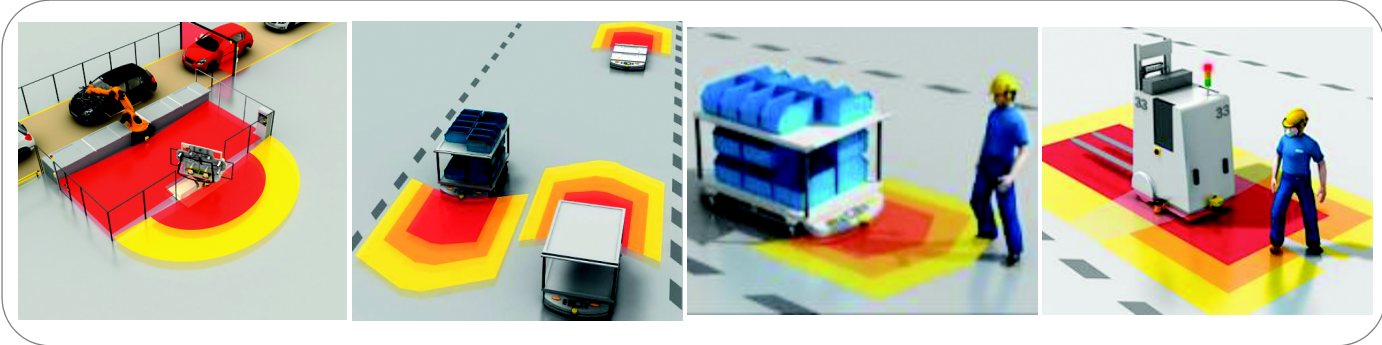


# SafeZone Mini Safety Laser Scanner User Manual



## Important User Information





Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in the guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Rockwell Automation publication SGI-1.1, Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control (available from your local Rockwell Automation sales office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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Throughout this manual we use notes to make you aware of safety considerations:

<b>WARNING</b> 	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.
<b>IMPORTANT</b>	Identifies information that is critical for successful application and understanding of the product.
<b>ATTENTION</b> 	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 consequences.
<b>SHOCK HAZARD</b> 	Labels may be on or inside the equipment (for example, drive or motor) to alert people that dangerous voltage may be present.
<b>BURN HAZARD</b> 	Labels may be on or inside the equipment (for example, drive or motor) to alert people that surfaces may reach dangerous temperatures.

It is recommended that you save this user manual for future use.

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## About this document

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

### Function of this document

These operating instructions are designed to address *the technical personnel of the machine manufacturer or the machine operator* in regards to correct mounting, electrical installation, commissioning, operation and maintenance of the SafeZone Mini safety laser scanner.

These operating instructions do *not* provide instructions for operating the machine, the system or the vehicle on which the safety laser scanner is, or will be, integrated. Information on this is to be found in the appropriate operating instructions for the machine, the system or the vehicle.

### Target group

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

### Scope

These operating instructions are original operating instructions.

These operating instructions are only applicable to the SafeZone Mini safety laser scanner with the following entry on the type label in the field *Operating Instructions (Pub. No. 10000337275)*.

For the configuration and diagnostics of these devices you require the SCD (version 3.0 or higher) programming software. To determine the software version, select the **Module Info...** option in the **Help** menu.

### Depth of information

These operating instructions contain information on the SafeZone Mini safety laser scanner. They have 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 also require specific technical skills which are not detailed in this documentation.

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

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

**Note:** Please refer also to the Rockwell Automation home page on the Internet at [www.rockwellautomation.com](http://www.rockwellautomation.com).

Here you will find information on:

- Application examples
- A list of frequently asked questions regarding the SafeZone Mini
- These operating instructions in different languages for viewing and printing

### Abbreviations used

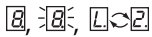
- AGV** Automated Guided Vehicle
- ANSI** American National Standards Institute
- AWG** American Wire Gauge = standardization and classification of wires and cables by type, diameter etc.
- EDM** External device monitoring
- EMC** Electromagnetic compatibility




<b>ESD</b>	Electrostatic discharge
<b>ESPE</b>	Electro-sensitive protective equipment
<b>FPLC</b>	Fail-safe programmable logic controller
<b>OSSD</b>	Output signal switching device = signal output of the protective device that is used to stop the dangerous movement
<b>RIA</b>	Robotic Industries Association
<b>SCD software</b>	Rockwell Automation Safety Configuration and Diagnostic Software (SCD software) = software for configuration and diagnostics on the SafeZone Mini


## Symbols used




**Recommendation** Recommendations are designed to give you some assistance in your decision-making process with respect to a certain function or a technical measure.

**Note** Refer to notes for special features of the device.

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

-  Constant indication of characters, e.g. 8
-  Flashing indication of characters, e.g. 8
-  Alternating indication of characters, e.g. L and 2

 LED symbols describe the status of an LED:

-  The "OSSDs in the OFF state" LED is illuminated continuously.
-  The "Error/contamination" LED is flashing.
-  The "Warning field interrupted" LED is off.

**➤ Take action...** Instructions for taking action are shown by an arrow. Read carefully and follow the instructions for action.

**Warning!** A warning indicates an actual or potential risk or health hazard. Observation and implementation of the warning will protect you from accidents.

Read carefully and follow the warning notices!



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

### The term "dangerous state"

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

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

## On safety

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

- Please read this chapter carefully before working with the SafeZone Mini or with the machine protected by the SafeZone Mini.

## Qualified safety personnel

The SafeZone Mini safety laser scanner must be installed, connected, commissioned and serviced only by qualified safety personnel. Qualified safety personnel are defined as persons who:

- Due to their specialist training and experience have adequate knowledge of the power-driven equipment to be checked,
- Have been instructed by the responsible machine owner in the operation of the machine and the current valid safety guidelines,
- Are sufficiently familiar with the applicable official health and safety regulations, directives and generally recognized engineering practice (e.g. DIN standards, VDE stipulations, engineering regulations from other EC member states) that they can assess the work safety aspects of the power-driven equipment, and
- Have access to these operating instructions and have read them.

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

## Applications of the device

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

- It is not allowed to use the SafeZone Mini outdoors.
- The SafeZone Mini cannot provide protection from parts thrown out of the machine or emitted radiation.
- The SafeZone Mini complies with the requirements in the standard on the radiated emissions as defined for class A (industrial application); the SafeZone Mini is therefore only suitable for use in an industrial environment.
- The device is a *type 3 ESPE* as defined by EN 61496-1 and CLC/TS 61496-3 and is therefore allowed for use with category 3 PL d controls as per EN ISO 13849-1 or SIL2 as per IEC 61508.
- The SafeZone Mini is suitable for:
  - Hazardous area protection
  - Hazardous point protection
  - Access protection
  - Vehicle protection (electrically powered industrial trucks)

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

## Correct use

The SafeZone Mini safety laser scanner must be used only as defined in Chapter 2, “Applications of the device” on page 6. It must be used only by qualified personnel and only on the machine where it has been installed and initialized by qualified safety personnel in accordance with these operating instructions. It is only permitted to be used on machines on which the dangerous state can be stopped immediately by the SafeZone Mini and/or it is possible to prevent the machine being placed in operation.

**Note** If the device is used for any other purposes or modified in any way — also during mounting and installation — any warranty claim against Rockwell Automation shall become void.



## General safety notes and protective measures

### ATTENTION



#### Pay attention to the safety notes!

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

#### Repair only by authorized persons!

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



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

- This device meets the norms: IEC 60825-1 as well as CDRH 21 CFR 1040.10 and 1040.11; excluded are deviations due to Laser Notice No. 50, dated 24.06.2007. In the standards CDRH 21 CFR 1040.10 and 1040.11 the following note is required: "Caution — use of controls, adjustments or performance of procedures other than those herein specified may result in hazardous radiation exposure!"
- During the mounting, installation and usage of the SafeZone Mini, observe the standards and directives applicable in your country. You will find an overview of the most important regulations in Chapter 2, "Applicable directives and standards" on page 8.
- The national/international rules and regulations apply to the installation, commissioning, use and periodic technical inspections of the SafeZone Mini safety laser scanner, in particular . . .
  - Machinery Directive 2006/42/EC
  - Work Equipment Directive 2009/104/EC
  - The work safety regulations/safety rules
  - Other relevant health and safety regulations
- Manufacturers and operators of the machine on which the SafeZone Mini is used are responsible for obtaining and observing all applicable safety regulations and rules.
- The notes, in particular the test notes (see Chapter 9, "Commissioning" on page 47) in these operating instructions (e.g. on use, mounting, installation or integration into the machine control) must be observed.
- Changes to the configuration of the devices can degrade the protective function. After every change to the configuration you must therefore check the effectiveness of the protective device. The person who makes the change is also responsible for the correct protective function of the device. When making configuration changes, please always use the password hierarchy provided by Rockwell Automation to ensure that only authorized persons make changes to the configuration.
- The tests must be carried out by qualified safety personnel or specially qualified and authorized personnel and must be recorded and documented to ensure that the tests can be reconstructed and retraced at any time.
- The operating instructions must be made available to the operator of the machine where the SafeZone Mini is used. The machine operator is to be instructed in the use of the device by qualified safety personnel and must be instructed to read the operating instructions.
- To meet the requirements of the relevant product standards (e.g. 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.
- Enclosed with these operating instructions is a checklist for checking by the manufacturer and OEM (see Chapter 14, "Checklist for the manufacturer" on page 70). Use this checklist when checking the system that is protected with the SafeZone Mini.

## Environmental protection

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

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

### Disposal

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

- Note**
- Information on the individual materials in the SafeZone Mini is given in Chapter 12 “Technical specifications” on page 55.

### Separation of materials

**ATTENTION**



**Only qualified safety personnel are allowed to separate materials!**

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

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

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

Table 1: Overview on disposal by components

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

### Applicable directives and standards

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

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

### Application and installation of protective devices

Machinery Directive 2006/42/EC, e.g.:

- 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 prevent hazard zones being reached by 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) as well as part 2: Validation (EN ISO 13849-2)
- Safety of machinery — electro-sensitive protective equipment — Part 1: General requirements (EN 61496-1) as well as 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)

**Note** To some extent these standards require the protective device to have the safety level **“Control reliable.”** The SafeZone Mini safety laser scanner 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 two or three meters maximum protective field radii)
- Configuration using PC or notebook 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 safety laser scanner operates correctly as a protective device only if the following conditions are met:

- The control of the machine, system or vehicle must be electrical.
- It must be possible to transfer the dangerous machine, system or vehicle state to a safe state using the OSSDs on the SafeZone Mini at any time, i.e. before a person has reached the hazardous point or hazardous area.

#### Or:

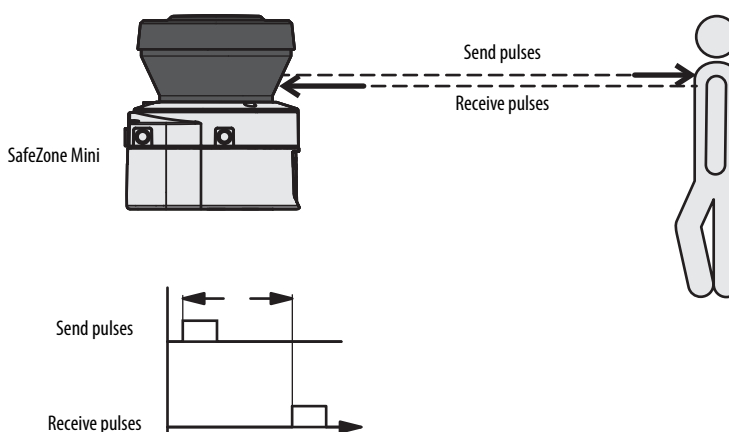
It must be possible to transfer the dangerous state of the machine, the system, or the vehicle to a safe state at any time using the OSSDs on a safety controller connected to the SafeZone Mini.

- The SafeZone Mini must be mounted and configured such that it detects objects as they enter the hazardous area (see Chapter 5, "Mounting" on page 35 and Chapter 9, "Commissioning" on page 47).
- The safety laser scanner's optical path must always remain clear and is not allowed to be covered by transparent objects such as protective windows, Plexiglas, lenses etc. The safety laser scanner's protective function can only be ensured if the contamination measurement function is not bypassed by such measures.

### Principle of operation

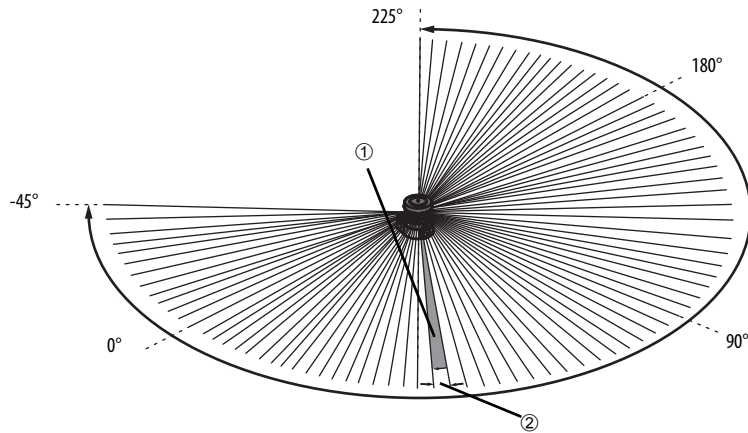
The SafeZone Mini is an optical sensor that scans its surroundings in two dimensions using infrared laser beams. It is used to monitor hazardous areas on machines or vehicles.

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



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

Fig. 2: Principle of operation, rotation of the SafeZone Mini



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

The SafeZone Mini sends a pulse of light with an angular resolution of  $0.5^\circ$  ①. As a result resolutions between 30 mm (1.18 in.) and 70 mm (2.76 in.) can be achieved ②.

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

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

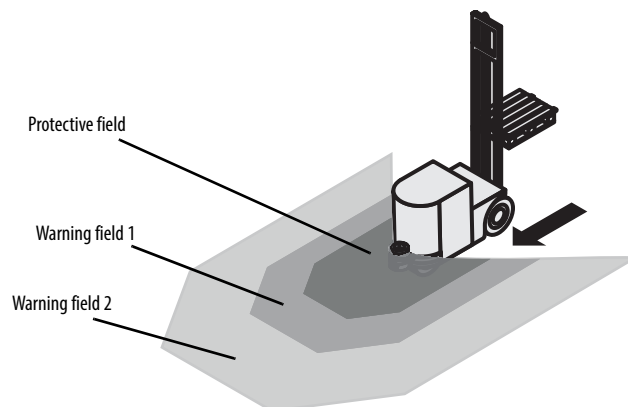
### Field set comprising protective field and warning field(s)

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

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

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

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



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

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

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

**Contour monitoring**

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

**SafeZone Mini**

**Device components**

The SafeZone Mini safety laser scanner comprises three components:

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

Fig. 4: Device components

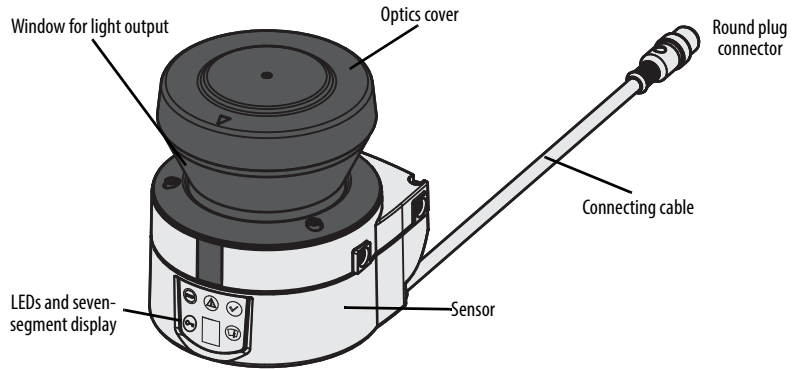
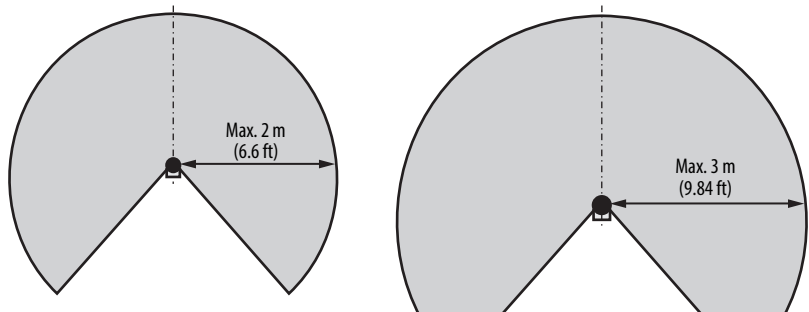
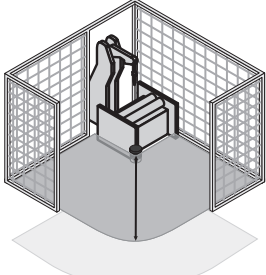
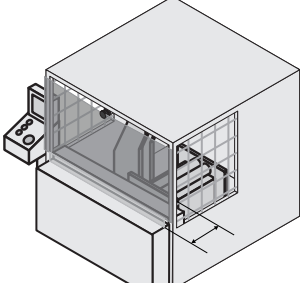
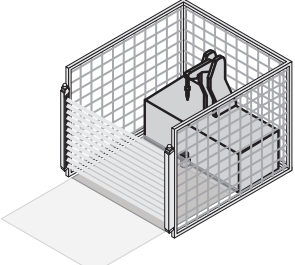
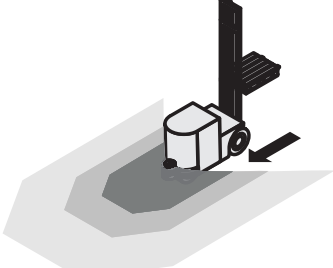
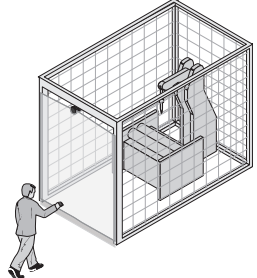


Fig. 5: Protective Field Range



### Applications

Table 2: Possible applications for the SafeZone Mini

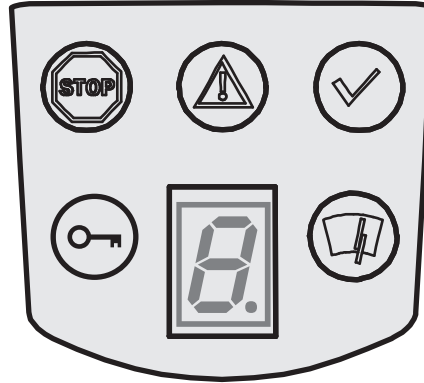
<p>SafeZone Mini: Hazardous area protection on an insertion station</p>	
<p>SafeZone Mini: Hazardous point protection on an insertion station</p>	
<p>SafeZone Mini: Presence detection for a safety light curtain</p>	
<p>SafeZone Mini: Protection of an automated guided vehicle (AGV) for one velocity</p>	
<p>Access protection for high areas of access</p>	

## Status indicators

### LEDs and seven-segment display

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

Fig. 6: Status indicators on the SafeZone Mini



The symbols have the following meaning:

Table 3: Status indicators on the SafeZone Mini

Symbol	SafeZone Mini
	OSSDs in the OFF state (e.g. in case of object in the protective field, monitored contour changed, reset required, lock-out)
	Warning field interrupted (object in 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

**Note** You will find detailed information in Chapter 11, “Error and status indications on the LEDs” on page 52 and in “Error and status indications on the seven-segment display” on page 52).



