User Manual

Original Instructions

Allen-Bradley

Guardmaster®

SafeZone Mini Safety Laser Scanner

Catalog Number 442L-SFZNMN









Allen Bradley 442L-AMBSFZNMZ3 | gesrepair.com

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.

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

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

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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 operating the machine, system, or vehicle on which the safety laser scanner is, or will be, integrated. This information can be found in the user manual for the machine, system, or vehicle.

Summary of Changes

This manual contains new and updated information as indicated in the following table.

Topic	Page
Updated Applications of the Device section.	12
Added Safe state in case of error to Table 23.	90
Added Safe state in case of error to Glossary.	101

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 devices. It is also for people that integrate SafeZone Mini devices into a machine, system, or vehicle, initialize its use, or who are in charge of servicing and maintaining the device.

Scope of Publication

This user manual is only applicable to the SafeZone Mini device with the following entry on the type label in the field Operating Instructions (Part Number 10000337275).

For the configuration and diagnostics of these devices, 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.

Depth of Information

This user manual contains information on the SafeZone Mini device in the following parts:

- Mounting
- Electrical installation
- Commissioning and configuration
- Care and maintenance
- Fault diagnosis and troubleshooting
- Catalog numbers
- Accessories
- Conformity and approval

Planning and using protective devices such as the SafeZone Mini device also require specific technical skills that are not detailed in this documentation.

General information on accident prevention using optoelectronic protective devices can be found in the competence brochure “Guidelines Safe Machinery.”

When operating the SafeZone Mini device, the national, local, and statutory rules and regulations must be observed.

TIP Also refer to the Safety Laser Scanner product page at http://ab.rockwellautomation.com/Sensors-Switches/Operator-Safety/SafeZone-Mini-Laser-Scanners.

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 device:

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

Symbols describe the status of an status indicator:

Symbol	Description
	The “OSSDs in the OFF state” status indicator is illuminated continuously.
	The “Error/contamination” status indicator is flashing.
	The “Warning field interrupted” status indicator is off.



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

Additional Resources

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

Resource	Description
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.rockwellautomation.com/global/certification/overview.page	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/global/literature-library/overview.page. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Notes:

Safety

This chapter deals with your safety and the safety of the system operators.

IMPORTANT Read this chapter carefully before working with the SafeZone™ Mini device or with the machine that is protected by a SafeZone Mini device.

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:

- They have adequate knowledge of the power-driven equipment to be checked due to their specialist training and experience.
- The responsible machine owner has instructed them in the operation of the machine and the current valid safety guidelines.
- They are 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 they can assess the work safety aspects of the power-driven equipment.
- They have access to this user manual and have read them.

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

Applications of the Device

The SafeZone Mini device is used to help protect persons and systems. It is intended to be used to monitor hazardous areas indoors.

- It is not allowed to use the SafeZone Mini device outdoors.
- The SafeZone Mini device cannot provide protection from parts that are thrown out of the machine or emitted radiation.
- The SafeZone Mini device complies with the requirements in the standard on the radiated emissions as defined for class A (industrial application); the SafeZone Mini device is therefore only suitable for use in an industrial environment.
- The device is a type 3 ESPE as defined by IEC 61496-1 and IEC 61496-3 and is therefore allowed for use with category 3 PLd controls as per EN ISO 13849-1 or SIL 2 as per IEC 61508.
- The SafeZone Mini device is suitable for:
  - Hazardous area protection
  - Hazardous point protection
  - Access protection
  - Vehicle protection (electrically powered industrial trucks)

IMPORTANT Depending on the application, you may require other protective devices and measures in addition to the safety laser scanner.

Correct Use

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



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

General 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 device.
- Repair only by authorized persons.
  The improper repair of the protective device can result in the loss of the protective function. Only the manufacturer or persons authorized by the manufacturer can repair the protective device.



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

- This device meets the norms: IEC 60825-1, 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 device, observe the standards and directives applicable in your country. An overview of the most important regulations can be found in Applicable Directives and Standards on page 15.
- The national/international rules and regulations apply to the installation, commission, use, and periodic technical inspections of the SafeZone Mini device, including:
  - Machinery Directive
  - Work Equipment Directive
  - The work safety regulations/safety rules
  - Other relevant health and safety regulations
- Manufacturers and operators of the machine on which the SafeZone Mini device is used are responsible for obtaining and observing all applicable safety regulations and rules.
- The notes, in particular the test notes (see Commissioning on page 71) in these operating instructions (for example, on use, mounting, installation, or integration into the machine control) must be observed.
- Changes to the configuration of the devices can degrade the protective function. After every change to the configuration, you must check the effectiveness of the protective device. The person who makes the change is also responsible for the correct protective function of the device. When making configuration changes, 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 made available to the operator of the machine where the SafeZone Mini device is used. The machine operator is to be instructed in the use of the device by qualified safety personnel and must be instructed to read the operating instructions.
- To meet the requirements of the relevant product standards (for example, EN 61496-1), the external voltage supply for the devices 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.

TIP Enclosed with these operating instructions is a checklist for checking by the manufacturer and OEM (see Checklist to Install Electro-sensitive Protective Equipment (ESPE) on page 97). Use this checklist when checking the system that the SafeZone Mini device helps to protect.

Environmental Protection

The SafeZone Mini device is constructed in such a way that it adversely affects the environment as little as possible and uses only a minimum of power and natural resources.

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

Disposal

Unusable or irreparable devices must be disposed of per the applicable national regulations on waste disposal (for example, European waste code 16 02 14).

TIP Information on the individual materials in the SafeZone Mini device is given in Table 18 on page 87.

Separation of Materials



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

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

- 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 optoelectronic protective devices in Europe, are listed in Application and Installation of Protective Devices. Further regulations may be of importance to you, depending on the application. You can 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 hazard 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 "Control reliable." The SafeZone Mini device meets this requirement.

Product Description

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

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 comprising of 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 device operates correctly as a protective device only if the following conditions are met:

- The control of the machine, system, or vehicle must be electrical.
- It must be possible to transfer the dangerous machine, system, or vehicle state to a safe state with the OSSDs on the SafeZone Mini device at any time, that is before a person has reached 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 device.

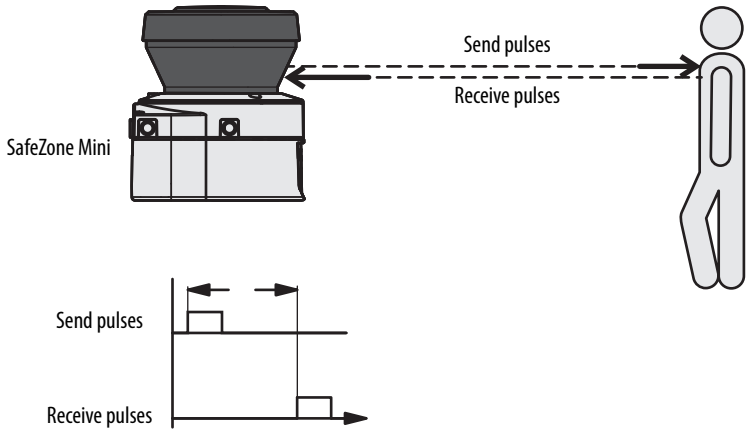
- The SafeZone Mini device must be mounted and configured such that it detects objects as they enter the hazardous area (see Mounting on page 39 and Commissioning on page 71).
- The optical path of the safety laser scanner must always remain clear. Do not cover the optical path with transparent objects 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 device is an optical sensor that scans its surroundings in two dimensions with infrared laser beams. It is used to monitor hazardous areas on machines or vehicles.

The SafeZone Mini device works on the principle of time-of-flight measurement (Figure 1). It sends out short pulses of infrared light (send pulses). Simultaneously, an "electronic stopwatch" is started. When the light hits an object, it is reflected and the safety laser scanner receives it (receive pulses). From the time between sending and reception (Δt), the SafeZone Mini device calculates the distance to the object.

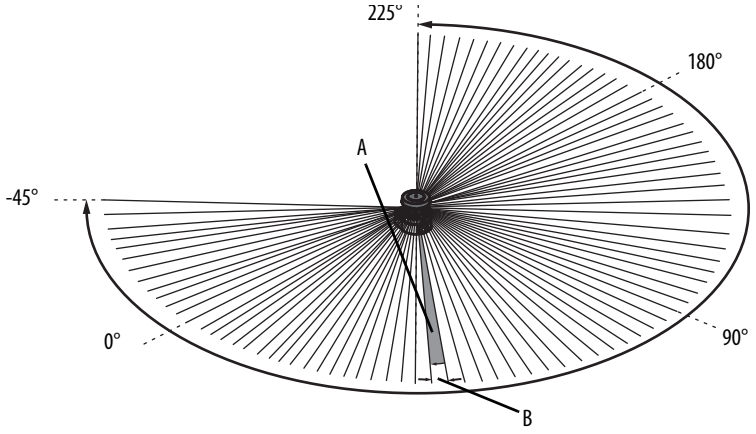
Figure 1 - Time-of-flight Measurement



In the SafeZone Mini device, there is also a mirror that rotates at constant speed and deflects the light pulses such that they cover an arc of 270° (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 device 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 Device



Due to its active scanning principle, the SafeZone Mini device does not require receivers or reflectors, which has the following advantages:

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

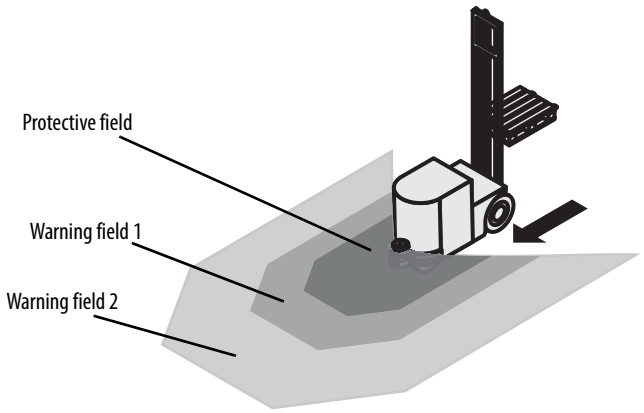
Field Set Comprising Protective and Warning Fields

Protective fields and warning fields form the field set. You can configure these field sets with the aid of the SCD software. The fields can be configured as circular, rectangular or of arbitrary shape. If the monitored area changes, then you can reconfigure the SafeZone Mini device in software without additional mounting effort.

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

The SafeZone Mini device 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. This action initiates the shutdown of the machine or stop of the vehicle.

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



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

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

ATTENTION: A warning field on the SafeZone Mini device is not allowed to be used for tasks that are related to the protection of people.

Contour Monitoring

In addition to the protective field, the SafeZone Mini device can also monitor a contour (for example, the floor in vertical applications).

Device Components

The SafeZone Mini device comprises following components:

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

Figure 4 - Device Components

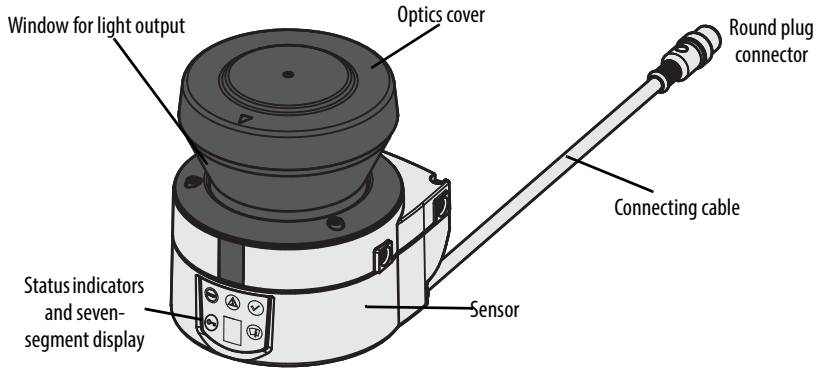
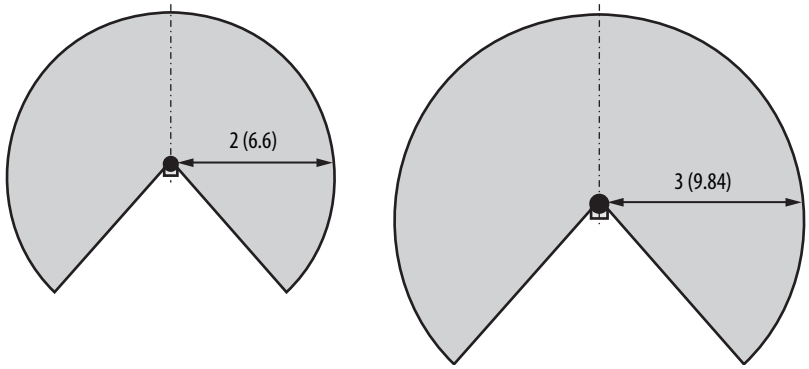
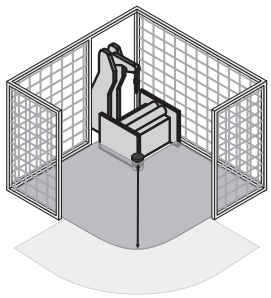
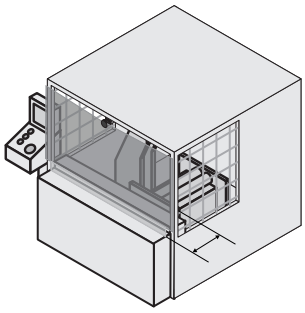
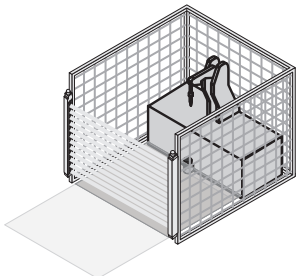
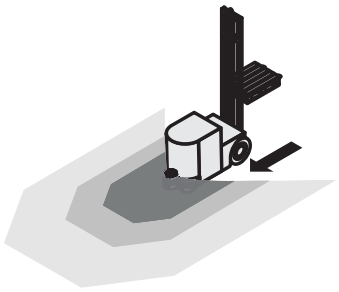
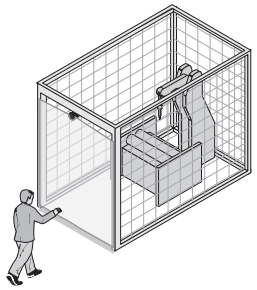


Figure 5 - Maximum Protective Field Range [m (ft)]



Applications

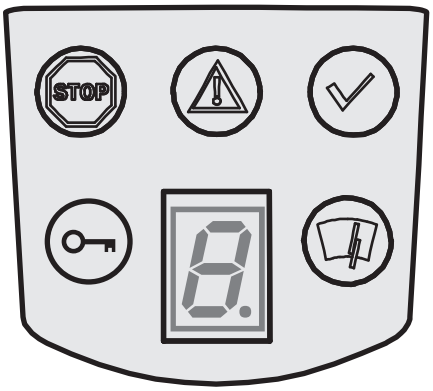
Table 2 - Possible Applications for the SafeZone Mini Device

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 automated guided vehicle (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 device. They are on the front face of the safety laser scanner.

