Allen-Bradley

Guardmaster®

User Manual

SafeZone™ Safety Laser Scanner

Conditions required for proper use of the SafeZone Safety Laser Scanner

Please make sure you read and understand these requirements before you select and install the SafeZone safety laser scanner. SafeZone safety laser scanners are noncontact, area monitoring safeguarding devices. These safety laser scanners are intended to be used to protect people and objects within a defined monitored hazardous area.

The installation of SafeZone safety laser scanner must comply with all applicable federal, state and local rules, regulations, and codes.

It is the responsibility of the employer to properly install, operate and maintain the SafeZone safety laser scanner.

SafeZone safety laser scanners must be properly installed by qualified personnel.

SafeZone safety laser scanners are noncontact monitoring devices and will not protect personnel from heat, chemicals or flying parts. They are intended to signal a stop of hazardous machine motion when the sensing field is penetrated.

SafeZone safety laser scanners can only be used on hazardous areas where machinery can be stopped anywhere in its stroke or cycle.

The effectiveness of the SafeZone safety laser scanners depends upon the integrity of the machine control circuit. The hazardous area that the SafeZone safety laser scanner is monitoring should have control circuitry that is fail safe in design.

All stopping mechanisms for the machinery should be inspected regularly to ensure proper operation. The protected machinery must have a consistent reliable and repeatable stopping time.

ATTENTION! Failure to read and follow these instructions can lead to misapplication or misuse of the SafeZone safety laser scanner, resulting in personal injury and damage to equipment.

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Agency Approvals

CE c UL us

IMPORTANT: Save these instructions for use at a future time.

Generally recognized technical regulations and quality assurance system ISO 9000 are carefully applied during the development and production of Rockwell Automation products.

This technical description must be observed when installing and commissioning the SafeZone. Inspection and commissioning must be carried out by a qualified person.

Pour obtenir une version électronique en Français merci de visiter le site *www.ab.com/manuals/pd/slightc.htm*.

Per ottenere la versione elettronica in Italiano di questo manuale, si prega di visitare: *www.ab.com/manuals/pd/slightc.htm*.

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Para obter a versão eletrônica deste manual favor visítar *www.ab.com/manuals/pd/slightc.htm*.

Introduction

Please read this introduction carefully before working with this documentation and the SafeZone safety laser scanner.

The Function of this Document

This document provides information on the technical properties of the SafeZone Safety Laser Scanner. You will find information on:

- Safety
- Structure and operation
- Planning
- Maintenance

The Target Group of this Document

This document is intended for those persons who constructively integrate the SafeZone safety laser scanner, and commission and operate it as a safety system.

Scope

This document contains all the information necessary for planning, acquisition and maintenance of the SafeZone safety laser scanner. Information is provided on its operating principle, possible uses and mounting.

Abbreviations and Terms

Abbreviations

ESPE: Electro-sensitive protective equipment (e.g. SafeZone safety laser scanner)

SCD: Safety Configuration and Diagnostic Software. With a **PC** and the **SCD software**, as a user you can define the monitored areas, and define or check the correct configuration of the SafeZone safety laser scanner.

The SafeZone safety laser scanner uses a reference target fixed to the SafeZone for self-checking. Any change to this target is interpreted as a system error.

OSSD: Output signal switching device

AOPDDR: Active opto-electronic protective devices responsive to diffuse reflection

FE: Functional earth, an internal circuit ground

Important Terms

Machine: In these operating instructions, machine is used as a term for the system to be monitored. A dangerous state or a dangerous movement that rules out the presence of persons or objects in the protective field, is involved in the operation of the machine.

Scanning Range: The maximum scanning range describes an arc of 300° around the sensor with a maximum radius of 7.5m.

Protective Field: The safety area that, when infringed, results in the immediate shut down of the dangerous movement, is termed the protective field. If a person or object enters the protective field the SafeZone safety laser scanner provides a stop signal to the machine via the **OSSD** outputs.

Protective Field Size: The maximum protective field size is defined by the distance of the safety laser scanner scanning head to the most distant point of the protective field including a safety margin.

Monitored Areas: Monitored areas is a general term used for **protective fields** (up to 6m) and/or **warning fields** (up to 7.5m). Monitored areas can have irregular shapes or shapes adapted to the surroundings. The SafeZone safety laser scanner monitors them continuously by means of individual radial laser beams.

Warning Field: The warning field is described as that safety area whose infringement causes an optical or acoustic warning signal. If a person or object enters the warning field the SafeZone safety laser scanner provides a signal to the monitored machine via the output for warning field.

Symbols Used

LED symbols describe the state of a diagnostics LED. Examples:

O **Red**The red LED is illuminated constantly.

√ **Yellow**The yellow LED is flashing.

o **Green**The green LED is off.

Throughout this manual we use the labels **ATTENTION** and **IMPORTANT** to alert you to the following:

ATTENTION!
Failure to observe may result in dangerous operation.

ATTENTION: Identifies information about practices of circumstances that can lead to personal injury or death, property damage, or economic loss

ATTENTION helps you

- Identify a hazard
- Avoid a hazard
- Recognize the consequences

Always read attentively and follow instructions carefully!

IMPORTANT: Identifies information that is especially important for successful application and understanding of the product.

Note: Refer to notes for special features of the device or software.

Software notes show the location in the SCD (Safety Configuration and Diagnostic Software) where you can make the appropriate settings and adjustments. In the SCD software open the menu **View**, **Dialog boxes** and select the item **File Cards** to go straight to the above dialog fields. Alternatively, the Software Wizard will guide you through the appropriate setting.

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
- Electrical conductors
- Visible or invisible radiation
- A combination of several hazards

Safety

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

Safety Notes

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

Prior to commissioning the SafeZone safety laser scanner for the first time, please read these operating instructions and the user manual for the SCD software carefully.

All appropriate legal regulations, the requirements of the trade associations and the instructions of the manufacturer of the machine to be monitored must be observed without fail.

The protective function of the SafeZone safety laser scanner depends on the correct definition and programming of the **warning field** and **protective field**.

Installation of the SafeZone safety laser scanner, definition and programming of the areas to be monitored and integration in the machine control system may only be carried out by authorized personnel who are appropriately trained.

After completing the programming, the arrangement of the protective and warning fields are to be tested on the machine while it is switched on, but **not running**. On this topic see *Testing the Monitor Functions* on page 12.

Please read this handbook and the description of the configuration software carefully before the first commissioning of the SafeZone safety laser scanner. Get to know the system and the configuration software.

Use of the Device

The SafeZone safety laser scanner has been developed and approved as a Type 3 noncontact safety device according to the IEC-EN 61496-1 standard.

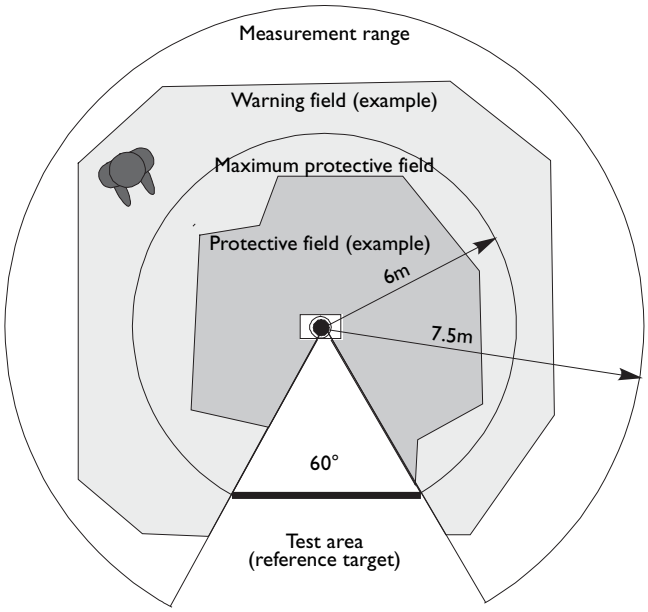


Figure 1: Schematic diagram of the monitored areas

The SafeZone safety laser scanner has been designed for industrial use. Its task is to detect access of persons to dangerous areas and stop the hazardous movement of a machine in this area. A signal is triggered as soon as a person or object enters the monitored area:

- If a person or object is present within the **warning field** the SafeZone safety laser scanner switches a relay contact at the corresponding signal output. This signal can be used for acoustic and optical warnings. Warnings are to indicate that the hazardous area is to be left before the protective field is activated, and the SafeZone safety laser scanner OSSDs issue a stop signal that would trigger a machine stop.
- If a person or object is present within the **protective field** the SafeZone safety laser scanner switches two independent relay contacts. This signal must lead to an immediate switching off of the dangerous machine movement.