# Chapter 4

## Configurable functions

### System parameters

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



You enter the application name and the names of the safety laser scanners used in the 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 may “reserve” the devices for certain duties. A machine maintenance person comparing exchanged devices with the configuration data saved in the SCD software will be notified that the application name does not match. He may then exchange these devices for those 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.

#### Recommendation

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

#### User data

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

#### Display direction of the seven-segment display

The depiction of numbers on the seven-segment display can be rotated by 180° with the aid of the SCD software. This is useful, for example, when the SafeZone Mini must be rotated by 180° owing to the specific assembly.

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

#### How to 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, the numbers of the seven-segment display are rotated by 180°.

## Application



With the help of the SCD software you can configure the SafeZone Mini 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.)]
<b>Resolution</b>	
<ul style="list-style-type: none"> <li>• 30 (1.2) (hand detection with smaller protective field size)</li> <li>• 40 (1.6) (hand detection with larger protective field size)</li> <li>• 50 (2.0) (leg detection with smaller protective field size)</li> <li>• 70 (2.8) (leg detection with larger protective field size)<sup>①</sup></li> </ul>	<ul style="list-style-type: none"> <li>• 30 (1.2) (hand detection with smaller protective field size)</li> <li>• 40 (1.6) (hand detection with larger protective field size)</li> <li>• 50 (2.0) (leg detection with smaller protective field size)</li> <li>• 70 (2.8) (leg detection with larger protective field size)</li> <li>• 150 (5.9) (whole body detection)</li> </ul>
<b>Manipulation prevention</b>	
The safety laser scanner checks whether in any 90° segment all measured values correspond to the maximum distance value that can be measured.	
If this is the case, the SafeZone Mini shuts down after <b>2 hours</b> and signals .	If this the case, the SafeZone Mini shuts down after <b>5 seconds</b> and signals .

### Resolution

The maximum protective field range<sup>②</sup> 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	3 m
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)	

**Note** 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 Chapter 12, “Technical Specifications” on page 55).

### Basic response time

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

**Note** You may need to add supplements to the basic response time due to multiple sampling (see Chapter 12, “OSSD response times” on page 55).

### Maximum protective field range

Depending on the configured resolution used (see Chapter 4, “Resolution” on page 16), the maximum protective field range of the safety laser scanner is shown in the SCD software.

**Note** The maximum protective field range of the SafeZone Mini must be sufficient to cover the calculated protective field size including the necessary supplements (see Chapter 5, “Protective field size” on page 25).

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

② Radial distance to the safety scanner.

## Universal I/O connections of the SafeZone Mini

### 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 has two universal I/O connections (see Chapter 6, “Round plug connector SafeZone Mini” on page 40). 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 18)
- Resetting the restart interlock (see page 18)

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

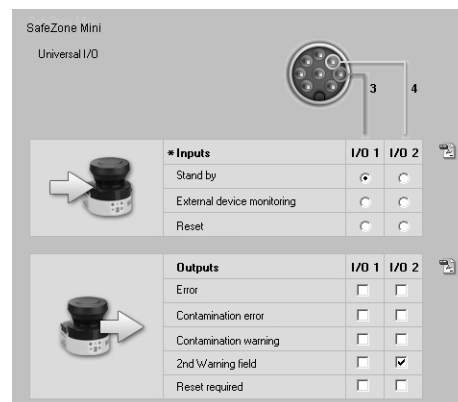
- Device error
- Contamination error
- Contamination warning
- Second warning field
- Reset required

**Note** 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. Fig. 7 shows a configuration example.

Fig. 7: Configuration example universal I/O connections of the SafeZone Mini



#### 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 can be switched off. In this way the power consumption of the device is reduced.

**Recommendation** Use this function if, e.g. you use several vehicles and do not move them for a time.

The SafeZone Mini remains in the stand-by mode as long as the related input information is present.

## OSSDs

### Internal OSSDs of the SafeZone Mini



If there is an object in the protective field, the internal OSSDs on the SafeZone Mini always switch. This can **not** be configured differently in the SCD software.

### External device monitoring (EDM) SafeZone Mini

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 checks the contactors after each interruption of the protective field and prior to the machine restart. The EDM can so identify if one of the contactors has welded, for instance. In this case the external device monitoring places the system in a safe operational state and the OSSDs are not switched back to the ON state.

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

Table 6: Behavior of the SafeZone Mini on a contactor malfunction

Without internal restart interlock or with restart delay	<ul style="list-style-type: none"> <li>The system locks completely (lock-out).</li> <li>The error message 8 appears in the seven-segment display.</li> </ul>
With restart interlock	<ul style="list-style-type: none"> <li>The SafeZone Mini switches its OSSDs to the OFF state.</li> <li>The LED  is illuminated.</li> <li>The error message  e appears in the seven-segment display.</li> </ul>



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

#### Note

You will find examples on the connection of the external device monitoring in Chapter 7, “Connection diagrams” on page 43.

## Restart of the SafeZone Mini Standard

You can configure the restart behavior of the SafeZone Mini 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 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 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 (see Chapter 5, “Methods of preventing unprotected areas” on page 33).

### Configuration of the SafeZone Mini without restart interlock

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

This configuration is only allowed . . .

- If an external restart interlock is realized on the machine controller

or

- If the protective field **cannot** be left in the direction of the hazardous point and if people can be detected by the SafeZone Mini **at every point in the hazardous area!**

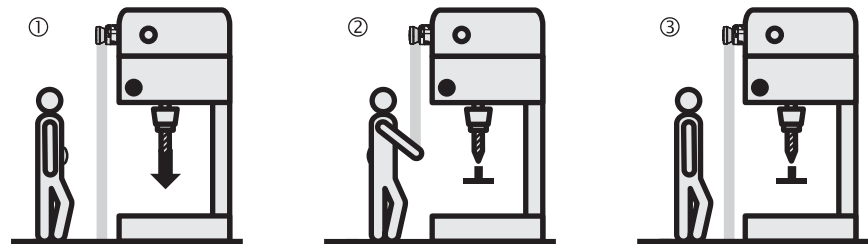
### Restart delay for mobile applications

In mobile applications you can configure a restart delay from 2 to 60 seconds on the SafeZone Mini. The OSSDs on the SafeZone Mini 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!

Fig. 8: Schematic outline of the operation with restart interlock

### Configuration of the SafeZone Mini with restart interlock



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

The OSSDs on the SafeZone Mini change to the OFF state to initiate a machine ① or vehicle stop as soon as there is an object in the protective field ②. They do not change to the ON state ③, 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. Ensure that the person who operates the control switch has a full view of the hazardous area.


#### Notes

- You will find examples on the connection of the internal restart interlock in Chapter 7, “Connection diagrams” on page 43.
- 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 Chapter 4, “Universal I/O connections of the SafeZone Mini” on page 17).

#### Reset

**Note** The reset function is often also called “preparation for restart.” In these operating instructions the term **reset** is used. If you want to activate the restart interlock on the SafeZone Mini (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 SafeZone Mini switches its OSSDs to the ON state.
- The LED  on the SafeZone Mini illuminates green.

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

#### ATTENTION



**Ensure that the correct sequence is followed!**

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

#### Reset signals

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

#### ATTENTION



**The reset signal must be safety-related (single failure proof)!**

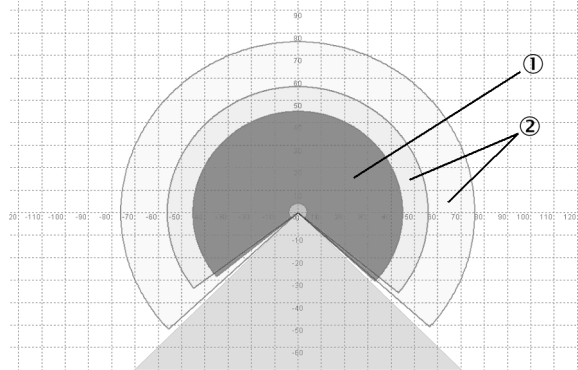
## Field sets

### Configuring the protective field 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.

Fig. 9: Creating a field set in the SCD software



**Note** The area to be monitored is scanned radially by the SafeZone Mini. The SafeZone Mini cannot see through objects during this process. The area behind objects that are in the area to be monitored (pillars, grilles, etc.) can thus not be monitored. Protective fields and warning field can cover up an angle of up to 270° and have different radial scanning ranges depending on the resolution configured (see Chapter 4, "Resolution" on page 16).

**ATTENTION**

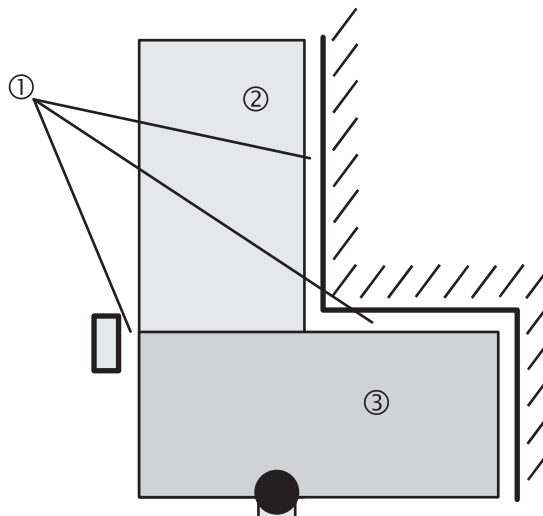


**Check the protective fields configured!**

Prior to commissioning the machine or vehicle, check the configuration of the protective fields using the instructions in Chapter 9, "Commissioning" on page 47 and using the "Checklist" on page 70.

**Note** If the protective field ③ or the warning fields ② stretch as far as a wall or another object (pillar, neighboring machine, shelf), there should be a distance of 100 mm (3.94 in.) between the protective field or warning field and the object to prevent false triggering ①.

Fig. 10: Configuring protective field and warning field



**ATTENTION**



**Secure unprotected areas!**

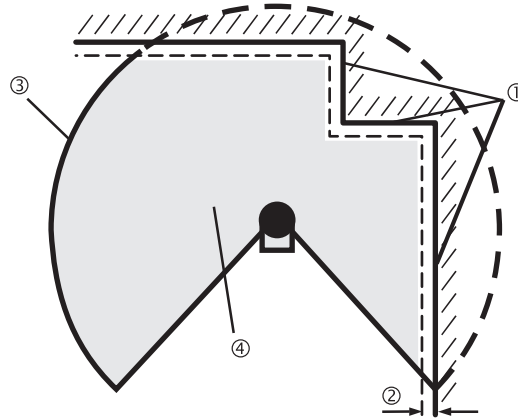
If it is possible to access a narrow strip between the protective field and a wall or another object, you must protect this strip using additional measures (e.g. fence or floor protection).

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



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

Fig. 11: Reading the protective field



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

**Note** The measuring error tolerances for the SafeZone Mini are automatically subtracted from the protective field size. As a result the protective field is slightly smaller than the surface covered ②.

In those places where the surrounding contour is larger than the protective field range ③, the protective field corresponds to the possible scanning range.

#### ATTENTION



#### Check the protective field suggested by the SCD software

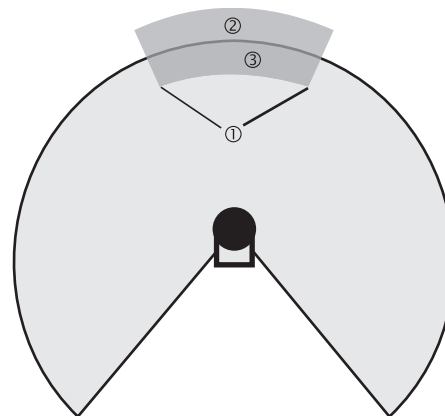
The protective field suggested by the SCD software is not a replacement for the calculation of the minimum distance. Calculate the minimum distance and check the effectiveness of the protective fields prior to commissioning the application!

Pay attention to the descriptions in Chapter 5, “Mounting” on page 24, the notes in Chapter 9, “Commissioning” on page 47 and the “Checklist” on page 70.

#### Using the contour as a reference

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

Fig. 12: Schematic diagram of contour as reference



For contour monitoring you define a contour segment ①. The contour segment comprises a positive ② and a negative ③ tolerance band.

The OSSDs on the SafeZone Mini change to the OFF state or the SafeZone Mini Remote signals if . . .

- There is an object in the protective field.
- The monitored surrounding contour is no longer in the tolerance band (e.g. if the position of the SafeZone Mini is changed).

**Notes**

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

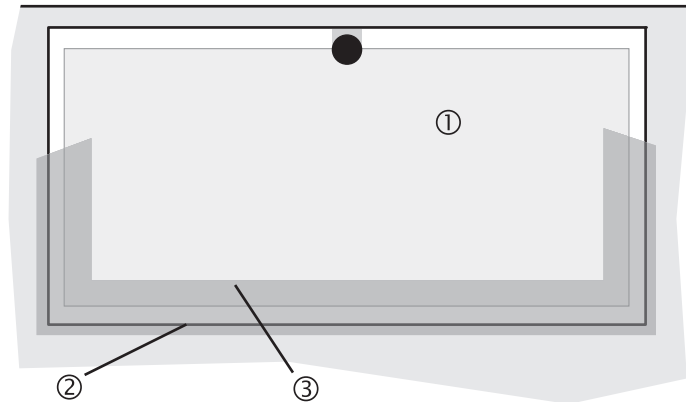


You define the contour as a reference in the SCD software field set editor.

**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 used with the contour as reference function.

Fig. 13: Contour as reference for vertical operation  
 ① Protective field  
 ② Contours of the machine opening  
 ③ Contour segment



**Recommendation**

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

**Monitoring cases**

The SafeZone Mini supports a configuration with monitoring cases.

**ATTENTION**



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

See Chapter 5, "Mounting" on page 24.



You can configure the monitoring cases in the SCD software.

Each monitoring case includes . . .

- The input conditions, the so-called control signals, that control the activation of the monitoring case.
- A field set, comprising of protective field and warning field or fields.
- 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 switches its OSSDs to the OFF state. In this way you can reduce the probability that insects, welding sparks or other particles result in the shutdown of the system.

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

### ATTENTION



#### The total response time is increased by the multiple sampling!

With a multiple sampling greater than two, note that you must add a supplement to the basic response time (see Chapter 12, "OSSD response times" on page 55)!

On the SafeZone Mini, 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 resulting 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

**Recommendation** Using 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 (e.g. for battery charging), the OSSDs can be switched to the OFF state and the laser on the SafeZone Mini can be switched off. In this way the power consumption of the device is reduced.

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

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

In order to switch to the stand-by mode, on the SafeZone Mini one universal I/O connection must be configured as stand-by input. (see Chapter 4, "Universal I/O connections of the SafeZone Mini" on page 17).

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

## 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

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 ensured.

- Notes**
- Mount the SafeZone Mini in a dry place and protect the device from dirt and damage.
  - Avoid the installation of the SafeZone Mini in the vicinity of strong electric fields. These can, e.g., be produced by welding cables, induction cables in the immediate vicinity and also by mobile telephones operated nearby.
  - Ensure that there are no obstacles in the area to be monitored in the field of view of the SafeZone Mini that could cause interference or shadowing. Such shadowed areas cannot be monitored by the SafeZone Mini. 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 may be impaired and incorrect switching may occur.
  - Avoid placing highly reflective objects in the scan plane of the SafeZone Mini. Examples: Retroreflectors can affect the measurement results of the SafeZone Mini. Highly reflective objects within the protective field can blank a part of the area to be monitored in certain circumstances.
  - Mount the SafeZone Mini 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 may affect the SafeZone Mini in specific circumstances.
  - Mark the protective field on the floor, if this is reasonable for the application (see EN 61496-1 in Chapter 7).