Figure 6 - Status Indicators



The symbols have the following meaning:

Table 3 - Status Indicator Meaning

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

TIP Detailed information can be found in Table 14 on page 80 and in Table 15 on page 81).

Notes:

Configurable Functions

System Parameters

A name can be assigned to the application configured and to safety laser scanners. The names are saved in the devices after the configuration is transferred. The name that is chosen can be, for example, the identifier for the vehicle, system or the machine.



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

Application Name

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

If you assign unique application names, you can reserve the devices for certain duties. When a machine maintenance person compares exchanged devices with the configuration data that is saved in the SCD software they are notified that the application name does not match. They can then exchange these devices for devices with the correct application name.

Name of the Scanner

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

You can enter your name in the field Name of the user. You can enter a name with a maximum of 22 characters. The name is added 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 goes out.

Determine the Display Direction of the Seven-segment Display

Under seven-segment display, activate the Rotated by 180° option. After the configuration draft has been transferred to the SafeZone Mini device, the numbers of the seven-segment display rotate by 180°.

Application

With the help of the SCD software, you can configure the SafeZone Mini device for the required application. Depending on whether you select a stationary or a mobile application, different configuration options are available:

Table 4 - Comparison of 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 device shuts down after 2 hours and signals [i] ⟳ [i].	If so, the SafeZone Mini device shuts down after 5 seconds and signals [i] ⟳ [i].

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

Resolution

The maximum protective field range(1) depends on the configured resolution. The following table 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 m (6.6 ft)	3 m (9.8 ft)
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 The warning field can be configured 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 83).

Basic Response Time

The basic response time of the SafeZone Mini device is 80 ms.

TIP You may need to add supplements to the basic response time due to multiple sampling (see OSSD Response Times on page 84).

Maximum Protective Field Range

Depending on the configured resolution that is used (see Resolution), the maximum protective field range of the safety laser scanner is shown in the SCD software.



ATTENTION: The maximum protective field range of the SafeZone Mini device must be sufficient to cover the calculated protective field size including the necessary supplements (see Protective Field Size on page 41).

(1) Radial distance to the safety scanner.

Universal I/O Connections

ATTENTION: You are not allowed to use the universal I/O connections for safety-relevant functions.
You are only allowed to use the universal I/O connections for signaling. You must never use the signals for controlling the application or for safety-relevant functions.

The SafeZone Mini device has two universal I/O connections (see Round Plug Connector on page 63). You can configure these two connections for the following functions:

- Inactive (factory default setting)

As inputs (it is only possible to select one function per universal I/O connection):

- Stand-by
- External device monitoring (EDM) (see page 29)
- Resetting the restart interlock (see page 30)

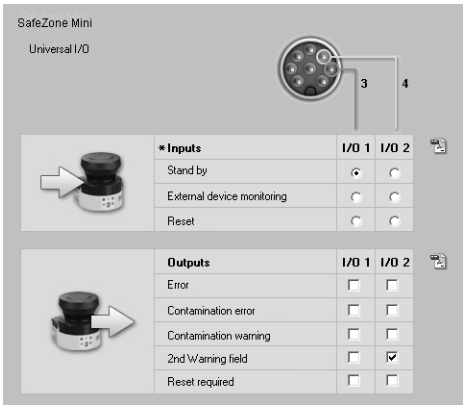
As outputs (it is possible to select several functions per universal I/O connection, these functions are linked together using an OR operator):

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

TIP 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 of the universal I/Os 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 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 be switched to the OFF state and the laser on the SafeZone Mini device can be switched off. In this way, the power consumption of the device is reduced.

IMPORTANT Use this function if, for example, you use several vehicles and do not move them for a time. The SafeZone Mini device 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 device always switch. This response cannot be configured differently in the SCD software.

External Device Monitoring (EDM)

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

Figure 6 shows how the SafeZone Mini device reacts if the external device monitoring detects a contactor malfunction:

Table 6 - Behavior of the SafeZone Mini Device on a Contactor Malfunction

Without internal restart interlock or with restart delay	• The system locks completely (lockout). • The error message 8 appears in the seven-segment display.
With restart interlock	• The SafeZone Mini device switches its OSSDs to the OFF state. • The status indicator (STOP) is illuminated. • The error message 8 appears in the seven-segment display.



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

TIP Examples of the connection of external device monitoring can be found in Connection Diagrams on page 66.

Restart of the SafeZone Mini Device

You can configure the restart behavior of the SafeZone Mini device as follows:

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



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



ATTENTION: It is imperative that you configure the SafeZone Mini device or the application with restart interlock if the protective field can be left to approach the hazardous point or if a person cannot be detected by the SafeZone Mini device 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 device (see Methods to Prevent Unprotected Areas on page 53).

Configuration without Restart Interlock

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

This configuration is only allowed 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 device 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 device. The OSSDs on the SafeZone Mini device change to the ON state if there is no object in the protective field for the duration given.

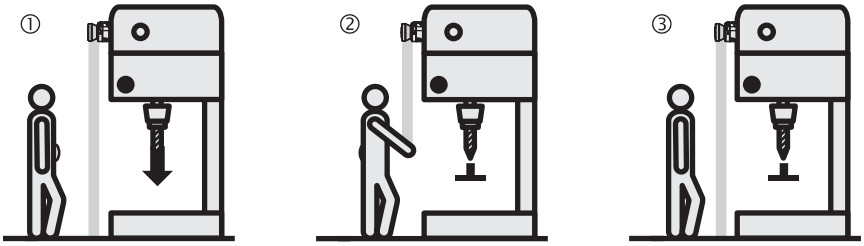
This configuration is only allowed if the protective field cannot be left in the direction of the hazardous point and if a person can be detected at every point in the hazardous area by the SafeZone Mini device.

Configuration with Restart Interlock

The OSSDs on the SafeZone Mini device change to the OFF state to initiate a machine (1 in Figure 8) or vehicle stop as soon as there is an object in the protective field (2 in Figure 8). They do not change to the ON state (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 it can clearly be seen from the hazardous area.
Place the control switch for restart or reset outside the hazardous area such that it cannot be operated by a person in the hazardous area. Confirm that the person who operates the control switch has a full view of the hazardous area.

Figure 8 - Schematic Outline of the Operation with Restart Interlock



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

TIP Examples of the connection of internal restart interlocks can be found in Connection Diagrams on page 66.

If you do not use the internal restart interlock, then do not configure any of the universal I/Os as an input for resetting (see Universal I/O Connections on page 28).

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 device (internal) and also a restart interlock on the machine (external), then each restart interlock has its own control switch.

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

- The SafeZone Mini device switches its OSSDs to the ON state.
- The status indicator (⍻) on the SafeZone Mini device illuminates green.

The external restart interlock helps prevent the machine from restarting. After resetting the SafeZone Mini device, 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 such that the machine only restarts if the SafeZone Mini device is first reset and then the control switch for restarting the machine controller is operated.

Reset Signals

If the SafeZone Mini device is operated using the ¡§With restart interlock¡¨ function, then after a protective field infringement and the subsequent clearing of the protective field, it requests a reset signal from the control system (reset required).

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

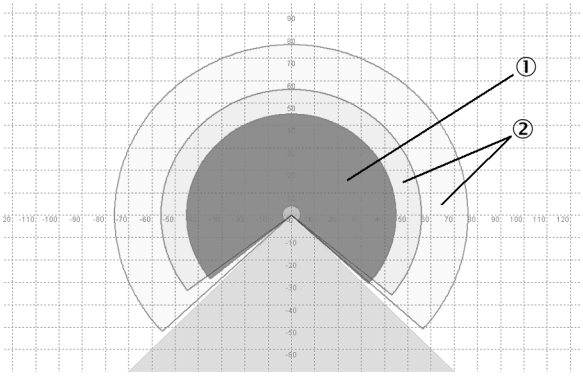
Field Sets

Fields sets can be configured manually or suggested by 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



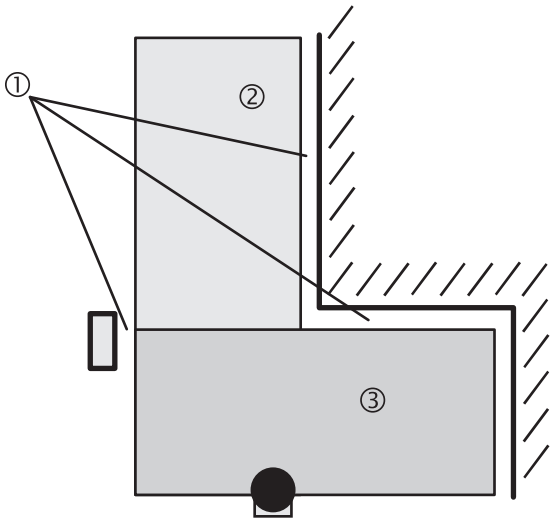
The SafeZone Mini device radially scans the area to be monitored. The SafeZone Mini device cannot see through objects during this process. Therefore, the area behind objects that are in the area to be monitored (pillars, grilles, and so on) cannot be monitored.

Protective fields and warning field can cover up an angle of up to 270° and have different radial scanning ranges depending on the resolution configured (see Resolution on page 27).

ATTENTION: Check the protective fields configured.
Before commissioning the machine or vehicle, check the configuration of the protective fields using the instructions in Commissioning on page 71 and using the Checklist to Install Electro-sensitive Protective Equipment (ESPE) on page 97.

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

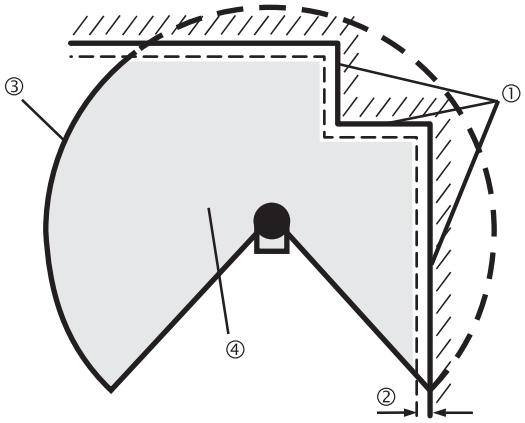


ATTENTION: Secure unprotected areas.
If it is possible to access a narrow strip between the protective field and a wall or another object, you must protect this strip with additional measures (for example, fence or floor protection).

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

TIP The measuring error tolerances for the SafeZone Mini device are automatically subtracted from the protective field size. As a result the protective field is slightly smaller than the surface covered (2 in Figure 11).

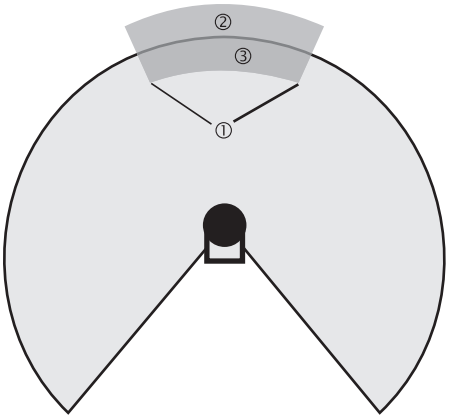
In those places where the surrounding contour is larger than the protective field range (3 in Figure 11) the protective field corresponds to the possible scanning range.

ATTENTION: Check the protective field suggested by the SCD software
The protective field suggested by the SCD software 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 39, the notes in Commissioning on page 71, and the Checklist to Install Electro-sensitive Protective Equipment (ESPE) on page 97.

Use the Contour as a Reference

In addition to the protective field, the SafeZone Mini device can also monitor a contour (for example, the floor in vertical applications).

Figure 12 - Schematic Diagram of Contour as Reference



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

The OSSDs on the SafeZone Mini device 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 device is changed).

TIP
- You can define any number of contour segments.
- The contour segments must not be narrower than the configured resolution.
- At the points where a contour has been configured as a reference you cannot define warning fields. If, for example, you use the floor as a reference for access protection, you cannot configure a warning field there. However, you can, 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.

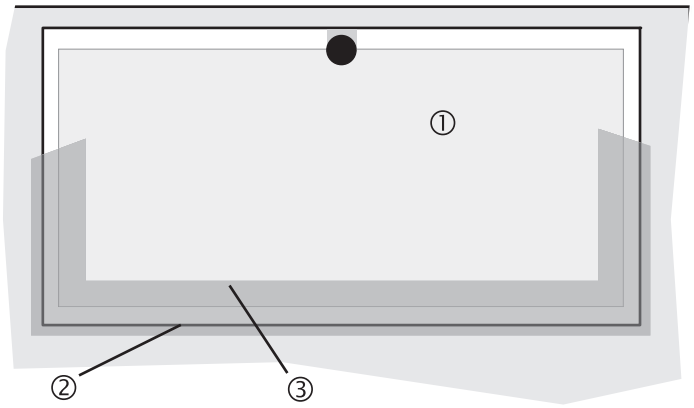


You define the contour as a reference in the SCD software field set editor.

