GuardShield PAC Type 4 (Perimeter Access Control) Safety Light Curtain

Catalog Numbers 440L-P4Ax, 440L-T4Ax, 440L-R4Ax

Allen-Bradley
by ROCKWELL AUTOMATION

Guardmaster®

User Manual

Original Instructions

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.

IMPORTANT Identifies information that is critical for successful application and understanding of the product.

These labels may also be on or inside the equipment to provide specific precautions.

SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

The following icon may appear in the text of this document.

Identifies information that is useful and can help to make a process easier to do or easier to understand.

Table of Contents

About This Publication

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

This manual covers the operation and installation of the Standard GuardShield PAC safety light curtain, GuardShield PAC safety light curtain with Integrated Laser Alignment system, GuardShield PAC safety light curtain with Integrated Laser Alignment, and ArmorBlock® Guard I/O™ connectivity.

Who Would Use This Manual

Read and understand these requirements before you select and install the GuardShield PAC safety light curtain. GuardShield PAC safety light curtains are perimeter access safeguarding devices. These safety light curtains are intended for use to provide a perimeter access safeguard of personnel around various machinery.

Only qualified personnel must properly install the GuardShield PAC safety light curtains.

The employer is responsible for the proper installation, operation, and maintenance of the product and the machinery on which the GuardShield PAC safety light curtain presence sensing device is installed.

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.

Topic	Page
Corrected Approximate Dimensions	46
Updated Declaration of Conformity	48
Updated Corner Mirrors	49

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
System Security Design Guidelines Reference Manual, SECURE-RM001	Provides guidance on how to conduct security assessments, implement Rockwell Automation products in a secure system, harden the control system, manage user access, and dispose of equipment.
UL Standards Listing for Industrial Control Products, publication CMPNTS-SR002	Assists original equipment manufacturers (OEMs) with construction of panels, to help ensure that they conform to the requirements of Underwriters Laboratories.
American Standards, Configurations, and Ratings: Introduction to Motor Circuit Design, publication IC-AT001	Provides an overview of American motor circuit design based on methods that are outlined in the NEC.
Industrial Components Preventive Maintenance, Enclosures, and Contact Ratings Specifications, publication IC-TD002	Provides a quick reference tool for Allen-Bradley industrial automation controls and assemblies.
Safety Guidelines for the Application, Installation, and Maintenance of Solid-state Control, publication SGI-1.1	Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies incorporating solid-state components.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, rok.auto/certifications.	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at rok.auto/literature.

Introduction

General Description

The GuardShield™ PAC family of safety light curtains consists of general-purpose presence sensing devices, which are designed to protect personnel working on or near machinery.

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

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

GuardShield PAC safety light curtains must never be used for guarding full revolution clutched machinery.

The effectiveness of the GuardShield PAC safety light curtains depends upon the integrity of the machine control circuit. The machinery on which the GuardShield PAC 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 confirm proper operation. The protected machinery must have a consistent, reliable, and repeatable stopping time.

IMPORTANT	Recognized technical regulations and quality assurance system ISO 9000 are carefully applied during the development and production of Allen-Bradley®/Guardmaster® products.

IMPORTANT	This technical description must be followed when installing and commissioning the GuardShield PAC safety light curtain. A qualified person must conduct the inspection and commissioning.

GuardShield PAC Safety Light Curtain

The GuardShield PAC safety light curtain is a multiple-beam, presence sensing device that is designed for perimeter or access detection around hazardous machinery or equipment. The GuardShield PAC safety light curtain is a Type 4 AOPD per IEC 61496. This device is a self-contained, optically synchronized, two-box (transmitter and receiver) safety light curtain with DIP switch selectable operating modes.

The GuardShield PAC safety light curtain consists of a non-matched pair of optic units: A transmitter and a receiver. The transmitter and receiver operate on +24V DC. The maximum distance between the 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 receiver receives and processes sequential pulses of infrared light that the transmitter emits. The first beam, which is next to the status indicators, optically synchronizes the timing of the emission and reception of infrared light pulses. This beam is referred to as the synchronization beam. Because the GuardShield PAC safety light curtain transmitter and receiver are optically synchronized, no electrical connection is required between the transmitter and receiver.

The GuardShield PAC safety light curtain receiver has two safety outputs, Output Signal Switching Devices (OSSDs) and one non-safety auxiliary output. When the GuardShield PAC 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 short-circuit protected. Interruption of the sensing field causes the receiver to switch off the sourced current (0V DC).

Restoring the GuardShield PAC safety light curtain sensing field, (in Guard only configuration) causes all outputs (OSSDs) to switch to the active high state (resume current sourcing +24V DC with a switching capacity of 500 mA).

The GuardShield PAC safety light curtain is offered in a number of configurations that are based on a standard Type 4 safety light curtain platform.

The GuardShield PAC safety light curtain is also offered with an integrated laser alignment system with or without connectivity to ArmorBlock® Guard I/O™. The ArmorBlock Guard I/O option allows network connectivity providing OSSDs over a DeviceNet® or DeviceNet safety network. The ArmorBlock Guard I/O option is only available in GuardShield PAC safety light curtains with integrated laser alignment systems.

Selectable functions of the GuardShield PAC safety light curtain and GuardShield PAC safety light curtain with integrated laser alignment are:

- Beam coding
- EDM (External Device Monitoring)
- Start interlock
- Restart interlock

Selectable functions of GuardShield PAC safety light curtain with ArmorBlock Guard I/O connectivity:

- Beam coding

Device Range of Uses

The GuardShield PAC safety light curtain is classified as electro-sensitive protective equipment (ESPE). The maximum protective field width is 16 m (52.5 ft) for the GuardShield PAC safety light curtain.

The device is a Type 4 ESPE as defined by IEC 61496-1 and CLC/TS 61496-2 and is therefore allowed for use with controls in safety category Type 4 in compliance with EN ISO 13849, SIL CL 3 in accordance with EN 62061 or up to PLe in accordance with EN ISO 13849. The device is suitable for:

- 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 Range of Use Examples on page 14 for an illustration of the protective modes.

The GuardShield PAC safety light curtain is intended as a perimeter or access protection device for whole body detection and cannot be used in horizontal detection applications as it can be possible for personnel to step between the beams and access the hazard without being detected.

Depending on the application, additional mechanical protection devices can be required.

IMPORTANT These installation instructions are designed to address 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 safety light curtain.

These installation instructions do not provide instruction for the operation of machinery to which the GuardShield safety light curtain is, or will be, integrated. Only qualified personnel must install this equipment.

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

Laser Alignment

The laser light source in the integrated laser alignment system of the GuardShield PAC safety light curtain is a Class 1, eye-safe laser diode with a wavelength of 670 nm.

The control circuitry of the Class 1, eye-safe laser, which detects reflected laser light from a temporary blockage of the emitted laser light, switches the laser from a low output power state to a high output power state (and back again). The most common blockage method is to place your finger over the laser overlay window. There is also an automatic shutdown feature that switches the laser diode from the high-power state to the low-power state, if there is no finger or other interruption detected for 5 minutes.

During the High Output mode of operation, the laser pulses at a rate of approximately 2 Hz to facilitate finger detection in high ambient light conditions.

ATTENTION: Use of controls or adjustments or performance of procedures other than what is specified in this publication, can result in hazardous radiation exposure.

Notes:

Safety Concepts

Principles for Safe Use

The following instructions are preventive warnings to deliver the safe and proper operation of the GuardShield™ PAC safety light curtain. These instructions are an essential part of the safety precautions and therefore must be observed at any time. Throughout this publication, we use the labels ATTENTION and IMPORTANT to alert you to the following:

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

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

ATTENTION helps you:

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

IMPORTANT Identifies information that is especially important for successful application and to understand the product.

ATTENTION: The GuardShield PAC safety light curtain must not be used with machines that cannot be stopped electrically in an emergency.
The safety distance between the GuardShield 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 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 to flammable or explosive gases. Regular safety inspections are imperative (see Safety Instructions and Maintenance on page 41).

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

Specialist Personnel

Only qualified personnel must install, commission, and service the GuardShield PAC safety light curtain. A qualified person is defined as a person who has accomplished all following training:

- Has undergone the appropriate technical training.
- Is 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.

Proper Use

Only by qualified personnel must use the GuardShield PAC safety light curtain, as defined in Device Range of Uses on page 8, and only on the machine where the device is installed and initialized by qualified personnel.

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

Protective Measures

IMPORTANT Observe the following items to achieve the proper and safe use of the GuardShield safety light curtain.

- The national/international rules and regulations apply to the installation, use, and periodic technical inspections of the safety light curtain, in particular:
  - Machine Directive 98/37/EEC
  - Equipment Usage Directive 89/655/EEC
  - The work safety regulations/safety rules
  - Other relevant health and safety regulations

Manufacturers and users of the machine that uses the safety light curtain are responsible to obtain and observe all applicable safety regulations and rules.

- You must observe the notices, in particular, the test regulations of these installation instructions (for example, on the use, mounting, installation, or integration into the existing machine controller).
- Specialist or specially qualified and authorized personnel must perform, record, and document the tests so 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 PAC safety light curtain is installed. The machine operator is to be instructed in the use of the device by specialist personnel and must be instructed to read the installation instructions.

Operation

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 you mount, install, and commission the unit.

Special Features

- Start interlock
- Restart interlock
- External Device Monitoring (EDM)
- Machine test signal
- Beam coding

Principle of Operation

The GuardShield™ PAC safety light curtain consists of a non-matched pair of optic units: A transmitter and a receiver with the same number of beams and spacings. The transmitter and receiver operate on +24V DC. The maximum distance between the transmitter and receiver is referred to as the protective field width or range. The protective field height is the distance between the first beam and the last beam in the device.

The transmitter emits sequential pulses of infrared light, which the GuardShield PAC safety light curtain receiver receives and processes. The synchronization beam optically synchronizes the timing of the emission and reception of infrared light pulses. The synchronization beam is the first beam on the unit that is next to the status indicators. Because the GuardShield PAC safety light curtain transmitter and receiver synchronize optically, no electrical connection is required between the transmitter and receiver.

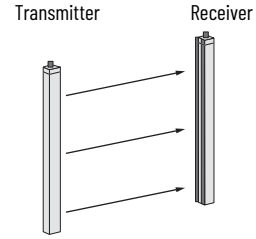
The receiver of the GuardShield PAC safety light curtain has two safety outputs, OSSDs (Output Signal Switching Devices) and one non-safety auxiliary output. When the GuardShield PAC safety light curtain transmitter and receiver are properly powered and aligned, all OSSDs are current sourcing +24V DC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

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

GuardShield PAC Safety Light Curtain Components

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

Figure 1 - Components of the GuardShield PAC Safety Light Curtain



You can identify the individual beams of the GuardShield PAC safety light curtain by the markings on the housings.

The width of the protective field is derived from the length of the light path between sender and receiver and must not exceed the maximum rated width of the protective field of 16 m (52.5 ft).

The GuardShield PAC safety light curtain is also offered with an integrated laser alignment system, which has a constantly powered Class 1, eye-safe laser in the top of the transmitter and in the bottom of the receiver. Each Class 1, eye-safe laser emits a low level of visible light. Blocking this light below the finger symbol causes the light to reflect back to a photo sensor, which changes the condition of the laser light. If this light is at a low level, an interruption causes the laser to emit a highly visible level of light. An interruption of the visible light in the same location causes the laser to switch to a low level of emission. The emission of visible light will also change to a low level after 5 minutes of activation.

Across from each laser is a target that is used to help with the alignment of the GuardShield PAC safety light curtain pair. Position the visible light in the center of the top and bottom targets for optimal alignment of the GuardShield PAC safety light curtain pair.

Range of Use Examples

The GuardShield PAC 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 safety light curtain.
- The Restart button must be located outside the hazardous area such that a person working inside the hazardous area cannot operate the button.
- The statutory and local rules and regulations must be observed when you install and use the device.

Safety Functions

The GuardShield PAC safety light curtain offers various functions, which are integral to the system.

Operating modes, functions, and features of the GuardShield PAC safety light curtain system are activated through DIP switch settings.

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, meaning the OSSD outputs switch off/on according to an obstruction or clearance of the detection field. The GuardShield PAC safety light curtain is shipped from the factory in the Guard Only mode.

Start Interlock

The Start Interlock mode of operation helps prevent 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 PAC safety light curtain to enter the on state.

You can reset the system by one of two methods:

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

You must use DIP switch settings to activate Start Interlock mode and to select the reset method. A yellow status indicator on the GuardShield PAC safety light curtain receiver indicates Start Interlock mode.

IMPORTANT Start Interlock mode is not available in GuardShield PAC safety light curtains with ArmorBlock® Guard I/O™ connectivity.

Restart Interlock

The Restart Interlock mode of operation helps prevent the OSSD outputs from switching to on after the interruption and clearance of the protective field. A manual reset of the GuardShield PAC safety light curtain system is required. A momentary N.O. push button or keyswitch resets the system. You must use DIP switch settings to configure and activate Restart Interlock mode. A yellow status indicator on the GuardShield PAC safety light curtain receiver indicates Restart Interlock mode.

IMPORTANT It is not possible to have both Start Interlock and Restart Interlock modes that are configured simultaneously in the GuardShield PAC safety light curtain. The configuration of either Start Interlock and Restart Interlock mode requires a reset of the system at power-up.

Restart Interlock mode must always be configured for the GuardShield PAC safety light curtains. The reset switch must be located outside of the work cell and positioned so that a clear view of the work cell is possible.

Restart Interlock mode is not available in GuardShield PAC safety light curtains with ArmorBlock Guard I/O connectivity. This functionality must be configured and through the safety PLC.

External Device Monitoring (EDM) or Machine Primary Control Element (MPCE) Monitoring

The External Device Monitoring function (EDM) is an input signal to the GuardShield receiver from the Final Switching Device (FSD), usually relay contactors, which control the hazardous motion of equipment or machinery. The EDM circuit is required to see a change of state of the FSD within 300 ms of the restoration of the sensing field of the GuardShield after its interruption. Detection of an unsafe condition, such as a welded contact, causes the GuardShield receiver to go to a lockout condition (OSSDs off).