The SCD (Safety Configuration and Diagnostic Software) is included with the SafeZone safety laser scanner for definition and testing the protective field and warning fields.

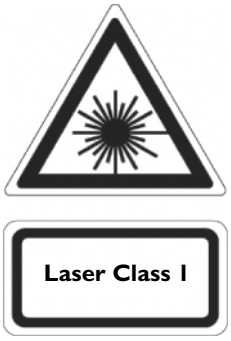
Correct Use of the Device

The SafeZone safety laser scanner may only be used as protective equipment for detecting persons or objects (horizontal protective field). Operation of the device is only permissible according to the technical specifications. All warranty claims against Rockwell Automation are forfeited in the case of any other use, or alterations being made to devices, even as part of their mounting or installation.

General Safety Information and Protective Measures

ATTENTION: The SafeZone safety laser scanner may only be employed for monitoring tasks fulfilling all the following conditions:

- The SafeZone safety laser scanner must be able to terminate the dangerous state within a defined time period by triggering the stop signal.
- The safety distance monitored by the SafeZone safety laser scanner must be smaller than the maximum protective field.
- The maximum value of the machine's stopping time plus the SafeZone safety laser scanner's response time must be calculated so that nobody can gain access to the hazardous point before the dangerous movement has come to a complete stop.



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

Stationary Application

According to Chapter 6 of the EN 999 standard the safety distance between the limit of the protective field and the hazardous area of a stationary machine is calculated as follows:

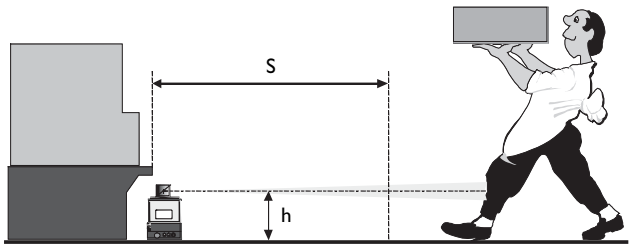


Figure 2: Calculation of the safety distance for a stationary application

$$S = 1.6\ (t_1 + t_2) + (1200 - 0.4\ h) + ZM$$

Please note: $1200 - 0.4\ h \geq 850$

Here...

S = The safety distance in mm

t_1 = The SafeZone response time (see *Technical Data* on page 15)

t_2 = The machine stopping time (in ms)

h = Height of protective field above the floor (in mm) $300 \leq h < 1000$

1.6 = The assumed approach speed (in m/s)

ZM = Maximum measuring error of the SafeZone (see *Technical Data* on page 15)

ATTENTION: Ensure that the correct mounting height is used!

When selecting the mounting height ensure that it is not possible to enter the hazardous area from below the protective field.

ATTENTION: The SafeZone safety laser scanner must be supplemented by further safety equipment if one of the following situations applies:

- A hazardous point can be reached without passing through the monitored areas;
- The area monitored by the SafeZone safety laser scanner can be reached from above, below or from the side;
- According to EN 999, possible access by crawling below the protective field must be taken into account above the regulation minimum protective field height of 300mm.

Example for a stationary application:

Machine width M = 2.2m (7.2ft) = 2200mm (86.6in)

Response time of the SafeZone = 280ms

The machine stopping time = 300ms

Height of protective field above the floor = 0.5m (1.64ft) = 500mm (19.6in)

Maximum measuring error of the SafeZone = 350mm (13.77in)

Protective field width = M + safety supplement left and right

S = 1.6m/s (280ms + 300ms) + (1200mm – 0.4 x 500mm) + 350mm = 2278mm

Protective field width = 2200mm (86.61in) + 350mm (13.77in) + 350mm (13.77in) = 2900mm (114.17in)

Maximum protective field size = $(S^2 + \frac{1}{2}\ \text{protective field width}^2)^{-\frac{1}{2}}$ = 2700mm (106.29in)

IMPORTANT: The example only applies if no access from the side is possible. Access from the side must be prevented either by a wider protective field and/or other measures.

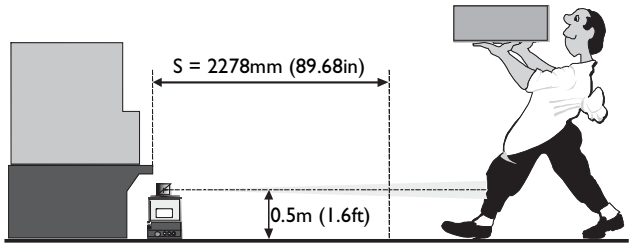


Figure 3: Example: minimum distance for stationary application

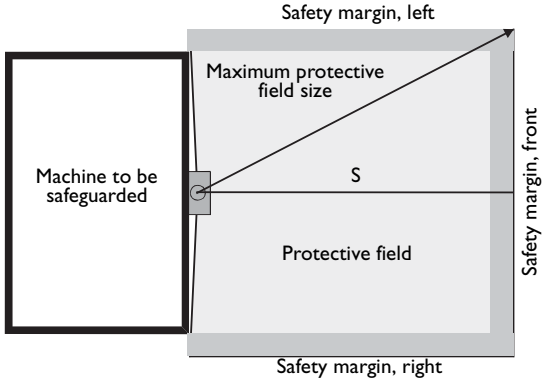


Figure 4: Maximum protective field size and safety margins for stationary applications

Safety margins are to be determined for maximum safety field sizes.

The following applies if the access of persons from behind cannot be hindered by appropriate sizing of the protective field:

- A manual restart interlock must be present in the machine control system (generally necessary).
- The width of the accessible, unmonitored, area directly in front of the machine must be smaller than 35mm (1.37in) for a maximum protective field size of up to 3m (9.8ft). For larger maximum protective field sizes the distance must be reduced to zero.

Application on Automated Guided Vehicles (AGVs)

Taking the regulations for automated guided vehicles (e.g. EN 1525) into account, the minimum distance between the edge of the protective field and the hazardous area of the AGV is calculated as follows:

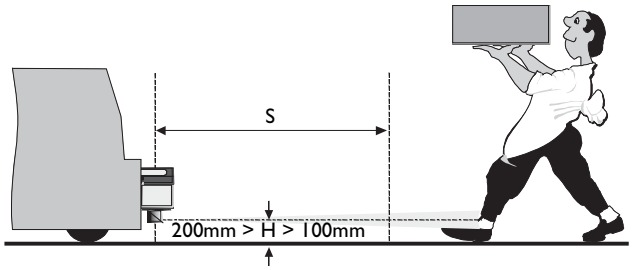


Figure 5: Calculating the minimum distance for automated guided vehicles

$$S = 1.1((V_{max.} \times (t_1 + t_2)) + B) + ZM + F \text{ ❶}$$

Here...

S	=	Min. distance in mm = max. AGV stopping distance
t_1	=	Response time of SafeZone (see *Technical Data* on page 15)
t_2	=	AGV control system reaction time (in ms)
V_{max}	=	Max. speed of the AGV (m/s)
B	=	Max. braking path for the AGV (in mm)
ZM	=	Max. measuring error of the SafeZone (see *Technical Data* on page 15)
F	=	Foot clearance: 150mm (5.9in) (if AGV foot clearance less than 50mm (1.96in))
h	=	Height of protective field above the floor in mm
1.1	=	Safety supplement for possible brake wear

ATTENTION: The SafeZone safety laser scanner must be supplemented by further safety equipment if one of the following situations applies:

- A hazardous point can be reached without passing through the monitored area;
- The area monitored by the SafeZone safety laser scanner can be reached from above, below or from the side.

ATTENTION: Define protective field coverage correctly!

The protective field must cover the entire width of the AGV. The protective field must be increased at the sides by the safety margins (see *Technical Data* section on page 15).

ATTENTION: Define the protective field correctly where routes bisect each other!

At "crossroads" where there are "blind spots," the protective field must have the same configuration as in the direction of motion.

ATTENTION: Avoid undercutting of the protective field!

The protective field must be configured in such a way that stepping between the protective field and the AGV from behind in the direction of motion (undercutting) is not possible. The SafeZone safety laser scanner has a maximum scanning angle of 300°.