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 lateral and vertical boundaries of the opening (for example, door frame) and the floor as reference. In this case, if the position of the SafeZone Mini device is changed in one or more planes, the distance to the reference changes and the SafeZone Mini device switches its OSSDs to the OFF state.

Monitoring Cases

The SafeZone Mini device 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 39.



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 be switched 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 device switches its OSSDs to the OFF state. This setting helps reduce the probability that insects, welding sparks, or other particles 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 device 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 Response Times on page 84).

On the SafeZone Mini device, 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

TIP 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 be switched to the OFF state and the laser on the SafeZone Mini device can be switched off. In this way, the power consumption of the device is reduced.

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, one universal I/O connection must be configured as standby input on the SafeZone Mini device. (see Universal I/O Connections on page 28).

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

Mounting

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

Mounting requires four steps:

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



ATTENTION: No protective function without sufficient minimum distance. Only if you configure the protective field such that there is an adequate minimum distance to the hazardous area, is protection by the SafeZone Mini device achieved.

Mounting Notes

- Mount the SafeZone Mini device in a dry place and protect the device from dirt and damage.
- Avoid the installation of the SafeZone Mini device 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 device that could cause interference or shadowing. The SafeZone Mini device 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 device can be impaired and incorrect switching can occur.
- Avoid placing highly reflective objects in the scan plane of the SafeZone Mini device. Examples: Retroreflectors can affect the measurement results of the SafeZone Mini device. Highly reflective objects within the protective field can blank a part of the area to be monitored in certain circumstances.

- Mount the SafeZone Mini device such that 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 device in specific circumstances.
- If reasonable for the application, mark the protective field on the floor (see EN 61496-1).

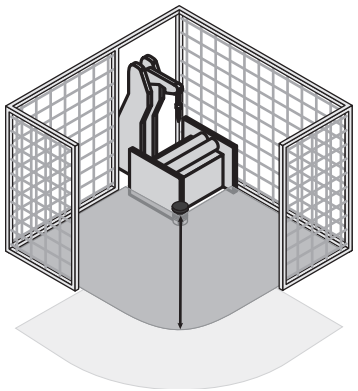
The following steps are necessary after mounting:

- Completing the electrical connections (Electrical Installation on page 61)
- Configuration of the protective field (Configuration on page 69)
- Commissioning and checking of the installation (Commissioning on page 71)
- Checking the function and safe shutdown (Test Notes on page 72)

Stationary Application in Horizontal Operation

This type of protective device 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 device.

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

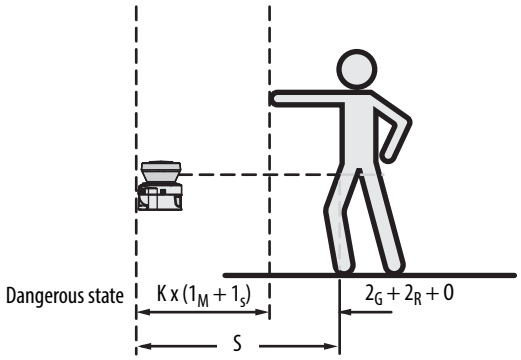
Protective Field Size

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

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

ATTENTION: Verify that a human leg can be detected 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 52).

Figure 15 - Minimum Distance S



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

- Approach speed of the body or parts of the body
- Stopping/run-down time of the machine or system
  (The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- Response time of the SafeZone Mini device
- 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	Stopping/run-down time of the machine or system
T_S	Response time of the SafeZone Mini device and the downstream controller
Z_G	General safety supplement of the SafeZone Mini device = 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 Device

The response time T_S of the SafeZone Mini device depends on the following:

- The basic response time of the SafeZone Mini device.
- The multiple sampling set.

See OSSD Response Times on page 84.

Supplement Z_R for Measurement Errors Caused by Reflection

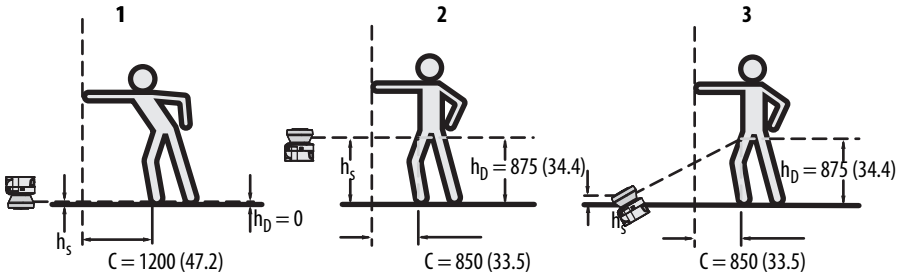
ATTENTION: Avoid mounting retroreflectors at a distance of less than one meter from the boundary of the protective field.
With retroreflectors that are positioned at a distance of less than 1 m (3.28 ft) from the boundary of the protective field a supplement Z_R of 200 mm (7.87 in.) must be added to the protective field.

Supplement C for Protection Against Reaching Over

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

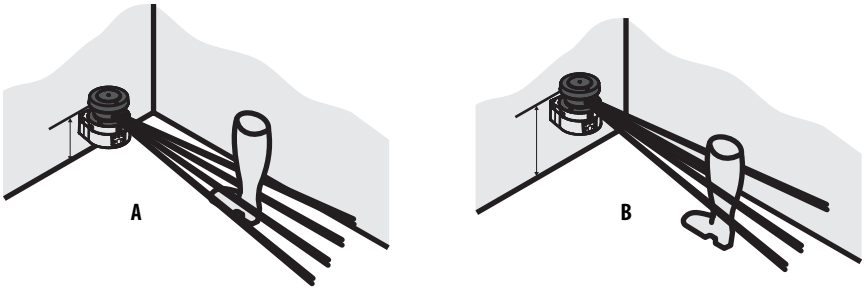
- If there is enough empty space in front of your machine or system, use 1200 mm (47.2 in.) for the supplement C.
- If the minimum distance is to be kept as small as possible, calculate C with the following formula:
  $C = 1200 \text{ mm} - (0.4 \times H_D)$
  Here H_D is the height at which the protective field is mounted.

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

Scan Plane Height (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 may, in certain circumstances, not be detected (for example, scan to left and right of the bone - A in Figure 17).

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

Stationary Application in Vertical Operation for Access Protection

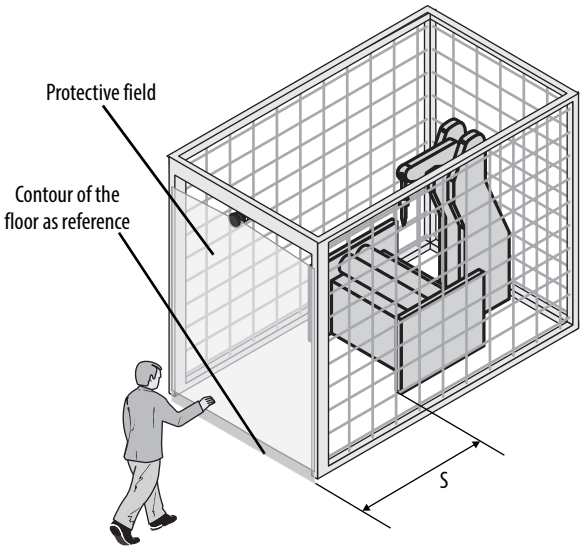
Access protection can be used when the access to the machine can be defined by physical means. For access protection, the SafeZone Mini device detects the entry of an entire body.

- 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 device against inadvertent adjustment or manipulation, you must use the contour of the surroundings as a reference for the SafeZone Mini device (see Use the Contour as a Reference on page 35).

Minimum Distance

For access protection, a minimum distance (S) must be maintained between protective field and hazardous area. This safety distance helps ensure that the hazardous point can only be reached after the dangerous state of the machine has been stopped 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
- Stopping/run-down time of the machine or system (The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- Response time of the SafeZone Mini device
- 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 device and the downstream controller
C	Supplement for prevention of reaching over (850 mm (33.5 in.))

Response Time T_S of the SafeZone Mini Device

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

The response time T_S of the SafeZone Mini device depends on the following:

- The basic response time of the SafeZone Mini device.
- The multiple sampling set.

See OSSD Response Times on page 84.

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 The SafeZone Mini device must be configured with a resolution of at least 40 mm (1.6 in.)

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

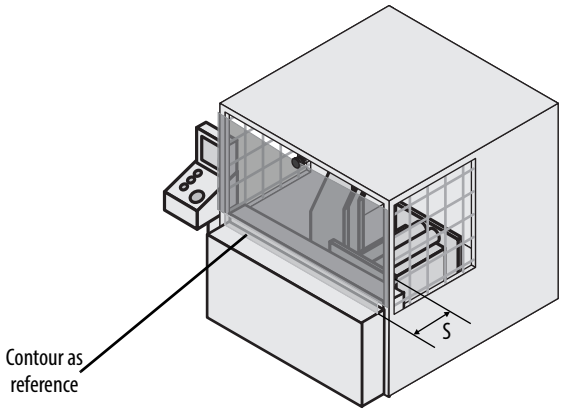
To help protect the protective device against inadvertent adjustment or manipulation, you must use the contour of the surroundings as a reference for the SafeZone Mini device (see Use the Contour as a Reference on page 35).

Minimum Distance

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

ATTENTION: Prevent reaching around or behind the protective field.
Always mount the safety laser scanner such that 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:

- Stopping/run-down time of the machine or system
  (The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- Response time of the SafeZone Mini device
- Reach or approach speed
- Resolution of the SafeZone Mini device

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 device
d	Resolution of the SafeZone Mini device [mm]

The reach/approach speed is already 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 may be able to reduce the minimum distance with the following calculation:
  $S = 1600 \times (TM + TS) + 8 \times (d - 14)$ [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 Device

The response time T_S of the SafeZone Mini device depends on the following:

- The basic response time of the SafeZone Mini device.
- The multiple sampling set.

See OSSD Response Times on page 84.

Mobile Applications

If a vehicle (for example, AGV or fork lift) produces the dangerous state, the hazardous area that the movement of the vehicle produces is protected by the SafeZone Mini device.

Application Notes

- The SafeZone Mini device may 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 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, then you need to use different assumptions.

For a horizontally mounted mobile application, determine:

- Protective field length
- Protective field width
- Height of the scan plane
- Restart behavior
- Methods of preventing unprotected areas

Protective Field Length

You must configure the protective field such that a minimum distance to the vehicle is maintained. This distance helps ensure that a vehicle that is monitored by the SafeZone Mini device comes to a stop before a person or object is reached.

Calculate the Protective Field Length S_L

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

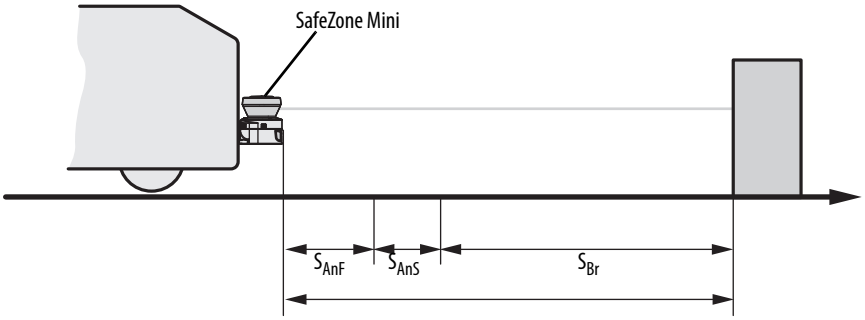
$$S_L = S_A + Z_G + Z_R + Z_F + Z_B$$

Variable	Description
S_A	Stopping distance
Z_G	General safety supplement of the SafeZone Mini device = 100 mm (3.94 in.)
Z_R	Supplement for any reflection-related measurement error of the SafeZone Mini device
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

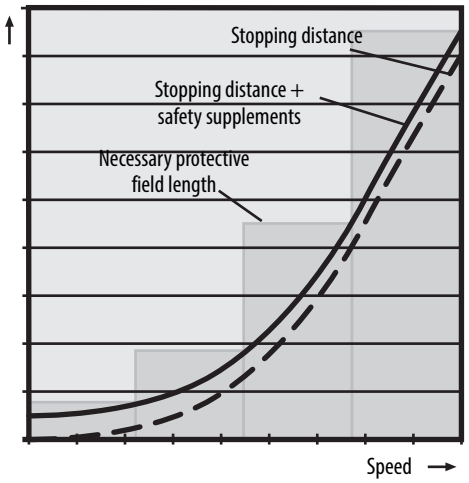
The stopping distance comprises the braking distance for the vehicle, the distance covered during the response time of the safety laser scanner, and the response time of the vehicle controller.

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 is covered during the response time of the safety laser scanner 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 TS of the SafeZone Mini device depends on the following:

- The basic response time of the SafeZone Mini device.
- The multiple sampling set.

See OSSD Response Times on page 84.