The activation and use of this GuardShield functionality usually allows the GuardShield OSSDs to connect directly to the FSD of a machine and attain a Category 4 safety circuit. You must connect the EDM circuit to two separate FSDs that are wired in series to attain the Category 4 rating. You must set DIP switch number 3 to the off position, then perform the teach function to activate this functionality. You must connect the yellow wire of the GuardShield receiver EDM to a N.C. output from the FSD.

IMPORTANT EDM is not available in GuardShield PAC safety light curtains with ArmorBlock Guard I/O connectivity.

System Testing

The GuardShield PAC 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, and the Start/Restart Interlock modes of operation are deactivated.

External Test (Machine Test Signal)

An external test signal to the GuardShield PAC safety light curtain transmitter can trigger the test cycle of the system. Supply or remove a signal (+24V DC) via a N.C. or N.O. switch at the test input to deactivate the transmitter during the test signal, which simulates an interruption of the protective sensing field.

You must set the DIP switches (in the GuardShield PAC safety light curtain transmitter) to configure the test input.

Beam Coding

If several safety light curtains are operating near to one another, the receiver of one GuardShield PAC safety light curtain system can possibly see the infrared light of the transmitter of another GuardShield PAC safety light curtain system.

This arrangement can cause a nuisance stop. To help prevent this optical interference, the GuardShield PAC safety light curtain can have the transmitter generate different beam patterns, which is referred to as beam coding. You must set the DIP switches in both the transmitter and receiver to select and activate beam coding.

Non-coded and coded settings are available in the GuardShield PAC safety light curtain.

IMPORTANT Beam coding improves resistance to optical interference.

Beam coding increases the response time of the system, which can also increase the required safety distance. See Determine the Safety Distance on page 21.

Applications and Application Requirements

Applications

The GuardShield PAC multi-beam safety light curtain can be used as an opto-electronic fence, which detects the presence of personnel as they pass through the sensing field, or safeguards access to a hazardous area or machine process. Used in combination with corner mirrors, GuardShield PAC multi-beam safety light curtains provide multiple-side access detection.

When using corner mirrors to protect multiple sides of a machine or work cell, the GuardShield PAC safety light curtain with integrated laser alignment is the preferred solution. Activation of visible laser light allows positioning and adjustment of the transmitter, receiver, and corner mirrors.

A typical system configuration for access detection to a hazardous area or machine process is to connect the GuardShield PAC multi-beam safety light curtain to an external module along with two or four sensors. The external module allows material to pass through the GuardShield PAC safety light curtain multi-beam sensing field without stopping the machine or equipment as long as the muting conditions are met. As the material moves through the process, the multi-beam sensing field interrupts and the outputs switch to the off state. However, if the muting module sensors are interrupted with the proper timing, the module disregards the multi-beam outputs and remains in the on condition, which allows the machinery or equipment to continue operation.

If the muting sensors do not interrupt and maintain in the required timing and or sequence, the muting module switches off when the GuardShield PAC safety light curtain multi-beam sensing field is interrupted.

Figure 2 is an example of a GuardShield PAC three-beam safety light curtain that is used as an opto-electronic fence with corner mirror columns.

Figure 3 is an example of a GuardShield PAC three-beam safety light curtain with four retroreflective sensors and an external muting module.

Figure 2 - GuardShield PAC Three-beam Safety Light Curtain with Corner Mirror Columns

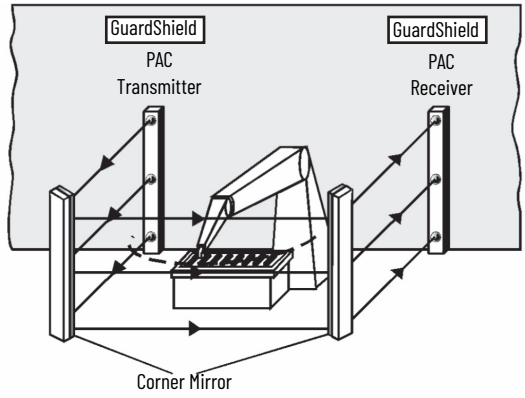
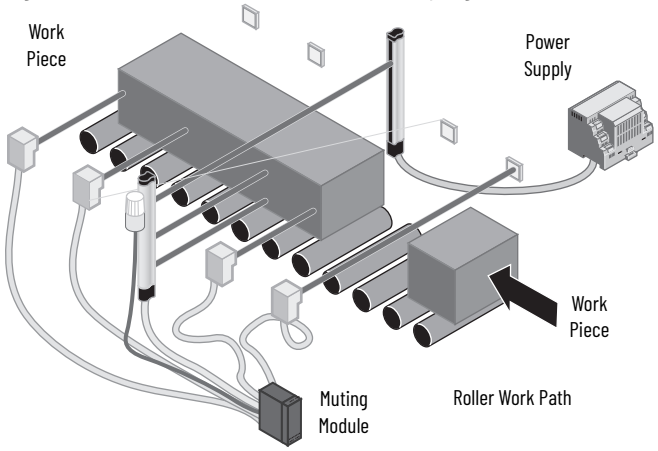


Figure 3 - GuardShield PAC Three-beam Safety Light Curtain with Muting Module



Application Requirements

The protective functions of the PAC safety light curtain can only be used properly when the following conditions are satisfied:

- The machine or installation must be controlled electrically.
- It must be possible to stop hazardous machine movement.
- The PAC safety light curtain must be installed so that entry into the danger zone interrupts one or more of the light beams.

To enable a change in the state of outputs, the light beam diameter of 23 mm (0.90 in.) must be fully covered.

Only the use of a restart switch can trigger release.

You must locate the restart switch so you cannot press the switch from inside the danger zone.

You must mount the GuardShield PAC safety light curtain so that upon interruption of the light beam, you can only reach the dangerous location if the dangerous condition of the machine is stopped. To achieve this restriction, you are required to have a proper safety distance between the light beams and the nearest point of danger.

Persons situated inside the danger zone, but outside the protection field, are not recognized. Therefore, you must confirm that a dangerous condition is only possible when nobody is present in the danger zone.

You must comply with the relevant legal and government regulations with the implementation of protection installations. These regulations vary, depending on areas of application.

Corner Mirrors and Pedestal Mounting Stands

Use the GuardShield two and three-beam PAC safety light curtains with one or two corner mirrors to provide two or three-sided protection. The use of each corner mirror reduces the maximum range of the GuardShield PAC safety light curtain by at least 10% per mirror.

It is possible to use full-length corner mirrors (catalog number series 440L-AM075*xxxx* and 440L-AM125*xxxx*). See Table 18 on page 50.

Rockwell Automation also offers pedestal floor mounting stands (catalog number 440L-AMSTD), which accommodates the mounting of the GuardShield two or three-beam PAC safety light curtain with the appropriate full-length corner or mirror column mirrors.

Figure 4 - Multi-sided Access Control to Danger Zones with PAC Multi-beam Safety Light Curtain Barrier

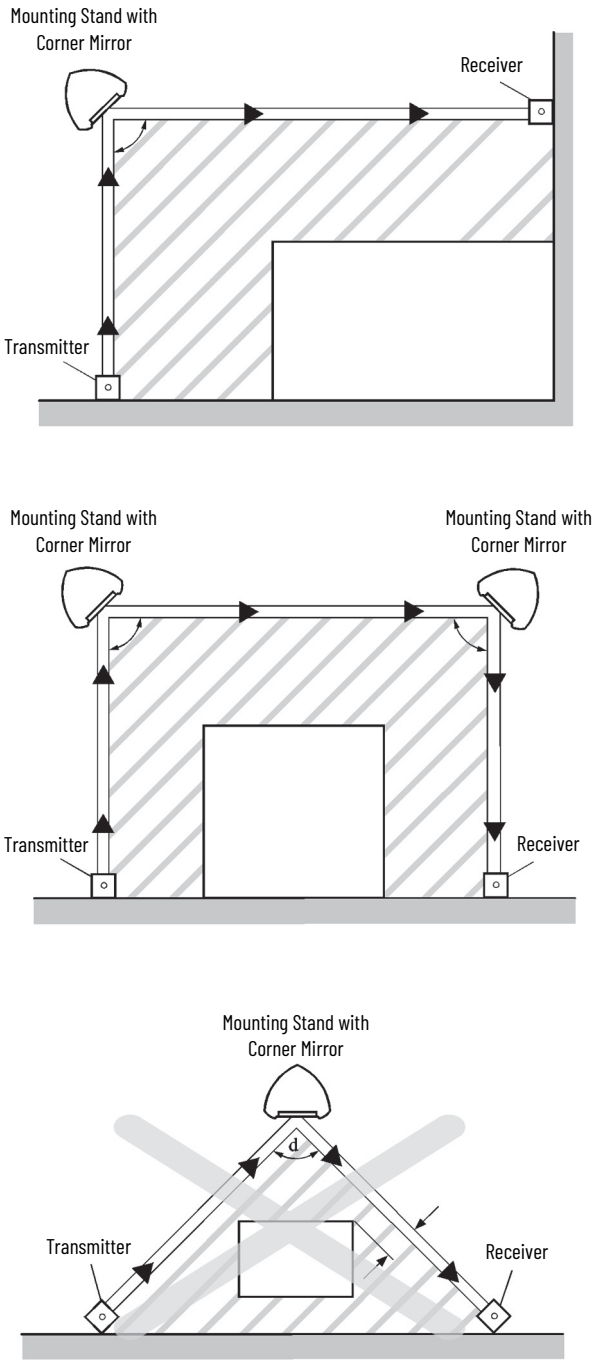


Figure 5 - GuardShield Three-beam PAC Safety Light Curtain and Corner Mirrors Mounted to Pedestal Mounting Stands

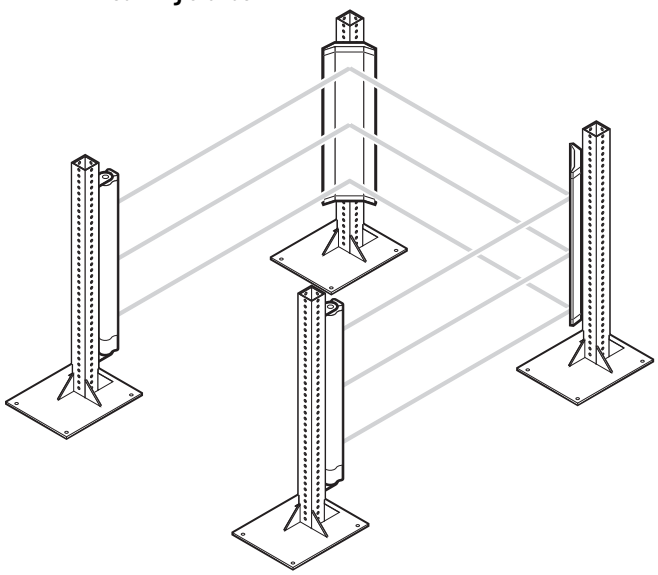


Figure 6 - GuardShield Two-beam PAC Safety Light Curtain and Corner Mirrors Mounted to Pedestal Mounting Stands

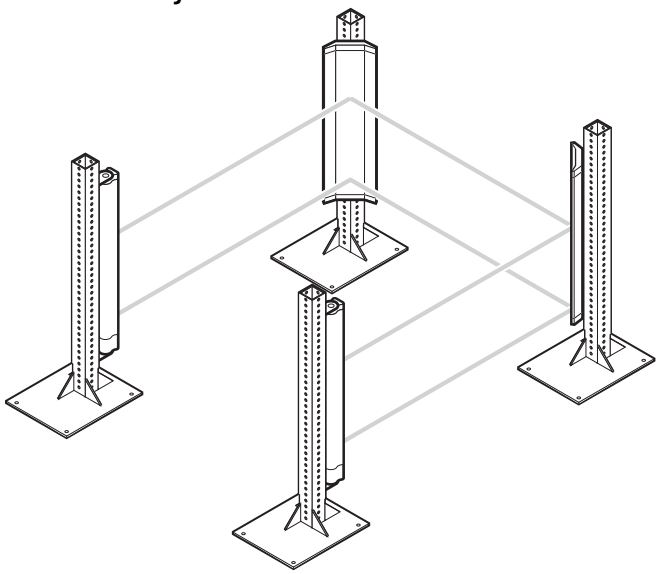


Figure 5 and Figure 6 show two and three-beam GuardShield PAC safety light curtains with two corner mirrors providing three-sided detection. Rockwell Automation offers mirrors in either narrow or wide styles in heights to accommodate two or three-beam GuardShield PAC safety light curtains.

Response Time

The response time of the two and three-beam GuardShield PAC safety light curtain is 20 ms without beam coding or 30 ms with beam coding.

IMPORTANT	Determine Stop Time: The measurement of stopping time (T_s) must include the stopping times of all devices in the stop circuit. Not including all device and control system elements when you calculate T_s results in an inaccurate safety distance calculation.

Determine the Safety Distance

You must mount the safety light curtain must with proper safety distance from:

- The point of danger
- Reflective surfaces

US Safety Distance Formula

ATTENTION: You must mount the GuardShield PAC safety light curtains at a sufficient distance from the hazardous motion so that the machine stops before a person reaches the hazard.

You must calculate this distance, referred to as the safety distance, before you mount the safety light curtains around the machinery. Failure to calculate this safety distance properly can result in operator injury.

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

OSHA Safety Distance Formula

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

$$D_s = 63 \times T_s$$

D_s	Safety Distance
63	The OSHA recommended hand speed constant in inches per second.
T_s	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 90º position of the crankshaft rotation.

