SafeZone 3 Safety Laser Scanner with CIP Safety over EtherNet/IP

Catalog Numbers 442L-SZNMZCP, 442L-SZNCPMOD

Allen-Bradley
by ROCKWELL AUTOMATION

User Manual Original Instructions

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

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Project Planning

Chapter 4

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Chapter 5

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About This Publication

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.

Scope of Publication

The operating instructions (publication number 442L-UM008A) only apply to the SafeZone™ 3 safety laser scanner with CIP Safety™ over EtherNet/IP™.

Who Should Use This Publication?

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	Chapters of these operating instructions
Project developers (planners, developers, designers)	• Project Planning on page 29 • Configure the SafeZone 3 Safety Laser Scanner on page 85 • Technical Data on page 167 • Accessories on page 191
Installers	Mounting on page 69
Electricians	Electrical Installation on page 77
Safety experts (such as CE authorized representatives, compliance officers, people who test and approve the application)	• Project Planning on page 29 • Configure the SafeZone 3 Safety Laser Scanner on page 85 • Commissioning on page 135 • Technical Data on page 167 • Checklist for Commissioning on page 196
Operators	• Operation on page 139 • Troubleshooting on page 153
Maintenance personnel	• Maintenance on page 145 • Troubleshooting on page 153

More Information

The following information is available on ab.rockwellautomation.com:

- Data sheets and application examples
- CAD data of drawings and dimensional drawings
- Certificates (such as the EU declaration of conformity)
- 442L Add-on Profile (software for configuring the safety laser scanner and further safety solutions)
- SafeZone 3 EDS file

Status Indicator Symbols

These symbols indicate the status of an indicator:

- ○ The status indicator is Off.
- ✳ The status Indicator Is Flashing.
- ● The Status Indicator Is Illuminated Continuously

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
GuardLogix 5580 and Compact GuardLogix 5380 Controller Systems Safety Reference Manual, publication 1756-RM012	Provides the safety requirement needed to reach SIL 3 in a safety system.
GuardLogix Application Instruction Safety Reference Manual, publication 1756-RM095	Describes the Rockwell Automation GuardLogix Safety Application Instruction Set. Provides instructions on how to design, program, or troubleshoot safety applications that use GuardLogix controllers.
ControlLogix 5580 and GuardLogix 5580 Controllers User Manual, publication 1756-UM543	Provides information on how to install, configure, program, and use ControlLogix® 5580 and GuardLogix® 5580 controllers in Studio 5000 Logix Designer® projects.
CompactLogix 5380 and Compact GuardLogix 5380 Controllers User Manual, publication 5069-UM001	Provides information on how to install, configure, program, and use CompactLogix™ 5380 and Compact GuardLogix 5380 controllers.
EtherNet/IP Network Devices User Manual, ENET-UM006	Describes how to configure and use EtherNet/IP devices to communicate on the EtherNet/IP network.
Ethernet Reference Manual, ENET-RM002	Describes basic Ethernet concepts, infrastructure components, and infrastructure features.
System Security Design Guidelines Reference Manual, SECURE-RM001	Provides guidance on how to conduct security assessments, implement Rockwell Automation products in a secure system, harden the control system, manage user access, and dispose of equipment.
Industrial Components Preventive Maintenance, Enclosures, and Contact Ratings Specifications, publication IC-TD002	Provides a quick reference tool for Allen-Bradley industrial automation controls and assemblies.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-state Control, publication SGI-1.1	Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies incorporating solid-state components.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications.	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at rok.auto/literature.

Safety Information

General Safety Notes

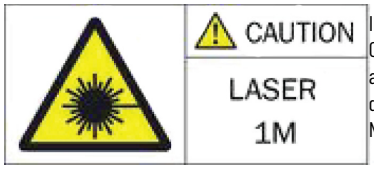
This chapter contains general safety information about the safety laser scanner. Further information about specific product use situations can be found in the relevant chapters.

WARNING: 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

Figure 1 - Laser class 1M



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

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.

ATTENTION: 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.

ATTENTION: 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.

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 Rockwell Automation; in addition, any responsibility and liability of Rockwell Automation for damage and secondary damage caused by this is excluded.

Inappropriate Use

WARNING: 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

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 on page 145 and Operation on page 139.

Notes:

Product Description

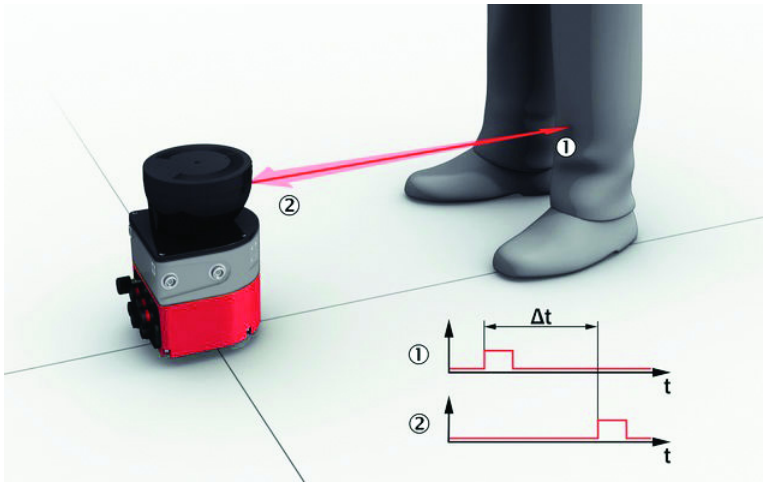
Setup and Function

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. The machine or its control must safely analyze the signals (for example using a safe control) 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).

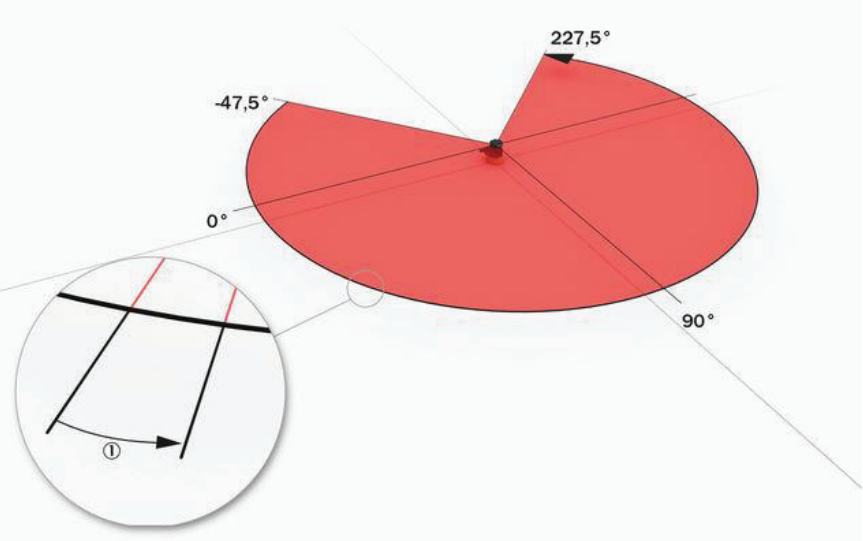
Figure 2 - Principle of Time-of-flight Measurement



Item	Description
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



Item	Description
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...+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 (Figure 3).

Device Overview

Figure 4 - SafeZone™ Overview

Item	Description
1	Optics cover
2	Display
3	Keypad
4	USB port (disabled)
5	Status indicators
6	Additional indicators for ON state and OFF state

Item	Description
7	Network indicators
8	Four M5 mounting inserts
9	System plug (mounted in back)
10	System plug (mounted on bottom)
11	Cover plate

The SafeZone 3 safety laser scanner has 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 four push buttons is located below the optics cover. The safety laser scanner also has a number of light emitting diodes, see Status Indicators on page 19 and Buttons and Display on page 140.

Information about connections: see Connections on page 20.

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:

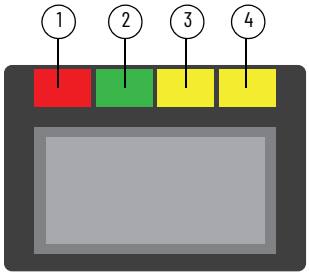
- The top is the side of the safety laser scanner on which the optics cover is located.
- The bottom is the side of the safety laser scanner opposite the optics cover.
- The front is the side of the safety laser scanner on which the display is located. The 90° angle of the sector of a circle scanned 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.

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 four push buttons for additional information.

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

Figure 5 - Status LEDs



Number	Function	Color	Meaning
1	OFF state	Red	Lights up red when at least one safety output is in the OFF state.
2	ON state	Green	Lights up green when at least one safety output 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. Three 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.

The device has different light emitting diodes for every network interface. These network light emitting diodes are located below the display.

More information about the meaning of the light emitting diodes see Diagnostic LEDs on page 153.

Depending on the configuration, the display shows current information about the safety laser scanner's status, see Buttons and Display on page 140.

Connections

- 1 x male connector, M12, A-coding for voltage supply
- 2 × female connector, M12, D-coding for Ethernet (EtherNet/IP - CIP Safety, data output, configuration, and diagnostics)

System Plug

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

The metal plate with the connections is the system plug (Figure 4 on page 19). The system plug can either be mounted on the rear side or the underside.

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.

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

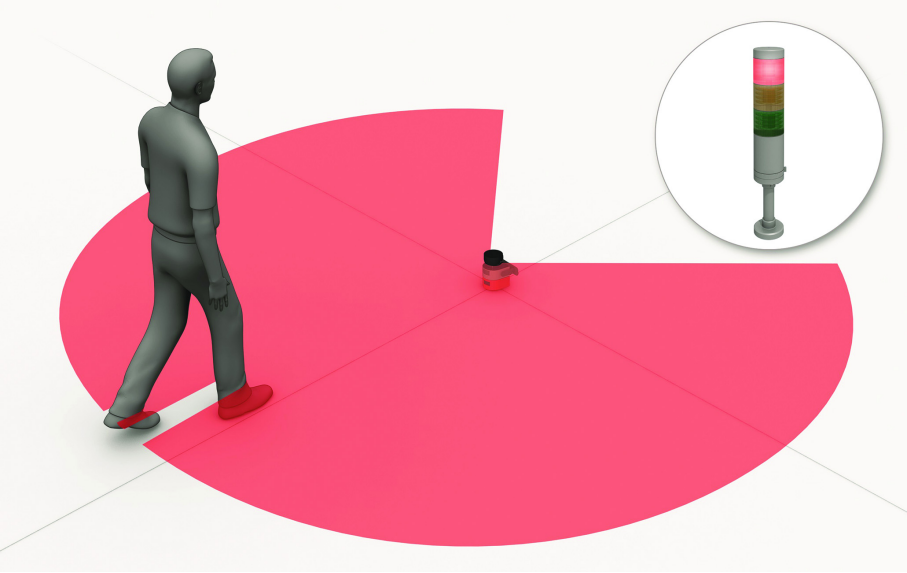
Table 2 - Field Types and Function

	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
Scanning range of the safety laser scanner, max	5.5 m	5.5 m	5.5 m	40 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

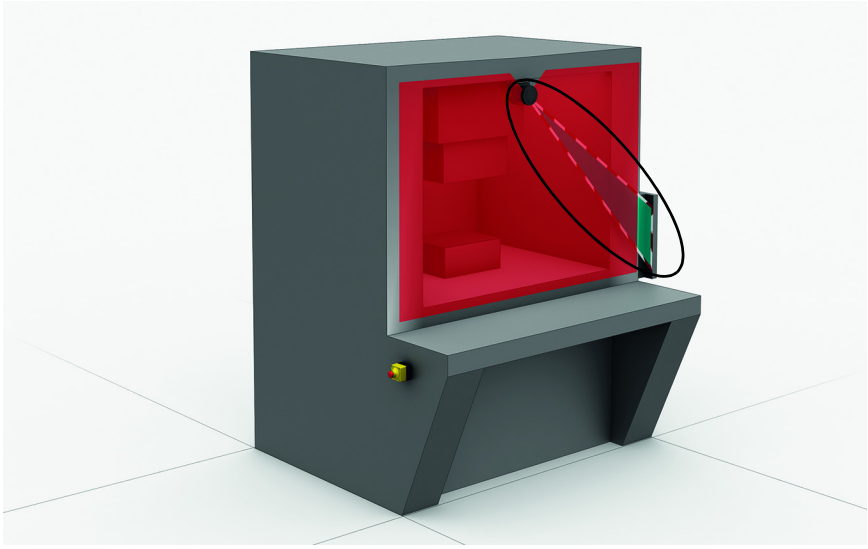
The reference contour field monitors a contour of the environment. The safety laser scanner switches all safety outputs to the OFF state if a contour does not

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 Circled Area)



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.

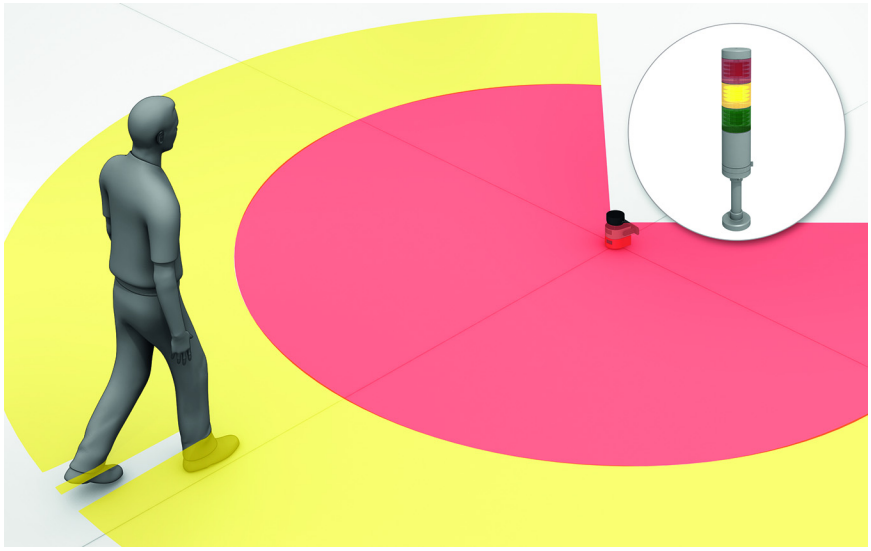
The contour detection field is used for detecting changes in the environment and only switches the outputs in the current monitoring case. By contrast, the reference contour field is used for detecting changes at the safety laser scanner and switches all safety outputs.

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)



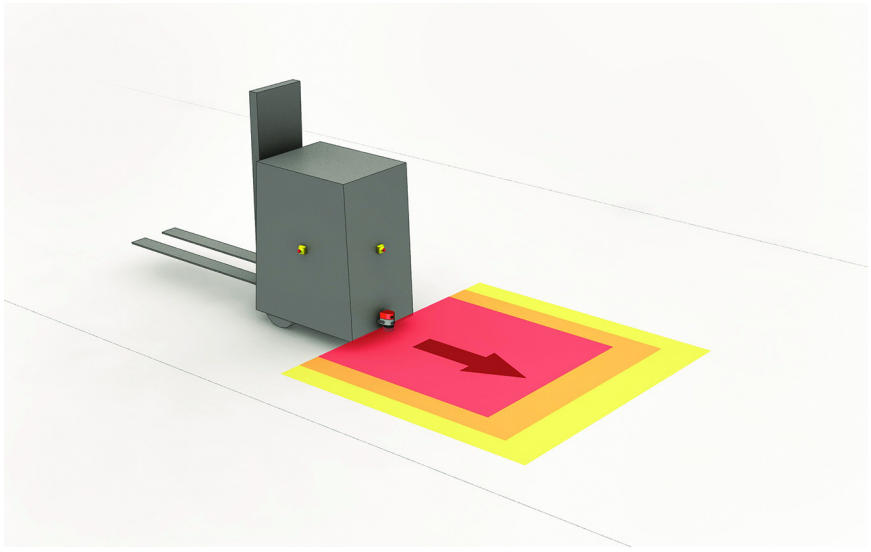
Field Set

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 Two Warning Fields [Orange and Yellow])



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 safety-related 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.

Figure 10 - Monitoring Case 1 with Field Set 1

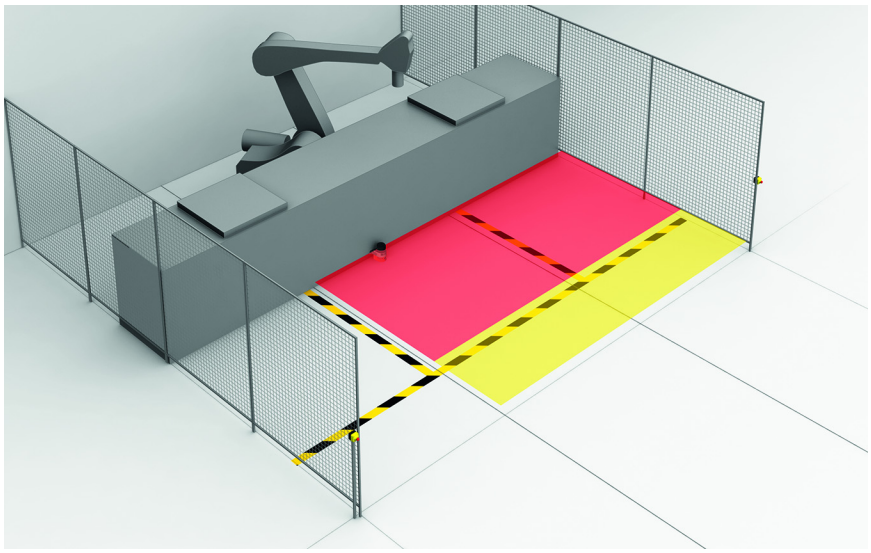
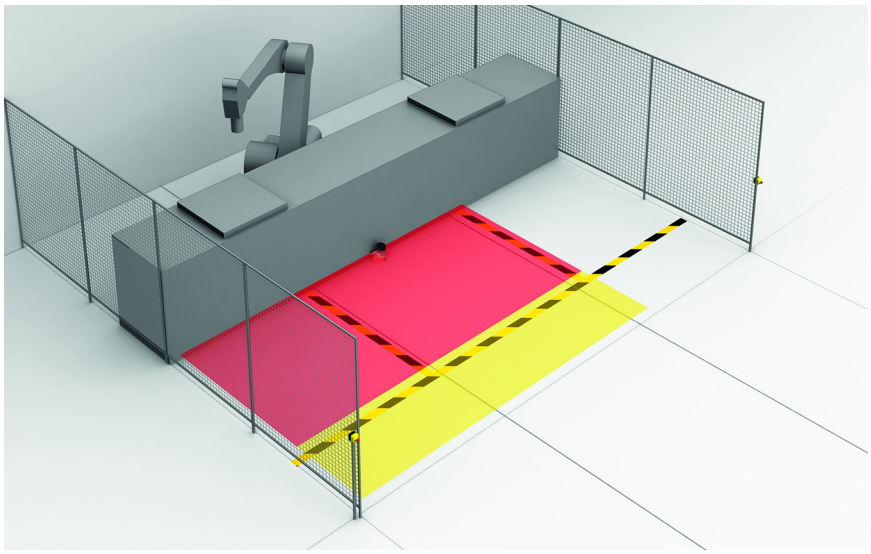


Figure 11 - Monitoring Case 2 with Field Set 2



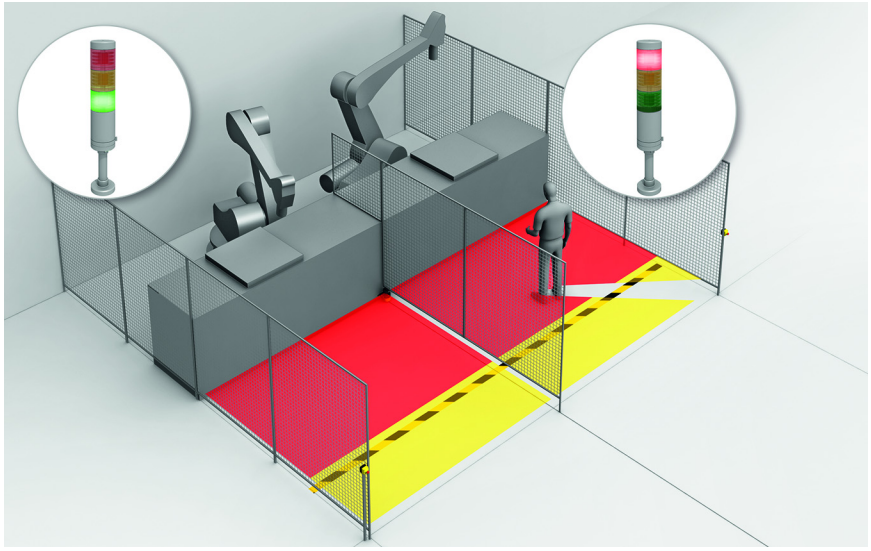
Simultaneous Monitoring

The safety laser scanner can monitor several field sets in one monitoring case (e.g. hazardous area to the left and hazardous area to the right). The field sets can affect different safety outputs in variants with several safety outputs.

For example, they can protect two machines with only one safety laser scanner.

In order to configure simultaneous monitoring, assign several field sets to a monitoring case in the 442L Add-on Profile, see Assigning Field Sets to a Monitoring Case on page 126.

Figure 12 - Simultaneous Monitoring



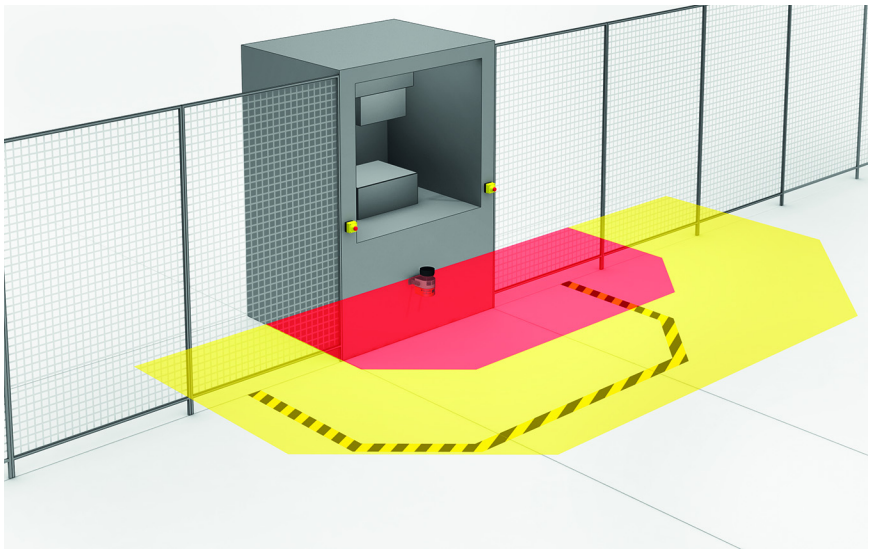
Example Applications

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 push button. When the hazardous area is entered, a stop signal is triggered and starting is prevented.

Figure 13 - Detection of the Presence of a Person in the Hazardous Area

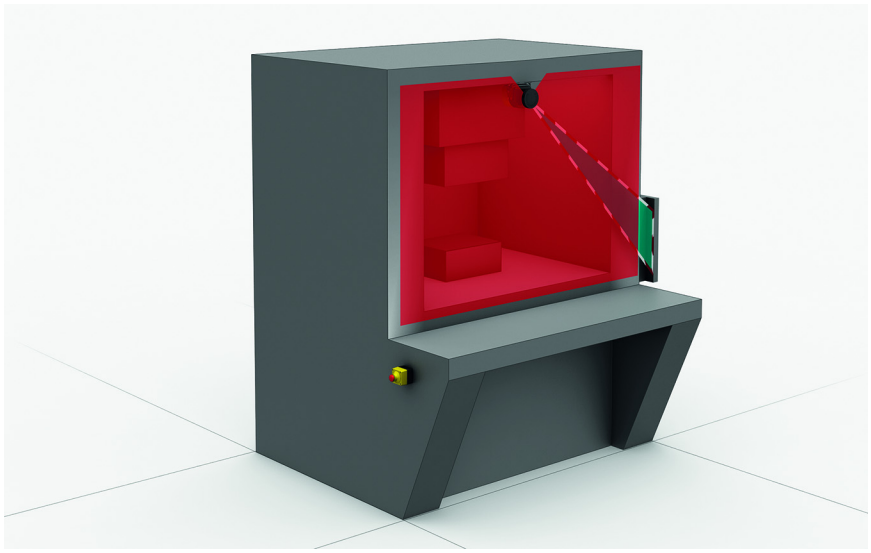


Hazardous Point Protection

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 14 - Hand Detection

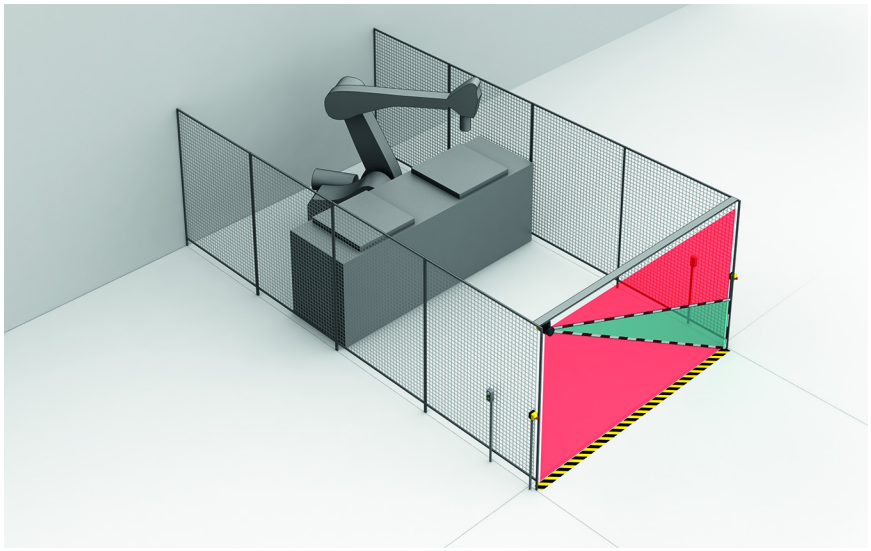


Access Protection

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 15 - Detection of a Person When Accessing a Hazardous Area

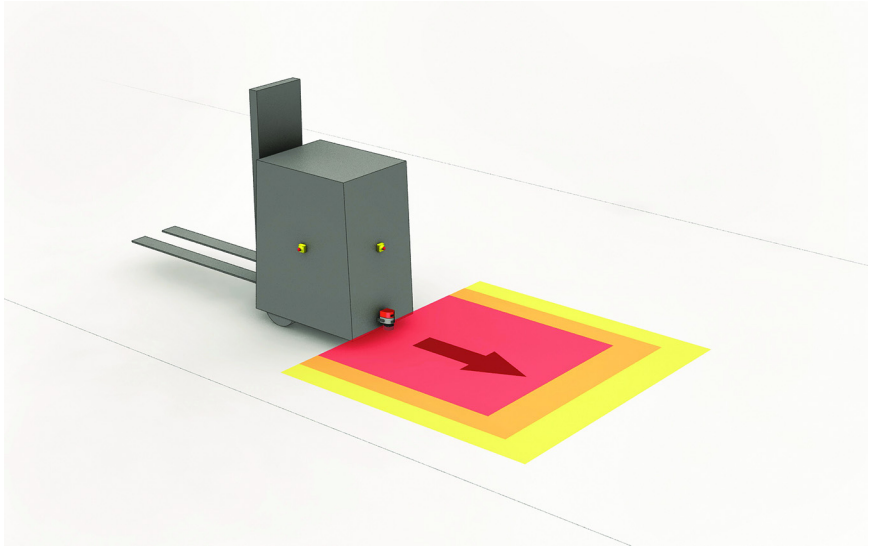


Mobile Hazardous Area Protection

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 16 - Detection of a Person When a Vehicle Approaches



Notes:

Project Planning

Manufacturer of the Machine

ATTENTION: 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.

Operator of the Machine

ATTENTION: 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.

Assembly

This chapter contains important information about the design.

Information about the individual steps for mounting the device: see Mounting on page 69.

ATTENTION: 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 17 - Prevent Crawling Beneath

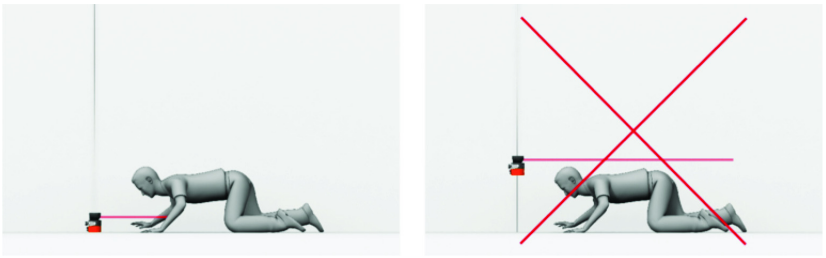


Figure 18 - Prevent Stepping Over

ATTENTION: 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 on page 187.

IMPORTANT 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.

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 on page 109.
- 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 on page 107.
- You can further increase the availability by choosing a suitable mounting method, see Mounting Methods for Protection from Interference from Systems in Close Proximity on page 197.
- 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.

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

Preventing Unprotected Areas

ATTENTION: 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:

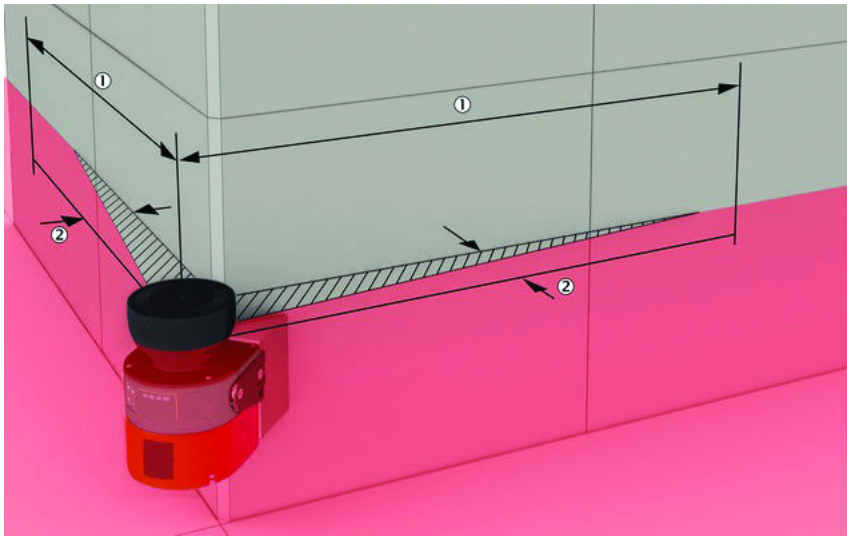
- Attach deflector plates to prevent anyone standing behind.
- Mount the safety laser scanner in an undercut.
- Mount the safety laser scanner in the paneling of the machine or vehicle.
- Mount a frame to prevent access to the area.

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 19 - Unsecured Areas



Item	Description
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.

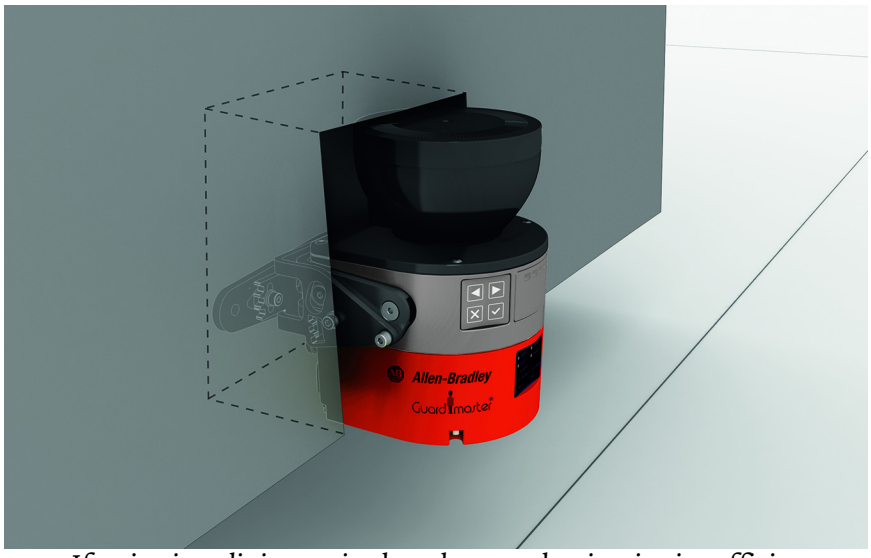
Figure 20 - Mounting with Deflector Plates (Example)

- 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.

Figure 21 - 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.

Figure 22 - Mounting in the Machine or Vehicle's Paneling (Example)



- If a viewing slit is required, make sure that its size is sufficient, see Dimensional Drawings on page 187.

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 on page 171.

The response time of the safety laser scanner resulting from current settings is shown in the 442L Add-on Profile (AOP).

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°.

