



GuardShield 450L POC and 450L PAC Safety Light Curtain

Catalog Numbers 450L-B4FNxYD, 450L-B4HNxYD,
450L-E4FLxYD, 450L-E4HLxYD, 450L-E4AxLxYD



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.

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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.

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Notes:

This manual is a reference guide for the 450L-B and 450L-E POC and the 450L GuardShield™ PAC Safety Light Curtains. It describes the procedures to install, wire, and troubleshoot the safety light curtains.

Who Should Use This Manual

Use this manual if you design, install, program, or troubleshoot systems that use the 450L GuardShield safety light curtain.

You must have a basic understanding of electrical circuitry and familiarity with safety-related systems. If you do not, obtain the proper training before using this product.

Qualified personnel must conduct all inspections. A qualified person must perform these tasks:

- Undergo the appropriate technical training
- The responsible machine operator must instruct personnel in the operation of the machine and the current safety guidelines.
- You must read and have access to the user manual.

Qualified personnel must install the light curtain and only use the light curtain on that specific machine.

Summary of Changes

Topic	Page
Added 450L PAC safety light curtain information	Throughout
Added interference rejection information	Throughout
Updated Additional Resources	10
Updated Table 19	50
Updated Mount Multiple 450L GuardShield Safety Light Curtains	72
Updated Plug-in Label	113
Updated Optional Accessories	174
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Terminology

Abbreviation	Definition
DoC	Declaration of Conformity
EDM	External Device Monitoring
ESPE	Electro-sensitive protective equipment
FSD	Final switching device
NC	Not connected
NEC	National Electric Code (U.S.)
OID	Optical Interface Device
OSSD	Output Signal Switching Device: Typically designates a pair of solid-state signals that are pulled up to the DC source supply. The signals are tested for short circuits to the DC power supply, short circuits to the DC common, and short circuits between the two signals.
PAC	Perimeter Access Control: A safety light curtain that is designed for whole body detection to create a safety perimeter around a machine.
POC	Point of Operation Control: A safety light curtain that is designed for installation close to the hazard where personnel could frequently interact with the machine as part of the process. These safety light curtains are therefore designed for partial body detection. The 450L safety light curtain family offers finger and hand detection.
PL	Performance Level
QD	Quick disconnect
RB	Restart button
Rx	Receiver
SIL	Safety integrity level
Tx	Transmitter

Additional Resources

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

Resource	Description
450L GuardShield Safety Light Curtain Quick Start, publication 450L-QS001	Provides a quick start information to configure and run a system using 450L Safety Light Curtains.
GuardShield 450L-B Safety Light Curtain Package Content, publication 450L-PC001	Provides installation information for 450L Safety Light Curtain replacement units.
450L GuardShield Light-Curtain Weld-Shield Installation Instructions, publication 450L-IN001	Provides installation information for weld shield kits.
Side Mount Bracket Set for GuardShield Light Curtains Installation Instructions, publication 450L-IN002	Provides installation information for side mount brackets.
GuardShield Light Curtain Optical Interface Device Installation Instructions, publication 450L-IN003	Provides installation information for the optical interface device.
GuardShield Safety Light Curtain Installation Instructions, publication 450L-IN004	Provides installation information for 450L-B and 450L-E POC Safety Light Curtains.
GuardShield Muting Distribution Block Installation Instructions, publication 450L-IN005	Provides installation information for the 450L Muting Distribution Block.
GuardShield Safety Light Curtain Status Light Installation Instructions, publication 450L-IN007	Provides installation information for the 450L Status Light.
GuardShield 450L PAC Safety Light Curtain Installation Instructions, publication 450L-IN009	Provides installation information for the 450L PAC Safety Light Curtains.
Safety Book 5, Safety-related Control Systems for Machinery, publication SAFE5BK-RM002	Provides principles, standards, and implementation of safety-related control systems for machinery.
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.

Product Overview

General Description

The 450L GuardShield™ safety light curtain family consists of general-purpose presence sensing devices that are designed for use on hazardous machinery for both Perimeter Access Control (PAC) and Point of Operation Control (POC) applications. The product family is certified as Type 4 electro-sensitive protective equipment (ESPE) (as defined by EN 61496-1 and IEC 61496-2). This certification allows this product to be used in applications that require PLe category 4 according to EN ISO 13849-1.

The 450L PAC safety light curtains are based on the 450L-E POC safety light curtain models and are offered in single-beam (Area Access Control [AAC]), 2-beam, 3-beam, and 4-beam options and range in length from 150...1050 mm (5.91...41.34 in.).

The 450L POC safety light curtains are offered in multiple lengths from 150...1950 mm (5.9...76.77 in.) in increments of 150 mm (5.9 in.). Each length is available in finger (14 mm [0.56 in.]) or hand (30 mm [1.19 in.]) resolution with a basic set of sensing functions.

The 450L POC safety light curtain family consists of two product lines:

- 450L-B (Basic)
- 450L-E (Enhanced)

The 450L-B safety light curtain is suitable for basic ON/OFF applications, whereas the 450L-E safety light curtain provides enhanced features for more sophisticated applications. [Table 1](#) provides an overview of the differences between the two product versions:

Table 1 - Differences Between 450L-B and 450L-E/450L PAC Safety Light Curtain Systems

Description	450L-B	450L-E and 450L PAC
Alignment aid	Two zone indicator light-emitting diode (LED)	Integrated laser alignment and two zone indicator LED
Operation range finger resolution, min...max	0.5...4 m (1.6...13.12 ft)	0.5...9.0 m (1.64...29.53 ft) ⁽¹⁾
Operation range hand resolution, min...max	0.9...7.0 m (2.95...22.97 ft)	0.9...16.2 m (2.95...53.15 ft)
Functionality	Start modes External device monitoring (EDM) Operation range	Start modes EDM Operation range Beam coding Blanking ⁽²⁾ Muting Cascading
CIP Safety™ functionality ⁽³⁾	Yes	Yes

(1) Not applicable for 450L PAC, which is based on 450L-E hand resolution.

(2) Blanking is not available on 450L PAC safety light curtain models.

(3) Only with appropriate plug-in and module. CIP safety is not available on 450L PAC models

The two 450L safety light curtain versions have no differences in cross section, protective heights and resolutions, sealing, operating and storage temperature, and length passive zones at the ends of each stick and mounting options. The 450L PAC safety light curtain also has the same cross section, sealing, operating and storage temperatures, and mounting options.

What makes each GuardShield light curtain system unique from other safety light curtain transmitter and receiver solutions is that it consists of two identical transceiver sticks. These safety light curtains are not designated as transmitter or receiver right out-of-the-box. The configuration of a stick as a transmitter or a receiver is done by inserting either:

- A dedicated transmitter or receiver plug-in into the transceiver sticks
- A universal plug-in module in each transceiver stick, which allows a selection for the transmitter or the receiver function by wiring.

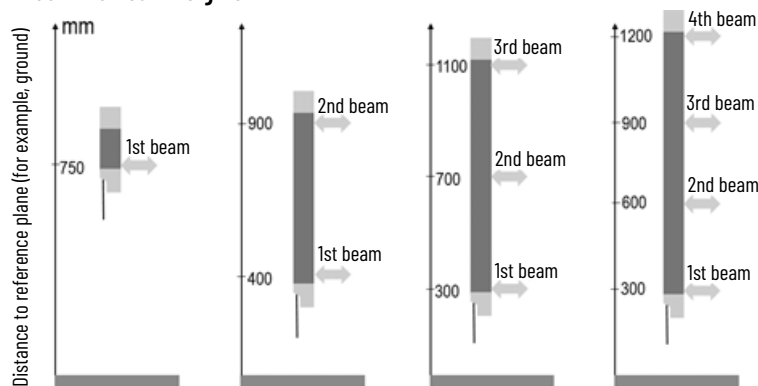
The GuardShield 450L POC safety light curtains are designed as a two-box system, which has no inactive sensing area or dead/blind zones at the top and bottom of each stick. This design allows a perfect and easy integration in individual machine designs.

The GuardShield 450L PAC safety light curtains are also designed as a two-box system. By design, PAC systems are produced with several single-beam light barriers or, for 450L PAC safety light curtains, a combination of active and passive elements in accordance with EN ISO 13855 [2010].

Figure 1 - 450L PAC Front View - Active and Passive Zones (2-beam model used for illustration)



Figure 2 - 450L PAC Beam Heights



Selectable function depends on the installed receiver plug-in, which can be inserted in a GuardShield safety light curtain transceiver stick. Different operation modes can be selected via the DIP switch on the receiver plug-ins.

Depending on the type of plug-in that is installed in a GuardShield stick, the system offers:

- Connectivity to ArmorBlock® Guard I/O™ (5-pin M12 QD) for network connectivity providing CIP Safety™ over DeviceNet™ or EtherNet/IP™ (not applicable for 450L PAC safety light curtain models).
- Auto or manual start modes
- External device monitoring (EDM)
- Beam coding
- Muting, blanking, and cascading capabilities (only for the 450L-E safety light curtain)



LASER LIGHT CLASS 2 HAZARD: Do not stare into the beam. The 450L-E safety light curtains are equipped with an integrated laser alignment help option (see [Laser Alignment on page 23](#)).

Recognized technical regulations and ISO 9001 quality assurance procedures are carefully applied during the development and production of Allen-Bradley® GuardShield products.

IMPORTANT 450L-B safety light curtain transceiver stick cannot operate with a 450L-E safety light curtain transceiver stick. 450L PAC safety light curtain transceiver stick cannot operate with a 450L POC safety light curtain transceiver stick of either kind.

Figure 3 - Compatibility Limitations

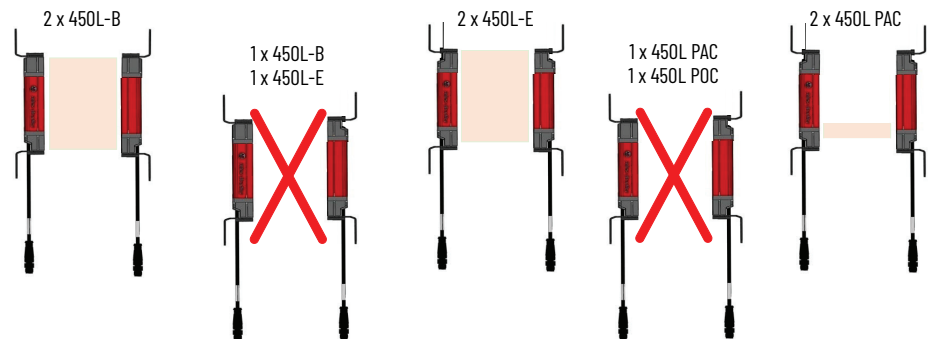


Figure 4 - Assembly Overview for the 450L-B Safety Light Curtain System

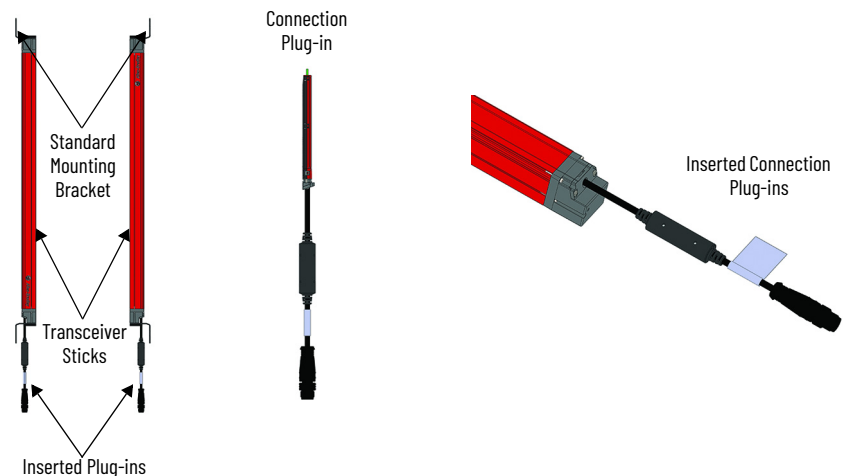
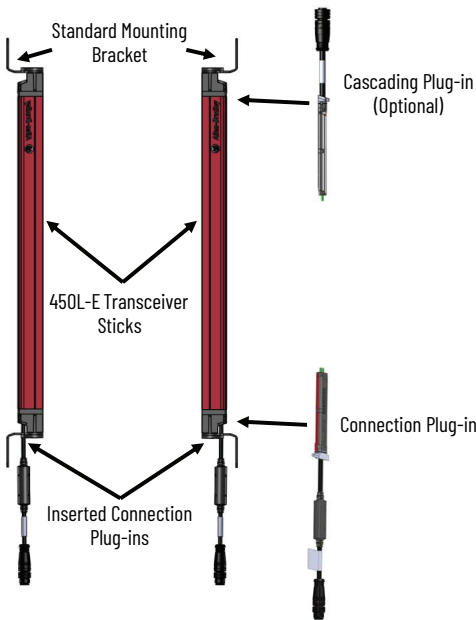


Figure 5 - Assembly Overview for the 450L PAC and 450L-E POC Safety Light Curtain System



A 450L-E and 450L PAC safety light curtain also provides the option to insert a cascading plug-in into the opposite stick end at the gray slot cover (see [Cascading on page 43](#) and [Figure 7 on page 15](#)).

Package Contents

A GuardShield safety light curtain is normally shipped as an individual component (single transceiver). A functional system includes four individual boxes.

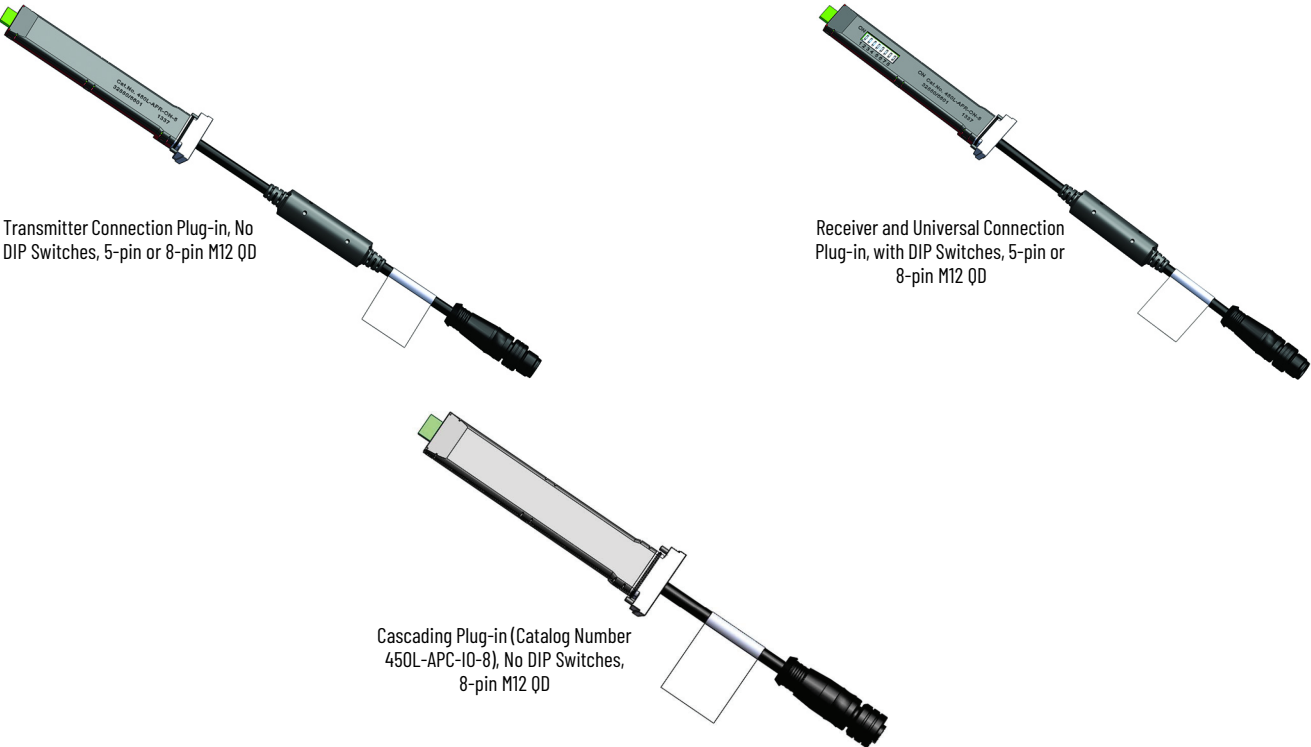
Table 2 - List for a Complete System

Item	Required Quantity	Description	Remark
1	2	450L GuardShield safety light curtain transceiver stick	Each box contains: <ul style="list-style-type: none">• One stick• Mounting kit (top and bottom)• Test rod• Short instruction manual
2	1	Transmitter plug-in	150 mm (5.9 in.) pigtail with M12 QD connector (convex)
3	1	Receiver plug-in	150 mm (5.9 in.) pigtail with M12 QD connector (convex)

Figure 6 - Contents of 450L POC Safety Light Curtain Transceiver Stick Box



Figure 7 - Plug-ins



Firmware Revisions

The feature list of the 450L-B and of the 450L-E safety light curtains continuously expands. [Table 3 on page 16](#) lists the components that have firmware that can be upgraded using ControlFLASH™ software.

Table 3 - Firmware Revisions of 450L Safety Light Curtains

Family	Version	Description
450L-B	1.001	Initial Release. Does not support Connected Components Workbench™ software.
	2.001	Support Connected Components Workbench software diagnosis and connection with T-connector. Can be used as the last pair of cascading.
	3.001	Same feature as 2.001 but 4K security key. Engineering version only - not released to users.
	4.001	Support Connected Components Workbench software diagnosis.
	5.001	Same feature as 4.001 4K security key.
	5.002	Initial release to support CIP Safety functionality.
	5.003	Engineering version only - not released to users.
	5.004	Introduction of interference rejection option.
450L-E	2.001	Initial release and supports Connected Components Workbench software diagnosis. Supports Safety Override, Dry Contact Switch, and E-stop. Cascaded light curtains Tx side cannot use universal plug-in, the host pairs can still use universal plug-in.
	3.001	Same feature as 2.001. Engineering version only - not released to users.
	4.001	Support Connected Components Workbench software diagnosis and configuration. Not backward compatible with 450L-APC-IO-8.
	5.001	Same feature as 4.001 4K security key.
	5.002	Initial release to support CIP Safety functionality.
	5.003	Engineering version only - not released to users.
	5.004	Introduction of interference rejection option.
450L PAC	1.001	Initial Release. Does not support Connected Components Workbench software, or Studio 5000® (CIP Safety).
450L-APC-IO-8	1.001	Initial Release.
	2.001	Allows 450L-APU-UN-8 to be used as a transmitter in a cascaded stick.
	3.001	Same feature as 2.001.
	4.001	Backward compatible with LC.
	5.001	Same feature as 4.001 4K security key.
450L-OID	1.001	Initial Release, does not support the 450L-E safety light curtain. If you get a message, "The connection to the 450L safety light curtain will be terminated because of repeatedly mismatched checksum calculation errors" then upgrade the FW to 1.002 or later.
	1.002	Support LC Diagnosis and FW update.
	3.001	Backward compatible with LC. It supports LC FW 3.001 diagnosis, FW update, reset, confirm, and blanking teach command. Added 4K key certificate support.
	4.001	Backward compatible with LC. Example: 2.001, 3.001, 4.001 LC can work with 5.001 OID, but 3.001, 4.001 OID cannot work with 5.001 LC.
	5.001	Backward compatible with LC 4K security key.

For maintenance reasons, a 450L safety light curtain stick with an old firmware version can be operated with a 450L safety light curtain stick with newer firmware.

Safety Concepts

This section describes the safety Performance Level concept and explains how the 450L safety light curtains meet the requirements for SIL 3 and PLe for Category 4 architectures.

Safety Standards Applied to GuardShield

The 450L safety light curtain satisfies applicable requirements in the following standards that are related to functional and machinery assembly:

- IEC 61496-1/-2 (Type 4)
- IEC 61508 (SIL 3)
- IEC 62061 (SIL CL 3)
- EN/ISO 13849-1 (Performance Level e (PLe), Category 4)
- UL 508

The 450L-E safety light curtain satisfies applicable requirements that are provided in IEC 60825-1 for the integrated laser alignment aid (see [Laser Alignment on page 23](#)).

Published dates of the individual standards are given in the Declaration of Conformity (see rok.auto/certifications).

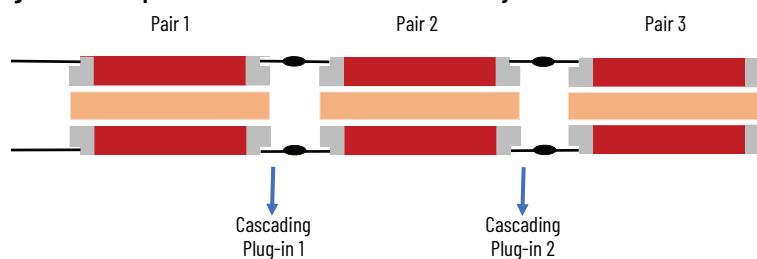
Functional Safety Data

The functional safety data are listed in [Table 72 on page 165](#). These values refer to the longest light curtain system length (1950 mm [76.77 in.]) with the smallest resolution (14 mm [0.55 in.]).

For cascaded 450L-E safety light curtain applications, the final PFH value of the complete system is the sum of the individual PFH values of each pair plus the sum of the PFH values of the cascading plug-in.

The following example ([Figure 8](#)) shows the calculation of the PFH of a cascaded system with 450L-E safety light curtain and two cascading plug-ins.

Figure 8 - Example and PFH Calculation of Cascaded Systems



$$\text{PFH (total)} = 3 \times \text{PFH (450L pair)} + 2 \times \text{PFH (cascading plug-in)}$$

IMPORTANT For 450L-E safety light curtains, if cascading the PFH of each cascade and each cascading plug-in must be considered.

Safety Certification

Each 450L safety light curtain is a Type 4 ESPE as defined by IEC 61496-1 and CLC/TS 61496-2. The safety light curtains are allowed for use with controls in compliance with these certifications.

- PLe (in a Category 4 architecture) in compliance with EN ISO 13849
- SIL CL3 in accordance with EN 62061
- SIL 3 in accordance with IEC 61508

Safety requirements are based on the standards applicable at the time of certification with a proof test interval of 20 years.

The device is suitable for the following:

- Point of Operation Control (POC) finger- and hand-detection
- 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 [Correct Installation on page 70](#)).

Depending on the application, mechanical protective devices are potentially required in addition to the safety light curtain.

TÜV Rheinland has approved the 450L GuardShield™ safety light curtains for use in safety-related applications where Performance Level (PL) up to e and safety integrity level up to SIL 3 are required.

TÜV Rheinland confirmed that the integrated laser alignment aid in 450L-E GuardShield safety light curtains conforms to the classification of laser class two according to IEC 60825-1.

IMPORTANT Observe the following directives, rules, and regulations to help conform to 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
- Low Voltage Directive
- Equipment Usage Directive
- Work safety regulations/safety rules
- Other relevant health and safety regulations

Published dates of the individual standards are given in the Declaration of Conformity (see [Compliance with European Union Directives on page 169](#)).

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 this user manual (for example, on use, mounting, installation, or integration into the existing machine controller) must be observed.
- Specialist personnel or specially qualified and authorized personnel implement the tests and must record and document that the tests can be reconstructed and retraced at any time.
- This user manual must be made available to the user of the machine where the GuardShield safety light curtain is installed. The machine operator is instructed in the use of the device by specialist personnel.

Installation Requirements

The GuardShield safety light curtains must be installed in accordance with applicable regulations and standards.

While the GuardShield safety light curtains can be used for SIL 3, PLe, and Category 4 applications, the installer must comply with the minimum (safe) distance requirements. For example, according to EN ISO 13855, if installed in the European Union.

The installed system, including the safety control system and the means by which the machine stops, must achieve the needed safety Performance Level. The GuardShield safety light curtains are only one element in the safety system. Additional guidance can be found in publication [SAFEBC-RM002](#).

Possible Misuse

GuardShield safety light curtains are used as electro-sensitive protective equipment in the sense of the Machinery Directive. These devices are only used in applications such as:

- POC device
- Access control device
- Hazardous area control device



ATTENTION: The following applications and/or environmental conditions can lead to misuse and potentially cause severe injuries or death (for more information see IEC 62046).

- Machines, which eject materials, swarf, or component parts
- Risk of injury from thermal or other radiation
- Unacceptable noise levels
- Transparent objects are detected
- An environment, which exceeds the specification, limits provided in [Specifications on page 165](#).

Some, but not all, possible limits are electrostatic discharge, radio frequency interference, vibration/shock, ambient light, pollution, temperature, and humidity.

Without additional measures (IEC 62998), GuardShield safety light curtains are not designed to be used for the following applications:

- Outdoors
- Under water
- Explosive atmospheres
- Altitudes over 3000 m (1.86 miles) above sea level
- With enhanced ionizing or radar radiation.

Notes:

Operation

This chapter provides information on the special features and properties of the 450L safety light curtain. It also describes the structure and functions of the unit, particularly the different operating modes.

Principle of Operation

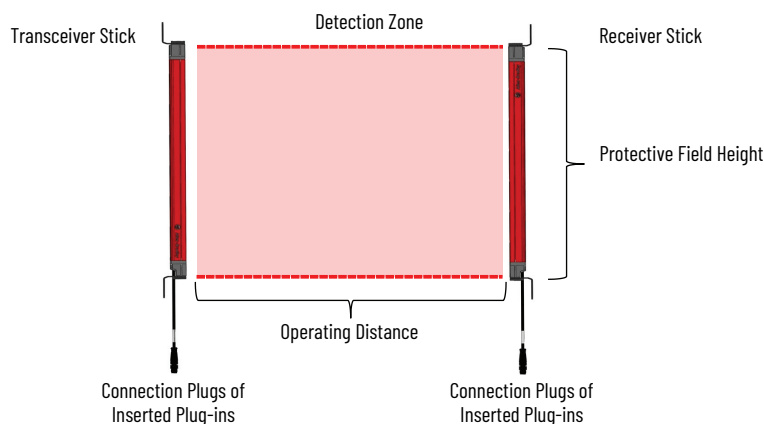
A functional GuardShield™ safety light curtain system includes:

- Two transceiver sticks (same model, length, and resolution)
- A transmitter plug-in
- A receiver plug-in

The type of plug-in defines which way a transceiver stick performs: As a transmitter stick or as a receiver stick. The maximum distance between transmitter and receiver sticks is referred to as the operating distance or operating range (see [Figure 9](#)). The GuardShield systems also require a minimum operating distance. If a system is installed below this distance, the safety outputs do not switch to on. The maximum operating range is reduced by using deflector mirrors and/or weld shields.

The protective field height of a GuardShield safety light curtain is equal to the total length of the stick.

Figure 9 - Principle Operation of a 450L Safety Light Curtain System



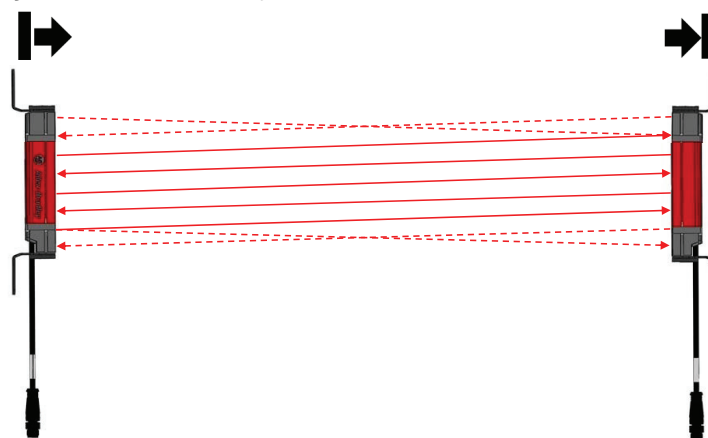
A short time after the power-up and alignment of a system, nonvisible infrared light beams build up a plane of detection (protective field) between the two sticks. The axis of the detection zone is vertical to the front window of the light curtain sticks.

Sequential pulses of infrared light are sent between the two sticks. The beam status analysis and the processing are done by the receiver. When one or more beams are interrupted, the two output signal switching devices (OSSDs) turn off. A safety control, safety relay, or safety contactor evaluates the signal to stop the dangerous state of the machine.

The first laser beam, or the last beam near the end of the sticks, optically synchronizes the timing of the emission and reception of infrared light pulses. These beams are referred to as the synchronization beams. Because the GuardShield systems are optically synchronized, no electrical connection is required between the transmitter and receiver sticks.

The unique design of the GuardShield platform allows every 450L safety light curtain transceiver to transmit and receive infrared light. In contrast to the classical architecture of common pure transmitter and receiver light curtain systems, GuardShield transceiver sticks exchange protective field information via infrared light. Therefore infrared light is not only sent from a transceiver working as a transmitter to a receiver. As indicated in [Figure 10](#), a transceiver stick configured as a receiver transmits some infrared light to the transmitter. The dashed lines in [Figure 10](#) indicate the synchronization beams.

Figure 10 - Schematic Display of Beam Center Lines



The slightly slanted beams and the maximum operating angle of the IR light require that a transmitter and a receiver stick are installed beyond a minimum operating distance. A 450L safety light curtain system is safe against manipulation because a transmitter stick cannot be installed directly in front of a receiver stick.

A GuardShield transceiver, which acts as a receiver, has two OSSD safety outputs and, depending on the plug-in that is used, one additional non-safety auxiliary output. When the GuardShield transmitter and receiver are properly powered, aligned, not obstructed, and the start/restart mode has been correctly initiated, both the OSSDs and the auxiliary output are ON (output voltage = +24V DC). The two safety OSSDs are cross fault monitored and short-circuit protected.



ATTENTION: The Auxiliary output is only a status output for diagnosis purposes to connect, for example, an indicator lamp. Do not use this output for safety purposes.

Interruption of the sensing field causes the receiver OSSD to switch OFF (sourced current 0 mA DC, source voltage 0V DC).

For automatic restart: No obstruction of the GuardShield sensing field causes the two safety outputs (OSSD) to switch to the active high (On) state (+24V DC).

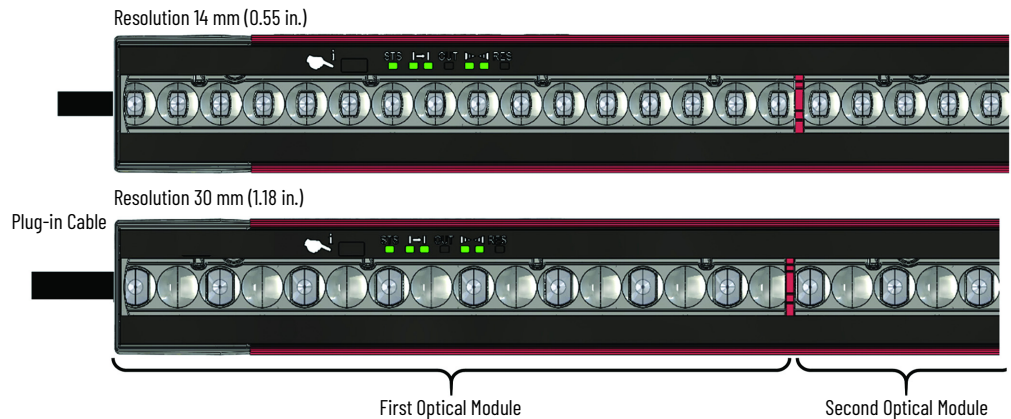
With the appropriate resolution, the GuardShield safety light curtain system provides finger or hand protection. The resolution corresponds to the diameter of the provided test rod belonging to the safety light curtain. The test rod is reliably detected when positioned in the protective field. The resolution of a GuardShield stick is printed on the product label.



ATTENTION: The resolution of a 450L-E safety light curtain system that is configured with blanking, changes depending on the configuration (see [Blanking and Reduced Resolution on page 28](#)). Any change in the resolution must be considered in the safety distance calculation (see [Determine the Safety Distance on page 62](#)) and in the installation.

[Figure 11](#) shows the active lenses for the two resolutions of the safety light curtain.

Figure 11 - Active Lenses for Different Resolutions



Resolution [mm (in.)]	Lens Number Per Module															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
14 (0.56)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
30 (1.19)	X	—	X	—	X	—	X	—	X	—	X	—	X	—	X	—

IMPORTANT The gap (approximately 1.5 mm (0.05 in.) between adjacent modules, which are red (indicated in [Figure 11](#) for hand and finger resolution), has no impact on resolution.

Laser Alignment

All 450L-E and 450L PAC safety light curtain transceiver sticks have an integrated laser alignment system (ILAS). The laser works with visible light, which makes the alignment of a 450L-E and 450L PAC safety light curtain system much easier.



LASER LIGHT HAZARD: Do not stare into the beam. Each 450L-E and 450L PAC safety light curtain has a built-in laser alignment system.
LASER CLASS 2 (IEC 60825-1).
Conforms to 21 CFR 1040.10.

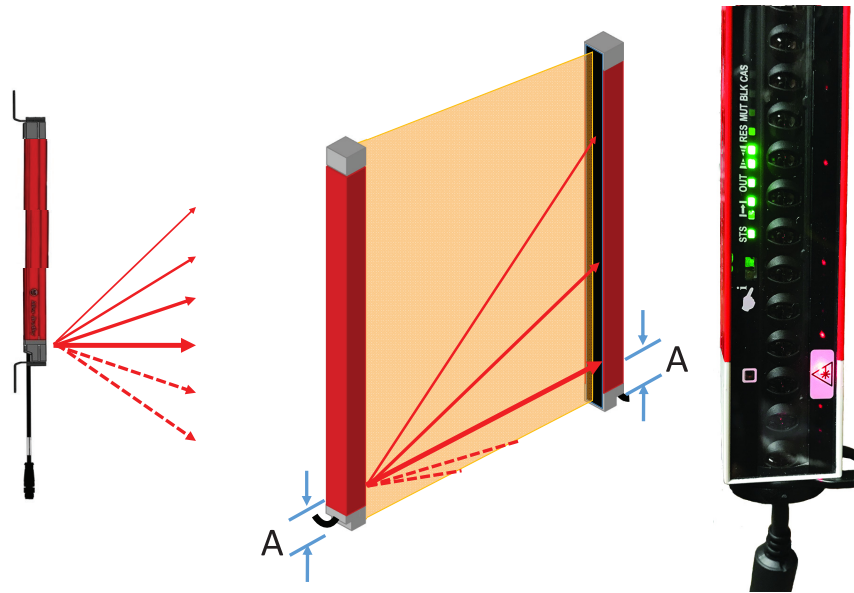
The ILAS can be switched on and off by simply placing a finger on the optical push button, which is located close to the hand symbol on the front window (see [Figure 33 on page 59](#)). As soon as the laser is activated, several red laser beams are transmitted (see [Figure 12 on page 24](#)) from a source close to the optical push button.

[Figure 12 on page 24](#) shows the principle operation of the ILAS. The brightest beam is transmitted perpendicular to the front window, which is also parallel to the infrared light of the stick. The brightest beam has to be positioned at the opposite stick at the same level as indicated with distance A in [Figure 12 on page 24](#). The other slanted laser beams must also be targeted between the optics center and the housing of the opposite stick on the front window. The quantity of slanted beams on the opposite stick depends on the installation

distance. To find optimum alignment for a 450L-E and 450L PAC safety light curtain system, the laser of each stick must be aligned to the opposite stick.

IMPORTANT A white background (for example, paper) makes it easy to identify the brightest beam.

Figure 12 - Principal Function of the Integrated Laser Alignment System



IMPORTANT [Figure 12](#) indicates additional visible laser beams (dotted) to the connection end of the stick. Such beams do not have to be considered for the alignment procedure.

In a cascading system, each integrated laser system works independently and can be switched on or off individually.

The 450L-B safety light curtain sticks have no integrated laser alignment system. For those sticks, an optional external alignment aid (see [Figure 191 on page 178](#)) with a mounting clamp ([Figure 192 on page 178](#)) is available.

Safety Function

The 450L safety light curtain offers a range of functions that are integral to the safety system. The functions are selected through DIP switch settings on the receiver plug-in.

A confirmation of a new configuration at the receiver stick is only required if the stick was previously operated with another DIP switch setting or with another plug-in type (see [Confirmation of a New System Configuration on page 59](#)).

A confirmation of a new configuration at the transmitter stick is only required if the stick was previously operated with another beam coding (see [Beam Coding on page 27](#)).



ATTENTION: The protective system must be tested for proper operation after each change to the configuration.

Some safety functions can only be selected with the 450L-E safety light curtain. A complete overview is provided in [Table 1 on page 11](#).

Start Modes

The four start modes are configurable for all GuardShield™ product lines (450L PAC and both 450L-B and 450L-E POC safety light curtain product lines). Manual reset options are only provided for 8-pin connection plug-ins. 5-pin plug-ins have only the automatic (re)start option.

IMPORTANT

The Start button can also be used to power cycle a receiver stick if there is a lockout. A receiver stick performs the power off/on cycle if the input of the Start button is activated for a minimum of 10 seconds, but not longer than 20 seconds. This function is also available if automatic start is configured for receiver plug-ins, which allow a start mode selection, see [Restart Button on page 91](#) for additional installation hints.

Automatic (Re) Start (Default)

When in the automatic start mode of operation (also known as Guard only mode), the light curtain operates as an on/off device. The OSSD outputs switch off, according to an interruption of the sensing field, and automatically switch on when the protective field is cleared. The GuardShield pairs that are equipped with bottom plug-ins and factory-default DIP switch settings work in Automatic Start mode.

Manual (Re) Start

The manual start mode of operation (also known as restart interlock) helps prevent the OSSD outputs from switching ON automatically after interruption and clearance of the protective field or power-up. A manual start of the GuardShield system is required. Startup of the system is accomplished through a momentary N.O. push button or keyswitch. An orange status indicator (RES) on the 450L safety light curtain receiver indicates that the system is ready for manual restart.

Manual start is not available in GuardShield light curtains with ArmorBlock® Guard I/O™ connectivity (5-pin bottom plug-in).

The Start button must be pressed a minimum of 50 ms. The maximum time for accepting the start pulse is 5 seconds. If the pulse width is too short or too long, the start function is not executed. The start reacts on the falling edge of the start pulse.

Manual Cold Start

The manual cold start (also known as start interlock) helps prevent the OSSD outputs from switching ON after power-up of the system, even when the protective field is unobstructed. After each power-up, a one-time manual start of the system is required for the GuardShield system OSSD outputs to enter the ON state.

The Start button must be pressed a minimum of 50 ms. The maximum time for accepting the start pulse is 5 seconds. If the pulse width is too short or too long, the start function is not executed. The start reacts on the falling edge of the start pulse.

After the initial power-up and manual start has taken place, the light curtain system operates in the automatic start mode. Activation of this mode of operation and selection of the starting method is through DIP switch settings. An orange status indicator (RES) on the GuardShield receiver indicates that the system is ready to be manually started.

Manual cold start is not available in GuardShield light curtains with ArmorBlock Guard I/O connectivity (5-pin bottom plug-in).

Manual (Re) Start with Off Function

This start mode allows the OSSD outputs to be switched on manually (if the protection field is unobstructed) and switched off manually. The OSSD outputs can be manually turned OFF by use of the same momentary N.O. push button or keyswitch that is used for manual start. When the OSSDs switched off because of an interruption of the protective field, the protective field must be cleared and the push button or key must be operated again.

Configuration and activation of this mode of operation is through DIP switch settings. An orange status indicator (RES) on the GuardShield receiver indicates that the system is ready to be manually started.

Power Cycle

When a GuardShield receiver goes into a lockout state, power must be cycled after the cause of the lockout has been corrected. The Start input signal and the Optical Push Button, can be used to cycle power. Press and hold the Start button or the optical push button between 10...20 seconds. The power cycle function is available for all start modes, including automatic.

External Device Monitoring (EDM)

External device monitoring is configurable for both GuardShield product lines.

EDM is an input signal to the GuardShield receiver. It is used to monitor the state of the primary control contactors of the guarded machinery or other final switching devices (FSD). The EDM input is looking for a change of state of the contactors/FSD within a time period of 300 ms before the system faults. A fault causes the safety light curtain to enter a lockout condition (OSSDs OFF and error indication). One reason to select the EDM function can be the detection of an unsafe condition such as welded contacts in one of the FSD. Activation of this mode of operation is through the DIP switch setting on the GuardShield receiver plug-in or by enabling this function in the General settings in Connected Components Workbench™ software.

EDM is not available in GuardShield safety light curtains with ArmorBlock Guard I/O connectivity (M12 5-pin QD plug-in).

Low Operating Range

Low operating range is designed to minimize the influence of neighboring optical sensors on the 450L safety light curtain performance. This feature is available on all 450L GuardShield safety light curtains. Low operating range narrows the operating distance. The maximum operating distance is reduced, and the minimum operating distance is increased.

Low operating range is configured by enabling the appropriate DIP switch on the receiver plug-in, or by enabling the function in the General settings in Connected Components Workbench software. The default setting is disabled.

The regional intensity status indicators on the transmitter and receiver indicate the activation of the low range function.

Beam Coding

Beam coding is only configurable for 450L-E and 450L PAC safety light curtains.

If several safety light curtains are operating close to one another, it is possible that one 450L-E/450L PAC safety light curtain system can see the transmitter infrared light from another 450L-E/450L PAC safety light curtain receiver. Such a situation is called optical cross talk (see [Mount Multiple 450L GuardShield Safety Light Curtains on page 72](#)) and can cause an unsafe installation. To reduce the probability of optical cross talk, the 450L-E/450L PAC safety light curtain is able to exchange the addresses of the sticks that are paired, and to generate a different transmitter pulse pattern. This process is referred to as beam coding.

Two settings are available in the 450L-E and 450L PAC safety light curtain — non-coded and coded. The factory default is non-coded.

If beam coding is selected, you must perform a teach-in procedure once at the transmitter and the corresponding receiver for pairing the two sticks.

The pairing procedure for systems out of the box is only required at the Rx and at the Tx transceiver stick when the beam coding function is selected. It must be done only once after the first power-up.

Set beam coding with the appropriate DIP switch on the plug-in of the receiver (Rx) stick and power the system up. A confirmation of the configuration can be required first at the receiver (Rx), if the Rx stick was operated before. In this case, perform first the configuration confirmation at the Rx and then the confirmation for the pairing.

When the STS status indicator at the transmitter is blinking red/green, it indicates that the Tx stick beam coding must be paired with the Rx stick. Follow the procedure that is described in [Confirmation of a New System Configuration on page 59](#).



ATTENTION: If several systems are in the area, only one single transmitter is allowed to be paired with a given receiver. Make sure that any other adjacent installed safety light curtain system is switched off during the pairing process.

The beam coding settings do have an impact on the response time (see [Response Time on page 47](#)).