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

ANSI Safety Distance Formula

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

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

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 (2)	Stop time of the machine tool that is measured at the final control element. Measurement starts at maximum machine velocity.
T_c (2)	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_{bm}	Additional time allowed for the brake monitor to compensate for variations in normal stopping time.
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 safety light curtain's object sensitivity. Object sensitivity is the smallest diameter object that is always detected anywhere in the sensing field.

(1) ANSI B11.19 1990 E4.2.3.3.5 states: The value of the hand speed constant, K, is determined by various studies and although these studies indicate speeds of 63 inches/second to over 100 in./second, they are not conclusive determinations. The employer must consider all factors, including the physical ability of the operator, when determining the value of K to be used.
(2) Usually, a stop time measuring device measures T_s and T_c.

Example Reach Over Calculation

In this example, the value of K is the hand speed constant of 63 in. per second, the T_s machine stop time is 250 ms (0.250 sec), the 20% brake wear factor is 0.05 s and the GuardShield PAC safety light curtain response time is 20 ms (0.020 s). The D_{pf} is 48 in. for reach over applications.

D_s = 63 in./sec x (0.250 + 0.050 + 0.02) + 48 in.

D_s = 20.16 in. + 48 in.

D_s = 68.16 in. from hazardous motion

You must mount the GuardShield three-beam PAC safety light curtain at least 1732 mm (68.2 in.) from the closest reachable hazard point of the protected machinery or equipment.

European Safety Distance Formula

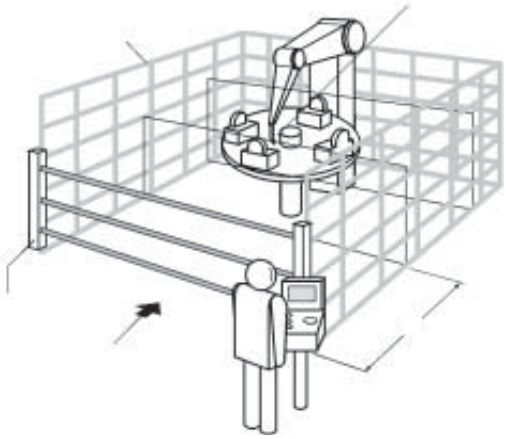
You must maintain a safety distance between the safety light curtain and the point of danger. This safety distance is so you can only reach the point of danger after the dangerous state of the machine is removed.

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

- Stop/run-down time of the machine or system. (The stop/run-down time is in the machine documentation or you must take a measurement to determine the time.)
- Response time of the protective device
- The speed of approach of a person
- Resolution of the safety light curtain and/or beam separation

When using the GuardShield PAC safety light curtain three-beam with 400 mm (15.75 in.) beam spacing, EN 999 requires that the first beam is mounted at 300 mm (11.81 in.) above the floor. When mounted in this configuration, you must add 850 mm (33.46 in.) as the value for C in the safety distance calculation equation.

Figure 7 - 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 = 1600 × (Ts + Tr) + C

Where:

Ts = stop/run-down time of the machine
+ response time of the protective device [s]
Tr = response time of the GuardShield PAC safety light curtain
S = safety distance [mm]
C = safety supplement

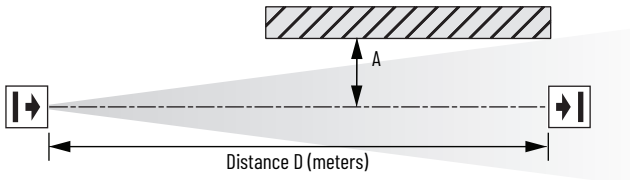
S = 1600 x (0.250 + 0.020) + 850 mm
S = 1600 x (0.270) + 850 mm
S = 432 + 850 mm
S = 1282 mm

Minimum Distance from Reflecting Surfaces

The infrared light from the sender can reflect off shiny surfaces and be received by the receiver of the system. If this condition occurs, it can result in an object that is not detected when it enters the sensing field of the GuardShield PAC safety light curtain.

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

Figure 8 - Minimum Distance from Reflecting Surfaces [(a)]

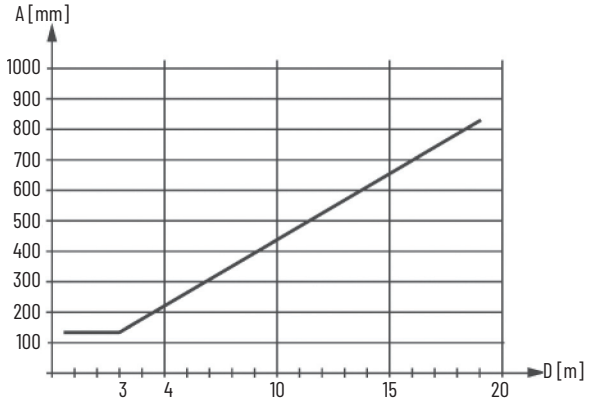


(a) A = minimum distance to reflective surfaces
D = distance between transmitter and receiver

Determine the Minimum Distance from the Reflective Surfaces

1. Determine the distance D [m] between sender and receiver.
2. Read the minimum distance A [mm] from Figure 9.

Figure 9 - Minimum Distance from Reflective Surfaces



The effective aperture angle for the GuardShield system is within ± 2.5° 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 ± 2.5°, or take the appropriate value from Table 1.

Table 1 - Minimum Safety Distance to Reflective Surfaces

Distance Between Transmitter and Receiver (Range L) [m (ft)]	Minimum Distance (a) (1) [mm (in.)]
0.2...3.0 (0.65...9.8)	135 (5.31)
4.0 (13.1)	175 (6.88)
5.0 (16.4)	220 (8.66)
6.0 (19.6)	265 (10.43)
7.0 (22.9)	310 (12.2)
10.0 (32.8)	440 (17.32)
16.0 (52.4)	700 (27.55)

(1) a = tan 2.5° x D [mm]

Installation and Mounting

This section describes the preparation, selection, and installation of the GuardShield™ PAC safety light curtain.

The GuardShield PAC safety light curtain is suitable for most operating environments (IP65 environmental rating). You must observe the proper safety distance.

IMPORTANT The installation of the GuardShield PAC safety light curtain must adhere to the ANSI standard B11.19/E4.2.3.3.6, which requires that a presence sensing device helps prevent the operator or others from reasonably reaching over, around, or under the sensing field into the hazardous area. To meet this requirement, auxiliary safeguards can be required with the GuardShield PAC safety light curtain.

Determine if the machinery, on which the GuardShield PAC safety light curtain will be mounted, meets the requirements as specified in the beginning of this publication. The machinery must be able to stop anywhere in its stroke or cycle, consistently and repeatedly.

You must mount the GuardShield PAC safety light curtain the proper distance from the point of operation hazard. This distance is referred to as the Safety Distance (see Determine the Safety Distance on page 21).

ANSI/RIA 15.06 requires that the first beam of the GuardShield PAC safety light curtain is mounted at 300 mm (12 in.) off the floor in vertical applications. The protective height of the GuardShield PAC safety light curtain three-beam is 820 mm (32.28 in). The combination of 300 mm (12 in.) and 820 mm (32.28 in) equals 1120 mm (44.09 in.), which meets the ANSI/RIA 15.06 requirements of a reach-over application. This requirement dictates that the depth penetration factor (D_{pf}) is 1219 mm (48 in.) when performing the safety distance calculation.

The standard GuardShield PAC safety light curtain has a status indicator in the receiver, for use as an alignment aid. This status indicator flashes when the receiver sees the infrared light from the transmitter. This status indicator turns off when you attained optimal alignment. An external laser (catalog number 440L-ALAT) and mounting bracket (catalog number 440L-AF6109) is offered as an accessory for aligning the GuardShield PAC safety light curtain.

Alignment Procedure

Standard GuardShield PAC Safety Light Curtain

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

Turn on power to GuardShield PAC safety light curtain system.

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

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

Cycle power to confirm that the system powers up and goes to the on state (alignment indicator is off).

The GuardShield PAC safety light curtain meets the requirements of IEC 61496, which requires that the optics of the transmitter and receiver emit and receive infrared light at a maximum of ±2.5°. This requirement creates a tight optical path of infrared light and can make the GuardShield PAC safety light curtain difficult to align at maximum range, or when corner mirrors are used in the application to provide two or three sided perimeter guarding.

When using the GuardShield PAC safety light curtain in perimeter guarding applications, particularly with corner mirrors, use the Allen-Bradley® Guardmaster® laser alignment tool (catalog number 440L-ALAT) to ease the alignment process. You must use the GuardShield mounting bracket (catalog number 440L-AF6109) to mount the laser alignment tool to the GuardShield PAC safety light curtain housing.

The GuardShield PAC safety light curtain is also offered with an integrated laser alignment system. Select the appropriate catalog numbers for this model of GuardShield PAC safety light curtain.

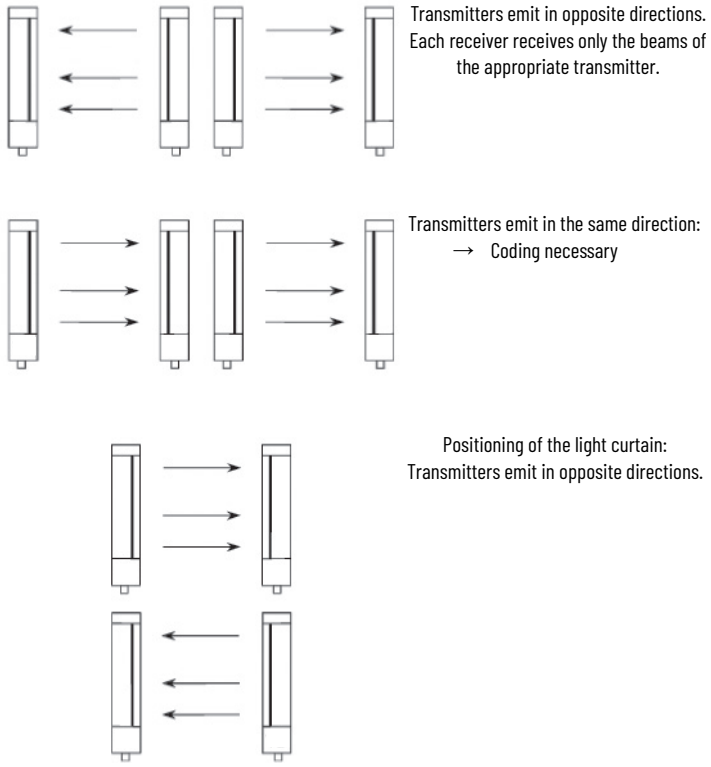
GuardShield PAC Safety Light Curtain with Integrated Laser Alignment

1. Properly locate the GuardShield PAC safety light curtain pair from the point of operation hazard after you perform the safety distance calculation.
2. Use the GuardShield PAC safety light curtain mounting brackets to mount the transmitter and receiver so that they face one another and are positioned in the same direction. The status indicators are opposite one another.
3. To turn on each laser, place a finger or hand in front of each laser.
4. Adjust the transmitter and receiver so that both visible laser beams reach the laser targets opposite each laser. A small deviation from the center of the target is allowable.

Multiple GuardShield PAC Safety Light Curtains

When two or more GuardShield PAC safety light curtains are mounted near one another, the receiver of one GuardShield PAC safety light curtain system can possibly see the infrared light of the transmitter of another GuardShield PAC safety light curtain pair. This optical interference can be over come by the beam code feature of the GuardShield PAC safety light curtain (see Beam Coding on page 16). Beam coding changes the pulse pattern of infrared light that the GuardShield PAC safety light curtain transmitter emits.

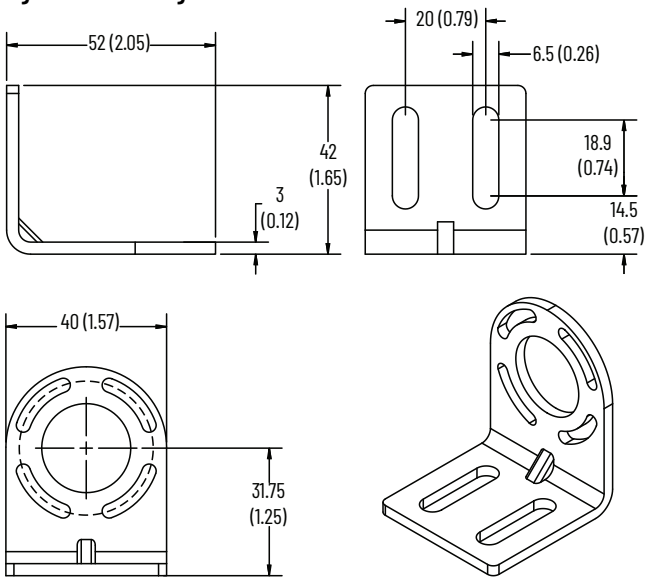
Figure 10 - Multiple GuardShield PAC Safety Light Curtain Alignment Options



Mounting Brackets

The GuardShield PAC safety light curtain mounts using right angle brackets that are attached to the end caps of both transmitter and receiver. Each GuardShield PAC safety light curtain is supplied with standard right angle mounting brackets and self-threading screws. If necessary, use additional brackets to mount the GuardShield PAC safety light curtain at a proper safety distance from the machinery hazard.

