

GuardShield Type 2 Safety Light Curtain

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

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IMPORTANT Save these instructions for use at a future time.

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

This technical description must be followed when installing and commissioning the GuardShield™ Type 2. Only qualified personnel can implement inspection and commissioning.

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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 providing point of operation, and perimeter and access detection.

It 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 are designed to direct the technical personnel of the machine manufacturer and or the installer of the safety system regarding the proper mounting, configuration, electrical installation, commissioning, operation, and maintenance of 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. These instructions are an essential part of the safety precautions and therefore have to 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 required for proper use of the GuardShield Type 2 Safety Light Curtain

Please make sure you 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 a variety of machinery.

The GuardShield Type 2 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 GuardShield Type 2 safety light curtains 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 GuardShield Type 2 presence sensing device is installed.

GuardShield Type 2 safety light curtains must be properly installed by qualified personnel.

GuardShield Type 2 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.

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

GuardShield Type 2 safety light curtains should 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 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.



Failure to read and follow these instructions can lead to misapplication or misuse of the GuardShield Type 2 safety light curtains, resulting in personal injury and damage to equipment.

The GuardShield™ Type 2 may 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 SIL1 (EN 62061).



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

The safety distance between the GuardShield™ Type 2 and a dangerous machine movement has to be maintained always.

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

The GuardShield™ Type 2 has to 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 are connected to +24V DC, they are in ON-state and cannot stop hazardous spots at the machine/application.

Never expose the GuardShield™ Type 2 to flammable or explosive gases.

Regular safety inspections are imperative (see maintenance).

Do not repair or modify the GuardShield™ Type 2. 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 endcaps voids the warranty terms of this product.

Specialist Personnel

A qualified person is required to 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 and
- Instructed by the responsible machine operator in the operation of the machine and the currently valid safety guidelines and
- 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. Therefore it is allowed for use with controls:

- In safety Cat 2 up to PLC in accordance with EN ISO 13849-1
- SIL CL1 in accordance with EN 62061

The device is suitable for:

- Point of operation protection (finger and 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 4 for an illustration of the protection modes.

Mechanical protection devices could 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 the “Range of Uses of the Device.” 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: Safety Notes

Observe the following items to help ensure 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. The results are recorded and documented to help ensure that the tests can be reconstructed and retraced at any time.
- The installation instructions must be made 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. It describes the structure and functions of the unit, in particular the different operating modes.

→ **Read this section before mounting, installing, and commissioning the unit.**

GuardShield™ Type 2 Light Curtain 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.

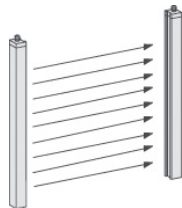
The GuardShield™ Type 2 receives and processes the sequential pulses of the infrared light that is transmitted by the transmitter. The synchronization of the timing of the emission and reception of infrared light pulses is optically. The first beam that's next to the GuardShield™ Type 2 status indicators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

The GuardShield™ Type 2 receiver has two safety outputs, Output Signal Switching Devices (OSSDs) and one nonsafety auxiliary output. When the GuardShield™ Type 2 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 the sourced current OFF (0V DC).

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

The GuardShield™ Type 2 Light Curtain

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



Components of the GuardShield™ Type 2

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 machines 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 It's possible, that additional measures are necessary to help ensure that the ESPE does not fail to danger when other forms of light radiation are present in a particular application. That is, use of cableless control devices on cranes, radiation from weld spatter or effects from strobe lights.

IMPORTANT The protective system must be tested for proper operation after every change to the configuration.

Guard Only

When in the guard only mode of operation, the light curtain operates as an on/off device. The OSSD outputs switch off/on according to 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 to enter the ON state.

The manual reset can be accomplished by one of two methods.

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

GuardShield™ Type 2 is factory that is ordered with this functionality. Indication of this mode of operation is through illumination of a yellow status indicator on the GuardShield™ Type 2 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 system is required. The system reset is accomplished through a momentary N.O. push button or key switch. The restart interlock mode is indicated when the illumination of a yellow indicator on the GuardShield™ Type 2 receiver. GuardShield™ Type 2 is factory ordered with this functionality.

Relay Monitoring (MPCE/EDM)

The relay monitoring function is an input signal to the GuardShield™ Type 2 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 to enter a lockout condition (OSSDs OFF).

System Testing

The GuardShield™ Type 2 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)

A test cycle of the system is triggered by an external test signal to the GuardShield™ Type 2 transmitter. 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 does not include all device and control system elements results in an inaccurate safety distance calculation.

Determine the Safety Distance

The light curtain must be mounted with proper safety distance

- From the point of danger
- From reflective surfaces

US Safety Distance Formula



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

This distance, referred to as the safety distance, must be properly calculated before determining the safety light-curtain protective-height and mounting 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 that are used 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 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:

$$D_s = 63 \times T$$

D_s Safety Distance

63 Is the OSHA recommended hand speed constant in inches per second

T Is the 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.

Note: 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. **NOTE:** 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 usually 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 does not include other body movements, which can affect the actual approach speed. Consideration of the above factors should be included when determining the speed constant for a given application. The employer should consider all factors, including the physical ability of the operator, when determining the value of K to be used.”

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. This value is stated by the device manufacturer or it is measured by the user.

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.

Note: $T_s + T_c + T_r + T_{spm}$ is measured by a stop time measuring device.

Example (for US):

In a perpendicular safety-light curtain application with object sensitivity (effective resolution) less than 64 mm (2.5 in.), the **D_{pf}** can be approximated 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:

Object sensitivity = 30 mm (1.18 in.)