ATTENTION: 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

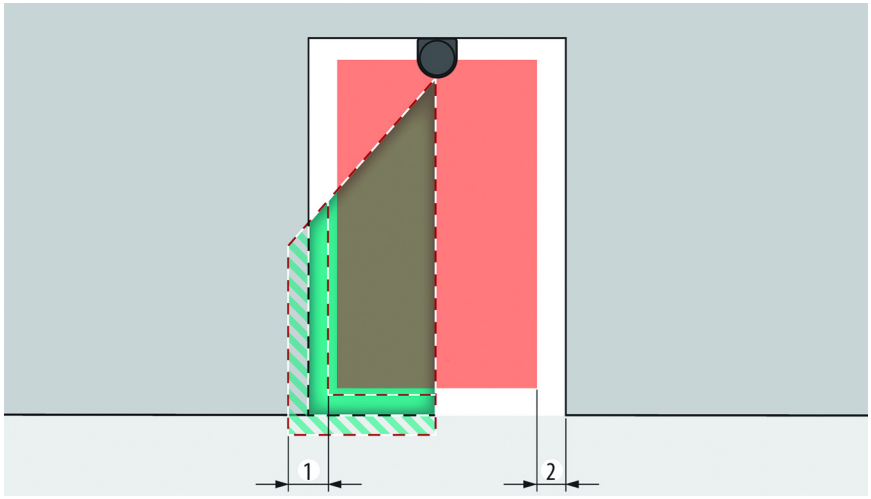
Note the following points in particular when configuring the reference contour field:

- 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 on page 167.)
  - 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 on page 167.)

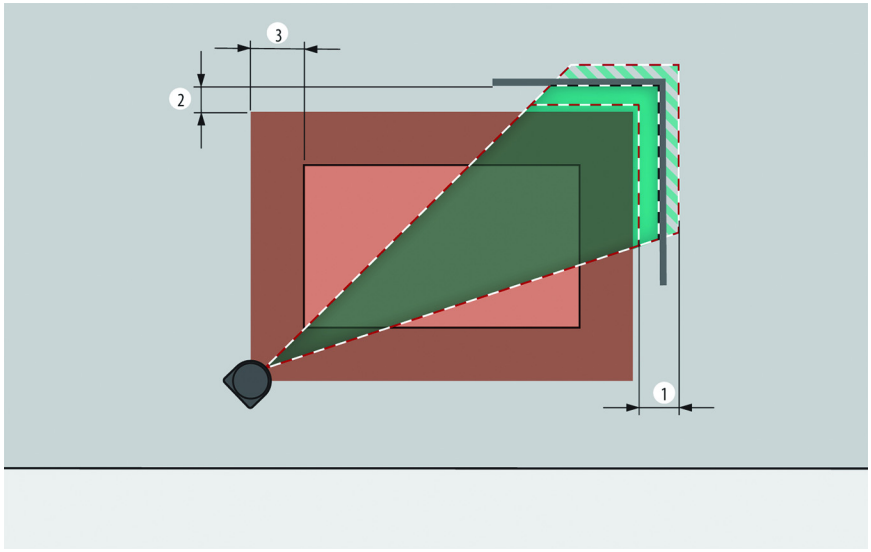
    If the reference contour does not represent the edge of the protected opening, the protective field must be larger than the protected opening. The required overrun (o) is calculated using the same formula as for hazardous point protection.
  - Hazardous point protection:
    The protective field must 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 on page 167.
    d = set resolution
- You can define a number of contours in the reference contour field and so monitor various areas in the environment.

Figure 23 - Tolerance Band of the Reference Contour Field (Protective Field within the Protected Opening, Edge of the Protected Opening = Reference Contour)



Item	Description
1	Tolerance band of the reference contour field
2	Distance of the protective field from the reference contour, to ensure availability

Figure 24 - Overrun of the Protective Field in Front of an Opening



Item	Description
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

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) can ensure protection.

ATTENTION: 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.

ATTENTION: 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. These include the network cycle time and the processing time of a control, 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 switch-on delay (“Input delay”).
- 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) (only when using Assembly 100)
   - t_I = processing time for the selected switching type in milliseconds (ms)
     Switching signal via network: t_I = 28 ms
2. Then, calculate how much time is available in the response time for switching between monitoring cases:
   $t_{CSA} = (n - n_{CS}) \times t_S$
   where:
   - t_{CSA} = time available for switching between monitoring cases in milliseconds (ms)
   - n = set multiple sampling (default: n = 2)
   - n_{CS} = multiple sampling after switching between monitoring cases (with setting Fast (presetting): $n_{CS} = 1$, with setting Reliable: $n_{CS} = n - 1$, with setting User-defined: $n_{CS} \leq n - 1$)
   - t_S = scan cycle time (poss. incl. supplement due to interference protection) in milliseconds (ms)

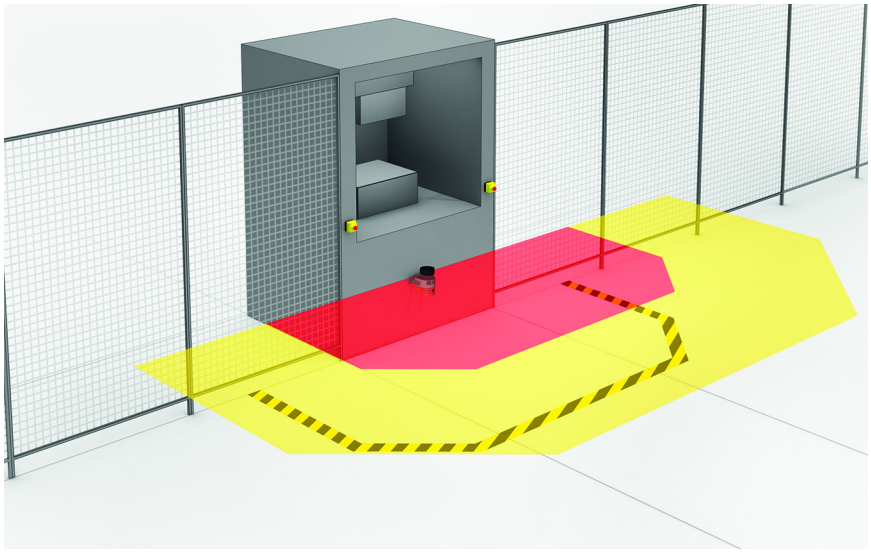
3. Then, check whether there is enough time available for switching between monitoring cases:
   - If $t_{CSA} \geq t_{CSR}$: Earlier start is not necessary.
   - If $t_{CSA} < t_{CSR}$: You must start switching between monitoring cases earlier. The time advance t_{CSP} required is: $t_{CSP} = t_{CSR} - t_{CSA}$

IMPORTANT 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.
- Temporarily monitor both hazardous areas simultaneously.

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 25 - Stationary Application with Horizontal Scan Plane for Hazardous Area Protection



IMPORTANT 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.

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 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.

ATTENTION: 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.

ATTENTION: 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 on page 43.

IMPORTANT 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. (1)

Always take the actual response time into account when calculating the minimum distance, see Response Times on page 171.

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 (Protective Field Range on page 172), recalculate the minimum distance on the basis of the response time for a large scan cycle time.

(1) 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.

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, including signal propagation times in the network and processing time in the control)
- Response time of the protective device, see Response Times on page 171

- 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 More information is available in the ISO 13855 standard.

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 on page 167
- 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.

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[(a)]. 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.

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 26 - Protection Against Reaching Over when Mounted Low (Dimensions in mm)

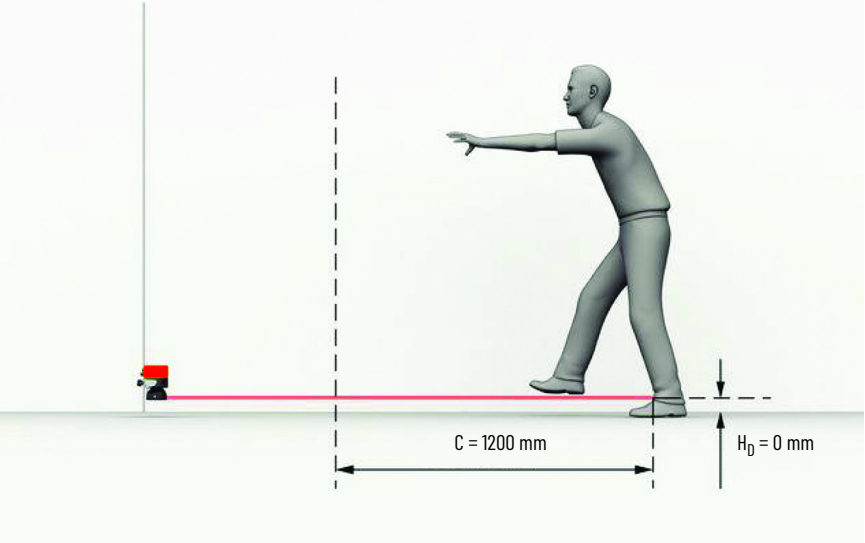
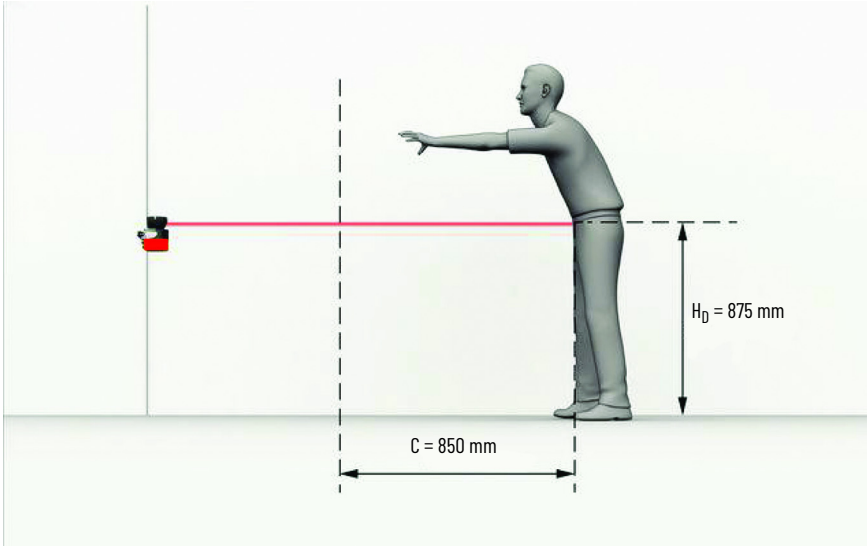


Figure 27 - Protection Against Reaching Over when Mounted High (Dimensions in mm)



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:
  $C = 1200\ mm - (0.4 \times H_D)$

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

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).

Height of the Scan Plane

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 (Figure 28). 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 (Figure 29).

Figure 28 - Scan Plane at Ankle Height

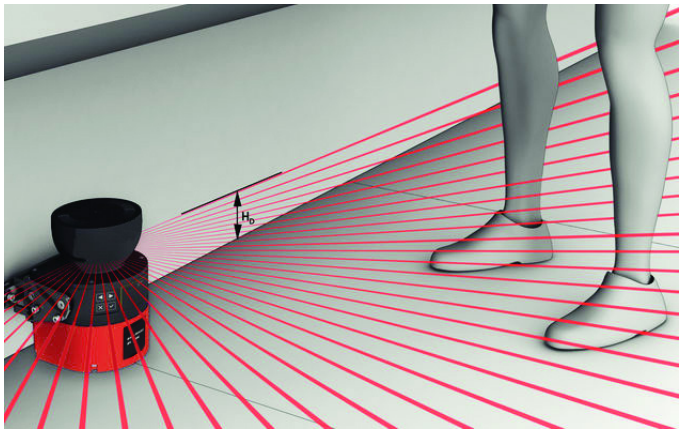
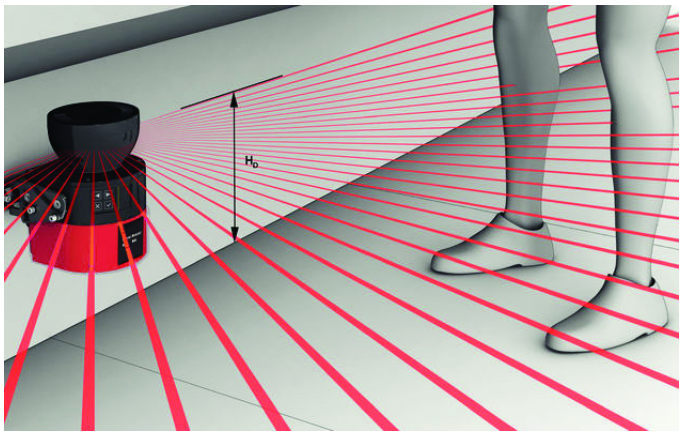


Figure 29 - Scan Plane at Calf Height



ATTENTION: 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.

ATTENTION: 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).

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:

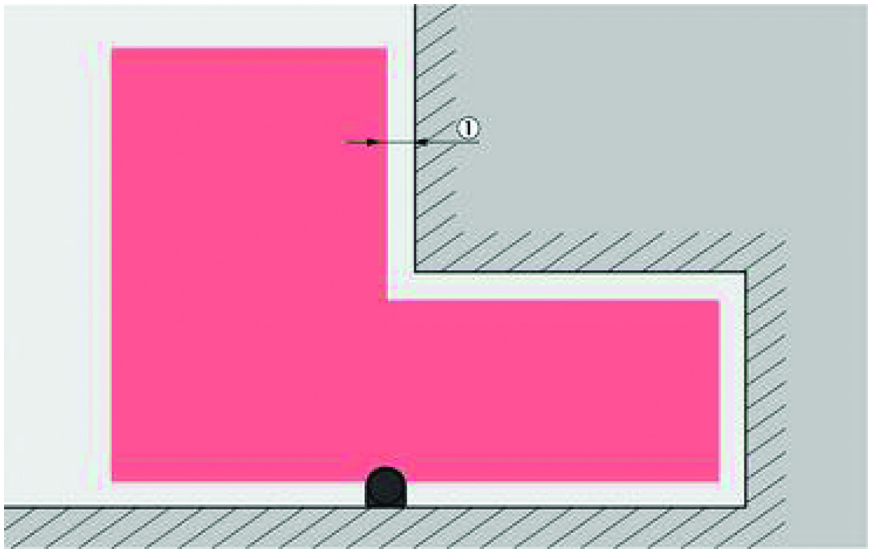
- d_r = coarsest permissible resolution of the safety laser scanner in millimeters (mm)
- H_D = height of the protective field above the floor in millimeters (mm)

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 ($d \leq d_r$).

Distance from Walls

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 on page 167.)

Figure 30 - Distance of the Protective Field from the Wall



Item	Description
1	Recommended distance of the protective field from the wall.

ATTENTION: 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:

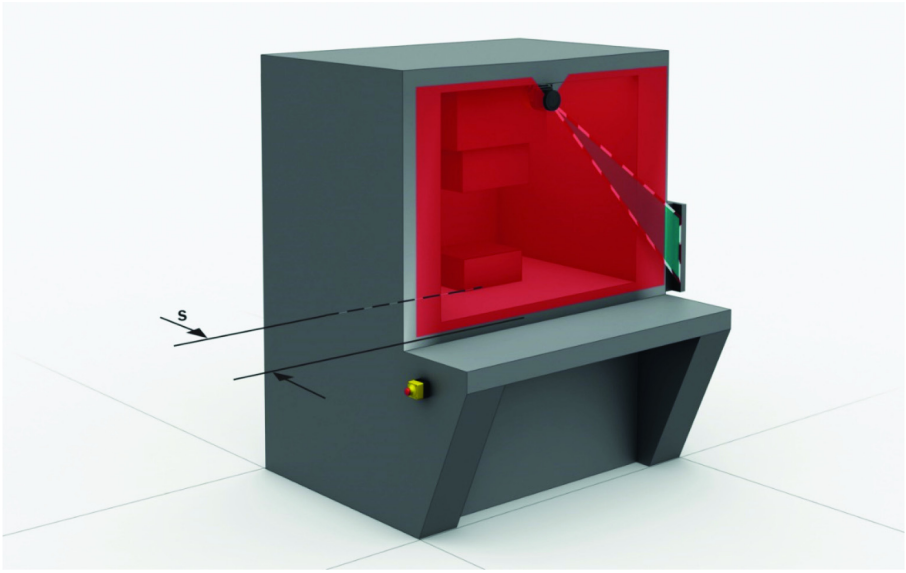
- Attaching deflector plates
- Attaching fence

Hazardous Point Protection

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 31 - Stationary Application in Vertical Operation for Hazardous Point Protection



ATTENTION: 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 on page 34).

ATTENTION: 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 ZR = 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.

ATTENTION: 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.

ATTENTION: 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.

IMPORTANT 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 (the time interval between triggering the sensor function and the end of the machine's dangerous state, including signal propagation times in the network and processing time in the control)
- Response time of the protective device, see Response Times on page 171
- 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

IMPORTANT More information is available in the ISO 13855 standard.

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:

$S = 2000\ mm/s \times T + 8 \times (d - 14\ mm)$

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:

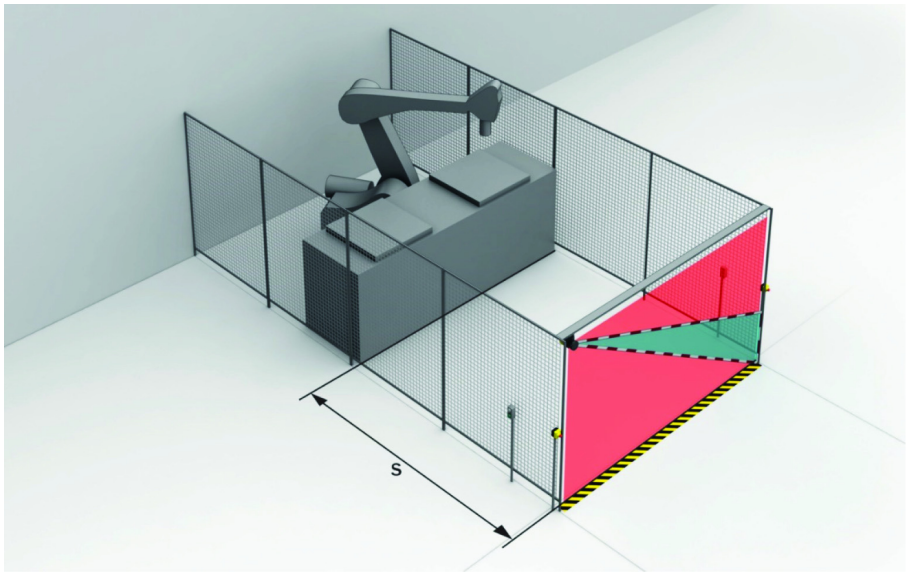
  $S = 1600\ mm/s \times T + 8 \times (d - 14\ mm)$

  - 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.

Access Protection

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 32 - Stationary Application in Vertical Operation for Access Protection



ATTENTION: 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 (Reference Contour Monitoring on page 34).

ATTENTION: 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 ZR = 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.

ATTENTION: 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, including signal propagation times in the network and processing time in the control)
- Response time of the protective device, see Response Times on page 171
- 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

IMPORTANT More information is available in the ISO 13855 standard.

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:

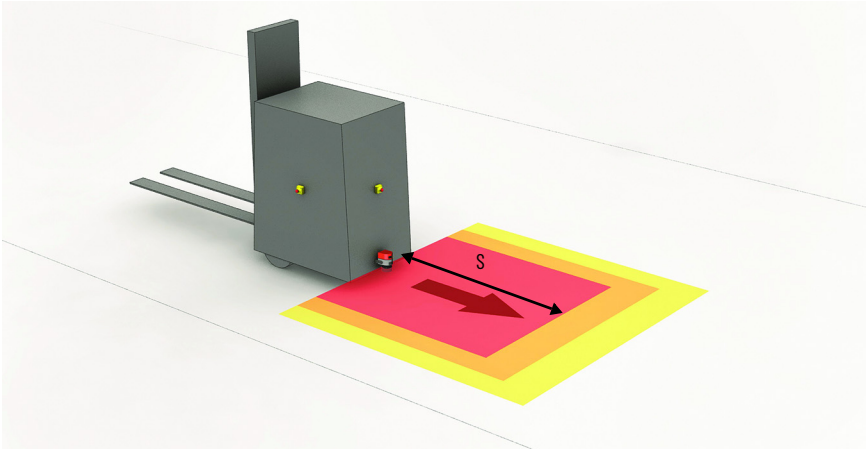
- S = minimum distance in millimeters (mm)
- T = stopping/run-down time for the entire system in seconds (s) (Response time of the safety laser scanner + machine's stopping/run-down time, incl. response time of the machine's control system and signal propagation time)

The approach speed is already included in the formula.

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 33 - Mobile Application in Horizontal Operation for Hazardous Area Protection



ATTENTION: 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.

IMPORTANT

- 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.

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.

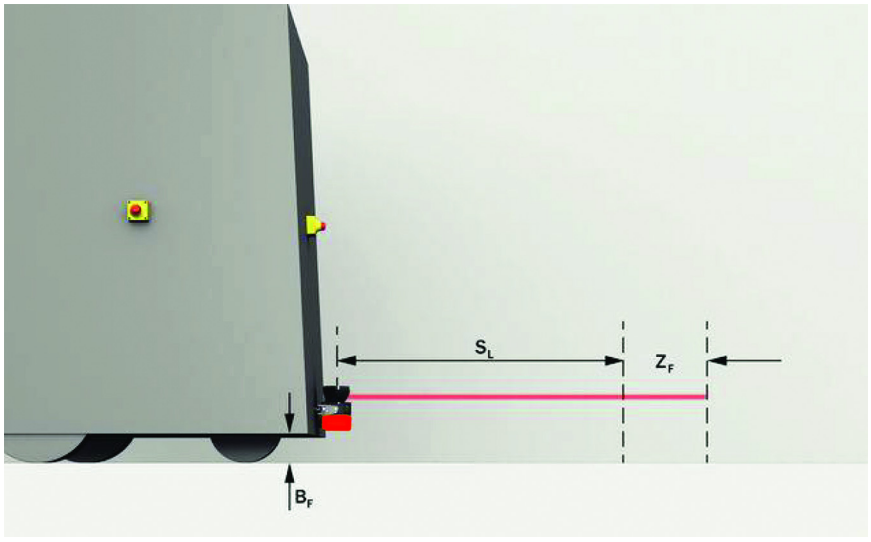
Supplement Z_R for Reflection-based Measurement Errors

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.

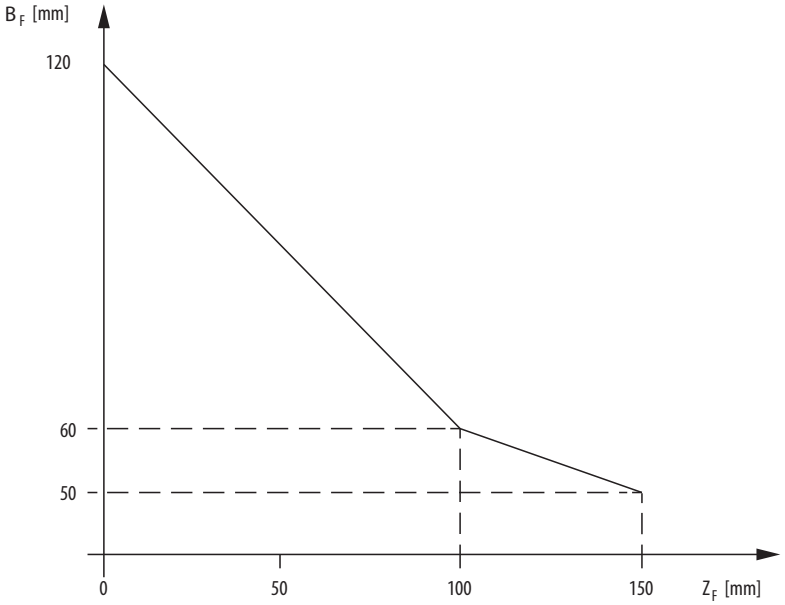
Figure 34 - Flat-rate Supplement Z_F for Lack of Ground Clearance



Item	Description
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 35 - Minimum Supplement for Lack of Ground Clearance



Item	Description
B_F	Ground clearance
Z_F	Supplement for lack of ground clearance

Calculation Example for the Protective Field Length S_L

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

where:

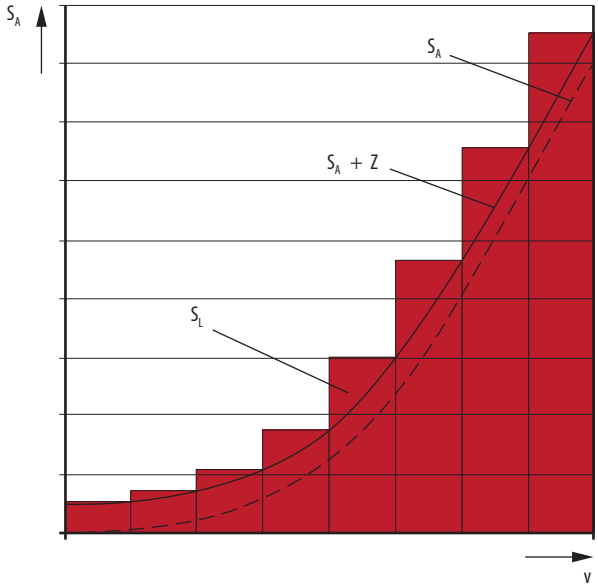
- S_L = protective field length in millimeters (mm)
- S_A = stopping distance in millimeters (mm)
- TZ = tolerance range of the safety laser scanner, see Data Sheet on page 167
- Z_R = supplement for reflection-based measurement errors in millimeters (mm)
- Z_F = supplement for lack of ground clearance 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).

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

Figure 36 - Stopping distance as a function of the vehicle's speed



Item	Description
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 on page 171)
- 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)

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 on page 50.

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 on page 167
- 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)

IMPORTANT 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.

Height of the Scan Plane

ATTENTION: 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 37 - Recommended Fitting Height

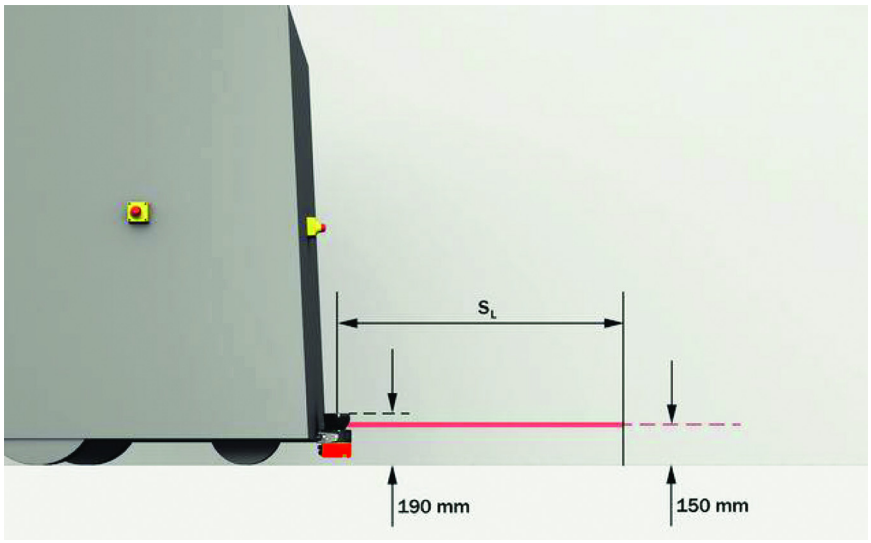
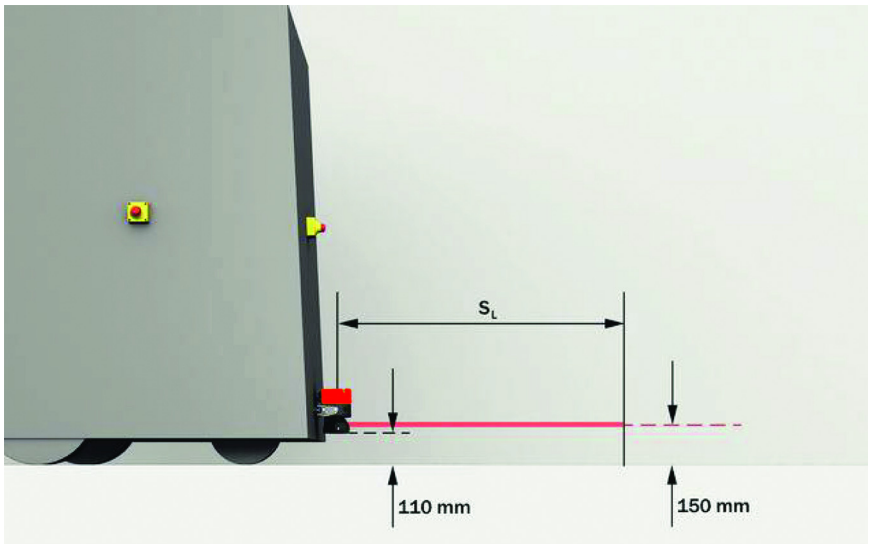


Figure 38 - Recommended Fitting Height for Inverted Mounting



Integrating the Equipment into the Electrical Control

This section contains important information about integration in the electrical control. Information about the individual steps for electrical installation of the device: see Electrical Installation on page 77.

Information about pin assignment: see Pin Assignment on page 78.

Requirements for Use

The protective device delivers safety-related shut-off signals via the network. Reliable evaluation and switch-off of the machine must be realized in the machine controller.

ATTENTION: 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.
- 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).

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

Voltage Supply

ATTENTION: 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 withstand 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 on page 167.
- 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 Rockwell Automation, see Connection Technology on page 194.
- 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 on page 167.

- 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.

Control Inputs

The safety laser scanner can accept signals for switching between monitoring cases via the network.

Depending on the assembly used, the monitoring case can be switched to different types, see Assemblies on page 64. Assembly 100 represents locally connected static control inputs

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) can ensure protection, see Monitoring Case Switching Time on page 36.

Static Control Inputs

The static control inputs represented in Assembly 100 support the following evaluation methods:

- Complementary analysis
- 1-of-n-evaluation

You can define the switching criteria for the monitoring cases (see Monitoring Cases on page 123).

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 3 - 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 two 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.

1-of-n-evaluation

In the 1-off-n-evaluation, use the channels of the control inputs represented in Assembly 100 individually.

Table 4 - True Vales with 1-off-n-evaluation with 2 Input Pairs (Example)

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

IMPORTANT At any time, exactly one channel must have logic value 1.

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.

The connection can also be used for configuration, diagnostics, and data output.

Data output includes data on the active monitoring case and data relating to field interruptions, for example.

Data output can be used for general monitoring and control tasks. This data must not be used for safety-related applications.

Information about pin assignment: see Ethernet for EtherNet/IP - CIP Safety, Data Output, Configuration, and Diagnostics (XF1, XF2) on page 79.

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 push button 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.

ATTENTION: Hazard due to lack of effectiveness of the protective device
The dangerous state may not be stopped in the event of non-compliance.

If a protective field is interrupted, the safety output switches to the OFF state for at least 80 ms, even if the interruption is shorter than that time. It is possible that the control will not detect the OFF state in the event of a very short protective field interruption, e.g. if the network time expectation (1) is greater than 80 ms.

The internal restart interlock of the safety laser scanner must be used to end the dangerous state.

- If the network time expectation is longer than 80 ms, use the internal restart interlock of the safety laser scanner.

(1) The network expectation time is sometimes referred to as the connection reaction time limit.

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 push button.
- 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.

With safety outputs via the network, resetting is done via a network signal.