❶ F only applies when there is no foot clearance according to prEN 1493

The protective field must be defined so that it is not possible for a person to pass unnoticed between the protective field and vehicle.

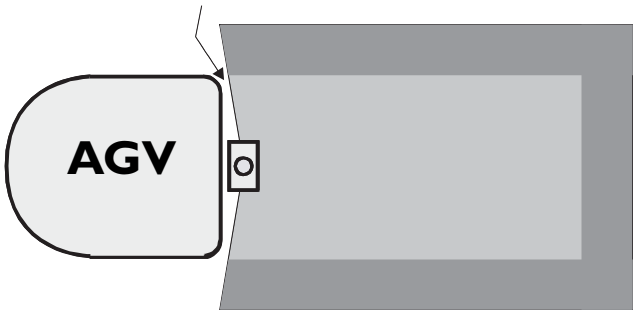


Figure 6: Prevent undercutting of the AGV protective field

If it is not possible to prevent undetected personnel standing in front of the AGV by appropriate sizing of the protective field, then there must be a manual restart interlock in the AGV.

The width of the accessible area that is not monitored directly in front of the AGV must be less than 35mm (1.37in) for a maximum protective field size of up to 3m (9.8ft). For larger maximum protective field sizes the distance must be reduced to zero.

ATTENTION: Program reactivation delay!

In case of AGV applications, you must program a reactivation delay for the SafeZone. The reactivation delay defines the time (ms) after which the relay is reactivated when the monitored field is clear (automatic restart after time).

With automatic restart the restart period must be set to a minimum of 2000ms.

You can stipulate the reactivation delay independently for the warning field and the protective field. Device symbol SafeZone, context menu **Configuration draft, Edit**. The values permitted are between 200 and 5000ms.

Example for application on AGVs

AGV_{Width}= 1.6m (5.24ft) = 1600mm (62.9in)

Response time of the SafeZone = 280ms

AGV control system reaction time = 300ms

Maximum speed of the AGV = 1m/s

Maximum braking distance for the AGV = 0.3m (0.98ft) = 300mm (11.8in)

Maximum measuring error of the SafeZone = 250mm (9.8in)

F unnecessary: the AGV has foot clearance

Safety supplement for possible brake wear = 1.1

Protective field width = AGV_{Width} + safety margin left and right

S = 1.1 ((1m/s x (280ms + 300ms)) + 300mm (11.8in)) + 250mm (9.8in) = 1218mm (47.95in)

Protective field width = 1600mm (62.99in) + 250mm (9.8in) + 250mm = 2100mm (82.67in)

Maximum protective field size = $(S^2 + ½ \text{ safety field width}^2)^{-½}$ = 1608mm (63.3in)

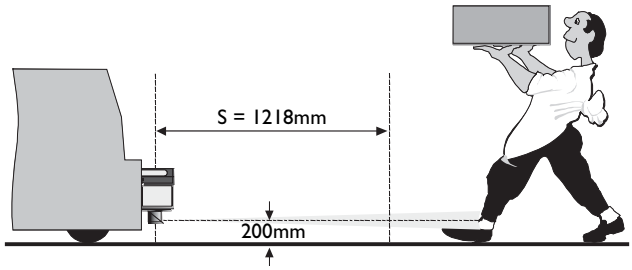


Figure 7: Example: minimum distance for automated guided vehicles

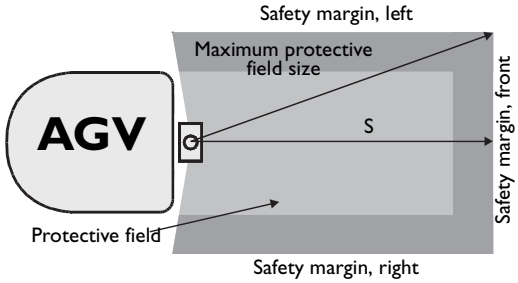


Figure 8: Maximum protective field size and safety supplements for AGVs

Protection of the Environment

The SafeZone safety laser scanner is constructed in such a way that it adversely affects the environment as little as possible. It emits and contains no environmentally damaging substances and requires only a minimum of energy and resources.

Disposal

➢ Always dispose of unusable or irreparable devices according to the particular waste disposal regulations applicable in the country of use.

Product Description

Construction of the Device

The sensor of the SafeZone safety laser scanner is housed in a robust aluminium housing. The housing is protected against water spray according to IP 65 (only applicable if the connection sockets are equipped with plugs or covers).

ATTENTION: Do not damage seals!

The housing screws are sealed. Any damage to seals leads to forfeiting of the product's warranty.

The deflecting mirror and laser optics are located on the top side of the housing in a rotating housing component. The laser transmitter and receiver use the same lens. This complex co-axial construction prevents angular error resulting from separate transmitter and receiver optics.

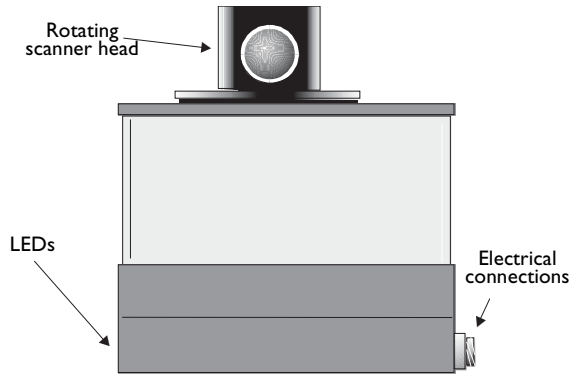


Figure 9: Construction of the SafeZone safety laser scanner

The invisible laser beams emitted conform to laser safety class 1. The measurement area begins immediately in front of the optics.

ATTENTION: Do not mount the device at eye level!

Fix the SafeZone safety laser scanner such that the measuring beam is not at eye level during use.

There are four LEDs on the side of the housing showing the state of the system:

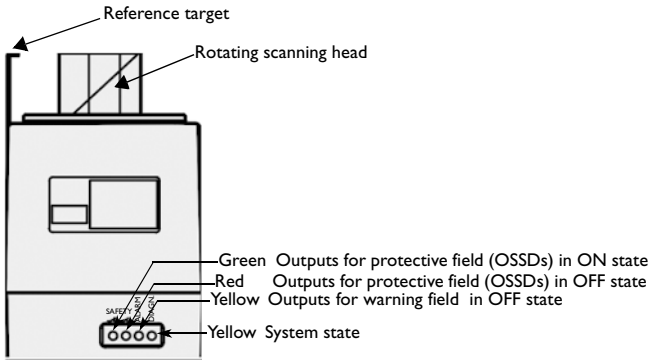


Figure 10: LEDs on the SafeZone safety laser scanner

LED Indication				Meaning
Green	Red	Yellow	Yellow	
○	○	○	○	Device switched off
●	●	●	●	Test LEDs for 1 sec. after Power On ❶
●	○	○	○	The system is ready for operation, the outputs for protective field(OSSDs) and for warning field are in an ON state
○	●		○	Outputs for protective field (OSSDs) in OFF state
			○	Outputs for warning field in OFF state
○	●	●	●❷	System error

Table 1: Status of the LEDs for the SafeZone safety laser scanner

There are two connection sockets on the opposite side of the housing labelled **Interface** and **24V DC/signal**.

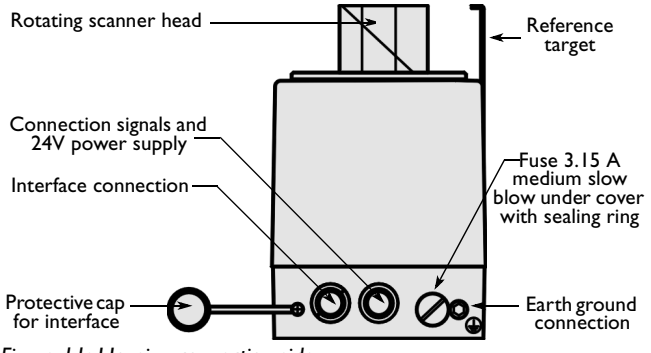


Figure 11: Housing connection side

❶ The system state LED lights up during the start-up test after Power On. During the last 5 seconds before operational readiness is achieved and the release of the outputs for protective field (OSSDs) this LED blinks at 2 Hz.
❷ On this topic see *LED Indications* on page 14.

