



User Manual

SafeShield™
Safety Light
Curtain Hardware

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 this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation Allen-Bradley does not assume responsibility or liability, including intellectual property liability for actual use based upon the examples shown in this publication.

Related Safety Information

You are responsible for the safety of the entire installed control system and for meeting all applicable laws, codes, and safety requirements.



ATTENTION: As the installer of this control system, you must be knowledgeable of other applicable standards pertaining to safety recommendations related to:

- Machine Construction
- General Electrical
- Machine Guarding
- Point of Operation guards, safety light curtains, mechanical guards, and Two hand controls

In addition to local laws and codes, you are responsible for the safety recommendations detailed in all applicable codes and standards including:

- OSHA Regulations
- ANSI Standards
- NFPA
- CSA

IMPORTANT	Rockwell Automation reserves the right to make revisions to these installation instructions and disclaims liability for all incidental and consequential damages related to the furnishing, performance and use of this material.
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Conditions required for proper use of the SafeShield Safety Light Curtain

Please make sure you read and understand these requirements before you select and install the SafeShield safety light curtain. SafeShield safety light curtains are point of operation safeguarding devices. These safety light curtains are intended to be used to provide point of operation safeguarding of personnel on a variety of machinery.

The SafeShield family of safety light curtains are general purpose presence sensing devices which are designed to protect personnel working on or near machinery.

The installation of the SafeShield safety light curtain 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 product as well as the machinery on which the SafeShield presence sensing device is installed.

SafeShield safety light curtains must be properly installed by qualified personnel.

SafeShield safety light curtains are presence sensing 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 broken.

SafeShield safety light curtains can only be used on machinery which can be stopped anywhere in its stroke or cycle.

SafeShield safety light curtains should never be used on full revolution clutched machinery.

The effectiveness of the SafeShield safety light curtain depends upon the integrity of the machine control circuit. The machinery that the SafeShield presence sensing device is installed 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 SafeShield safety light curtain, resulting in personal injury and damage to equipment.

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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 SafeShield. Inspection and commissioning must be carried out by a qualified person.

Introduction

Please read this chapter carefully before working with this documentation and the SafeShield safety light curtain.

These operating instructions are designed to address *the technical personnel of the machine manufacturer or the machine operator* in regards to safe mounting, installation, configuration, electrical installation, commissioning, operation and maintenance of the SafeShield safety light curtain.

These operating instructions do *not* provide instructions for operating machines on which the safety light curtain is, or will be, integrated. Information on this is to be found in the appropriate operating instructions of the machine.

Target Group

These operating instructions are addressed to *planning engineers, developers and the operators* of machinery and systems which are to be protected by one or several SafeShield safety light curtains. It also addresses persons who integrate the SafeShield safety light curtain into a machine, initialize its use, or who are in charge of servicing and maintaining the unit.

Scope

Note For the configuration and diagnostics of these devices you require SCD (Safety Configuration & Diagnostic) Software version 2.10 or higher. To determine the version of your software version, select the **Module-Info...** option in the ? menu.

Depth of Information

These operating instructions contain information on:

- Installation and mounting
- Electrical installation
- Commissioning and configuration
- Care and maintenance
- Fault, error diagnosis and troubleshooting
- Catalog numbers
- Conformity and approval

of the safety light curtain SafeShield safety light curtain.

Planning and using protective devices such as the SafeShield safety light curtain also require specific technical skills which are not detailed in this documentation.

When operating the SafeShield safety light curtain, the national, local and statutory rules and regulations must be observed.

Abbreviations

- ADO** Application diagnostic output = configurable signal output that indicates a specific status of the protective device
- ESPE** Electro-sensitive protective equipment (e.g. SafeShield safety light curtain)

- SCD** Allen-Bradley Guardmaster Safety Configuration & Diagnostic Software
- EDM** External device monitoring
- OSSD** Output signal switching device

Symbols Used

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

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

ATTENTION helps you

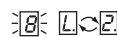
- Identify a hazard
- Avoid a hazard
- Recognize the consequences

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

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

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

Notes Refer to notes for special features of the device.



Display indicators show the status of the 7-segment display of sender or receiver:



Constant indication of characters, e.g. U



Flashing indication of characters, e.g. 8



Alternating indication of characters, e.g. L and 2

The depiction of numbers on the 7-segment display can be rotated by 180° with the aid of the SCD. In this document the depiction of the numbers on the 7-segment display is however always in the normal, non-rotated position.

- Red, ● Yellow,
- Green

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



Red

The red LED is illuminated constantly.



Yellow

The yellow LED is flashing.

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

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



Software notes show the location in the SCD where you can make the appropriate settings and adjustments. Go to the menu View, Dialog box of the SCD and activate the item File cards to view the named dialog fields as required. Alternatively, the Software Assistant will guide you through the appropriate setting.

If you use the Allen-Bradley Guardmaster SafeShield function module, you will find the functions under the same names, however to some extent in different places in the SCD dialog box. This is dependent on the scope of the related function. The operating instructions for the SafeShield function module contain detailed information.

Sender and Receiver

In drawings and diagrams, the symbol  denotes the sender and the symbol  denotes the receiver.

The term “dangerous state”

The dangerous state (standard term) of the machine is always shown in the drawings and diagrams of this document as the 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 risks and hazards

Safety

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

- Please read this chapter carefully before working with the SafeShield safety light curtain or with the machine protected by the SafeShield safety light curtain.

Specialist Personnel

The SafeShield safety light curtain must be installed, commissioned and serviced only by specialist personnel. Specialist personnel are defined as persons who

- Have undergone the appropriate technical training
- and
- Who have been instructed by the responsible machine operator in the operation of the machine and the current valid safety guidelines
- and
- Who have access to these operating instructions.

Applications of the Device

The SafeShield safety light curtain is an item of electro-sensitive protective equipment (ESPE). The physical resolution is 14 and 30. The realizable protective field height is between 300 and 1800mm.

The device is a *Type 4 ESPE* as defined by IEC 61496-1 and -2 and is therefore allowed for use with controls in control category 4 in compliance with EN 954-1. The emergency stop monitoring in the device corresponds to stop category 0 in accordance with EN 418. The device is suitable for:

- Hazardous point protection (finger and hand protection)
- Hazardous area protection
- Access protection

Access to the hazardous point must be allowed only through the protective field. The equipment/system is not allowed to start as long as personnel are within the hazardous area. Refer to “Examples of Range of Use” on page 9 for an illustration of the protection modes.



ATTENTION: Only use the safety light curtain as an indirect protective measure!

An opto-electronic protective device provides indirect protection, e.g., by switching off the power at the source of the hazard. It cannot provide protection from parts thrown out, nor from emitted radiation. Transparent objects are not detected.

Depending on the application, mechanical protection devices may be required in addition to the safety light curtain.

Notes The SafeShield safety light curtain operates as a standalone system, comprising a sender and receiver, or in combination with other cascable SafeShield safety light curtain systems. This means that the protective field can be adapted to suit individual safety requirements.

Correct Use

The SafeShield safety light curtain must be used only as defined in “Applications of the Device.” It must be used only by qualified personnel and only on the machine where it has been installed and initialized by qualified personnel.

If the device is used for any other purposes or modified in any way—also during mounting and installation—any warranty claim against Allen-Bradley Guardmaster shall become void.

General Protective Notes and Protective Measures



ATTENTION: Safety notes

Please observe the following procedures in order to ensure the correct and safe use of the SafeShield safety light curtain.

The national/international rules and regulations apply to the installation, use and periodic technical inspections of the safety light curtain, in particular:

- Machine Directive 98/37/EEC
- Equipment Usage Directive 89/655/EEC
- The work safety regulations/safety rules
- Other relevant health and safety regulations

Manufacturers and operators of the machine with which the safety light curtain is used are responsible for obtaining and observing all applicable safety regulations and rules.

- The notices, in particular the test regulations (see “Test Notes” on page 31) of these operating instructions (e.g. on use, mounting, installation or integration into the existing machine controller) must be observed.
- Changes to the configuration of the devices can modify 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, always use the password hierarchy provided by Allen-Bradley Guardmaster to ensure that only authorized persons make changes to the configuration.
- The tests must be carried out by specialist 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 SafeShield safety light curtain is installed. The machine operator is to be instructed in the use of the device by specialist personnel and must be instructed to read the operating instructions.
- The external voltage supply of the device must be capable of buffering brief mains voltage failures of 20ms as specified in EN 60204-1. Suitable power supplies are available as accessories from Rockwell Automation.

Protection of the Environment

The SafeShield safety light curtain has been designed to minimize environmental impact. It uses only a minimum of power and natural resources.

Disposal

- Always dispose of unserviceable or irreparable devices in compliance with local/national rules and regulations.

Product Description

This chapter provides information on the special features and properties of the SafeShield safety light curtain. It describes the construction and the operating principle of the device, in particular the different operating modes.

- Please read this chapter before mounting, installing and commissioning the device.

Special Features

SafeShield Safety Light Curtain

- Protection with either internal or external (realized on the machine) restart interlock
- Connection for the reset button either in the control cabinet or directly to the device
- Ability to connect an emergency stop button to the device
- External device monitoring (EDM)
- 2 beam codings possible in addition to noncoded operation
- Configurable signal output (ADO) for improved availability
- Status display with 7-segment display
- Range of functions can be expanded using the SafeShield function module
- Blanking of several areas
- Blanking with tolerance of up to 2 beams
- Floating blanking
- Reduced resolution
- Object monitoring for areas with floating blanking
- Increased size tolerance for areas with fixed blanking

Operating Principle of the Device

Components of the Device

Host without cascading connection or—in this case guest 1 connected—with cascading connection.

Optional: 1. Guest system without cascading connection or—in case guest 2 connected—with cascading connection.

Optional: 2. Guest system with or without cascading connection.



Figure 1: Components of the SafeShield safety light curtain

Please refer to “Technical Specifications” on page 35 for the data sheet. Please refer to page 39 for dimensional drawings.

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Function That Can Be Configured	SafeShield Safety Light Curtain		Special Features
	Without Cascading Connection	With Cascading Connection	
Emergency stop can be connected to the device		■	
Reset button can be connected directly to the device	□	■	□ = On devices without an extension connection, these functions can be accessed using the terminal strip in the control cabinet from the system connection for the SafeShield safety light curtain!
Output for “Reset required” on the device	□	■	
Signal output (ADO)	■	■	
External device monitoring (EDM)	■	■	
Reduced resolution	■	■	
Blanking	■	■	
Teaching in blanked areas	□	■	□ = Only in conjunction with SafeShield function module
PSDI mode	□	□	
Bypass	□	□	
Operating mode switching	□	□	

Table 1: Special features and configurable functions of the SafeShield safety light curtain.

The Light Curtain Principle

The SafeShield safety light curtain consists of a sender and a receiver (Figure 1). Between these two units is the protective field, defined as the protective field height and the protective field width.

The construction height determines the *height of the protective field* of the appropriate system. For the exact protective field height, please see Table 30 on page 39.

The *width of the protective field* is derived from the dimension of the light path between sender and receiver and must not exceed the maximum rated width of the protective field (see “Technical Specifications on page 35).

Sender and receiver automatically synchronize themselves optically. An electrical connection between both components is not required.

The SafeShield safety light curtain is modular in construction. All optical and electronic components and assemblies are housed in a slim and torsionally rigid housing.

Cascading

To provide effective point-of-operation protection, a maximum of three SafeShield safety light curtains can be connected in series in a cascaded configuration. The device connected to the control cabinet is the main sensor, called *Host*. The subsequent sensors are called *Guest* (see Figure 1 on page 7).

Benefits of Cascading

- No additional external circuitry required
- Resolution and protective field height may differ among the individual systems

Limits of Cascading

- The maximum protective field width must be guaranteed for each individual system!
- The maximum total number of beams must not exceed 480 beams in noncoded operation, and a maximum of 405 beams in coded operation.
- The maximum cable length between two cascaded systems must not exceed 3 meters.

Recommendation

With the exception of the last guest, for cascading you will require devices with an extension connection. It is worthwhile choosing devices with an extension connection because the extension connection provides additional possible connection methods and facilitates a significant reduction in the wiring effort.

Examples of Range of Use

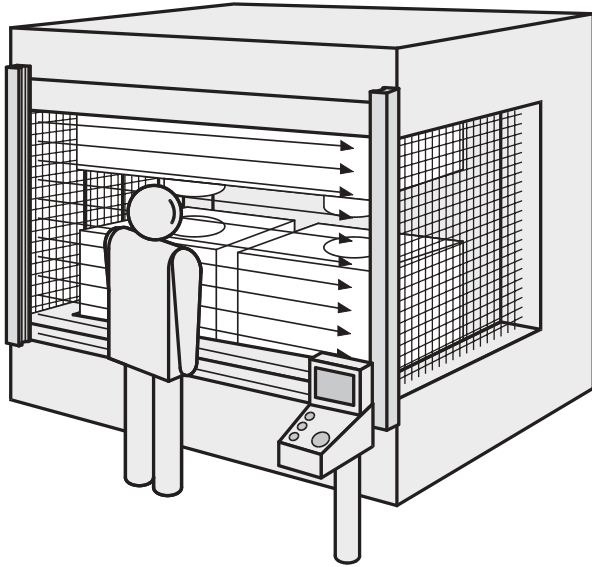


Figure 2: Hazardous point protection using a SafeShield safety light curtain

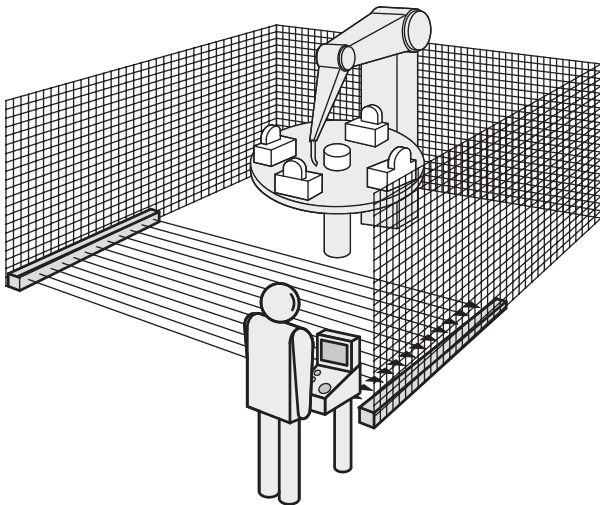


Figure 3: Hazardous area protection using a SafeShield safety light curtain

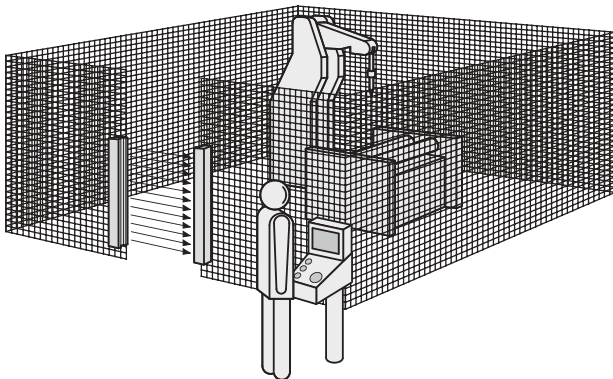


Figure 4: Access protection using a SafeShield safety light curtain

The SafeShield safety light curtain operates correctly as a protective device only if the following conditions are met:

- The control of the machine must be electrical.
- The dangerous state of the machine must be transferable at any time into a safe state.
- Sender and receiver unit must be so mounted that objects penetrating the hazardous area are safely identified by the SafeShield safety light curtain.
- The restart button must be located outside the hazardous area such that it cannot be operated by a person working inside the hazardous area. When operating the reset button, the operator must have full view of the hazardous area.
- The statutory and local rules and regulations must be observed when installing and using the device.

Status Indicators

The LEDs and the 7-segment displays of the sender and the receiver signal the operational status of the SafeShield safety light curtain.

Notes The depiction of numbers on the 7-segment display can be rotated by 180° with the aid of the SCD software. In this case the point on the 7-segment display goes out:

- Point visible: The bottom edge of the numbers on the 7-segment display is pointing towards the configuration connection.
- Point not visible: The bottom edge of the numbers on the 7-segment display is pointing towards the LED display.



Device symbol SafeShield safety light curtain Host (receiver) or SafeShield safety light curtain Host (sender), context menu Configuration draft, Edit, option 7-segment display of the related device.