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 push button, which is outside the hazardous area. If there is an object in the protective field when the reset push button 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 39 - How the Restart Interlock Works (1): No One in Protective Field, Machine Operates

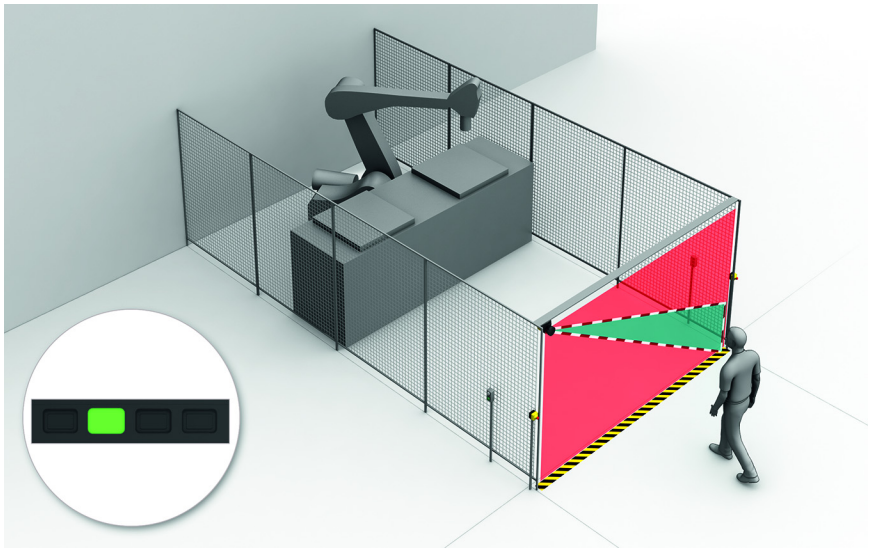


Figure 40 - How the Restart Interlock Works (2): Person Detected in Protective Field, Safety Output in OFF State

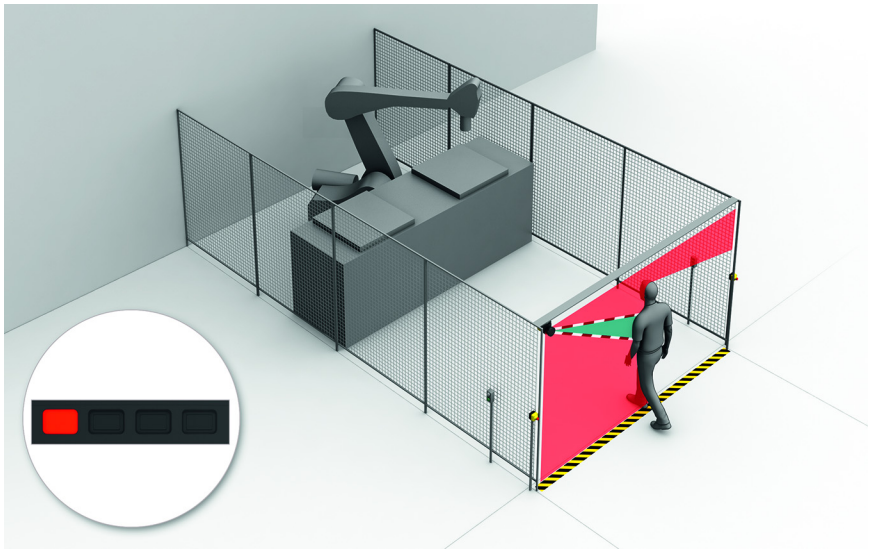


Figure 41 - How the Restart Interlock Works (3): Person in Hazardous Area, No Detection in Protective Field, Safety Output Still in OFF State

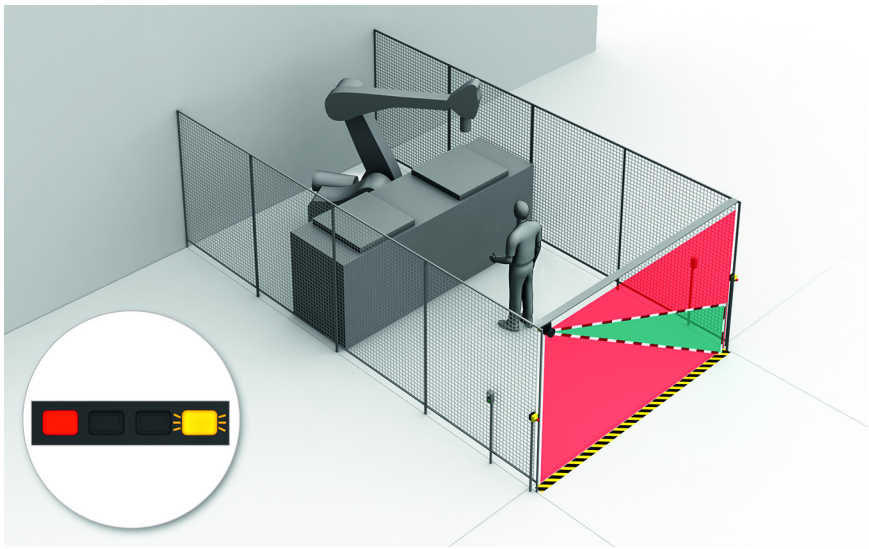
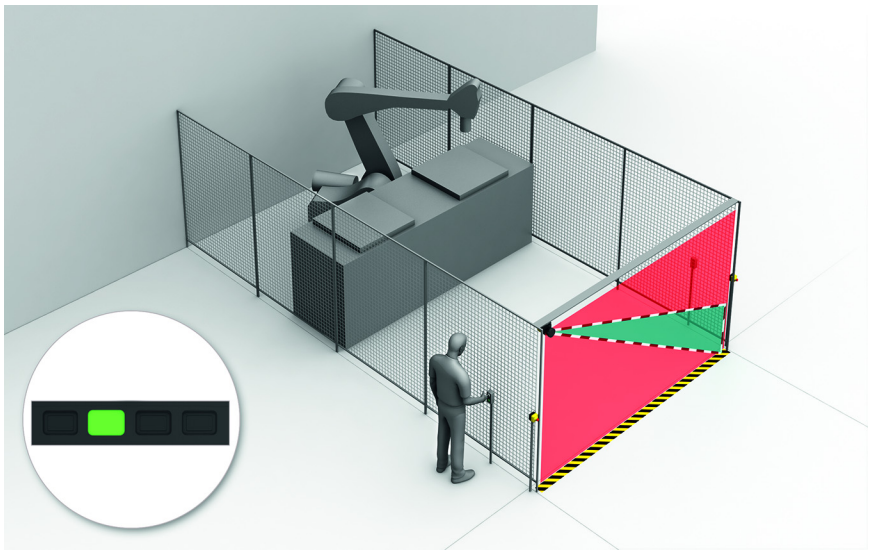


Figure 42 - How the Restart Interlock Works (4): The Reset Push Button Must be Pressed Before Restarting the Machine



ATTENTION: 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.

Integration into the Network of the Control

Network Topology

The device is suitable for the following network topologies:

- Star
- Linear
- Device Level Ring (DLR)

Integration of the Safety Laser Scanner into the Network

ATTENTION: Danger due to unintended use of SIL 2 data of the safety laser scanner in SIL 3 applications
- Ensure that the safety-related data of the safety laser scanner is only used in applications which do not exceed safety integrity level SIL 2 (IEC 61508) of the safety laser scanner.

Before integrating an already-configured safety laser scanner into a safety-related network: reset the safety laser scanner to its factory settings, see Factory Settings on page 131.

Addressing

The safety laser scanner needs a unique IP address, the subnetwork mask and, possibly, the IP address of the router to be able to exchange data with other devices in the network.

Options for assigning the data to the safety laser scanner:

- In the 442L AOP in the Addressing dialog box
- With a BOOTP- or DHCP server
- Via CIP with the TCP/IP object (0xF5)

Upon delivery, the safety laser scanner requests an IP address via BOOTP and DHCP. Once the safety laser scanner has received an IP address, it can only be changed via the AOP or via CIP with the TCP/IP object (0xF5).

Assigning Safety Network Number

The safety laser scanner requires a safety network number (SSN) in a safety-relevant EtherNet/IP network. The SNN should be identical for all devices in a safety-related EtherNet/IP network for V20. For revisions V21 and newer, the SNN does not have to be identical for all devices in a safety-related EtherNet/IP network. The safety network is identified using the SNN. The SNN is a 48-bit identifier.

You can assign the safety network number to the safety laser scanner in the AOP in the General dialog box

A function of automatic setting of the safety network number is not supported.

Integration into a Control

If the safety laser scanner has already been connected to a control and should be connected to another control, the link to the old control must be explicitly removed.

You can remove the link to a control in different ways:

- Click Remove link to control (reset ownership) in the 442L AOP in the EtherNet/IP dialog box
- Reset the device to the factory settings in the 442L AOP in the Factory settings dialog box

Configuring Control

You will find information below on entries in the configuration software for the control unit.

Information about the configuration of the safety laser scanner see Configure the SafeZone 3 Safety Laser Scanner on page 85.

ATTENTION: Hazard due to lack of effectiveness of the protective device The dangerous state may not be stopped in the event of non-compliance.

If a protective field is interrupted, the safety output switches to the OFF state for at least 80 ms, even if the interruption is shorter than that time. It is possible that the control will not detect the OFF state in the event of a very short protective field interruption, e.g. if the network time expectation(1) is greater than 80 ms.

The internal restart interlock of the safety laser scanner must be used to end the dangerous state.

- If the network time expectation is longer than 80 ms, use the internal restart interlock of the safety laser scanner.

(1) The network expectation time is sometimes referred to as the connection reaction time limit.

IMPORTANT With safety modules (unlike with other modules), some of the following steps can only be taken in offline mode.

IMPORTANT At rok.auto/pcdc, you will find an electronic data sheet (EDS file) which simplifies integration in many cases.

The configuration software of some safety controllers does not support the connection of safety modules with an EDS file (unlike with non-safe modules). In these cases, the device must be integrated as a generic EtherNet/IP safety module, as described in the following.

IMPORTANT The values named in the following can also be found in the 442L AOP in the EtherNet/IP overview dialog box.

Table 5 - Connection Parameters (Module Definition)

Field	Value
Vendor	1
Product type	158
Product code	SafeZone™ 3 Multizone (Cat. No. 442L-SZNMZCP)
Major revision	1
Minor revision	1
Electronic keyring	According to need: • Exact match: major revision and minor revision must be identical in the configuration and in the device. • Compatible module: the major revision must be identical in the configuration and in the device. The minor revision in the device must be greater than or the same as the minor revision in the configuration.
Input data	Safety
Output data	Safety
Data format	Integer SINT

Table 6 - Connection Parameters (Assembly Data)

Field	Input assembly instance	Output assembly instance	Size (in 8-bit words)
Safety input (from the view of the control)	110	1278	110:8
Safety output (from the view of the control)	1278	100	100:8
Configuration assembly instance	1278		

Table 7 - Safety Parameters

Field	Value
Input (from the view of the control) (1)	
Requested packet interval (RPI)	5 ms (or a multiple of this) The AOP allows an input RPI of 10...500 ms. The safety laser scanner faults if a non-multiple of five is chosen. To clear the fault, choose an RPI value that is a multiple of five and apply. 20 ms is default input RPI. (Useful in many cases: 10 ms. Smaller values make network transmission more prone to errors. Larger values lead to longer response times.)
Timeout multiplier	Depending on the network, the required response times and the required availability
Network delay multiplier	Dependent on the complexity of the network: • Simple networks can do with lower values • Complex networks require higher values
Output (from the view of the control) (2)	
Timeout multiplier	Depending on the network, the required response times and the required availability
Network delay multiplier	Dependent on the complexity of the network: • Simple networks can do with lower values • Complex networks require higher values

(1) These values affect the response time of the entire safety function.
(2) These values affect the time needed to switch monitoring cases.

IMPORTANT You can assign your own alias names (tag names) and descriptions for the data areas (controller tags). This facilitates the use of inputs and outputs in the logic.

Available Data

The safety laser scanner provides certain data via explicit messaging, e.g. for diagnostic purposes. Certain functions can also be called up via explicit messaging.

The data is organized in CIP objects. You will find the CIP objects provided by the safety laser scanner in the following.

Standard objects (open objects), see page 175

Manufacturer-specific objects (vendor-specific objects), see page 180

- Current Error Object (0x400) on page 180
- Operating Time Object (0x401) on page 181
- Config Info Object (0x402) on page 181
- Device Info object (0x403) on page 182

Assemblies

The cyclical data transmission between the control and safety laser scanner is done via implicit messaging in CIP and CIP Safety.

The safety laser scanner receives and sends the data in assemblies.

The safety laser scanner supports the following assemblies:

- Input of the safety laser scanner, corresponds to the output of the control
  Assembly 100: input of the device, output of the control
- Output of the safety laser scanner, corresponds to the input of the control
  Assembly 110: output of the device, input of the control

Detailed information about the structure of the assemblies: see Assemblies on page 184.

Assembly 100: input of the device, output of the control

- CIP Safety
- Update cycle: 5 ms (or a multiple of this, depending on RPI)
- Length: 8 bytes
- Switching between monitoring cases via dual-channel information, like with devices with locally connected static control inputs.

Available data:

- Restart safety function
- Monitoring case switching
- Activate sleep mode
- Control input
- Reset
- Restarting safety function and connections
- Restart device completely

Assembly 110: output of the device, input of the control

- CIP Safety
- Update cycle: 5 ms (or a multiple of this, depending on RPI)
- Length: 8 bytes

Available data:

- Status of security function
- Status sleep mode
- Contamination warning
- Contamination error

- Reference contour monitoring
- Manipulation
- Cut-off path (safety-oriented)
- Cut-off path (not safety-related)
- Current monitoring case
- Reset required
- Application error
- Device error

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 on page 137.
- The regular thorough checks on the safety laser scanner must fulfill certain minimum requirements, see Minimum Requirements for the Regular Thorough Check.
- In many cases, depending on the application conditions, the risk assessment determines that further thorough checks are required, see Recommendations for Further Thorough Checks on page 66.

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.

Minimum Requirements for the Regular Thorough Check

ATTENTION: 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 on page 66.
- Thorough check of the detection capability (resolution) in the context of the Thorough Check of the Area to be Protected on page 67.

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.

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 on page 68
- Test of the Contour Detection Field on page 68
- Thorough check of the relevant points on the checklist, see Checklist for Commissioning on page 196

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

- Thorough Visual Check of the Machine and the Protective Device on page 68
- Thorough Check of the Principal Function of the Protective Device

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.

Carrying Out Thorough Checks

Thorough Check of the Principal Function of the Protective Device

We recommend the following procedure:

1. 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.
2. 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 test object and observe whether the machine stops.
   - Mobile application (mobile hazardous area protection):
     Place the 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

We recommend the following procedure:

- Hazardous area protection
  a. Position the 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.
  b. 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
  a. Move the 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.
  b. If a number of protective fields are used (in different monitoring cases for example), check the edges of all protective fields.
  c. 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
  a. Place the test object in the path of the vehicle and check whether the vehicle comes to a stop in time.
  b. 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.
  c. 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.
  d. 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 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

We recommend the following procedure:

1. Check whether the machine or the protective device has been modified or manipulated so that the effectiveness of the protective device may be impaired.
2. Check the following points in particular:
   a. Has the machine been retrofitted?
   b. Have machine parts been removed?
   c. Have modifications been made to the machine's surroundings?
   d. Are there any defective cables or open cable ends?
   e. Have the protective device or its parts been dismantled?
   f. Is the protective device damaged?
   g. Is the protective device severely contaminated?
   h. Is the optics cover contaminated, scratched or destructed?
   i. Has the protective device's alignment been changed?
   j. 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.

Mounting

Safety

Information about the requirements for properly mounting the safety laser scanner, see Assembly on page 29.

ATTENTION: 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.

ATTENTION: 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 brackets approved by Rockwell Automation 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 on page 167.

ATTENTION: 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.

IMPORTANT Mount the SafeZone™ 3 safety laser scanner in the following order.

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 on page 189.

Mounting Procedure

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

- Mounting directly without a mounting kit
- Mounting using mounting kit 1 (catalog number 442L-AMBSZCP1)
- Mounting using mounting kits 1 and 3 (catalog number 442L-AMBSZCP3)

The mounting kits 1 and 3 are built upon one another. This means that for mounting using mounting kit 3, 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.

ATTENTION: 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 on page 29.
- Mount the safety laser scanner so that crawling beneath, climbing over and standing behind the protective fields is impossible.

Figure 43 - Prevent Crawling Beneath

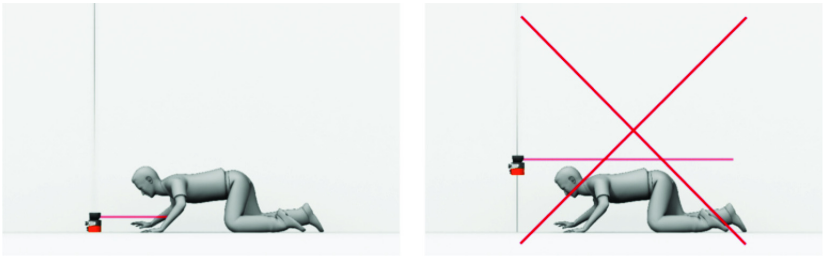


Figure 44 - Prevent Stepping Over

IMPORTANT Read this section completely before mounting the safety laser scanner.

Mounting Instructions

1. 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.
2. Mount the safety laser scanner so that it is protected from moisture, dirt, and damage.
3. Make sure that the safety laser scanner's field of view is not restricted.
4. Make sure that there are not mirrors or other very reflective objects in the protective field.
5. 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.

6. Mount the safety laser scanner so that the status indicators are clearly visible.
7. Mount the safety laser scanner so that you can plug in and pull out the system plug.
8. 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 on page 167.
9. For machines that vibrate heavily, use thread-locking compounds to prevent the possibility of fixing screws coming loose unintentionally.
10. 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 rotated by a maximum of 2.5° about the vertical axis.
11. Location of the scan plane: see Dimensional Drawings on page 187.
12. Take account of the tightening torque for the fixing screws:
    - M5 at rear/at side = 4.5...5.0 N•m
    - M4 at rear/at side = 2.2...2.5 N•m

    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.

Changing Position of the System Plug

You can change the position of the system plug if needed.

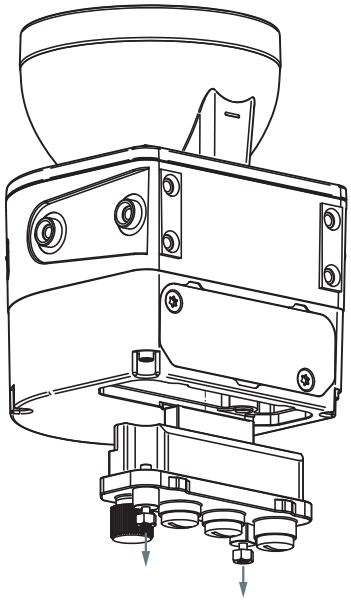
Tool required:

- TX20 Torx wrench

Approach:

1. Loosen the screws of the system plug.
2. Carefully remove the system plug from the safety laser scanner.

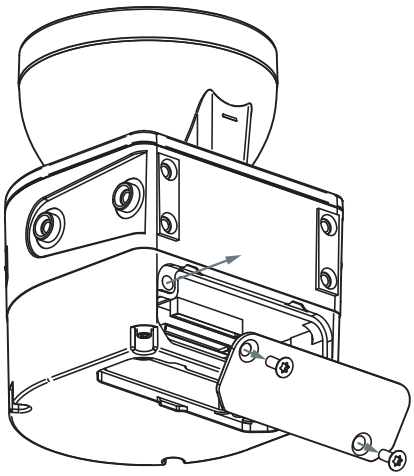
Figure 45 - Change System Plug Position



3. Loosen the cover plate screws.

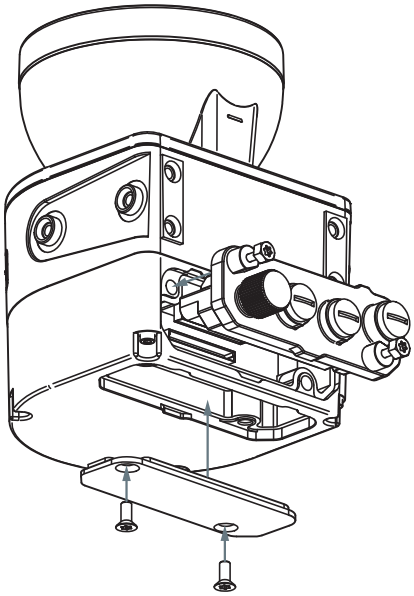
4. Remove the cover plate from the safety laser scanner.

Figure 46 - Remove Back Cover Plate



5. Carefully slide the new system plug into the safety laser scanner at the desired position (bottom or rear).
6. Screw in the system plug using the captive screws. Tightening torque: 2.25…2.75 N•m.
7. Install the cover plate on the safety laser scanner. Tightening torque: 2.25…2.75 •Nm.

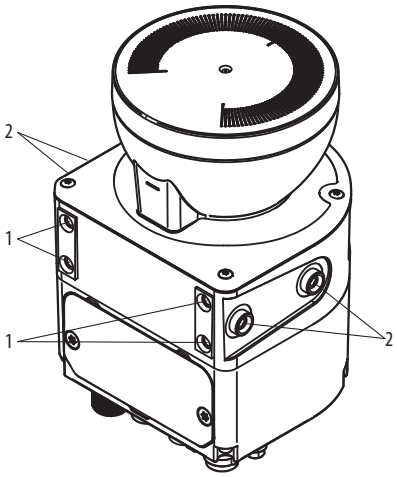
Figure 47 - System Plug



Direct Mounting

The safety laser scanner has four 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



Item	Description
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.
- Use all four rear or all four 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 on page 187).
- Tightening torque: 4.5…5.0 N•m.

Mounting Using Mounting Kit 1 (Catalog Number 442L-AMBSZCP1)

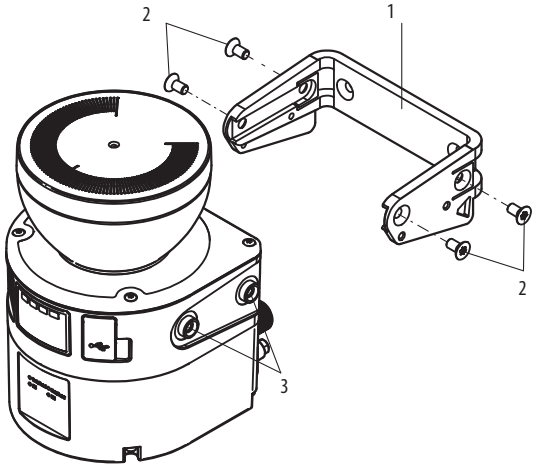
If you are not able to drill through the mounting surface from behind, you can use the mounting kit 1 to mount the safety laser scanner. Mounting kit 1 makes it possible to replace the safety laser scanner easily.

The mounting kit is available as mounting kit 1 without protection for the optics cover and as mounting kit 2 with protection for the optics cover, see Accessories on page 191.

Tool required:

- TX20 Torx wrench

Figure 49 - Mounting Using Mounting Kit 1



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

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

Mounting Using Mounting Kit 3 (Catalog Number 442L-AMBSZCP3)

You can use mounting kit 3 to align the safety laser scanner in two 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 1 or 2 for mounting using mounting kit 3.

Mounting kit 3 consists of two parts: holding plate and alignment bracket.

The mounting kit is available as mounting kit 3 with shallower depth and as mounting kit 4 with greater depth. Mounting kit 4 is recommended when the system plug is installed on the rear side of the safety laser scanner and the angled plug connector is used.

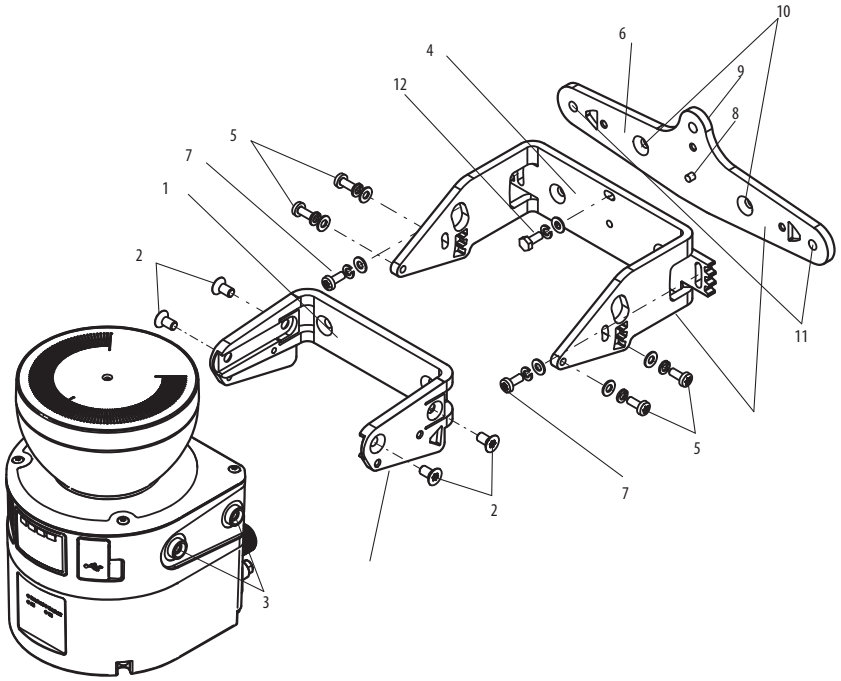
IMPORTANT If you use mounting kit 4 and install the system plug with angled plug connectors on the rear side of the safety laser scanner, the following assembly sequence is recommended:

1. Mount the holding plate and alignment bracket on the mounting surface.
2. Mount cables with M12 plug connectors to the system plug and lay the cables.
3. Install the mounting bracket and safety laser scanner on the alignment bracket.
4. Install the system plug on the safety laser scanner.

Tool required:

- TX20 Torx wrench

Figure 50 - Mounting Using Mounting Kit 3



Item	Description
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

Item	Description
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 4)

1. Make sure that the holding plate is oriented correctly.
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):

   a. Loosen the screws (7) and remove the alignment bracket from the holding plate.

   b. Mount the holding plate on the mounting surface.

   c. Make sure that the alignment bracket is oriented correctly.

   d. 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 1 or 2 is oriented correctly.
4. Use the supplied M4 screws, washers, and spring rings to fix mounting bracket 1 or 2 on the alignment bracket.
5. Only with mounting kit 4: 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 four supplied M5 screws to fix the safety laser scanner on the mounting bracket.
8. Tighten the M5 screws. Tightening torque: 4.5…5.0 N•m.
9. Align the safety laser scanner. You can use a slotted screwdriver (blade width 8 mm) for fine alignment, see Alignment on page 136.
10. Tighten the M4 screws. Tightening torque: 2.2…2.5 N•m.

Electrical Installation

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 on page 55.

IMPORTANT Mounting should be completed before electrical installation.

ATTENTION: 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.

ATTENTION: 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.
- Connect functional earth correctly.

IMPORTANT Enclosure rating IP65 only applies if the safety laser scanner is closed and the system plug is mounted.

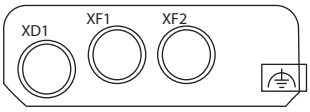
- Mount the system plug and the cover plate.
- Close each M12 plug connector on the safety laser scanner using a male cable connector or a protective cap.
  Tightening torque for plug connector: 0.4...0.6 N•m.
  Tightening torque for protective caps: 0.6...0.7 N•m.
- Mount the optics cover.

Connection Overview

The permanent connections are contacted via M12 plug connectors.

SafeZone 3 Laser Scanner - EtherNet/IP

Table 8 - System Plug and Connections: SafeZone™ 3 Laser Scanner - EtherNet/IP™

Safety Laser Scanner	Suitable system plug	Plug connector
SafeZone 3 Laser Scanner - EtherNet/IP	 Cat. No. 442L-SZNCPMOD	• XD1: voltage supply, page 78 • XF1, XF2: 2 × Ethernet for EtherNet/IP - CIP Safety, data output, configuration, and diagnostics, page 79 • Alternative FE connection, page 78

Pin Assignment

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

Voltage Supply (XD1)

Voltage supply is supplied via a 4-pin, A-coding M12 male connector on the device side.

Figure 51 - Pin Assignment of the Voltage Supply (Male Connector, M12, 4-pin, A-coded)

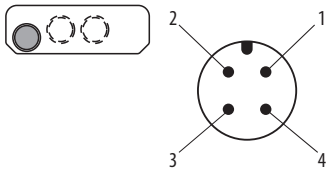


Table 9 - Pin Assignment of the Voltage Supply

Pin	Marking	Function	Wire Color (1)
1	+24V DC	24V DC supply voltage	Brown
2	NC	Not connected	White
3	0V DC	0V DC supply voltage	Blue
4	FE	Functional earth/shield	Black

(1) Applies to the connecting cables recommended as accessories.

Alternative FE Connection

Figure 52 - Alternative FE Connection

Screw connection of the alternative FE connection:

- Screw: M5 × 12
- Tightening torque: 3.5…5.0 N•m

Suitable cable lugs:

- Forked cable lug or ring cable lug
- Width ≤10 mm
- Hole diameter for screw: typically 5.2 mm

The functional earth must be connected via one, and only one of the available FE connections:

- Pin on the M12 plug connector
- Thread on the M12 plug connector
- Alternative FE connection

The functional earth must be connected in a low-inductance manner and with an adequate cross-section while keeping the cable length as short as possible. Functional earth and protection earth must be isolated.

Ethernet for EtherNet/IP - CIP Safety, Data Output, Configuration, and Diagnostics (XF1, XF2)

On the device side, Ethernet and EtherNet/IP are connected via 4-pin, D-coded M12 female connectors. There is a network switch in the safety laser scanner which connects the two Ethernet female connectors. The two Ethernet female connectors therefore have the same function. The pin assignment corresponds to IEC 61918, Appendix H.

Figure 53 - Ethernet Pin Assignment

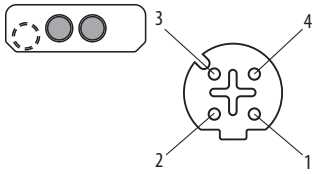


Table 10 - Ethernet Pin Assignment

Pin	Designation	Function
1	TX+	Send data +
2	RX+	Receive data +
3	TX-	Send data -
4	RX-	Receive data -
Thread	SH	Shielding

Notes:

Configure the Ethernet/IP Network

The SafeZone™ 3 safety laser scanner is not configured from the factory. This chapter describes the configuration of the SafeZone 3 safety laser scanner for EtherNet/IP™ via the Logix Designer application.

ATTENTION: Safety Requirements for Integrated Safety Applications
Safety application requirements include evaluating the probability of failure rates (PFD and PFH), system reaction time settings, and functional verification tests.
For safety system requirements, including information on the safety network number (SNN), functional verification test intervals, system reaction time, and PFD/PFH calculations, refer to the GuardLogix® safety reference manual for your controller. You must read, understand, and fulfill the requirements that are detailed in the safety reference manual before operating a safety system that uses this module.

EtherNet/IP connection is established through the two 4-pin M12 female connectors on the back of the SafeZone 3 laser scanner. Table 10 on page 79 shows the EtherNet/IP pin assignment of these two connectors.

It is necessary to configure an Ethernet driver for your workstation. The steps for adding a driver are described below.

Set the Network IP Address

The module ships with DHCP enabled.

ATTENTION: Set a suitable network IP address before connecting the module to a network.

To set the network IP address, use a Dynamic Host Configuration Protocol (DHCP) server, such as Rockwell Automation BootP/DHCP Server Utility.

The subnet mask of the module is 255.255.255.0 and the gateway address is set to 0.0.0.0, the module does not have a host name assigned to it or use any Domain Name System.

DHCP is enabled. The DHCP server also assigns other Transport Control Protocol (TCP) parameters.

Set the IP Address with a BOOTP/DHCP Server

The BOOTP/DHCP server is a standalone server that you can access from either of these locations:

- Programs > Rockwell Software > BOOTP-DHCP Server
  If you have not installed the server, you can download and install it from compatibility.rockwellautomation.com/Pages/MultiProductDownload.aspx?crumb=112
- Tools directory on the Studio 5000® installation CD

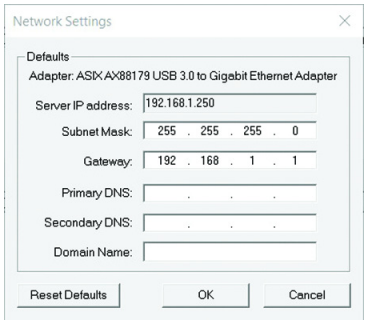
IMPORTANT Before you start the BOOTP/DHCP server, make sure that you have the EtherNet address (MAC ID) of the module. The MAC ID can be found on the display of the SafeZone 3 safety laser scanner.

The BOOTP/DHCP server also limits the possibility of assigning duplicate IP addresses.

If you use the BOOTP/DHCP server in an uplink subnet where an enterprise DHCP server exists, a module can get an address from the enterprise server before the Rockwell Automation utility sees the module. If necessary, disconnect from the uplink to set the address and configure the module to retain the static address before reconnecting to the uplink. This is not a problem if you have configured the node names in the module and leave DHCP enabled.

To set the IP address with a BOOTP/DHCP server, follow these steps.

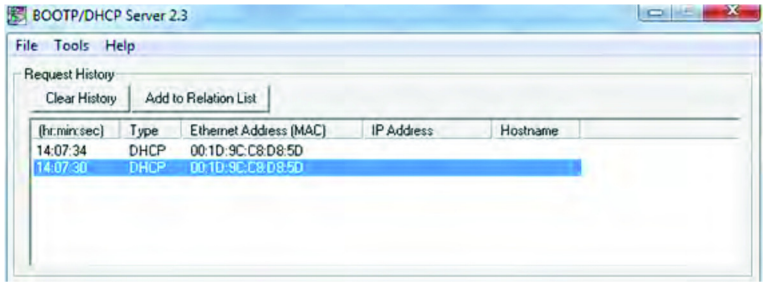
1. Start the BOOTP/DHCP software.
2. From the Tools menu, choose Network Settings.
3. If appropriate for the network, type the Subnet Mask, Gateway address, Primary and/or Secondary DNS address, and Domain Name.



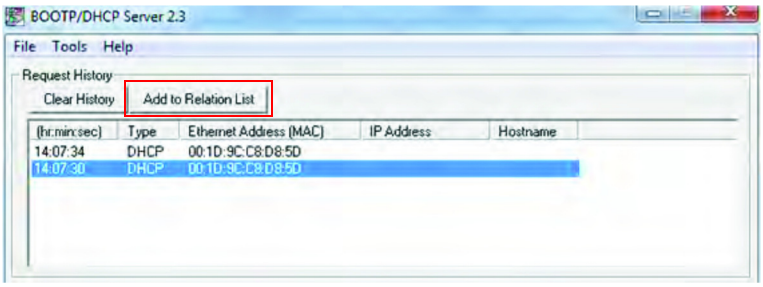
4. Click OK.

The Request History panel displays the MAC IDs of modules that issue DHCP requests.