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

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

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

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

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

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

$$D_s = 63 \times (0.241 + 0.01 + 0.02 + 0.049) + 3.08 \text{ in.}$$

$$= 63 \times 0.32 + 3.08 \text{ in.}$$

$$= 20.16 + 3.08 \text{ in.}$$

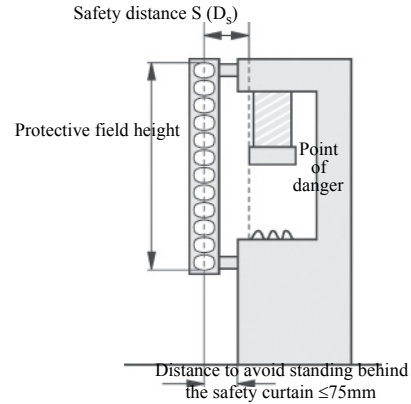
$$= 23.24 \text{ in. (600 mm)}$$

European Safety Distance Formula

A safety distance must be maintained between the light curtain and the point of danger. This safety distance helps ensure that the point of danger can only be reached after the dangerous state of the machine has been completely removed.

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

- Stopping/run-down time of the machine. (The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.)
- Response time of the protective device, for example, GuardShield™ Type 2 (for “Response Time” see page 4).
- Response time of the safety circuit:
- Reach or approach speed.
- Resolution of the light curtain.



Safety distance from the point of danger

How to Calculate the Safety Distance *S*

According to EN ISO 13855 and EN ISO 13857:

→ **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 [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 (for Europe):

Stopping/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.)

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

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

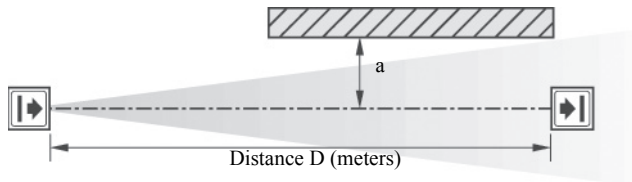
$S > 500 \text{ mm (19.7 in.)}$, therefore:

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

Minimum Distance from Reflecting Surfaces

The infrared light from the sender is reflected 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 sensing field.

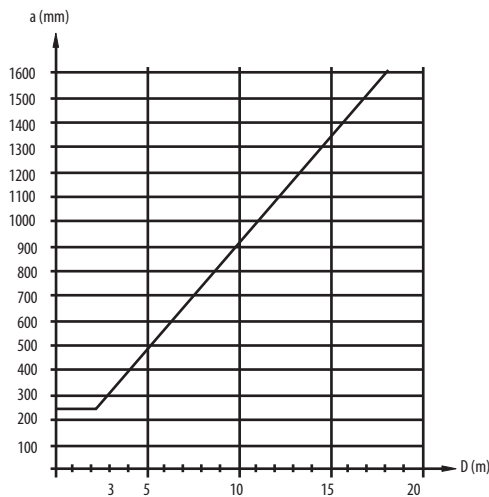
All reflecting surfaces and objects (for example, material bins) must therefore be at the minimum distance *a* from the protective field of the system. The minimum distance *a* depends on the distance *D* between sender and receiver.



Minimum distance from reflecting surfaces

How to Determine the Minimum Distance from the Reflecting Surfaces:

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



Graph, minimum distance from reflective surfaces

The effective aperture angle for the GuardShield™ Type 2 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 the following table:

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)

Note: Formula: $a = \tan 5^\circ \times D$ [mm] = $0.0875 \times D$ [mm]

a = minimum distance to reflecting 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 has an amber status indicator in the receiver, which is used as an alignment aid. The status indicator begins to flash when the infrared light from the transmitter is “seen” by the receiver. This status indicator turns off when optimal alignment is attained.

Alignment Procedure: Standard GuardShield™ Type 2

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 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 goes off.

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

Cycle power to assure that the system powers up and goes to the ON state (alignment indicator is OFF).

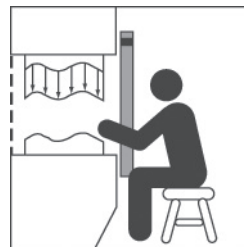
An external laser (440L-ALAT) and mounting bracket (440L-AF6109) is offered as an accessory for aligning the GuardShield™ Type 2.

The GuardShield™ Type 2 safety light curtain is suitable for most operating environments (IP65 environmental rating). Proper safety distance and adequate protective height must be observed.

IMPORTANT The installation of the GuardShield™ Type 2 safety light curtain must be such that access to the hazard is only possible through the sensing field of the GuardShield™ Type 2. Auxiliary safe guarding is required with the GuardShield™ Type 2 to meet this requirement.

Determine if the machinery, on which the GuardShield™ Type 2 is mounted, meets the requirements as specified in the beginning of this manual. That is, machinery must be able to be stopped anywhere in its stroke or cycle, consistently and repeatedly.

Correct Installation

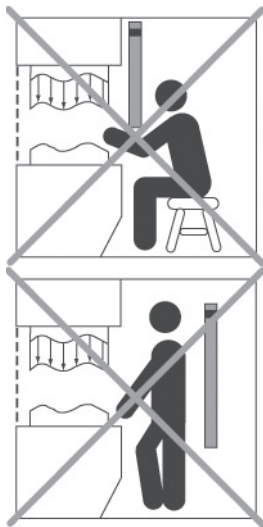


Operators cannot reach hazardous machine parts without passing through the protective field.



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

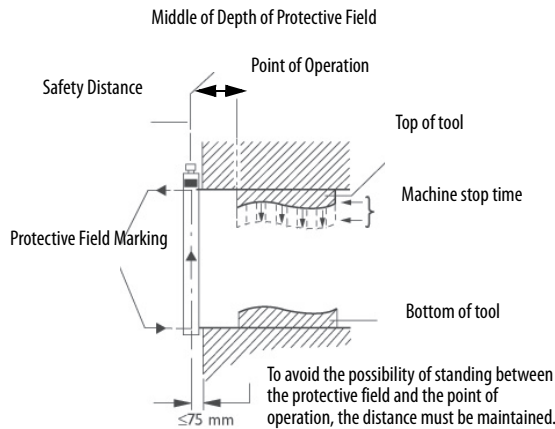
Incorrect Installation



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

Operators can step between protective field and hazardous machine parts.