Status Indicators of the Sender

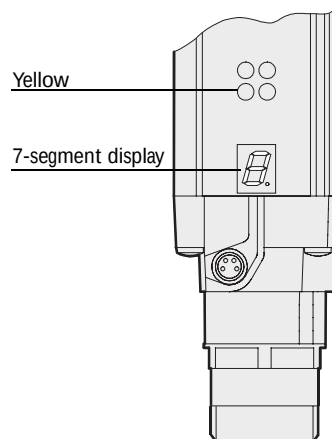


Figure 5: Status indicators of the sender

Display	Meaning
● Yellow	Supply voltage OK
	System error. Disconnect the supply voltage to the SafeShield safety light curtain for at least 3 seconds. If the problem persists, replace the unit.
	The device is in the test mode.
	Noncoded operation (only after switching on)
	Operation with code 1 (only after switching on)
	Operation with code 2 (only after switching on)
Other displays	All other displays are error messages. Please refer to “Fault Diagnosis” on page 32

Table 2: Status indicators of the sender

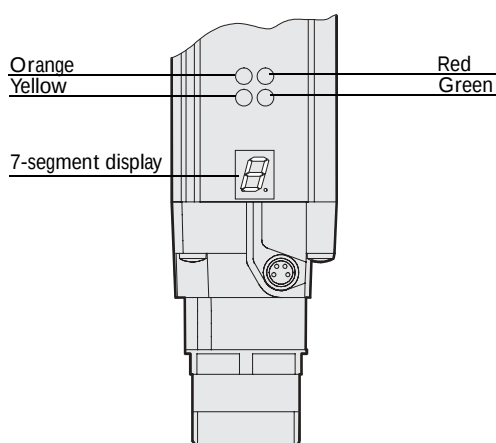


Figure 6: Status indicators of the receiver

Display	Meaning
● Orange	Cleaning or realignment required
● Yellow	Reset required
● Red	System providing signals for shutting down the machine (switching output off)
● Green	System enabled (switching output on)
	Bypass active (only in conjunction with the SafeShield function module)
	System error. Disconnect the supply voltage to the SafeShield safety light curtain for at least 3 seconds. If the problem persists, replace the unit.
	Poor alignment to sender. Please refer to “Aligning Sender and Receiver” on page 30.
	Operation with large protective field width (only after switching on)
	Operation with reduced resolution and/or blanking
	Noncoded operation (only after switching on)
	Operation with code 1 (only after switching on)

	Operation with code 2 (only after switching on)
	Emergency stop active
Other displays	All other displays are error messages. Please refer to “Fault Diagnosis” on page 32.

Table 3: Status indicators of the receiver

Configurable Functions

This section describes the functions of the safety light curtain which are selectable via software. Some of the functions can be combined. An overview of the possible combinations and possible limitation is given in the section “Functions that Cannot Be Combined” on page 21.



ATTENTION: Test the protective device after any changes!

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 (see “Test Notes” on page 31).

The person who makes the change is also responsible for the correct protective function of the device. When making configuration changes, always use the password hierarchy provided by Allen-Bradley Guardmaster to ensure that only authorized persons make changes to the configuration.

When starting to configure the device, you may save an application name with a maximum of 22 characters. Use this function as a “memory jog,” e.g. to describe the application of the current device configuration. Device symbol SafeShield safety light curtain Host (receiver) or SafeShield safety light curtain Host (sender), context menu Configuration draft, Edit, file card General, option Application name.

Restart Interlock

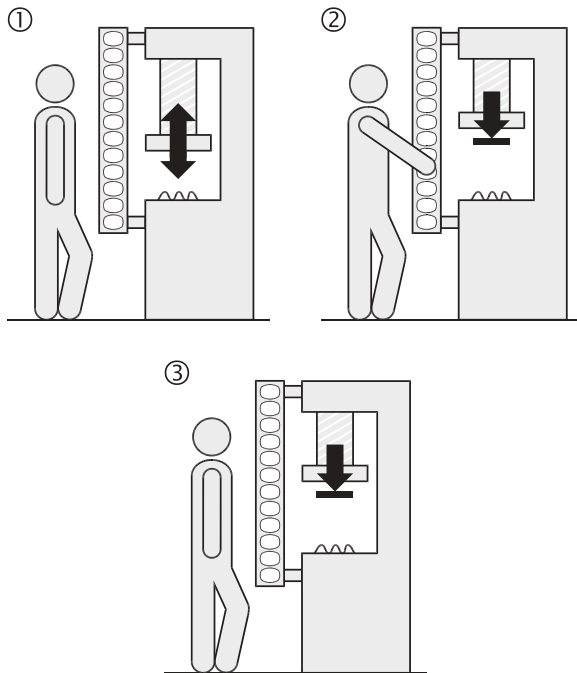


Figure 7: Schematic layout of the protective operation

The dangerous state of the machine (1) is interrupted if the light path is broken (2), and is not re-enabled (3) until the operator presses the reset button.

Notes Do not confuse the restart interlock with the starting interlock on the machine. The start interlock prevents the machine starting at power up. The restart interlock prevents the machine starting again after an error or an interruption in the light path.

The restart interlock can be implemented in two different ways:

- With the internal restart interlock of the SafeShield safety light curtain: The SafeShield safety light curtain controls the restart.
- With the restart interlock of the machine (external): The SafeShield safety light curtain has no control over the restart.

The possible combinations are shown in the following table:

Restart interlock of SafeShield	Restart interlock of the Machine	Permissible Application
Deactivated	Deactivated	Only if one cannot stand between the light curtain and the machine. Observe EN 60_204-1!
Deactivated	Activated	All
Activated	Deactivated	Only if one cannot stand between the light curtain and the machine. Observe EN 60_204-1!
Activated	Activated	All. Restart interlock of the SafeShield safety light curtain handles the reset function (see "Reset" below).

Table 4: Permissible configuration of the restart interlock



ATTENTION: Always configure the application with restart interlock!

Ensure that there is always a restart interlock. The SafeShield safety light curtain is unable to verify if the restart interlock of the machine is operable. If you deactivate both the internal and the machine's restart interlock, the operators of the machine will be at an acute risk of injury.

The electrical connection of the reset button is described in the "Reset Button" section on page 28.



Device symbol SafeShield safety light curtain Host (receiver), context menu Configuration draft, Edit, file card General, option Restart interlock.

Recommendation

You can indicate the status "Reset required" using a signal lamp. The SafeShield safety light curtain has a dedicated output for this purpose. The electrical connection of the signal lamp is described in "Connection of a Signal Lamp to the Output *Reset Required*" on page 28.

Notes You can define whether the operator must press the reset button, or press and release it to start the function. If you configure Press, then the reset is performed before the operator releases the reset button again. This can be useful if you want, for example, to use a two-hand control unit also as the reset button for the safety light curtain.



ATTENTION: Never configure Reset after press if it is possible to stand behind the light curtain!

Reason: If pressing the reset button (without releasing it) is sufficient as the reset signal, then the safety light curtain cannot differentiate the operation of the reset button from a short-circuit to 24V. In case of a short-circuit, the light curtain would be inadvertently reset. In this case the operator would be in serious danger.



Device symbol SafeShield safety light curtain Host (receiver), context menu Configuration draft, Edit, file card General, option Reset button active.

Reset

If you want to activate the restart interlock on the SafeShield safety light curtain (internal) and also a restart interlock on the machine (external), then each restart interlock has its own button.

When actuating the reset button (for the internal restart interlock) ...

- The SafeShield safety light curtain activates the switching outputs.
- The SafeShield safety light curtain changes to green.

Only the external restart interlock prevents the machine from restarting. After pressing the reset button for the SafeShield safety light curtain, the operator must also press the restart button for the machine. If the reset button and the restart button are not pressed in this specified sequence, the dangerous state remains unchanged.

Recommendation

The reset button prevents the accidental and inadvertent operation of the external restart button. The operator must first acknowledge the dangerous state with the reset button.

External Device Monitoring (EDM)

The EDM checks if the contactors actually de-energize when the protective device responds. If you activate external device monitoring, then the SafeShield safety light curtain checks the contactors after each interruption to the light path and prior to machine restart. The EDM can also identify if one of the contactors has fused, for instance. In this case ...

- The error message 8 appears in the 7-segment display.
- The safety light curtain remains red.
- With the internal restart interlock activated, the safety light curtain uses the flashing LED  Yellow to signal "Reset required."

Notes If the system is unable to change to a safe operational state (e.g. after contactor failure), the system locks and shuts down completely (lock-out). The 7-segment display will then show the error message .

The electrical connection for the external device monitoring is described in "External Device Monitoring (EDM)" on page 12.



Device symbol SafeShield safety light curtain receiver, context menu Configuration draft, Edit, file card General, option EDM.

Emergency Stop

The SafeShield safety light curtain has an input for a two-channel emergency stop button. The emergency stop monitoring in the device corresponds to stop category 0 in accordance with EN 418. You can connect e.g. a door contact or an emergency stop button to the emergency stop input. The operation of the emergency stop button has the following effect:

- The safety light curtain deactivates the OSSDs.
- The host switches to red.
- The 7-segment display on the host indicates .

Notes The emergency stop function deactivates the OSSDs even if the bypass function is activated.

Take into account the response time of the emergency stop function! The response time of the safety light curtain on interruption via the emergency stop input is up to 200ms.



ATTENTION: Pay attention to the way in which the emergency stop function works!

The emergency stop button connected to the extension connection on the SafeShield safety light curtain affects only the switching outputs (OSSDs) on the SafeShield safety light curtain.

Notes The SafeShield safety light curtain checks after power up whether an emergency stop has been configured and whether a door switch or similar switch is connected. If the configuration and the electrical connection do not match, the system locks completely (lock-out). The 7-segment display will then show the error message .

The safety light curtain has a signal output (ADO) at which the status of the emergency stop input can be signalled. For details refer to the next section.



ATTENTION: Regularly check the connected emergency stop button or door contact!

- By means of organizational measures ensure that the emergency stop button or door contact is operated once at a specified interval.

This is necessary so that the SafeShield safety light curtain can detect any fault that has occurred on the emergency stop button or door switch. The interval is to be defined to suit the specific case dependant on the application.

- Always check whether the switching outputs on the light curtain are deactivated on the operation of the emergency stop button or door switch.

The electrical connection of the emergency stop is described in the "Emergency Stop" section on page 12.



Device symbol **SafeShield** safety light curtain Host (receiver), context menu **Configuration draft, Edit**, file card **General**, option **Emergency Stop active**.

Signal Output (ADO)

The SafeShield safety light curtain has a signal output (ADO) that can be configured. With the aid of the signal output, the safety light curtain can signal specific states. This signal output can be connected to a PLC/relay/lamp.



ATTENTION: You must not use the signal output for safety-relevant functions!

You are only allowed to use the signal output for signalling. You must never use the signal output for controlling the application or with safety-relevant functions.

The connection can signal one of the following states:

Assignment	Possible uses
Contamination	Eases diagnostics in case of dirty front screen
OSSD status with delay of [s]	Signals the status of the switching outputs. If the safety light curtain switches to red, then it signals the status immediately. If it switches to green, then it signals the status only after an adjustable delay in the range from 0.1 to 3.0 seconds.
Status of the emergency stop	Signal is present if the button connected to the emergency stop input on the SafeShield safety light curtain has been pressed.

Table 5: Possible configuration for the signal output



Device symbol **SafeShield safety light curtain Host (receiver)**, context menu **Configuration draft, Edit**, file card **General**, option **Assignment of the signal output**.

The electrical connection of a PLC/controller to the signal output is described in "Signal Output (ADO)" on page 12.

Beam Coding

If several SafeShield safety light curtains operate in close proximity to each other, the sender beams of one system may interfere with the receiver of another system. With code 1 or 2 activated, the receiver can distinguish the beams designated for it from other beams. The following settings are available: noncoded, code 1 and code 2.



ATTENTION: Use different beam codings if the systems are mounted in close proximity!

Systems mounted in close proximity to each other must be operated with different beam codings (code 1 or code 2). If this precaution is neglected, the system may be impaired in its protective function by the beams from the neighboring system and so change to the unsafe state. This would mean that the operator is at risk.



Figure 8: Schematic layout of the beam coding

Notes Beam coding increases the availability of the protected machine. Beam coding also enhances the resistance to optical interference.

In a cascaded system the host and guest always have the same beam coding. There is no mutual interference.

Beam coding will increase the response time of the system. This will also change the required safety distance. Instructions can be found in the "Determining the Safety Distance" section on page 21.

After activating the system, sender and receiver will briefly display the coding.

Beam coding is only possible on systems with a maximum total of 405 beams.



Device symbol **SafeShield safety light curtain Host (receiver)** or **SafeShield safety light curtain Host (sender)**, context menu **Configuration draft, Edit**, file card **General**, option **Beam coding**.

Scanning Range



ATTENTION: Match the scanning range with the protective field width!

The scanning range of the system (host, guest 1 and guest 2) must be adapted to the width of the protective field.

- If the scanning range is set too low, the light curtain may not switch to green.
- If the scanning range is too great, the light curtain may malfunction. This would mean that the operator is at risk.

The available settings depend on the physical resolution of the system:

Physical Resolution	Selectable Scanning Ranges	Scanning Range with 1 Weld Shield	Scanning Range with 2 Weld Shields
14mm	0-2.5m 2-6m	0-2.3m 1.8-5.5m	0-2.1m 1.7-5
30mm	0-6m 5-19m	0-5.5m 4.6-17.4m	0-5m 4.2-16m

Table 6: Physical resolution and scanning range



Device symbol **SafeShield safety light curtain Host (receiver)**, context menu **Configuration draft, Edit**, file card **Host** or **Guest**, option **Scanning range [m]**.

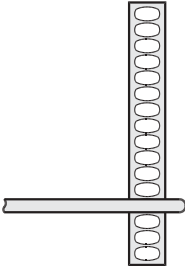
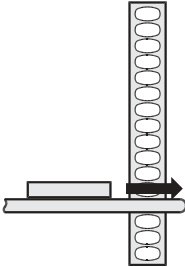
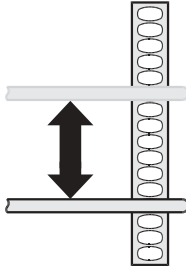
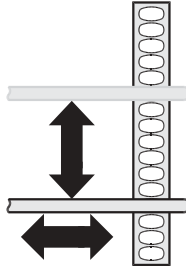
Fixed Blanking		Floating Blanking	
Fixed blanking	Fixed blanking with increased size tolerance	Floating blanking with complete object monitoring	Floating blanking with partial object monitoring
An object of <i>fixed</i> size must be at a specific point in the protective field.	On one side of the fixed blanking an object of <i>limited</i> size is allowed to move through the protective field.	An object of <i>fixed</i> size <i>must</i> be within a specific area of the protective field. The object is allowed to move.	An object of <i>limited</i> size is allowed in a specific area of the protective field. The object is allowed to move.
			

Table 7: Overview of the blanking function

Notes If you are using the weld shields (see page 45) available as an accessory, the overall scanning range will be reduced by 8% per shield.

Mirrors, available as accessories (see page 45) reduce the usable scanning range as a function of the number of mirrors in the light path (see Table 7). When using mirrors, you must configure the light curtain for a long scanning range.



ATTENTION: Do not use mirrors if the formation of droplets or heavy contamination of the mirrors is to be expected.

The formation of droplets or heavy contamination can be detrimental to the reflection behavior. The protective function of the system will be affected and the system will thus become unsafe. This would mean that the operator is at risk.

Mirror	14mm	20, 30 or 40mm
1	5.4m	17.0m
2	4.8m	15.2m

Table 8: Scanning Range when using 1 or 2 mirrors

The information in the table relates to 90° beam deflection per mirror and a protective field height of 900mm.

Blanking

Notes The SafeShield safety light curtain offers various ways of blanking the protective field. In this way in many applications a higher level of safety and availability can be assured than would be possible without the usage of the blanking function. This requires the careful analysis of the usage of blanking as part of a risk analysis for these

applications. Only if the analysis produces advantages in reliability and thus advantages in safety when the blanking function is used the usage of the function is recommended.

The person responsible for the machine has the responsibility to decide whether or not to use the blanking function and to undertake the installation, mounting and configuration of the light curtain such that

- The necessary safety is achieved on the machine
- and
- Access to the hazardous area through the light curtain in conjunction with the blanking function is prevented by other guards.



ATTENTION: Blanked areas require a separate risk analysis!

A blanked area is in principle a hole in the protective field. Check in detail whether and where blanking is actually required. You must protect the blanked area in another way, e.g. mechanically. Otherwise you must take the blanked area into consideration in the calculation of the safety distance and mount the safety light curtain appropriately.

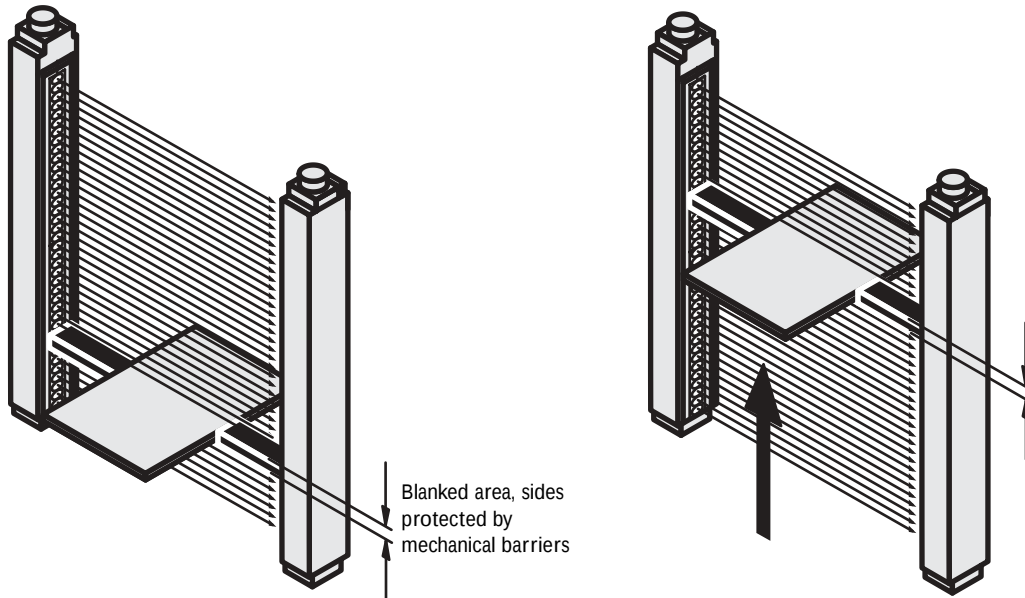


Figure 9: Example of mechanical protection of fixed or floating blanking

- After modifying the blanking, check the protective field with the test rod. Instructions can be found in the “Daily Functional Checks of the Protective Device on page 31.
- Also pay attention to the warnings in the related chapter.