5. Select the appropriate module.

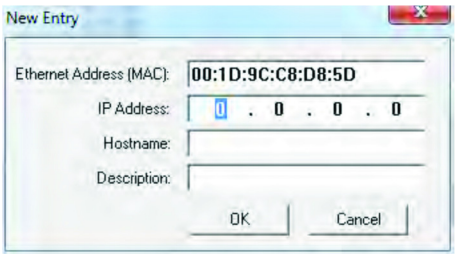


6. Click Add to Relation List.

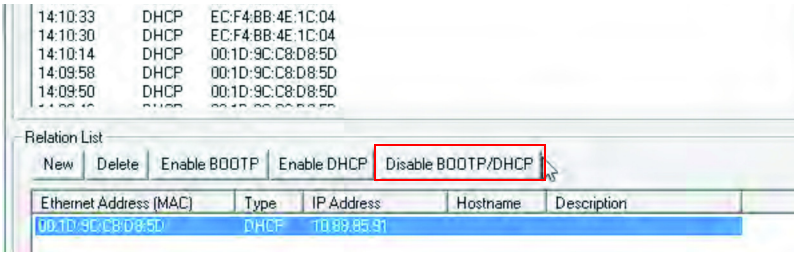


The New Entry dialog box appears

7. Type an IP Address, Hostname, and Description for the module



8. Click OK.
9. To assign this configuration to the module, wait for the module to appear in the Relation List panel and select it.
10. Click Disable BOOTP/DHCP.



IMPORTANT If clicking Disable BootP does not work, right-click the item in the Relation List and select Disable BootP/DHCP in pop-up menu.

The module now uses the assigned configuration and will no longer issue DHCP requests.

IMPORTANT If you do not select Disable BOOTP/DHCP, then on a power cycle the module clears the current IP configuration and begins sending DHCP requests again.

Duplicate IP Address Detection and Resolution

The module verifies that its IP address does not match any other module IP address on the network when you perform either of these tasks:

- Connect the module to an EtherNet/IP network.
- Change the IP address on the module.

If the IP address matches that of another module on the network, the EtherNet/IP port on the module transitions to conflict mode. In conflict mode, the Network (NET) status indicator is steady red.

Table 11 on page 84 describes how to resolve duplicate IP addresses.

Table 11 - Duplicate IP Addresses

Duplicate IP Address Detection Conditions	Resolution Process
• Both modules support duplicate IP address detection. • Second module is added to the network after the first module is operating on the network.	1. The module that began operation first uses the IP address and continues to operate without interruption. 2. The module that begins operation second, detects the duplication and enters Conflict mode. 3. Assign a new IP address to the module that is in Conflict mode.
• Both modules support duplicate IP address detection. • Both modules were powered up at approximately the same time.	Both EtherNet/IP modules enter Conflict mode. To resolve this conflict, follow these steps: 1. Assign a new IP address to one of the modules. 2. Cycle power to the other module.
One module supports duplicate IP address detection and a second module does not.	1. Regardless of which module obtained the IP address first, the module that does not support IP address detection uses the IP address and continues to operate without interruption. 2. The module that supports duplicate IP address detection detects the duplication and enters Conflict mode. 3. Assign a new IP address to the module that is in conflict mode.

Configure the SafeZone 3 Safety Laser Scanner

General Requirements

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

Delivery State

The SafeZone™ 3 safety laser scanner is not configured from the factory. This chapter describes the configuration of the SafeZone 3 safety laser scanner using the 442L Add-on Profile (AOP) software. It also describes transferring configuration data to the SafeZone 3, creating reports and the service options offered by the AOP.

IMPORTANT To transfer a configuration to the SafeZone 3, the user group must be Authorized Client with the factory-default password of ABGM.

The 442L AOP is used to configure the parameters of the SafeZone 3. Before launching the 442L AOP, you must first complete the network configuration in Set the Network IP Address on page 81.

Once the network connection is configured, launch the 442L AOP from the Field set configuration category in the laser scanner properties dialog box.

442L Add-on Profile (AOP)

The safety laser scanner is configured with the 442L AOP.

Installation Assistant

An installation assistant will help you to install the 442 AOP.

1. Call up the download webpage and enter 442L AOP in the search field on rok.auto/pcdc.
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.

Add and Configure a SafeZone 3 Safety Laser Scanner in the Logix Designer Application

An Add-on Profile (AOP) is available for the SafeZone 3 safety laser scanner and can be used with RSLogix 5000® version 20 and higher. The profile can be downloaded from http://www.rockwellautomation.com/global/support/overview.page

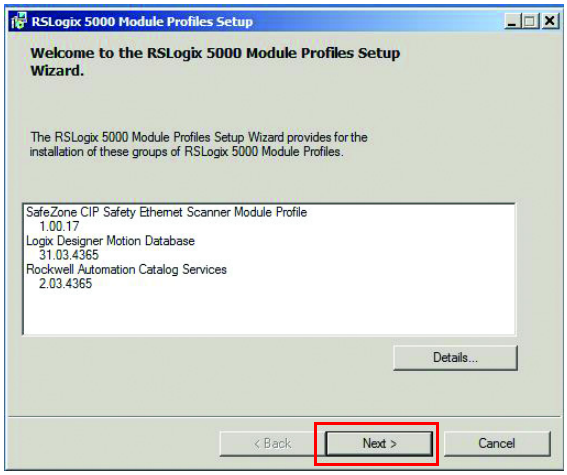
Install the SafeZone 3 Add-on Profile

If this is the first time you have used a SafeZone3 safety laser scanner with a particular instance of Studio 5000 Logix Designer®, you must download and install the AOP. The profile can be downloaded from rok.auto/pcdc.

To install, follow these steps:

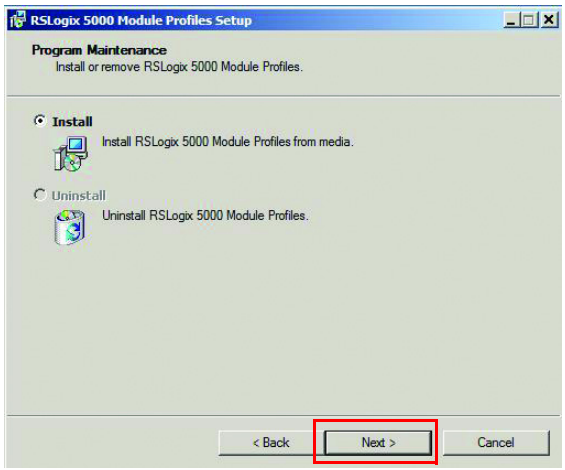
1. In the installation package, double-click MPSetup.exe.

   The Welcome dialog box appears. Click Next.

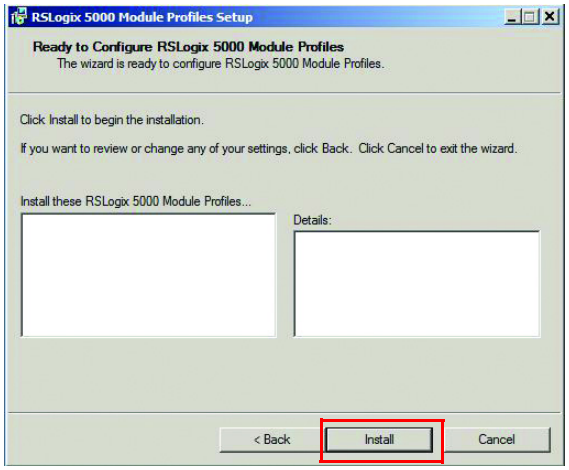


2. Review and accept the license. Click Next.

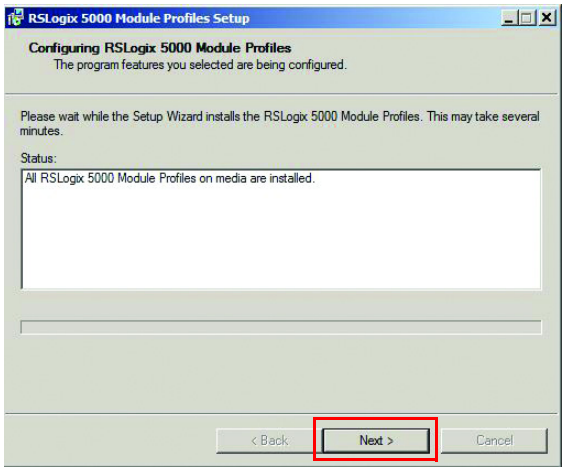
3. Select Install and click Next.



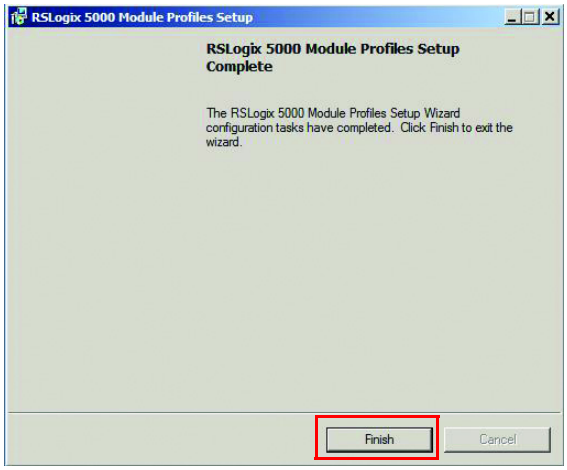
4. The Setup Wizard displays the profiles to be installed. Click Install to start the installation.



5. The Setup Wizard installs the profiles. Once the install is complete, click Next.



6. When the installation is complete, the following dialog box appears. Click Finish.

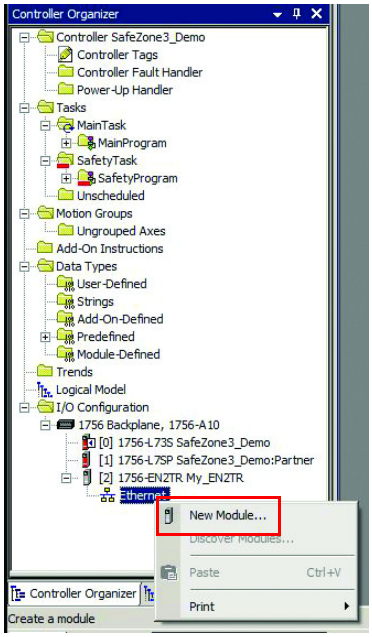


Add Module to the I/O Configuration Tree

Before you begin, you must have a Logix Designer application project with a safety controller that has a connection to the EtherNet/IP network — check the controller user manual for details.

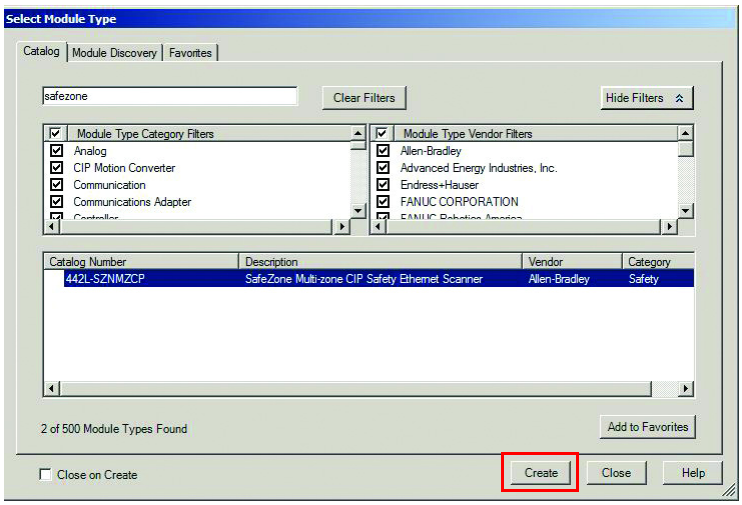
To add a SafeZone 3 safety laser scanner to the I/O configuration tree, follow these steps:

1. From the I/O Configuration tree, right-click the Ethernet bridge module and choose New Module.



2. In the Select Module dialog box, enter SafeZone 3 to see a list of available models.

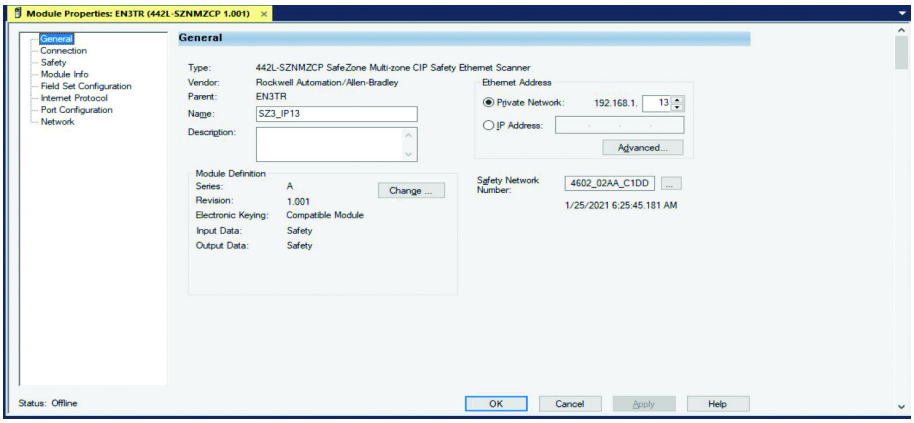
3. Choose the appropriate module, and click Create at the bottom of the dialog box.



Configure the Module

To configure the general properties of the module, follow these steps:

1. If not already open, double-click the module from the I/O configuration tree to see the Module Properties dialog box.

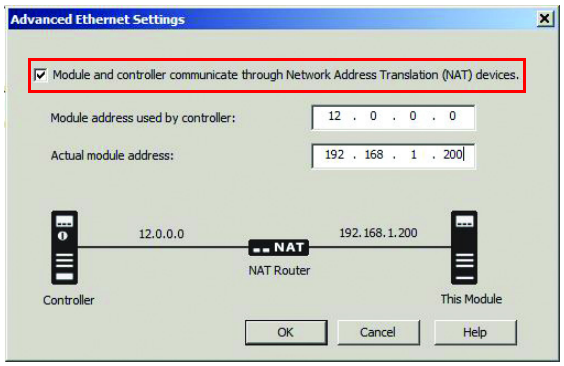


2. Type a unique name for the module.
3. If desired, type a description.
4. If you are not using Network Address Translation (NAT), type the IP address of the module in the IP Address field.

If you are using NAT, follow these steps:

1. In the IP Address field, type the controller IP address.
2. Click Advanced to open the Advanced Ethernet Settings dialog box

   Check the box to indicate that this module and the controller communicate through NAT modules.



3. Type the actual module address.

   If you configured the IP address using the BOOTP/DHCP, this is the address you set on the module.

4. Click OK.

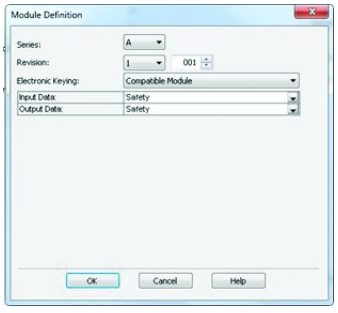
IMPORTANT When NAT is used in a safety application with a GuardLogix® controller, the module does not accept a safety connection unless the actual module address is provided.

Change the Module Definition

On the General tab, click Change to open the Module Definition dialog box, and enter the following.

- Series, major and minor revisions
- Electronic keying

The catalog number in the Type field represents the catalog number of the module being used.



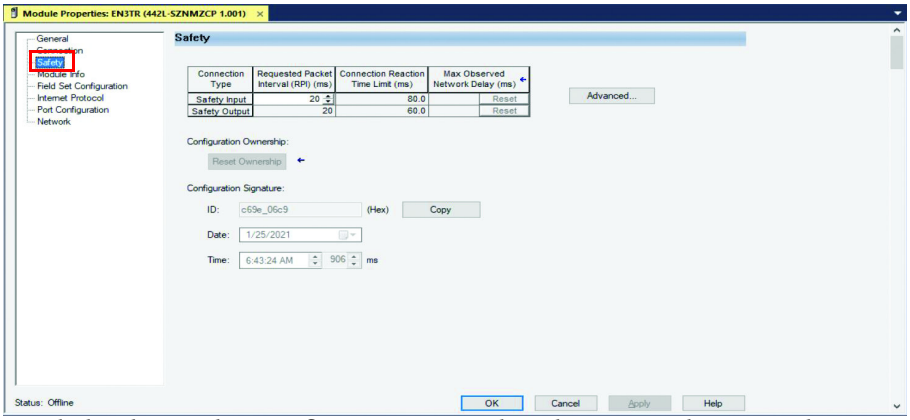
Save and Download the Module Configuration

After the module is configured, download the project to the controller. It is recommended that the project be saved prior to downloading.

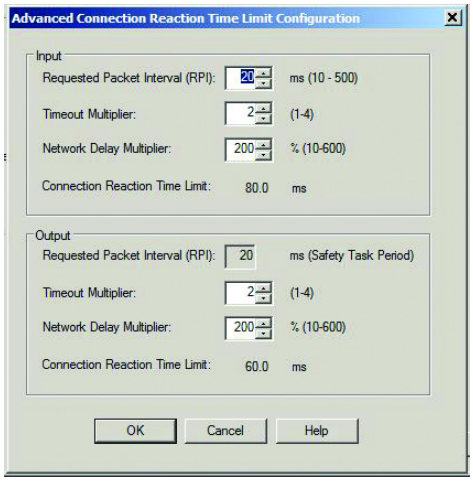
Configure the Safety Connection

Follow these steps to complete entries when you choose the Safety tab.

1. From the Module Properties dialog box, choose the Safety tab to see the Safety dialog box.



2. Click Advanced to configure Requested Packet Interval (RPI) and Configure Connection Reaction Time Limit (CRTL)



We suggest that you keep the Timeout Multiplier and Network Delay Multiplier at their default values of 2 and 200.

See GuardLogix® Controllers User Manual listed in the Additional Resources on page 12, for more information about the CRTL.

IMPORTANT Make sure that input RPI is set to match the need. The RPI value must be between 10...500 ms and be divisible by 5, otherwise, the module fault "(Code 16#0111) Requested Packet Interval (RPI) out of range." is shown.

The smallest input RPI supported by the module is 10 ms. The AOP allows an input RPI of 10...500 ms. The safety laser scanner faults if a non-multiple of five is chosen. To clear the fault, choose an RPI value that is a multiple of 5 and apply. The default value is 20 ms. Selecting an appropriate RPI will result in a system with maximum (best) performance.

As an example, a safety input module with only E-stop switches connected to it generally can work well with settings of 50...100 ms. An input module with a light curtain guarding a hazard can need the fastest response that is possible.

Appropriate RPI selection results in a system with maximum (best) performance.

IMPORTANT	Analyze each safety channel to determine what is appropriate. The default time out multiplier of two and network delay multiplier of 200 will create an input connection reaction time limit of four times the RPI and an output connection reaction limit of three times the RPI. Changes to these parameters must be approved by a safety administrator.

A connection status bit (Connection Faulted) exists for every connection.

Configure and Reset Ownership

The Reset Ownership button on the 442L AOP Safety page is inoperable. Reset Ownership is done in the SafeZone 3 configuration tool on the following tab: Service>EtherNet/IP.

The Reset Ownership button on the 442L AOP Safety page is inoperable. Reset Ownership is done in the SafeZone 3 configuration tool on the following tab: Service>EtherNet/IP. The following procedure shows how to Remove Link which Resets Ownership, then follow the process to take ownership of the device.

Configuration ownership must be established when a new safety I/O module is added to a project and any time there is a change in one of the following.

- EtherNet/IP™ address
- Safety Network Number
- GuardLogix Safety Network Number
- Communication path from GuardLogix controller to module.

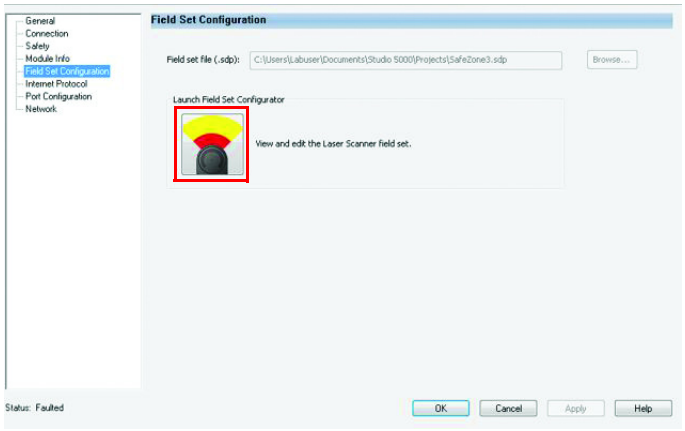
IMPORTANT	When replacing an SafeZone 3 safety laser scanner, if the controller does not automatically re-establish the safety connection, it may be necessary to reset the ownership and the SNN.

If any of these items change, the connection between the GuardLogix controller and the module is lost, and the yellow yield in the project tree appears. Reset ownership to re-establish the connection by using this procedure.

IMPORTANT	When replacing a device, if the replacement device was used previously and if the connection is local (as shown on the safety tab in RSLogix 5000), the device must first be reset to out-of-box condition. See publication 1756-UM543.

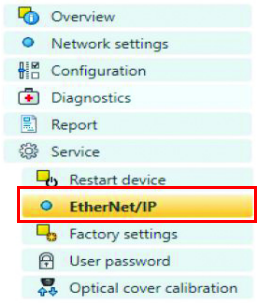
1. Verify that the controller is in Program or Remote Program mode.
2. Open the AOP, and click the Field Set Configuration tab.

3. Launch the Field Set Configurator.

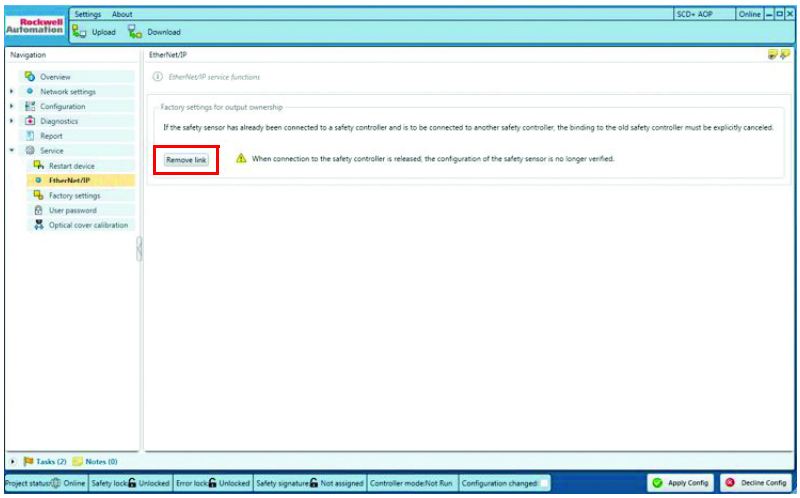


IMPORTANT Your computer must be connected to the same network as the SafeZone 3 safety scanner.

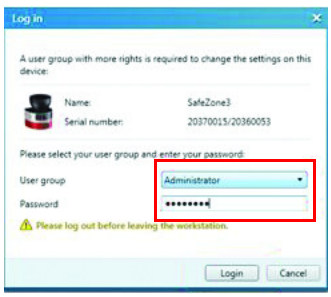
4. On the Navigation pane, expand Service, and select EtherNet/IP.



5. Click Remove link.



6. When prompted, Login as administrator with password. See Managing Passwords on page 132.



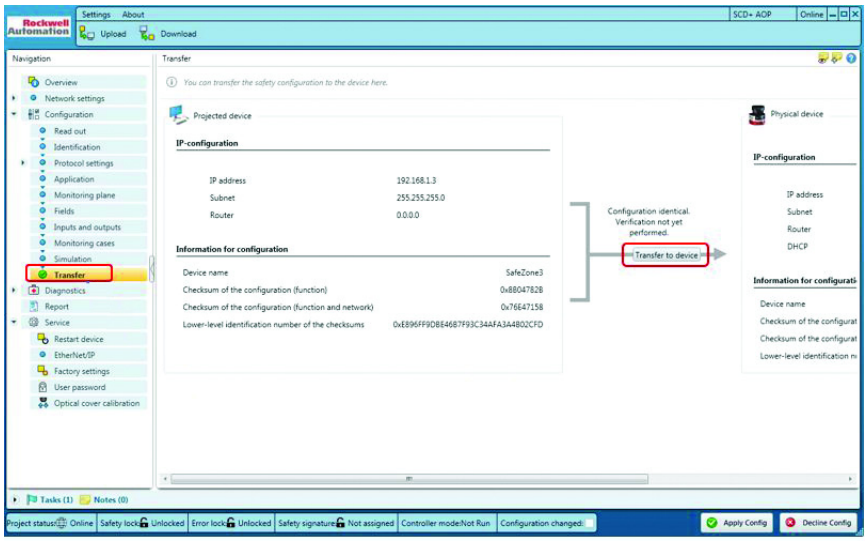
7. When completed, the following message appears. Click OK to continue.

8. The display of the SafeZone 3 safety laser scanner should read, “No Configuration” if there is no program in the scanner.

If the link was removed from a scanner that has a configuration, the display alternately flashes a yellow screen with “Safety function stopped” and a red screen with “Configuration not verified”.

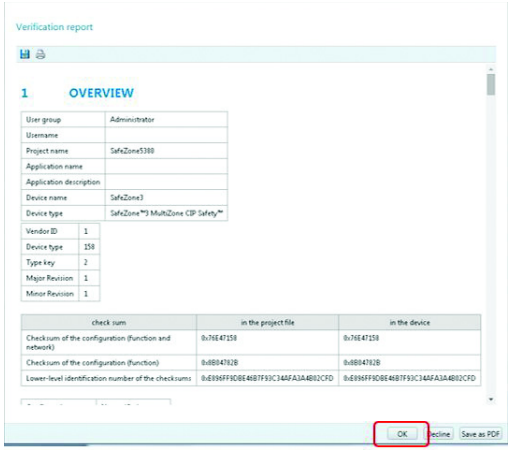
To resolve this, the program must be downloaded to the laser scanner.

9. Select Transfer and click Transfer to device.

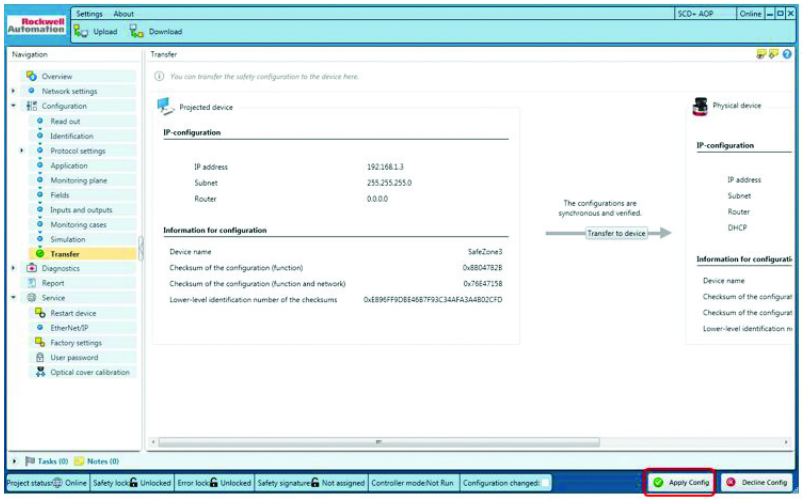


If prompted, verify your decision to transfer and click OK.

10. Scroll though the Verification Report and click OK.



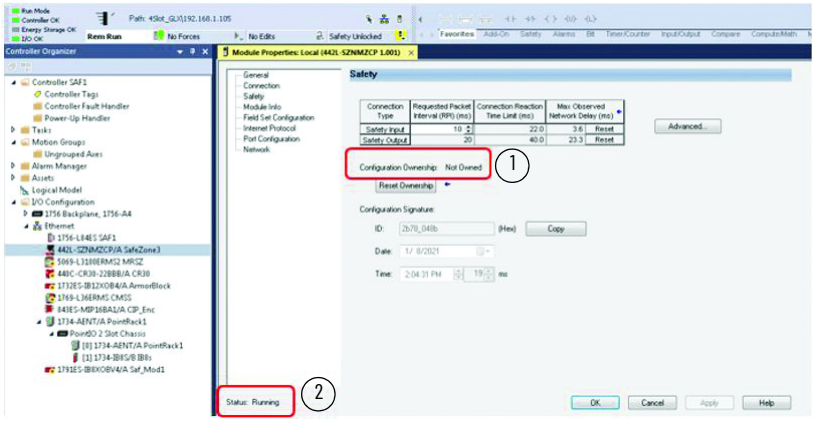
11. Click Apply Config.



12. Confirm Reset Ownership is complete.

IMPORTANT As shown in the following screen capture, it is normal for the Configuration Ownership to read 'Not Owned' (1) when revisiting the Safety page in the 442L AOP.

To confirm Ownership reset, the Status should be Running (2).



Safety Device Replacement

The replacement of safety devices requires that the replacement device is configured properly and that the operation of the replacement device is user-verified.

ATTENTION: During replacement or functional testing of a device, the safety of the system must not rely on any portion of the affected device.

Access Module Data with Add-on Profiles

With configuration of the Logix controller and the SafeZone 3 safety laser scanner complete, the Logix controller can exchange data with the safety laser scanner.

1. After downloading to the Logix controller, open the Controller tags window.

2. Select the Monitor Tags tab.

   In the following example, predefined input tags were created for the SafeZone 3 safety laser scanner. For detailed information on the individual tag members and their meaning, see Assemblies on page 184.

Name	Value
SZ3_IP13:SI	{...}
SZ3_IP13:SI.RunMode	1
SZ3_IP13:SI.ConnectionFaulted	0
SZ3_IP13:SI.DiagnosticActive	0
SZ3_IP13:SI.RunModeActive	0
SZ3_IP13:SI.StandbyModeActive	0
SZ3_IP13:SI.ContaminationWarning	0
SZ3_IP13:SI.ContaminationError	0
SZ3_IP13:SI.ReferenceContourStatus	0
SZ3_IP13:SI.ManipulationStatus	0
SZ3_IP13:SI.SafeCutOffPath01	0
SZ3_IP13:SI.SafeCutOffPath02	0
SZ3_IP13:SI.SafeCutOffPath03	0
SZ3_IP13:SI.SafeCutOffPath04	0
SZ3_IP13:SI.NonSafeCutOffPath01	0
SZ3_IP13:SI.NonSafeCutOffPath02	0
SZ3_IP13:SI.NonSafeCutOffPath03	0
SZ3_IP13:SI.NonSafeCutOffPath04	0
SZ3_IP13:SI.CurrentMonitoringCaseNumber	2#0000_0000
SZ3_IP13:SI.ResetRequiredCutOffPath01	0

Projects

Using the 442L AOP, 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

To create and open an empty project, click New Project.

Configure a Device Online (Device Connected to PC)

If a device is connected to the PC, the Logix Designer application establishes a connection to the device. [a]

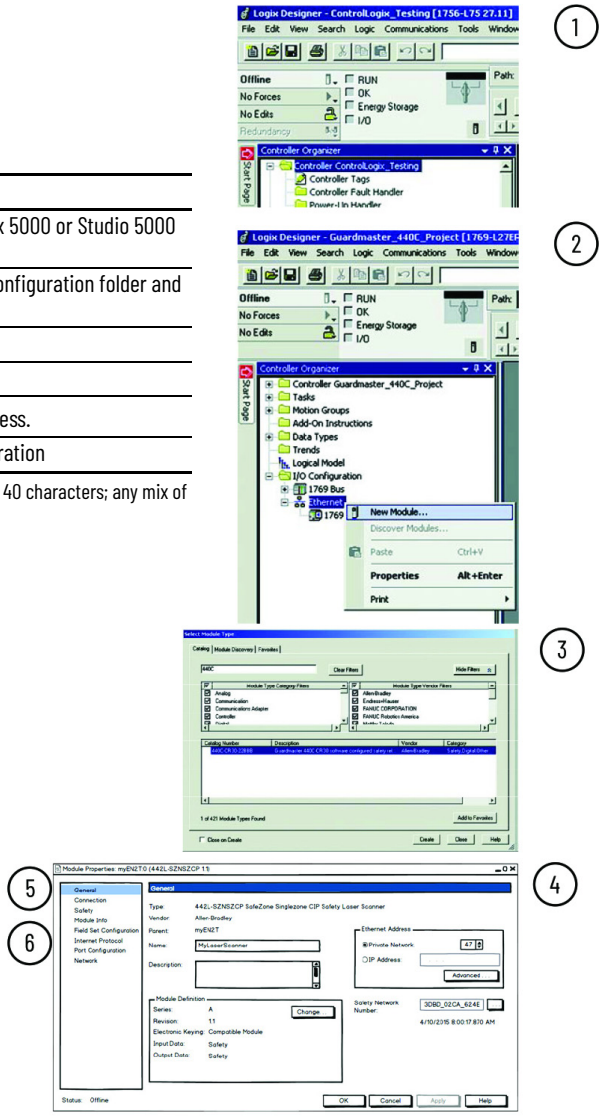
You then configure the device online. In this case, you can transfer the configuration to the devices directly and use diagnostic functions.

1. Click on Connect.
2. Logix Designer application searches for connected devices with which it can establish a connection.

Configure a Device Offline (Device not Connected to PC)

The safety laser scanner AOP can be added to the project through the “Select Module Type” dialog box under the “Safety” Module Type Filtering Category.