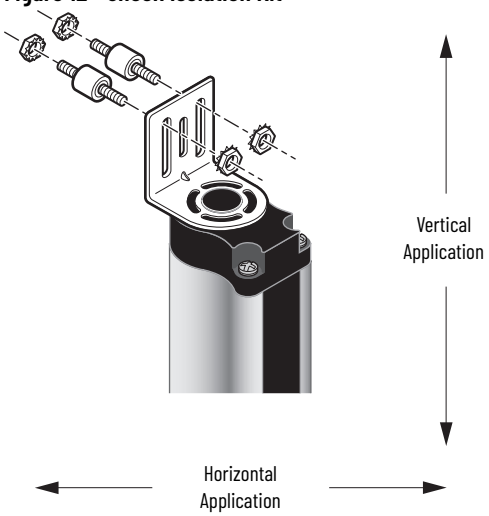
Figure 11 - Mounting Brackets



Shock Isolation Kits

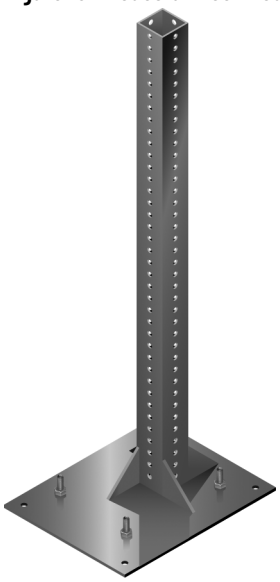
Rockwell Automation offers a shock and vibration isolation kit (catalog number 440L-AF6120) for attenuating excessive shock and vibration in vertical applications of the GuardShield PAC safety light curtain. This kit effectively extends the operational life of the GuardShield PAC safety light curtains in excessive shock and vibration applications, particularly in applications where shock levels can exceed 50 g.

Figure 12 - Shock Isolation Kit



Rockwell Automation also offers pedestal floor stands for mounting the GuardShield safety light curtains when the shock and vibration levels of the equipment are excessively high. These mounting stands isolate the GuardShield safety light curtains from receiving the shock through the equipment, however, the area immediately around the machine can also experience high levels of shock and vibration. Therefore, it can be necessary to use the shock mount kits when mounting the safety light curtains to the mounting stands.

Figure 13 - Pedestal Floor Mounting Stand



Electrical Installation

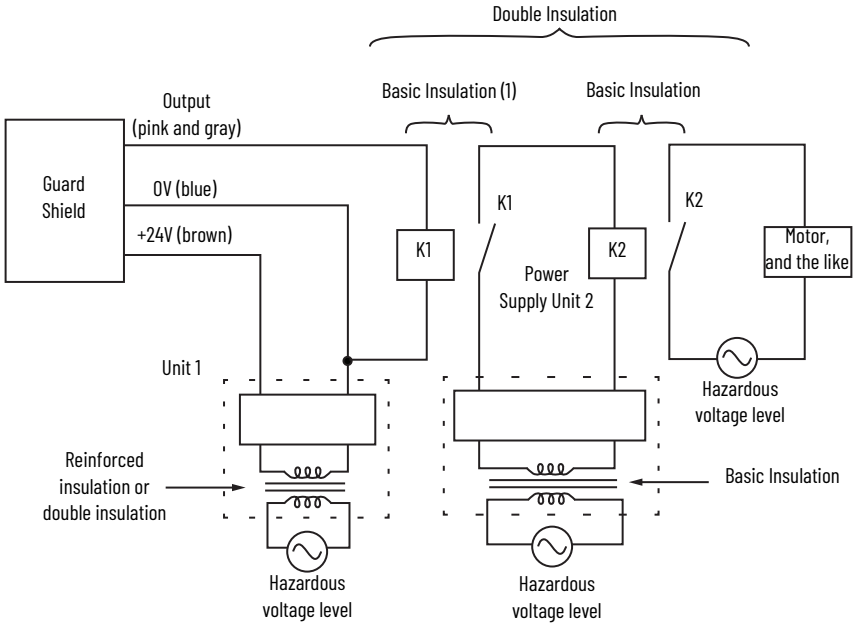
Electrical Connections

Power Supply

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

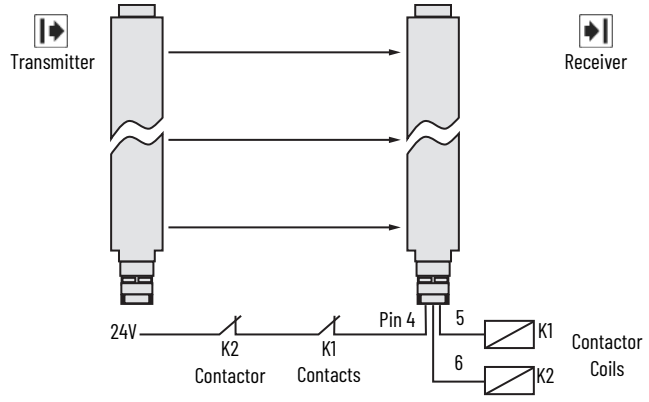
- The power supply bridges short-term power failures of 20 ms.
- The power supply has double insulation between the primary and the secondary side.
- The power supply is protected against overload.
- The power supply corresponds to the guidelines of the EWG (industrial environment).
- The power supply corresponds to the Low Voltage Directives.
- The grounded conductor of the power supply device must connect to a grounded conductor PE.
- The maximum deviation of the voltage levels is 24V DC ±20%.

Figure 14 - Typical Wiring Diagram



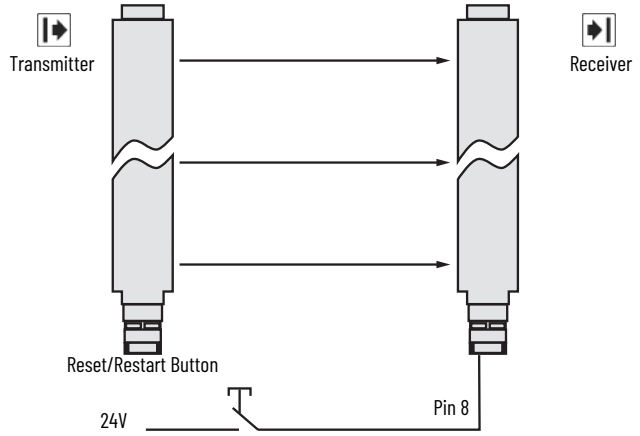
EDM Connection

Figure 15 - Connecting the Contact Elements to the EDM



IMPORTANT Not available for GuardShield™ PAC safety light curtain with ArmorBlock® Guard I/O™ connectivity.

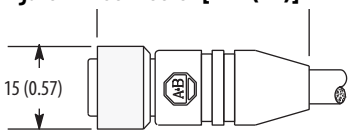
Figure 16 - Connecting the Reset/Restart Button



IMPORTANT Not available for GuardShield PAC safety light curtain with ArmorBlock Guard I/O connectivity.

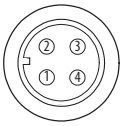
Cables and Connectors

Figure 17 - Connector [mm (in.)]



The GuardShield PAC safety light curtain transmitter connector is a 4-pin DC micro connector that is offered in cable lengths 2...30 m (6.65...98.42 ft).

Table 2 - Standard and ArmorBlock Guard I/O Transmitter Connectivity

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

(1) The transmitter is not expected to be connected to the ArmorBlock Guard I/O module.

Table 3 - Standard Receiver Connectivity

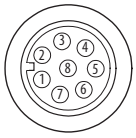
Top View of Concave DC Micro	Color	Pin	Signal Receiver
	White	1	Auxiliary output
	Brown	2	+24V DC
	Green	3	Ground
	Yellow	4	EDM
	Gray	5	OSSD 1
	Pink	6	OSSD 2
	Blue	7	0V DC
	Red	8	Start/restart

Table 4 - Receiver Connector for ArmorBlock Guard I/O Connectivity

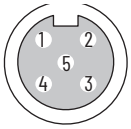
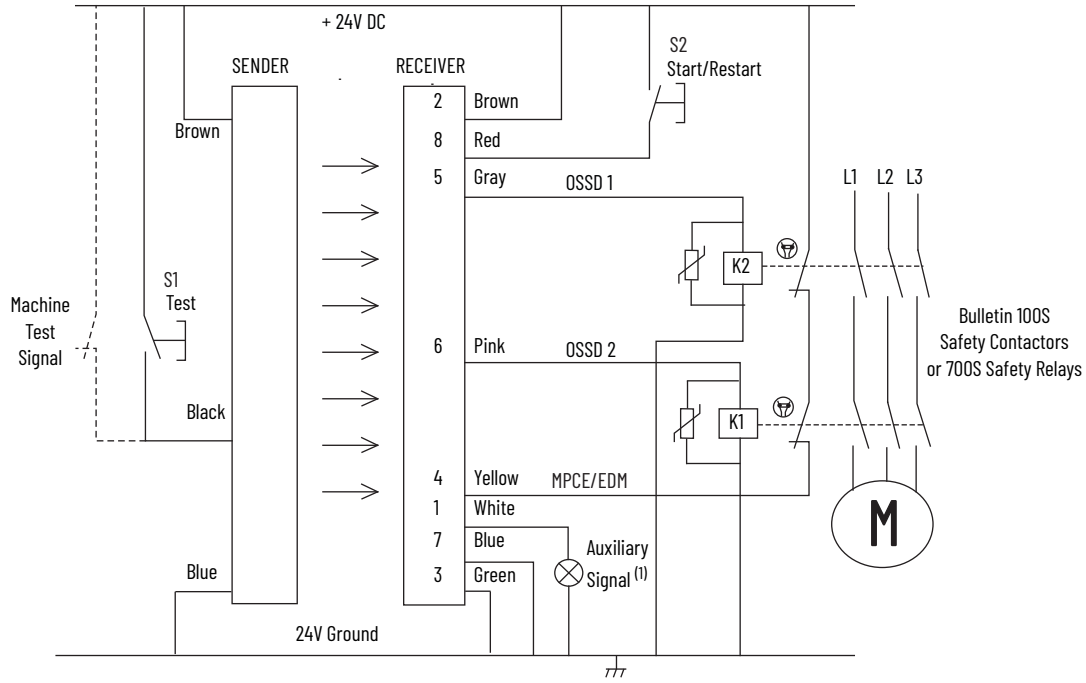
Top View	Color	Pin	Signal Receiver
	Brown	1	+24V
	White	2	OSSD 2
	Blue	3	0V
	Black	4	OSSD 1
	Gray	5	NC

Table 5 - Receiver Interconnecting Patchcords to ArmorBlock Guard I/O

Cat. No.	Description
889D-F5ACDM-0M3	5-pin M12 patchcord, 0.3 m (1 ft)
889D-F5ACDM-1	5-pin M12 patchcord, 1 m (3.3 ft)
889D-F5ACDM-2	5-pin M12 patchcord, 2 m (6.6 ft)
889D-F5ACDM-5	6-pin M12 patchcord, 5 m (16.4 ft)
889D-F5ACDM-10	7-pin M12 patchcord, 10 m (32.8 ft)

Typical Wiring

Figure 18 - Models with Start/Restart Interlock, EDM, and the OSSDs Connected Directly to Contactors



(1) Non-safety auxiliary output can be connected to a lamp, motor, or status to a PLC.

IMPORTANT If MPCE/EDM is activated in the GuardShield PAC safety light curtain, the application requires a safety contactor. If MPCE/EDM is not used K1, K2 can be standard contactors.

Figure 19 - To MSR127 Safety Relay Module

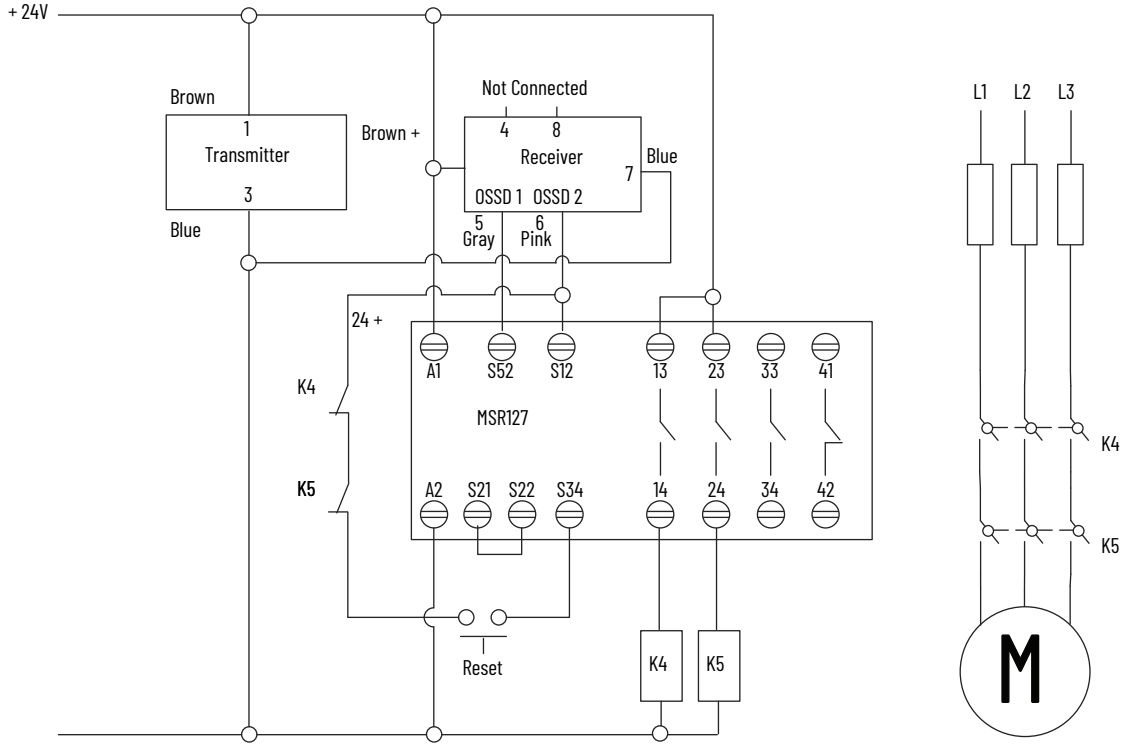


Figure 20 - GuardShield Safety Light Curtain Connected to MSR22LM with Two Sensor Muting