Properties of Blanked Areas

- The SafeShield safety light curtain is capable of blanking a total of four areas simultaneously.
- Fixed and floating blanking can be mixed.
- A minimum of one beam spacing must exist between two blanked areas. The SCD software automatically ensures that this is the case during the configuration. Exception: It is not necessary to maintain any distance between an area of floating blanking with partial object monitoring and an area of fixed blanking without a positional tolerance. In this case the effective resolution for the overlapping is equal to the sum of the effective resolutions in the two areas (see Table 10 and Table 11).
- The first beam of the light curtain (closest to the 7-segment display) cannot be blanked. It is needed for the synchronization between sender and receiver.
- With fixed blanking, the 7-segment display indicates r as soon as sender and receiver are aligned.

Fixed Blanking

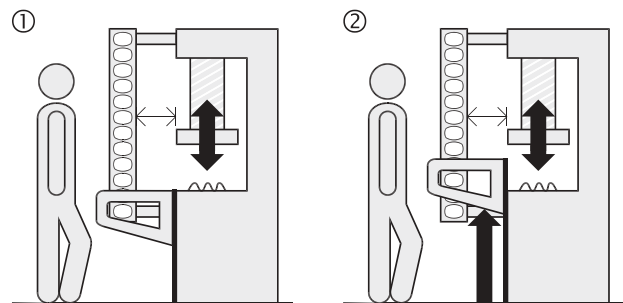


Figure 10: Schematic layout of the fixed blanking

The SafeShield safety light curtain is capable of fixed-blanking one or several adjacent beams, e.g. to allow continued operation in spite of an obstruction such as a table placed permanently in the light path.

The blanked area will no longer be part of the protective field. Objects to be blanked out must therefore be permanently located inside the blanked area (1). As soon as the object is removed from the beam path, the light curtain will send a signal to stop the dangerous movement (2). Protection is otherwise no longer guaranteed.

Notes On devices with a physical resolution of 14mm, you can set an area positional tolerance for the fixed blanking of maximum ± 2 beams. This is e.g. helpful when blanking vibrating objects. The effective resolution of the light curtain does not change due to the positional tolerance. In addition you can define a size tolerance of -1 beam, i.e. the blanked object is allowed to be a maximum of 1 beam smaller.

Depending on the size tolerance configured, the effective resolution reduces at the edges of the blanked area as per

Table 10. For this reason the moving area must always be greater than the effective resolution at the edges of the area.

If you configure a blanked area *without* positional and *without* size tolerance, the movement of the object within the area is very limited before the light curtain may change to red.

The maximum selectable tolerance values depend on the size of the blanked area: The actual tolerance expansion in millimetres differs. It depends on the physical resolution of the device.



Device symbol **SafeShield safety light curtain Host (receiver)**, context menu **Configuration draft, Edit**, file card **Blanking** of the appropriate system, option **Type of blanking** = fixed. Here you can also set the positional tolerance and size tolerance directly in millimetres.

Increased Size Tolerance

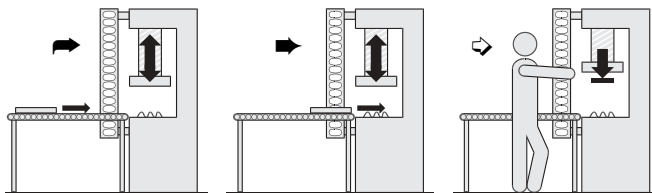


Figure 11: Schematic layout of the fixed blanking with increased size tolerance

You can configure an increased size tolerance of the fixed blanking. In this way objects can pass through the protective field on one side of the fixed blanking, e.g. for material feed on a conveyor belt (➡ and ➡). Configure fixed blanking for the conveyor, for the material input an increased size tolerance above the fixed blanking.

Unlike the normal size tolerance for blanking, the increased size tolerance allows the blanked object on a specific side of the area to be larger than the blanked area.

In the area of the increased size tolerance, the object can penetrate the protective field if it does not exceed the increased size tolerance defined.

Notes The increased size tolerance must not cover the last beam.

On fixed blanking with increased size tolerance, you cannot configure a positional tolerance or a normal size tolerance in addition.

You can expand the increased size tolerance to the next blanked area as a maximum, or to the second or second last beam of the light curtain.



ATTENTION: Blanked areas require a separate risk analysis!

A blanked area is in principle a hole in the protective field. Check in detail whether and where blanking is actually required. You must protect the blanked area in another way, e.g. mechanically. Otherwise you must take the blanked area into consideration in the calculation of the safety distance and mount the safety light curtain appropriately.

- After modifying the blanking, check the protective field with the test rod. Instructions can be found in the "Daily Functional Checks of Protective Device" on page 31.
- Also pay attention to the warnings in the related chapter.

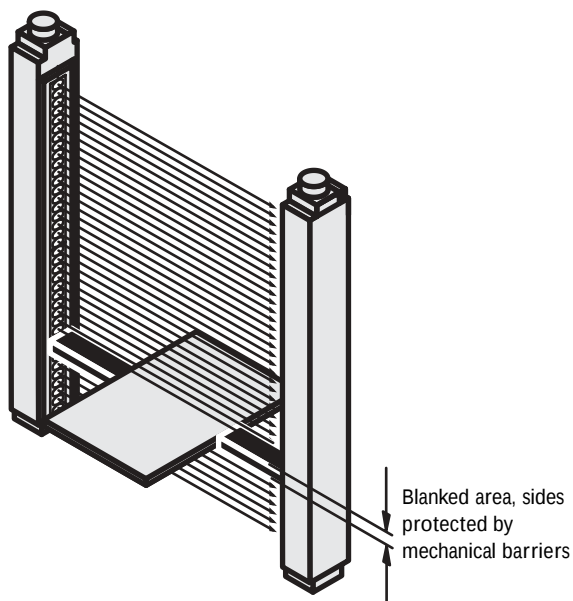
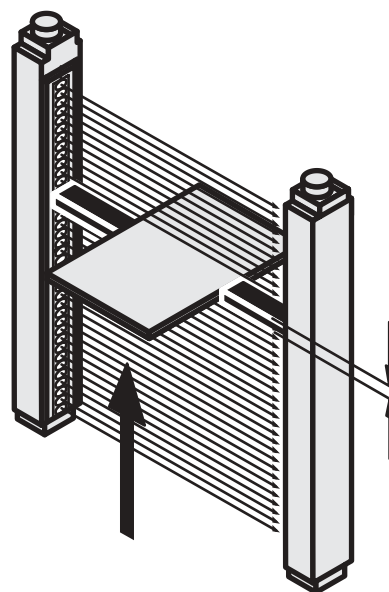


Figure 12: Example of mechanical protection of fixed or floating blanking





Device symbol **SafeShield safety light curtain Host (receiver)**, context menu **Configuration draft, Edit**, file card **Blanking** of the related system, option **Type of blanking** = fixed + increased size tolerance. Here you can adjust the position of the increased size tolerance and the size of this area in millimeters directly.

Floating Blanking

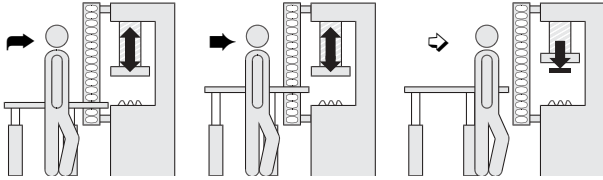


Figure 13: Schematic layout of the floating blanking

The SafeShield safety light curtain is capable of blanking an area of two or more adjacent beams (➡). In contrast to fixed blanking, the blanked area is allowed to move (➡) without the light curtain changing to red. The safety light curtain detects whether the object is in the blanked area or not (⇔, so-called Object Monitoring, see below in chapter).

Notes You cannot combine the function Floating blanking with partial object monitoring with the function Reduced resolution (see page 18).

For each floating area with complete object monitoring you must choose a size tolerance of -1 or -2 beams, i.e. the blanked object is allowed to be a maximum total of 1 beam or 2 beams smaller.

Table 10. For this reason the moving area must always be greater than the effective resolution at the edges of the area.

The size of the blanked area for floating blanking with complete object monitoring must be at least equal to the effective resolution.

The size tolerance of -2 beams can be used only in devices with a physical resolution of 14mm.



Device symbol **SafeShield safety light curtain Host (receiver)**, context menu **Configuration draft, Edit**, file card **Blanking** of the related system, option **Type of blanking** = floating (full) or floating (partial). With the help of the selection fields, the size of the area can be selected directly (in millimeters).



ATTENTION: Blanked areas require a separate risk analysis!

A blanked area is in principle a hole in the protective field. Check in detail whether and where blanking is actually required. You must protect the blanked area in another way, e.g. mechanically. Otherwise you must take the blanked area into consideration in the calculation of the safety distance and mount the safety light curtain appropriately.

Object Monitoring

Despite the floating blanking of the area, the safety light curtain monitors whether there are objects in the area with floating blanking. For areas with floating blanking you must configure which type of object monitoring is to apply to the areas:

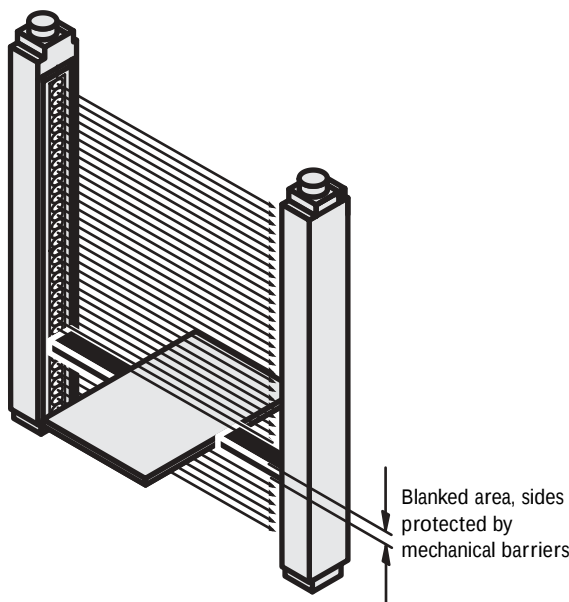


Figure 14: Example of mechanical protection of fixed or floating blanking

Depending on the size tolerance configured, the effective resolution reduces at the edges of the blanked area as per

Object monitoring	Description
Complete	The blanked area must be completely covered by the object within the size tolerance. If this is not the case, then the safety light curtain switches to red.
Partial	The blanked area does not need to be covered by an object. However within the size tolerance it can be partially or completely covered. If you have configured several areas with floating blanking, then only one area can use this setting.

Table 9: Types of object monitoring for floating blanking

Notes Directly adjacent to the area with floating blanking with partial object monitoring you can only configure areas with fixed blanking.

During operation an area with floating blanking with partial object monitoring is allowed to overlap with an area of fixed blanking without positional tolerance.

- After modifying the blanking, check the protective field with the test rod. Instructions can be found in the “Daily Functional Checks of the Protective Device” on page 31.
- Also pay attention to the warnings in the related chapter.

Effective Resolution for Blanking

The effective resolution of an optical system depends on both its optical components and on its configuration. The effective resolution cannot be higher than the highest possible physical resolution of the system. However, it can be reduced by the configuration, e.g. by blanking beams.

In conjunction with size tolerance, the effective resolution is reduced at the edges of the blanked areas. For blanking with size tolerance, the effective resolution depends on the physical resolution and the size tolerance chosen.



ATTENTION: Check the safety distance!

When using floating blanking with increased size tolerance, the required safety distance will depend on the *effective* resolution (see Table 10).

- If required, recalculate the safety distance and readjust it on the machine.

Example: – physical resolution 14mm
– size tolerance –2 beams
– effective resolution 22mm
Calculate the safety distance with a resolution of 22mm

- Mark the effective resolution on the information label “Operation with blanking combined with size tolerance ...” on the related sender and receiver.



ATTENTION: During operation with “Blanking” combined with “Size tolerance,” the safety distance that corresponds to the modified resolution is to be observed.

Resolution modified to: (please mark)	Physical resolution					
	14mm			30mm		
Size Tolerance	Effective Resolution					
1 beam	14mm			40mm		
2 beams	22mm			Not possible		

Figure 15: Marking the effective resolution on the device label

Physical Resolution	Size Tolerance	Effective Resolution at the Edges of the Blanked Area	Permissible Types of Blanking
14mm	Without	14mm	Fixed
	–1 beam	14mm	Fixed and floating
	–2 beams	22mm	Floating
30mm	Without	30mm	Fixed
	–1 beam	40mm (no PSDI mode)	Fixed and floating
	–2 beams	Not permitted	Not permitted

Table 10: Effective resolution for blanking with size tolerance

For floating blanking with partial object monitoring and for fixed blanking with increased size tolerance, a hole is produced in the protective field for technical reasons. With the aid of Table 11 you can determine the effective resolution of the safety light curtain at this point and the minimum size of an object to ensure that the safety light curtain reliably switches to red.

Physical resolution	Size of the blanked area	Blanked beams (= reduction)	Effective resolution/ size of the hole
14mm	7.5mm	1 beam	22mm
	15mm	2 beams	30mm
	22.5mm	3 beams	37mm
	$n \times 7.5\text{mm}$	n beams	$(n + 2) \times 7.5\text{mm}$
30mm	20mm	1 beam	50mm
	40mm	2 beams	70mm
	60mm	3 beams	90mm
	$n \times 20\text{mm}$	n beams	$n \times 20\text{mm} + 30\text{mm}$

Table 11: Effective resolution for floating blanking with partial object monitoring and for fixed blanking with increased size tolerance

Mark the effective resolution on the information label “Operation with reduced resolution or blanking ...” on the related sender and receiver.



ATTENTION: During operation with “Reduced resolution” or “Blanking” the safety distance that corresponds to the modified resolution is to be observed.

Resolution modified to: (please mark)	Physical resolution							
	14mm				30mm			
Reduction	Effective Resolution/min. object size							
1 beam	22mm	√			50mm			
2 beams	30mm				70mm			
3 beams	37mm				90mm			
n beams		mm		mm		mm		mm

Figure 16: Marking the effective resolution on the device label

Teach-in of Blanked Areas

Teach-in enables the operator to re-define the size of blanked areas in a simple manner by introducing an object of appropriate size into the protective field at the required position. This is, e.g., useful during a tool change.

Requirements

To be able to use the teach-in function, the application must meet the following requirements:

- A reset button is connected to the SafeShield safety light curtain and is correctly configured (see “Reset Button” on page 28).
- A teach-in key-operated switch is connected to the SafeShield safety light curtain (see “Teach-in Key-operated Switch” on page 29).
- As an option you can connect a switch for deactivating blanking to the SafeShield safety light curtain (see “Teach-in Key-Operated Switch” on page 29).
- You have already configured the number and type of blanked areas as well as the tolerances with the aid of the SCD software.
- You have activated the option Teach-in key-operated switch active in the SCD software:

Device symbol SafeShield safety light curtain Host (receiver), context menu Configuration draft, Edit, file card General, option Teach-in key-operated switch active.

Limits for Teach-In Operation

- You can only activate the teach-in function for the entire system. It is not possible to limit the teach-in to specific sub-systems (host, guest), specific areas, or specific operating modes.



ATTENTION: Prevent teach-in areas or operating modes where it is not intended to be used!

A successfully completed teach-in process changes the size and, for fixed blanking, also the position of the blanked areas. Areas of unsuitable size or in an unsuitable position can reduce the availability of the system. For this reason:

- Ensure by means of organizational measures that the operator only teaches in those areas and only in those operating modes that are also suitable in relation to the application.
- Ensure that only authorized persons have access to the teach-in key.

- You cannot add or delete any blanked areas using teach-in. Use the SCD to define the number of blanked areas.
- If you use a SafeShield function module in conjunction with an operating mode selector switch, then the change in the operating mode is effective when the teach-in key-operated switch has been set to the “Operation” position again. The taught-in areas always apply for the operating mode that was set when the teach-in key-operated switch was switched on.
- The mounting position can change slightly on a device change. For this reason it is recommended in this case to teach-in the areas again.

This is how you teach-in a blanked area:

- Set the teach-in key-operated switch to the “Teach-in” position. The safety light curtain changes to red.
- Guide the object or objects into the protective field. You must guide an object of suitable size into the protective field for all blanked areas. There must be no other objects in the protective field.
- Press the reset button for at least 0.2 seconds. After the button is released, the SafeShield safety light curtain saves the interrupted part of the protective field as a blanked area. The 7-segment display on the receiver indicates  if the objects represent valid areas to be blanked.

Notes If the number or arrangement of the objects does not match the configured areas for the individual system, or the necessary minimum distance is not met, then the old areas for the system remain valid. In this case the 7-segment display on the receiver indicates . You can correct the arrangement and repeat the step.

- Set the teach-in key-operated switch back to the “Operation” position, and remove the key. The safety light curtain performs a switch on cycle (see page 30) and is ready for use.



ATTENTION: Test the protective device after teach-in!

- Test the entire protective device for effectiveness (see “Test Notes” on page 31).
- Check whether the safety light curtain behaves as expected when you introduce the object into the protective field, remove it again, or operate the system without the object.
- If required, recalculate the safety distance and readjust it on the machine.