- Interface
  Communication with the computer or restart. At this connection an RS-232 interface is available.
- 24V DC/Signal
  For connecting the power supply, the two outputs for protective field, OSSD 1 and OSSD 2, and the output for warning field.

Operating Principles of the Device

Measurement Principle

The SafeZone safety laser scanner emits pulsed laser beams throughout a complete 360° with the help of a rotating mirror. The light pulses are reflected diffusely from objects in the vicinity and received by a photodiode in the sensor. The SafeZone safety laser scanner derives the distance to the object from the propagation time that the light requires from emission to reception of the reflection in the sensor.

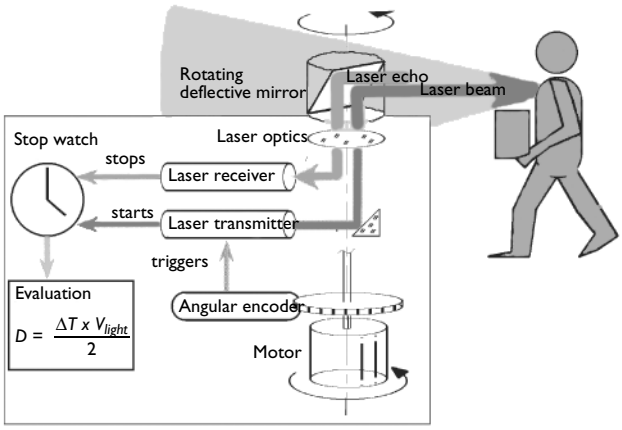


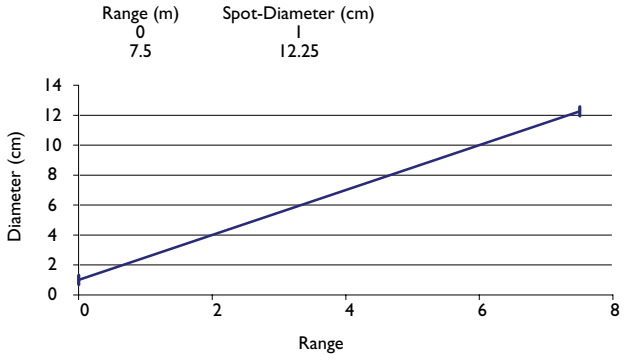
Figure 12: Schematic diagram of SafeZone safety laser scanner operating principle

The direction of each individual measurement beam is determined with the help of an angular encoder.

The measurement data for distance and direction can be called up by a computer via the interface.

The effective scanning arc is 300°.

SafeZone Spot-Diameter According to Range



Monitoring the Protective Field and Warning Field

Two distance limit values, representing the warning field and protective field, can be defined for each measurement beam with the help of the SCD software. During monitoring the SafeZone safety laser scanner compares the measured object distance with defined limit values.

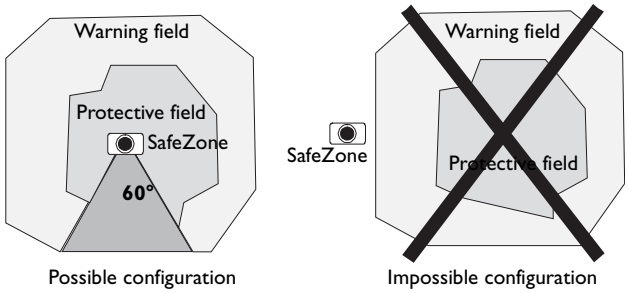


Figure 13: Configuration of monitored areas

The tables of distance limit values are determined with a computer and laid down in the SafeZone safety laser scanner. The warning and protective field limits can be of any shape and ideally adapted to the surroundings. The SafeZone safety laser scanner must therefore be within the limits of both the warning field and the protective field.

Self-Testing

Comprehensive internal tests run continuously within the SafeZone safety laser scanner. This ensures the system's high level of operational reliability. All basic components are either present in duplicate or are monitored by testing logic that operate independently.

The reference or test target is an important constituent of the self-testing systems. This involves a stationary target firmly mounted on the SafeZone safety laser scanner, detected on each rotation. Any alteration in the measurement value indicates a system error and leads to an error state.

While monitoring, the SafeZone safety laser scanner checks that it is functioning correctly.

IMPORTANT: The system sensitivity of the device is monitored through the measurement of the light reflected from the reference target. Contamination of the optics or the reference target can thus lead to the system analysis: **Device insensitive/ Reference target error** (LED indicators). In such a case, clean the device optics as well as the reference target as per the instructions given in the *Maintenance and Care* section on page 14.

Installation and Mounting

Operating Conditions

Please note the following points before using the device:

- The device is only for use in predominantly closed areas.
- The SafeZone safety laser scanner is protected against water spray according to IP 65 and operates within a temperature range of 0°C to 50°C (32°F to 122°F). Protect the system from moisture and temperatures that are outside the temperature range.
- Protect the SafeZone safety laser scanner from continuous direct sunlight.
- To prevent condensation do not expose the SafeZone safety laser scanner to rapidly changing temperatures.
- Do not expose the SafeZone safety laser scanner to aggressive chemicals (detergents).
- Glass panes or reflective surfaces are not reliably detected by the SafeZone safety laser scanner as objects.
- The SafeZone safety laser scanner only detects objects that are visible from its location and not covered up.
- Rain, snow, dust and smoke are detected as "objects" and may trigger **warning field** or **protective field** states.

Mounting the Device

ATTENTION: Observe the machine manufacturer's safety regulations.

It is essential that the safety instructions for working on the machine, defined by the machine manufacturer, are observed when mounting the SafeZone safety laser scanner.

Mounting of the SafeZone safety laser scanner may only be carried out by qualified personnel.

The SafeZone safety laser scanner can be mounted in any orientation.

IMPORTANT: The emitted laser beam has a divergence of 1°. This means that it is essential that during mounting a minimum distance of 100mm (3.93in) to the floor must be maintained.

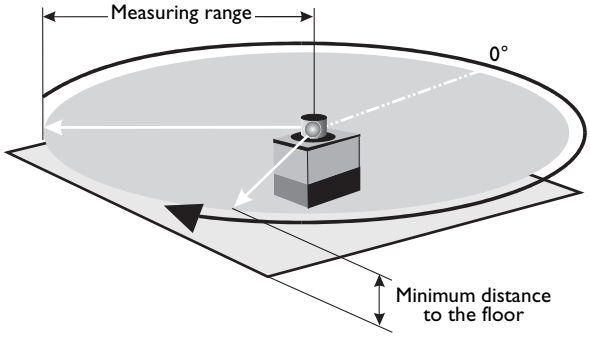


Figure 14: Minimum distance to the floor

IMPORTANT: When installing several safety laser scanners, mounting must be carried out in such a way that there cannot be any mutual interference:

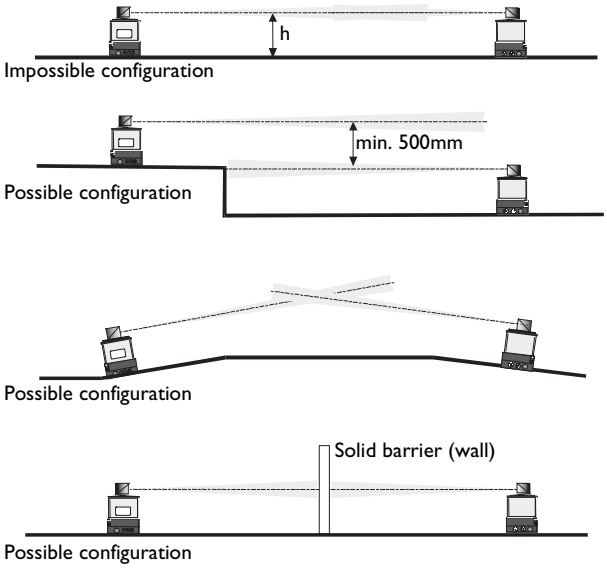


Figure 15: Mounting several safety laser scanners

You require the following aids for mounting the device:

- Four bolts M4 x 10 screws for fastening to a horizontal surface
- 4 washers and locking washers
- If necessary, a spirit level for ensuring level mounting

Fit SafeZone safety laser scanner to machine:

1. Switch off the machine and check that you are not taking any risks!
2. Turn the mounting screws with the washers and locking washers in place and tighten them up finger tight.

3. When attaching to nonmobile machines it is recommended that the spirit level is used in two axes to ensure level mounting.
4. Tighten the attachment screws.

