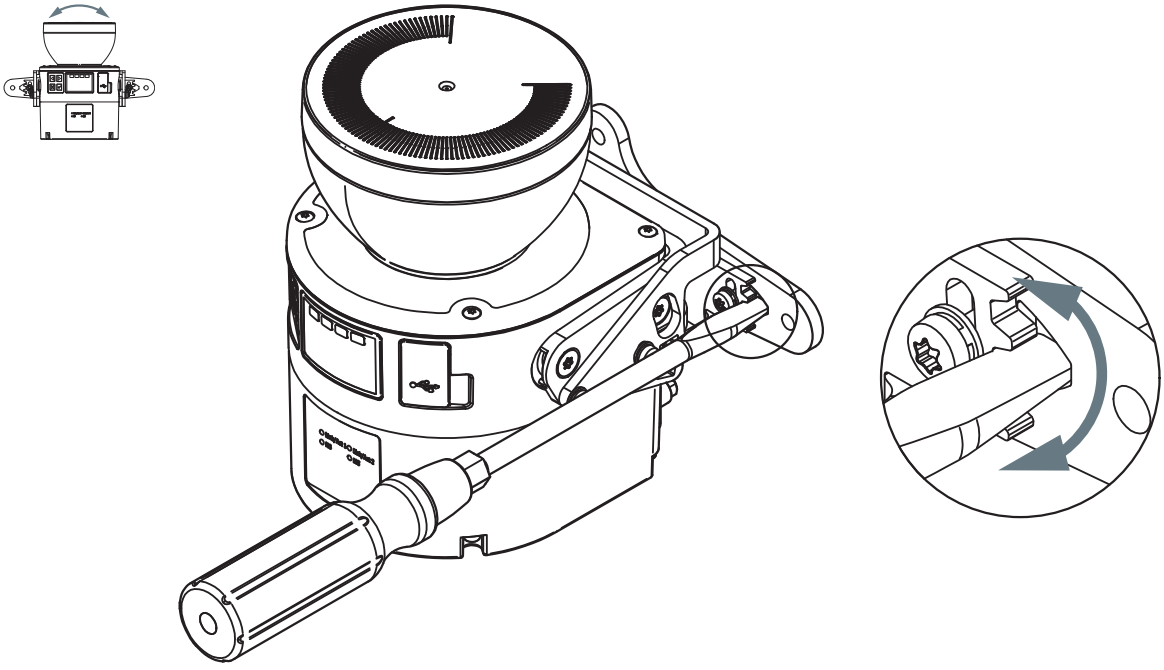


Figure 73: Alignment about the depth axis

▶ After alignment, tighten the screws with the specified tightening torque.

Further topics

- "Mounting using mounting kit 2", page 69

8.3 Switching on

After switching on, the safety laser scanner performs various internal tests. The OFF LED illuminates continually. The ON LED is off.

The start procedure lasts approx. 10 seconds.

When the start procedure is complete, the status LEDs and the display show the safety laser scanner's current operational status.

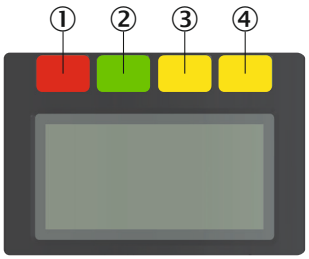


Figure 74: Status LEDs

Table 14: Status LEDs

Number	Function	Color	Meaning
①	OFF state	Red	Lights up red when the OSSD pair is in the OFF state.
②	ON state	Green	Lights up green when the OSSD pair is in the ON state.
③	Warning field	Yellow	Shines yellow if at least one warning field is interrupted.
④	Restart interlock	Yellow	Setup with reset: Flashes if the restart interlock has been triggered. Configuration with automated restart after a time: Lights up while the configured time to restart expires.

The OFF state and ON state light emitting diodes can be found in multiple locations on the safety laser scanner. 3 additional sets are arranged in pairs on the base of the optics cover. So the light emitting diodes can also be seen in many cases when it is not possible to see the display, e.g. due to the mounting situation or because it is hidden from the operator's position.

More information about what the light emitting diodes mean and the symbols and information shown on the display: see "Troubleshooting", page 131.

8.4 Thorough check

Requirements for the thorough check during commissioning and in certain situations

The protective device and its application must be thoroughly checked in the following situations:

- Before commissioning
- After changes to the configuration or the safety function
- After changes to the mounting, the alignment or the electrical connection
- After exceptional events, such as after manipulation has been detected, after modification of the machine, or after replacing components

The thorough check ensures the following:

- Compliance with all relevant regulations and effectiveness of the protective device for all of the machine's operating modes. This includes the following points:
  - compliance with standards
  - correct use of the protective device
  - suitable configuration and safety function
  - correct alignment

- The documentation matches the state of the machine, incl. the protective device
- The verified configuration report corresponds to the desired project planning (see "Verifying configuration", page 109)

The thorough checks must be carried out by qualified safety personnel or specially qualified and authorized personnel and must be documented in a traceable manner.

In many cases, other data must be documented, see "Reports", page 110.

Recommended thorough checks

In many cases, it makes sense to carry out the following thorough checks during commissioning and in certain situations:

- Thorough check of the relevant points on the checklist, see "Checklist for initial commissioning and commissioning", page 170
- "Thorough visual check of the machine and the protective device", page 65
- "Thorough check of the principal function of the protective device", page 63
- "Thorough check of the area to be protected", page 64
- "Test of the contour detection field", page 65
- Make sure that the operating personnel has been instructed in the protective device's function before starting work on the machine. The instruction is the responsibility of the machine operator and must be carried out by qualified personnel.

9 Operation

9.1 Safety

DANGER
Hazard due to lack of effectiveness of the protective device

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

- Maintenance work, alignment work, fault diagnoses, and any changes to the integration of the protective device in the machine must only be carried out by qualified personnel.
- The effectiveness of the protective device must be checked following such work.

NOTE
This document does not provide instructions for operating the machine in which the safety laser scanner is integrated.

9.2 Regular thorough check

The protective device must be checked regularly. The type and frequency of thorough checks is defined by the manufacturer and the operating entity of the machine, see "Testing plan", page 62.

The regular thorough checks serve to investigate the effectiveness of the protective device and detect any ineffectiveness due to modifications or external influences (such as damage or tampering).

- Carry out the thorough checks according to the instructions from the manufacturer and the machine operator.

9.3 LEDs

Figure 75: LEDs

① Status LEDs
② Additional LEDs for ON state and OFF state

4 status light emitting diodes are located directly above the display.

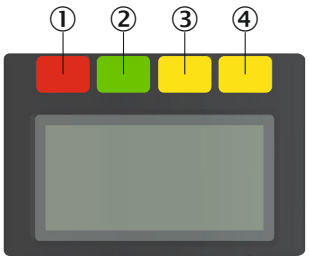


Figure 76: Status LEDs

Table 15: Status LEDs

Number	Function	Color	Meaning
①	OFF state	Red	Lights up red when the OSSD pair is in the OFF state.
②	ON state	Green	Lights up green when the OSSD pair is in the ON state.
③	Warning field	Yellow	Shines yellow if at least one warning field is interrupted.
④	Restart interlock	Yellow	Setup with reset: Flashes if the restart interlock has been triggered. Configuration with automated restart after a time: Lights up while the configured time to restart expires.

The OFF state and ON state light emitting diodes can be found in multiple locations on the safety laser scanner. 3 additional sets are arranged in pairs on the base of the optics cover. So the light emitting diodes can also be seen in many cases when it is not possible to see the display, e.g. due to the mounting situation or because it is hidden from the operator's position.

9.4 Buttons and display

The safety laser scanner is equipped with 4 pushbuttons and a graphical display. You can use the buttons to show information on the display and make simple settings.

NOTE

The display language is set using Safety Designer during configuration. The display language and the configuration cannot be changed using the buttons on the display.

Buttons

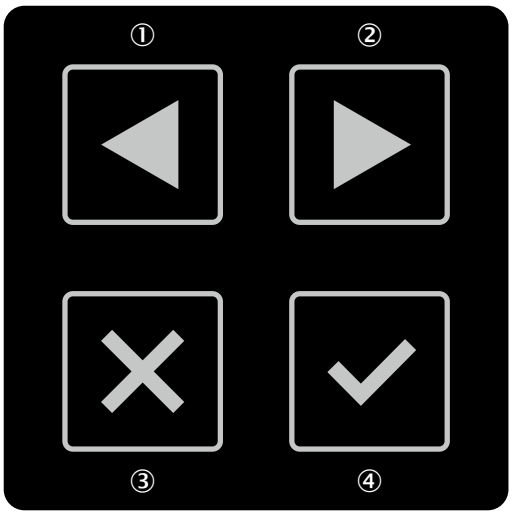


Figure 77: Pushbuttons on the device

①, ② You can use the arrow buttons to change between various displays and menu items.

③ You can use the back button to change to the previous display or a higher-level menu item.

④ You can use the OK button to show details for current information or confirm a menu point. Press the OK button twice to call up the menu.

If you do not press any pushbuttons for a time, the display changes back to the status display.

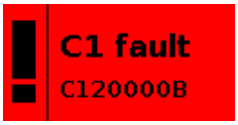
Status display

The display shows current information about the safety laser scanner's status. The display switches off after approx. 60 s if all fields are clear and no other notification is displayed.

- If the display is switched off, press any pushbutton to activate the display.
- Press any pushbutton to obtain more details about the displayed status information.
- If there are a number of pages with detailed information, this is shown in the top right of the display.
- Press the arrow buttons to change between a number of pages with detailed information.

Table 16: Overview of status information

Display	Device or configuration	Meaning
	All devices and configurations	All fields clear, OSSD pair in ON state. The number at bottom right indicates the active monitoring case.
	Devices with an OSSD pair	OSSD pair in OFF state.
	Configuration with restart interlock	Protective field is clear, reset can take place.

Display	Device or configuration	Meaning
	Configuration with restart interlock	Reset button pressed Safety output in the OFF state.
	Configuration with restart interlock	Reset button pressed Safety output in the ON state.
	Configuration with automated restart after a time	Protective field is clear, configured time to restart expires.
	Configuration with at least one warning field	Warning field interrupted (left column: number of interrupted warning fields, right column: number of warning fields in the current monitoring case).
 Display flashes	All devices and configurations	Fault. All safety outputs in the OFF state. Additional information: see "Fault display", page 136.
 Display flashes	All devices and configurations	Contamination warning. Check the optics cover for damage. Clean the optics cover.
 Display flashes	All devices and configurations	Contamination fault. All safety outputs in the OFF state. Check the optics cover for damage. Clean the optics cover.
 Display flashes	All devices and configurations	Dazzle warning. Check whether the safety laser scanner is being dazzled by an external light source in the scan plane, e.g., sun, halogen light, infrared light source, stroboscope. Remove or cover the light source.
 Display flashes	All devices and configurations	Dazzle error. All safety outputs in the OFF state. Check whether the safety laser scanner is being dazzled by an external light source in the scan plane, e.g., sun, halogen light, infrared light source, stroboscope. Remove or cover the light source.
 Display flashes	Configuration with external device monitoring (EDM)	Fault in the external device monitoring (EDM). OSSD pair in OFF state.

Display	Device or configuration	Meaning
 Display flashes	Configuration with reference contour field	Tamper protection. The safety laser scanner does not detect a contour in the set tolerance band. All safety outputs in the OFF state.
 Display flashes	All devices and configurations	Tamper protection. The safety laser scanner measures no values within the distance measurement range in an area of at least 90°. All safety outputs in the OFF state.
	All devices and configurations	Safety function stopped. All safety outputs in the OFF state. Restart the device using the keypad or Safety Designer.
	All devices and configurations	A valid input signal is not yet applied at the control inputs. All safety outputs in the OFF state. After switching on, the safety laser scanner waits for a valid input signal. During this time, an invalid input signal does not result in a fault.
	All devices	The device is not configured. The device is in the as-delivered state or has been reset to factory settings. All safety outputs in the OFF state.
	All devices and configurations	Sleep mode. All safety outputs in the OFF state. Press any pushbutton to obtain more information.

Menu

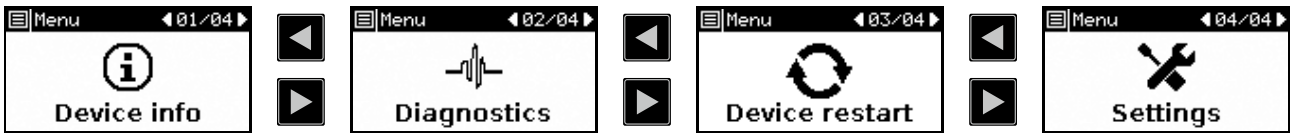


Figure 78: Menu

The menu offers access to the main areas of device information, diagnostics, device restart and settings.

- Press the OK pushbutton ④ twice in succession to call up the menu.
- Change to the desired menu point using the arrow buttons ①, ②.
- Confirm the desired menu point using the OK button ④.
- Use the same pushbuttons to navigate through the sub-menus.
- Press the back button ③ to return to the higher-level menu point.
- Press the back button ③ multiple times to return to the status display. If you do not press any pushbuttons for a time, the display likewise changes back to the status display.

Device information

You will find information about the following subjects in the **device information** area:

- Hardware: for example type code, part numbers, serial numbers, firmware versions, functional scope of device
- Configuration: for example device name, application name, checksum, date of last configuration, functional scope of the configuration

Diagnostics

You will find information about the following subjects in the **diagnostics** area:

- Intrusion history: position and time of the last 10 objects in a protective field that have led to a safety output switching to the OFF state.
- Message history: error code and error type of the last 10 error messages.
- Service: currently measured contamination of the optics cover, operating hours, number of power-up processes.

Device restart

You have the following options in the **device restart** area:

- Restart the safety laser scanner.

Settings

You have the following options in the **settings** area:

- Set the display brightness and contrast.

10 Maintenance

10.1 Safety

DANGER
Hazard due to lack of effectiveness of the protective device

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

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

10.2 Regular cleaning

Overview

Depending on the ambient conditions, the optics cover must be cleaned regularly and in the event of contamination. For example, static charges can cause dust particles to be attracted to the optics cover.

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

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

- Regularly check the degree of contamination on all components based on the application conditions.

DANGER
Hazard due to lack of effectiveness of the protective device

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

- Make sure that the optical properties of the optics cover are not changed by:
  - beading water, mist, frost, or ice formation. If necessary, remove any residues of this type or any other form of contamination and restart the safety laser scanner.
  - Damage. Replace damaged optics covers.
  - Substances containing oil or fat. Substances like this may impair the detection capability of the safety laser scanner. Therefore keep the optics cover free from substances containing oil or fat.

DANGER
Hazard due to unexpected starting of the machine

- Make sure that the dangerous state of the machine is and remains switched off during cleaning.
- Make sure that the safety laser scanner's outputs do not affect the machine during cleaning.