With the aid of the SCD diagnostics function, you can check whether defined areas have been changed using teach-in. Menu **Project, Connect**. Then device symbol for the related system, context menu **Diagnostics, Show**.

Reduced Resolution

Under reduced resolution, the light curtain ignores the interruption of 1, 2 or 3 adjacent beams. Objects which are not larger than specified in Table 12 may be moved through the light curtain without the light curtain changing to red (Figure 17, ❶ and ❷).

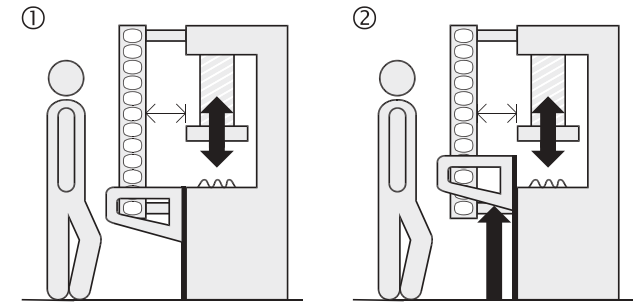


Figure 17: Schematic layout of the operation with reduced resolution (example: reduction by one beam)

Physical resolution	Reduction	Effective resolution	Maximum size of movable objects
14mm	1 beam	22mm	10mm
	2 beams	30mm	18mm
	3 beams	37mm	25mm

Table 12: Effective resolution and maximum size of moving objects under reduced resolution

Notes

- The reduced resolution function can only be used with the SafeShield safety light curtain with a physical resolution of 14mm.
- The first beam of the light curtain (close to the 7-segment display) must not be interrupted. Otherwise, the safety light curtain will change to red.

- The system response time does not change under reduced resolution.
- You cannot combine the function *Reduced resolution* with the function *Floating blanking with partial object monitoring* (see page 17).
- With reduced resolution, the 7-segment display indicates  as soon as sender and receiver are aligned.



ATTENTION: Check the safety distance!

The safety distance required under reduced resolution depends on the *effective* resolution.

- If required, recalculate the safety distance and readjust it on the machine.

Example: – physical resolution 14mm
– resolution reduced by 1 beam
– effective resolution 22mm
Calculate the safety distance with a resolution of 22mm (see page 21).

- Mark the effective resolution on the information label “Operation with reduced resolution or blanking ... on the related sender and receiver.



ATTENTION: During operation with “Reduced resolution” or “Blanking” the safety distance that corresponds to the modified resolution is to be observed.

Resolution modified to: (please mark)	Physical resolution					
	14mm			30mm		
Reduction	Effective Resolution/min. object size					
1 beam	22mm	√		50mm		
2 beams	30mm			70mm		
3 beams	37mm			90mm		
n beams		mm			mm	

Figure 18: Marking the effective resolution on the device label



Device symbol SafeShield safety light curtain Host (receiver), context menu **Configuration draft, Edit**, file card **Host** or **Guest** for the related system, option **Reduced resolution**. Here you can adjust the effective resolution in millimetres directly.

Sender Test

The SafeShield safety light curtain sender has a test input on pin 3 for checking the sender and the related receiver. During the test, the sender no longer emits light beams. Thus, it simulates — for the receiver — an interruption of the protective field.

- During the test the sender indicates .
- The test is successful, if the SafeShield safety light curtain receiver switches to red, i.e. the output signal switching devices (OSSDs) are deactivated. In a cascade this only applies for the host.

Notes SafeShield safety light curtain-Sender and receiver are self-testing and do not require any external sender test. You can deactivate the sender test with the aid of the SCD, if the test is not required for the current application.

To be able to perform a sender test ...

- The option **Enable sender test** must be active. This is the condition as supplied.
- A means of controlling the test input must be available.



Device symbol **SafeShield safety light curtain Host (sender)**, context menu **Configuration draft, Edit**, option **Enable sender test**.

Notes If you do not connect the test input, then you must deactivate the **Sender test** function with the aid of the SCD. Otherwise the light curtain will be permanently switched to red.

The electrical connection at the test input is described in "Test Input (Sender Test)" on page 30.

Functions That Cannot Be Combined

Function that can be configured	Limitation
Teach-in key-operated switch on the extension connection	• Emergency stop function can only be used in conjunction with a SafeShield function module (teach-in on the module, emergency stop on the SafeShield safety light curtain)
Emergency stop	• Teach-in only possible in conjunction with SafeShield function module
Reduced resolution	• Not with floating blanking with partial object monitoring • Not with fixed blanking and increased size tolerance
Floating blanking with partial object monitoring	• Not with floating blanking with partial object monitoring • Cannot be used if a neighboring area uses floating blanking with complete object monitoring • Not with fixed blanking and increased size tolerance • Not with reduced resolution
Floating blanking with complete object monitoring	• Cannot be used if a neighboring area uses floating blanking with partial object monitoring • Not with fixed blanking with increased size tolerance
Fixed blanking with increased size tolerance	• Not with floating blanking with partial object monitoring • Not with floating blanking with complete object monitoring • Not with reduced resolution

Table 13: Functions that cannot be combined

Installation and Mounting

This section describes the preparation and completion of the installation of the SafeShield safety light curtain. The installation and mounting requires two steps:

- Determining the necessary safety distance
- Installation with swivel mount or side brackets

The following steps are necessary after mounting and installation:

- Making the electrical connections (page 26)
- Aligning sender and receiver (page 30)
- Checking the installation (page 21)

Determining the Safety Distance

The light curtain must be mounted with the correct safety distance

- From the hazardous point
- From reflective surfaces



ATTENTION: No protection without correct safety distance!

The reliable protective effect of the light curtain depends on the system being mounted with the correct safety distance from the hazardous point.

Safety Distance from the Hazardous Point

A safety distance must be maintained between the light curtain and the 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.

The safety distance as defined in EN 999 and EN 294 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 entire protective device, e.g. SafeShield safety light curtain consisting of host and guest (see "Response Times" on page 37)
- Reach or approach speed
- Resolution of the light curtain and/or beam separation
- Other parameters that are stipulated by the standard depending on the application

Under the authority of OSHA and ANSI the safety distance as specified by ANSI B11.19 1990 E.4.2.3.3.5 and Code of Federal Regulations, Volume 29, Part 1910.217 ... (h) (9) (v) 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 entire protective device, e.g. SafeShield safety light curtain consisting of host and guest (see "Response Times" on page 37)
- Reach or approach speed

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- Resolution of the light curtain and/or beam separation
- Other parameters that are stipulated by the standard depending on the application

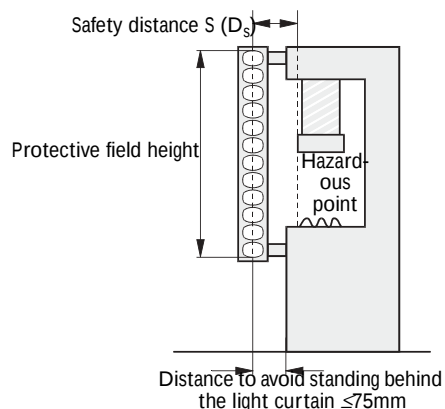


Figure 19: Safety distance from the hazardous point

US Safety Distance Formula



ATTENTION: The SafeShield safety light curtains must be mounted at a sufficient distance from the pinch point or point of operation hazard to ensure that the machine stops before a person's finger, hand, arm(s), or body reaches the hazard.

This distance, referred to as the safety distance, must be properly calculated prior to determining the safety light curtain protective height and mounting the light curtains on the machine. Failure to properly calculate this safety distance may result in operator injury.

IMPORTANT: Regardless of the calculated safety distance, SafeShield safety light curtains should never be mounted closer than six inches from the point of operation or pinch point hazard.

In the United States there are two formulas that are used to properly calculate the safety distance. The first, the OSHA formula, is the minimum requirement for the calculation of the safety distance. The second formula, the one recommended by Rockwell Automation, is the ANSI formula, which incorporates additional factors to be considered when calculating the safety distance.

OSHA Safety Distance Calculation Formula

The OSHA safety distance formula as specified in CFR Subpart O 1910.217 is as follows:

$$Ds = 63 \times T_s$$

- | | |
|----|---|
| Ds | Safety Distance |
| 63 | Is the OSHA recommended hand speed constant in inches per second |
| Ts | Is the total stop time of all devices in the safety circuit, measured in seconds. This value must include all |

components involved in stopping the hazardous motion of the machinery. For a mechanical power press it is the stopping time measured at approximately the 90° position of the crankshaft rotation.

Note: The T_s number must include the response times of *all* devices, including the response time of the safety light curtain, the safety light curtain controller (if used), the machine's control circuit and any other devices that react to stop the hazardous motion of the machinery. Not including the response time of a device or devices in the stop time calculation will result in insufficient safety distance for the application. This may result in operator injury.

The ANSI Safety Distance Formula

The ANSI safety distance formula, which is the Rockwell Automation recommended formula, is as follows:

$$Ds = K \times (T_s + T_c + T_r + T_{bm}) + D_{pf}$$

- | | |
|-----|--|
| Ds | Minimum safety distance between the safe guarding device and the nearest point of operation hazard, in inches. |
| K | Hand speed constant in inches per second. The ANSI standard value is 63 inches per second when the operator begins reaching toward the point of operation hazard from rest. NOTE: ANSI B11.19 1990 E4.2.3.3.5 states "The value of the hand speed constant, K, has been determined by various studies and although these studies indicate speeds of 63 inches/second to over 100 inches/second, they are not conclusive determinations. The employer should consider all factors, including the physical ability of the operator, when determining the value of K to be used." |
| Ts | Stop time of the machine tool measured at the final control element. |
| Tc | Response time of the control system |
| Tr | Response time of the presence sensing device (safety light curtain) and its interface, if any. This value is generally stated by the device manufacturer or it can be measured by the user. |
| Tbm | Additional time allowed for the brake monitor to compensate for variations in normal stopping time. |
| Dpf | Depth penetration factor. It is an added distance to allow for how far into the protective field an object, such as a finger or hand, can travel before being detected. D_{pf} is related to the safety light curtain's object sensitivity. Object sensitivity is the smallest diameter object which will always be detected anywhere in the sensing field. |

How to calculate the safety distance S according to EN 999 and EN 294:

Notes The following calculation shows an example calculation of the safety distance. Depending on the application and the ambient conditions, a different calculation may be necessary.

- First, calculate S using the following formula:

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

Where ...

T = Stopping/run-down time of the machine
 + response time of the protective device after light path interruption [s]

d = Resolution of the light curtain [mm]

S = Safety distance [mm]

The reach/approach speed is already included in the formula.

- If the result S is $\leq 500\text{mm}$, then use the determined value as the safety distance.
- If the result S is $> 500\text{mm}$, then recalculate S as follows:

$$S = 1600 \times T + 8 \times (d - 14) \text{ [mm]}$$
- If the new value S is $> 500\text{mm}$, then use the newly determined value as the minimum safety distance.
- If the new value S is $\leq 500\text{mm}$, then use 500mm as the safety distance.

Example:

Stopping/run-down time of the machine = 290 ms
 Response time after light path interruption = 30 ms
 Resolution of the light curtain = 14mm
 $T = 290 \text{ ms} + 30 \text{ ms} = 320 \text{ ms} = 0.32 \text{ s}$
 $S = 2000 \times 0.32 + 8 \times (14 - 14) = 640\text{mm}$
 $S > 500\text{mm}$, therefore:
 $S = 1600 \times 0.32 + 8 \times (14 - 14) = \underline{512\text{mm}}$

How to calculate the safety distance D_s according to ANSI B11.19-1990 E.4.2.3.3.5 and Code of Federal Regulations, Volume 29, Part 1910.217 ... (h) (9) (v):

Notes The following calculation shows an example calculation of the safety distance. Depending on the application and the ambient conditions, a different calculation may be necessary.

- Calculate D_s using the following formula:

$$D_s = H_s \times (T_s + T_c + T_r + T_{bm}) + D_{pf}$$

Where ...

D_s = The minimum distance in inches (or millimetres) from the hazardous point to the detection point, plan or zone

H_s = A parameter in inches/second or millimetres/second, derived from data on approach speeds of the body or parts of the body. Often 63 inches/second (1600 millimetres/second) is used for H_s .

T_s = Stopping time of the machine tool measured at the final control element

T_c = Response time of the control system

T_r = Response time of the presence-sensing device and its interface

T_{bm} = Additional response time allowed for brake monitor to compensate for wear

Notes Any additional time delays must be accounted for in this calculation.

D_{pf} = An additional distance added to the overall safety distance required. This value is based on intrusion toward the hazardous point prior to actuation of the electro-sensitive protective equipment (ESPE). Values range from 0.25 inches to 48 inches (6 to 1220 millimetres) or more depending on application.

Example In opto-electronic protection, such as with a perpendicular safety light curtain applications with object sensitivity (effective resolution) less than 2.5 inches (64 millimeters), the D_{pf} can be approximated based on the following formula:

$$D_{pf} \text{ (inches)} = 3.4 \times (\text{object sensitivity} - 0.276), \text{ but not less than } 0.$$

Minimum Distance to Reflective Surfaces

The light beams from the sender may be deflected by reflective surfaces. This can result in failure to identify an object.

All reflective surfaces and objects (e.g. material bins) must therefore be located at a minimum distance a from the protective field of the system. The minimum distance (a) depends on the distance (D) between sender and receiver.

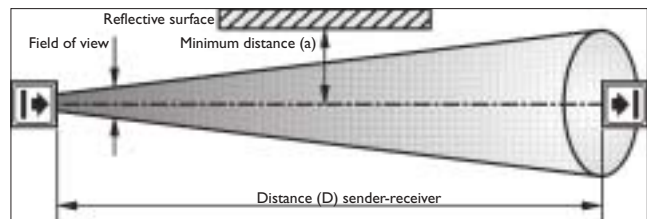


Figure 20: Minimum distance from reflective surfaces

Notes The field of view of the sender and receiver optics is identical.

How to determine the minimum distance from reflective surfaces:

- Determine the distance (D) [m] sender-receiver.
- Read the minimum distance (a) [mm] from the graph:

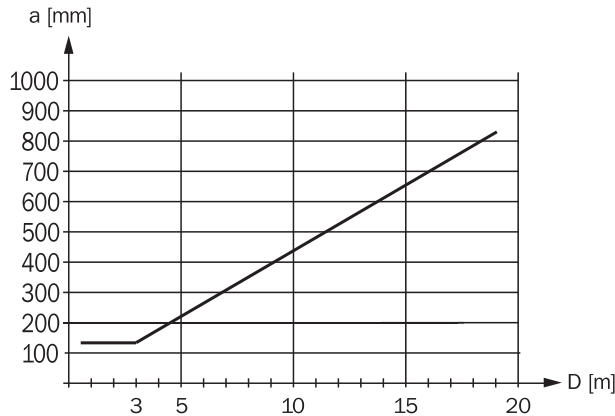


Figure 21: Graph, minimum distance from reflective surfaces

Steps for Mounting the Device



ATTENTION: Special features to note during mounting:

- Always mount the sender and receiver parallel to one another.
- During mounting, make sure that sender

and receiver are aligned correctly. The optical lens systems of sender and receiver must be located in exact opposition to each other; the display elements must be mounted at the same height. The system plugs of both devices must point in the same direction.

- Take suitable measures to attenuate vibration if the shock requirements are above the values given in the "Data Sheet" section on page 35.
- Observe the safety distance of the system during mounting. On this topic read the "Determining the Safety Distance" on page 21.
- Connect a maximum of three systems into a cascaded system.
- Always connect sender-sender and receiver-receiver within a system configuration.
- Mount the safety light curtain such that the hazardous point cannot be reached from below, above or behind the safety light curtain and that the light curtain cannot be repositioned.

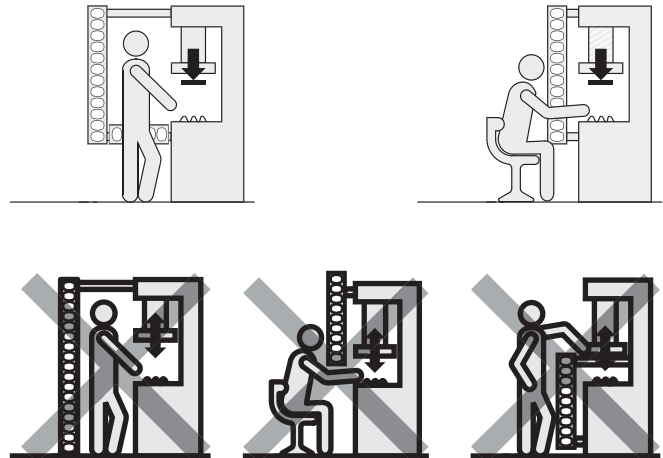


Figure 22: The correct installation (above) must eliminate the errors (below) standing behind, reaching below and reaching above

- Once the system is mounted, one or several of the enclosed self-adhesive safety information labels must be affixed.
 - ◆ Use only labels in the language which the operators of the machine understand.
 - ◆ Affix the information labels such that they are easily visible by the operators during operation. After attaching additional objects and equipment, the information labels must not be concealed from view.
 - ◆ Affix the information label "Important Notices" to the system in close proximity to sender and receiver.
 - ◆ Operation with floating blanking: Affix the information label for floating blanking to each sender or receiver so configured. Mark the effective resolution on the information label.
 - ◆ For operation with reduced resolution: Affix the information label for reduced resolution to each sender or receiver so configured. Mark the effective resolution on the information label.

