SafeZone Mini Safety Laser Scanner

Catalog Numbers 442L-SFZNMN, 442L-SFZNMN3

Allen-Bradley
by ROCKWELL AUTOMATION

GuardMaster®

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.

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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.

These 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).

The following icon may appear in the text of this document.

Identifies information that is useful and can help to make a process easier to do or easier to understand.

About This Publication

IMPORTANT Read this preface carefully before working with this documentation and the SafeZone™ Mini safety laser scanner.

This user manual shows you how to mount, install, commission, operate, and maintain your SafeZone Mini safety laser scanner correctly.

This user manual does not provide instructions for the operation of the machine, system, or vehicle on which the safety laser scanner is, or will be, integrated. This information is found in the user manual for the machine, system, or vehicle.

This user manual is only applicable to the SafeZone Mini safety laser scanner with the following entry on the type label in the field Operating Instructions (part number 10000337275).

For the configuration and diagnostics of these safety laser scanners, you require the Safety Configuration and Diagnostic (SCD) software (version 3.0 or higher) programming software. To determine the software version, select the Module Info... option in the Help menu.

To plan and use protective safety laser scanners, such as the SafeZone Mini safety laser scanner, also requires specific technical skills that are not detailed in this documentation.

General information on accident prevention using opto-electronic protective safety laser scanners can be found in the competence brochure, Guidelines Safe Machinery.

When operating the SafeZone Mini safety laser scanner, you must observe the national, local, and statutory rules and regulations.

Also refer to the safety laser scanner product page at https://www.rockwellautomation.com/en-us/products/hardware/allen-bradley/safety-products/safety-presence-sensors/442l-safezone-mini.html

Here you can find information on:

- Application examples
- This user manual in different languages for viewing and printing

Symbols

Display indicators show the status of the seven-segment display on the SafeZone Mini safety laser scanner:

Symbol	Description
	Constant indication of characters
	Flashing indication of characters
	Alternating indication of characters

Symbols describe the status of a status indicator:

Symbol	Description
	The OSSDs in the off-state status indicator illuminates continuously.
	The Error/contamination status indicator is flashing.
	The Warning Field Interrupted status indicator is off.

Information is displayed in the software to indicate which settings you can make in the Safety Configuration and Diagnostic (SCD) software.

Who Should Use This Manual

This user manual is intended for planning engineers, machine designers, and the operators of machines and systems that are to be protected by one or several SafeZone Mini safety laser scanners. This manual is also for people who integrate or initialize SafeZone Mini safety laser scanners into a machine, system, or vehicle, or for people who are in charge of servicing and maintaining the safety laser scanner.

Summary of Changes

This publication contains the following new or updated information. This list includes substantive updates only and is not intended to reflect all changes.

Topic	Page
Updated Safety Notes and Protective Measures	10
Updated Monthly Testing	64
Updated Table 20	78
Updated Declaration of Conformity	91

Additional Resources

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

Resource	Description
EtherNet/IP Network Devices User Manual, publication ENET-UM006	Describes how to configure and use EtherNet/IP™ devices to communicate on the EtherNet/IP network.
Ethernet Reference Manual, publication ENET-RM002	Describes basic Ethernet concepts, infrastructure components, and infrastructure features.
System Security Design Guidelines Reference Manual, publication 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.
UL Standards Listing for Industrial Control Products, publication CMPNTS-SR002	Assists original equipment manufacturers (OEMs) with construction of panels, to help ensure that they conform to the requirements of Underwriters Laboratories.
American Standards, Configurations, and Ratings: Introduction to Motor Circuit Design, publication IC-AT001	Provides an overview of American motor circuit design based on methods that are outlined in the NEC.
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

This chapter informs your safety and the safety of the system operators.

IMPORTANT Read this chapter carefully before you work with the SafeZone™ Mini safety laser scanner or with the machine that is protected by a SafeZone Mini safety laser scanner.

Qualified Safety Personnel

Only qualified safety personnel must install, connect, commission, and service the SafeZone Mini safety laser scanner. Qualified safety personnel meet the following criteria:

- The person has adequate knowledge of the power-driven equipment to be checked due to their specialist training and experience.
- The responsible machine owner has instructed the person in the operation of the machine and the current valid safety guidelines.
- The person is sufficiently familiar with the applicable official health and safety regulations, directives, and recognized engineering practice (for example, DIN standards, VDE stipulations, engineering regulations from other EU member states), so the person can assess the work safety aspects of the power-driven equipment.
- The person has access to and has read this user manual.

As a rule, these qualified safety personnel are from the electro-sensitive protective equipment (ESPE) manufacturer, or are appropriately trained at the ESPE manufacturer, are primarily involved in checking ESPE, and are allocated the task by the organization operating the ESPE.

Safety Laser Scanner Applications

The SafeZone Mini safety laser scanner is used to help protect persons and systems. The safety laser scanner is intended to monitor hazardous areas indoors.

- Do not use the SafeZone Mini safety laser scanner outdoors.
- The SafeZone Mini safety laser scanner cannot provide protection from parts that are thrown out of the machine or emit radiation.
- The SafeZone Mini safety laser scanner complies with the requirements in the standard on the radiated emissions as defined for class A (industrial application); the SafeZone Mini safety laser scanner is therefore only suitable for use in an industrial environment.
- The safety laser scanner is a type 3 ESPE as defined by IEC 61496-1 and IEC 61496-3 and is therefore allowed for use with category 3 PLd controls as per EN ISO 13849-1 or SIL 2 as per IEC 61508.

- The SafeZone Mini safety laser scanner is suitable for:
  - Hazardous area protection
  - Hazardous point protection
  - Access protection
  - Vehicle protection (electrically powered industrial trucks)

IMPORTANT Depending on the application, you can require other protective safety laser scanners and measures with the safety laser scanner.

Correct Use

- Only use the SafeZone Mini safety laser scanner as defined in Applicable Directives and Standards on page 12.
- Only qualified personnel can use the SafeZone Mini safety laser scanner.
- Only use the SafeZone Mini safety laser scanner on the machine where the installation and initialization is done by qualified safety personnel in accordance with this user manual.
- Only use on machines where the SafeZone Mini safety laser scanner can stop the dangerous state immediately and/or it is possible to prevent the machine being placed in operation.

ATTENTION: If the safety laser scanner is used for any other purposes or modified in any way, also during mounting and installation, any warranty claim against Rockwell Automation becomes void.

Safety Notes and Protective Measures

ATTENTION:
- Pay attention to the safety notes.

Observe the following items to verify the correct use of the SafeZone Mini safety laser scanner.
- Repair only by authorized persons.

The improper repair of the protective safety laser scanner can result in the loss of the protective function. Only the manufacturer or persons who the manufacturer authorizes to repair the protective safety laser scanner.

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

- This safety laser scanner meets the norms: IEC 60825-1, CDRH 21 CFR 1040.10 and 1040.11; excluded are deviations due to Laser Notice No. 50, dated 24.06.2007. In the standards CDRH 21 CFR 1040.10 and 1040.11 the following note is required: “Caution – use of controls, adjustments, or performance of procedures other than those herein specified may result in hazardous radiation exposure!”
- During the mounting, installation and usage of the SafeZone Mini safety laser scanner, observe the standards and directives applicable in your country. An overview of the most important regulations is found in Applicable Directives and Standards on page 12.

- The national/international rules and regulations apply to the installation, commission, use, and periodic technical inspections of the SafeZone Mini safety laser scanner, including:
  - Machinery Directive (2006/42/EC)
  - Work Equipment Directive (2009/104/EC)
  - The work safety regulations/safety rules
  - Other relevant health and safety regulations
- Manufacturers and operators of the machine on which the SafeZone Mini safety laser scanner is used are responsible to obtain and observe all applicable safety regulations and rules.
- You must observe the notes, in particular the test notes (see Configuration on page 61) in these operating instructions (for example, on use, mounting, installation, or integration into the machine control).
- Changes to the configuration of the safety laser scanners can degrade the protective function. After every change to the configuration, you must check the effectiveness of the protective safety laser scanner. The person who makes the change is also responsible for the correct protective function of the safety laser scanner. When you make configuration changes, always use the password hierarchy that is provided by Rockwell Automation to verify that only authorized persons change the configuration.
- Qualified safety personnel or specially qualified and authorized personnel must conduct the tests and must record and document the test to allow for tests to be reconstructed and retraced at any time.
- The user manual must be available to the operator of the machine where the SafeZone Mini safety laser scanner is used. The machine operator is to be instructed in the use of the safety laser scanner by qualified safety personnel and must be instructed to read the operating instructions.
- To meet the requirements of the relevant product standards (for example, EN 61496-1), the external voltage supply for the safety laser scanners must be able to bridge a brief mains failure of 20 ms. Power supplies according to EN 60204-1 satisfy this requirement. Suitable power supplies are available as accessories from Rockwell Automation.

Enclosed with these operating instructions is a checklist for checking by the manufacturer and OEM (see Checklist to Install ESPE on page 89). Use this checklist when you check the system that the SafeZone Mini safety laser scanner helps to protect.

Environmental Protection

The SafeZone Mini safety laser scanner is constructed for minimal adverse effects on the environmental, and for the minimal use of power and natural resources.

While at work, always act in an environmentally responsible manner.

Disposal

Dispose of unusable or irreparable safety laser scanners per the applicable national regulations on waste disposal (for example, European waste code 16 02 14).

See Table 21 on page 79 for information on the individual materials in the SafeZone Mini safety laser scanner.

Separation of Materials

ATTENTION: Only qualified safety personnel are allowed to separate materials. Caution is required when safety laser scanners are dismantled. There is a risk of injuries.

Before you send the safety laser scanners for appropriate recycling, you must separate the different materials in the SafeZone Mini safety laser scanner.

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

Table 1 - Overview of Disposal by Components

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

Applicable Directives and Standards

The most important directives and standards, valid for the use of opto-electronic protective safety laser scanners in Europe, are listed in Application and Installation of Protective Devices. Further regulations can be important, depending on the application. Obtain further information of machine-specific standards from national institutions (for example, DIN, BSI, AFNOR), the authorities, or your trade association.

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

Application and Installation of Protective Devices

Machinery Directive:

- Safety of machinery – Basic concepts, general principles for design (EN ISO 12100)
- Industrial automation systems – Safety of integrated manufacturing systems – Basic requirements (ISO 11161)
- Safety of machinery – Electrical equipment of machines – Part 1: General requirements (EN 60204-1)
- Safety of machinery – safety distances to help prevent reaching hazardous zones with the upper and lower limbs (EN ISO 13857)
- Safety requirements for robots (EN ISO 10218-1)
- Safety of industrial trucks. Driverless trucks and their systems (EN 1525)
- Safety of machinery – The positioning of protective equipment in respect of approach speeds of parts of the human body (EN ISO 13855)
- Safety of machinery – Principles for risk assessment (EN ISO 14121-1)
- Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design (EN ISO 13849-1) and part 2: Validation (EN ISO 13849-2)

- Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements (EN 61496-1) and part 3: Special requirements for AOPDDR (CLC/TS 61496-3)
- Safety of machinery – Application of protective equipment to detect the presence of persons (IEC/TS 62046)

Regional standards, for example:

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

IMPORTANT To some extent, these standards require the protective device to have the safety level of control reliable. The SafeZone Mini safety laser scanner meets this requirement.

Notes:

Product Description

This chapter provides information on the special features and properties of the SafeZone™ Mini safety laser scanner. This chapter describes the construction and the operating principle of the safety laser scanner.

Special Features

- Small design
- 270° scan area
- Increased dust and particle tolerance due to light saturation and particle algorithms
- With scanning ranges of 2 m (6.6 ft) or 3 m (9.8 ft) maximum protective field radii
- Configuration using computer with Rockwell Automation® SCD software
- Field sets comprise one protective field and up to two warning fields
- Contour monitoring of the protective field if only one warning field is used
- Only standalone operation
- One field set
- One monitoring case
- Integrated external device monitoring (EDM)
- Integrated restart interlock/restart interlock delay for which the parameters can be set
- Two universal I/O connections

Function

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

- The control of the machine, system, or vehicle must be electrical.
- It must be possible to transfer the dangerous machine, system, or vehicle state to a safe state with the OSSDs on the SafeZone Mini safety laser scanner at any time before a person reaches the hazardous point or hazardous area.

Or, it must be possible to transfer the dangerous state of the machine, system, or vehicle to a safe state at any time with the OSSDs on a safety controller connected to the SafeZone Mini safety laser scanner.

- You must mount and configure the SafeZone Mini safety laser scanner so it detects objects as they enter the hazardous area (see Mounting on page 33 and Commissioning on page 63).
- The optical path of the safety laser scanner must always remain clear. Do not cover the optical path with transparent objects such as protective windows, Plexiglas, and lenses. To maintain the protective function of

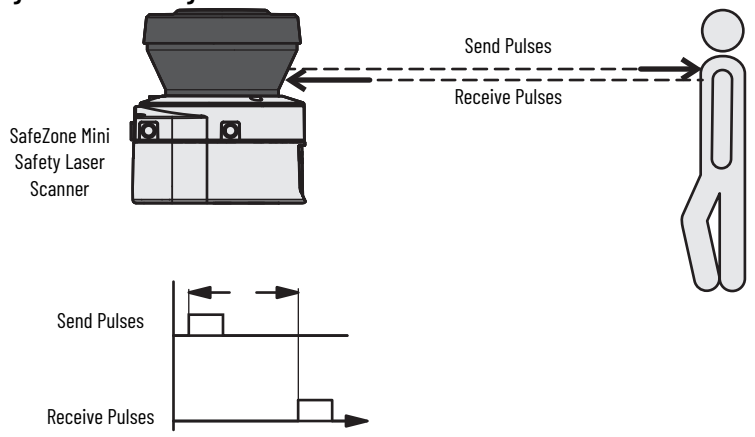
the safety laser scanner, do not bypass the contamination measurement function by such measures.

Principle of Operation

The SafeZone Mini safety laser scanner is an optical sensor that scans its surroundings in two dimensions with infrared laser beams. The optical sensor monitors hazardous areas on machines or vehicles.

The SafeZone Mini safety laser scanner works on the principle of the time of flight measurement, which is shown in Figure 1. The unit sends out short pulses of infrared light (send pulses). Simultaneously, an electronic stopwatch starts. When the light reaches an object, it reflects and the safety laser scanner receives it (receive pulses). From the time between sending and reception (Δt), the SafeZone Mini safety laser scanner calculates the distance to the object.

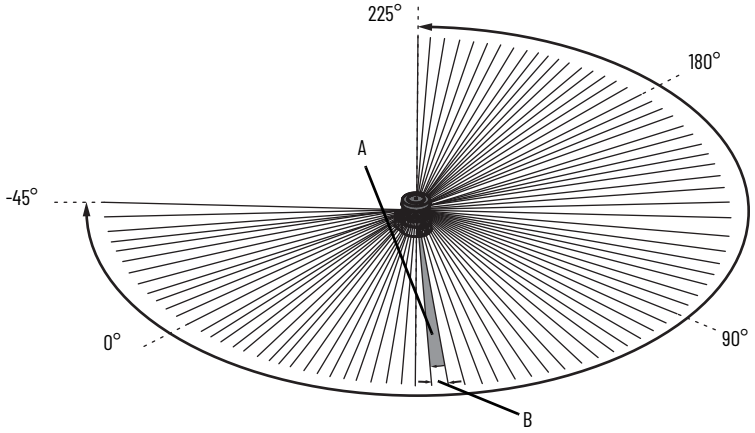
Figure 1 - Time of Flight Measurement



In the SafeZone Mini safety laser scanner, there is also a mirror that rotates at constant speed and deflects the light pulses such that they cover an arc of 270°, shown in Figure 2. In this way, an object can be detected in the protective field within 270°. The first beam of a scan starts at -45° relative to the back of the safety laser scanner.

The SafeZone Mini safety laser scanner sends a pulse of light with an angular resolution of 0.5° (A). As a result resolutions between 30...70 mm (1.18...2.76 in.) can be achieved (B).

Figure 2 - Rotation of the SafeZone Mini Safety Laser Scanner



Due to its active scanning principle, the SafeZone Mini safety laser scanner does not require receivers or reflectors, and offers the following advantages:

- Your installation effort is lower.

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

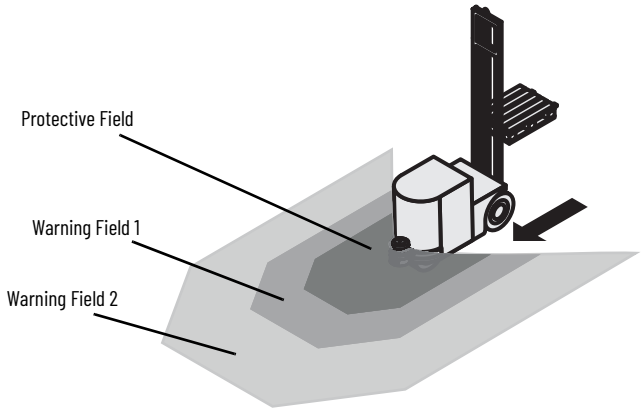
Field Set Comprising Protective and Warning Fields

Protective fields and warning fields form the field set. You can configure these field sets with the aid of the SCD software. You can configure the fields as circular, rectangular, or of arbitrary shape. If the monitored area changes, you can reconfigure the SafeZone Mini safety laser scanner in the software without additional mounting efforts.

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

The SafeZone Mini safety laser scanner secures the hazardous area on a machine or vehicle. Once the safety laser scanner detects an object in the protective field, it switches the OSSDs to the off-state. This action initiates the shutdown of the machine or the stop of the vehicle.

Figure 3 - Field Set with One Protective Field and Two Warning Fields



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

You can use warning field 1 in particular for vehicle protection to detect an object even before the actual hazardous area, and to slow the movement of the vehicle or bring it to a standstill. This use can reduce wear on automated guided vehicle (AVG) brakes. You can also use warning field 2 to trigger a warning signal.

ATTENTION: Do not use a warning field on the SafeZone Mini safety laser scanner for tasks that are related to the protection of people.

Contour Monitoring

Additionally, the SafeZone Mini safety laser scanner can also monitor a contour (for example, the floor in vertical applications).

Safety Laser Scanner Components

The SafeZone Mini safety laser scanner comprises the following components:

- The sensor with the opto-electronic detection system, the status indicators, the seven-segment display, and the connecting cable with the electrical connections.
- The optics cover with a window for the light output.

Figure 4 - Safety Laser Scanner Components

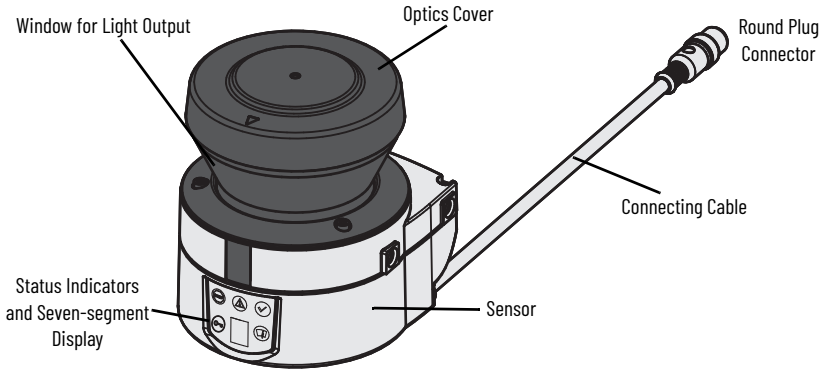
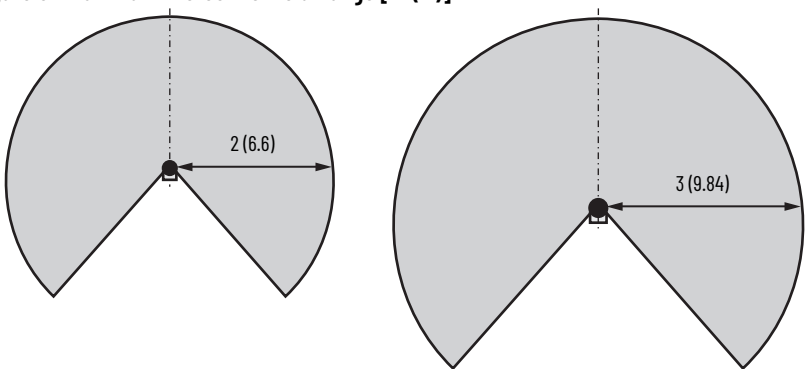
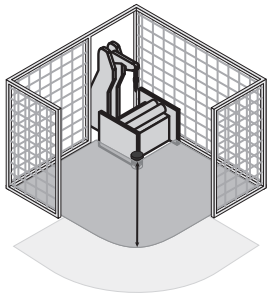
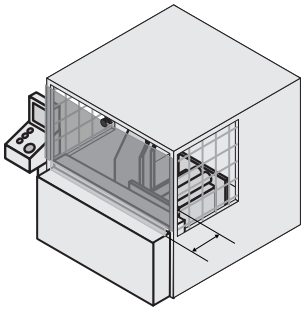
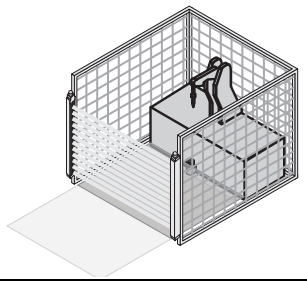
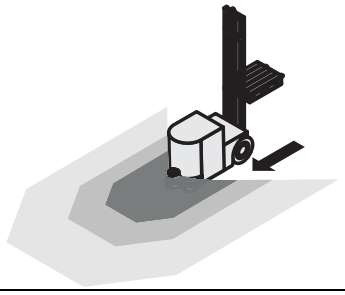
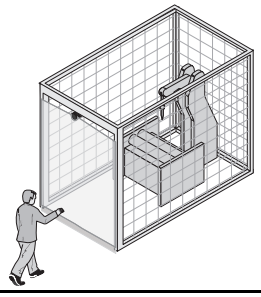


Figure 5 - Maximum Protective Field Range [m (ft)]



Applications

Table 2 - Possible Applications for the SafeZone Mini Safety Laser Scanner

Application	Representation
Hazardous area protection on an insertion station.	
Hazardous point protection on an insertion station.	
Presence detection for a safety light curtain.	
Protection of an AGV for one velocity.	
Access protection for high areas of access.	