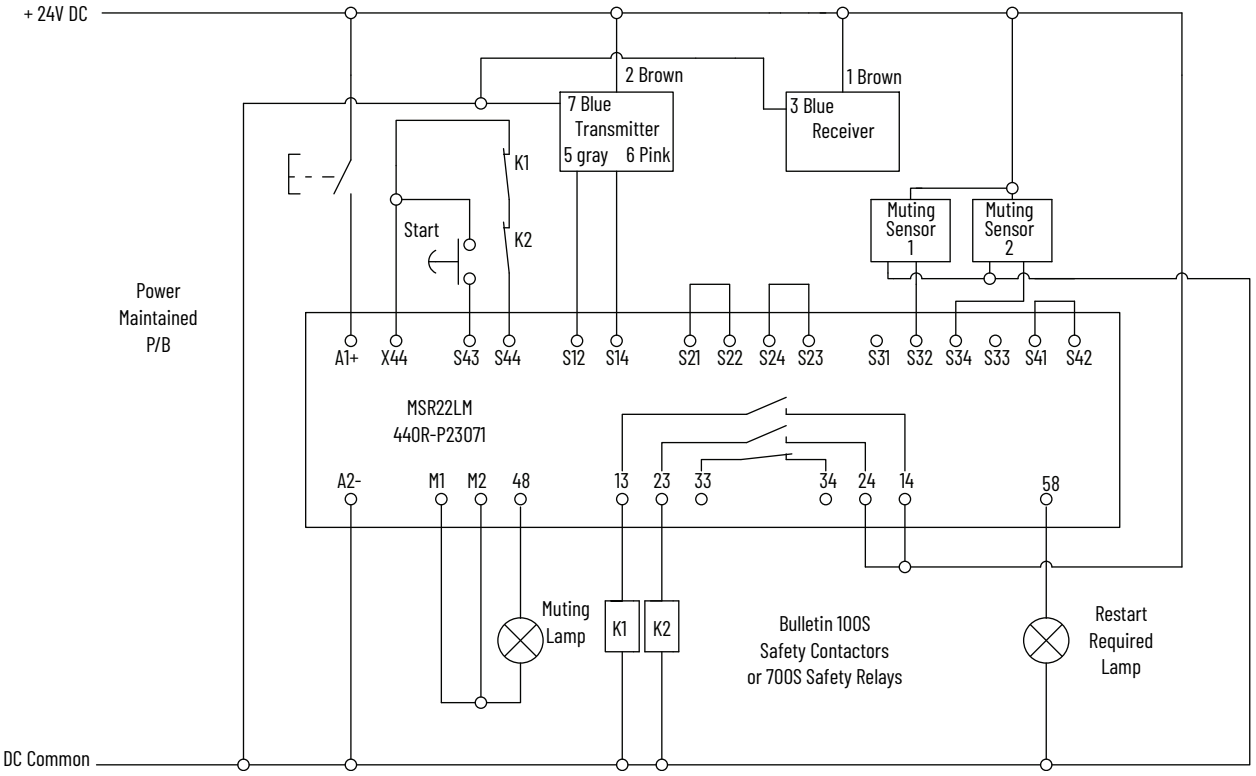
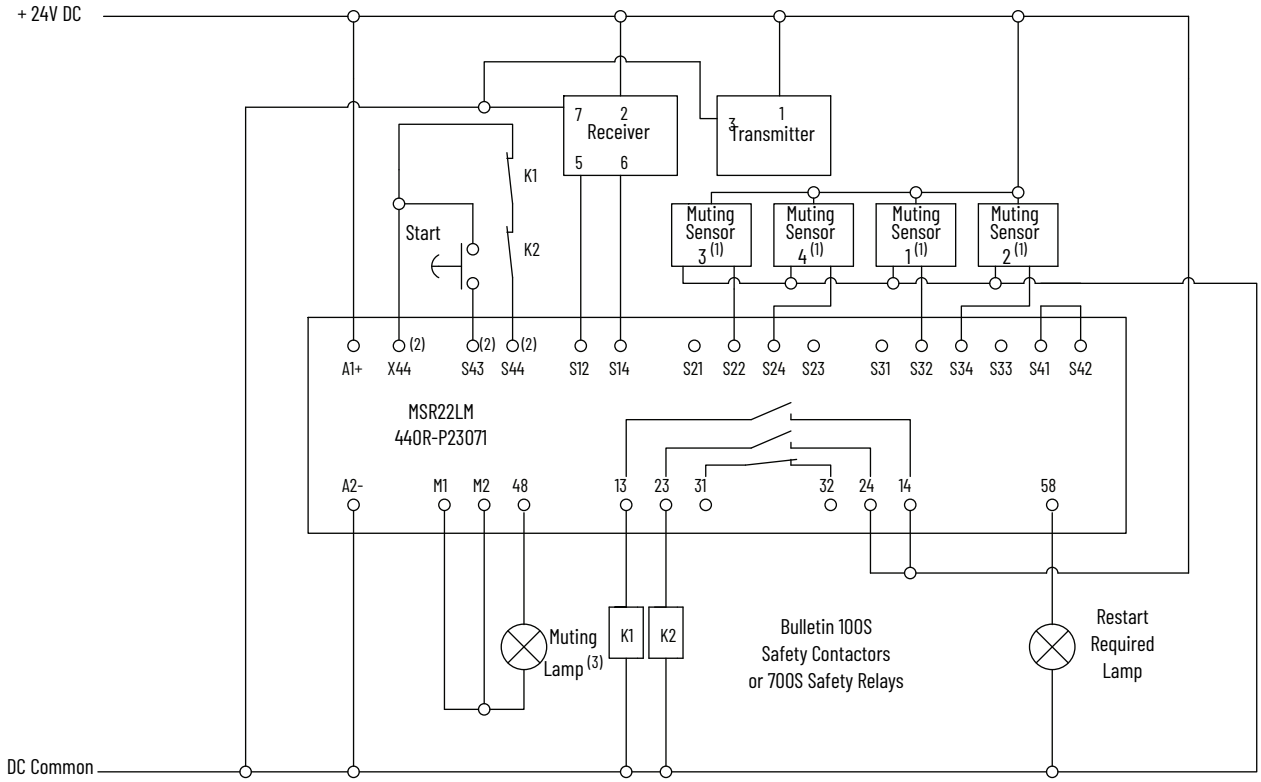


Figure 21 - GuardShield Safety Light Curtain Connected to MSR22LM with Two Sensor Muting



(1) Muting sensors are N.C. PNP type.
(2) Wire the reset switch to S43 and S44 when external monitoring is not required. Terminal X44 is not used.
(3) The muting lamp must meet the following current specs:
- Minimum current: 25 mA
- Maximum current: 100 mA

Figure 22 - GuardShield Safety Light Curtain Connected to MSR42/MSR45E with Two-sensor Muting [a]

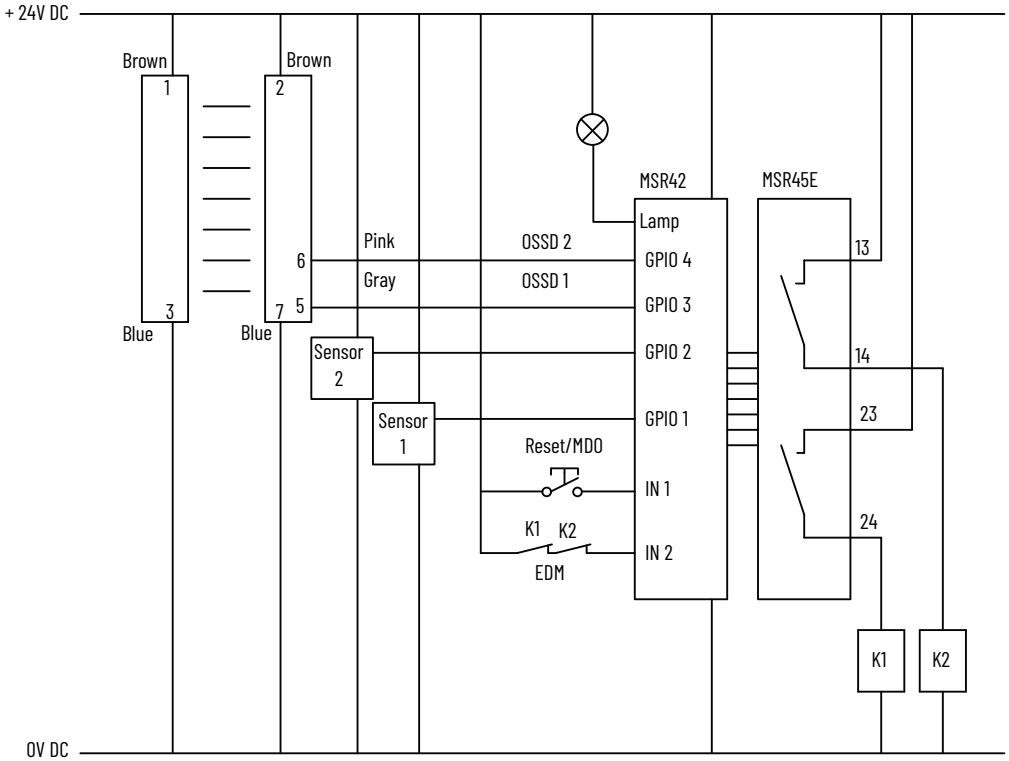
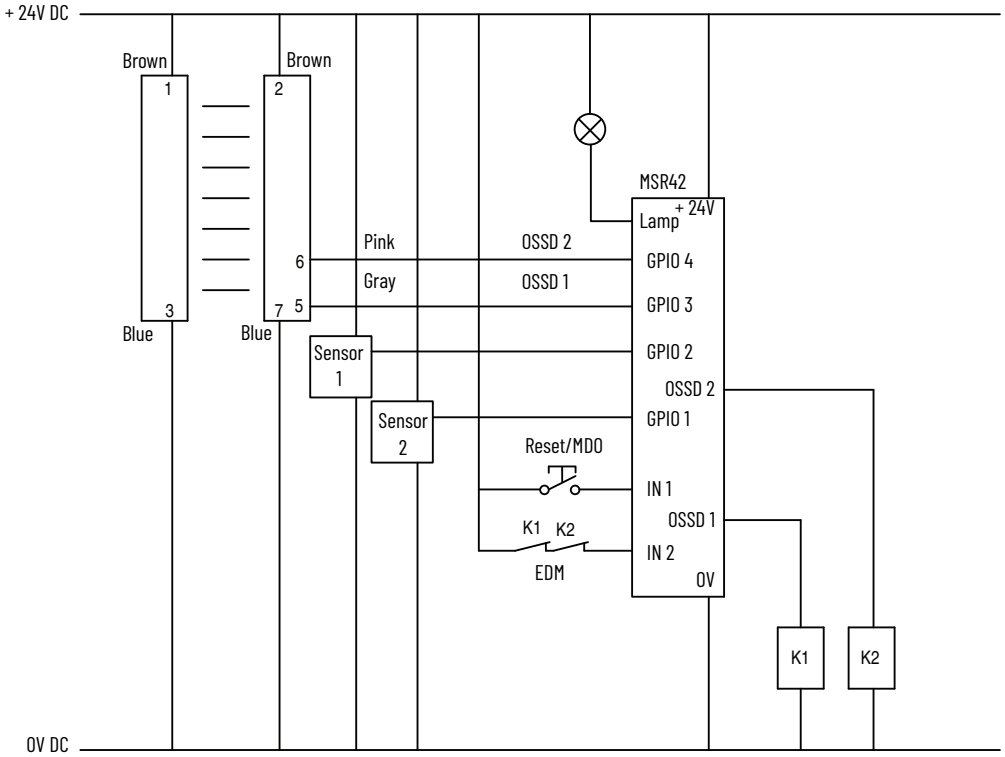


Figure 23 - GuardShield Safety Light Curtain Connected to MSR42 with Two-sensor Muting [a]



(a) Use the optical interface (catalog number 445L-AF6150) to program the MSR42 safety relay.

System Configuration

DIP Switch Selection Settings

Figure 24 - Transmitter

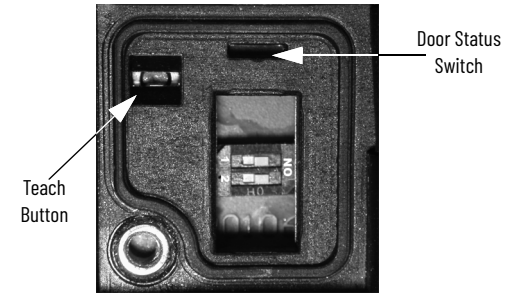
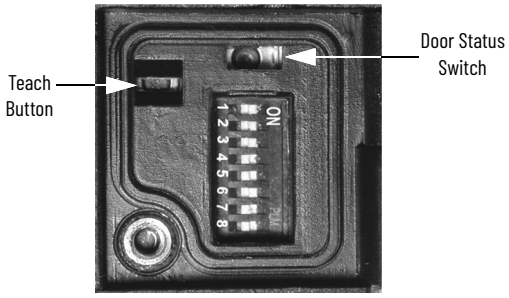


Figure 25 - Receiver



After you mount, electrically connect, and align the GuardShield™ PAC safety light curtain, you can now configure your system.

To begin the system configuration, use the security tool that is provided to loosen the screw in the configuration door. The configuration door screw has a captive screw.

IMPORTANT	You can only configure the transmitter for beam coding and machine test signal. If you do not require either of these configurations, then only configure the GuardShield PAC safety light curtain receiver.

Identify and set the appropriate DIP switches for the desired configuration.

DIP switch identification and function are explained in Table 6...
Table 8 on page 36.

Follow Teach Function on page 36 to reconfigure the GuardShield PAC safety light curtain.

IMPORTANT	After each reconfiguration of the GuardShield PAC safety light curtain, test the system for proper configuration and operation before placing the guarded machine in operation.

Factory Settings

The following settings are configured from the factory.

Table 6 - Receiver

Switch	Switch Function	Default	Setting Description
1	Mode Activation - Combination activates one of the following modes: Guard Only, Start Interlock, Restart Interlock	On	Guard only
2		On	
3	MPCE monitoring disable	On	Disabled
4	Not used	Off	-
5	Not used	Off	-
6	Not used	Off	-
7	Set beam coding	Off	Disabled
8	Not used	Off	-

Table 7 - Transmitter

Switch	Switch Function	Default	Setting Description
1	Set beam coding	Off	Disabled
2	Machine test signal	Off	Off: Signal high active - No connection or connect N.O. On: Signal low active - Connect N.C.