Sender and receiver can be mounted in two different ways:

- Mounting with swivel mount bracket
- Mounting with side bracket

Mounting with Swivel Mount Bracket

The swivel mount bracket is made of black polyamide PA6. The bracket is designed such that sender and receiver can still be accurately aligned even after the bracket has been mounted.

Note

- Attach the bolts of the swivel mount bracket with a torque of between 2.5 and 3Nm. Higher torques can damage the bracket; lower torques provide inadequate protection against vibration.

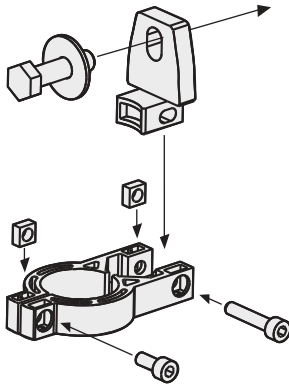


Figure 23: Composition of the swivel mount bracket

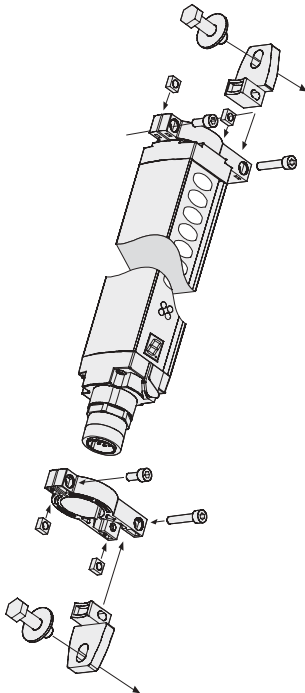


Figure 24: Mounting sender and receiver using swivel mount brackets

Note

- Mount the bolts marked with ❶ to ❹ on the operator side of the system to ensure that they remain accessible after mounting and to allow you to readjust the light curtain later, if necessary.
- If you wish to use the additional front screen (see "Additional Front Screen (weld shield)" on page 45), make sure that the curved side of the device remains accessible after mounting.

Mounting with Side Bracket

The side bracket is made of die cast zinc ZP 0400. It is anodized in black. The side bracket will be covered by the device after mounting. But it is only suitable for mounting surfaces lying parallel to the desired protective field because the alignment of sender and receiver can only be adjusted by a maximum of $\pm 2.5^\circ$ after mounting.

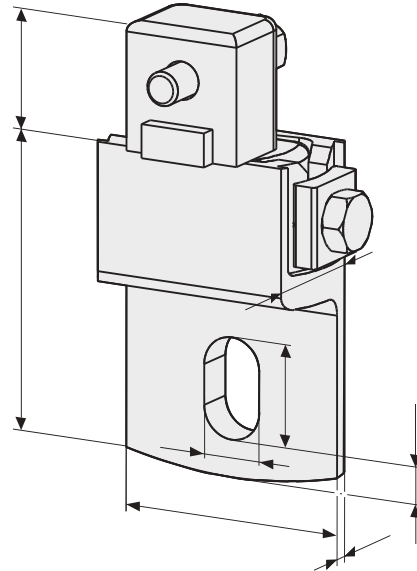


Figure 25: Composition of the side bracket

Note

- Attach the bolts of the side bracket with a torque of between 5 and 6Nm. Higher torques can damage the bracket; lower torques provide inadequate protection against vibration.
- When mounting the bracket, note the distance and the position of the sliding nuts as described in the "Dimensional Drawings" on page 39.

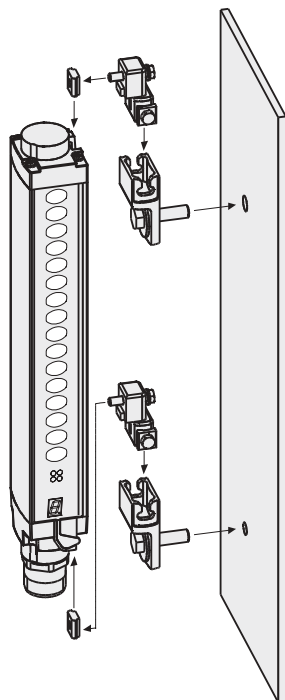


Figure 26: Mounting the SafeShield safety light curtain with side bracket

Note

- When mounting the side bracket make sure that the bolts marked ② and ③ remain accessible, allowing you later to adjust and lock the light curtain in position.
- If you wish to use the additional front screen (see page 45), make sure that the curved side of the device remains accessible after mounting.

Electrical Installation



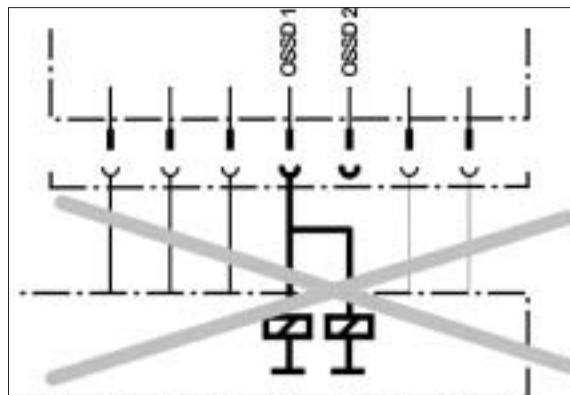
ATTENTION: Switch the entire machine/system off line!

The machine/system could inadvertently start up while you are connecting the unit.

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

Connect OSSD1 and OSSD2 separately!

To ensure that the signals are safe, OSSD1 and OSSD2 are to be connected separately to the machine controller and the machine controller must process the two signals separately. OSSD1 and OSSD2 must not be connected together.



Notes

- The two outputs are protected against short-circuits to 24V DC and 0V. When the light path is clear, the signal level on the outputs is HIGH DC (at potential), when the light beams are interrupted or there is a device fault the outputs are LOW DC.
- The SafeShield safety light curtain meets the interference suppression requirements (EMC) for industrial use (interference suppression class A). When used in residential areas it can cause interference.
- To ensure full electromagnetic compatibility (EMC), functional earthing (FE) must be connected.
- The external voltage supply of the device must be capable of buffering brief mains voltage failures of 20 ms as specified in EN 60204-1.
- System connections and extension connections in a cascaded system must be connected only if the system is off line. The configuration connection however, may be connected/disconnected with the system on line.

System Connection M23 × 11 + FE

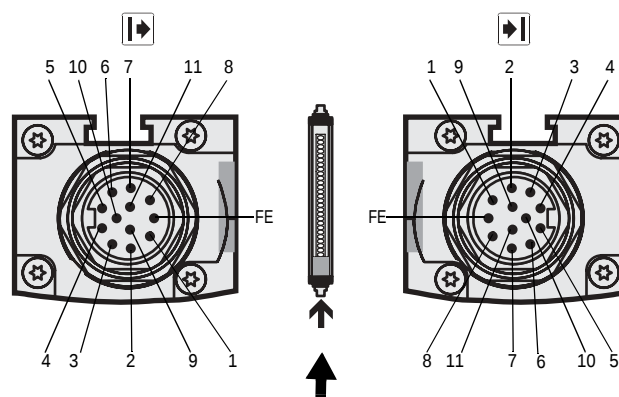


Figure 27: Pin assignment system connection M23 × 11 + FE

Pin	Wire Color	Sender	Receiver
1	Brown	24V DC input (voltage supply)	24V DC input (voltage supply)
2	Blue	0V DC (voltage supply)	0V DC (voltage supply)
3	Grey	Test input: 0V: external test active 24V: external test inactive	OSSD1 (output signal switching device 1)
4	Pink	Reserved	OSSD1 (output signal switching device 2)
5	Red	Reserved	Reset/restart
6	Yellow	Reserved	External device monitoring (EDM)
7	White	Reserved	Signal output (ADO)
8	Red/blue	Reserved	Output Reset required
9	Black	Device communication A	Device communication A
10	Purple	Device communication B	Device communication B
11	Grey/pink	Input host/guest SEL	Input host/guest SEL
FE	Green	Functional earthing	Functional earthing

Table 14: Pin Assignment system connection M23 x 11 + FE

Notes

- For the connection of pin 9 and 10 only use cable with twisted pairs, e.g. the Allen-Bradley Guardmaster connection cables available as accessories (see "Accessories" on page 45).
- If you do not use either a SafeShield function module to improve the EMC behavior we recommend, especially on cascaded systems, the termination of the connections pin 9 and 10 (device communication) on the system connection in the control cabinet using a resistor of 182 W.

Configuration Connection M8 x 4 (Serial Interface)

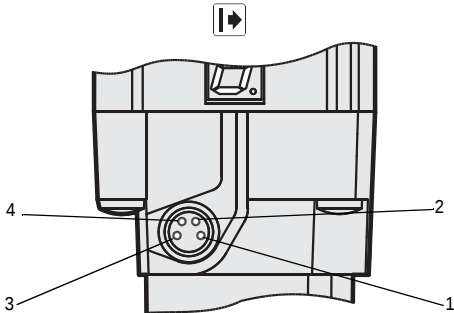


Figure 28: Pin assignment configuration connection M8 x 4

Pin	Sender/ Receiver	PC-Side RS-232-D-Sub
1	Not assigned	
2	RxD	Pin 3
3	0V DC (voltage supply)	Pin 5
4	TxD	Pin 2

Table 15: Pin assignment configuration connection M8 x 4

Notes The pin assignment of sender and receiver is identical.

- 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.

Extension Connection M23 x 11 + FE

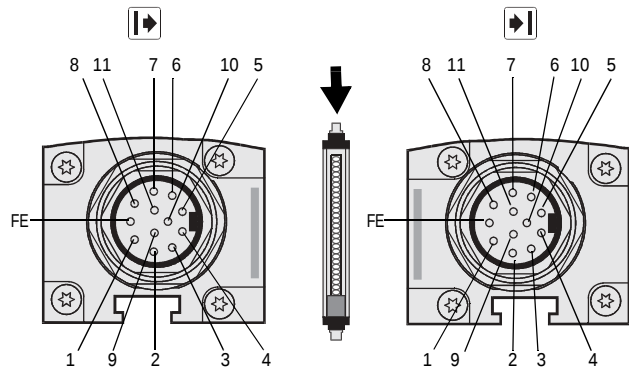


Figure 29: Pin assignment extension connection M23 x 11 + FE

Pin	Wire Color	Sender	Receiver
1	Brown	24V DC output (voltage supply)	24V DC output (voltage supply)
2	Blue	0V DC (voltage supply)	0V DC (voltage supply)
3	Grey	Reserved	Input emergency stop/switch for deactivating the blanking
4	Pink	Reserved	Input emergency stop/teach-in
5	Red	Reserved	Reset/restart
6	Yellow	Reserved	Test output emergency stop/teach-in
7	White	Reserved	Test output emergency stop/switch for deactivating the blanking
8	Red/blue	Reserved	Output Reset required
9	Black	Device communication A	Device communication A
10	Purple	Device communication B	Device communication B
11	Grey/pink	Output host/guest SEL	Output host/guest SEL
FE	Green	Functional earthing	Functional earthing

Table 16: Pin assignment extension connection M23 x 11 + FE

Notes

- The plug alignment (direction of turn) in the housing may vary from device to device. You can identify the correct pin assignment by the position of the pins in relation to each other as shown in the drawings.
- If you do not connect any further safety light curtain to an extension connection, then you must also not connect any cable to pins 9 and 10.
- If the extension connection is no longer required, always screw the attached protective cap over the extension connection.

External Device Monitoring (EDM)

The EDM checks if the contactors actually de-energize when the protective device responds. If, after an attempted reset, the EDM does not detect a response from the switched device within 300ms, the EDM will deactivate the OSSD switching outputs again.

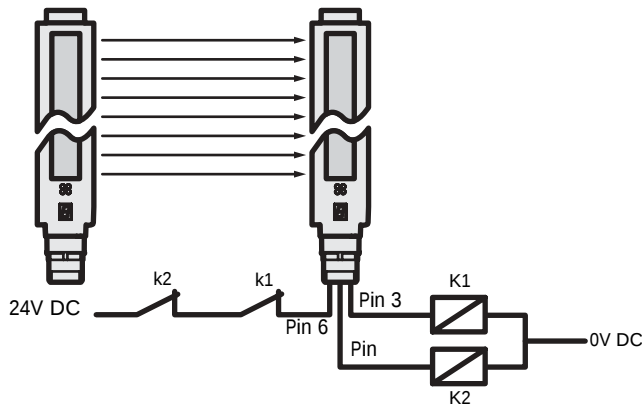


Figure 30: Connecting the contact elements to the EDM

You must implement the external device monitoring electrically by the positive closing action of both N/C contacts (k1, k2) when the contact elements (K1, K2) reach their de-energized position after the protective device has responded. 24V is then applied at the input of the EDM. If 24V is not present after the response of the protective device, then one of the contact elements is faulty and the external device monitoring prevents the machine starting up again.

Notes

- If you connect the contact elements to be monitored to the EDM input, then you must activate the option **EDM** in the SCD software. If not, the device will show the error .
- If you later deselect the **EDM** option, pin 6 of the system plug must not remain connected to 24V.

Reset Button

In the protective operation mode with internal restart interlock (see page 11) the operator must first press the reset button before restarting.



ATTENTION: Select the correct installation site for the reset button!

Install the reset button outside the hazardous area such that it cannot be operated from inside the hazardous area. When operating the reset button, the operator must have full visual command of the hazardous area.

Recommendation

You can reduce the wiring effort by connecting the reset button directly to the spare extension connection on the receiver. In a cascaded system this is the extension connection on the last receiver.

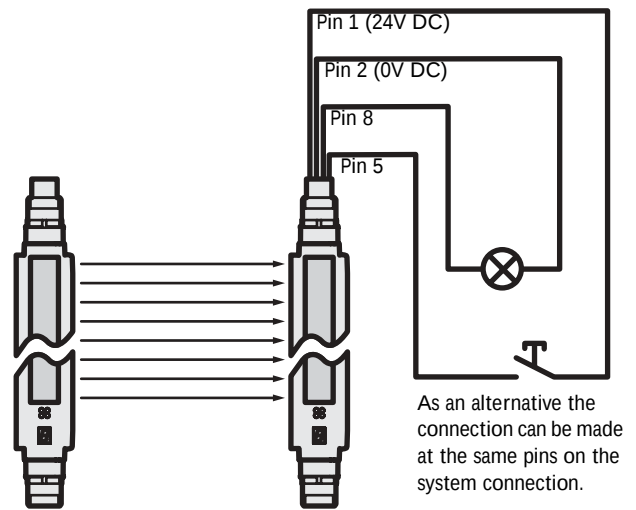


Figure 31: Connection of the reset button and the signal lamp "Reset required" to the extension connection



ATTENTION: Device configuration after replacement!

If you replace a safety light curtain with active reset function with a replacement unit, the reset function must again be activated via the software. It is not sufficient to make the electrical connections, because new devices are supplied ex factory with deactivated reset function.

Connection of a Signal Lamp to the Output *Reset Required*

Pin 8 of the extension connection is the output "Reset required" (24V). You can connect a signal lamp here to indicate this status. The output has a frequency of 1Hz.

Teach-In Key-Operated Switch

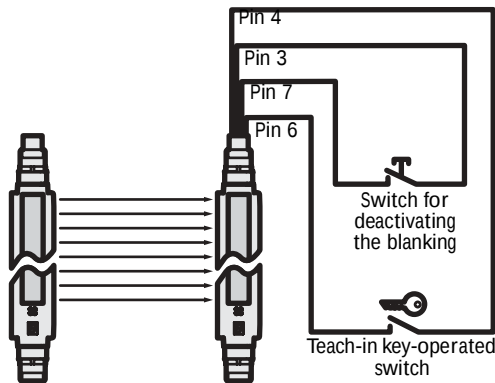


Figure 32: Connection of an external teach-in key-operated switch

Notes

- For teach-in a reset button must be connected to the SafeShield safety light curtain (see “Reset Button” on page 28).
 - If you connect a teach-in switch to the SafeShield safety light curtain, then you can no longer use the emergency stop function in the SafeShield safety light curtain.
 - If you use a SafeShield function module then you can also connect the teach-in key-operated switch to the switching amplifier.
- Ensure that only authorized persons have access to the teach-in key.



Device symbol **SafeShield safety light curtain Host (receiver)**, context menu **Configuration draft, Edit**, file card **General**, option **Teach-in key-operated switch active**.

Emergency Stop

The emergency stop input has two channels. The emergency stop monitoring in the device corresponds to stop category 0 in accordance with EN 418. Switch off at the emergency stop input (see “Emergency Stop” on page 29) has the same effect as reaching into the protective field. You can connect the emergency stop input e.g. to a door switch.

Equivalent

Complementary Switching

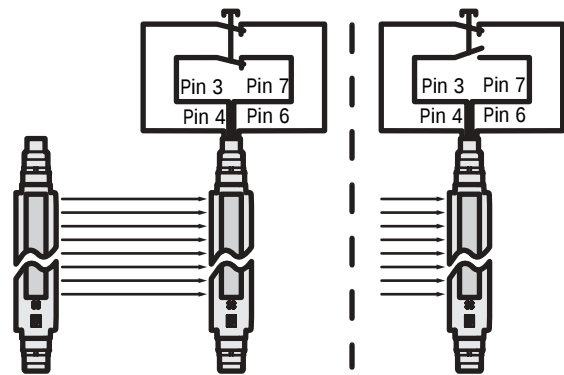


Figure 33: Possible methods of connection of a door switch or similar to the emergency stop input

You can design the two-channel button as equivalent (N/C, N/C) or complementary (N/O, N/C). You must configure the SafeShield safety light curtain as appropriate with the aid of the SCD. If the configuration and the electrical connection do not match, the system locks completely (lock-out). The 7-segment display will then show the error message .