Status Indicators

The status indicators and the seven-segment display indicate the operational status of the SafeZone Mini safety laser scanner. They are on the front face of the safety laser scanner.

Figure 6 - Status Indicators

Table 3 - Status Indicator Symbols

Symbol	Meaning
	OSSDs in the off-state (for example, object in the protective field, monitored contour is changed, reset required, lockout)
	Warning field is interrupted (object in one of the warning fields)
	OSSDs in the on-state (no object in protective field)
	Reset required
	Optics cover contaminated
	Seven-segment display for the indication of the status and errors

Detailed information is in Table 17 on page 71 and in Table 18 on page 72).

Configurable Functions

System Parameters

You can assign names to the configured application and to safety laser scanners. After the configuration transfers, the names are saved in the safety laser scanners. The chosen name can be, for example, the identifier for the vehicle, the system, or the machine.

Enter the application name and the names of the safety laser scanners that are used in the SCD software.

Application Name

Enter a name for your application (max 16 characters).

You can assign unique application names to reserve the safety laser scanners for certain duties. When a machine maintenance person compares the exchanged safety laser scanners with the saved configuration data from the SCD software, they are notified that the application name does not match. They can then exchange these safety laser scanners for safety laser scanners with the correct application name.

Name of the Scanner

Enter a device name for each of the safety laser scanners in the system (max eight characters).

IMPORTANT Use meaningful names (example: front and rear) for vehicle monitoring. Unique device names make the subsequent configuration steps easier (for example, on control inputs allocation or the OSSDs).

User Data

Enter your name in the Name of the User field (max 22 characters). The name adds to the configuration protocol and in the diagnostics report.

Display Direction of the Seven-segment Display

The numbers on the seven-segment display can rotate 180° with the aid of the SCD software. Rotation is useful, for example, when the SafeZone™ Mini is rotated 180° due to the specific application.

If you rotate the numbers of the seven-segment display, the point in the seven-segment display is off.

Determine the Display Direction of the Seven-segment Display

Under the seven-segment display, activate the Rotated by 180° option. After the configuration draft transfers to the SafeZone Mini safety laser scanner, the numbers of the seven-segment display rotate by 180°.

Application

Use the SCD software to configure the SafeZone Mini safety laser scanner for the required application. Depending on whether you select a stationary or a mobile application, different configuration options are available.

Table 4 - Mobile and Stationary Applications

Mobile Applications [mm (in.)]	Stationary Applications [mm (in.)]
Resolution	
Hand detection: • 30 (1.2) (with smaller protective field size) • 40 (1.6) (with larger protective field size) Leg detection: • 50 (2.0) (with smaller protective field size) • 70 (2.8) (with larger protective field size) (1)	Hand detection: • 30 (1.2) (with smaller protective field size) • 40 (1.6) (with larger protective field size) Leg detection: • 50 (2.0) (with smaller protective field size) • 70 (2.8) (with larger protective field size) Whole body detection: • 150 (5.9)
Manipulation prevention	
The safety laser scanner checks whether in any 90° segment all measured values correspond to the maximum distance value that can be measured.	
If so, the SafeZone Mini safety laser scanner shuts down after 2 hours and signals .	If so, the SafeZone Mini safety laser scanner shuts down after 5 seconds and signals .

(1) In mobile applications, a resolution of only 70 mm (2.8 in.) is required for leg detection.

Resolution

The maximum protective field range depends on the configured resolution. Table 5 shows the related maximum protective field range at the resolutions that can be set.

Table 5 - Maximum Protective Field Range at Different Resolutions

Configured Resolution [mm (in.)]		Maximum Protective Field Range [m (ft)]	
		2 (6.6)	3 (9.8)
30 (1.2)	Hand detection	1.25 (4.1)	1.25 (4.1)
40 (1.6)	Hand detection	1.60 (5.2)	1.60 (5.2)
50 (2.0)	Leg detection	2.00 (6.6)	2.10 (6.89)
70 (2.8)	Leg detection	2.00 (6.6)	3.00 (9.84)
150 (5.9)	Whole body detection	3.00 (9.84)	

IMPORTANT You can configure the warning field to up to 8 m (26.25 ft) for all resolutions. The detection capability within the warning field is dependent on the remission of the objects to be detected (see Technical Specifications on page 75).

Basic Response Time

The basic response time of the SafeZone Mini safety laser scanner is 80 ms.

It can be necessary to add supplements to the basic response time due to multiple sampling (see OSSD Response Times on page 76).

Maximum Protective Field Range

The maximum protective field range of the safety laser scanner shows in the SCD software, which depends on the configured resolution that is used (see Resolution on page 22).

ATTENTION: The maximum protective field range of the SafeZone Mini safety laser scanner must be sufficient to cover the calculated protective field size, including the necessary supplements (see Protective Field Size on page 34).

Universal I/O Connections

ATTENTION: Do not use the universal I/O connections for safety-relevant functions.
Only use the universal I/O connections for signaling. Never use the signals for controlling the application or for safety-relevant functions.

The SafeZone Mini safety laser scanner has two universal I/O connections (see Round Plug Connector on page 52). You can configure these two connections for the following functions:

- Inactive (factory default setting)

Inputs (you can only select one function per universal I/O connection):

- Stand-by
- External device monitoring (EDM)
  (see External Device Monitoring (EDM) on page 24)
- Reset the restart interlock
  (see Restart of the SafeZone Mini Safety Laser Scanner on page 25)

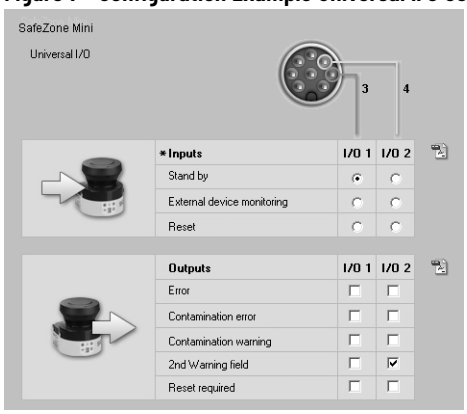
Outputs (it is possible to select several functions per universal I/O connection, an OR operator link these functions together):

- Device error
- Contamination error
- Contamination warning
- Second warning field
- Reset required

Other functions that can be configured are dependent on the configuration of the universal I/O connections. For example, you can only realize a restart interlock if you configure one universal I/O as an input for resetting the restart interlock.

The universal I/O connections are configured in the SCD software in the Universal I/O area. Figure 7 on page 24 shows a configuration example.

Figure 7 - Configuration Example Universal I/O Connections



Stand-by

If, in mobile applications, vehicles are not moved for a time, the OSSDs can switch to the off-state and the laser on the SafeZone Mini safety laser scanner can switch off. This reduces the power consumption of the safety laser scanner.

IMPORTANT Use this function if, for example, you use several vehicles and do not move them for a time. The SafeZone Mini safety laser scanner remains in the Stand-by mode as long as the related input information is present.

OSSDs

Internal OSSDs

If there is an object in the protective field, the internal OSSDs on the SafeZone Mini safety laser scanner always switch. This response cannot be configured differently in the SCD software.

External Device Monitoring (EDM)

The EDM checks if the contactors de-energize when the protective device trips. If you activate external device monitoring, then the SafeZone Mini safety laser scanner checks the contactors after each interruption of the protective field and before the machine restart. The EDM can identify if one of the contactors is welded, for instance. In this case, the external device monitoring places the system in a safe operational state and the OSSDs do not switch back to the on-state.

Figure 6 on page 20 shows how the SafeZone Mini safety laser scanner reacts if the external device monitoring detects a contactor malfunction.

Table 6 - Behavior of the SafeZone Mini Safety Laser Scanner on a Contactor Malfunction

Malfunction	Behavior
Without internal restart interlock or with restart delay	• The system locks (lockout). • The error message 8 appears in the seven-segment display.
With restart interlock	• The SafeZone Mini safety laser scanner switches its OSSDs to the off-state. • The status indicator (error) is illuminated. • The error message 8 appears in the seven-segment display.

You can configure the external device monitoring in the SCD software.

See Connection Diagrams on page 56 for examples of the connection of external device monitoring.

Restart of the SafeZone Mini Safety Laser Scanner

You can configure the restart behavior of the SafeZone Mini safety laser scanner as follows:

- Without restart interlock
- With restart delay
- With restart interlock

You can configure the type of restart in the SCD software.

ATTENTION: Configure the SafeZone Mini safety laser scanner or the application with restart interlock if the protective field can be left to approach the hazardous point, or if the SafeZone Mini safety laser scanner cannot detect a person at every point in the hazardous area.
During the assessment, pay attention to whether the protective field can be left in the direction of the hazardous point, to areas that are unprotected due to the mounting, and the unprotected near-range of the SafeZone Mini safety laser scanner (see Methods to Help Prevent Unprotected Areas on page 44).

Configuration without Restart Interlock

After the OSSDs on the SafeZone Mini safety laser scanner switch to the off-state due to an object in the protective field, the OSSDs re-enable again immediately when there is no longer an object in the active protective field.

This configuration is only allowed in the following cases:

- An external restart interlock is realized on the machine controller.
- The protective field cannot be left in the direction of the hazardous point and the SafeZone Mini safety laser scanner detects people at every point in the hazardous area.

Restart Delay for Mobile Applications

In mobile applications, you can configure a restart delay from 2...60 seconds on the SafeZone Mini safety laser scanner. The OSSDs on the SafeZone Mini safety laser scanner change to the on-state if there is no object in the protective field for the duration given.

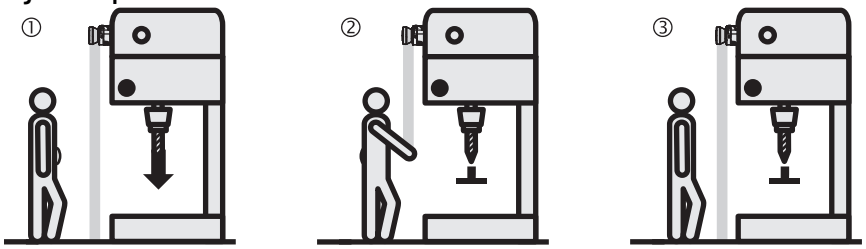
This configuration is only allowed if the protective field cannot be left in the direction of the hazardous point and if a person can be detected at every point in the hazardous area by the SafeZone Mini safety laser scanner.

Configuration with Restart Interlock

The OSSDs on the SafeZone Mini safety laser scanner change to the off-state to initiate a machine (view (1) in Figure 8) or vehicle stop as soon as there is an object in the protective field (view (2) in Figure 8). They do not change to the on-state (view (3) in Figure 8), even if there is no longer an object in the protective field. The OSSDs only change to the on-state if the operator operates the control switch for restart or reset.

ATTENTION: Place the control switch for restart or reset outside the hazardous area in a place where the control switch is clearly seen from the hazardous area.
Place the control switch for restart or reset outside the hazardous area so a person in the hazardous area cannot operate the control switch. Confirm that the person who operates the control switch has a full view of the hazardous area.

Figure 8 - Operation with Restart Interlock



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

See Connection Diagrams on page 56 for examples of the connection of internal restart interlocks.
If you do not use the internal restart interlock, then do not configure any universal I/O as an input for resetting (see Universal I/O Connections on page 23).

Reset

IMPORTANT The reset function is often also called preparation for restart. In this user manual, the term reset is used.

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

After operating the control switch for the internal restart interlock (with the protective field unoccupied) the following occurs:

- The SafeZone Mini safety laser scanner switches its OSSDs to the on-state.
- The status indicator (✓) on the SafeZone Mini safety laser scanner illuminates green.

The external restart interlock helps prevent the machine from restarting. After resetting the SafeZone Mini safety laser scanner, the operator must press the control switch to restart the machine controller.

ATTENTION: Verify that the correct sequence is followed.
The controller must be realized so the machine only restarts if the SafeZone Mini safety laser scanner is first reset and then the control switch for restarting the machine controller is operated.

Reset Signals

If the SafeZone Mini safety laser scanner is operated using the with-restart-interlock function, then after a protective field infringement and the subsequent clearing of the protective field, the safety laser scanner requests a reset signal from the control system (reset required).

ATTENTION: The reset signal must be safety-related (single failure proof).

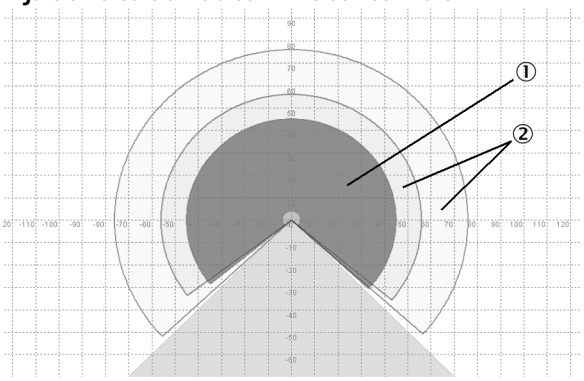
Field Sets

You can configure fields sets manually or by the suggestion of the laser scanner and your SCD software.

Configure the Protective and Warning Field

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

Figure 9 - Create a Field Set in the SCD Software



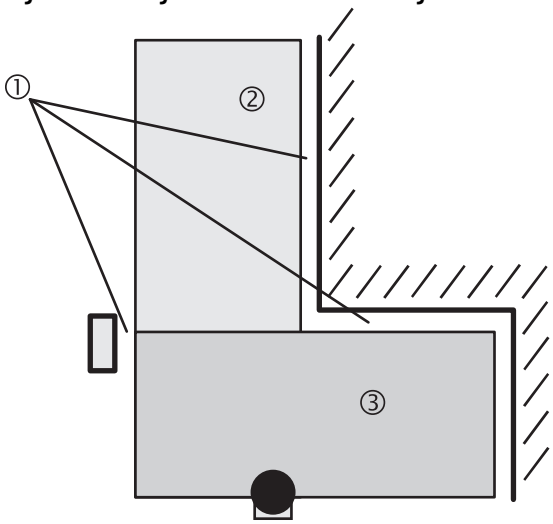
The SafeZone Mini safety laser scanner radially scans the area to be monitored. The SafeZone Mini safety laser scanner cannot see through objects during this process. Therefore, the area behind objects that are in the monitored area (pillars, grilles, and so on) cannot be monitored.

Protective fields and warning fields can cover an angle of up to 270° and have different radial scanning ranges, depending on the configured resolution (see Resolution on page 22).

ATTENTION: Check the configured protective fields.
Before you commission the machine or vehicle, use the instructions in Configuration on page 61 and using the Checklist to Install ESPE on page 89 to check the configuration of the protective fields.

In Figure 10, if the protective field (3) or the warning fields (2) stretch as far as a wall or another object (pillar, neighboring machine, shelf), there must be a distance of 100 mm (3.94 in.) between the protective field or warning field and the object to help prevent false triggering (1).

Figure 10 - Configure Protective and Warning Fields

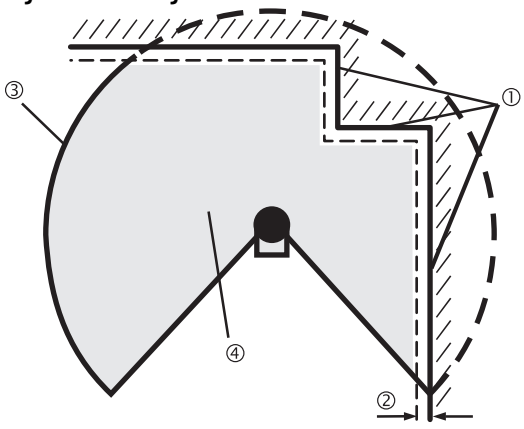


ATTENTION: Secure unprotected areas.
If it is possible to access a narrow strip between the protective field and a wall or another object, you must protect this strip with additional measures (for example, fence or floor protection).

Protective or Warning Field Suggested by the Safety Laser Scanner

The SCD software can suggest the protective or warning field in the field set editor. The safety laser scanner scans the visible surrounding contour several times. From the data that is obtained, the SCD software suggests the contour and size of the field. Figure 11 shows an example for the reading of a protective field.

Figure 11 - Reading the Protective Field



In places where the surrounding contour is smaller than the maximum protective field range (for example, at (1) in Figure 11), the protective field (shown at (4) in Figure 11) corresponds to the surrounding contour.

The measuring error tolerances for the SafeZone Mini safety laser scanner automatically subtract from the protective field size. As a result the protective field is slightly smaller than the surface covered (shown at (2) in Figure 11).

In those places where the surrounding contour is larger than the protective field range (shown at (3) in Figure 11 on page 28) the protective field corresponds to the possible scanning range.

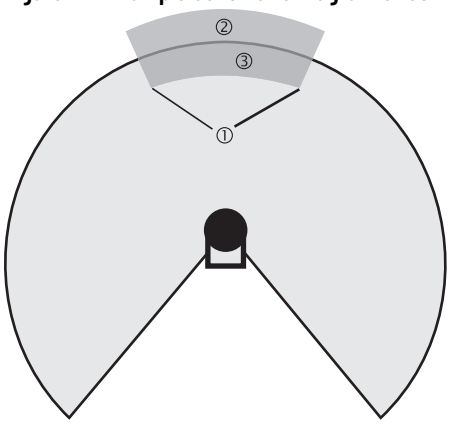
ATTENTION: Check that the protective field that the SCD software suggests. The protective field that the SCD software suggests is not a replacement for the calculation of the minimum distance. Calculate the minimum distance and check the effectiveness of the protective fields before commissioning the application.

Pay attention to the descriptions in Mounting on page 33, the notes in Commissioning on page 63, and the Checklist to Install ESPE on page 89.

Use the Contour as a Reference

Additionally, the SafeZone Mini safety laser scanner can monitor a contour (for example, the floor in vertical applications).

Figure 12 - Example Schematic Diagram of Contour



For contour monitoring, define a contour segment (shown at (1) in Figure 12). The contour segment comprises a positive (shown at (2) in Figure 12) and a negative (shown at (3) in Figure 12) tolerance band.

The OSSDs on the SafeZone Mini safety laser scanner change to the off-state or the SafeZone Mini Remote signals in the following situations:

- There is an object in the protective field.
- The monitored surrounding contour is no longer in the tolerance band (for example, if the position of the SafeZone Mini safety laser scanner changed).

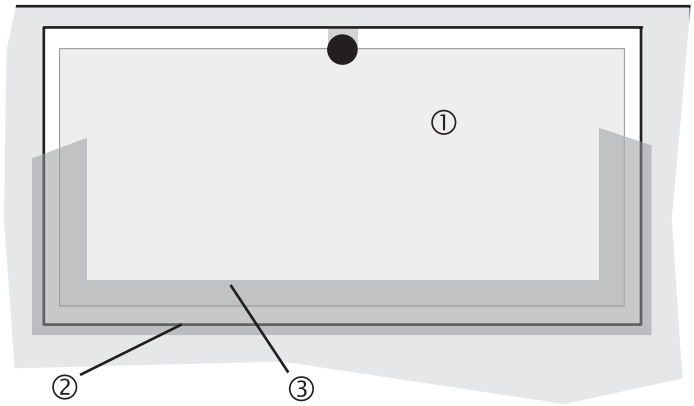
- You can define any number of contour segments.
- The contour segments must not be narrower than the configured resolution.
- At the points where a contour is configured as a reference, you cannot define warning fields. For example, if you use the floor as a reference for access protection, you cannot configure a warning field there. However, you can, for example, configure a warning field to the left and right of the contour segment to control a warning signal on approach from the side.
- The contour as reference function and the warning field 2 function are mutually exclusive.