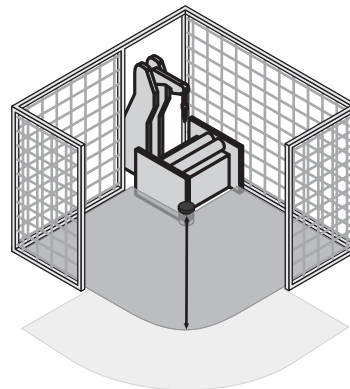
The following steps are necessary after mounting:

- Completing the electrical connections (Chapter 6, "Electrical installation")
- Configuration of the protective field (Chapter 8, "Configuration")
- Commissioning and checking of the installation (Chapter 9, "Commissioning")
- Checking the function and safe shutdown (Chapter 9, "Test notes")

### Stationary application in horizontal operation

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

Fig. 14: Horizontal stationary application



For a horizontal stationary application determine . . .

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

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

### Protective field size

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

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

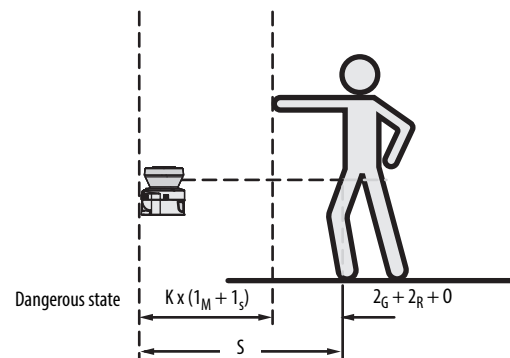
**ATTENTION**



**Ensure 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 the scan plane at 70 mm resolution" on page 33).

Fig. 15: Minimum distance  $S$



### The minimum distance $S$ depends on:

- Approach speed of the body or parts of the body
- Stopping/run-down time of the machine or system  
(The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- Response time of the SafeZone Mini
- Supplements for general measurement errors and any measurement errors related to reflection
- Supplement for prevention of reaching over
- Height of the scan plane
- Possibly the time for switching between the monitoring cases

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

➤ First, calculate  $S$  using the following formula:

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

Where . . .

$K$  = Approach speed (1600 mm/s (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 and the downstream controller

$Z_G$  = General safety supplement of the SafeZone Mini = 100 mm (3.94 in.)

$Z_R$  = Supplement for measurement error related to reflection

$C$  = Supplement for prevention of reaching over

**Response time  $T_S$  of the SafeZone Mini**

The response time  $T_S$  of the SafeZone Mini depends on ...

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

See Chapter 12 "OSSD response times" on page 55.

**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!**

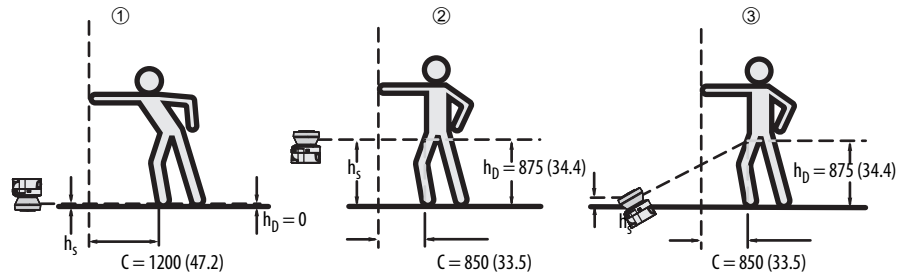
With retroreflectors positioned at a distance of less than 1 m (39.4 in.) from the boundary of the protective field a supplement,  $Z_R$ , of 200 mm (7.87 in.) must be added to the protective field.

**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 shuts down the dangerous state. For this reason the calculation of the minimum distance must take into account a supplement to prevent persons from finding themselves in a hazardous situation by reaching over (see EN ISO 13857) before the SafeZone Mini triggers.

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

Fig. 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. The optimal variation depends on the related application. Table 8 provides assistance making the selection.

Table 8: Advantages and disadvantages of mounting variations [mm (in.)]  
 $H_D$  = Detection height  
 $H_S$  = Scanner mounting height

Mounting orientation	Benefit	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

**ATTENTION**



**In case of scan planes at a height of more than 300 mm (11.81 in.) ensure 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 prevent crawling beneath by means of additional measures. For applications that are accessible to the public, the mounting height may need to be reduced to 200 mm (7.87 in.) (on this subject see the appropriate regulations).

**How to calculate the supplement C:**

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

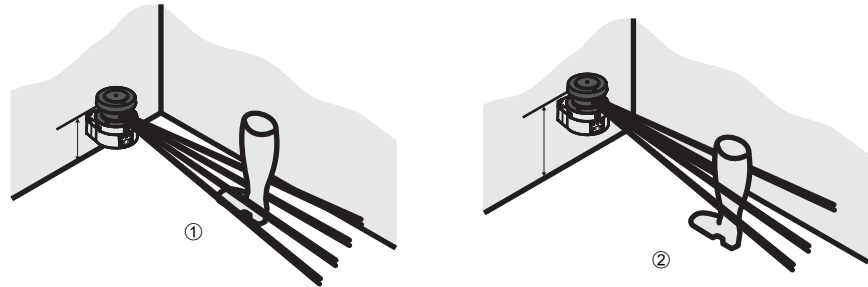
$$C = 1200 \text{ mm} - (0.4 \times H_D)$$
 Here  $H_D$  is the height at which the protective field is mounted.

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

**Height of the scan plane at 70 mm (2.8 in.) resolution**

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

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

If you mount the SafeZone Mini higher, the scan plane is at fibula height and the leg is also detected with an object resolution of 70 mm (2.8 in.) ②.

**Stationary vertical operation for access protection**

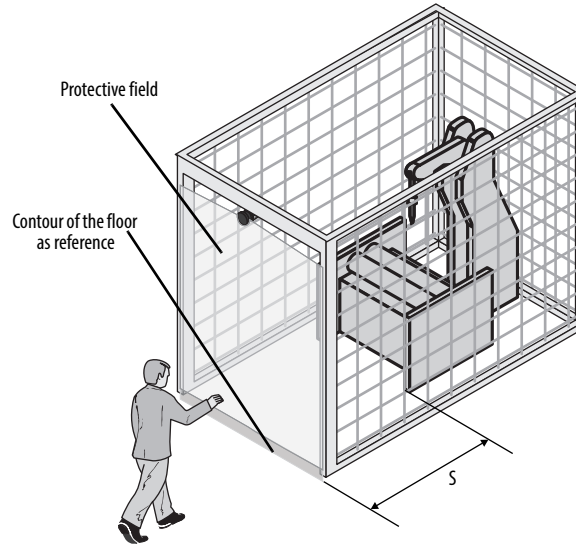
Access protection can be used when the access to the machine can be defined by physical means. For access protection the SafeZone Mini detects the entry of an entire body.

- Notes**
- To ensure adequate access protection, a response time of  $\leq 90$  ms and a resolution of 150 mm (5.91 in.) or finer are required.
  - To protect the protective device against inadvertent adjustment or manipulation, you must use the contour of the surroundings as a reference for the SafeZone Mini (see Chapter 4, "Using the contour as a reference" on page 21).

**Minimum distance**

For access protection, a minimum distance (S) must be maintained between protective field and hazardous area. This safety distance ensures that the hazardous point can only be reached after the dangerous state of the machine has been completely stopped.

Fig. 18: Access protection



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

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

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

➤ First, calculate S using the following formula:

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

Where ...

- K = Approach speed (1600 mm/s (63 in./s), defined in EN ISO 13855)
- T<sub>M</sub> = Stopping/run-down time of the machine or system
- T<sub>S</sub> = Response time of the SafeZone Mini
- C = Supplement against reaching through (850 mm (33.5 in.))

**Response time T<sub>S</sub> of the SafeZone Mini**

**ATTENTION**



**The total response time of the SafeZone Mini 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 ensure that the areas the safety laser scanner cannot see are protected by additional measures.

The response time T<sub>S</sub> of the SafeZone Mini depends on ...

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

See Chapter 12, "OSSD response times" on page 55.

## Stationary vertical operation for hazardous point protection

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

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

### ATTENTION



#### Never use the SafeZone Mini for safety applications in which finger protection is required!

Due to the finest possible resolution of 30 mm (1.2 in.), the SafeZone Mini is not suitable for finger protection.

To protect the protective device against inadvertent adjustment or manipulation, you must use the contour of the surroundings as a reference for the SafeZone Mini (see Chapter 4, "Using the contour as a reference" on page 21).

#### Minimum distance

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

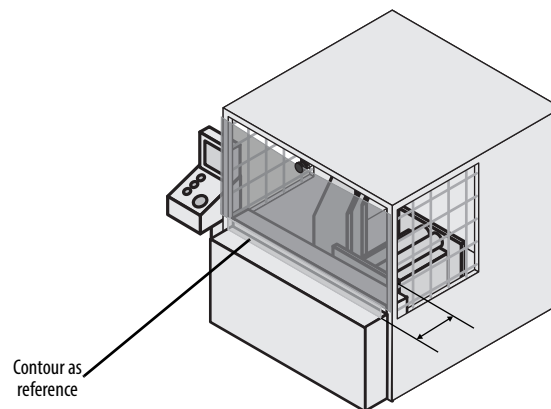
### ATTENTION



#### Prevent reaching around or reaching behind the protective field!

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

Fig. 19: Minimum distance to the hazardous area



#### The minimum distance $S$ as defined in EN ISO 13855 and EN ISO 13857 depends on:

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

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

➤ First, calculate  $S$  using the following formula:

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

Where ...

$S$  = Minimum distance [mm]

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

$T_S$  = Response time of the SafeZone Mini

$d$  = Resolution of the SafeZone Mini [mm]

- Note** The reach/approach speed is already included in the formula.
- If the result  $S$  is  $\leq 500$  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 using the following calculation:
 
$$S = 1600 \times (T_M + T_S) + 8 \times (d - 14) \text{ [mm]}$$
  - If the new value  $S$  is  $> 500$  mm (19.7 in.), then use the newly calculated value as the minimum distance.
  - If the new value  $S$  is  $\leq 500$  mm (19.7 in.) then use 500 mm (19.7 in.) as the minimum distance.

### Response time $T_S$ of the SafeZone Mini

The response time  $T_S$  of the SafeZone Mini depends on ...

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

See Chapter 12, "OSSD response times" on page 55.

## Mobile applications

If the dangerous state is produced by a vehicle (e.g. AGV or fork lift), the hazardous area that is produced by the movement of the vehicle is protected by the SafeZone Mini.

- Notes**
- The SafeZone Mini may only be used to protect vehicles powered by electric motor.
  - In the following calculations only take into account the velocity of the vehicle, not the speed of the person walking. This is based on the assumption that the person will recognize the danger and stand still.
  - For vehicle protection, observe EN 1525 "Safety of industrial trucks. Driverless trucks and their systems."
  - If the application is to protect vehicles from collisions, then you may need to use different assumptions.

For a horizontally mounted mobile application, determine:

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

### Protective field length

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

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

- Calculate the necessary protective field length  $S_L$  using the formula:

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

Where ...

$S_A$  = Stopping distance

$Z_G$  = General safety supplement of the SafeZone Mini = 100 mm (3.94 in.)

$Z_R$  = Supplement for any reflection related measurement error of the SafeZone Mini

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

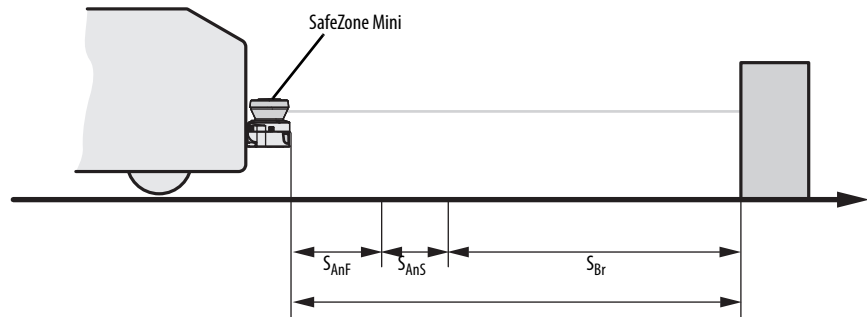
$Z_B$  = Supplement for the reduction in the braking performance of the vehicle to be found in the related vehicle documentation

### Stopping distance $S_A$

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

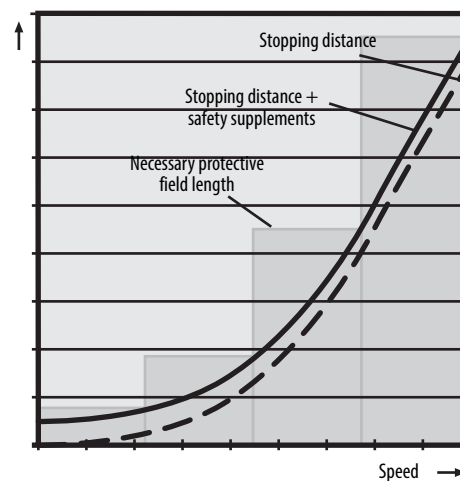


Fig. 20: Stopping distance



**Note** Take into account that the braking distance for a vehicle is not linear with increasing velocity, but increases in a square function.

Fig. 21: Stopping distance as a function of the vehicle velocity



#### How to calculate the stopping distance $S_A$ :

➤ Calculate the stopping distance  $S_A$  using the formula:

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

Where ...

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

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

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

#### Distance covered during the response time of the safety laser scanner

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

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

The response time  $T_S$  of the SafeZone Mini depends on ...

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

See Chapter 12, "OSSD response times" on page 55

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

➤ Calculate the distance  $S_{AnS}$  using the formula:

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

Where ...

$T_S$  = Response time of the safety laser scanner

$V_{max}$  = Maximum velocity of the vehicle from the related vehicle documentation

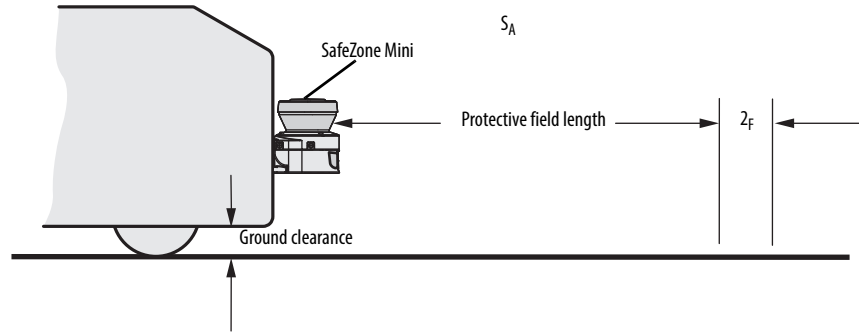
**Supplement  $Z_R$  for measurement errors caused by reflection**

With retroreflectors in the background at a distance of less than 1 m (39.4 in.) from the boundary of the protective field, the supplement  $Z_R$  is 200 mm (7.87 in.).

**Supplement  $Z_F$  due to lack of ground clearance**

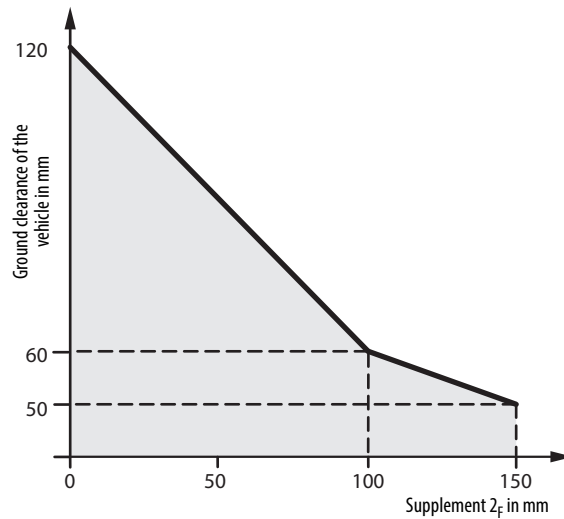
This supplement is necessary because a person is generally detected above the foot and the braking action can therefore not take into account the length of the foot in front of the detection point. If a vehicle has no ground clearance, a person may receive foot injuries.

Fig. 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 the diagram below:

Fig. 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.

**How to calculate the protective field width  $S_B$  (see EN ISO 13855):**

- Calculate the protective field width  $S_B$  using the formula:

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

Where ...

$F_B$  = Vehicle width

$Z_G$  = General safety supplement of the SafeZone Mini = 100 mm (3.94 in.)

$Z_R$  = Supplement for any reflection related measurement error of the SafeZone Mini

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

## Height of the scan plane

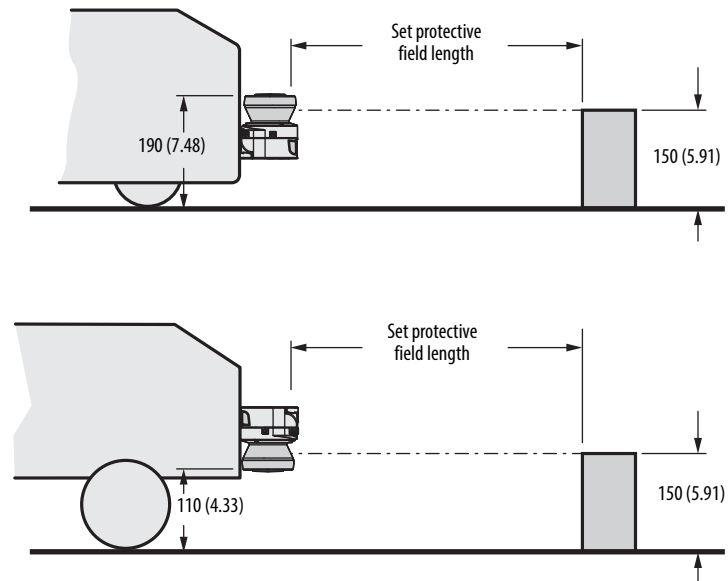
### ATTENTION



**Mount the SafeZone Mini such that the scan plane is at a maximum height of 200 mm (7.87 in.)!**

In this way also persons lying down will be reliably detected. Tilting the protective field so that 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.)