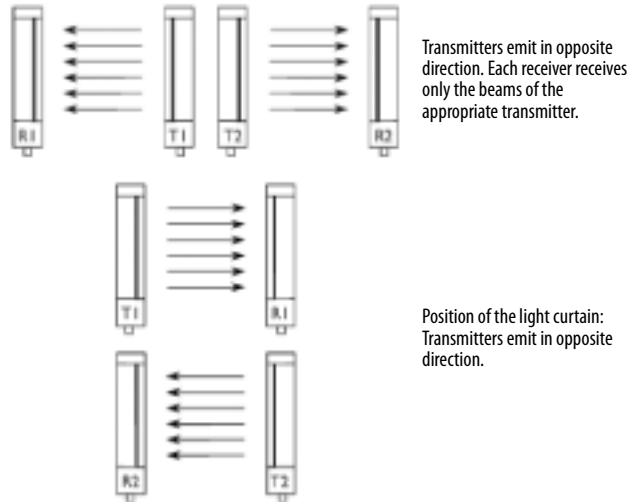
The GuardShield™ Type 2 must be mounted at the proper distance from the point of operation hazard. This distance is referred to as the Safety Distance.



Determining machine stopping time and safety distance

Multiple GuardShield™ Type 2

When two or more GuardShield™ Type 2 are mounted close to one another, it is possible for the receiver of one pair to receive infrared light from the transmitter of another pair. The transmitter and receiver pairs must be mounted in accordance with the following figure or a barrier is used to guard against optical interference.



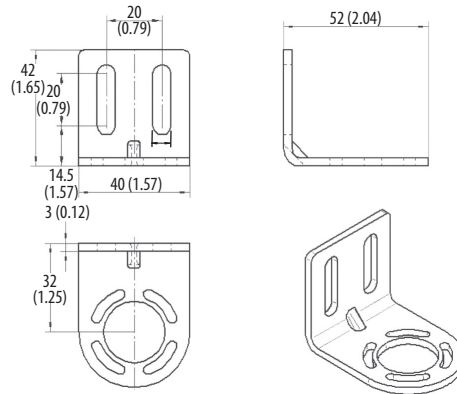
Transmitters emit in opposite direction. Each receiver receives only the beams of the appropriate transmitter.

Position of the light curtain: Transmitters emit in opposite direction.

Multiple GuardShield™ Type 2 alignment options

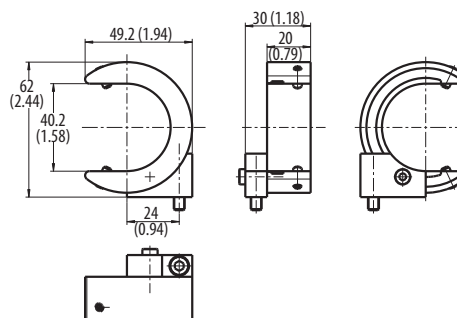
Mounting Brackets

The GuardShield™ Type 2 is mounted using right angle brackets that are attached to the endcaps of both transmitter and receiver. It is necessary to use additional brackets to mount the GuardShield™ Type 2 at a proper safety distance from the machinery hazard.



Mounting brackets

Optional Middle Mounting Bracket (440L-AF6108)



Middle mounting brackets

Note: Middle mounting brackets are used in vibration applications for protective heights of 1120 mm (44.09 in.) and larger.

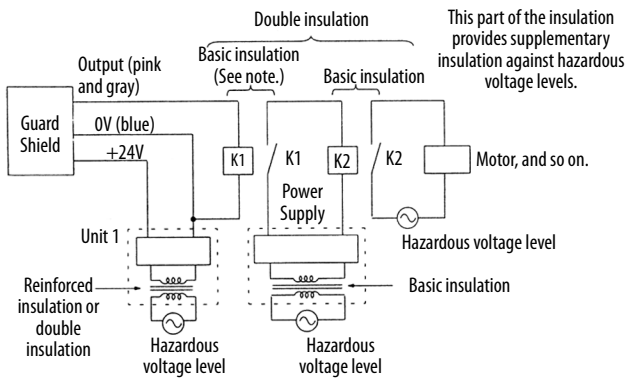
Electrical Installation

Connections

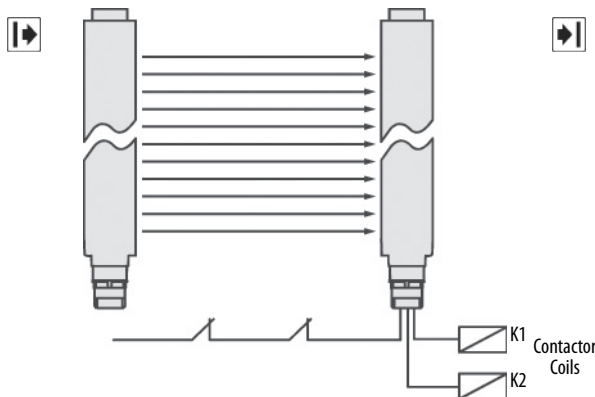
Power Supply

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

- A short-term power failure of 20 ms must be bridged by the power supply.
- 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%.



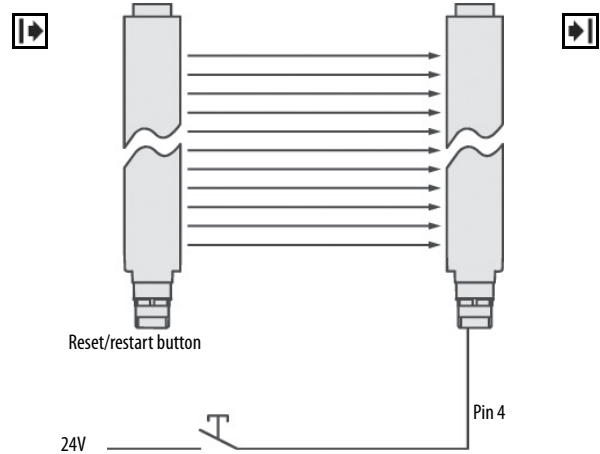
EDM Connection



Connecting the contact elements to the EDM

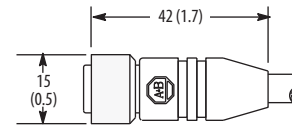
Start/Restart interlock

Note: Start/restart interlock requires a N.O. momentary push button or key switch.