Interference Rejection

Interference rejection is only configurable for the 450L-E safety light curtain and is permanently enabled on the 450L PAC safety light curtain.

Interference rejection is an enhancement to beam coding to mitigate optical interference and cross talk. In applications where enabling beam coding alone does not mitigate interference, the interference rejection feature can be enabled to alter the scan pattern to restrict stray light from a neighboring 450L-E safety light curtain from affecting operation. Set interference rejection with the appropriate DIP switch^(a) on the plug-in of the receiver.

Another application for interference rejection is in cascaded systems, as the sticks can be mounted closely without needing to adhere to the minimum distance spacing requirements.

IMPORTANT Using interference rejection affects the response time, which can impact safety distance. Always verify safety distance when using this feature.

Blanking and Reduced Resolution

Blanking and reduced resolution is only configurable for the 450L-E safety light curtain.

Blanking and reduced resolutions are typically used to allow objects wider than the optical resolution to stay in or to pass through the protective field during normal operation without causing a fault or stop condition (for blanking application, see [Fixed Blanking Application on page 182](#)).

Both are available in the 450L-E safety light curtain per DIP switch configuration:

- Fixed Teach-in Blanking (see [Figure 198 on page 182](#))
- Reduced Resolution (see [Reduced Resolution \(Object Number Limited\) on page 32](#)).

IMPORTANT You must verify for all blanking and reduced resolution modes that no undetected access is possible into the danger zone via the blanked protective field throughout the whole width of the protective field (also left and right of the blanked object). This verification can be achieved, for example, by using additional mechanical barriers.

The blanking settings do have an impact on the response time (see [Response Time on page 47](#)).

Muting and blanking cannot be configured simultaneously. It is possible to activate fixed blanking and reduced resolution simultaneously.

(a) Setting interference rejection by DIP switch assumes the worst case scenario of protection from a neighboring 1950 mm (76.78 in.) length stick with finger resolution, irrespective of the actual length or resolution of the sticks. See [Table 18 on page 49](#). You can refine and greatly reduce response time by configuring interference rejection in the software, see [Table 19 on page 50](#).

Teach-in Fixed Blanking

Beams are taught to ignore up to four fixed objects in the sensing field. The blanked fixtures or objects must remain in the sensing field or the 450L-E safety light curtain enters a Fault state (OSSDs off).

Theoretically, the maximum number that can be blanked can nearly reach the whole length of the protective field. At minimum, the first two active lenses at the connection end or the last two active lenses at the cascading end must be unblocked ([Table 4 on page 29](#)).

IMPORTANT Blanked areas can require an additional risk analysis. If no mechanical or other guarding is used to restrict access to the hazard, the blanked area must be considered in the calculation of the safety distance.

The fixed Teach-in blanking mode of operation is activated through DIP switch settings that are on following plug-ins:

- 450L-APR-BL-5 ([Table 25 on page 56](#)) or
- 450L-APR-MU-8 ([Table 26 on page 56](#))

With Teach-in blanking, the beams to be blanked are taught by activating the optical teach button, which is located near the hand symbol on the 450L-E safety light curtain front window (see [Figure 14 on page 31](#)), in a specific sequence (see [Figure 15 on page 31](#)) while the object is in the 450L-E safety light curtain sensing field. The safety light curtain fixed blanking mode of operation is not activated until the teach procedure is complete.

The fixed blanking mode of operation is always monitored. If any part or all blanked objects are removed from the protective field, the OSSD outputs of the 450L-E safety light curtain go to the OFF state and the Rx stick displays a blanking error (see [Table 56 on page 104](#)).

Due to vibrations often present in industrial applications, the number of physically interrupted beams is allowed to be one less than the specified number of beams. A local adjustment of this tolerance value -1 is not possible with DIP switches.

If the fixed blanked object only blocks one beam, the tolerance value is zero. This value means that a minimum of one beam has to be blocked, there is no tolerance.

The 450L-E safety light curtain can perform fixed blanking of one or more adjacent beams. At minimum, one of the two synchronization beams ([Figure 10 on page 22](#)) must be unblocked before and during the Teach-in procedure.

A teach-in error occurs if one of the cases that are described in [Table 4](#) (see [Figure 13](#) for illustration) happens:

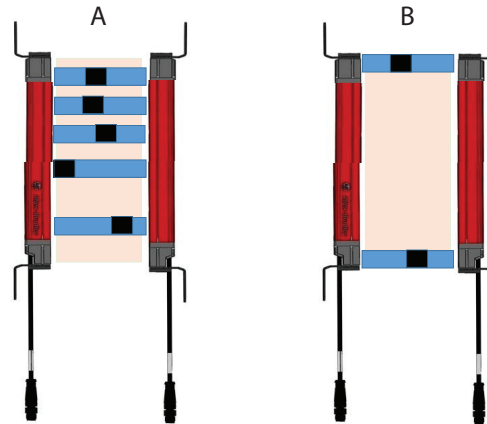
Table 4 - Teach-in Errors and Behavior

Case	Description	Behavior
1	More than four independent objects are in the protective field	In this case, the first four interrupted objects that start from the connection plug-in are taught, all other objects are not taught. As a result, the OSSDs stay in the OFF condition as long as the additional objects are in the protective field.
2	The beams at top and bottom are simultaneously blocked	In this case, the teach-in command is ignored and the 450L-E safety light curtain continues operating with the previously taught objects.
3	One object was moving during teach-in	In this case, the teach-in command is completed, but the error indication at the end of the teach-in process warns the user that the taught limits can cause sporadic OSSD switching.

Two setups that cause a teach-in blanking error:

- Case A: Number of objects > 4
- Case B: Top and Bottom end interrupted.

Figure 13 - Teach-in Blanking Error



IMPORTANT

Fully test the protective field with the provided test rods according to the instructions given in [Regular Inspection on page 109](#).

The configuration and activation of fixed blanking creates a hole to the left and/or right of the object in the protective field. (Objects are indicated in black in [Figure 13 on page 30](#).) If the fixed object that is in the protective field does not entirely fill the area between the GuardShield transmitter and receiver, it is necessary to obstruct access to the hazard by additional means. Hard guarding the open area can accomplish this obstruction. Open areas are indicated blue in [Figure 13 on page 30](#).

Hard guards refer to mechanical barriers.



ATTENTION: A fixed blanking zone changes the resolution of the 450L-E safety light curtain system (see [Resolution with Blanking on page 34](#)). This change must be considered when calculating the safety distance.

[Table 6 on page 33](#) shows the reaction of the OSSD outputs with Fixed Blanking deactivated and activated for different use cases.

Teach-in Blanking Procedure

The procedure to teach a new fixed blanked object is similar to the procedure to conduct a confirmation of a changed configuration ([Confirmation of a New System Configuration on page 59](#)) with the help of the optical push button.

The optical push button ([Figure 14 on page 31](#)) must be activated two times for 5 seconds ([Figure 15 on page 31](#)). Between the two activations, a break of a maximum of 2 seconds is allowed. The following two descriptions describe the same process that is shown in [Figure 15 on page 31](#).

Figure 14 - Position of Optical Push Button, ILAS, and Status Indicators

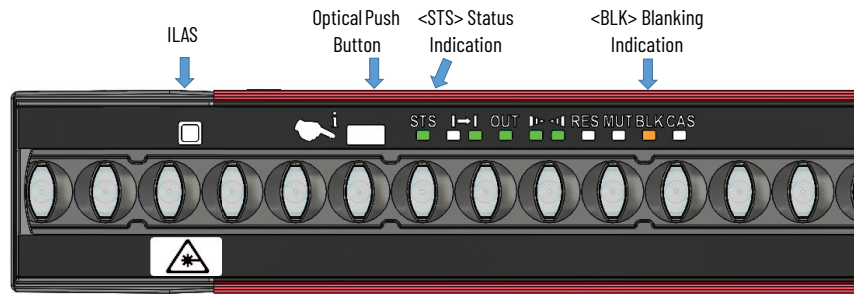
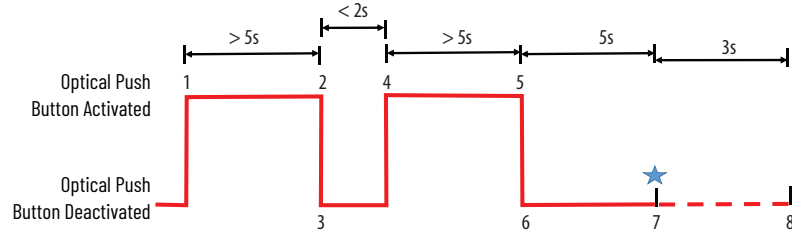


Figure 15 - Teach-In Blanking Configuration Process



Configuration Process

1. The status indicator STS is green, which indicates normal operation (no fault).
2. Actuate the optical push button (Figure 14) for 5 seconds.
3. The STS remains continuously green.
4. Once the status indicator STS starts green/off blinking, release the optical push button.
5. Release is indicated with a change of frequency 10...1 Hz (status indicator STS green/off and a 50:50 duty cycle).
6. Within 2 seconds, actuate the optical push button.
7. The status indicator STS indicates the activation by a green/off and the status indicator BLK indicates the activation by an orange/off frequency of 10 Hz and a 50% duty cycle.
8. Actuate the optical push button for at least for 5 seconds.
9. Once the status indicator and the blanking indicator changes frequency 10...1 Hz, release the optical push button.
10. After releasing the optical push button, the status indicator STS is steady green and the BLK indicator continues blinking for 5 seconds (orange/off).
11. In these 5 seconds, remove your hand and all objects that are not being taught.
12. At the end of these 5 seconds, the 450L-E safety light curtain teaches all interrupted beams.
13. A successful Teach-in is indicated with a 3 second blinking of the BLK indicator (orange/off) and STS green on.
14. A failed Teach-in is indicated with a 3 second blinking of the BLK indicator (orange/off) and the STS indicator (green/red).

IMPORTANT

If there is an error in the Teach-in procedure, the new fixed blanking zone limits are not accepted and the light curtain continues working with the previously taught zone limits.

Once the configuration confirmation procedure is completed, verify the changed resolution.

A Teach-in procedure can also be conducted with the Rockwell Automation Connected Components Workbench software and an installed optical interface device (see [Optical Interface Device \(OID\) on page 106](#)).

These options lead to the deletion of taught fixed blanking areas:

- Change DIP switch setting and confirm new DIP setting.
- Insert and confirm another plug-in type.

Reduced Resolution (Object Number Limited)

Reduced resolution is a type of blanking without monitoring whether the beams are interrupted. The comparable blanking function with monitoring is called floating blanking. Floating blanking and reduced resolution have similar functionality, the difference, according to the standard IEC 61496, is the object monitoring.

Reduced resolution is always specified in combination with a beam number. There are different types of reduced resolution:

- All blanked beams must be adjacent. The maximum size of the object is equal to the beam value. This type is only good for one single object (reduced resolution, single object).
- Blanked beams can be, but do not have to be, adjacent. The sum of the size of all objects in the protective field is not larger than the beam value (reduced resolution, multiple objects, object number limited).
- Blanked beams can be, but do not have to be, adjacent. The size of each object in the protective field is not larger than the beam value (reduced resolution, multiple objects, object number unlimited).

The reduced resolution that can be activated with a DIP switch in a 450L-E safety light curtain refers to the definition (b) multiple objects, object number limited.

Reduced resolution is not available on 450L PAC safety light curtains.

IMPORTANT The blanking modes that can be activated with the DIP switches in a 450L-E safety light curtain system are equal to the blanking modes that can be activated in a 440L safety light curtain system.

The reduced resolution mode of operation is activated through DIP switch settings that are on the following plug-ins:

- 450L-APR-BL-5 ([Table 25 on page 56](#)) or
- 450L-APR-MU-8 ([Table 26 on page 56](#))

Reduced resolution of one beam or reduced resolution of two beams allows one or two beams that are located anywhere in the protective field to be blanked out. An example is when blocked beams are ignored and the 450L-E safety light curtain remains with OSSD outputs active. Reduced resolution allows an object to float in (move within, or in and out of) the 450L-E safety light curtain protective field without causing the light curtain outputs to change to the OFF state. For details, see [Table 7 on page 33](#) and [Table 8 on page 33](#).

For reduced resolution with the object number limited, the maximum number of blanked objects is equal to the beam number (see [Table 6 on page 33](#)).

If activated by the DIP switch the reduced resolution is active over the entire protective field, except the zones that are already taught with another blanking type.

IMPORTANT With reduced resolution activated, protective field holes that are left and/or right of the protective field can occur. This occurrence means at times when no object is blocking the protective field, there is a danger that the operator can reach through the protective field without deactivating the machine.

Table 5 - Nomenclature for [Table 6](#)...[Table 8](#)

Symbol	Description
○	Beam not interrupted
⊗	Beam interrupted
□	Beam is activated for Fixed Blanking and not interrupted
⊠	Beam is activated for Fixed Blanking and interrupted

Table 6 - Status of OSSDs for Different Situations in Case of Fixed Teach-in Blanking

Case	1	2	3	4	5	6	7	8
IR-Beam	No Blanking	Fixed Teach-in Blanking						
N	○	○	○	○	○	○	○	○
N+1	○	⊗	⊗	□	⊗	□	⊗	⊗
N+2	⊗	⊗	□	⊗	□	□	□	□
N+3	○	○	○	○	○	○	○	○
N+4	○	○	○	○	⊗	○	⊗	⊗
N+5	○	○	○	○	○	○	○	⊗
N+6	○	○	○	○	○	○	○	○
Status OSSDs	OFF	ON	ON	ON	OFF	OFF	ON	OFF

IMPORTANT For case 3 and case 4 in [Table 6](#), the OSSDs stay on because of the tolerance -1.

Table 7 - Status of OSSDs for Different Reduced Resolution Instances

Case	1	2	3	4	5	6	7	8	9	10	11	12
IR-Beam	Reduced Resolution Deactivated	Reduced Resolution 1 Beam Active				Reduced Resolution 2 Beams Active						
N	○	○	○	○	○	○	○	○	○	○	○	○
N+1	○	○	⊗	⊗	⊗	○	⊗	⊗	⊗	⊗	⊗	⊗
N+2	⊗	○	○	○	⊗	○	○	○	⊗	⊗	⊗	○
N+3	○	○	○	⊗	○	○	○	⊗	○	⊗	○	⊗
N+4	○	○	○	○	○	○	○	○	○	○	⊗	○
N+5	○	○	○	○	○	○	○	○	○	○	○	⊗
N+6	○	○	○	○	○	○	○	○	○	○	○	○
Status OSSDs	OFF	ON	ON	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF

Table 8 - Status of OSSDs for Different Cases of Reduced Resolution in Combination with Fixed Teach in Blanking

Case	1	2	3	4	5	6	7	8	9	10	11	12
IR-Beam	Reduced Resolution Deactivated	Reduced Resolution 1 Beam and Teach-in Fixed Blanking				Reduced Resolution 2 Beams and Teach-in Fixed Blanking						
N	○	○	○	○	○	○	○	○	○	○	○	○
N+1	○	○	⊗	⊗	⊗	○	⊗	⊗	⊗	⊗	⊗	⊗
N+2	⊗	⊗	⊗	⊗	□	⊗	⊗	⊗	⊗	⊗	□	⊗

Table 8 - Status of OSSDs for Different Cases of Reduced Resolution in Combination with Fixed Teach in Blanking

Case	1	2	3	4	5	6	7	8	9	10	11	12
N+3	○	○	○	⊗	○	○	○	⊗	○	○	○	⊗
N+4	○	○	○	○	○	○	○	○	○	○	⊗	○
N+5	○	○	○	○	○	○	○	○	○	○	○	⊗
N+6	○	○	○	○	○	○	○	○	○	⊗	○	○
Status OSSDs	ON	ON	ON	OFF	OFF	ON	ON	ON	ON	OFF	OFF	OFF

Resolution with Blanking



ATTENTION: Actuation of the reduced resolution mode changes the resolution of the 450L-E safety light curtain.

[Table 9](#) shows resolution of a 450L-E safety light curtain for different blanking mode combinations.

Table 9 - Resolution

GuardShield Resolution (No Blanking)	Configured Blanking Type	Configured Resolution
14 mm (0.56 in.)	No blanking	14 mm (0.56 in.)
	Fixed blanking	Single object: 28 mm (1.11 in.) Multiple objects: 42 mm (1.66 in.)
	Reduced resolution one beam	23 mm (0.91 in.)
	Reduced resolution one beam in combination with Fixed Teach-In blanking	42 mm (1.66 in.)
	Reduced resolution two beams	33 mm (1.30 in.)
	Reduced resolution two beams in combination with Fixed Teach-in blanking	52 mm (2.05 in.)
30 mm (1.19 in.)	No blanking	30 mm (1.19 in.)
	Fixed blanking	Single object: 53 mm (2.09 in.) Multiple objects: 82 mm (3.23 in.)
	Reduced resolution one beam	44 mm (1.74 in.)
	Reduced resolution one beam in combination with Fixed Teach-In blanking	82 mm (3.23 in.)
	Reduced resolution two beams	63 mm (2.49 in.)
	Reduced resolution two beams in combination with Fixed Teach-In blanking	100 mm (3.94 in.)

IMPORTANT After each configuration or reconfiguration of a GuardShield safety light curtain, the configuration of the safety light curtain is tested using an appropriate test piece.

The borders between two adjacent blanking zones are especially critical for the resolutions. [Table 9](#) provides the largest resolution for a complete light curtain system for different DIP switch settings.

For blanking if there is cascading, see [Cascading and Blanking on page 46](#).

Muting

The cascading feature is only available for the 450L-E and 450L PAC safety light curtain. To enable the muting functionality, the receiver plug-in 450L-APR-MU-8 must be installed.

IMPORTANT A detailed description about muting, muting restrictions and hints for the installation are given in the standard IEC 62046. Additional hints are mentioned in the attachment A7 of IEC 61496-1. The muting function, is only allowed after a thorough safety analysis according to EN 13849-1 and ISO EN 12100 is completed.

Certain applications in practice require that the protective field of the 450L-E or 450L PAC safety light curtain is muted automatically without the safety outputs switching off. A typical example of such an application is a conveyor belt. It is possible to transport the goods on a pallet through the protective field without stopping the pallet movement.

Muting is the temporary automatic suspension of the protective function of a safeguarding device like a light curtain. The muting function allows the transport of material through a light curtain without stopping a conveyor. To distinguish between material and persons, a certain sequence of events and timings are used. Muting sensors are mounted in a certain pattern, and the material must pass by the sensors and light curtain within specified time limits. If the muting sensor sequence is incorrect or the timing parameters are violated, the safeguarding device stops the conveyor. An override signal allows the movement of the material through the light curtain after a violation.

The 450L-E or 450L PAC safety light curtain has three distinct types of muting where the sequence and timing of signals that the light curtain monitors allows objects to pass through the light curtain without shutting down the machine process. The three available types are:

- Two sensors, T-type muting (bidirectional operation)
- Four sensors, T-type muting (bidirectional operation)
- Two sensors, L-type muting (unidirectional operation)

The two-sensor muting types can be connected at the connection plug-in (see [Figure 74 on page 95](#)) or at the cascading plug-in 450L-APC-IO-8 (see [Figure 80 on page 100](#)). The four-sensor muting type can only be connected at the cascading plug-in 450L-APC-IO-8.

To activate the desired muting functionality, select the DIP switches of the receiver plug-in 450L-APR-MU-8 according to [Table 26 on page 56](#) and [Table 28 on page 58](#).

Each of these functions can be configured with manual or automatic reset.

IMPORTANT The safety function block muting must be set to manual reset. In case the safety light curtain is set to automatic start, the safety relay or the safety PLC manages the manual reset.

Muting Lamp

Depending on the risk assessment of the application, a muting lamp is necessary to warn an operator when the light curtain is muted (see details in IEC 62046). The muting lamp is on when the light curtain is muted.

If an error in the muting sequence has occurred, the muting lamp blinks (see [Troubleshoot on page 103](#)), which indicates that the muting condition is not initiated, or has been discontinued.

Muting Sensors

IMPORTANT Detailed information about muting sensors (for example, positioning) is given in the standard IEC 62046.

Mechanical muting sensors must have an opening contact. For proper operation, the muting sensors are on (normally closed) if the safety light curtain is not muted.

The safety relay, the 450L-E or 450L PAC safety light curtain, and the muting sensors must have the same reference (24V Com) for proper operation.

Photoelectric muting sensors do not need to be certified according to safety type 2 or 4 of IEC 61496-1/-2. The detection zone of the muting sensors must be within 30° of the horizontal and are mounted at a height suitable to detect a person's leg (see IEC 62046).

Various positions and sizes of materials on the pallet can make it difficult to guarantee an uninterrupted muting signal over the entire passage through the guarded area. For this reason, an off-delay time t_{msdel} for the muting sensor inputs and the light curtain is set to 50 ms.

IMPORTANT The muting sensors detect the material on a pallet and not the pallet itself.

Mute Dependent Override Function (MDO)

Normal activation of the manual start button is only permitted if no muting sensors are activated and the light curtain is not interrupted.

An error in the muting sequence does not allow a muting condition. If the safety light curtain is interrupted, the OSSD safety outputs of the 450L-E safety light curtain switch off. This error typically leads to a cessation of movement.

In such a case, it can be difficult to move the material out of the protected area. If this situation is anticipated (an error in the muting sequence or timing), the Reset button provides an MDO (depending on DIP switch settings). The OSSD safety outputs can be reactivated temporarily by activating the Reset button (manual start). The maximum allowable duration t_{mdo} for this MDO is provided in [Table 10 on page 38](#), [Table 11 on page 39](#), and [Table 13 on page 42](#) of the individual muting types.

IMPORTANT Make sure that the MDO can be installed based on the risk assessment of the application. Some applications can require a spring loaded keyswitch for the reset.

The MDO is possible at the same pin when automatic start is configured. For this case, the connected safety relay or safety logic performs the manual reset.

IMPORTANT In muting applications, the reset of the muting function block must be a manual reset. Either the light curtain and/or the safety relay that is connected to the light curtain performs the manual reset.

A push button or a spring loaded keyswitch activates the MDO. The push button/keyswitch is mounted at a location from which the dangerous area can be seen.

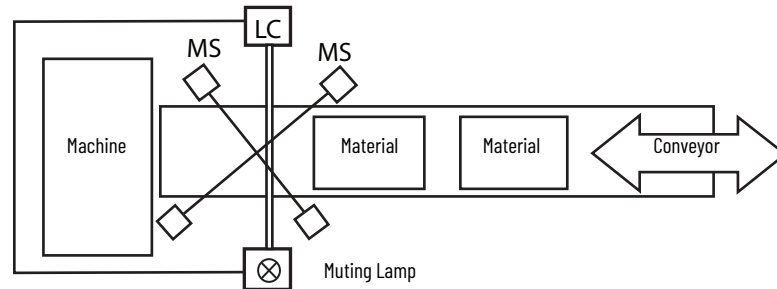
The MDO is automatically ended after the mute dependent override time (t_{mdo}) has elapsed, or when the safety light curtain is no longer interrupted, whichever occurs first.

The muting functionality does not have an impact on the response time of the 450L-E or 450L PAC safety light curtain.

Two-sensor T-type Muting

The sensors and light curtain form the shape of an upside down “T,” when viewed from the side. The muting sensors (MS) are mounted to form an “X” sensing pattern where the sensing beams cross near the center of the light curtain (LC).

Figure 16 - Two-sensor T-type Muting Arrangement



The muting sensors can be mounted symmetrically (equal distance from the light curtain) or asymmetrically (unequal distance from the light curtain).

The material can break either MS1 first (or MS2 first), then the other sensor, and then the light curtain. As the material clears the light curtain, it must then clear MS2 (or MS1) first and then the other sensor. The muting lamp turns on shortly after the second sensor is blocked, and the light curtain is muted.

Either of these two patterns is acceptable:

- MS1↑ MS2↓ LC↓ LC↑ MS2↑ MS1↑
- MS2↓ MS1↑ LC↓ LC↑ MS1↑ MS2↑

The crossing point of the two light beams is situated behind the sensing field of the safety light curtain in the direction of the dangerous area.

The height of the crossing point of the two muting sensors is at the same level as or higher than the lowest beam of the light curtain.

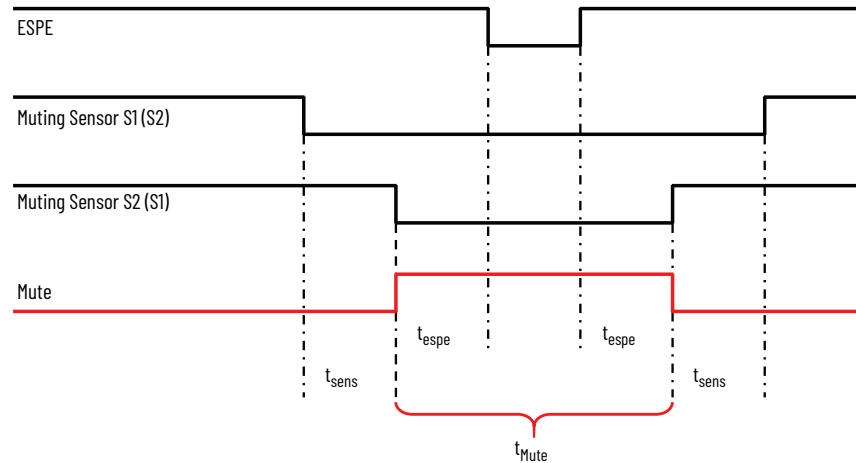
Verify that the distance from the crossing point to the protective field of the safety light curtain is as short as possible.

During the muting process, it is not possible for a person to enter the undetected dangerous area to the left or right of the object.

With proper arrangement of the sensors, the conveyor can move in the forward or reverse direction, while also maintaining safeguard integrity.

For connecting the sensors, see [Table 39 on page 84](#) and [Table 43 on page 86](#) for the cascading plug-in.

Figure 17 - Muting Time for Two-sensor T-type Muting Arrangement



For proper operation, MS1 and MS2 must be activated/deactivated within the time (t_{sens}), and the light curtain must be clear before the muting time (t_{Mute}) expires.

Muting of the safety light curtain is achieved only when muting sensor MS1 and MS2 are activated within the specified time (t_{sens}). Since this muting mode is bidirectional, the muting sequence also functions in reverse (for example, muting sensor one before muting sensor two, or two before one are both allowed). Both signals, however, cannot arrive simultaneously (t_{sens} minimum). The muting condition stops if one of the muting sensors is not activated or if the maximum muting time (t_{Mute}) is exceeded (muting timeout).

The minimum time between the sensors (t_{sens} minimum) is dependent on the position of the muting sensors and the speed of the object to be muted. You must maintain at least a delay of t_{sens} minimum for more dependable operation.

[Table 10](#) shows the default timing values for T-type muting. These values can be adjusted by using Connected Components Workbench software.

Table 10 - Two-sensor T-type Muting Default Settings

Parameter	Default Value	Parameter	Default Value
t_{sens}	4 s	t_{mdo}	20 s
$t_{sens\ min}$	50 ms	t_{espe}	5 s
t_{Mute}	5 minutes		

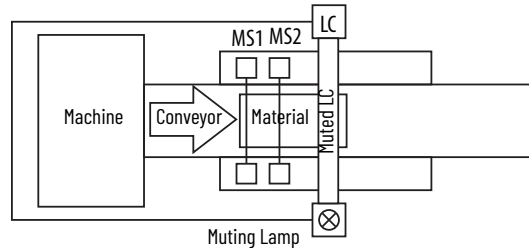
If t_{sens} , t_{espe} or t_{Mute} is exceeded, the STS and the MUT indicator flashes ([Table 56 on page 104](#)). The muting lamp output has the same characteristic as the MUT indicator. If the material is backed away from the sensors, the fault is cleared and the muting lamp turns off. If the material proceeds to break the light curtain, the OSSD output turns off. The STS and MUT indicator continue to flash. Use the muting override command to turn on the OSSD outputs temporarily and clear the material from the protective field.

IMPORTANT It must not be possible for a person to pass undetected to the left or right of the object during the muting process.

Two-sensor L-type Muting

The sensors and light curtain form the shape of the letter L, when viewed from the side. The muting sensors (MS) are mounted on one side of the light curtain.

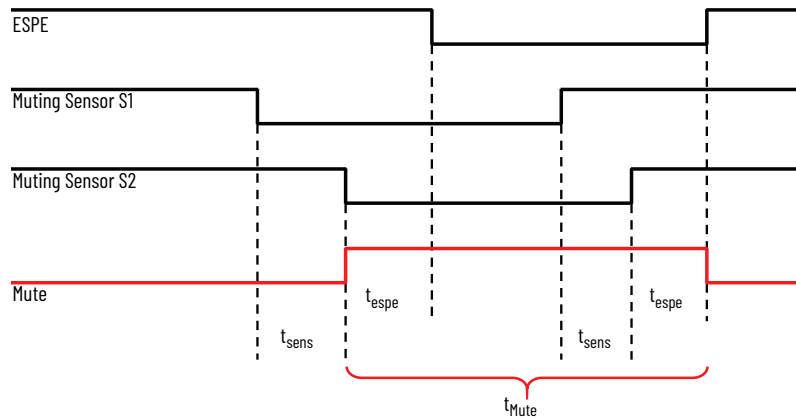
Figure 18 - Two-sensor L-type Muting Arrangement



This muting mode is used to allow a load to exit a dangerous area while helping to prevent access from outside the dangerous area. The object coming from the dangerous area interrupts the two muting sensors, which initiates the muting of the safety light curtain. As the object continues to move through the protective field, muting remains active until the light curtain is no longer interrupted.

For connecting the sensors, see [Table 39 on page 84](#) and [Table 43 on page 86](#) for the cascading plug-in.

Figure 19 - Timing Sequence for Two-sensor L-type Muting Arrangement



Muting of the safety light curtain is initiated only after muting sensor MS1 and MS2 are activated within the specified time (t_{sens}). The muting condition stops after t_{espe} is exceeded, the light curtain is no longer interrupted, or the maximum muting time (t_{Mute}) is exceeded (muting timeout), which ever occurs first.

[Table 11](#) shows the default muting and synchronization times. These values can be adjusted by using Connected Components Workbench software.

Table 11 - Two-sensor L-type Muting Default Settings

Parameter	Default Value	Parameter	Default Value
t_{sens}	3 s	t_{mdo}	20 s
$t_{sens\ min}$	50 ms	t_{espe}	3 s
t_{Mute}	5 min		

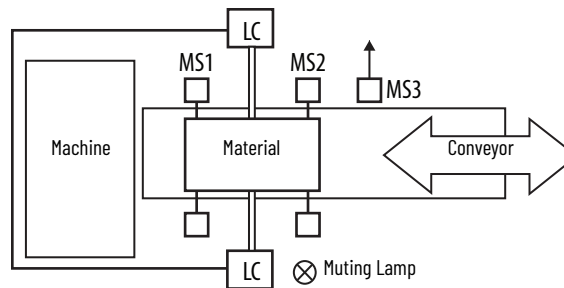
The two-sensor L-type muting arrangement must only be used for material that exits the hazardous area. It must not be used for material that enters the hazardous area.

It must be impossible for a person to pass undetected to the left or right of the object during the muting process.

Two-sensor T-type Muting with Enable

This muting mode can only be configured with Connected Components Workbench software. This muting mode is suited for applications when muting is only possible at certain times; for example, only when a conveyor is running. It can also be considered when the size and position of the pallet load is irregular or the size of the pallet is much smaller than the width of the conveyor. Because only one optical sensor is on either side of the light curtain, this mode requires an additional enable signal to initiate the muting sequence (for example, a conveyor run signal). This signal must be low before muting can be initiated.

Figure 20 - Two-sensor T-type Muting with Enable Arrangement

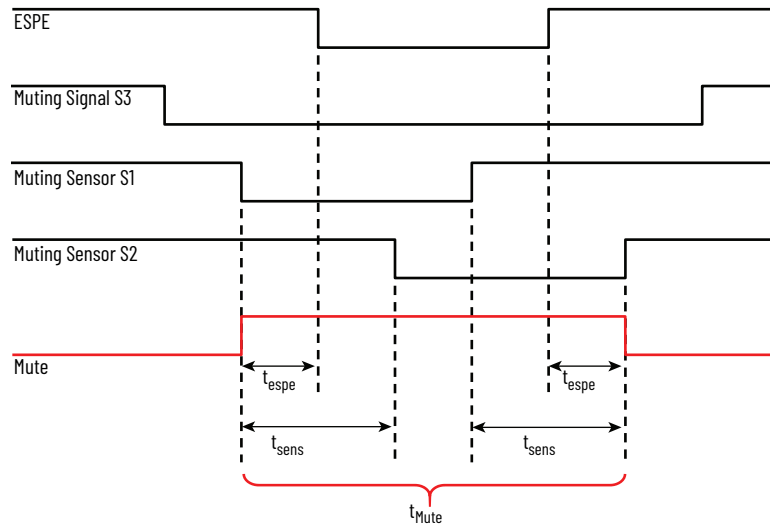


The height of the two muting sensors must be at the same level as or higher than the lowest beam of the light curtain.

The distance between S1 or S2 sensors to the light curtain must be sufficient so that a person's leg cannot activate them simultaneously (>250 mm [9.8 in.]).

A person must not be able to pass undetected to the left or right of the object during the muting process. [Figure 21](#) shows the corresponding timing sequence for such an arrangement.

Figure 21 - Timing Sequence for Two-sensor T-type Muting with Enable



Muting of the light curtain is active only when both enable signal S3 and sensor S1 in one direction or enable signal S3 and sensor S2 in the opposite direction are activated simultaneously. There are no timing limitations from when the S3 signal goes LO to when the applicable muting sensor goes LO.

The object must be long enough to block both sensors.

The muted condition remains only if muting sensors S1 and S2 are activated within the specified time (t_{sens}) and less than the muting time (t_{Mute}).

The muting condition stops if one of the following occurs:

- S3 and S1 are no longer activated (one direction)
- S3 and S2 are no longer activated (other direction)
- The maximum muting time (t_{Mute}) is exceeded (muting timeout)

Only after one muting sequence is finished can a new muting sequence be started. The enable signal S3 must first go HI before returning to LO, in order for a second object to pass through the light curtain (for example, the equivalent to a conveyor stop and restart).

[Table 12](#) shows the default settings for two-sensor L-type muting with enable. Use Connected Components Workbench software to change the settings.

Table 12 - Two-sensor T-type Muting with Enable Default Settings

Parameter	Default Value
t_{sens}	4 s
t_{Mute}	5 min
t_{mdo}	20 s
t_{espe}	4 s

If you get a timing error, the mute lamp flashes at 1 Hz and the mute timing error output turns ON.

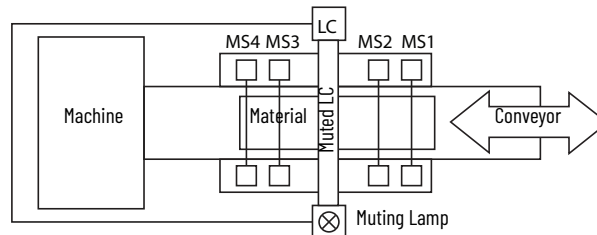
If the object stops in front of the first sensor and does not block the light curtain, the mute timing error goes HI and the mute lamp flashes at 1 Hz. The OSSD outputs remain ON, which allows you to reverse the conveyor and restart the muting sequence.

Use the S3 muting signal to clear the errors. When S3 goes HI, it clears the mute timing error, mute sequence error, and the muting error outputs.

Four-sensor Muting

The sensors and light curtain form the shape of an upside down “T”, when viewed from the side. Two muting sensors (MS) are mounted on either side of the light curtain (LC).

Figure 22 - Four-sensor Muting



The material can travel in either direction, which breaks MS1 first and MS4 last, or breaks MS4 first and MS1 last. The muting lamp turns on and the light curtain is muted after the second sensor is blocked. The object must be large enough to interrupt all four sensors.

For connecting the muting sensors, see [Table 44 on page 86](#).

This muting mode is considered when the size and position of the pallet load is irregular, or the size of the pallet is much smaller than the width of the conveyor. This mode can require more space than the two-sensor T-type with enable signal muting mode.

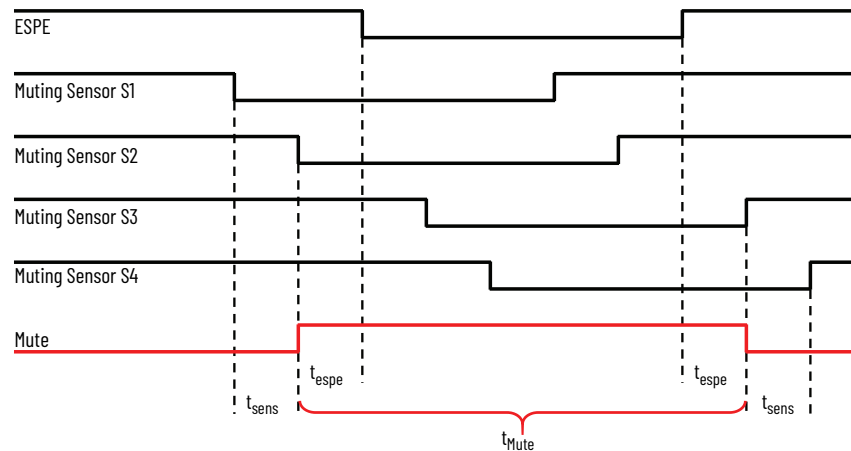
Sensors two and three (closest to the light curtain) are mounted within 200 mm (7.87 in.) of the light curtain. This position makes it difficult for a person to enter the dangerous zone undetected by preceding or following a load system into the dangerous zone.

The distance between any two muting sensors must be greater than 250 mm (9.84 in.) so that a person's leg cannot activate them simultaneously.

The distance between sensors MS1 and MS4 is such that a cylindrical object with a diameter of 500 mm (19.68 in.) with its axis parallel to the protective field cannot activate the muting function when moved in any point of the gate at any speed up to 1.6 m/s (see IEC 62064).

The muting sensors MS1-MS4 detect the objects on pallets and not the pallet itself. When this action is impractical, additional measures can be necessary to deter people from entering the zone by sitting on the pallet.

Figure 23 - Timing Sequence for Four-Sensor Muting



Muting of the 450L-E safety light curtain is achieved only when muting sensors MS1 and MS2 are activated within the specified time (t_{sens}). The delay between the sensors must be larger than $t_{sens\ min}$ minimum. For a successful muting sequence, all four sensors must be simultaneously activated for a certain time period.

The muting condition stops when either sensor MS3 or MS4 is deactivated, or the maximal muting time (t_{Mute}) is exceeded (muting timeout). Since this muting mode is bidirectional, the muting sensor sequence also functions in reverse (such as MS4 => MS1).

[Table 13](#) shows the default time limits. These values can be adjusted by using Connected Components Workbench software.

Table 13 - Four-sensor T-type Muting Default Time Limit Settings

Parameter	Default Value
t_{sens}	4 s
$t_{sens\ min}$	50 ms
t_{Mute}	5 minutes
t_{mdo}	20 s
t_{espe}	5 s

A time (t_{sens}) of 4 s is recommended in IEC 62046.

The behavior of the muting lamp indicator is analogous to the behavior described in [Two-sensor T-type Muting on page 37](#).

It is not possible for a person to pass undetected to the left or right of the object during the muting process.

Cascading

The cascading feature is only available for the 450L-E and 450L PAC safety light curtain. A 450L-B safety light curtain can only be used as the last pair of a cascaded 450L-E safety light curtain system.

The insertion of an additional cascading plug-in (450L-APC-IO-8) at the top cascading end of the stick enables cascading. Depending on the configuration of the DIP switches at the connection plug-in module, the functions of the I/Os at the cascading plug-in can be changed (for example, for muting applications). The different settings for the pins of the cascading plug-in are provided in [Table 41 on page 85](#) ... [Table 44 on page 86](#).

IMPORTANT Unless you are using either 450L-E firmware 5.004 (min) with interface rejection enabled, or 450L PAC, cascading with the 450L-APC-IO-8 cascading plug-in requires a minimum distance between two adjacent cascaded pairs ([Figure 26 on page 45](#)).
See [450L Safety Light Curtain with Interference Rejection on page 75](#) for more information on interference rejection.

Once the 450L-APC-IO-8 cascading plug-in is inserted, the I/Os of the cascading plug-in provide the option to connect an additional 450L safety light curtain with an 8-pin connection in series (see [Figure 25 on page 44](#)). This feature allows up to four pairs of 450L-E or 450L PAC safety light curtain transmitters and receivers to be interconnected in series.

[Figure 24](#) and [Figure 25 on page 44](#) specify the nomenclature that is used for cascaded systems.

Figure 24 - Nomenclature Used for a Noncascaded Setup

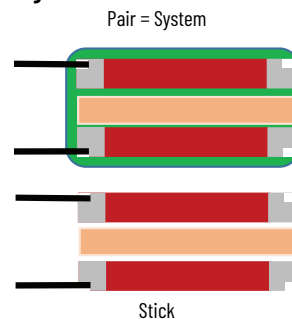
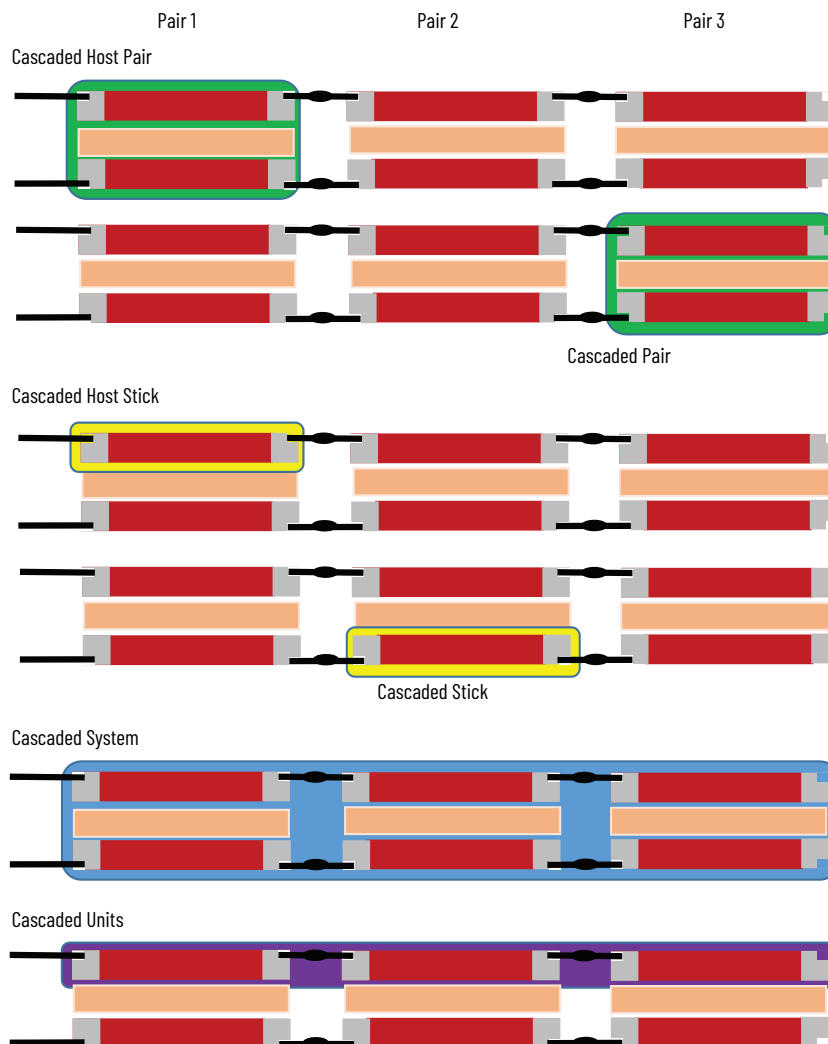


Figure 25 - Nomenclature for Cascaded Design

Nomenclature that is used for a cascaded design (example for a cascaded system with three cascaded pairs).