Figure 54 - Configure Offline



Step	Description
1	With Logix controller offline, create a new, or open an existing, RSLogix 5000 or Studio 5000 Logix Designer project.
2	Right-click the Ethernet tree of the EtherNet/IP bridge within the I/O Configuration folder and select New Module.
3	Search for SZ AOP. Select it and click Create.
4	The New Module dialog box appears.
5	On the General tab, edit the Name[1], Description (optional), and IP Address.
6	Navigate to the Field Set configuration page to start SafeZone configuration

(1) A unique name to identify the SafeZone laser scanner. The name can contain as many as 40 characters; any mix of upper/lower case letters, numbers, and underscore characters.)

(a) If the device is only connected via the network and has no network address, the 442L AOP can find the device but can-not establish a connection to it. You first need to assign the device a valid network address.

Saving Verified Configuration

When you save a project, information is saved for each device as to whether the configuration is verified. When you open a project file, each device tile and the Overview dialog of the device window show whether the configuration is verified.

You can transfer a verified configuration to the same or an identical device again.

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 12 - User Groups

User Group	Password	Authorization
Machine operator	No password required. Anyone can log on as a machine operator.	May read configuration from the device.
Maintenance	Deactivated ex-works, i.e. it is not initially possible to log on as a maintenance technician. The user group can be activated by the admin and provided with a password.	• May read configuration from the device. • May transmit verified configuration to the device. • Change own password allowed.
Authorized client	Deactivated ex-works, i.e. it is not initially possible to log on as an authorized customer. The user group can be activated by the admin and provided with a password.	• May read configuration from the device. • May transmit verified and unverified configuration to the device. • May verify configuration. • Resetting the safety function and communication settings to factory defaults is allowed. • Change own password allowed. • Changing the password of the Maintenance user group is allowed.
Admin	The password ABGM is created at the factory. Change this password to protect the device against unauthorized access.	• May read configuration from the device. • May transmit verified and unverified configuration to the device. • May verify configuration. • Resetting whole device to factory settings allowed. • Activating and deactivating Maintenance and Authorized customer user groups is allowed. • Change own password allowed. • Changing the passwords of the Maintenance and Authorized customer user groups is allowed.

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

IMPORTANT If you leave a computer that is connected to devices unattended, you must log out and switch to the Machine operator user group so that unauthorized persons cannot transfer configurations to the devices.

See Version Numbers and Functional Scope on page 167.

Change User Group

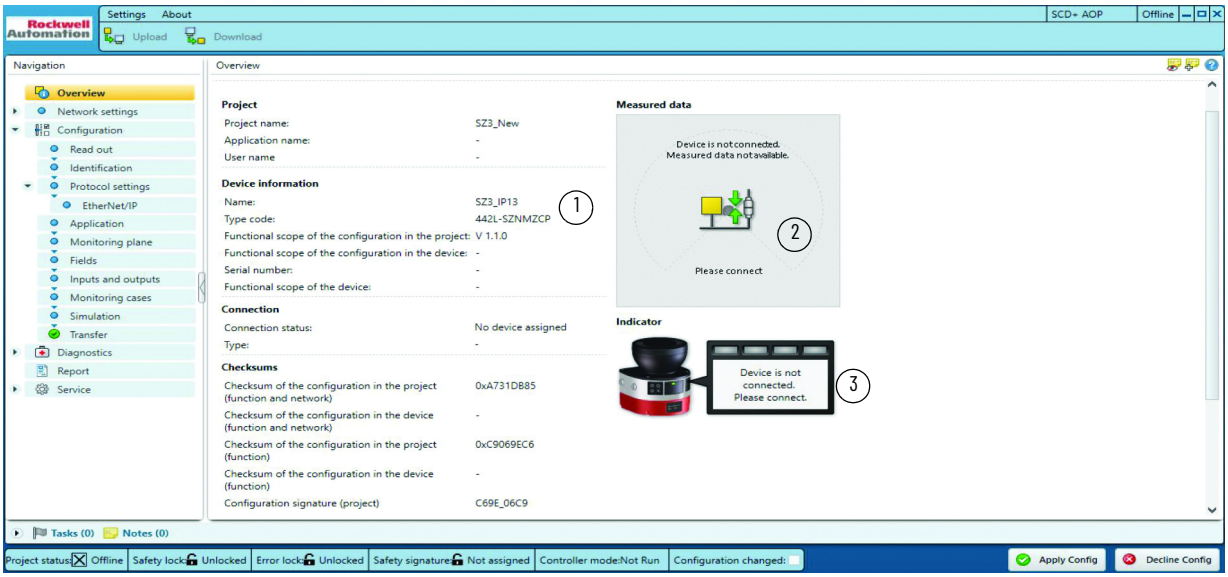
1. Establish a connection to the device.
2. In the toolbar, click on the User button.

   The dialog box is opened.
3. Select the desired user group.
4. Enter the password and click Log in.

Overview

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

Figure 55 - Overview



Item	Description
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.
- User Name: The user name helps future users to find a contact for the application.

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
- Functional scope of the device

Connection

- Connection status
- Type of connection

Checksum

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 the 442L AOP and the configuration in the device are identical.
- Verification status of the configuration in the project
- Verification status of the configuration in the device

Display – Indicator

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 Connect in the toolbar.
   The 442L AOP creates the connection to the safety laser scanner.

Functional Scope

To identify the different levels of the functionality, we use a three-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 442L AOP to the device, the functional scope of the configuration and the functional scope of the device must match one another:

- The first digit of both version numbers must be identical
- The second digit of the version numbers on the device must be at least as large as that of the configuration in the 442L AOP
- The third 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
- 442L AOP, Overview dialog box (only with connected devices)
- 442L AOP, Report

Figure 56 - Functional scope

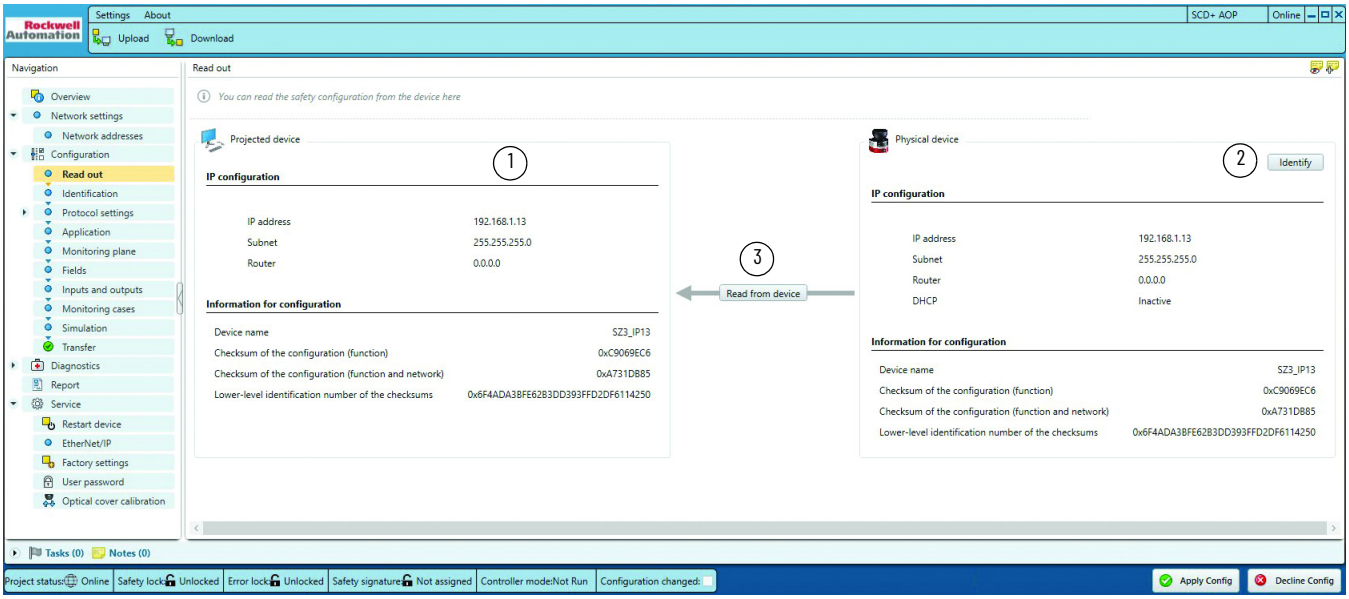
Item	Description
1	Functional scope of the device

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 442L AOP.

Network Settings

EtherNet/IP

Figure 57 - Network settings: EtherNet/IP



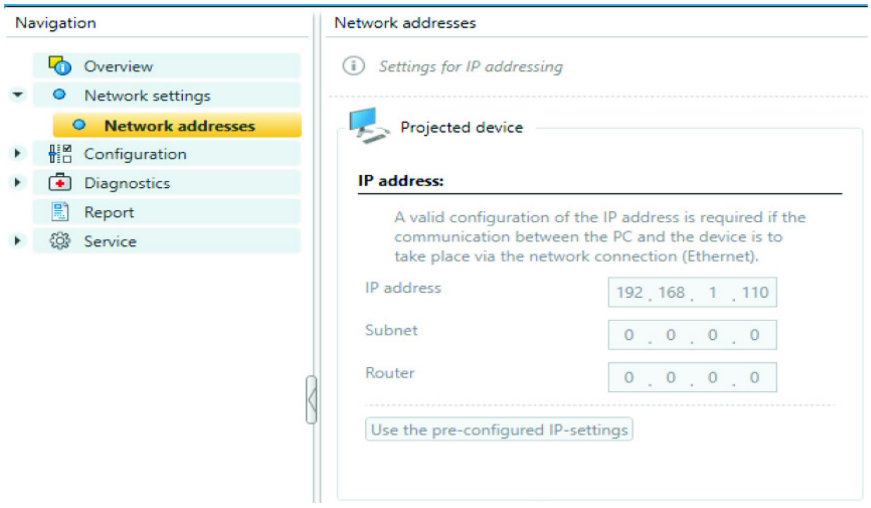
Item	Description
1	Values in the project
2	The Identify button reads the values in the device
3	Buttons to read or transmit values

IMPORTANT If a device has already been configured, the entire configuration will be transmitted from the project to the device when the IP settings are changed. The configuration of the control may also be invalid.

- Before changing the IP settings: read the configuration from the safety laser scanner with the 442L AOP and save if necessary.

Addressing

It is not possible to set the IP address in Network addresses tab. This functionality was removed when the USB port was disabled in order to meet Design for Security requirements. The IP address can be set in the General tab of the 442L AOP.



Reading and Transmitting Values

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 (see Figure 57 on page 101). Alternatively, you can transmit values from the project to the device.

- Click Read from the device: The values are read from the device and adopted in the project.

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 Read from the device: The values are read from the device and adopted in the project.

Configuration

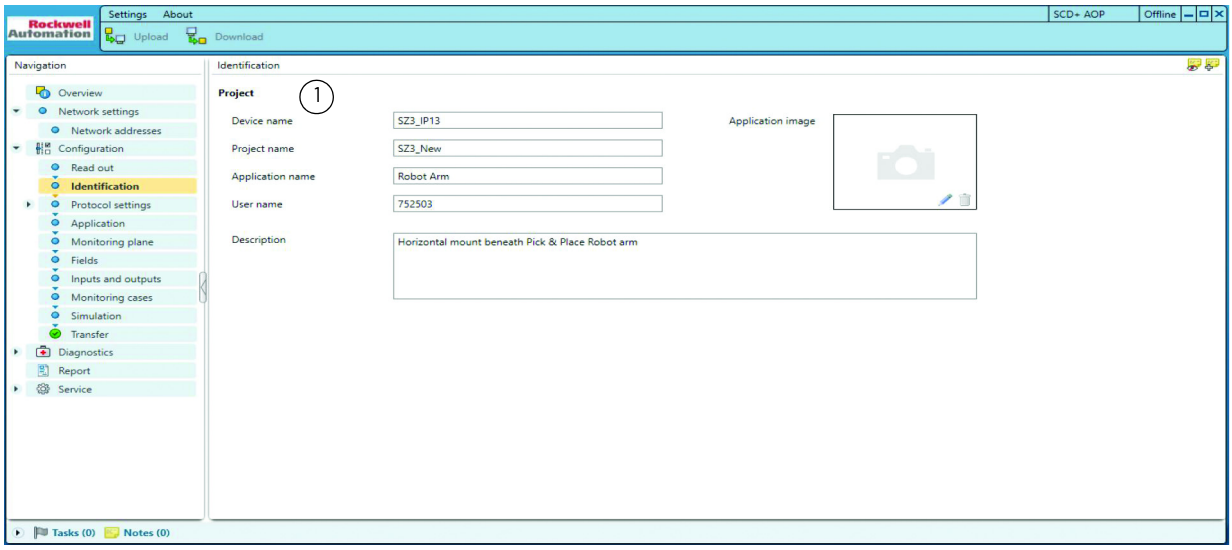
- Name: If a number of safety laser scanners are used in an application or in a project, a unique device name helps to tell the individual devices apart.
- Checksums: A checksum is used as a unique identification for a configuration. Using the checksum, it is possible to work out whether a setup was 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.

Identification

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

Figure 58 - Identification



Item	Description
1	Parameters for the project and the device

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 442L AOP supports the following file formats: BMP, GIF, JPG, PNG, TIF.

1. Click the pencil icon.
2. Select an image file for the application.
   The image is incorporated as a thumbnail.

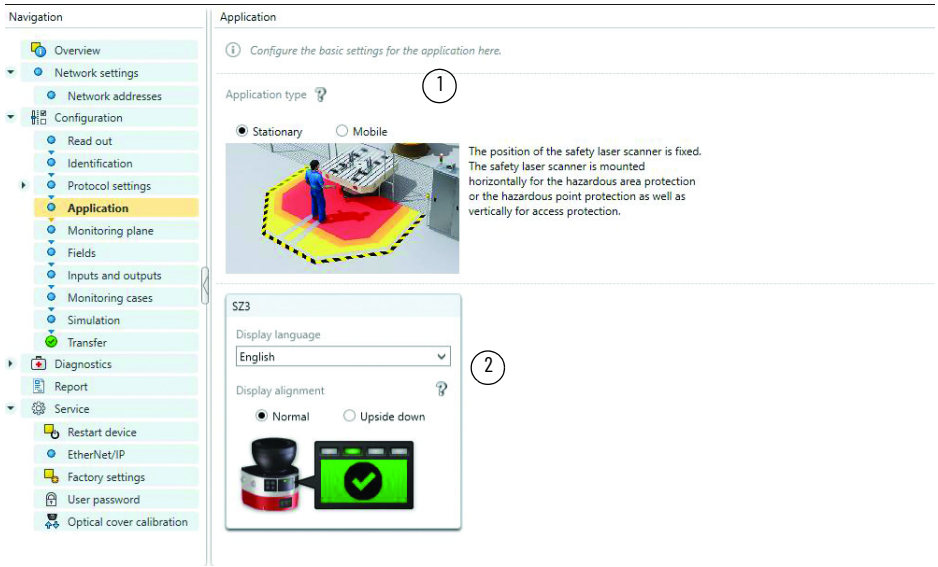
Description

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

- Enter a description with a maximum of 1000 characters.

Application

Figure 59 - Application



Item	Description
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.

- 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 and Buttons

The display of the safety laser scanner outputs notifications and statuses (see Buttons and Display on page 140).

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.

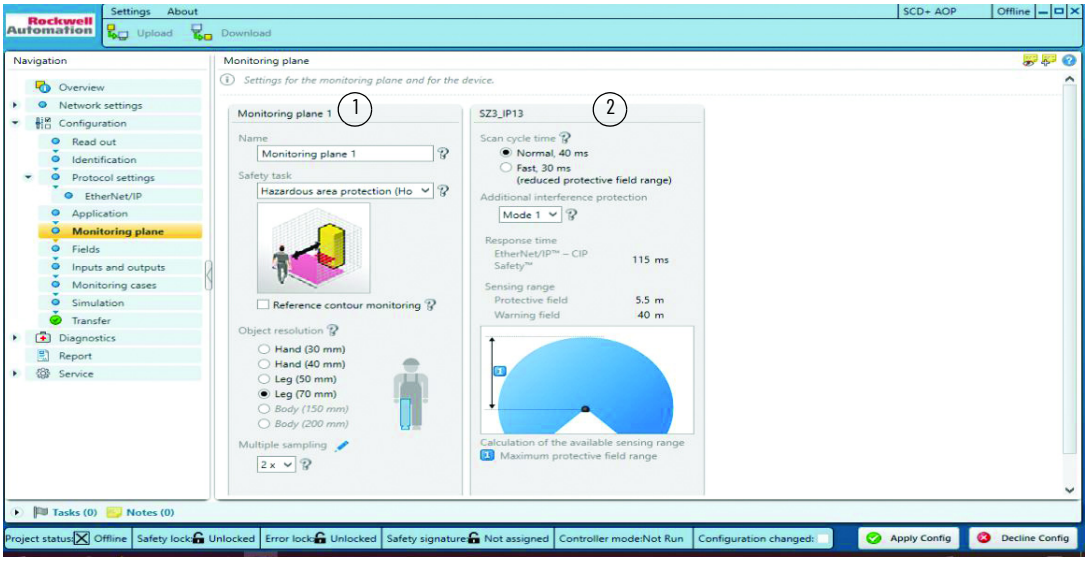
Monitoring Plane

The scan plane of a safety laser scanner forms its monitoring plane.

Define the following parameters:

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

Figure 60 - Monitoring Plane



Item	Description
1	Parameters for the monitoring plane
2	Parameters for the safety laser scanner

Parameters for the Monitoring Plane

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, the 442L AOP 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 on page 29).

- 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

IMPORTANT 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 on page 110.

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
- 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.

IMPORTANT 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 on page 108.

Multiple Sampling

ATTENTION: 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 the 442L AOP.
- 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 seen this many times.

Table 13 - 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×

Multiple Sampling After Switching Between Monitoring Cases

ATTENTION: Hazard due to lack of effectiveness of the protective device
If combined with very short switchover times, higher multiple sampling after switching between monitoring cases can result in a person or part of their body not being detected.

- Make sure that every monitoring case is active for at least the amount of time required for detection by the safety laser scanner (setting for multiple sampling after switching between monitoring cases multiplied by the scan cycle time set, including the supplement due to interference protection).

When switching between monitoring cases, it is possible that a person may already be in the newly activated protective field when switching takes place. In order to ensure that the person is detected quickly and the dangerous state is brought to an end swiftly, you must adjust the settings for multiple sampling immediately after switching between monitoring cases - regardless of any other multiple sampling in place.

- Fast (presetting): Multiple sampling after switching between monitoring cases $n_{CS} = 1$. An object needs to be scanned once before the safety laser scanner reacts. Fastest reaction and safest behavior of the safety laser scanner.
- Reliable: Multiple sampling after switching between monitoring cases $n_{CS} = n - 1$. Multiple sampling after switching between monitoring cases is one scan fewer than any other multiple sampling in place. This reduces the possibility that insects, weld sparks, or other particles cause the machine to be switched off. This increases machine availability. The standard response time applies from the outset in the new field.
- User-defined: You can adjust the settings for multiple sampling after switching between monitoring cases in line with your requirements for the response time and reliability. Regardless of the exact settings here, multiple sampling after switching between monitoring cases is always at least one scan fewer than any other multiple sampling in place: $n_{CS} \leq n - 1$

Parameters for the Safety Laser Scanner

You can configure the parameters for the safety laser scanner here.

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 maximum 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

Select scan cycle time.

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

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...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

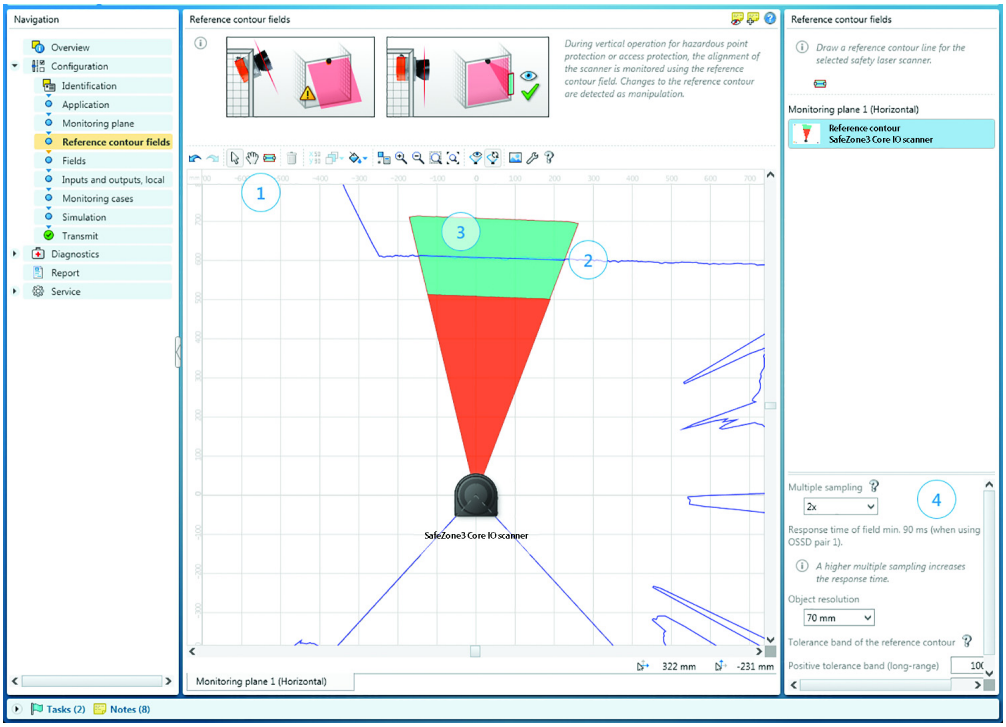
Configure a different mode for each safety laser scanner that is mounted in close proximity.

The resulting response time is shown.

IMPORTANT The safety laser scanner's response time depends on the scan cycle time, interference protection and multiple sampling, see Response Times on page 171. 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.

Reference Contour Field

Figure 61 - Reference Contour Field



Item	Description
1	Tool for drawing reference contour fields
2	Drawn contour with tolerance band
3	Visible spatial contour
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 on page 34).

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.
   a. First, use the mouse to click the desired contour.
   b. Click to add the corners of the contour.
   c. Finally, double-click the contour.

   The reference contour field is displayed.

Multiple Sampling and Object Resolution

ATTENTION: 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 the 442L AOP.
- Adjust the minimum distance from the hazardous point to the new response time.

The 442L AOP 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.

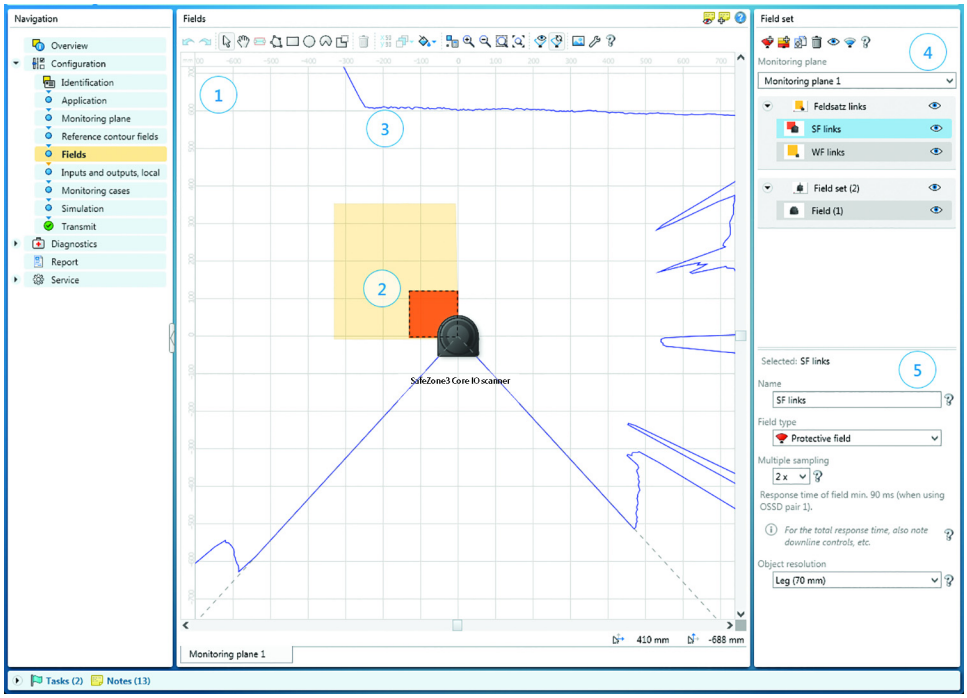
Fields

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 Variant Overview on page 167.

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

Using the Field Editor

Figure 62 - Field Editor



Item	Description
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 14 - Buttons on the Toolbar

Icon	Description
	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 on page 119). 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 on page 119)
	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 on page 117)
	Open field editor settings

Field Display

The 442L AOP displays the field types in different colors.

Colors of the Field Types

Protective Field	Warning Field	Reference Contour Field and Contour Detection Field
Red	Yellow	Turquoise

Create Fields and Field Sets

IMPORTANT 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 on page 126).

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 15 - Buttons for Field Sets

Icon	Description
	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 on page 116)
	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 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 Duplicate field set.
   The field set is duplicated and pasted in as a copy.

Manage Field Set Templates

1. Click 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 on page 116).

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 on page 21.

Multiple Sampling and Object Resolution

ATTENTION: 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 the 442L AOP.
- Adjust the minimum distance from the hazardous point to the new response time.

The 442L AOP 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.

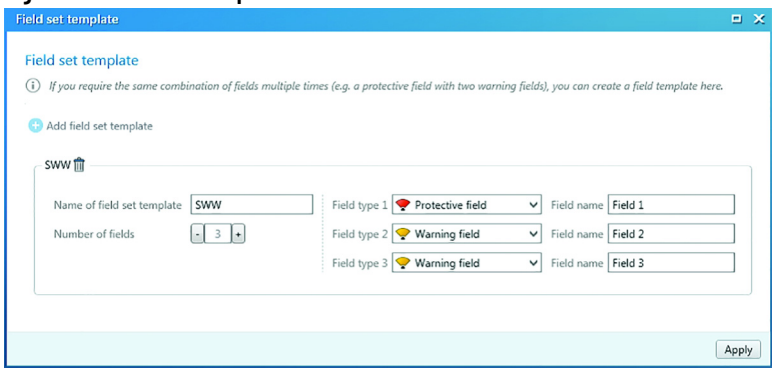
Creating Field Set Templates

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



1. Click 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 Apply.
   The field set template is saved.

Importing and Exporting Field Sets and Fields

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 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 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.

Background Image

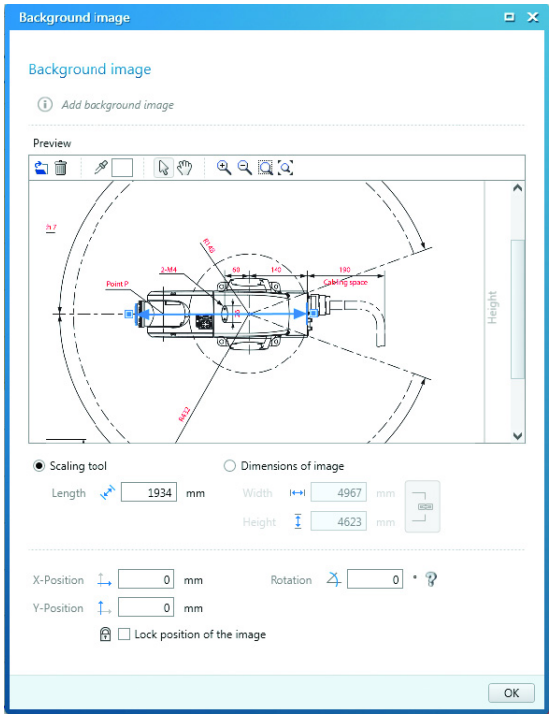
You can select a background image for the field editor. For example, the plan view of the machine to be protected can be used as a sample.

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 442L AOP supports the following file formats: BMP, JPG, PNG.

Figure 64 - Background Image



1. Click Edit background image in the toolbar.
   The dialog box opens.
2. Click Search....
3. Select the file for the background image.
   The 442L AOP 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.

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 442L AOP 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

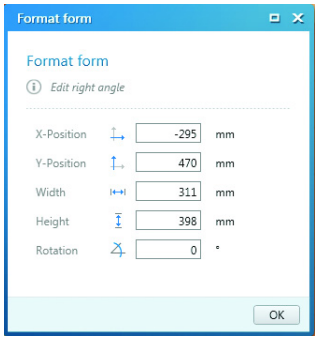
You can use a Cartesian or a polar coordinates system and select the colors for the grid and the drawing area.

- 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.

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



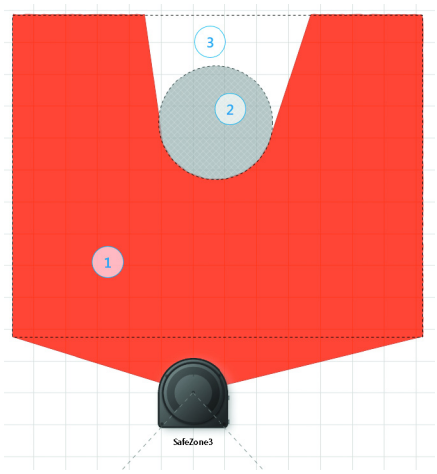
The reference points for the X and Y values are as follows:

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

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



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

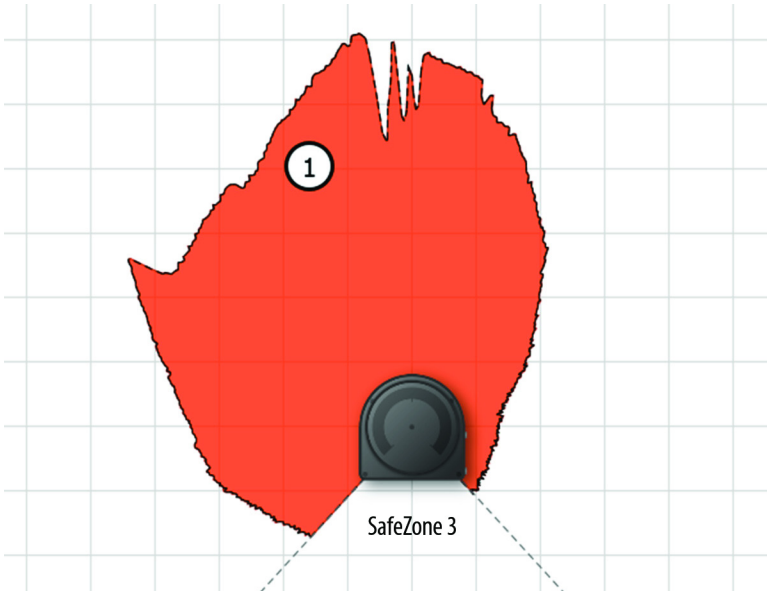
Drawing Masked Areas

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.

Enable Propose Field

Figure 67 - Enable Propose Field



Item	Description
1	Proposal for a protective field

You can have a protective field or warning field suggested by the 442L AOP.

For this purpose, the safety laser scanner scans the visible surrounding contour several times. Based on the data obtained, the 442L AOP suggests the contour and size of the field.

You can create a field using the Propose field tool ( ).

IMPORTANT	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

Existing Field Geometries

- Delete existing geometries: The field is redrawn according to the surrounding contour.
- Modify existing geometries: The existing field is adapted to the surrounding contour.

Measuring Method

- Use any distance value: Each scan of the surrounding contour is used individually to draw the field.
- Use median of the distance values: The median of the last 25 scans is used to draw the field.

Type of Teach-in

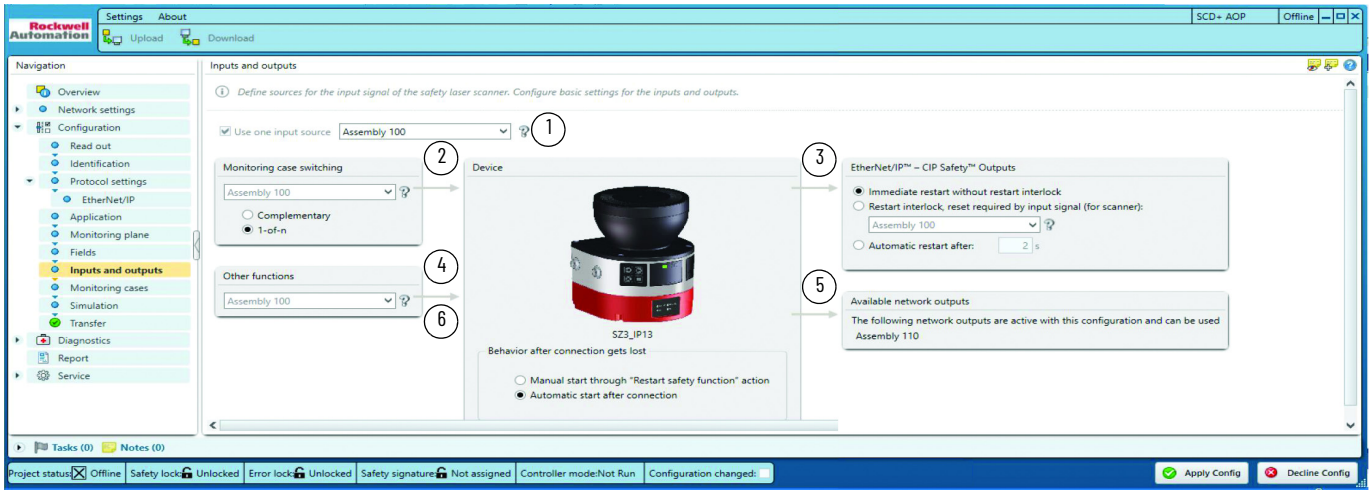
- Only allow zooming out: The shortest measured distance is used at each angle. If you walk the imaginary field on its borders and, e.g. hold a board or cardboard into the laser beam, the surrounding contour is thereby limited.
- Allow zooming in: The surrounding contour is used as it is measured.