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

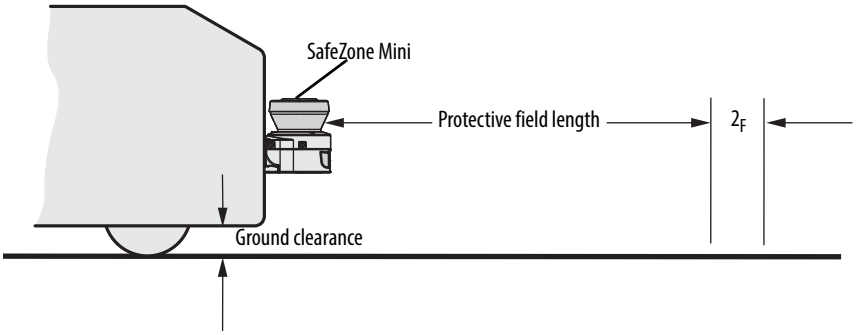
Supplement Z_R

Supplement Z_R is used for measurement errors that are caused by reflection. With retroreflectors 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

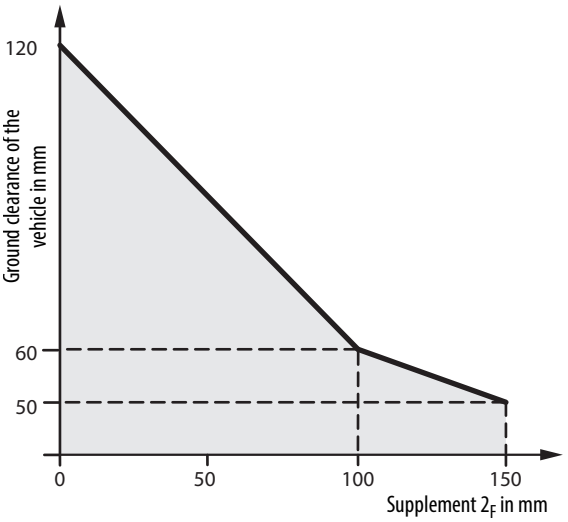
Supplement Z_F is due to lack of ground clearance. This supplement is necessary because a person is detected above the foot and the braking action therefore cannot consider the length of the foot in front of the detection point. If a vehicle has no ground clearance, a person can receive foot injuries.

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 be further reduced in specific cases. For this purpose, read off the actual supplement necessary for the ground clearance of your vehicle from Figure 23.

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:

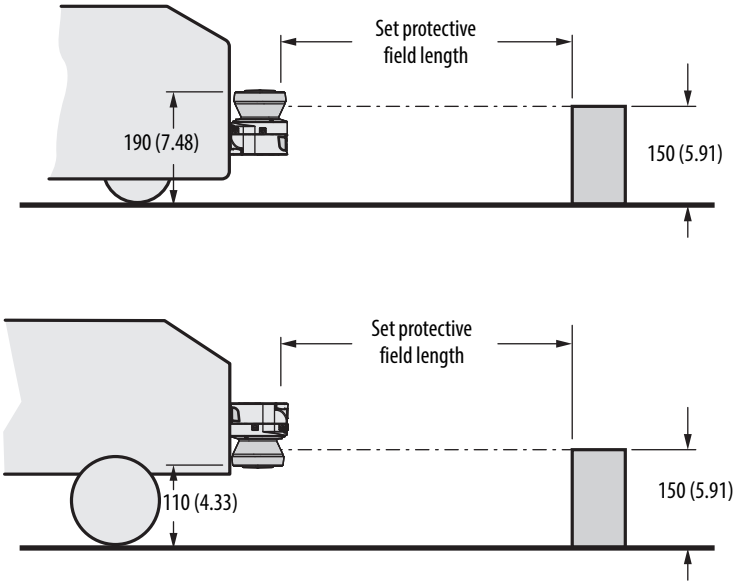
$$S_B = F_B + 2 \times (Z_G + Z_R + Z_F)$$

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

Height of Scan Plane

ATTENTION: Mount the SafeZone Mini device 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.)]

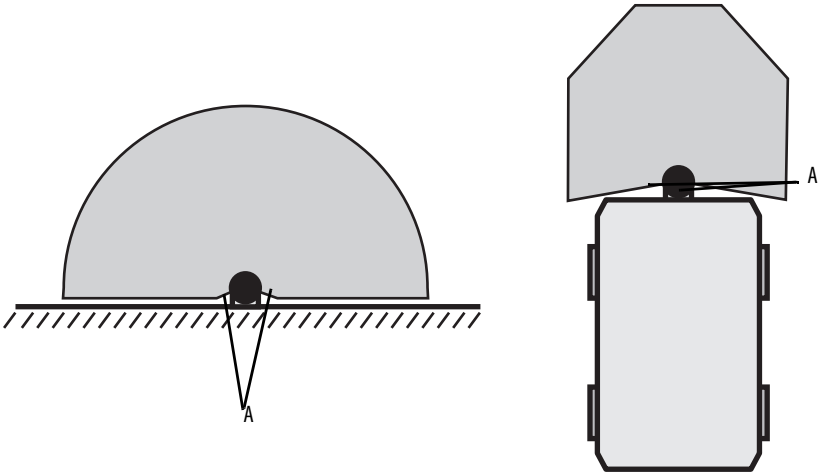


TIP To produce the optimal scan plane, you can also mount the SafeZone Mini device reversed.

Methods to Prevent Unprotected Areas

During mounting the SafeZone Mini device, areas may be found that are not covered by the safety laser scanner (A in Figure 25).

Figure 25 - Unprotected Areas

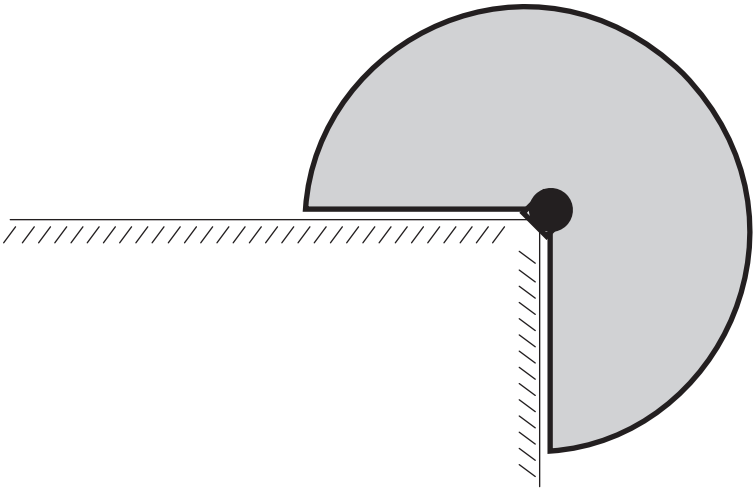


ATTENTION: Prevent or secure unprotected areas.

- Mount the SafeZone Mini device such that there are no unprotected areas.
- For mobile applications, if the vehicle is accelerated 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 device in the vehicle trim panels.

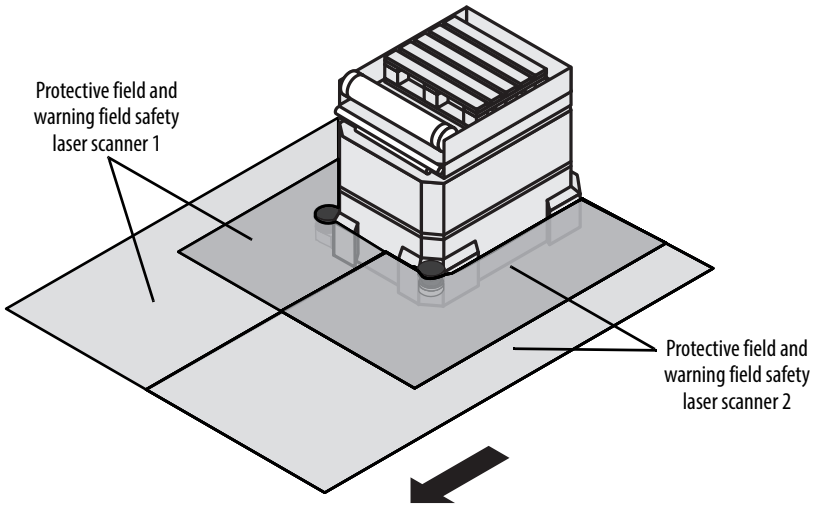
Mount the SafeZone Mini device, for example, on a corner to help prevent unprotected areas.

Figure 26 - Preventing Unprotected Areas



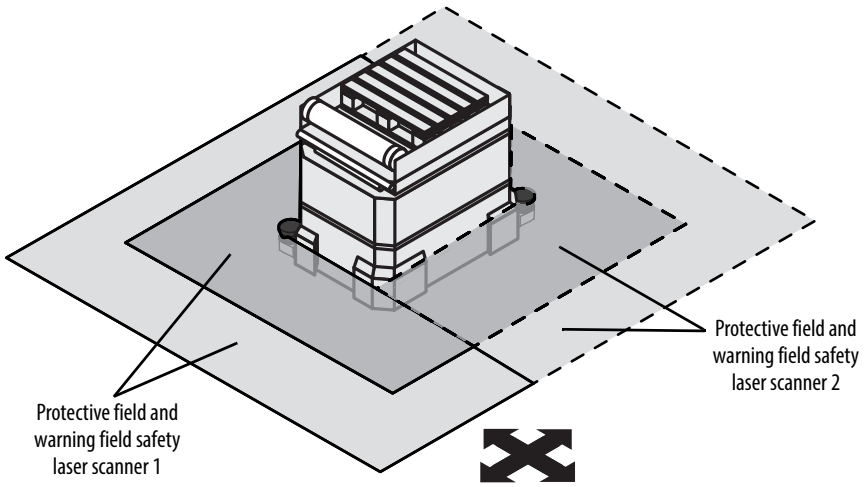
With two SafeZone Mini devices mounted at an angle of 45° on the front corners of a vehicle, you can configure the protective fields so that there are no unprotected areas and the hazardous areas in narrow aisles can also be protected.

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



With two SafeZone Mini devices 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

Make the near range impassible using a bar or a recess, or additionally protect the near range (50 mm (2.0 in.)) wide area in front of the optics cover using a proximity switch with 50 mm (2.0 in.) acquisition range. The vehicle can then be accelerated as required.

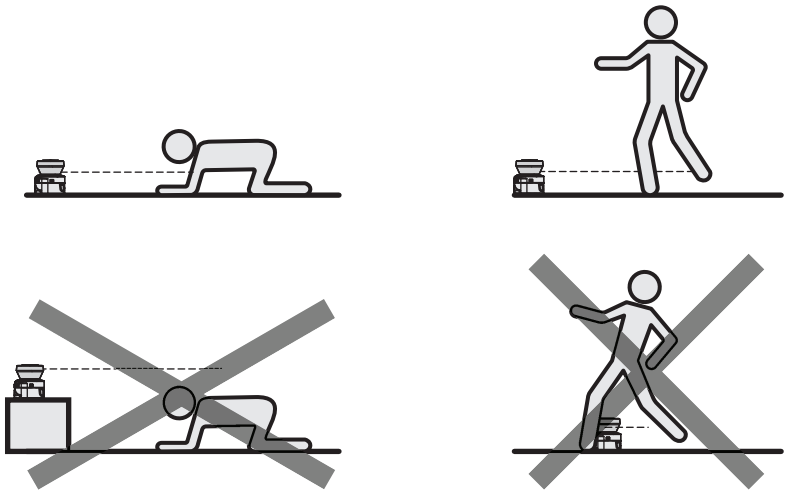
Mounting Steps

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

Special features to note during mounting:

- Mount the SafeZone Mini device such that it is protected from moisture, dirt, and damage.
- Verify that the entire field of view of the SafeZone Mini device is not restricted.
- Mount the safety laser scanner such that the indicators are easy to see.
- Avoid excessive shock and vibration loading on the safety laser scanner.
- On systems that suffer from heavy vibration, help prevent the fixing screws from coming loose by using screw-locking devices.
- Regularly check the tightness of the fixing screws.
- Prevent personnel from being able to crawl beneath, stand behind or climb over the protective field with appropriate mounting of the SafeZone Mini device.

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 device (see Figure 54 on page 91).

There are three possible ways of mounting the SafeZone Mini device:

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

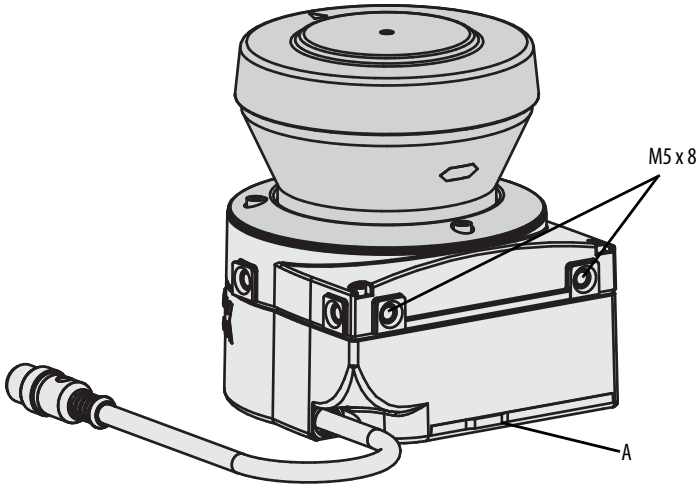
The mounting kit part numbers are found in Table 25 on page 95.

IMPORTANT Pay attention to the maximum torque of the M5 fixing screws on the SafeZone Mini device (5.9 N•m [4.4 ft•lb], max).

Direct Mounting

The SafeZone Mini device has two threaded holes M5×8 on the rear. Using them you can mount the SafeZone Mini device directly on the intended mounting surface. To avoid a possible tendency to vibrate, if necessary the reference surface on the rear can be used as the third mounting point (A in Figure 30).

