

Installation Instructions

Original Instructions



Allen-Bradley
by ROCKWELL AUTOMATION



GuardShield Type 2 Safety Light Curtain

Catalog Numbers 440L-P2Kx, 440L-T2KAx, 440L-R2Kx

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Summary of Changes

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

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IMPORTANT Save these instructions for future use.

Description

A recognized technical regulations and quality assurance system, ISO 9000 are carefully applied during the development and production of Allen-Bradley® Guardmaster® products.

Follow this technical description when you install and commission the GuardShield™ Type 2 safety light curtain. Only qualified personnel can inspect and commission the unit.

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Introduction

The GuardShield Type 2 safety light curtain is a general-purpose presence sensing device, which is designed for use on hazardous machinery and provides point of operation, and perimeter and access detection.

The unit is a self-contained, two boxes, Type 2 ESPE (electro-sensitive protective equipment).

The GuardShield Type 2 is offered in either Guard Only mode or with a Restart Interlock and EDM.

IMPORTANT These installation instructions direct the technical personnel of the machine manufacturer and or the installer of the safety system to properly mount, configure, install electrical, commission, operate, and maintain the GuardShield Type 2 safety light curtain. These installation instructions do not provide instruction for the operation of machinery to which the GuardShield Type 2 safety light curtain is integrated. Only qualified personnel are able to install this equipment.

Safety Precautions

Principles for Safe Use and Symbols Used

The following instructions are preventive warnings for the proper operation of the GuardShield Type 2 safety light curtain. These instructions are an essential part of the safety precautions and therefore must be observed at any time.

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



ATTENTION: Failure to observe results in dangerous operation. Identifies information about practices of circumstances that can lead to personal injury or death, property damage, or economic loss.

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.



ATTENTION: Potentially hazardous situation, which, if not prevented, leads to serious or deadly injury. Failure to observe results in dangerous operation.

Conditions for Proper Use

Read and understand these requirements before you select and install the GuardShield Type 2 safety light curtain. GuardShield Type 2 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 various machines.

The GuardShield Type 2 family of safety light curtains consists of general-purpose presence sensing devices that are designed to protect personnel working on or near machinery.

The installation of GuardShield Type 2 safety light curtains must comply with all applicable federal, state, and local rules, regulations, and codes.

The employer is responsible to install, operate, and maintain the product properly, and the machinery on which the GuardShield Type 2 presence sensing device is installed.

Only qualified personnel can properly install GuardShield Type 2 safety light curtains.

GuardShield Type 2 safety light curtains are presence sensing devices and do 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.

GuardShield Type 2 safety light curtains can only be used on machinery that can be stopped anywhere in its stroke or cycle.

GuardShield Type 2 safety light curtains must never be used on full revolution clutched machinery.

The effectiveness of the GuardShield Type 2 safety light curtains depends upon the integrity of the machine control circuit. The machinery on which the GuardShield Type 2 presence sensing device is installed must have control circuitry that is fail-safe in design.

All stopping mechanisms for the machinery must be inspected regularly to achieve 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 GuardShield Type 2 safety light curtains, which results in personal injury and damage to equipment.

The GuardShield Type 2 safety light curtain can be used in safety applications in which a risk analysis according to ANSI Z590.3, Z690.3, ISO 14121 and ISO 12100 have reached PLC in a safety Category 2 (EN ISO 13849-1) or SIL 1 (EN 62061).



ATTENTION: The GuardShield Type 2 safety light curtain must not be used with machines that cannot be stopped electrically in an emergency.

The safety distance between the GuardShield Type 2 safety light curtain and a dangerous machine movement must be maintained always.

Additional mechanical protective devices must be installed in a way that hazardous machine elements cannot be reached without passing through the protective field.

The GuardShield Type 2 safety light curtain must be installed in a way that operators can only operate within the sensing area. Improper installation can result in serious injury.

Never connect the outputs to +24V DC. If the outputs connect to +24V DC, they are in the on-state and cannot stop hazardous spots at the machine/application.

Never expose the GuardShield Type 2 safety light curtain to flammable or explosive gases.

Regular safety inspections are imperative (see [Safety Instructions and Maintenance on page 10](#)).

Do not repair or modify the GuardShield Type 2 safety light curtain. The GuardShield Type 2 safety light curtain is not field repairable and can only be repaired at the factory. Removal of either of the GuardShield Type 2 safety light curtain end caps voids the warranty terms of this product.

Specialist Personnel

A qualified person must install, commission, and service the GuardShield Type 2 safety light curtain. A qualified person is defined as a person who:

- Has undergone the appropriate technical training
- Instructed by the responsible machine operator in the operation of the machine and the currently valid safety guidelines
- Has read and has ongoing access to these installation instructions.

Range of Uses of the Device

The GuardShield Type 2 safety light curtain is classified as electro-sensitive protective equipment (ESPE). The physical resolution is 30 mm (1.18 in.). The maximum protective field width is 16 m (52.5 ft). The protective field height is between 160 mm (6.3 in.) and 1760 mm (69.2 in.).

The device is a Type 2 ESPE as defined by IEC 61496-1 and IEC 61496-2 and is allowed for use with controls:

- In safety Cat 2 up to PLC in accordance with EN ISO 13849-1
- SIL CL 1 in accordance with EN 62061
- The device is suitable for:
 - Point of operation protection (hand protection)
 - Hazardous area protection
 - Access protection

Access to the hazardous point must be allowed only through the protective field. The machine/system is not allowed to start as long as personnel are within the hazardous area. See the [Examples of Range of Use on page 3](#) for an illustration of the protective modes.

Mechanical protection devices can be required and the safety light curtains for some applications.

Proper Use

The GuardShield Type 2 safety light curtain must be used only as defined in [Range of Uses of the Device on page 2](#). Only qualified personnel can install and initialize the safety light curtain.

If the device is used for any other purposes or modified in any way, warranty claims against Allen-Bradley Guardmaster become null and void.

General Protective Notes and Protective Measures



ATTENTION: Observe the following items to help achieve compliance of the proper and safe use of the GuardShield Type 2 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 2006/42/EC
 - Low Voltage Directive 2006/95/EC
 - The work safety regulations/safety rules
 - Other relevant health and safety regulations
- Manufacturers and users 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 of these installation instructions (for example, on use, mounting, installation, or integration into the existing machine controller) must be observed.
- The tests are conducted specialist personnel or specially qualified and authorized personnel. Record and document the results so you can reconstruct and retrace the tests at any time.

- The installation instructions must be available to the user of the machine where the GuardShield Type 2 safety light curtain is installed. The machine operator is instructed in the use of the device by specialist personnel and must be instructed to read the installation instructions.

Product Description

This section provides information on the special features and properties of the safety light curtain. This section describes the structure and functions of the unit, in particular the different operating modes.

IMPORTANT Read this section before you mount, install, and commission the unit.