Automated Reduction

You can specify that the proposed field is drawn smaller than the measured surrounding contour so that the field will be at a distance from walls. The default value corresponds to the value TZ (tolerance zone of the safety laser scanner).

Inputs and Outputs

Figure 68 - Inputs and Outputs



Item	Description
1	Use an input source
2	Input for switching between monitoring cases
3	Input and settings for restart interlock
4	Input for additional functions
5	Network outputs
6	Behavior on connection termination

The 442L AOP provides a selection of the possible signal inputs.

Using an Input Source

You can adjust the settings so that the same assembly is used for all inputs and you can select the required assembly.

Monitoring Case Switching

If you would like to switch between different monitoring cases, define which assembly will be used.

Depending on the assembly used, you must also define the evaluation of the static control inputs:

- Complementary output
  A static control input consists of two channels. To switch correctly, one channel must be switched inversely to the other.
- 1-of-n
  In the 1-of-n evaluation, use the channels of the control inputs individually.

IMPORTANT At any time, exactly one channel must have logic value 1, when using 1 of n inputs.

Restart Interlock

You decide the restart behavior and, if necessary, the assembly used for resetting.

Other Functions

You decide which assembly is used to restart the device or activate sleep mode.

Network Outputs

The 442L AOP displays which network outputs are available.

Behavior on Connection Termination

You can configure the way in which the device behaves when secure communication is reestablished in the network after an interruption:

- Manual start via “Restart safety function” after reconnection

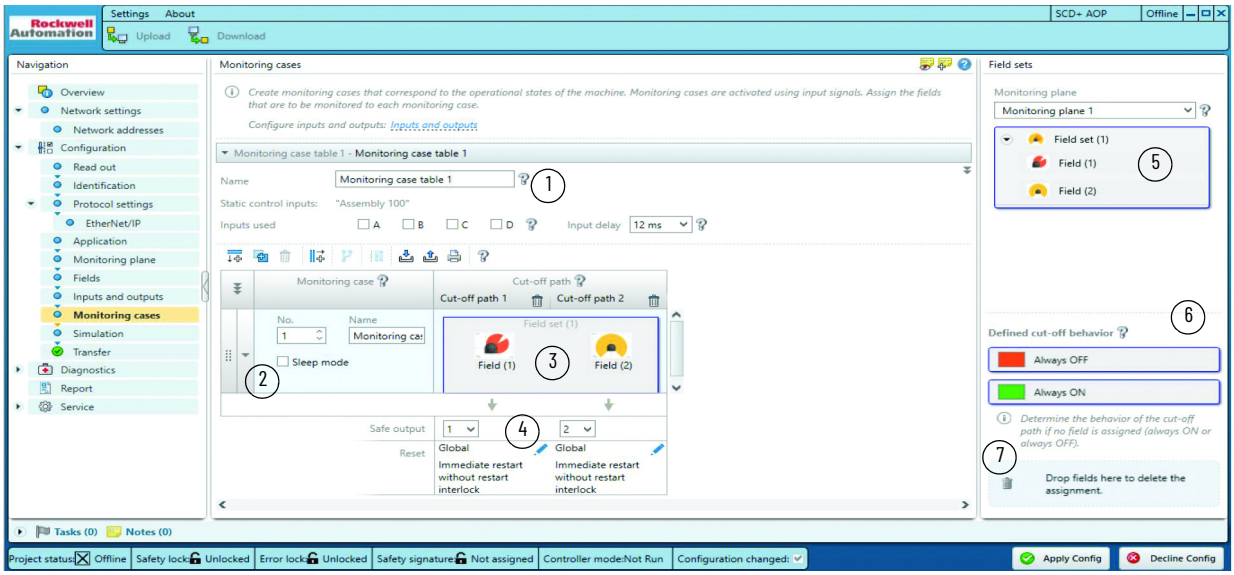
  After canceling secure communication, the safety function is stopped and the device reports an application error. Once the connection is established again, you must send the command Restart safety function to the device via the assembly or via the 442L AOP.

- Automatic start after reconnection

  After aborting the safe communication, the safety laser scanner signals to Wait for inputs. As soon as the connection has been reestablished, the device automatically switches to the current monitoring case. No additional command is required.

Monitoring Cases

Figure 69 - Monitoring Cases



Item	Description
1	Settings for the whole monitoring case table
2	Settings for the individual monitoring case
3	Field set in the monitoring case and in the cut-off path
4	Cut-off paths
5	Configured field sets
6	Areas for defined cut-off behavior
7	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.

For more information, see Monitoring Case on page 24.

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 two 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.

Table 16 shows the empirical values that exist for the switching time using various methods:

Table 16 - Empirical Values for the Required Input Delay

Switching Method	Required Input Delay
Electronic switching via control, complementary electronic outputs with 0...12 ms bounce time	12 ms
Tactile controls (relays)	30...150 ms
Control via independent sensors	130...480 ms

Also, take account of the notes relating to when to switch between monitoring cases (see Monitoring Case Switching Time on page 36).

Switching Order

You can specify the order in which the monitoring cases can be called.

You can specify one or two subsequent monitoring cases for each monitoring event. If you do not specify a subsequent monitoring case for a monitoring case, then any monitoring case may follow.

If input conditions are present which do not call up any of the defined subsequent monitoring cases, the safety laser scanner switches all safety outputs to the OFF state.

You can specify the order of the monitoring cases as a process or in individual steps.

Process

1. You define one or more sequences. You can use a sequence to map the sequence of work steps for your machine.
2. In all sequences, you can define a maximum of two subsequent monitoring cases for each monitoring case.
3. If you do not specify a subsequent monitoring case for a monitoring case, then any monitoring case may follow.

Individual Steps

You define individually for each monitoring case which one or two monitoring cases may follow.

If you do not specify a subsequent monitoring case for a monitoring case, then any monitoring case may follow.

You can use the changeover order as an additional check of your control unit. For example, deviations of a vehicle from the route or a plant from the prescribed production process can be detected.

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.

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.

Cut-off Paths

You can create cut-off paths and define the outputs switched by the cut-off paths.

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 the Number of the Cut-off Path in the Assembly

Select the desired number. The number is assigned to the cut-off path.

Restart Behavior

Define the restart behavior for all cut-off paths in the Inputs and outputs window.

If needed, define a deviating restart behavior for one or several cut-off paths.

Assigning Field Sets 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 on page 126.
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

ATTENTION: 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.

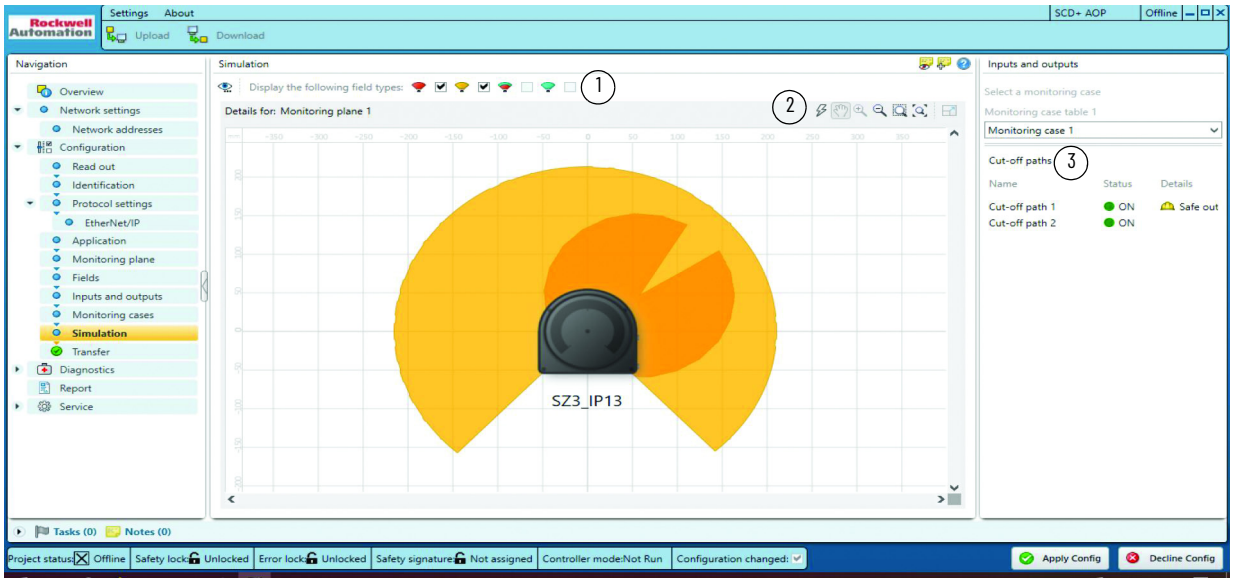
- Drag the Always OFF function onto the cut-off path.
  The field is viewed as being permanently interrupted.
  If the monitoring case becomes active, the cut-off path is always in the OFF state.
- Drag the Always ON function onto the cut-off path.
  The field is viewed as being permanently clear.
  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, the 442L AOP assigns the Always OFF function to these cells.

Simulation

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

Figure 70 - Simulation



Item	Description
1	Show or hide field types
2	Simulation tools
3	Display the cut-off paths

Simulation Components and Options

- 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)

Transfer

Transferring Configuration

ATTENTION: 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 Configuration

ATTENTION: 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.

Verifying Configuration

ATTENTION: 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, the 442L AOP reads back the transmitted configuration from the safety laser scanner. It compares the configuration with the configuration saved in the 442L AOP. If both configurations are identical, the 442L AOP 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 Identification to ensure that the desired device is connected.
   The display of the connected device flashes blue.
2. If the checksums on the computer and the device differ, click on Transmit to device.
   The transfer process is shown in the 442L AOP and on the device.
   the 442L AOP will notify you as soon as the transfer process is complete.
3. Click Verify.
   The 442L AOP displays the verification report.
4. Check the verification report and if appropriate, click on Confirm.
   Device configuration is shown as verified.

ATTENTION: 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.

Lower Toolbar

Figure 71 - Toolbar

Tab	Description
Project Status	Logix Designer application project status • Offline: X in box • Online: Network symbol indicates the connection to controller and device is online.
Safety Locked/ Unlocked status	GuardLogix processor safety lock status • Safety Unlocked: Lock icon open • Safety Locked: Lock icon closed
Error Locked/ Unlocked status	Information if error-lock of the controller is active Status of the error-lock of the current Logix Designer application project. • False: Not locked • True: Error-lock active
Safety Signature Status	GuardLogix processor safety signature status • Not assigned: Lock icon open • Assigned: Lock icon closed
Controller Mode Status	GuardLogix controller status • Run: Run mode • Not run: Remote Run mode, Program mode
Configuration Status	Logix Designer application scanner configuration status Configuration changed: • Checkbox checked: The configuration has changed • Checkbox cleared: The configuration remains the same.

Reports

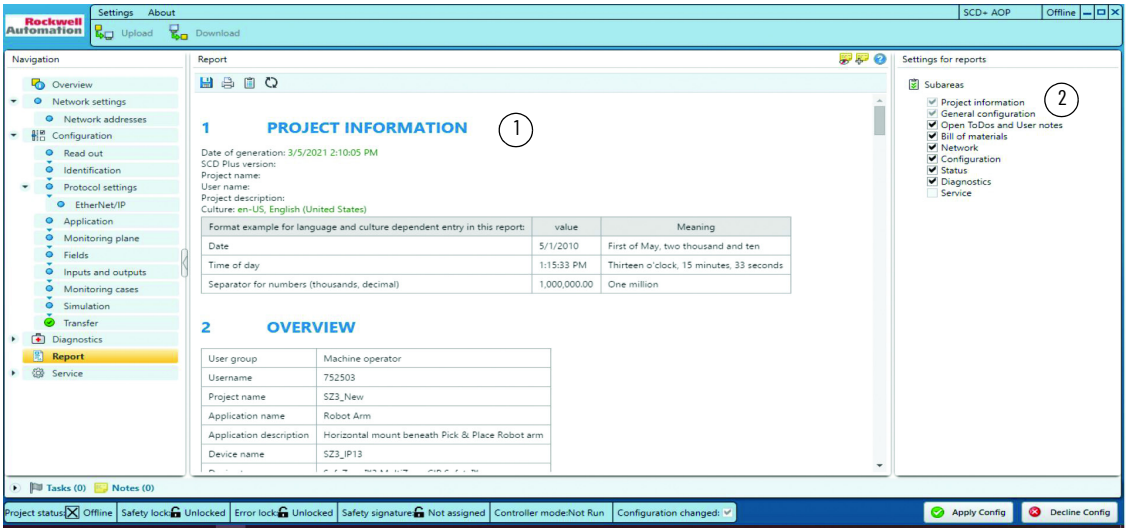
You can show the data of a device with a report. You have the option of saving and archiving these data as a PDF.

The 442L AOP 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 72 - Report



Item	Description
1	Contents of the report
2	Composition of the report

You compose the contents of a report individually:

- Select the contents of the report under Settings for reports. The 442L AOP creates a report with the selected contents.

Service

This section describes service options you have with the 442L AOP on the safety laser scanner.

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.

EtherNet/IP

If the safety laser scanner has already been connected to a control and should be connected to another control, the link to the old control must be explicitly removed.

1. Click Remove link to control (reset ownership) to remove the link to the control. See Configure and Reset Ownership on page 92 for more information.

Factory Settings

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

Resetting Safety Function to Factory Settings

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

Resetting the Safety Function and Communication Settings 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).

Resetting 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).
- The Maintenance and Authorized customer user groups are deactivated.
- The password of the Admin user group is reset to the factory settings.

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 Transmit to device to confirm.
5. When you are prompted to log on, select your user group and enter the corresponding password.
   The new password is valid for the user group immediately.

Resetting a Password

If you have forgotten the password of the Admin user group, you can reset it.

1. Request the form for resetting your password from Rockwell Automation Technical Support (rok.auto/support).
2. Connect to the device in the 442L AOP.
3. In the device window, under Service, choose the entry User password.
4. In the User password dialog box, select the Start password reset process option.
5. Using the form, send the displayed information to Rockwell Automation Technical Support.
   You will then receive an activation code.
6. In the corresponding menu of the device's display, confirm the password reset by pressing the OK button.
7. Enter and confirm the activation code in the field provided.
   The password of the Admin user group is reset to factory settings. The Maintenance and Authorized client user groups are deactivated. The configuration is not changed.

Optics Cover Calibration

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).

ATTENTION: 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 442L AOP every time the optics cover is replaced.
- Carry out the optics cover calibration at room temperature (10...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.

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.

Notes:

Commissioning

Safety

ATTENTION: 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.

ATTENTION: 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 noone in the hazardous area during commissioning.

ATTENTION: 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 on page 29
- Mounting on page 69
- Electrical Installation on page 77
- Configure the SafeZone 3 Safety Laser Scanner on page 85

Alignment

The following options are available to you for precisely aligning the safety laser scanner using mounting kit 3 or 4:

Figure 73 - Alignment About the Transverse Axis

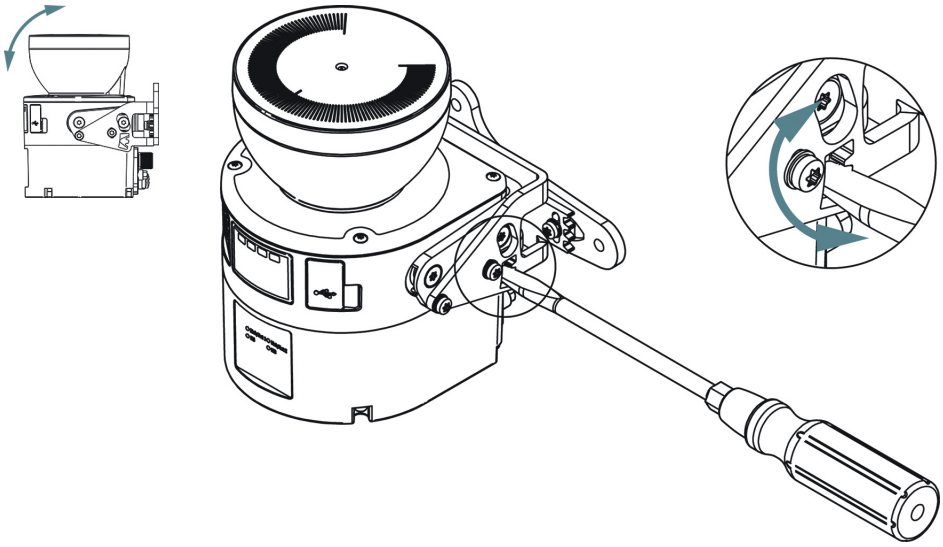
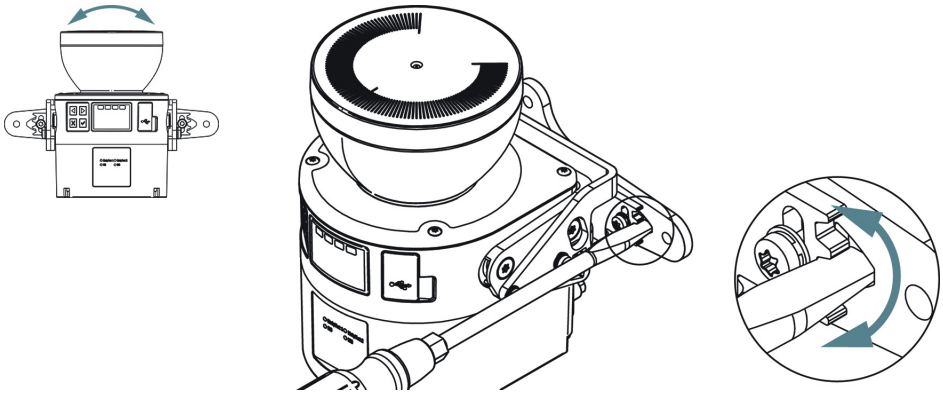


Figure 74 - Alignment About the Depth Axis



After alignment, tighten the screws with the specified tightening torque. See Mounting Using Mounting Kit 3 (Catalog Number 442L-AMBSZCP3) on page 74.

Switching On

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

When first switching on the safety laser scanner, the start process can last up to 100 seconds. When switching on again, the required start time depends on the scope of the configuration data. The start process then takes about 10...30 seconds.

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

Figure 75 - Status LEDs

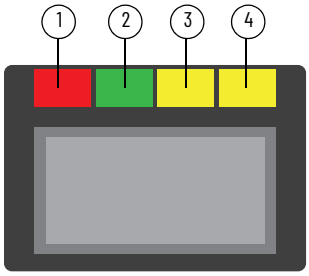


Table 17 - Status LEDs

Item	Function	Color	Meaning
1	OFF state	Red	Lights up red when at least one safety output is in the OFF state.
2	ON state	Green	Lights up green when at least one safety output 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. Three 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.

The device has different light emitting diodes for every network interface. These network light emitting diodes are located below the display.

More information about what the light emitting diodes mean and the symbols and information shown on the display: see Troubleshooting on page 153.

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 confirms 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 on page 128)

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 on page 130.

Additional thorough checks for CIP Safety:

- Check CIP Safety connection cables and ensure they function as intended.
- Check all CIP Safety-relevant settings in the configuration.
- Before entering the configuration signature into the configuration of the control: check the configuration of the safety laser scanner.

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 Commissioning on page 196
- Thorough Visual Check of the Machine and the Protective Device on page 68
- Thorough Check of the Principal Function of the Protective Device on page 66
- Thorough Check of the Area to be Protected on page 67
- Test of the Contour Detection Field on page 68
- 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.

Operation

Safety

ATTENTION: 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.

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

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 on page 65.

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).

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

LEDs

Figure 76 - LEDs

Item	Description
1	Status LEDs
2	Additional LEDs for ON state and OFF state
3	Network LEDs

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

Figure 77 - Status LEDs

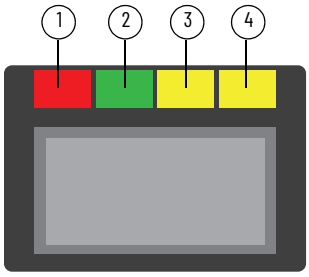


Table 18 - Status LEDs

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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.

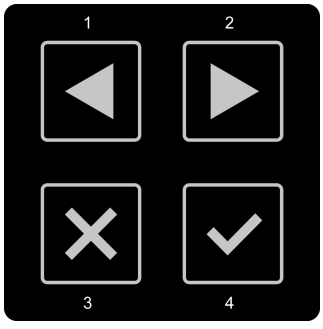
The OFF state and ON state light emitting diodes can be found in multiple locations on the safety laser scanner. Three additional sets are arranged in pairs on the base of the optics cover. So the light emitting diodes can also be seen in many cases when it is not possible to see the display, e.g. due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

Buttons and Display

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

Buttons

Figure 78 - Push Buttons on the Device



Item	Description
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 push buttons 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 push button to activate the display.
- Press any push button 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 19 - Overview of Status Information

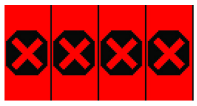
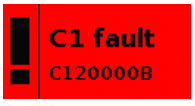
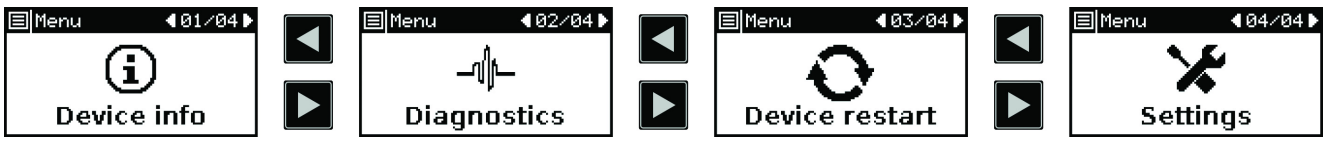
Display	Device or Configuration	Meaning
	All devices and configurations	All fields clear, safety outputs in ON state. The number at bottom right indicates the active monitoring case.
	Devices and configurations with a configured safety output	Protective field interrupted, safety output in OFF state.
	Devices and configurations with 2...4 configured safety outputs	For every of 4 cut-off paths, the following applies: the protective field is interrupted or there is a warning field in the active monitoring case. Safety outputs in the OFF state. Each column stands for a safety output. Safety outputs in the OFF state are marked with a cross if they could be in the safety-related ON state in at least one monitoring case.
	Devices and configurations with 2...4 configured safety outputs	The protective field in position 3 is interrupted or there is a warning field in the active monitoring case. The associated safety output is in the OFF state. Safety outputs for which no field is interrupted and which are in the ON state are marked with their number.
	Devices and configurations with 2...4 configured safety outputs	Cut-off paths in which no protective field is located are not marked. The associated safety output is in the OFF state. A non-safety-related output can still be in the ON state, e.g. if a warning field is free.
	Configuration with restart interlock	Protective field is clear, reset can take place.
	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 on page 159.

Table 19 - Overview of Status Information (Continued)

Display	Device or Configuration	Meaning
 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 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 the 442L AOP.
	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 push button to obtain more information.

Menu

Figure 79 - Menu



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

1. Press the OK push button 4 twice in succession to call up the menu.

2. Change to the desired menu point using the arrow buttons 1, 2.
3. Confirm the desired menu point using the OK button 4.
4. Use the same push buttons to navigate through the sub-menus.
5. Press the back button 3 to return to the higher-level menu point.
6. Press the back button 3 multiple times to return to the status display. If you do not press any push buttons 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
- Network: e.g. MAC address, IP address, sub-network
- Data output: e.g., status, target IP address

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.

Notes:

Maintenance

Safety

ATTENTION: 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.

Regular Cleaning

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.

ATTENTION: 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.

ATTENTION: 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.

ATTENTION: 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.

IMPORTANT

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

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 on page 66.

IMPORTANT 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.

For more information, see Accessories on page 191.

Replacing the Optics Cover

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

You can order the replacement optics cover from Rockwell Automation (see Accessories on page 191).

ATTENTION: 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 442L Add-on Profile (AOP) every time the optics cover is replaced.
- Carry out the optics cover calibration at room temperature (10...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.

IMPORTANT

- 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 enable IP65 leak tightness of the housing.
- Only use a new optics cover as a replacement.
- Provide ESD protection when replacing the optics cover.

IMPORTANT Enclosure rating IP65 only applies if the safety laser scanner is closed and the system plug is mounted.

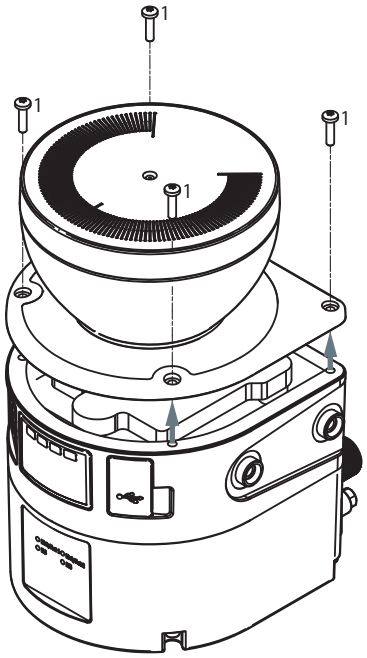
- Mount the system plug and the cover plate.
- Close each M12 plug connector on the safety laser scanner using a male cable connector or a protective cap.
  Tightening torque for plug connector: 0.4...0.6 N•m.
  Tightening torque for protective caps: 0.6...0.7 N•m.
- Mount the optics cover.

Tool required:

- TX10 torque wrench

Replace the optics cover as follows:

Figure 80 - Fixing Screws for the Optics Cover



Item	Description
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.
6. Check whether the mirror on the motor is dirty and, if necessary, remove dirt using an optic brush.
7. Set 1.0...1.2 N•m 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(Figure 80 on page 147).
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 on page 69.
2. Recreate all of the electrical connections to the safety laser scanner.
3. Carry out the optics cover calibration, see Optics Cover Calibration on page 132.
4. Start the safety function using the 442L AOP.
5. Check the effectiveness of the protective device.
   - Generally, the protective device is checked exactly as during commissioning, see Thorough Check on page 137
   - 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 on page 66.

Replacing the Safety Laser Scanner

If the safety laser scanner is damaged or defective, you must replace it.

ATTENTION: 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.

IMPORTANT Enclosure rating IP65 only applies if the safety laser scanner is closed and the system plug is mounted.

- Mount the system plug and the cover plate.
- Close each M12 plug connector on the safety laser scanner using a male cable connector or a protective cap.
  Tightening torque for plug connector: 0.4...0.6 N•m.
  Tightening torque for protective caps: 0.6...0.7 N•m.
- Mount the optics cover.

IMPORTANT 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:

- TX20 Torx wrench

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.

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 on page 150.
5. Mount the new safety laser scanner, see Mounting on page 69.
6. Check the effectiveness of the protective device.
   - Generally, the protective device is checked exactly as during commissioning, see Thorough Check on page 137.
   - 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 on page 66.

In certain cases (in the event of dust, high air humidity), it may make sense not to initially disconnect the system plug and the safety laser scanner. In these cases, proceed as follows:

1. Disconnect the connecting cables to 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.

For more information, see Managing Passwords on page 132 and Version Numbers and Functional Scope on page 167.

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 on page 69.
4. Reconnect the connecting cables to the system plug.
5. Configure the safety laser scanner, see Configure the SafeZone 3 Safety Laser Scanner on page 85.
6. Perform commissioning again, taking particular care to conduct all of the thorough checks described, see Commissioning on page 135.

Replacing the System Plug

If the system plug is damaged or defective, you must replace it.

IMPORTANT Enclosure rating IP65 only applies if the safety laser scanner is closed and the system plug is mounted.

- Mount the system plug and the cover plate.
- Close each M12 plug connector on the safety laser scanner using a male cable connector or a protective cap.
  Tightening torque for plug connector: 0.4...0.6 N•m.
  Tightening torque for protective caps: 0.6...0.7 N•m.
- Mount the optics cover.

IMPORTANT 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.

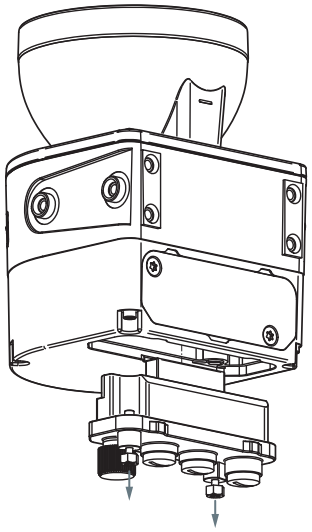
Tool required:

- TX20 Torx wrench

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.

Figure 81 - Replacing the System Plug



5. Carefully insert the new system plug into the safety laser scanner.
6. Screw in the system plug using the captive screws.
   Tightening torque: 2.25…2.75 N•m.
7. Reconnect the connecting cables to the system plug.
8. Configure the safety laser scanner, see Configure the SafeZone 3 Safety Laser Scanner on page 85.
9. Perform commissioning again, see Commissioning on page 135. In particular, carry out all of the described thorough checks, see Thorough Check on page 137.

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 on page 65.

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).

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

Notes:

Troubleshooting

Safety

ATTENTION: 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.

ATTENTION: Hazard due to unexpected starting of the machine

- When any work is taking place, use the protective device to secure the machine or to prevent the machine from being switched on unintentionally.

ATTENTION: 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.

Additional information on troubleshooting error codes can be found by contacting Rockwell Automation technical support (rok.auto/support) or accessing the Knowledgebase (rockwellautomation.custhelp.com).

Diagnostic LEDs

The safety laser scanner has diagnostic light emitting diodes (LEDs) for initial diagnostics.

Every safety laser scanner has four status LEDs above the display.

The device has different LEDs for every network interface. These network LEDs are located below the display.

Status LEDs

Four status LEDs are located directly above the display.

Figure 82 - Status LEDs

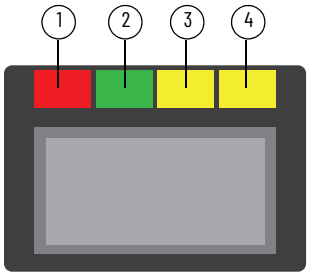


Table 20 - Status LEDs

Item	Function	Color	Meaning
1	OFF state	Red	Lights up red when at least one safety output is in the OFF state.
2	ON state	Green	Lights up green when at least one safety output 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.

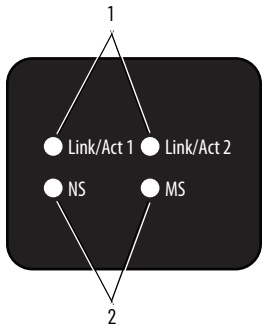
The OFF state and ON state LEDs can be found in multiple locations on the safety laser scanner. Three additional sets are arranged in pairs on the base of the optics cover. So the LEDs can also be seen in many cases when it is not possible to see the display, e.g. due to the mounting situation or because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

Network LEDs

The device has different LEDs for every network interface. These network LEDs are located below the display.

ATTENTION: The network LEDs are only used for diagnostic purposes and are not safety-relevant. The safety function of the device is not impaired even if the status indicators are incorrectly displayed or fail.

Figure 83 - Network LEDs



Item	Description
1	LEDs for network interfaces
2	EtherNet/IP™ light emitting diodes

The safety laser scanner has an LED for every network interface.

The safety laser scanner has two additional LEDs for EtherNet/IP.

LEDs for Network interfaces

The safety laser scanner has an LED for every network interface.

Table 21 - LEDs for Network Interfaces, Labeling: Link/Act

LED Status	Meaning	Troubleshooting
○	No supply voltage No Ethernet connection	• Check the voltage supply. • Check the network cable. • Check whether the device at the other end of the network cable is switched on.
● Green	Ethernet connection established	–
✳ Yellow	Data transmission	–

EtherNet/IP LEDs

The safety laser scanner has two EtherNet/IP LEDs. These LEDs are used collectively for both EtherNet/IP connections.

Table 22 - Network Status LED, Labeling: NS

LED Status	Meaning	Troubleshooting
○	No supply voltage	Check the voltage supply.
● Green	Device connected, IP address present, CIP connection established	–
✳ Green	Device connected, IP address present, no CIP connection	–
● Red	Error: IP address has already been assigned to a different device	–
✳ Red	Warning: connection was interrupted or was then reset or restructured	–
✳ Red/green	Connection interrupted or terminated	–

Table 23 - Module Status LED, Labeling: MS

LED Status	Meaning	Troubleshooting
○	No supply voltage	Check the voltage supply.
● Green	Device in operation	–
✳ Green	Device in sleep mode Device is ready	End sleep mode
● Red	Serious error, device not ready	
✳ Red	Correctable error (e.g. CIP connection interrupted)	Reestablish CIP connection
✳ Red/green	Device self-test Device is being configured Configuration error	Configure device

Diagnostics Using the Display

The display supplies information about the status of the safety laser scanner, and for diagnostics and troubleshooting.