NOTICE

- Do not use aggressive or abrasive cleaning agents.
- Recommendation: Use anti-static cleaning agents.
- Recommendation: Use anti-static plastic cleaners and lens cloths from SICK.

Approach

Cleaning the optics cover

1. Remove dust from the optics cover using a soft, clean brush.
2. Moisten a clean, soft towel with anti-static plastic cleaner and use it to wipe the optics cover.
3. Check the effectiveness of the protective device, see "Thorough check of the principal function of the protective device", page 63.

Complementary information

NOTE

The display shows a contamination warning if the optics cover is contaminated and needs to be cleaned soon. If it is not cleaned and the contamination continues to increase, the safety laser scanner switches to the OFF state for safety reasons and the display shows a contamination fault.

- Check the optics cover for damage.
- Clean the optics cover in a timely manner.

Further topics

- "Spare parts", page 159
- "Accessories", page 160

10.3 Replacing the optics cover

If the optics cover is scratched or damaged, it must be replaced.

You can order the replacement optics cover from SICK (see "Spare parts", page 159).

Important information

WARNING

Incorrect reference value of optical properties

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

- Carry out an optics cover calibration with the Safety Designer every time the optics cover is replaced.
- Carry out the optics cover calibration at room temperature (10 °C to 30 °C).
- Only carry out the optics cover calibration using a new optics cover.
- Make sure that the entire system is clear of contamination when the adjustment is carried out.

NOTICE

- The optics cover of the safety laser scanner is an optical component. Make sure that the optics cover does not become dirty or scratched during unpacking and mounting. Prevent fingerprints on the optics cover. Wear the gloves supplied with the new optics cover during replacement.
- Replace the optics cover in an environment free of dust and dirt.
- Never replace the optics cover during continuous operation, as dust particles could penetrate into the safety laser scanner.
- Avoid soiling the inside of the optics cover, e.g, by fingerprints.
- Do not use any additional sealant, such as silicone, for sealing the optics cover. Any vapors that are created may damage the optical components.
- Mount the optics cover according to the following instructions to ensure IP65 leak tightness of the housing.
- Only use a new optics cover as a replacement.
- Provide ESD protection when replacing the optics cover.

NOTICE

Enclosure rating IP65 only applies if the safety laser scanner is closed and the system plug is mounted.

Replace the optics cover as follows:

Tool required:

- TX10 torque wrench

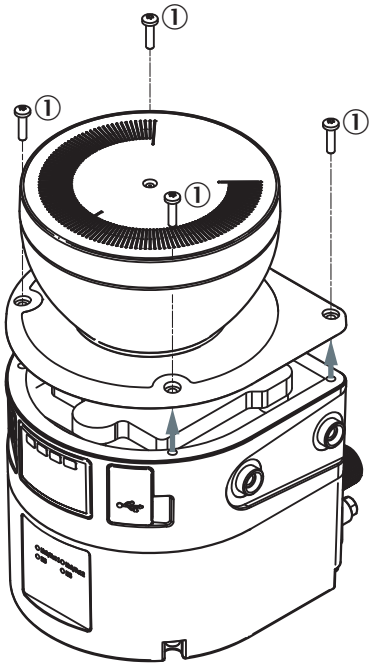


Figure 79: Fixing screws for the optics cover

① Fixing screw

1. Make sure that the environment is clean and clear of fog, moisture, and dust.
2. First, clean the safety laser scanner from the outside, so that no foreign bodies penetrate into the open device.
3. Unscrew the fixing screws for the optics cover.

4. Slowly and carefully detach the optics cover from the safety laser scanner. If the optics cover's seal sticks to the safety laser scanner, carefully detach the optics cover using a screwdriver.
5. If necessary, remove contamination from the sealing groove and the bearing surface of the safety laser scanner. Use residue-free plastic cleaner (see "Cleaning agent", page 163).
6. Check whether the mirror on the motor is dirty and, if necessary, remove dirt using an optic brush.
7. Set 1.0 Nm ... 1.2 Nm tightening torque on the torque wrench.
8. During the following steps, wear the gloves supplied with the new optics cover.
9. Take the new optics cover out of the packaging and remove the seal's protective cap.
10. Remove any packaging residue if necessary.
11. Carefully push the optics cover over the mirror. Make sure that the optics cover does not touch the mirror.
12. Place the optics cover onto the safety laser scanner. Make sure that the optics cover rests over the whole area without any gaps.
13. Screw in new fixing screws, see figure 79, page 126.
14. Tighten the screws using the set tightening torque.
15. Make sure that the optics cover is clear of dirt and damage.

Recommission the safety laser scanner as follows

1. Properly remount the safety laser scanner, see "Mounting", page 66.
2. Recreate all of the electrical connections to the safety laser scanner.
3. Carry out the optics cover calibration, see "Optics cover calibration", page 113.
4. Start the safety function using Safety Designer, see "Starting and stopping safety function", page 110.
5. Check the effectiveness of the protective device.
   - Generally, the protective device is checked exactly as during commissioning, see "Thorough check", page 116.
   - If, during project planning, the possible tolerances of the devices have been considered and it is ensured that neither the configuration nor the wiring or the alignment of the safety laser scanner have been changed, a function test is sufficient, see "Thorough check of the principal function of the protective device", page 63.

10.4 Replacing the safety laser scanner

If the safety laser scanner is damaged or defective, you must replace it.

DANGER
Hazard due to lack of effectiveness of the protective device

If an unsuitable configuration is saved in the system plug, it may cause the dangerous state to not end in time.

- ▶ After replacement, make sure the same system plug is used or the configuration is restored.
- ▶ Make sure that the safety laser scanner is aligned correctly after the replacement.

NOTICE
Enclosure rating IP65 only applies if the safety laser scanner is closed and the system plug is mounted.

NOTICE
If the system plug is mounted with excessive force, the contacts can break or bend.

- ▶ Plug in the system plug carefully.
- ▶ Do not force it.

Tool required:
- TX10 Torx wrench
- TX20 Torx wrench

10.4.1 Replacing the safety laser scanner without system plug

In many cases, you can reuse the existing bracket and the existing system plug. Detach the defective safety laser scanner from the bracket and the system plug. Then, mount the new safety laser scanner on the bracket and the system plug. When the new safety laser scanner is switched on for the first time, it reads the configuration from the system plug and can be used without having to be reconfigured.

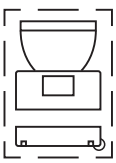
Approach

1. Make sure that the environment is clean and clear of fog, moisture, and dust.
2. Unscrew screws in the system plug and remove the system plug from the defective safety laser scanner.
3. Unscrew the fixing screws and remove the defective safety laser scanner.
4. Mount the system plug on the new safety laser scanner, see "Replacing the system plug", page 129.
5. Mount the new safety laser scanner, see "Mounting", page 66.
6. Check the effectiveness of the protective device.
   - Generally, the protective device is checked exactly as during commissioning, see "Thorough check", page 116.
   - If, during project planning, the possible tolerances of the devices have been considered and it is ensured that neither the configuration nor the wiring or the alignment of the safety laser scanner have been changed, a function test is sufficient, see "Thorough check of the principal function of the protective device", page 63.

NOTE
In certain cases (in the event of dust, high air humidity), it may make sense not to disconnect the system plug and the safety laser scanner initially. In these cases, proceed as follows:

1. Disconnect the connecting cables the system plug.
2. Unscrew screws from the bracket and remove the defective safety laser scanner from the bracket.
3. Move the safety laser scanner with the system plug to a clean location (e.g. office, maintenance areas).
4. Unscrew screws in the system plug and remove the system plug from the defective safety laser scanner.
5. See above for further steps.

10.4.2 Completely replacing the safety laser scanner



1. Disconnect the connecting cables the system plug.
2. Unscrew the fixing screws and remove the defective safety laser scanner.
3. Mount the new safety laser scanner, see "Mounting", page 66.
4. Reconnect the connecting cables to the system plug.

5. Configure the safety laser scanner, see "Configuration", page 75.
6. Perform commissioning again, taking particular care to conduct all of the thorough checks described, see "Commissioning", page 114.

10.5 Replacing the system plug

If the system plug is damaged or defective, you must replace it.

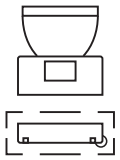
NOTICE
Enclosure rating IP65 only applies if the safety laser scanner is closed and the system plug is mounted.

NOTICE
If the system plug is mounted with excessive force, the contacts can break or bend.

- ▶ Plug in the system plug carefully.
- ▶ Do not force it.

Tool required:
- TX10 Torx wrench

Approach



1. Make sure that the environment is clean and clear of fog, moisture, and dust.
2. Disconnect the connecting cables from the system plug.
3. If necessary: move the safety laser scanner to a clean location.
4. Unscrew screws in the defective system plug and remove the system plug from the safety laser scanner.
5. Make sure that the seal is seated correctly (①).
6. Carefully place the new system plug onto the safety laser scanner at the back (②).
7. Carefully fold the system plug onto the safety laser scanner (③).
8. Screw in the system plug using the captive screws. Tightening torque: 1.4 Nm.
9. Reconnect the connecting cables to the system plug.
10. Configure the safety laser scanner, see "Configuration", page 75.
11. Perform commissioning again, see "Commissioning", page 114. In particular, carry out all of the described thorough checks, see "Thorough check", page 116.

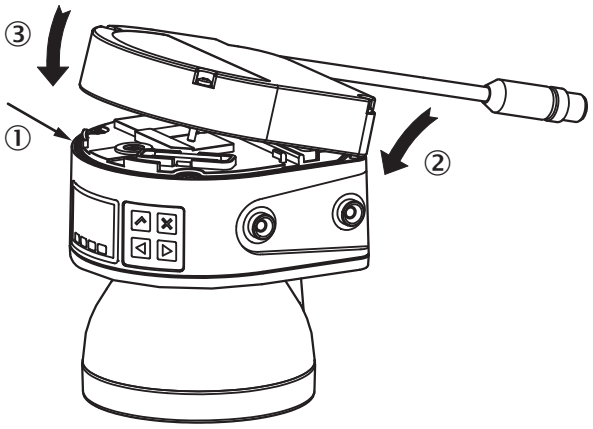


Figure 80: Installing the system plug on the safety laser scanner

10.6 Regular thorough check

The protective device must be checked regularly. The type and frequency of thorough checks is defined by the manufacturer and the operating entity of the machine, see "Testing plan", page 62.

The regular thorough checks serve to investigate the effectiveness of the protective device and detect any ineffectiveness due to modifications or external influences (such as damage or tampering).

- Carry out the thorough checks according to the instructions from the manufacturer and the machine operator.

11 Troubleshooting

11.1 Safety

DANGER
Hazard due to lack of effectiveness of the protective device

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

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

DANGER
Hazard due to unexpected starting of the machine

- When any work is taking place, use the protective device to secure the machine or to ensure that the machine is not switched on unintentionally.

DANGER
Hazard due to lack of effectiveness of the protective device

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

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

NOTE
Additional information on troubleshooting can be found at the responsible SICK subsidiary.

11.2 Diagnostic LEDs

The safety laser scanner has diagnostic LEDs for initial diagnostics.

Every safety laser scanner has 4 status light emitting diodes above the display.

11.2.1 Status LEDs

4 status light emitting diodes are located directly above the display.

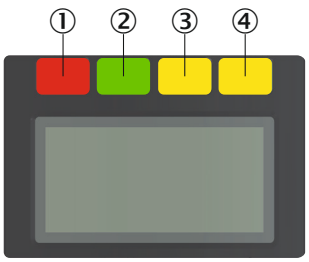


Figure 81: Status LEDs

Table 17: Status LEDs

Number	Function	Color	Meaning
①	OFF state	Red	Lights up red when the OSSD pair is in the OFF state.
②	ON state	Green	Lights up green when the OSSD pair is in the ON state.
③	Warning field	Yellow	Shines yellow if at least one warning field is interrupted.
④	Restart interlock	Yellow	Setup with reset: Flashes if the restart interlock has been triggered. Configuration with automated restart after a time: Lights up while the configured time to restart expires.

The OFF state and ON state light emitting diodes can be found in multiple locations on the safety laser scanner. 3 additional sets are arranged in pairs on the base of the optics cover. So the light emitting diodes can also be seen in many cases when it is not possible to see the display, e.g. due to the mounting situation or because it is hidden from the operator's position.

11.3 Diagnostics using the display

The display supplies information about the status of the safety laser scanner, and for diagnostics and troubleshooting.

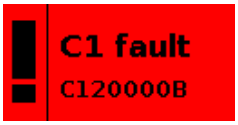
11.3.1 Status display

The display shows current information about the safety laser scanner's status. The display switches off after approx. 60 s if all fields are clear and no other notification is displayed.

- If the display is switched off, press any pushbutton to activate the display.
- Press any pushbutton to obtain more details about the displayed status information.
- If there are a number of pages with detailed information, this is shown in the top right of the display.
- Press the arrow buttons to change between a number of pages with detailed information.

Table 18: Overview of status information

Display	Device or configuration	Meaning
	All devices and configurations	All fields clear, OSSD pair in ON state. The number at bottom right indicates the active monitoring case.
	Devices with an OSSD pair	OSSD pair in OFF state.
	Configuration with restart interlock	Protective field is clear, reset can take place.

Display	Device or configuration	Meaning
	Configuration with restart interlock	Reset button pressed Safety output in the OFF state.
	Configuration with restart interlock	Reset button pressed Safety output in the ON state.
	Configuration with automated restart after a time	Protective field is clear, configured time to restart expires.
	Configuration with at least one warning field	Warning field interrupted (left column: number of interrupted warning fields, right column: number of warning fields in the current monitoring case).
 Display flashes	All devices and configurations	Fault. All safety outputs in the OFF state. Additional information: see "Fault display", page 136.
 Display flashes	All devices and configurations	Contamination warning. Check the optics cover for damage. Clean the optics cover.
 Display flashes	All devices and configurations	Contamination fault. All safety outputs in the OFF state. Check the optics cover for damage. Clean the optics cover.
 Display flashes	All devices and configurations	Dazzle warning. Check whether the safety laser scanner is being dazzled by an external light source in the scan plane, e.g., sun, halogen light, infrared light source, stroboscope. Remove or cover the light source.
 Display flashes	All devices and configurations	Dazzle error. All safety outputs in the OFF state. Check whether the safety laser scanner is being dazzled by an external light source in the scan plane, e.g., sun, halogen light, infrared light source, stroboscope. Remove or cover the light source.
 Display flashes	Configuration with external device monitoring (EDM)	Fault in the external device monitoring (EDM). OSSD pair in OFF state.