Connecting the reset button/restart button

Connections [mm (in.)]



Cables/Connectors

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

Transmitter Connection Face View of Female DC Micro	Color	Pin No.	Signal
			Transmitter
	Brown	1	+24V DC
	White	2	No Connection
	Blue	3	0V DC
	Black	4	Machine Test Signal

Standard GuardShield™ Type 2 Receiver Connector

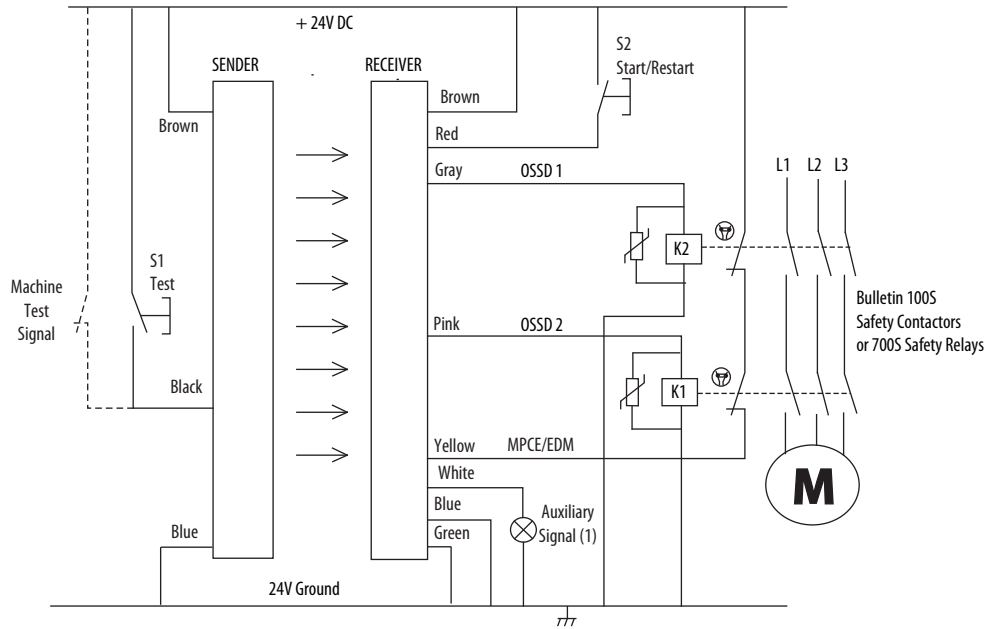
Receiver Connection Face View of Female DC Micro	Color	Pin No.	Signal
			Receiver
	White	1	Auxiliary Output
	Brown	2	+24V DC
	Green	3	Ground
	Yellow	4	EDM
	Gray	5	OSSD 1
	Pink	6	OSSD 2
	Blue	7	0V DC
	Red	8	Start/Restart

Troubleshooting Guide

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

Condition No.	Error Description	Action
6	Internal fault, receiver	<ul style="list-style-type: none"> Replace receiver
7	Internal fault, transmitter	<ul style="list-style-type: none"> Check connections transmitter/receiver Exchange transmitter
8	External fault	<ul style="list-style-type: none"> 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 is activated and after clearing the OSSD the input Relay monitoring does not recognize a change of state.	<ul style="list-style-type: none"> Check connection for Relay monitoring Check connected relay for closed contact (if OSSD ON—input Relay monitoring must have GND level, if OSSD OFF—input Relay monitoring must have +24V) Switch-on only after POWER OFF/ON

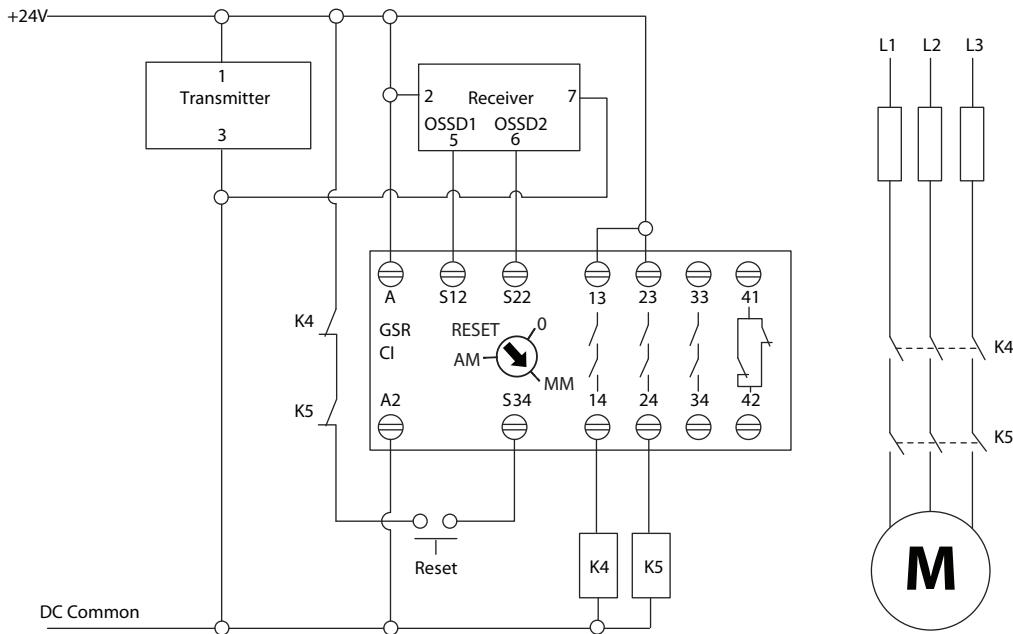
Typical Wiring Diagram (GuardShield™ Type 2 with start/restart interlock and EDM and the OSSDs connected directly to contactors)



Note: If MPCE/EDM is not used, the GuardShield™ Type 2 OSSDs is connected to a safety relay module, which is configured for EDM.