The first pair in a cascaded system is called the host pair. The OSSD outputs of the host pair are connected to safety contactors, a safety relay, or a safety PLC.

Cascading allows the 450L-E or 450L PAC safety light curtain to help protect multiple sides of a machine and to connect the complete design with only two OSSD safety outputs to the machine safety control.

See [Cascading Application on page 183](#) for a typical application with cascading.



ATTENTION: Unless you are using either 450L-E firmware 5.004 (min) with interface rejection enabled, or 450L PAC, to avoid optical crosstalk (see [Mount Multiple 450L GuardShield Safety Light Curtains on page 72](#)) or optical interference between the two adjacent pairs, a minimum spacing distance must be maintained. This minimum spacing distance is a function of the operating distance D between the transmitter and receiver. The spacing distance, S, must be larger than $0.026 \times D$. [Figure 26](#) identifies the spacing distance and operating distance of a cascaded pair. [Table 14](#) shows examples of the spacing distance, S, for typical operating distances when no additional optical barriers are installed between the pairs. See [450L Safety Light Curtain with Interference Rejection on page 75](#) for more information on interference rejection.

The minimum spacing distance does not apply for 450L-E with interference rejection enabled, or 450L PAC.

[Figure 26](#) identifies the spacing and operating distance of a cascaded light curtain pair.

Figure 26 - Identification of Spacing (S) and Distance (D)

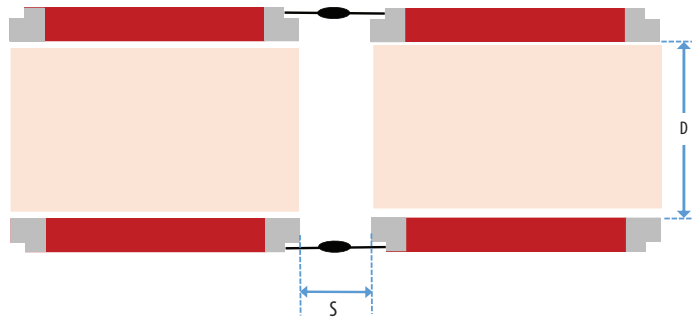


Table 14 - Minimum Spacing Distance (S) between Cascaded Pairs without Optical Barriers

D [m (ft)]	S [mm (in.)]
1 (3.28)	26 (1.02)
5 (16.4)	132 (5.2)
10 (32.8)	264 (10.4)
15 (49.2)	393 (15.5)

The cascade feature is available for protective field heights of 300 mm (11.81 in.) and longer. 450L safety light curtain transceiver sticks with a length of 150 mm (5.9 in.) cannot be used as a host pair or a middle pair in a cascaded system. However, a 150 mm (5.95 in.) 450L-E or 450L PAC safety light curtain can be used as the last pair in a cascaded system.

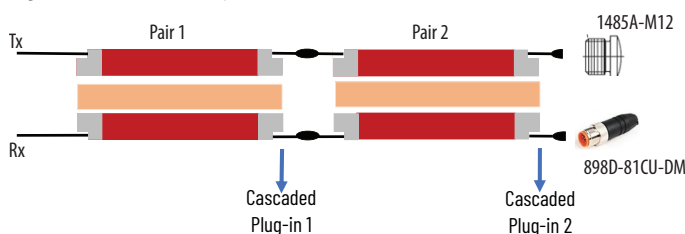
A maximum of four 450L-E or 450L PAC safety light curtains can be interconnected with a common pair of OSSDs. For POC systems, each cascaded pair can have a resolution of 14 mm (0.56 in.) or 30 mm (1.19 in.) and a protective field height of up to 1950 mm (76.77 in.). PAC systems are all 30 mm (1.19 in) resolution and all 4 versions (single-beam, 2-beam, 3-beam, and 4-beam) can be cascaded. An exception is noted previously for the single-beam, which can only be used as the last pair in a cascaded system. Each cascading pair operates as an independent light curtain.

A cable length between two cascaded sticks must not exceed 10 m (32.8 ft).

If a 450L-E or 450L PAC safety light curtain transceiver with an installed 450L-APC-IO-8 cascading plug-in is used as a standalone light curtain pair or as the last segment in a cascaded system, the cascading plug-in must be ended:

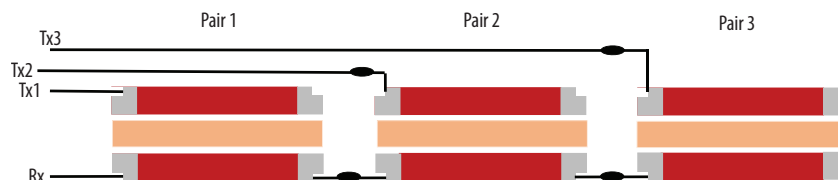
- Use termination plug 898D-81CU-DM^(a) at the cascading plug-in of a transceiver working as an Rx.
- Use termination plug 898D-81CU-DM or M12 sealing cap (1485A-M12) at the cascading plug-in of a transceiver working as a Tx.

Figure 27 - Cascaded System with 450L-APC-IO-8 as Last Module



When a 450L-E or 450L PAC safety light curtain stick operates as a receiver with a 450L-APC-IO-8 cascading plug-in, the corresponding transmitter can accept, but does not require, the installation of a 450L-APC-IO-8 cascading plug-in (see [Figure 28](#)).

Figure 28 - Cascaded System



A cascaded system with three pairs and only two 450L-APC-IO-8 supply power for all transmitters that are wired separately.

Manual start modes and relay monitoring (EDM) are not available on cascaded middle and end pairs of a cascading 450L safety light curtain system with DIP switch configuration. However, it is possible to configure these operating modes at the receiver of the host pair and allow the whole cascading system to operate in these modes.

For features like beam coding or blanking, each cascaded pair must be configured separately.

For two-sensor muting applications, the muting function applies to the cascaded system. Four-sensor muting cannot be applied to cascaded systems.

Cascading and Blanking

When a 450L-E safety light curtain is installed for cascading, each cascading 450L-E pair operates as a standalone safety light curtain pair with its OSSDs connected in series to the host pair OSSDs. Therefore, if requested, it is necessary to configure fixed blanking and/or reduced resolution in each cascaded pair. This configuration is accomplished by inserting in each 450L-E safety light curtain receiver an 8-pin 450L-APR-MU-8 plug-in that the blanking functionality is provided. First, set the DIP switches for the requested blanking function before you start assembling the light curtain sticks. Then, align all pairs and secure the brackets. It is then possible to teach each light curtain pair receiver with the Teach-In procedure. A successful completion of the teach function changes the operating mode of that pair only. During the teach-in process, the OSSDs of that pair and the OSSDs of the host segment are off (0V). Connected Components Workbench software can also be used to configure blanking for each cascaded pair.

(a) The termination plug has three pins that are shorted together (pins 2, 5, and 6). It is only needed on the receiver side.

Blanking is not available on 450L PAC safety light curtains.

Response Time

The response time (T_r) of the light curtain is the time from when the protective field of the light curtain is interrupted to when the safety outputs turn OFF. The light curtain features that are used in the application affect the response time.

Standard Response Time, T_s

The standard response time refers to the response time for standard on/off application. The standard application includes the following:

- Any start mode
- All operating ranges
- All EDM settings

The standard application excludes the advanced features:

- Beam coding
- Interference Rejection
- Blanking (fixed or floating)
- Cascading
- Multiple zones
- Muting
- Reduced resolution
- Multiple scans
- Short interruption ignore time

For the purposes of determining the response time, floating blanking is equivalent to reduced resolution.

Although muting is considered an advanced feature, muting has no effect on the response time.

The standard response time is dependent on the following:

- Light curtain type (PAC or POC [B or E])
- Resolution (finger or hand)
- Protective height

The standard response time for the 450L-B safety light curtain is shown in [Table 15 on page 48](#). The standard response time for the 450L-E safety light curtain is shown in [Table 16 on page 48](#). In these tables, $T_r = T_s$.

Table 15 - Standard Response Time for 450L-B

Protective Height [mm (in.)]	Response Time (T_s)	
	Finger [14 mm (0.55 in.)] Resolution [ms]	Hand [30 mm (1.18 in.)] Resolution [ms]
150 (5.91)	14	14
300 (11.81)	14	14
450 (17.72)	14	14
600 (23.62)	14	14
750 (29.53)	14	14
900 (35.43)	14	14
1050 (41.34)	16	14
1200 (47.24)	17	14
1350 (53.15)	19	14
1500 (59.06)	20	14
1650 (64.96)	22	14
1800 (70.87)	23	14
1950 (76.77)	25	15

Table 16 - Standard Response Time for 450L-E

Protective Height [mm (in.)]	Response Time (T_s)	
	Finger [14 mm (0.55 in.)] Resolution [ms]	Hand [30 mm (1.18 in.)] Resolution [ms]
150 (5.91)	9	8
300 (11.81)	10	9
450 (17.72)	11	9
600 (23.62)	12	10
750 (29.53)	14	11
900 (35.43)	14	11
1050 (41.34)	14	12
1200 (47.24)	15	12
1350 (53.15)	16	13
1500 (59.06)	17	13
1650 (64.96)	18	13
1800 (70.87)	19	13
1950 (76.77)	20	13

Table 17 - Standard Response Time for 450L PAC

Number of Beams	Protective Height [mm (in.)]	Response Time (T_s) Resolution [ms]
1	150 (5.91)	<20
2	600 (23.62)	<20
3	900 (35.43)	<20
4	1050 (41.34)	<20

Advanced Feature Response Time, T_a

The response time of advanced features requires a complex algorithm. The response time is also dependent upon whether the features are configured via the DIP switches on the plug-in or by Connected Components Workbench software.

[Table 18](#) shows response times when the DIP switches on the plug-in are used to set the advanced features. The description of each column is:

Column	Description
1	Standard operation with beam coding
2	Fixed blanking up to four zones
3	Fixed blanking up to four zones with beam coding
4	Reduced resolution, single beam
5	Reduced resolution, single beam with beam coding
6	Reduced resolution, two beams
7	Reduced resolution, two beams with beam coding

Column	Description
8	Fixed blanking up to four zones + reduced resolution, single beam
9	Fixed blanking up to four zones + reduced resolution, single beam with beam coding
10	Fixed blanking up to four zones + reduced resolution, two beams
11	Fixed blanking up to four zones + reduced resolution, two beams with beam coding
12	Standard operation with interference rejection

Table 18 - Response Time, T_a (Set by DIP Switches)

Protective Height [mm (in)]	Response Time, T_a (ms)											
	1	2	3	4	5	6	7	8	9	10	11	12
Finger Resolution												
150 (5.91)	9	14	16	12	13	15	16	17	19	18	20	83
300 (11.81)	11	15	17	13	14	17	18	19	20	20	21	83
450 (17.72)	13	17	19	15	16	18	19	20	22	21	23	83
600 (23.62)	14	18	20	16	18	19	21	21	23	22	24	83
750 (29.53)	15	19	21	17	18	20	21	23	24	24	25	83
900 (35.43)	15	19	21	17	18	20	21	23	24	24	25	83
1050 (41.34)	16	19	22	17	20	20	23	23	26	24	27	83
1200 (47.24)	18	20	24	18	21	21	24	23	27	24	28	83
1350 (53.15)	19	21	26	19	23	22	26	24	29	25	30	83
1500 (59.06)	21	22	27	20	24	23	27	25	30	27	31	83
1650 (64.96)	22	23	29	21	26	24	29	27	32	28	33	83
1800 (70.87)	24	25	30	23	27	26	30	28	33	29	34	83
1950 (76.77)	25	26	32	24	29	27	32	29	35	30	36	83
Hand Resolution												
150 (5.91)	9	12	13	12	12	15	15	16	16	17	17	83
300 (11.81)	9	14	16	12	13	15	16	17	19	18	20	83
450 (17.72)	10	15	16	13	14	16	17	18	19	19	21	83
600 (23.62)	11	15	17	13	14	17	18	19	20	20	21	83
750 (29.53)	12	16	18	14	15	17	18	19	21	20	22	83
900 (35.43)	13	17	19	15	16	18	19	20	22	21	23	83
1050 (41.34)	13	17	19	15	17	18	20	20	23	21	24	83
1200 (47.24)	14	18	20	16	18	19	21	21	23	22	24	83
1350 (53.15)	14	19	21	17	18	20	21	22	24	23	25	83
1500 (59.06)	14	19	21	17	18	20	21	22	24	23	25	83
1650 (64.96)	14	19	21	17	18	20	21	22	24	23	25	83
1800 (70.87)	15	19	21	17	18	20	21	22	24	23	25	83
1950 (76.77)	16	19	22	17	19	20	22	22	25	23	26	83

[Table 19 on page 50](#) shows the worst-case response times when the configuration in Connected Components Workbench software is used to set the multiple advanced features. Shorter response times are typically achieved. The Connected Components Workbench software reports a diagnostic table that shows the actual response time.

The initial release of the 450L PAC safety light curtain does not support the Connected Components Workbench software.

Table 19 - Response Time, T_a (Set by Connected Components Workbench Software Configuration)

Protective Height [mm (in)]	Response Time, T_a (ms)		
	Reduced Resolution (Floating Blanking), single beam Reduced Resolution one object outside the blanked zones	Reduced Resolution (Floating Blanking), single beam Reduced Resolution one object outside the blanked zones, with beam coding	Standard Operation with Interference Rejection ⁽¹⁾
Finger Resolution			
150 (5.91)	23	24	22
300 (11.81)	26	28	27
450 (17.72)	32	35	32
600 (23.62)	33	36	37
750 (29.53)	48	51	42
900 (35.43)	48	51	47
1050 (41.34)	49	53	52
1200 (47.24)	50	54	57
1350 (53.15)	55	60	63
1500 (59.06)	57	62	68
1650 (64.96)	72	78	73
1800 (70.87)	73	79	78
1950 (76.77)	74	81	83
Hand Resolution			
150 (5.91)	21	22	19
300 (11.81)	23	24	22
450 (17.72)	25	27	24
600 (23.62)	26	28	27
750 (29.53)	31	34	29
900 (35.43)	32	35	32
1050 (41.34)	32	35	34
1200 (47.24)	33	36	37
1350 (53.15)	47	51	40
1500 (59.06)	47	51	42
1650 (64.96)	47	51	45
1800 (70.87)	47	51	47
1950 (76.77)	48	52	50

(1) When the interference rejection feature is used and configured using software, the response time for both systems is derived from the system that has the largest response time. For example, enabling interference rejection on two systems where one system is 1200 mm (47.24 in.) finger resolution and the other system is 1650 mm (64.96 in.) hand resolution would result in both systems having a response time of 57 ms.

Multiple Scan

When multiple scan is enabled, the response time increases by approximately 33%. See the diagnostic property 3.30 in the Connected Components Workbench software for the actual response time.

Not applicable for 450L PAC safety light curtains.

Short Interruption Time

The 450L-E safety light curtain can be configured to ignore interruptions up to 174 ms. This value is added to the response time. See the diagnostic property 3.30 in the Connected Components Workbench software for the actual response time.

Not applicable for 450L PAC safety light curtains.

Cascading Response Time, Tc

The response time of a cascaded light curtain is simply an additional adder due to the cascading plug-in (450L-APC-IO-8). The adder must consider the total number of cascading plug-ins between the cascaded stick and the host stick. Therefore, the total response time is calculated as such:

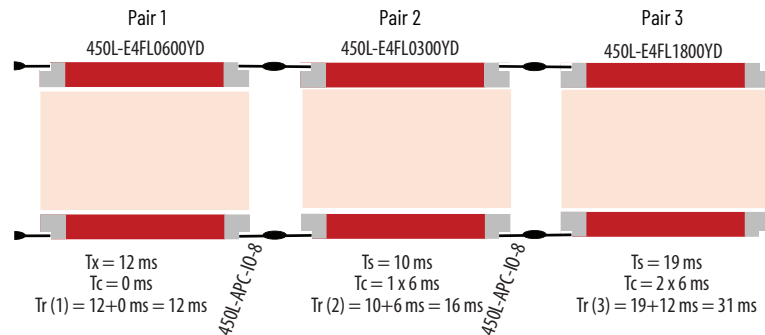
$$T_c = 6 \text{ ms}$$

$$\text{Standard Features: } T_r = T_s + (n \times T_c)$$

$$\text{Advanced Features: } T_r = T_a + (n \times T_c)$$

Figure 29 shows an example with three pairs of light curtains. The cascading adder for Pair 1 is zero, as Pair 1 is the host. Pair 2 has one cascading plug-in between itself and the host, so the additional adder is 6 ms. Pair 3 has two cascading plug-ins between itself and the host, so the additional adder to the response time is 12 ms.

Figure 29 - Response Time Calculation for each Cascaded Pair



Connected Components Workbench Response Time

Connected Components Workbench software reports the response time when the configuration is locked. Figure 30 shows an example of the response time report from the Connected Components Workbench software. On the Diagnose screen, scroll down the diagnostic parameter to 3.30.

The Connected Components Workbench software does not support the initial release of 450L PAC safety light curtains.

Figure 30 - Response Time in Connected Components Workbench Diagnostic Parameter 3.30

#	Name	Value	Remark	Description
3.30	Response time	17	Unit: ms	Specifies the current response time of the 450L system depending on actual DIP-Switch settings or actual SW configuration

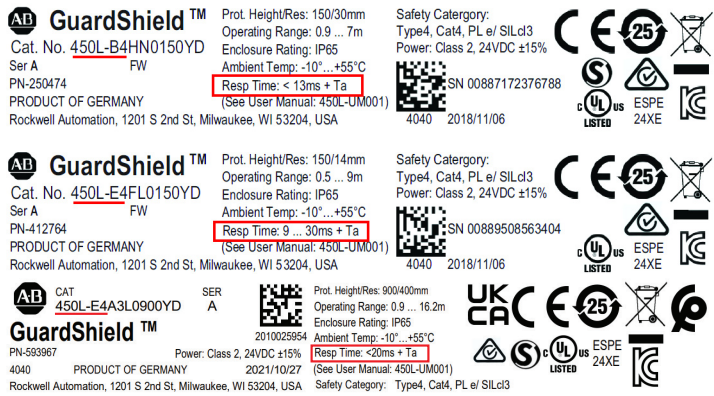
IMPORTANT

Determine Stop Time: The stopping time calculation must include the response times of all devices in the stop circuit (see [Determine the Safety Distance on page 62](#)). Not including all device and control system elements when calculating the stopping time results in an inaccurate safety distance calculation.

Product Labels

Figure 31 shows examples of the response time that is printed on the GuardShield sticks. This response time must not be used to calculate the safety distance calculation. Use the information in this user manual to determine the response time. This information will be removed in future changes of the label.

Figure 31 - Response Time on the Product Label



System Configuration

An authorized person must perform the system configuration by setting the DIP switches at the receiver plug-in. First set the DIP switches, then mount the light curtain and establish the electrical connections.

[Table 20 on page 53](#)...[Table 22 on page 54](#) show which plug-ins are available and which functionality can be selected with the receiver plug-in.

The blanking and the muting plug-in can be used to operate a 450L-B safety light curtain, but no muting, blanking, or beam coding functionality can be selected.

Table 20 - Functionalities Available for 450L-B Safety Light Curtain

Description	Transmitter Plug-in		Receiver Plug-in				Universal Plug-in
	450L-APT-PW-5	450L-APT-PW-8	ON/OFF 450L-APR-ON-5	EDM 450L-APR-ED-8	Blanking 450L-APR-BL-5	Muting 450L-APR-MU-8	450L-APU-UN-8
Number of Connection Pins	5	8 ⁽¹⁾	5	8	5	8	8
Number of DIP Switches	0	0	4	8	8	8	12
Low Range Activation	—	—	✓	✓	✓	✓	✓
Start Mode Selection	—	—	—	✓	—	✓	✓
EDM	—	—	—	✓	—	✓	✓
Transmitter and Receiver Functionality	—	—	—	—	—	—	✓
Blanking ⁽²⁾	—	—	—	—	—	—	—
Muting ⁽²⁾	—	—	—	—	—	—	—
Interference Rejection	—	—	—	—	—	—	—
Beam Coding	—	—	—	—	—	—	—

(1) The 8-pin M12 for the transmitter is simply for the convenience of specifying two 8-conductor cordsets for the system.

(2) Not available on 450L-B safety light curtain.

Table 21 - Functionalities Available for 450L-E Safety Light Curtain

Description	Transmitter Plug-in		Receiver Plug-in				Universal Plug-in
	450L-APT-PW-5	450L-APT-PW-8	ON/OFF 450L-APR-ON-5	EDM 450L-APR-ED-8	Blanking 450L-APR-BL-5	Muting 450L-APR-MU-8	450L-APU-UN-8
Number of Connection Pins	5	8 ⁽¹⁾	5	8	5	8	8
Number of DIP Switches	0	0	4	8	8	8	12
Low Range Activation	—	—	✓	✓	✓	✓	✓
Start Mode Selection	—	—	—	✓	—	✓	✓
EDM	—	—	—	✓	—	✓	✓
Transmitter and Receiver Functionality	—	—	—	—	—	—	✓
Blanking	—	—	—	—	✓	✓	—
Muting	—	—	—	—	—	✓	—
Interference Rejection	—	—	✓	✓	✓	✓	✓
Beam Coding	—	—	✓	✓	✓	✓	✓

(1) The 8-pin M12 for the transmitter is simply for the convenience of specifying two 8-conductor cordsets for the system.

Table 22 - Functionalities Available for 450L PAC Safety Light Curtain

Description	Transmitter Plug-in		Receiver Plug-in			Universal Plug-in
	450L-APT-PW-5	450L-APT-PW-8	ON/OFF 450L-APR-ON-5	EDM 450L-APR-ED-8	Muting 450L-APR-MU-8	450L-APU-UN-8
Number of Connection Pins	5	8 ⁽¹⁾	5	8	8	8
Number of DIP Switches	0	0	4	8	8	12
Low Range Activation	—	—	✓	✓	✓	✓
Start Mode Selection	—	—	—	✓	✓	✓
EDM	—	—	—	✓	✓	✓
Transmitter and Receiver Functionality	—	—	—	—	—	✓
Blanking	—	—	—	—	—	—
Muting	—	—	—	—	✓	—
Interference Rejection ⁽²⁾	—	—	✓	✓	✓	✓
Beam Coding	—	—	✓	✓	✓	✓

(1) The 8-pin M12 for the transmitter is simply for the convenience of specifying two 8-conductor cordsets for the system.

(2) IR is always enabled in 450L PAC models, this is not user configurable.

The universal plug-in can be set to perform as an emitter or receiver. If pins 4 and 8 of the connectors are short circuited at power-up, the stick behaves like a transmitter. In this case, the DIP switches have no functionality. Also, the beam coding functionality is still set at the 450L-E Receiver (Rx). For the confirmation of the beam coding configuration and the pairing procedure, see [Confirmation of a New System Configuration on page 59](#). If pin 4 and pin 8 of the plug-in are not short circuited at power-up, the corresponding stick behaves like a receiver. In this case, the DIP switches have the same functionality as the 450L-APR-ED-8 receiver plug-in.

Receiver Plug-in DIP Switch Settings

The transmitter plug-ins and the cascading plug-ins don't have DIP switches.

Identify and set the appropriate DIP switches for the configuration desired. [Figure 32](#) shows DIP switch identification. The number of DIP switches varies depending on the plug-in type.

Figure 32 - DIP Switch Location at Receiver Plug-in



IMPORTANT

DIP switches must be switched to OFF if the Switch Function is not defined. Otherwise, an error condition occurs (see [Status Indicator Error Display on page 103](#)).

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



ATTENTION: Every modification of the DIP switches must be confirmed with a configuration confirmation procedure after the first power-up (see [Confirmation of a New System Configuration on page 59](#)).

After installing the plug-in on the 450L-B safety light curtain transmitter stick and power-up, a configuration confirmation can be performed (signaled by the red/ green blinking of the STS status indicator). The confirmation of the configuration can be performed without the receiver and transmitter aligned.

[Table 23 on page 55](#)...[Table 29 on page 58](#) describe the switch functions and default settings for the receiver plug-ins.

450L-APR-ON-5 Connection Plug-in

Table 23 - Function and Default Settings

Switch Number	Switch Function	Default	Description
1	450L-E only: Software Configuration	OFF	OFF: Disabled ON: Enabled
2	Low Range Activation	OFF	OFF: Disabled ON: Enabled
3	450L-E and 450L PAC only: Activates Beam Coding	OFF	OFF: Disabled ON: Enabled
4	450L-E only: Activates Interference Rejection	OFF	OFF: Disabled ON: Enabled

450L-APR-ED-8 Connection Plug-in

[Table 24](#) shows the function and default settings for the M12 8-pin EDM receiver plug-in (450L-APR-ED-8) that is inserted in a 450L safety light curtain transceiver stick (450L-APR-BL-5) connection plug-in.

Table 24 - Function and Default Settings

Switch Number	Switch Function	Default	Description
1	450L-E only: Software Configuration	OFF	OFF: Disabled ON: Enabled
2	Low Range Activation	OFF	OFF: Disabled ON: Enabled
3	450L-E and 450L PAC only: Activates Beam Coding	OFF	OFF: Disabled ON: Enabled
4	450L-E only: Activates Interference Rejection	OFF	OFF: Disabled ON: Enabled
5	Combination activates the following start modes: • Automatic start • Manual (re) start • Manual cold start • Manual start with off function	OFF	<ul style="list-style-type: none"> DIP 5: OFF, DIP 6: OFF: Automatic start (Default) DIP 5: ON, DIP 6: OFF: Manual (re) start DIP 5: OFF, DIP 6: ON: Manual cold start DIP 5: ON, DIP 6: ON: Manual start with off function
6		OFF	
7	External Device Monitoring	OFF	OFF: Disabled ON: Enabled
8	—	OFF	—

450L-APR-BL-5 Connection Plug-in

[Table 25](#) shows the function and default settings for the M12 5-pin blanking receiver (450L-APR-BL-5) plug-in that is inserted in a 450L transceiver stick. Not applicable to 450L PAC safety light curtains.

Table 25 - Function and Default Settings

Switch Number	Switch Function	Default	Description
1	450L-E only: Software Configuration	OFF	OFF: Disabled ON: Enabled
2	Low Range Activation	OFF	OFF: Disabled ON: Enabled
3	450L-E and 450L PAC only: Activates Beam Coding	OFF	OFF: Disabled ON: Enabled
4	450L-E only: Activates Interference Rejection	OFF	OFF: Disabled ON: Enabled
5	450L-E only: Teach-in Blanking	OFF	OFF: Disabled ON: Enabled
6	450L-E only: Combination activates the following start modes: • No reduced resolution • Reduced resolution 1 lens • Reduced resolution 2 lenses	OFF	<ul style="list-style-type: none"> DIP 6: OFF, DIP 7: OFF: Reduced resolution disabled (Default) DIP 6: OFF, DIP 7: ON: Reduced resolution 2 beam DIP 6: ON, DIP 7: OFF: Reduced resolution 1 beam DIP 6: ON, DIP 7: ON: Invalid selection (error)
7		OFF	
8	—	OFF	—

450L-APR-MU-8 Connection Plug-in

[Table 26](#) shows the function and default settings for the M12 8-pin muting receiver plug-in (450L-APR-MU-8) inserted in a 450L safety light curtain transceiver stick.

Table 26 - Function and Default Settings

Switch Number	Switch Function	Default	Description
1	450L-E only: Software Configuration	OFF	OFF: Disabled ON: Enabled
2	Low Range Activation	OFF	OFF: Disabled ON: Enabled
3	450L-E and 450L PAC only: Activates Beam Coding	OFF	OFF: Disabled ON: Enabled
4	450L-E only: Activates Interference Rejection	OFF	OFF: Disabled ON: Enabled
5	Combination activates one of the following start modes: • Automatic start • Manual (re)start • Manual cold start • Manual start with off function	OFF	<ul style="list-style-type: none"> DIP 5: OFF, DIP 6: OFF: Automatic start (Default) DIP 5: ON, DIP 6: OFF: Manual (re)start DIP 5: OFF, DIP 6: ON: Manual cold start DIP 5: ON, DIP 6: ON: Manual start with off function
6		OFF	
7	External Device Monitoring	OFF	OFF: Disabled ON: Enabled
8	450L-E only: Muting or Blanking	OFF	OFF: see blanking modes in Table 27 on page 57 ON: see muting modes in Table 28 on page 58
9	450L-E only: Teach-in Blanking	OFF	OFF: Disabled ON: Enabled

Table 26 - Function and Default Settings

Switch Number	Switch Function	Default	Description
10	Combination activates the following start modes: <ul style="list-style-type: none"> • No reduced resolution • Reduced resolution 1 lens • Reduced resolution 2 lenses 	OFF	<ul style="list-style-type: none"> • DIP 10: OFF, DIP 11: OFF: Reduced resolution disabled (Default) • DIP 10: ON, DIP 11: OFF: Reduced resolution 1 beam • DIP 10: OFF, DIP 11: ON: Reduced resolution 2 beam • DIP 10: ON, DIP 11: ON: Invalid selection (error)
11		OFF	
12	—	OFF	—

For 450L-E safety light curtain only: If DIP 8 is set to OFF: Blanking can be activated and DIP 9 to DIP12 provide a selection of different blanking configurations, see [Table 27](#).



The 450L PAC safety light curtain does not support blanking. Setting DIP switch 8 to OFF in a 450L PAC safety light curtain results in a lockout condition.

If pin 8 is set to ON: Muting is activated and DIP 9 to DIP 12 allow for the selection of different muting configurations, see [Table 28](#).

[Table 27](#) shows the function and default settings for the M12 8-pin muting receiver plug-in (450L-APR-MU-8) inserted in a 450L-E safety light curtain transceiver stick; DIP 8 = OFF.

Table 27 - Function and Default Settings

Switch Number	Switch Function	Default	Description
9	450L-E only Teach-in blanking	OFF	OFF: Disabled ON: Enabled
10	Combination activates one of the following configurations: <ul style="list-style-type: none"> • No reduced resolution • Reduced resolution 1 lens • Reduced resolution 2 lenses 	OFF	<ul style="list-style-type: none"> • DIP 10: OFF, DIP 11: OFF: Reduced resolution disabled (Default) • DIP 10: ON, DIP 11: OFF: Reduced resolution 1 beam • DIP 10: OFF, DIP 11: ON: Reduced resolution 2 beams • DIP 10: ON, DIP 11: ON: Invalid selection (error)
11		OFF	
12	—	OFF	—

[Table 28](#) shows the function and default settings for the M12 8-pin muting receiver plug-in (450L-APR-MU-8) inserted in a 450L-E or 450L PAC safety light curtain transceiver stick; DIP 8 = ON.

Table 28 - Function and Default Settings

Switch Number	Switch Function	Default	Description
9	450L-E only Combination activates one of the following muting configurations:	OFF	<ul style="list-style-type: none"> DIP 9: OFF, DIP 10: OFF, DIP 11: OFF: No muting DIP 9: OFF, DIP 10: ON, DIP 11: OFF 2L muting sensors connected to connection plug-in DIP 9: OFF, DIP 10: ON, DIP 11: ON 2L muting sensors connected to I/O cascading plug-in DIP 9: ON, DIP 10: OFF, DIP 11: OFF 2T muting sensors connected to connection plug-in DIP 9: ON, DIP 10: OFF, DIP 11: ON 2T muting sensors connected to cascading plug-in DIP 9: ON, DIP 10: ON, DIP 11: ON 4T muting sensors connected to cascading plug-in
10		OFF	
11		OFF	
12	—	OFF	—

450L-APR-UN-8 Connection Plug-in

[Table 29](#) shows the function and default settings for the M12 8-pin muting receiver plug-in (450L-APR-UN-8) inserted in a 450L safety light curtain transceiver stick.

Table 29 - Function and Default Settings

Switch Number	Switch Function	Default	Description
1	450L-E only: Software Configuration	OFF	OFF: Disabled ON: Enabled
2	Low Range Activation	OFF	OFF: Disabled ON: Enabled
3	450L-E and 450L PAC only: Activates Beam Coding	OFF	OFF: Disabled ON: Enabled
4	450L-E only: Activates Interference Rejection	OFF	OFF: Disabled ON: Enabled
5	Combination activates one of the following start modes: <ul style="list-style-type: none"> Automatic start Manual (re)start Manual cold start Manual start with off function 	OFF	<ul style="list-style-type: none"> DIP 5: OFF, DIP 6 OFF: Automatic start (Default) DIP 5: ON, DIP 6 OFF: Manual (re)start DIP 5: OFF, DIP 6 ON: Manual cold start DIP 5: ON, DIP 6 ON: Manual start with off function
6		OFF	
7	External Device Monitoring	OFF	OFF: Disabled ON: Enabled
8	—	OFF	—
9	—	OFF	—
10	—	OFF	—
11	—	OFF	—
12	—	OFF	—

For the UNIV plug-in: if pin 4 and pin 8 are short circuited (transmitter mode), the DIP switch settings have no impact on the transmitter functionality.

Confirmation of a New System Configuration

IMPORTANT The confirmation procedure is not required when the receiver stick is operated for the first time (brand new receiver). The STS status indicator flashes red/green when a confirmation is required.

Confirmation of a system configuration must only be performed when the receiver stick was previously operated with another configuration or when the receiver stick was previously operated with another transmitter.

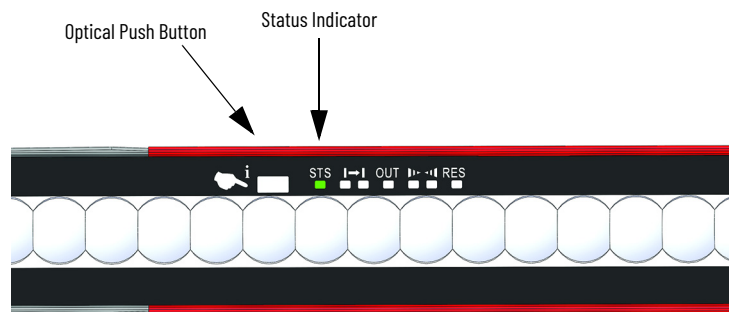
If the receiver plug-in is exchanged with a new plug-in with the same plug-in type and DIP switch settings as the original one, no confirmation procedure is required.

Also, no configuration confirmation procedure is required for a complete pair of 450L safety light curtain transceiver sticks out-of-the-box.

Perform a confirmation procedure of a new configuration when you reinsert the plug-in to the light curtain stick with a changed DIP switch setting. The request for such a confirmation is displayed via a 1 Hz red/green blinking STS status indicator (Figure 33).

This process must be performed only once, after the first power-up of a plug-in with new settings. It is not required at any following power-up (only when DIP switches are changed again).

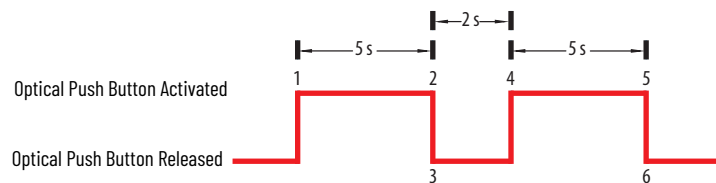
Figure 33 - Position of Optical Push Button and Status Indicator



Confirmation

Figure 34 shows the configuration timing sequence. The optical push button must be activated two times for 5 seconds. Between the two activations, a break of a maximum of 2 seconds is allowed.

Figure 34 - Configuration Process



Confirmation Procedure

To confirm a new configuration, follow these steps:

1. The status indicator STS blinks green/red (1 Hz, one time red, and one time green per second, 50:50 duty cycle) which indicates that the stick is in the configuration mode.
2. Actuate the optical push button for 5 seconds.
3. STS blinks green/red to indicate actuation with a frequency of 10 Hz and 50:50 duty cycle.

4. As soon as the status indicator STS changes from green/red to green/off, release the optical push button.
5. Release is indicated with a change of frequency of 10 Hz to 1 Hz (status indicator STS green/off and a 50:50 duty cycle).
6. Within 2 seconds, actuate the optical push button.
7. Status indicator STS indicates the activation by a new green/red frequency of 10 Hz and a 50% duty cycle.
8. Actuate the optical push button for 5 seconds.
9. As soon as the status indicator changes from green/red blinking to green/off blinking, release.
10. After releasing, the status indicator STS is steady green.

If any error occurs in this procedure, the new configuration is not stored and the STS-indicator starts blinking again (1 Hz, green/red, and 50:50 duty cycle). For example:

- If the actuator is released before the 5 seconds.
- It is not actuated within the 2 seconds thereafter.

IMPORTANT	Once the configuration confirmation procedure is completed, verify that the operating mode has changed to the intended configuration.
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Installation and Wiring



ATTENTION: The GuardShield™ safety light curtain must not be used with machines that cannot be stopped electrically in an emergency. The required safety distance (see [Determine the Safety Distance on page 62](#)) between the GuardShield safety light curtain and dangerous machine movement must always be maintained.

Additional mechanical protective devices must be installed if hazardous machine elements can be reached without passing through the protective field.

Improper installation can result in serious injury.

Never connect the safety outputs (OSSDs) to +24V DC. If the safety outputs are connected to +24V DC, they are in the ON-state and cannot stop hazardous machine/application movements.

Never expose the GuardShield safety light curtain to flammable or explosive gases. Do not install GuardShield safety light curtains in outdoor or underwater applications without additional measures.

Regular safety inspections are imperative (see [Maintenance on page 109](#)).

Do not open or attempt to repair or modify the GuardShield safety light curtain. Removal of either of the gray GuardShield safety light curtain end caps or the transparent front window voids the warranty terms of this product.



LASER LIGHT CLASS 2 HAZARD: Do not stare into beam. The 450L-E and 450L PAC GuardShield safety light curtains are equipped with an integrated laser alignment aid (see [Laser Alignment on page 23](#)).

IMPORTANT

Do not insert or remove plug-ins when power is applied to the plug-in. The GuardShield safety light curtain must be used only as defined in [Product Overview on page 11](#).

If the device is used for any other purposes or modified in any way, warranty claims against Rockwell Automation become null and void. Installation must be in accordance with this manual and implemented by qualified personnel exclusively.

A GuardShield safety light curtain system is intended to be part of the safety-related control system of a machine. Before installation, a thorough risk assessment must be performed to determine whether the specifications of this device are suitable for all foreseeable operational and environmental characteristics of the application.

See [Specifications on page 165](#) for certification information and ratings. The requirements that are defined in this appendix, for example, power supply, cables, and ambient conditions, must be observed and maintained to allow for the safety function.

Use appropriate screws, bolts, and/or nuts to mount the sticks and plug-ins to avoid damage.

Do not over-torque the mounting hardware:

- The required screwdriver type for installation of the plug-ins is a Phillips tip screwdriver for M2 x 8 Phillips screw. Maximum torque is 0.38 N•m (3.36 lb•in).
- The required screwdriver type for installation of the standard top/bottom mounting kit is a Phillips tip screwdriver for M3 x 10 Phillips DIN 965 A screw. Maximum torque is 0.7 N•m (6.19 lb•in).

Only use the designated mounting holes of the mounting bracket.

Use only fixed, stable, and sturdy mounting posts or frames to mount a 450L-B GuardShield safety light curtain system.

For the installation of the plug-ins, see [Electrical Installation on page 81](#).

Determine the Safety Distance

The light curtain must be mounted with proper safety distance:

- From the point of danger
- From reflective surfaces

To help prevent a person from reaching through the protective field to a dangerous area (while the machine is still moving), both points must be considered in an installation.

The calculation of point one varies depending on the region (country) where it is operated.

U.S. Safety Distance Formula

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 properly can result in operator injury.



ATTENTION: The GuardShield safety light curtains must be mounted at a sufficient distance from the pinch point or point of operation hazard. This distance helps confirm that the machine stops before a finger, hand, arms, or body reach the hazard.

Regardless of the calculated safety distance, the protective field of a GuardShield safety light curtain is never mounted closer than 152.4 mm (6 in.) from the point of operation to the pinch point hazard.

In the United States, two formulas are commonly used to calculate the safety distance.

- The OSHA formula is the minimum requirement for the calculation of the safety distance.
- The ANSI formula, the formula we recommend, incorporates additional factors for consideration when calculating the safety distance.

OSHA Safety Distance Formula

The OSHA safety distance formula as specified in CFR29 Subpart O1910.217 is as follows:

$$Ds = 63 \times T$$

Ds	Safety Distance in inches (1 in. = 25.4 mm)
63	Is the OSHA recommended hand speed constant in inches per second (63 in/s = 1600 mm/s)
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, the stopping time is measured at approximately the 90° position of the crankshaft rotation.

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

ANSI Safety Distance Formula

The ANSI B11.19 safety distance formula, which is the formula we recommend for USA, is as follows:

$$Ds = K \times (Tst + Tc + Tt + Tbm) + Dpf$$

Ds	Minimum safety distance between the safe guarding device and the nearest point of operation hazard (in inches).
K	Hand-speed constant in inches per second. The ANSI standard value is 63 inches per second when the operator begins reaching toward the point of operation hazard from rest.

IMPORTANT ANSI B11.19 1990 E4.2.3.3.5 states "The value of the hand-speed constant, K, is determined in various studies. Although these studies indicate speeds of 63 inches/second to over 100 inches/second, they are not conclusive. The employer can consider all factors, including the physical ability of the operator, when determining the value of K to be used."

Tst	Stop time of the machine tool that is measured at the final control element.
Tc	Response time of the control system
Tt	Response time of the presence sensing device (safety light curtain) and its interface, if any. The device manufacturer states this value or you can measure it.

IMPORTANT A stop time device is used to measure Tst + Tc + Tr.