Display	Device or configuration	Meaning
 Display flashes	Configuration with reference contour field	Tamper protection. The safety laser scanner does not detect a contour in the set tolerance band. All safety outputs in the OFF state.
 Display flashes	All devices and configurations	Tamper protection. The safety laser scanner measures no values within the distance measurement range in an area of at least 90°. All safety outputs in the OFF state.
	All devices and configurations	Safety function stopped. All safety outputs in the OFF state. Restart the device using the keypad or Safety Designer.
	All devices and configurations	A valid input signal is not yet applied at the control inputs. All safety outputs in the OFF state. After switching on, the safety laser scanner waits for a valid input signal. During this time, an invalid input signal does not result in a fault.
	All devices	The device is not configured. The device is in the as-delivered state or has been reset to factory settings. All safety outputs in the OFF state.
	All devices and configurations	Sleep mode. All safety outputs in the OFF state. Press any pushbutton to obtain more information.

11.3.2 Detailed diagnostics

The safety laser scanner is equipped with 4 pushbuttons and a graphical display. You can use the buttons to show information on the display and make simple settings.

NOTE

The display language is set using Safety Designer during configuration. The display language and the configuration cannot be changed using the buttons on the display.

Buttons

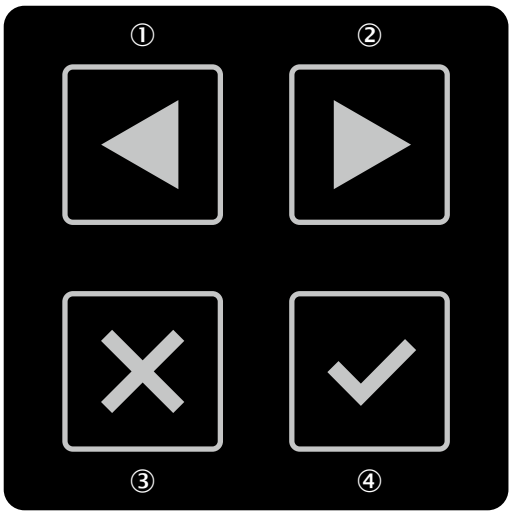


Figure 82: Pushbuttons on the device

①, ② You can use the arrow buttons to change between various displays and menu items.

③ You can use the back button to change to the previous display or a higher-level menu item.

④ You can use the OK button to show details for current information or confirm a menu point. Press the OK button twice to call up the menu.

If you do not press any pushbuttons for a time, the display changes back to the status display.

Menu

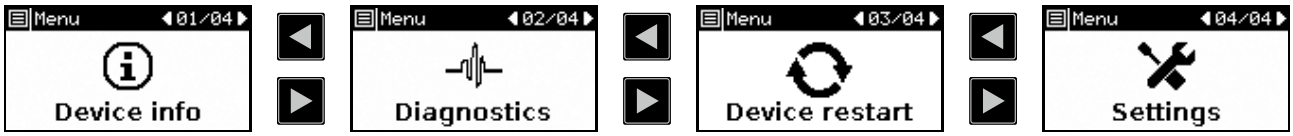


Figure 83: Menu

The menu offers access to the main areas of device information, diagnostics, device restart and settings.

- ▶ Press the OK pushbutton ④ twice in succession to call up the menu.
- ▶ Change to the desired menu point using the arrow buttons ①, ②.
- ▶ Confirm the desired menu point using the OK button ④.
- ▶ Use the same pushbuttons to navigate through the sub-menus.
- ▶ Press the back button ③ to return to the higher-level menu point.
- ▶ Press the back button ③ multiple times to return to the status display. If you do not press any pushbuttons for a time, the display likewise changes back to the status display.

Device information

You will find information about the following subjects in the **device information** area:

- Hardware: for example type code, part numbers, serial numbers, firmware versions, functional scope of device
- Configuration: for example device name, application name, checksum, date of last configuration, functional scope of the configuration

The **Functionality of the device** and **Functionality of the configuration** show whether a configuration is compatible with the firmware version of a device. This can be important when exchanging a device, for example.

Configuration and firmware version of a device are compatible if the following conditions are met:

- The 1st place of both numbers must be identical
- The 2nd place for the device must be at least as large as that for the configuration
- The 3rd place does not have an effect on the compatibility

Diagnostics

You will find information about the following subjects in the **diagnostics** area:

- Intrusion history: position and time of the last 10 objects in a protective field that have led to a safety output switching to the OFF state.
- Message history: error code and error type of the last 10 error messages.
- Service: currently measured contamination of the optics cover, operating hours, number of power-up processes.

Device restart

You have the following options in the **device restart** area:

- Restart the safety laser scanner.

Settings

You have the following options in the **settings** area:

- Set the display brightness and contrast.

11.3.3 Fault display

If there is a fault, the display shows a warning symbol, a type of fault and a fault code on a red flashing background.

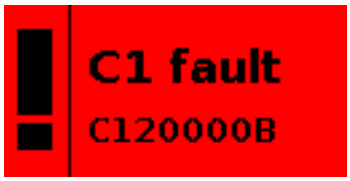


Figure 84: Fault display

- The two-character fault type will help you during troubleshooting.
- The eight-character fault code in the bottom line helps SICK support during the detailed fault analysis.

▶ By pressing any pushbutton, you will obtain more information about the fault and for troubleshooting. You can use the arrow buttons to change to further pages with additional information.

▶ You will find an overview of the two-character fault types and what they mean in the following table.

▶ You will find detailed information in Safety Designer's message history about the individual faults and information about events not shown by the display.

Table 19: Fault types

Fault type	Brief description	Cause	Troubleshooting
C1	Faulty configuration	The configuration is faulty.	▶ Reconfigure the device.

Fault type	Brief description	Cause	Troubleshooting
C2	Incompatible configuration	The configuration in the system plug does not match the device's functionality.	▶ Check device variant. ▶ Replace or reconfigure the device.
C3	Incompatible firmware	The configuration in the system plug does not match the device's firmware version.	▶ Check the firmware version of the device. ▶ Replace or reconfigure the device.
E1	Fault in the safety laser scanner	The safety laser scanner has an internal fault.	▶ Perform a device restart using the display or Safety Designer or interrupt the voltage supply for at least two seconds. ▶ Replace the safety laser scanner and send it to the manufacturer for repair.
E2	Fault in the system plug	The system plug has an internal fault.	▶ Perform a device restart using the display or Safety Designer or interrupt the voltage supply for at least two seconds. ▶ Replace the system plug.
E3	Fault in the system plug	The system plug has an internal fault.	▶ Perform a device restart using the display or Safety Designer or interrupt the voltage supply for at least two seconds. ▶ Replace the system plug.
E4	Incompatible system plug	The system plug is unsuitable for the safety laser scanner.	▶ Check part number or type code. ▶ Replace the system plug.
F1	Current too high at an OSSD	The current is too high at an OSSD. The limit has been exceeded for current allowed short-term or permanently.	▶ Check the connected switching element.
F2	OSSD short-circuit to 24 V	There is a short-circuit to 24 V at an OSSD.	▶ Check the wiring.
F3	OSSD short-circuit to 0 V	There is a short-circuit to 0 V at an OSSD.	▶ Check the wiring.
F4	Short-circuit between 2 OSSDs	There is a short-circuit between 2 OSSDs.	▶ Check the wiring.
F9	General OSSD fault	At least one OSSD is showing unexpected behavior.	▶ Check the wiring of the OSSDs.
L2	Invalid configuration of the external device monitoring (EDM)	The configuration of the external device monitoring (EDM) is invalid. The configuration is unsuitable for the wiring.	▶ Check whether the external device monitoring is connected correctly. ▶ Use Safety Designer to check the configuration.
L3	Fault in the external device monitoring (EDM)	A faulty signal is applied at the external device monitoring (EDM). The allowed tolerance time has been exceeded.	▶ Check whether the connectors are wired correctly and operating correctly.
L8	Fault in the reset input	An invalid signal is applied at a reset input. The reset signal is applied for too long.	▶ Check the reset pushbutton, the wiring, and any other components affected.
L9	Short-circuit at the reset input	Exactly the same signal is applied at a reset input as at another input, an OSSD or an output. There is possibly a short-circuit.	▶ Check the wiring for cross-circuits.

Fault type	Brief description	Cause	Troubleshooting
N1	Invalid input signal	The signal applied at the control inputs is not assigned to a monitoring case. The signal is applied for longer than the set input delay +1 s.	▶ Check the configuration with Safety Designer. ▶ Check the working process of the machine.
N2	Incorrect switching sequence	The configured switching sequence was interrupted by the new monitoring case.	▶ Check the machine's work process. ▶ Change the configured switching sequence monitoring.
N3	Invalid input signal	The signal applied at the static control inputs does not match the complementary condition. The signal is applied for longer than 1 s.	▶ Check the control of the control inputs.
T1	Temperature error	The Safety laser scanner's operating temperature has exceeded or fallen below the permitted range.	▶ Check whether the safety laser scanner is being operated in accordance with the permissible ambient conditions.
W1	Warnings exceed tolerance time	The combination of multiple warnings has resulted in a fault. The tolerance time of 1 s has been exceeded as there are multiple warnings.	▶ Use Safety Designer to check what warnings exist.

11.4 Diagnostics using Safety Designer

The following diagnostics tools are available in the device window:

- Data recorder
- Event history
- Message history

The following interfaces are suitable for diagnostics:

- USB 2.0 mini-B (female connector) [6)]

6) The USB connection may only be used temporarily and only for configuration and diagnostics.

11.4.1 Data recorder

Overview

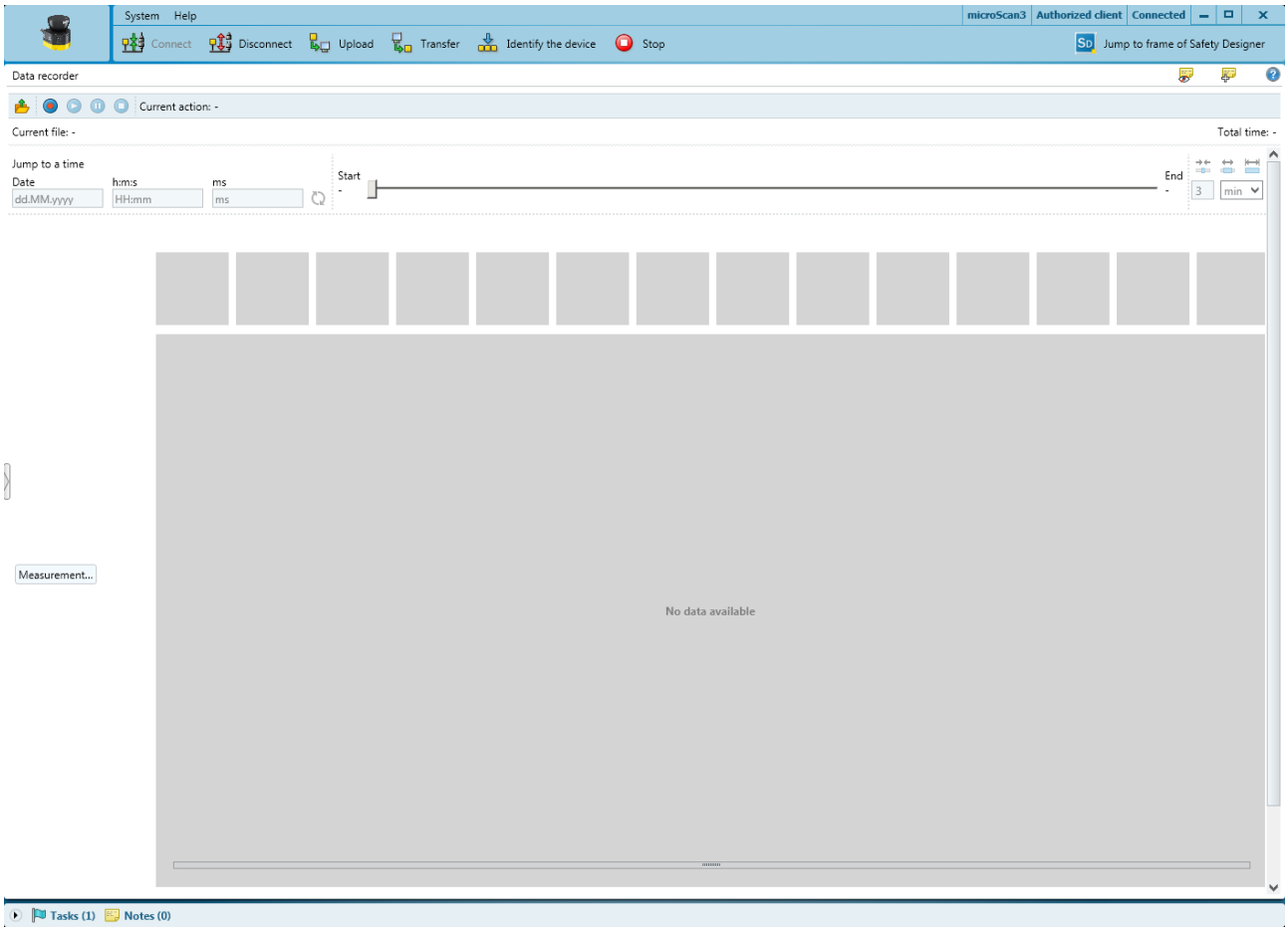


Figure 85: Data recorder

You can use the data recorder to record the device's signals continuously. The measurement data are not transmitted and shown for every scan cycle, depending on the interface and your capacity.

The data is saved in a data recorder diagnostics file.

The data recorder diagnostics file can be run in the data recorder.

Settings can be made in the safety designer frame.