Fig. 24: Mounting height [mm (in.)]

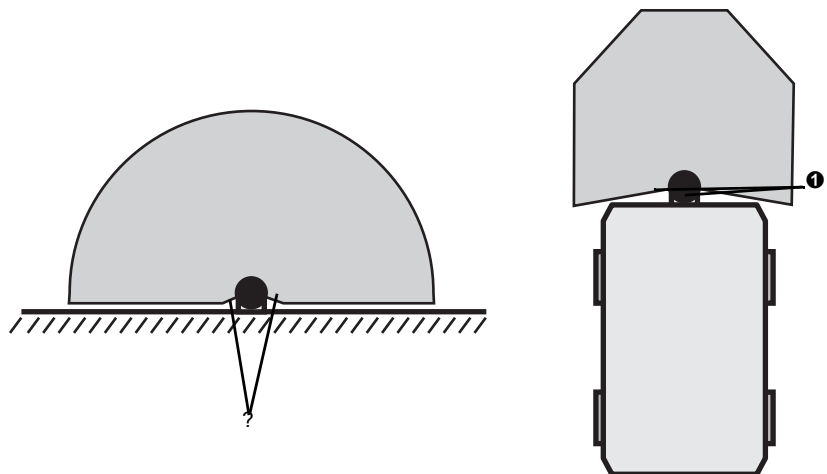


**Note** To produce the optimal scan plane, you can also mount the SafeZone Mini reversed.

## Methods of preventing unprotected areas

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

Fig. 25: Unprotected areas



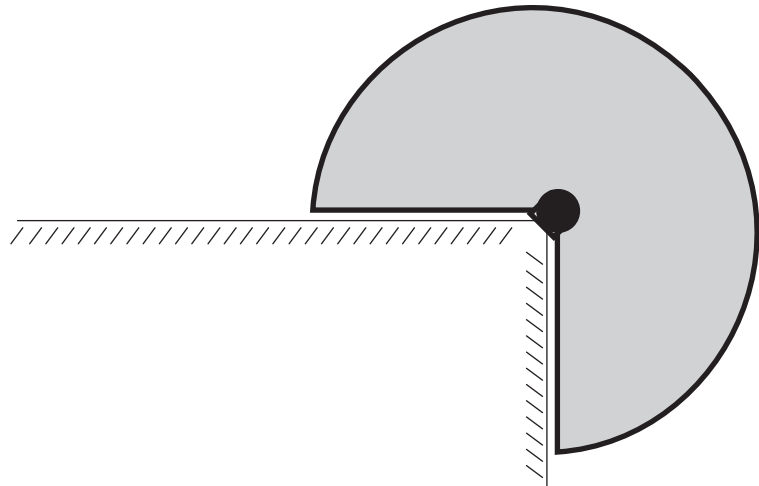
### ATTENTION



**Prevent or secure unprotected areas!**

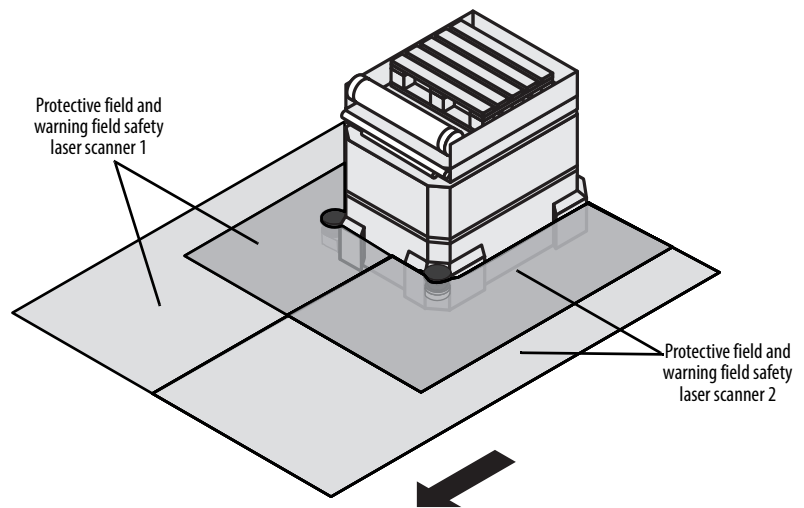
- Mount the SafeZone Mini such that there are no unprotected areas.
- For mobile applications, if the vehicle is accelerated to a maximum velocity of 0.3 m/s (11.8 in./s) in less than three seconds when in operation, you must prevent personnel from entering the unprotected areas by means of mechanical trim panels, switch strips or fitting the SafeZone Mini in the vehicle trim panels.

Fig. 26: Preventing unprotected areas



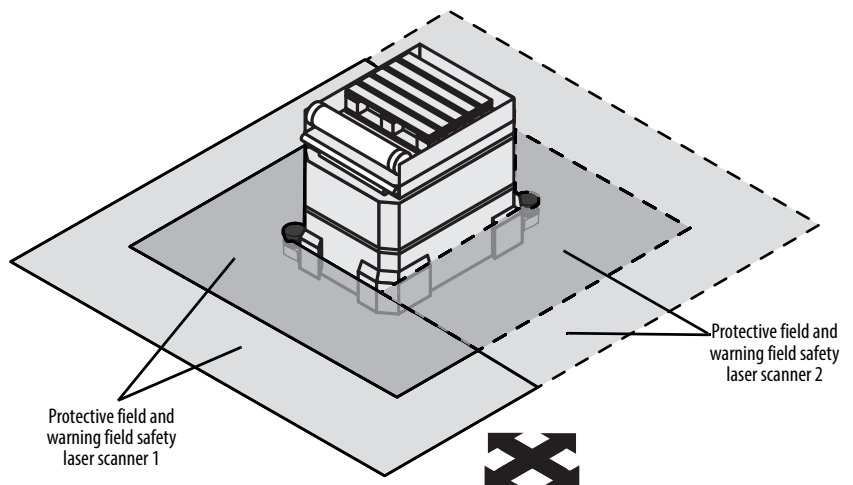
Mount the SafeZone Mini for example on a corner to prevent unprotected areas.

Fig. 27: Mounting example for front and side protection in a direction of travel



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

Fig. 28: Mounting example for all-round protection in all directions of travel



With two SafeZone Mini mounted diagonally opposite, you can implement protective fields on the vehicle for all-round 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 may then be accelerated as required.

## Mounting steps

### ATTENTION



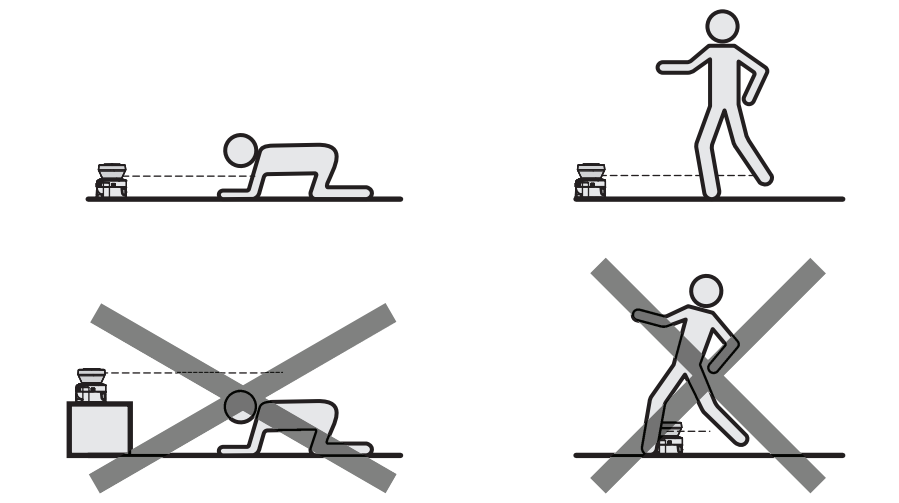
#### Only qualified safety personnel are allowed to separate materials!

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

#### Special features to note during mounting:

- Mount the SafeZone Mini such that it is protected from moisture, dirt and damage.
- Ensure that the entire field of view of the SafeZone Mini 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, prevent the fixing screws from coming loose using screw locking devices.
- Regularly check the tightness of the fixing screws.
- Prevent personnel from being able to crawl beneath, stand behind or climb over the protective field by means of appropriate mounting of the SafeZone Mini.

Fig. 29: Prevent crawling beneath, standing behind, climbing over



The origin of the scan plane is 80 mm (3.15 in.) above the bottom edge of the SafeZone Mini (see Fig. 54 on page 61).

There are three possible ways of fixing the SafeZone Mini:

- Direct mounting without mounting kit
- Mounting with mounting kit 1 or 2
- Mounting with mounting kit 3 (only in conjunction with mounting kit 1 or 2)

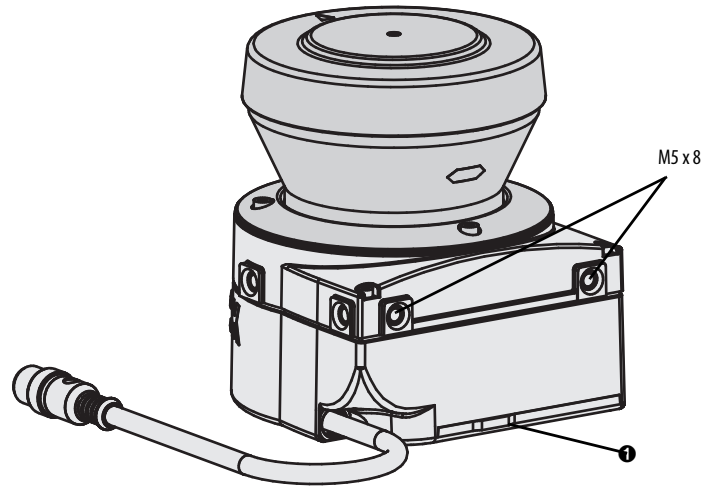
You will find the part numbers for the mounting kits in Chapter 13, "Mounting kits" on page 62.

**Note** Pay attention to the maximum torque of the M5 fixing screws on the SafeZone Mini of max. 5.9 Nm (4.4 ft-lb).

### Direct mounting

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

Fig. 30: Direct mounting

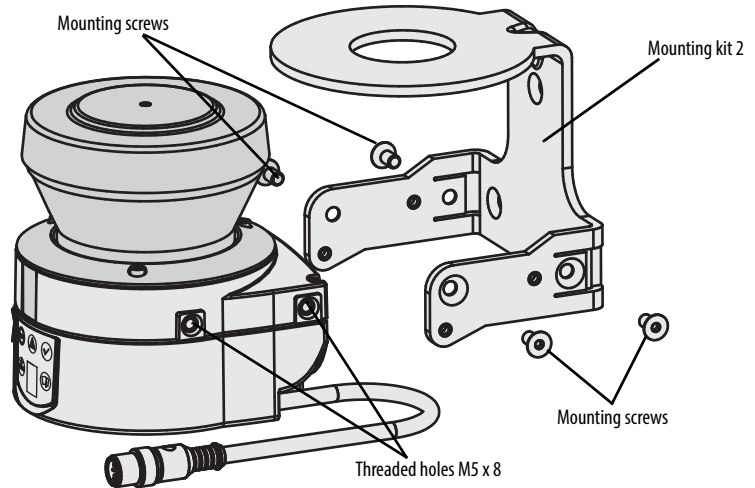


**Notes** During mounting, please observe the dimensional drawings in Chapter 12, “Dimensions” on page 61.

### Mounting with mounting kit 1 or 2

With the aid of mounting kit 1 or 2 you can mount the SafeZone Mini 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.

Fig. 31: Mounting with mounting kit 2 including protection for the optics cover



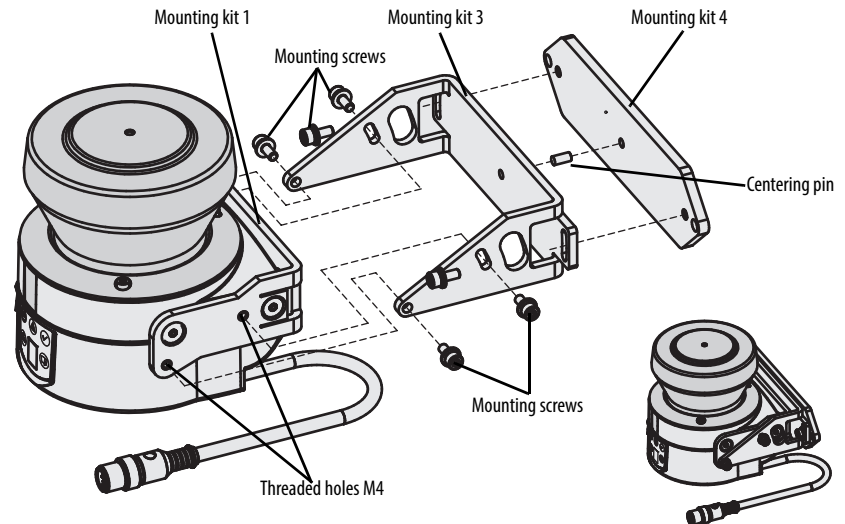
- Mount mounting kit 1 or 2 on the mounting surface.
- Then mount the SafeZone Mini on the mounting kit 1 or 2.

**Note** During mounting, please observe the dimensional drawings in Chapter 12, “Technical specifications” (see “Dimensions” on page 61).

### Mounting with mounting kit 3 and 4

With the aid of mounting kits 3 and 4 (only in conjunction with mounting kit 1 or 2) you can align the SafeZone Mini in two planes. The maximum adjustment angle is  $\pm 11^\circ$  in both planes.

Fig. 32: Mounting with mounting kit 2



- Mount mounting kit 1 or 2 to the SafeZone Mini.
- Mount the mounting kit 4 on the mounting surface.
- Fit the centering pin [4 mm (0.16 in.)] in the central hole on mounting bracket 4.
- Fit mounting kit 3 to mounting kit 4 and mount it using two fixing screws M4 × 10.
- Then mount the SafeZone Mini on mounting kit 3 with the aid of the threaded holes in mounting kit 1.
- Adjust the SafeZone Mini longitudinally and transversely and then tighten the six fixing screws on the mounting kits.

**Note** During mounting, please observe the dimensional drawings in Chapter 12, “Technical specifications” (see “Dimensions” on page 61).

### Information label Important information

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

### Using multiple SafeZone Mini safety laser scanners

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

**Note** In any circumstance observe EN ISO 13855 when calculating the minimum distance.

Use mounting kits 1 or 2 and 3 to adjust the safety laser scanners to different angles (see Chapter 13, “Mounting kits” on page 65).

Fig. 33: Opposite mounting



Fig. 34: Offset parallel mounting

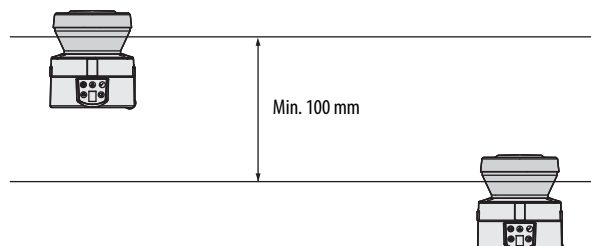


Fig. 35: Mounting on a cross

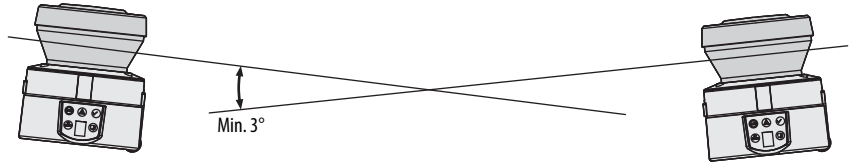


Fig. 36: Reverse mounting, parallel offset

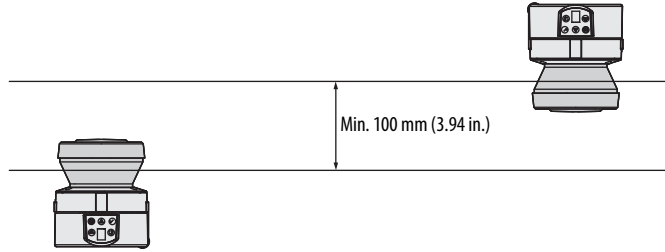
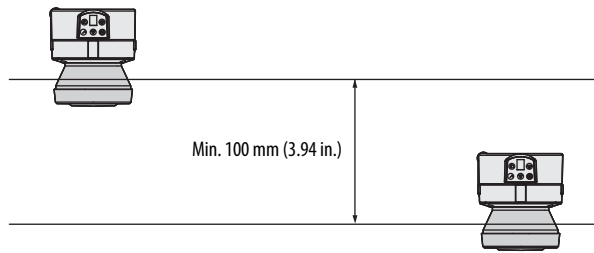


Fig. 37: Reverse mounting of two SafeZone Mini, with parallel offset





# Chapter 6

## Electrical installation

**ATTENTION**



**Switch the entire machine/system off line!**

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

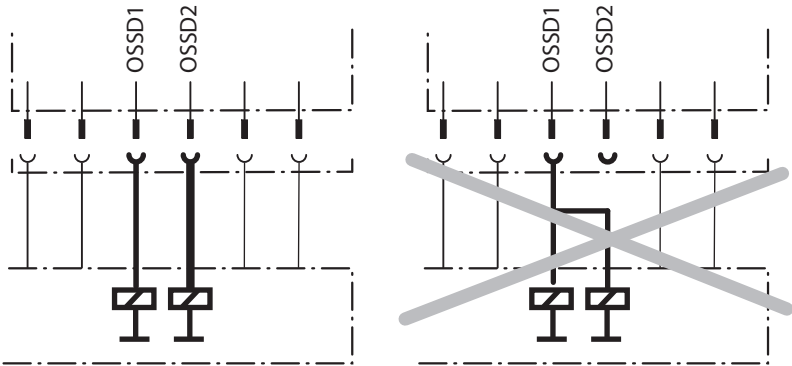
- Ensure that the entire machine/system is disconnected during the electrical installation.