Electrical Installation

Integrating the SafeZone Outputs into the Machine Control System

ATTENTION: Connection only by qualified personnel!

Connection of the SafeZone safety laser scanner to the machine may only be carried out by appropriately qualified personnel.

These persons must have all the information provided by the suppliers of the machine.

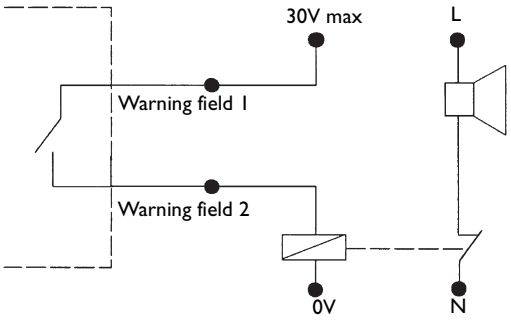


Figure 16: Example of integration of the warning field signal

Three potential-free relay outputs are available for connection to the machine for **warning field** and **protective field** states. The outputs are designed as N.O. contacts.

Output for Warning Field

The **warning field** relay contact can be used for the output of a warning signal. The **warning field** relay output is opened when the warning field is activated or there is a SafeZone safety laser scanner fault.

If the object is again removed from the warning field, its relay contact closes after an adjustable time from 200 to 5000ms (reactivation delay).

The output for **warning field** can be switched with a maximum of 30 Volts and is internally fuse-protected at 2 Amps.

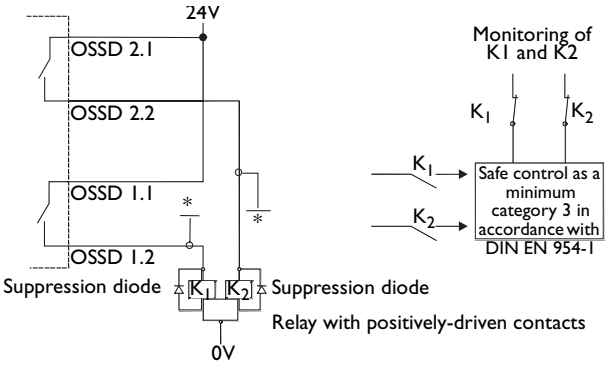


Figure 17: Example of integration of the OSSD outputs. The wiring is to be laid down in such a way that it is protected against mechanical effects
*) Shield to prevent cross talk

OSSD Outputs

The OSSD outputs can be used as emergency stop trips in the system controller. The OSSD outputs are open if

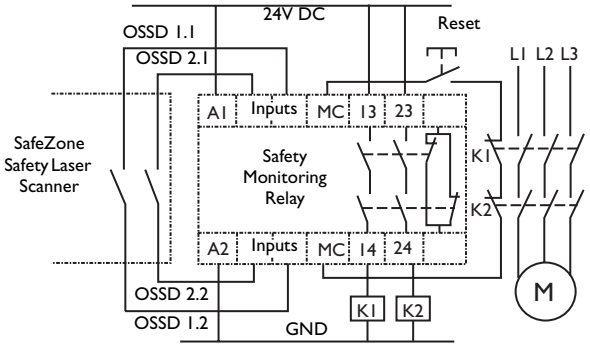
- The protective field has been activated,
  or
- The SafeZone safety laser scanner has a fault.

The relay contact closes after a programmable time of between 200 and 5000ms (reactivation delay), assuming that there is no system fault.

You can stipulate the reactivation delay independently for the warning field and the protective field. Device symbol SafeZone, context menu **Configuration draft, Edit**.

The **OSSD 1** and **OSSD 2** outputs can be wired with a maximum of 30 Volts and are internally fuse-protected at 2 Amps.

Typical Wiring Diagram

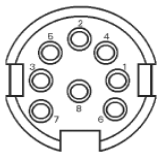


SafeZone OSSD's to a TYPE 4 Safety Relay Module

Connecting the Power Supply and Signal Cables

ATTENTION: Electrical work is only to be carried out by appropriately trained electrical specialists.

Electrical connection of the power supply and connection of the signal cables for the **warning field**, **OSSD 1** and **OSSD 2** take place together via the middle socket on the right-hand side of the housing.



View of the Soldered Side of the 8-Pin Socket

Figure 18: Plug allocation for connection of the power supply and the signal cables

Pin #	Signal	Explanation	Marking	Color
1	24V	24V DC supply	+	Brown
2	GND24	Ground	-	Blue
3	OSSD 2.1	Relay contact for protective field 2.1	S2	White
4	OSSD 2.2	Relay contact for protective field 2.2	S2	Grey
5	OSSD 1.1	Relay contact for protective field 1.1	S1	Black
6	OSSD 1.2	Relay contact for protective field 1.2	S1	Green
7	Warning field 1.1	Relay contact for warning field 1.1	A	Red
8	Warning field 1.2	Relay contact for warning field 1.2	A	Pink
	FE	Functional Ground (shield)	FE	Thick Black

Table 2: Plug allocation for connection of the power supply and the signal cables

Note:

- On connecting the SafeZone safety laser scanner it is imperative to ensure that the earth ground is connected correctly. The SafeZone safety laser scanner must be provided with a safety insulating transformer according to IEC 742. This also applies for the charging devices for vehicle batteries, if charging is to take place on the vehicle.
- For stationary applications, the SafeZone safety laser scanner must be properly grounded (earth ground connection see *Construction of the Device* on page 7).
- The **functional earth** is to be connected with ground potential for installation on transport vehicles. For applications with battery-powered vehicles a DC voltage transformer must be connected in series before the SafeZone safety laser scanner. On request, please consider a relevant protection against "low dump" (voltage drop).

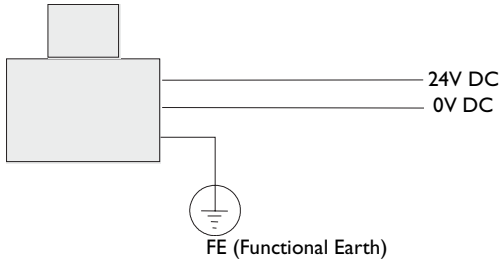


Figure 19: Example of the power supply and grounding of stationary applications

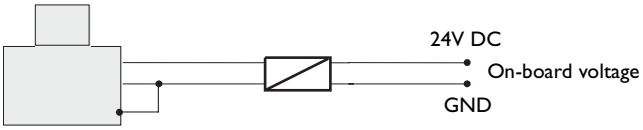
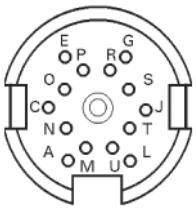


Figure 20: Example of the power supply and grounding on a transport vehicle

Connecting the Data Cables

Data cables with 9-pin D-sub plugs are available as accessories from Rockwell Automation for connection to a computer.



View of the Soldered Side of the 14-Pin Socket

Figure 21: Pin assignments for the connection of the data cables

Pin # (14-Pin Connector)	Signal	Explanation	Pin # (9-Pin DSUB Connector)
A	GND	Ground, RS 232	5
C	RTS	RS 232: Ready to send	8
E	CTS	RS 232: Clear to send	7
G	RxD	RS 232: Receive data	2
J	TxD	RS 232: Transmit data	3
L	—	No connection!	—
M	RES	Reset (active LOW)	4
N thru U	—	No connection!	—

Table 3: Pin assignments for the connection of the data cables

Configuration

Delivery status

The SafeZone as supplied is configured with a warning field of 7.5 meters and a protective field of 6 meters. The relay hold time is set to the standard value of 200 ms. Prior to commissioning, the SafeZone safety laser scanner must be configured for the planned application with the aid of the SCD (Safety Configuration and Diagnostic Software) supplied.

Preparing the Configuration

How to prepare the configuration:

➢ Make sure that the SafeZone safety laser scanner has been properly mounted and that the electrical connections are correct and in place.

➢ Plan all settings necessary (warning field, protective field, reactivation delay, etc.).

➢ To configure the SafeZone safety laser scanner, you need:
- SCD (Safety Configuration and Diagnostic Software) on CD-ROM.
- User manual for SCD software on CD-ROM.
- PC/Notebook with Windows 9x/NT 4/2000 Professional/ XP and a serial interface (RS 232) (PC/notebook not included).
- Connecting cable for the connection between PC and SafeZone safety laser scanner (connecting cable not included).