Status Display

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

- If the display is switched off, press any push button to activate the display.
- Press any push button 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 24 - Overview of Status Information

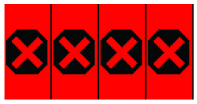
Display	Device or Configuration	Meaning
	All devices and configurations	All fields clear, safety outputs in ON state. The number at bottom right indicates the active monitoring case.
	Devices and configurations with a configured safety output	Protective field interrupted, safety output in OFF state.
	Devices and configurations with 2...4 configured safety outputs	For every of 4 cut-off paths, the following applies: the protective field is interrupted or there is a warning field in the active monitoring case. Safety outputs in the OFF state. Each column stands for a safety output. Safety outputs in the OFF state are marked with a cross if they could be in the safety-related ON state in at least one monitoring case.
	Devices and configurations with 2...4 configured safety outputs	The protective field in position 3 is interrupted or there is a warning field in the active monitoring case. The associated safety output is in the OFF state. Safety outputs for which no field is interrupted and which are in the ON state are marked with their number.
	Devices and configurations with 2...4 configured safety outputs	Cut-off paths in which no protective field is located are not marked. The associated safety output is in the OFF state. A non-safety-related output can still be in the ON state, e.g. if a warning field is free.
	Configuration with restart interlock	Protective field is clear, reset can take place.
	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).

Table 24 - Overview of Status Information (Continued)

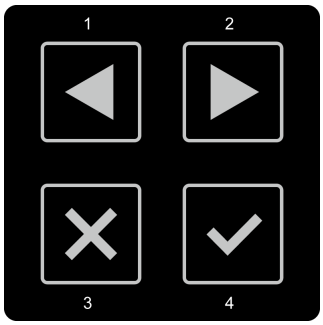
Display	Device or Configuration	Meaning
 Display Flashes	All devices and configurations	Fault. All safety outputs in the OFF state. Additional information: see Fault Display on page 159.
 Display Flashes	All devices and configurations	Contamination warning. Check the optics cover for damage. Clean the 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 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 the 442L Add-on Profile (AOP).
	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 push button to obtain more information.

Detailed Diagnostics

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

Buttons

Figure 84 - Push Buttons on the Device

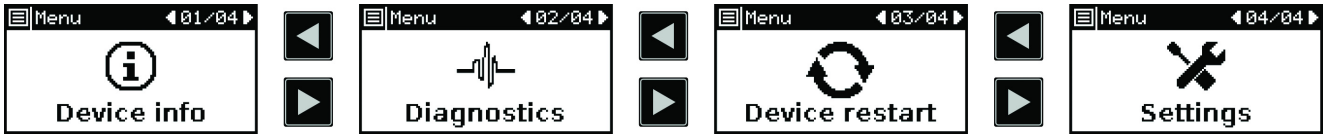


Item	Description
1, 2	You can use the arrow buttons to change between various displays and menu items.
3	You can use the back button to change to the previous display or a higher-level menu item.
4	You can use the OK button to show details for current information or confirm a menu point. Press the OK button twice to call up the menu.

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

Menu

Figure 85 - Menu



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

1. Press the OK push button 4 twice in succession to call up the menu.
2. Change to the desired menu point using the arrow buttons 1, 2.
3. Confirm the desired menu point using the OK button 4.
4. Use the same push buttons to navigate through the sub-menus.
5. Press the back button 3 to return to the higher-level menu point.
6. Press the back button 3 multiple times to return to the status display. If you do not press any push buttons 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
- Network: e.g. MAC address, IP address, sub-network
- Data output: e.g., status, target IP address

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

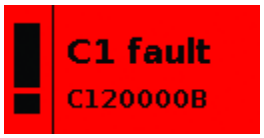
You have the following options in the settings area:

- Set the display brightness and contrast.

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 86 - Fault Display



- The two-character fault type will help you during troubleshooting.
- The eight-character fault code in the bottom line helps Rockwell Automation technical support during the detailed fault analysis.

By pressing any push button, 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 Table 25 on page 160.

You will find detailed information in the 442L AOP message history about the individual faults and information about events not shown by the display.

Table 25 - Fault Types

Fault Type	Description	Cause	Troubleshooting
C1	Faulty configuration	The configuration is faulty.	Reconfigure the device.
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 the 442L AOP or interrupt the voltage supply for at least 2 seconds. • Replace the safety laser scanner and send it to the manufacturer for repair.
E2	Fault in the safety laser scanner	The safety laser scanner has an internal error.	• Perform a device restart using the display or the 442L AOP or interrupt the voltage supply for at least 2 seconds. • Replace the safety laser scanner and send it to the manufacturer for repair.
E3	Fault in the system plug	The system plug has an internal fault.	• Perform a device restart using the display or the 442L AOP or interrupt the voltage supply for at least 2 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.
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 push button, the wiring, and any other components affected.
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 the 442L AOP. • 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 input signal for switching between monitoring cases received via the network is invalid. The invalid signal is applied for longer than 1 s.	Check the control over the network.
N4	Incorrect activation of the control inputs via the network	The input signal for activating switching between monitoring cases received via the network is invalid. The invalid signal is applied for longer than 1 s.	Check the control over the network.
N5	Invalid input signal	The input signal for switching between monitoring cases received via the network is invalid. The invalid signal is applied for longer than 1 s.	Check the control over the network.
N6	Invalid monitoring case number	The monitoring case number received via the network does not match the configuration of the device. The incorrect number is applied for longer than 1 s.	• Check the configuration with the 442L AOP. • Check the control over the network.
R1	Connection errors	The data connection between the control and device is interrupted.	• Check the connection between the device and control. • Adjust the data transmission rate in the control if necessary.
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 the 442L AOP to check what warnings exist.

Diagnostics using 442L Add-on Profile

The following diagnostics tools are available in the device window:

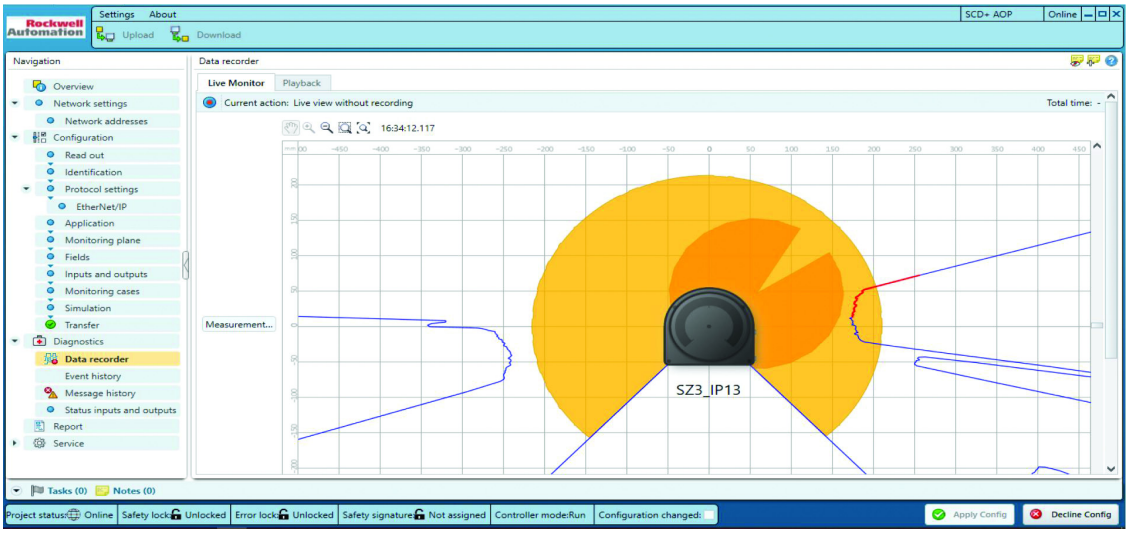
- Data recorder
- Event history
- Message history
- Inputs and outputs

The following interfaces are suitable for diagnostics:

- Ethernet/IP™

Data Recorder

Figure 87 - Data Recorder



You can use the data recorder to record the signals of the device continuously. The measurement data is 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 442L AOP frame.

Button	Description
	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:

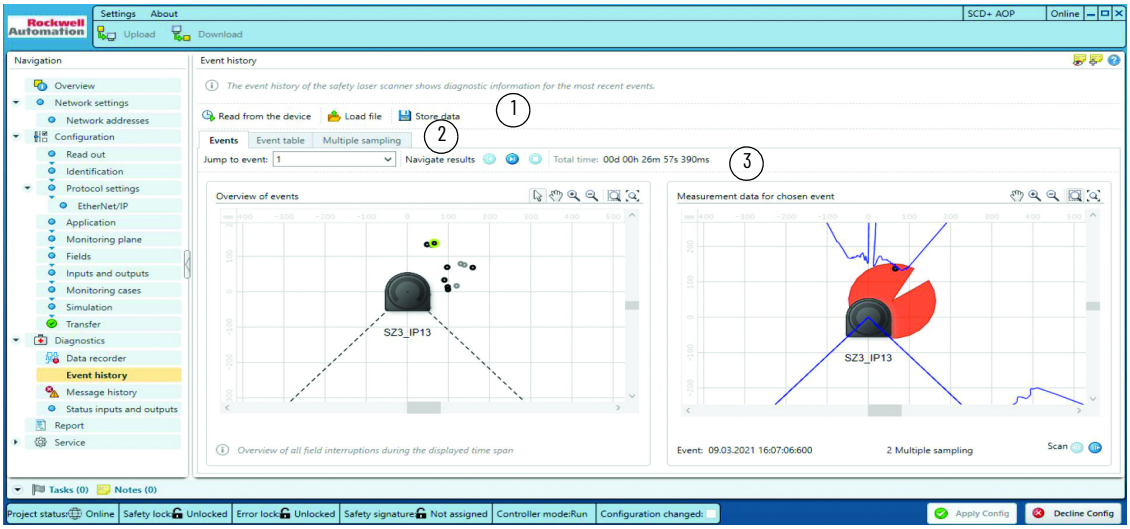
- Existing connection between the 442L AOP and device
- Configuration in the project and configuration in the device are synchronized

Approach:

1. Import configuration from the device.
2. Take an image.

Event History

Figure 88 - Event History



Item	Description
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.

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.

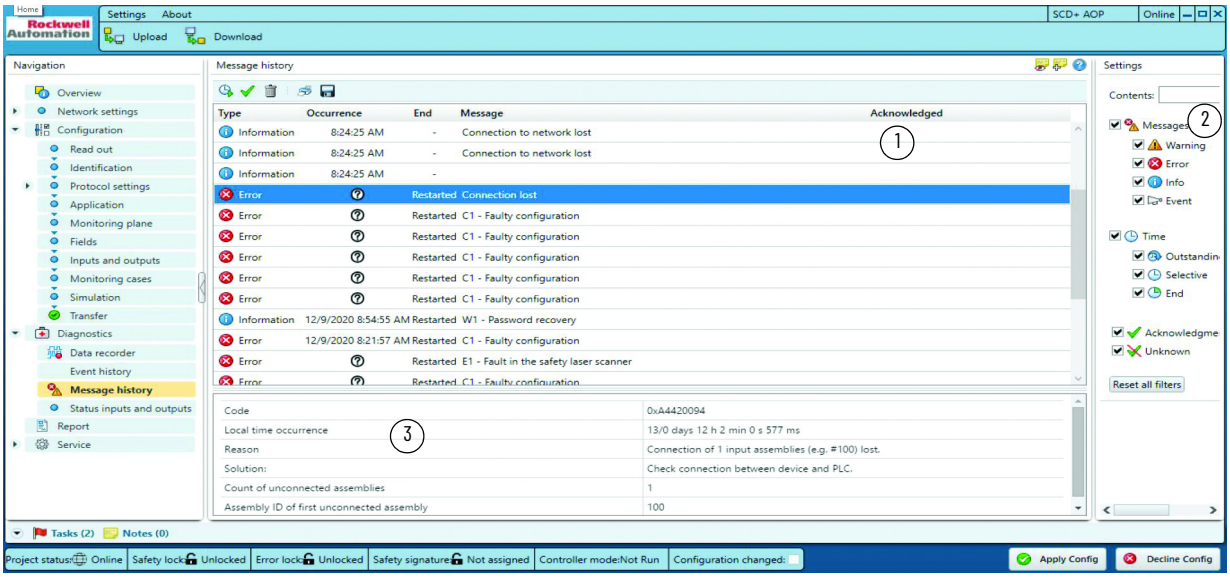
Multiple Sampling

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.

Message History

Figure 89 - Message History



Item	Description
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.

The 442L AOP shows details about the events in the bottom part of the window, ways to solve them are also shown.

Table 26 - Print message history or save as a PDF

Button	Description
	Print message history
	Save message history as a PDF

Inputs and Outputs

The 442L AOP displays information on the supported assemblies.

The arrows to the device symbolize the output assemblies (from the view of the control). The arrows away from the device symbolize the input assemblies (from the view of the control).

Double-click on an assembly to open a detailed view featuring the individual data fields.

Diagnostics Using the Control

You can access the CIP objects with the control, see Available Data on page 63.

Decommissioning

Disposal

Always dispose of unusable devices in accordance with national waste disposal regulations.

Rockwell Automation will be glad to help you dispose of these devices on request.

Notes:

Technical Data

Variant Overview

Ordering information: see Ordering Information on page 189.

Table 27 - Devices and Type Codes

Performance Package Integration in the Control	Protective Field Range	Device Without System Plug	System Plug
SafeZone™ 3	≤ 5.5 m	442L-SZNMZCP	442L-SZNCPMOD

Version Numbers and Functional Scope

To identify the different levels of the functionality, we use a three-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
- 442L Add-on Profile (AOP), Overview dialog box (only with connected devices)
- 442L AOP, Report

Data Sheet

Table 28 - Features

Attribute	Cat. No. 442L-SZNMZCP
Protective field range	
Devices with a max protective field range of 5.5 m	≤ 5.5 m, details: see Sensing Range on page 172
Scanning range of the reference contour field	Same as protective field range, see Sensing Range on page 172
Scanning range of the contour detection field	Same as protective field range, see Sensing Range on page 172
Warning field range	
Devices with a max protective field range of 5.5 m	≤ 40 m
Distance measurement range	
Devices with a max protective field range of 5.5 m	≤ 40 m
Fields	≤8
Simultaneously monitored fields	
Devices with a max protective field range of 5.5 m	≤ 4
Simultaneous cut-off paths	
Devices with a max protective field range of 5.5 m	≤ 4
Field sets	≤ 8
Monitoring cases	≤ 8
Scanning angle	275° (-47.5…+227.5°)
Protective field resolution	30 mm, 40 mm, 50 mm, 70 mm, 150 mm, 200 mm

Table 28 - Features (Continued)

Attribute	Cat. No. 442L-SZNMZCP
Angular resolution	
Devices with a maximum protective field range of 5.5 m	
Scan cycle time 30 ms	0.51°
Scan cycle time 40 ms	0.39°
Response time	
Devices with a max protective field range of 5.5 m	≥ 95 ms, details: see Response Times on page 171
Scan cycle time	
Devices with a max protective field range of 5.5 m	30 ms or 40 ms (adjustable)
Generally necessary protective field supplement (TZ = tolerance range of the safety laser scanner)	
Devices with a max protective field range of 5.5 m	65 mm
Additional supplement ZR for reflection-based measurement errors	350 mm
Deviation from ideal flatness of scan field at 5.5 m (1)	≤ ±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 (2)

(1) Devices with max. protective field range of 5.5 m.
(2) Can be adjusted collectively for all fields or individually for each field.

Safety-related Parameters

Table 29 - Safety-related Parameters

Attributes	Cat. No. 442L-SZNMZCP
Type	Type 3 (IEC 61496)
Safety integrity level	SIL 2 (IEC 61508)
SIL claim limit	SIL CL 2 (IEC 62061)
Category	Category 3 (ISO 13849-1)
Performance level	PLd (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	The safety outputs via the network are logic 0.

Interfaces

Table 30 - Interfaces

Attributes	Cat. No. 442L-SZNMZCP
Safety outputs via network (Quantity)	
Devices with a max protective field range of 5.5 m	4
Duration of OFF state	≥ 80 ms
Automatic restart after	2…60 s (can be configured)
Voltage supply	
Connection type	Male connector, M12, 4-pin, A-coding
Length of cable (power supply unit tolerance ± 5%)	
Length of cable with wire cross-section 0.25 mm^2	≤ 100 m
Configuration and diagnostic interface	
Type of interface	EtherNet/IP™
Configuration	The 442L AOP is required to configure the SafeZone 3 safety laser scanner.
Fieldbus/industrial network	
Type of fieldbus integration	EtherNet/IP
Connection type	M12 female connector, 4-pin, D-coded
Supported protocol versions	• Common Industrial Protocol: The CIP Networks Library Volume 1, Edition 3.20 • EtherNet/IP: The CIP Networks Library Volume 2, Edition 1.21 • CIP Safety™: The CIP Networks Library Volume 5, Edition 2.13

Electrical Data

Table 31 - Electrical Data

Attributes	Cat. No. 442L-SZNMZCP
Operating data	
Protection class	III (IEC 61140)
Supply voltage UV	24V DC (16.8…30V DC) (SELV/PELV) (1)
Residual ripple	± 5% (2)
Start-up current at 24V	≤ 3 A
Current consumption at 24V	
Operation	≤ 0.45 A (typ. 0.3 A)
Sleep mode	Typ. 0.29 A
Power consumption	
Operation	≤ 11 W (typ. 7.2 W)
Sleep mode	Typ. 7 W
Power-up delay	≤ 45 s (typ. 20 s)

(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 Rockwell Automation
(2) The voltage level must not fall below the specified minimum voltage.

Mechanical Data

Table 32 - Mechanical Data

Attributes	Cat. No. 442L-SZNMZCP
Dimensions — without system plug (W × H × D)	112 × 150.8 × 111.1 mm (4.41 x 5.94 x 4.37 in.)
Weight — with system plug	1.45 kg (3.2 lb)
Housing material	Aluminum
Housing color	RAL 3020 (red) and Pantone Cool Gray 5 (gray)
Optics cover material	Polycarbonate
Optics cover surface	Outside with scratch-resistant coating

Ambient Data

Table 33 - Ambient Data

Attributes	Cat. No. 442L-SZNMZCP
Enclosure rating (1)	IP65 (IEC 60529)
Ambient light immunity	≤ 3000 lx (IEC 61496-3)
Ambient operating temperature	-10…+50 °C (14…122 °F)
Storage temperature	-25…+70 °C (-13…+158 °F)
Air humidity	≤95%, noncondensing (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…150 Hz
Amplitude	0.35 mm (10…60 Hz), 5 g (60…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 and the cover plate are mounted, and all of the safety laser scanner's M12 system plugs are closed using a male cable connector suitable for the enclosure rating 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 34 - Miscellaneous Data

Attributes	Cat. No. 442L-SZNMZCP
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 5.5 m distance	20 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.

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).

ATTENTION: 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. These include the network cycle time, 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.

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
- t_I = time for interference protection
  Mode 1 (default): tI = 0 ms
  Mode 2: tI = 1 ms
  Mode 3: tI = 2 ms
  Mode 4: tI = 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:
  - EtherNet/IP: t_O = 35 ms

Table 35 - 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	EtherNet/IP	n × 30 ms + 35 ms
	Mode 2	1 ms	EtherNet/IP	n × 31 ms + 35 ms
	Mode 3	2 ms	EtherNet/IP	n × 32 ms + 35 ms
	Mode 4	3 ms	EtherNet/IP	n × 33 ms + 35 ms
40 ms	Mode 1	0 ms	EtherNet/IP	n × 40 ms + 35 ms
	Mode 2	1 ms	EtherNet/IP	n × 41 ms + 35 ms
	Mode 3	2 ms	EtherNet/IP	n × 42 ms + 35 ms
	Mode 4	3 ms	EtherNet/IP	n × 43 ms + 35 ms

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 36 - Protective Field Range (Devices with a Maximum Protective Field Range of 5.5 m [1.7 ft])

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

Scanning Range of the Reference Contour Field

The effective scanning range of the reference contour field is the same as the protective field range.

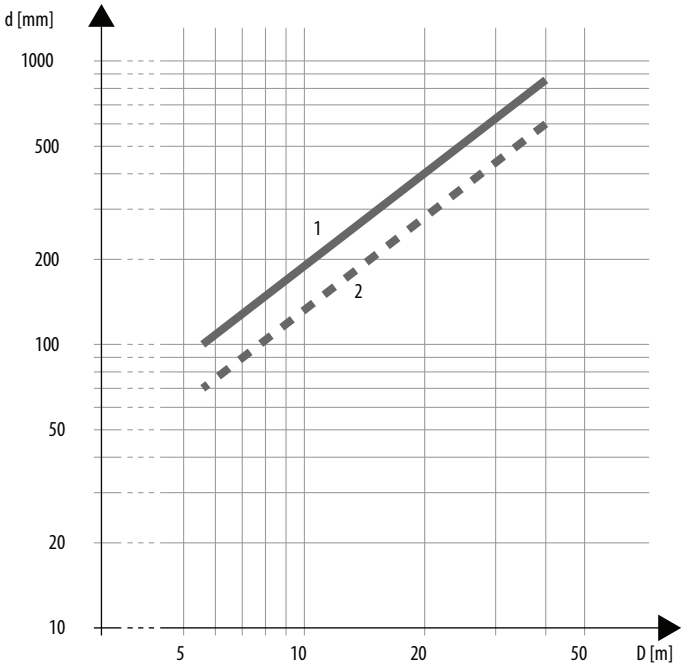
Scanning Range of the Contour Detection Field

The effective scanning range of the contour detection field is the same as the protective field range.

Range for Warning Fields

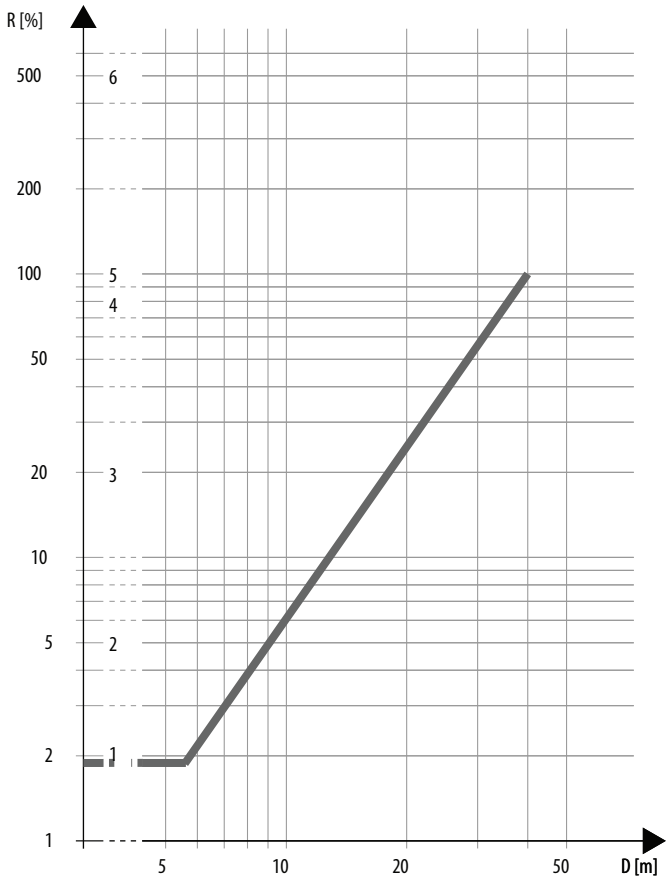
For non-safety applications (warning fields), the safety laser scanner has a larger range than the maximum protective field range. The requirements for size and remission of objects to be detected are illustrated in the following graphs as a function of the desired range.

Figure 90 - Scanning range and object size for warning fields (devices with M=maximum protective field range of 5.5 m)



Item	Description
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 required remission for warning fields protective field



Item	Description
R	Necessary minimum remission in %
D	Range in m
1	Black shoe leather
2	Matte black paint
3	Gray cardboard
4	Writing paper
5	White plaster
6	Reflectors > 2000%, reflective tapes > 300%

Data Exchange in the Network

Standard Objects (Open Objects)

Identity Object (0x01)

Table 37 - Object Class

Attribute ID		Access Rule	Name	Data type
Dec	Hex			
1	0x01	Get	Revision	UINT
2	0x02	Get	Max Instance	UINT
6	0x06	Get	Max Number Class Attributes	UINT
7	0x07	Get	Max Number Instance Attributes	UINT

Services

- Get_Attributes_All
- Get_Attribute_Single

Table 38 - Object Instance

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Vendor ID	UINT
2	0x02	Get	Device Type	UINT
3	0x03	Get	Product Code	UINT
4	0x04	Get	Revision	STRUCT
5	0x05	Get	Status	WORD
6	0x06	Get	Serial Number	UDINT
7	0x07	Get	Product Name	SHORT_STRING
8	0x08	Get	State	USINT
9	0x09	Get	Conf. Consistent. Value	UINT

Services

- Get_Attributes_All
- Get_Attribute_Single

Available instances

- ID1

Assembly Object (0x04)

Table 39 - Object Class

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Revision	UINT

Services

- Get_Attribute_Single

Table 40 - Object Instance

Attribute ID		Access rule	Name	Data type
Dec	Hex			
3	0x03	Get/Set	DATA	ARRAY of BYTE
4	0x04	Get	Number of bytes in ATTR 3	UINT

Services

- Get_Attribute_Single

Available instances

- ID100: Assembly 100: input of the device, output of the control
- ID110: Assembly 110: output of the device, input of the control

Connection Manager Object (0x06)

Table 41 - Object Class

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Revision	UINT
2	0x02	Get	Max Instance	UINT

Services

- Get_Attribute_Single

Object Instance

Services

- Get_Attribute_Single
- Forward_Open
- Forward_Close

Safety Supervisor Object (0x39)

Table 42 - Object Instance

Attribute ID		Access rule	Name	Data type
Dec	Hex			
11	0x0B	Get	Device Status	USINT
12	0x0C	Get	Exception Status	BYTE
15	0x0F	Set	Alarm Enable	BOOL
16	0x10	Set	Warning Enable	BOOL
25	0x19	Get	Configuration UNID	10 octets
26	0x1A	Get	Safety Configuration Identifier	10 octets
27	0x1B	Get	Target UNID	10 octets
28	0x1C	Get	OCPOUNID	STRUCT

Services

- Get_Attribute_Single
- Set_Attribute_Single
- Safety Reset
  - Type 0: completely restart device

Available instances

- ID1

Safety Validator Object (0x3A)

Table 43 - Object Class

Attribute ID		Access rule	Name	Data type
Dec	Hex			
8	0x08	Get	Safety Connection Fault Count	UINT

Services

- Get_Attribute_Single
- Reset All Error Counters

Table 44 - Object Instance

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Safety Validator State	USINT
2	0x02	Get	Safety Validator Type	USINT
3	0x03	Get	Ping Interval EPI Multiplier	UINT
7	0x07	Get	Max Consumer Number	USINT
12	0x0C	Get	Max Data Age	UINT
13	0x0D	Get	Application Data Path	EPATH
15	0x0F	Get	Producer/Consumer Fault Counters	STRUCT

Services

- Get_Attribute_Single
- Set_Attribute_Single

Available instances

- ID1...ID58

DLR Object (Device Level Ring) (0x47)

Table 45 - Object Class

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Revision	UINT

Services

- Get_Attribute_Single

Table 46 - Object Instance

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Network Topology	USINT
2	0x02	Get	Network Status	USINT
10	0x0A	Get	Active Supervisor Address	STRUCT
12	0x0C	Get	Capability Flags	DWORD

Services

- Get_Attributes_All
- Get_Attribute_Single

Available instances

- ID1

QoS Object (Quality of Service) (0x48)

Table 47 - Object Class

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Revision	UINT
2	0x02	Get	Max Instance	UINT

Services

- Get_Attribute_Single

Table 48 - Object Instance

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get/Set	802.1Q Tag Enable	USINT
4	0x04	Get/Set	DSCP Urgent	USINT
5	0x05	Get/Set	DSCP Scheduled	USINT
6	0x06	Get/Set	DSCP High	USINT
7	0x07	Get/Set	DSCP Low	USINT
8	0x08	Get/Set	DSCP Explicit	USINT

Services

- Get_Attribute_Single
- Set_Attribute_Single

Available instances

- ID1

TCP/IP Object (0xF5)

Table 49 - Object Class

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Revision	UINT
2	0x02	Get	Max Instance	UINT

Services

- Get_Attribute_Single

Table 50 - Object instance

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Status	DWORD
2	0x02	Get	Configuration Capability	DWORD
3	0x03	Get/Set	Configuration Control	DWORD
4	0x04	Get	Physical Link Object	STRUCT
5	0x05	Get/Set	Interface Configuration	STRUCT
6	0x06	Get/Set	Host Name	STRING
7	0x07	Get	Safety Network Number	6 octets
10	0x0A	Get/Set	SelectACD	BOOL
11	0x0B	Get/Set	LastConflictDetected	STRUCT
13	0x0D	Get/Set	Encapsulation Inactivity Timeout	UINT

Services

- Get_Attributes_All
- Get_Attribute_Single
- Set_Attribute_Single

Available instances

- ID1

Ethernet Link Object (0xF6)

Table 51 - Object Class

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Revision	UINT
2	0x02	Get	Max Instance	UINT
3	0x03	Get	Number of Instances	UINT

Services

- Get_Attribute_Single

Table 52 - Object instance

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Interface Speed	UDINT
2	0x02	Get	Interface Flags	DWORD
3	0x03	Get	Physical Address	ARRAY
4	0x04	Get	Interface Counters	STRUCT
5	0x05	Get	Media Counters	STRUCT
6	0x06	Get/Set	Interface Control	STRUCT
7	0x07	Get	Interface Type	USINT
8	0x08	Get	Interface State	USINT
10	0x0A	Get	Interface Label	SHORT_STRING
11	0x0B	Get	Interface Capability	STRUCT

Services

- Get_Attribute_Single
- Set_Attribute_Single
- Get_and_Clear

Available instances

- ID1
- ID2

Manufacturer-specific Objects (Vendor-specific Objects)

There is only one instance for each of the manufacture-specific objects. This instance has ID 1.