**Connect OSSD1 and OSSD2 separately!**

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

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

Downstream contactors must be positively guided and monitored.

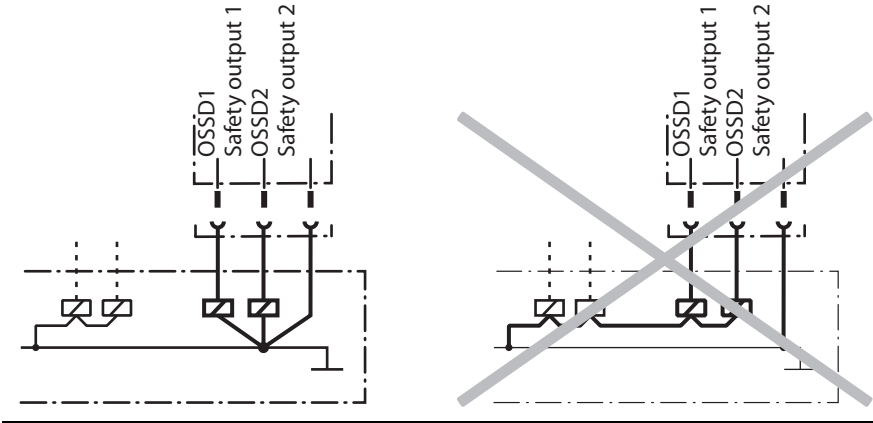


**Only ever connect one downstream switching element to an OSSD!**

Each output signal switching device (OSSD) is only allowed to be connected to one switching element (e.g. relay or contactor). If several switching elements are required, you must choose a suitable form of contact duplication.

**Prevent the occurrence of a potential difference between the load and the protective device!**

- If you connect loads that are not reverse-polarity protected to the OSSDs or the safety outputs, you must connect the 0 V connections of these loads and those of the corresponding protective device individually and directly to the same 0 V terminal strip. This is the only way to ensure that, in the event of a defect, there can be no potential difference between the 0 V connections of the loads and those of the corresponding protective device.



- Notes**
- Route all cables and connection cables such that they are protected from damage.
  - Ensure that also the controller connected and all devices related to safety have the required category as per EN ISO 13849-1 or the required performance level as per EN ISO 13849-1!
  - If you use screened cables, lay the screen evenly around the connection terminal.
  - Ensure that the SafeZone Mini is adequately protected electrically. You will find the electrical data necessary for determining the correct fuse in Chapter 12, "Data sheet" on page 58.

## System connection

You will find all the inputs and outputs on the SafeZone Mini on the round plug connector on the connecting cable. Connect the SafeZone Mini using pre-assembled extension cables (see Table 10 on page 41).

- Notes**
- All inputs and outputs on the SafeZone Mini 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 claims against Rockwell Automation under the warranty will be rendered void.

### Wiring in accordance with EMC regulations

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

- If it is not possible to connect the screen via threaded fittings, connect the screen physically close, e.g. to a control cabinet chassis using a metal clamp.

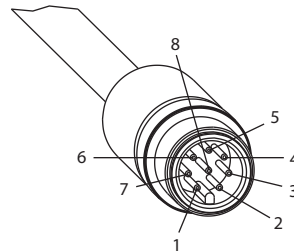
- Notes**
- If there is a PE in an installation, it can be used for the connection of the FE. However a functional earth connection (FE) is never allowed to be used as a PE!

### Functional earth

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

### Round plug connector SafeZone Mini

Fig. 38: Round plug connector SafeZone Mini



### Pin assignment:

Table 9: Pin assignment of the SafeZone Mini

Pin	Signal	Function
1	WF	Output for warning field 1
2	+24V DC	Supply voltage SafeZone Mini
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

Use the cordsets listed in [Table 18: Ordering information on page 65](#) to connect the SafeZone Mini.

### Core assignment of the SafeZone Mini extension cable

Table 10: Core assignment of the SafeZone Mini 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 of the SafeZone Mini

**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, e.g. for the transfer of information to controllers.

### Configuration connection M8 × 4 (serial interface)

Fig. 39: Pin assignment configuration connection M8 × 4

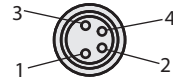


Table 11: Pin assignment configuration connection M8 × 4

Pin	SafeZone Mini	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

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

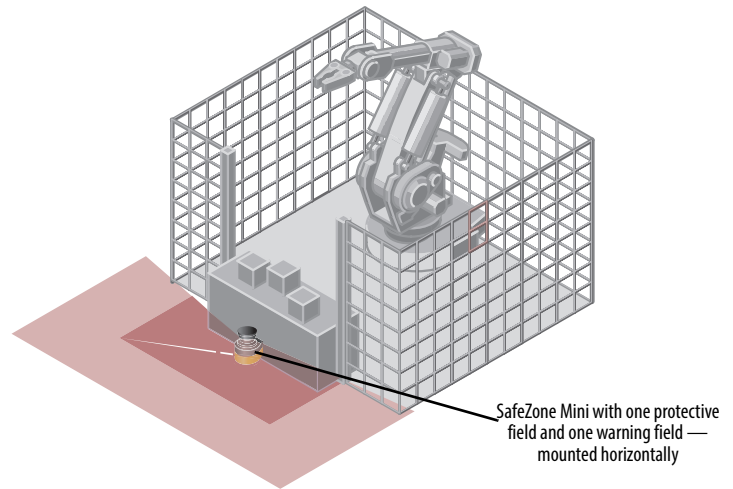
## Application examples and connection diagrams

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

### Stationary applications

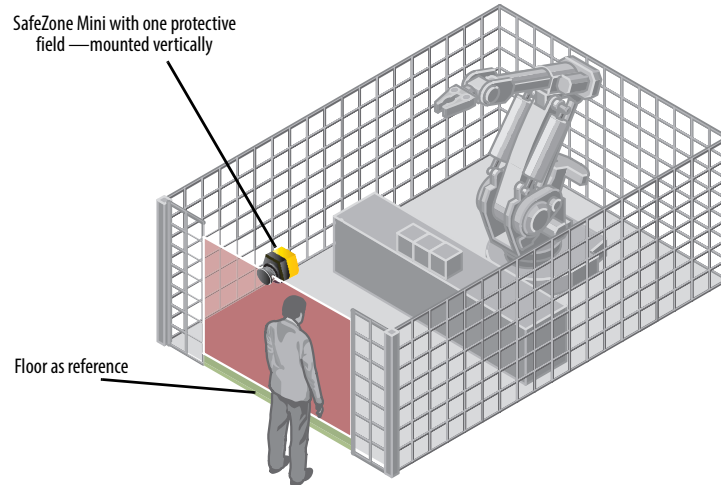
### Applications with one monitored area (SafeZone Mini)

Fig. 40: Hazardous area protection with SafeZone Mini



The area is permanently monitored by the SafeZone Mini.

Fig. 41: Access protection with SafeZone Mini

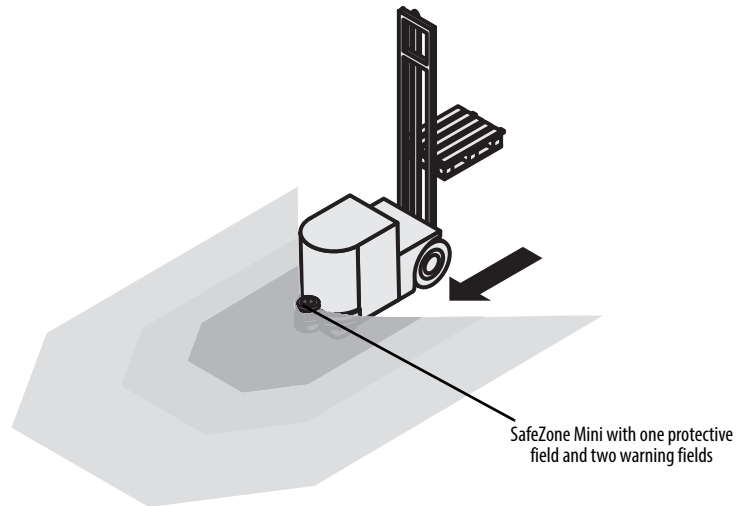


The access is monitored permanently. For safety against manipulation on the SafeZone Mini, e.g. the floor is used as a reference. If the alignment of the SafeZone Mini changes (e.g. due to changes to the bracket), the SafeZone Mini switches its OSSDs to the OFF state.

## Mobile applications

### Vehicle monitoring for unidirectional travel (SafeZone Mini)

Fig. 42: Vehicle monitoring with SafeZone Mini



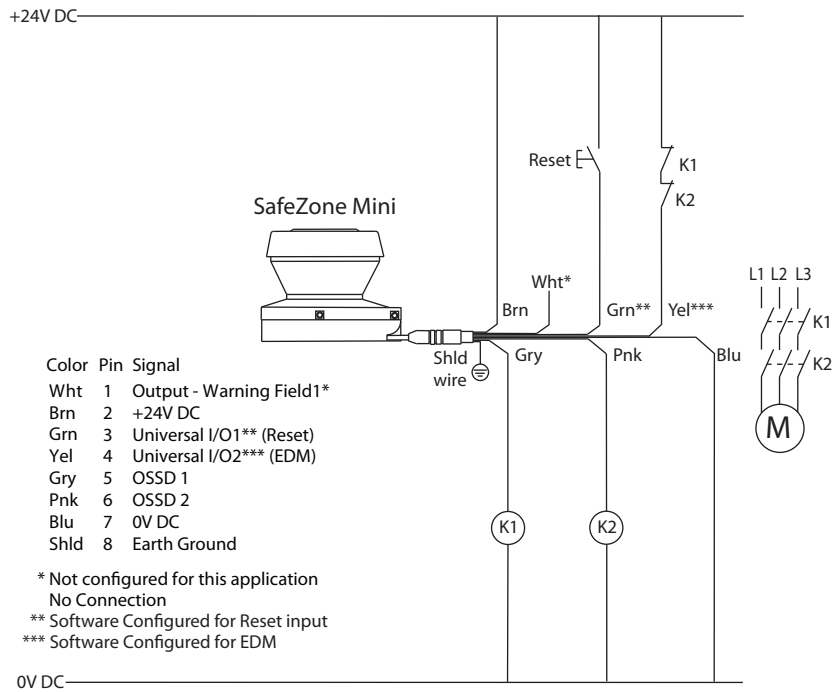
The SafeZone Mini monitors the area in the direction of travel and switches its OSSDs to the OFF state to stop the vehicle as soon as there is an object in the protective field.

## Connection diagrams

- Notes**
- Only use relays/contacts with positively guided contacts. The protection elements connected in parallel with the relays/contactors are used for arc-suppression.
  - Ensure that there is adequate arc-suppression at the relays/contactors. Take into account that arc-suppressors may lengthen the response time.
  - The arc-suppressors must be in parallel with the relays/contactors (not across the contacts).

### SafeZone Mini with restart interlock and external device monitoring

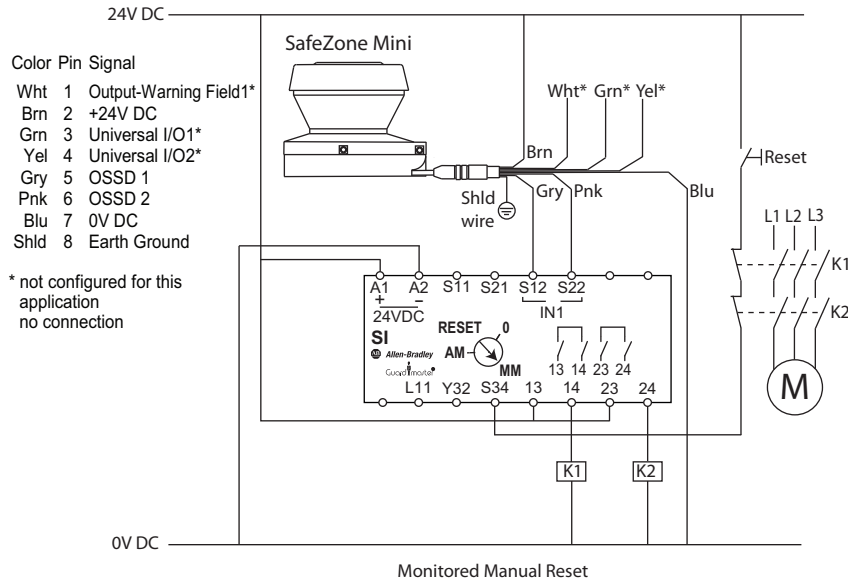
Fig. 43: Connection diagram for SafeZone Mini with restart interlock and external device monitoring



SafeZone Mini in conjunction 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).

### SafeZone Mini in combination with a GSR SI safety relay

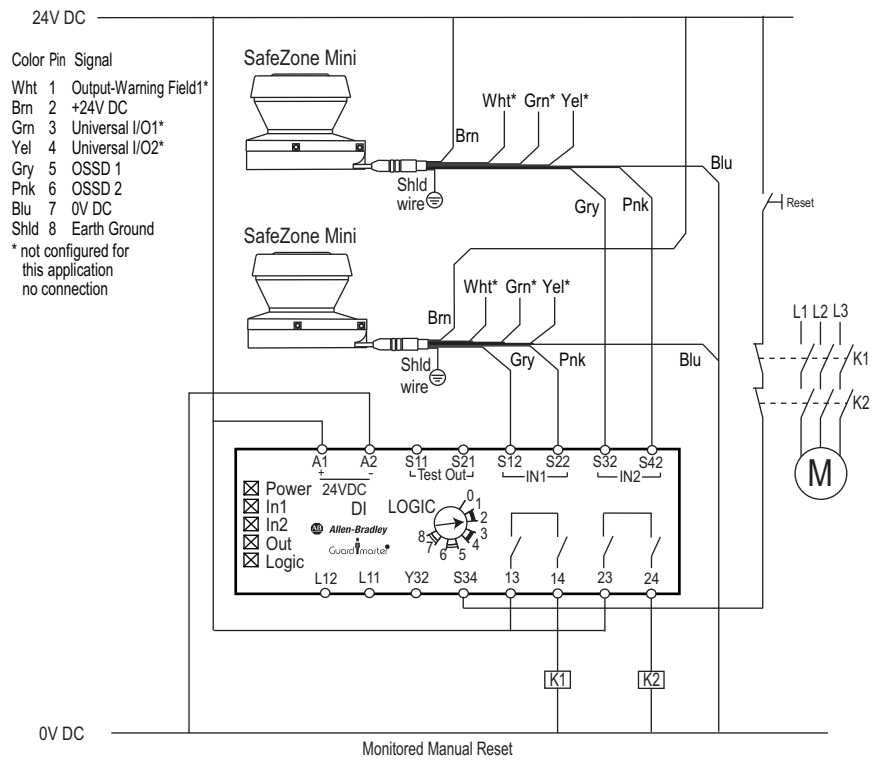
Fig. 44: Connection diagram for SafeZone Mini in combination with a GSR SI safety relay



SafeZone Mini in combination with a GSR SI safety relay; operating mode of SafeZone Mini is ON/OFF and GSR SI is configured for monitored manual reset.

**Two SafeZone Mini safety laser scanners with GSR DI**

Fig. 45: SafeZone Mini in combination with a GSR DI safety relay





Two SafeZone Mini safety laser scanners connected to a GSR DI safety relay. The GSR DI is configured for monitored manual reset. SafeZone Mini scanners are configured for ON/OFF.

## Configuration

### Default delivery status

The SafeZone Mini is delivered in a non-configured default state.

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

### Preparation of the configuration

#### How to prepare the configuration:

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

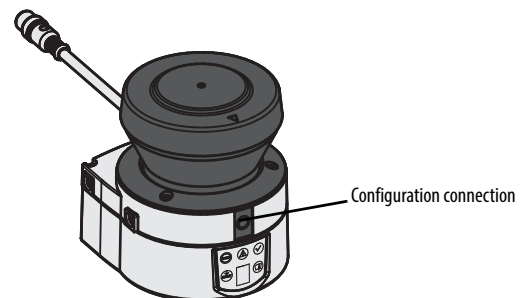
To configure the safety laser scanner you need:

- SCD Software on CD-ROM or downloaded from [www.ab.com/safety](http://www.ab.com/safety)
- PC/notebook with Windows NT 4/2000 Professional/XP/Vista/7 (32 Bit) and a serial RS-232 interface (PC/notebook not included)
- Service cable for connecting PC and SafeZone Mini

#### How to configure the SafeZone Mini with the aid of the SCD software:

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

Fig. 46: Configuration connection



Two service cables of different lengths are available for the connection of the PC/notebook (see Chapter 13, “Accessories” on page 65).

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

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



# Chapter 9

## Commissioning

### Initial commissioning

**ATTENTION**



**Commissioning requires a thorough check by qualified safety personnel!**

Before you operate a system protected by the SafeZone Mini safety laser scanner for the first time, make sure that the system is first checked and released by qualified safety personnel. The result of the test must be documented. Please read the notes in Chapter 2, "On safety" on page 6.