Figure 30 - Direct Mounting



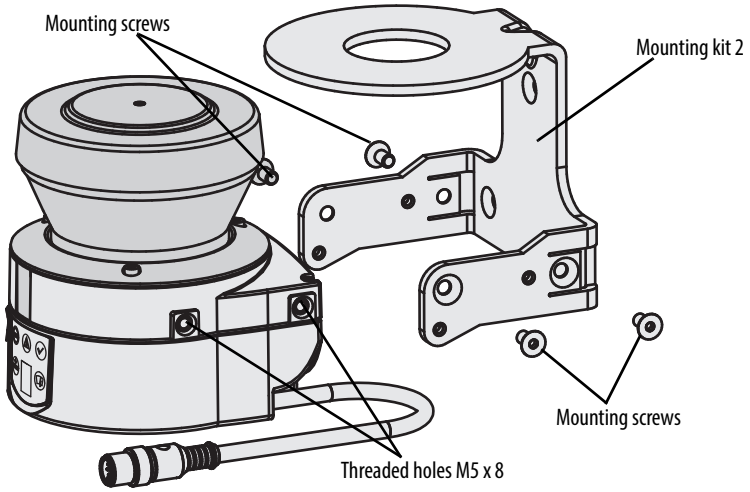
IMPORTANT During mounting, review the Dimension Drawings on page 91.

Mounting with Mounting Kit 1or 2

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

1. Mount mounting kit 1 or 2 on the mounting surface.
2. Then, mount the SafeZone Mini device on the mounting kit 1 or 2.

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



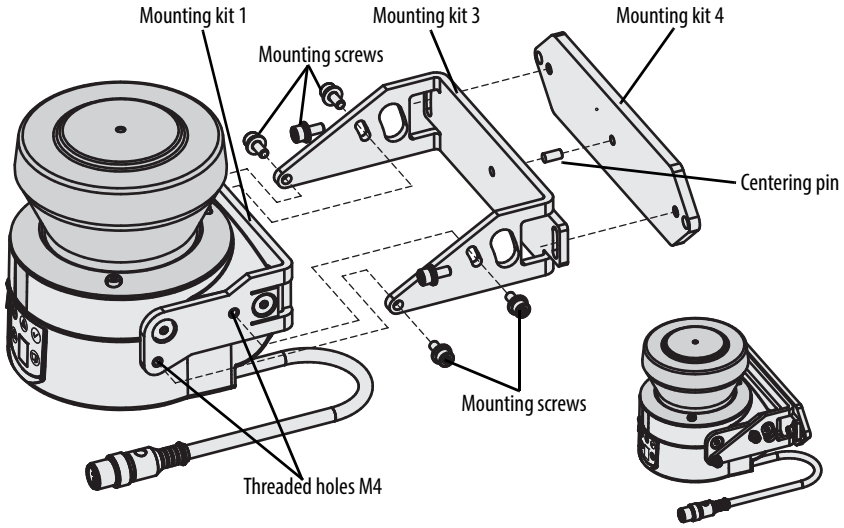
IMPORTANT During mounting, review the Dimension Drawings on page 91.

Mounting with Mounting Kit 3 and 4

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

1. Mount mounting kit 1 or 2 to the SafeZone Mini device.
2. Mount the 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 fixing screws M4 × 10.
5. Then, mount the SafeZone Mini device on mounting kit 3 with the aid of the threaded holes in mounting kit 1.
6. Adjust the SafeZone Mini device longitudinally and transversely and then tighten the six fixing screws on the mounting kits.

Figure 32 - Mounting with Mounting Kit 2



IMPORTANT During mounting, review the Dimension Drawings on page 91.

Information Label Important Information

On completion of mounting, you must affix the self-adhesive information label Important information supplied:

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

Using Multiple Safety Laser Scanners

The SafeZone Mini device 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 the following examples.

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

Use mounting kits 1 or 2 and 3 to adjust the safety laser scanners to different angles (see Table 25 on page 95).

Figure 33 - Opposite Mounting

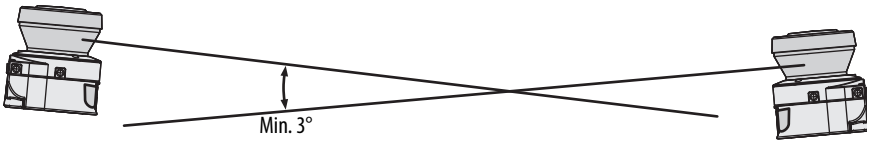


Figure 34 - Offset Parallel Mounting

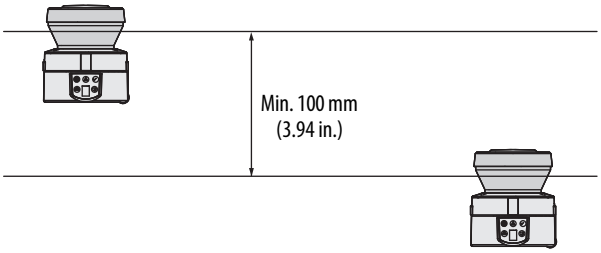


Figure 35 - Mounting on a Cross

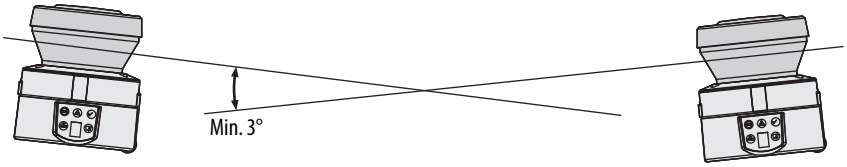


Figure 36 - Reverse Mounting, Parallel Offset

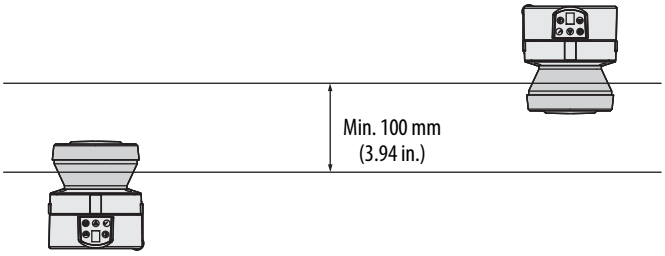
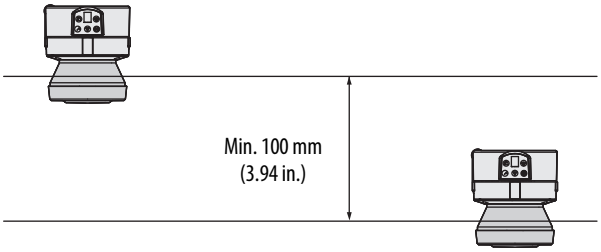


Figure 37 - Reverse Mounting of Two SafeZone Mini Devices, with Parallel Offset

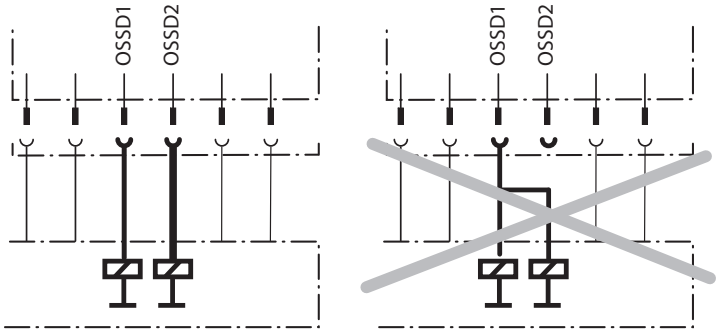


Notes:

Electrical Installation

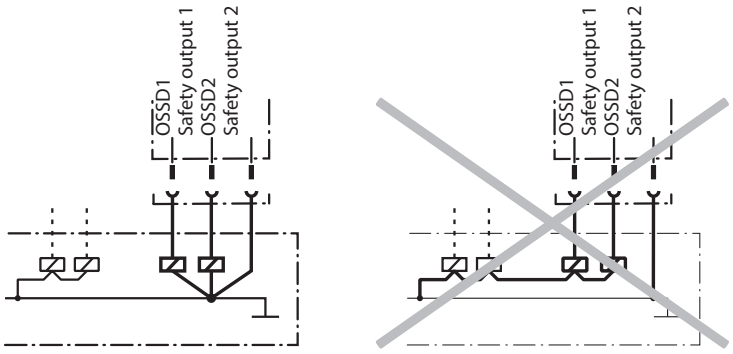
ATTENTION: Switch the entire machine/system offline.
The machine/system could unintentionally start up while you are connecting the devices. Verify that the entire machine/system is disconnected during the electrical installation.

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.
Downstream contactors must be positively guided and monitored.



ATTENTION: Only connect one downstream switching element to an OSSD.
Each output signal switching device (OSSD) is only allowed to be connected to one switching element (for example, relay or contactor). If several switching elements are required, you must 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 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 such that they are protected from damage.
- Verify that the controller that is connected and all devices that are related to safety 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 device is adequately protected electrically. See Electrical Specifications on page 89 for the electrical data necessary for determining the correct fuse.

System Connection

All inputs and outputs on the SafeZone Mini device are on the round plug connector on the connecting cable. Connect the SafeZone Mini device with pre-assembled extension cables (see Table 10 on page 64).

All inputs and outputs on the SafeZone Mini device are to be used 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, the best screening action can only be achieved 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, an FE is never allowed to be used as a PE.

Functional Earth

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

Round Plug Connector

Figure 38 - Round Plug Connector

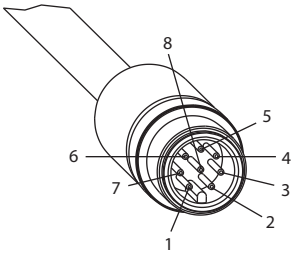


Table 9 - Pin Assignment (1)

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 25 on page 95 to connect the SafeZone Mini device.

Table 10 - Core Assignment of the SafeZone Mini Device 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

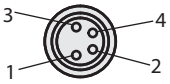


Table 11 - Pin Assignment Configuration Connection M8 × 4

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

After configuration:

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

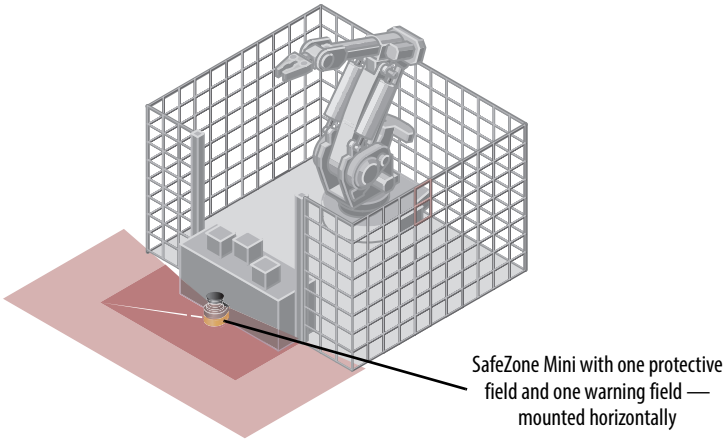
Application Examples and Connection Diagrams

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

Stationary Applications

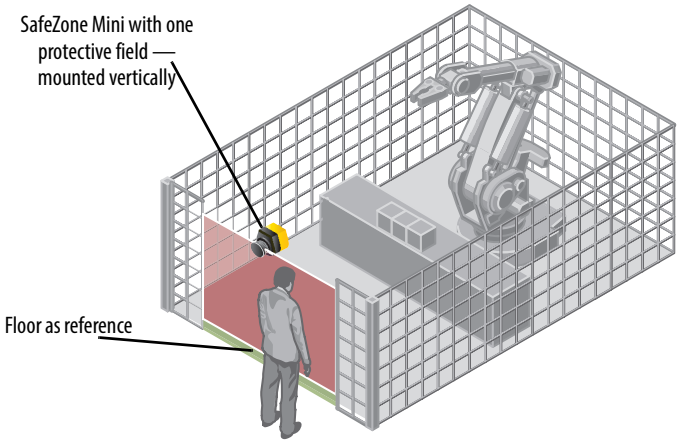
Figure 40 shows coverage of one area that a SafeZone™ Mini safety laser scanner monitors permanently.

Figure 40 - Hazardous Area Protection with SafeZone Mini Device (Horizontal Mounting)



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

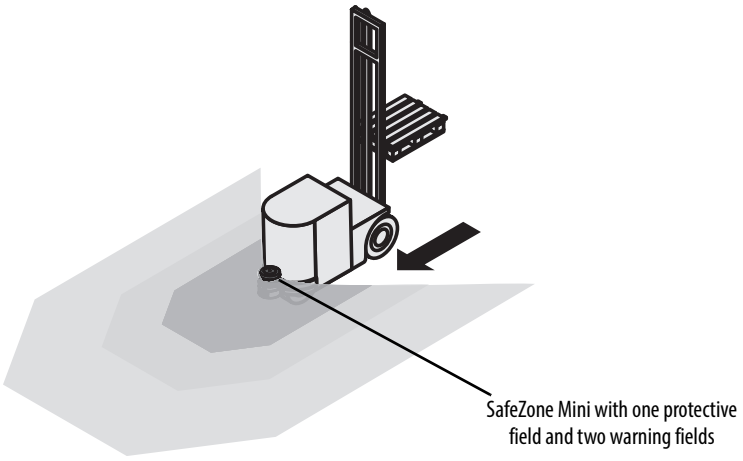
Figure 41 - Access Protection with SafeZone Mini Device (Vertical Mounting)



Mobile Applications

Figure 42 shows vehicle monitoring for unidirectional travel with a SafeZone Mini device. The SafeZone Mini device 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

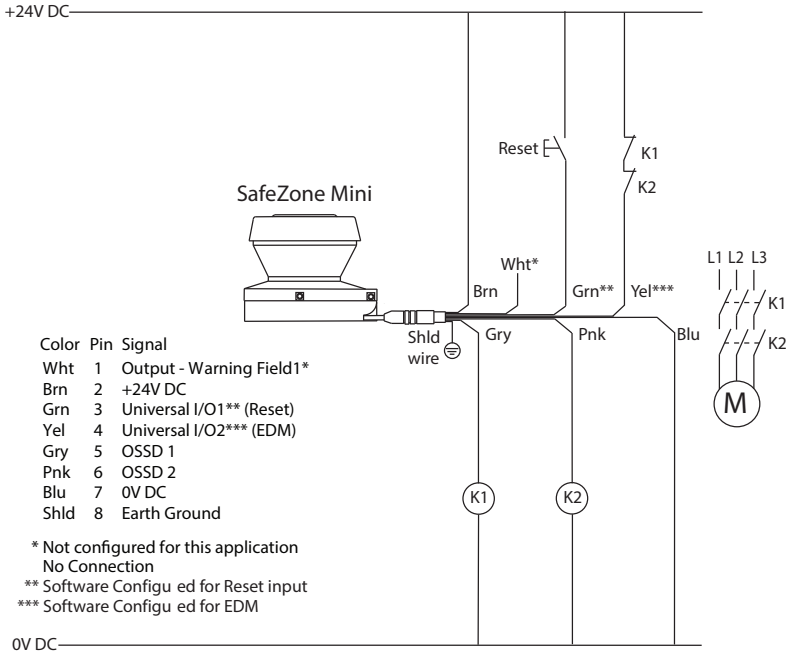
IMPORTANT

- Only use relays/contacts with positively guided contacts. The protection elements connected in parallel with the relays/contactors are used for arc-suppression.
- Verify that there is adequate arc-suppression at the relays/contactors. Consider that arc-suppressors can 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 device 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).