- T_{bm} Additional time that is allowed for the brake monitor to compensate for variations in normal stop 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 object sensitivity. Object sensitivity is the smallest diameter object that is detected anywhere in the sensing field (commonly also known as resolution).

Example for D_{pf}

The D_{pf} can be approximated in a perpendicular safety light curtain application with object sensitivity (effective resolution) less than 63.5 mm (2.5 in.):

$$D_{pf} \text{ (inches)} = 3.4 \times (\text{Object Sensitivity [inch]} - 0.276 \text{ [inch]}), \text{ but not less than } 0.$$

Table 30 - Depth of Penetration Factor

Description	Depth Penetration Factor
Finger resolution (14 mm [0.56 in.])	23.7 mm (0.935 in.)
Hand resolution (30 mm [1.19 in.])	78.1 mm (3.077 in.)

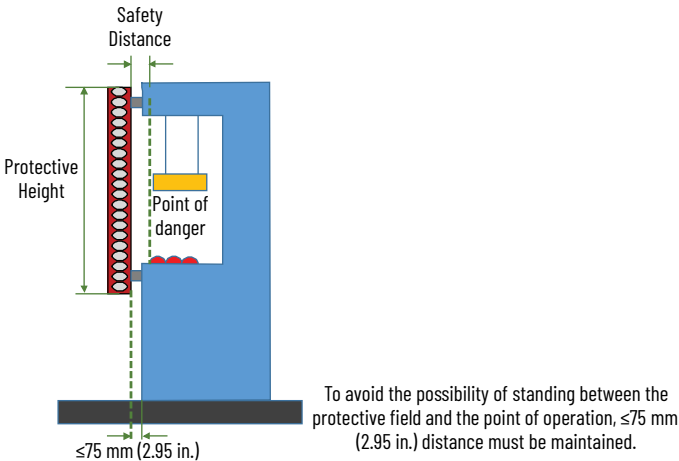
European Safety Distance Formula

A safety distance must be maintained between the light curtain and the point of danger (Figure 38 on page 66), as described in IEC/TS 62046. This safety distance helps confirm that the point of danger can only be reached after the dangerous state of the machine has been removed.

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

- Machine stop time
- Response time of the protective device (safety light curtain + control circuit)
- Resolution of the safety light curtain
- Approach speed to the danger point
- Position of the AOPD

Figure 35 - Safety Distance from the Point of Danger to the Light Curtain



How to calculate the Safety Distance (S) for 450L POC safety light curtain systems according to EN ISO 13855 and EN ISO 13857:

- First, calculate S use the following formula:

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

Where:

- T = Stopping/run-down time of the machine [s] + response time Tt of the safety light curtain [s] + response time of the control circuit [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: $S = 1600 \times T + 8 \times (d - 14)$ [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:

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

Response time safety-light curtain Tt < 20 ms

Response time of the control circuit = 10 [ms]

$T = 290 \text{ [ms]} + 20 \text{ [ms]} + 10 \text{ [ms]} = 320 \text{ [ms]} = 0.32 \text{ [s]}$

Resolution of the light curtain = 14 mm (0.56 in.)

$S = 2000 \times 0.32 + 8 \times (14 - 14) = 640 \text{ mm (25.1 in.)}$ $S > 500$ mm, therefore:

$S = 1600 \times 0.32 + 8 \times (14 - 14) = 512 \text{ mm (20.1 in.)}$

[Figure 35 on page 64](#) also indicates the distance to avoid standing behind the safety light curtain. If the light curtain is installed more than 75 mm (2.95 in.) from the machine:

- With auto restart
- Where the dangerous area is not visible from the Reset button more protective measures must be considered (for example, an additional horizontal installed light curtain).

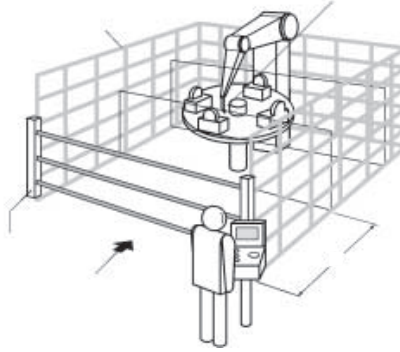
How to calculate the Safety Distance (S) for 450L PAC safety light curtain systems according to EN ISO 13855 and EN ISO 13857:

If there are perimeter systems or light curtains with a resolution $d > 40$ mm (1.57 in.), the safety distance is calculated for vertical mounting light curtains and horizontal approach, according to the formula:

$S = (1600 \times T) + 850 \text{ mm (33.46 in.)}$

More detailed information regarding safety distance and safety heights can be found in standard EN ISO 13855 (2010).

Figure 36 - Safety Distance from the Point of Danger to the Light Curtain



Minimum Distance from Reflective Surfaces

The infrared light that is transmitted from the two transceivers can be reflected off shiny surfaces. If this condition occurs, it can result in an object not being detected when it enters the GuardShield safety light curtain sensing field.

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

Figure 37 - Minimum Distance A from Reflective Surfaces (Top View)

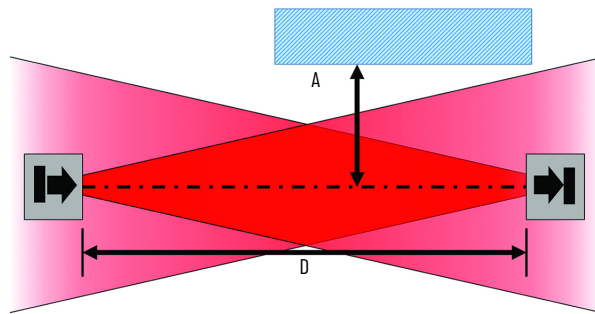
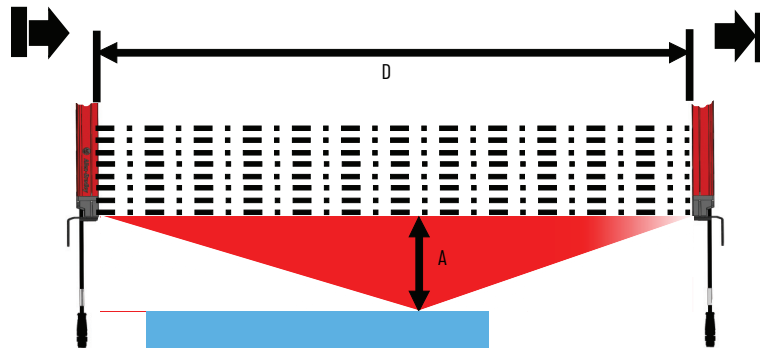
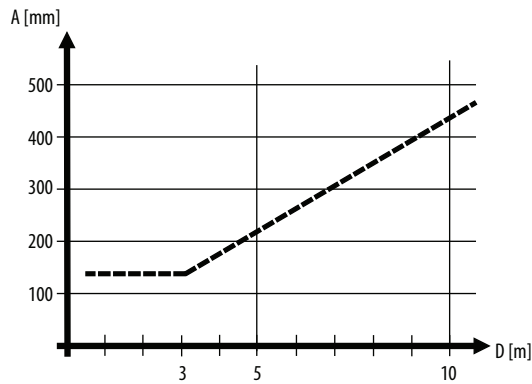


Figure 38 - Minimum Distance A from Reflective Surfaces (Side View)



The minimum distance from the reflective surfaces can be determined as follows:

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

Figure 39 - Minimum Distance A from Reflective Surfaces (D= Distance between Receiver and Transmitter)

The effective aperture angle for the 450L safety light curtain system is $\pm 2.5^\circ$ 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, with an aperture angle of 2.5° .

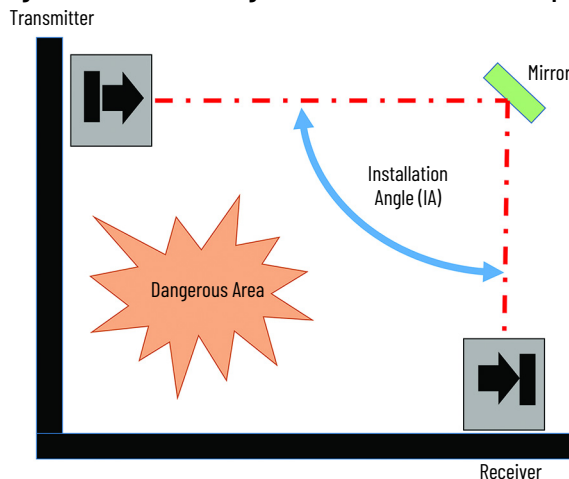
IMPORTANT Formula: $A [\text{mm}] = \tan 2.5^\circ \times D = 43.7 \times D [\text{m}]$
 A = Minimum distance to reflective surfaces
 D = Distance between transmitter and receiver or take the appropriate value from [Table 31](#).

Table 31 - Minimum Distance for Various Distances D Between Transmitter and Receiver

Distance between Transmitter and Receiver (Range D) [m (ft)]	Minimum Distance A [mm (in.)]
0.5...3.0 (1.64...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)

Mirrors

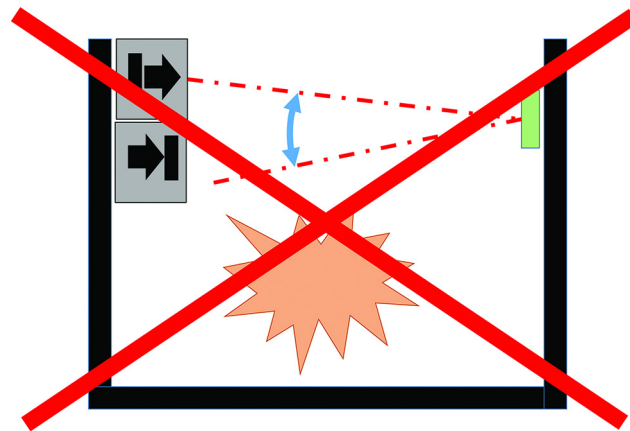
The GuardShield safety light curtains can be used with corner mirrors (see [Corner Mirror on page 175](#)). Mirrors are only allowed for applications without undetected access into the protected area.

Figure 40 - Installation Angle for Mirrors (View from the Top)



ATTENTION: When using mirrors, all sides of the protective field have to fulfill the requirements for minimum safety distance and minimum distance from the reflective surfaces.
The installation angle (IA) must be between $70^{\circ} < IA < 110^{\circ}$ otherwise serious injury or death could result.

Figure 41 - Possible Misuse of a Mirror

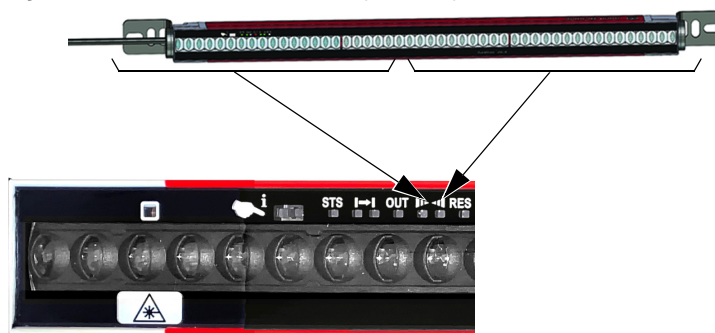


Install and Mount

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

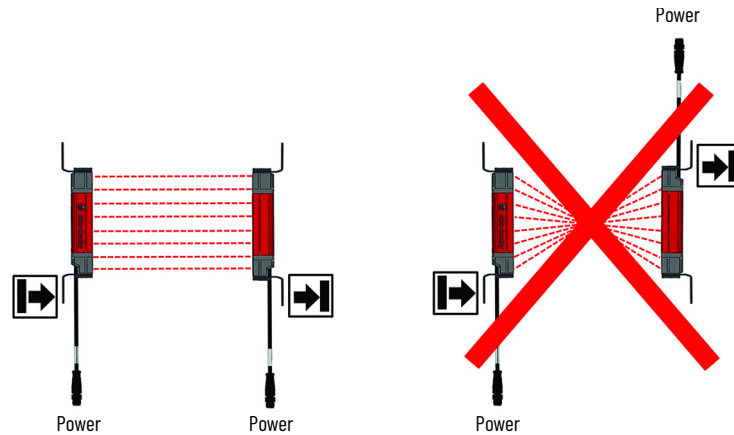
- A GuardShield safety light curtain system can be used in all mounting orientations.
- The GuardShield safety light curtain has two status indicators in each stick to display the status of the intensity ([Figure 42](#)). One status indicator refers to the first half of the protective field, the other status indicator refers to the second half of the protective field. These status indicators begin to flash green when the receiver sees the infrared light from the transmitter. The status indicators turn steady green when optimal alignment is attained. These two status indicators can be used as an alignment aid.


Figure 42 - Status Indicators to Display Intensity



- Mount both sticks so that the distance of the protective field is at or greater than the calculated safety distance (see [Determine the Safety Distance on page 62](#)).
- Mount both sticks away from any reflective surfaces (see [Figure 37 on page 66](#)).
- They must be parallel to each other and be positioned at the same height. The transmitter and receiver connection plug-in locations must point in the same direction ([Figure 43 on page 69](#)).

Figure 43 - Correct Positioning and Incorrect Positioning of Transmitter and Receiver Sticks



- The optical lens system of transmitter and receiver stick must be in exact opposition to each other.
- Take suitable measures to attenuate vibration.
- The safety light curtain must be mounted such that the hazardous point cannot be reached from below, above, or behind the safety light curtain and that the light curtain cannot be repositioned (see [Correct Installation on page 70](#) and [Incorrect Installation on page 71](#)).
- Connect both sticks.
- Turn on power to the GuardShield safety light curtain system.
- If the STS status indicator at the receiver stick displays a configuration change (blinking red/green), confirmation is required to proceed with [Confirmation of a New System Configuration on page 59](#).
- Rotate the transmitter and receiver sticks while watching the two regional intensity status indicators on the sticks. Find the point where the two indicators for the intensity state illuminate to a steady green condition. 
- Determine the maximum left and right adjustment angles and position each unit in the center. Tighten all hardware until the alignment (intensity) indicators are not blinking.
- Cycle power to confirm that the system powers up, goes to the ON state (STS status indicator steady green) and the intensity status indicators indicate steady green.

An external laser alignment tool (440L-ALAT) and a dedicated mounting bracket (450L-ALAT-C) are offered as accessories (see [Alignment Tool and Bracket on page 178](#)). Use these items for aligning the 450L-B safety light curtain for larger operating distances or when corner mirrors are used in the application.

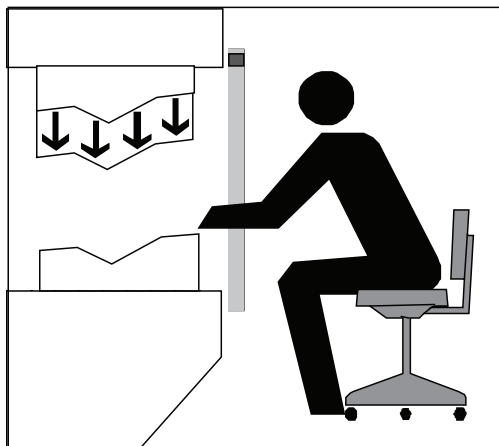
IMPORTANT If EDM or manual start functions are configured through DIP switch settings, confirm that the proper receiver wire connections are made.

The minimum operating distance must always be followed (see [Table 73 on page 165](#)). Stable operation cannot be guaranteed when operating below the specified value. When the transmitter and the receiver stick are positioned closer than specified, it results in an interruption of the protective field and switches off the two OSSDs.

IMPORTANT We recommend that you only use the mounting brackets that we offer. Take appropriate measures to dampen vibration if the vibration and shock requirements are above the specified values and test conditions.

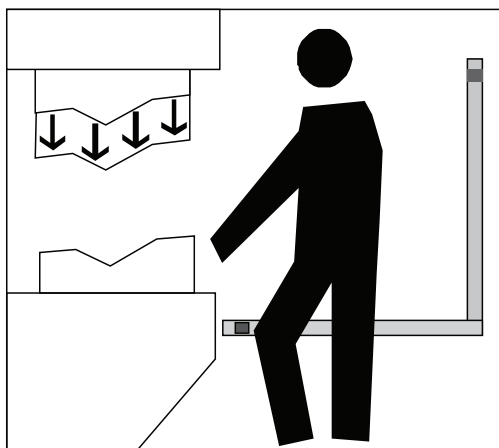
Correct Installation

Figure 44 - Operators Cannot Reach Hazardous Machine Parts without Passing Through the Protective Field



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

Figure 45 - Operators Must Not Step between Protective Field and Hazardous Machine Parts (Pass Through Prevention)



Incorrect Installation

Figure 46 - Operators Can Reach Hazardous Machine Parts without Passing Through the Protective Field

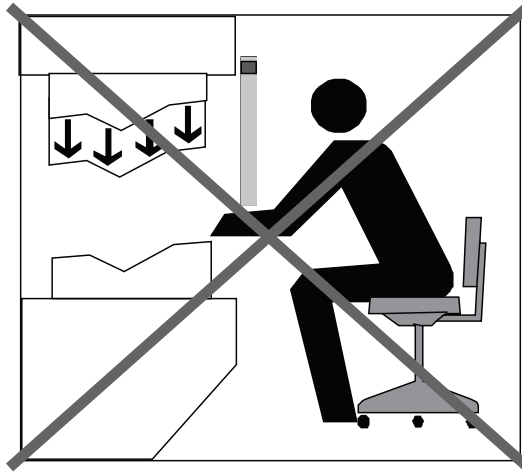
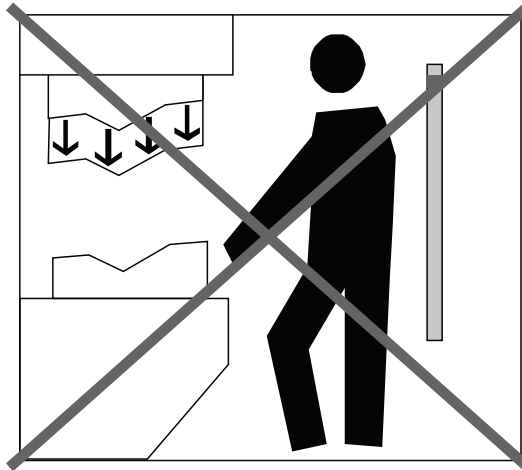
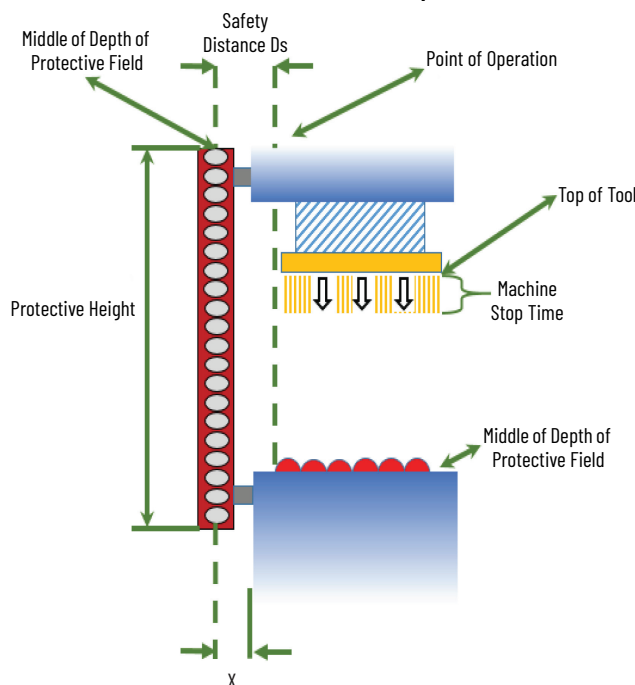


Figure 47 - Operators Can Step between Protective Field and Hazardous Machine Parts



The GuardShield safety light curtain must be mounted at the proper distance from the point of operation hazard. This distance is referred to as the safety distance. If the safety distance calculation is such that a person can step between a vertically mounted safety light curtain and the machine hazard, more protective measures are required.

Figure 48 - Terms to Help Define Safety Distance to Avoid the Possibility of Standing between the Protective Field and the Point of Operation



IMPORTANT Confirm that an operator is not able to stand between the protective field and the point of operation (hazard). EN ISO 13855 requires a minimum distance X at an installation height of 300 mm (11.9 in.). Check EN ISO 13855 for other installation heights.

Mount Multiple 450L GuardShield Safety Light Curtains

When two or more 450L safety light curtain pairs are mounted closely, the following possibilities can happen:

1. Optical interference: The receiver of one pair “sees” sporadically infrared light from the transmitter of another pair. Optical interference between neighboring 450L safety light curtain systems can affect light curtain system reliability by the sporadic switching off of the OSSDs.
2. Optical crosstalk (see [Figure 50 on page 73](#)): The receiver of one pair communicates continuously with the transmitter of another pair. Optical crosstalk between neighboring 450L safety light curtain systems causes holes in the protective field and is therefore an unsafe installation. Optical crosstalk can only occur if:
 - a. Both systems have the same resolution and the same height of the protective field.
 - b. The height of the protective field is smaller than the minimum separation distance S provided in [Table 14 on page 45](#).
 - c. The space between both pairs is smaller than the minimum separation distance S provided in [Table 14 on page 45](#).



ATTENTION: Cross talking between adjacent installed pairs can cause an unsafe situation.

Measures to avoid optical interference or optical cross talk are:

1. Minimum installation distance S between adjacent installed pairs (see [Table 14 on page 45](#)).
2. Installation of optical barriers (see [Figure 51 on page 74](#)).

For 450L-E safety light curtains, a measure to help prevent optical cross talk is also the beam code function (see [Beam Coding on page 27](#)). The beam code function helps prevent optical cross talking. It also reduces the probability for optical interferences but it does not fully stop them. You can also use interference rejection, see [Interference Rejection on page 28](#).

Figure 49 - Two Adjacent Installed Pairs without Optical Crosstalk

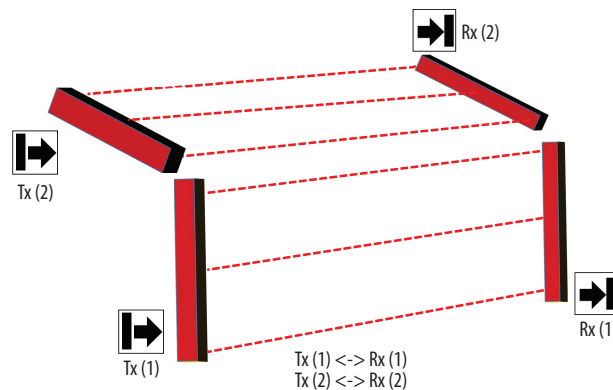
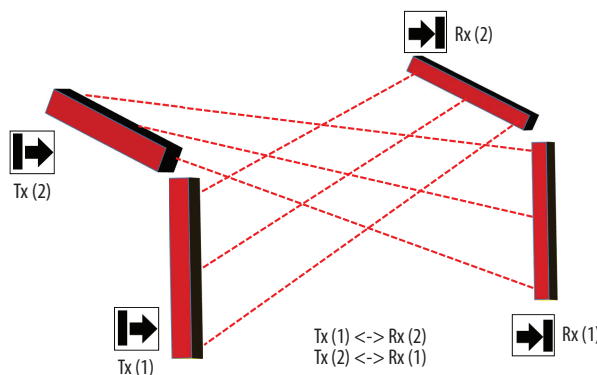


Figure 50 - Two Adjacent Installed Pairs with Optical Crosstalk



[Figure 51 on page 74](#) shows a number of installation techniques to stop optical interference or optical crosstalk between adjacent light curtains.

- Check that the maximum operation range can be reduced (see [Low Operating Range on page 27](#)).
- Invert adjacent pairs.
- Install mechanical (optical) barriers to help prevent optical interference ([Figure 51 on page 74](#)).
- For 450L-E safety light curtains only: Check if the beam code feature is a possible option (see [Beam Coding on page 27](#)).

Figure 51 - Optical Barriers (Ob) Are Required for Adjacent Light Curtains Installations
Horizontal Adjacent Pairs

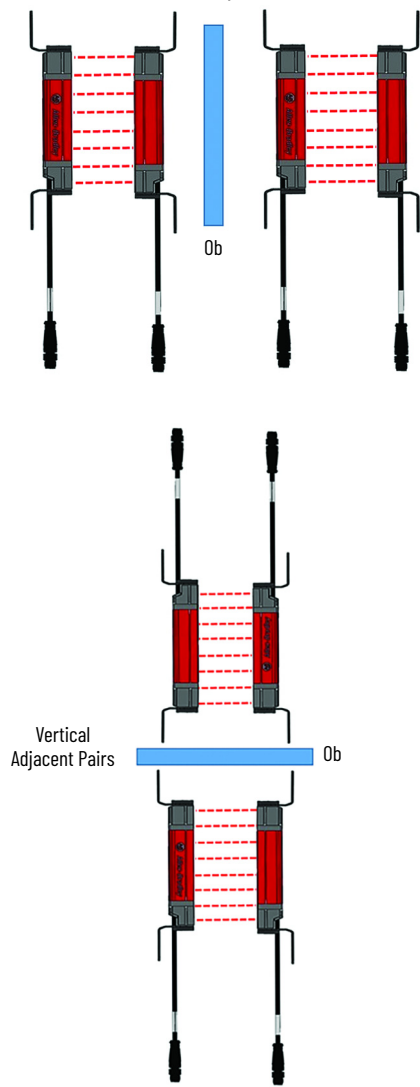
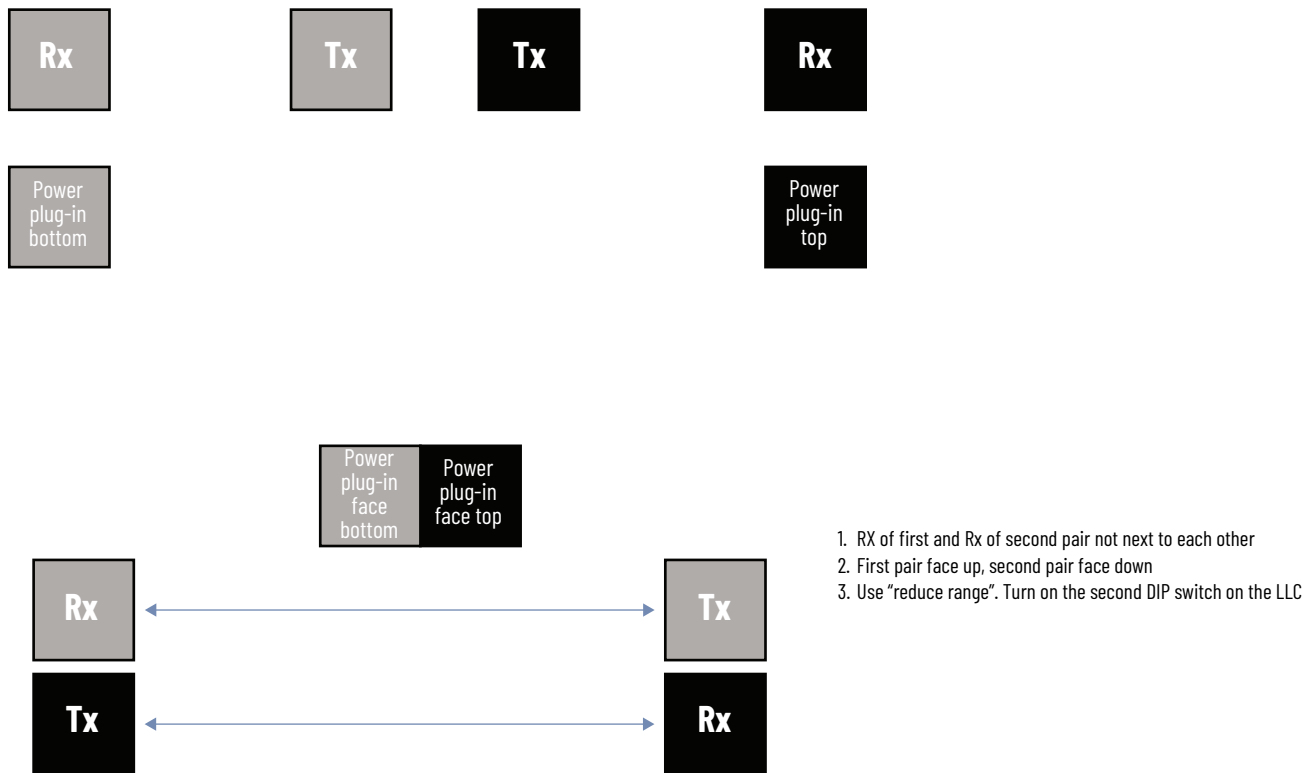


Figure 52 - Invert Adjacent Pairs



Invert the sticks in adjacent pairs such that the "top" and "bottom" of the sticks are opposite: The more accurate the alignment of 450L safety light curtains, the less probability there is of cross-talk/optical interference.

The transceiver architecture of safety light curtains does not allow a back-to-back installation of adjacent transmitters as is common with safety light curtain systems with a pure transmitter and receiver architecture.

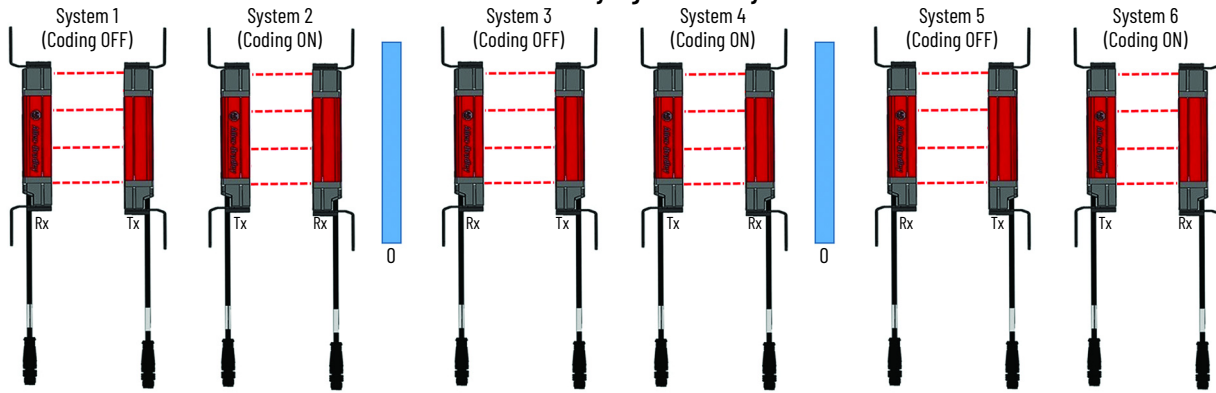
Depending on the installed distance, the reduced operating functionality (see [Low Operating Range on page 27](#)) instead of an optical barrier can be used to stop optical interference of adjacent GuardShield safety light curtain systems.

For 450L-E safety light curtains only: To stop optical interference between neighbor 450L-E safety light curtain systems can cause a safety issue, in addition of an optical barrier the beam code feature (see [Beam Coding on page 27](#)) can be selected. Beam code changes the pulse pattern of infrared light that a 450L-E safety light curtain stick emits.

450L Safety Light Curtain with Interference Rejection

450L PAC safety light curtains have permanently enabled interference rejection. This feature is a user-configurable option for 450L-E safety light curtains. This scheme allows multiple 450L PAC safety light curtain systems to be mounted next to others or on the same plane. Where only two pairs are mounted, beam coding must be enabled for only one of the pairs and they must be oriented with both transmitter (Tx) sticks back-to-back or both receiver (Rx) sticks back-to-back, as shown in [Figure 53 on page 76](#). If both pairs are powered up simultaneously without this orientation, it is possible for the Rx of one system to attempt to pair with the Tx of the other system, which causes both sticks to prompt for a teach-in.

Figure 53 - Mounting Arrangement for 450L PAC and 450L-E with Interference Rejection Enabled Safety Light Curtain Systems



Mounting Brackets

Standard Top/Bottom Mounting Kit

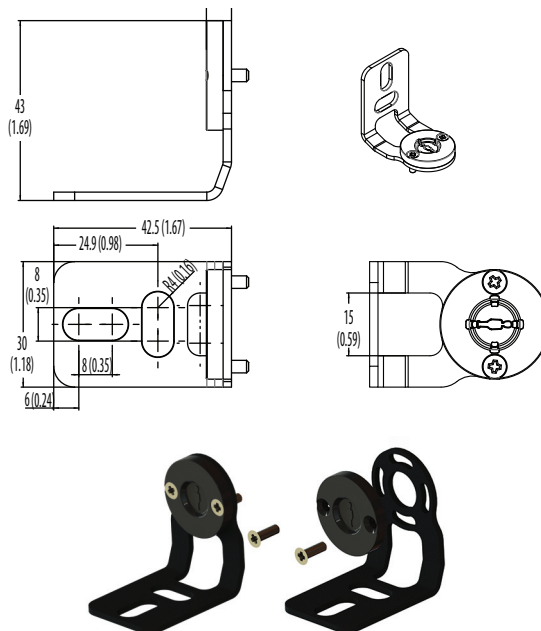
The GuardShield safety light curtain can be mounted using right angle brackets that are attached to the end caps of both the transmitter and receiver sticks. A pair of end cap mounting brackets are supplied with each stick.

The required screwdriver type for installation of the standard top/bottom mounting kit is a Phillips screwdriver for M3 x 10 Phillips DIN 965 A screw. The maximum torque cannot be above 0.7 N•m (6.19 lb•in) otherwise the light curtain could become damaged.

The top/bottom mounting kit allows a rotation of $\pm 20\%$ of the GuardShield safety light curtain aluminum profile.

The length of the transceiver stick and the vibration and shock conditions of the application often require use of additional side mounting brackets.

Figure 54 - Standard Mounting Bracket Kit, Supplied with Each Stick, (Cat. No. 450L-AM-TBM: Contains Two Brackets for One Stick) (mm [in.])



Two M6 DIN 912 screws (not provided) are required for proper mounting of each stick.

[Figure 55](#) presents different cable guide options. The bend radius of the plug-in pig tail cable is small enough so that the cable can be routed at a 90° angle. The minimum bend radius is specified in [Table 79 on page 168](#).

Figure 55 - Connection Cable Guide Options



[Figure 56](#) and [Figure 57](#) show possible mounting when attaching to extruded aluminum profiles.

Figure 56 - 450L Safety Light Curtain Mounted on an Extruded Aluminum Profile Using the Standard Top/Bottom Mounting Bracket

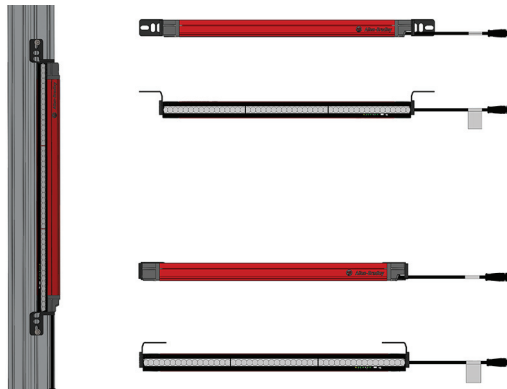
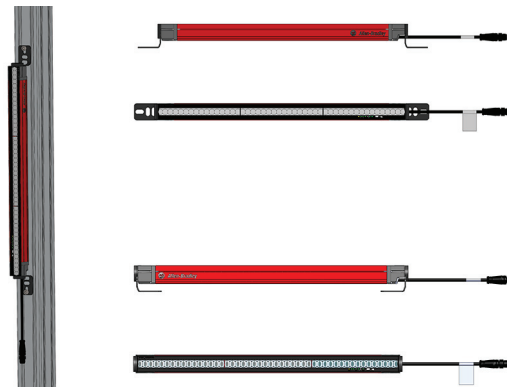


Figure 57 - 450L Safety Light Curtain Mounted Backwards on an Extruded Aluminum Profile Using the Standard Top/Bottom Mounting Bracket



Side Mounting Bracket

The side mounting clamp allows a rotation of the snapped in GuardShield safety light curtain profile of $\pm 5^\circ$ (Figure 58).

Figure 58 - Dimensions of the Side Mounting Bracket 450L-AM-SM (Contains Two Brackets)
(mm [in.])

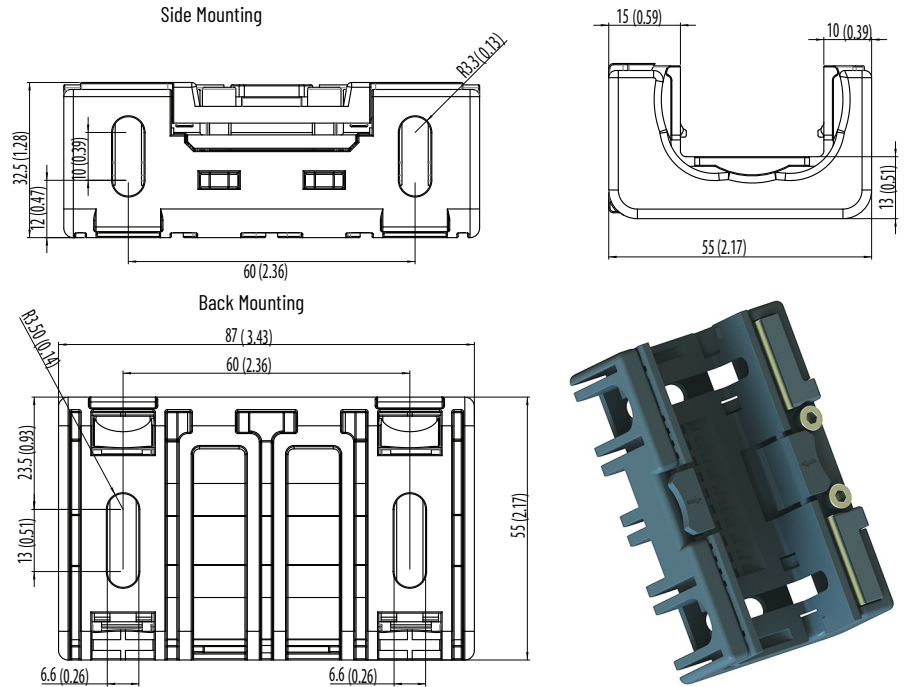


Figure 59 - 450L Safety Light Curtain Snapped in a Side Mounting Kit (mm [in.])

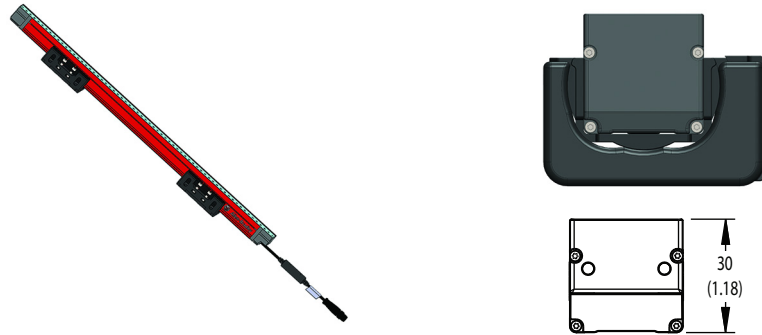
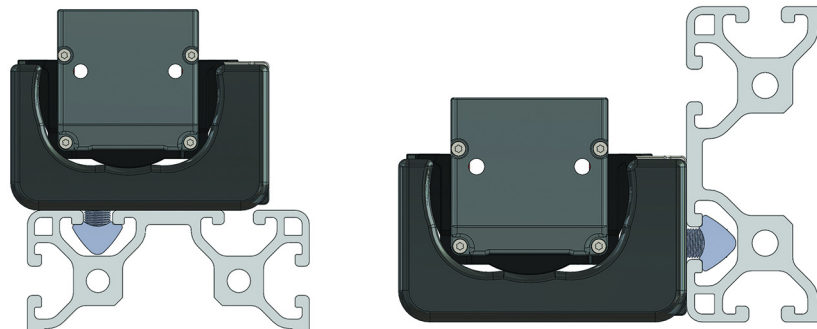


Figure 60 - 450L Safety Light Curtain Mounted on an Extruded Aluminum Profile Using Side-mount Bracket Kit (450L-AM-SM: Contains Two Brackets)



Two M6 DIN 912 screws (not provided) are required (minimum) for proper mounting of each clamp.

IMPORTANT Use side mounting brackets and, or instead of, the top/bottom mounting kits in vibration applications.

Use additional side mounting brackets in vibration applications for protective heights of 1050 mm (41.3 in.) and larger. Position and mount the additional bracket in the middle of each stick.

Table 32 - Number of Side Mounting Brackets without Top/Bottom Brackets

Stick Length	Number of Side Mounting Brackets Per Stick
150 mm (5.9 in.)	1
300...900 mm (11.8...35.43 in.)	2
1050...1950 mm (41.34...76.77 in.)	2 (3 for vibration applications)

Table 33 - Number of Side Mounting Brackets and Top/Bottom Brackets

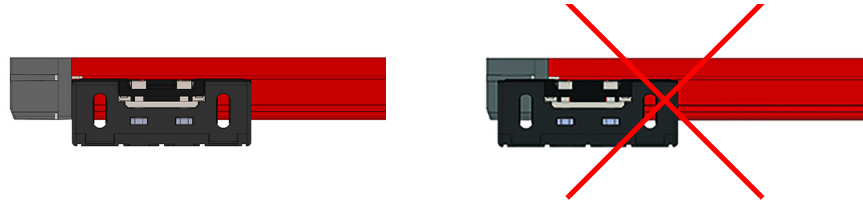
Stick Length	Number of Side Mounting Brackets Per Stick
150...900 mm (5.9...35.43 in.)	0
1050...1950 mm (41.34...76.77 in.)	1 for vibration applications

The required screwdriver type for installation of the side mounting kit is a hex tip screwdriver for M6 screws.



ATTENTION: The light curtain can be damaged if the maximum torque exceeds 11 N•m (97.36 lb•in). Do not clamp the gray plastic end cap ([Figure 61](#)).

Figure 61 - Correct and Incorrect Positioning of the Side Mounting Bracket

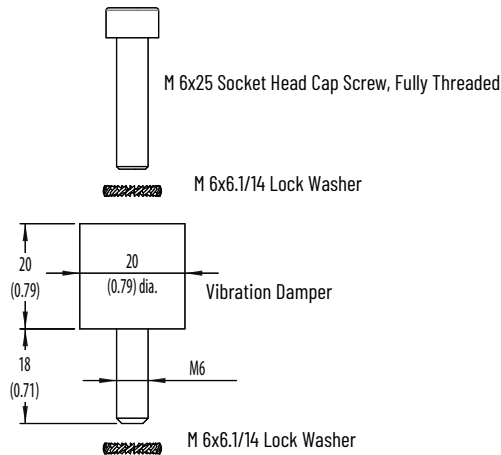


Position the side mount brackets close to the gray end cap. Position additional brackets so that the distance between each bracket is equal (symmetric). The optical interface device 450L-AD-OID (see [Optical Interface Device \(OID\) on page 106](#)) can also be installed in combination with the side mounting brackets.