Device symbol **SafeShield safety light curtain Host (receiver)**, context menu **Configuration draft, Edit**, file card **General**, option **Emergency stop active**.



ATTENTION: Device configuration after replacement!

If you replace a safety light curtain with the emergency stop function active, then you must transfer the configuration to the device again. It is not sufficient to make the electrical connections, because new devices are supplied ex factory with deactivated Emergency stop function.

Signal Output (ADO)

Pin 7 on the system connector is a signal output (ADO). You can use this output for a relay or a PLC.

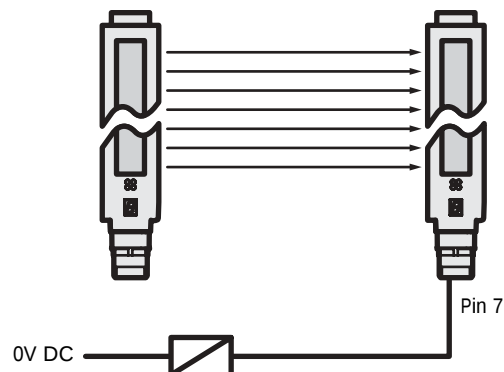


Figure 34: Connection to the signal output

 If you connect the signal output, then you must configure it with the aid of the SCD prior to commissioning. Details can be found in the “Signal Output (ADO)” section on page 29.

Notes **Device configuration after replacement!**
If you replace a safety light curtain on which the signal output (ADO) is connected, then you must transfer the configuration to the device again. It is not sufficient to make the electrical connections, because new devices are supplied ex factory with the signal output deactivated.

Test Input (Sender Test)

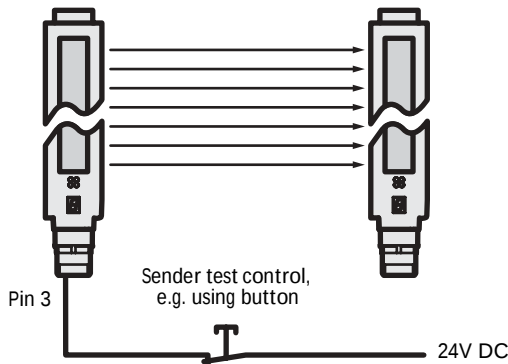


Figure 35: Connection of the sender test button

The sender test is performed when 0V is present at the test input (pin 3).

 To be able to use the sender test button, you must also configure the Sender test function with the aid of the SCD: Device symbol **SafeShield safety light curtain Host (sender)**, context menu **Configuration draft, Edit**, option **Enable sender test**.

Notes If you do not connect the test input, then you must deactivate the **Sender test** function with the aid of the SCD. Otherwise, the safety light curtain remains permanently red.

Commissioning



ATTENTION: Commissioning requires a thorough check by qualified personnel!

Before you operate a system protected by the SafeShield safety light curtain for the first time, make sure that the system is first checked and approved by qualified personnel. Please read the notes in the “Safety” section on page 6.

Display Sequence During Power-Up

After the system is activated, sender and receiver go through a power-up cycle. The 7-segment display indicates the device status during the power-up cycle.

The display values have the following meaning:

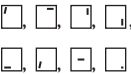
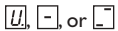
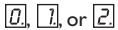
Display	Meaning
	Testing the 7-segment display. All segments are activated sequentially.
	Is displayed only at the receiver and only in operation with large scanning range.
	Only on cascaded systems: Ca. 0.5 s. System operates as host () or as guest 1 () or guest 2 ()
	Noncoded operation or operation with code 1 or 2.
No display or 	The device is operational. Display  appears if the device is operated with reduced resolution and/or with blanking.
	Receivers only: Receiver-sender alignment incorrect (see “Aligning Sender and Receiver” below).
Other display	Device error. See “Fault Diagnosis” on page 32.

Table 17: Displays shown during the power-up cycle

Aligning Sender and Receiver

After the light curtain has been mounted and connected, the sender and receiver must be aligned in relation to each other. The light beams emitted by the sender must hit the receiver with pin-point accuracy.

Note If you wish to align a cascaded system, always align the individual systems in the following sequence: host, guest 1, guest 2.

How to align sender and receiver in relation to each other:



ATTENTION: Secure the machinery/ system. No dangerous movement possible!

Make sure that the dangerous state of the machine is (and remains) switched off! During the alignment process, the outputs of the safety light curtain are not allowed to have any effect on the machine.

- > Loosen the clamping bolts which hold the light curtain in place.
- > Switch on the power supply to the light curtain.
- > Watch the alignment information on the 7-segment display of the receiver (see Table 18 below). Correct the alignment of the sender and receiver, until the 7-segment display goes off.
- > Using the clamping bolts, fix the light curtain in place.

- Switch the power supply off and then back on again and check via the 7-segment display whether the alignment is correct after tightening the clamping bolts (Table 18).

The display values have the following meaning:

Display	Meaning
	The receiver cannot synchronise with the sender; the alignment is very poor.
	Some light beams do not hit the receiver.
	All the light beams hit the receiver, but the alignment is still slightly off.
No display or	The alignment is now true; the devices must be locked in this position. Display appears if the device is operated with reduced resolution and/or with blanking.

Table 18: Display values during the alignment of sender and receiver

Note

- If the optimum alignment (= no display) persists for longer than 2 minutes, the system automatically deactivates the alignment mode.
- If you wish to readjust the alignment later, switch the power supply of the SafeShield safety light curtain off and back on again.
- The host in a cascaded system remains on red until all guests have been correctly aligned.

Test Notes

Tests Before the First Commissioning

The purpose of the tests before the first commissioning is to confirm the safety requirements specified in the national/international rules and regulations, especially in the Machine and Equipment Usage Directive (EC Conformity).

- 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 “Checklist for the Manufacturer” on page 46).
- Make sure that the operating personnel of the machine protected by the light curtain are properly instructed by specialist personnel before being allowed to operate the machine. Instructing the operating personnel is the responsibility of the machine owner.
- Annex Checklist for the Manufacturer of this document shows a checklist for review by the manufacturer and OEM. Use this checklist as a reference before commissioning the system for the first time.

Regular Inspection of the Protective Device by Qualified 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 are detected before use/re-use.

- If any modifications have been made to the machine or the protective device, or if the safety light curtain has been changed or repaired, the system must be checked again as specified in the checklist in the annex.

Daily Functional Checks of the Protective Device

The effectiveness of the protective device must be checked daily by a specialist or by authorised personnel, using the correct test rod.

Note Always test along the complete hazardous area to be protected, never solely at the mounting position of the light curtain.

How to check the effectiveness and proper function of the safety light curtain:

- Select the correct test rod depending on device resolution. By means of the configuration, the entire system or individual areas can have a *physical resolution* that is different to the *effective resolution*, e.g. in case of blanking or reduced resolution. In this case you must select the test rod to suit the effective resolution. The effective resolution is described with the related function in “Configurable Functions” on page 10.

Example: – physical resolution 14mm
– operation with resolution reduced by 1 beam
– effective resolution 22mm
Use the test rod for a resolution of 22mm.



ATTENTION: Do not operate the machine if the green or yellow LED is lit during the test!

If the green or yellow LED lights up during the test even for a short period, work must stop at the machine. In this case the mounting and the configuration of the safety light curtain must be checked by specialised personnel (see “Installation and Mounting”).

- *Before* inserting the test rod, check that the green LED is lit if the internal restart interlock is deactivated and that the yellow LED flashes (“Reset required”). If this is not the case, make sure that this condition is reached. The test is otherwise meaningless.

- Move the test rod slowly through the protective field to be tested, as shown in ➡ in Figure 36.
- Then move the test rod along the edges of the protective field, as shown in ➡ in Figure 36. This procedure allows you to test if the point-of-operation/reaching behind protection is functioning properly (see “Steps for Mounting the Device” on page 24).
- If you use one or more mirrors, then also guide the test rod slowly through the protective field directly in front of the mirrors.

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Note In all three tests, the receiver of the SafeShield safety light curtain must show the red LED only.

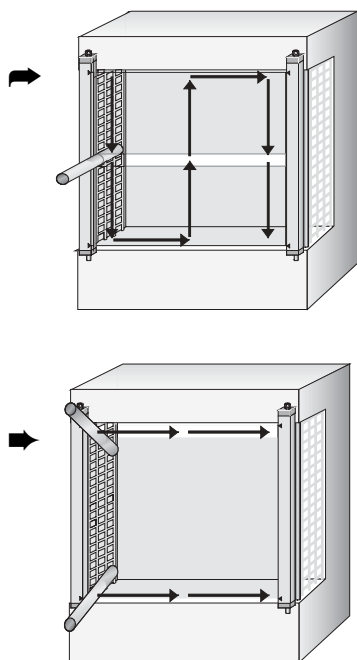


Figure 36: Daily checks of the protective device

Configuration

Delivery Status

As delivered the SafeShield safety light curtain is configured ready for protective operation.

Function that Can Be Configured	SafeShield
Restart interlock	External
External device monitoring (EDM)	Deactivated
Beam coding	Non-coded
Blanking	None
Scanning range	■
0-2.5 m or 0-6 m	
2-6 m or 5-19 m	

Table 19: Delivery status of the SafeShield safety light curtain

Preparing the Configuration

How to prepare the configuration:

- Make sure that the safety light curtain has been correctly mounted and that the electrical connections are correct and in place.
- Plan all required settings (operating mode, beam coding, resolution, cascading etc.)

To configure the safety light curtain, you need:

- SCD software on CD-ROM
- User manual for SCD 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 connecting PC and SafeShield safety light curtain 442L-ACRS232

- To configure the device, please read the user manual for the SCD software and use the online help function of the programme.

Care and Maintenance

The SafeShield safety light curtain is maintenance-free. The front screen of the SafeShield safety light curtain and any additional front screen(s) (see “Additional Front Screen (Weld Spark Guard)” on page 45) should be cleaned at regular intervals and when dirty.

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

Note Static charges cause dust particles to be attracted to the front screen. You can prevent this effect by using the antistatic plastic cleaner.

How to clean the front screen and/or the additional front screen (optional extra):

- Use a clean and soft brush to remove dust from the front screen.
- Then wipe the front screen with a clean and damp cloth.

Note

- After cleaning, check the position of sender and receiver to make sure that the protective device cannot be bypassed (reaching above, below or behind).
- Verify the effectiveness of the protective device as described in “Test Notes” on page 31.

Fault Diagnosis

This section describes how to identify and remedy errors and malfunctions during the operation of the safety light curtain.

Recommendation

You can speed up the fault diagnostics of some frequent faults by querying a signal on the signal output on the safety light curtain on the occurrence of the fault. Details can be found in “Signal Output (ADO)” on page 12.

What To Do in Case of Faults



ATTENTION: Cease operation if the cause of the malfunction has not been clearly identified!

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

The system state lock-out

In case of certain faults or an erroneous configuration, the system can go into the lock-out status. The 7-segment display on the safety light curtain then indicates , , , , or . To place the device back in operation:

- Rectify the cause of the fault as per Table 21.
- Switch the power supply for the SafeShield safety light curtain off and on again (e.g. by unplugging the system plug and reinserting it).

Allen-Bradley Guardmaster Support

If you cannot remedy an error with the help of the information provided in this chapter, please contact Rockwell Automation technical support.

Error Displays of the Diagnostics LEDs

This section explains the meaning of the error displays of the LEDs and how to respond. Please refer to the description in "Status Indicators" on page 9.

Display	Possible Cause	Remedying the Error
● Orange	LED of receiver lights up	➤ Check the alignment of sender and receiver. ➤ Check the front screen (dirt) and clean, if necessary.
⚡ Yellow	LED of receiver flashes	➤ Press the reset button.
○ Yellow	LED of sender fails to light up	➤ Check the voltage supply and activate, if necessary.
○ Red and ○ Green	Neither the red nor the green receiver LED lights up	

Table 20: Error displays of the LEDs

Error Displays of the 7-Segment Display

This section explains the meaning of the error displays of the 7-segment display and how to respond to the messages. Please refer to the "Status Indicators" section on page 9.

Display	Possible Cause	Remedying the Error
 ,  , or 	Inadequate alignment	➤ Re-align sender and receiver (see page 30). The display goes off after 2 minutes.
	Configuration incomplete	➤ The display goes off automatically once the configuration has been successfully transferred. If display 6 does not go off: ➤ Check the configuration of the system using the SCD software. ➤ Re-transfer the corrected configuration to the system.
 or 	EDM error	➤ Check the contactors and their wiring, eliminate any wiring errors, if necessary. ➤ If (is displayed, switch the device off and back on again.
	Reset button fault	➤ Check the reset button for correct function. The button may be defective or stuck. ➤ Check the wiring of the reset button/ for any short-circuit to 24V.
 ↔ 	Configuration of the SafeShield function module	➤ Configure the switching amplifier connected with the aid of the SCD. ➤ Check the connection from the SafeShield safety light curtain to the function module.
 ↔ 	Several operating modes configured, but none selected	➤ Check the connection and the function of the operating mode selector switch. ➤ Check the connection for the operating mode selector switch on the function module.
 ↔ 	Several operating modes selected simultaneously	➤ Check the connection and the function of the operating mode selector switch. ➤ Check the connection for the operating mode selector switch on the function module for a short-circuit.
 ↔ 	Unconfigured operating mode selected	➤ Configure the operating mode set on the operating mode selector switch, or ensure that this operating mode cannot be selected.
 ↔ 	Key-operated pushbutton for bypass is malfunctioning or invalid configuration	➤ Check whether the configuration of the key-operated pushbutton for bypass in the SCD matches the electrical connection. ➤ Check the function of the key-operated pushbutton for bypass and replace it if necessary. ➤ Ensure that both contacts on the key-operated pushbutton for bypass are pressed within 2 seconds.
 ↔ 	Short-circuit at the operating mode selector switch	➤ Check the operating mode inputs on the switching amplifier connected for short-circuit to 24V.
	System error	➤ Disconnect the supply voltage to the SafeShield safety light curtain for at least 3 seconds. ➤ If the problem persists, then have the unit (sender or receiver) replaced.

Table 21: Error displays of the 7-segment display

Display	Possible Cause	Remedying the Error
 	SafeShield function module	➤ Interrupt the supply of power to the SafeShield safety light curtain and to the function module for at least 3 seconds. ➤ If the problem persists, replace the function module.
 	Overcurrent at switching output 1	➤ Check the contactor. Replace, if necessary. ➤ Check the wiring for short-circuit to 0V.
 	Short-circuit at switching output 1	➤ Check the wiring for short-circuit to 24V.
 	Short-circuit at switching output 1	➤ Check the wiring for short-circuit to 0V.
 	Overcurrent at switching output 2	➤ Check the contactor. Replace, if necessary. ➤ Check the wiring for short-circuit to 0V.
 	Short-circuit at switching output 2	➤ Check the wiring for short-circuit to 24V.
 	Short-circuit at switching output 2	➤ Check the wiring for short-circuit to 0V.
 	Short-circuit between switching output 1 and 2	➤ Check the wiring and rectify the error.
 	Teach-in key-operated switch or emergency stop button fault	➤ Check whether the configuration of the teach-in key-operated switch or emergency stop button in the SCD matches the electrical connection. ➤ Check the function of the teach-in key operated switch or emergency stop button.
 	Invalid configuration of the EDM	➤ Verify that the machine-side EDM is connected correctly.
 	External sender detected	➤ Check the distance from reflective surfaces (page 20) or from other light curtains. ➤ If necessary, re-configure the device with another beam coding (page 13) or install non-reflective partitions.
 	Connection problem between host and guest	➤ Check the connection between the cascaded devices. If necessary, replace defective cables.
 	Communication in cascaded system failed	➤ Verify the configuration of the system using the SCD software. Retransfer the corrected configuration to the system. ➤ Check the connection between the cascaded devices. If necessary, replace defective cables.
 	Supply voltage too low	➤ Check the supply voltage and the power supply. If necessary, replace defective components.
 	Fault in PSDI mode	➤ Verify the configuration of the system using the SCD software. Retransfer the corrected configuration to the system. ➤ Check the switch for the machine cycle contacts. Ensure that these are correctly connected and configured. Replace this if necessary.

Table 21: Error displays of the 7-segment display (continued)

Status Indicators on the SafeShield Safety Light Curtain

Display	Meaning
● Yellow	Supply voltage o.k.
	System error. Disconnect the supply voltage to the SafeShield safety light curtain for at least 3 seconds. If the problem persists, replace the unit.
	The device is in the test mode.
	Noncoded operation (only after switching on)
	Operation with code 1 (only after switching on)
	Operation with code 2 (only after switching on)
Other displays	All other displays are error messages.

Table 22: Status indicators of the sender

Display	Meaning
● Orange	Cleaning or realignment required
★ Yellow	Reset required
● Red	System providing signals for shutting down the machine (output signal switching devices off)
● Green	System enabled (output signal switching devices on)
	Bypass active (only in conjunction with the SafeShield function module)
	System error. Disconnect the supply voltage to the SafeShield safety light curtain for at least 3 seconds. If the problem persists, replace the unit.
	Poor alignment to sender. Please refer to section "Aligning Sender and Receiver on page 30.
	
	
	Operation with large protective field width (only after switching on)
	Operation with reduced resolution and/or blanking
	Non-coded operation (only after switching on)
	Operation with code 1 (only after switching on)
	Operation with code 2 (only after switching on)
	Emergency stop active
Other displays	All other displays are error messages.