Principle of Operation

The GuardShield Type 2 safety light curtain consists of a non-matched pair of optic units, that is, transmitter and receiver with the same protective height and resolution. The transmitter and receiver operate on +24V DC. The maximum distance between transmitter and receiver is referred to as the protective field width or range. The protective field height is the distance between the first and last beam in the device.

The GuardShield Type 2 safety light curtain receives and processes the sequential pulses of the infrared light that the transmitter emits. The synchronization of the timing of the emission and reception of infrared light pulses is optically. The first beam next to the GuardShield Type 2 safety light curtain status indicators is the synchronization beam. Because the GuardShield Type 2 safety light curtain transmitter and receiver are optically synchronized, no electrical connection is required between the transmitter and receiver.

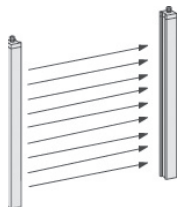
The GuardShield Type 2 safety light curtain receiver has two safety outputs, Output Signal Switching Devices (OSSDs) and one non-safety auxiliary output. When the GuardShield Type 2 safety light curtain transmitter and receiver are properly powered and aligned, all OSSDs are current sourcing +24V DC with a switching capacity of 500 mA. The two safety OSSDs are cross monitored and have short-circuit protection. Interruption of the sensing field causes the receiver to switch off the sourced current (0V DC).

Restoration of the GuardShield Type 2 safety light curtain sensing field (in guard only configuration) causes all outputs (OSSDs) to switch to the active high state. This switch resumes current sourcing +24V DC with a switching capacity of 500 mA.

The GuardShield Type 2 Safety Light Curtain

The GuardShield Type 2 safety light curtain consists of a transmitter and a receiver.

Figure 1 – Components of the GuardShield Type 2 Safety Light Curtain [mm (in.)]



Marks on the housing indicate the upper and lower limit of the protective field.

The width of the protective field is derived from the length of the light path between sender and receiver. This length must not exceed the maximum rated width of the protective field.

Examples of Range of Use

The GuardShield Type 2 safety light curtain operates as a proper protective device only if the following conditions are met:

- The control of the machine must be electrical.
- The controlled machine must be able to be stopped anywhere in the machine's stroke or cycle.
- The transmitter and receiver must be mounted such that access to the hazard is only through the protective field of the light curtain.
- The Restart button must be located outside the hazardous area so a person working inside the hazardous area cannot operate it.
- The statutory and local rules and regulations must be observed to install and use the device.

IMPORTANT Additional measures can be necessary to help confirm that the ESPE does not fail to danger when other forms of light radiation are present in a particular application. Examples include the use of cableless control devices on cranes, radiation from weld spatter, or effects from strobe lights.

IMPORTANT You must test the protective system for proper operation after every change to the configuration.

Guard Only

When in the Guard Only mode of operation, the safety light curtain operates as an on/off device. The OSSD outputs switch off/on according to whether an obstruction is or is not in the detection field.

Start Interlock

The start interlock is designed to protect against the OSSD outputs from switching to the on state after power-up of the system with the protective field unobstructed. A manual reset of the system is required for the GuardShield Type 2 safety light curtain to enter the on state.

You can manually reset by one of two methods:

- Actuation of a momentary N.O. push button
- Interruption and restoration of the protective field within 1 second

The GuardShield Type 2 safety light curtain is factory supplied with this functionality. Indication of this mode of operation is by the illumination of a yellow status indicator on the GuardShield Type 2 safety light curtain receiver.

Restart Interlock

The Restart Interlock mode of operation is designed to protect against the OSSD outputs from switching to on after interruption and clearance of the protective field. A manual reset of the GuardShield Type 2 safety light curtain system is required. The system reset is accomplished through a momentary N.O. push button or keyswitch. The illumination of a yellow status indicator on the GuardShield Type 2 safety light curtain receiver indicates Restart Interlock mode. GuardShield Type 2 safety light curtain is factory-ordered with this functionality.

Relay Monitoring (MPCE/EDM)

The relay monitoring function is an input signal to the GuardShield Type 2 safety light curtain receiver. It is used to monitor the state of the primary control contactors or other final switching devices of the protected machinery. Detection of unsafe conditions such as welded contacts, cause the GuardShield Type 2 safety light curtain to enter a lockout condition (OSSDs off).

System Testing

The GuardShield Type 2 safety light curtain performs a complete system self-test at power-up and switches to the on state if the system is properly aligned and the protective field is unobstructed. If the start/restart interlock version is used, a reset is required to switch to a green state.

External Test (Machine Test Signal)

An external test signal to the GuardShield Type 2 safety light curtain transmitter triggers a test cycle of the system. To supply or remove a signal (+24V DC) via a N.C. or N.O. switch at the test input, deactivate the transmitter during the test signal. It simulates an interruption of the protective sensing field.

Response Time

The response time of the GuardShield Type 2 safety light curtain depends on the height of the protective field.

Resolution [mm (in.)]	Protective Height [mm (in.)]	Number of Beams	Response Time
30 (1.18)	160 (6.3)	8	20 ms
30 (1.18)	320 (12.5)	16	20 ms
30 (1.18)	480 (18.8)	24	20 ms
30 (1.18)	640 (25.1)	32	20 ms
30 (1.18)	800 (31.4)	40	20 ms
30 (1.18)	960 (37.7)	48	20 ms
30 (1.18)	1120 (44.0)	56	20 ms
30 (1.18)	1280 (50.3)	64	20 ms
30 (1.18)	1440 (56.6)	72	20 ms
30 (1.18)	1600 (62.9)	80	20 ms
30 (1.18)	1760 (69.2)	88	20 ms

IMPORTANT

Determine Stop Time

The measurement of stop time (T) must include the stop times of all devices in the stop circuit. A calculation T, which excludes all device and control system elements results in an inaccurate safety distance calculation.

Determine the Safety Distance

You must mount the safety light curtain with proper safety distance

- From the point of danger
- From reflective surfaces

US Safety Distance Formula



ATTENTION: You must mount the GuardShield Type 2 safety light curtains at a sufficient distance from the pinch point or point of operation hazard. A sufficient distance helps confirm that the machine stops before a finger, hand, arm, or body reaches the hazard.

You must properly calculate this distance, referred to as the safety distance, before you determine the safety light-curtain protective-height, and mount the light curtains on the machine. Failure to calculate this safety distance accurately results in operator injury.

IMPORTANT

According to EN ISO 13855, regardless of the calculated safety distance, never mount GuardShield Type 2 safety light curtains closer than 100 mm (4 in.) from the point of operation or pinch point hazard.

In the United States, there are two formulas to 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 consider 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:

$$D_s = 63 \times T$$

D_s Safety Distance

63 OSHA recommended hand speed constant in inches per second

T Total stop time of all devices in the safety circuit, which is measured in seconds. This value must include all components that are involved to stop the hazardous motion of the machinery. For a mechanical power press, it is the stop time that is measured at approximately the 90° position of the crankshaft rotation.