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

Vertical Operation

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

Figure 13 - Contour as Reference for Vertical Operation



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

IMPORTANT Use the lateral and vertical boundaries of the opening (for example, the door frame) and the floor as reference. In this case, if the position of the SafeZone Mini safety laser scanner changes in one or more planes, the distance to the reference changes and the SafeZone Mini safety laser scanner switches its OSSDs to the off-state.

Monitoring Cases

The SafeZone Mini safety laser scanner supports a configuration with monitoring cases.

ATTENTION: Confirm for each monitoring case that the minimum distance to the hazardous area is maintained.
See Mounting on page 33.

You can configure the monitoring cases in the SCD software.

Each monitoring case includes:

- The input conditions (or control signals) that control the activation of the monitoring case.
- A field set, including a protective field and warning field or fields.
- The multiple sampling for the field set.

Monitoring cases can switch with the following input information:

- Static information

Multiple Sampling

If multiple sampling is set, an object must be scanned several times before the SafeZone Mini safety laser scanner switches its OSSDs to the off-state. This setting helps reduce the probability that insects, welding sparks, or other particles to result in the shutdown of the system.

If a multiple sampling of three is configured, for instance, an object must be detected in the protective field three times in succession before the SafeZone Mini safety laser scanner switches the OSSDs to the off-state.

ATTENTION: The total response time increases by the multiple sampling. With a multiple sampling greater than two, you must add a supplement to the basic response time (see OSSD Timing Behavior on page 76).

On the SafeZone Mini safety laser scanner, a multiple sampling of two is the minimum setting. You can set the multiple sampling to up to 16 with the aid of the SCD software. The supplement to the basic response time that results from your setting is displayed in the SCD software.

Table 7 - Recommended Multiple Sampling

Application	Recommended Multiple Sampling
Stationary under clean ambient conditions	2 times
Vertical applications	2 times
Mobile	4 times
Stationary under dusty ambient conditions	8 times

With multiple sampling, you can increase the availability of a system.

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

Stand-by Mode

If, in mobile applications, vehicles are not moved for a time (for example, for battery charging), the OSSDs can switch to the off-state and the laser on the SafeZone Mini safety laser scanner can switch off. This mode reduces the power consumption of the safety laser scanner.

In this way, you also help prevent the safety laser scanners from optically interfering with each other and entering an error condition.

The function can be realized with the aid of the Stand-by mode.

To switch to the Stand-by mode, you must configure one universal I/O connection as stand-by input on the SafeZone Mini safety laser scanner. (see Universal I/O Connections on page 23).

IMPORTANT The Stand-by mode does not occupy a monitoring case.

Notes:

Mounting

This chapter describes the preparation and completion of the mounting of the SafeZone™ Mini safety laser scanner.

Mounting requires three steps:

- Definition of the application and the necessary mounting location for the safety laser scanner.
- Calculation of the protective field sizes and minimum distances (see EN ISO 13855).
- Mounting the safety laser scanner, with or without mounting kits.

ATTENTION: No protective function without sufficient minimum distance. You can only achieve protection by the SafeZone Mini safety laser scanner if you configure the protective field with an adequate minimum distance to the hazardous area.

Mounting Notes

- Mount the SafeZone Mini safety laser scanner in a dry place and protect the safety laser scanner from dirt and damage.
- Avoid the installation of the SafeZone Mini safety laser scanner in the vicinity of strong electric fields. Welding cables, induction cables in the immediate vicinity, and mobile telephones operated nearby can produce these electrical fields.
- Verify that there are no obstacles in the area to be monitored in the field of view of the SafeZone Mini safety laser scanner that could cause interference or shadowing. The SafeZone Mini safety laser scanner cannot monitor shadowed areas. If there are unavoidable shadowed areas, check whether there is a risk. Take additional safety precautions as necessary.
- Keep the area to be monitored free of smoke, fog, steam, or other forms of air impurities. There must not be any condensation on the optics cover. Otherwise, the function of the SafeZone Mini safety laser scanner can be impaired and incorrect switching can occur.
- Avoid placing highly reflective objects in the scan plane of the SafeZone Mini safety laser scanner. For example, retro-reflectors can affect the measurement results of the SafeZone Mini safety laser scanner. Highly reflective objects within the protective field can blank a part of the area to be monitored in certain circumstances.
- Mount the SafeZone Mini safety laser scanner so it is not saturated by incident sunlight. Do not position stroboscopic and fluorescent lights or other strong light sources directly in the scan plane, as these light sources can affect the SafeZone Mini safety laser scanner in specific circumstances.
- If it is reasonable for the application, mark the protective field on the floor (see EN 61496-1).

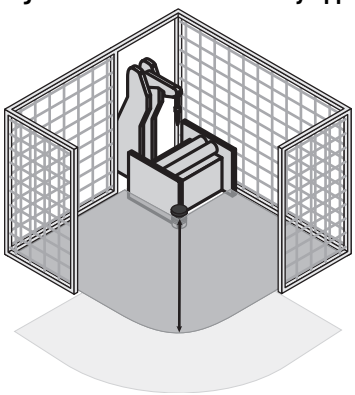
Complete the following steps after mounting:

- Complete the electrical connections (Electrical Installation on page 51).
- Configure the protective field (Configuration on page 61).
- Commission and check the installation (Commissioning on page 63).
- Check the function and safe shutdown (Test Notes on page 64).

Stationary Application in Horizontal Operation

This type of protective safety laser scanner is suitable for machines and systems on which, for example, a guard does not enclose a hazardous area entirely.

Figure 14 - Horizontal Stationary Application



For a horizontal stationary application, determine the following:

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

IMPORTANT	Once you have defined the protective field size, mark the boundaries of the protective field on the floor. This marking makes the protective field boundaries visible for the operator and eases subsequent testing of the protective function.

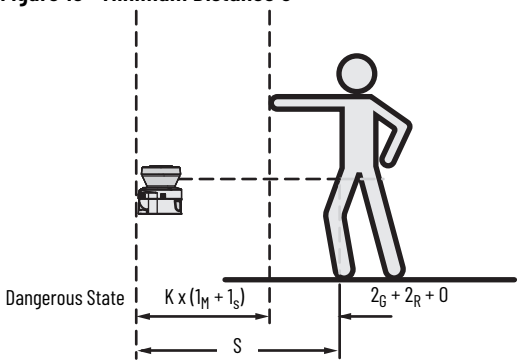
Protective Field Size

You must configure the protective field to maintain the minimum distance (S) to the hazardous area. This safety distance helps maintain that the hazardous point is only reached after the dangerous state of the machine stops completely.

IMPORTANT	You can operate the SafeZone Mini safety laser scanner in stationary horizontal operation with 30 mm (1.2 in.), 40 mm (1.6 in.), 50 mm (2.0 in.), or 70 mm (2.8 in.) resolution. The resolution gives the maximum protective field range for the SafeZone Mini safety laser scanner.

ATTENTION: Verify that a human leg is detectable with 70 mm (2.8 in.) resolution.
As per EN ISO 13855, mount the scan planes for horizontal stationary applications with 70 mm (2.8 in.) resolution at least 300 mm (11.8 in.) above the floor (see Height of Scan Plane on page 44).

Figure 15 - Minimum Distance S



The minimum distance S (see Figure 15) depends on the following:

- Approach speed of the body or parts of the body
- Stop/run-down time of the machine or system

  The stop/run-down time is in the machine documentation, or you must take a measurement to determine the stop/run time.
- Response time of the SafeZone Mini safety laser scanner
- Supplements for general measurement errors and any measurement errors that are related to reflection
- Supplement for prevention of reaching over
- Height of the scan plane
- Possibly the time for switching between the monitoring cases

Calculate Minimum Distance S

See EN ISO 13855. Calculate S with the following formula:

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

Variable	Description
K	Approach speed (1600 mm/s (63 in./s), defined in EN ISO 13855)
T_M	Stop/run-down time of the machine or system
T_S	Response time of the SafeZone Mini safety laser scanner and the downstream controller
Z_G	General safety supplement of the SafeZone Mini safety laser scanner = 100 mm (3.94 in.)
Z_R	Supplement for measurement error that is related to reflection
C	Supplement for prevention of reaching over

Response Time T_S of the SafeZone Mini Safety Laser Scanner

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

- The basic response time of the SafeZone Mini safety laser scanner
- The multiple sampling set

See OSSD Response Times on page 76.

Supplement Z_R for Measurement Errors Caused by Reflection

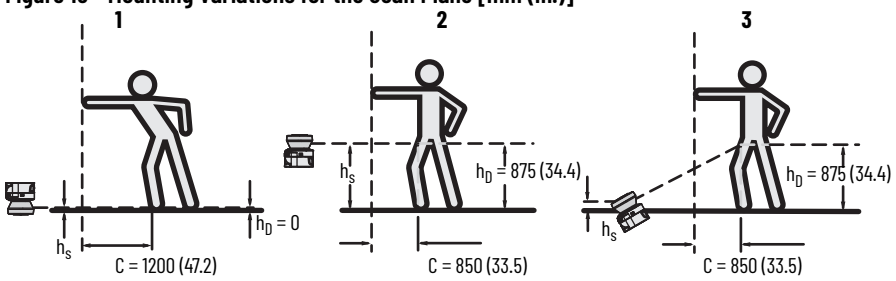
ATTENTION: Avoid mounting retro-reflectors at a distance of less than 1 m (3.28 ft) from the boundary of the protective field.
If you position retro-reflectors at a distance of less than 1 m (3.28 ft) from the boundary of the protective field, you must add a supplement Z_R of 200 mm (7.87 in.) to the protective field.

Supplement C for Protection Against Reaching Over

With a protective field installed horizontally, there is a risk that people can reach over the protective field and so reach the hazardous area before the SafeZone Mini safety laser scanner shuts down the dangerous state. For this reason, the calculation of the minimum distance must account for a supplement to help prevent persons from finding themselves in a hazardous situation by reaching over (see EN ISO 13857) before the SafeZone Mini safety laser scanner triggers.

The necessary supplement for the minimum distance is dependent on the height of the scan plane for the protective field. In Figure 16, At low heights (1) the supplement is larger than at greater heights, see (2) and (3).

Figure 16 - Mounting Variations for the Scan Plane [mm (in.)]



In summary, there are three usual variations of mounting the scan plane for the SafeZone Mini safety laser scanner. The optimal variation depends on the related application. Table 8 helps make the selection.

Table 8 - Advantages and Disadvantages of Mounting Variations [mm (in.)]

Mounting Orientation (1)	Advantage	Disadvantage
Safety laser scanner low (H_S < 300 (11.81 in.)) Low inclination of the scan plane ($H_D \approx H_S$)	Low external effects due to ambient light interference, crawling beneath not possible.	Higher supplement C.
Safety laser scanner high (H_S > 300 (11.81 in.)) Low inclination of the scan plane ($H_D \approx H_S$)	Lower protective field supplement C.	Danger of crawling beneath (at the front and side).
Safety laser scanner low (H_S < 3300 (11.81 in.)) High inclination of the scan plane ($H_D > H_S$)	Lower protective field supplement C.	Danger of crawling beneath (at the front), external effect due to ambient light interference possible.

(1) H_D = detection height; H_S = scanner mounting height.

ATTENTION: If the scan planes are at a height of more than 300 mm (11.81 in.), verify that people cannot reach the hazardous area by crawling underneath the scan plane.
If you mount the protective safety laser scanner higher than 300 mm (11.81 in.), you must help prevent crawling beneath with additional measures. For applications that are accessible to the public, the mounting height must be reduced to 200 mm (7.87 in.)[1].

(1) See the appropriate regulations.

Calculate the Supplement C

- If there is enough empty space in front of your machine or system, use 1200 mm (47.2 in.) for the supplement C.
- If the minimum distance must be kept as small as possible, calculate C with the following formula:

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

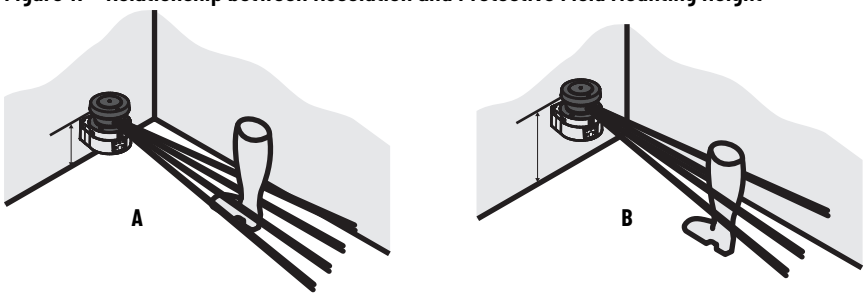
  Here H_D is the height at which the protective field is mounted.

IMPORTANT The minimum supplement C to help prevent reaching over is 850 mm (33.5 in.) (arm length).

Scan Plane Height at 70 mm (2.8 in.) Resolution

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

Figure 17 - Relationship between Resolution and Protective Field Mounting Height



If you choose a resolution of 70 mm (2.8 in.) in the SCD software for hazardous area protection, a human leg, in certain circumstances, cannot be detected (for example, scan to left and right of the bone - (A) in Figure 17).

If you mount the SafeZone Mini safety laser scanner higher, the scan plane is at calf height and the leg is also detected with an object resolution of 70 mm (2.8 in.) (see (B) in Figure 17).

Stationary Application in Vertical Operation for Access Protection

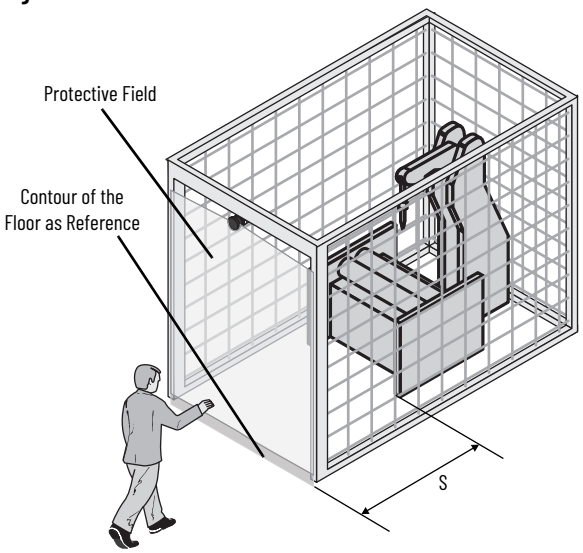
You can use access protection when the access to the machine is defined by physical means. For access protection, the SafeZone Mini safety laser scanner detects the entry of an entire body.

- To achieve adequate access protection, a response time of ≤ 90 ms and a resolution of 150 mm (5.91 in.) or finer are required.
- To help protect the protective safety laser scanner against inadvertent adjustment or manipulation, you must use the contour of the surroundings as a reference for the SafeZone Mini safety laser scanner (see Use the Contour as a Reference on page 29).

Minimum Distance

For access protection, maintain a minimum distance (S) between the protective field and hazardous area. This safety distance helps maintain that the hazardous point is only reached after the dangerous state of the machine stops completely.

Figure 18 - Access Protection



The minimum distance S as defined in EN ISO 13855 and EN ISO 13857 depends on the following:

- Reach or approach speed
- Stop/run-down time of the machine or system

  The stop/run-down time is in the machine documentation, or you must take a measurement to determine the stop/run time.
- Response time of the SafeZone Mini safety laser scanner
- Supplement C against reaching through

Calculate Minimum Distance S

See EN ISO 13855. Calculate S with the following formula:

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

Variable	Description
K	Approach speed [1600 mm/s (63 in./s), defined in EN ISO 13855]
T_M	Stopping/run-down time of the machine or system
T_S	Response time of the SafeZone Mini safety laser scanner and the downstream controller
C	Supplement for prevention of reaching over [850 mm (33.5 in.)]

Response Time T_S of the SafeZone Mini Safety Laser Scanner

ATTENTION: The total response time of the SafeZone Mini safety laser scanner must not be more than 80 ms for access protection.
If a critical response time is exceeded, a person can no longer be detected under certain circumstances.
In specific cases in agreement with the responsible authorities, higher response times can be allowed (for example by increasing the detection time available by positioning the safety laser scanner at an angle). In this case, verify that the areas the safety laser scanner cannot see are protected by additional measures.

The response time TS of the SafeZone Mini safety laser scanner depends on the following:

- The basic response time of the SafeZone Mini safety laser scanner
- The multiple sampling set

See OSSD Response Times on page 76.

Stationary Application in Vertical Operation for Hazardous Point Protection

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

IMPORTANT Configure the SafeZone Mini safety laser scanner with a resolution of at least 40 mm (1.6 in.).

ATTENTION: Never use the SafeZone Mini safety laser scanner for safety applications that require finger protection.
Due to the finest possible resolution of 30 mm (1.2 in.), the SafeZone Mini safety laser scanner is not suitable for finger protection.

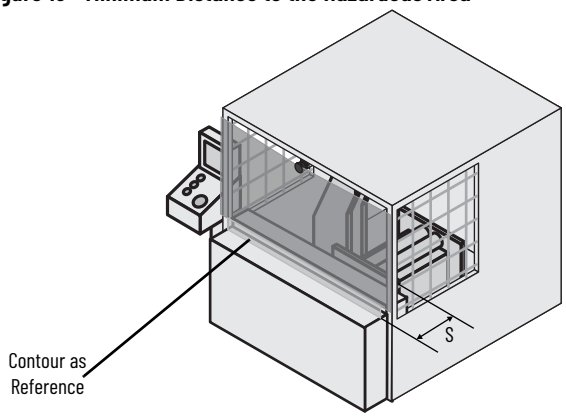
To help protect the safety laser scanner against inadvertent adjustment or manipulation, use the contour of the surroundings as a reference for the SafeZone Mini safety laser scanner (see Use the Contour as a Reference on page 29).

Minimum Distance

For hazardous point protection, observe a minimum distance the between protective field and hazardous point. This safety distance helps maintain that the hazardous point is only reached after the dangerous state of the machine stops completely.

ATTENTION: Help prevent reaching around or behind the protective field.
Always mount the safety laser scanner so reaching around and behind is impossible. Provide suitable additional precautions as necessary.

Figure 19 - Minimum Distance to the Hazardous Area



The minimum distance S as defined in EN ISO 13855 and EN ISO 13857 depends on the following:

- Stop/run-down time of the machine or system

  The stop/run-down time is in the machine documentation, or you must take a measurement to determine the stop/run time.
- Response time of the SafeZone Mini safety laser scanner
- Reach or approach speed
- Resolution of the SafeZone Mini safety laser scanner

Calculate Minimum Distance S

See EN ISO 13855. Calculate S with the following formula:

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

Variable	Description
T_M	Stopping/run-down time of the machine or system
T_S	Response time of the SafeZone Mini safety laser scanner
d	Resolution of the SafeZone Mini safety laser scanner [mm]

The reach/approach speed is included in the formula.

- If the result S is ≤ 500 mm (19.7 in.), then use the determined value as the minimum distance.
- If the result S is > 500 mm (19.7 in.), you can reduce the minimum distance with the following calculation:

  $S = 1600 \times (T_M + T_S) + 8 \times (d - 14)$ [mm]
- If the new value S is > 500 mm (19.7 in.), then use the newly calculated value as the minimum distance.
- If the new value S is ≤ 500 mm (19.7 in.), then use 500 mm (19.7 in.) as the minimum distance.

Response Time T_S of the SafeZone Mini Safety Laser Scanner

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

- The basic response time of the SafeZone Mini safety laser scanner
- The multiple sampling set

See OSSD Response Times on page 76.

Mobile Applications

If a vehicle (for example, AGV or fork lift) produces the dangerous state, the SafeZone Mini safety laser scanner protects the hazardous area that the movement of the vehicle produces.

Application Notes

- The SafeZone Mini safety laser scanner can only be used to help protect vehicles that are powered by an electric motor.
- In the following calculations, only consider the velocity of the vehicle, not the speed of the person walking. This calculation is based on the assumption that the person recognizes the danger and stands still.
- For vehicle protection, observe EN 1525 - Safety of industrial trucks. Driverless trucks and their systems.
- If the application is to help protect vehicles from collisions, use different assumptions.

For a horizontally mounted mobile application, determine:

- Protective field length
- Protective field width
- Height of the scan plane
- Restart behavior
- Methods to help prevent unprotected areas

Protective Field Length

You must configure the protective field so you maintain a minimum distance to the vehicle. This distance helps maintain that a vehicle that is monitored by the SafeZone Mini safety laser scanner comes to a stop before the vehicle reaches a person or object.