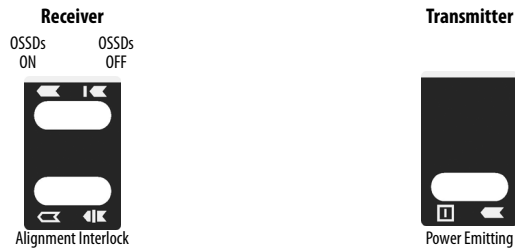
(1) Nonsafety auxiliary output can be connected to a lamp or a PLC.

Typical Wiring Diagram—To GSR CI Safety Relay Module



ATTENTION: The GuardShield™ Type 2 is a Type 2 safety device. The use of a PLE, SIL3 safety relay in a safety circuit does not increase the safety level of the safety circuit above a PLC, SIL1.

System Status Indicators



Condition No.	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	ON	OFF	ON	ON
4	ON	OFF	OFF	ON	ON	ON
5	ON	OFF	OFF	OFF	ON	OFF
6	FLASH	OFF	OFF	OFF	ON	ON
7	ON	OFF	OFF	OFF	FLASH	ON
8	FLASH	OFF	ON	OFF	ON	ON
9	FLASH	OFF	OFF	ON	ON	ON

6 through 9 = Fault conditions

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

Condition No.	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)

Note: For fault conditions 6 through 9, see Troubleshooting guide on page [10](#).



Assure that all power to the machine, and safety system is disconnected during electrical installation.

IMPORTANT Before powering up the GuardShield™ Type 2 system, the responsible person must review the following Checklist.

Checklist

Before the initiation of the GuardShield™ Type 2, the responsible person must work through the following checklist.

Cable check before initiation:

1. The power supply is a 24V DC device, which must comply to 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.
3. The transmitter connection cable is properly connected to the transmitter, the receiver connection cable is properly connected to the receiver.
4. The double insulation between the light curtain output and an external potential is confirmed.
5. The OSSD outputs are not connected to +24V DC.
6. The connected switching elements (load) are not connected to 24V DC.
7. No connection to a conventional power supply.
8. If two or more GuardShield™ Type 2 are to be used, make sure that each system is properly installed, to avoid optical interference.

Switch on the GuardShield™ Type 2 and check its function by observing the following:

9. Two seconds after switching on, the system starts to work properly, if the protective field is free of obstructions.

Safety Instructions—Maintenance



ATTENTION: Never operate the GuardShield™ Type 2 before conducting the following inspection. Improper inspection can lead to serious or even deadly injury.

Note:

1. For safety reasons, all inspection results are recorded.
2. The inspection is performed only by persons who clearly understand the functioning of the GuardShield™ Type 2 and of the machine.
3. To perform the inspection, make sure that the user has sufficient information.

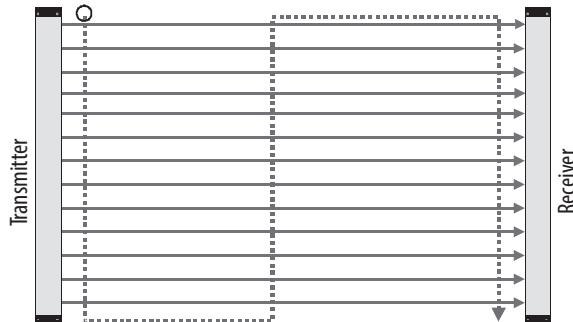
Daily Inspection

1. Approach to hazardous machine parts must only be possible through passage through the protective field of GuardShield™ Type 2.
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.

5. The protective field is interrupted.
6. Hazardous machine movement stops immediately, if the protective field is interrupted by the test rod:
 - directly in front of the transmitter,
 - directly in front of the receiver, and
 - in the middle between transmitter and receiver.
7. No hazardous machine movement while the test rod is anywhere within the protective field.
8. The power supply of the GuardShield™ Type 2 is turned off.
9. If the blanking function is activated, check all sections of the protective field with the appropriate test piece.

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



Proper testing of protective field using test rod

Six-Month Inspection

Check the following items every six months or whenever a machine setting was 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 are properly connected 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 are in flawless condition.
6. Mounting brackets, caps, and cables are tightly secured.

Cleaning

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

Date Code

Allen-Bradley

GuardMaster®

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

SER REV
CAT 440L-T2KA0320YD A A

MAT NO XXXX

CE c UL US LISTED Electro-Sensitive Protective Equip. 19KP



SN 1234567890

PRODUCT OF MEXICO

DATE 1602

PLANT 1150

Ambient Temp. -10..... +55C

Power Consumption 7W MAX.

Supply Voltage 24VDC+/-20%

Safety Parameters TYPE 2/Cat. 2

IEC61489/ EN ISO 13849 PLc/SIL CL1, SIL1

EN62061/ IEC61508 PN-112459

Operating Instructions

GuardShield™ Type 2

Degree of Protection IP65

Resolution 30mm

Range 0.3-16M

Protective Height 320mm

Response Time ≤20ms

Explanation of data code

The production date is printed in the format:

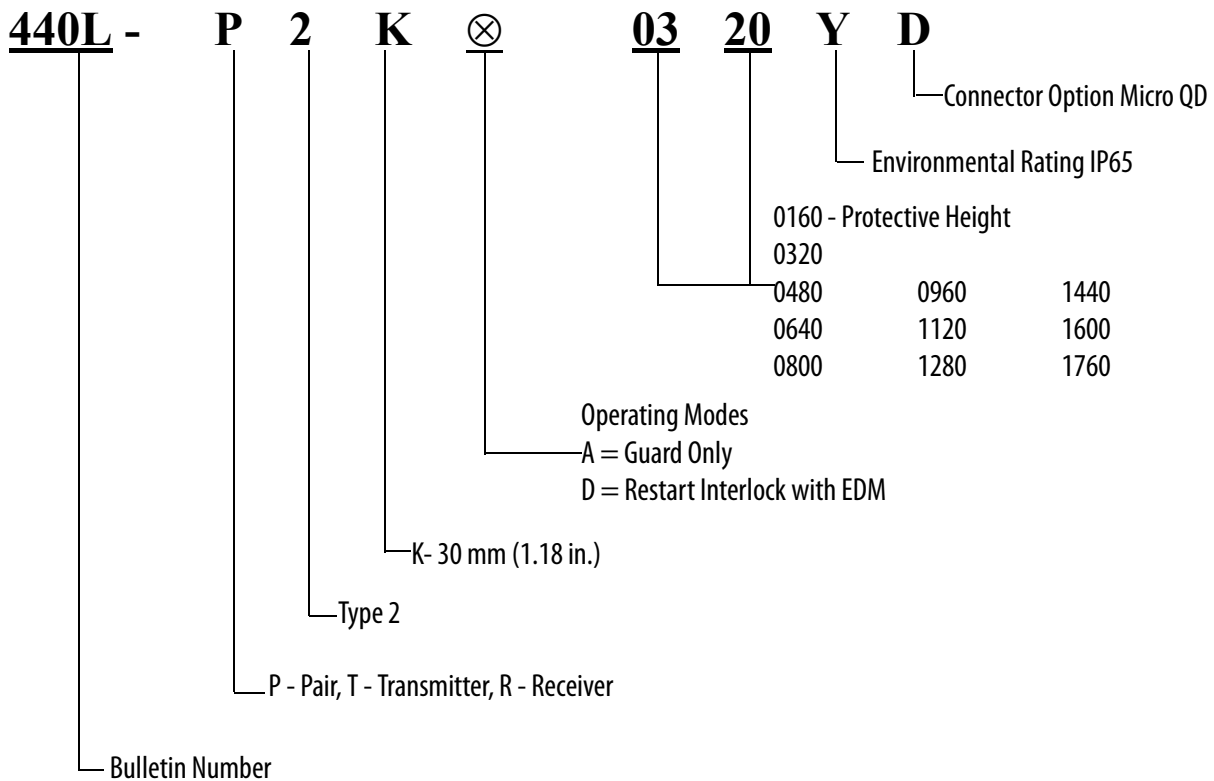
YYWW (YY= year, WW=week)

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

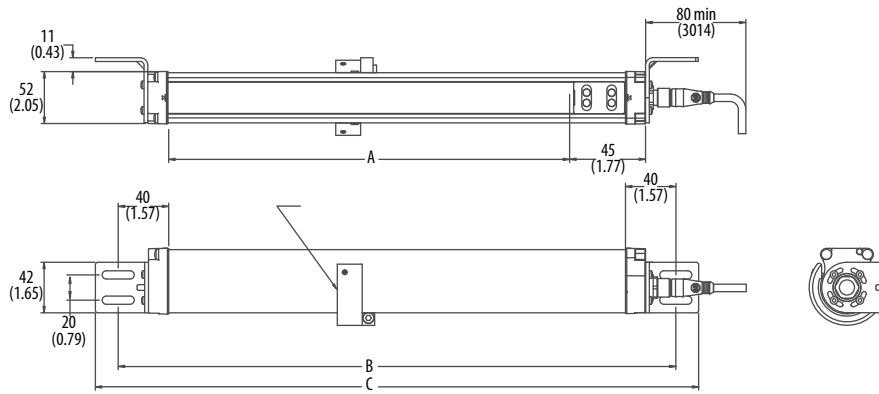
GuardShield™ Type 2 Catalog Numbers

Sensor Pair Catalog Numbers	Transmitter Catalog Numbers	Receiver Catalog Numbers	Resolution—mm (in)	No. of Beams	Protective Heights—mm (in.)	Pair Weight—kg (lbs)
440L-P2K⊗0160YD	440L-T2KA0160YD	440L-R2K⊗01604D	30 (1.18)	8	160 (6.2)	0.9 (1.9)
440L-P2K⊗0320YD	440L-T2KA0320YD	440L-R2K⊗0320YD	30 (1.18)	16	320 (12.59)	1.1 (2.4)
440L-P2K⊗0480YD	440L-T2KA0480YD	440L-R2K⊗0480YD	30 (1.18)	24	480 (18.89)	1.6 (3.5)
440L-P2K⊗0640YD	440L-T2KA0640YD	440L-R2K⊗0640YD	30 (1.18)	32	640 (25.19)	2.0 (4.4)
440L-P2K⊗0800YD	440L-T2KA0800YD	440L-R2K⊗0800YD	30 (1.18)	40	800 (31.49)	2.5 (5.5)
440L-P2K⊗0960YD	440L-T2KA0960YD	440L-R2K⊗0960YD	30 (1.18)	48	960 (37.79)	2.9 (6.4)
440L-P2K⊗1120YD	440L-T2KA1120YD	440L-R2K⊗1120YD	30 (1.18)	56	1120 (44.09)	3.4 (7.5)
440L-P2K⊗1280YD	440L-T2KA1280YD	440L-R2K⊗1280YD	30 (1.18)	64	1280 (50.39)	3.8 (8.4)
440L-P2K⊗1440YD	440L-T2KA1440YD	440L-R2K⊗1440YD	30 (1.18)	72	1440 (56.69)	4.3 (9.5)
440L-P2K⊗1600YD	440L-T2KA1600YD	440L-R2K⊗1600YD	30 (1.18)	80	1600 (62.99)	4.7 (10.4)
440L-P2K⊗1760YD	440L-T2KA1760YD	440L-R2K⊗1760YD	30 (1.18)	88	1760 (69.29)	5.2 (11.5)