IMPORTANT

The T number must include the response times of all devices, including:

- Response time of the safety light curtain
- Safety light curtain controller (if used)
- Control circuit of the machine, and
- Any other devices that react to stop the hazardous motion of the machinery.



WARNING: Not including the response time of a device or devices in the stop time calculation results in insufficient safety distance for the application, which results in operator injury.

The ANSI Safety Distance Formula

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

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

D_s 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 1600.2 mm (63 in.) per second when the operator begins reaching toward the point of operation hazard from rest. ⁽¹⁾

T_s Stop time of the machine tool that is measured at the final control element. Measurement starts at maximum machine velocity.

T_c Response time of the control system

T_r Response time of the presence sensing device (safety light curtain) and its interface, if any. You must measure the value, or the device manufacturer states the value.

T_{spm} Additional time is allowed for the stop performance monitor to compensate for variations in normal stopping time T_s . Check ANSI B11.19 Annex D for details.

D_{pf} 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 object sensitivity of the safety light curtain. Object sensitivity (resolution) is the smallest diameter object, which is detected anywhere in the sensing field.

(1) ANSI B11.19 2000 E8.3.2.3 and Annex D states: One of the accepted values for K is the hand speed constant (it is considered as the horizontal motion of the hand and arm while seated). The common value of K is 1.6 m/s (63 in./s), although other values (typically greater) are also used. The hand speed constant excludes other body movements, which can affect the actual approach speed. Consideration of the previous factors must be included when determining the speed constant for a given application. The employer must consider all factors, including the physical ability of the operator, when determining the value of K to be used.

IMPORTANT

A stop time measurement device measures

$$T_s + T_c + T_r + T_{spm}$$

Example Calculation (for US):

In a perpendicular safety-light curtain application with object sensitivity (effective resolution) less than 64 mm (2.5 in.), approximate the D_{pf} based on the following formula:

$$D_{pf} (\text{inches}) = 3.4 \times (\text{object sensitivity} - 0.276),$$

But not less than 0.

For GuardShield Type 2 safety light curtain:

Object sensitivity = 30 mm (1.18 in.)

$$D_{pf} = 3.4 \times (1.18 - 0.276 \text{ in.}) = 3.08 \text{ in.}$$

$$T_s = 241 \text{ ms} = 0.241 \text{ s}$$

$$T_c = 10 \text{ ms} = 0.01 \text{ s}$$

$$T_r = 20 \text{ ms} = 0.02 \text{ s}$$

$$T_{spm} = 20\% \text{ of } T_s (\text{calculated by the machine manufacturer}) = 49 \text{ ms} = 0.049 \text{ s}$$

$$K = 63 \text{ in./s (determined by the machine manufacturer)}$$

$$\begin{aligned} D_s &= 63 \times (0.241 + 0.01 + 0.02 + 0.049) + 3.08 \text{ in.} \\ &= 63 \times 0.32 + 3.08 \text{ in.} \\ &= 20.16 + 3.08 \text{ in.} \\ &= 23.24 \text{ in. (600 mm)} \end{aligned}$$

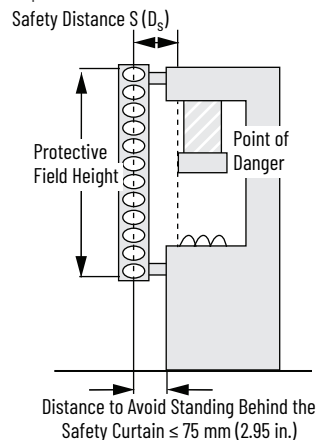
European Safety Distance Formula

A safety distance must be maintained between the light curtain and the point of danger. This safety distance helps achieve that you can only reach the point of danger after removal of the dangerous state of the machine.

The safety distance as defined in EN ISO 13855 and EN ISO 13857 depends on:

- Stop/run-down time of the machine (the machine documentation shows the stop/run-down time, or you must take a measurement to determine the stop/run-down time)
- Response time of the protective device, for example, GuardShield Type 2 safety light curtain (for [Response Time on page 4](#))
- Response time of the safety circuit
- Reach or approach speed
- Resolution of the light curtain

Figure 2 - Safety Distance from the Point of Danger

**Calculate the Safety Distance S**

According to EN ISO 13855 and EN ISO 13857:

- First, use the following formula to calculate S:

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

Where:

T = Stopping/run-down time of the machine
 + response time of the protective device [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 ≤ 500 mm (19.6 in.), then use the determined value as the safety distance.
- If the result S is > 500 mm (19.6 in.), then recalculate S as follows:

$$S = 1600 \times T + 8 \times (d - 14) [\text{mm}]$$
- If the new value S is > 500 mm (19.6 in.), then use the newly determined value as the minimum safety distance.
- If the new value S is ≤ 500 mm (19.6 in.), then use 500 mm (19.6 in.) as the safety distance.

Example Calculation (for Europe)

Stop/run-down time of the machine = 290 ms

Response time safety circuit = 10 ms

Response time light curtain = 20 ms

Resolution of the light curtain = 30 mm (1.18 in.)

$$T = 290 \text{ ms} + 30 \text{ ms} = 320 \text{ ms} = 0.32 \text{ s}$$

$$S = 2000 \times 0.32 + 8 \times (30 - 14) = 768 \text{ mm (30.24 in.)}$$

S > 500 mm (19.7 in.), therefore:

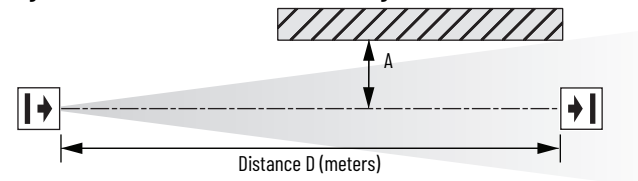
$$S = 1600 \times 0.32 + 8 \times (30 - 14) = 640 \text{ mm (25.1 in.)}$$

Minimum Distance from Reflecting Surfaces

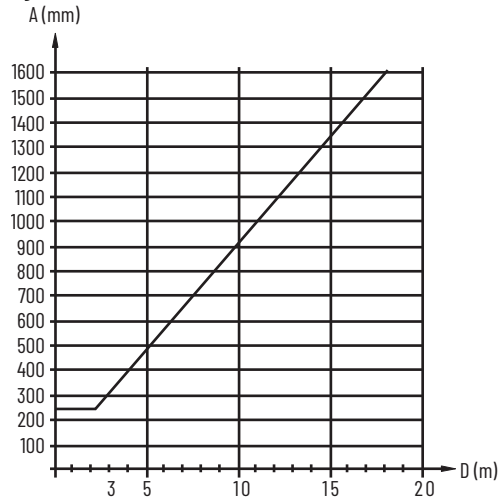
The infrared light from the sender reflects off shiny surfaces and received by the system receiver. If this condition occurs, it can result in an object not being detected when it enters the GuardShield Type 2 safety light curtain sensing field.