➢ To configure the device, please read the user manual for the SCD (Safety Configuration and Diagnostic Software) and use the online help in the program.

Commissioning

Access Rights for the Configuration Software

Access to the SafeZone safety laser scanner is protected.

- The password is ABGM on delivery.
- The user (Safety Officer) must ensure that the password is only known by authorized persons.

Recommendation: It is recommended that the ABGM password is replaced by a new password that you select.

Device symbol ABGM, context menu **Access rights, Change password**...

- It is possible to select the Monitor function on the PC and edit protective fields **without** a password, but it is not possible to **change** the protective field or parameters without it.
- **Using** the password it is possible to change the protective field and parameters.

Testing the Monitor Functions

After you have defined the monitored areas with the SCD software, you must check and accept the installation. For this purpose proceed in two steps:

- First check the definition of the protective field with a computer connected and document the test.
- Then connect the machine and repeat the test.

Check definition of the protective field and document:

➢ Insert a dark test object with a diameter of about 70mm (2.75in) from all sides into the protective field. Check every section of the protective field limit.

The green LED must go out and the red LED on the front of the SafeZone safety laser scanner must light up.

Checking installation of the safety system to the machine:

➢ When you are sure that the definition of the protective field is correct, connect the SafeZone safety laser scanner signal cables to the machine control system. Repeat the test with the machine switched on but not running.

➢ Also check the behaviour when the SafeZone safety laser scanner is switched off.

➢ Switch on the machine. Carefully insert an object, e.g. a box, into the monitored areas. Observe the machine's reaction.

Before accepting the system, take the following points into consideration:

➢ Use the test to ensure that no dangerous state can be set in motion as long as an object is present in the hazardous area.

➢ Ensure that the dangerous state or the dangerous movement comes to a stop before any part of a person's body can reach the hazardous point. When defining the protective field, take the machine stop time and the SafeZone safety laser scanner response time into account.

➢ Ensure that the SafeZone safety laser scanner and other protective devices monitor all access points to the hazardous areas.

➢ Check that the SafeZone safety laser scanner is firmly mounted. Check that the system doesn't move under normal operating conditions and that its position cannot be changed.

➢ Train the machine operating personnel in how the SafeZone safety laser scanner operates. Explain its design and how to use the system (LEDs, faults).

Regular Examinations

ATTENTION: Carry out regular tests!

Daily tests can be carried out by the machine's operating personnel.

The six-month maintenance (see below) and testing of the monitored areas may only be carried out by authorized personnel.

Daily Tests

➢ Check the state and installation of the SafeZone safety laser scanner for any changes. If in doubt, switch off the SafeZone and immediately inform the authorized maintenance personnel.

➢ Keep the optics clean. Only use a soft brush or optical cloth for cleaning the optics.

➢ Check the surroundings for changes (e.g. structural alterations) that may have taken place since configuration.

Six-Month Tests

➢ Check the definition of the protective field at least every six months.

➢ Follow the regulation procedure described in *Testing the Monitor Functions* on page 12.

Transport and Storage

Transport of the SafeZone Safety Laser Scanner

Adhere to the following instructions when transporting the SafeZone safety laser scanner:

1. Remove all plugs to prevent buckling of the cable.
2. Fix rotating parts with adhesive tape to prevent scratching of the optics.
3. Do not allow any mechanical loads to affect the rotating parts.
4. Use the original packaging.

This is how you pack the safety laser scanner in its original packaging:

1. Place the lower membrane cushion upright in the box and lay the SafeZone safety laser scanner on it on its side.

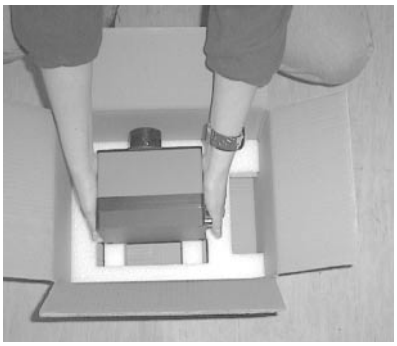


Figure 22: Place the SafeZone on its side in the original packaging

2. Place the upper membrane cushion on top of the SafeZone safety laser scanner.

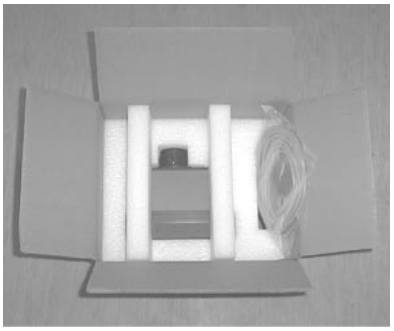


Figure 23: Place the upper membrane cushion on top of the SafeZone safety laser scanner

3. Finally, place the accessories in the box.

Figure 24: Put the accessories in the original packaging

4. Before sending the package label it clearly: "Sensitive measurement device — fragile!"

Storage

Adhere to the following instructions when storing the SafeZone safety laser scanner:

Notes:

➢ Carefully dry the system before storage. Condensation can damage optical parts.

➢ Do not store the system in closed airtight containers, so that any remaining dampness can evaporate. If possible, use the original packaging.

➢ Store with an air humidity of 5% to 85% (without condensation).

➢ Storage temperature: -20°C to +70°C (-4°F to +158°F).

Maintenance and Care

The SafeZone safety laser scanner requires no maintenance apart from the regular examinations already mentioned. No adjustments or calibration are necessary.

Please observe the following general instructions for handling the SafeZone safety laser scanner:

Notes:

➢ You should clean the beam exit (prism) of the scanning head as soon as there is evidence of visible contamination, so that the sensor operates without error. Do not touch the prism directly when cleaning. Use a plastic cleaner with a soft optical cloth to clean the prism. Never use rough cloths or aggressive detergents such as acetone.

➢ Clean the SafeZone safety laser scanner housing with a soft, damp cloth. Do not use aggressive detergents.

➢ Protect the SafeZone safety laser scanner from continuous direct sunlight.

➢ Do not expose the SafeZone safety laser scanner to rapid temperature changes to prevent the formation of condensation.

➢ Never open the SafeZone safety laser scanner! The system does not contain any components that can be repaired or maintained by the operator.

➢ If errors occur or you have difficulty using the SafeZone safety laser scanner, Rockwell Automation's Customer Service would be pleased to be of assistance.

Troubleshooting

Correcting Faults

All the LEDs are off and the laser optics are not rotating:

- Power supply 18 ... 30V (24V ± 25%) present?
- Fuse intact?
- Plug correctly mounted on the SafeZone safety laser scanner and tightly connected?
- Plug cables with correct polarity?

Green LED for "System OK" does not light up, OSSDs and warning field are active:

- Clean optics (see *Regular Examinations* on page 12).
- Check power supply for high current.
- Connect the computer and display SCD diagnostics

Device symbol ABGM, context menu **Diagnostics, Display.**

- If you cannot solve the problem, please contact Rockwell Automation's Customer Service.

Objects within the monitored areas are not detected:

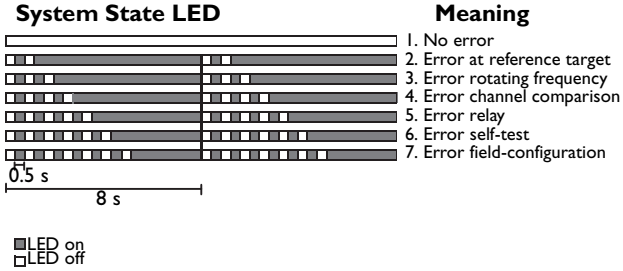
- Is the yellow LED for **system state** lit or blinking?
  - Yes: the SafeZone safety laser scanner has found an error: Check optics.
  - No: With the aid of the computer and the SCD software, check the definitions of the protective and warning field.

Device symbol ABGM, context menu **Configuration draft, Edit monitored areas.**

Objects are reported within the monitored areas without actually existing:

- Check the surroundings for changes (e.g. structural alterations) that have taken place since configuration.
- Rain, snow, smoke and dust could be the cause of the false object detection!