Catalog Number Explanation



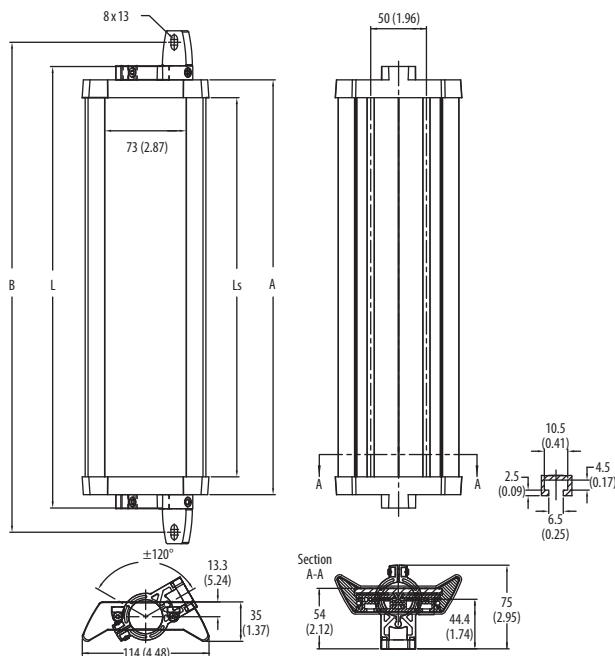
Dimensions [mm (in.)]



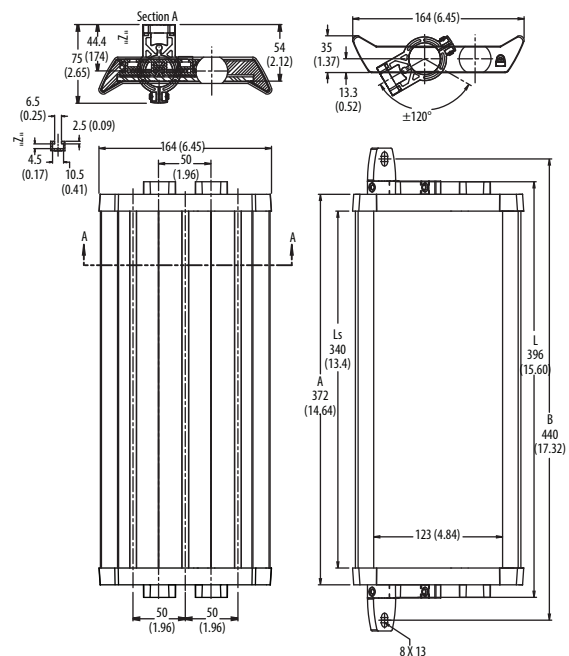
Type ⁽¹⁾	A Protective Height	B Mounting Value	C Total Length
440L-P2K⊗0160YD	160 ±0.5	285	321 ±1.5
440L-P2K⊗0320YD	320 ±0.5	445	481 ±1.5
440L-P2K⊗0480YD	480 ±0.5	605	641 ±1.5
440L-P2K⊗0640YD	640 ±0.5	765	801 ±1.5
440L-P2K⊗0800YD	800 ±0.5	925	961 ±1.5
440L-P2K⊗0960YD	960 ±0.5	1085	1121 ±1.5
440L-P2K⊗1120YD	1120 ±0.5	1245	1281 ±1.8
440L-P2K⊗1280YD	1280 ±0.5	1405	1441 ±1.8
440L-P2K⊗1440YD	1440 ±0.5	1565	1601 ±1.8
440L-P2K⊗1600YD	1600 ±0.5	1725	1636 ±2.0
440L-P2K⊗1760YD	1760 ±0.5	1885	1796 ±2.0

(1) Replace ⊗ with A or D: A for guard only mode; D for restart interlock with EDM.

Mirror 440L-AM075





Mirror 440L-AM125



Corner Mirror for Multi-Sided Guarding

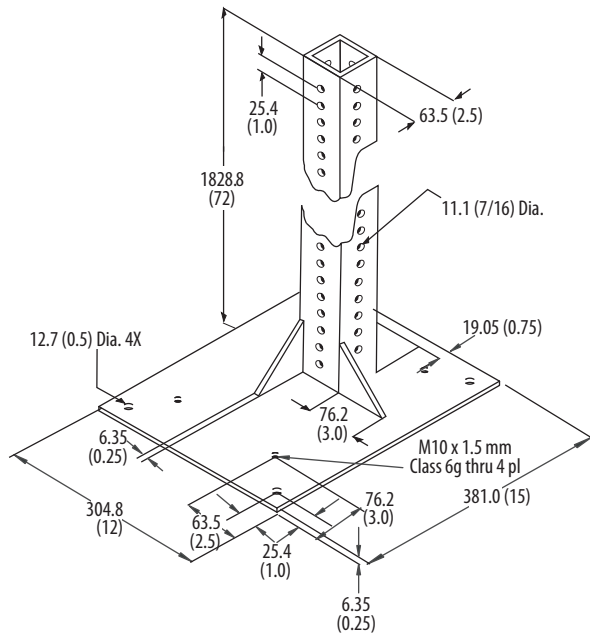
Specially constructed glass mirrors for 2- and 3-sided safeguarding applications.

Note: Each mirror reduces maximum scan range by 10% per mirror. Each corner mirror supplied with two end-cap mounting brackets.