All reflecting surfaces and objects (for example, material bins) must therefore be at the minimum distance A from the protective field of the system. The minimum distance A depends on the distance D between sender and receiver.

Figure 3 - Minimum Distance from Reflecting Surfaces

**Determine the Minimum Distance from the Reflecting Surfaces**

- Determine the distance D [m] sender-receiver
- Read the minimum distance A [mm] from the graph:

Figure 4 - Minimum Distance from Reflective Surfaces

The effective aperture angle for the GuardShield Type 2 safety light curtain system is within $\pm 5.0^\circ$ at a mounting distance of > 3.0 m (9.8 ft). Calculate the minimum distance to reflective surfaces depending on the distance between the transmitter and the receiver. Use an aperture angle of $\pm 5.0^\circ$, or take the appropriate value from [Table 1](#).

Table 1 - Minimum Safety Distance to Reflective Surfaces

Distance Between Transmitter and Receiver Range D [m (ft)]	Minimum Distance A [mm (in.)]
0.2...3.0 (0.65...9.8)	263 (10.4)
4.0 (13.1)	350 (13.8)
5.0 (16.4)	437 (17.2)
6.0 (19.6)	525 (20.7)
7.0 (22.9)	613 (24.1)
10.0 (32.8)	875 (34.5)
16.0 (52.4)	1400 (55.1)

IMPORTANT Formula: $A = \tan 5^\circ \times D [\text{mm}] = 0.0875 \times D [\text{mm}]$
 A = minimum distance to reflective surfaces
 D = distance between transmitter and receiver

Installation and Mounting

This section describes the preparation, selection, and installation of the GuardShield Type 2 safety light curtain.

The standard GuardShield Type 2 safety light curtain has an amber status indicator in the receiver to use as an alignment aid. The status indicator flashes when the receiver sees the infrared light from the transmitter. This status indicator turns off when you attain optimal alignment.

Standard Alignment Procedure

Mount and connect both transmitter and receiver. They must be parallel to each other and be positioned at the same height.

Turn on power to GuardShield Type 2 safety light curtain system.

Rotate the transmitter while watching the amber indicator on the receiver to find the point where the indicator for the on-state (green indicator) illuminates and the amber indicator turns off.

Determine the maximum left and right turning angles and position the unit in the center. Tighten all hardware so that the alignment indicator is not illuminated.

Cycle power so that the system powers up and enters the on-state (alignment indicator is off).

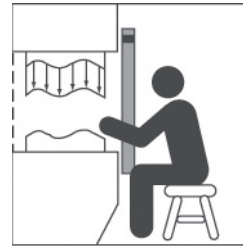
We offer an external laser (catalog number 440L-ALAT) and mounting bracket (catalog number 440L-AF6109) as accessories for GuardShield Type 2 safety light curtain alignment.

The GuardShield Type 2 safety light curtain is suitable for most operating environments (IP65 environmental rating). You must observe proper safety distance and adequate protective height.

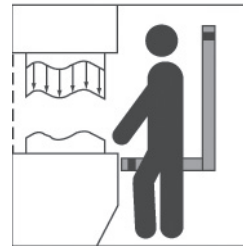
IMPORTANT Install the GuardShield Type 2 safety light curtain so that access to the hazard is only possible through the sensing field of the GuardShield Type 2 safety light curtain. Auxiliary safe guarding is required with the GuardShield Type 2 safety light curtain to meet this requirement.

Determine if the machinery, on which the GuardShield Type 2 safety light curtain is mounted, meets the requirements as specified in [Conditions for Proper Use on page 2](#). That is, machinery must be able to stop anywhere in its stroke or cycle, consistently and repeatedly.

Correct Installation



Operators cannot reach hazardous machine parts without passing through the protective field.



Operators must not step between protective field and hazardous machine parts (by-pass prevention).

Incorrect Installation

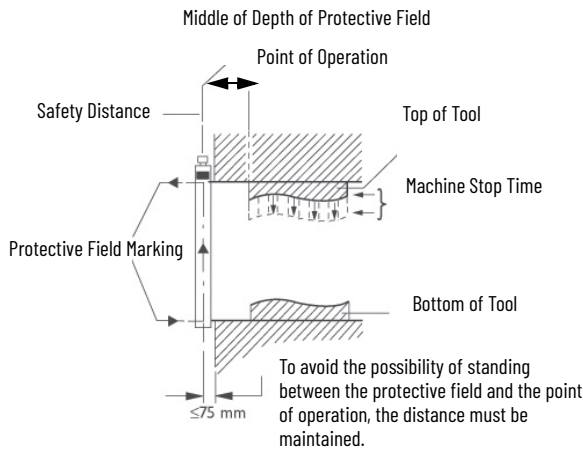


Operators can reach hazardous machine parts without passing through the protective field.



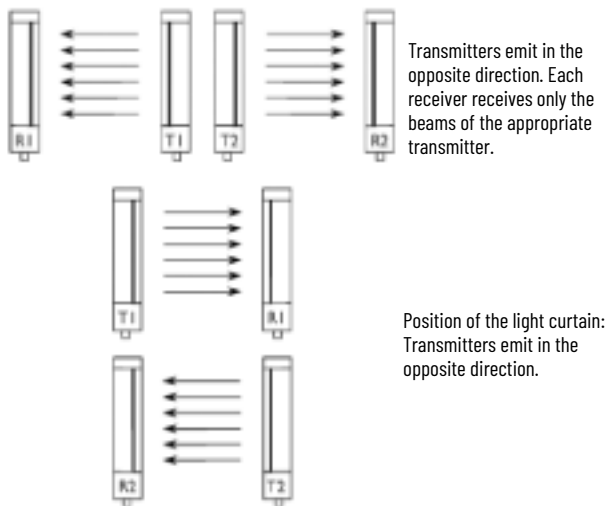
Operators can step between protective field and hazardous machine parts.

You must mount the GuardShield Type 2 safety light curtain at the proper distance from the point of operation hazard. This distance is referred to as the safety distance.

Figure 5 - Determine Machine Stop Time and Safety Distance [mm (in.)]

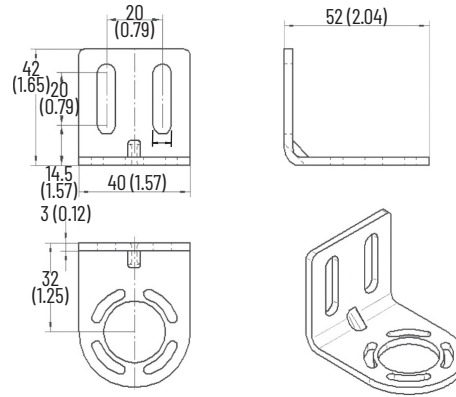
Multiple GuardShield Type 2 Safety Light Curtains

When you mount two or more GuardShield Type 2 safety light curtains close to one another, it is possible for the receiver of one pair to receive infrared light from the transmitter of another pair. You must mount the transmitter and receiver pairs in accordance with [Figure 6](#), or use a barrier to guard against optical interference.