LED Indications



Further Advices to Error States

Error #	Description	Background	Measures
2	Contamination of target; target bent or missing	System can not run various dynamical tests	Clean target with isopropyl alcohol and a soft cloth; adjust target
3	Scanning frequency out of range	Optical head blocked	Check Optical head
		Optical head does not turn	Send device for repair
4	Redundant evaluation channels not equal	Evaluation electronics faulty	Send device for repair
5	Safety relay does not work properly	Captive contacts blocked or relay electrical defective	Send device for repair
6	Safety related internal test failed	Various reasons; safety function disturbed	Send device for repair
7	Monitoring fields not useable	Fields not configured; all fields on max. size	Configure monitoring fields

Figure 25: The system state LED indications

SafeZone Trouble Shooting Table

Fault Description	Action
Communication Error	
Connection between PC and device failed	Verify that the connections to the PC and to the device are properly configured and secure.
Incorrect PC connection used	The PC being used may have several COMM ports. Verify that the communication connection is through the designated COMM port, (In the toolbar of the SCD software, left click on Extras, left click on Communication connection and left click on Connection), verify that a COMM port is available. Software such as RS Linx, pda synchronization or external printers may take control of a COMM port and not allow the SCD software access to the computers COMM port.
Device software crashed	Cycle power to the device and restart the SCD software.
No Device Found	
Connection between PC and device failed	Verify that the connections to the PC and to the device are properly configured and secure. The PC being used may have several COMM ports. Verify that the communication connection is through the designated COMM port, (In the toolbar of the SCD software, left click on Extras, left click on Communication connection and left click on Connection), verify that a COMM port is available. Software such as RS Linx, pda synchronization or external printers may take control of a COMM port and not allow the SCD software access to the computers COMM port.
Reference Target Error	
Rotating optics not "seeing" the reference target	Verify that the reference target (plate attached to back of SafeZone) is present and not bent. If reference target is bent attempt to straighten and reboot software. Check for damage(cuts, scratches, marks, dirt, etc.) to the surface of the reference target. Clean the lens and the reference target with a soft lint free cloth and Isopropyl Alcohol.
Rotating Frequency Error	
Low voltage Friction between rotating optic head and device housing	Verify power supplied is 24V DC +/-25%. Check for obstructions/debris between the rotating head and the device housing.
No Internal Trigger	
Internal error in processing the signal	Return to factory for repair.
Software Error Codes	
1002	Reboot the SCD software and cycle power to SafeZone.

Technical Data

Data Sheet

Safety Classes

Safety Category	Type 3 ESPE acc. to EN 61496-1 error-proof acc. to EN 61496-1
Laser Protection Class	IEC 825 Laser Class 1 (eye safe)

Characteristic Data for the SafeZone Laser Scanner

Measurement & Tolerance Range	0 to 7.5m (0 to 24.6ft)
Range for a Safe Detection of Objects the "Nominal Leg" ❶	0 to 6m (0 to 19.6ft) (includes safety supplement)
Protective Field Response Time	280ms
Maximum Angle	300°

Laser and Angular Measurement

Laser Diode	Avalanche Photo Diode
Wavelength	905nm
Laser Protection Class	1 (IEC 825)
Pulse Frequency	5.76KHz + 5%
Scanning Frequency	8Hz + 5%
Scanning Angle	300°
Angle Encoder Resolution	360 x 4 increments
Point Resolution	0.5°
Vibration	per IEC 2-6 Frequency 10-55Hz amplitude: 0.35mm
Shock	per IEC 2-29 Acceleration 10g, pulse duration 16ms

Optics (Co-axial Transmitter and Receiver Optics)

Laser Beam Divergence	15 mrad
Focal Length	30mm (1.18in)
Lens Diameter	30mm (1.18in)

Power Supply

Operating Voltage	24V DC ± 25% (via a safety insulating transformer acc. to IEC 742, see *Connecting the Power Supply and Signal Cables* on page 11).
Current Uptake	Approx. 1A at 24V DC
Switch on Current	2A for 100ms
Power Consumption	24W total

Housing and Environmental Resistance

Material	Aluminium
Enclosure Rating	IP 65
Length	168mm (6.61in)
Width	108mm (4.25in)

Height	176mm (6.92in)
Weight	3.0kg
Operating Temperature	0°C ... 50°C (32°F to 122°F)
Storage Temperature	-20°C ... 70°C (-4°F to 158°F)

Interfaces

Data Interfaces to Computer	RS 232: 9600 baud, 8 data bits, 1 stop bit, no parity
Signal Outputs for Warning Field, OSSD 1, OSSD 2	Potential-free relay outputs, max. 2A, max. 30V, purely resistive load, number of operations; 2 million

Cable Plug

Interface Connection	14-pin, Binder type
24V DC/Signal Connection	8-pin, Binder type

Table 4: Technical data for the SafeZone safety laser scanner

❶ Definition of the "nominal leg": black cylinder with 70mm diameter and 1.8% reflectivity. This corresponds approximately to a leg in child's clothing made of black corduroy.

Device Accuracy and Safety Margin

The accuracy of the device depends on distance. Accuracy is as follows:

Distance up to m (ft)	Safety Margin cm (in)
2 (6.56)*	25 (9.84)
3 (9.8)*	35 (13.77)
4 (13.1)*	45 (17.71)
5 (16.4)*	55 (21.65)
6 (19.6)*	70 (27.55)

Table 5: Accuracy of SafeZone in relation to distance

* All distance figures include safety margin.

All possible influences, and particularly the reflective properties of the materials that could come into question and all background effects, have been taken into consideration in these tolerances.

Note: When programming the device the safety margin must be calculated in.

Minimum Distance from Objects

When mounting in front of a wall, for reasons of availability the programmed monitored areas may not be closer than 25cm (9.84in) to the wall.

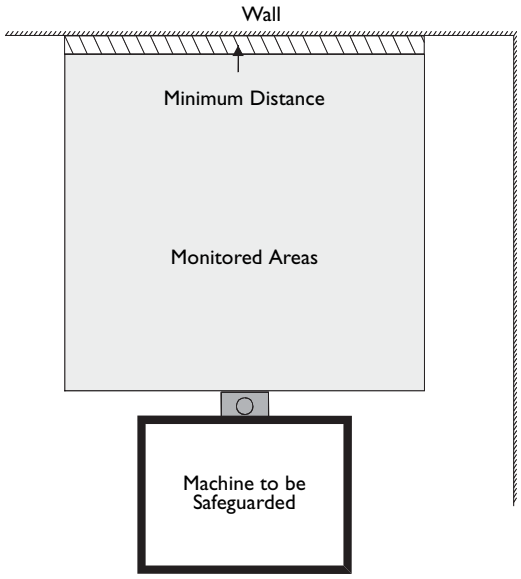


Figure 26: Minimum distance of the area monitored by the SafeZone safety laser scanner from surrounding objects

Order Data

Delivery

The precise order description for the SafeZone safety laser scanner is:

SafeZone Laser Scanner, Catalog Number 442L-SSFZN

The following components are supplied as constituents of the SafeZone safety laser scanner package:

- The SafeZone safety laser scanner
- CD ROM: SafeZone SCD software, SafeZone manual and software manual
- Bolt set 1 (fastening to the underside of the SafeZone safety laser scanner):
  - 4 bolts M4 x 10
  - 4 washers
  - 4 locking washers
- Plastic cap for the interface socket
- Packing instructions
- Packaging box

Additional Required Components

Independent of the number of safety laser scanners that you want to use you will need at least one:

- RS-232 cable for connection to the computer
  Catalog Number: 442L-SCCFG
- Power and OSSD output cable
  Catalog Number: 442L-SCPWR

Appendix

Dimensions—mm (in)