- Prior to releasing the machine, check whether the access to the hazardous area or the hazardous point is completely monitored by the protective devices.
- Also after approval of the machine, at regular intervals (e.g. in the morning prior to starting work) check whether the OSSDs (on the SafeZone Mini, a safety laser scanner 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 should be performed along all protective field boundaries as per the specific regulations for the application (see Chapter 9, "Test notes" on page 47).

**Power-up sequence**

After power up the SafeZone Mini 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 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 Chapter 11, "Error and status indications on the seven-segment display" on page 52.

Table 13: LED indication of the SafeZone Mini 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 Chapter 11, "Error and status indications on the LEDs" on page 52)

### Test notes

**Pre-commissioning tests**

The purpose of the pre-commissioning tests is to confirm the safety requirements specified in the national/international rules and regulations (EC conformity). This applies particularly to the safety requirements in the machinery directive or work equipment directive.

**ATTENTION**



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

Always expect that the machine, system or the protective device does not yet behave as you have planned.

- Ensure that there are no persons in the hazardous area during initial commissioning.

- Check the effectiveness of the protective device mounted to the machine, using all selectable operating modes as specified in the checklist in the annex (see Chapter 14, “Checklist for the manufacturer” on page 70).
- Ensure that the operating personnel of the machine protected by the safety laser scanner are correctly instructed by qualified safety personnel before being allowed to operate the machine. Instructing the operating personnel is the responsibility of the machine owner.
- Ensure that the information label **Important information**, which is included with the safety laser scanner on delivery, is affixed to the machine in a place where it is clearly visible for the operators. Ensure that the operators have the possibility to perform this daily check correctly.
- The annex to this document includes a checklist for review by the manufacturer and OEM. Use this checklist as a reference before commissioning the system for the first time (see Chapter 14.2 “Checklist for the manufacturer” on page 70).
- Document the adjustment of the safety laser scanner and the results of the testing during initial commissioning in a traceable manner. For this purpose also print out the complete configuration of the safety laser scanner (including protective field shapes) and include these with the documentation.

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

**Note** Your Rockwell Automation representative will be pleased to provide you with advice on initial commissioning.

### Regular inspection of the protective device by qualified safety personnel

- Check the system following the inspection intervals specified in the national rules and regulations. This procedure ensures that any changes on the machine or manipulations of the protective device after the initial commissioning are detected.
- If major changes have been made to the machine or the protective device, or if the safety laser scanner has been modified or repaired, check the system again as per the checklist in the annex (see Chapter 14, “Checklist for the manufacturer” on page 70).

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

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

**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 the installation of the SafeZone Mini must be checked by qualified safety personnel (see Chapter 9, “Regular inspection of the protective device by qualified safety personnel” on page 48).

- The test must be carried out for the relevant preset monitoring case.
- Check the mechanical installation to ensure that all mounting screws are secure and that the is properly aligned SafeZone Mini.
- Check each SafeZone Mini device for visible changes such as damage, manipulation etc.
- Switch on the machine/system.
- Watch the LEDs on each SafeZone Mini.
- If not at least one LED of each SafeZone Mini 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 in order to test the protective function for the entire system. The LEDs of the SafeZone Mini 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 stored in the SafeZone Mini and that any gaps are protected by additional safety measures. In the case of mobile applications, check that the moving vehicle actually stops in a timely manner at the protective field boundaries which are set in the SafeZone Mini 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.

# Chapter 10

## Maintenance and care

**ATTENTION**

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

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

**Switch the entire machine/system off line!**

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

### Cleaning optics cover

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

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

**Note** Static charges cause dust particles to be attracted to the optics cover. You can diminish this effect by using the anti-static plastic and the lens cloth.

**How to clean the optics cover:**

- Use a clean and soft brush to remove dust from the optics cover.
- 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.

### Replacing the 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. For this purpose the optics cover calibration must first be performed; this then serves as a reference for the contamination measurement (status = not contaminated).

The optics cover calibration is only allowed to be performed with a new optics cover! The new optics cover must be free of contamination at the time of the optics cover calibration. The optics cover calibration should be performed at room temperature [10°...30°C (50°...86° F)]!

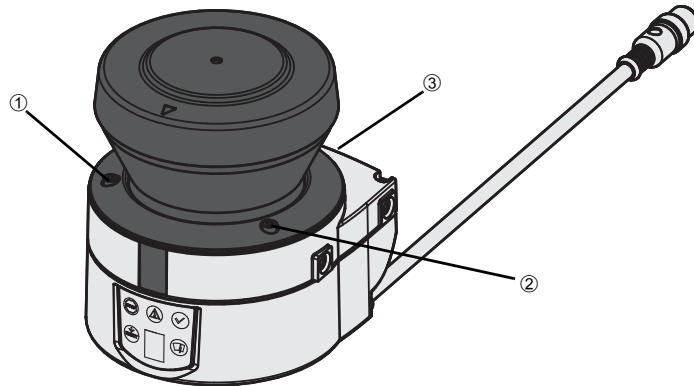
If the optics cover is scratched or damaged, you must replace the optics cover. Order the replacement optics cover from Rockwell Automation (see Chapter 13, "Accessories/spare parts" on page 65).

- Notes**
- The optics cover on the SafeZone Mini is an optical part that must not be soiled or scratched on replacement.
  - The optics cover is only allowed to be replaced by qualified safety personnel in a dust and dirt-free environment.
  - Never replace the optics cover during ongoing operation, as internal parts may be irreparably damaged in certain circumstances and dust particles may enter the device.
  - It is imperative that you avoid contamination of the inside, e.g. with fingerprints.
  - Do not use any additional sealant for sealing the optics cover, e.g. silicon, as these substances may affect the optics.
  - Use a torque wrench (universal joint) with 2.5 mm hex socket bit.
  - Mount the optics cover as per the following instructions to ensure that the housing is sealed to IP 65.

**How to replace the optics cover:**

- Notes**
- Only use a **new** optics cover (see Chapter 13, “Miscellaneous,” on page 65).
  - When replacing the optics cover, take ESD protection measures.
  - Set the torque wrench to 1.2 Nm (hand-tight) and have this at hand.
  - Disconnect the round plug connector on the end of the connecting cable and remove the SafeZone Mini.
  - Take the SafeZone Mini to a clean place (office, repair shop or similar).
  - First clean the outside of the SafeZone Mini. This prevents foreign bodies entering the device when it is opened.
  - Undo the mounting screws ① to ③. for the optics cover.

Fig. 47: Undo the mounting screws for the optics cover



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

**Re-commissioning the SafeZone Mini:**

- Correctly re-mount the SafeZone Mini (see Chapter 5, “Mounting,” on page 24).
- Connect the round plug connector on the end of the connection cable for the SafeZone Mini.
- Then perform an optics cover calibration with the aid of the SCD software.



# Chapter 11

## Diagnostics

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

### In the event of faults or errors

**ATTENTION**



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#### **Do not operate if behavior is unclear!**

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

#### **Repair only by authorized persons!**

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

---

### Rockwell Automation support

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

## Error and status indications on the LEDs

This section describes the meaning of the error and status indications of the LEDs and how you can respond. You will find a description of the indicators in Chapter 3, “Status indicators” on page 14, the connections for the outputs of the SafeZone Mini in Chapter 6, “System connection” on page 40.

Table 14: Error and status indications of the LEDs on the SafeZone Mini

Display	Output level	Possible cause	Rectification of the error
	At the OSSDs 	Object in the protective field, OSSDs in the OFF state	No error
	At the OSSDs 	Protective field unoccupied, OSSDs in ON state	No error
	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 If 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 indications on the 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 will find a description of the positions and symbols on the SafeZone Mini in Chapter 3, “LEDs and seven-segment display” on page 14.

### The lock-out operational status

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

- Rectify the cause of the fault per Table 15 on page 53.
- Switch off the power supply for the SafeZone Mini, wait at least three 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 indications on the seven-segment display

Display	Possible cause	Rectification of the error
	Power-up cycle — all segments are activated sequentially.	No error
	Object in protective field	No error
	Object in warning field 1	No error
	Object in warning field 2	No error
	Initialization of the device	<ul style="list-style-type: none"> <li>➤ The display goes out automatically when the SafeZone Mini has been initialized and/or the connection to the second device has been made.</li> </ul> <p>If the display  does not go off:</p> <ul style="list-style-type: none"> <li>➤ Check whether the partner device is in operation.</li> <li>➤ Check the wiring.</li> </ul> <p>If no partner device is connected:</p> <ul style="list-style-type: none"> <li>➤ Check the system configuration with the aid of the SCD software. Transfer the corrected configuration to the SafeZone Mini again.</li> </ul>
	Waiting for configuration or configuration not completed	<ul style="list-style-type: none"> <li>➤ The display goes off automatically once the configuration has been successfully transferred.</li> </ul> <p>If the display  does not go off:</p> <ul style="list-style-type: none"> <li>➤ Check the system configuration with the aid of the SCD software. Transfer the corrected configuration to the SafeZone Mini again.</li> </ul>
	Waiting for restart of the device	<ul style="list-style-type: none"> <li>➤ Switch off the voltage supply for the SafeZone Mini for at least two seconds and then switch it back on.</li> </ul>
or	Error of the external device monitoring (EDM)	<ul style="list-style-type: none"> <li>➤ Check whether the contactors are working correctly or if they are wired incorrectly and rectify any error.</li> <li>➤ If  is displayed: also switch off the voltage supply for the SafeZone Mini for at least two seconds and switch it back on.</li> </ul>
	Error in the control switch for restart or reset	<ul style="list-style-type: none"> <li>➤ Check the functionality of the control switch. The button may be defective or permanently operated.</li> <li>➤ Check the wiring of the control switch for short-circuit to 24 V.</li> </ul>
	SafeZone Mini has a malfunction or is faulty	<ul style="list-style-type: none"> <li>➤ Switch off the voltage supply for the SafeZone Mini for at least two seconds and then switch it back on.</li> </ul> <p>If the display does not go off:</p> <ul style="list-style-type: none"> <li>➤ Send the SafeZone Mini to the manufacturer for repair.</li> </ul>
	Overcurrent on OSSD connection 1	<ul style="list-style-type: none"> <li>➤ Check the switching element connected (contactor, relay). Replace, if necessary.</li> <li>➤ Check the wiring for short-circuit to 0V.</li> </ul>
	Short-circuit to 24V at OSSD connection 1	<ul style="list-style-type: none"> <li>➤ Check the wiring for short-circuit to 24V.</li> </ul>
	Short-circuit to 0V at OSSD connection 1	<ul style="list-style-type: none"> <li>➤ Check the wiring for short-circuit to 0V.</li> </ul>
Display	Possible cause	Rectification of the error
	Overcurrent on OSSD connection 2	<ul style="list-style-type: none"> <li>➤ Check the switching element connected (contactor, relay). Replace, if necessary.</li> <li>➤ Check the wiring for short-circuit to 0V.</li> </ul>
	Short-circuit to 24V at OSSD connection 2	<ul style="list-style-type: none"> <li>➤ Check the wiring for short-circuit to 24V.</li> </ul>
	Short-circuit to 0V at OSSD connection 2	<ul style="list-style-type: none"> <li>➤ Check the wiring for short-circuit to 0V.</li> </ul>

	Short-circuit between OSSD connection 1 and 2	➤ Check the wiring and rectify the error.
	General OSSD wiring error	➤ Check the complete wiring of the OSSDs.
	The SafeZone Mini is receiving no measured values within a range of at least 90° (measuring range maximum 29.9 m(98.1 ft)), it thus is not detecting any obstacles such as e.g. building walls.	➤ For the correct function of the safety laser scanner, always ensure that measured values are received within a range of 90°; this range can be moved as required within the scan range.
	Device is faulted.	➤ Check whether the SafeZone Mini is being affected by an external light source, e.g. headlight, infrared light sources, stroboscopic light, sun etc. ➤ If necessary, re-mount the device.
	Temperature error. The operating temperature of the SafeZone Mini has exceeded the permissible range.	➤ Check whether the SafeZone Mini is operated as per the permissible ambient conditions.
	Invalid configuration of the EDM	➤ Verify that the machine-side EDM is connected correctly.
	Undervoltage of the supply voltage	➤ Check the power supply or the connecting cables.
	There is a short-circuit between the input for the control switch for restart or reset and another input or output.	➤ Check the wiring for cross-circuits.
	Park/stand-by mode, the OSSDs of the SafeZone Mini are in the OFF state; the laser is deactivated.	No error. If the criteria for the park mode or the stand-by mode are withdrawn, readiness for operation is re-established.  If the display  does not go off: ➤ Test the level(s) at the universal I/O and at the control inputs that switch to the monitoring case with park mode.
	Optics cover calibration active	➤ No error
	Window for light output on the optics cover contaminated	➤ Clean the window for the light output on the optics cover.
	Optical saturation of the contamination measurement (there may not be an optics cover fitted)	➤ Check whether the SafeZone Mini is being affected by an external light source, e.g. headlight, infrared light source, stroboscopic light, sun etc.  Or: ➤ Fit the new optics cover (then perform optics cover calibration).

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

### The lock-out operational status

In case of certain faults or an erroneous configuration, the system can go into the lock-out status. The seven-segment display on the safety laser scanner then indicates , , , , , , , or . To place the device back in operation, proceed as follows:

- Rectify the cause of the fault as per Tab. 18.
  - Switch off the voltage supply for the SafeZone Mini for at least two seconds and then switch it back on.
- Or:
- Restart the safety laser scanner with the aid of the SCD software.

### 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.



# Chapter 12

## Technical specifications

Fig. 48: Diagram scanning range 2 meter SafeZone Mini

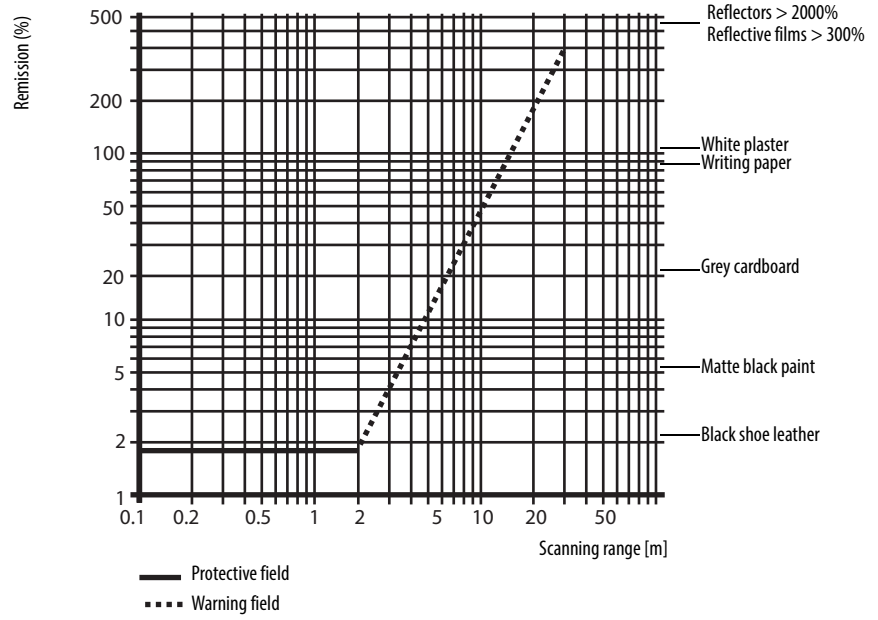
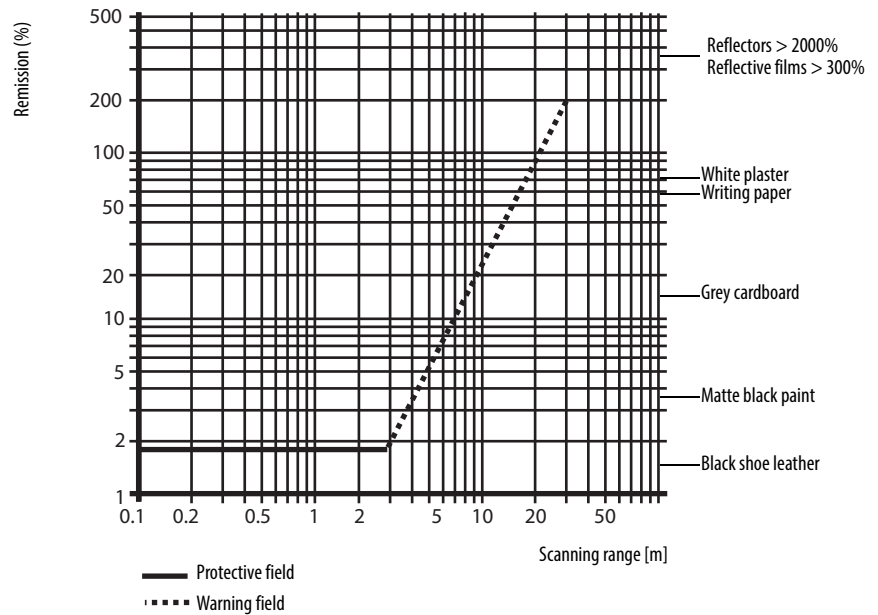


Fig. 49: Diagram scanning range 3 meter SafeZone Mini



### OSSD response times

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

- The basic response time of the SafeZone Mini.
- The multiple sampling set.
- The OSSDs used.
- The control inputs used.

**How to calculate the total response time  $T_S$ :**

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

Where ...