Start recording

Stop recording

Typical applications

- Check spatial geometry
- Check where a person can stay or when a person is detected
- Check input information about the current monitoring case
- Check why safety outputs have switched

Prerequisites

- Existing connection between Safety Designer and device
- Configuration in the project and configuration in the device are synchronized

Approach

1. Import configuration from the device.
2. Take an image.

11.4.2 Event history

Overview

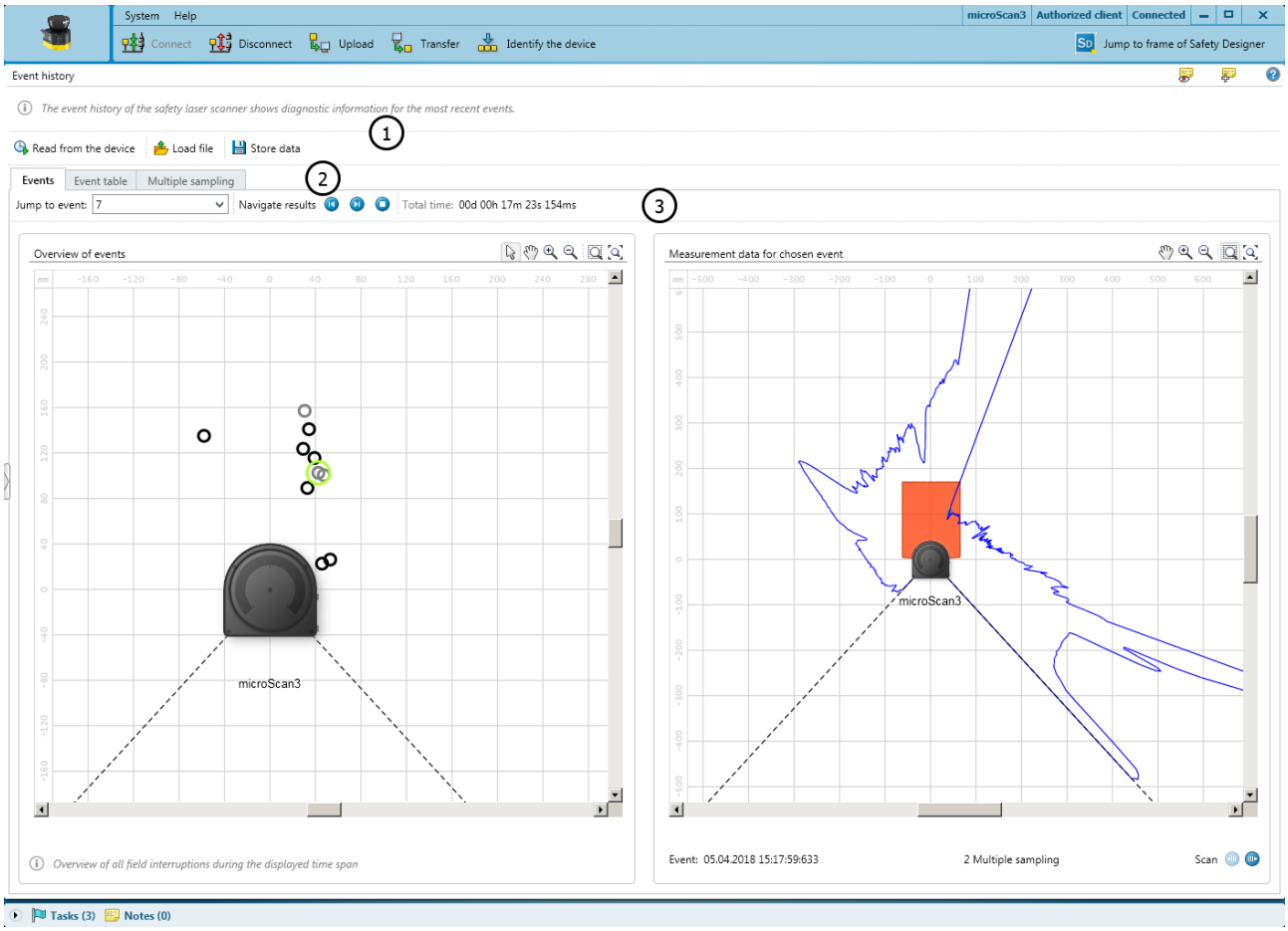


Figure 86: Event history

① Data source
② Available views
③ Navigation

The safety laser scanner stores data on important events. The event history displays information about the most recently stored events.

Event memory in the safety laser scanner

The safety laser scanner stores data on the following events:

- Safety output switches to the OFF state
- The protective field, the reference contour field or the contour identification field is interrupted

For each field interruption where a safety output switches to the OFF state, the safety laser scanner stores the data from 10 scans. When the internal memory of the safety laser scanner is full, the scan data of the oldest field interruption is overwritten to store a new field interruption. The position and time of the field interruption are retained.

The internal memory of the safety laser scanner is emptied when it is restarted.

Data source

- Read from the device: Available only when a device is connected. The data stored in the device will be read.
- Load file: You can open a file that stores events that were previously read from a device.
- Save Data: You can save the events read from a device to a file for later analysis.

Events

The **Events** view shows a graphical overview of the interrupts of protection fields, reference contours, and contingency identifiers, which have led to a safety output switched to the OFF state.

- Navigation: You can select the event whose measurement data is displayed in the right area.
- Overview of events: The position of each recorded field interruption relative to the safety laser scanner is displayed. If you hold the mouse pointer on a position, the set multiple sampling is displayed. When you click a position, the corresponding measurement data are displayed in the right-hand area.
- Measurement data for the selected event: The measurement data of the selected field interruption is displayed. If multiple scans are stored for the selected field interruption, you can view the individual scans one by one by clicking the icons next to **Scan**.

Event table

The event table shows detailed information about the events which have led to a safety output switching to the OFF state.

Based on the measurement data, a probable cause is assigned to each event:

- Object: The protective field was probably interrupted by an object.
- Contour: A reference contour field or a contour identification field has been interrupted.
- Contamination: The shutdown was triggered by a soiling of the optics cover in the area of the protective field.
- Dazzling: The shutdown was triggered by an external light source in the scan plane in the area of the protective field, e.g., sun, halogen light, infrared light source, stroboscope.
- Near the edge of the field or particles in the field: The protective field was probably interrupted at the edge or by particles.

Multiple sampling

The **Multiple sampling** view shows how frequently field interruptions with different durations have occurred. All interruptions of protective fields, reference contour fields and contour identification fields are taken into account. Therefore, the number of entries in this view may deviate from the other views.

The duration is specified as the number of successive scans in which a field is interrupted. For each duration, the diagram shows the corresponding number of field interruptions.

11.4.3 Message history

Overview

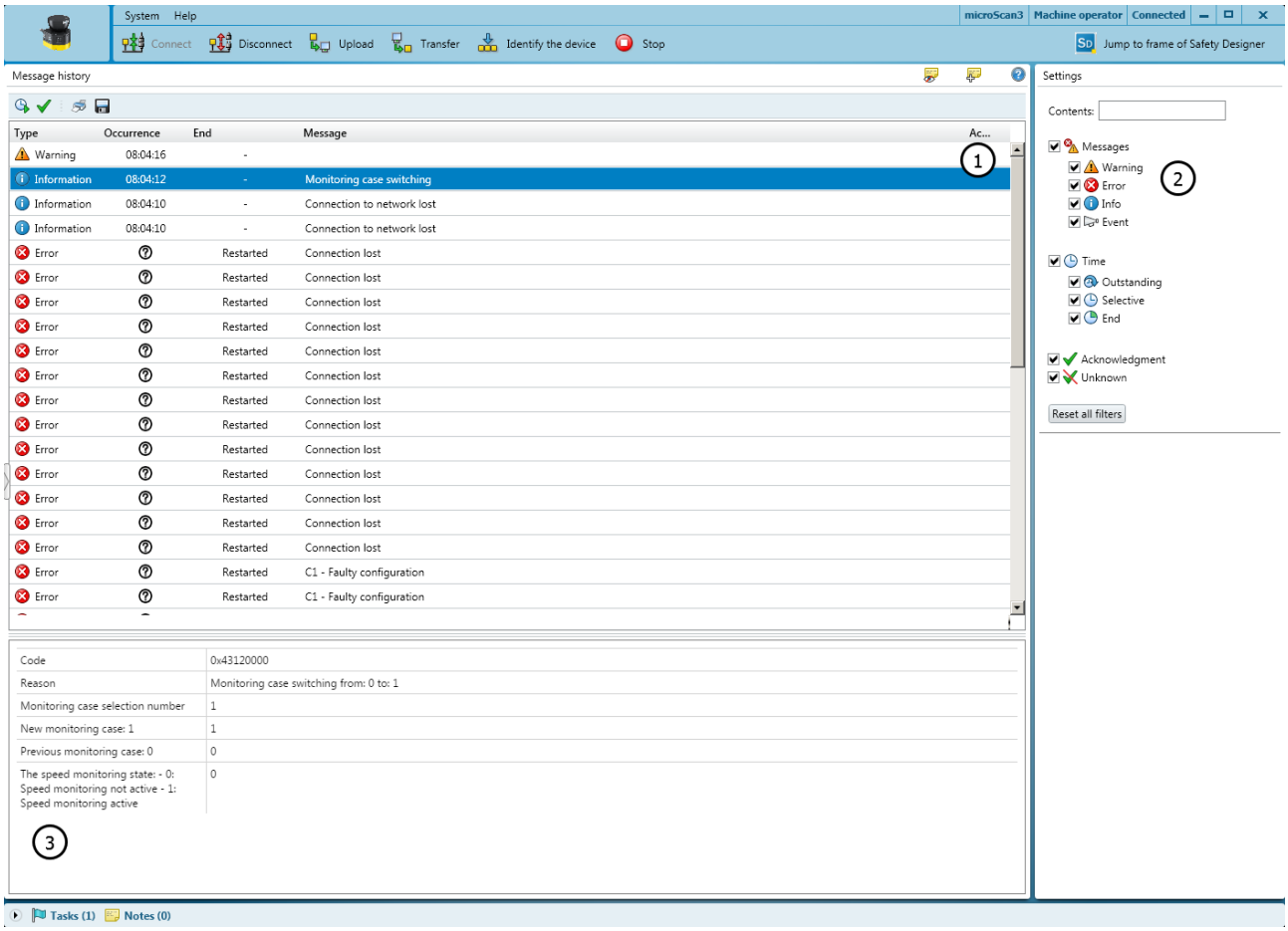


Figure 87: Message history

① Message history

② Display filter

③ Details about the selected message

All events, such as faults, warnings and information are stored in the message history.

By right-clicking on the table header, you can select the columns displayed in the message history.

Safety Designer shows details about the events in the bottom part of the window, ways to solve them are also shown.

Table 20: Print message history or save as a PDF

	Print message history
	Save message history as a PDF

12 Decommissioning

12.1 Disposal

Approach

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

Complementary information

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

13 Technical data

13.1 Variant overview

Ordering information: see "Ordering information", page 158.

Table 21: Devices and type codes

Performance package Integration in the control	Protective field range	Device without system plug	System plug	Device with system plug
• Core • I/O	≤ 4.0 m	MICS3-AAAZ40AZ1	MICSX-ABIZZZZZ1	MICS3-AAAZ40AZ1P01
	≤ 5.5 m	MICS3-AAAZ55AZ1		MICS3-AAAZ55AZ1P01
	≤ 9.0 m	MICS3-AAAZ90AZ1		MICS3-AAAZ90AZ1P01

13.2 Version numbers and functional scope

Functional scope

Older devices might not support the full functional scope of the latest Safety Designer.

To identify the different levels of the functionality, we use a 3-digit version number. The version number is marked with the letter V on the device.

The functional scope of the device can be read at the following locations:

- Label on the device
- Display, entry in the menu **Device information** under **Hardware**
- Safety Designer, **Overview** dialog box (only with connected devices)
- Safety Designer, report

Table 22: Functional scope of the microScan3 Core I/O (devices with a max. protective field range of 4.0 m and devices with max. protective field range of 5.5 m)

Version number	Amendments and new functions
1.0.0	• First published version
1.1.0	• Improved separation of the checksum from the Safety Designer version

Table 23: Functional scope of the microScan3 Core I/O (devices with a max. protective field range of 9.0 m)

Version number	Amendments and new functions
1.0.0	• First published version (incl. improved separation of the checksum from the Safety Designer version)

Revision

In some cases, new system plugs are not suitable for older devices.

The different revision statuses of the devices are identified by “Rev” followed by a three-digit version number. New devices have a label which indicates the revision status.

New system plugs have a label which indicates the devices for which they are suitable.

Table 24: Compatibility

Label on the device	Label on the system plug	Compatible
–	–	Yes
–	Only compatible with Rev ≥ 1.1.0	Information is available from your SICK subsidiary.
Rev 1.1.0	–	Yes

Label on the device	Label on the system plug	Compatible
Rev 1.1.0	Only compatible with Rev ≥ 1.1.0	Yes
Rev 1.2.0	–	Yes
Rev 1.2.0	Only compatible with Rev ≥ 1.1.0	Yes

13.3 Data sheet

13.3.1 microScan3 Core I/O

Features

Table 25: Features

	microScan3 Core I/O
Protective field range	
Devices with a max. protective field range of 4.0 m	≤ 4.0 m, details: see "Sensing range", page 152
Devices with a max. protective field range of 5.5 m	≤ 5.5 m, details: see "Sensing range", page 152
Devices with a max. protective field range of 9.0 m	≤ 9.0 m, details: see "Sensing range", page 152
Scanning range of the reference contour field	Same as protective field range, see "Sensing range", page 152
Scanning range of the contour detection field	Same as protective field range, see "Sensing range", page 152
Warning field range	
Devices with a max. protective field range of 4.0 m	≤ 40 m
Devices with a max. protective field range of 5.5 m	≤ 40 m
Devices with a max. protective field range of 9.0 m	≤ 64 m
Distance measurement range	
Devices with a max. protective field range of 4.0 m	≤ 40 m
Devices with a max. protective field range of 5.5 m	≤ 40 m
Devices with a max. protective field range of 9.0 m	≤ 64 m
Fields	≤ 8
Simultaneously monitored fields	≤ 4
Field sets	≤ 8
Monitoring cases	≤ 2
Scanning angle	275° (–47.5° ... 227.5°)
Protective field resolution	30 mm, 40 mm, 50 mm, 60 mm, 70 mm, 150 mm, 200 mm [1)]
Angular resolution	
Devices with a max. protective field range of 4.0 m	
Scan cycle time 30 ms	0.51°

	microScan3 Core I/O
Scan cycle time 40 ms	0.39°
Devices with a max. protective field range of 5.5 m	
Scan cycle time 30 ms	0.51°
Scan cycle time 40 ms	0.39°
Devices with a max. protective field range of 9.0 m	
Scan cycle time 40 ms	0.125°
Scan cycle time 50 ms	0.1°
Response time	
Devices with a max. protective field range of 4.0 m	≥ 70 ms, details: see "Response times", page 150
Devices with a max. protective field range of 5.5 m	≥ 70 ms, details: see "Response times", page 150
Devices with a max. protective field range of 9.0 m	≥ 90 ms, details: see "Response times", page 150
Scan cycle time	
Devices with a max. protective field range of 4.0 m	30 ms or 40 ms (adjustable)
Devices with a max. protective field range of 5.5 m	30 ms or 40 ms (adjustable)
Devices with a max. protective field range of 9.0 m	40 ms or 50 ms (adjustable)
Generally necessary protective field supplement (TZ = tolerance range of the safety laser scanner)	
Devices with a max. protective field range of 4.0 m	65 mm
Devices with a max. protective field range of 5.5 m	65 mm
Devices with a max. protective field range of 9.0 m	100 mm
Additional supplement Z_R for reflection-based measurement errors	350 mm
Deviation from ideal flatness of scan field at 5.5 m [2]	≤ ±100 mm
Deviation from ideal flatness of scan field at 9.0 m [3]	≤ ± 100 mm
Distance of mirror rotational axis (zero point of x and y axis) to rear side of device	66 mm
Distance between center point of scan plane and top edge of the housing	40 mm
Multiple sampling	2 ... 16

1) Protective field resolution 60 mm only available for devices with max. protective field range of 9.0 m.
2) Devices with a max. protective field range of 4.0 m and Devices with a max. protective field range of 5.5 m.
3) Devices with a max. protective field range of 9.0 m.