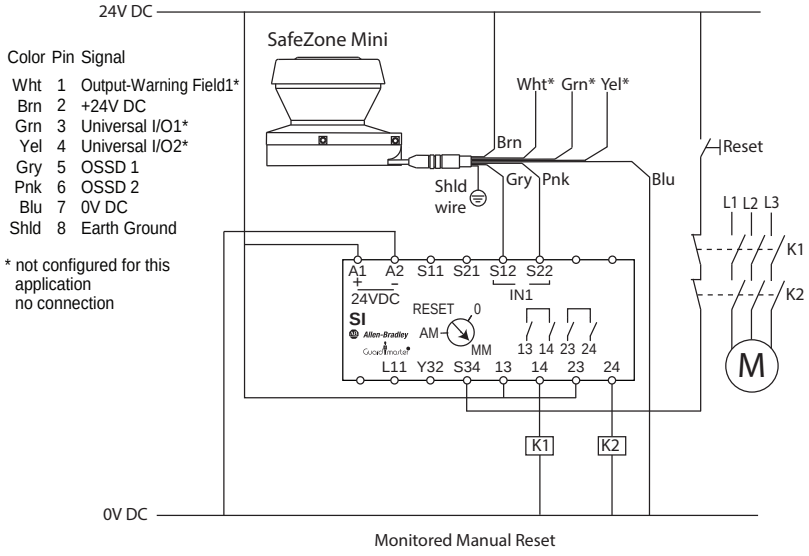
Figure 43 - Connection Diagram with Restart Interlock and External Device Monitoring



SI Guardmaster Safety Relay

SafeZone Mini device in combination with a SI Guardmaster safety relay: operating mode of SafeZone Mini device is ON/OFF and SI safety relays is configured for monitored manual reset.

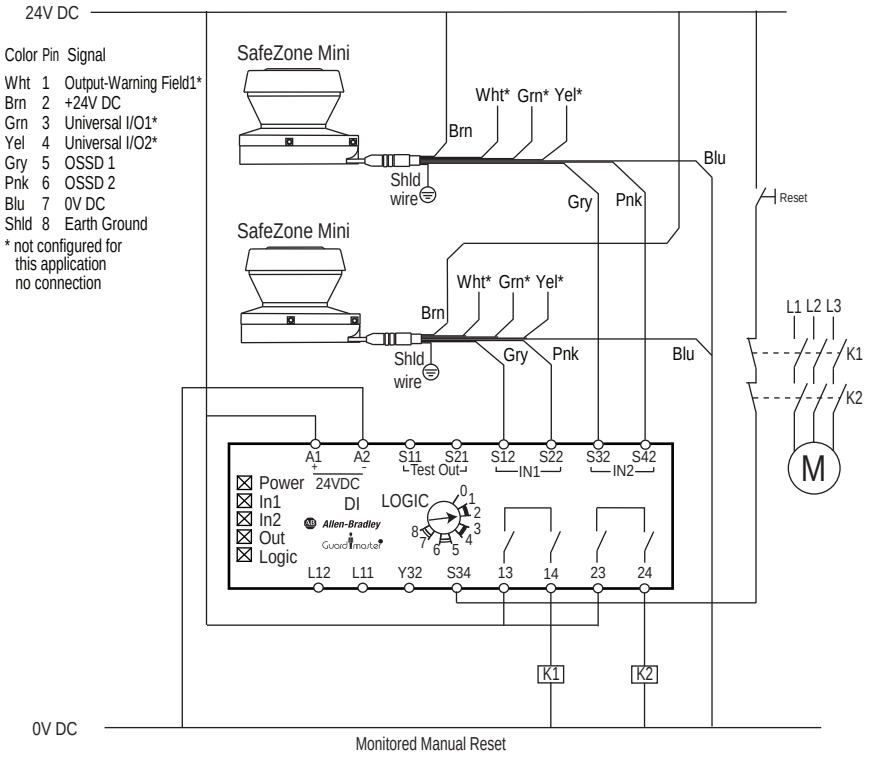
Figure 44 - Connection Diagram in Combination with a GSR SI Safety Relay



Two SafeZone Mini Devices with DI Guardmaster Safety Relay

Two SafeZone Mini devices that 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



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 is illuminated: 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.

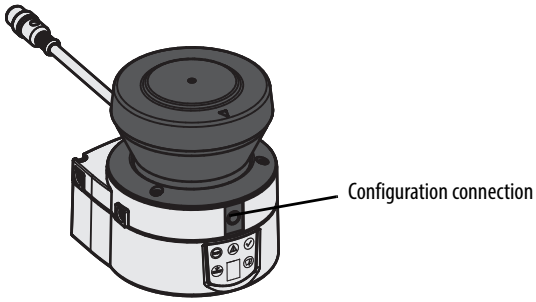
To configure the safety laser scanner, you need:

- SCD software on CD-ROM or downloaded from http://ab.rockwellautomation.com/sensors-switches/operator-safety/safezone-mini-laser-scanners#software.
- Computer with Windows NT 4/2000 Professional/XP/Vista/7 (32-Bit) and a serial RS-232 interface (computer not included)
- Service cable for connecting computer and SafeZone Mini device

Configuration with the SCD Software

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

Figure 46 - Configuration Connection



Two service cables of different lengths are available for computer connection (see Table 25 on page 95).

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.
- The service cable is only allowed to be connected for configuration and diagnostics. The service cable must be disconnected and the protective cap is in place while in operation.

TIP 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 is monitored by the SafeZone™ Mini device for the first time, make sure qualified safety personnel check and release the system. The result of the test must be documented. Read the notes in Chapter 1 on page 11.

- 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 device, a 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 72).

Power-up Sequence

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

During the initial commissioning of an SafeZone Mini device, the following indications are possible:

Table 12 - Seven-segment Display during and after the Power-up Sequence on Initial Commissioning

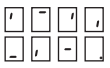
Step	Display	Meaning
1		Power-up cycle, testing the seven-segment display. All segments are activated sequentially.
2		Power up cycle, during initial commissioning: device in configuration mode
	Other display	Safety lock activated. Malfunction in external conditions or in the device itself. See Error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

Table 13 - Status Indication after the Power-up Sequence

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

Test Notes

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

- Verify that there are no persons in the hazardous area during initial commissioning.
- Check the effectiveness of the protective device that is mounted to the machine, using all selectable operating modes as specified in the checklist in the annex (see Checklist to Install Electro-sensitive Protective Equipment (ESPE) on page 97).
- Verify that the qualified safety personnel instructs the operating personnel of the machine that is protected by the safety laser scanner before being 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.
- Appendix B on page 97 includes a checklist for review by the manufacturer and OEM. Use this checklist 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.

TIP 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 in this way document the state during initial commissioning at any time.

Inspection of the Protective Device

Your protective device must be inspected by qualified safety personnel 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 have been made to the machine or the protective device, or if the safety laser scanner has been modified or repaired, check the system again as per the checklist in the annex (see Checklist to Install Electro-sensitive Protective Equipment (ESPE) on page 97).

Daily Testing

A specialist or authorized personnel must check the effectiveness of the protective device daily. The test must also be performed if the operating mode is changed.



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

- The test must be conducted for the relevant preset monitoring case.
- Check the mechanical installation to verify that all mounting screws are secure and that the SafeZone Mini device is properly aligned.
- Check each SafeZone Mini device for visible changes such as damage and manipulation.
- Switch on the machine/system.
- Watch the status indicators on each SafeZone Mini device.
- If not at least one status indicator of each SafeZone Mini device is permanently lit when the machine/system is switched on, it is to be assumed that there is a fault in the machine or system. In this case, the machine must be shut down immediately and checked by qualified safety personnel.
- Deliberately infringe the protective field while the machine is running to test the protective function for the entire system. The status indicators of the SafeZone Mini device 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 devices. If you discover any non-conformance of this function, the machine/system must be shut down immediately and checked by qualified safety personnel.

- For stationary applications, check that the hazardous areas marked out on the floor match the shapes of the protective fields that are stored in the SafeZone Mini device 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 device 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.

Maintenance and Care

ATTENTION: Do not make any repairs to the device.
The SafeZone™ Mini device does not contain any repairable components. For this reason, do not open the SafeZone Mini device 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 device requires little maintenance. However, the optics cover on the safety laser scanner must be cleaned on a regular basis and when it becomes contaminated.

- Do not use aggressive cleaning agents.
- Do not use abrasive cleaning agents.
- Static charges cause dust particles to be attracted to the optics cover. You can reduce this effect by using the anti-static plastic and the lens cloth.

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 device. For this purpose, the optics cover calibration must first be performed; this information serves as a reference for the contamination measurement (status = not contaminated).
The optics cover calibration is only allowed to be performed with a new optics cover. The new optics cover must be free of contamination at the time of the optics cover calibration. The optics cover calibration must be performed at room temperature [10…30 °C (50…86 °F)].

If the optics cover is scratched or damaged, it must be replaced. Order the replacement optics cover from Rockwell Automation (see Table 25 on page 95).

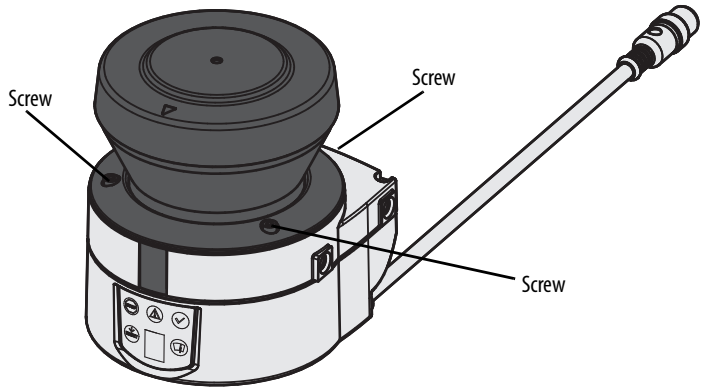
- The optics cover on the SafeZone Mini device is an optical part that must not be soiled or scratched on replacement.
- Only qualified safety personnel are allowed to replace the optics cover in a dust and dirt-free environment.
- Never replace the optics cover during ongoing operation, as internal parts can be irreparably damaged in certain circumstances and dust particles can enter the device.
- It is imperative that you 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

TIP
- Only use a new optics cover (see Table 25 on page 95).
- 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 device.
2. Take the SafeZone Mini device to a clean place (office, repair shop, or similar).
3. Clean the outside of the SafeZone Mini device. Cleaning keeps foreign bodies from entering the device 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 Device

1. Correctly remount the SafeZone Mini device (see Mounting on page 39).
2. Connect the round plug connector on the end of the connection cable for the SafeZone Mini device.
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 protective device can result in the loss of the protective function. Only the manufacturer, or persons who are authorized by the manufacturer, are allowed to repair the protective device.

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 Indication — 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 23, the connections for the outputs of the SafeZone™ Mini device in System Connection on page 62.

Table 14 - 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/Os	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.
	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 warning field 1 is infringed.
(2) If this is configured as the output for warning field 2 and warning field 2 is infringed.
(3) If this is configured as the output for "Reset required."
(4) f this is configured as the output for a contamination error/warning.
(5) If this is configured as the output for a contamination error.
(6) If this is configured as the output for a contamination warning.

Error and Status Indication — 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 device in Status Indicators on page 23.

Lockout Operational Status

In case of certain faults or an erroneous configuration, the device can go into the lockout operational status. The seven-segment display on the safety laser scanner then indicates 6, 8, d, E, F, I, L, n, P, or U. To place the device back in operation, follow these steps:

1. Rectify the cause of the fault per Table 15 on page 81.
2. Switch off the power supply for the SafeZone Mini device, 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 15 - Error and Status Indication on the Seven-segment Display

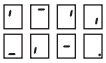
Display	Possible Cause	Corrective Action
	Power-up cycle — all segments are activated sequentially.	No error
	Object in protective field	No error
	Object in warning field 1	No error
	Object in warning field 2	No error
	Initialization of the device	The display goes out automatically when the SafeZone Mini device has been initialized and/or the connection to the second device has been made. If the display 3 does not go off: • Check whether the partner device is in operation. • Check the wiring. If no partner device is connected: Check the system configuration with the aid of the SCD software. Transfer the corrected configuration to the SafeZone Mini device again.
	Waiting for configuration or configuration not completed	The display goes off automatically once the configuration has been 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 device again.
	Waiting for restart of the device	Switch off the voltage supply for the SafeZone Mini device for at least 2 seconds and then switch it back on.
 or 	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 device for at least 2 seconds and switch it back on.
	Error in the control switch for restart or reset	• Check the functionality of the control switch. The button may be defective or permanently operated. • Check the wiring of the control switch for short circuit to 24V.
	SafeZone Mini device has a malfunction or is faulty	Switch off the voltage supply for the SafeZone Mini device for at least 2 seconds and then switch it back on. If the display does not go off: Send the SafeZone Mini device to the manufacturer for repair.
	Overcurrent on OSSD connection 1	• Check the switching element connected (contactor, relay). Replace, if necessary. • Check the wiring for short circuit to 0V.
	Short circuit to 24V at OSSD connection 1	Check the wiring for short circuit to 24V.