$t_B$  = Basic response time = 80 ms

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

**Multiple sampling**

On the SafeZone Mini 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: Supplements for multiple sampling

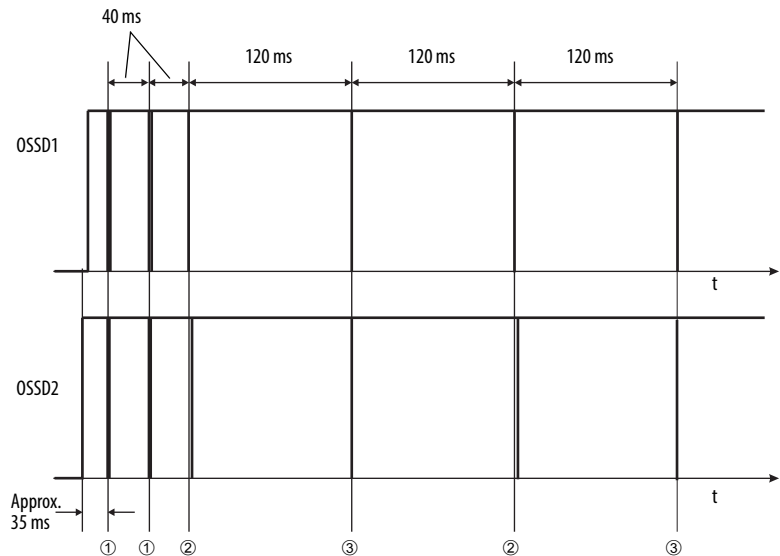
Multiple sampling	Supplement	Basic response time + supplement
2 times (basic setting)	0 ms	80 ms
3 times	40 ms	120 ms
4 times	80 ms	160 ms
5 times	120 ms	200 ms
6 times	160 ms	240 ms
7 times	200 ms	280 ms
8 times	240 ms	320 ms
9 times	280 ms	360 ms
10 times	320 ms	400 ms
11 times	360 ms	440 ms
12 times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

**Timing behavior of the OSSDs of the SafeZone Mini**

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

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

Fig. 50: Diagram of the test pulses at the OSSDs



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

After a further half basic response time of the SafeZone Mini there is a shut-down test ②, 120 ms later a further voltage test ③. Then the SafeZone Mini performs a shut-down test and a voltage test alternately at an interval of 120 ms. Fig. 51, Fig. 52 and Fig. 53 show the pulse duration for the individual tests.

Fig. 51: Voltage test after switching on the OSSDs

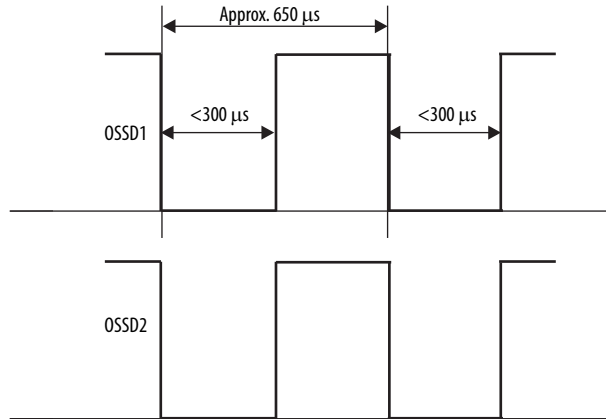


Fig. 52: Shut-down test

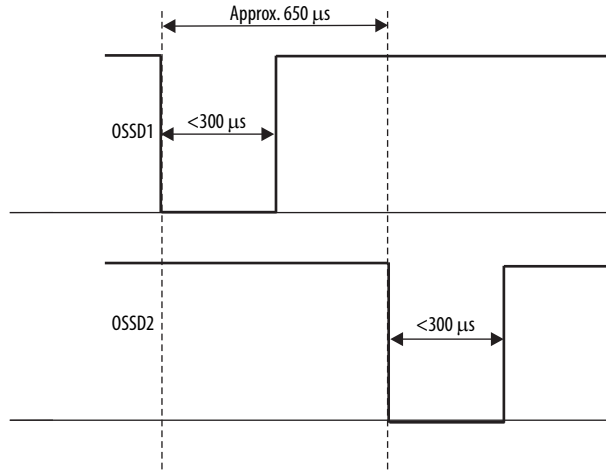
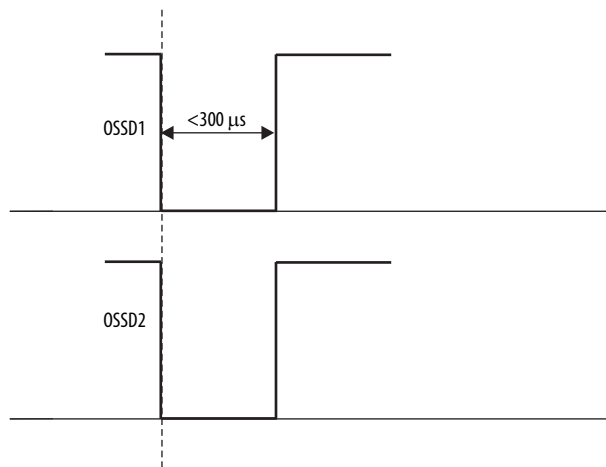


Fig. 53: Voltage test



## Data sheet

Table 17: Data sheet SafeZone Mini

	Minimum	Typical	Maximum
<b>General data</b>			
Type	3 (EN 61496-1)		
Safety Integrity Level ①	SIL2 (IEC 61508)		
SIL claim limit ①	SILCL2 (EN 62061)		
Category	Category 3 (EN ISO 13849-1)		
Performance Level ①	PL d (EN ISO 13849-1)		
PFHd (mean probability of a dangerous failure per hour)	$8 \times 10^{-8}$		
T <sub>M</sub> (mission time)	20 years (EN ISO 13849)		
Laser protection class	Laser class 1 (according to IEC 60825-1 as well as CDRH 21 CFR 1040.10 and 1040.11; excluded are deviations due to Laser Notice No. 50, dated 24.06.2007)		
Enclosure rating	IP 65 (EN 60529)		
Protection class	III (EN 50178 and EN 60950)		
Operating temperature range	-10 °C		+50 °C
Storage temperature range	-25 °C -25 °C		+50 °C +70 °C (≤24 h)
Humidity (taking into account the operating temperature range)	EN 61496-1, CLC/TS 61496-3, Chapter 5, "Protective field width"		
Vibration	EN 61496-1 as well as CLC/TS 61496-3		
Frequency range	10 Hz		150 Hz
Amplitude	0.35 mm or 5 g		
Shock resistance	EN 61496-1, Chapter 5 as well as CLC/TS 61496-3		
Single shock	15 g, 11 ms		
Continuous shock	10 g, 16 ms		
Sender	Pulsed laser diode		
Wavelength	895 nm	905 nm	915 nm
Divergence of the collimated beam (solid angle)		14 mrad	
Pulse duration		5.0 ns	5.5 ns
Average output power			3.42 mW
Light spot size at optics cover [mm (in.)]		8 (0.31)	
Size of light spot at 2.0 m (6.6 ft) scanning range [mm (in.)]		28 (1.1)	
Housing			
Material	Aluminium die-cast		
Color	RAL 1021 (rapeseed yellow) and RAL 9005 (black)		
Optics cover			
Material	Polycarbonate		
Surface finish	Outside with scratch-resistant coating		
<b>Dimensions SafeZone Mini</b>			
Height [mm (in.)]			116 (4.57)
Width [mm (in.)]			102 (4.02)
Depth [mm (in.)]			105 (4.13)
<b>Dimensions connecting cable</b>			
Length [mm (in.)]		250 (9.84)	
Diameter of round plug connector [mm (in.)]			15 (0.59)
Total weight (without connecting cables) [kg (lb)]		0.8 (1.76)	

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

	Minimum	Typical	Maximum
<b>Functional data</b>			
Resolution of the 2 m SafeZone Mini [mm (in.)]	30, 40, 50, 70 (1.2, 1.6, 2.0, 2.8)		
Resolution of the 3 m SafeZone Mini [mm (in.)]	30, 40, 50, 70, 150 (1.2, 1.6, 2.0, 2.8, 5.9)		
Protective field of the 2 m SafeZone Mini Medium Range [m (ft)]			
At 30 mm (1.2 in.) resolution			1.25 (4.10)
At 40 mm (1.6 in.) resolution			1.60 (5.25)
At 50 mm (2.0 in.) resolution			2.00 (6.56)
At 70 mm (2.8 in.) resolution			2.00 (6.56)
Protective field of the 3 m SafeZone Mini Medium Range [m (ft)]			
At 30 mm (1.2 in.) resolution			1.25 (4.10)
At 40 mm (1.6 in.) resolution			1.60 (5.25)
At 50 mm (2.0 in.) resolution			2.10 (6.89)
At 70 mm (2.8 in.) resolution			3.00 (9.84)
At 150 mm (5.9 in.) resolution			3.00 (9.84)
Scan angle			270°
Remission	1.8%		Several 1000% (reflectors) ②
Angular resolution		0.5°	
Protective field supplement generally necessary [mm (in.)]			100 (3.94)
Supplement for retroreflectors in scan plane at a distance of less than 1 m (39.4 in.) to the protective field boundary [mm (in.)]			200 (7.87)
Evenness of the scan field at 2 m (6.56 ft.) [mm (in.)]			±50 (2.0)
Distance from mirror axis of rotation (zero point on the X and Y axis) to the rear of the device [mm (in.)]		55 (2.17)	
Distance between center of the scan plane and the bottom edge of the housing [mm (in.)]		80 (3.15)	
Warning field [m (ft)] ③		8 (26.25)	
Distance measuring range [m (ft)]			30 (98.4)
Number of multiple samplings (configurable via SCD software)	2		16
Power-up delay of a configured device		18 s	
Restart after (configurable)	2 s		60 s
Basic response time ④	80 ms		
<b>Electrical data</b>			
Supply voltage (SELV) ⑤	16.8 V	24 V	30 V
Permissible residual ripple ⑥			±5%
Switch on current ⑦			2.0 A
Operating current without output load 2 m SafeZone Mini ⑧		0.16 A	0.20 A
Operating current without output load 3 m SafeZone Mini ⑧		0.18 A	0.25 A
Operating current without output load 2 m SafeZone Mini ⑧			1.35 A
Operating current without output load 3 m SafeZone Mini ⑧			1.35 A
Power consumption without output load) 2 m SafeZone Mini ⑧		3.9 W	4.8 W
Power consumption without output load) 3 m SafeZone Mini ⑧		4.4 W	6.0 W
Power consumption w/max. output load) 2 m SafeZone Mini ⑧			33 W
Power consumption w/max. output load) 3 m SafeZone Mini ⑧			33 W
Power consumption in the stand-by mode or park mode without output load) SafeZone Mini ⑧		3.6 W	4.8 W
Power consumption in the stand-by mode or park mode without output load) SafeZone Mini ⑧		4.4 W	6.0 W

② Complies with Diamond Grade 3000X™ (approx. 1250 cd/lx × m²).

③ The detection capability of the warning field is dependent on the remission of the objects to be detected.

④ The total response time of your application is dependent on further factors.

⑤ To meet the requirements of the relevant product standards (e.g., 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.

⑥ The absolute voltage level must not drop below the specified minimum voltage.

⑦ The load currents for the input capacitors are not taken into account.

⑧ With the typical supply voltage of 24V.

	Minimum	Typical	Maximum
Electrical connection	Connecting cable with round plug connector		
Cable length for power supply tolerance $\pm 10\%$ [m (ft)]			25 (82.0)
Cable length for power supply tolerance $\pm 5\%$ [m (ft)]			34 (111.5)
Cable length for power supply tolerance $\pm 1\%$ [m (ft)]			40 (131.2)
Universal I/Os			
Input resistance when HIGH		2 k $\Omega$	
Voltage for HIGH	11 V	24 V	30 V
Voltage for LOW	-3 V	0 V	5 V
Input capacitance		15 nF	
Static input current	6 mA		15 mA
Actuating time of the control switch for restart	120 ms	200 ms	
HIGH switching voltage at 100 mA	$V_S - 3.3$ V		$V_S$
Source switching current		100 mA	200 mA
Current limiting (after 5 ms at 25 °C)	600 mA		920 mA
Power up delay		1.4 ms	2 ms
Switch off delay		0.7 ms	2 ms
Response time with configuration as second warning field output	Corresponds to the resulting response time of the OSSDs plus 50 ms		
OSSDs			
Output signal switching device pair	2 PNP semiconductors, short-circuit protected <sup>⑨</sup> , cross-circuit monitored		
HIGH switching voltage at 250 mA	$V_S - 2.7$ V		$V_S$
Switching voltage LOW	0 V	0 V	2 V
Source switching current <sup>⑩</sup>	6 mA		250 mA
Leakage current <sup>⑪</sup>			250 $\mu$ A
Load inductance			2.2 H
Load capacity			2.2 $\mu$ F at 50 $\Omega$
Switching sequence (without switching)			5 1/3
Permissible cable resistance <sup>⑫</sup>			2.5 $\Omega$
Test pulse width <sup>⑬</sup>		230 $\mu$ s	300 $\mu$ s
Test frequency		120 ms	
Power-up delay of the OSSDs from red to green		120 ms	
Time offset on switching the OSSDs between OSSD2 and OSSD1			2 ms
Configuration and diagnostics interface			
Communication protocol	RS-232 (proprietary)		
Transmission speed	38400 Baud		
Cable length at 38400 Baud and 0.25 mm <sup>2</sup> cables			15 m (49 ft)
Galvanic isolation	No		
Output TxD HIGH	5 V		15 V
Output TxD LOW	-15 V		-5 V
Voltage range RxD	-15 V		15 V
Switching threshold RxD LOW	-15 V		0.4 V
Switching threshold RxD HIGH	2.4 V		15 V
Short-circuit current at TxD	-60 mA		60 mA
Max. voltage level at RxD	-15 V		15 V
Max. voltage level at TxD	-11 V		11 V

<sup>⑨</sup> Applies to the voltage range between  $V_S$  and 0 V.

<sup>⑩</sup> Switching currents up to 500 mA are allowed briefly ( $\leq 100$  ms).

<sup>⑪</sup> In the case of a fault (0 V cable open circuit) maximally the leakage current flows in the OSSD cable. The downstream controller must detect this status as LOW. An FPLC (fail-safe programmable logic controller) must be able to identify this status.

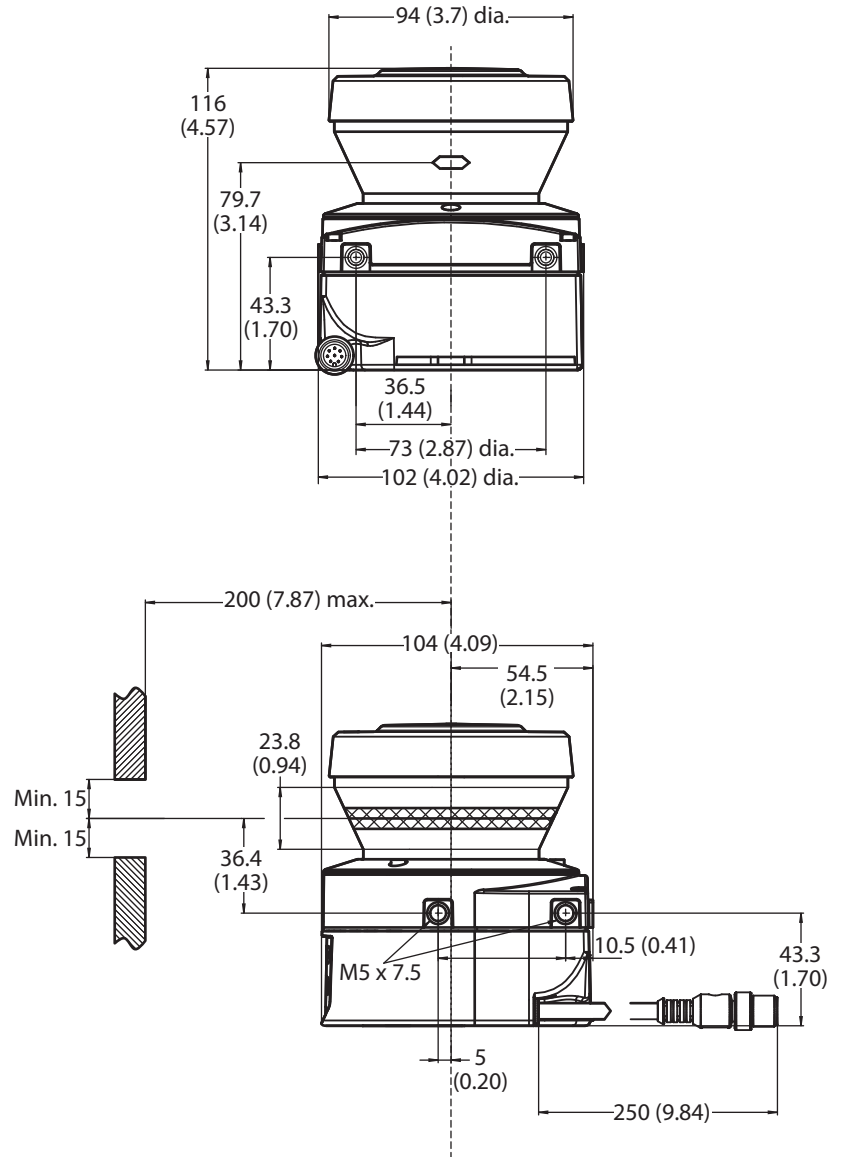
<sup>⑫</sup> Make sure to limit the individual line core resistance to the downstream controller to this value to ensure that a cross-circuit between the outputs is safely detected. (Also note EN 60 204-1.)

<sup>⑬</sup> 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.