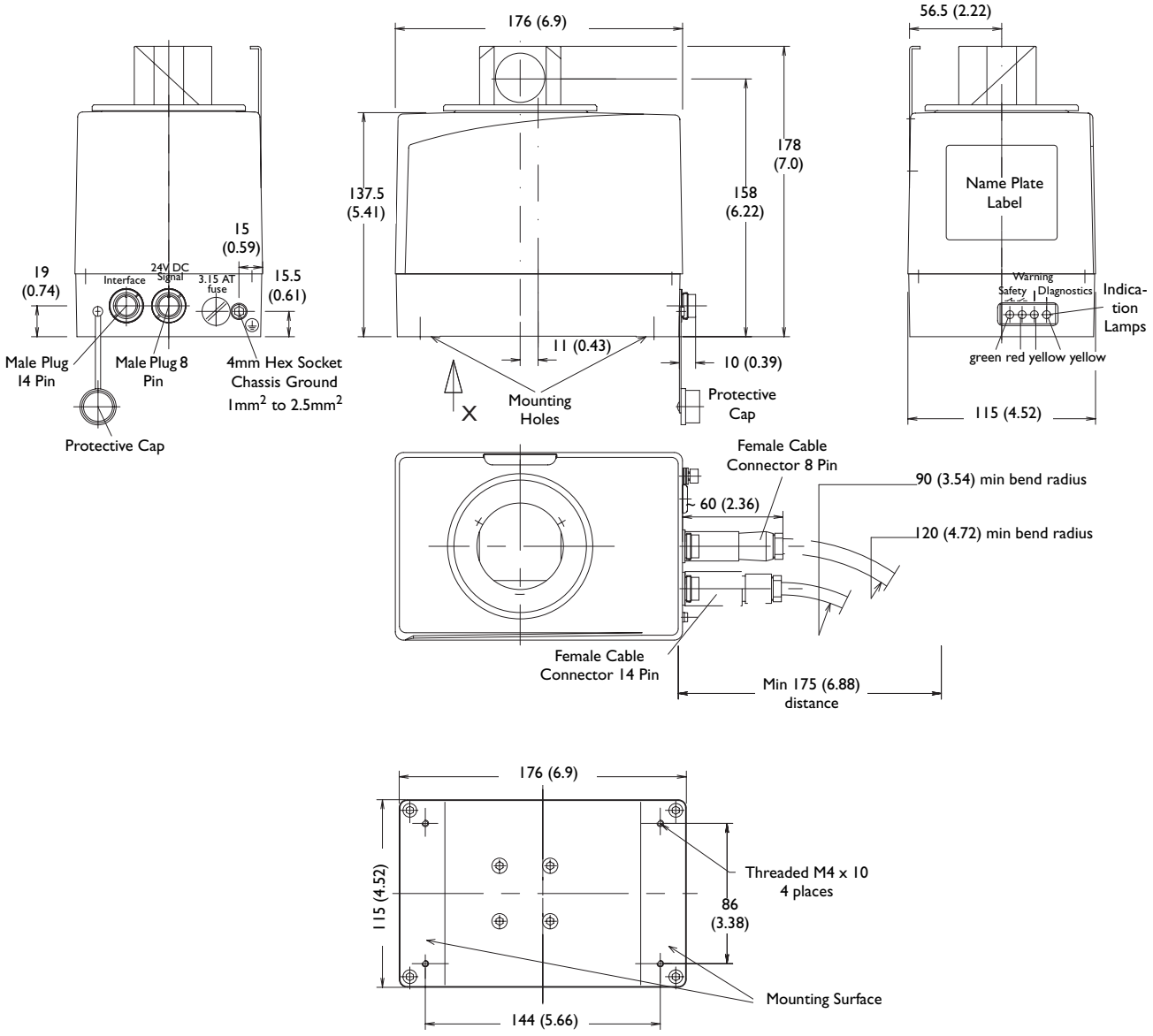


Figure 27: Dimensional diagram for the SafeZone safety laser scanner

Standards and Directives

The most important standards and directives, valid for the use of opto-electronic safety systems in Europe, are listed below. Further regulations may be of importance to you, depending on the type of use. Information on further device-specific standards can be obtained from the responsible authorities or from your trade association.

If the machine or vehicle is to be operated in a country that does not belong to the European Union, we recommend that you contact the plant operator or local authorities.

On the application and installation of safety systems:

- The 98/37 EC Machinery Directive
- Machine safety—basic terms, general design guidelines (EN 292)
- The safety of integrated production systems (DIN EN 1921)
- Machine safety—electrical machine equipment—Part 1: general requirements (EN 60 204)
- Machine safety—safety distances for preventing access to hazardous points-of-operation with upper limbs (EN 294)
- Safety requirements for robots (EN 775)
- Safety rules for electro-sensitive protective equipment on power-driven equipment (ZH 1/597)
- Machine safety—arrangement of safety devices with reference to the approach speed of body parts (EN 999)
- Machine safety—consideration of risk (EN 1050)

On the construction and equipping of safety systems

- Safety of machines—electro-sensitive protective equipment—Part 1: General requirements (IEC/EN 61496-1 as well as based on IEC/EN 61496-3)
- Basic safety considerations for MSR safety systems (DIN V 19 250)
- Machine safety—electrical equipping of machines—Part 1: General requirements (EN 60204)
- Machine safety—safety-related components of control systems—Part 1: General design guidelines (EN 954)

Please request our brochure on this topic "Safe Machines with Opto-electronic Safety Systems."

Check List for the Manufacturer

Check list for the manufacturer/OEM for the installation of electro-sensitive protective equipment (ESPE).

The details on the items listed below must be available at the latest when the system is commissioned for the first time, depending, however, on the various applications the requirements of which must be reviewed by the manufacturer/OEM.

This check list 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 O No O
2. Are the applied directives and standards listed in the Declaration of Conformity? Yes O No O
3. Does the protective device comply with the required control category? Yes O No O
4. Is the access to the hazardous area/hazard point only possible through the protective field of the ESPE? Yes O No O
5. Have appropriate measures been taken to prevent or monitor presence sensing in the hazardous area when safeguarding hazardous area/hazard point (mechanical point-of-operation guarding) and have these been secured against removal? Yes O No O
6. Are additional mechanical protective measures fitted and secured against manipulation which prevent reaching below, above or around the ESPE? Yes O No O
7. Has the maximum shutdown and/or stopping time of the machine been measured, specified and documented (at the machine and/or in the machine documentation)? Yes O No O
8. Has the ESPE been mounted such that the required safety distance from the nearest hazardous point has been achieved? Yes O No O
9. Are the ESPE devices properly mounted and secured against manipulation after adjustment? Yes O No O
10. Are the required protective measures against electric shock in effect (protection class)? Yes O No O
11. Is the command unit for resetting the protective devices (ESPE) or restarting the machine present and correctly installed? Yes O No O
12. Are the outputs of the ESPE (OSSDs) integrated in compliance with the required control category and does the integration comply with the circuit diagrams? Yes O No O
13. Has the protective function been checked in compliance with the test notes of this documentation? Yes O No O
14. Are the given protective functions effective at every setting of the operating mode selector switch? Yes O No O
15. Are the switching elements activated by the ESPE, e.g. contactors, valves, monitored? Yes O No O
16. Is the ESPE effective over the entire period of the dangerous state? Yes O No O
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 O No O

This check list does not replace the initial commissioning nor the regular inspection by specialist personnel.

EC Declaration of Conformity

The undersigned, representing the following supplier	*and the authorized representative established within the Community*
Rockwell Automation/Allen-Bradley ***2 Executive Drive*** ***Chelmsford, MA 01824 -- USA***	***Rockwell Automation, Subsidiary of Rockwell International GmbH*** ***Düsselberger Straße 15*** ***D-42781 Haan, Germany***
herewith declare that the Products	***442L SafeZone Safety Laser Scanner***
Product identification (brand and catalogue number/part number):	***Allen-Bradley 442L SafeZone Safety Laser Scanner*** *(reference the attached list of catalogue numbers)*
Product Safety Function:	***442L SafeZone Safety Laser Scanner is an active opto-electronic protection device responsive to diffuse reflection (AOPDDR). The SafeZone Safety Laser Scanner is a Type 3 noncontact safety device.***

are in conformity with the provisions of the following EC Directive(s) when installed in accordance with the installation instructions contained in the product documentation:

98/37/EC	*Machine Safety Directive*
89/336/EEC	*EMC Directive as amended by 92/31/EEC, 93/68/EEC, 93/465/EEC*

and complies with the provisions of the following harmonized standards:

EN 61496-1:1997	*Safety of machinery - Electro-sensitive protective equipment - Part 1:*
EN 50081-2:1993	*Electromagnetic compatibility - Generic emission standard -- Part 2: Industrial environment*
EN 61000-6-2: 1999	*Electromagnetic compatibility (EMC) Part 6-2: Generic standards –Immunity for industrial environments*
EN 50178: 1998	*Electronic equipment for use in power installations*

Year of CE marking	*2002*

Supplier:	*Authorized Representative in the Community:*
	***i.V.*** 
Signature	***Signature***
Name: James Pazaris	*Name:* Viktor Schiffer
Position: Director of Engineering	*Position:* Engineering Manager
Date: 06-Sep-2002	*Date:* 18-Sep-2002

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