Table 8 - Receiver Settings for Mode of Operation

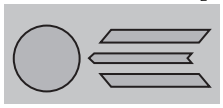
Switch 1	Switch 2	Condition	Operation
On	On	Guard only	On/off operation
Off	On	Start interlock (push-button reset)	Interlock at startup - Reset by actuation of the push-button switch
Off	Off	Restart interlock	Interlock at interruption of sensing area - Reset by actuation of the push-button switch
On	Off	Start interlock	Interlock at startup - Reset by Interruption/restoration of sensing area for < 1 sec

ATTENTION: You must store every modification at the DIP switches in the memory of the device through the teach function. A change to the position of a DIP switch alone does not change the GuardShield. You must first change the DIP switch position and then perform the teach function. If the changes are enabled in the GuardShield, the amber status indicator flashes three times as a visual confirmation that the change is accepted.

IMPORTANT GuardShield PAC safety light curtains with ArmorBlock® Guard I/O™ connectivity are configured from the factory as standard GuardShield PAC safety light curtains. However, the only configurable functionality is beam coding. All other configurable functions are disabled.

Teach Function

1. Open cover of the end cap (the status indicator blinks: The receiver has a red status indicator, the transmitter has an amber status indicator).
2. Select the desired switch setting.
3. Press and hold the Teach button. The yellow status indicator flashes at 10 Hz (10x per second).



4. The yellow status indicator stops blinking while the button is depressed. After the yellow stops flashing, release the Teach button within 2 seconds.
   - After three flashes of the yellow status indicator, the function is activated.
5. Close and secure the cover.

IMPORTANT The doors on the transmitter and receiver must be closed for the GuardShield PAC safety light curtain to operate.
If the GuardShield PAC safety light curtain teach procedure does not properly complete, the unit remains in the previous operating mode.
Once the teach function is complete and the door is secured, verify that the operating mode has changed to the intended mode.

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.

Table 9 - Errors

Condition No.	Error Description	Action
6	Internal fault, receiver	• Check the configuration of the transmitter and receiver • Replace the receiver
7	Internal fault, transmitter	• Check the configuration of the transmitter and receiver • Check the protective field of the transmitter/receiver • Check the connections of the transmitter/receiver • Exchange the transmitter
8	External fault	• Check the connections of OSSD outputs for a short circuit against +24V DC and GND (cable, connected devices) • Exchange the 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.	• Check the connection to relay monitoring • Check the connected relay for closed contact – If OSSD on: The input relay monitoring must have GND level – If OSSD off: The input relay monitoring must have +24V • Switch on only after power off/on
10	Configuration mode (receiver)	• The cover for the DIP switch setting at the receiver is open
11	Configuration mode (transmitter)	• The cover for the DIP switch setting at the transmitter is open

System Status Indicators

Table 10 - System Status Indicators

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

(1) Conditions No. 6...11 are fault conditions.
(2) Flash rate is approximately 2 Hz (two times per second).
(3) Data transmission (factory configuration interface), not available for use outside factory.

Table 11 - Conditions

Condition No. (1)	Description
1	Guard Only mode, safety light curtain unobstructed (aligned, not in interlock)
2	Guard Only mode, safety light curtain interrupted (aligned, not in interlock)
3	Guard Only mode, misaligned (not in interlock)
4	In start or 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)
10	Configuration mode (receiver access door open)
11	Configuration mode (transmitter access door open)

(1) For fault conditions 6...11, see Troubleshooting Guide on page 37.

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

IMPORTANT Before power-up of the GuardShield PAC safety light curtain system, you must review Power-up Checklist on page 39.

Power-up Checklist

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

Cable check before initiation:

- The power supply solely connects to the GuardShield PAC safety light curtain.
- 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).
- The power supply at the GuardShield PAC safety light curtain has proper polarity.
- The transmitter connection cable properly connects to the transmitter, the receiver connection cable properly connects to the receiver.
- Confirm the double insulation between the safety light curtain output and an external potential.
- The OSSD outputs do not connect to +24V DC.
- The connected switching elements (load) do not connect to 24V DC.
- There is no connection to a conventional power supply.
- If two or more GuardShield PAC safety light curtains are used, confirm that each system is properly installed to avoid optical interference.

Switch on the GuardShield PAC safety light curtain and observe the following to check its function:

- If the protective field is free of obstructions, 2 seconds after switching on, the system starts to work properly.

Notes:

Safety Instructions and Maintenance

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

- For safety reasons, all inspection results are recorded.
- Only persons who clearly understand the functioning of the GuardShield PAC safety light curtain and of the machine, can conduct an inspection.
- If the installer, planning engineer, and operator are different people, confirm that they have sufficient information available to conduct the inspection.

Daily Inspection

1. Approach to hazardous machine parts is only possible through passage through the protective field of the GuardShield PAC 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.

5. The protective field is interrupted.
6. The hazardous movement stops immediately if you interrupt the protective field if you place the test rod directly:
   - In front of the transmitter
   - In front of the receiver
   - In between the transmitter and receiver
7. There is no hazardous machine movement while completely interrupting any of the PAC safety light curtain beams.
8. The power supply of the GuardShield PAC safety light curtain is turned off.

IMPORTANT If any of the previously described conditions do not stop the hazardous motion of the machine, do not allow the protected machine to be placed in operation.

6-month Inspection

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

1. The 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 PAC safety light curtain 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 PAC 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 PAC safety light curtain is dirty, the outputs of the GuardShield PAC safety light curtain turn off. Take a clean, soft cloth and rub without pressure. Do not apply aggressive, abrasive, or gritty cleaning agents, which can attack the surface.

Date Code

Figure 26 - Product Label for Units Produced Before 2017

Table 12 - Explanation of Data Code

Location of Manufacture [XX]	Year of Manufacturer [X]		Week of Manufacturer [XX]
M or 4K (1)	J=2004	S=2011	02
	K=2005	T=2010	
	L=2006	U=2013	
	M=2007	V=2014	
	N=2008	W=2015	
	P=2009	Y=2016	
	R=2010	Z=2017	

(1) M represents Manchester.
4K replaces NH for Monterrey, Mexico.

Specifications

Technical Specifications

Table 13 - Specifications

Attribute	Value	
Light beams	• 440L-P4A3400YD: 3/400 mm spacing • 440L-P4A2500YD: 2/500 mm spacing	
Protective field	• 3-beam: 820 mm (31.8 in.) • 2-beam: 820 mm (31.8 in.)	
Range	16 m (52.5 ft)	
Response time	OSSD – on to off (reaction times)	• 20 ms uncoded • 30 ms coded
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 LED (wave length 870 nm)	
Aperture angle	Within ± 2.5° for transmitter and receiver	
Operating condition	IR transmitter on	
Functions	• Guard only • Start interlock • Restart interlock • Relay monitoring • Beam coding • Test function	• On/off operation with clear/obstructed detection area • Interlock at startup - reset by actuation of momentary N.O. push-button switch (or interruption/restoration of the safety light curtain) • Interlock at interruption of sensing field - reset by actuation of momentary N.O. push-button switch • Monitoring a switch contact of the installation • Can be necessary for multiplex alignment • 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	• Safety outputs (OSSDs) • Auxiliary output	• Two solid-state outputs, max switching capacity 500 mA, short circuit protection, max residual voltage 2V (excl. voltage drop through cables) • Solid-state output, max power consumption 500 mA, max residual voltage 2V - non-safety output. •Max off-state leakage current: 1 mA •Max capacitive load: 0.18 uF
Status indicators receiver	• On-state • Off-state • Alignment • Interlock	• Constant on when system is in on-state (green status indicator) • Constant on when system is in off-state (red status indicator) •Lights up at interruption of protective field or if fault occurs • Lights up, if input signal is too weak (amber status indicator) • Lights up when safety light curtain is in Start or Restart Interlock mode (yellow status indicator)
Status indicators sender	• Power on • Emitting	• Lights up when voltage is on (amber status indicator) • Constant on when transmitter is active (yellow status indicator)
QD connectors	• Transmitter • Receiver	• M12 4-pin plug • M12 8-pin plug for GuardShield™ PAC standard safety light curtain or with integrated laser alignment system M12 5-pin plug GuardShield PAC safety light curtain with ArmorBlock® Guard I/O™
Cable length	• Maximum 30 m (100 ft) • Maximum resistance: 5 Ω	
Ambient temperature	• 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.)	

Table 13 - Specifications (Continued)

Attribute	Value
Shock	Per IEC 61496-1, IEC 60068-2-29 acceleration 10 g, duration 16 ms
Material	• Housing: Aluminum • Cover: PMMA (acrylic)
Dimensions (cross section)	Approximately 40 x 50 mm (1.57 x 1.96 in.)
Accessories included	Mounting brackets, operating instructions, security tool, plastic tool for setting DIP switch and teach function
Approvals	IEC 61496 Parts 1 and 2, UL 61496 Parts 1 and 2, UL 1998
Safety classification	• Type 4 per EN/IEC 61496, category 4 EN/ISO 13849 • SIL 3, IEC 61508, SIL CL 3 EN 62061, PLe, EN/ISO 13849
PFH (mean probability of a dangerous failure/hr)	• Standalone system: 9.51×10^{-9} • Cascading system (host/guest): 1.95×10^{-8} • Cascading system (host/guest/guest): 2.75×10^{-8}
T_M (mission time)	20 years (EN ISO 13849)
Transmitter wave length	870 nm

Model Overview

Table 14 - GuardShield PAC Safety Light Curtain Models by Type

Cat No.	Beam Spacing	No. of Beams	Protective Heights [mm (in.)]
Standard (1)			
440L-x4A2500YD	500	2	520 (20.4)
440L-x4A3400YD	400	3	820 (32.2)
With Integrated Laser Alignment (1)			
440L-x4AL2500YD	500	2	520 (20.4)
440L-x4AL3400YD	400	3	820 (32.2)
With Integrated Laser Alignment and Guard I/O Connectivity (2)			
440L-x4AL2500YA	500	2	520 (20.4)
440L-x4AL3400YA	400	3	820 (32.2)

(1) Units are sold in pairs.
x = P for a transmitter or receiver; R for the receiver; T for the transmitter
(2) Units are sold in pairs. The pair consists of a standard GuardShield PAC safety light curtain with integrated laser alignment transmitter with a 4-pin M12 quick-disconnect (catalog number 440L-T4AXXXXYD).
x = P for a transmitter or receiver; R for the receiver

Catalog Number Explanation

Table 15 - GuardShield PAC Standard Safety Light Curtain

440L	-	P	4	A	2	400	Y	D
a		b	c	d	e	f	g	h

a	
Code	**Description**
440L	Bulletin number

b	
Code	**Description**
P	Pair
T	Transmitter
R	Receiver

c	
Code	**Description**
4	Category Type 4

d	
Code	**Description**
A	PAC

e	
Code	**Description**
2	2 beams
3	3 beams

f	
Code	**Description**
400	Beam spacing
500	

g	
Code	**Description**
Y	Environmental rating IP65

h	
Code	**Description**
D	Micro QD

Table 16 - GuardShield PAC Safety Light Curtain with Integrated Laser Alignment

440L	-	P	4	A	L	2	400	Y	D
a		b	c	d	e	f	g	h	i

a	
Code	**Description**
440L	Bulletin number

b	
Code	**Description**
P	Pair
T	Transmitter
R	Receiver

c	
Code	**Description**
4	Category Type 4

d	
Code	**Description**
A	PAC

e	
Code	**Description**
L	Integrated laser alignment system

f	
Code	**Description**
2	2 beams
3	3 beams

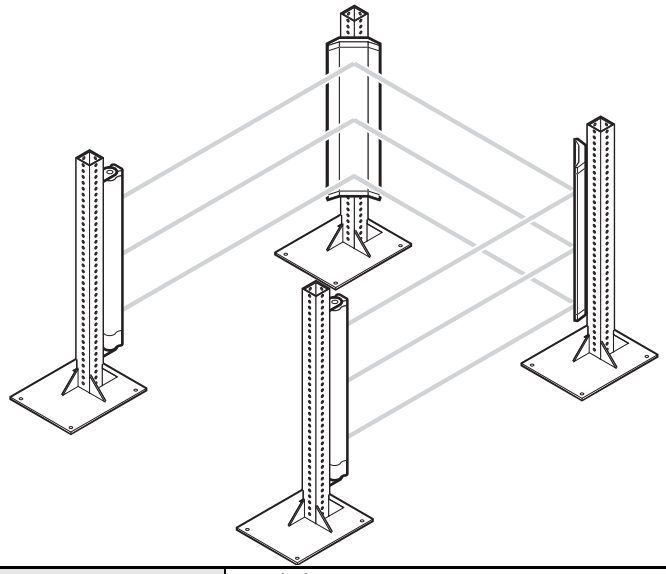
g	
Code	**Description**
400	Beam spacing
500	

h	
Code	**Description**
Y	Environmental rating IP65

i	
Code	**Description**
A	5-pin M12 (1)
D	M12 QD

(1) For ArmorBlock Guard I/O

Table 17 - Bill of Materials for 3-sided Guarding



Quantity	Cat. No.	Description
1	440L-P4A3400YD	GuardShield 3-beam PAC safety light curtain pair
2 (1)	440L-AM0751050	Narrow 1050 mm (41.34 in.) corner mirror
	440L-AM1251050	Wide 1050 mm (41.34 in.) corner mirror
4	440L-AMSTD	Pedestal floor stand

(1) Either two narrow or two wide mirrors.

Approximate Dimensions

Figure 27 - GuardShield PAC Standard Safety Light Curtain 440L-P4A2500YD [mm (in.)]