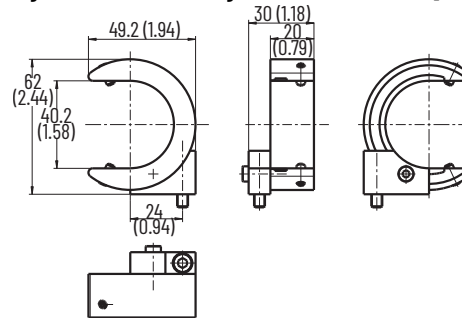
Figure 6 - Multiple Unit Alignment Options

Mounting Brackets

The GuardShield Type 2 safety light curtain mounts using right angle brackets that attach to the end caps of both transmitter and receiver. Use additional brackets to mount the GuardShield Type 2 safety light curtain at a proper safety distance from the machinery hazard.

Figure 7 - Mounting Brackets [mm (in.)]

Optional Middle Mounting Bracket

Figure 8 - Middle Mounting Brackets 440L-AF6108 [mm (in.)]

Use middle mounting brackets in vibration applications for protective heights of 1120 mm (44.09 in.) and larger.

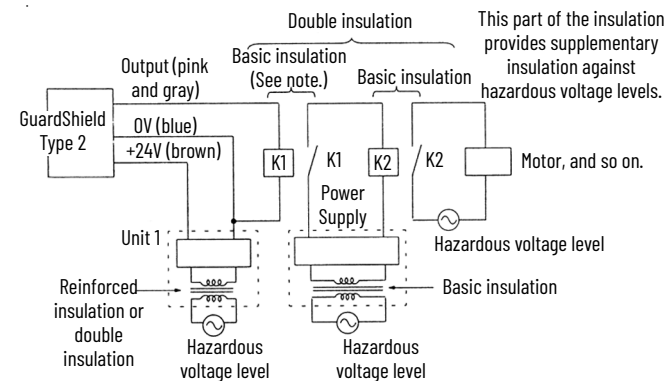
Electrical Installation

Connections

Power Supply

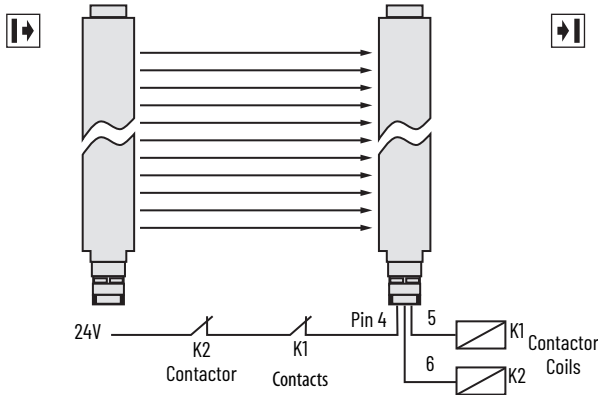
The external voltage supply (+24V DC) must meet the requirements of IEC 61496-1. In addition, the following requirements must be fulfilled:

- The power supply must bridge a short-term power failure of 20 ms.
- The power supply has double insulation between the primary and the secondary side.
- The power supply has overload protection
- The power supply corresponds to the guidelines of the EWG (industrial environment).
- The power supply corresponds to the Low Voltage Directives.
- The grounded conductor of the power supply device must be connected to a grounded conductor PE.
- The maximum deviation of the voltage levels is 24V DC $\pm 20\%$.



EDM Connection

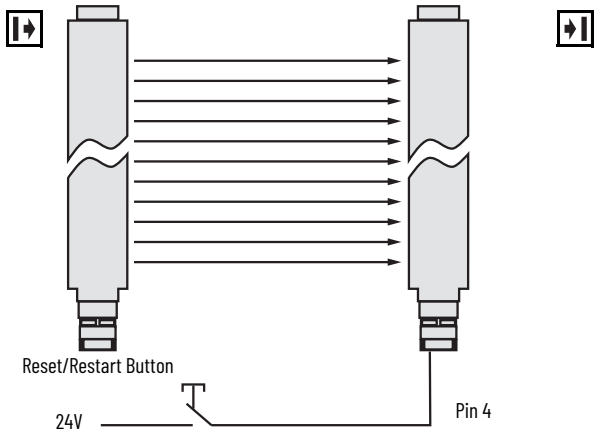
Figure 9 - Connect the Contact Elements to the EDM



Start/Restart Interlock

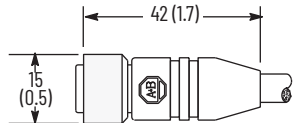
Start/restart interlock requires a N.O. momentary push button or keyswitch.

Figure 10 - Connecting the Reset/Restart Button



Cables and Connectors

Figure 11 - Connector [mm (in.)]



The GuardShield Type 2 safety light curtain transmitter connector is a 4-pin DC micro connector that is offered in cable lengths from 2...30 m (6.56...98.4 ft). The GuardShield Type 2 safety light curtain receiver connector is an 8-pin DC micro connector that is offered in cable lengths of 2...30 m (6.56...98.4 ft).

Table 2 - Transmitter Connector

Face View of Concave DC Micro	Color	Pin No.	Signal
			Transmitter
	Brown	1	+24V DC
	White	2	No connection
	Blue	3	0V DC
	Black	4	Machine test signal

Table 3 - Standard Receiver Connector

Face View of Concave DC Micro	Color	Pin No.	Signal
			Receiver
	White	1	Auxiliary output
	Brown	2	+24V DC
	Green	3	Ground
	Yellow	4	EDM
	Gray	5	OSSD 1
	Pink	6	OSSD 2
	Blue	7	0V DC
	Red	8	Start/restart