Table 15 - Error and Status Indication on the Seven-segment Display

Display	Possible Cause	Corrective Action
F.⊃3.	Short circuit to 0V at OSSD connection 1	Check the wiring for short circuit to 0V.
F.⊃4.	Overcurrent on OSSD connection 2	• Check the switching element connected (contactor, relay). Replace, if necessary. • Check the wiring for short circuit to 0V.
F.⊃5.	Short circuit to 24V at OSSD connection 2	Check the wiring for short circuit to 24V.
F.⊃6.	Short circuit to 0V at OSSD connection 2	Check the wiring for short circuit to 0V.
F.⊃7.	Short circuit between OSSD connection 1 and 2	Check the wiring and rectify the error.
F.⊃9.	General OSSD wiring error	Check the complete wiring of the OSSDs.
1.⊃1.	The SafeZone Mini device 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.
1.⊃2.	Device is faulted.	• Check whether an external light source, for example, headlight, infrared light sources, stroboscopic light, or sun is affecting the SafeZone Mini device. • If necessary, remount the device.
1.⊃3.	Temperature error. The operating temperature of the SafeZone Mini device has exceeded the permissible range.	Check whether the SafeZone Mini device is operated as per the permissible ambient conditions.
L.⊃2.	Invalid configuration of the EDM.	Verify that the machine-side EDM is connected correctly.
L.⊃8.	Undervoltage of the supply voltage	Check the power supply or the connecting cables.
L.⊃9.	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 device 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 reestablished. 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.⊃1.	Window for light output on the optics cover contaminated	Clean the window for the light output on the optics cover.
u.⊃8. and u.⊃9.	Optical saturation of the contamination measurement (there may 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 device. 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 devices. It 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 Device)

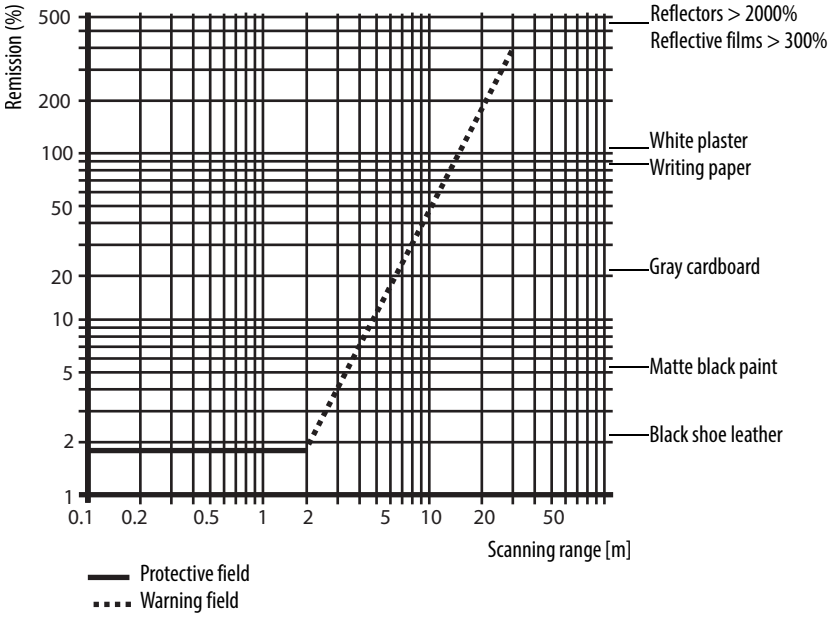
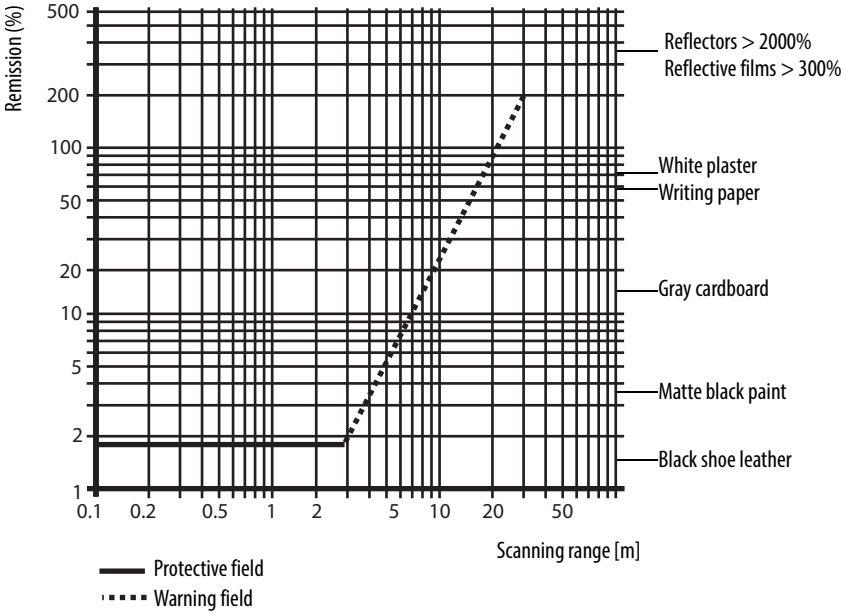


Figure 49 - Scanning Range Diagram (3 m [9.84 ft] SafeZone Mini Device)



OSSD Response Times

The total response time of your application is dependent on:

- The basic response time of the SafeZone Mini device.
- 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 device 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 16 - Multiple Sampling Supplements

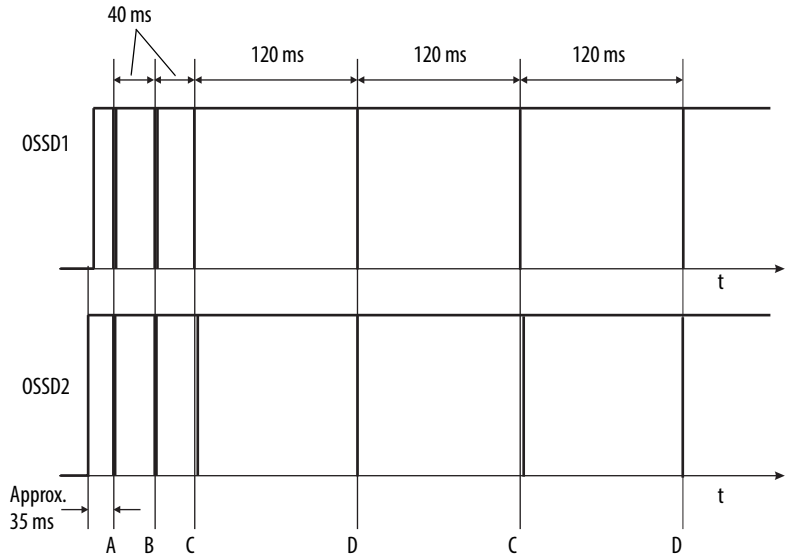
Multiple Sampling	Supplement	Basic Response Time + Supplement
2 times (basic setting)	0 ms	80 ms
3 times	40 ms	120 ms
4 times	80 ms	160 ms
5 times	120 ms	200 ms
6 times	160 ms	240 ms
7 times	200 ms	280 ms
8 times	240 ms	320 ms
9 times	280 ms	360 ms
10 times	320 ms	400 ms
11 times	360 ms	440 ms
12 times	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 device tests the OSSDs immediately after switch-on and then at regular intervals. For this purpose, the SafeZone Mini device 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 unintentionally shut down.

Figure 50 - Diagram of OSSD Test Pulses



Approximately 35 ms after the switch-on of the OSSDs, the SafeZone Mini device 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 device, there is a shutdown test (C). 120 ms later another voltage test (D). Then, the SafeZone Mini device 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

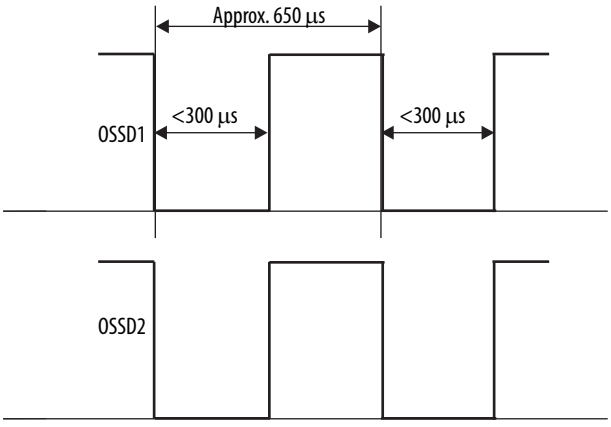


Figure 52 - Shutdown Test

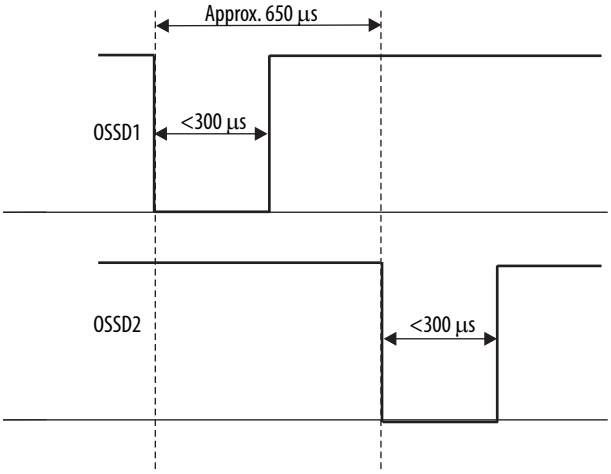
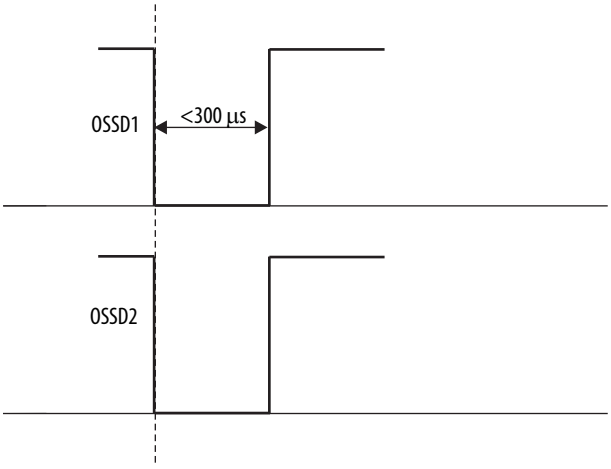


Figure 53 - Voltage Test



General Specifications

Table 17 - General Specifications

Attribute	442L-SFZNMN
Type	3 (EN 61496-1)
Safety integrity level (1)	SIL 2 (IEC 61508)
SIL claim limit (1)	SILCL2 (EN 62061)
Category	Category 3 (EN ISO 13849-1)
Performance Level (1)	PLd (EN ISO 13849-1)
PFHd (T_{amb} = 25 °C) (mean probability 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 (EN 50178 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)
Vibration	EN 61496-1 and CLC/TS 61496-3
Frequency range	10…150 Hz
Amplitude	0.35 mm (0.01 in.) or 5 g (0.18 oz)
Shock resistance	EN 61496-1, Chapter 4 and CLC/TS 61496-3
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 Rockwell Automation sales office or Allen-Bradley distributor.

Material

Table 18 - Material

Attribute	442L-SFZNMN
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

Dimensions

Table 19 - Dimensions [mm (in.)]

Attribute	442L-SFZNMN
SafeZone Mini Safety Laser Scanner	
Height	116 (4.57)
Width	102 (4.02)
Depth	105 (4.13)
Total weight (without connecting cables)	0.8 kg (1.76 lb)
Connecting Cable	
Length	250 (9.84)
Diameter of round plug connector	15 (0.59)

Functional Data

Table 20 - Functional Data

Attribute	442L-SFZNMN
Resolution of the 2 m (6.56 ft) SafeZone Mini Device	30, 40, 50, 70 mm (1.2, 1.6, 2.0, 2.8 in.)
Resolution of the 3 m (9.84 ft) SafeZone Mini Device	30, 40, 50, 70, 150 mm (1.2, 1.6, 2.0, 2.8, 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)(3)
Angular resolution	0.5°
Protective field supplement necessary	100 mm (3.94 in.)
Supplement for retroreflectors 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 device	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 (1)	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 device	18 s
Restart after (configurable)	2…60 s
Basic response time (2)	80 ms

(1) The detection capability of the warning field is dependent on the remission of the objects to be detected.

(2) The total response time of your application is dependent on further factors.

(3) Complies with Diamond Grade 3000X™ (approx. 1250 cd/lx × m^2).