Safety technology parameters

Table 26: Safety-related parameters

	microScan3 Core I/O
Type	Type 3 (IEC 61496)
Safety integrity level	SIL 2 (IEC 61508)
SIL claim limit	SILCL 2 (IEC 62061)
Category	Category 3 (ISO 13849-1)
Performance level	PL d (ISO 13849-1)
PFH_D (mean probability of a dangerous failure per hour)	8×10^{-8}
T_M (mission time)	20 years (ISO 13849-1)
Safe status when a fault occurs	At least one OSSD is in the OFF state.

Interfaces

Table 27: Interfaces

	microScan3 Core I/O
OSSD pairs	1
Automatic restart of OSSDs after	2 s ... 60 s (configurable)
Voltage supply	
Connection type	Male connector, M12, 8 pin, A-coding (collective male connector for voltage supply and inputs and outputs)
Length of cable (power supply unit tolerance ± 5%)	
Length of cable with wire cross-section 0.25 mm^2	≤ 35 m
Local inputs and outputs	
Connection type	Male connector, M12, 8 pin, A-coding (collective male connector for voltage supply and inputs and outputs)
Length of cable with wire cross-section 0.25 mm^2	≤ 35 m
Configuration and diagnostic interface	
Type of interface	USB 2.0
Connection type	USB 2.0 mini-B (female connector)
Transmission rate	≤ 12 Mbit/s
Length of cable	≤ 5 m

Electrical data

Table 28: Electrical data

	microScan3 Core I/O
Operating data	
Protection class	III (IEC 61140)
Supply voltage U_V	24 V DC (16.8 V ... 30 V DC) (SELV/PELV) [1]
Residual ripple	±5% [2]
Start-up current at 24 V	≤ 3 A
Current consumption at 24 V	
No output load	Typ. 0.3 A

	microScan3 Core I/O
With maximum output load	Typ. 1.4 A
In sleep mode, no output load	Typ. 0.27 A
Power consumption	
No output load	Typ. 7 W
With maximum output load	Typ. 34 W
In sleep mode, no output load	Typ. 6.5 W
Power-up delay	≤ 12 s
Safety outputs (OSSD)	
Type of output	2 PNP semiconductors for each OSSD pair, short-circuit protected, cross-circuit monitored
Output voltage for ON state (HIGH)	(U_V –2.7 V) ... U_V
Output voltage for OFF state (LOW)	0 V ... 2 V
Output current for ON state (HIGH)	≤ 250 mA per OSSD
Leakage current [3)]	≤ 250 µA
Load inductance	≤ 2.2 H
Load capacity	≤ 2.2 µF in series with 50 Ω
Switching sequence (no toggling and no simultaneous monitoring)	Depending on the load inductance
Permissible resistivity between load and device	≤ 2.5 Ω
Test pulse width	≤ 300 µs (typ. 230 µs)
Test pulse interval	
Scan cycle time 30 ms	240 ms ... 264 ms (typ. 240 ms)
Scan cycle time 40 ms	320 ms ... 344 ms (typ. 320 ms)
Scan cycle time 50 ms	400 ms
Duration of OFF state	≥ 80 ms
Discrepancy time (offset between switching from OSSD2 and OSSD1 within an OSSD pair)	≤ 1 ms (typ. 25 µs)
Universal output, universal I/O (configured as output)	
Output voltage HIGH	(U_V –3.7 V) ... U_V
Output voltage LOW	0 V ... 2 V
Output current HIGH	≤ 200 mA
Leakage current	≤ 0.5 mA
Switch-on delay	40 ms
Switch-off delay	40 ms
Static control input, universal input, universal I/O (configured as input)	
Input voltage HIGH	24 V (13 V ... 30 V)
Input voltage LOW	0 V (–30 V ... 5 V)
Input current HIGH	3 mA ... 6 mA

	microScan3 Core I/O
Input current LOW	0 mA ... 2 mA
Input resistance at HIGH	Typ. 5 kΩ
Input capacity	10 nF
Input frequency (max. switching sequence when used as control input)	≤ 20 Hz
Sampling time	4 ms
Response time at EDM after switching on OSSDs (when used as EDM input)	300 ms
Actuating duration of control switch for reset (when used as reset input)	60 ms ... 30 s
Actuating duration of switch for sleep mode (when used as sleep mode input)	≥ 120 ms

1) The power supply unit must be able to jumper a brief power failure of 20 ms as specified in IEC 60204-1. Suitable power supply units are available as accessories from SICK.
2) The voltage level must not fall below the specified minimum voltage.
3) In the event of a fault (interruption of the 0 V cable), the specified leak current at most flows in the OSSD cable. The downstream control element must detect this state as the OFF state.

Mechanical data

Table 29: Mechanical data

	microScan3 Core I/O
Dimensions (W × H × D)	112 mm × 135.1 mm × 111.1 mm
Weight (including system plug)	1.15 kg
Housing material	Aluminum
Housing color	RAL 9005 (black) and RAL 1021 (colza yellow)
Optics cover material	Polycarbonate
Optics cover surface	Outside has a scratch-resistant coating

Ambient data

Table 30: Ambient data

	microScan3 Core I/O
Enclosure rating [1]	IP65 (IEC 60529)
Ambient light immunity	≤ 3,000 lx (IEC 61496-3)
Ambient operating temperature	–10 °C ... 50 °C
Storage temperature	–25 °C ... 70 °C
Air humidity	≤ 95%, non-condensing [2]
Height above sea level during operation	≤ 2300 m
Vibration resistance [3]	
Standards	IEC 60068-2-6 IEC 61496-1, clause 4.3.3.1 and 5.4.4.1 IEC 61496-3, clause 5.4.4.1
Frequency range	10 Hz ... 150 Hz

	microScan3 Core I/O
Amplitude	0.35 mm (10 Hz ... 60 Hz), 5 g (60 Hz ... 150 Hz)
Shock resistance [3]	
Standards	IEC 60068-2-27 IEC 61496-3, clause 5.4.4.4.2 and clause 5.4.4.4.3
Single shock	15 g, 11 ms
Continuous shock	10 g, 16 ms
EMC	In accordance with IEC 61496-1, IEC 61000-6-2, and IEC 61000-6-4

1) The specified enclosure rating is only valid if the safety laser scanner is closed, the system plug is mounted and all of the safety laser scanner's M12 system plugs are closed using a male cable connector or using a protective cap.
2) IEC 61496-1, no. 4.3.1 and no. 5.4.2, IEC 61496-3, no. 4.3.1 and no. 5.4.2. Condensation has an influence on normal operation.
3) In direct mounting.

Miscellaneous data

Table 31: Miscellaneous data

	microScan3 Core I/O
Wavelength	845 nm
Detectable reflectance factor	1.8% ... several 1000%
Maximum uniform contamination of the optics cover without reducing the detection capability [1]	30%
Area where detection capability is restricted	≤ 50 mm [2]
Light spot diameter	
At front screen	18 mm
At 4.0 m distance	12 mm
At 5.5 m distance	20 mm
At 9.0 m distance	30 mm
Divergence of collimated beam	0.17°
Receiving angle	0.75°
Pulse duration	Typ. 4 ns
Average output power	9.2 mW
Laser class	1M

1) In the event of heavy contamination, the safety laser scanner displays a contamination fault and switches all safety outputs to the OFF state.
2) In close proximity (50 mm wide area in front of the optics cover), the detection capability of the safety laser scanner may be restricted. If required, this area must be secured using an undercut or frame, for example.

13.4 Response times

The protective device's response time is the maximum time between the occurrence of the event leading to the sensor's response and supply of the switch-off signal to the protective device's interface (for example OFF state of the OSSD pair).

DANGER
Hazard due to lack of effectiveness of the protective device

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

In addition to the protective device's response time, further signal transmission and processing also influence the time up until the end of the dangerous state. This includes a control's processing time and the response times of downstream contactors, for example.

▶ Take the time for further signal transmission and processing into account.

Response time

The safety laser scanner's response time depends on the following parameters:

- Scan cycle time
- Set interference protection
- Set multiple sampling

You can calculate the response time using the following formula:

$t_R = (t_S + t_I) \times n + t_O$

The following rules apply:

- t_R = response time
- t_S = scan cycle time
  - Setting "30 ms": t_S = 30 ms
  - Setting "40 ms": t_S = 40 ms
  - Setting "50 ms": t_S = 50 ms
- t_I = time for interference protection
  - Mode 1 (default): t_I = 0 ms
  - Mode 2: t_I = 1 ms
  - Mode 3: t_I = 2 ms
  - Mode 4: t_I = 3 ms
- n = set multiple sampling
  Preset to n = 2.
  Multiple sampling can be changed for the safety laser scanner or for each individual field ($2 \le n \le 16$).
- t_O = time for processing and output
  Dependent on output used:
  - OSSD pair 1: t_O = 10 ms

Table 32: Response time of an individual safety laser scanner

Scan cycle time (t_S)	Interference protection (t_I)		Output (t_O)	t_R = response time for multiple sampling n
30 ms	Mode 1	0 ms	OSSD pair 1	n × 30 ms + 10 ms
	Mode 2	1 ms	OSSD pair 1	n × 31 ms + 10 ms
	Mode 3	2 ms	OSSD pair 1	n × 32 ms + 10 ms
	Mode 4	3 ms	OSSD pair 1	n × 33 ms + 10 ms
40 ms	Mode 1	0 ms	OSSD pair 1	n × 40 ms + 10 ms
	Mode 2	1 ms	OSSD pair 1	n × 41 ms + 10 ms
	Mode 3	2 ms	OSSD pair 1	n × 42 ms + 10 ms
	Mode 4	3 ms	OSSD pair 1	n × 43 ms + 10 ms
50 ms	Mode 1	0 ms	OSSD pair 1	n × 50 ms + 10 ms

13.5 Course of the OSSD test over time

The safety laser scanner tests the OSSDs at regular intervals. To do this, the safety laser scanner switches each OSSD briefly (for max. 300 µs) to the OFF state and checks whether this channel is voltage-free during this time.

Make sure that the machine's control does not react to these test pulses and the machine does not switch off.

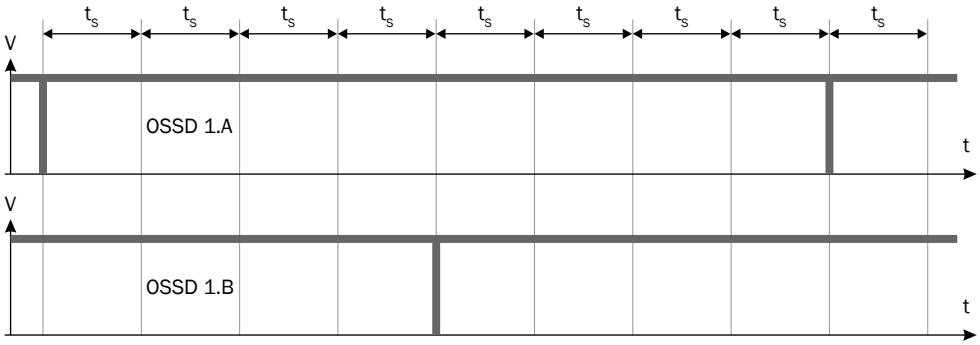


Figure 88: Switch-off tests

t_S Scan cycle time

- Setting "30 ms": t_S = 30 ms
- Setting "40 ms": t_S = 40 ms
- Setting "50 ms": t_S = 50 ms

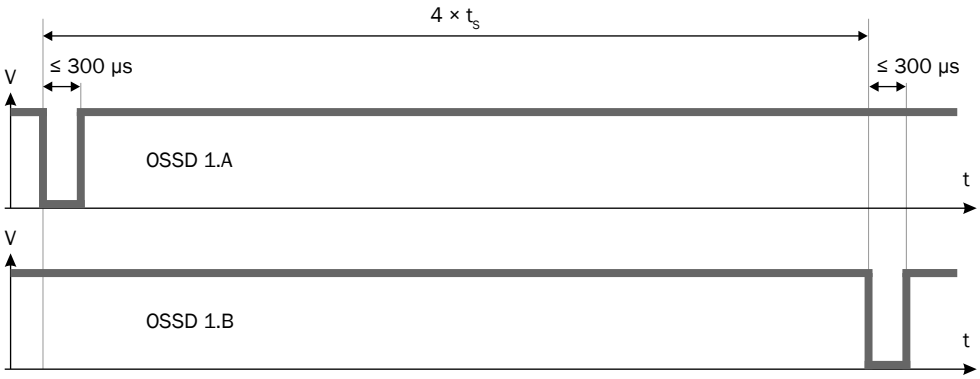


Figure 89: Duration and time offset for the switch-off tests in an OSSD pair

t_S Scan cycle time

- Setting "30 ms": t_S = 30 ms
- Setting "40 ms": t_S = 40 ms
- Setting "50 ms": t_S = 50 ms

13.6 Sensing range

Protective field range

The effective protective field range depends on the variant, on the set scan cycle time and on the set object resolution.

Table 33: Protective field range (devices with a max. protective field range of 4.0 m)

Resolution	Scan cycle time 40 ms	Scan cycle time 30 ms
≥ 70 mm	4.00 m	4.00 m
50 mm	3.50 m	3.00 m

Resolution	Scan cycle time 40 ms	Scan cycle time 30 ms
40 mm	3.00 m	2.30 m
30 mm	2.30 m	1.70 m

Table 34: Protective field range (devices with a max. protective field range of 5.5 m)

Solution	Scan cycle time 40 ms	Scan cycle time 30 ms
≥ 70 mm	5.50 m	4.00 m
50 mm	3.50 m	3.00 m
40 mm	3.00 m	2.30 m
30 mm	2.30 m	1.70 m

Table 35: Protective field range (devices with a max. protective field range of 9.0 m)

Resolution	50 ms scan cycle time	40 ms scan cycle time
≥ 150 mm	9.00 m	9.00 m
70 mm	9.00 m	7.00 m
60 mm	8.00 m	6.00 m
50 mm	7.00 m	5.00 m
40 mm	5.00 m	4.00 m
30 mm	4.50 m	3.00 m

Scanning range of the reference contour field

The effective scanning range of the reference contour field is the same as the protective field range.

Scanning range of the contour detection field

The effective scanning range of the contour detection field is the same as the protective field range.

Range for warning fields

For non-safety applications (warning fields), the safety laser scanner has a larger range than the maximum protective field range. The requirements for size and remission of objects to be detected are illustrated in the following graphs as a function of the desired range.