Calculate the Protective Field Length S_L

See EN ISO 13855. Calculate the necessary protective field length S_L with the formula:

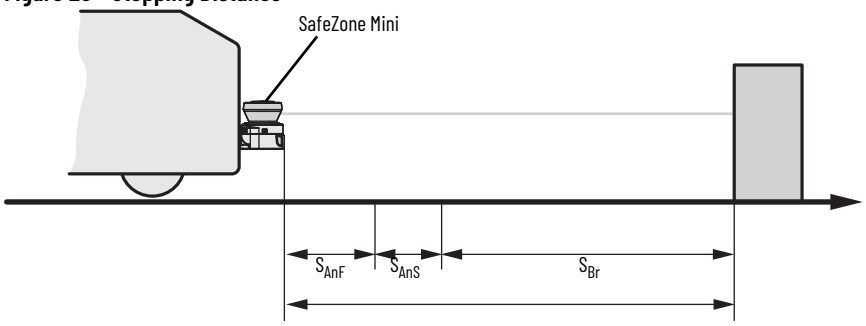
$$S_L = S_A + Z_G + Z_R + Z_F + Z_B$$

Variable	Description
S_A	Stopping distance
Z_G	General safety supplement of the SafeZone Mini safety laser scanner = 100 mm (3.94 in.)
Z_R	Supplement for any reflection-related measurement error of the SafeZone Mini safety laser scanner
Z_F	Supplement for any lack of ground clearance of the vehicle
Z_B	Supplement for the reduction in the braking performance of the vehicle to be found in the related vehicle documentation

Calculate the Stopping Distance S_A

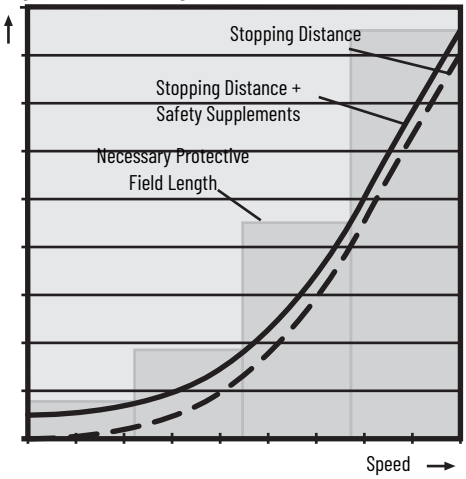
The stopping distance comprises the braking distance for the vehicle, the distance covered during the response time of the safety laser scanner, and the response time of the vehicle controller.

Figure 20 - Stopping Distance



IMPORTANT Consider that the braking distance for a vehicle is not linear with increasing velocity, but increases in a square function.

Figure 21 - Stopping Distance as a Function of the Vehicle Velocity



Calculate the stopping distance S_A with the formula:

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

Variable	Description
S_{Br}	Braking distance, to be found in the vehicle documentation
S_{AnF}	Distance that is covered during the response time of the vehicle controller, to be found in the vehicle documentation
S_{AnS}	Distance that is covered during the response time of the safety laser scanner

The distance that the safety laser scanner covers during the response time depends on the following:

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

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

- The basic response time of the SafeZone Mini safety laser scanner
- The multiple sampling set

See OSSD Response Times on page 76.

Calculate the Distance S_{AnS}

This distance is covered during the response time of the safety laser scanner. Calculate the distance S_{AnS} with the formula:

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

Variable	Description
T_S	Response time of the safety laser scanner
V_{max}	Maximum velocity of the vehicle from the related vehicle documentation

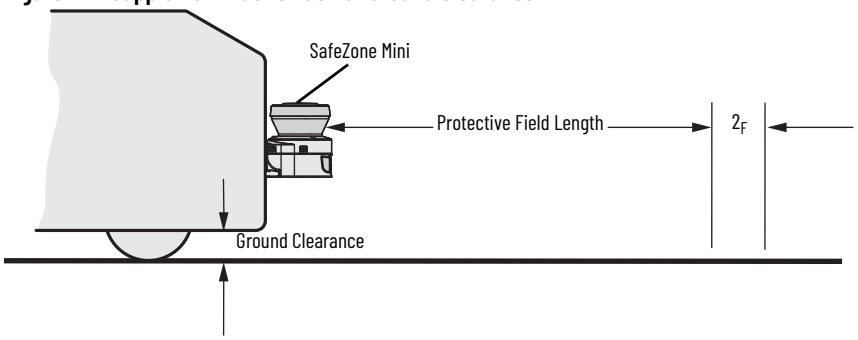
Supplement Z_R

Supplement Z_R is used for measurement errors that reflection causes. With retro-reflectors in the background at a distance of less than 1 m (3.28 ft) from the boundary of the protective field, the supplement Z_R is 200 mm (7.87 in.).

Supplement Z_F

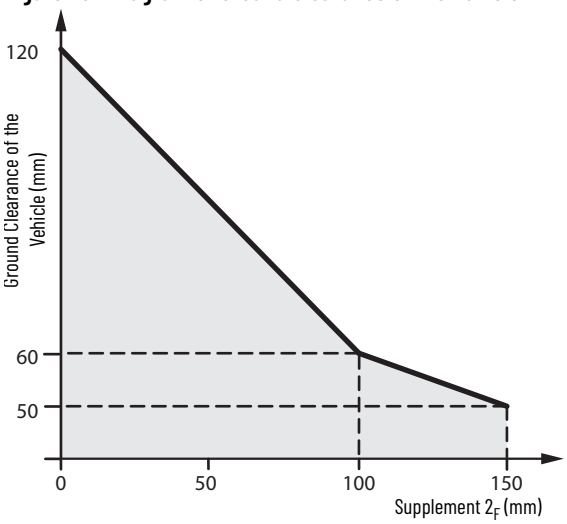
Supplement Z_F is due to lack of ground clearance. This supplement is necessary because a person is detected above the foot and the braking action therefore cannot consider the length of the foot in front of the detection point. If a vehicle has no ground clearance, a person can receive foot injuries.

Figure 22 - Supplement Due to Lack of Ground Clearance



The flat rate supplement for ground clearance below 120 mm (4.7 in.) is 150 mm (5.91 in.). This supplement can reduce further in specific cases. For this purpose, read off the actual supplement necessary for the ground clearance of your vehicle from Figure 23 on page 43.

Figure 23 - Diagram of Ground Clearance of the Vehicle



Protective Field Width

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

Calculate the Protective Field Width S_B

See EN ISO 13855. Calculate the protective field width S_B with the formula:

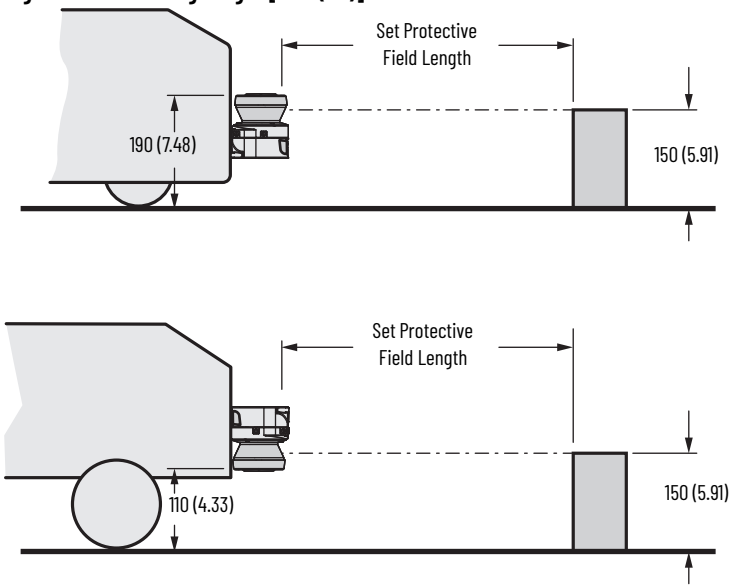
$S_B = F_B + 2 \times (Z_G + Z_R + Z_F)$

Variable	Description
F_B	Vehicle width
Z_G	General safety supplement of the SafeZone Mini safety laser scanner = 100 mm (3.94 in.)
Z_R	Supplement for any reflection-related measurement error of the SafeZone Mini safety laser scanner
Z_F	Supplement for any lack of ground clearance of the vehicle

Height of Scan Plane

ATTENTION: Mount the SafeZone Mini safety laser scanner such that the scan plane is at a maximum height of 200 mm (7.87 in.).
In this way, persons lying down are reliably detected. Tilting the protective field so objects with a diameter of 200 mm (7.87 in.) are not detected, is not allowed. We recommend aligning the scan plane horizontally at 70 mm (2.76 in.).

Figure 24 - Mounting Height [mm (in.)]

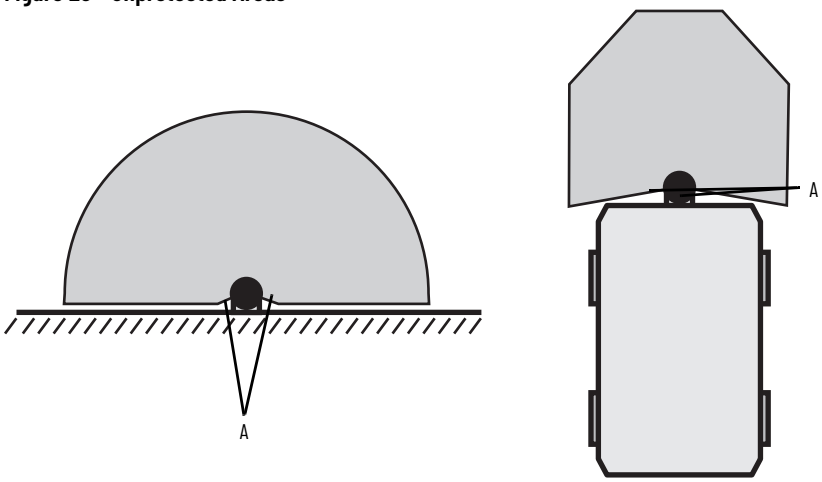


To produce the optimal scan plane, you can also reverse-mount the SafeZone Mini safety laser scanner.

Methods to Help Prevent Unprotected Areas

When you mount the SafeZone Mini safety laser scanner, you can find areas that are not covered by the safety laser scanner (see (A) in Figure 25 on page 45).

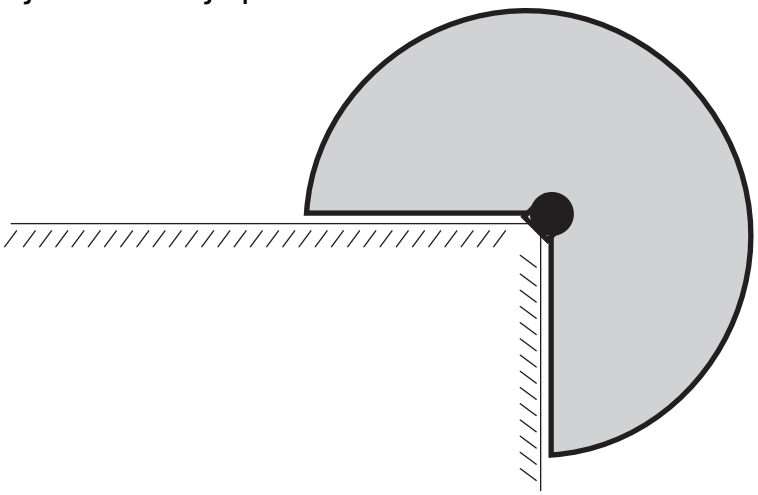
Figure 25 - Unprotected Areas



ATTENTION: Prevent or secure unprotected areas.
Mount the SafeZone Mini safety laser scanner such that there are no unprotected areas.
For mobile applications, if the vehicle accelerates to a maximum velocity of 0.3 m/s (0.98 ft/s) in less than 3 seconds when in operation, you must help prevent personnel from entering the unprotected areas with mechanical trim panels, switch strips, or fitting the SafeZone Mini safety laser scanner in the vehicle trim panels.

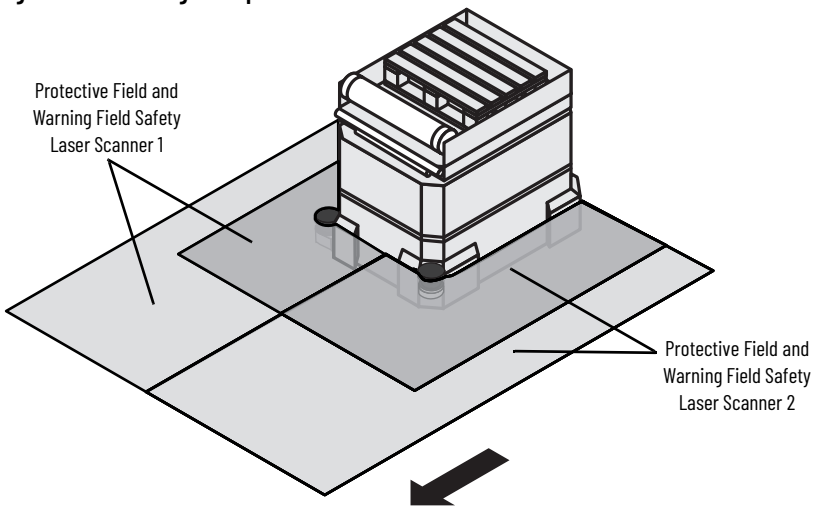
Mount the SafeZone Mini safety laser scanner, for example, on a corner to help prevent unprotected areas.

Figure 26 - Preventing Unprotected Areas



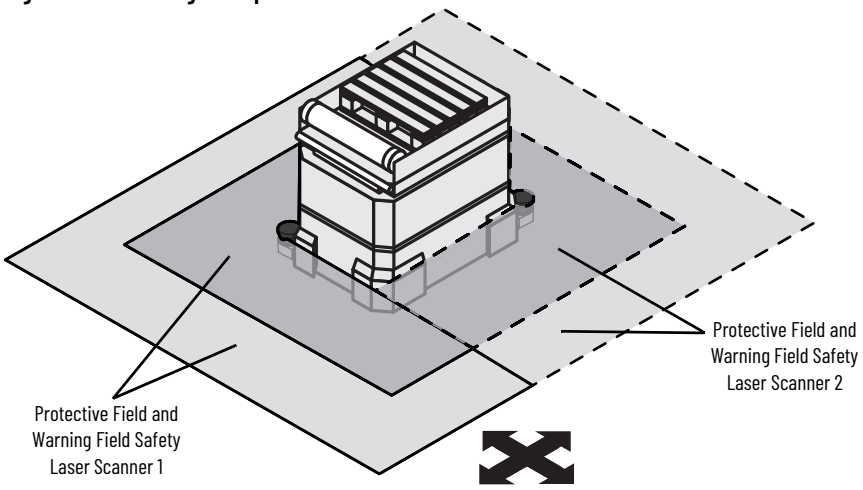
With two SafeZone Mini safety laser scanners mounted at an angle of 45° on the front corners of a vehicle, you can configure the protective fields so that there are no unprotected areas, and the hazardous areas in narrow aisles are also protected.

Figure 27 - Mounting Example for Front and Side Protection in a Direction of Travel



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

Figure 28 - Mounting Example for All-around Protection in All Directions of Travel



Near Range

Use a bar or recess to make the near range impassible, or additionally use a proximity switch with 50 mm (2.0 in.) acquisition range to protect the near range 50 mm (2.0 in.) wide area in front of the optics cover. The vehicle can then accelerate as required.

Mounting Steps

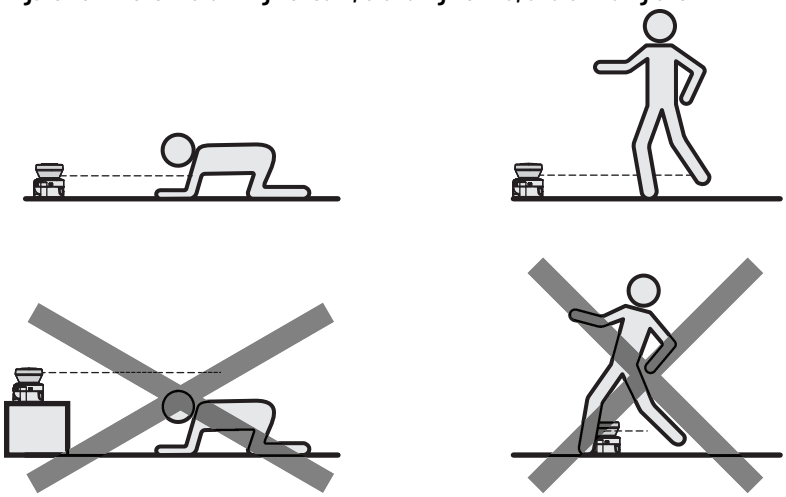
ATTENTION: Only qualified safety personnel are allowed to separate materials.
Take caution when safety laser scanners are dismantled. There is a risk of injuries.

Special notes for mounting:

- Mount the SafeZone Mini safety laser scanner so the unit is protected from moisture, dirt, and damage.

- Verify that the entire field of view of the SafeZone Mini safety laser scanner is unrestricted.
- Mount the safety laser scanner so the status indicators are easy to see.
- Avoid excessive shock and vibration load on the safety laser scanner.
- On systems that suffer from heavy vibration, use screw-locking devices to help prevent the mounting screws from coming loose.
- Regularly check the tightness of the mounting screws.
- Prevent personnel from being able to crawl beneath, stand behind or climb over the protective field with appropriate mounting of the SafeZone Mini safety laser scanner.

Figure 29 - Prevent Crawling Beneath, Standing Behind, and Climbing Over



The origin of the scan plane is 80 mm (3.15 in.) above the bottom edge of the SafeZone Mini safety laser scanner (see Figure 54 on page 83).

There are three possible ways to mount the SafeZone Mini safety laser scanner:

- Direct mount without a mounting kit
- Mount with mounting kit 1 or 2
- Mount with mounting kit 3 and 4 (only with mounting kit 1 or 2)

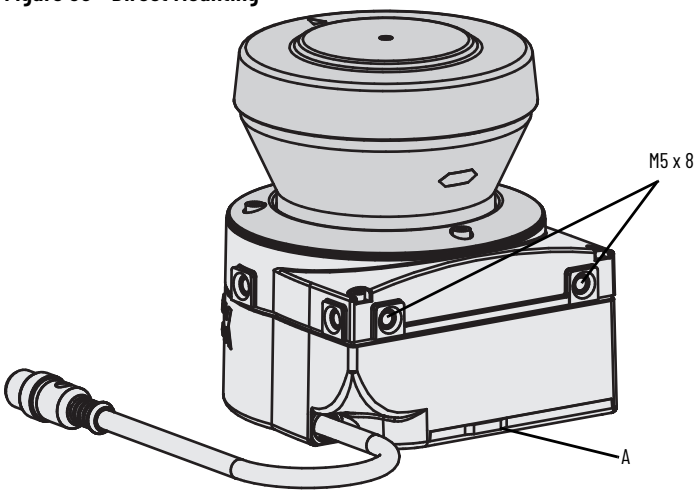
The mounting kit part numbers are in Table 28 on page 87.

IMPORTANT Pay attention to the maximum torque of the M5 mounting screws on the SafeZone Mini safety laser scanner (5.9 N•m [52.21 lb•in], max).

Direct Mounting

The SafeZone Mini safety laser scanner has two threaded holes M5×8 on the rear. You can use the threaded holes to mount the SafeZone Mini safety laser scanner directly on the intended mounting surface. To avoid a possible tendency to vibrate, if necessary, use the reference surface on the rear as the third mounting point (see (A) in Figure 30 on page 48).

Figure 30 - Direct Mounting



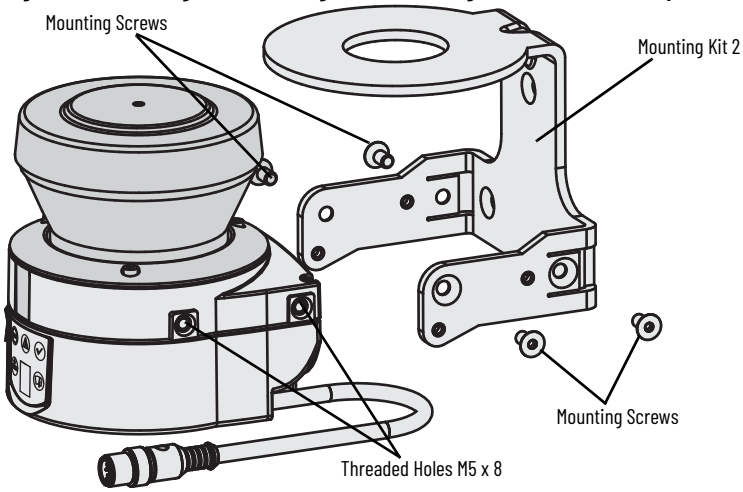
IMPORTANT During mounting, review the Approximate Dimension on page 83.