Shock Mounting Kit

Special shock mount brackets are offered for applications that exhibit shock and vibration ([Figure 62 on page 80](#)). For vertical installations, the vibration damper (445L-AF6142) can be used in combination with the standard L-shaped top/bottom mounting bracket and side mounting.

Figure 62 - Shock Mount Brackets 445L-AF6142 (mm [in.])



Replacement Mounting Kit

The Replacement Mounting Kit provides an easier mechanical conversion from installed safety light curtains to GuardShield safety light curtains if previous mounting holes have to be used. The GuardShield safety light curtain transceiver stick can be directly mounted to the replacement kit bracket. The replacement kit bracket can also be used in combination with the default mounting kit (catalog number 450L-AM-TBM) or the optional side-mount kit (catalog number 450L-AM-SM). See [Figure 64 on page 81](#).

Figure 63 - Replacement Mounting Kit (450L-AM-RK) (mm [in.])

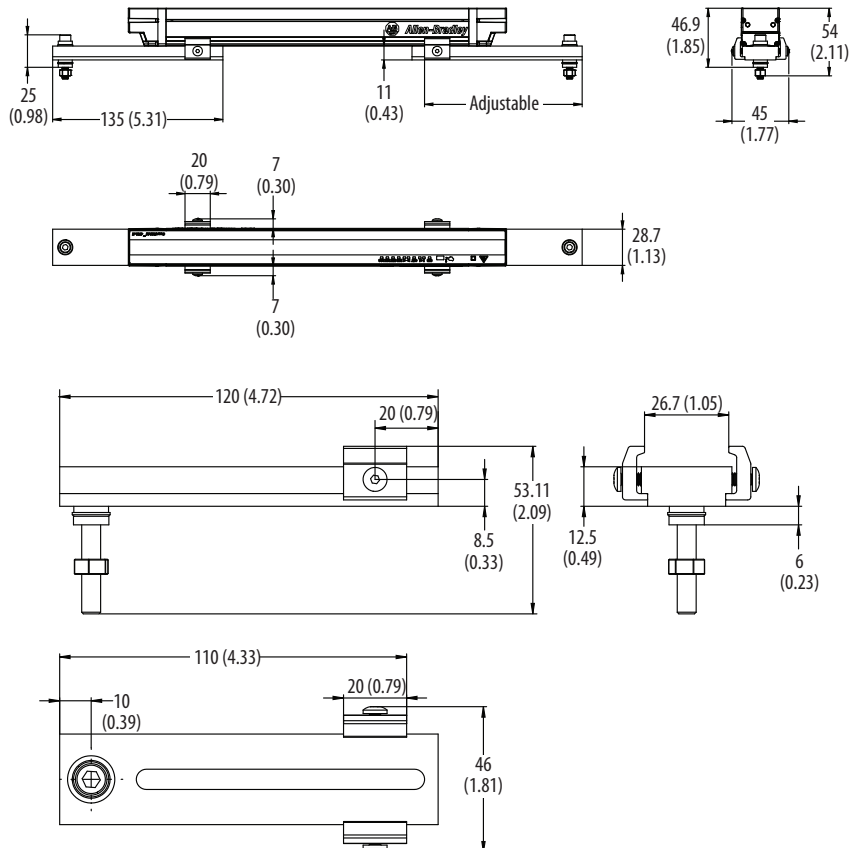
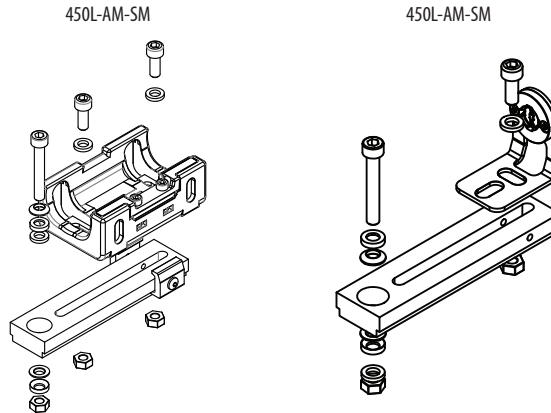


Figure 64 - Replacement Kit in Combination with the Default L-bracket (450L-AM-TBM) and the Side-mounting Bracket (450L-AM-SM) (mm [in.])]



Electrical Installation



ATTENTION: Remove power from the entire machine/system line.

The machine system could inadvertently start up while you are connecting the devices if power is not removed.



ATTENTION: Make sure that the entire system power is disconnected during the electrical installation.

Plug-ins

To assemble a 450L safety light curtain system two 450L safety light curtain sticks (two 450L-B sticks, two 450L-E sticks, or two 450L PAC sticks) — one transmitter and one receiver plug-in — are required. Instead of one transmitter and one receiver plug-in, two universal plug-ins can be used. Unpack the plug-ins and set the DIP switches according to the required functional settings. Remove the red slot cover from the 450L safety light curtain stick and insert the connection plug-in. Remove the gray slot cover from the 450L-E or 450L PAC safety light curtain to insert a cascading plug-in, if necessary.

IMPORTANT

The connection and the cascading plug-ins are mechanically coded. Do not attempt to insert a connection plug-in into the slot for the cascading plug-in and vice versa. If you feel resistance when inserting a plug-in into the safety light curtain, remove the plug-in immediately and verify it is the correct type/end.

Do not insert plug-ins more than 100 times in one GuardShield safety light curtain stick.




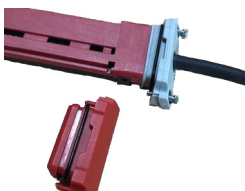
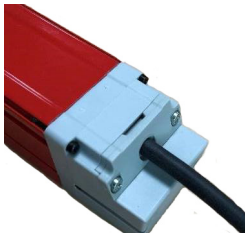



ATTENTION: To avoid pollution or contamination, the installation of a plug-in into a stick must be implemented in a dry and clean area. Make sure that the rubber seal at the plug-in does not get out of place when the plug-in is inserted in the light curtain.

Plug-in Installation

To maintain the IP65 rating, the slot covers must be inserted fully into the light curtain. If the slot cover has been removed, it must be replaced with a plug-in that must be properly inserted into the light curtain. [Figure 65](#) shows example of correct and incorrect installation.

Figure 65 - Plug-in Installation Examples

Correct ✓	Incorrect ✗
 Cap fully seated	 Cap missing
 Gasket in groove No nicks, splits, or flat spots	 Gasket mis-located
 Fully seated, screws tight	 Screws not torqued

Transmitter Plug-in

[Figure 66](#) shows the plug-ins that can make a transceiver a transmitter. [Table 34...Table 36 on page 83](#) show the pinout connections for each plug-in.

Figure 66 - Transmitter Plug-ins

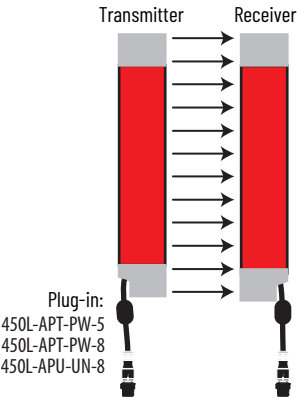


Table 34 - Pin Assignment – Cat. No. 450L-APT-PW-5


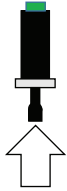
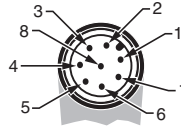
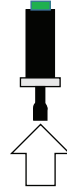
Face View of Convex M12 5-pin	View	Pin No.	Signal Transmitter
		1	24V DC
		2	No connection
		3	0V (ground)
		4	No connection
		5	Functional earth FE

Table 35 - Pin Assignment – Cat. No. 450L-APT-PW-8

Face View of Convex M12 8-pin	View	Pin No.	Signal Transmitter
		1	Do not connect
		2	+24V DC
		3	Functional earth FE
		4	Do not connect
		5	Do not connect
		6	Auxiliary output (lockout stick) (ON=24V DC)
		7	0V (GND)
		8	Do not connect

Receiver Plug-in

Any receiver plug-in type works with any transmitter plug-in type and vice versa (see [Figure 66 on page 82](#)).

Table 36 - Pin Assignment – Cat. Nos. 450L-APR-ON-5 and 450L-APR-BL-5

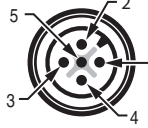
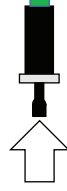
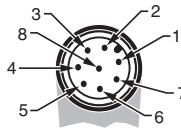
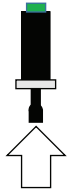
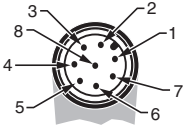

Receiver Bottom Plug-in Face View of Convex M12 5-pin (DC Micro)	View	Pin No.	Signal Receiver
		1	+24V DC
		2	OSSD1
		3	0V (GND)
		4	OSSD2
		5	Functional earth FE

Table 37 - Pin Assignment – Cat. No. 450L-APR-ED-8

Receiver Bottom Plug-in Face View of Convex M12 8-pin (DC Micro)	View	Pin No.	Signal Receiver
		1	Auxiliary output (OSSD emulation)
		2	+24V DC
		3	Functional earth FE
		4	EDM (Input) ⁽¹⁾
		5	OSSD1
		6	OSSD2
		7	0V (GND)
		8	Start ⁽¹⁾

(1) If set with DIP switches.

Table 38 - Pin Assignment – Cat. No. 450L-APR-MU-8 (Configured for (a) No Muting, or for (b) Muting Sensors Connected at Cascading 450L-APC-IO-8 Plug-in)

Receiver Bottom Plug-in Face View of Convex M12 8-pin (DC Micro)	View	Pin No.	Signal Receiver
		1	Auxiliary output (OSSD emulation)
		2	+24V DC
		3	Functional earth FE
		4	EDM (Input) ⁽¹⁾
		5	OSSD1
		6	OSSD2
		7	0V (GND)
		8	Start ⁽¹⁾ /mute dependent override

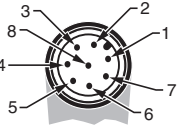

(1) If set with DIP switches.

See [Table 39](#) for a configuration for muting sensors that are connected at the 450L-APR-MU-8 connection plug-in.



ATTENTION: The Auxiliary output is only a status output for diagnosis purposes to connect, for example, an indicator lamp. Do not use this output for safety purposes.

Table 39 - Pin Assignment – Cat. No. 450L-APR-MU-8 if Two-sensor Muting Are Connected at the Connection Plug-in Are Configured (450L-E Safety Light Curtains Only)

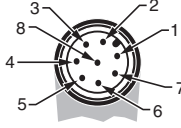
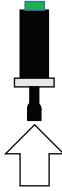
Receiver Bottom Plug-in Face View of Convex M12 8-pin (DC Micro)	View	Pin No.	Signal Receiver
		1	Sensor 1
		2	+24V DC
		3	Functional earth FE
		4	Sensor 2
		5	OSSD1
		6	OSSD2
		7	0V (GND)
		8	Start ⁽¹⁾ /mute dependent override

(1) If set with DIP switches.



ATTENTION: The Auxiliary output is only a status output for diagnosis purposes to connect, for example, an indicator lamp. Do not connect this output to fulfill safety functions.

Table 40 - Pin Assignment – Cat. No. 450L-APU-UN-8

Receiver Bottom Plug-in Face View of Convex M12 8-pin (DC Micro)	View	Pin No.	Signal Transmitter	Signal Receiver
		1	Do not connect	Auxiliary output (OSSD emulation)
		2	+24V DC	+24V DC
		3	Functional earth FE	Functional earth FE
		4	(1)	EDM (Input) ⁽²⁾
		5	Do not connect	OSSD1
		6	Auxiliary output (Lockout)	OSSD2
		7	OV (GND)	OV (GND)
		8	(1)	(2)

(1) Pin 4 connected to pin 8 (short circuit).

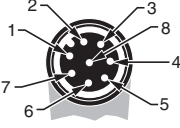

(2) If set with DIP switches.

IMPORTANT If pin 4 is connected to pin 8, the corresponding 450L safety light curtain stick acts like a transmitter.

Cascading

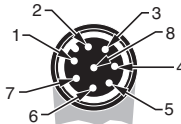
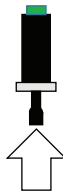
The cascading plug-in can be inserted in a 450L-E POC or 450L PAC safety light curtain transceiver operating as a transmitter ([Table 41](#)) or as a receiver ([Table 42...Table 46 on page 87](#))

Table 41 - Pin Assignment of the Cascading Plug-in (Concave M12 8-pin), Cat. No. 450L-APC-IO-8 Connected to a 450L-E POC or 450L PAC Safety Light Curtain, which Operates as a Tx

Receiver Bottom Plug-in Face View of Convex M12 8-pin (DC Micro)	View	Pin No.	Signal Receiver
		1	No connection
		2	+24V DC
		3	Functional earth FE
		4	No connection
		5	No connection
		6	No connection
		7	OV (GND)
		8	No connection

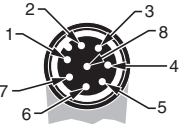

The 450L-APC-IO-8 cascading plug-in that is connected to a GuardShield safety light curtain transceiver that is operating as a transmitter allows the cascading of an additional GuardShield safety light curtain transceiver operating as a transmitter (see [Cascading on page 43](#)). However, in a cascaded system for the transceiver working as a transmitter the 450L-APC-IO-8 cascading plug-ins can be used, but are not required ([Figure 28 on page 46](#)).

Table 42 - Pin Assignment of the Cascading Plug-in (Concave M12 8-pin), Cat. No. 450L-APC-IO-8 Connected to a 450L-E POC or 450L PAC Safety Light Curtain, which Operates as an Rx (DIP Switch Connection Plug-in Default Setting)

Receiver Bottom Plug-in Face View of Convex M12 8-pin (DC Micro)	View	Pin No.	Signal Receiver
		1	No connection
		2	+24V DC
		3	Functional earth FE
		4	No connection
		5	OSSD in 1
		6	OSSD in 2
		7	OV (GND)
		8	Not connected

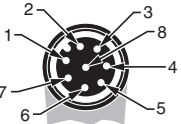
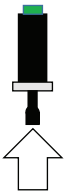
For most DIP switch configurations, the 450L-APC-IO-8 cascading plug-in allows the cascading of an additional light curtain. There is no DIP switch that enables the cascading option. For some DIP switch settings that enable muting functionality, the pins of the 450L-APC-IO-8 plug-in are used for the connection of muting sensors. In those cases, the cascading feature is not enabled (see [Table 43](#) and [Table 44](#)).

Table 43 - Pin Assignment of the Cascading Plug-in (Concave M12 8-pin), Cat. No. 450L-APC-IO-8 Connected to a 450L-E Safety Light Curtain (DIP Switch Connection Plug-in Is Set for Muting Two Sensors, Muting Sensors Connected to the Cascade Plug-in)

Receiver Bottom Plug-in Face View of Convex M12 8-pin (DC Micro)	View	Pin No.	Signal Receiver
		1	MFO out
		2	+24V DC
		3	Functional earth FE
		4	Not connected
		5	Muting Sensor S1 In
		6	Muting Sensor S2 In
		7	OV (GND)
		8	Muting Lamp

The pin assignment of [Table 43](#) belongs to a two-sensor muting configuration. For DIP switch settings, see [Table 28 on page 58](#).

Table 44 - Pin Assignment of the Cascading Plug-in (Concave M12 8-pin), Cat. No. 450L-APC-IO-8 Connected to a 450L-E Safety Light Curtain (DIP Switch Connection Plug-in Set for Muting Four Sensors)

Receiver Bottom Plug-in Face View of Concave M12 8-pin (DC Micro)	View	Pin No.	Signal Receiver
		1	Muting Sensor S3 In
		2	+24V DC
		3	Functional earth FE
		4	Muting Sensor S4 In
		5	Muting Sensor S1 In
		6	Muting Sensor S2 In
		7	OV (GND)
		8	Muting Lamp

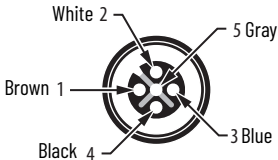
The pin assignment of [Table 44 on page 86](#) belongs to a four-sensor muting configuration. For DIP switch settings, see [Table 28 on page 58](#).

Transmitter Cable Connection

Depending on the selected plug-in, the GuardShield safety light curtain transmitter plug-in has either a 5-pin or 8-pin M12 (DC micro) convex connector. Connection cable accessories are offered from 2...30 m (6.6...98 ft) lengths.

All 450L safety light curtain models with 5-pin M12 QD plug-in (catalog number 450L-APT-PW-5) can be used with ArmorBlock® Guard I/O™ connectivity or GuardLink® systems.

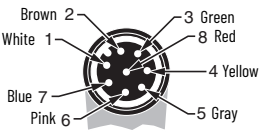
Table 45 - Pin Assignment of the Cable if Connected to a M12 5-pin Transmitter Bottom Plug-in (Cat. No. 450L-APT-PW-5)

Transmitter Connection Cable Face View of Concave M12 5-pin (DC Micro)	Color (Cat. No. 889D-F5BC-x) (1)	Pin No.	Signal Transmitter
	Brown	1	+24V DC
	White	2	Not connected
	Blue	3	0 (GND)
	Black	4	Not connected
	Gray	5	Functional earth FE

(1) Replace x with 2, 5, 10, 15, 20, or 30 for available lengths in meters.

IMPORTANT The transmitter itself is not expected to be connected to the ArmorBlock Guard I/O module or a GuardLink tab. Consider a separate connection cable or use the 5-pin T-connector for implementation of a transmitter (see [T-connector on page 95](#)).

Table 46 - Pin Assignment of the Cable if Connected to a M12 8-pin Transmitter Bottom Plug-in (Cat. No. 450L-APT-PW-8)

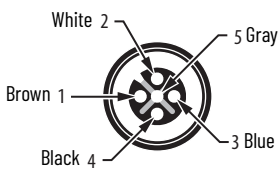
Transmitter Connection Cable Face View of Concave M12 8-pin (DC Micro)	Color (Cat. No. 889D-F8AB-x) (1)	Pin No.	Signal Transmitter
	White	1	Do not connect
	Brown	2	+24V DC
	Green	3	Functional earth FE
	Yellow	4	Do not connect
	Gray	5	Do not connect
	Pink	6	Auxiliary output (lockout stick) (24V = normal operation, 0V = lockout stick)
	Blue	7	0V (GND)
	Red	8	Do not connect

(1) Replace x with 2, 5, 10, 15, 20, or 30 for available lengths in meters.

Receiver Cable Connection

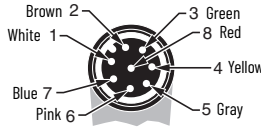
Depending on the selected plug-in, the GuardShield safety light curtain receiver plug-in has either a 5-pin or 8-pin M12 (DC micro) connector (convex). Connection cable accessories are offered from 2...30 m (6.6...98 ft) lengths.

Table 47 - Pin Assignment of the Cable if Connected to a M12 5-pin Receiver Plug-in (Cat. No. 450L-APR-ON-5 or 450L-APR-BL-5)

Receiver Connection Cable Face View of Concave M12 5-pin (DC Micro)	Color (Cat. No. 889D-F5BC-x) ⁽¹⁾	Pin No.	Signal Transmitter
	Brown	1	+24V DC
	White	2	OSSD1
	Blue	3	0V (GND)
	Black	4	OSSD2
	Gray	5	Functional earth FE

(1) Replace x with 2, 5, 10, 15, 20, or 30 for available lengths in meters.

Table 48 - Pin Assignment of the Cable if Connected to a M12 Eight-pin Receiver Plug-in (Cat. No. 450L-APR-ED-8 or 450L-APR-MU-8)

Receiver Connection Cable Face View of Concave M12 8-pin (DC Micro)	Color (Cat. No. 889D-F8AB-x) ⁽¹⁾	Pin No.	Signal Receiver
	White	1	Auxiliary output (OSSD high = 24V)
	Brown	2	+24V DC
	Green	3	Functional earth FE
	Yellow	4	EDM (Input) ⁽²⁾
	Gray	5	OSSD1
	Pink	6	OSSD2
	Blue	7	0V (GND)
	Red	8	Start ⁽²⁾

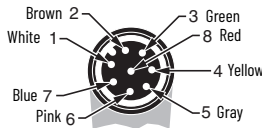
(1) Replace x with 2, 5, 10, 15, 20, or 30 for available lengths in meters.

(2) If set with DIP switches.



ATTENTION: The Auxiliary output is only a status output for diagnosis purposes to connect, for example, an indicator lamp. Do not connect this output to fulfill safety functions.

Table 49 - Pin Assignment of the Cable if Connected to a M12 8-pin Universal Plug-in; (Depending on Wiring Can Either Be a Transmitter or a Receiver) (Cat. No. 450L-APU-UN-8)

Connection Cable Face View of Concave M12 8-pin (DC Micro)	Color (Cat. No. 889D-F8AB-x) ⁽¹⁾	Pin No.	Signal Transmitter	Signal Receiver
	White	1	—	Auxiliary output (OSSD high = 24V)
	Brown	2	+24V DC	+24V DC
	Green	3	Functional earth FE	Functional earth FE
	Yellow	4	(2)	EDM (Input) ⁽³⁾
	Gray	5	Do not connect	OSSD1
	Pink	6	Auxiliary output (Lockout) (24V = normal operation, 0V = lockout)	OSSD2
	Blue	7	0V (GND)	0V (GND)
	Red	8	(2)	(3)

(1) Replace x with 2, 5, 10, 15, 20, or 30 for available lengths in meters.

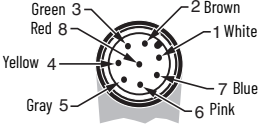
(2) Pin 4 connected to pin 8 (short circuit).

(3) If set with DIP switches.

Cascading Cable Connection

The pin assignment for the cable connected to a cascading plug-in (catalog number 450L-APC-IO-8) depends on if the cascading plug-in is inserted in a 450L-E safety light curtain transceiver stick working as a transmitter or as a receiver. It also depends on the settings of the DIP switches on the RX plug-in.

Table 50 - Pin Assignment of the Cable if Connected to a M12 8-pin I/O Cascading Plug-in; (Cat. No. 450L-APC-IO-8)

Connection Cable Face View of Convex M12 8-pin (DC Micro)	Color (Cat. No. 889D-M8AB-x) ⁽¹⁾	Pin No.	Signal Transmitter	Signal Receiver (4 Sensor Muting) ⁽²⁾
	White	1	—	Muting sensor S3 in
	Brown	2	+24V DC	+24V DC
	Green	3	Functional earth FE	Functional earth FE
	Yellow	4	—	Muting sensor S4 in
	Gray	5	—	Muting sensor S1 in
	Pink	6	—	Muting sensor S2 in
	Blue	7	0V (GND)	0V (GND)
	Red	8	—	Muting lamp

(1) Replace the x with 2 [2 m (6.6 ft)], 5 [5 m (16.4 ft)], 10 [10 m (32.8 ft)] for desired length.

(2) If set with DIP switches.

Power Supply

The external voltage supply (+24V DC) must meet the requirements of IEC 61496-1. Pay special attention to the following requirements:

- The power supply must bridge a short-term power failure of 20 ms (according to IEC 60204-1).
- The maximum deviation of the voltage levels is 24V DC $\pm 15\%$.
- The power supply is protected against overload (use NEC Class 2 or fuse with 4 A in the 24V DC circuit).
- The light curtain devices must be provided with a 24V DC PELV or SELV power supply that conforms to the requirements of 414-3 or IEC 60364-4-41. These provisions have been taken to confirm that, even if an internal fault occurs, the voltage at the outgoing terminals cannot exceed 60V DC.

To comply with UL restrictions, GuardShield safety light curtain sticks are powered by DC sources whose secondary circuits have double insulation or reinforced insulation to isolate them from the primary circuit. The DC power supply must satisfy the requirements for National Electric Code (NEC) Class 2.

The following are Rockwell Automation power supplies that are NEC Class 2 and PELV compliant. They also meet the isolation and output hold-off time requirements of two GuardShield safety light curtain transceiver sticks (GuardShield safety light curtain outputs not loaded):

- 2080-PS120-240V AC
- 1606-XLP15E
- 1606-XLP30E
- 1606-XLP50E
- 1606-XLP50EZ
- 1606-XLP72E
- 1606-XLP95E
- 1606-XLSDNET4

Grounding

There are two types of recommended grounding for 450L safety light curtains:

- Protective earth (PE)
- Functional earth (FE)

Protective earth is intended to help protect personnel from electric shock. Protective earth is also known as dirty earth as it can contain many types of noise transients and stray currents. The 24V common side of the 24V power supply must be connected to protective earth at one location.

Functional earth is intended to reduce the high frequency (RF) noise and is also known as clean earth. The functional earth must carry only returning RF noise currents. Ground schemes must include a functional earth ground to minimize common mode disturbances that were capacitively coupled between cables, transients on the 24V common, or radiated noise. Functional earth must be separated from other earths and must be connected to protective earth at one point.

The 450L safety light curtain plug-in modules have a pin that is labeled functional earth and a pin that is labeled 0V (GND). The 0V (GND) must be connected to the 24V common. At some point, the 24V Com is connected to protective earth. In the absence of electrical noise, the functional earth could be connected to 24V Com or directly to protective earth point. In the presence of electrical noise, the functional earth connection becomes critical; the connection must be made to return the noise to its source in as short a distance as possible.

[Figure 67](#) shows the symbols that are used to designate functional and protective earth grounds.

Figure 67 - Earth Symbols

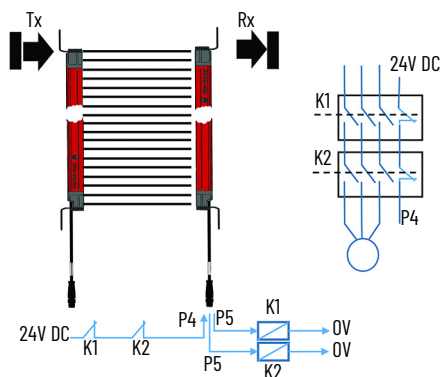


Protective Earth

External Device Monitoring (EDM) Connection

The External Device Monitor (EDM) describes the EDM feature. The EDM function can be performed with the receiver plug-ins according to [Table 20 on page 53](#) and [Table 21 on page 53](#).

Figure 68 - Connect the Contact Elements to the EDM Input

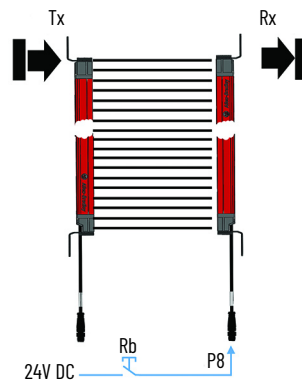


IMPORTANT EDM function is not available for GuardShield safety light curtain with receiver M12 5-pin plug-in (ArmorBlock Guard I/O connectivity). Surge suppression elements are often required for the contactors depending on the contactor.

Restart Button

[Start Modes on page 25](#) describes the options for the individual start modes.

Figure 69 - Connect the Restart Button to Pin 8



The Start button must be pressed a minimum of 50 ms. The maximum time for accepting the start is 5 seconds. The start reacts on the falling edge of the start pulse.

If there is a manual start, the Start button must be located outside the hazardous area such that a person working inside the hazardous area cannot operate it. Manual start is not available in GuardShield safety light curtains with 5-pin M12 QD connection plug-ins (ArmorBlock Guard I/O connectivity).

IMPORTANT Start is not available for GuardShield safety light curtain with M12 5-pin plug-in (ArmorBlock, Guard I/O connectivity). The Start button can also be used to reset the system if there is a lockout. The stick performs a manual start if the button is pressed a minimum of 10 seconds and not longer than 20 seconds.

For information on Grounding, see [Grounding on page 90](#).

OSSD Output

OSSD Signal Processing

The dangerous movement of the machine must reach a safe state at any time if at least one of the two OSSDs switches off (oV).

In the application, the signals of both OSSDs must be processed separately. Both signals must always be connected to either a safety controller, safety relay or safety contactors. When safety contactors are used (positively guided contactors), verification of the status of each must be implemented (see [External Device Monitoring \(EDM\) Connection on page 90](#), [Figure 68 on page 90](#), and [Figure 70 on page 92](#)).

OSSD Restart Time (from OFF to ON)

The times that are necessary to switch on the OSSDs after clearance of an interruption of the protective field if automatic reset is as follows:

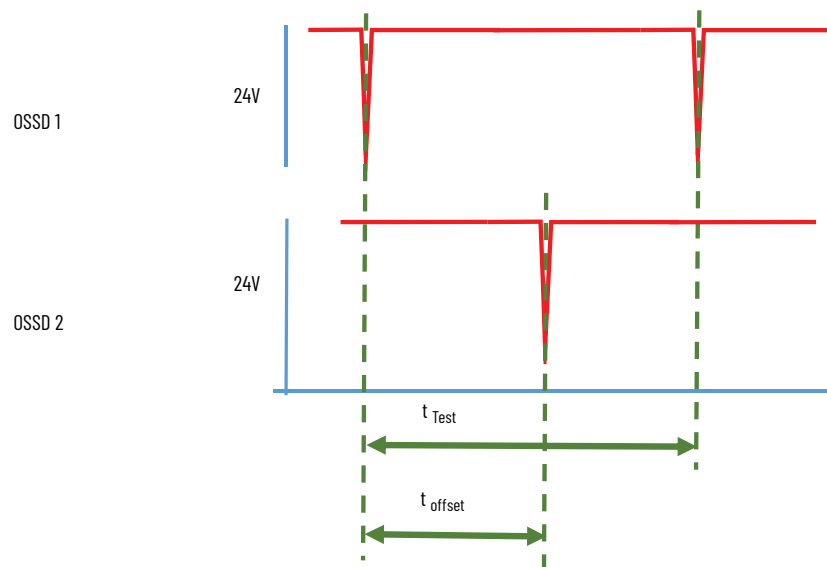
- Both synchronization beams interrupted before clearance is <210 ms
- Zero or one synchronization beams interrupted before clearance is <33 ms

Each GuardShield safety light curtain system has two synchronization beams: One beam is at the bottom and one beam is at the top of the protective field.

Test Pulses

The safety outputs of a GuardShield safety light curtain system use test pulses to check for OSSD output faults. This process is illustrated graphically in [Figure 70](#).

Figure 70 - OSSD Safety Output Test Pulse Characteristic



$t_{\text{Test}} = 100...125$ ms. Actual value depends on stick length. OSSD2 has same timing between pulses as OSSD1, with offset approximately half of t_{Test} .

Pulse is as short as possible, depends on load. 50 ms is typical for resistive load and longer if a capacitive load is used.

The test pulses can lead to the connected device being switched off sporadically if the device does not filter the test pulses correctly.

Guardmaster SI Safety Relay

Figure 72 is an example of connecting to a 450L-B safety light curtain with a 5-pin transmitter plug-in (catalog number 450L-APT-PW-5) and 5-pin receiver plug-in (catalog number 450L-APR-ON-5) to an SI safety relay (catalog number 440R-S12R2).

Figure 72 - Example of Connecting to a 450L-B Safety Light Curtain System

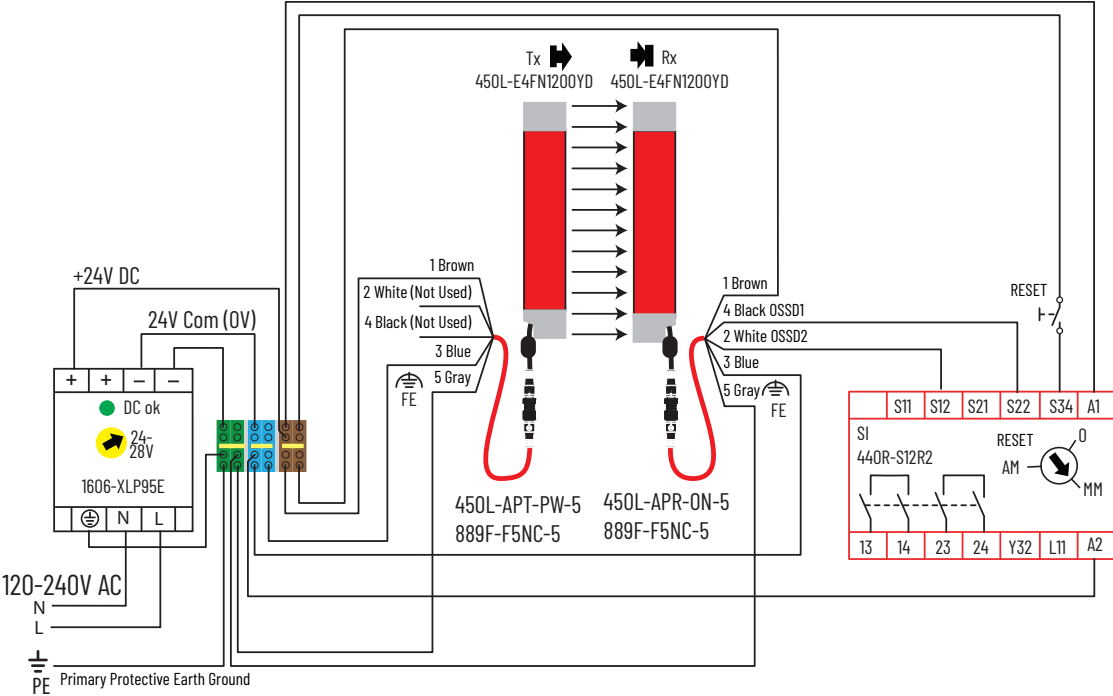
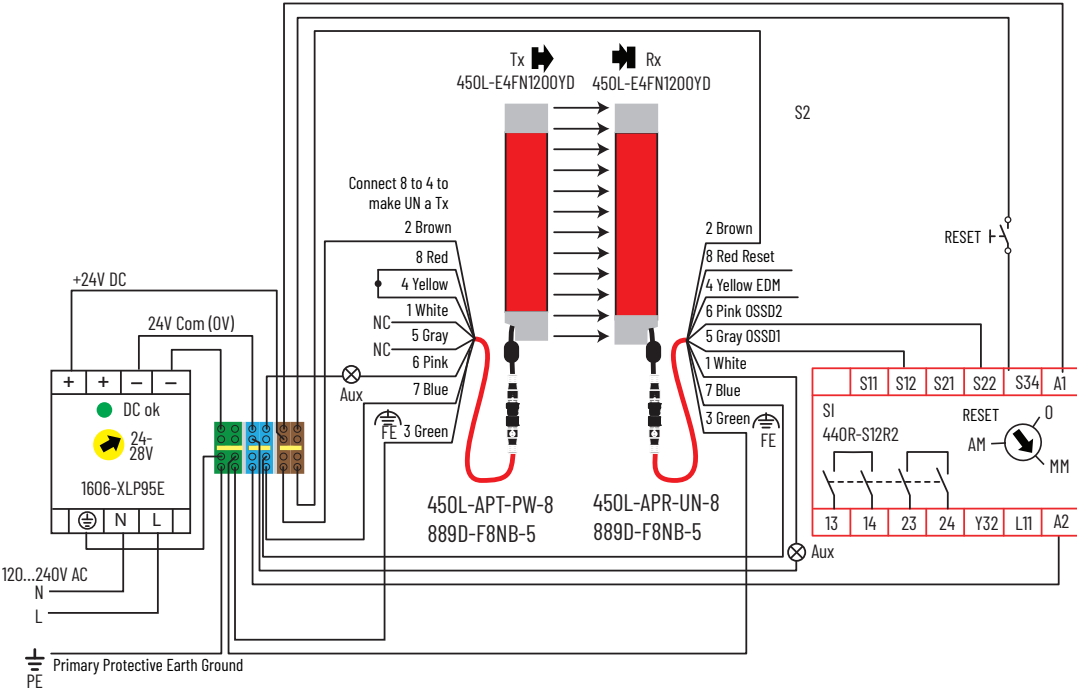


Figure 73 shows a connection example of a 450L-B safety light curtain with two universal plug-ins (catalog number 450L-APU-UN-8) to an SI safety relay (catalog number 440R-S12R2).

Figure 73 - Connection Example

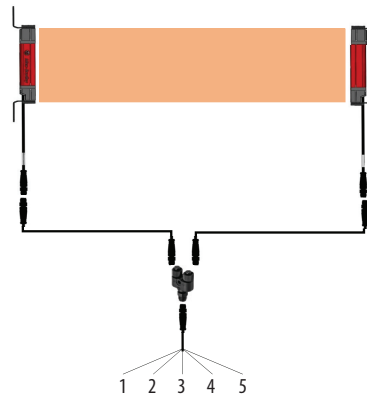


[Figure 74](#) is an example of a muting application that connects the 450L-E safety light curtain with a 5-pin transmitter plug-in (catalog number 450L-APT-PW-5) and an 8-pin receiver plug-in (catalog number 450L-APR-MU-8) to an SI safety relay (catalog number 440R-S12R12).

T-connector

If a safety light curtain system has an Rx and a Tx plug-in with M12 5-pin connectors, then a T-connector can also be used to design and connect the system (see [Figure 74](#)).

Figure 74 - Wiring with T-connector 1485P-RDR5.



For the description of the pins, see [Table 47 on page 88](#).



ATTENTION: Verify that the connected power supply is able to source both connected sticks simultaneously (Power Consumption, see [Table 73 on page 165](#)).

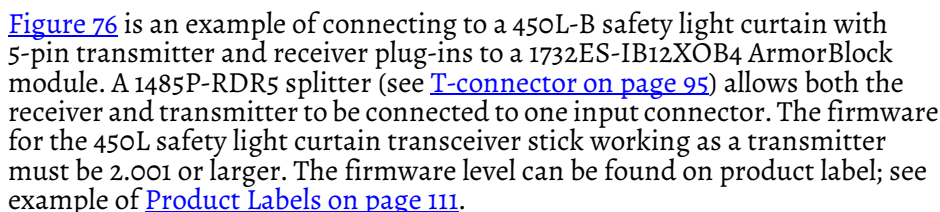
The 450L safety light curtain transceiver stick working as a transmitter must have firmware 2.001 or higher.

The T-connector can also be used to attach a 450L safety light curtain system to GuardLink technology (see www.rockwellautomation.com/en-us/products/hardware/allen-bradley/safety-products/guardlink-technology.html).

GuardLink Tap Connections

[Figure 75 on page 96](#) shows an example for connecting a 450L-B safety light curtain with 5-pin transmitter and 5-pin receiver plug-ins to a 440S-SF5D GuardLink tap. A 1485P-RDR5 splitter (see [T-connector](#)) allows both the receiver and transmitter to be connected to one tap. The firmware for the 450L safety light curtain transceiver stick working as a transmitter must be 2.001 or larger. The firmware level can be found on product label (see [Product Labels on page 111](#)).

1732 ArmorBlock Connections



The DIP switch settings for the receiver plug-in module are shown in [Table 51 on page 97](#). Switches 2 and 3 can be set to ON, if needed by the application. The transmitter plug-in does not have DIP switches.

Table 51 - DIP Switch Settings

Switch	450L-APR-ON-5	Description	Comment
1	OFF	Software Configuration Disabled	Optional
2	OFF	Low Range Disabled	Optional
3	OFF	Beam Coding Disabled	Optional
4	OFF	Interference Rejection Disabled	Optional

Figure 77 shows the screen captures of the ArmorBlock module properties setup for the example schematic.

Tab	Description
General	Configure the module definition.
Input Configuration	Points 0 and 1 monitor the light curtain OSSD outputs. Points 4 and 5 use pulse testing to monitor the status of the output contactors K1 and K2. The Point Operation Types are set to Single to allow the logic function block to detect faults.
Test Output	Point 0 must be set to Not Used as pin 5 on the connector is connected to the light curtain housing. Point 1 is set to Standard to allow the program to cycle the power to the light curtains if the light curtain has to be power cycled. Points 4 and 5 are the test pulses to monitor the contactors K1 and L2.
Output Configuration	Points 0 and 1 turn the output contactors, K1 and K2, on and off.