Table 23: Status indicators of the receiver

Extended Diagnosis

The SCD software supplied with the device includes extended diagnostic options. It allows you to narrow down the problem if the error is non-specific or if you experience usage downtime problems. Detailed information to be found ...

- In the online help for the SCD.
- In the user manual for the SCD.

Technical Specifications

Data Sheet

	Minimum	Typical	Maximum
General System Data			
Protective field height, depending on type	300mm to 1800mm		
Resolution, depending on type	14mm and 30mm		
Protective field width Resolution 14mm Resolution 30mm	0m 0m		6m 19m
Protection class (IEC 536:1976)	III		
Enclosure rating (IEC 60_529)	IP 65		
Supply voltage U_V at device ¹⁾	19.2V	24V	28.8V
Residual ripple ²⁾			±10%
Synchronization	Optical, without separate synchronization		
Type according to IEC 61496	4		
Safety Integrity Level per IEC 61508	SIL 3		
Power-up delay of sender and receiver before ready			8s



Sender Unit

Test input			
Input voltage ³⁾ HIGH (active)	11V	24V	30V
Input current HIGH	7mA	10mA	20mA
Switching voltage LOW (inactive)	−30V	0V	5V
Input current LOW ³⁾	−3.5mA	0mA	0.5mA
Response time to test	Depending on the number of beams, maximum 150ms		
Wavelength of sender		950nm	
Power consumption			2A (host/guest/guest)
Weight	Depending on protective field height (see page 38)		



Receiver Unit

Switching outputs (OSSDs)	2 PNP semiconductor, short-circuit protected ⁴⁾ , cross-circuit monitored		
Response time	See page 37		
Switch off time	100ms		
Switch on time	2.5 × response time (single system)		4.5 × response time (cascade)
Switching voltage ^{5) 6)} HIGH (active, U_{eff})	$U_V - 2.25V$	24V	U_V
Switching voltage) LOW (inactive)	0V	0V	3.5V
Switching current	0mA		500mA
Leakage current ⁷⁾			0.25mA
Load capacity			2.2μF
Switching sequence	Depending on load inductance		
Load inductance ⁸⁾			2.2 H
Test pulse data ⁹⁾			
Test pulse width	120μs	150μs	300μs
Test pulse rate	$3^{1/s}$	$5^{1/s}$	$10^{1/s}$
Permissible line resistance between device and load ¹⁰⁾			2.5Ω
Supply lead			1Ω
Power consumption			3A (host/guest/guest)
External device monitoring (EDM) input			
Input voltage ¹¹⁾ HIGH (inactive)	11V	24V	30V
Input current HIGH	6mA	10mA	20mA
Input voltage ¹¹⁾ LOW (active)	−30V	0V	5V
Input current LOW	−2.5mA	0mA	0.5mA
Contactors			
Permissible dropout time			300ms
Permissible pick-up time			300ms
Control input (reset button)			
Input voltage ¹¹⁾ HIGH (active)	11V	24V	30V
Input current HIGH	6mA	10mA	20mA

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	Minimum	Typical	Maximum
Input voltage ¹¹⁾ LOW (inactive)	–30V	0V	5V
Input current LOW	–2.5mA	0mA	0.5mA
Operation time control switch input	200ms		
Output <i>Reset</i> required	PNP semiconductors, short-circuit protected ¹²⁾		
24V lamp output			4 W/0.2 A
Switching voltage HIGH (active)	15V	24V	28.8V
Switching voltage LOW (inactive)		High resistance	
Signal output (ADO)	PNP semiconductors, short-circuit protected ¹²⁾		
Switching voltage HIGH (active)	$U_V - 4.2V$	24V	U_V
Switching voltage LOW (inactive)		High resistance	
Switching current	0mA		100mA
Emergency stop			
Changeover time			2s
Latency time			200ms
Cable resistance			30 Ω
Cable capacitance			10 nF
Teach-in key-operated switch/ switch for deactivating the blanking			
Cable resistance			30 Ω
Cable capacitance			10 nF
Operation time (reset button)	240ms		
Weight	Depending on protective field height (see page 38)		
Operating data			
Connection	M23 metal body connector		
Cable length ¹³⁾			50m
Wire cross-section		0.75mm ²	
Ambient operating temperature	0°C (32°F)		+55°C (131°F)
Air humidity (non-dewling)	15%		95%
Storage temperature	–25°C (13°F)		+70°C (158°F)
Housing cross-section	40mm × 48mm		
Rigidity	5g, 10-55Hz acc. to IEC 60_068-2-6		
Shock resistance	10g, 16ms acc. to IEC 60_068-2-29		

1. The external voltage supply must be capable of buffering brief mains failures of 20 ms as specified in EN 60204-1. Suitable power supplies are available as accessories from Rockwell Automation.
2. Within the limits of U_V .
3. As per IEC 61131-2.
4. Applies to the voltage range between –30V and +30V.
5. As per IEC 61131-2.
6. On the device plug.
7. In the case of a fault (0-V cable open circuit) the max. leakage current flows in the OSSD cable. The downstream controller must detect this status as LOW. A FPLC (Fail-safe Programmable Logic Controller) must be able to identify this status.
8. The maximum rated load inductance is higher with lower switching sequence.
9. When active, the outputs are tested cyclically (brief LOW). When selecting the downstream controllers, make sure that the test pulses do not result in deactivation when using the above parameters.
10. ⁰Make sure to limit the individual line core resistance to the downstream controller to this value to ensure that a short-circuit between the outputs is safely detected. (Also note EN 60204 Electrical Machine Equipment, Part 1: General Requirements.)
11. ¹⁾As per IEC 61131-2.
12. ²⁾Applies to the voltage range between –30V and +30V.
13. Depending on load, power supply and wire cross-section. The technical specifications must be observed.

Table 24: Technical data SafeShield safety light curtain

Response Time

The response time depends on the following parameters:

- Number of beams
- Beam coding
- Configuration of floating blanking
- Number of cascaded systems

How to determine the response time of the system:

- Read the response times of the individual systems (shown on type label). Note whether the system is operated with or without beam coding.

Note If you are planning the application without actually having any devices available, you may also determine the response time using Table 26 on page 37 and Table 27 on page 38. When determining the number of beams in Table 26, the physical resolution is important. The physical resolution of the light curtain does not change even if fixed or floating blanking has been selected.

- Fill out the following table to determine the total response time.

Line	Required Detail		Response Time	
1	Host			ms
2	Guest 1		+	ms
3	Guest 2		+	ms
4	Only if floating blanking is used:	Greatest response time from lines 1 to 3: $\times 0.5 =$	+	ms
		Deduct 4ms here.	–	ms
5	If single guest is used, then add 8ms here. (If no guest is used or two guests are used, do not add anything here.)		+	ms
6	Total response time to be taken into account (The total response time must be $\leq 108\text{ms}$!)		=	ms

Table 25: Determining the response time of a SafeShield safety light curtain system

- Verify that the total response time determined is $\leq 108\text{ms}$. EN 61 496 does not permit response times exceeding 108ms. If necessary, adjust the configuration.

Example

Calculating the response time for a cascaded system without beam coding in which fields are configured with floating blanking:

Line	Required Detail		Response Time	
1	Host: 750mm protective field height, resolution 14mm			16ms
2	Guest 1: 300mm protective field height, resolution 40mm		+	9ms
3	Guest 2: —		+	0ms
4	Only if floating blanking is used:	Greatest response time from lines 1 to 3: $16\text{ms} \times 0.5 =$	+	8ms
		Deduct 4ms here.	–	4ms
5	If single guest is used, then add 8ms here. (If no guest is used or two guests are used, do not add anything here.)		+	8ms
6	Total response time to be taken into account		=	37ms

Protective Field Height [mm]	Number of Beams for Physical Resolution	
	14mm	30mm
300	40	15
450	60	23
600	80	30
750	100	38
900	120	45
1050	140	53
1200	160	60
1350	180	68
1500	200	75
1650	220	83
1800	240	90

Table 26: Number of beams depending on the protective field height and the physical resolution

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Number of Beams	Without Beam Coding	With Beam Coding
10	9ms	11ms
15	10ms	12ms
20	10ms	13ms
23	10ms	14ms
25	10ms	14ms
30	11ms	15ms
35	11ms	16ms
38	11ms	17ms
40	11ms	17ms
45	12ms	18ms
50	12ms	19ms
53	12ms	20ms
55	12ms	20ms
60	13ms	21ms
68	13ms	22ms
75	14ms	24ms
80	14ms	25ms
83	14ms	25ms
90	15ms	27ms
100	16ms	29ms
105	16ms	30ms
120	17ms	33ms
135	18ms	36ms
140	19ms	37ms
150	19ms	39ms
160	20ms	40ms
165	20ms	41ms
180	22ms	44ms
200	23ms	48ms
220	24ms	52ms
240	26ms	56ms

Table 27: Response time as factor of the number of beams

Table of Weights

SafeShield Safety Light Curtain

Protective Field Height [mm]	Weight [g]	
	 Sender	 Receiver
300	820	850
450	1100	1130
600	1390	1420
750	1670	1700
900	1960	1990
1050	2250	2280
1200	2530	2560
1350	2820	2850
1500	3110	3140
1650	3390	3420
1800	3680	3710

Table 28: Weight of sender and receiver

Dimensional Drawings

SafeShield Safety Light Curtain Without Cascading Connection

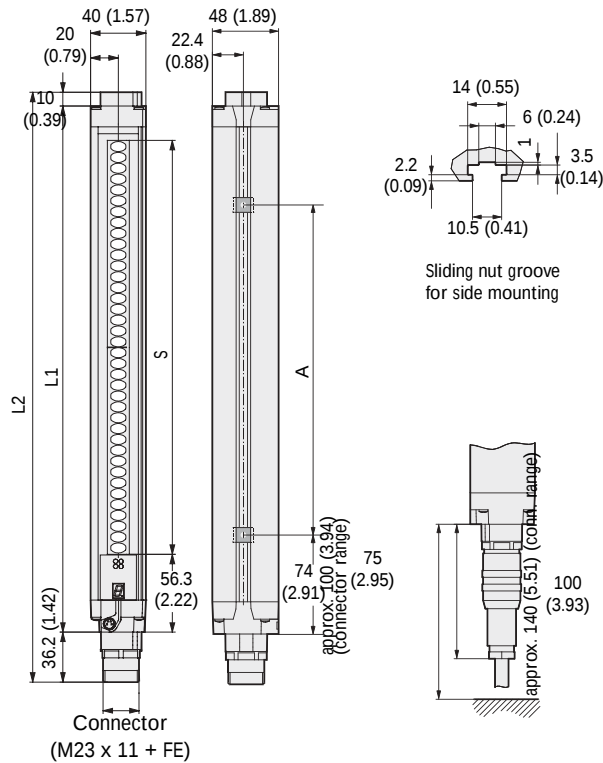


Figure 37: Dimensional drawing SafeShield safety light curtain without cascading connection, sender.
Receiver, mirror image

Protective Field Height S [mm]	Dimension L1 [mm]	Dimension L2 [mm]	Dimension A [mm]
300	381	427	224
450	532	578	374
600	682	728	524
750	833	879	674
900	984	1030	824
1050	1134	1180	974
1200	1283	1329	1124
1350	1435	1481	1274
1500	1586	1632	1424
1650	1736	1782	1574
1800	1887	1933	1724

Table 29: Dimensions dependent on the protective field height, SafeShield safety light curtain without cascading connection

SafeShield Safety Light Curtain with Cascading Connection

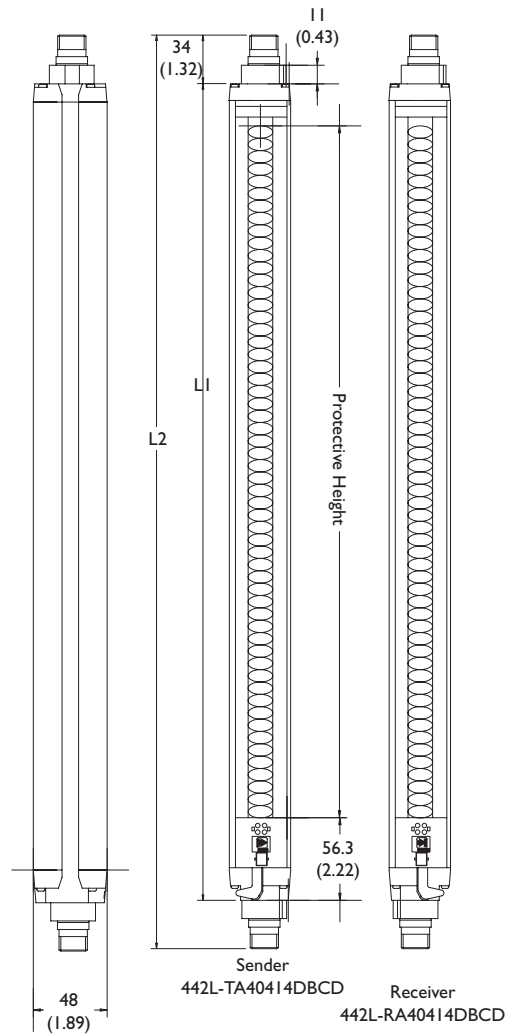


Figure 38: Dimensional drawing SafeShield safety light curtain with cascading connection, sender
Receiver, mirror image

Protective Field Height S [mm]	Dimension L1 [mm]	Dimension L2 [mm]	Dimension A [mm]
300	381	464	224
450	532	614	374
600	682	765	524
750	833	915	674
900	984	1066	824
1050	1134	1216	974
1200	1283	1366	1124
1350	1435	1517	1274
1500	1586	1669	1424
1650	1736	1818	1574
1800	1887	1969	1724

Table 30: Dimensions dependent on the protective field height, SafeShield safety light curtain with cascading connection

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Swivel Mount Bracket

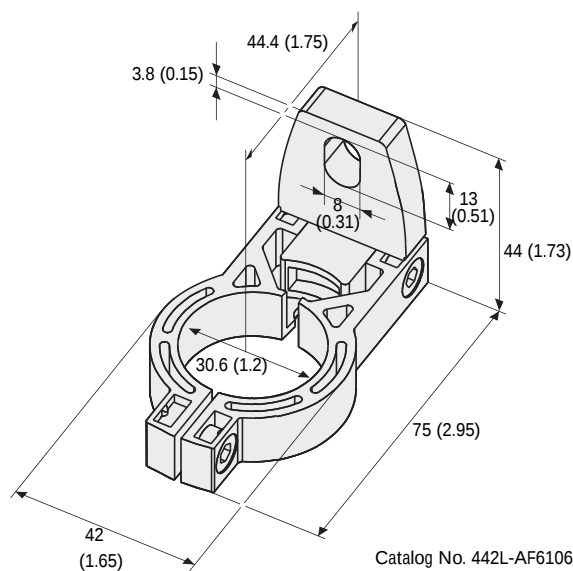
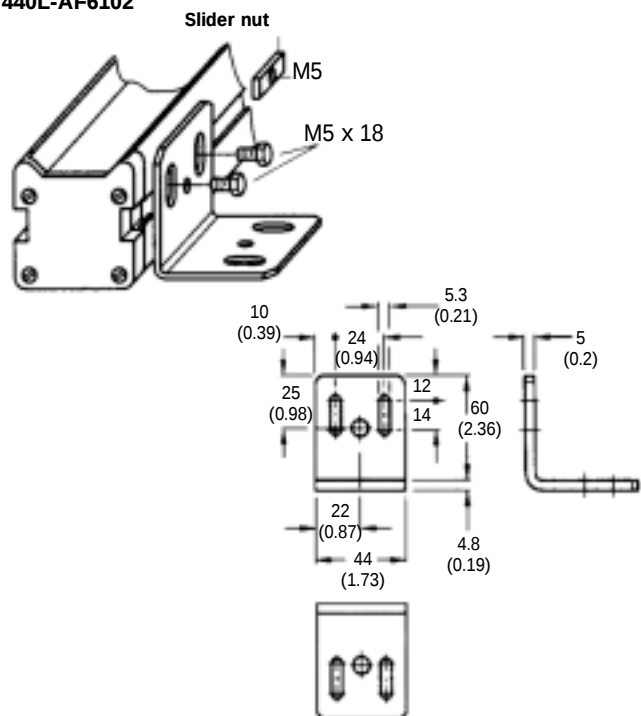


Figure 39: Dimensional drawing, swivel mount bracket (mm)