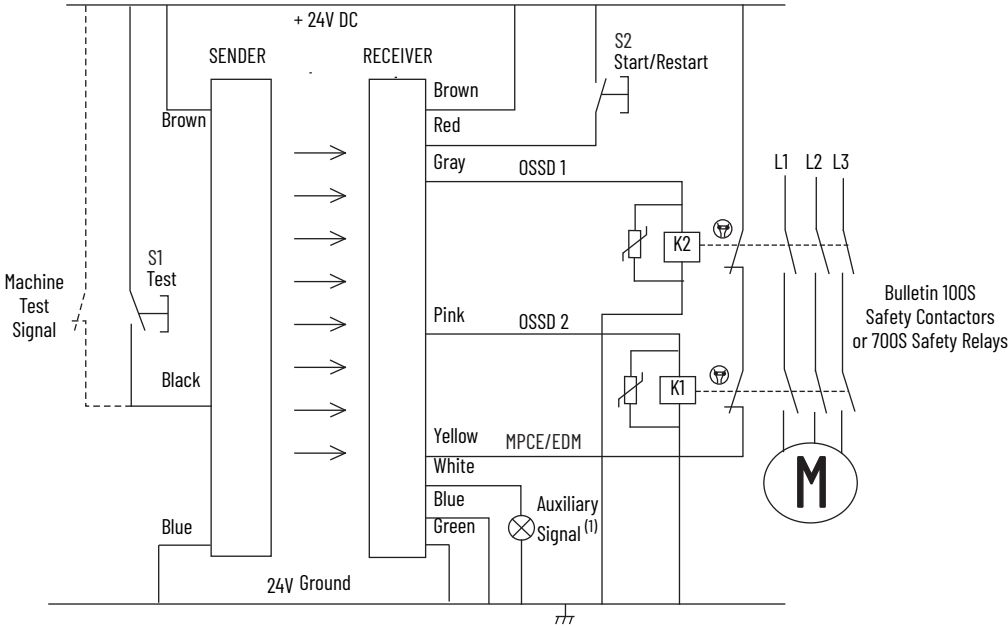
Troubleshooting Guide

The safety light curtain conducts an internal self-test after startup. If an error occurs, an appropriate signal combination sends through the status indicators to the transmitter and receiver.

Condition No.	Error Description	Action
6	Internal fault, receiver	• Replace receiver
7	Internal fault, transmitter	• Check connections transmitter/receiver • Exchange transmitter
8	External fault	• Check connections of OSSD outputs for short circuit against +24V DC and GND (cable, connected devices) • Replace receiver
9	External fault (MPCE error) The function relay monitoring activates and after clearing the OSSD, the input relay monitoring does not recognize a change of state.	• Check connection for relay monitoring • Check connected relay for closed contact - OSSD on - input relay monitoring must have GND level - OSSD off - input relay monitoring must have +24V • Switch-on only after power off/on

Typical Wiring

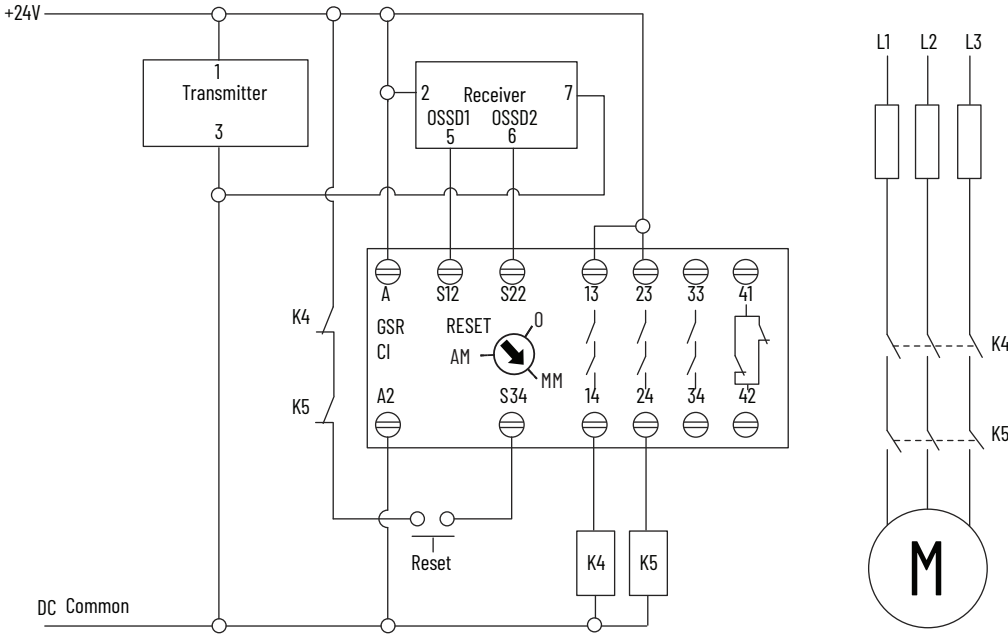
Figure 12 - Models with Start/restart Interlock, EDM, and the OSSDs Connected Directly to Contactors



(1) Non-safety auxiliary output can connect to a lamp or a PLC.

IMPORTANT If MPCE/EDM is not in use, the GuardShield Type 2 safety light curtain OSSDs connects to a safety relay module, which is configured for EDM.

Figure 13 - To GSR CI Safety Relay Module



ATTENTION: The GuardShield Type 2 safety light curtain is a Type 2 safety device. The use of a PLe, SIL 3 safety relay in a safety circuit does not increase the safety level of the safety circuit above a PLC, SIL 1.

System Status Indicators

Receiver
OSSDs On OSSDs Off









Alignment Interlock

Transmitter



Power Emitting

Condition No. (1)	Receiver Status Indicators				Transmitter Status Indicators	
	OSSDs Off  Red	OSSDs On  Green	Alignment  Amber	Interlock  Yellow	Power On  Amber	Emitting  Yellow
1	Off	On	Off	Off	On	On
2	On	Off	Off	Off	On	On
3	On	Off	Off	Off	On	On
4	On	Off	Off	Off	On	On
5	On	Off	Off	Off	On	On
6	Flash ⁽²⁾	Off	Off	Off	On	On
7	On	Off	Off	Off	Flash ⁽²⁾	On
8	Flash ⁽²⁾	Off	On	Off	On	On
9	Flash ⁽²⁾	Off	Off	On	On	On

(1) 6...9 = Fault conditions

(2) Flash rate is approximately 2 Hz (two times per second)

Condition No. (1)	Description
1	Guard Only mode, light curtain unobstructed (aligned, not in interlock)
2	Guard Only mode, light curtain interrupted (aligned, not in interlock)
3	Guard Only mode, misaligned (not in interlock)
4	Restart interlock (aligned)
5	Transmitter test input active (pin 4)
6	Internal fault, receiver
7	Internal fault, transmitter
8	External fault (OSSD short to ground, +V, or cross connection)
9	External fault (MPCE/EDM error)

(1) For fault conditions 6...9, see [Troubleshooting Guide on page 8](#).



ATTENTION: Confirm that all power to the machine and safety system is disconnected during electrical installation.

Initiation Checklist

Before the initiation of the GuardShield Type 2 safety light curtain, you must complete the following checklist.

Cable check before initiation:

1. The power supply is a 24V DC device, which must comply with all applicable standards of the Machinery Directive 2006/42/EC, and the product standard (IEC 61496).
2. Proper polarity of the power supply at the GuardShield Type 2 safety light curtain.
3. The transmitter connection cable properly connects to the transmitter, the receiver connection cable properly connects to the receiver.
4. Confirm the double insulation between the safety light curtain output and an external potential.
5. The OSSD outputs do not connect to +24V DC.
6. The connected switching elements (load) do not connect to 24V DC.
7. No connection to a conventional power supply.
8. If two or more GuardShield Type 2 safety light curtains are in use, to avoid optical interference, verify the proper installation of each system.