Figure 77 - ArmorBlock Module Properties Setup

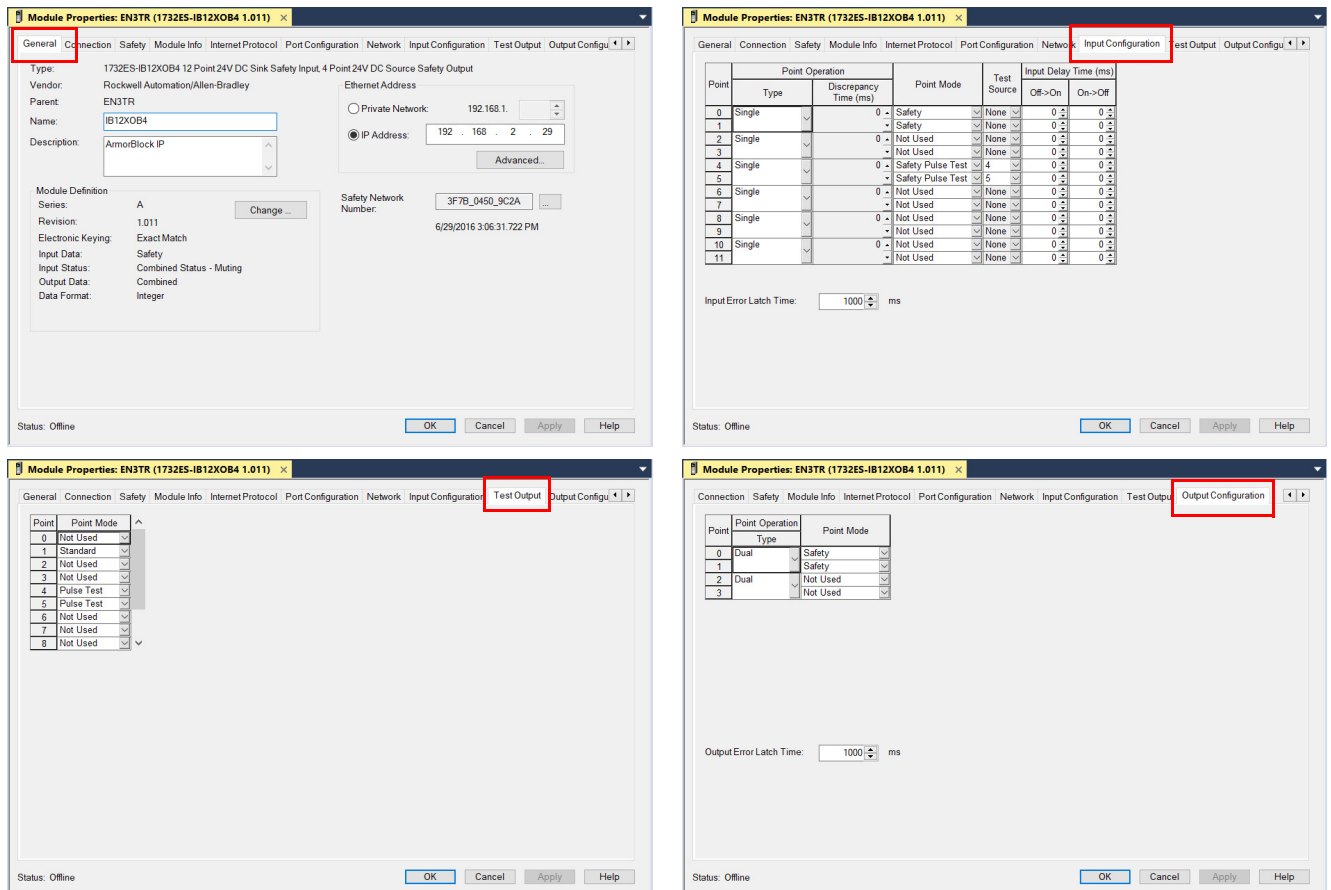
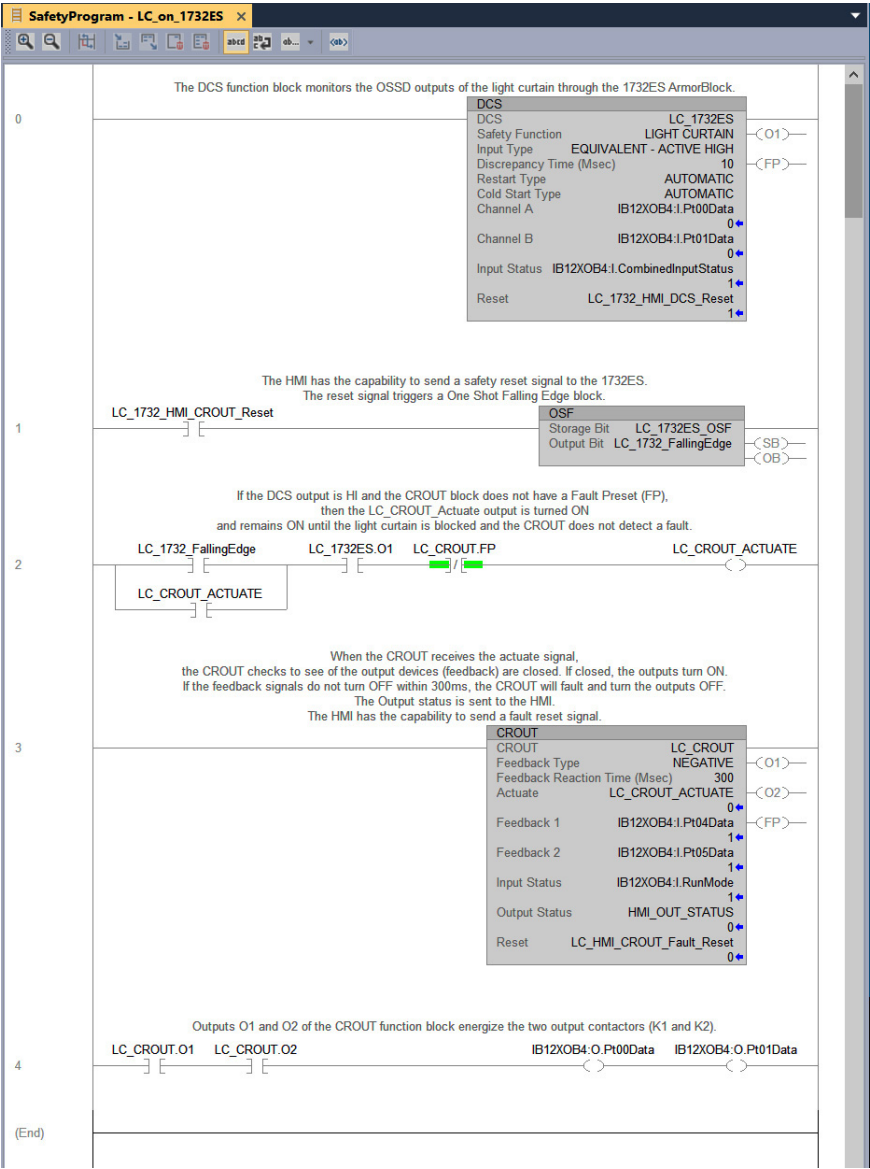


Figure 78 on page 98 shows a typical example of a ladder logic program that could be used with the example schematic. The comments that are embedded in the program explain the usage of each rung.

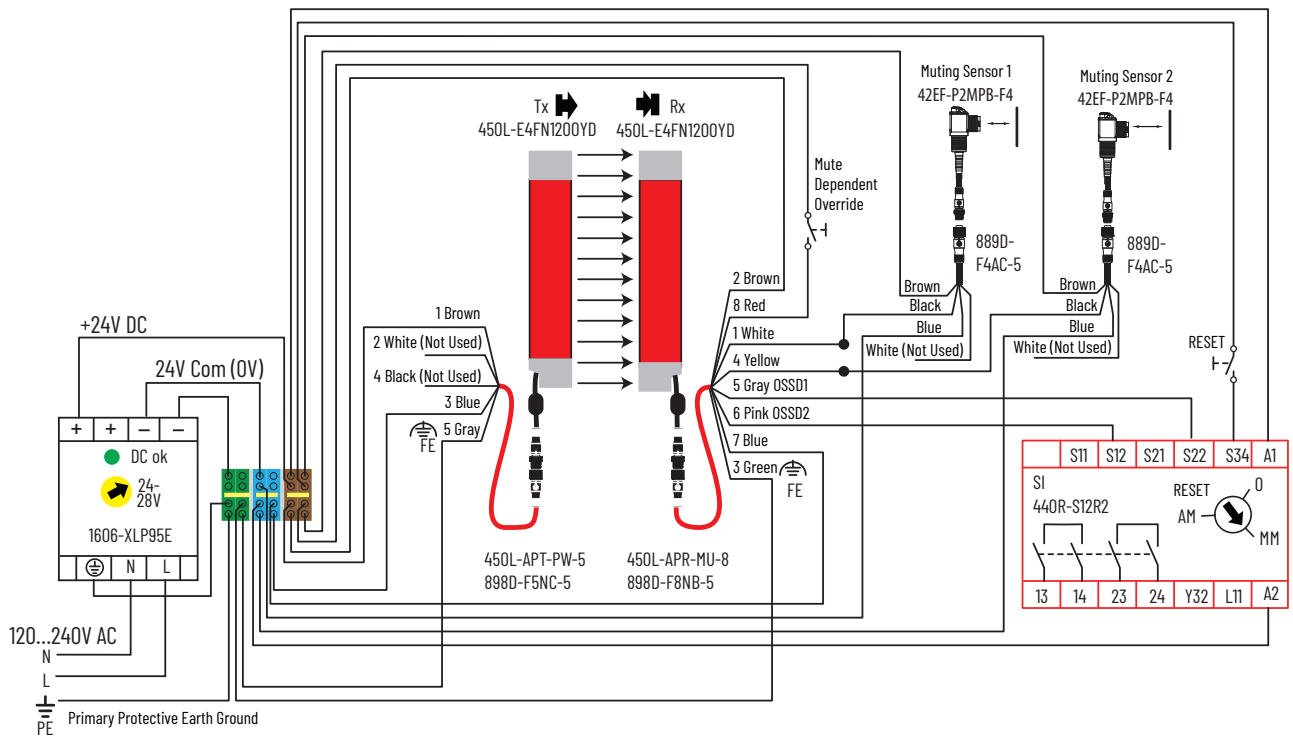
Figure 78 - ArmorBlock Ladder Logic Program



Two-sensor Muting with Muting Plug-in

[Figure 79 on page 99](#) is a two-sensor muting example with the 450L-E safety light curtain. The transmitter uses the 5-pin transmitter plug-in, and the receiver uses the 8-pin muting plug-in.

Figure 79 - Example Schematic for Two-sensor Muting of a 450L-E Safety Light Curtain



The DIP switch settings for the receiver muting plug-in are shown in [Table 52](#). Switches 2, 3, 5, and 6 can be changed to ON, if needed by the application. Switch 7 must be OFF and switch 8 must be ON. Switches 9, 10, and 11 determine the type of muting. The transmitter plug-in does not have DIP switches.

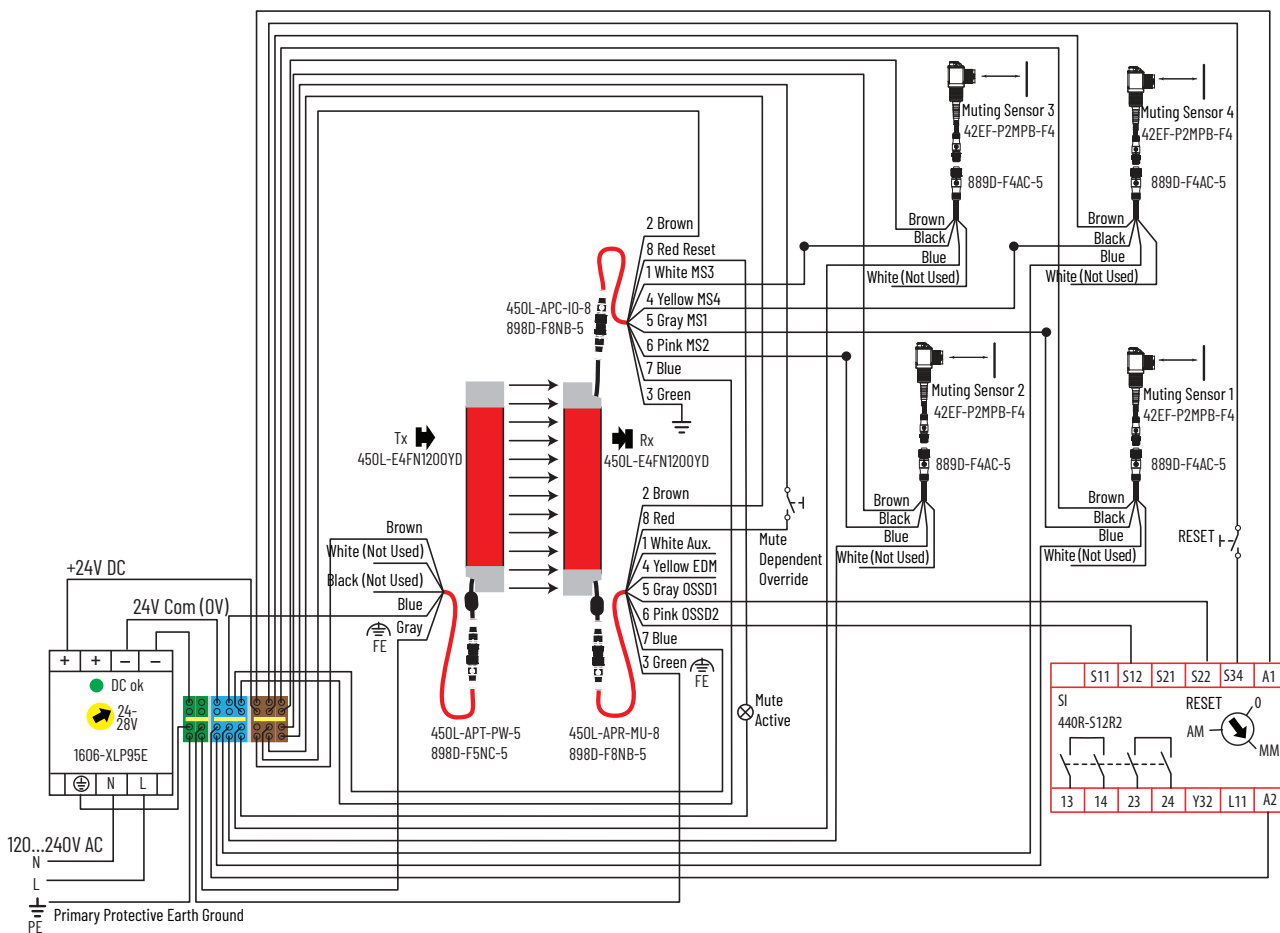
Table 52 - Receiver DIP Switch Settings

Switch	450L-APR-MU-8	Description	Comment
1	OFF	—	—
2	OFF	Low Range Disabled	Optional
3	OFF	Beam Coding Disabled	Optional
4	OFF	—	—
5	OFF	Automatic Start	Optional
6	OFF		Optional
7	OFF	EDM Disabled	—
8	ON	Muting	Required
9	OFF or ON	DIP 9: OFF, DIP 10: ON, DIP 11: OFF 2L muting DIP 9: ON, DIP 10: OFF, DIP 11: OFF 2T muting	Determines muting type
10	OFF or ON		
11	OFF		
12	OFF	—	—

Four-sensor Muting with Muting Plug-in

[Figure 80 on page 100](#) is a four-sensor muting example with the 450L-E safety light curtain. The transmitter uses the 5-pin transmitter plug-in. The receiver uses the 8-pin muting plug-in at the bottom and the 8-pin I/O plug-in at the top.

Figure 80 - Example Schematic for Four-sensor Muting of a 450L-E Safety Light Curtain



The DIP switch settings for the receiver muting plug-in are shown in [Table 53 on page 100](#). Switches 2, 3, 5, and 6 can be changed to ON, if needed by the application. Switch 7 must be OFF and switch 8 must be ON. Switches 9, 10, and 11 must be set to ON for four-sensor muting. The transmitter and I/O plug-in do not have DIP switches.

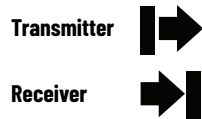
Table 53 - Receiver Muting Plug-in DIP Switch Settings

Switch	450L-APR-MU-8	Description	Comment
1	OFF	—	—
2	OFF	Low Range Disabled	Optional
3	OFF	Beam Coding Disabled	Optional
4	OFF	—	—
5	OFF	Automatic Start	Optional
6	OFF		Optional
7	OFF	EDM Disabled	—
8	ON	Muting	Required
9	OFF or ON	DIP 9: OFF, DIP 10: ON, DIP 11: OFF 2L muting DIP 9: ON, DIP 10: OFF, DIP 11: OFF 2T muting DIP9: ON, DIP 10: ON DIP: 11 ON 4T muting.	Determines muting type
10	OFF or ON		
11	OFF or ON		
12	OFF	—	—

Status Indicators and Troubleshooting

Status Indicators

The light curtain conducts an internal self-test after startup. If an error occurs, an appropriate signal combination displays the indicator status. If a GuardShield™ safety light curtain acts like a transmitter or as a receiver, it is also shown on the plug-in label.



IMPORTANT If you use a universal plug-in, only the status indicators or the wiring can inform you if a light curtain is a transmitter or a receiver.

A quick categorization of an error can be done by checking the status indicator STS (see [Table 55 on page 103](#) and [Table 56 on page 104](#)).

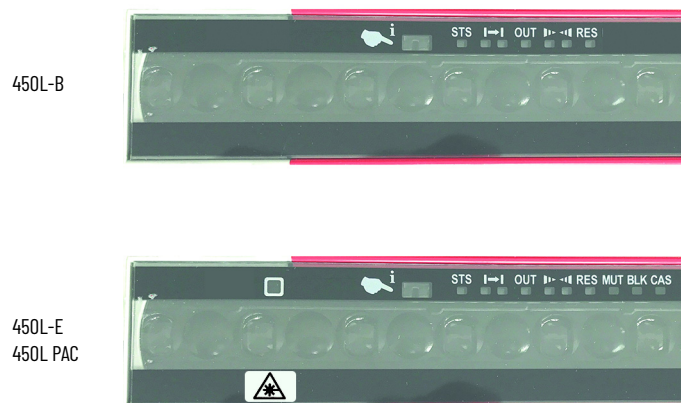
System Status Indicators

There are different status indicator lights in the area closest to the connection plug-in. The number of indicators depends on the stick type:

- 450L-B: Seven indicators
- 450L-E and 450L PAC: 10 indicators

The STS and OUT status indicators are bicolor. Their functions and colors are defined in [Table 54 on page 102](#).

Figure 81 - Status Indicators of a 450L Safety Light Curtain







The transceiver architecture of the 450L safety light curtain results in the Rx and Tx having the same status indicators.

Status Indicator for Normal Operation

[Table 54](#) lists normal operation status indicators on a 450L safety light curtain (colors and functions) for normal operation.

Table 54 - Status Indicators

No.	Marking	Status Indicator Name	Color		Behavior	Description	System Status
1	STS	Status indicator	Green		On	Power on and system is OK	No
			Green	Red	Blinking	Configuration that is changed or receiver was operated previously with another transmitter	No
			Green	Off	Blinking (98:2)	Interference rejection is enabled	No
			Green	Red	Blinking (90:10)	Optical interference is detected (this status will be indicated, even if interference rejection is already enabled)	No
			Green	Off	Blinking	See Troubleshoot on page 103	No
			Off	Red	Blinking		No
			Red		On		No
2		Transmitter	Green	On	Plug-in identifies stick as a transmitter	No	
				Blinking 1 Hz (50:50)	See Troubleshoot on page 103	No	
				Blinking 1 Hz (98:2)	Reduced range and/or beam coding is activated	No	
				Off	Stick is receiver	No	
3		Receiver	Green	On	Plug-in identifies stick as a receiver	No	
				Blinking 1 Hz (98:2)	Reduced range and/or beam coding is activated	No	
					Off	Stick is transmitter	No
			4	OUT	Safety outputs	Green	On
Red	On	Safety outputs are off (receiver)				No	
—	Off	Transmitter				No	
5		Regional light intensity level 1	Green	On	Bottom half zone is not interrupted and intensity is OK	Yes	
				Blinking 1 Hz (50:50)	Bottom half zone intensity is at the limit	Yes	
			—		Off	Bottom half zone interrupted	Yes
6		Regional light intensity level 2	Green	On	Top half zone is not interrupted and intensity is OK	Yes	
				Blinking 1 Hz (50:50)	Top half zone intensity is at the limit	Yes	
			—		Off	Top half zone interrupted	Yes
7	RES	Start	Amber	On	Start required (receiver)	No	
			—	Off	No start is required (receiver)	No	
8	MUT	Muting	Orange		Off	Light curtain that is not muted	No
					On	Light curtain that is muted	No
			Orange	Off	Blinking	Muting error	No
9	BLK	Blanking	Orange		Off	No blanking feature selected	No
			Orange		On	Blanking feature that is selected	No
			Orange	Off	Blinking	Blanking error	No
10	CAS	Cascading	Red		Off	No cascading plug-in that is inserted or Tx OSSDs of connected cascade are in ON-state (Rx only)	No
					On	OSSDs of connected cascade are in OFF-state (Rx only)	No
			Red	Off	Blinking	Error cascading plug-in	No

The last column in [Table 54](#) describes whether the signal displays simultaneously at both sticks.

- “No” means that the status indicator shows only the status of the individual stick.
- “Yes” means that the status indicator shows the status of the complete system.

Optical Push Button

The optical push button is on the front window next to the status indicators. For activation, place your finger on the square (see [Figure 82](#)). It is operated with infrared light and can be used to:

- Confirm a new configuration (see [Confirmation of a New System Configuration on page 59](#)).
- Switch on/off the integrated laser alignments system (450L-E safety light curtain only) ([Laser Alignment on page 23](#)).
- Start power off/on cycle if there is a lockout. For recycling, the optical push button must be pressed between 10...20 seconds. Otherwise, the recycle command is ignored (see [Table 56 on page 104](#)).
- Communication with the Optical Interface Device (see [Optical Interface Device \(OID\) on page 106](#)).

Figure 82 - Optical Push Button



Troubleshoot

Status Indicator Error Display

If the STS status indicator is red, blinks red on/off, or blinks green, an error occurred which stops the system from working in normal operation.

Figure 83 - Status Indicator



Error types are differentiated according to [Table 55](#).

Table 55 - Error Types

Number	STS Code	Error Type
1	Red on	Internal error
2	Red/OFF blinking	External error
3	Green/OFF blinking	Invalid DIP switch settings
4	Green/Red blinking	Configuration changed

Errors can be caused externally (STS = red on/off blinking) and internally (STS = red on). Examples of external recoverable errors include ambient light and/or Start button fault.

If there is an error, the second status indicator provides more information about the root cause ([Table 56 on page 104](#)).



ATTENTION: To indicate if a system is in the configuration mode, the STS status indicator blinks alternately red/green (50:50; 1 Hz). The configuration mode is not an error, but indicates that the DIP switch configuration and/ or plug-in was changed and must be confirmed. For normal operation, the configuration must be confirmed first. This procedure is described in [Confirmation of a New System Configuration on page 59](#).

The timing of the status indicator blinking defines a frequency and a duty cycle. The frequency defines one sequence of on and off, as a default frequency 1 Hz is used if not otherwise mentioned. The duty cycle defines the ratio of the on duration and the off duration of the status indicator. If not otherwise mentioned, the default value for the duty cycle is 50:50, meaning 50% on, 50% off.

Table 56 - Status Indicators for External Errors and System Errors

No.	Error	First Status Indicator				Second Status Indicator			
	Short Description	Marking (Name)	Color	Blink Frequency	Duty Cycle (On/Off)	Marking (Name)	Color	Blink Frequency	Duty Cycle ⁽¹⁾
0	Configuration changed ⁽²⁾	STS	Red/ Green	1 Hz	50:50	—	—	—	—
1	Internal lockout ⁽³⁾	STS	Red	ON	100:0	—	—	—	—
2	EDM error ⁽¹⁾	STS	Red	1 Hz	50:50	RES	Amber	1 Hz	10:90
3	Start error ⁽³⁾	STS	Red	1 Hz	50:50	RES	Amber	1 Hz	90:10
4	Ambient light or EMC disturbances	STS	Red	1 Hz	50:50	—	—	—	—
5	Short circuit between OSSDs to 24V DC (lockout) ⁽¹⁾	STS	Red	1 Hz	50:50	OUT	Red	1 Hz	50:50
6	Error supply voltage ⁽³⁾	STS	Red	1 Hz	50:50	Stick type (transmitter or receiver)	Green	1 Hz	50:50
7	24V DC connected to transmitter plug-in input ⁽³⁾	STS (Tx)	Green	ON	100:0	Stick type transmitter	Green	1 Hz	50:50
8	Mixed design of 450L-B and 450L-E sticks or stick identification mismatch when beam coding is used	STS (Tx)	Red	1 Hz	50:50	Regional light intensity level 1 and level 2	Green	1 Hz	50:50
9	Invalid DIP switch setting	STS	Green	1 Hz	50:50	Stick type receiver	Green	1 Hz	50:50
10	Muting timing error (450L-E only)	STS (Rx)	Red	1 Hz	50:50	MUT	Amber	1 Hz	90:10
11	Muting sequence error (450L-E only)	STS (Rx)	Red	1 Hz	50:50	MUT	Amber	1 Hz	10:90
12	Blank error (450L-E only)	STS	Red	1 Hz	50:50	BLK	Amber	1 Hz	50:50
13	Cascade error (450L-E only)	STS	Red	1 Hz	50:50	CAS	Red	1 Hz	50:50
14	Failure in a safety component or logic that is connected to a Top I/O-Plug-in	STS	Red	1 Hz	50:50	Regional light intensity level 2	Green	1 Hz	50:50
15	Failure in a safety component or logic that is connected to a Bottom Plug-in	STS	Red	1 Hz	50:50	Regional light intensity level 1	Green	1 Hz	50:50

(1) The interpretation is first value on time, second value off time, for example, 10:90 means 10% on, 90% off.

(2) Error: If there is an error, remove the error source. For manual restart, activate the Restart button.

(3) If there is a lockout, remove the lockout source. Lockout requires power recycling or adequate action (see [Table 57 on page 105](#), [Manual \(Re\) Start on page 26](#), and [Optical Push Button on page 103](#)).



ATTENTION: If automatic restart is used, the system starts immediately.

For fault conditions 0...13 and corrective actions, see [Table 57 on page 105](#).

Table 57 - Errors, Lockouts, and Corrections

Condition	Error Description	Action
0	Confirmation changed	See Confirmation of a New System Configuration on page 59 .
1	Internal lockout	<p>Make sure that the correct plug-in is inserted and that the DIP switch settings of the plug-in are in correct position.</p> <p>One of the following methods clears the lockout mode of a transmitter stick:</p> <ol style="list-style-type: none"> 1. Power down, then power up. If the fault is still present, the module lockout occurs again. 2. A reset signal longer than 10 seconds and less than 20 seconds acts like a power-up. 3. Press your finger on the optical push button longer than 10 seconds and less than 20 seconds (Optical Push Button on page 103) <p>If the fault persists, replace the 450L-B safety light curtain transceiver stick.</p> <p>Further diagnosis options are possible with the Connected Components Workbench™ software in combination with the USB/ optical interface device (OID; Cat No. 450L-AD-OID). If the 450L-B safety light curtain unit has a lockout, the exact fault description can be determined with these tools.</p>
2	EDM feedback signal at receiver plug-in not okay (external error)	<p>Short circuit between or to ground or over current at OSSDs</p> <ol style="list-style-type: none"> 1. Check wiring and function of external contactor 2. 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) 3. Repower the system or use adequate action after the lockout source is removed.
3	Start signal not okay	Check signal status and signal timing at receiver plug-in for the manual start
4	Ambient light can lead to short sporadic switch off the OSSD.	<p>Check system set-up and remove foreign ambient light source. Ambient light sources can be:</p> <ul style="list-style-type: none"> • Strong flashing beacon • Infrared remote controls • Laser pointers • Infrared light sensors
5	Short circuit between or to ground or over current at OSSDs	Check wiring and connected components at the two OSSDs
6	Error supply voltage	Check 24V DC power that is supplied to the stick
7	Voltage that is connected to transmitter plug-in input	Make sure DIP switch 4 is set to the default position (off). Make sure that the 24V DC voltage is not supplied to pin 4 of the 450L-APT-PW-5 part or voltage supply to pin 1 of the 450L-APT-PW-8 plug-in connector.
8	Stick identification mismatch when beam coding is used	Check design according to chapter: Beam coding on page 30
9	Invalid DIP switch setting	Make sure that the DIP switch settings of the inserted plug-in refer to one that is described in Receiver Plug-in DIP Switch Settings on page 54
10	Muting timing error (450L-E only)	Make sure that of the muting times are not above maximum or below minimum limits (see Muting on page 34)
11	Muting sequence error (450L-E only)	Make sure that the connected muting sensors are interrupted in the right sequence (see Muting on page 34)
12	Blanking error (450L-E only)	Make sure that beams of fixed blanked objects are always interrupted (see Teach-in Fixed Blanking on page 29)
13	Cascading error (450L-E only)	Make sure that the OSSDs of the connected safety component do not exhibit an error (see Cascading on page 43).
14	System cannot be aligned	<p>Make sure that both edges are parallel and installed at the same level.</p> <p>Make sure that the transparent front cover is clean, no dust and is not scratched.</p> <p>Make sure that the distance between transmitter and receiver is above the minimum distance.</p> <p>Make sure that the distance between transmitter and receiver is below maximum distance.</p> <p>Make sure that "low operation range" is not activated if operated above maximum range of the "low operation range" function</p>
15	OSSD outputs switch off sporadically	<p>Check all hints of condition 14 first</p> <p>Check that no ambient light from other sensors or sun or adjacent light curtain system can have an impact on the performance of a GuardShield safety light curtain system.</p> <p>Make sure that the power supply is adequate and the devices that are connected to the OSSD outputs are within the limits.</p> <p>Make sure that the GuardShield safety light curtain connection cables are not parallel to high-power supply cables of the application</p>

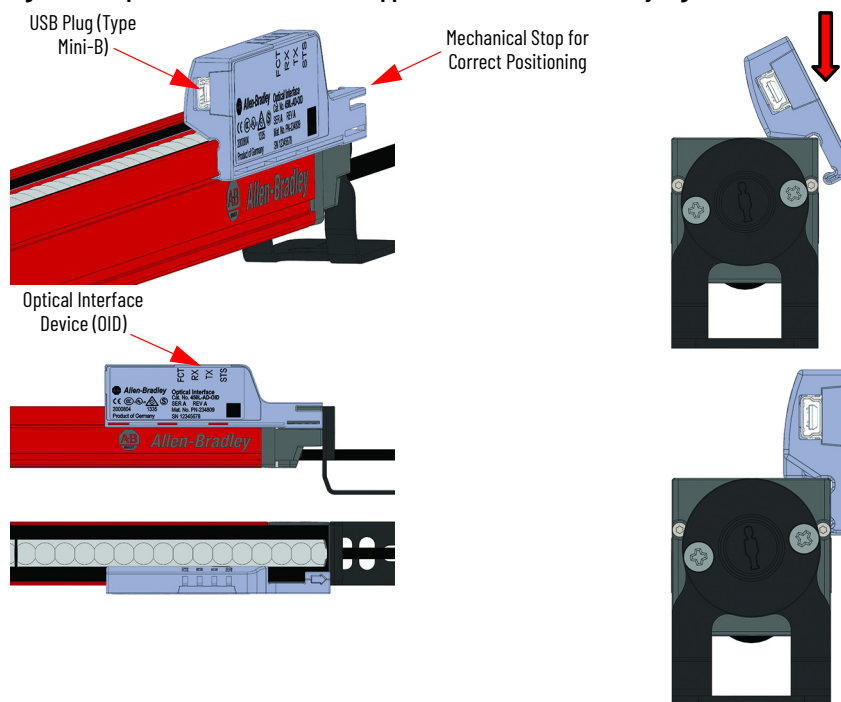
IMPORTANT Conditions 0...13 of [Table 56 on page 104](#) show the status indicator for condition numbers 0...13 in [Table 57](#).

Optical Interface Device (OID)

More service information is available by using the optical interface device (450L-AD-OID) and the Rockwell Automation Connected Components Workbench package. This device can be snapped on a stick and used, for example, to visualize the protective field status if connected to a computer via a USB interface. The required Connected Components Workbench software is available from rok.auto/ccw.

The initial release of the 450L PAC safety light curtain does not support the Connected Components Workbench software.

Figure 84 - Optical Interface Device Snapped on a GuardShield Safety Light Curtain



The Optical Interface Device (OID) has a USB interface for connection to a personal computer for diagnostic purposes. Use a standard USB A Convex to USB Mini-B Convex cable for connecting to the OID. The OID is delivered including a USB (Type A <=> Type Mini-B) 1 m (3.28 ft) long connection cable (catalog number 2711C-CBL-UU02). The device must be positioned correctly at the end of the protective field (2) above the status indicators to allow communication. First move the latch of the interface close to the bottom end cap so that it touches the end cap and rotate it so that it snaps in.

The OID can be used when the light curtain is mounted with the top/bottom and/or the side mounting kit. If there is a weld shield, the weld shield must be removed before the OID can be installed.

IMPORTANT We continuously improve and expand the functionality of the GuardShield safety light curtain product line. Therefore, new firmware releases could be available. For diagnostic purposes, make sure that both sticks (Rx and Tx) and the OID are operated with the latest available firmware revision.

Troubleshoot with Connected Component Workbench Software

When connected to the GuardShield safety light curtain through the USB port with the Optical Interface Device, the Connected Component Workbench diagnosis function displays the status of the connected stick. If there is an error, detailed diagnostic information of the corresponding stick is provided.

IMPORTANT	We continuously improve and expand the functionality of Connected Component Workbench software. Therefore, new software releases could be available. For diagnostic purposes, make sure that the Connected Component Workbench software and the OID are operated with the latest firmware revision. Update the Connected Component Workbench software to the latest version.
------------------	--

Notes:

Safety Instructions



LASER LIGHT CLASS 2 HAZARD: Do not stare into beam. The 450L-E and 450L PAC GuardShield safety light curtains are equipped with an integrated laser alignment aid (see [Laser Alignment on page 23](#)).

Maintenance



ATTENTION: Never operate the 450L safety light curtain before conducting the [Regular Inspection](#). Improper inspection can lead to serious, or even deadly, injury. Confirm that all power to the machine and safety system is disconnected during electrical installation. Before powering up the 450L safety light curtain system, the responsible person reviews the checklist:

- For safety reasons, all inspection results are recorded.
- Only people who clearly understand the function of the 450L safety light curtain and the machine, can perform the inspection.

If the installer, engineer, and operator are different people, they all must have sufficient information available for the inspection.

Regular Inspection

The following inspection actions must be done regularly. For example, the frequency of inspection must be daily or according to the risk assessment.

1. Approach to hazardous machine parts must only be possible by passage through the GuardShield™ safety light curtain protective field.
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.

The inspection interval for [step 1](#)...[step 4](#) are:

- Daily or whenever the machine setting is changed (electrical or mechanical).
- Whenever a light curtain component (stick and/or plug-in) is replaced.
- According to the requirements of local regulation or an application-specific standard.
- According to the inspection instruction and the risk assessment of the application.

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

- The protective field is interrupted.
- If the test rod directly in front of the transmitter or receiver, or between the transmitter and receiver, interrupts the protective field, the hazardous machine movement stops immediately (see [Figure 85](#)).
- There is no hazardous machine movement while the test rod is anywhere within the protective field.
- Verify that there are no reflective surfaces within the calculated distance (see [Minimum Distance from Reflective Surfaces on page 66](#)).

Before introducing the test rod, verify that the protective field is free. Both intensity indicators are green at the stick, which acts as the receiver (see [Figure 42 on page 68](#)). If the two intensity indicators are not green, adjust the sticks until the intensity indicators are green. Move the test rod through the protective field as indicated in [Figure 85](#). Use test rod 450L-AT-14 for the light curtain with finger resolution (14 mm [0.56 in.]) and test rod 450L-AT-30 for the light curtain with hand resolution (30 mm [1.19 in.]). The catalog number of the test rod is printed on a label on each rod. The protective field must always be interrupted:

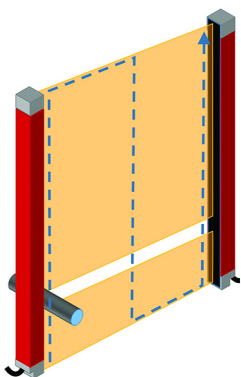
- If the test rod is placed at any angle anywhere within the protective field (static).
- If the test rod is moved (according to [Figure 85](#)) with the axis of the test rod normal to the plane of the detection zone, at any speed from 0...0.3 m/s (dynamic).

The interruption of the protective field is displayed at the indicator diodes. Verify that the minimum of one intensity indicator ([Figure 42 on page 68](#)) is off as long as the test rod is in the protective field. If both intensity indicators are simultaneously green or flashing green during the static and dynamic testing, the resolution to operate the application is not fulfilled.



ATTENTION: If any of the previous conditions do not stop the hazardous motion of the machine or simultaneously lead to two green intensity indicators (see [Figure 42 on page 68](#)), then do not allow the machine to be placed into operation.

Figure 85 - Proper Testing of Protective Field Using Test Rod



IMPORTANT If one or more mirrors are used (see [Mirrors on page 67](#)), inspect each protective field separately. The movement of the test rod is also performed directly in front of the mirrors.

Additionally, a more detailed inspection must be conducted:

- Whenever a machine setting is changed.
- The local regulation or an application-specific standard requires an inspection.

- According to the inspection instruction and the risk assessment of the application.
- Frequently (for example, every six months).

A more detailed inspection must consider these actions:

- The machine stops or does not obstruct any safety function.
- The latest machine or connection modifications have no effect on the control system.
- The outputs of the GuardShield safety light curtain are properly connected to the machine.
- The total response time of the machine is shorter than the calculated value.
- Cables and plugs of the GuardShield safety light curtain are in flawless condition.
- Mounting brackets, caps and cables are tightly secured.
- Optical windows and components (mirrors or weld shields) are clean.

IMPORTANT Document the test results, sign, and file them appropriately.

Verifying 450L PAC

The 450L PAC is a Perimeter Access Control safety light curtain that is designed for whole body detection to create a safety perimeter around a machine or hazardous location. To verify correct operation, first place the machine or hazardous location in a safe state. Then interrupt the beams, refer to [Figure 2 on page 12](#) for the beam positions of different models. Confirm that the OSSD safety output switches to the OFF state (refer to [Figure 80 on page 170](#) for the indicator status) and remains OFF for as long as the beams are interrupted.

Clean Optic Front Window

The effectiveness and the reliability of the safety light curtain system is reduced if the optic front window of the GuardShield safety light curtain is dirty. Regularly clean the window with a soft cloth and rub without pressure. Do not apply aggressive or abrasive agents, which can attack the surface.



LASER LIGHT CLASS 2 HAZARD: Do not stare into beam.
The 450L-E and 450L PAC GuardShield safety light curtains are equipped with an integrated laser alignment aid (see [Laser Alignment on page 23](#)).

Disposal

The GuardShield safety light curtain has been designed according to the main environmental protection directives (for example, RoHS). Always dispose of unserviceable devices in compliance with local/national rules and regulations.

Product Labels

The address that is printed on the stick and on the plug-in products and packaging labels refers to the Rockwell Automation global address. For the regional office addresses, see the listing on the back cover of this publication.

Stick Labels

The following labels are for illustration only and are subject to change.

Figure 86 - Explanation of Date Code on a Stick [1335: Year 2013, Week: 35; Serial Number 450L-B is 1068700055; 450L-E is 1068800055] (Printed Before November 2018)



Figure 87 - 450L POC Transceiver Stick Label (Printed Since November 2018)
 Production date code: yyyy/mm/dd

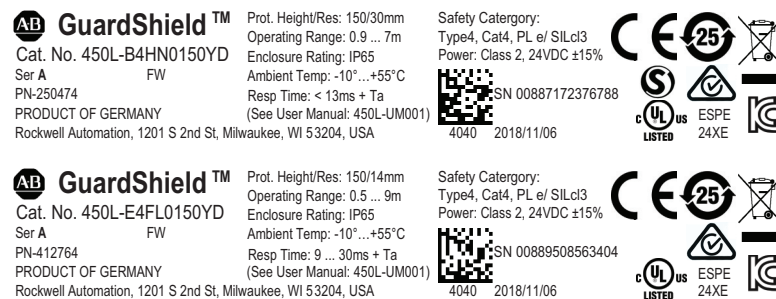


Figure 88 - 450L PAC Transceiver Stick Label (Printed Since September 2021)
 Production date code: yyyy/mm/dd

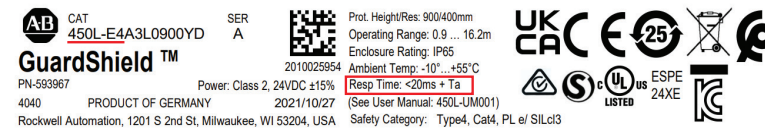
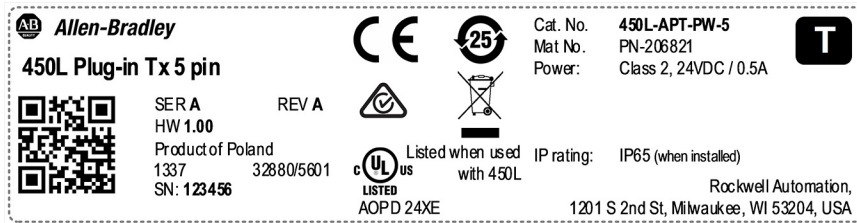


Figure 89 - 450L-E and 450L PAC Laser Warning Label (Positioned on the Backside of the Aluminum Profile)



Plug-in Label

Figure 90 - Explanation of Date Code at a 450L Plug-in [1337: Year 2013, Week: 37; Serial Number Is 123456]



A black square with a gray letter quickly indicates the principle type of plug-in (see [Figure 90](#)), where:

- C = Cascading
- R = Receiver
- T = Transmitter
- U = Universal

IMPORTANT The catalog number is also printed on the plug-in housing, which is inside the transceiver stick.

Notes:

Connected Components Workbench Software

Overview

The Connected Components Workbench™ software can be used to monitor the 450L POC safety light curtains and to configure the 450L-E version of safety light curtain. The Bulletin 450L POC safety light curtain has two versions:

- 450L-B: Basic ON/OFF
- 450L-E: Enhanced features

The Connected Components Workbench software can only monitor the 450L-B version of safety light curtain; the 450L-B safety light curtain does not have configurable parameters. The advantage of the 450L-E safety light curtain is that the Connected Components Workbench software can monitor and configure it. Use the Connected Components Workbench software to do the following:

- Setup
 - Muting
 - Floating blanking
 - Reduced resolution
 - Fixed blanking
 - A combination of floating, reduced resolution, and fixed blanking
- Diagnostics
 - Know which beams are blanked or blocked
 - Review last 10 lockout codes
- Export the configuration to a file

The Connected Components Workbench software performs its function with the 450L-OID Optical Interface Device (OID). For more information on the OID, [Optical Interface Device \(OID\) on page 106](#).

The initial release of 450L PAC safety light curtain does not support the Connected Components Workbench software.

Multiple Subconfigurations

This manual assumes that the Connected Components Workbench software, version 12 or later, has been loaded.

Start a New Project

The following example uses the Connected Components Workbench software (version 12) loaded onto a Windows® 10 environment.

[Figure 91 on page 116](#) shows the Windows “Start” icon.

1. Click the windows “Start” icon in the lower left corner.
2. Scroll down to Rockwell Automation. Expand the selection and click Connected Components Workbench.

Figure 91 - Start Menu

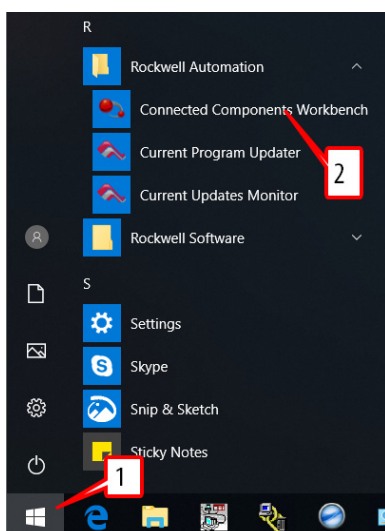


Figure 92 shows the Start Page. This page allows you to do the following:

- Create a project
- Open an existing project
- Open a recent project
- Open online training videos (requires an internet connection)

You can bypass this page by clearing the Show page on startup checkbox.

3. Start a new project three ways:
 - Click New... under the “Project” heading.
 - Click File in the main menu, then click New.
 - Press Ctrl-N on your keyboard.