Mounting Bracket
440L-AF6102



Side Bracket

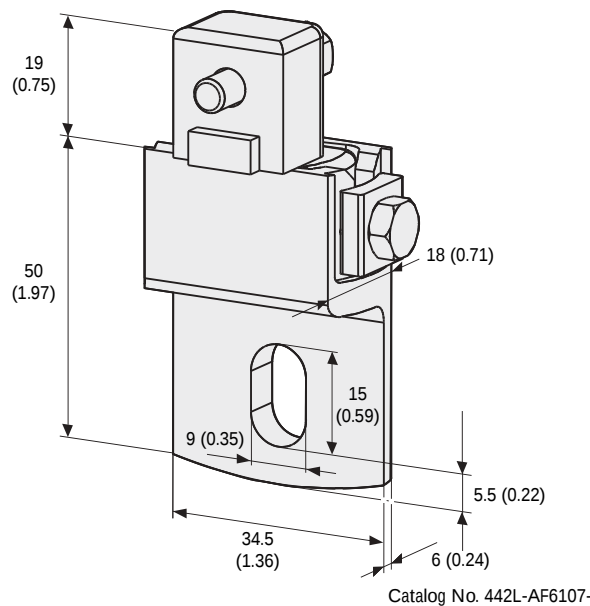
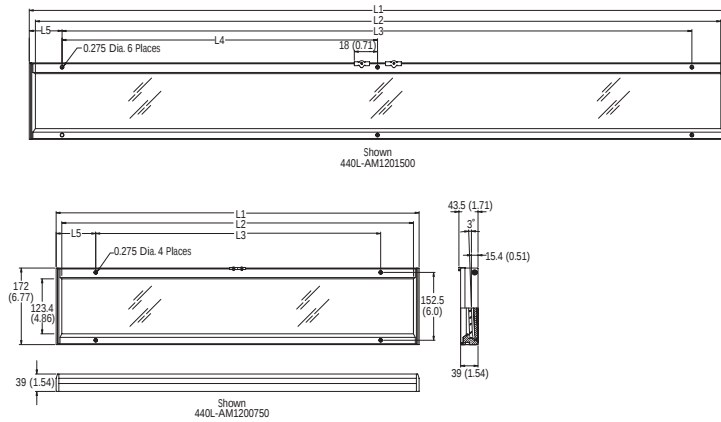


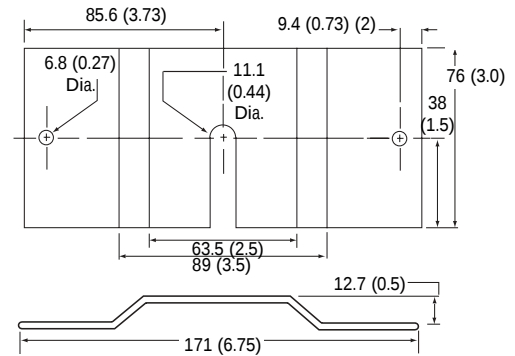
Figure 40: Dimensional drawing, side bracket (mm)

Accessories

Corner Mirror



Mounting Bracket 440L-AM120BRK



Protective Field Height S	Approximate Dimensions—mm (in)				
	L1	L2	L3	L4	L5
300 (11.8)	366 (19.4)	340 (13.4)	307 (12.1)	—	29.5 (1.2)
450 (17.7)	523 (20.1)	497 (19.6)	307 (12.1)	—	108 (4.3)
600 (23.6)	666 (26.2)	640 (25.2)	528.5 (20.8)	—	68.75 (2.7)
750 (29.5)	816 (32.1)	790 (31.1)	639.5 (25.2)	—	88.25 (3.5)
900 (35.4)	966 (38.0)	940 (37.0)	750 (29.5)	—	108 (4.3)
1050 (41.3)	1116 (43.9)	1090 (42.9)	972 (38.3)	—	72 (2.8)
1200 (47.3)	1266 (49.8)	1240 (48.8)	1146 (45.1)	—	60 (2.4)
1350 (53.2)	1416 (55.8)	1390 (54.7)	1296 (51.0)	—	60 (2.4)
1500 (59.1)	1566 (61.7)	1540 (60.6)	1415.5 (55.7)	707.95 (27.9)	75.25 (2.9)
1650 (65.0)	1716 (67.6)	1690 (66.5)	1596 (62.8)	798 (31.4)	60 (2.4)
1800 (70.9)	1866 (73.5)	1840 (72.5)	1746 (68.7)	873 (34.4)	60 (2.4)

Corner Mirror Selection

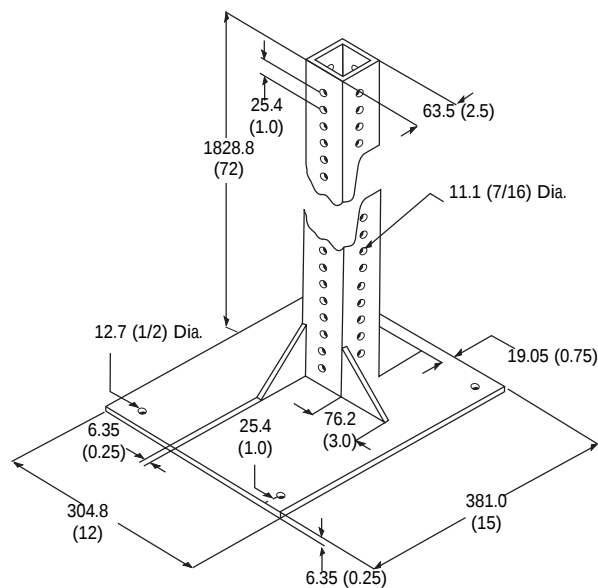
Specially constructed glass mirrors for 2 and 3 sided safeguarding applications.

Note: Each mirror reduces maximum scan range by approximately 10-15% per mirror.

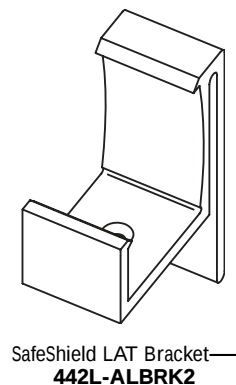
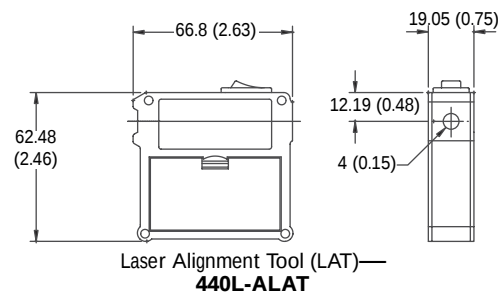
	For SafeShield Models	Catalog Number
	300	440L-AM1200300
	450	440L-AM1200450
	600	440L-AM1200600
	750	440L-AM1200750
	900	440L-AM1200900
	1050	440L-AM1201050
	1200	440L-AM1201200
	1350	440L-AM1201350
	1500	440L-AM1201500
	1650 or 1800	440L-AM1201800
Mounting kit for mirrors. Each kit contains 1 bracket with fasteners. Order 2 kits per mirror.		440L-AM120BRK
Mounting stand for mirror and light curtains		440L-AMSTD

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Mounting Stand—440L-AMSTD



Laser Alignment Tool



Optional Accessories

	Products	Catalog Number
	Plastic Swivel Mount Bracket (4 per package)	442L-AF6106 (1 package per system)
	Metal Side Mount (4 per package)	442L-AF6107 (1 package per system)
	Steel L-Mounting bracket, fixed (4 per package)	440L-AF6102 (1 package per system)
	Power supply: Input—85...265V AC Output—24V DC, 3 Amps	1606XLP72E
	Laser alignment aid	440L-ALAT
	SafeShield adaptor for laser alignment aid	442L-ALBRK2
	Sliding nuts (4 pieces supplied with SafeShield system)	440L-AF6105

Ordering Information

Delivery

SafeShield Safety Light Curtain

Delivery, sender

- Sender unit
- 4 sliding nuts for side bracket

Delivery, receiver

- Receiver unit
- 4 sliding nuts for side bracket
- Test rod with diameter corresponding to the physical resolution of the safety light curtain
- Label "Important Information"
- Operating instructions on CD-ROM
- SCD software on CD-ROM
- Information label "Operator's notes"

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System without Cascading Connection

For use as single system or as last guest of a cascable system.

SafeShield Safety Light Curtain without Cascading Connection

Protective Field Height [mm]	Catalog Numbers for Resolution	
	14mm	30mm
300	442L-PA40314CBCD	442L-PA40330CBCD
450	442L-PA40414CBCD	442L-PA40430CBCD
600	442L-PA40614CBCD	442L-PA40630CBCD
750	442L-PA40714CBCD	442L-PA40730CBCD
900	442L-PA40914CBCD	442L-PA40930CBCD
1050	442L-PA41014CBCD	442L-PA41030CBCD
1200	442L-PA41214CBCD	442L-PA41230CBCD
1350	442L-PA41314CBCD	442L-PA41330CBCD
1500	442L-PA41514CBCD	442L-PA41530CBCD
1650	442L-PA41614CBCD	442L-PA41630CBCD
1800	442L-PA41814CBCD	442L-PA41830CBCD

Table 31: Catalog numbers SafeShield safety light curtain without cascading connection

System with Cascading Connection

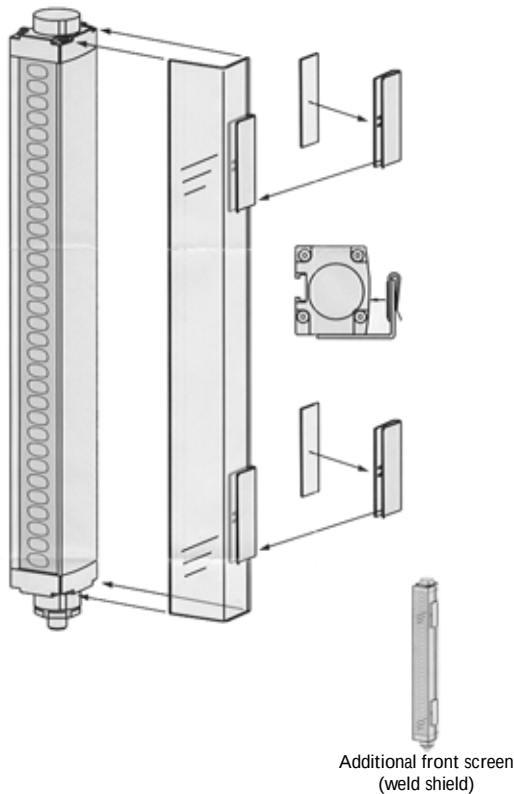
For use as single system, as host or as first or second guest of a cascaded system.

SafeShield Safety Light Curtain with Cascading Connection

Protective Field Height [mm]	Catalog Numbers by Resolution	
	14mm	30mm
300	442L-PA40314DBCD	442L-PA40330DBCD
450	442L-PA40414DBCD	442L-PA40430DBCD
600	442L-PA40614DBCD	442L-PA40630DBCD
750	442L-PA40714DBCD	442L-PA40730DBCD
900	442L-PA40914DBCD	442L-PA40930DBCD
1050	442L-PA41014DBCD	442L-PA41030DBCD
1200	442L-PA41214DBCD	442L-PA41230DBCD
1350	442L-PA41314DBCD	442L-PA41330DBCD
1500	442L-PA41514DBCD	442L-PA41530DBCD
1650	442L-PA41614DBCD	442L-PA41630DBCD
1800	442L-PA41814DBCD	442L-PA41830DBCD

Table 32: Catalog numbers SafeShield safety light curtain with cascading connection

Additional Front Screen (Weld Shield)



Note

- Two additional front screens (weld shields) supplied for each part number.
- The additional front screen fits both on the sender and on the receiver.
- The additional front screen may be used only if the curved enclosure side is accessible.
- An additional front screen reduces the scanning range of the system by 8%. If sender and receiver each use an additional front screen, the scanning range will be reduced by 16%.

Protective Field Height [mm]	Catalog Number	Protective Field Height [mm]	Catalog Number
300	442L-AWS300	1200	442L-AWS1200
450	442L-AWS450	1350	442L-AWS1350
600	442L-AWS600	1500	442L-AWS1500
750	442L-AWS750	1650	442L-AWS1650
900	442L-AWS900	1800	442L-AWS1800
1050	442L-AWS1050		

Table 33: Catalog numbers additional front screen (weld shield)

Accessories

Part	Catalog Number
Connection cable for standard type and cascable devices:	
Straight female—2 (6.5)	889M-F12AH-2
Straight female—5 (16.4)	889M-F12AH-5
Straight female—10 (32.8)	889M-F12AH-10
Straight female—15 (49.2)	889M-F12AH-15
Straight female—20 (65.6)	889M-F12AH-20
Straight female—30 (98.4)	889M-F12AH-30
Right angle female—2 (6.5)	889M-R12AH-2
Right angle female—5 (16.4)	889M-R12AH-5
Right angle female—10 (32.8)	889M-R12AH-10
Right angle female—15 (49.2)	889M-R12AH-15
Right angle female—20 (65.6)	889M-R12AH-20
Right angle female—30 (98.4)	889M-R12AH-30
Cables for interconnection of cascable devices: Patchcords, M23 overmolded straight male to female, 22AWG yellow PVC cable with one twisted pair	
0.3 (1.0)	889M-F12AHMU-0M3
0.6 (2.0)	889M-F12AHMU-0M6
1 (3.3)	889M-F12AHMU-1
2 (6.5)	889M-F12AHMU-2
3 (9.8)	889M-F12AHMU-3
Swivel mount brackets, 4 pcs. for any protective field height	442L-AF6106
Side mounting, 4 pcs. for any protective field height. For higher vibration & shock	442L-AF6107
Accessories included in a standard delivery	442L-AF6105
Sliding nuts or side mounting bracket, 4 pcs.	
CD-ROM incl. online documentation	75046-465-01
2m Connection cable between the serial interface of the PC and the configuration interface	442L-ACRS232

Table 34: Catalog numbers, accessories

Note

- The minimum bending radius of the cables is 150 mm.
- The cable sheath is made of PVC (UL listed).

Appendix

Checklist for the Manufacturer

Checklist 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 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 ☐ No ☐
2. Are the applied directives and standards listed in the declaration of conformity?	Yes ☐ No ☐
3. Does the protective device comply with the required control category?	Yes ☐ No ☐
4. Is the access to the hazardous area/hazardous point only possible through the protective field of the ESPE?	Yes ☐ No ☐
5. Have appropriate measures been taken to prevent (mechanical point-of-operation guarding) or monitor unprotected presence in the hazardous area when protecting a hazardous area/hazardous point and have these been secured against removal?	Yes ☐ No ☐
6. Are additional mechanical protective measures fitted and secured against manipulation which prevent reaching below, above or around the ESPE?	Yes ☐ No ☐
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 ☐ No ☐
8. Has the ESPE been mounted such that the required safety distance from the nearest hazardous point has been achieved?	Yes ☐ No ☐
9. Are the ESPE devices properly mounted and secured against manipulation after adjustment?	Yes ☐ No ☐
10. Are the required protective measures against electric shock in effect (protection class)?	Yes ☐ No ☐
11. Is the command device for resetting the protective devices (ESPE) or restarting the machine present and correctly installed?	Yes ☐ No ☐
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 ☐ No ☐
13. Has the protective function been checked in compliance with the test notes of this documentation?	Yes ☐ No ☐
14. Are the given protective functions effective at every setting of the operating mode selector switch?	Yes ☐ No ☐
15. Are the switching elements activated by the ESPE, e.g. contactors, valves, monitored?	Yes ☐ No ☐
16. Is the ESPE effective over the entire period of the dangerous state?	Yes ☐ No ☐
17. Once initiated, will a dangerous state be stopped when switching the ESPE on or off and when changing the operating mode, or when switching to another protective device?	Yes ☐ No ☐
18. Has the information label "Important Information" for the daily check been attached so that it is well visible for the operator?	Yes ☐ No ☐

This checklist does not replace the initial commissioning, nor the regular inspection by specialist personnel.

Declaration of Conformity



EC Declaration of Conformity

The undersigned, representing the following supplier

Rockwell Automation/Allen-Bradley
2 Executive Drive
Chelmsford, MA 01824 – USA

and the authorized representative established within the Community

Rockwell Automation, Subsidiary of
Rockwell International GmbH
Düsseldorfer Straße 15
D-42781 Haan, Germany

herewith declare that the Products
 Product identification (brand and
 catalogue number/part number):

442L Safety Light Curtains, 442L Optional Function Module
Allen-Bradley 442L light curtain models with 14mm, and 30mm
resolution, (reference the attached list of catalogue numbers)

Product Safety Function:

442L safety light curtains are active opto-electronic protection devices
(AOPD) with resolutions of 14mm, and 30mm. These safety light curtains
are self-checking and belong to Safety Category 4.

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/EEC

Machine Safety Directive

89/336/EEC

EMC Directive as amended by 92/31/EEC, 93/68/EEC

and complies with the provisions of the following harmonized standards:

EN 954-1: 1996

Safety of machinery-Safety related parts of control systems – Part 1: General Principles for Design. Meets requirements of Category 4

EN 60204-1: 1997

Safety of machinery – Electrical equipment of machines, Part 1: General requirements

EN 61496-1: 1997

Safety of machinery-Electrosensitive protective equipment – Part 1: General requirements and tests Meets requirements of Type 4

IEC 61496-2: 1997

Safety of machinery-Electro sensitive protective equipment – Part 21: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)

EN 61508 Parts 1 -7: 2001

Functional safety of electrical/ electronic programmable electronic safety related systems. Meets requirements of SIL 3

EN 61000-6-4: 2001

Electromagnetic compatibility (EMC) Part 6-4 – Emission standard for Industrial Environments

EN 61000-6-2: 2001

Electromagnetic compatibility (EMC) Part 6-2: Generic standards- Immunity for Industrial Environments

EN 50178: 1997

Electronic equipment fore use in power installations

Conformance of a type sample belonging to the above-mentioned product family with the regulations from the EC machine directives has been certified by:

TÜV Rheinland

EC type sample test No.

Am Grauen Stein

BB 60011281 001 dated 07-Apr-2005

D-51105 Köln, Germany

Year of CE marking

Not applicable

Supplier:

Authorized Representative in the Community:

Signature

Name: Ed Giachelli
 Position: Quality manager
 Date: 01-May-2005

i.V. Signature

Name: Viktor Schiffer
 Position: Engineering Manager
 Date: 02-May-2005

Document Control Number: SEN-0334-C-EN

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