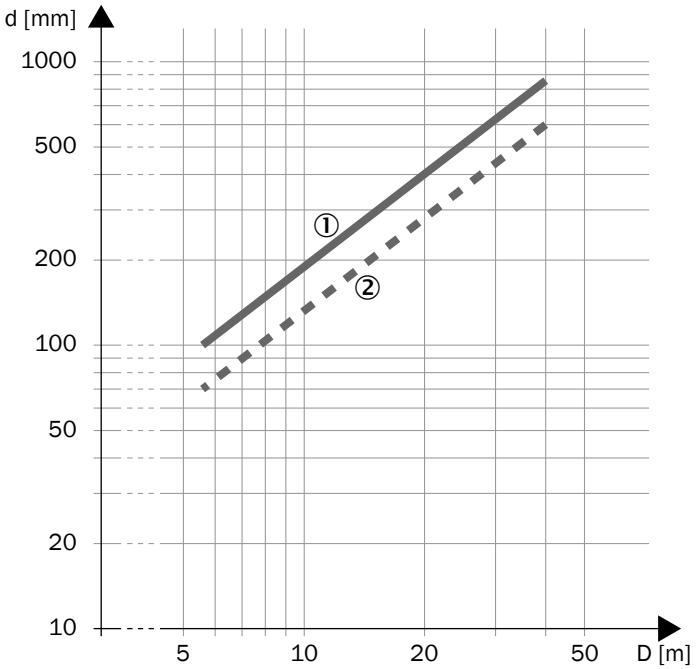


Figure 90: Scanning range and object size for warning fields (devices with a max. protective field range of 4.0 m and devices with max. protective field range of 5.5 m)

d Required minimum size of the object in mm
D Range in m
① Scan cycle time = 30 ms
② Scan cycle time = 40 ms

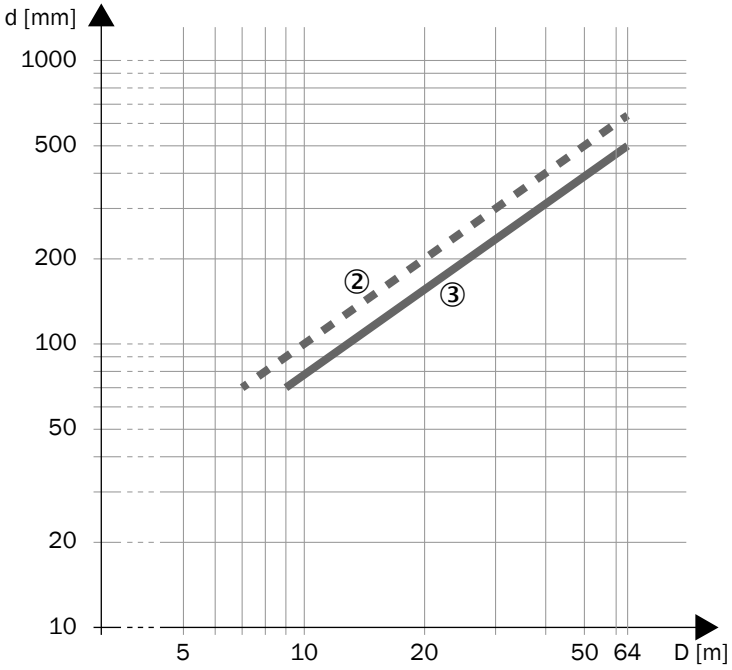


Figure 91: Scanning range and object size for warning fields (devices with a max. protective field range of 9.0 m)

d Required minimum size of the object in mm
D Scanning range in m
② Scan cycle time = 40 ms

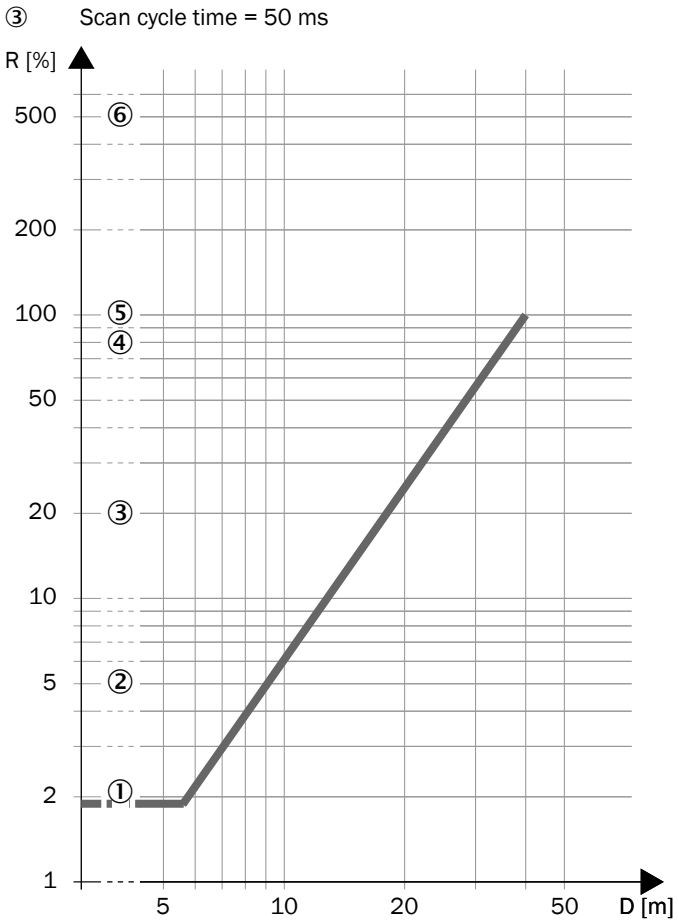


Figure 92: Scanning range and required remission for warning fields (devices with a max. protective field range of 4.0 m and devices with max. protective field range of 5.5 m)

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

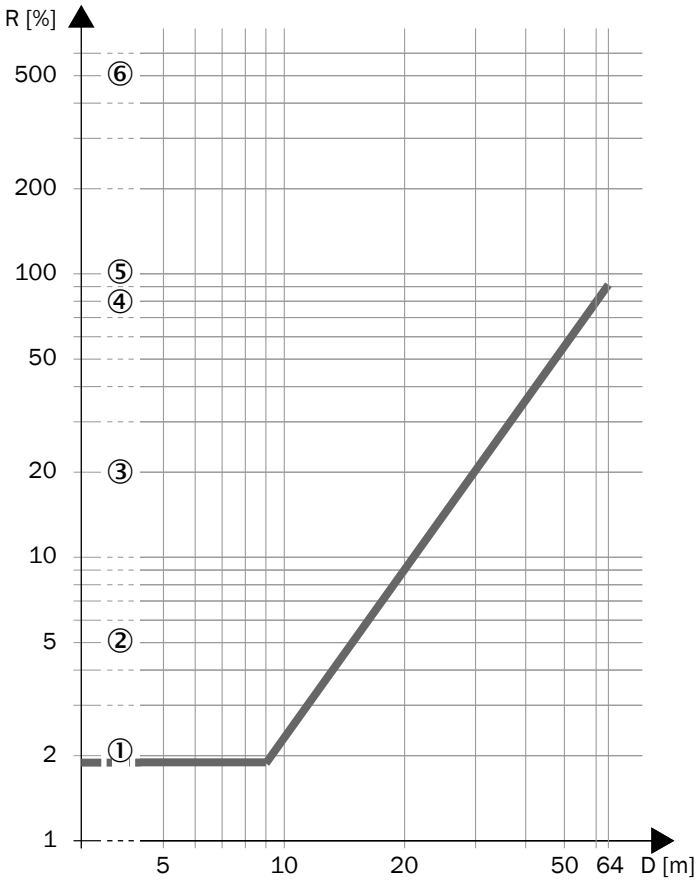


Figure 93: Scanning range and required remission for warning fields (devices with a max. protective field range of 9.0 m)

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

13.7 Dimensional drawings

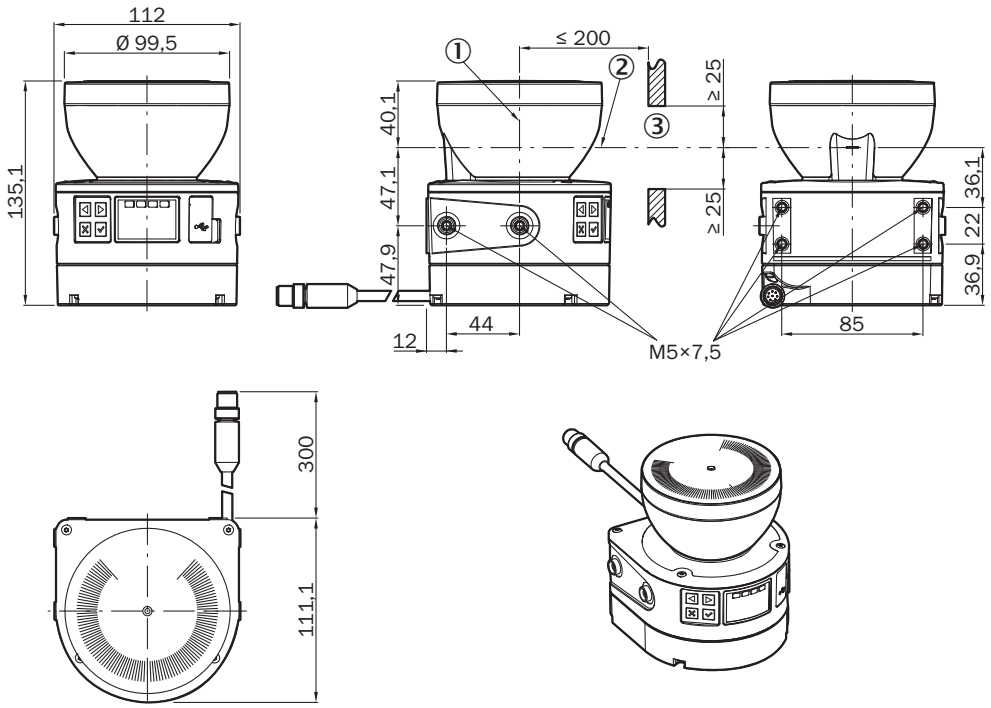


Figure 94: Dimensional drawing

All dimensions in mm.

① Mirror rotational axis

② Scan plane

③ Required viewing slit

14 Ordering information

14.1 Scope of delivery

- Safety laser scanner with system plug
- Safety note
- Mounting Instructions
- Operating instructions for download: www.sick.com

14.2 Ordering information

Table 36: microScan3 Core I/O ordering information

Integration in the control	Protective field range	Type code	Part number
I/O	≤ 4.0 m	MICS3-AAAZ40AZ1P01	1075842
I/O	≤ 5.5 m	MICS3-AAAZ55AZ1P01	1075843
I/O	≤ 9.0 m	MICS3-AAAZ90AZ1P01	1089492

15 Spare parts

15.1 Safety laser scanner without system plug

Table 37: Safety laser scanner without system plug

Spare part for			Type code	Part number
Device	**Part number**	**Protective field range**		
microScan3 Core I/O	1075842	≤ 4.0 m	MICS3-AAAZ40AZ1	1067360
microScan3 Core I/O	1075843	≤ 5.5 m	MICS3-AAAZ55AZ1	1067875
microScan3 Core I/O	1089492	≤ 9.0 m	MICS3-AAAZ90AZ1	1089325

15.2 System plug

Table 38: System plug

Spare part for		Connection type	Type code	Part number
Device	**Part number**			
microScan3 Core I/O	1075842, 1075843, 1089492	Cable with plug connector	MICSX-ABIZZZZZ1	2073156

15.3 Additional spare parts

Table 39: Additional spare parts

Part	Part number
Optics cover (with seal and screws)	2073673

16 Accessories

16.1 Brackets

Table 40: Brackets ordering information

Part	Part number
Mounting kit 1a	2073851
Mounting kit 1b (with protection for optics cover)	2074242
Mounting kit 2a (alignment bracket, alignment with cross-wise axis and depth axis possible, distance between mounting surface and device: 22.3 mm, only in conjunction with mounting kit 1a or 1b)	2073852
Mounting kit 2b (alignment bracket, alignment with cross-wise axis and depth axis possible, distance between mounting surface and device: 52.3 mm, only in conjunction with mounting kit 1a or 1b)	2074184
Heavy duty mounting kit	2102289

Dimensional drawings

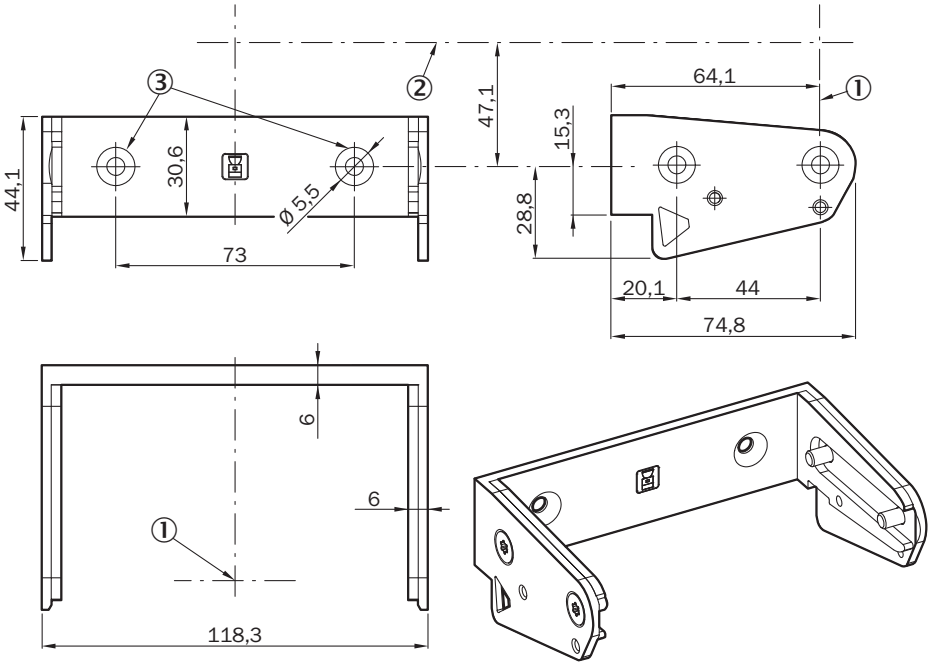


Figure 95: Mounting kit 1a

All dimensions in mm.

① Mirror rotational axis

② Scan plane

③ Countersink for M5 countersunk screw

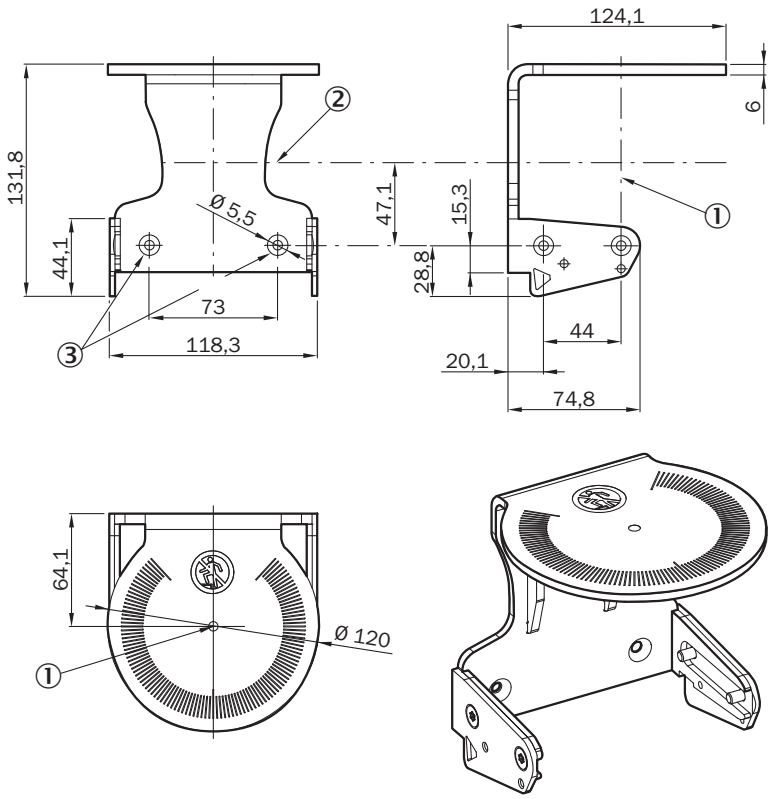


Figure 96: Mounting kit 1b

All dimensions in mm.