Figure 92 - New Project

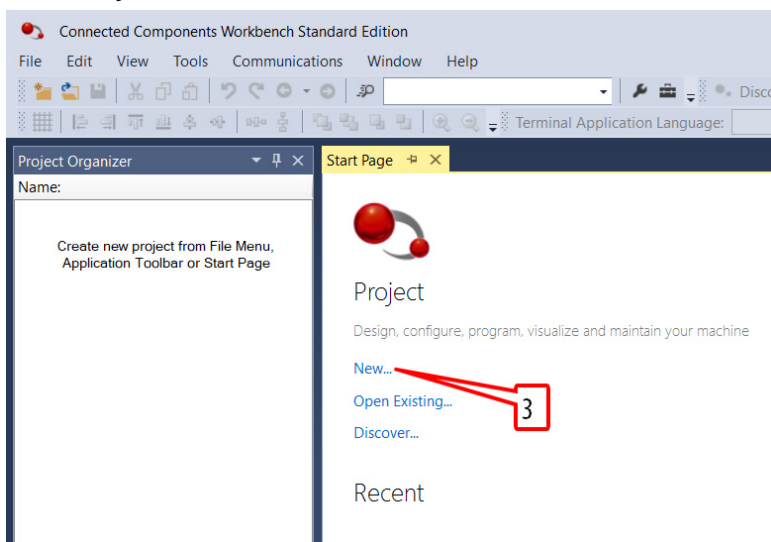


Figure 93 on page 117 shows the New Project window. The Connected Components Workbench software maintains a list of projects to help prevent you from overwriting an existing project. The name of each new project increments by one (for example, Project90). This window allows you to customize the name and browse for a location for the file.

4. Type a new name, for example, “My 450L Project.”
5. Click Create.

Figure 93 - Project Name

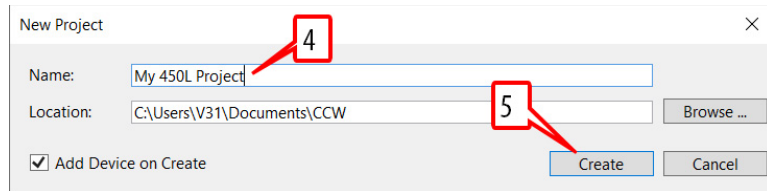
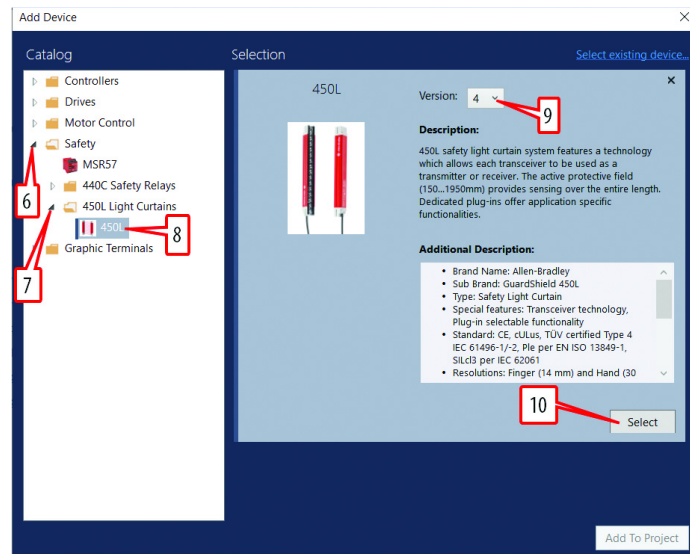


Figure 94 shows the Add Device window.

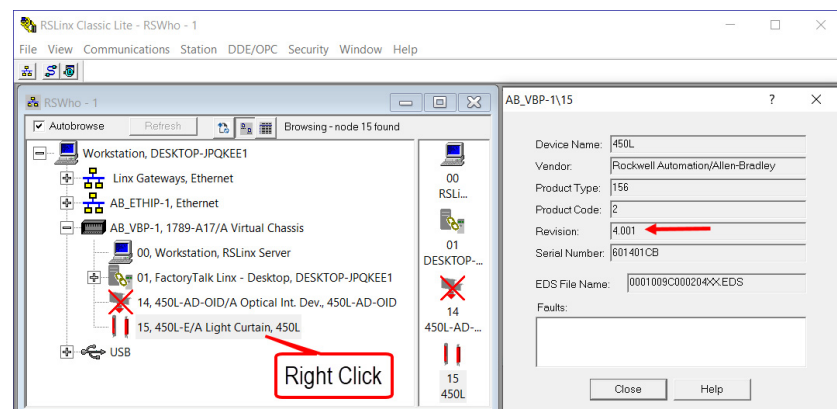
6. Expand the Safety listing.
7. Expand The Bulletin 450L Safety Light Curtains.
8. Click the Bulletin 450L.
9. Select the version number that matches the stick firmware.
10. Click Select.

Figure 94 - Add a Device



To determine the current firmware revision of the safety light curtain, open RSLinx® software, right-click the Bulletin 450L, and click Device Properties. An example is shown in Figure 95.

Figure 95 - Firmware Revision



The firmware selection process is confirmed in Figure 96 on page 118.

11. Verify that the selection and firmware revision are correct and click Add to Project.

Figure 96 - Add to Project

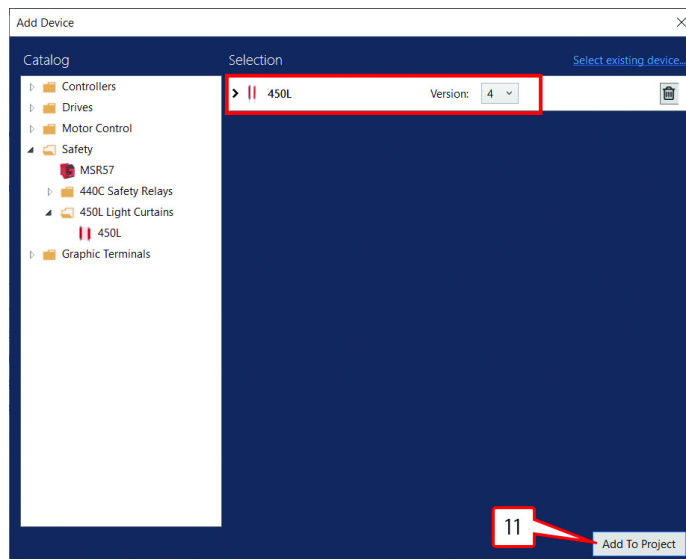


Figure 97 shows the Bulletin 450L safety light curtain device in the Project Organizer.

The project name appears in the title of the window and in the Project Organizer. In this example, the safety light curtain project name is “My 450L Project.”

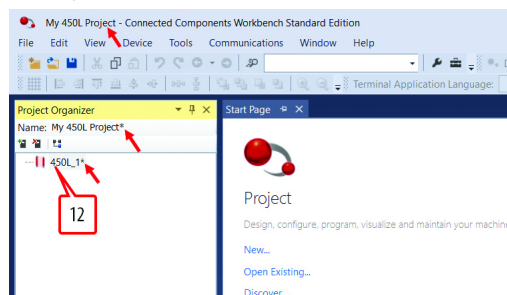
The Bulletin 450L device appears in the Project Organizer with the default name “450L_1.” If desired, the name of the safety controller can be changed. Click the name to change the name of the safety light curtain (or right-click and select Rename). This step is not required to complete the configuration or to run the Bulletin 450L. The name that you choose must follow these rules:

- No special characters, except underscore
- No double underscore
- 1...32 characters

An asterisk appears after the controller name and project name to indicate that a valid project has not yet been saved.

12. In the Project Organizer, double-click the device name or icon to open the product configuration tab.

Figure 97 - Project Created



Workbench Layout

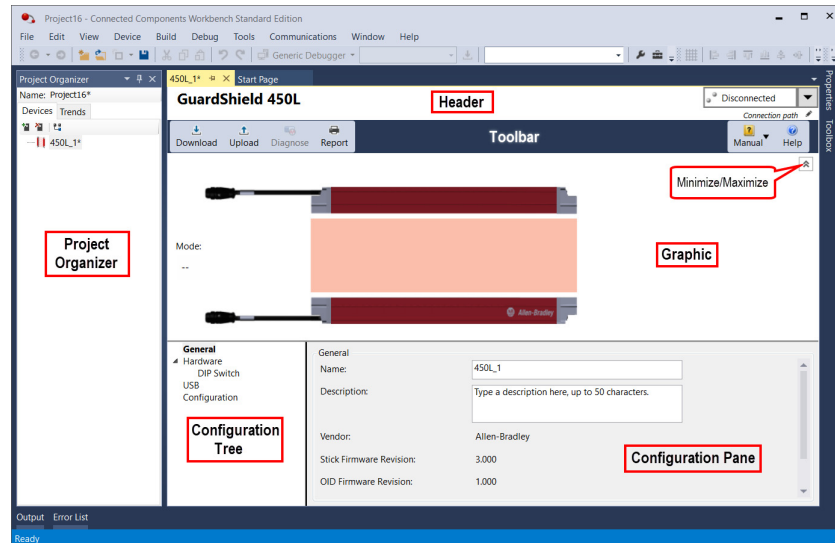
Figure 98 on page 119 shows the six major sections of the workbench layout.

- Project Organizer – shows all devices that are contained in the project.
- Header – shows the device identity and the connection information.
- Toolbar – shows the operations/commands for the Bulletin 450L device. The set of operations for Bulletin 450L-B and Bulletin 450L-E (DIP switch

1=OFF) are: Diagnose, Report, Manual, Help. The set of operations for Bulletin 450L-E (DIP switch 1=ON) is: Download, Upload, Diagnose, Report, Manual, and Help.

- Graphic – shows a graphical representation of the safety light curtain device and the system mode status. The graphic pane can be minimized to expand the Configuration Pane and Diagnostic Information.
- Configuration Tree – provides the navigation to the configuration of a light curtain.
- Configuration Pane – sets the configuration details of the Bulletin 450L-E safety light curtain. The content of this pane coincides with the selection in the Configuration Tree.

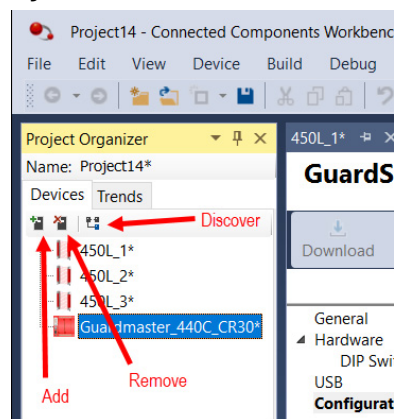
Figure 98 - Project Opened - Workbench Layout



Project Organizer

[Figure 99](#) shows an example with multiple devices that are used in the project. Click the icons in the Project Organizer add, remove, or discover devices.

Figure 99 - Add, Remove, and Discover Devices



General

[Figure 100 on page 120](#) shows the General setup. The device is automatically assigned the name 450L_1 and this name can be customized. A 50-character description can also be entered. This description shows the vendor, Stick Firmware Revision, OID Firmware Revision. If installed, the Cascading Plug-in Firmware Revision is also shown.

Figure 100 - General Setup

General

Name:

450L_1

Description:

Type a description - up to 50 characters

Vendor:

Allen-Bradley

Stick Firmware Revision:

4.000

OID Firmware Revision:

1.009

Cascading Plug-In Firmware Revision:

N/A

Hardware

Figure 101 shows the hardware setup. Select the appropriate values to match the light curtain in use.

Figure 101 - Hardware Setup

Hardware

450L Type

E

Series

A

Length

600mm (23.6 in)

Resolution

14mm (0.56 in)

Laser

Integrated

Catalog

450L-E4FL0600YD

Connection plug-in Tx

450L-APT-PW-8

Connection plug-in Rx

450L-APR-MU-8

Cascading plug-in Tx

None

Cascading plug-in Rx

None


DIP Switch

Figure 102 shows the hardware DIP switch settings for the connection plug-in. The graphic is updated to match the actual switch settings when a connection is made to the device.

To use the Connected Components Workbench software to configure the Bulletin 450L-E safety light curtains, switch 1 must be set to ON and all other switches set to OFF. If switch 1 is OFF, then the Connected Components Workbench software shows the status of the safety light curtain.

Figure 102 - Hardware DIP Switch Settings

Hardware DIP Switch Settings

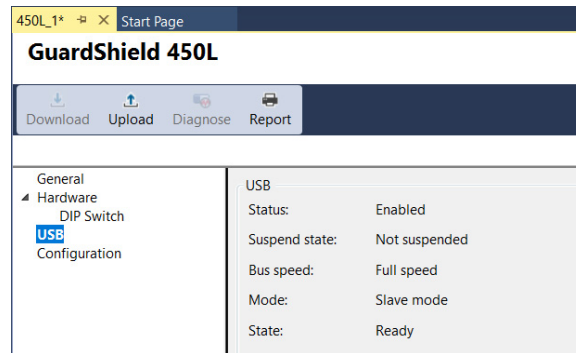


DIP-#	Function	Setting
1	SW configuration activation	ON
2	--	OFF
3	--	OFF
4	--	OFF
5	--	OFF
6	--	OFF
7	--	OFF
8	--	OFF
9	--	OFF
10	--	OFF
11	--	OFF
12	--	OFF

USB Status

[Figure 103](#) shows the status of the USB connection. The status is read-only.

Figure 103 - USB Status



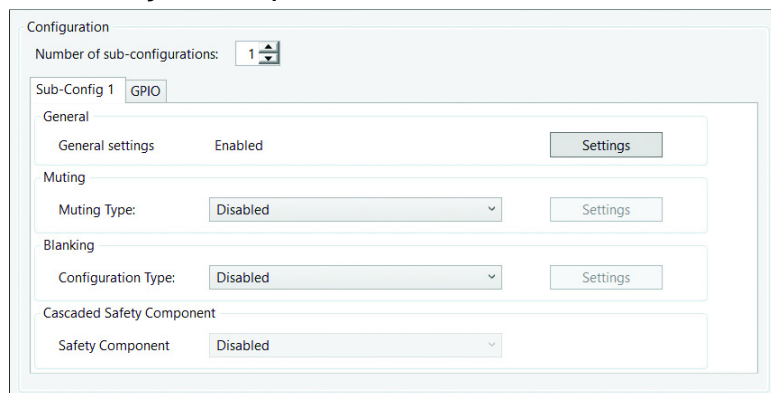
Subconfigurations

[Figure 104](#) shows the subconfiguration setup. The subconfiguration setup is only available when the OID is connected to a receiver; the transmitter does not require a configuration.

Key elements of subconfigurations include:

- With DIP switch 1 set to ON, up to four subconfigurations can be created.
- The General, Muting, and Blanking settings can be adjusted for each sub-configuration.
- If a cascading plug-in is installed, the Cascaded Safety Component is automatically refreshed when a configuration is uploaded from the light curtain.
- The four configurations use the same GPIO.
- If DIP switch 1 is set back to 0, the configuration via the Connected Components Workbench software is erased.

Figure 104 - Sub-Configuration Setup



General Settings

[Figure 105 on page 122](#) shows the default general settings. The general settings apply to both the muting and blanking functions, if these functions are enabled. See [Table 58 on page 122](#) for descriptions of each setting.

Figure 105 - General Settings

General settings

Start mode ☐ Automatic start

Start release ☐ Disabled

EDM enable ☐ Max. EDM reaction time Disabled ms

Operating range ☐ Long range

Beam coding ☐ Disabled

Interference rejection ☐ Length Resolution Disabled

External test enable ☐ Logic external test: Disabled

Multiple scan ☐ Disabled

Short interruption ignore ☐ Short interruption ignore time Disabled ms

Minimum OSSD OFF Time ☐ 250 ms

OSSD threshold time ☐ "ON" threshold 500 ms
"OFF" threshold 250 ms

Laser switch off time ☐ 240 s

Configured response time 10 ms


Configured resolution 14 mm

OK Cancel Help

Table 58 - General Setting Descriptions

Setting	Description
Start mode	Can only be selected for 8-pin Rx plug-in or for 5-pin Rx plug-in with I/O cascading plug-in. The selections are: <ul style="list-style-type: none"> Automatic start – If the safety light curtain is clear, the OSSD outputs turn ON. This mode applies to power-up and after power-up. Power up Start Interlock – Upon power-up, the start must be pressed and released within a window of 50...5000 ms. After power-up, the OSSD output operates automatically. Manual Start – Upon power-up and after the OSSDs turn OFF, the start must be pressed and released within a window of 50...5000 ms. The OSSD outputs energize on the trailing edge of the start signal. Manual Start with Off Function – Upon power-up and after the OSSDs turn OFF, the start must be pressed and released within a window of 50...5000 ms. The OSSD outputs energize on the trailing edge of the start signal. The OSSD outputs can also be turned OFF with the start.
Start release	Start release function can be selected with either the 8-pin Rx plug-ins or the 5-pin plug-ins with an I/O plug-in. Start Release and EDM cannot be ON simultaneously. When the light curtain is clear, the OSSD outputs energize on the leading edge of the start release input.
EDM enable	EDM function can only be selected with 8-pin Rx plug-ins. Start Release and EDM cannot be ON simultaneously. The EDM input must change state within the selected time. If the EDM signal does not change state, the OSSD outputs de-energize and the light curtain is locked out; a lockout requires a power cycle to clear the fault. <ul style="list-style-type: none"> Min: 50 ms Max: 1275 ms Increment: 5 ms Default: 300 ms (when enabled)
Operating range	Allows you to set the operating range to either long range (default) or short range.
Beam coding	Enables beam coding. Beam coding helps prevents interference from neighboring light curtains. The response time increases if beam coding is selected.
Interference rejection	Enables interference rejection. Interference rejection is an enhancement to beam coding. In applications where enabling beam coding alone does not mitigate interference, the interference rejection feature can be enabled to alter the scan pattern to restrict stray light from a neighboring 450L-E safety light curtain from affecting operation. The response time increases if interference rejection is selected, however, configuring in Connected Components Workbench, as opposed to by DIP switch, refines the settings and ensures that the most appropriate scan pattern is used, which can be less than the response time derived for DIP switch configuration – refer to Table 18 on page 49 and Table 19 on page 50 for response times set by DIP switch or Connected Components Workbench.
External test enables	Enables an input to either turn the OSSD outputs ON or OFF.

Table 58 - General Setting Descriptions

Setting	Description
Multiple scans	Defines whether the safety light curtain operates in a multiple scanning mode. When enabled, multiple scan modes only turn OSSDs OFF if there are at least three consecutive scans with an interruption. The normal mode of operation is the double-scan, which turns OSSDs OFF if there is an interruption in at least two consecutive scans. This extra measure of resiliency against spurious trips adds an additional 33% (approximately) to the response time.
Short interruption ignored	<p>You can define a filter time to ignore short interruptions of the safety light curtain.</p> <ul style="list-style-type: none"> Min: 0 ms Max: 174 ms Increment: 2 ms <div>  <p>ATTENTION: If the response is set time longer than 90 ms, it can allow a person to walk through the safety light curtain undetected. Safety distance/physical barriers must be adjusted accordingly.</p> </div>
OSSD threshold time	<p>You can define a filter time the OSSD outputs from changing too quickly. This function is applicable when the OSSD outputs are connected to electromechanical devices like relays and contactors, and the light curtain is set for automatic start.</p> <p>If the safety light curtain is broken and cleared more than twice within the OFF time, the OSSD outputs turn OFF during the ON time. The ON time must be equal to or greater than the OFF time.</p> <ul style="list-style-type: none"> Min: 30 ms Max: 5000 ms Default: ON 500 ms, OFF 250 ms
Laser switch off time	<p>If enabled, the laser turns off automatically after the selected time expires.</p> <ul style="list-style-type: none"> Min: 0 s Max: 255 s Increment: 1 s
Configured response time	The response time is automatically adjusted based on protective height, multiple scanning, beam coding, and short interruption ignore functions.
Configured resolution	The resolution is automatically adjusted when reduced resolution or floating blanking are configured.

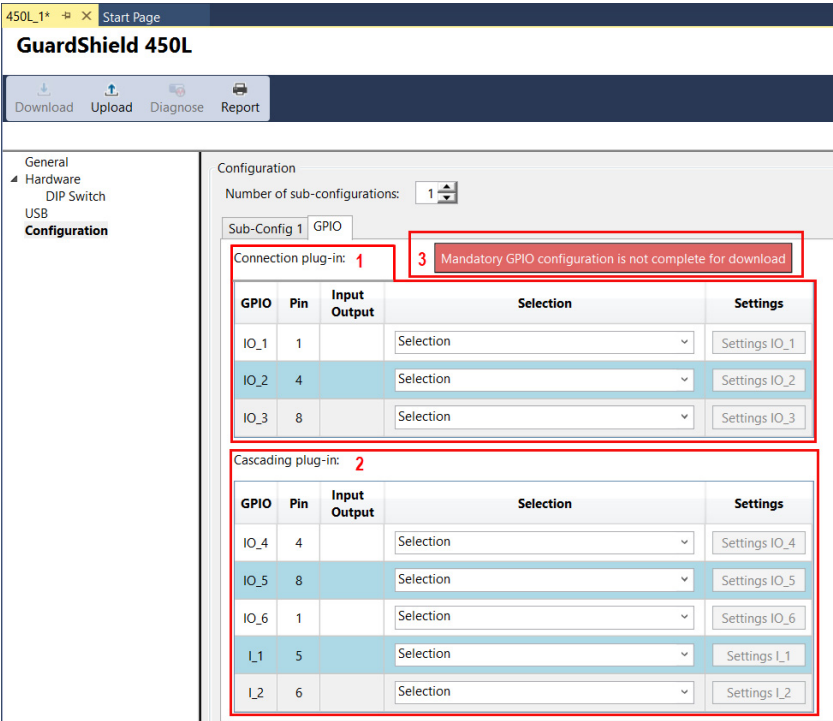
GPIO

[Figure 106 on page 124](#) shows an overview of the layout of the General Purpose Input Output (GPIO) window. The window has three significant areas:

1. Connection plug-in
2. Cascading plug-in
3. Message box — informs you whether the mandatory GPIO has been specified

The configuration cannot be downloaded to the stick until the mandatory GPIO is completed. When completed, the message box has a green background.

Figure 106 - GPIO Overview



[Figure 107 on page 125](#) shows an example of the General Purpose Input Output selections. The Connected Components Workbench software automatically determines the available pins on the connection [1] and cascading [2] plug-ins. A message [3] is displayed to show whether mandatory configuration points are selected. When complete, the message background turns from red to green.

The subconfiguration setup automatically determines the available selections. This selection is a four-sensor muting example with two subconfigurations. The connection plug-in has three I/O and the cascading plug-in has three I/O (inputs or outputs) and two I (inputs).

The selection for IO_1 shows seven mandatory inputs. Three of the mandatory inputs have white boxes. At least two of the three mandatory inputs must be assigned to the connection plug-in. The third mandatory input can be assigned to the connection or cascading plug-in. The four mandatory muting sensors are disabled as these sensors can only be assigned on the cascading plug-in.

With eight potential I/O and seven mandatory inputs, one of the I/O can be used for the optional inputs or outputs.

Figure 107 - GPIO Selection Settings

Configuration

Number of sub-configurations: 2

Sub-Config 1 Sub-Config 2 GPIO

Connection plug-in: Mandatory GPIO configuration is not complete for download

GPIO	Pin	Input Output	Selection	Settings
IO_1	1		Selection	Settings IO_1
IO_2	4			Settings IO_2
IO_3	8		Selection	Settings IO_3

Cascading plug-in:

GPIO	Pin	Input Output	Selection	Settings
IO_4	4			Settings IO_4
IO_5	8			Settings IO_5
IO_6	1			Settings IO_6
I_1	5			Settings I_1
I_2	6		Selection	Settings I_2

Selection menu contents:

- Selection
- Mandatory inputs:
 - ☐ Activate sub-configuration 1
 - ☐ Activate sub-configuration 2
 - ☐ Mute dependent override input
- Muting sensors:
 - ☐ Muting Sensor 1
 - ☐ Muting Sensor 2
 - ☐ Muting Sensor 3
 - ☐ Muting Sensor 4
- Optional inputs:
 - ☐ Laser alignment ON/OFF
- Optional outputs:
 - ☐ Combined Status
 - ☐ Muting active
 - ☐ Muting error

Item	Description
1	Mandatory inputs
2	Mandatory muting sensors
3	Optional inputs or outputs

Table 59 lists the possible selections and their descriptions. The possible selection choices are dependent on the hardware and automatically determined by the Connected Components Workbench software. See Table 58 on page 122 for detailed descriptions of the selections.

Table 59 - GPIO Selections

I/O	Selection	Description
Input	Activate subconfiguration #	Activates this subconfiguration. Only one subconfiguration can be active. At least one subconfiguration must be active.
	External device monitoring	Monitors external devices that the light curtain OSSD outputs drive.
	Laser alignment ON/OFF	Turns the integrated laser alignment function ON and OFF.
	Manual (re)start	Input turns on the OSSD outputs if the light curtain is clear.
	Mute dependent override	Turns on the OSSD outputs if a muting error occurs and the light curtain is blocked.
	Muting sensor #	Indicates that a sensor is blocked.
	Start release	With the light curtain clear, the start release input turns on the OSSD outputs on the leading edge of the signal.
	Test input	Turns the OSSD outputs ON or OFF, depending on the configuration.

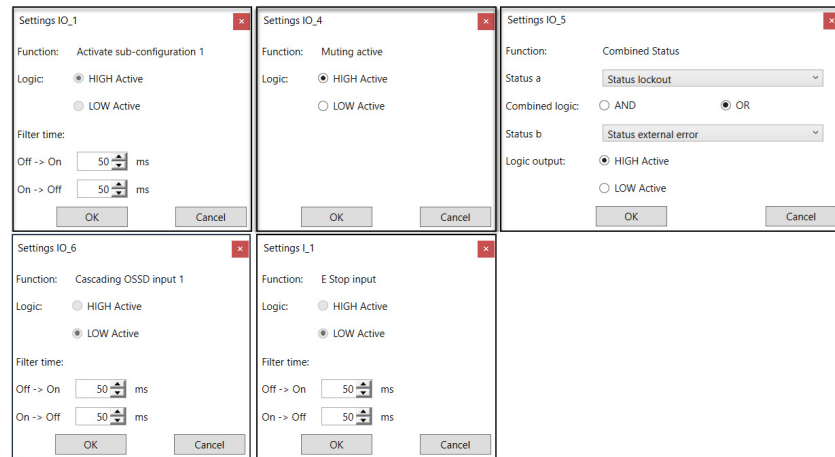
Table 59 - GPIO Selections

I/O	Selection	Description
Output	Combined status	Indicates the logic applied to the combined status of two parameters are satisfied.
	Muting active	Indicates when muting is active. The appropriate muting inputs (signals/sensors) go low within the T(sens) time and within the proper sequence.
	Muting error	Indicates when either a muting timing error or muting sequence error is present.
	Muting sequence error	Indicates that the muting inputs occurred in an incorrect order.
	Muting timing error	Indicates the T(sens) time or the T(espe) time are exceeded.
	Start	Indicates that the light curtain is waiting for the start input. After the OSSD outputs energize, the start output turns OFF.
	Status EDM/start release	Indicates the status of the EDM or start release input.
	Status error (lockout/external error)	Indicates that a lockout or external error has occurred.
	Status external error	Indicates that an external error has occurred.
	Status intensity (cascading end)	The intensity of one or more of the beams on the cascading half (top side) of the light curtain is below Good Intensity. This occurrence is reported as Diagnostic Parameter 3.14.
	Status intensity (connection end)	The intensity of one or more of the beams on the connection half (bottom side) of the light curtain is below Good Intensity. This occurrence is reported as Diagnostic Parameter 3.124.
	Status intensity (connection/ cascading end)	The intensity of one or more of the beams on the connection half (bottom side) or the cascading side (top side) of the light curtain is below Good Intensity. This occurrence is reported as Diagnostic Parameter 3.12 and 3.14.
	Status lockout	Indicates that a lockout status has occurred.
	Status mutes dependent override	Indicates that the mute dependent override signal is active.
	Status OSSD outputs	Indicates the status of the OSSD outputs.
	Status helps protected field free	Indicates the status of the whole helps protected height (both the bottom side and the top side) of the light curtain.
	Status test input	Indicates the status of the test input.

[Figure 108 on page 127](#) shows the settings that can be made for each of the I/O types. The Connected Components Workbench software automatically determines the allowable selections.

- Many inputs can be assigned High/Low logic and have filter times that are adjusted from 0...255 ms.
- Muting, Cascading OSSD and (Cascading) E-stop inputs have the logic that is fixed at Low Active and cannot be changed.
- Cascading OSSD input filter times range from 3...255 ms.
- E-stop input filter times range from 4...255 ms.
- The outputs only have logic options.

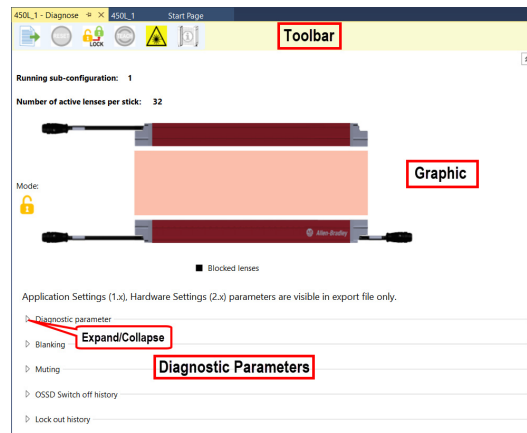
The Combined Status output allows and/or logic to be applied to two selectable status outputs.

Figure 108 - GPIO Selection Settings

Diagnose Window

[Figure 109](#) shows the Diagnose window layout. The Diagnose window is only available when the Connected Components Workbench software has a connection with the light curtain. This layout has three regions:

- Toolbar
- Graphic
- Diagnostic parameters

Figure 109 - Diagnose Window Layout

Export

The Export creates a CSV file of the complete light curtain hardware setup and all available diagnostic data.

Before saving to a file, one dialog window, which contains default full name (path and file name) is provided to you. You can change the saving path or the saving name. After you press Save, the parameter information is exported to the pointed folder. The default path and file name are:

- Default path: C:\Users\Current User\Documents\CCW\Project Name
- Default file name: 'Device Name' + '_' + 'YYYYMMDD'

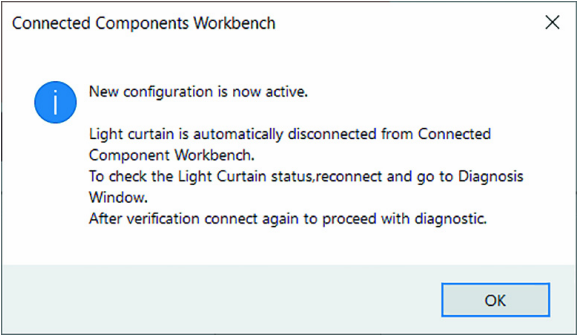
Reset

The Reset clears a safety light curtain that has been locked out. After you resolve the lockout condition and press Reset, the safety light curtain powers off and then powers on. The stick disconnects from the Connected Components Workbench software because of this power off/on cycle.

Lock

All new and changed configurations must be locked before run mode. The Lock is enabled if the safety light curtain is in unlocked mode and is disabled if device system is in run mode. After locking, the configuration active window in [Figure 110](#) appears. The safety light curtain is disconnected from the Connected Components Workbench software.

Figure 110 - Configuration Active



Mode

The mode symbol provides a quick way of determining the operating status of the safety light curtain.

Symbol	Description	Explanation
	Error	Mouse over the icon for additional information.
	Run	The configuration is locked, and the light curtain is in run mode.
	Unlocked	The light curtain configuration must be confirmed.
	Lock out	See the diagnostic 7.1. Upload and click Reset.

Teach

Teach is only shown when the Connected Components Workbench software is connected to a Bulletin 450L-E safety light curtain. Teach is only enabled when:

- The connection plug-in is either catalog number 450L-APR-BL-5 or catalog number 450L-APR-MU-8,
- The stick status is “Run mode after synchronization,” and either:
 - DIP switch 1 is set to ON, and the Blanking Configuration Type is set to Push Button Teach-in, or
 - DIP switch 1 is set to OFF, and
 - Switch 5 is ON when using the catalog number 450L-APR-BL-5, or

- Switch 8 is OFF and switch 9 is ON when using the catalog number 450L-APR-MU-8.

Teach blanking can also be accomplished in the Blanking Configuration window.

Laser

The Laser turns the Integrated Laser Alignment ON and OFF. The Laser is only shown when the Connected Components Workbench software is connected to a Bulletin 450L-E safety light curtain.

A confirmation window is shown when the Laser is turned ON and when it is turned OFF.

Beam Status



The Beam Status provides a snapshot table of the status of each individual beam at each lens. The length of the table is equal with the number of lenses of the connected stick. An example of the Beam Status table is shown in [Figure 108 on page 127](#). The information that is provided is:

- Connected stick is a Tx or an Rx
- Snapshot date
- Snapshot time
- Cascade number
- Lens number
- Beam status – Free or Blocked
- Beam intensity – Low, Med-Low, Med-High, High, N/A when the beam status is Blocked.
- Blanking status – no blanking, fixed blanking, reduced resolution, or floating blanking.
- Muting status – Free (not muted) or muting active

The export provides the user the option to export the data in a *.CSV file.

- Default path: C:\Users\Current User\Documents\CCW\Project Name
- Default name: 'Device Name' + '_' + 'BeamStatus' + '_' + 'MMddyyyy' + '_' + 'hhmmss'

Blanking Example – In [Figure 111 on page 130](#), lenses 1 and 2 are fixed blanking. Beams 3...14 are floating blanking, with beam 10 blocked. Beams 15...18 have no blanking. Beams 19...31 have reduced resolution and no beams are currently blocked. Finally, beam 32 has no blanking.

Figure 111 - Beams Status -Blanking Example

Connected Components Workbench

Snap shot beam status RX

Date (dd.mm.yyyy): 14.06.2019Time: 16:01:42

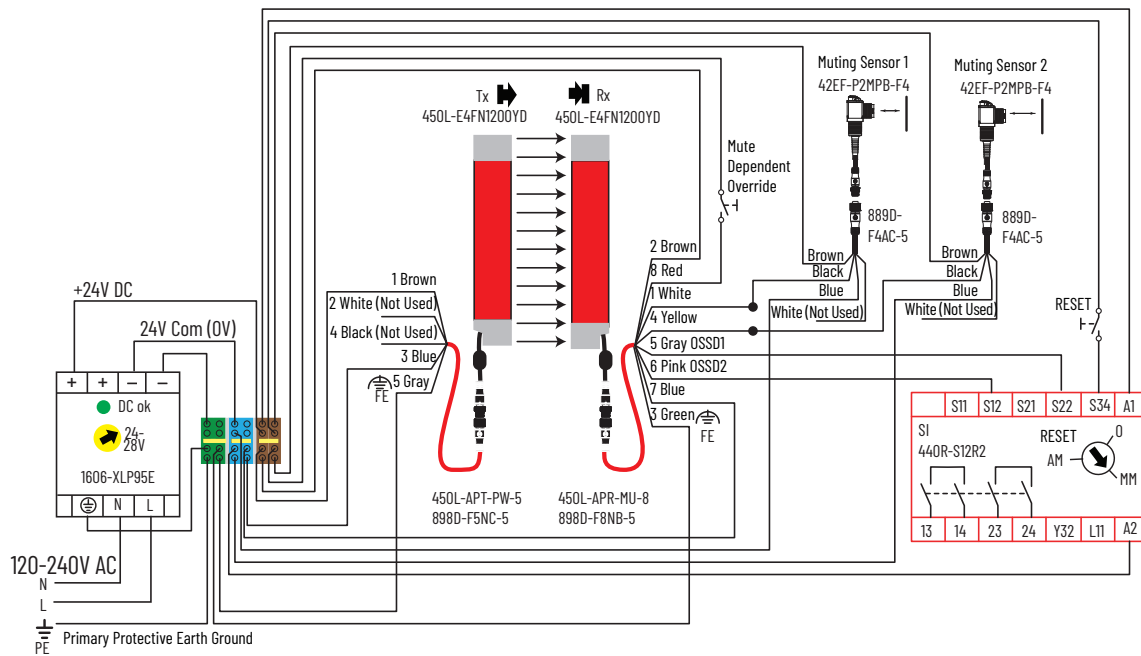
Cascade	Lens	Status	Intensity	Blanking	Muting
1	1	Blocked	N/A	Fixed Blanking	No
1	2	Blocked	N/A	Fixed Blanking	No
1	3	Free	High	Floating Blanking	No
1	4	Free	High	Floating Blanking	No
1	5	Free	High	Floating Blanking	No
1	6	Free	High	Floating Blanking	No
1	7	Free	High	Floating Blanking	No
1	8	Free	High	Floating Blanking	No
1	9	Free	High	Floating Blanking	No
1	10	Blocked	N/A	Floating Blanking	No
1	11	Free	High	Floating Blanking	No
1	12	Free	High	Floating Blanking	No
1	13	Free	High	Floating Blanking	No
1	14	Free	High	Floating Blanking	No
1	15	Free	High	No	No
1	16	Free	High	No	No
1	17	Free	High	No	No
1	18	Free	High	No	No
1	19	Free	High	Reduced Resolution One Object	No
1	20	Free	High	Reduced Resolution One Object	No
1	21	Free	High	Reduced Resolution One Object	No
1	22	Free	High	Reduced Resolution One Object	No
1	23	Free	High	Reduced Resolution One Object	No
1	24	Free	High	Reduced Resolution One Object	No
1	25	Free	High	Reduced Resolution One Object	No
1	26	Free	High	Reduced Resolution One Object	No
1	27	Free	High	Reduced Resolution One Object	No
1	28	Free	High	Reduced Resolution One Object	No
1	29	Free	High	Reduced Resolution One Object	No
1	30	Free	High	Reduced Resolution One Object	No
1	31	Free	High	Reduced Resolution One Object	No
1	32	Free	High	No	No

ExportCancel

Two-sensor Muting Schematic Example

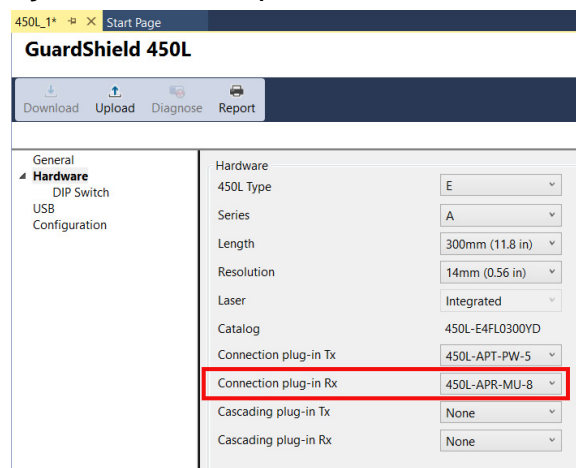
Figure 112 on page 131 shows an example wiring diagram for two-sensor muting. The muting sensors are connected to pins 1 and 4 of the connection plug-in. If the Connected Components Workbench software is not used, the connections of the muting sensors must be as shown in the schematic. If the Connected Components Workbench software is used, the muting sensors can be connected in any of the muting wires and then configured in the Connected Components Workbench software.

Figure 112 - Example Schematic for Two Sensor Muting



In the hardware setup, which is shown in [Figure 113](#), select the muting plug-in, Bulletin 450L-APR-MU-8, as the Connection plug-in Rx. On the plug-in, set switch 1 to ON, and all other switches are OFF. This step allows the Connected Components Workbench software to configure the muting setup.

Figure 113 - Hardware Setup



Muting Type and Settings

In [Figure 114 on page 132](#), select the Muting Type. Since the receiver only has the muting plug-in, the muting types are limited to two sensors. Select the type of muting. Click Settings to adjust the muting time parameters.

Figure 114 - Select Muting Type

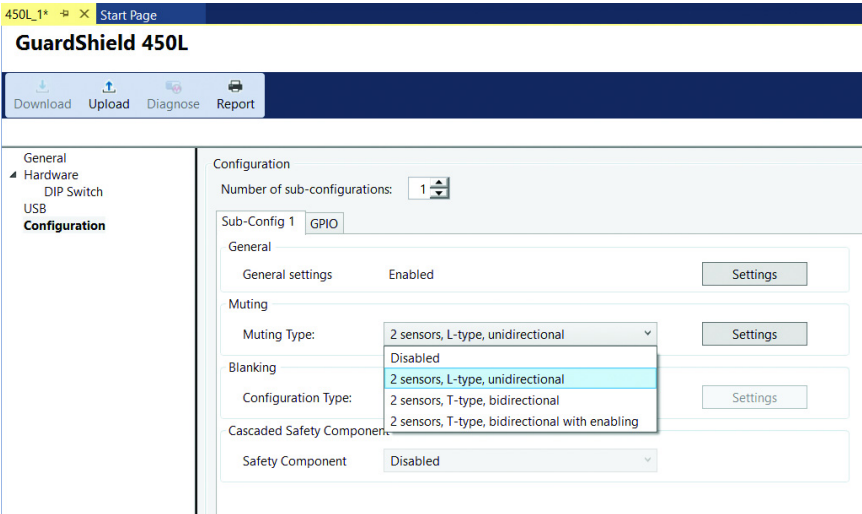


Figure 115 shows the two-sensor muting settings. These settings apply to all three types of two-sensor muting. Table 60 describes the settings. Select the values appropriate for the application.