Mounting with Mounting Kit 1 or 2

With the aid of mounting kit 1 or 2, you can mount the SafeZone Mini safety laser scanner indirectly on the mounting surface. Mounting kit 1 comes without a protection device for the optics cover and mounting kit 2 comes with a protection device for the optics cover.

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

Figure 31 - Mounting with Mounting Kit 2 (Including Protection for the Optics Cover)



IMPORTANT During mounting, review the Approximate Dimension on page 83.

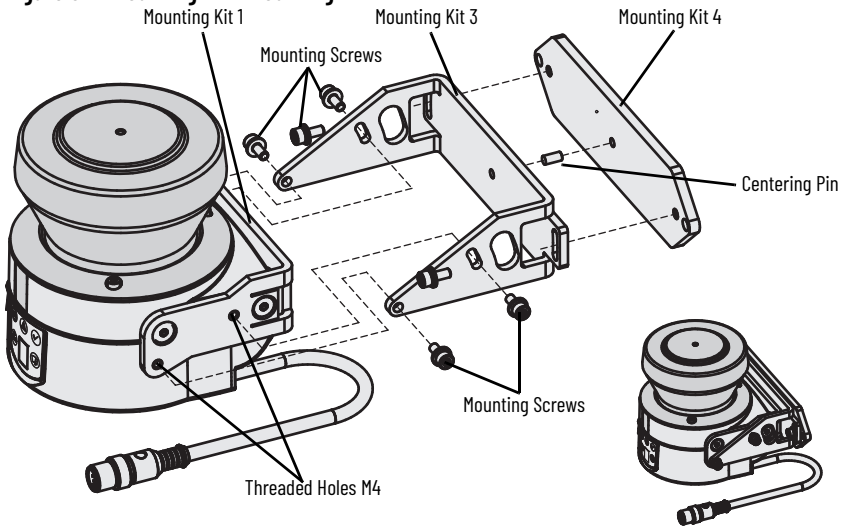
Mounting with Mounting Kit 3 and 4

With the aid of mounting kits 3 and 4 (only use with mounting kit 1 or 2), you can align the SafeZone Mini safety laser scanner in two planes. The maximum adjustment angle is ±11° in both planes.

1. Mount mounting kit 1 or 2 to the SafeZone Mini safety laser scanner.
2. Mount mounting kit 4 on the mounting surface.

3. Fit the centering pin [4 mm (0.16 in.)] in the central hole on mounting bracket 4.
4. Fit mounting kit 3 to mounting kit 4 and mount it using two mounting screws M4 × 10.
5. Then, mount the SafeZone Mini safety laser scanner on mounting kit 3 with the aid of the threaded holes in mounting kit 1.
6. Adjust the SafeZone Mini safety laser scanner longitudinally and transversely and then tighten the six mounting screws on the mounting kits.

Figure 32 - Mounting with Mounting Kit 2



IMPORTANT During mounting, review the Approximate Dimension on page 83.

Information Label Important Information

Once you complete the mounting process, you must affix the supplied self-adhesive information label Important information:

- Use only the information label in the language that the operators of the machine can read and understand.
- Place the information label so it is clearly visible for the operators during operation. The information label must not be covered even after additional items are mounted.

Using Multiple Safety Laser Scanners

The SafeZone Mini safety laser scanner is designed so that mutual interference between several safety laser scanners is unlikely. To exclude erroneous switching, you must mount the safety laser scanners as shown in Figure 33...Figure 37 on page 50.

IMPORTANT In any circumstance, observe EN ISO 13855 when you calculate the minimum distance.

Use mounting kits 1 or 2 and 3 to adjust the safety laser scanners to different angles (see Table 28 on page 87).

Figure 33 - Opposite Mounting

Figure 34 - Offset Parallel Mounting [mm (in.)]

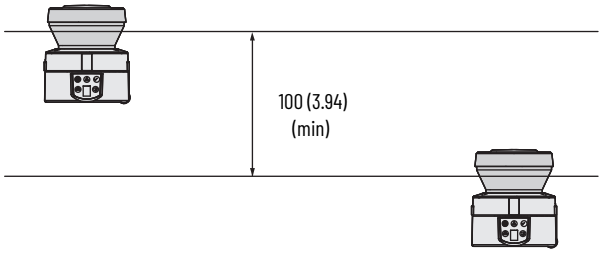


Figure 35 - Mounting on a Cross

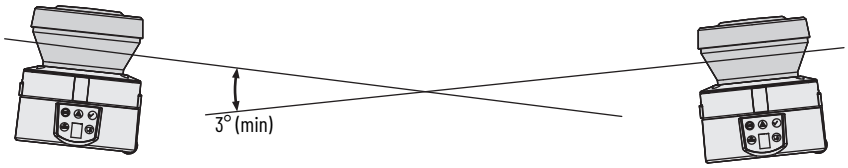
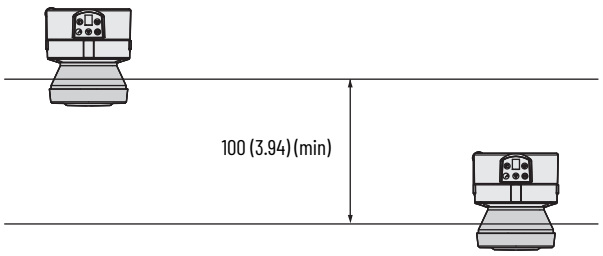


Figure 36 - Reverse Mounting, Parallel Offset [mm (in.)]

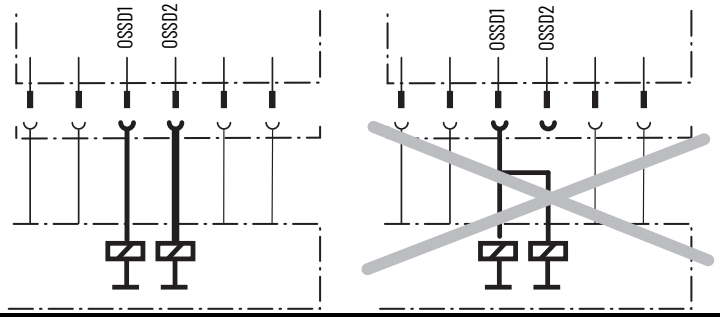
Figure 37 - Reverse Mounting of Two SafeZone Mini Safety Laser Scanners, with Parallel Offset [mm (in.)]



Electrical Installation

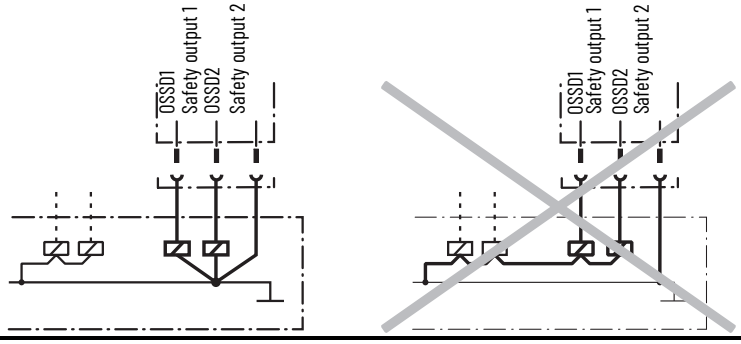
ATTENTION: Switch the entire machine/system offline.
The machine/system could unintentionally start up while you connect the devices. Verify that the entire machine/system is disconnected during the electrical installation.

ATTENTION: Connect OSSD1 and OSSD2 separately.
You are not allowed to connect OSSD1 and OSSD2 together, otherwise signal safety is not maintained.
Confirm that the machine controller processes the two signals separately.
You must positively guide and monitor downstream contactors.



ATTENTION: Only connect one downstream switching element to an OSSD.
Each output signal switching device (OSSD) can only connect to one switching element (for example, relay or contactor). If you require several switching elements, choose a suitable form of contact duplication.

ATTENTION: Help prevent the occurrence of a potential difference between the load and the protective device.
If you connect loads that are not reverse-polarity protected to the OSSDs or the safety outputs, you must connect the 0V connections of these loads and of the corresponding protective device individually and directly to the same 0V terminal strip. This configuration is the only way to verify that, if there is an anomaly, there is no potential difference between the 0V connections of the loads and of the corresponding protective device.



Electrical Notes

- Route all cables and connection cables to protect them from damage.
- Verify that the connected controller and all safety-related devices have the required category as per EN ISO 13849-1 or the required Performance Level as per EN ISO 13849-1.
- If you use screened cables, lay the screen evenly around the connection terminal.
- Verify that the SafeZone™ Mini safety laser scanner is adequately protected electrically. See Electrical Specifications on page 80 for the electrical data necessary for determining the correct fuse.

System Connection

All inputs and outputs on the SafeZone Mini safety laser scanner are on the round plug connector on the connecting cable. Connect the SafeZone Mini safety laser scanner with pre-assembled extension cables (see Table 10 on page 53).

Use all inputs and outputs on the SafeZone Mini safety laser scanner only in the context specified.

The round plug connectors are coded. If you use plug connectors other than the connectors intended, any claim against Rockwell Automation under the warranty is rendered void.

Wiring in Accordance with EMC Regulations

The quality of the shield is dependent on the quality of the connection of the screen. In principle, you can only achieve the best screening action with the connection of the shield at both ends with large area connections.

If it is not possible to connect the screen via threaded fittings, connect the screen physically close, for example, to a control cabinet chassis with a metal clamp.

IMPORTANT If there is a PE in an installation, it can be used for the connection of the functional earth connection (FE). However, never use an FE as a PE.

Functional Earth

To achieve the specified EMC safety, you must connect the functional earth FE (for example, to the central earth star point of the vehicle or system).

Round Plug Connector

Figure 38 - Round Plug Connector 15 mm (0.59 in.)

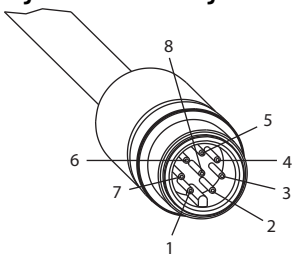


Table 9 - Pin Assignment (1)

Pin	Signal	Function
1	WF	Output for warning field 1
2	+24V DC	Supply voltage
3	I/O1	Universal I/O
4	I/O2	Universal I/O
5	OSSD1	Output signal switching device
6	OSSD2	Output signal switching device
7	0V DC	Supply voltage
8	FE/shield	Functional earth/shield
Housing	FE/shield	Functional earth/shield

(1) Use the cordsets that are listed in Table 28 on page 87 to connect the SafeZone Mini safety laser scanner.

Table 10 - Core Assignment of the SafeZone Mini Safety Laser Scanner Cable

Core	Color	Function
1	White	Output for warning field 1
2	Brown	Supply voltage 24V DC
3	Green	Universal I/O connection 1
4	Yellow	Universal I/O connection 2
5	Gray	Output signal switching device OSSD1
6	Pink	Output signal switching device OSSD2
7	Blue	Supply voltage 0V DC
8	FE/shield	Functional earth/shield

Universal I/O Connections

ATTENTION: Do not use the universal I/O connection outputs for safety-related tasks. The universal I/O connection outputs are purely application diagnostics outputs, for example, for the transfer of information to controllers.

Configuration Connection M8 × 4 (Serial Interface)

Figure 39 - Pin Assignment

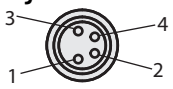


Table 11 - Pin Assignment Configuration Connection M8 × 4

Pin	SafeZone Mini Safety Laser Scanner	PC-side RS-232-D-Sub
1	Reserved	Not assigned
2	R x D	Pin 3
3	0V DC (voltage supply)	Pin 5
4	T x D	Pin 2

After configuration:

- Always remove the connecting cable from the configuration connection.
- Locate the attached protection cap to cover the configuration connection.

Notes:

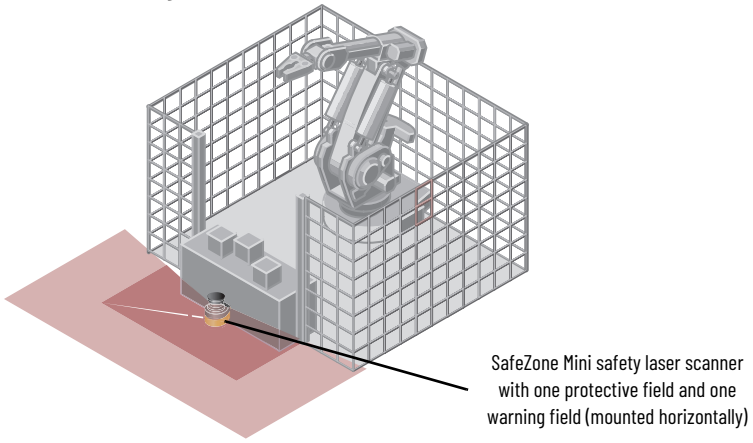
Application Examples and Connection Diagrams

The following examples are planning aids. Additional protection measures can be necessary for your application.

Stationary Applications

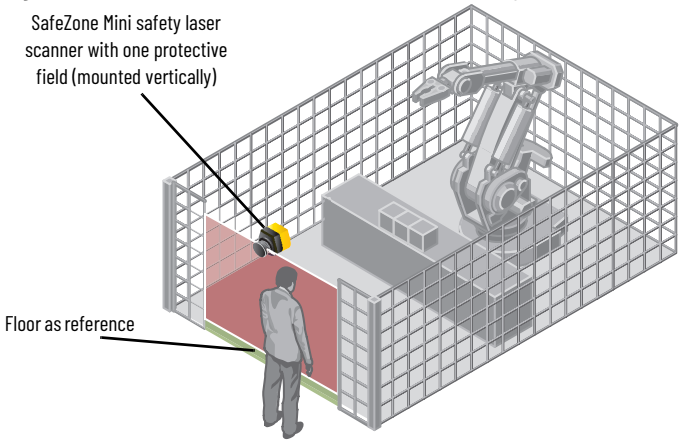
Figure 40 shows coverage of one area that a SafeZone™ Mini safety laser scanner monitors permanently.

Figure 40 - Hazardous Area Protection with SafeZone Mini Safety Laser Scanner (Horizontal Mounting)



The access in Figure 41 is monitored permanently. For safety against manipulation of the SafeZone Mini safety laser scanner, for example, the floor is used as a reference. If the alignment of the SafeZone Mini safety laser scanner changes (for example, due to changes to the bracket), it switches its OSSDs to the off-state.

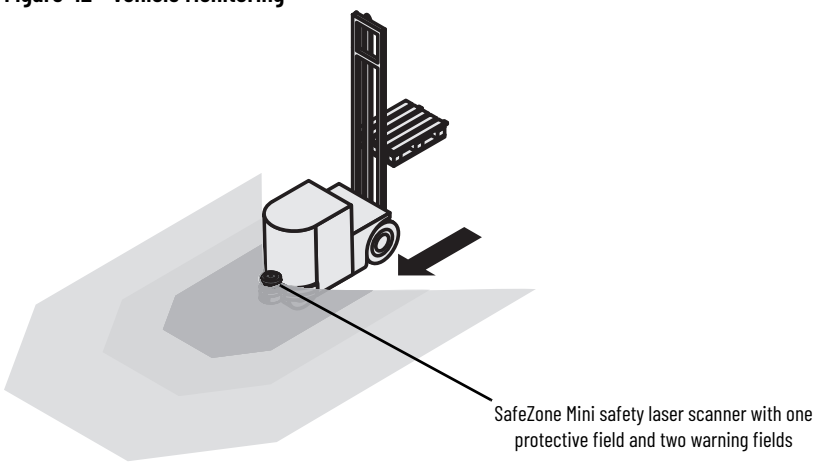
Figure 41 - Access Protection with SafeZone Mini Safety Laser Scanner (Vertical Mounting)



Mobile Applications

Figure 42 shows vehicle monitoring for unidirectional travel with a SafeZone Mini safety laser scanner. The SafeZone Mini safety laser scanner monitors the area in the direction of travel and switches its OSSDs to the off-state to stop the vehicle as soon as there is an object in the protective field.

Figure 42 - Vehicle Monitoring



Connection Diagrams

IMPORTANT
- Only use relays/contacts with positively guided contacts. The protection elements that are connected in parallel with the relays/contactors are used for arc-suppression.
- Verify that there is adequate arc-suppression at the relays/contactors. Consider arc-suppressors to lengthen the response time.
- The arc-suppressors must be in parallel with the relays/contactors (not across the contacts).

Restart Interlock and External Device Monitoring

SafeZone Mini safety laser scanner with relays/contactors: Operating mode with restart interlock (universal I/O 1 must be configured as reset) and external device monitoring (universal I/O 2 must be configured as EDM).

Figure 43 - Connection Diagram with Restart Interlock and External Device Monitoring

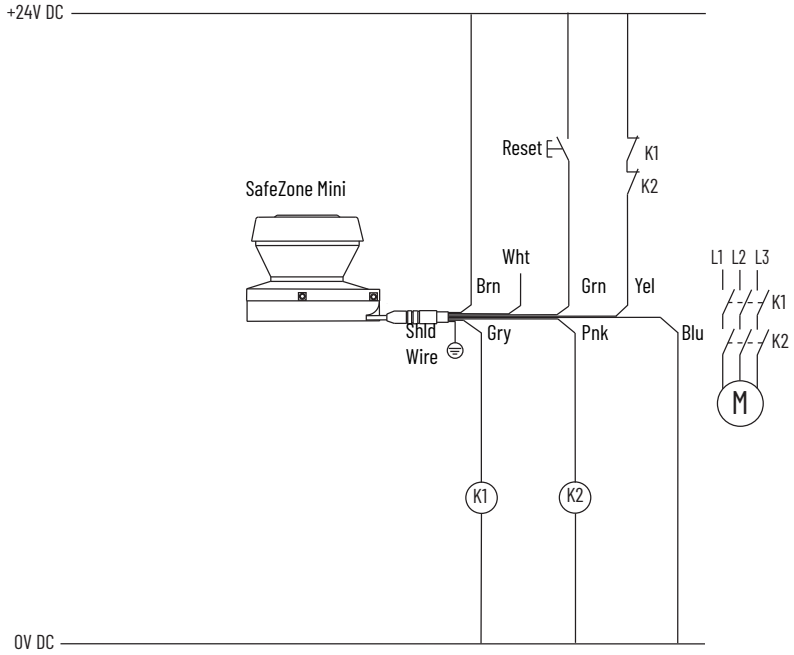


Table 12 - Diagram Explanation

Color	Pin	Signal
Wht	1	Output - Warning Field1 (1)
Brn	2	+24V DC
Grn	3	Universal I/O1 (Reset) (2)
Yel	4	Universal I/O2 (EDM) (3)
Gry	5	OSSD 1
Pnk	6	OSSD 2
Blu	7	0V DC
Shld	8	Earth Ground

(1) Not configured for this application.
Not connected.
(2) Software configured for Reset input.
(3) Software configured for EDM.

SI Guardmaster Safety Relay

SafeZone Mini safety laser scanner in combination with a SI Guardmaster® safety relay: Operating mode of SafeZone Mini safety laser scanner is on/off and SI safety relays is configured for monitored manual reset.

Figure 44 - Connection Diagram in Combination with a GSR SI Safety Relay

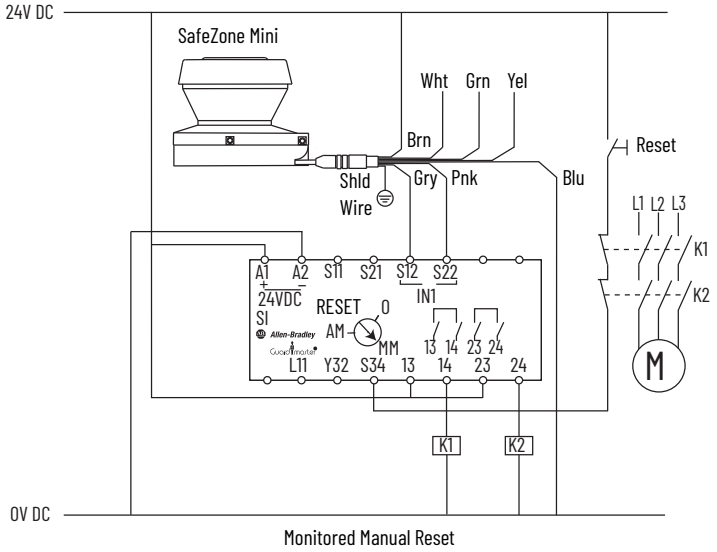


Table 13 - Diagram Explanation

Color	Pin	Signal
Wht	1	Output - Warning Field1 (1)
Brn	2	+24V DC
Grn	3	Universal I/O1 (1)
Yel	4	Universal I/O2 (1)
Gry	5	OSSD 1
Pnk	6	OSSD 2
Blu	7	0V DC
Shld	8	Earth Ground

(1) Not configured for this application.
Not connected.