Switch on the GuardShield Type 2 safety light curtain and check its function by observing the following:

9. 2 seconds after switching on, if the protective field is free of obstructions, the system works properly.

Safety Instructions and Maintenance



ATTENTION: Never operate the GuardShield Type 2 safety light curtain before you conduct the following inspection. Improper inspection can lead to serious or even deadly injury.

1. For safety reasons, record all inspection results.
2. Only perform the inspection if you clearly understand the functioning of the GuardShield Type 2 safety light curtain and of the machine.
3. To perform the inspection, verify that you have sufficient information.

Daily Inspection

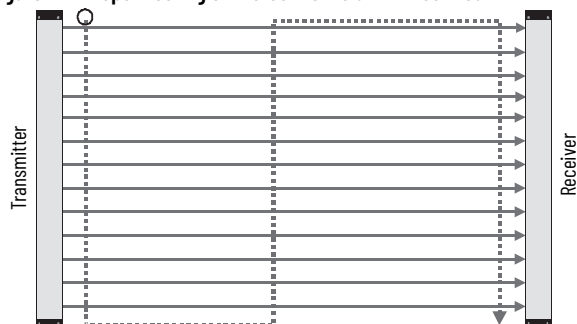
1. Approach to hazardous machine parts must only be possible by the passage through the protective field of the GuardShield Type 2 safety light curtain.
2. Operators cannot step through the sensing area while working on dangerous machine parts.
3. The safety distance of the application is bigger than the calculated value.
4. The optic front cover is not scratched or dirty.

Operate the machine and check if the hazardous movement stops under the following circumstances.

1. The protective field is interrupted.
2. If the test rod interrupts the protective field in the following locations, hazardous machine movement stops immediately.
 - Directly in front of the transmitter
 - Directly in front of the receiver
 - In the middle between transmitter and receiver
3. There is no hazardous machine movement while the test rod is anywhere within the protective field.
4. The power supply of the GuardShield Type 2 safety light curtain is off.
5. If the blanking function is active, check all sections of the protective field with the appropriate test piece.

IMPORTANT If any of the conditions that are previously listed do not result in the ceasing of hazardous motion of the machine, do not allow the machine to be in operation.

Figure 14 - Proper Testing of Protective Field with Test Rod



6-month Inspection

Check the following items every 6 months or whenever a machine setting is changed.

1. Machine stops or does not obstruct any safety function.
2. The latest machine or connection modifications have no effect on the control system.
3. The outputs of the GuardShield Type 2 safety light curtain properly connect to the machine.
4. The total response time of the machine is shorter than the calculated value.
5. Cables and plugs of the GuardShield Type 2 safety light curtain are in flawless condition.
6. Mounting brackets, caps, and cables are tightly secured.

Clean the Optic Front Cover

If the optic front cover of the GuardShield Type 2 safety light curtain is dirty, the outputs of the GuardShield Type 2 safety light curtain turn off. Use a clean, soft cloth and rub without pressure. Do not apply aggressive or abrasive cleansing agents, as they attack the surface.

Date Code



Allen-Bradley

Guardmaster®

Rockwell Automation Inc., 1201 South 2nd Street Milwaukee, WI 53204, USA

CAT 440L-T2KA0320YD
MAT NO XXXX
SER REV A A



Electro-Sensitive
Protective Equip.
19KP



SN 1234567890

PRODUCT OF MEXICO

DATE 1602

PLANT 1150

Explanation of Data Code

The production date is printed in the format:

YYWW (YY = year, WW = week)

Example: Date = 1602 (16 = Year - 02 = Week)

Ambient Temp.	-10.....+55C
Power Consumption	7W MAX.
Supply Voltage	24VDC+/-20%
Safety Parameters	TYPE 2/Cat. 2
IEC61489/ EN ISO 13849	PLoSIL CL1, SIL1
EN62061/ IEC61508	
Operating Instructions	PN-112459

GuardShield™ Type 2

Degree of Protection	IP65
Resolution	30mm
Range	0.3-16M
Protective Height	320mm
Response Time	≤20ms












Table 6 - Connection to Receiver

Cat. No.	Description [m (ft)]
889D-F8AB-2	8-pin DC Micro Straight Concave Cordset, 2 (6.5)
889D-F8AB-5	8-pin DC Micro Straight Concave Cordset, 5 (16.4)
889D-F8AB-10	8-pin DC Micro Straight Concave Cordset, 10 (32.8)
889D-F8AB-15	8-pin DC Micro Straight Concave Cordset, 15 (49.2)
889D-F8AB-20	8-pin DC Micro Straight Concave Cordset, 20 (65.6)
889D-F8AB-30	8-pin DC Micro Straight Concave Cordset, 30 (98.4)
889D-R8AB-2	8-pin/8-wire DC Micro Right Angle Concave Cordset, 2 (6.5)
889D-R8AB-5	8-pin/8-wire DC Micro Right Angle Concave Cordset, 5 (16.4)
889D-R8AB-10	8-pin/8-wire DC Micro Right Angle Concave Cordset, 10 (32.8)
889D-R8AB-15	8-pin/8-wire DC Micro Right Angle Concave Cordset, 15 (49.2)
889D-R8AB-20	8-pin/8-wire DC Micro Right Angle Concave Cordset, 20 (65.6)
889D-R8AB-30	8-pin/8-wire DC Micro Right Angle Concave Cordset, 30 (98.4)

Table 7 - Connection to Transmitter

Cat. No.	Description [m (ft)]
889D-F4AC-2	4-pin DC Micro Straight Concave Cordset, 2 (6.5)
889D-F4AC-5	4-pin DC Micro Straight Concave Cordset, 5 (16.4)
889D-F4AC-10	4-pin DC Micro Straight Concave Cordset, 10 (32.8)
889D-F4AC-15	4-pin DC Micro Straight Concave Cordset, 15 (49.2)
889D-F4AC-20	4-pin DC Micro Straight Concave Cordset, 20 (65.6)
889D-F4AC-30	4-pin DC Micro Straight Concave Cordset, 30 (98.4)
889D-R4AC-2	4-pin DC Micro Right Angle Concave Cordset, 2 (6.5)
889D-R4AC-5	4-pin DC Micro Right Angle Concave Cordset, 5 (16.4)
889D-R4AC-10	4-pin DC Micro Right Angle Concave Cordset, 10 (32.8)
889D-R4AC-15	4-pin DC Micro Right Angle Concave Cordset, 15 (49.2)
889D-R4AC-20	4-pin DC Micro Right Angle Concave Cordset, 20 (65.6)
889D-R4AC-30	4-pin DC Micro Right Angle Concave Cordset, 30 (98.4)