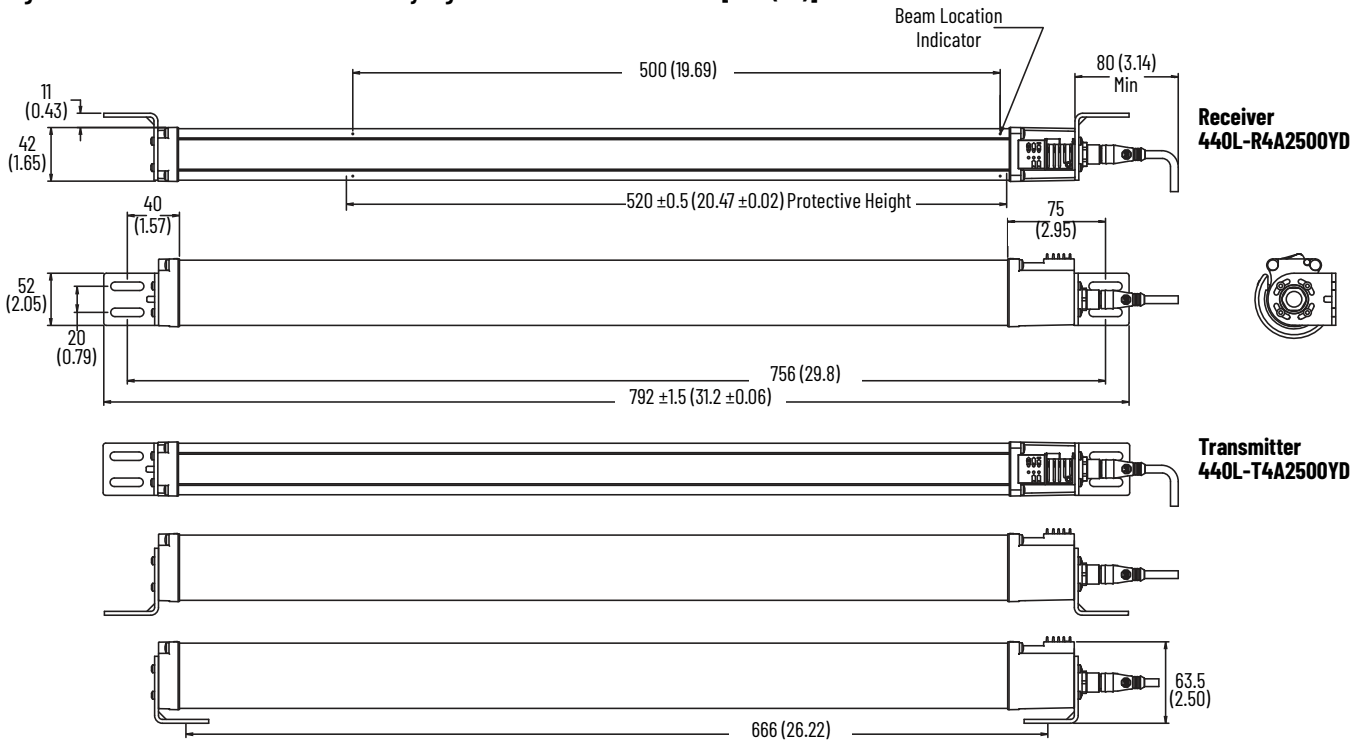


Figure 28 - GuardShield PAC Safety Light Curtain with Integrated Laser Alignment 440L-P4AL2500YD [mm (in.)]

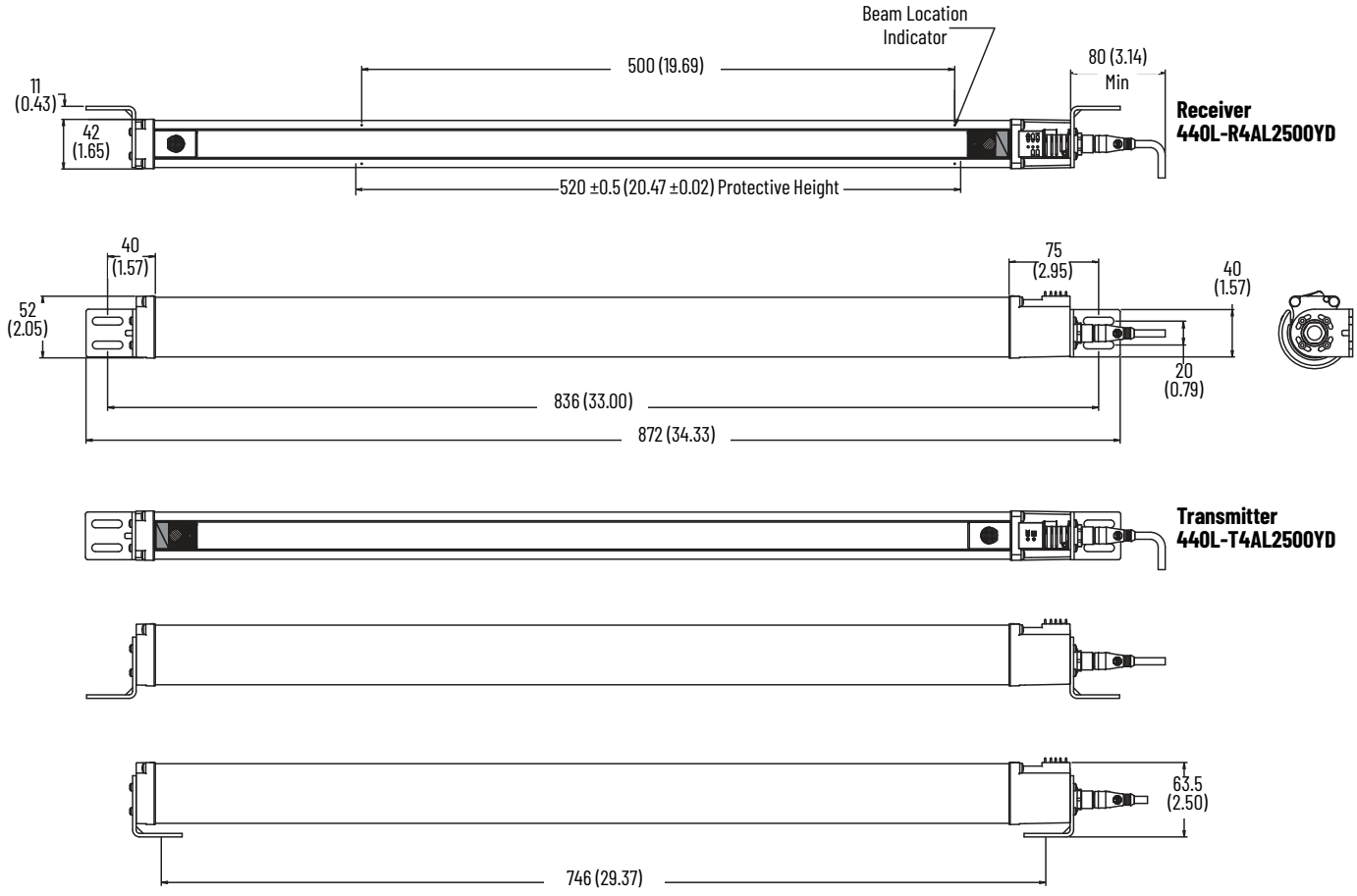


Figure 29 - GuardShield PAC Standard Safety Light Curtains 440L-P4A3400YD [mm (in.)]

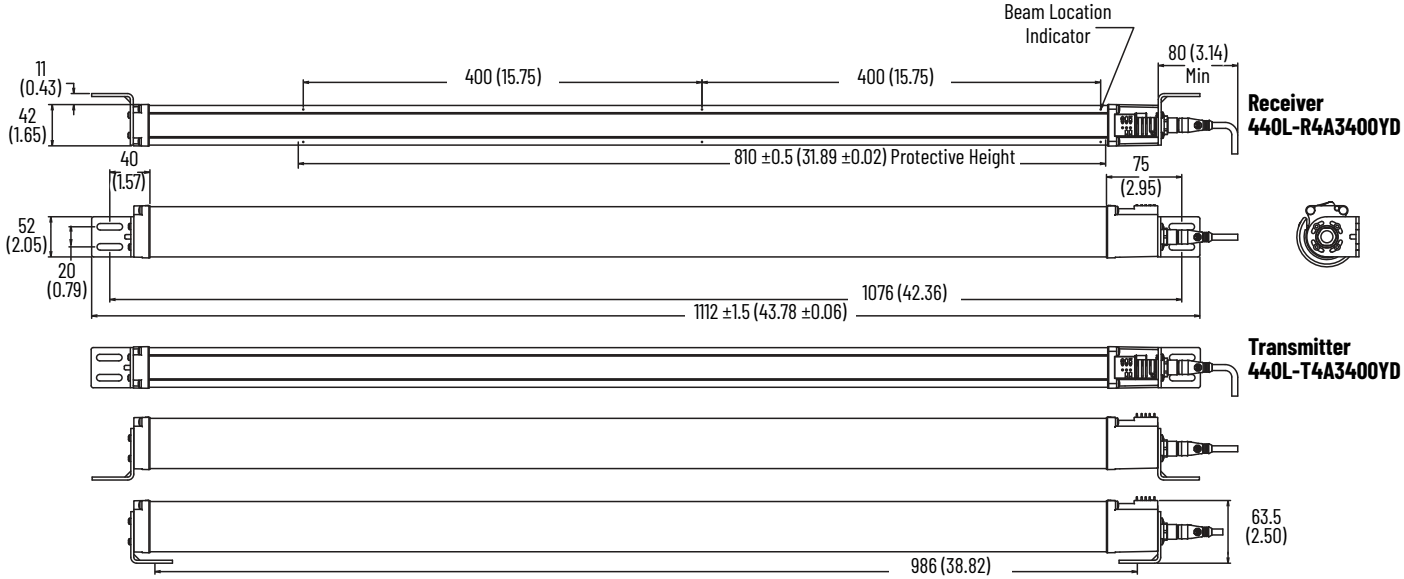
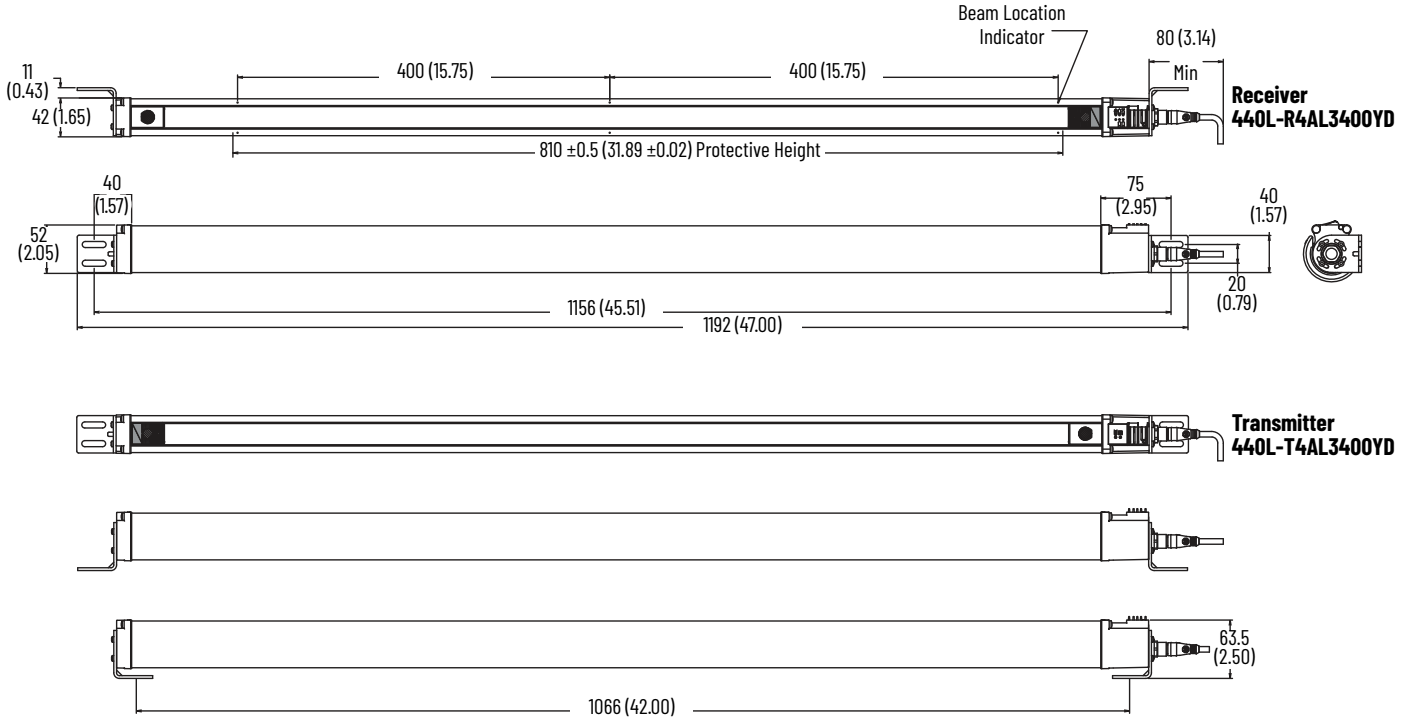


Figure 30 - GuardShield PAC Safety Light Curtain with Integrated Laser Alignment 440L-P4AL3400YD [mm (in.)]