Two SafeZone Mini Safety Laser Scanners with DI Guardmaster Safety Relay

Two SafeZone Mini safety laser scanners are connected to a DI Guardmaster safety relay. The DI safety relay is configured for monitored manual reset. SafeZone Mini scanners are configured for on/off.

Figure 45 - Connection Diagram in Combination with a GSR DI Safety Relay

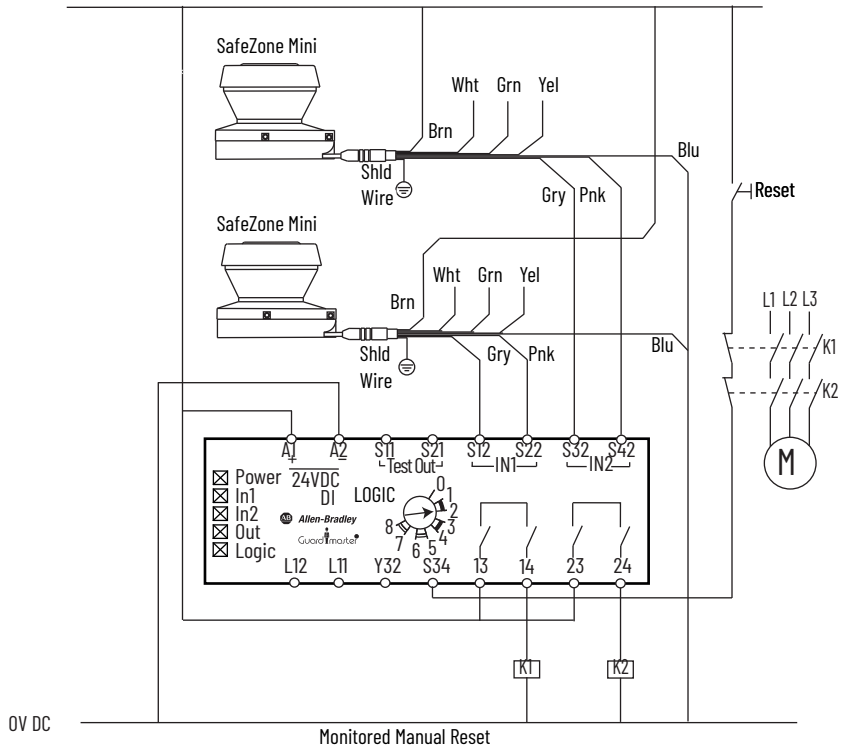


Table 14 - Diagram Explanation

Color	Pin	Signal
Wht	1	Output - Warning Field1 (1)
Brn	2	+24V DC
Grn	3	Universal I/O1 (1)
Yel	4	Universal I/O2 (1)
Gry	5	OSSD 1
Pnk	6	OSSD 2
Blu	7	0V DC
Shld	8	Earth Ground

(1) Not configured for this application.
Not connected.

Notes:

Configuration

Default Delivery Status

The SafeZone™ Mini safety laser scanner is delivered in a non-configured default state.

- The operational status is Waiting for configuration.
- The seven-segment display indicates 6.
  - The output signal switching devices (OSSDs) are in the off-state, the red status indicator illuminates STOP.

Prepare the Configuration

To prepare the configuration:

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

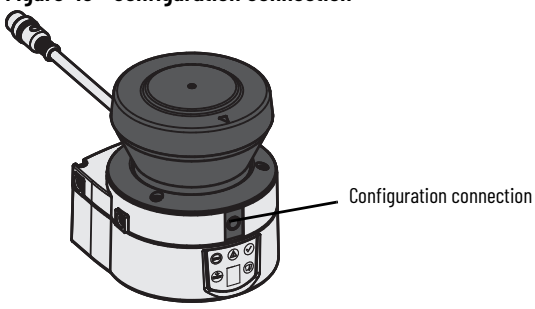
To configure the safety laser scanner, you need:

- SCD software on CD-ROM or downloaded from https://www.rockwellautomation.com/en-us/products/hardware/allen-bradley/safety-products/safety-presence-sensors/442l-safezone-mini.html.
- Computer with Windows® NT 4/2000 Professional/XP/Vista/7 (32-Bit) and a serial RS-232 interface (computer not included).
- A service cable to connect the computer and SafeZone Mini safety laser scanner.

Configuration with the SCD Software

To configure and perform diagnostics on the SafeZone Mini safety laser scanner, directly connect the computer to the configuration connection on the SafeZone Mini safety laser scanner.

Figure 46 - Configuration Connection



Two service cables of different lengths are available for computer connection (see Table 28 on page 87).

IMPORTANT
- Verify that the service cable is not laid near high-power electrical drives or cables that carry high power. In this way, you avoid EMC effects on the service cable.
- You can only connect the service cable for configuration and diagnostics. The service cable must be disconnected and the protective cap in place while in operation.

Use the password function in the SCD software to help protect the configuration settings from unauthorized access. Also, verify that the passwords are stored to help protect against unauthorized access.

Commissioning

Initial Commissioning

ATTENTION: Commissioning requires a thorough check by qualified safety personnel.
Before you operate a system that the SafeZone™ Mini safety laser scanner monitors for the first time, qualified safety personnel must check and release the system. You must document the result of the test. Read Qualified Safety Personnel on page 9.

- Before the machine is released, check whether the protective devices entirely monitor the access to the hazardous area or the hazardous point.
- After approval of the machine, at regular intervals (for example, in the morning before the start of work) check whether the OSSDs (on the SafeZone Mini safety laser scanner that is connected or on a safety controller) switch correctly to the off-state as soon as there is an object in the protective field. This test must be performed along all protective field boundaries as per the specific regulations for the application (see Test Notes on page 64).

Power-up Sequence

After power-up, the SafeZone Mini safety laser scanner runs through a power-up cycle. During the power-up cycle, the seven-segment display indicates the safety laser scanner status.

During the initial commissioning of a SafeZone Mini safety laser scanner, the following indications are possible:

Table 15 - Seven-segment Display during and after the Power-up Sequence on Initial Commissioning

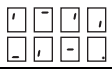
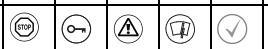
Step	Display	Meaning
1		Power-up cycle, testing the seven-segment display. All segments activate sequentially.
2		Power-up cycle, during initial commissioning: safety laser scanner in configuration mode
	Other display	Safety lock activated. Malfunction in external conditions or in the safety laser scanner itself. See Error and Status Indication — Seven-segment Display on page 81.

Table 16 - Status Indication after the Power-up Sequence

Step	Display	Meaning
1		Safety laser scanner self-test
2		Safety laser scanner self-test
3		Status: waiting for configuration or object in the protective field, OSSDs in the off-state
	Other display	Safety lock activated. Malfunction (see Error and Status Indication — Status Indicators on page 80)

Test Notes

ATTENTION: Do not place anybody at risk during initial commissioning of the machine.
Always expect that the machine, system, or the protective device does not yet behave as planned.

- Verify that there are no persons in the hazardous area during initial commissioning.
- Check the effectiveness of the safety laser scanner that is mounted to the machine. Use all selectable operating modes as specified in the checklist in the annex (see Checklist to Install ESPE on page 89).
- Verify that the qualified safety personnel instructs the operating personnel of the machine that is protected by the safety laser scanner before the operating personnel is allowed to operate the machine. Instruction of the operating personnel is the responsibility of the machine owner.
- Confirm that the information label Important information, which is included with the safety laser scanner on delivery, is affixed to the machine in a place where it is clearly visible for the operators. Confirm that the operators have the possibility to perform this daily check correctly.
- Use the For Manufacturer and Installer on page 89 as a reference before commissioning the system for the first time.
- Document the adjustment of the safety laser scanner and the results of the testing during initial commissioning in a traceable manner. For this purpose, also print the complete configuration of the safety laser scanner (including protective field shapes) and include these configurations with the documentation.
- Contact your Rockwell Automation sales office or Allen-Bradley distributor for questions regarding initial commissioning.

Use the Create Development Dump... function in the SCD software (right-click the COM interface to which the safety laser scanner is connected). You can keep this data as a backup and so document the state during initial commissioning at any time.

Inspection of the Protective Device

Qualified safety personnel must inspect your protective device regularly.

- Check the system following the inspection intervals that are specified in the national rules and regulations. This procedure verifies that any changes on the machine or manipulations of the protective device after the initial commissioning are detected.
- If major changes are made to the machine or the protective device, or if the safety laser scanner is modified or repaired, check the system again as per Checklist to Install ESPE on page 89.

Monthly Testing

A specialist or authorized personnel must check the effectiveness of the protective device daily. Also perform the test if the operating mode changes.

ATTENTION: No further operation if errors occur during the test.
If any one of the following points is not met, do not continue to work on the machine or operate the vehicle. In this case, qualified safety personnel must check the installation of the SafeZone Mini safety laser scanner (see Inspection of the Protective Device on page 64).

- Conducted the test for the relevant preset monitoring case.
- Check the mechanical installation to verify that all mounting screws are secure and that the SafeZone Mini safety laser scanner is properly aligned.
- Check each SafeZone Mini safety laser scanner for visible changes such as damage and manipulation.
- Switch on the machine/system.
- Watch the status indicators on each SafeZone Mini safety laser scanner.
- If at least one status indicator of each SafeZone Mini safety laser scanner is not permanently lit when the machine/system switches on, assume that there is a fault in the machine or system. In this case, the machine must be shut down immediately and checked by qualified safety personnel.
- Deliberately infringe the protective field while the machine is running to test the protective function for the entire system. The status indicators of the SafeZone Mini safety laser scanner must change from green to red and the dangerous movement must stop immediately.
- Repeat this test at different points in the hazardous area and on all SafeZone Mini safety laser scanners. If you discover any non-conformance of this function, the machine/system must be shut down immediately and checked by qualified safety personnel.
- For stationary applications, check that the hazardous areas marked out on the floor match the shapes of the protective fields that are stored in the SafeZone Mini safety laser scanner, and that any gaps are protected by additional safety measures. For mobile applications, check that the moving vehicle actually stops in a timely manner at the protective field boundaries that are set in the SafeZone Mini safety laser scanner and listed on the information label on the vehicle or in the configuration protocol. If you discover any non-conformance of this function, the machine/system/vehicle must be stopped immediately and checked by qualified safety personnel.
- If the reference contour monitoring feature is used, check the areas with the reference contour:
  - Move the test object along the inner edge of the tolerance band of the reference contour. The safety laser scanner must detect the test object at each position and indicate the detection.
  - If several reference contours are used, test all reference contours.

Notes:

Maintenance and Care

ATTENTION: Do not make any repairs to the safety laser scanner.
The SafeZone™ Mini safety laser scanner does not contain any repairable components. For this reason, do not open the SafeZone Mini safety laser scanner and only replace the parts that are described in the following chapters as replaceable.

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

Clean Optics Cover

The SafeZone Mini safety laser scanner requires little maintenance. However, the optics cover on the safety laser scanner must be cleaned regularly and when it becomes contaminated.

- Do not use aggressive cleaning agents.
- Do not use abrasive cleaning agents.
- Static charges cause dust particles to attract to the optics cover. Use the anti-static plastic cleaner and lens cloth to reduce this effect.

Optics Cover Cleaning Procedure

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

Replace Optics Cover

ATTENTION: Perform an optics cover calibration with the aid of the SCD software after the replacement of the optics cover.
The level of contamination is measured continuously during the operation of the SafeZone Mini safety laser scanner. For this purpose, the optics cover calibration must first be performed; this information serves as a reference for the contamination measurement (status = not contaminated).
Only perform the optics cover calibration with a new optics cover. The new optics cover must be free of contamination at the time of the optics cover calibration. The optics cover calibration must be performed at room temperature [10...30 °C (50...86 ° F)].

You must replace the optics cover if it is scratched or damaged. Order the replacement optics cover from Rockwell Automation (see Table 28 on page 87).

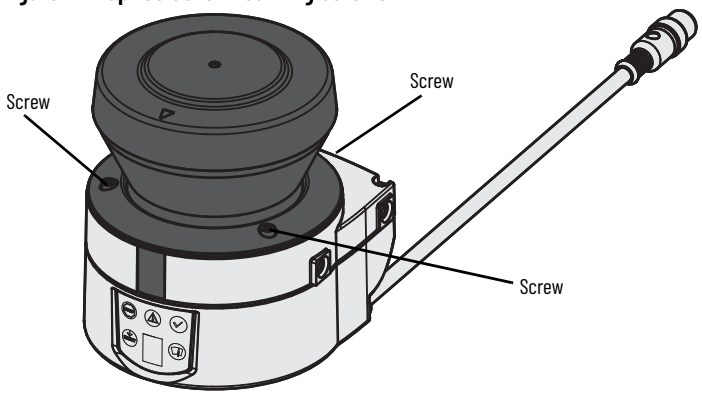
- The optics cover on the SafeZone Mini safety laser scanner is an optical part that must not be soiled or scratched on replacement.
- Only qualified safety personnel are allowed to replace the optics cover in a dust and dirt-free environment.
- Never replace the optics cover during ongoing operation, as internal parts can be irreparably damaged in certain circumstances and dust particles can enter the safety laser scanner.
- You must avoid contamination of the inside, for example, with fingerprints.
- Do not use any additional sealant for sealing the optics cover, for example, silicon, as these substances can affect the optics.
- Use a torque wrench (universal joint) with 2.5 mm (0.1 in.) hex socket bit.
- Mount the optics cover per the following instructions to verify that the housing is sealed to IP65.

Optics Cover Replacement Procedure

- Only use a new optics cover (see Table 28 on page 87).
- When replacing the optics cover, take electrostatic discharge (ESD) protection measures.
- Set your torque wrench to 1.2 N•m (10.6 lb•in) (hand-tight).

1. Disconnect the round plug connector on the end of the connecting cable and remove the SafeZone Mini safety laser scanner.
2. Take the SafeZone Mini safety laser scanner to a clean place (office, repair shop, or similar).
3. Clean the outside of the SafeZone Mini safety laser scanner. This step keeps foreign bodies from entering the safety laser scanner when it is opened.
4. Remove the optics cover mounting screws (Figure 47).

Figure 47 - Optics Cover Mounting Screws



5. Remove the optics cover.
6. Check whether the mirror on the motor is clean and remove any contamination with an optic brush.
7. Take the new optics cover out of the packaging and remove the protection for the seal.
8. Remove any remnants of packaging.
9. Place the optics cover on the safety laser scanner and place the new mounting screws.

IMPORTANT When fitting the new cover, verify that the arrow on the top of the cover points to the front and that the optics cover is fully in contact without a gap.

10. Tighten the front screws with the torque wrench.
11. Make sure that the optics cover is free of dirt and that it is not damaged.

Recommission the SafeZone Mini Safety Laser Scanner

1. Correctly remount the SafeZone Mini safety laser scanner (see Mounting on page 33).
2. Connect the round plug connector on the end of the connection cable for the SafeZone Mini safety laser scanner.
3. Perform an optics cover calibration with the aid of the SCD software.

Notes:

Diagnostics

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

Faults or Errors

ATTENTION: Do not operate if behavior is unclear.
Stop the machine, system, or vehicle if you cannot clearly identify or allocate an error and if you cannot safely remedy the malfunction.

ATTENTION: Repair only by authorized persons.
The improper repair of the safety laser scanner can result in the loss of the protective function. Only the manufacturer, or persons who the manufacturer authorizes, are allowed to repair the safety laser scanner.

Rockwell Automation Support

If you cannot rectify an error with the help of the information that is provided in this chapter, contact your local Rockwell Automation representative.

Error and Status Indications

Status Indicators

This section describes the meaning of the error and status indications of the status indicators and how you can respond. You can find a description of the indicators in Status Indicators on page 20, the connections for the outputs of the SafeZone™ Mini safety laser scanner in System Connection on page 52.

Table 17 - Error and Status Indication

Display	Output Level	Possible Cause	Corrective Action
	At the OSSDs	Object in the protective field, OSSDs in the OFF state	No error
	At the OSSDs	Protective field unoccupied, OSSDs in ON state	No error
	At the warning field output (1) On the universal I/O (2)	Object in one of the warning fields	No error
	At the OSSDs On the universal I/O	No operating voltage or voltage too low	Check the voltage supply and activate, if necessary.
	On the universal I/O (3)	Reset required	Operate the control switch for restart.

Table 17 - Error and Status Indication

Display	Output Level	Possible Cause	Corrective Action
	No level change	Restart delay is counting down.	No action is required.
	On the universal I/O (4)	No error	
	On the universal I/O (5)	Optics cover contaminated, no operation	Clean the optics cover.
	On the universal I/O (6)	Optics cover contaminated, still in operation	Clean the optics cover.

(1) If the warning field 1 is infringed.
(2) If configured as the output for warning field 2, and warning field 2 is infringed.
(3) If configured as the output for Reset Required.
(4) If configured as the output for a contamination error/warning.
(5) If configured as the output for a contamination error.
(6) If configured as the output for a contamination warning.

Seven-segment Display

This section explains the meaning of the error indications on the seven-segment display and how to respond to the messages. You can find a description of the positions and symbols on the SafeZone Mini safety laser scanner in Status Indicators on page 20.

Lockout Operational Status

In case of certain faults or an erroneous configuration, the safety laser scanner can go into the lockout operational status. The seven-segment display on the safety laser scanner then indicates E, B, d, E, F, I, L, n, P, or U. To place the safety laser scanner back in operation, follow these steps:

1. Rectify the cause of the fault per Table 18.
2. Switch off the power supply for the SafeZone Mini safety laser scanner, wait at least 3 seconds, and then switch back on the power supply.
   Or, restart the safety laser scanner with the aid of the SCD software.

Table 18 - Error and Status Indication on the Seven-segment Display

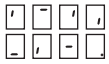
Display	Possible Cause	Corrective Action
	Power-up cycle — all segments are activated sequentially.	No error
	Object in protective field	No error
	Object in warning field 1	No error
	Object in warning field 2	No error
	Initialization of the safety laser scanner	The display turns off automatically when the SafeZone Mini safety laser scanner is initialized and/or the connection to the second safety laser scanner is made. If the display 3 does not go off: • Check whether the partner safety laser scanner is in operation. • Check the wiring. If no partner safety laser scanner is connected: Check the system configuration with the aid of the SCD software. Transfer the corrected configuration to the SafeZone Mini safety laser scanner again.
	Waiting for configuration or configuration not completed	The display turns off automatically once the configuration is successfully transferred. If the display 6 does not go off: Check the system configuration with the aid of the SCD software. Transfer the corrected configuration to the SafeZone Mini safety laser scanner again.
	Waiting for restart of the safety laser scanner	Switch off the voltage supply for the SafeZone Mini safety laser scanner for at least 2 seconds and then switch it back on.

Table 18 - Error and Status Indication on the Seven-segment Display

Display	Possible Cause	Corrective Action
8. or :8:	Error of the external device monitoring (EDM)	• Check whether the contactors are working correctly or if they are wired incorrectly and rectify any error. • If :8: is displayed: Also switch off the voltage supply for the SafeZone Mini safety laser scanner for at least 2 seconds and switch it back on.
9.	Error in the control switch for restart or reset	• Check the functionality of the control switch. The button can be defective or permanently operated. • Check the wiring of the control switch for short circuit to 24V.
E c1.	SafeZone Mini safety laser scanner has a malfunction or is faulty	Switch off the voltage supply for the SafeZone Mini safety laser scanner for at least 2 seconds and then switch it back on. If the display does not go off: Send the SafeZone Mini safety laser scanner to the manufacturer for repair.
F c1.	Overcurrent on OSSD connection 1	• Check the switching element connected (contactor, relay). Replace, if necessary. • Check the wiring for short circuit to 0V.
F c2.	Short circuit to 24V at OSSD connection 1	Check the wiring for short circuit to 24V.
F c3.	Short circuit to 0V at OSSD connection 1	Check the wiring for short circuit to 0V.
F c4.	Overcurrent on OSSD connection 2	• Check the switching element connected (contactor, relay). Replace, if necessary. • Check the wiring for short circuit to 0V.
F c5.	Short circuit to 24V at OSSD connection 2	Check the wiring for short circuit to 24V.
F c6.	Short circuit to 0V at OSSD connection 2	Check the wiring for short circuit to 0V.
F c7.	Short circuit between OSSD connection 1 and 2	Check the wiring and rectify the error.
F c9.	General OSSD wiring error	Check the complete wiring of the OSSDs.
I c1.	The SafeZone Mini safety laser scanner is receiving no measured values within a range of at least 90° (measuring range maximum 29.9 m (98.1 ft), it is not detecting any obstacles such as building walls.	For the correct function of the safety laser scanner, always verify that measured values are received within a range of 90°; this range can be moved as required within the scan range.
I c2.	Safety Laser Scanner is faulted.	• Check whether an external light source, for example, headlight, infrared light sources, stroboscopic light, or sun is affecting the SafeZone Mini safety laser scanner. • If necessary, remount the safety laser scanner.
I c3.	Temperature error. The operating temperature of the SafeZone Mini safety laser scanner has exceeded the permissible range.	Check whether the SafeZone Mini safety laser scanner is operated as per the permissible ambient conditions.
L c2.	Invalid configuration of the EDM.	Verify that the machine-side EDM is connected correctly.
L c8.	Undervoltage of the supply voltage	Check the power supply or the connecting cables.
L c9.	There is a short circuit between the input for the control switch for restart or reset and another input or output.	Check the wiring for cross-circuits.
o.	Park/stand-by mode, the OSSDs of the SafeZone Mini safety laser scanner are in the off-state; the laser is deactivated.	No error. If the criteria for the park mode or the stand-by mode are withdrawn, readiness for operation is re-established. If the display o. does not go off: Test the levels at the universal I/O and at the control inputs that switch to the monitoring case with park mode.
:u:	Optics cover calibration active.	No error.
u c1.	Window for light output on the optics cover is contaminated	Clean the window for the light output on the optics cover.
u c8. and u c9.	Optical saturation of the contamination measurement (there could not be an optics cover fitted)	Check whether an external light source, for example, headlight, infrared light source, stroboscopic light, or sun is affecting the SafeZone Mini safety laser scanner. Or: • Fit the new optics cover. • Then, perform optics cover calibration.