Optional Accessories

Description	Cat. No.
 Steel L-shape end cap mounting bracket (4 per package) ⁽¹⁾	440L-AF6101
 Aluminum middle mounting bracket for vibratory applications	440L-AF6108
 Power supply (output 24V DC, 3 amps, 72 W)	1606-XLP72E
 Laser alignment tool	440L-ALAT
 GuardShield Type 2 safety light curtain laser alignment tool bracket	440L-AF6109
 Pedestal mounting stand	440L-AMSTD
 Vertical shock mount kit	440L-AF6120
 Horizontal shock mount kit	440L-AF6121
 Middle vertical mount kit	440L-AF6122
 Middle horizontal mount kit	440L-AF6123
 GuardShield Type 2 safety light curtain weld shield pair	440L-AGWS0160 440L-AGWS0320 440L-AGWS0480 440L-AGWS0640 440L-AGWS0800 440L-AGWS0960 440L-AGWS1120 440L-AGWS1280 440L-AGWS1440 440L-AGWS1600 440L-AGWS1760

(1) Four brackets are supplied with each GuardShield Type 2 safety light curtain pair.

Technical Specifications

Attribute	Value	
Light beams	8...88	
Protective field	160...1760 mm (6.3...69.29 in.) in 160 mm (6.3 in.) increments	
Resolution	30 mm (1.18 in.)	
Range	0.3...16.0 m (0.98...52.5 ft)	
Response time	OSSD - on to off (reaction times); 20 ms	
Power supply	24V DC +/-20% Power supply must meet the requirements of IEC 60204-1 and IEC 61496-1	
Power consumption	400 mA max (unloaded)	
IR transmitter	Infrared status indicator (wave length 870 nm)	
Aperture angle	Within $\pm 5.0^\circ$ for transmitter and receiver	
Operating condition	IR transmitter on	
Functions	<ul style="list-style-type: none"> Guard only: On/off operation with clear/obstructed detection area Start interlock: Interlock at startup - reset by actuation of momentary N.O. push-button switch (or interruption/restoration of the safety light curtain) Restart interlock: Interlock at interruption of sensing field - reset by actuation of momentary N.O. push-button switch Relay monitoring: Monitoring a switch contact of the installation Test function: Triggering of system test via external switch 	
Inputs transmitter	Machine test signal	Minimum duration 100 ms Voltage level for Logic 0: 0...5V DC Voltage level for Logic Hi 1: > 16V DC
Inputs receiver	Start/restart interlock	Logic Lo Minimum duration 100 ms Maximum duration 900 ms Voltage level for Logic Lo 0: 0...5V DC Voltage level for Logic Hi 1: > 16V DC
	MPCE	300 ms after activation of OSSD: Voltage level for Logic 0: 0...5V DC Voltage level for Logic Hi 1: > 16V DC
Outputs	<ul style="list-style-type: none"> Safety Outputs (OSSDs): Two solid-state outputs, max switching capacity 500 mA, short circuit protection, max residual voltage 2V (excl. voltage drop through cables) Auxiliary output: Solid-state output, max power consumption 500 mA, max residual voltage 2V - non-safety output 	
Status indicators receiver	<ul style="list-style-type: none"> On-state: Constant on when system is in on-state (green status indicator) Off-state: Constant on when system is in off-state (red status indicator) Lights up at interruption of protective field or if fault occurs Alignment: Lights up, if input signal is too weak (amber status indicator) Interlock: Lights up when light curtain is in start or restart interlock mode (yellow status indicator) 	
Status indicators sender	<ul style="list-style-type: none"> Power on: Lights up, when voltage is on (amber status indicator) Emitting: Constant on when transmitter is active (yellow status indicator) 	
QD connectors	<ul style="list-style-type: none"> Transmitter: M12 plug 4 pin Receiver: M12 plug 8 pin 	
Cable length	Maximum 30 m (100 ft)	
Ambient temperature	<ul style="list-style-type: none"> During operation: -10...+55 °C (14...131 °F) For storage: -25...+75 °C (-13...+167 °F) 	
Humidity of the air	Up to 95% (without condensation) 20...55 °C (68...131 °F)	
Enclosure rating	IP65	
Vibration resistance	Per IEC 61496-1, IEC 60068-2-6 frequency 10...55 Hz amplitude 0.35 mm (0.01 in.)	
Shock	Per IEC 61496-1, IEC 60068-2-29 acceleration 10 g, duration 16 ms	
Material	<ul style="list-style-type: none"> Housing: Aluminum Cover: PMMA (acrylic) 	
Dimensions (cross section)	Approx. 40 x 50 mm (1.57 x 1.96 in.)	
Accessories included	Test rod, mounting brackets, installation instructions	
Approvals	IEC 61496 Parts 1 and 2, UL 61496 Parts 1 and 2, UL 1998	
Safety classification	<ul style="list-style-type: none"> Type 2 per EN IEC 61496-1/-2 SIL 1, IEC 61508, SIL CL 1 per EN 62061 Category 2 - PLC per EN ISO 13849 	
PFH (mean probability of a dangerous failure/hr)	Standalone sys.: 9.51×10^{-9}	
T _M (mission time)	20 years (EN ISO 13849)	
Transmitter wave length	870 nm	

Certification

See the Product Certification link at rok.auto/certifications for Declaration of Conformity, certificates, and other certification details.

- cULus Listed Industrial Control Equipment, which is certified for US and Canada.
- CE Marked for all applicable directives (see [Declaration of Conformity](#)).
- C-Tick Marked.
- TÜV Nord Certified for Functional Safety up to SIL 1 for use in safety applications up to and including SILcl1 in accordance with EN 61508 and EN 62061, Performance Level c and Category 2 in accordance with ISO 13849-1, ESPE Type 2 safety light curtain.

Declaration of Conformity

CE Conformity

Rockwell Automation B.V. (address: Rivium Promenade 160, 2909 LM Capelleaan den IJssel, The Netherlands) declares that this product is in conformity with the provisions of the following EC directives (including all applicable amendments):

- 2014/30/EU EMC Directive (EMC)
- 2006/42/EC Machinery Directive (MD)

And that the respective standards and/or technical specifications have been applied. It is approved for installation within the European Union and M regions.

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

UKCA Conformity

Rockwell Automation declares that the products that are shown in this document are in compliance with UK Supply of Machinery (Safety) Regulations (2008 No. 1597), UK Electromagnetic Compatibility Regulations (2016 No. 1091), EMC Regulations (2016 No. 1091), and have Third-party Approval.

For a comprehensive UKCA certificate visit: rok.auto/certifications.

Notes:

Notes:

Rockwell Automation Support

Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, and product notification updates.	rok.auto/support
Knowledgebase	Access Knowledgebase articles.	rok.auto/knowledgebase
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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Waste Electrical and Electronic Equipment (WEEE)



At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental compliance information on its website at rok.auto/pec.

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