Current Error Object (0x400)

Table 53 - Object Class

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Revision	UINT

Services

- Get_Attribute_List
- Get_Attributes_All
- Get_Attribute_Single

Table 54 - Object instance

Attribute ID		Access rule	Name	Data type	Description
Dec	Hex				
1	0x01	Get	Errorcode	UDINT	Error code of the current error; if no error is present: 0.
2	0x02	Get	Data	STRUCT of	Information on the current error
			Data 1	UDINT	
			Data 2	UDINT	
			Data 3	UDINT	
			Data 4	UDINT	
3	0x03	Get	Timestamp	DATE_AND_TIME (DT)	Date and time of the occurrence of the current error
4	0x04	Get	Flags	UINT	Flag of the current error: • Bit 0.0: error end. The error (or the previous error) with the error code is no longer present. • Bit 0.1: Consequential error. The error was caused by a previous error. (If this cannot be clearly identified, the value is FALSE.) • Bit 0.2: Time stamps are based on the network time. (If the time stamps are based on device time, the value is FALSE.) • Bit 0.3: time stamps are based on UTC. (If the time stamps are based on an operating hour counter or the time zone cannot be clearly determined, the value is FALSE.) • Bit 0.4: time stamps are exact. The value is TRUE when the deviation from the time of the network master is less than the maximum deviation configured. • Bits 1.0...1.7: source of the error. The meaning of the individual bits can deviate depending on the project. Standard: bit 0 = CPUA, bit 1 = CPUB etc. Several bits can be set.
5	0x05	Get	PowerOnCount	UDINT	Number of power-up processes until the current error occurs
6	0x06	Get	Errortype	SHORT_STRING	Error type (e.g. C1)
7	0x07	Get	Errortext	SHORT_STRING	Error text as shown on the display

Services

- Get_Attribute_List
- Get_Attributes_All
- Get_Attribute_Single

Operating Time Object (0x401)

Table 55 - Object Class

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Revision	UINT

Services

- Get_Attribute_List
- Get_Attributes_All
- Get_Attribute_Single

Table 56 - Object Instance

Attribute ID		Access rule	Name	Data type	Description
Dec	Hex				
1	0x01	Get	Operating Time	DATE_AND_TIME (DT)	If reference time is available: current time in ms. If reference time is not available: time since device start in ms.
2	0x02	Get	Start Time	DATE_AND_TIME (DT)	Date and time during device start. If reference time is not available: 0.
3	0x03	Get	PowerOnCount	UDINT	Number of power-up processes
4	0x04	Get	Flags	UINT	• Bit 0.0: Time stamps are based on the network time. (If the time stamps are based on device time, the value is FALSE.) • Bit 0.1: time stamps are based on UTC. (If the time stamps are based on an operating hour counter or the time zone cannot be clearly determined, the value is FALSE.) • Bit 0.2: time stamps are exact. The value is TRUE when the deviation from the time of the network master is less than the maximum deviation configured.
5	0x05	Get	OperatingHours	UDINT	Operating hours of the device

Services

- Get_Attribute_List
- Get_Attributes_All
- Get_Attribute_Single

Config Info Object (0x402)

Table 57 - Object Class

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Revision	UINT

Services

- Get_Attribute_List
- Get_Attributes_All
- Get_Attribute_Single

Table 58 - Object Instance

Attribute ID		Access rule	Name	Data type	Description
Dec	Hex				
1	0x01	Get	DeviceName	SHORT_STRING	Device name
2	0x02	Get	ApplicationName	SHORT_STRING	Application name
3	0x03	Get	ProjectName	SHORT_STRING	Project name
4	0x04	Get	UserName	SHORT_STRING	User name
5	0x05	Get	ModificationTime	DATE_AND_TIME (DT)	Time of the last change to the configuration
6	0x06	Get	TransferTime	DATE_AND_TIME (DT)	Time of the last transmission of the configuration to the device
7	0x07	Get	Reserved	UDINT	Reserved
8	0x08	Get	AppChecksum	UDINT	Checksum (function)
9	0x09	Get	OverallChecksum	UDINT	Checksum (function and network)
10	0x0A	Get	IntegrityHash	STRUCT of	Lower-level identification number of the checksums
			MD5[0]	UDINT	
			MD5[1]	UDINT	
			MD5[2]	UDINT	
			Reserved	UDINT	

Services

- Get_Attribute_List
- Get_Attributes_All
- Get_Attribute_Single

Device Info object (0x403)

Table 59 - Object Class

Attribute ID		Access rule	Name	Data type
Dec	Hex			
1	0x01	Get	Revision	UINT

Services

- Get_Attribute_List
- Get_Attributes_All
- Get_Attribute_Single

Table 60 - Object Instance

Attribute ID		Access rule	Name	Data type	Description
Dec	Hex				
1	0x01	Get	PackageSerial-Number	UDINT	Serial number (device with system plug)
2	0x02	Get	PackageOrderNumber	SHORT_STRING	Part number (device with system plug)
3	0x03	Get	DeviceSerial-Number	UDINT	Serial number (device without system plug)
4	0x04	Get	DeviceOrderNumber	SHORT_STRING	Part number (device without system plug)
5	0x05	Get	SysplugSerial-Number	UDINT	Serial number (system plug)
6	0x06	Get	SysplugOrderNumber	SHORT_STRING	Part number (system plug)
7	0x07	Get	FirmwareVersion	SHORT_STRING	Current firmware version (CPU A)
8	0x08	Get	CurrentConfigSetVersion	SHORT_STRING	Functionality of the configuration
9	0x09	Get	HighestConfigSetVersion	SHORT_STRING	Functionality of the device
10	0x0A	Get	Reserved	USINT	Reserved
11	0x0B	Get	Device Status	USINT	Device status • 0: unclear device status • 1: device start • 2: service mode (e.g. firmware update, optics cover calibration) • 3: normal operation • 4: device is waiting (e.g. for communication partner or input signal) • 5: waiting recommended (e.g. contamination warning) • 6: waiting required (e.g. configuration incompatible) • 7: correctable error (e.g. configuration error, network error) • 8: serious error (e.g. contamination error, configuration error, network error)
12	0x0C	Get	RequiredUserAction	UINT	Note on troubleshooting • Bit 0.0: configure device, verify configuration • Bit 0.1: Test configuration, test device variant • Bit 0.2: check communication partner, check manipulation • Bit 0.3: check input signals, check network and other connections • Bit 0.4: check error messages • Bit 0.5: configure device (including network settings) • Bit 0.6: check firmware • Bit 0.7: wait a few seconds

Services

- Get_Attribute_List
- Get_Attributes_All
- Get_Attribute_Single

Assemblies

Available Data

Table 61 - Input of the Device (Output of the Control)

Name	Use	Data Type	Definition	Values	Safety implication
ActivateCaseSwitching	Safety function	BOOL	Monitoring case switching Activates switching between monitoring cases. Only valid signals are then permitted for switching between monitoring cases.	• 0 = switching between monitoring cases not activated • 1 = switching between monitoring cases activated	Safety-relevant parameter
StandbyModeEnable	Additional function	BOOL	Activates sleep mode.	• 0 = no sleep mode • 1 = sleep mode	Parameter without safety implication
MonitorCaseSelA1	Safety function	BOOL	MonitorCaseSelA1 Control input for switching between monitoring cases. Control inputs can be evaluated complementarily in pairs or with a 1-off-n-condition.	0 = logic status of the control input is 0 1 = logic status of the control input is 1	Safety-relevant parameter
MonitorCaseSelA2... MonitorCaseSelD2	Safety function	BOOL	MonitorCaseSelA2...MonitorCaseSelD2 Control input for switching between monitoring cases. Control inputs can be evaluated complementarily in pairs or with a 1-off-n-condition.	• 0 = logic status of the control input is 0 • 1 = logic status of the control input is 1	Safety-relevant parameter
StopAlarmRecording	Additional function	BOOL	Stop Event history	• 0 = event history active, field interruptions are recorded • 1 = event history not active, field interruptions are not recorded, existing recordings are retained	Parameter without safety implication
ResetField01	Safety function	BOOL	Reset Cut-off path 01 Reset of the restart interlock of reset field 01. Resetting is performed with the rising signal flank.	• 0 = no reset • 0-1-0 = reset (duration of status 1 ≥60 ms)	Safety-relevant parameter
ResetField02... ResetField04	Safety function	BOOL	ResetField02...ResetField04 Reset of the restart interlock of reset field 02...04. Resetting is performed with the rising signal flank.	• 0 = no reset • 0-1-0 = reset (duration of status 1 ≥60 ms)	Safety-relevant parameter
InitiateRunMode	Safety function	BOOL	Restart safety function Restarts the safety function after an application error. (The device must be restarted to end the error state).	• 0 = no start command • 0-1-0 = start safety function (duration of status 1 ≥120 ms) • 1 = ignored	Safety-relevant parameter
ResetFault	Additional function	BOOL	Restarting safety function and connections Restarts the device without ending the network stack. The internal switch function is not interrupted.	• 0 = no restart • 0-1-0 = device restart (duration of status 1 ≥120 ms) • 1 = ignored	Parameter with implication for the safety function
ResetDevice	Additional function	BOOL	Restart device completely Restarts the device and the network stack. The internal switch function is interrupted.	• 0 = no restart • 0-1-0 = device restart (duration of status 1 ≥120 ms) • 1 = ignored	Parameter with implication for the safety function

Table 62 - Output of the Device (Input of the Control)

Name	Use	Data Type	Definition	Values	Safety implication
RunMode	Diagnostics	BOOL	Status of security function Signalizes the operational status of the device.	• 0 = safety function paused. • 1 = safety function is executed.	Parameter without safety implication
ApplicationFault	Diagnostics	BOOL	ApplicationFault Signalizes whether an application error is present, causing the safety function to be paused. To resolve this, rectify the cause of the error and then restart the safety function.	• 0 = no ApplicationFault • 1 = ApplicationFault	Parameter without safety implication
DeviceFault	Diagnostics	BOOL	DeviceFault Signalizes whether an application error (critical error) is present, causing the safety function to be paused. To resolve this, rectify the cause of the error and then restart the device.	• 0 = no DeviceFault • 1 = DeviceFault	Parameter without safety implication
SafetyField01	Safety function	BOOL	SafetyField01 (safety-oriented) The signal is ON if the currently monitored field in the cut-off path is safety-related and free.	• 0 = OFF state, protective field interrupted • 1 = ON state, protective field free	Safety-relevant parameter
SafetyField02... SafetyField04	Safety function	BOOL	SafetyField02...04 (safety-oriented) The signal is ON if the currently monitored field in the cut-off path is safety-related and free.	• 0 = OFF state, protective field interrupted • 1 = ON state, protective field free	Safety-relevant parameter
WarningField01	Additional function	BOOL	WarningField01 (Not safety-related) The signal is ON if the currently monitored field in the cut-off path is free.	• 0 = OFF state, field interrupted • 1 = ON state, field free	Parameter without safety implication
WarningField02... WarningField04	Additional function	BOOL	WarningField02...04 (Not safety-related) The signal is ON if the currently monitored field in the cut-off path is free.	• 0 = OFF state, field interrupted • 1 = ON state, field free	Parameter without safety implication
ActiveMonitoringCaseNumber	Diagnostics	USINT	ActiveMonitoringCaseNumber Signalizes the current (active) monitoring case of monitoring case table 1.	• 0 = no monitoring case is active • 1...8 = number of the current (active) monitoring case	Parameter without safety implication
Reset Required Field01	Diagnostics	BOOL	Reset Required Field01 Signalizes whether the device is waiting for a reset signal to switch safety-related Field01 to the ON state.	• 0 = reset not required • 1= reset required	Parameter with implication for the safety function
Reset Required Field02... ResetRequiredField04	Diagnostics	BOOL	Reset Required Field02...04 Signals whether the device is waiting for a reset signal to switch the respective safety-related cut-off path to the ON state.	• 0 = reset not required • 1= reset required	Parameter with implication for the safety function
StandbymodeActive	Diagnostics	BOOL	Status sleep mode Signalizes whether the device is in sleep mode.	• 0 = device not in sleep mode • 1 = device in sleep mode	Parameter without safety implication
ContaminationWarning	Diagnostics	BOOL	Contamination warning Optics cover is dirty. Clean the optics cover.	• 0 = no contamination warning • 1 = contamination warning	Parameter without safety implication
ContaminationFault	Diagnostics	BOOL	ContaminationFault Optics cover is dirty. All safety outputs in the OFF state. Clean the optics cover.	• 0 = No ContaminationFault • 1 = ContaminationFault	Parameter with implication for the safety function
ReferenceContourFault	Diagnostics	BOOL	Reference contour monitoring The safety laser scanner does not detect a contour in the set tolerance band. All safety outputs in the OFF state.	• 0 = contour in the set tolerance band or reference contour monitoring not active • 1 = contour not in set tolerance band	Parameter with implication for the safety function
ManipulationFault	Diagnostics	BOOL	Manipulation Signalizes if manipulation has been detected and the safety outputs are therefore in the OFF state, for example because the device has not detected an object over a long period of time.	• 0 = no manipulation detected • 1 = manipulation detected	Parameter with implication for the safety function

Content of the Assemblies

Assembly 100: input of the device, output of the control

- CIP Safety
- Update cycle: 5 ms (or a multiple of this, depending on RPI)
- Length: 8 bytes
- Switching between monitoring cases via dual-channel information, like with devices with locally connected static control inputs.

Table 63 - Assembly 100

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved				StandbyModeEnable	StopAlarmRecording	ActivateCase Switching	InitiateRunMode
1	Reserved							
2	Reserved							
3	MonitorCaseSelD2	MonitorCaseSelD1	MonitorCaseSelC2	MonitorCaseSelC1	MonitorCaseSelB2	MonitorCaseSelB1	MonitorCaseSelA2	MonitorCaseSelA1
4	Reserved							
5	Reserved				ResetField04	ResetField03	ResetField02	ResetField01
6	Reserved							
7	Reserved						ResetDevice	ResetFault

Assembly 110: output of the device, input of the control

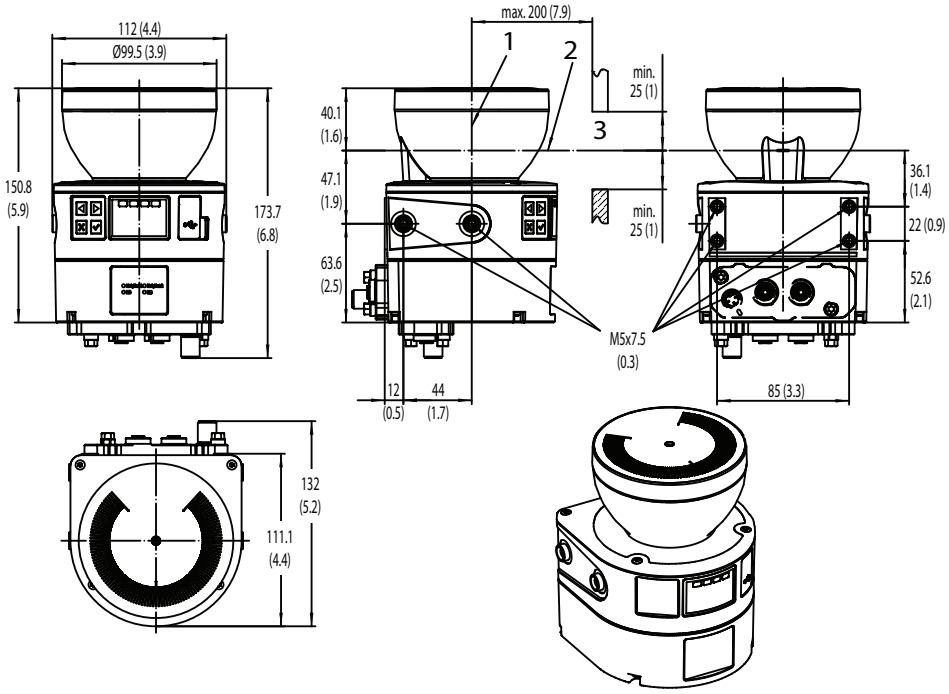
- CIP Safety
- Update cycle: 5 ms (or a multiple of this, depending on RPI). The AOP allows an input RPI of 10…500 ms. The safety laser scanner faults if a non-multiple of five is chosen. To clear the fault, choose an RPI value that is a multiple of five and apply.
- Length: 8 bytes

Table 64 - Assembly 110

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved		ManipulationFault	ReferenceContourFault	ContaminationFault	Contamination-Warning	Standbymode Active	RunMode
1	Reserved				SafetyField04	SafetyField03	SafetyField02	SafetyField01
2	Reserved				WarningField04	WarningField03	WarningField02	WarningField01
3	Reserved							
4	ActiveMonitoringCaseNumber							
5	Reserved				ResetRequiredField04	ResetRequiredField03	ResetRequiredField02	ResetRequiredField01
6	Reserved							
7	Reserved						DeviceFault	ApplicationFault

Dimensional Drawings

Figure 92 - Dimensional Drawing (All dimensions in mm)



Item	Description
1	Mirror rotational axis
2	Scan plane
3	Required viewing slit

Notes:

Ordering Information

Scope of Delivery

- Safety laser scanner
- Safety note
- Mounting Instructions
- Operating instructions for download: rok.auto/literature

Ordering Information

Table 65 - SafeZone™ 3 Laser Scanner

	Description (1)	Cat. No.
	SafeZone 3 Multizone CIP safety laser scanner, 5.5 m, 8 field sets, without system plug	442L-SZNMZCP

(1) For approximate dimensions, see Dimensional Drawings on page 187.

Table 66 - Required System Plug for SafeZone 3 Laser Scanner

	Description (1)	Cat. No.
	SafeZone 3 CIP safety laser scanner system plug	442L-SZNCPMOD

(1) For approximate dimensions, see Dimensional Drawings on page 187.

Notes:

Accessories

Brackets

Table 67 - Accessories

	Description	Cat. No.
	**Mounting kit 1** Mounts to housing.	442L-AMBSZCP1
	**Mounting kit 2** Mounts to housing.	442L-AMBSZCP2
	**Mounting kit 3** Mounts to kit 1 or kit 2. (Use when system plug is on housing bottom)	442L-AMBSZCP3
	Mounting kit 4 Mounts to kit 1 or kit 2 (Use when system plug is on housing back)	442L-AMBSZCP4

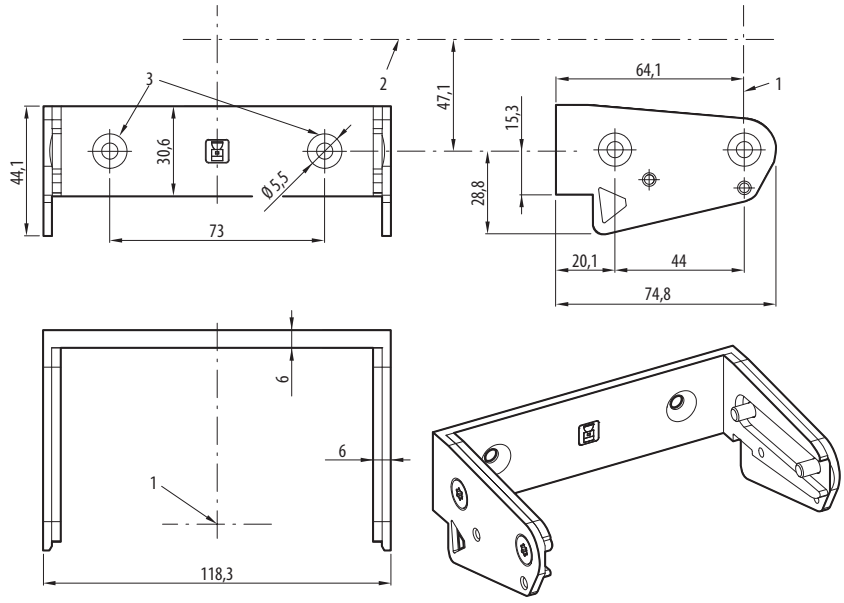
Replacement Parts

Table 68 - Replacement Parts

	Description	Cat. No.
	Optics cover replacement	442L-ASZNCPW
	Cover plate replacement	442L-ACVR

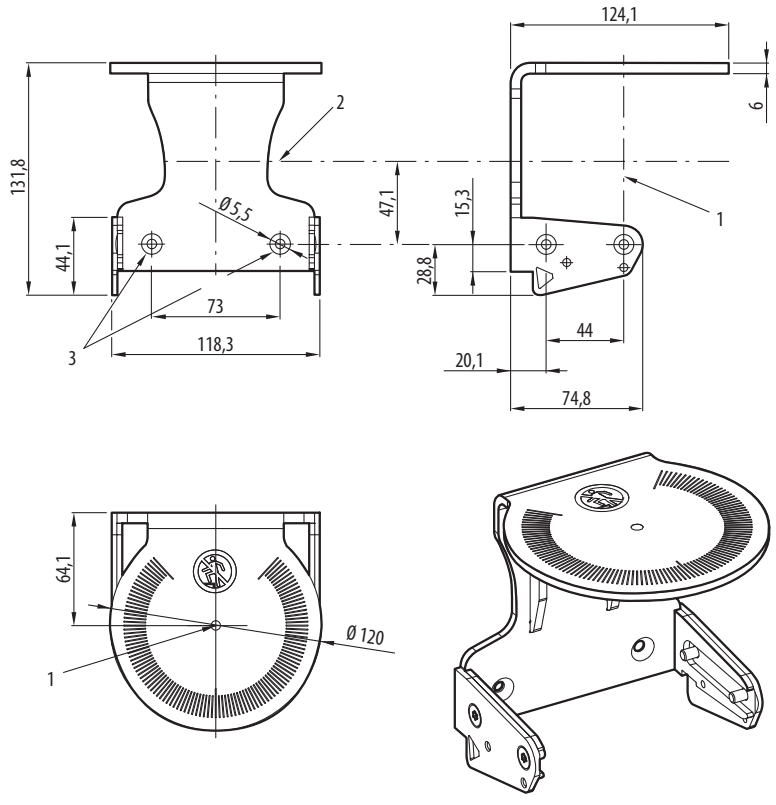
Dimensional Drawings

Figure 93 - Mounting Kit 1 (All Dimensions in mm)



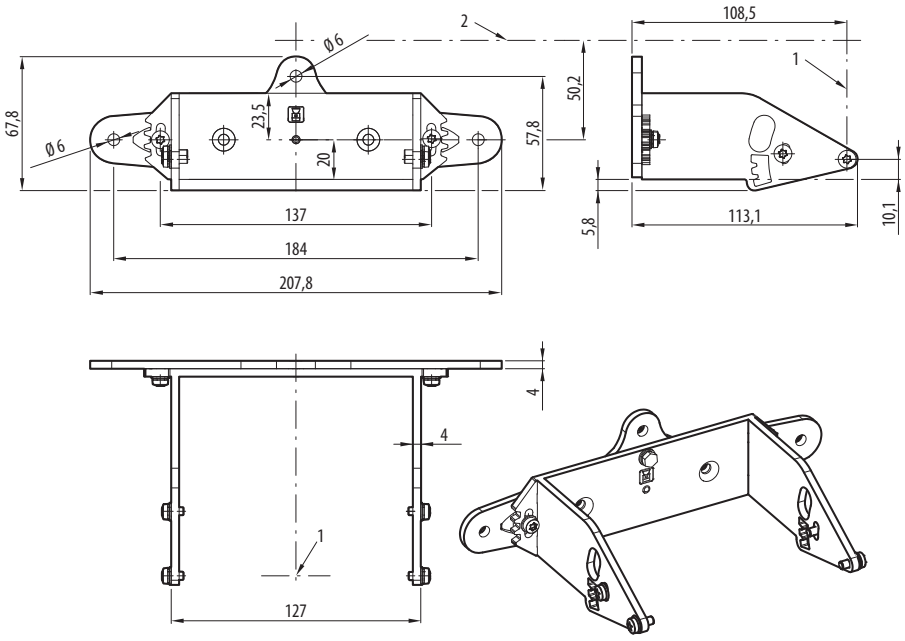
Item	Description
1	Mirror rotational axis
2	Scan plane
3	Countersink for M5 countersunk screw

Figure 94 - Mounting Kit 2 (All Dimensions in mm)



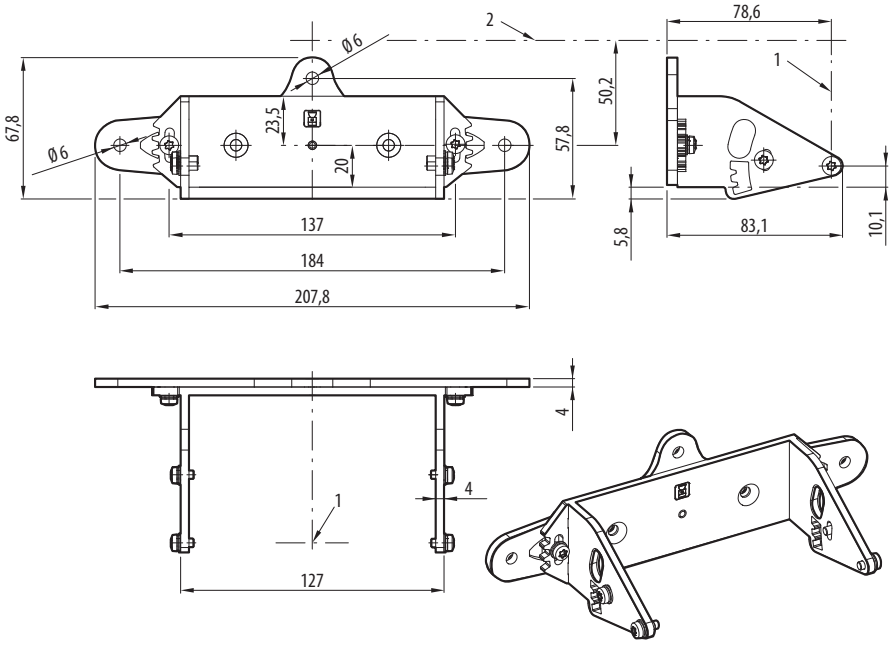
Item	Description
1	Mirror rotational axis
2	Scan plane
3	Countersink for M5 countersunk screw

Figure 95 - Mounting Kit 3 (All Dimensions in mm)



Item	Description
1	Mirror rotational axis
2	Scan plane

Figure 96 - Mounting Kit 4 (All Dimensions in mm)



Item	Description
1	Mirror rotational axis
2	Scan plane

Connection Technology

Table 69 - Connection Cables

Description	Cat. No.
Power Connection Cable	
4-pin, straight M12 QD female with flying leads, yellow PVC jacket, 22 AWG, 250V, 4 A	889D-F4AC-x (1)
4-pin, right M12 QD female with flying leads, yellow PVC jacket, 22 AWG, 250V, 4 A	889D-R4AC-x (1)
Ethernet Cabling	
M12 to Flying Leads 1585 Ethernet cables, 4 conductors, M12, straight male, standard, flying leads, teal PUR, shielded, 100BASE-TX, 100 Mbit/s, high flex, PUR, halogen-free, 10 million cycles	1585D-M4UB-x (2)
M12 to M12 1585 Ethernet cables, 4 conductors, M12, straight male, standard, M12, teal PUR, shielded, 100BASE-TX, 100 Mbit/s, high flex, PUR, halogen-free, 10 million cycles	1585D-M4UBDM-x (2)
M12 to M12 1585 Ethernet cables Cat 5e, 4 conductors, M12, straight male, standard, M12, right-angle male, teal PUR, shielded, 100BASE-TX, 100 Mbit/s, high flex, PUR, halogen-free, 10 million cycles	1585D-M4UBDE-x (2)
M12 to RJ45 1585 Ethernet cables, 4 conductors, M12, straight male, standard, RJ45, straight male, teal PUR, shielded, 100BASE-TX, 100 Mbit/s, high flex, PUR, halogen-free, 10 million cycles	1585D-M4UBJM-x (2)

(1) Replace the x with a 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
See rockwellautomation.com/en-us/products/hardware/allen-bradley/connection-devices/cables-and-cordsets/dc-micro-m12-/dc-micro-cordsets-and-patchcords.html for additional information.

(2) Replace the x with a 2 (2 m), 5 (5 m), or 10 (10 m) for standard cable lengths.
See ,rockwellautomation.com/en-us/products/hardware/allen-bradley/connection-devices/network-media/ethernet/1585-m12-and-variant-1.html for additional information.

Certifications

Compliance with EU Directives

EU declaration of conformity (extract)

Rockwell Automation herewith declares that the SafeZone™ 3 safety laser scanner is in conformity with the provisions of the following EU directive(s) (including all applicable amendments), and that the respective standards and/or technical specifications have been used as a basis for this declaration.

You may obtain the EU Declaration of Conformity with the standards used at rok.auto/certifications.

Directives used:

- Machinery Directive
- EMC Directive
- RoHS Directive

Note on Specified Standards

Standards are specified in this document. The table shows regional standards with similar or identical contents.

Table 70 - 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 61496-2	GB/T 19436.2
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

Checklist for 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.

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

Question	Circle One	
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 (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

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.

IMPORTANT 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 97 - Mounting Two Safety Laser Scanners with the Optics Cover Facing Upward

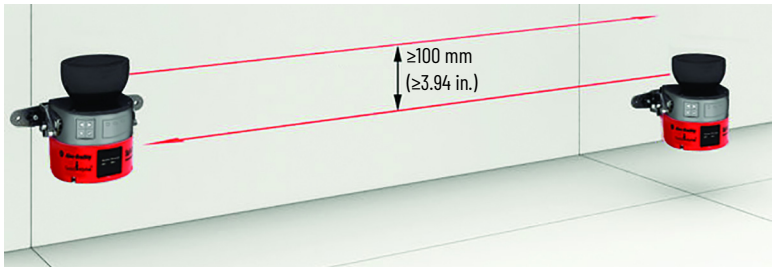
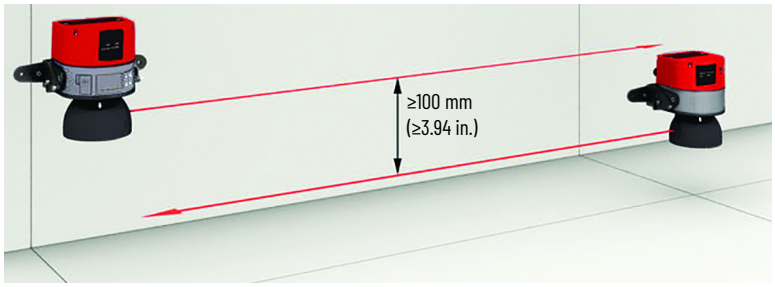


Figure 98 - Mounting Two Safety Laser Scanners with the Optics Cover Facing Downward



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 99 - 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

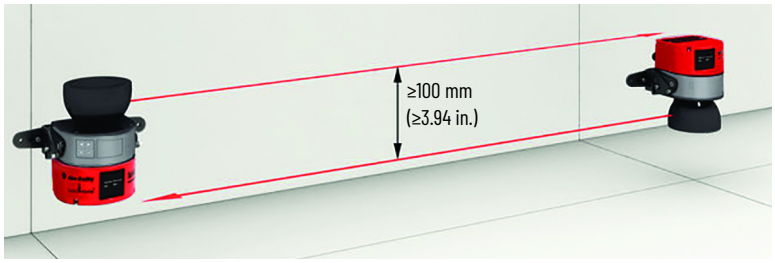
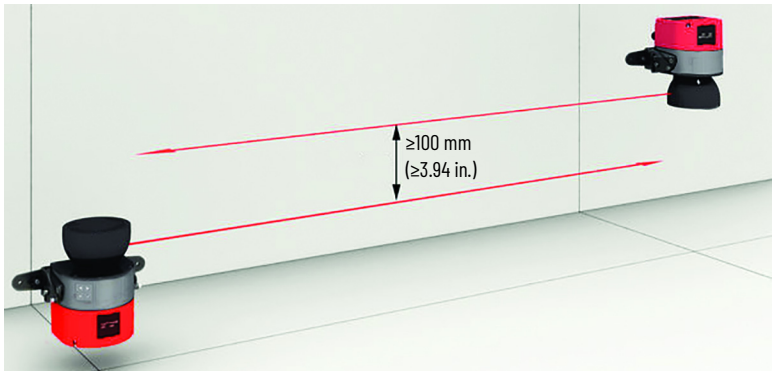


Figure 100 - Mounting the Upper Safety Laser Scanner with the Optics Cover Facing Downward and Mounting the Lower Safety Laser Scanner with the Optics Cover Facing Upward

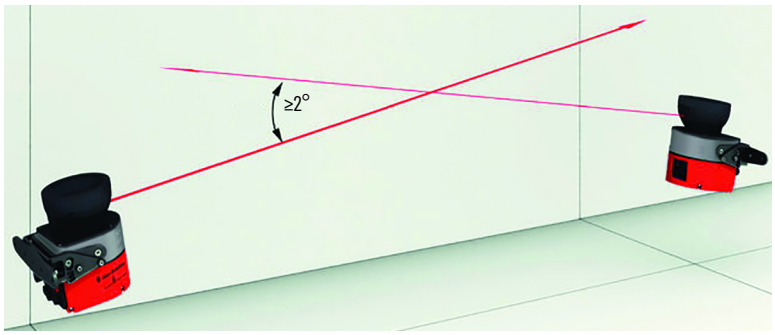


Mount Several Safety Laser Scanners Crosswise

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.

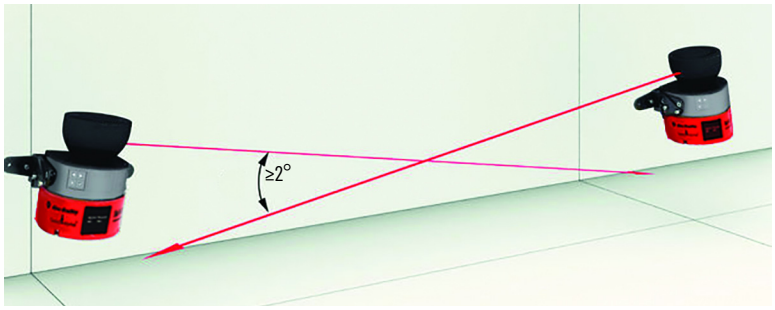
Figure 101 - Mounting Two Safety Laser Scanners Opposite One Another



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 102 - Mounting Two Safety Laser Scanners Next to One Another



The following terms and abbreviations are used throughout this manual. For definitions of terms not listed here, see the Allen-Bradley Industrial Automation Glossary, publication AG-7.1.

AGV Automated guided vehicle

CoLa2 CoLa2 (Command Language 2) is a protocol from Rockwell Automation, with which a client (control, computer, etc.) can access suitable Rockwell Automation sensors via a network (TCP/IP).

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 two 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

EDS file An electronic data sheet (EDS file) is a text file in ASCII format, which describes the properties of an EtherNet/IP™ device. Certain software programs for configuring devices and networks can interpret EDS files.
The configuration software of some safety controllers does not support the connection of safety modules with an EDS file (unlike with non-safe modules).

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.

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 fields.
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.

Master The master device actively builds data connections in a network.
A device in a network which is addressed by a master device has the role of slave.
In modern networks, many or all devices can switch between roles or have both roles at one time.

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 control output is 0, 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 control output is 1, so that the machine can run).

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 push button.
Automatic resets by the protective device are only permitted in special cases, if one of the following conditions is met:

- It must not be possible for people to be in the hazardous area without triggering the protective device.
- It must be ensured that no people are in the hazardous area during or after the reset.

Resolution The resolution of an active opto-electronic protective device (also known as the sensor detection capability) is the minimum size of an object for it to be reliably detected.

Response time The protective device's response time is the maximum time between the occurrence of the event leading to the sensor's response and supply of the switch-off signal to the protective device's interface.

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 push button, 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 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.

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.

Numerics

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Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
Knowledgebase	Access Knowledgebase articles.	rok.auto/knowledgebase
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

Documentation Feedback

Your comments help us serve your documentation needs better. If you have any suggestions on how to improve our content, complete the form at rok.auto/docfeedback.

Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental information on its website at rok.auto/pec.

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