IMPORTANT If you have problems during troubleshooting, contact Rockwell Automation support. Keep a copy of the results of the diagnostics at hand.

Extended Diagnostics

The SCD software is supplied with the safety laser scanners. The software allows you to narrow down the problem if the error is non-specific or if you experience usage downtime problems. Find detailed information in the online help for the SCD software.

Technical Specifications

Scanning Range

Figure 48 - Scanning Range Diagram (2 m [6.56 ft] SafeZone Mini Safety Laser Scanner)

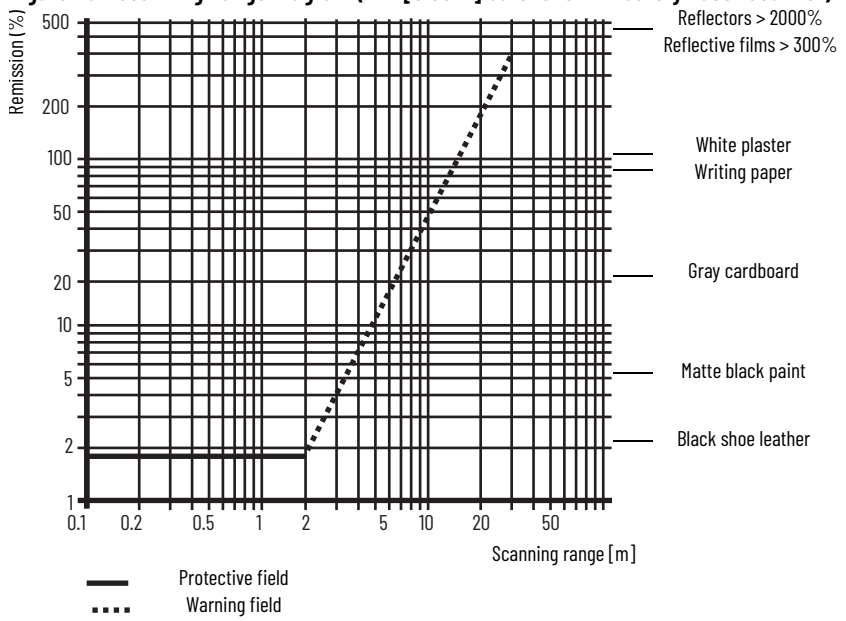
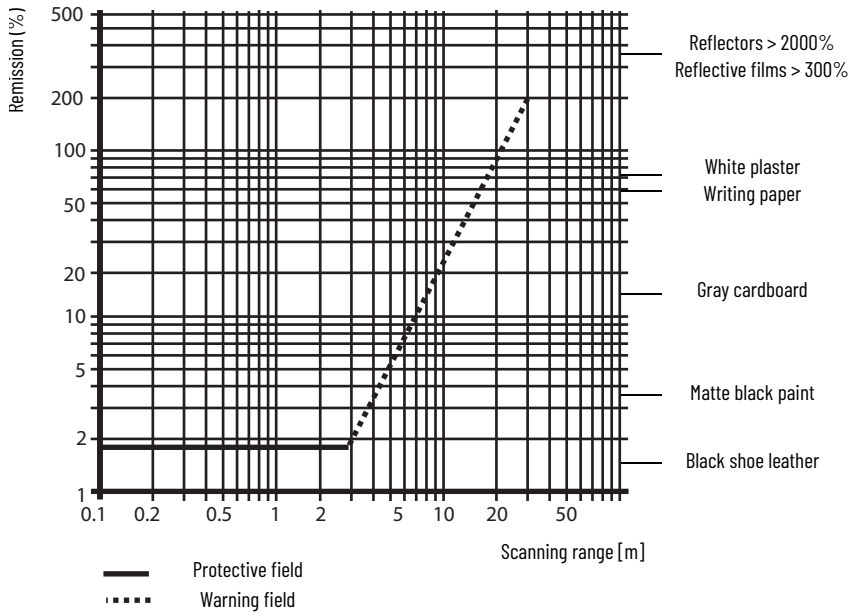


Figure 49 - Scanning Range Diagram (3 m [9.84 ft] SafeZone Mini Safety Laser Scanner)



OSSD Response Times

The total response time of your application is dependent on:

- The basic response time of the SafeZone™ Mini safety laser scanner
- The multiple sampling set
- The OSSDs that are used

Calculate the Total Response Time T_S

$T_S = t_B + T_{MFA}$

Variable	Description
t_B	Basic response time = 80 ms
T_{MFA}	Supplement due to multiple sampling > 2

Multiple Sampling

On the SafeZone Mini safety laser scanner, at least double multiple sampling is always set. For a multiple sampling of three or higher, you must add a supplement of 80 ms to the basic response time.

Table 19 - Multiple Sampling Supplements

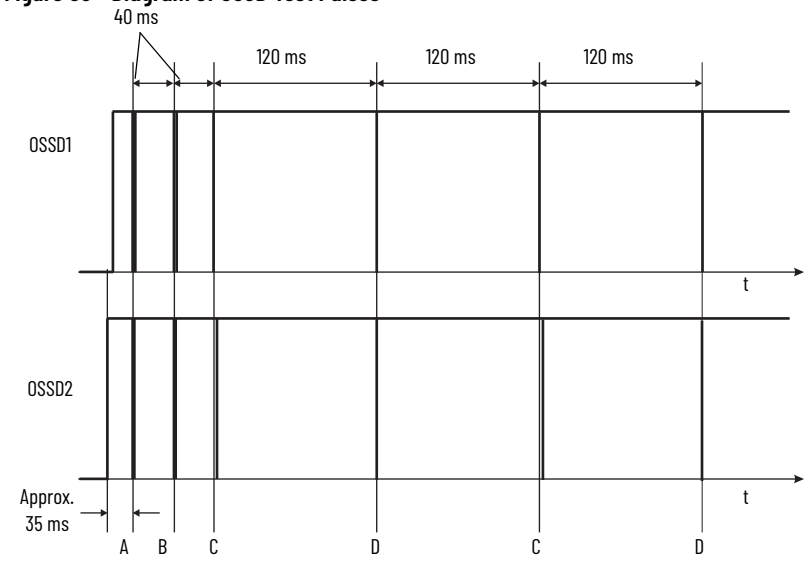
Multiple Sampling	Supplement	Basic Response Time + Supplement
2 times (basic setting)	0 ms	80 ms
3 times	40 ms	120 ms
4 times	80 ms	160 ms
5 times	120 ms	200 ms
6 times	160 ms	240 ms
7 times	200 ms	280 ms
8 times	240 ms	320 ms
9 times	280 ms	360 ms
10 times	320 ms	400 ms
11 times	360 ms	440 ms
12 times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

OSSD Timing Behavior

The SafeZone Mini safety laser scanner tests the OSSDs immediately after switch-on and then at regular intervals. For this purpose, the SafeZone Mini safety laser scanner briefly switches off both OSSDs (for 300 µs) and checks whether the OSSDs switch to the off-state during this time.

ATTENTION: Verify that the safety inputs on the controller that is used do not respond to these test pulses and as a result cause the machine or system to shut down unintentionally.

Figure 50 - Diagram of OSSD Test Pulses



Approximately 35 ms after the switch-on of the OSSDs, the SafeZone Mini safety laser scanner performs the first voltage test (A) and then after a half basic response time (40 ms), it performs a second voltage test (B).

After another half basic response time of the SafeZone Mini safety laser scanner, there is a shutdown test (C). 120 ms later another voltage test (D). Then, the SafeZone Mini safety laser scanner performs a shutdown test (C) and a voltage test (D) alternately at an interval of 120 ms. Figure 51, Figure 52, and Figure 53 show the pulse duration for the individual tests.

Figure 51 - Voltage Test after Switching on the OSSDs

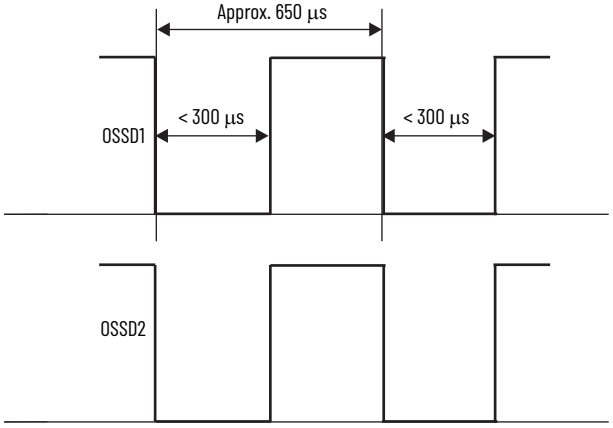


Figure 52 - Shutdown Test

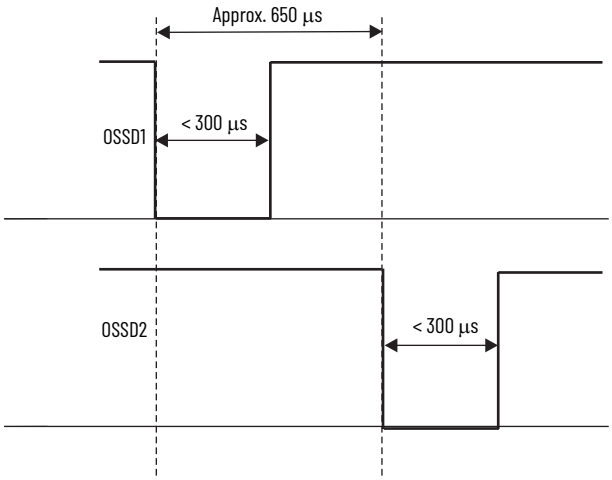
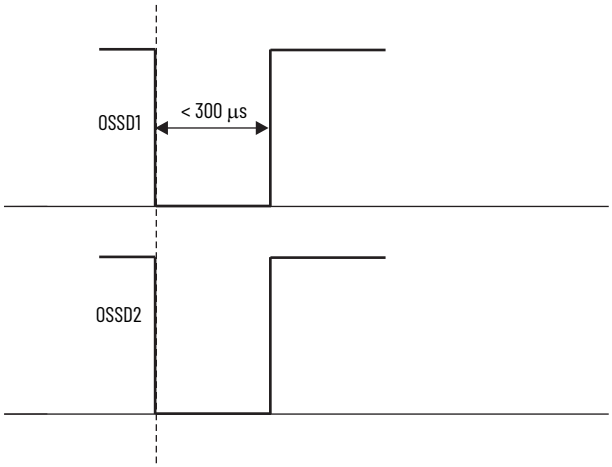


Figure 53 - Voltage Test



General Specifications

Table 20 - General Specifications

Attribute	Value
Type	3 (EN 61496-1)
Safety integrity level [1]	SIL 2 (IEC 61508)
SIL claim limit [1]	SIL CL 2 (EN 62061)
Category	Category 3 (EN ISO 13849-1)
Performance level [1]	PLd (EN ISO 13849-1)
PFH (T_{amb} = 25 °C) (average frequency of a dangerous failure per hour)	8×10^{-8}
TM (mission time)	20 years (EN ISO 13849)
Laser protection class	Laser class 1 (according to IEC 60825-1, CDRH 21 CFR 1040.10 and 1040.11; excluded are deviations due to Laser Notice No. 50, dated 24.06.2007)
Enclosure rating	IP65 (EN 60529)
Protection class	III (IEC 61140 and EN 60950)
Operating temperature range	-10…+50 °C (14…122 °F)
Storage temperature range	-25…+50 °C (-13…+122 °F) -25…+70 °C (-13…+158 ° F) (≤ 24 h)
Humidity (considering the operating temperature range)	EN 61496-1, CLC/TS 61496-3 (Protective Field Width on page 52)

Table 20 - General Specifications (continued)

Attribute	Value
Vibration resistance	For direct mounting
Standards	• IEC 60068-2-6 • IEC 60068-2-64 • IEC 60721-3-5 • IEC TR 60721-4-5 • IEC 61496-3
Class	5M1 (IEC 60721-3-5)
Sinusoidal vibrations	• 0.35 mm (0.1 in.), 50 m/s2, 10 Hz ... 150 Hz • 1.5 mm (0.6 in.), 0.5 g, 5 Hz ... 200 Hz
Noise vibrations	• 0.5 m2/s3, 5 Hz ... 200 Hz • 0.1 m2/s3, 200 Hz ... 500 Hz • 50 m/s2, 10 Hz ... 500 Hz
Frequency range	10...150 Hz
Amplitude	0.35 mm (0.01 in.) or 5 g (0.18 oz)
Shock resistance	For direct mounting.
Standards	• IEC 60068-2-27 • IEC 60721-3-5 • IEC TR 60721-4-5 • IEC 61496-3
Class	5M1 (IEC 60721-3-5)
Single shock	150 m/s2, 11 ms
Continuous shock	• 50 m/s2, 11 ms • 100 m/s2, 16 ms
Single shock	15 g (0.53 oz), 11 ms
Continuous shock	10 g (0.35 oz), 16 ms
Sender	Pulsed laser diode
Wavelength	895...915 nm (905 nm, typical)
Divergence of the collimated beam (solid angle)	14 mrad
Pulse duration	5.0 ns (5.5 ns, max)
Average output power	3.42 mW
Light spot size at optics cover	8 mm (0.31 in.)
Size of light spot at 2.0 m (6.56 ft) scanning range	28 mm (1.1 in.)

(1) For detailed information on the safety design of your machine/system, contact your local Allen-Bradley product distributor or Rockwell Automation sales office.

Material

Table 21 - Material

Attribute	Value
Housing	
Material	Aluminum die-cast
Color	RAL 1021 (rapeseed yellow) and RAL 9005 (black)
Optics cover	
Material	Polycarbonate
Surface finish	Outside with scratch-resistant coating

Functional Data

Table 22 - Functional Data

Attribute	Value
Resolution of the 2 m (6.56 ft) SafeZone Mini safety laser scanner	30 mm (1.2 in.), 40 mm (1.6 in.), 50 mm (2.0 in.), 70 mm (2.8 in.)
Resolution of the 3 m (9.84 ft) SafeZone Mini safety laser scanner	30 mm (1.2 in.), 40 mm (1.6 in.), 50 mm (2.0 in.), 70 mm (2.8 in.), 150 mm (5.9 in.)
Protective field of the 2 m (6.56 ft) SafeZone Mini medium range	
At 30 mm (1.2 in.) resolution	1.25 m (4.10 ft)
At 40 mm (1.6 in.) resolution	1.60 m (5.25 ft)
At 50 mm (2.0 in.) resolution	2.00 m (6.56 ft)
At 70 mm (2.8 in.) resolution	2.00 m (6.56 ft)
Protective field of the 3 m (9.84 ft) SafeZone Mini medium range	
At 30 mm (1.2 in.) resolution	1.25 m (4.10 ft)
At 40 mm (1.6 in.) resolution	1.60 m (5.25 ft)
At 50 mm (2.0 in.) resolution	2.10 m (6.89 ft)
At 70 mm (2.8 in.) resolution	3.00 m (9.84 ft)
At 150 mm (5.9 in.) resolution	3.00 m (9.84 ft)
Scan angle	270°
Remission	1.8% (min) Several 1000% (reflectors) (max)[1]
Angular resolution	0.5°
Protective field supplement necessary	100 mm (3.94 in.)
Supplement for retro-reflectors in scan plane at a distance of less than 1 m (39.4 in.) to the protective field boundary	200 mm (7.87 in.)
Evenness of the scan field at 2 m (6.56 ft)	±50 mm (2.0 in.)
Distance from mirror axis of rotation (zero point on the X and Y-axis) to the rear of the safety laser scanner	55 mm (2.17 in.)
Distance between center of the scan plane and the bottom edge of the housing	80 mm (3.15 in.)
Warning field [2]	8 m (26.25 ft)
Distance measuring range	30 m (98.4 ft)
Number of multiple samplings (configurable via SCD software)	2...16
Power-up delay of a configured safety laser scanner	18 s
Restart after (configurable)	2...60 s
Basic response time [3]	80 ms

(1) Complies with Diamond Grade 3000X (approx. 1250 cd/lx × m^2).
(2) The detection capability of the warning field is dependent on the remission of the objects to be detected.
(3) The total response time of your application is dependent on further factors.

Electrical Specifications

Table 23 - Electrical Specifications

Attribute		Value
Supply voltage (SELV) [1] [2]		16.8...30 V (24V, typical)
Permissible residual ripple [3]		±5%
Switch on current [4]		2.0 A
Operating current without output load	2 m (6.56 ft) SafeZone Mini safety laser scanner	0.16 A (0.20 A, max) [5]
	3 m (9.84 ft) SafeZone Mini safety laser scanner	0.18 A (0.25 A, max) [5]

Table 23 - Electrical Specifications

Attribute		Value
Operating current with max output load	2 m (6.56 ft) SafeZone Mini safety laser scanner	1.35 A (5)
	3 m (9.84 ft) SafeZone Mini safety laser scanner	1.35 A (5)
Power consumption without output load	2 m (6.56 ft) SafeZone Mini safety laser scanner	3.9 W (4.8 W, max) (5)
	3 m (9.84 ft) SafeZone Mini safety laser scanner	4.4 W (6.0 W, max) (5)
Power consumption with max output load	2 m (6.56 ft) SafeZone Mini safety laser scanner	33 W
	3 m (9.84 ft) SafeZone Mini safety laser scanner	33 W
Power consumption in the stand-by mode or park mode without output load	2 m (6.56 ft) SafeZone Mini safety laser scanner	3.6 W (4.8 W, max)
	3 m (9.84 ft) SafeZone Mini safety laser scanner	4.4 W (6.0 W, max)
Electrical connection		Connecting cable with round plug connector
Cable length for power supply tolerance ±10%		25 m (82.0 ft)
Cable length for power supply tolerance ±5%		34 m (111.5 ft)
Cable length for power supply tolerance ±1%		40 m (131.2 ft)

(1) To meet the requirements of the relevant product standards (for example, EN 61496-1), the external voltage supply for the safety laser scanner must be able to bridge a brief mains failure of 20 ms. Power supplies according to EN 60204-1 satisfy this requirement. Suitable power supplies are available as accessories from Rockwell Automation.
(2) Operation only in a short-circuit protected system with max 8 A
(3) The absolute voltage level must not drop below the specified minimum voltage.
(4) The load currents for the input capacitors are not considered.
(5) With the typical supply voltage of 24V.