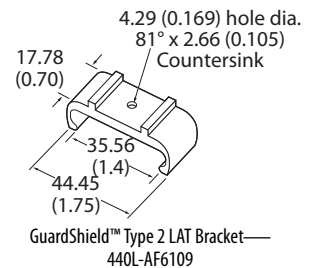
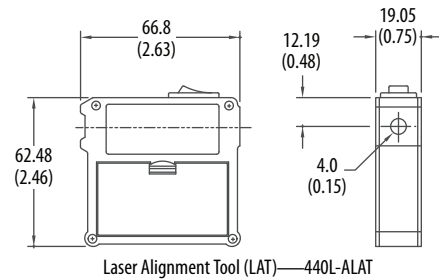
GuardShield™ Type 2 Light Curtain Cat. No.	Narrow Mirror Short-Range 0...4 m	Cat. No.	Wide Mirror Long-Range 4...15 m	Cat. No.
440L-P2K \bar{A} 0160YD		440L-AM0750300		440L-AM1250300
440L-P2K \bar{A} 0320YD		440L-AM0750450		440L-AM1250450
440L-P2K \bar{A} 0480YD		440L-AM0750600		440L-AM1250600
440L-P2K \bar{A} 0640YD		440L-AM0750750		440L-AM1250750
440L-P2K \bar{A} 0800YD		440L-AM0750900		440L-AM1250900
440L-P2K \bar{A} 0960YD		440L-AM0751050		440L-AM1251050
440L-P2K \bar{A} 1120YD		440L-AM0751200		440L-AM1251200
440L-P2K \bar{A} 1280YD		440L-AM0751350		440L-AM1251350
440L-P2K \bar{A} 1440YD		440L-AM0751500		440L-AM1251500
440L-P2K \bar{A} 1600YD		440L-AM0751650		440L-AM1251650
440L-P2K \bar{A} 1760YD		440L-AM0751800		440L-AM1251800

\bar{A} = A or D

Mounting Stand—440L-AMSTD



Laser Alignment Tool

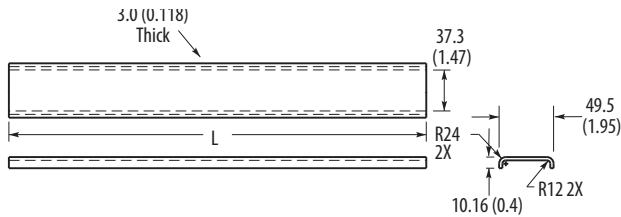


Weld Shields

The GuardShield™ Type 2 weld shields are sold as pairs in the same lengths as the protective heights of the GuardShield™ Type 2 safety light curtain.

These polycarbonate weld shields are designed as disposable devices whose purpose is to help protect the front window of the GuardShield™ Type 2 from damage.

Dimensions [mm (in.)]



GS Weld Shield Cat. No.	Dimension "L" [mm (in.)]
440L-AGWS0160	175.3 (6.9)
440L-AGWS0320	335.3 (13.20)
440L-AGWS0480	495.3 (19.50)
440L-AGWS0640	655.3 (25.80)
440L-AGWS0800	815.3 (32.10)
440L-AGWS0960	975.4 (38.40)
440L-AGWS1120	1135.4 (44.70)
440L-AGWS1280	1295.4 (51.00)
440L-AGWS1440	1455.4 (57.30)
440L-AGWS1600	1615.4 (63.60)
440L-AGWS1760	1778 (70.00)











For Connection to Transmitter

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

For Connection to Receiver

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

Optional Accessories

	Description	Cat. No.
	Steel L-shaped end cap mounting bracket (4 per package) Note: 4 brackets supplied with each GuardShield™ Type 2 pair.	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 laser alignment tool bracket	440L-AF6109
	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 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		

Technical Specifications

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	<p>Guard Only: On/Off operation with clear/obstructed detection area</p> <p>Start Interlock: Interlock at start-up—Reset by actuation of momentary N.O. push button switch (or interruption/restoration of light curtain)</p> <p>Restart Interlock: Interlock at interruption of sensing field—Reset by actuation of momentary N.O. push button switch</p> <p>Relay Monitoring: Monitoring a switch contact of the installation</p> <p>Test Function: Triggering of system test via external switch</p>
Inputs Transmitter Machine Test Signal	<p>Minimum duration 100 ms</p> <p>Voltage level for Logic 0: 0...5V DC Voltage level for Logic Hi 1: > 16V DC</p>
Inputs Receiver Start/Restart Interlock	<p>Logic Lo</p> <p>Minimum duration 100 ms; maximum duration 900 ms</p> <p>Voltage level for Logic Lo 0: 0...5V DC Voltage level for Logic Hi 1: > 16V DC</p>
MPCE	<p>300 ms after activation of OSSD</p> <p>Voltage level for Logic 0: 0...5V DC Voltage level for Logic Hi 1: > 16V DC</p>
Outputs: 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—nonsafety output
Status Indicators Receiver ON-state OFF-state	<p>Constant ON when system is in ON-state (green status indicator)</p> <p>Constant ON when system is in OFF-state (red status indicator)</p> <ul style="list-style-type: none"> Lights up at interruption of protective field or if fault occurs
Alignment Interlock	<p>Lights up, if input signal is too weak (amber status indicator)</p> <p>Lights up when light curtain is in start or restart interlock mode (yellow status indicator)</p>
Status Indicators Sender Power ON Emitting	<p>Lights up, when voltage is on (amber status indicator)</p> <p>Constant ON when transmitter is active (yellow status indicator)</p>
QD Connectors	Transmitter: M12 plug 4 pin; receiver: M12 plug 8 pin
Cable Length	Maximum 30 m (100 ft)
Ambient Temperature	During operation: $-10...55^\circ\text{C}$ ($14...131^\circ\text{F}$); For storage: $-25...75^\circ\text{C}$ ($-13...167^\circ\text{F}$)
Humidity of the Air	Up to 95% (without condensation) between 20°C and 55°C (68°F and 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 (0.32 oz), Duration 16 ms
Material	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	Type 2 per EN IEC 61496-1/-2; SIL 1, IEC 61508, SILCL1 per EN 62061; Category 2 - PLc per EN ISO 13849
PFHd (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 <http://www.rockwellautomation.com/global/certification/> for Declaration of Conformity, Certificates, and other certification details.

- eULus Listed Industrial Control Equipment, which is certified for US and Canada.
- CE Marked for all applicable directives (see “Compliance to European Union Directives”).
- 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.

Compliance to European Union Directives

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):

- 2004/108/EC 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 EEA regions. All relevant directives and standards are listed in the declaration of conformity, which is available on www.ab.com (Document: SEN-0351-E-EN).

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