**Dimensions [mm (in.)]**

**SafeZone Mini**

Fig. 54: Dimensional drawing SafeZone Mini



Mounting kits

Fig. 55: Dimensional drawing, mounting kit 1  
442L-AMBSZMN1

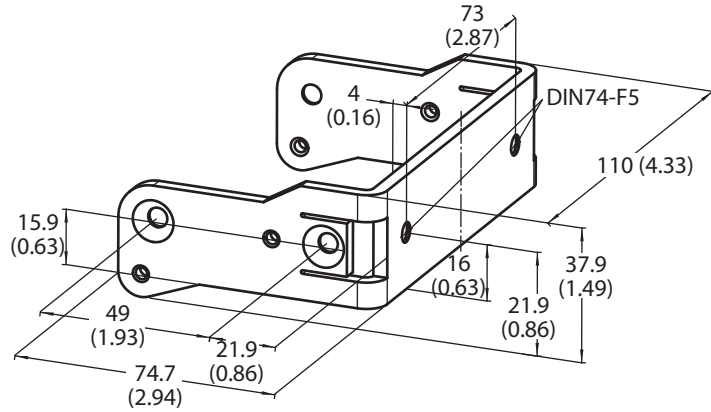


Fig. 56: Dimensional drawing, mounting kit 2  
442L-AMBSZMN2

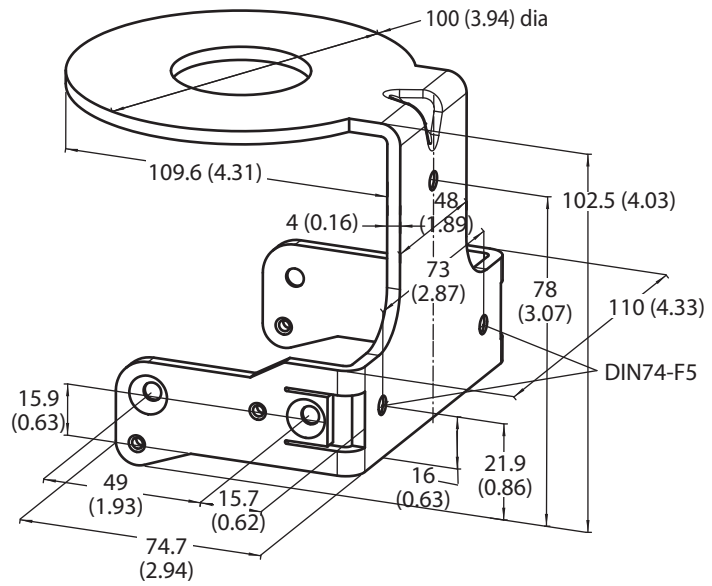


Fig. 57: Dimensional drawing, mounting kit 3  
442L-AMBSZMN3

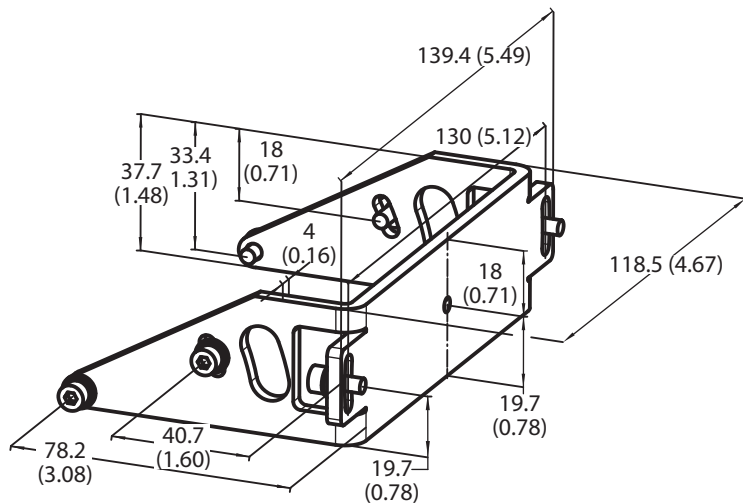
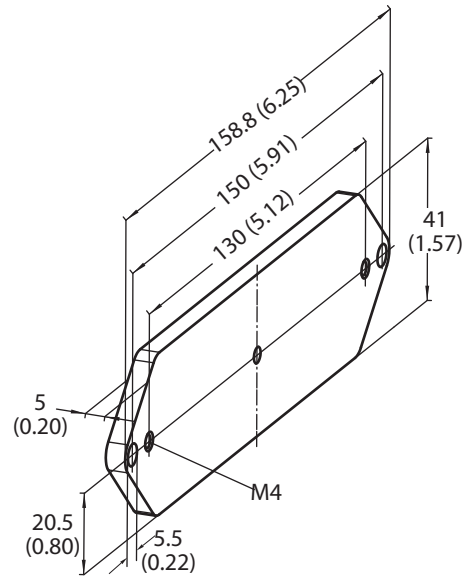


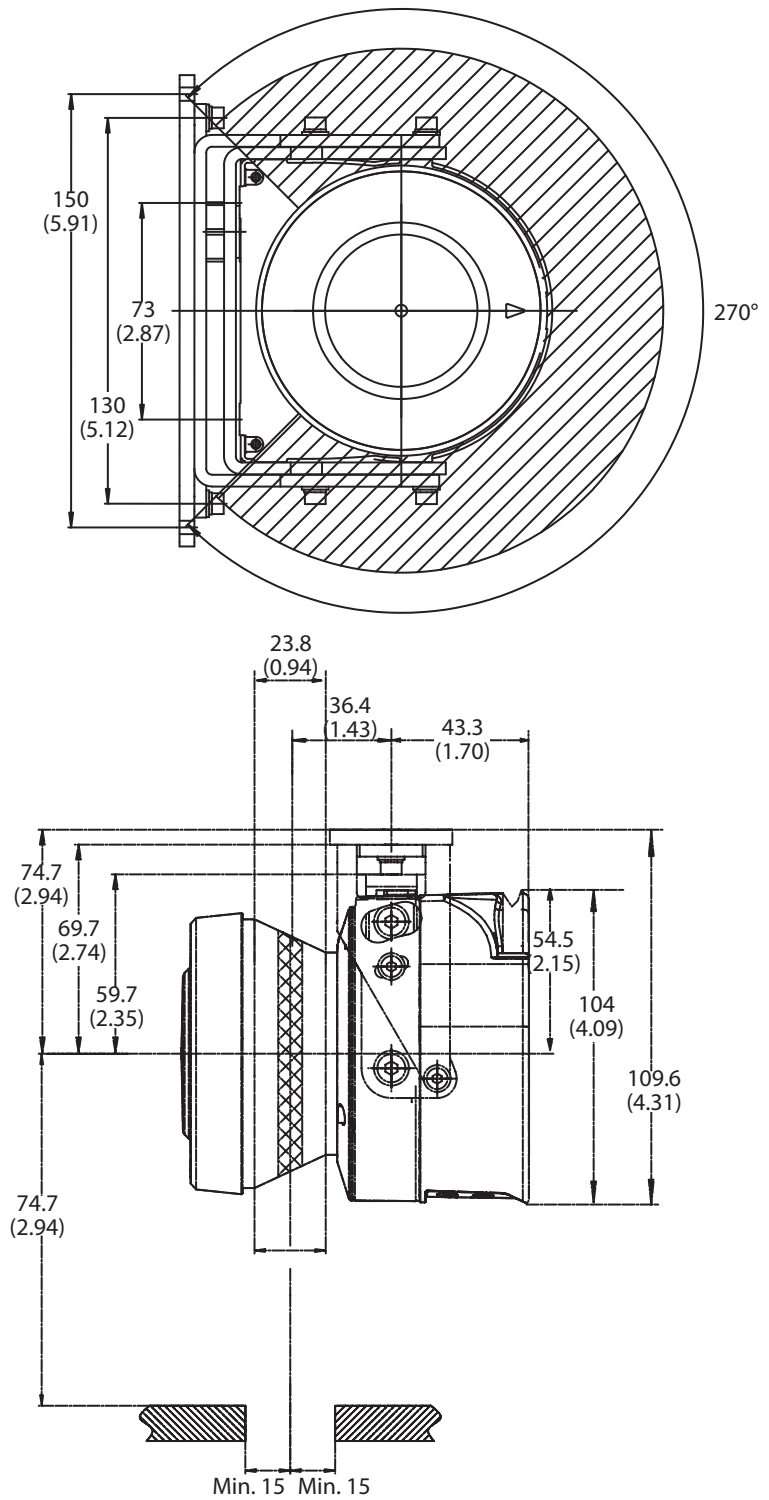


Fig. 58: Dimensional drawing, mounting kit 4  
442L-AMBSZMN4



### Scan plane origin

Fig. 59: Dimensional drawing of the scan plane with mounting kit 1, 3, and 4










# Chapter 13

## Items supplied for SafeZone Mini

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

**Note** Cordsets for the SafeZone mini not included.

Table 18: Ordering information

Image	Catalog number	Product description
	442L-SFZNMN	SafeZone mini safety laser scanner, 2 meter safety field
	442L-SFZNMN3	SafeZone mini safety laser scanner, 3meter safety field
<b>Cord sets</b>		
	442L-ACABL2	SafeZone mini cordset 2.5 meters
	442L-ACABL10	SafeZone mini cordset 10 meters
	442L-ACABL20	SafeZone mini cordset 20 meters
<b>Accessories</b>		
	442L-AMBSZMN1	442L-AMBSZMN1 SafeZone mini mounting bracket 1a
	442L-AMBSZMN2	442L-AMBSZMN2 SafeZone mini mounting bracket 1b
	442L-AMBSZMN3	442L-AMBSZMN3 SafeZone mini mounting bracket 2

	<p>442L-AMBSZMN4</p>	<p>442L-AMBSZMN4 SafeZone mini mounting bracket 3</p>
	<p>442L-SZMNW</p>	<p>442L-SZMNW SafeZone mini replacement window kit</p>
	<p>442L-ACUSB-2</p>	<p>2 m (6.6 ft) USB programming cable</p>
	<p>442L-ACUSB-10</p>	<p>10 m (32.8 ft) USB programming cable</p>

## Chapter 14

## Annex

**Rockwell  
Automation**

### EU Declaration of Conformity

<b>Identification of the product:</b>		<b>Safezone Safety Laser Scanner</b>
<b>Name and address of the manufacturer:</b>		<b>Name and address of the authorised representative:</b>
<b>Rockwell Automation, Inc.</b>		<b>Rockwell Automation B.V.</b>
<b>2 Executive Drive</b>		<b>Rivium Promenade 160</b>
<b>Chelmsford, MA 01824</b>		<b>2909 LM Capelle aan den IJssel</b>
<b>USA</b>		<b>The Netherlands</b>
<i>This declaration of conformity is issued under the sole responsibility of the manufacturer.</i>		
<b>Object of the declaration:</b>		<b>Allen-Bradley / GuardMaster 442L-SFZ Series</b> (reference the attached list of catalogue numbers)
<i>The object of the declaration described above is in conformity with the relevant EU harmonisation legislation:</i>		
2004/108/EC	EMC Directive	(EMC)
2006/42/EC	Machinery Directive	(MD)
<i>References to the relevant harmonised standards used or references to the specifications in relation to which conformity is declared:</i>		
EN 61496-1:2004 + A1:2008	Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements and tests	
IEC 61496-3:2008	Safety of machinery – Electro-sensitive protective equipment – Part 3: Particular requirements for Active Opto-electronic Protective Devices responsive to Diffuse Reflection (AOPDDR)	
EN ISO 13849-1:2008	Safety of Machinery – Safety related parts of control systems – Part 1: General principles for design	
EN 62061:2005	Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems	
EN 61508 (Parts 1-7):2010	Functional safety of electrical/electronic/programmable electronic safety-related systems	
EN 60204-1:2006+A1:2009	Safety of machinery – Electrical equipment of machines – Part 1: General requirements	
EN 50178:1997	Electronic equipment for use in power installations	
EN 61000-6-2:2005	Electromagnetic compatibility – Part 6-2: Generic standards – Immunity for industrial environments	
EN 61000-6-4:2007 + A1:2011	Electromagnetic compatibility – Part 6-4: Generic standards – Emission standard for industrial environments	
<b>Notified Body:</b>		<b>TÜV Rheinland Industrie Service GmbH</b> Alboinstrasse 56, 12103 Berlin, Germany
<b>performed:</b>		<b>EC Type Examination</b>
<b>and issued the certificate:</b>		<b>Registration No: 01/205/0616/09 and 01/205/5264.01/14</b>
<b>Additional information:</b>		
<b>Person authorised to compile the technical file (MD):</b>		<b>Authorised representative (see details above).</b>
<b>Product Safety Function (MD):</b>		<b>AOPDDR devices for use in applications up to Safety Category 3/PL d (EN ISO 13849-1) and SIL2/SIL CL2 (EN 61508 / EN 62061).</b>
<i>Signed for and on behalf of the above named manufacturer:</i>		
<b>Place and date of issue:</b>		<b>Chelmsford, MA USA 22-Oct-2014</b>
<b>Name, function:</b>		<b>Daniel L. Nachtigall, Technical Leader – Product Certification Engineering</b>
<b>Signature:</b>		

<i>Catalogue number</i>	<i>Series <sup>1</sup></i>	<i>Description</i>	<i>Directive <sup>2</sup></i>	
			<i>EMC</i>	<i>LVD</i>
442L-SFZNSZ		<i>Safezone single-zone safety laser scanner</i>	<i>Yes</i>	<i>Yes</i>
442L-SFZNMZ		<i>Safezone multi-zone safety laser scanner</i>	<i>Yes</i>	<i>Yes</i>
442L-SFZNMN		<i>Safezone mini safety laser scanner</i>	<i>Yes</i>	<i>Yes</i>
442L-SFZNMN3		<i>Safezone mini safety laser scanner</i>	<i>Yes</i>	<i>Yes</i>

- 1) *If no series number is given, then all series are covered.*
- 2) *Yes = Product is certified to this directive.*



## Checklist for the manufacturer

### Checklist for the manufacturer/installer for installing electro-sensitive protective equipment (ESPE)

Details about the points listed below must be present at least during initial commissioning — they are, however, dependent on the respective application, the specifications of which are to be controlled by the manufacturer/installer.

<b>IMPORTANT</b>	This checklist should be retained and kept with the machine documentation to serve as reference during recurring tests.	
1. Have the safety rules and regulations been observed in compliance with the directives/standards applicable to the machine?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2. Are the applied directives and standards listed in the declaration of conformity?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3. Does the protective device 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 <input type="checkbox"/>	No <input type="checkbox"/>
4. Is the access to the hazardous area/hazardous point only possible through the protective field of the ESPE?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
5. Have measures been taken to prevent and monitor unauthorized presence in the hazardous area when hazardous area/hazardous point protection (mechanical protection) and have these been secured against removal?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
6. Are additional mechanical protective measures fitted and secured against manipulation, which prevent reaching under, over, and around the ESPE?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
7. Has the maximum stopping and/or stopping/run-down time of the machine been measured, specified and documented (at the machine and/or in the machine documentation)?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
8. Has the ESPE been mounted such that the required minimum distance from the nearest hazardous point has been achieved?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
9. Are the ESPE devices properly mounted and secured against manipulation after adjustment?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
10. Are the required protective measures against electric shock in effect (protection class)?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
11. Is the control switch for resetting the protective device (ESPE) or restarting the machine present and correctly installed?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
12. Are the outputs of the ESPE (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 <input type="checkbox"/>	No <input type="checkbox"/>
13. Has the protective function been checked in compliance with the test notes of this documentation?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
14. Are the given protective functions effective at every setting of the operating mode selector switch?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
15. Are the switching elements activated by the ESPE, e.g. contactors, valves, monitored?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
16. Is the ESPE effective over the entire period of the dangerous state?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
17. Once initiated, will a dangerous state be stopped when switching the ESPE on or off and when changing the operating mode, or when switching to another protective device?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
18. Has the information label for the daily check been attached so that it is easily visible for the operator?	Yes <input type="checkbox"/>	No <input type="checkbox"/>

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



## Glossary

<b>AOPDDR</b>	Active opto-electronic protective device responsive to diffuse reflection (e.g. SafeZone Mini, see also CLC/TS 61496-3)
<b>External device monitoring (EDM)</b>	A device that electronically monitors the relay or contactor operated by the protective device prior to each new start.
<b>Field set</b>	Protective fields and warning fields form the so-called field set.
<b>Optics cover</b>	Plastic part with window for light output. The optics cover is available as a spare part.
<b>OSSD</b>	(Output signal switching device) The OSSD output is the switching output on the SafeZone Mini. This is a semiconductor output and is periodically tested for correct function. The SafeZone Mini has two OSSD outputs that operate in parallel; for safety reasons these must be evaluated using two channels.
<b>Protective field</b>	The protective field secures the hazardous area on a machine or vehicle. As soon as the safety laser scanner detects an object in the protective field, it switches the OSSDs to the OFF state and thus initiates the shutdown of the machine or stop of the vehicle.
<b>Remission</b>	Reflection of luminance. A measure of the remission is the level of remission defined as the ratio of the luminance reflected from a surface in the measuring direction and the luminance of a completely matte white surface (white standard).
<b>Resolution/ object resolution</b>	The minimum size of an object that is acquired by the protective device and is guaranteed by the manufacturer.
<b>Restart interlock</b>	The restart interlock is a protective device. In certain situations it prevents the machine from automatically restarting. This applies, e.g., after the scanner function has triggered during a dangerous machine state, after a change to the operating mode or the method of activation of the machine, or after the change to the start control device on the machine.
<b>Universal I/O</b>	The SafeZone Mini has two universal I/O connections. These two connections can be configured as inputs (e.g. for stand-by, EDM or reset) or as outputs (e.g. for device error, contamination or second warning field).
<b>Warning field</b>	The warning field is a field with a radius of up to 8 m (26.25 ft) (see Chapter 12, "Technical specifications" on page 55). Using this field larger areas can be controlled and simple switching functions (e.g., warning functions) triggered. The warning field is not allowed to be used for tasks related to personnel protection.

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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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