① Mirror rotational axis

② Scan plane

③ Countersink for M5 countersunk screw

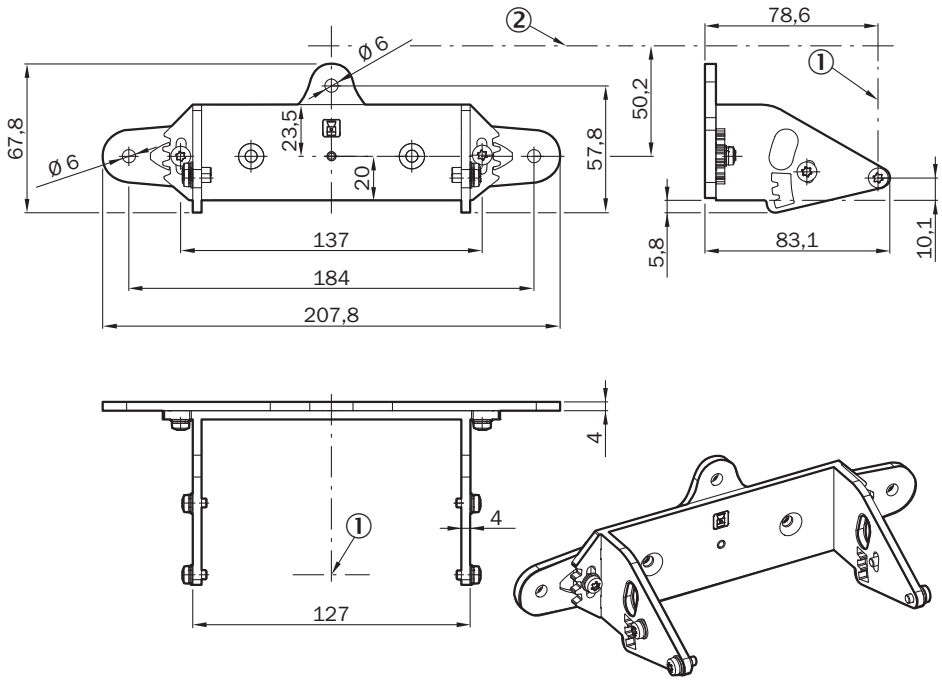


Figure 97: Mounting kit 2a

All dimensions in mm.

① Mirror rotational axis
② Scan plane

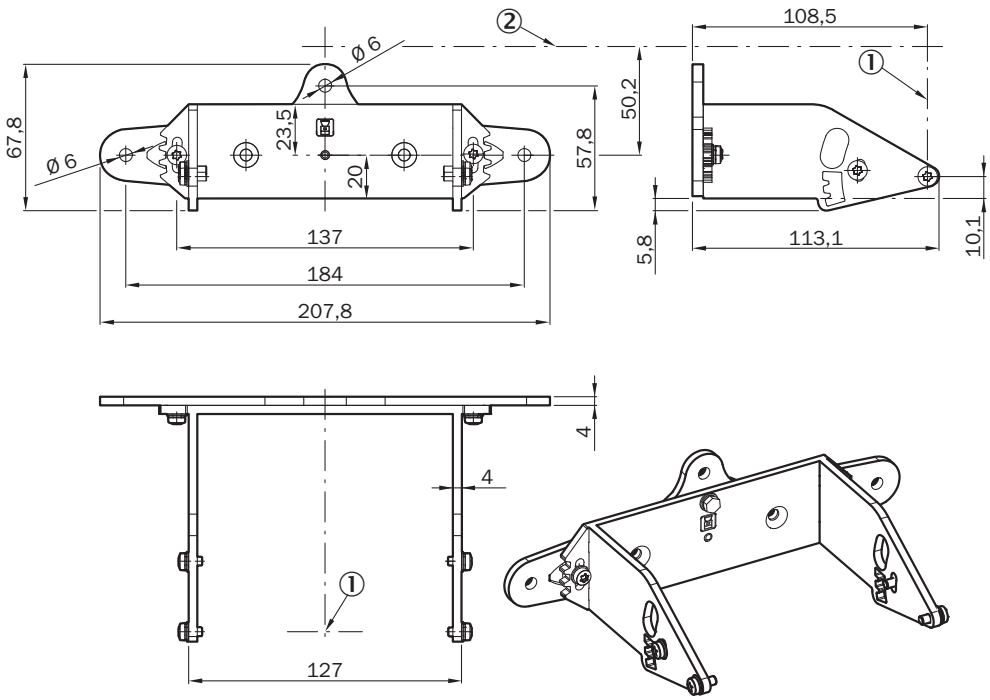


Figure 98: Mounting kit 2b

All dimensions in mm.
① Mirror rotational axis
② Scan plane

16.2 Connection technology

Cables

Table 41: Ordering information for M12 connecting cable, 8-pin, unshielded

Part	Type code	Part number
Female connector (straight), 2 m cable, flying leads	DOL-1208G02MD25KM1	2079314
Female connector (straight), 5 m cable, flying leads	DOL-1208G05MD25KM1	2079315
Female connector (straight), 10 m cable, flying leads	DOL-1208G10MD25KM1	2079316
Female connector (straight), 20 m cable, flying leads	DOL-1208G20MD25KM1	2092105
Female connector (straight), 30 m cable, flying leads	DOL-1208G30MD25KM1	2092106

Table 42: Ordering information, USB cable

Part	Part number
USB mini-B male connector, 3 m cable, USB A male connector	6042517
USB mini-B male connector, 5 m cable, USB A male connector	6053566
USB-A female connector, 10 m cable, USB-A male connector (active extension cable)	6069292

Power supply units

Table 43: Ordering information for power supply

Part	Type code	Part number
Output 24 V DC, 50 W (2.1 A), voltage supply NEC Class 2, SELV, PELV, input 120 V AC ... 240 V AC	PS50WE24V	7028789
Output 24 V DC, 95 W (3.9 A), voltage supply NEC Class 2, SELV, PELV, input 100 V AC ... 120 V / 220 V AC ... 240 V AC	PS95WE24V	7028790

16.3 Alignment aid

Table 44: Alignment aid ordering information

Part	Type code	Part number
Scanfinder	LS-80L	6020756
Alignment aid		2101720

16.4 Cleaning agent

Table 45: Cleaning agent ordering information

Part	Part number
Anti-static plastic cleaner	5600006
Lens cloth	4003353

16.5 Test rods

Table 46: Ordering information, test rods

Part	Part number
Test rod 50 mm	2095105
Test rod 70 mm	2095139

17 Glossary

AGV	Automated guided vehicle
Contour detection field	The contour detection field monitors a contour of the environment. The safety laser scanner switches the associated safety outputs to the OFF state if a contour does not match the set parameters, because, for example, a door or flap is open.
Control input	A control input receives signals, e.g. from the machine or from the control. Use of control inputs is how the protective device receives information about the conditions at the machine, e.g., if there is a change of operating mode. If the protective device is configured appropriately, it will activate a different monitoring case after receiving a new control input. The control input information must be transmitted reliably. Generally, at least 2 separate channels are used to do this. Depending on the device, a control input can be realized as a static control input or a dynamic control input.
Dangerous state	A dangerous state is a status of the machine or facility, where people may be injured. Protective devices prevent this risk if the machine is operated within its intended use. The figures in this document always show the dangerous state of the machine as movement of a machine part. In practice, there are different dangerous states, such as: • Machine movements • Electrical parts • Visible and invisible beam • A combination of multiple hazards
EDM	External device monitoring
Electro-sensitive protective device	An electro-sensitive protective device is a device or system of devices for safety-related detection of people or parts of the body. It is used to protect people from machines and facilities that pose a risk of injury. It triggers the machine or facility to adopt a safe state before a person is exposed to a hazardous situation. Examples include safety light curtains and safety laser scanners.
ESD	Electrostatic discharge
ESPE	Electro-sensitive protective device
EtherNet/IP	EtherNet/IP™ (EtherNet Industrial Protocol) is an Ethernet-based network used in industrial automation. EtherNet/IP™ implements the CIP™ (Common Industrial Protocol) based on the Ethernet and TCP/IP protocol family. EtherNet/IP™ with the CIP Safety™ protocol extension is also suitable for safety-related data communication.
External device monitoring	The external device monitoring (EDM) monitors the status of downstream contactors. In order to use external device monitoring, positively guided contactors must be used to switch off the machine. If the auxiliary contacts of the positively guided contactors are connected to the external device monitoring, the external device monitoring checks whether the contactors switch correctly when the OSSDs are switched off.

Field set	A field set consists of one or more fields. The fields in a field set are monitored simultaneously. A field set can contain various types of field. A typical application is the use of a protective field with one or more warning fields: if a vehicle approaches a person, a warning field triggers an optical or acoustic signal. If the person does not react to this and the vehicle continues to approach, the safety laser scanner detects an object in the protective field and switches the associated safety outputs to the OFF state. The vehicle stops before it reaches the person.
Monitoring case	A monitoring case signals the machine status to the safety laser scanner. The safety laser scanner activates the field set, which is assigned to the monitoring case and therefore a particular machine status. If a machine, e.g., has various operational statuses, a monitoring case can be assigned to each operational status. The safety laser scanner receives a defined signal for the current operational status via the control inputs or the network. If there is a change of signal, the safety laser scanner switches from one monitoring case to the monitoring case that is assigned to the new signal (as well as the new operational status). Generally, one field set is assigned to each monitoring case.
OFF state	The OFF state is the status of the outputs of the protective device, where the controlled machine is triggered to quit its dangerous state and the start-up of the machine is prevented (e.g., the voltage at the OSSDs is LOW, so that the machine is switched off and remains still).
ON state	The ON state is the status of the outputs of the ESPE, where the controlled machine is permitted to operate (e.g., the voltage at the OSSDs is HIGH so that the machine can run).
OSSD	Output signal switching device: signal output for the protective device, which is used for stopping the dangerous movement. An OSSD is a safety switching output. The functionality of each OSSD is tested periodically. OSSDs are always connected in pairs and must undergo dual-channel analysis for safety reasons. An OSSD pair is formed from 2 OSSDs that are connected and analyzed together.
PFHD	Probability of dangerous failure per hour
PL	Performance level (ISO 13849)
Protective field	The protective field protects the hazardous area of a machine or vehicle. As soon as the electro-sensitive protective device detects an object in the protective field, it switches the associated safety outputs to the OFF state. This signal can be passed to controllers resulting in the dangerous state coming to an end, e.g. to stop the machine or the vehicle. A horizontal or vertical protective field is required, depending on the application. The electro-sensitive protective device can therefore be mounted in horizontal or vertical alignment, depending on the requirements.

Reference contour field	The reference contour field monitors a contour of the environment. The safety laser scanner switches all safety outputs to the OFF state if a contour does not match the set parameters, because, for example, the mounting situation of the safety laser scanner were changed. National and international standards require or recommend that a reference contour is monitored, if the safety laser scanner is used in vertical operation for hazardous point protection or for access protection.
Reset	When a protective device has sent a stop command, the stopped state must be maintained until a reset device is activated and the machine can be restarted in a second step. The reset brings the protective device back to the monitoring state after it has sent a stop command. The reset also quits the start-up or restart interlock of a protective device, so that the machine can be restarted in a second step. The reset must only be possible, when all safety functions and protective devices are functional. The reset of the protective device must not introduce any movement or dangerous situations itself. The machine is only permitted to start after the reset once a separate start command has been sent. • Manual resets are performed using a separate, manually operated device, such as a reset pushbutton. • Automatic resets by the protective device are only permitted in special cases, if one of the following conditions is met: o It must not be possible for people to be in the hazardous area without triggering the protective device. o It must be ensured that no people are in the hazardous area during or after the reset.
Resolution	The resolution of an active opto-electronic protective device (also known as the sensor detection capability) is the minimum size of an object for it to be reliably detected.
Response time	The protective device's response time is the maximum time between the occurrence of the event leading to the sensor's response and supply of the switch-off signal to the protective device's interface (for example OFF state of the OSSD pair).
Restart interlock	The restart interlock prevents the machine from automatically starting up, for example after a protective device has responded while the machine is operating or after changing the machine's operating mode. The restart interlock can be implemented in the protective device or in the safety controller. A command to reset the protective device must be given, for example using a reset pushbutton, before the machine can be restarted.
Retroreflector	A retroreflector is a reflective material that extensively reflects the incoming beam regardless of the alignment of the reflector mainly in the direction back to the source of the beam (retroflection). In contrast to this, other bright or reflective materials reflect the incoming light in another direction (incoming angle equals outgoing angle). Examples of retroflectors include rear reflectors on bicycles, high-visibility vests, and the reflective points on guideposts.

Safety output	A safety output provides safety-related information. Safety outputs are OSSDs, for example, or safety-related information on a safety-related network.
Scan cycle time	The scan cycle time is the time required for the mirror of a safety laser scanner to complete one rotation.
SIL	Safety integrity level
SILCL	SIL claim limit (IEC 62061)
Static control input	A static control input is a dual-channel control input, which evaluates the status of every channel as the value 0 or 1. The signal states of one or more static control inputs give a unique signal pattern. This signal pattern activates a monitoring case.
Test rod	The test rod is an opaque, cylinder-shaped object used to check the detection capability of the active opto-electronic protective device. The diameter of the test rod is the same as the resolution of the active opto-electronic protective device.
Universal I/O	Universal I/O can be configured as universal input or as universal output.
Universal input	Depending on the device, a universal input can be used for resetting, external device monitoring (EDM), sleep mode, or restarting the protective device, for example. If sleep mode is activated by a universal input, the sleep mode must not be used for safety applications. Certain universal inputs can also be used in pairs as a static control input.
Universal output	A universal output outputs a signal depending on its configuration, e.g. if the reset pushbutton needs to be pushed or if the optical cover is contaminated. A universal output must not be used for safety functions.
Warning field	The warning field monitors larger areas than the protective field. Simple switching functions can be triggered with the warning field, e.g. a warning light or an acoustic signal can be triggered if a person approaches, even before the person enters the protective field. The warning field must not be used for safety applications.