Electrical Specifications

Table 21 - Electrical Specifications

Attribute		442L-SFZNMN
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 Device	0.16 A (0.20 A, max) (5)
	3 m (9.84 ft) SafeZone Mini Device	0.18 A (0.25 A, max) (5)
Operating current with max output load	2 m (6.56 ft) SafeZone Mini Device	1.35 A (5)
	3 m (9.84 ft) SafeZone Mini Device	1.35 A (5)
Power consumption without output load	2 m (6.56 ft) SafeZone Mini Device	3.9 W (4.8 W, max) (5)
	3 m (9.84 ft) SafeZone Mini Device	4.4 W (6.0 W, max) (5)
Power consumption with max output load	2 m (6.56 ft) SafeZone Mini Device	33 W
	3 m (9.84 ft) SafeZone Mini Device	33 W
Power consumption in the stand-by mode or park mode without output load	2 m (6.56 ft) SafeZone Mini Device	3.6 W (4.8 W, max)
	3 m (9.84 ft) SafeZone Mini Device	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 device 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 22 - Universal I/O Specifications

Attribute	442L-SFZNMN
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 23 - OSSD Specifications

Attribute	442L-SFZNMN
Output signal switching device pair	2 PNP semiconductors, short-circuit protected (5), 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 (1)	6…250 mA
Leakage current (2)	250 µA
Load inductance	2.2 H
Load capacity	2.2 µF at 50 Ω
Switching sequence (without switching	5 1/s
Permissible cable resistance (3)	2.5 Ω
Test pulse width (4)	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) Switching currents up to 500 mA are allowed briefly (≤100 ms).

(2) 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.

(3) 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.)

(4) 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.

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

Table 24 - Configuration and Diagnostics Interface Specifications

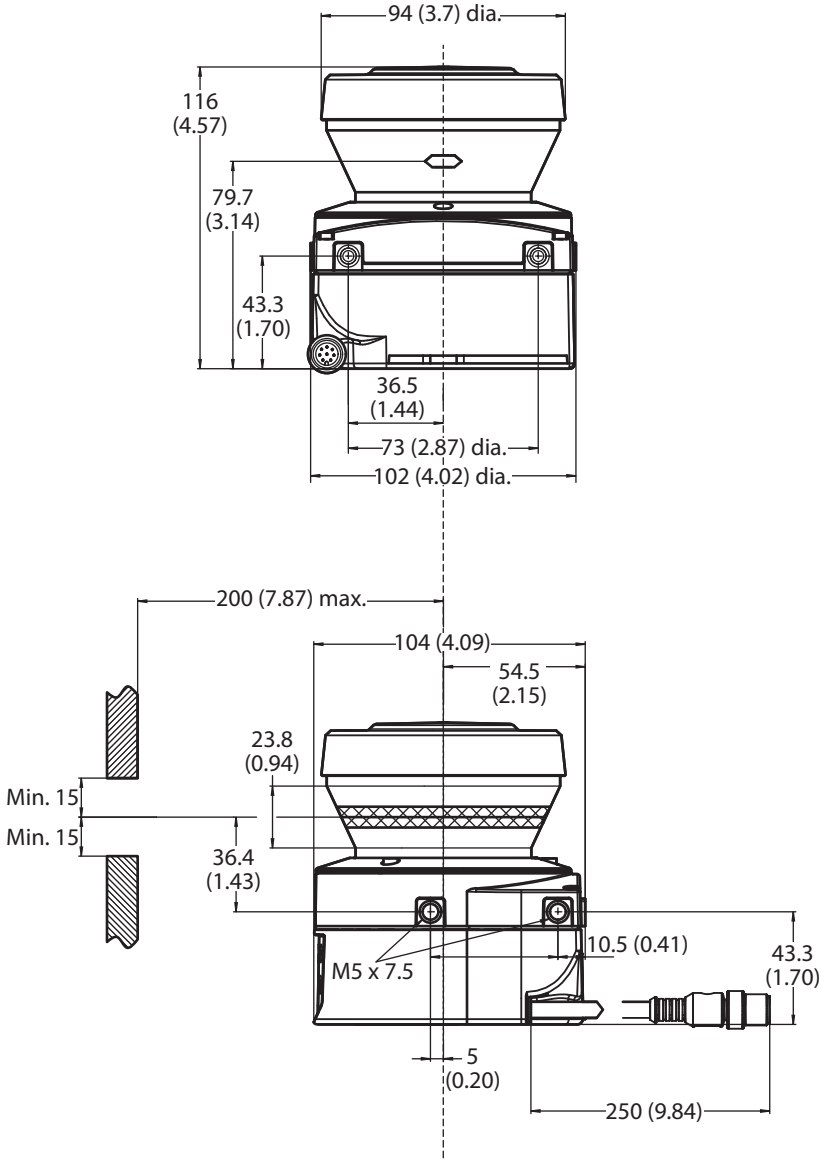
Attribute	442L-SFZNMN
Communication protocol	RS-232 (proprietary)
Transmission speed	38400 Bauds
Cable length at 38400 Baud and 0.25 mm^2 cables	15 m (49 ft)
Galvanic isolation	No
Output TxD HIGH	5…15 V
Output TxD LOW	-15…-5 V
Voltage range RxD	-15…+15 V
Switching threshold RxD LOW	-15…+0.4 V
Switching 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

Dimension Drawings

The measurements in the following drawings are in millimeters (inches).

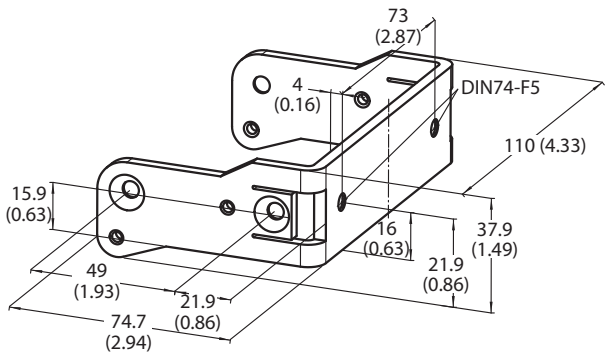
SafeZone Mini Safety Laser Scanner

Figure 54 - SafeZone Mini Device [mm (in.)]

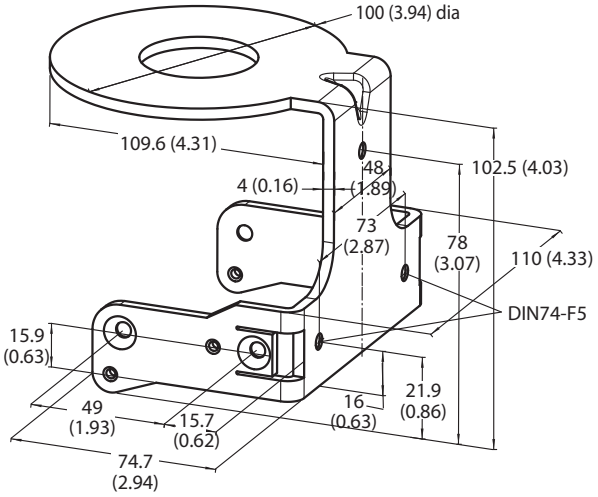


Mounting Kits

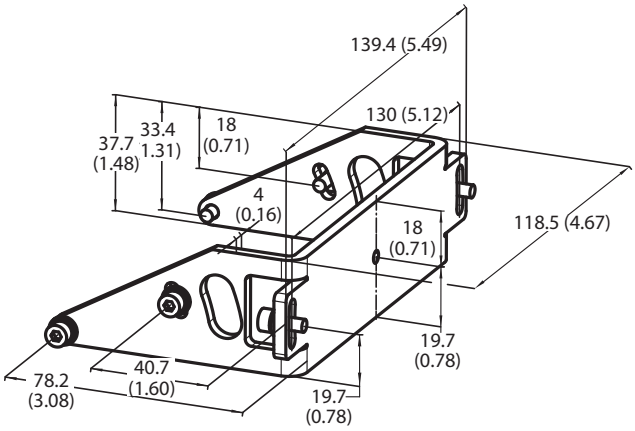
Figure 55 - Mounting Kit Dimensions [mm (in.)]



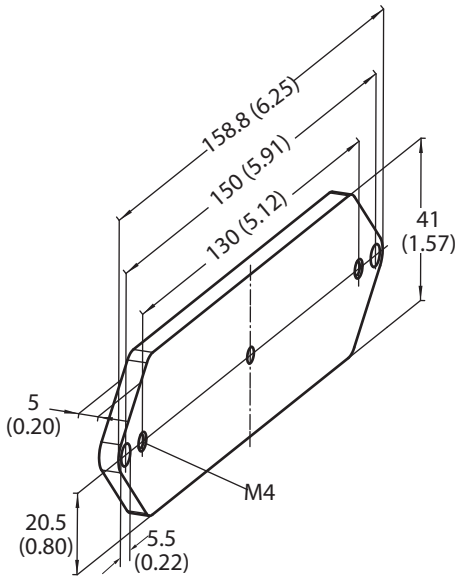
Mounting Kit 1
Cat. No. 442L-AMBSZMN1



Mounting Kit 2
Cat. No. 442L-AMBSZMN2



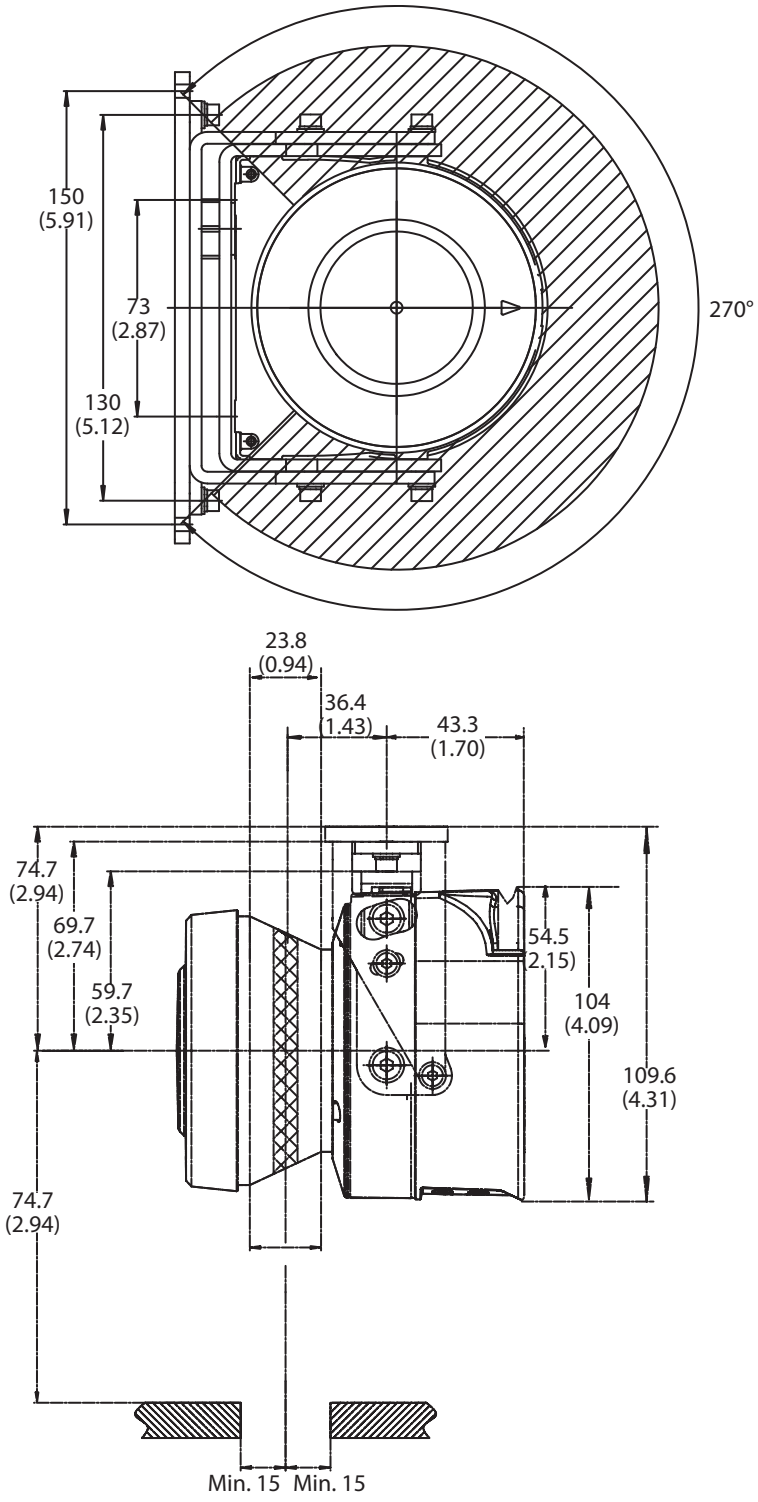
Mounting Kit 3
Cat. No. 442L-AMBSZMN3



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 Device

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

IMPORTANT Cordsets for the SafeZone™ Mini device are not included.

Table 25 - Product Selection

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

Notes:

Checklist to Install Electro-sensitive Protective Equipment (ESPE)

Checklist for the Manufacturer and Installer

Details about the points 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 protective device fulfill the required PL/SILCL and PFHd 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 stopping/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 protective device (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 be stopped when switching the ESPE on or off and when changing the operating mode, or when switching to another protective device?	Yes ☐	No ☐
18. 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:

EU Declaration of Conformity

Certificate

See our Product Certification site for Declarations of Conformity, certificates, and other certification details.

Notes:

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

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 device, 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 is operated by the protective device 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 device that is used to stop the dangerous movement. This output is a semiconductor output and is periodically tested for correct function. The SafeZone Mini device 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 protective device 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 device.

Universal I/O The SafeZone Mini device 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.

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Rockwell Automation Support

Use the following resources to access support information.

Technical Support Center	Knowledgebase Articles, How-to Videos, FAQs, Chat, User Forums, and Product Notification Updates.	https://rockwellautomation.custhelp.com/
Local Technical Support Phone Numbers	Locate the phone number for your country.	http://www.rockwellautomation.com/global/support/get-support-now.page
Direct Dial Codes	Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer.	http://www.rockwellautomation.com/global/support/direct-dial.page
Literature Library	Installation Instructions, Manuals, Brochures, and Technical Data.	http://www.rockwellautomation.com/global/literature-library/overview.page
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	http://www.rockwellautomation.com/global/support/pcdc.page

Documentation Feedback

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Rockwell Automation maintains current product environmental information on its website at http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page.

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