Table 24 - Universal I/O Specifications

Attribute	Value
Input resistance when HIGH	2 Ω
Voltage for HIGH	11...30V (24V, typical)
Voltage for LOW	-3...+5V (0V, typical)
Input capacitance	15 nF
Static input current	6...15 mA
Actuating time of the control switch for restart	120...200 ms
HIGH switching voltage at 100 mA	V_S – 3.3 V...V_S
Source switching current	100...200 mA
Current limiting (after 5 ms at 25 °C [77 °F])	600...920 mA
Power up delay	1.4...2 ms
Switch off delay	0.7...2 ms
Response time with configuration as second warning field output	Corresponds to the resulting response time of the OSSDs plus 50 ms

Table 25 - OSSD Specifications

Attribute	Value
Output signal switching device pair	2 PNP semiconductors, short-circuit protected (1), cross-circuit monitored
Safe state in case of error	At least one OSSD is in the off-state.
HIGH switching voltage at 250 mA	V_S – 2.7 V...V_S
Switching voltage LOW	0...2 V (0V, typical)
Source switching current (2)	6...250 mA
Leakage current (3)	250 µA
Load inductance	2.2 H

Table 25 - OSSD Specifications

Attribute	Value
Load capacity	2.2 µF at 50 Ω
Switching sequence (without switching	5 1/s
Permissible cable resistance (4)	2.5 Ω
Test pulse width (5)	230…300 ms
Test frequency	120 ms
Power-up delay of the OSSDs from red to green	120 ms
Time offset on switching the OSSDs between OSSD2 and OSSD1	2 ms

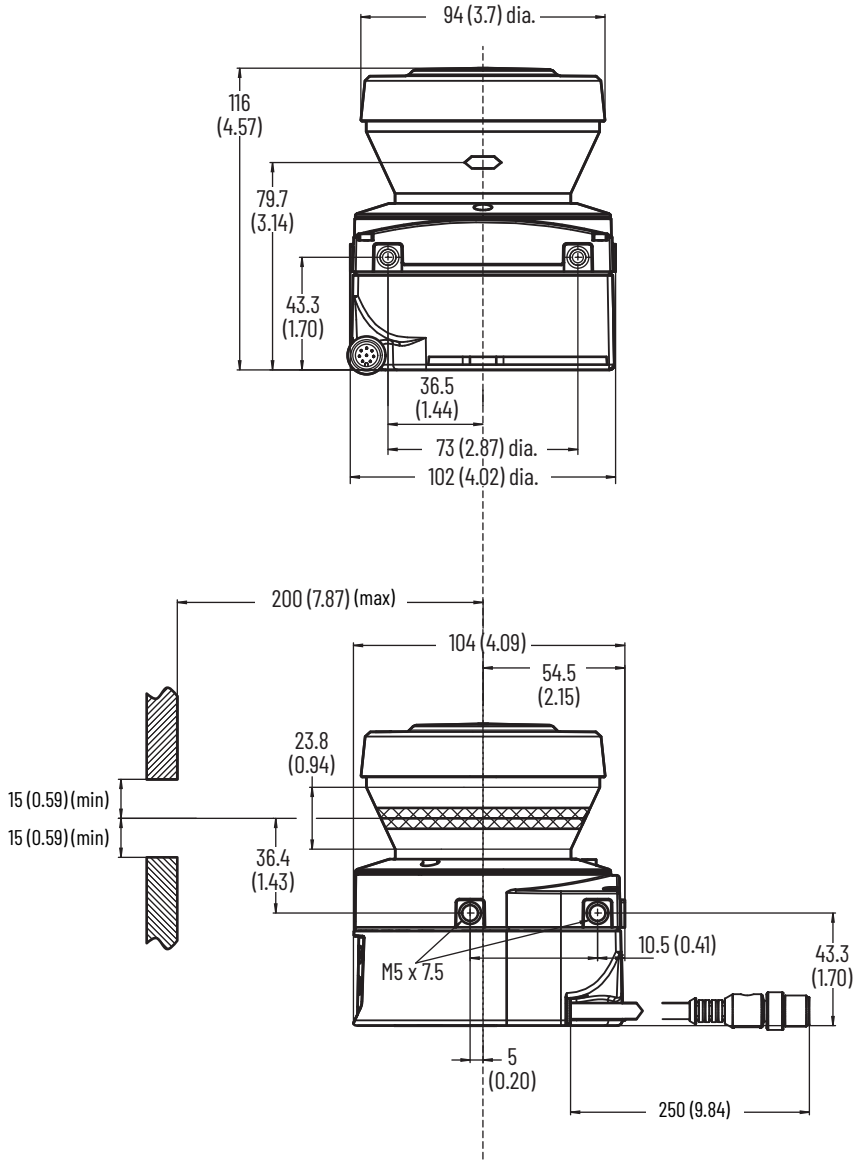
(1) Applies to the voltage range between V_S and 0V.
(2) Switching currents up to 500 mA are allowed briefly (≤ 100 ms).
(3) In the case of a fault (0V cable open circuit) maximally the leakage current flows in the OSSD cable. The downstream controller must detect this status as LOW. An FPLC (fail-safe programmable logic controller) must be able to identify this status.
(4) Make sure to limit the individual line core resistance to the downstream controller to this value to confirm that a cross-circuit between the outputs is safely detected. (Also note EN 60 204-1.)
(5) When active, the outputs are tested cyclically (brief LOW). When selecting the downstream controllers, make sure that the test signals do not result in deactivation.

Table 26 - Configuration and Diagnostics Interface Specifications

Attribute	Value
Communication protocol	RS-232 (proprietary)
Transmission speed	38,400 Baud
Cable length at 38,400 Baud and 0.25 mm^2 cables	15 m (49 ft)
Galvanic isolation	No
Output TxD HIGH	5…15 V
Output TxD LOW	-15…-5 V
Voltage range RxD	-15…+15 V
Switching threshold RxD LOW	-15…+0.4 V
Switching threshold RxD HIGH	2.4…15 V
Short-circuit current at TxD	-60…+60 mA
Max voltage level at RxD	-15…+15 V
Max voltage level at TxD	-11…+11 V

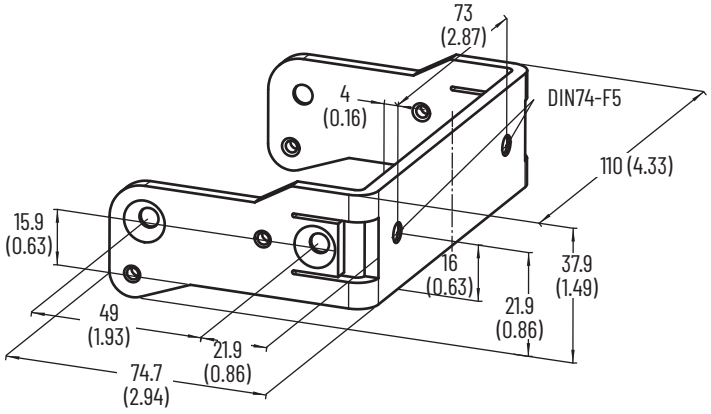
Approximate Dimension SafeZone Mini Safety Laser Scanner

Figure 54 - SafeZone Mini Safety Laser Scanner [mm (in.)]

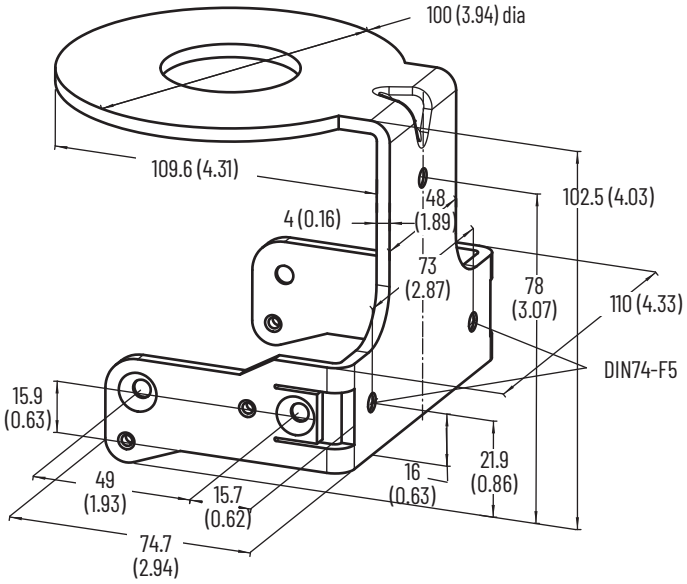


Mounting Kits

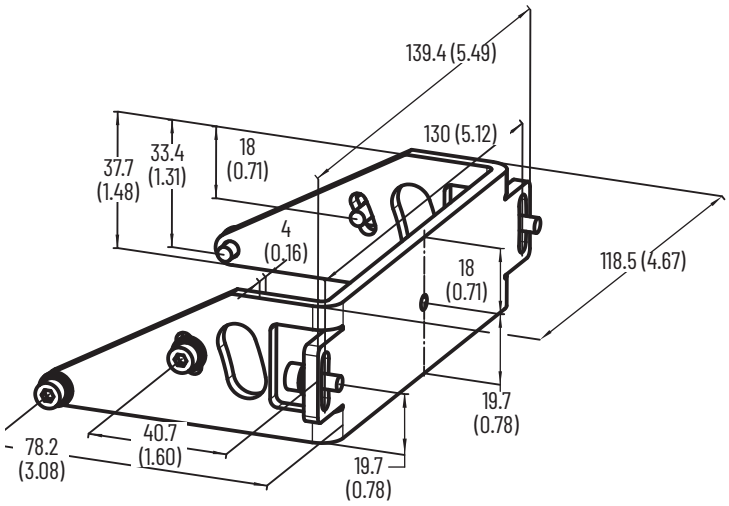
Figure 55 - Mounting Kit Dimensions [mm (in.)]



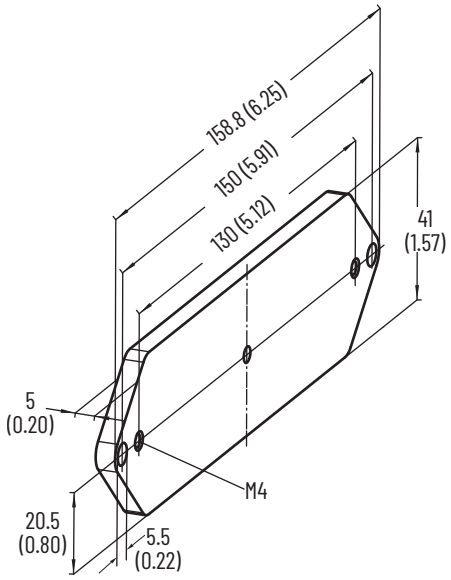
Mounting Kit 1
Cat. No. 442L-AMBSZMN1



Mounting Kit 2
Cat. No. 442L-AMBSZMN2



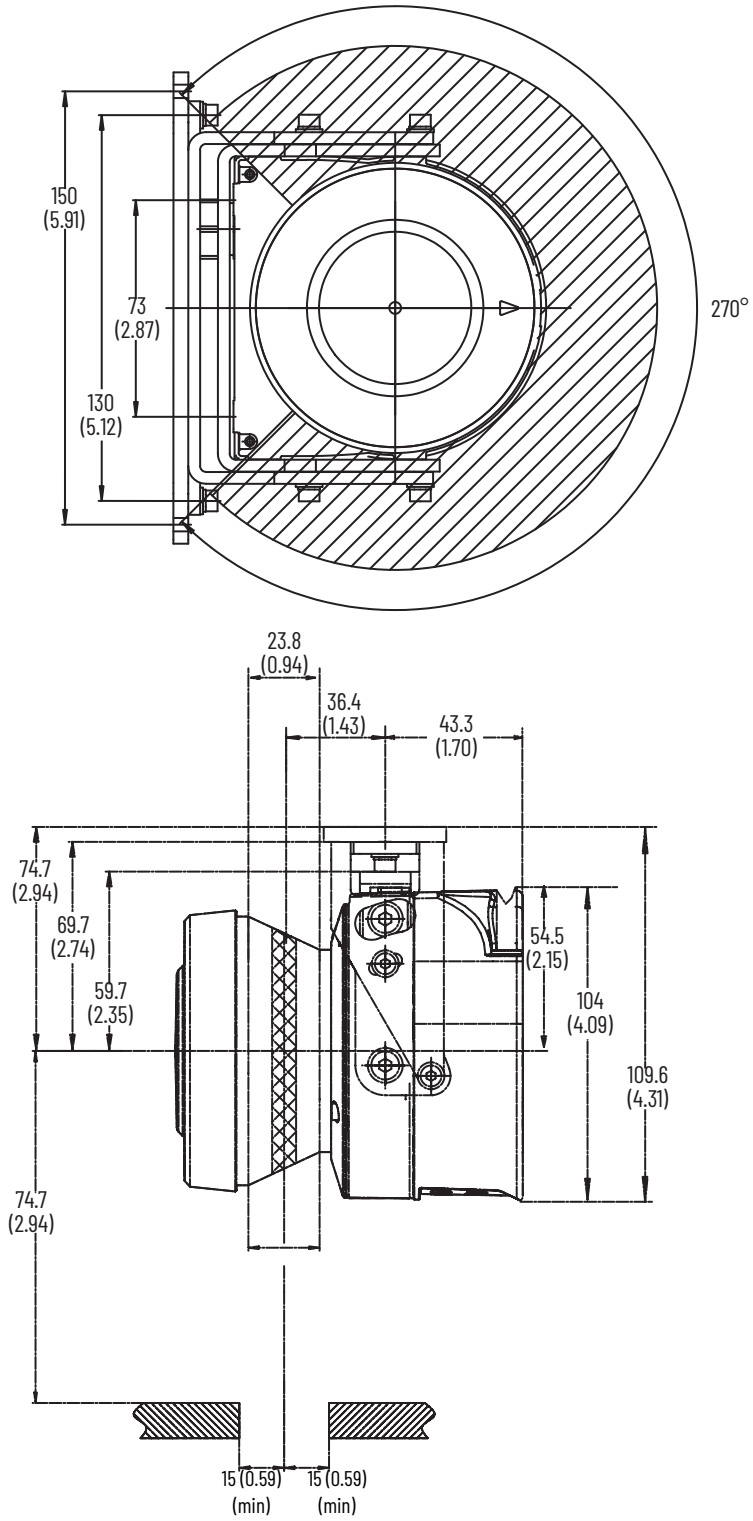
Mounting Kit 3
Cat. No. 442L-AMBSZMN3



Mounting Kit 4
Cat. No. 442L-AMBSZMN4

Scan Plane Origin

Figure 56 - Scan Plane with Mounting Kit 1, 3, and 4 [mm (in.)]



Notes:

Ordering Information

Items Supplied with SafeZone Mini Safety Laser Scanner

- Safety laser scanner
- Operating instructions and SCD software on CD-ROM
- Adhesive label Important information

IMPORTANT Cordsets for the SafeZone™ Mini safety laser scanner are not included.

Table 28 - Product Selection

	Description	Cat. No.
	SafeZone mini safety laser scanner, 2 m (6.56 ft) safety field	442L-SFZNMN
	SafeZone mini safety laser scanner, 3 m (9.84 ft) safety field	442L-SFZNMN3
Cordsets		
	2.5 m (8.2 ft) cordset	442L-ACABL2
	10 m (32.8 ft) cordset	442L-ACABL10
	20 m (65.6 ft) cordset	442L-ACABL20
Accessories		
	Mounting bracket 1a	442L-AMBSZMN1
	Mounting bracket 1b	442L-AMBSZMN2
	Mounting bracket 2	442L-AMBSZMN3
	Mounting bracket 3	442L-AMBSZMN4
	Replacement window kit	442L-SZMNW
	2 m (6.56 ft) USB programming cable	442L-ACUSB-2
	10 m (32.8 ft) USB programming cable	442L-ACUSB-10

Notes:

Checklist to Install ESPE

For Manufacturer and Installer

Details about the installation of Electro-sensitive Protective Equipment (ESPE) that are listed in the following checklist must be present at least during initial commissioning. The points are dependent on the respective application, the specification of which are to be controlled by the manufacturer/installer.

IMPORTANT This checklist must be retained and kept with the machine documentation to serve as reference during tests.

1. Have the safety rules and regulations been observed in compliance with the directives/standards applicable to the machine?	Yes ☐	No ☐
2. Are the applied directives and standards listed in the declaration of conformity?	Yes ☐	No ☐
3. Does the safety laser scanner fulfill the required PL/SILCL and PFH according to EN ISO 13 849-1/EN 62 061 and the type according to EN 61496-1?	Yes ☐	No ☐
4. Is the access to the hazardous area/hazardous point only possible through the protective field of the ESPE?	Yes ☐	No ☐
5. Have measures been taken to help prevent and monitor unauthorized presence in the hazardous area when hazardous area/hazardous point protection (mechanical protection) and have these measures been secured against removal?	Yes ☐	No ☐
6. Are additional mechanical protective measures fitted and secured against manipulation, which help prevent reaching under, over, and around the ESPE?	Yes ☐	No ☐
7. Has the maximum stopping and/or stop/run-down time of the machine been measured, specified, and documented (at the machine and/or in the machine documentation)?	Yes ☐	No ☐
8. Has the ESPE been mounted such that the required minimum distance from the nearest hazardous point has been achieved?	Yes ☐	No ☐
9. Are the ESPE devices properly mounted and secured against manipulation after adjustment?	Yes ☐	No ☐
10.Are the required protective measures against electric shock in effect (protection class)?	Yes ☐	No ☐
11. Is the control switch for resetting the safety laser scanner (ESPE) or restarting the machine present and correctly installed?	Yes ☐	No ☐
12.Are the outputs of the ESPE (OSSDs, ASInterface Safety at Work) integrated in compliance with the required PL/SILCL according to EN ISO 13 8491/ EN 62 061 and does the integration comply with the circuit diagrams?	Yes ☐	No ☐
13.Has the protective function been checked in compliance with the test notes of this documentation?	Yes ☐	No ☐
14.Are the given protective functions effective at every setting of the operating mode selector switch?	Yes ☐	No ☐
15.Are the switching elements activated by the ESPE, for example, contactors, valves, monitored?	Yes ☐	No ☐
16.Is the ESPE effective over the entire period of the dangerous state?	Yes ☐	No ☐
17.Once initiated, will a dangerous state stop when switching the ESPE on or off and when changing the operating mode, or when switching to another safety laser scanner?	Yes ☐	No ☐
18.Has the information label for the daily check been attached so that it is easily visible for the operator?	Yes ☐	No ☐

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

Notes:

Declaration of Conformity

CE/UKCA Conformity

Rockwell Automation herewith declares that the products that are shown in this document are in conformity with the provisions of the following EU directive(s) and UK regulation(s) (including all applicable amendments), and that the respective standards and/or technical specifications have been used as a basis for this declaration.

EU Directives used:

- Machinery Directive
- EMC Directive
- RoHS Directive

UK Regulations used:

- Supply of Machinery (Safety) Regulations
- EMC Regulations
- Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations

For a comprehensive CE or UK certificate visit: rok.auto/certifications.

Notes:

The following terms and abbreviations are used throughout this manual.

AGV Automated Guided Vehicle

ANSI American National Standards Institute

AWG American Wire Gauge. Standardization and classification of wires and cables by type, diameter, and so on.

AOPDDR Active opto-electronic protective device responsive to diffuse reflection (for example, SafeZone™ Mini safety laser scanner, see also CLC/TS 61496-3)

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

- Machine movements
- Vehicle movements
- Electrical conductors
- Visible or invisible radiation
- Combination of several risks and hazards

EDM External device monitoring

EMC Electromagnetic compatibility

ESD Electrostatic discharge

ESPE Electro-sensitive protective equipment

External device monitoring (EDM) A device that electronically monitors the relay or contactor that the safety laser scanner operates before each new start.

Field set Protective fields and warning fields form the so-called field set.

FPLC Fail-safe programmable logic controller

GSP Guardmaster® safety relay

Optics cover Plastic part with window for light output. The optics cover is available as a spare part.

OSSD Output signal switching device. The OSSD output is the switching output on the SafeZone Mini safety laser scanner that is used to stop the dangerous movement. This output is a semiconductor output and is periodically tested for proper function. The SafeZone Mini safety laser scanner has two OSSD outputs that operate in parallel; for safety reasons these outputs must be evaluated using two channels.

Protective field The protective field secures the hazardous area on a machine or vehicle. As soon as the safety laser scanner detects an object in the protective field, it switches the OSSDs to the OFF state and initiates the shutdown of the machine or stop of the vehicle.

Remission Reflection of luminance. A measure of the remission is the level of remission that is defined as the ratio of the luminance reflected from a surface in the measuring direction and the luminance of a matte white surface (white standard).

Resolution/object resolution The minimum size of an object the safety laser scanner acquires and the manufacturer certifies.

Restart interlock The restart interlock is a protective device. In certain situations, it helps prevent the machine from automatically restarting. It applies, for example, after the scanner function has triggered during a dangerous machine state, after a change to the operating mode or the method of activation of the machine, or after the change to the start control device on the machine.

RIA Robotic Industries Association

Safe state in case of an error If the internal error detection detects an error that prevents the correct operation of the safety component, the safety component adopts a defined safe state. The safety component remains in this state until the error has been rectified. Error cases in which the safety component adopts a safe state includes:

- Safety-related internal errors
- Invalid input signal conditions
- Supply voltage loss
- Loss of the assured detection capability

SCD software Rockwell Automation® Safety Configuration and Diagnostic software (SCD software). Software for configuration and diagnostics on the SafeZone Mini safety laser scanner.

Universal I/O The SafeZone Mini safety laser scanner has two universal I/O connections. These two connections can be configured as inputs (for example, for stand-by, EDM or reset) or as outputs (for example, for device error, contamination or second warning field).

Warning field The warning field is a field with a radius of up to 8 m (26.25 ft) (see Scanning Range on page 83). Using this field, larger areas can be controlled and simple switching functions (for example, warning functions) triggered. The warning field is not allowed to be used for tasks that are related to personnel protection.

A

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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 compliance information on its website at rok.auto/pec.

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