18 Annex

18.1 Compliance with EU directives

EU declaration of conformity (extract)

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

Complete EU declaration of conformity for download

You can call up the EU declaration of conformity and the current operating instructions for the protective device by entering the part number in the search field at www.sick.com (part number: see the type label entry in the “Ident. no.” field).

18.2 Note on specified standards

Standards are specified in this document. The table shows regional standards with similar or identical contents.

Table 47: Note on specified standards

Standard	Standard (regional)
	China
IEC 60068-2-6	GB/T 2423.10
IEC 60068-2-27	GB/T 2423.5
IEC 60204-1	GB 5226.1
IEC 60529	GB/T 4208
IEC 60825-1	GB 7247.1
IEC 61131-2	GB/T 15969.2
IEC 61140	GB/T 17045
IEC 61496-1	GB/T 19436.1
IEC 61496-3	GB 19436.3
IEC 61508	GB/T 20438
IEC 62061	GB 28526
ISO 13849-1	GB/T 16855.1
ISO 13855	GB/T 19876

18.3 Checklist for initial commissioning and commissioning

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

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

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

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

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

18.4 Mounting methods for protection from interference from systems in close proximity

Mutual interference of several safety laser scanners is unlikely thanks to the safeHDDM scanning technology. You can choose a suitable mounting method to guarantee particularly high availability or to avoid interference with laser scanners that do not have safeHDDM functionality. In many cases, you can use the following examples as a guide.

NOTE
You must comply with the standard ISO 13855 when choosing the mounting method.

Mount several safety laser scanners offset and parallel to one another

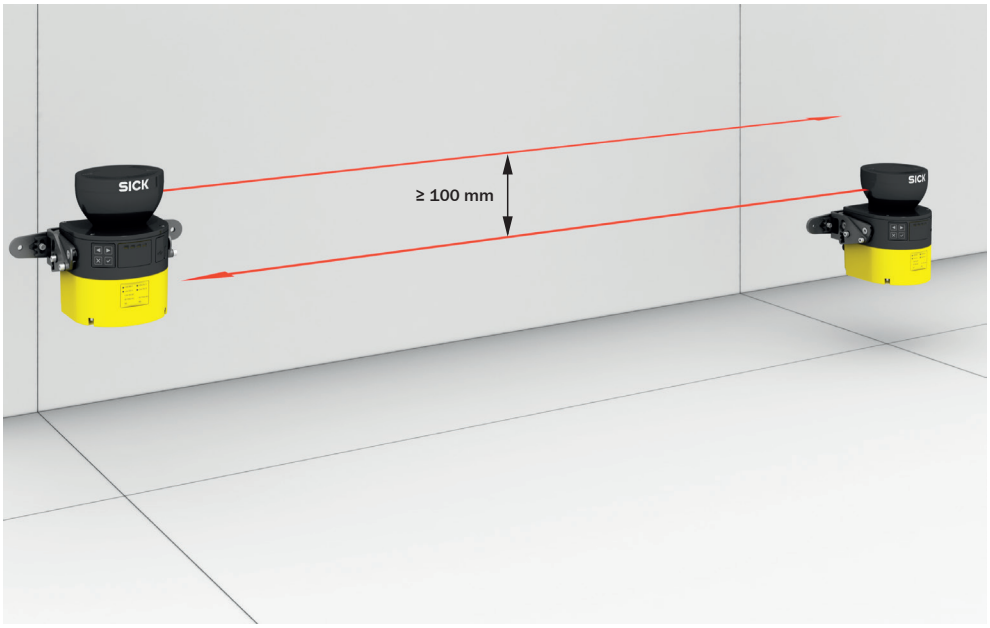


Figure 99: Mounting 2 safety laser scanners with the optics cover facing upward

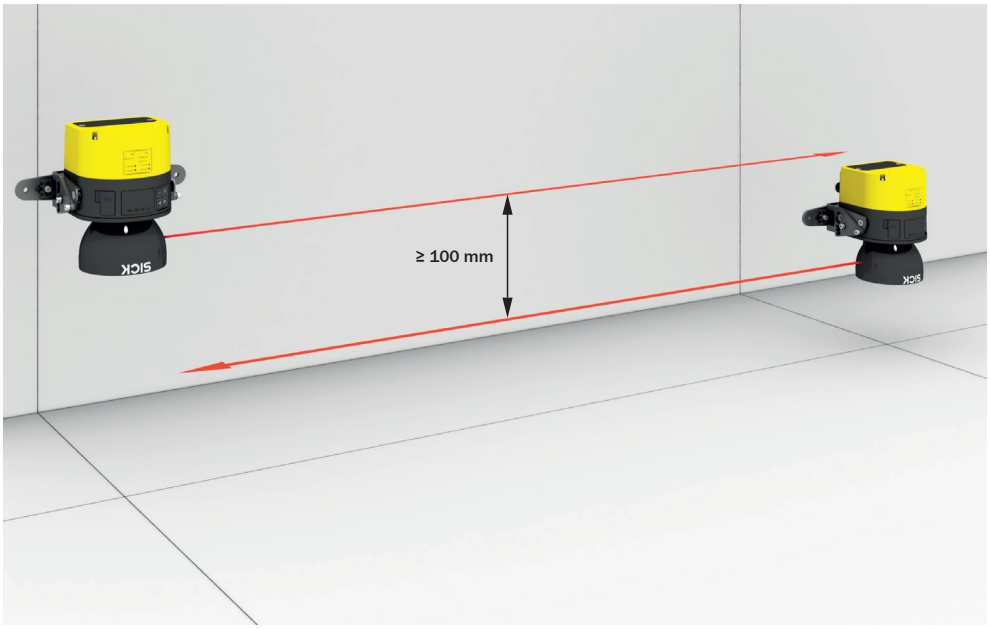


Figure 100: Mounting 2 safety laser scanners with the optics cover facing downward

The following mounting method has the advantage that both safety laser scanners can be mounted at a similar height. Nonetheless, there is enough space between the scan planes.

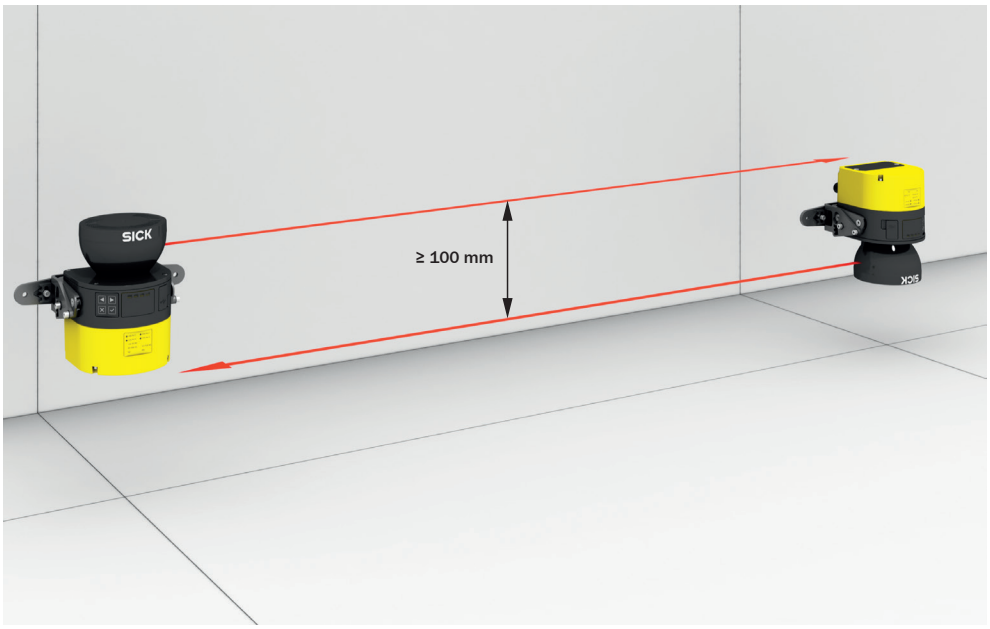


Figure 101: Mounting the upper safety laser scanner with the optics cover facing upward and mounting the lower safety laser scanner with the optics cover facing downward

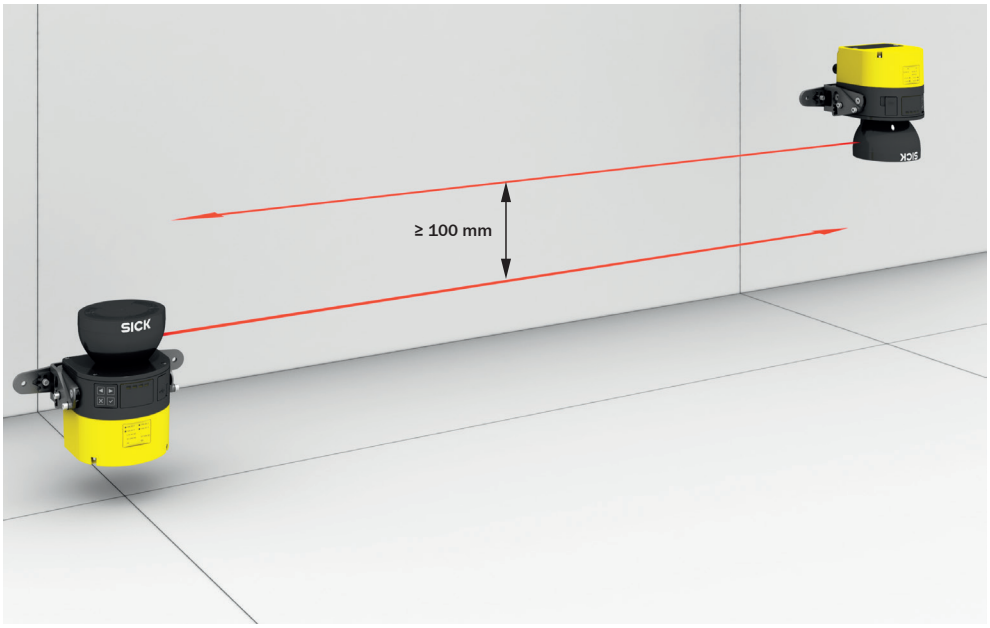


Figure 102: Mounting the upper safety laser scanner with the optics cover facing downward and mounting the lower safety laser scanner with the optics cover facing upward

Mount several safety laser scanners crosswise

If you tilt opposite safety laser scanners with respect to one another, both safety laser scanners must be tilted upward. (If mounted upside down, both safety laser scanners must be tilted downward.)

In any event, ensure that the protective field is at the right height so that crawling beneath and climbing over are prevented and so that the set resolution matches the mounting height.

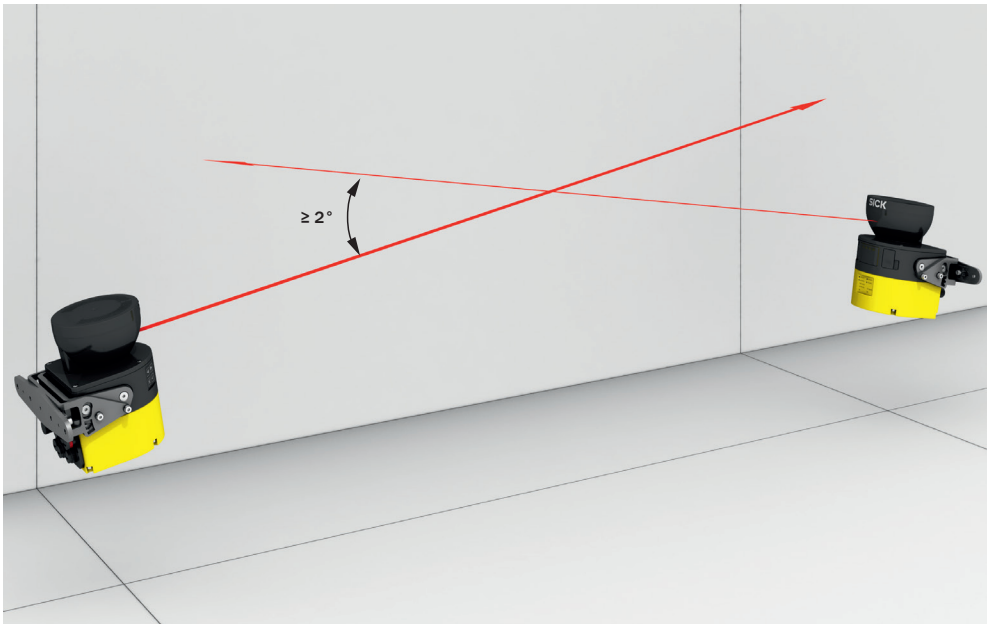


Figure 103: Mounting 2 safety laser scanners opposite one another

If you tilt neighboring safety laser scanners toward one another, the safety laser scanners can be tilted upward or downward.

In any event, ensure that the protective field is at the right height so that crawling beneath and climbing over are prevented and so that the set resolution matches the mounting height.

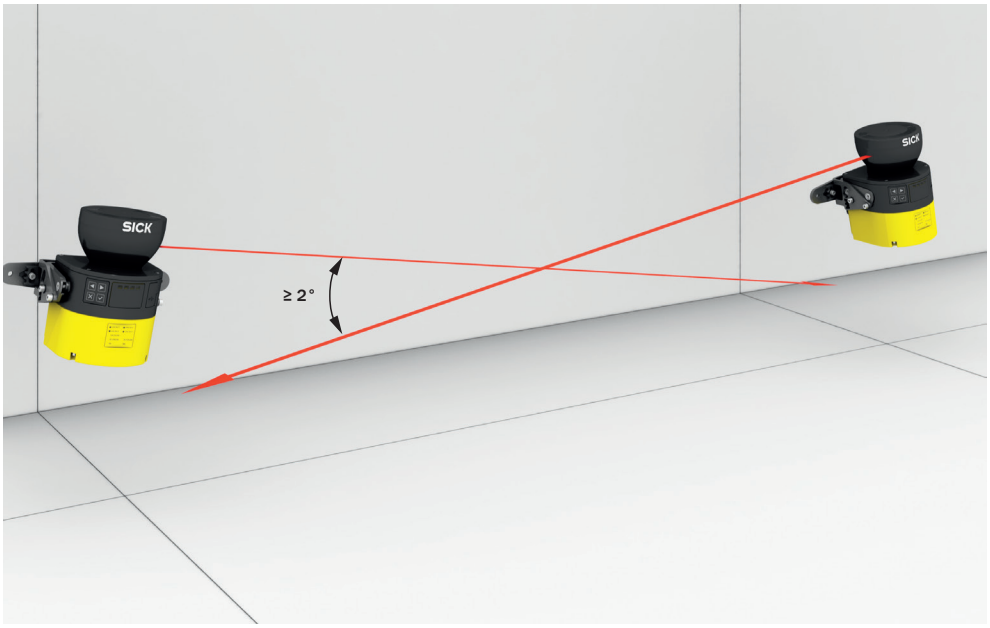


Figure 104: Mounting 2 safety laser scanners next to one another

19 List of figures

20 List of tables

8016346/15ZS/2019-11-14/en

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SICK
Sensor Intelligence.