Declaration of Conformity

CE Conformity

Rockwell Automation declares that the products that are shown in this document conform with the Essential Health and Safety Requirements (EHSRs) of the European Machinery Directive (2006/42/EC) and the EMC Directive (2014/30/EU). These products also conform to:

- EN 55022:1998 +A1:2000 +A2:2003- Information technology equipment – Radio disturbance characteristics -Limits and methods of measurement
- EN 61496-1:2004 + A1:2008 - Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements and tests
- CLC/TS 61496-2:2006 IEC 61496-2:2006 - Safety of machinery – Electro-sensitive protective equipment – Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)
- EN 61508:2001 - Functional safety of electrical/electronic/programmable electronic safety-related systems
- EN 62061:2005 - Safety of machinery – Functional safety of safety-related electrical, electronic and programmable control systems
- EN ISO 13849-1:2008 / AC:2009 - Safety of machinery – Safety related parts of control systems – Part 1: General principles for design

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 the Supply of Machinery (Safety) Regulations (2008 No. 1597) and the Electromagnetic Compatibility Regulations (2016 No. 1091). These products also conform to:

- EN 55022:1998 +A1:2000 +A2:2003- Information technology equipment – Radio disturbance characteristics -Limits and methods of measurement
- EN 61496-1:2004 + A1:2008 - Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements and tests
- CLC/TS 61496-2:2006 IEC 61496-2:2006 - Safety of machinery – Electro-sensitive protective equipment – Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)
- EN 61508:2001 - Functional safety of electrical/electronic/programmable electronic safety-related systems
- EN 62061:2005 - Safety of machinery – Functional safety of safety-related electrical, electronic and programmable control systems
- EN ISO 13849-1:2008 / AC:2009 - Safety of machinery – Safety related parts of control systems – Part 1: General principles for design

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

Accessories

Corner Mirrors

Figure 31 - Narrow Mirror

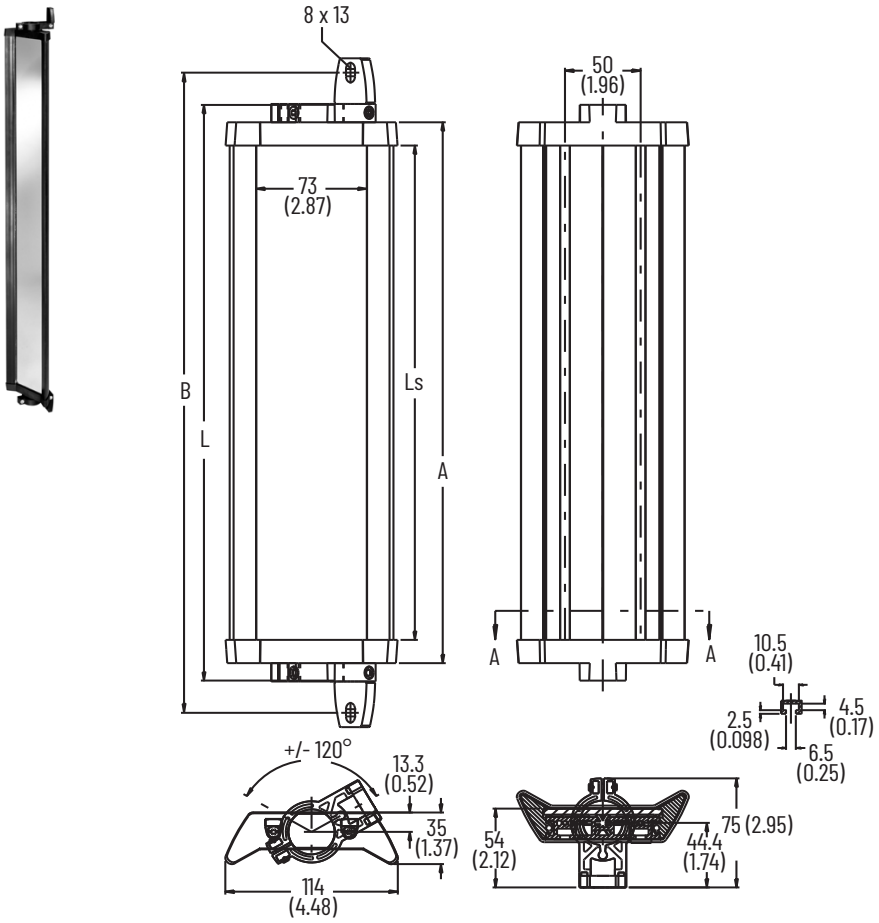


Figure 32 - Wide Mirror

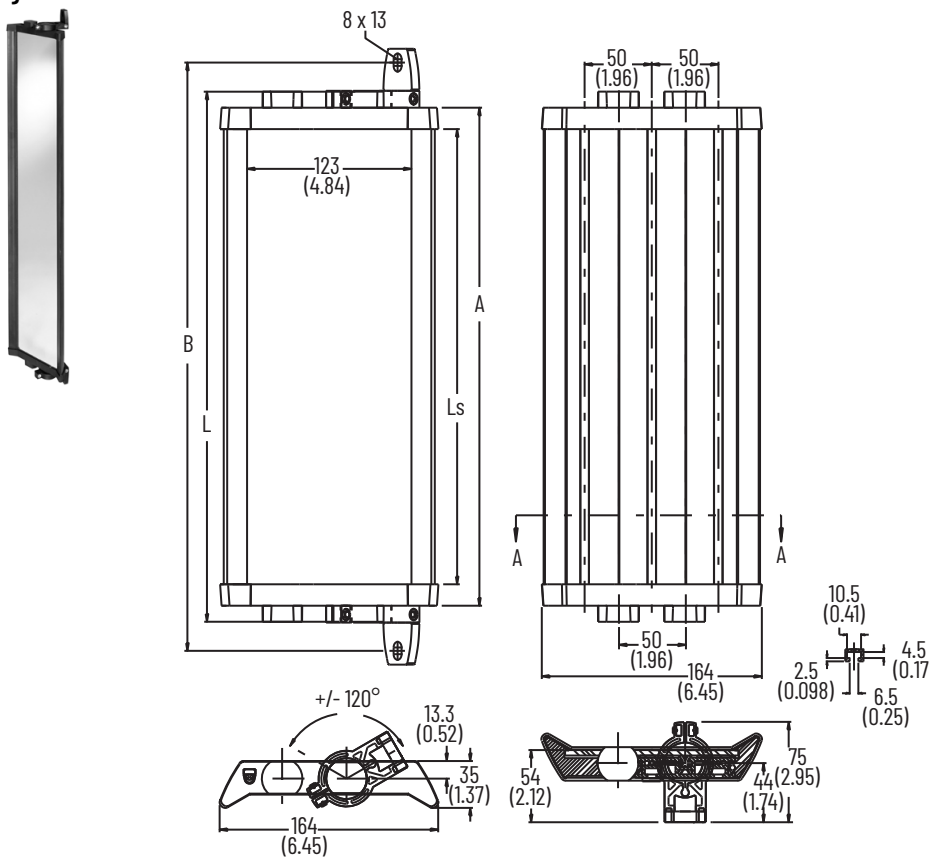


Table 18 - Mirror Dimensions

Safety Light Curtain Cat. No.	Mirror Cat. No.	Type	Dimensions [mm (in.)]			
			L	L_S	A	B
440L-P4A3400YD 440L-P4AL3400YD 440L-P4AL3400YA	440L-AM0751050	Narrow	1146	1090	1122	1190
	440L-AM1251050	Wide	1146	1090	1122	1190
440L-P4A2500YD 440L-P4AL2500YD 440L-P4AL2500YA	440L-AM0750750	Narrow	846	790	822	890
	440L-AM1250750	Wide	846	790	822	890

Pedestal Mounting Stand

Figure 33 - Pedestal Mounting Stand 440L-AMSTD [mm (in.)]

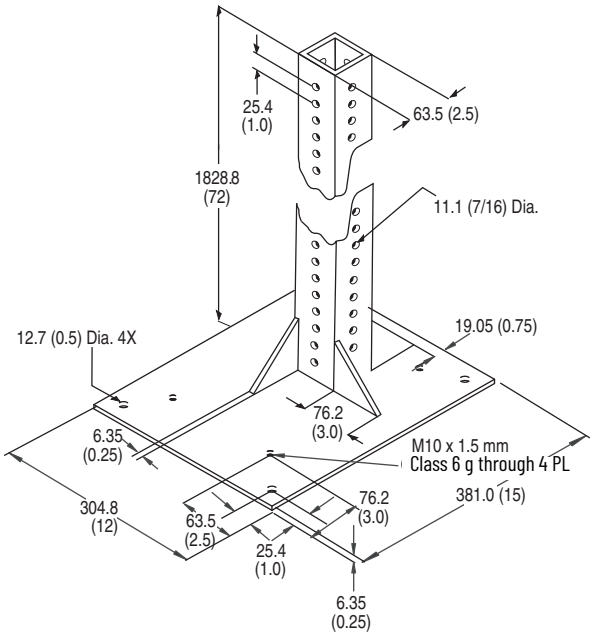


Figure 34 - Mounting Bracket

Two GuardShield™ mounting brackets are supplied with each 440L-AMSTD pedestal mounting stand.

GuardShield Washdown Enclosures

Table 19 - GuardShield Washdown Enclosures (1)

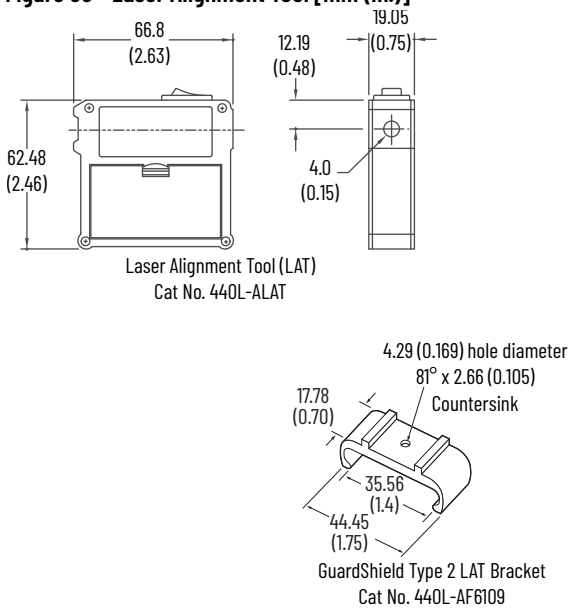
GuardShield PAC Cat. No.	Enclosure Kit Cat. No.
440L-P4A3400YD	440L-AGST960
440L-P4A2500YD	440L-AGST640

(1) The GuardShield washdown enclosures are designed for use with standard GuardShield PAC light curtains only.

Laser Alignment Tool

For used on standard GuardShield. Requires 440L-AF6109 bracket to mount to front of GuardShield PAC.

Figure 35 - Laser Alignment Tool [mm (in.)]



Weld Shields

The GuardShield PAC safety light curtain weld shields are sold as pairs.

These polycarbonate weld shields are designed as disposable devices whose purpose is to help protect the front window of the GuardShield PAC safety light curtain from damage.

Figure 36 - Weld Shield Dimensions [mm (in.)]

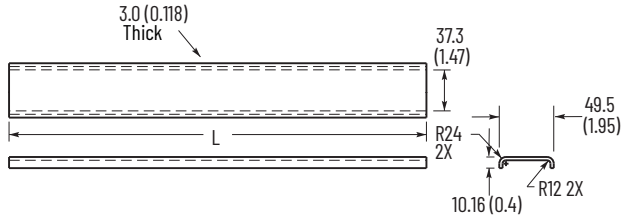


Table 20 - GuardShield PAC Weld Shield

GuardShield PAC Cat. No.	GuardShield Weld Shield Cat. No.	Dimension L [mm (in.)]
440L-P4A2500YD	440L-AGWS0640	655.3 (25.80)
440L-P4AL2500YD	440L-AGWS0800	815.3 (32.10)
440L-P4AL2500YA		
440L-P4A3400YD	440L-AGWS0960	975.4 (38.40)
440L-P4AL3400YD	440L-AGWS1120	1135.4 (44.70)
440L-P4AL3400YA		

Connectors and Patchcords

Table 21 - GuardShield PAC ArmorBlock Connectivity

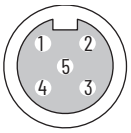
Top View	Color	Pin	Signal
			Receiver
	Brown	1	+24V
	White	2	OSSD 2
	Blue	3	0V
	Black	4	OSSD 1
	Gray	5	NC

Figure 37 - Example of Patchcord

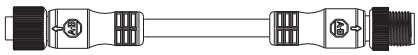


Table 22 - Interconnecting Patchcords - ArmorBlock Guard I/O Connection

Cat. No.	Description
889D-F5ACDM-0M3	5-pin M12 patchcord, 0.3 m (1 ft)
889D-F5ACDM-1	5-pin M12 patchcord, 1 m (3.3 ft)
889D-F5ACDM-2	5-pin M12 patchcord, 2 m (6.6 ft)
889D-F5ACDM-5	5-pin M12 patchcord, 5 m (16.4 ft)
889D-F5ACDM-10	5-pin M12 patchcord, 10 m (32.8 ft)

IMPORTANT The GuardShield PAC pair with ArmorBlock® Guard I/O™ Connectivity has a 5-pin M12 quick-disconnect connector on the receiver that is wired to connect to the ArmorBlock 5-pin connector. The transmitter in that GuardShield pair is a standard GuardShield PAC transmitter with integrated laser alignment system that is offered with a 4-pin M12 quick-disconnect connector. It is possible to connect either a standard 4-pin M12 cordset or the 5-pin M12 quick-disconnect connector patchcord to this transmitter.

Figure 38 - GuardShield PAC Cordsets [mm (in.)]

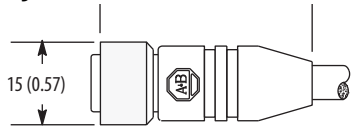


Table 23 - For Connection to GuardShield PAC and GuardShield PAC with Integrated Laser Alignment

Cat. No.	Description [m (ft)]
889D-F8AB-2	8-pin DC micro straight concave cordset, 2 (6.6)
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)

Table 24 - For Connection to GuardShield PAC Transmitters

Cat. No.	Description [m (ft)]
889D-F4AC-2	4-pin DC micro straight concave cordset, 2 (6.6)
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)

Notes:

Notes:

Notes:

Numerics

A

B

C

D

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

Documentation Feedback

Your comments help us serve your documentation needs better. If you have any suggestions on how to improve our content, complete the form at rok.auto/docfeedback.

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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