Figure 115 - Muting Settings

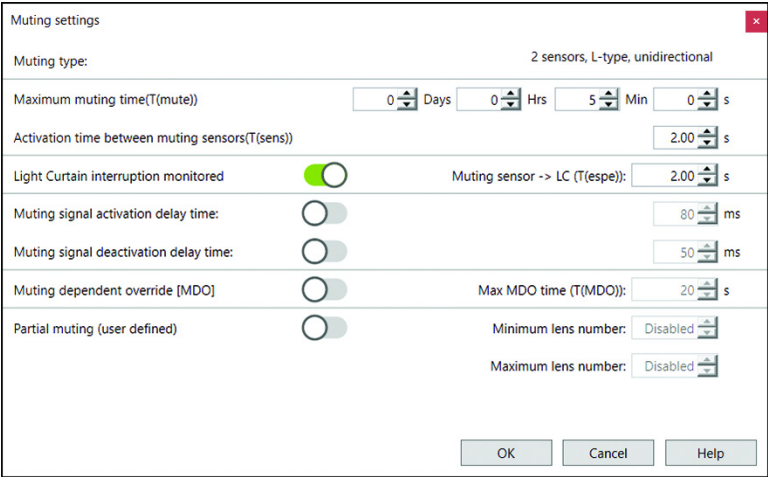


Table 60 - Muting Parameters

Parameter	Description
Muting type	This parameter is a read-only field, setup by the Configuration tab.
Maximum muting time	This parameter is the maximum time that the material can occupy the light curtain. If the time is exceeded, the OSSD outputs turn OFF and the object can be cleared by using the Mute Dependent Override.
Activation time between muting sensors T(sens)	Specifies the maximum time between sensors. This maximum is the time in which the object must block both sensors. If the time is exceeded, the muting timing error becomes active and the light curtain is not muted.
Light curtain interruption monitored T(espe)	If set to OFF, the time from the start of muting to when the object blocks the safety light curtain is not used in the muting sequence. If set to ON, specify the time that the safety light curtain must be interrupted after the muting state has been achieved. If the time is exceeded, the OSSD outputs turn OFF.
Muting signal activation delay time	Specifies a delay before muting becomes activate. <ul style="list-style-type: none">• Max setting: 2550 ms• Default setting: 80 ms• Min setting: 1 ms

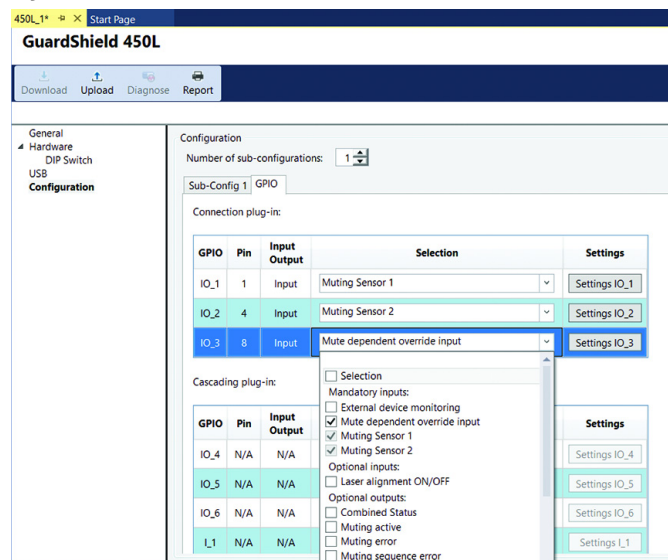
Table 60 - Muting Parameters

Parameter	Description
Muting signal deactivation delay time	Specifies a delay before muting becomes de-activated. <ul style="list-style-type: none"> • Max setting: 2550 ms • Default setting: 50 ms • Min setting: 0 ms • Increment: 10 ms
Muting dependent override (MDO)	Specifies the duration of the muting dependent override signal. Use this function to force the OSSD outputs ON after a muting error has occurred. The override signal becomes active on the trailing edge. <ul style="list-style-type: none"> • Max setting: 1275 s • Min setting: 0 ms • Increment: 10 ms
Partial muting (user defined)	The safety light curtain can be configured to allow muting of a specified number of lenses. Specify the first lens and last lenses to mute. If the other lenses are blocked, the OSSD outputs turn OFF.

GPIO Selection and Settings

[Figure 116](#) shows the GPIO tab. Click GPIO and select the function of the three inputs. Two of the inputs must be the muting sensors. A likely choice for the third input is a mute dependent override function.

Figure 116 - General Purpose Input Output Selection



Click Settings IO_x to set Logic and Filter times. [Figure 117 on page 134](#) shows the options for the GPIO settings.

The Logic function for muting sensor is fixed at LOW Active. When an object passes in front of the sensor, the sensor output turns OFF.

Adjust the filter times to help prevent inadvertent changes from the sensor output from disrupting the muting process. The filter times can be adjusted from 0...255 ms.

Click OK after adjustments are made.

Figure 117 - General Purpose Input Output Selection

Settings IO_1

Function: Muting Sensor 1

Logic: ☐ HIGH Active
☒ LOW Active

Filter time:

Off -> On 50

On -> Off 50

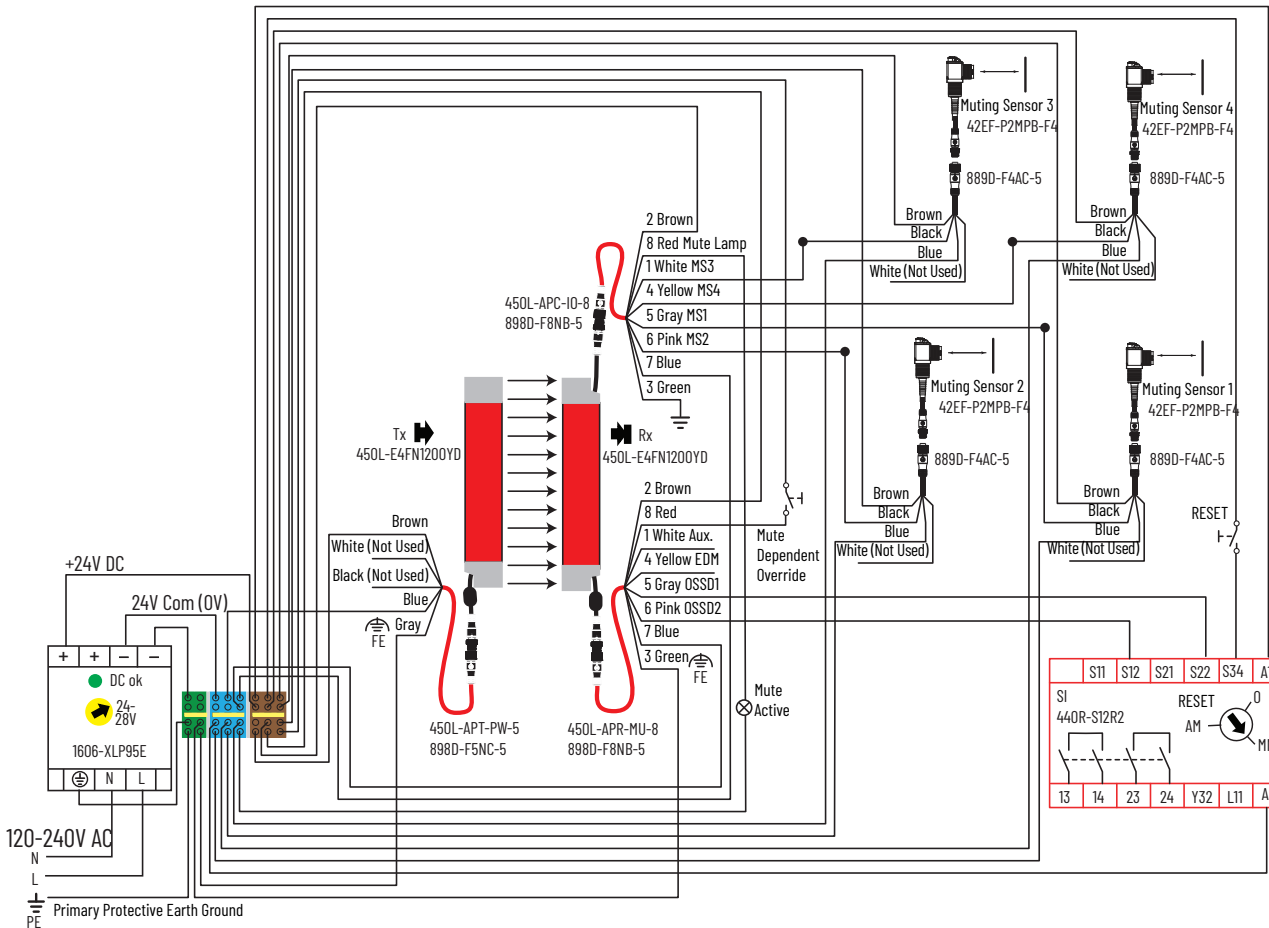
OK Cancel Help

Proceed to [Download and Upload Configurations on page 153](#).

Four-sensor Muting Schematic Example

Figure 118 shows an example wiring diagram for four-sensor muting. The muting sensors are connected to the cascading plug-in. If the Connected Components Workbench software is not used, the connections of the muting sensors must be as shown in the schematic. If the Connected Components Workbench software is used, the muting sensors can be connected in any of the muting wires and then configured in the Connected Components Workbench software.

Figure 118 - Example Schematic for Four Sensor Muting



Hardware

[Figure 119](#) shows the hardware settings for four-sensor muting. The receiver stick requires the muting connection plug-in and the cascading plug-in. When both plug-ins are selected, the Connected Components Workbench software allows for four-sensor muting to be selected.

Figure 119 - Hardware Settings for Four Sensor Muting

The screenshot shows the 'GuardShield 450L' configuration window. The 'Hardware' tab is active. The settings are as follows:

Setting	Value
450L Type	E
Series	A
Length	300mm (11.8 in)
Resolution	14mm (0.56 in)
Laser	Integrated
Catalog	450L-E4FL0300YD
Connection plug-in Tx	450L-APT-PW-8
Connection plug-in Rx	450L-APR-MU-8
Cascading plug-in Tx	None
Cascading plug-in Rx	450L-APC-IO-8

Muting Type and Settings

[Figure 120](#) shows the Configuration window. There is only one type of four-sensor muting. Select four sensors, T-type, bidirectional as the muting type. Click Settings to adjust the muting time parameters.

Figure 120 - Muting Type with Four Sensors

The screenshot shows the 'GuardShield 450L' configuration window. The 'Configuration' tab is active. The settings are as follows:

Setting	Value
Number of sub-configurations:	1
Sub-Config 1	GPIO
General settings	Enabled
Muting Type	4 sensors, T-type, bidirectional
Configuration Type	4 sensors, T-type, bidirectional
Cascaded Safety Component	2 sensors, T-type, bidirectional with enabling
Safety Component	Disabled

[Figure 121 on page 136](#) shows the four-sensor muting settings. [Table 61 on page 136](#) describes the muting settings. Select the values appropriate for the application.

Figure 121 - Muting Settings

Muting settings

Muting type: 4 sensors, T-type, bidirectional

Maximum muting time(T(mute)) 0 Days 0 Hrs 5 Min 0 s

Activation time between muting sensors(T(sens)) 4.00 s

Light Curtain interruption monitored ☐ Muting sensor -> LC (T(espe)): Disabled s

Muting signal activation delay time: ☐ 80 ms

Muting signal deactivation delay time: ☐ 50 ms

Muting dependent override [MDO] ☐ Max MDO time (T(MDO)): 20 s

Partial muting (user defined) ☐ Minimum lens number: Disabled

Maximum lens number: Disabled

OK Cancel Help

Table 61 - Muting Settings

Setting	Description
Muting type	This setting is a read-only field, setup by the Configuration tab.
Maximum muting time	This setting is the maximum time that the material can occupy the light curtain.
Activation time between muting sensors T(sens)	Specifies the maximum muting time between sensors. This setting is the time in which the object must block both sensors on either side of the safety light curtain. If the time is exceeded, the muting timing error becomes active, and the light is not be muted. If the object then blocks the second sensor, the muting sequence error becomes active. The object must be removed from the sensors.
Light curtain interruption monitored (T(espe))	If set to OFF, the time from the start of muting to when the object blocks the safety light curtain is not used in the muting sequence. If set to ON, specify the time that the light curtain must be interrupted after muting starts. If the time is exceeded, the OSSD outputs turn OFF.
Muting signal activation delay time	Specifies a delay before muting becomes activated. <ul style="list-style-type: none">• Max setting: 2550 ms• Default setting: 80 ms• Min setting: 0 ms
Muting signal deactivation delay time	Specifies a delay before muting becomes de-activated. <ul style="list-style-type: none">• Max setting: 2550 ms• Default setting: 50 ms• Min setting: 0 ms
Muting dependent override (MDO)	Specifies the duration of the muting dependent override signal. Use this function to force the OSSD outputs ON after a muting error has occurred. The override signal becomes active on the trailing edge. <ul style="list-style-type: none">• Max setting: 1275 s• Min setting: 0 s
Partial muting (user defined)	The light can be configured to allow muting to a specified number of lenses. Specify the first lens and last lenses that are muted. If the other lenses are blocked, the OSSD outputs turn OFF.

GPIO Selection and Settings

With the muting settings established, the General Purpose Input and Output (GPIO) must be set. Click the GPIO tab.

Figure 122 on page 137 highlights three sections of the GPIO settings:

1. The connection plug-in has three wiring connections that can be used as input or output. The I/O are available on connector pins 1, 4, and 8.
2. The cascading plug-in has five wiring connections. Three can be used as input or output, and two can only be used as inputs. The I/O are available on connector pins 4, 8, 1, 5, and 6.

- Initially, a red message box “Mandatory GPIO configuration is not complete for download” appears. After making the proper mandatory selections, the message turns green.

Figure 122 - GPIO Overview

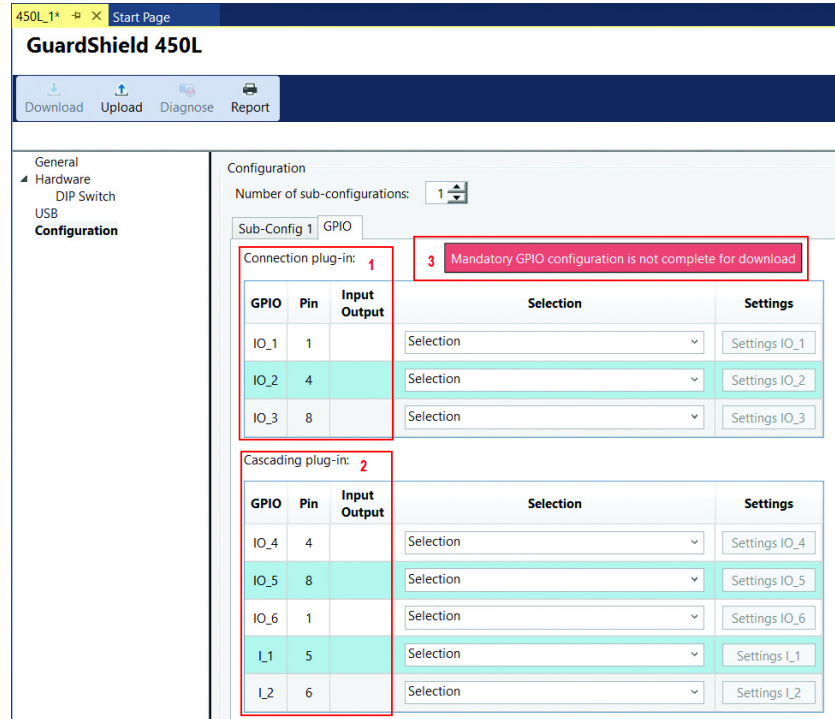


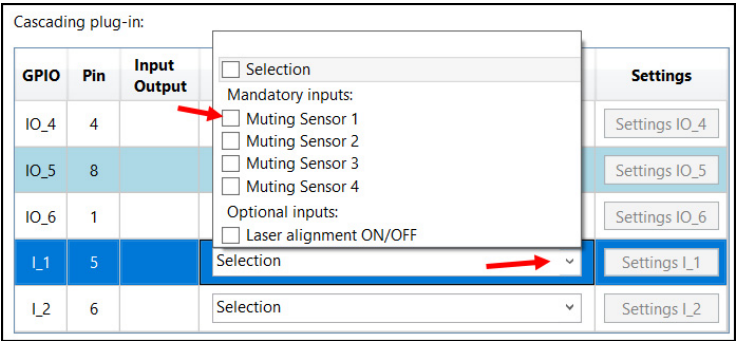
Figure 62 lists the I/O from the example schematic in Figure 118 on page 134. There are five inputs on the cascading plug-in and one output on the connection plug-in.

Table 62 - Muting I/O

Plug-in	I/O	Function	Pin
Cascading	Input	Muting sensor 1	5
		Muting sensor 2	6
		Muting sensor 3	1
		Muting sensor 4	4
	Output	Muting lamp	8
Connection	Input	Muting override	8
	Output	Mute timing error	1
		Mute sequence error	4

Figure 123 on page 138 shows the settings. Click the selection expander for Cascading plug-in pin five. The four muting sensors appear as mandatory inputs. Check Muting Sensor 1, as this sensor is connected to pin 5.

Figure 123 - Select I/O for Pin 5



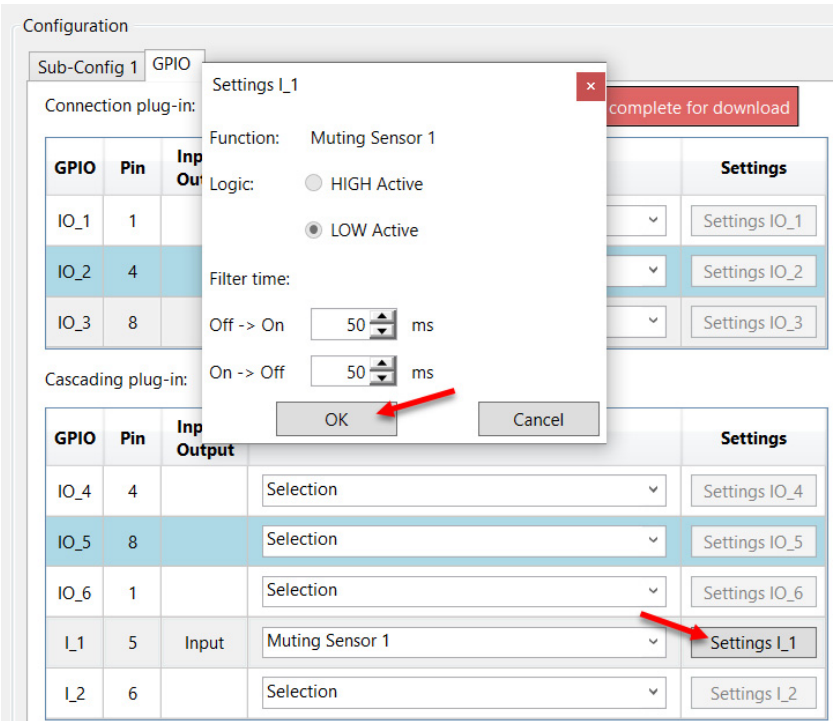
Click Settings L_1. [Figure 124](#) shows the sensor settings to adjust the sensor logic and filter times.

The Logic function for muting sensor is fixed at LOW Active. When an object passes in front of the sensor, the sensor output turns OFF.

Adjust the filter times to help prevent inadvertent changes from the sensor output from disrupting the muting process. The filter times can be adjusted from 0...255 ms.

Click OK after adjustments are made.

Figure 124 - Muting Sensor Settings



[Figure 125 on page 139](#) shows the final GPIO settings to meet the example schematic. The mandatory GPIO message box is green.

Figure 125 - Final GPIO Muting Settings

Configuration

Sub-Config 1 GPIO

Connection plug-in: Mandatory GPIO configuration complete for download

GPIO	Pin	Input Output	Selection	Settings
IO_1	1		Selection	Settings IO_1
IO_2	4		Selection	Settings IO_2
IO_3	8	Input	Mute dependent override input	Settings IO_3

Cascading plug-in:

GPIO	Pin	Input Output	Selection	Settings
IO_4	4	Input	Muting Sensor 3	Settings IO_4
IO_5	8	Input	Muting Sensor 4	Settings IO_5
IO_6	1	Output	Muting active	Settings IO_6
I_1	5	Input	Muting Sensor 1	Settings I_1
I_2	6	Input	Muting Sensor 2	Settings I_2

Proceed to [Download and Upload Configurations on page 153](#).

Blanking Overview

To use the blanking features, the transceiver must have either of these plug-ins:

- Catalog number 450L-APR-MU-8 – the muting/blanking plug-in
- Catalog number 450L-APR-BL-5 – the blanking plug-in

The Bulletin 450L-E safety light curtain has three types of blanking:

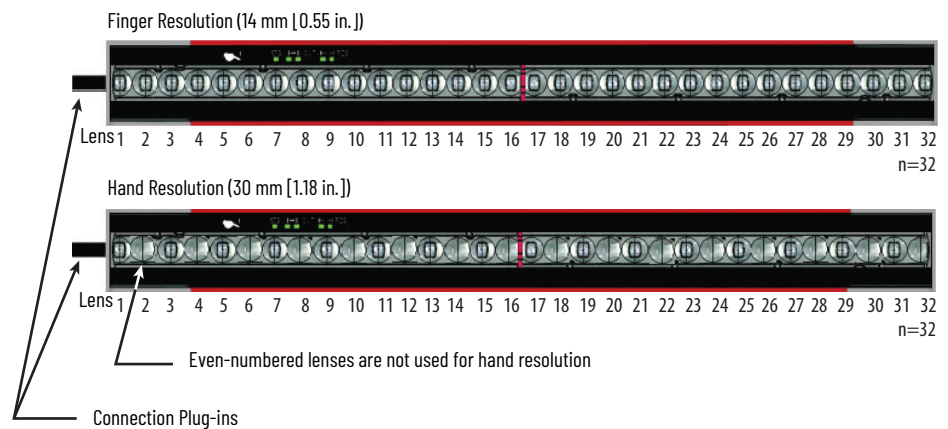
- Fixed blanking
- Floating blanking
- Reduced resolution blanking

Lens identification and zones help with the implementation of blanking.

Lens Identification

[Figure 126 on page 140](#) shows an example of the identification of the lenses for both finger and hand resolution for a light curtain that has a 300 mm (11.81 in.) height. Notice the following:

- Lens 1 is the lens closest to the connection plug-in (not the cascading plug-in). This arrangement is especially important for the hand resolution as lens 'n' is not used.
- Both resolutions have the name number of lenses.
- The even-numbered lenses of hand resolution are not used; the lens 'n' is not used.
- The Bulletin 450L safety light curtain transceivers are built on 16 lens segments; the number of lenses 'n' is a multiple of 16.

Figure 126 - Lens Identification Example - 300 mm (11.8 in.) Sensing Height

Zones

A zone is a range of lenses in the transceivers that are blanked with specific conditions. A maximum of eight zones can be specified. The zones must be used in order and must not be skipped. The lenses must be used in order, but lenses can be skipped. Each zone can be:

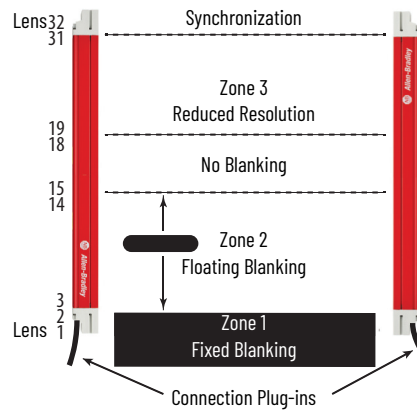
- Fixed blanking
- Floating blanking
- Reduced resolution blanking

The following rules apply to specifying zones:

- Zone definition begins with the lowest lens; the lens closest to the connection plug-in.
- Zones cannot overlap.
- Each zone must be a contiguous set of lenses.
- Each zone can be either fixed, floating, or reduced resolution.
- A non-blanking area is allowed between zones or at either end of the transceiver. This area is not considered a zone.
- Non-blanked areas can be assigned either 1) normal operation, 2) reduced resolution one object or 3) reduced resolution two objects.
- Only one of the synchronization beams can be blocked (either at the top or the bottom, but not both top and bottom).

[Figure 127 on page 141](#) shows an example with a finger resolution safety light curtain. Zone 1 applies fixed blanking (object always present and remains stationary) between lens 1 and 2. Zone 2 applies floating blanking (object can move but must always be present) between lens 3 and 14. Zone 3 applies reduced resolution between lens 19 and 30. Lenses 31...32 are used for synchronization, and normal operation (finger resolution) applies. The area from lens 15...18 is also normal operation (finger resolution).

Figure 127 - Three-zone Blanking Example - With Finger Resolution



Blanking settings

Reset Zone 1 to Zone 8 Teach blanking zones

Zone 1 Zone 2 Zone 3 Zone 4 Zone 5 Zone 6 Zone 7 Zone 8

Blanking type: Fixed Blanking

Zone defined from

minimum lens number 1

to maximum lens number 2

Object monitoring Enabled

Object size tolerance -1

Type of protection for regions outside blanked zones 1..8:

Normal operation

RULES

- Lens number counts from connection plug-in end.
- Max lens are calculated based on stick length, neglect whether the light curtain is finger/hand resolution.
- Zones could not be skipped.
- Object size >= Object tolerance size.

Apply the configuration would require a Light Curtain power cycle. Reconnect the OID from CCW accordingly.

OK Cancel Help

Blanking settings

Reset Zone 2 to Zone 8 Teach blanking zones

Zone 1 Zone 2 Zone 3 Zone 4 Zone 5 Zone 6 Zone 7 Zone 8

Blanking type: Floating Blanking

Zone defined from

minimum lens number 3

to maximum lens number 14

Object monitoring Enabled

Object size 2

Object size tolerance -1

Type of protection for regions outside blanked zones 1..8:

Normal operation

RULES

- Lens number counts from connection plug-in end.
- Max lens are calculated based on stick length, neglect whether the light curtain is finger/hand resolution.
- Zones could not be skipped.
- Object size >= Object tolerance size.

Apply the configuration would require a Light Curtain power cycle. Reconnect the OID from CCW accordingly.

OK Cancel Help

Blanking settings

Reset Zone 3 to Zone 8 Teach blanking zones

Zone 1 Zone 2 Zone 3 Zone 4 Zone 5 Zone 6 Zone 7 Zone 8

Blanking type: Reduced Resolution

Zone defined from

minimum lens number 19

to maximum lens number 31

Object monitoring Disabled

Number of object Single Object

Maximum Object size 1

Type of protection for regions outside blanked zones 1..8:

Normal operation

RULES

- Lens number counts from connection plug-in end.
- Max lens are calculated based on stick length, neglect whether the light curtain is finger/hand resolution.
- Zones could not be skipped.
- Object size >= Object tolerance size.

Apply the configuration would require a Light Curtain power cycle. Reconnect the OID from CCW accordingly.

OK Cancel Help

Configuration Options

On the configuration window, blanking has three types that can be selected when the Connected Components Workbench software is disconnected from the safety light curtain:

- Disable – blanking is not used
- Software configuration – configure for fixed, floating, or reduced resolution
- Push Button Teach-in – use the Teach command button on the Diagnose Window

Fixed Blanking

A fixed blanking zone is a set of lenses that has been configured to always expect an object to block the beams. The beams must always be blocked. A fixed zone that becomes unblocked causes the OSSD outputs of the light curtain receiver to turn OFF.

The Bulletin 450L-E safety light curtain accommodates changes in the set of lenses that can be blocked; this change is the object tolerance. The object tolerance can be set to zero (no lens tolerance) or to a negative number. The fixed blanking range can only be smaller by the tolerance number. A positive shift in the object size or location causes the OSSD outputs to turn OFF.

The Bulletin 450L-E safety light curtain uses the first or last beams for synchronization. If the first beam is blocked, then the last beam cannot be blocked. In contrast, if the last beam is blocked then the first beam cannot be blocked.

Settings

[Figure 128](#) shows the settings for Fixed Blanking for Zone 1. Up to eight zones can be configured for fixed blanking or other types of blanking. The Teach Blanking Zones is enabled for fixed blanking. [Table 64 on page 143](#) describes the blanking settings. Select the values appropriate for the application.

Reset Zone 1 to Zone 8 – Click to clear the settings of the specified zones. The specified zones are a range from the selected zone to Zone 8.

Figure 128 - Fixed Blanking Settings

Blanking settings

Reset Zone 1 to Zone 8 Teach blanking zones

Zone 1 Zone 2 Zone 3 Zone 4 Zone 5 Zone 6 Zone 7 Zone 8

Blanking type: Fixed Blanking

Zone defined from

minimum lens number 1

to maximum lens number 5

Object monitoring Enabled

Object size tolerance -2

Type of protection for regions outside blanked zones 1..8:

Normal operation

RULES

- Lens number counts from connection plug-in end.
- Max lens are calculated base on lens, neglect whether the light curtain is finger/hand resolution.
- Zones could not be skipped.
- Object size >= Object tolerance size.

Apply the configuration would require a Light Curtain power cycle. Reconnect the OID from CCW accordingly.

OK Cancel

Table 63 - Fixed Blanking Settings

Setting	Description
Blanking type	Select Fixed Blanking.
Minimum lens number	This number is the first lens, closest to the connection plug-in that participates in the range of lenses.
Maximum lens number	This number is the last lens that participates in the range of lenses.
Object monitoring	Always enabled for fixed blanking.
Object size tolerance	The light curtain allows the object size to be smaller by 0, 1, or 2 lenses for finger resolution and 0 or 1 (where 1 = 2 lenses) for hand resolution. Select the number of lenses that accommodate the variation in the fixed object height and location.
Outside blanked zones	Select normal operation, reduced resolution one object, or reduced resolution two objects for the other zones.

Fixed Blanking Rules

[Table 64](#) shows the rules for fixed blanking within a zone. The Connected Components Workbench software automatically enforces these blanking rules. Since the transceiver sticks are synchronized with either the first or last lens, only one end of the stick can be blocked (not both ends).

Table 64 - Fixed Blanking Rules

Resolution	Object Size Tolerance	Include/Exclude Lens 1	Min Lens Value	Max Lens Value	Rules
Finger (14 mm [0.55 in.])	0	Include	1	2,3,4...n-1	Since lens 1 is blanked, the last lens cannot be blanked. Max lens must be greater than min lens.
		Exclude	3,4,5...n	4,5,6...n	Since lens 1 is not blanked, lens 2 cannot be blanked. Max lens must be greater than min lens. Special case: Min lens and max lens can be n simultaneously.
	-1	Include	1	2,3,4...n-1	Since lens 1 is blocked, the last lens cannot be blocked. Max lens must be greater than min lens.
		Exclude	3,4,5...n	4,5,6...n	Max lens must be greater than min lens. Special case: Min lens and max lens can be n simultaneously.
	-2	Include	1	5,6,7...n-1	Since lens 1 is blanked, the last lens cannot be blanked. Max lens must be greater than min lens by a value of 4.
		Exclude	3,4,5...n-3	6,7,8...n	Since lens 1 is not blanked, Lens 2 cannot be blanked. Max lens must be greater than min lens by a value of 3.
Hand (30 mm [1.18 in.])	0	Include	1	3,5,7...n-1	Since lens 1 is blanked, the last lens cannot be blanked. Max lens must be an odd number and greater than the min value.
		Exclude	4,6,8...n	5,7,9...n-1	Min lens must be an even number equal to or greater than 4. Max lens must be an odd number greater than the min lens.
	-1	Include	1	3,5,7...n-3	Since lens 1 is blocked, the last lens cannot be blocked. Max lens must be an odd number greater than min lens.
		Exclude	4,6,8...n-2	7,9...n-1	Min lens must be an even number equal to or greater than 4. Max lens must be an odd number greater than the min lens by a value equal to or greater than 3. Special case: Min lens and max lens can be n simultaneously.

Proceed to [Download and Upload Configurations on page 153](#).

Teach Blanking Zones

The Connected Components Workbench software can learn new arrangements of fixed blanking. To learn new arrangements, it reads the beams, stores the new setting in a project, and then transfers the new settings down to the safety light curtain. Follow this process:

1. Arrange the fixed object within the safety light curtain field.
2. Connect the Connected Components Workbench software to the safety light curtain.
3. Teach the Connected Components Workbench software the new settings.

4. Download the new settings to the safety light curtain.
5. Upload and confirm (lock) the new settings.

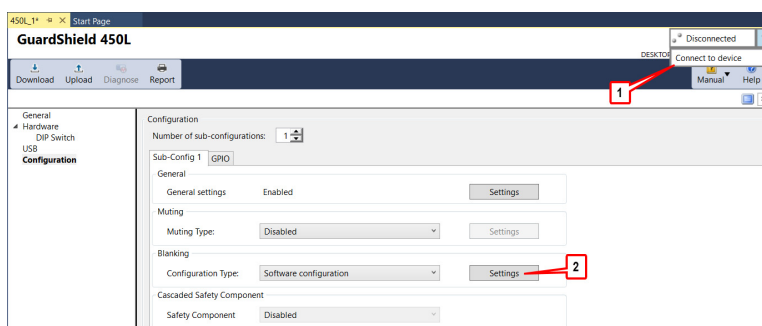
Process Details

Place only the fixed objects in the light curtain field. The object can be singular or multiple fixed objects can be within the light curtain field. Mount the Optical Interface Device onto the receiver. Connect the USB cable from computer with the Connected Components Workbench software to the Optical Interface Device. Turn on power to the light curtain.

[Figure 129](#) starts the process by connection to the safety light curtain.

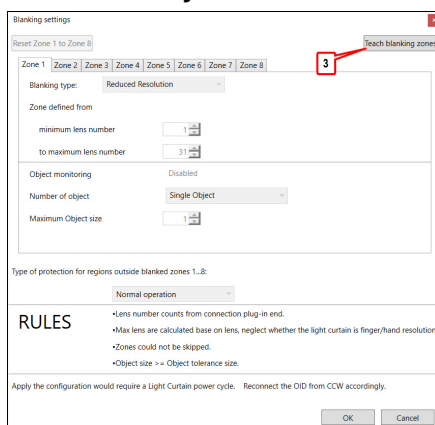
1. Click Connect to Device. Wait for the connection to be made. When the connection is made, Diagnose becomes enabled, and Download and Upload become disabled.
2. Click Blanking Settings. The Blanking configuration type is not relevant.

Figure 129 - Connect to Device



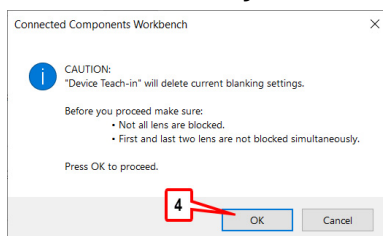
3. [Figure 130](#) shows the Blanking settings. Teach is enabled. Click Teach Blanking Zones.

Figure 130 - Teach Blanking Zones



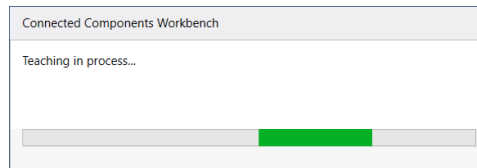
4. [Figure 131](#) shows the caution message that allows you to cancel if necessary. After reading the message, click OK.

Figure 131 - Delete Current Settings



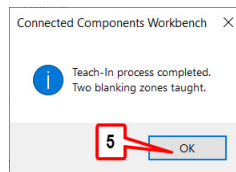
[Figure 132](#) shows the teaching in process window. If the safety light curtain is configured for automatic start, the OSSD outputs are ON. The OSSD outputs momentarily turn OFF and then back ON during the teaching process.

Figure 132 - Teaching in Process



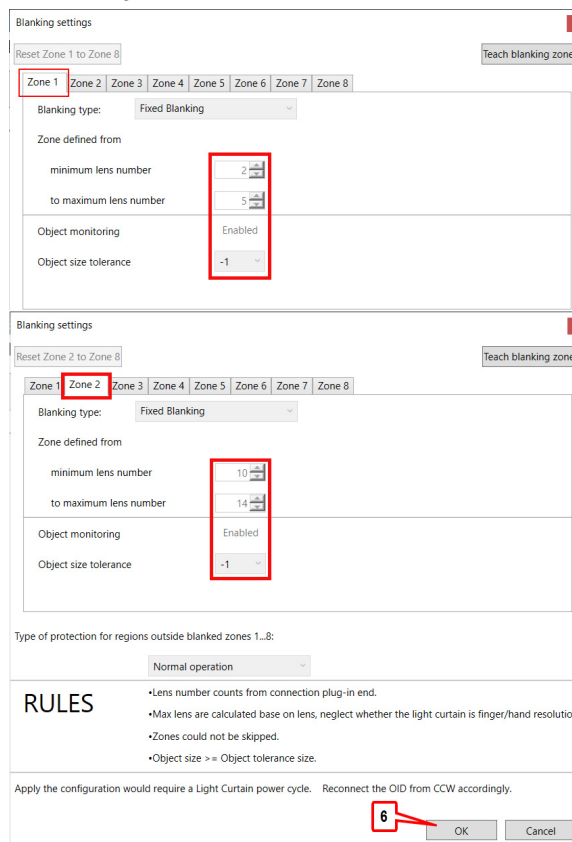
5. [Figure 133](#) shows that the teach-in process is complete. When completed, the Connected Components Workbench software generates a message and describes how many blanking zones were taught. Click OK.

Figure 133 - Teach-In Process Completed



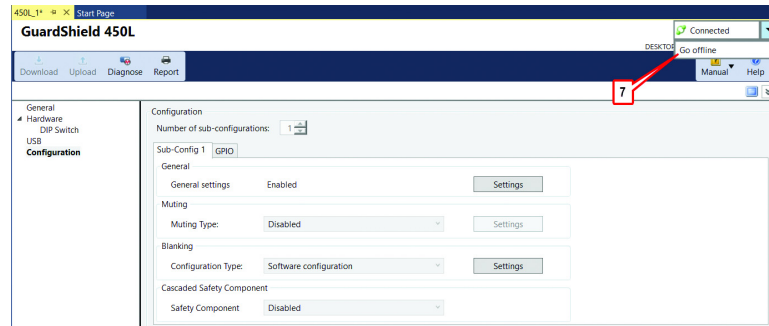
6. [Figure 134](#) shows the learned blanking settings. Review the settings in each zone. The settings cannot be changed in the Connected Components Workbench software, but the setting can be relearned by clicking the Teach blanking zones again. In this example, two zones have fixed blanking. The Connected Components Workbench software has learned the new settings. Click OK.

Figure 134 - Blanking Zone Review



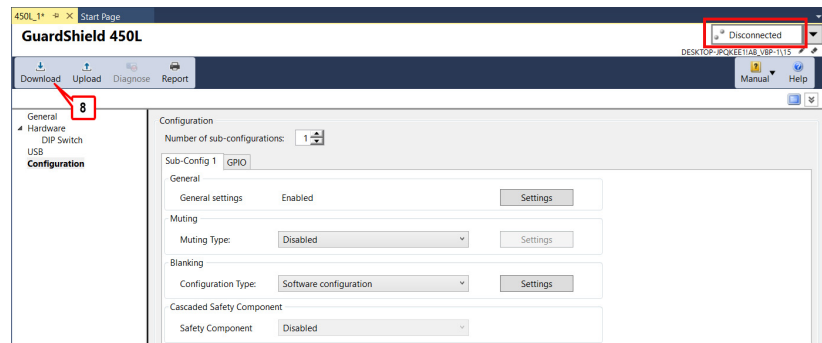
7. In [Figure 135 on page 146](#), click Go Offline to disconnect the Connected Components Workbench software from the safety light curtain.

Figure 135 - Go Offline



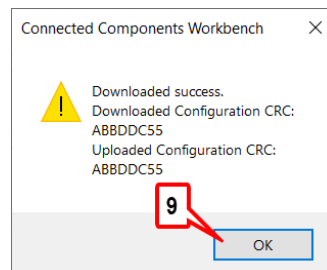
8. In [Figure 136](#), click Download with the safety light curtain disconnected. The OSSD outputs turn OFF while the new configuration is being downloaded.

Figure 136 - Download



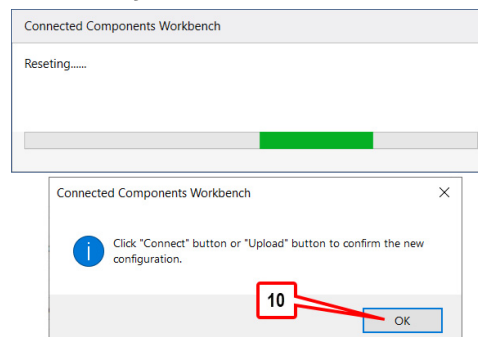
9. In [Figure 137](#), the download was a success. The downloaded and uploaded CRC values are the same. Click OK.

Figure 137 - Download Success



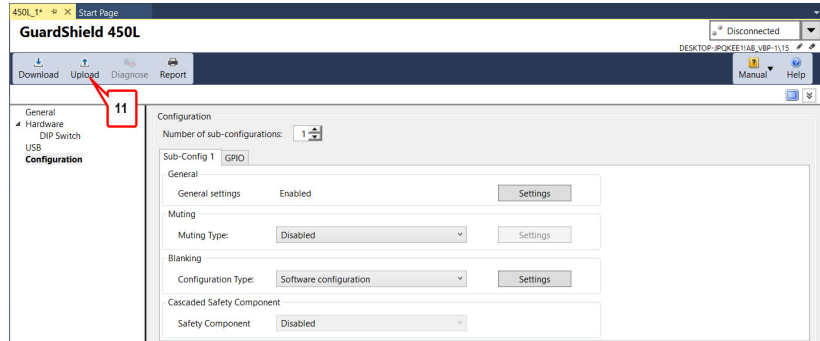
10. In [Figure 138](#), the Connected Components Workbench software resets. After resetting, the Connected Components Workbench software is disconnected from the safety light curtain, and the message box instructs you to click Upload or Connect to confirm the new configuration. On the safety light curtain, the status indicator is flashing red and green. The OSSD outputs are OFF. The Blanking indicator is OFF. Click OK.

Figure 138 - Resetting



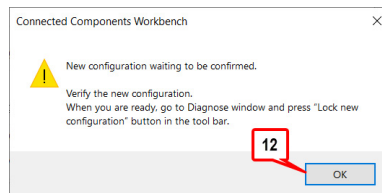
11. In [Figure 139](#), click Upload. This step uploads the configuration from the safety light curtain back into the Connected Components Workbench software, so the new configuration can be confirmed.

Figure 139 - Upload



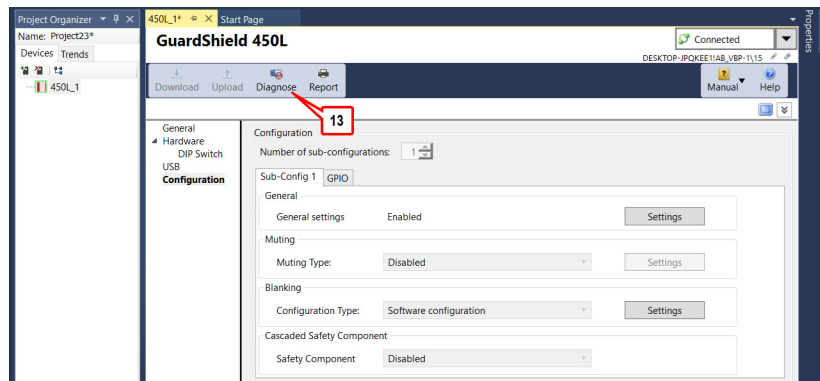
12. In [Figure 140](#), the new configuration is waiting to be confirmed. Instructions are provided in the message to confirm the configuration. Click OK.

Figure 140 - New Configuration Waiting to be Confirmed



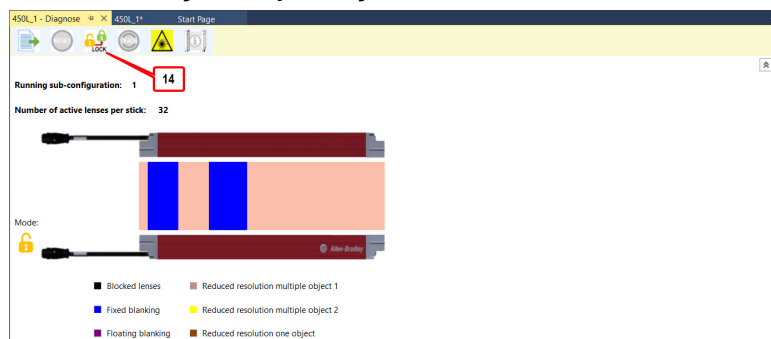
13. In [Figure 141](#), click Diagnose.

Figure 141 - Diagnose



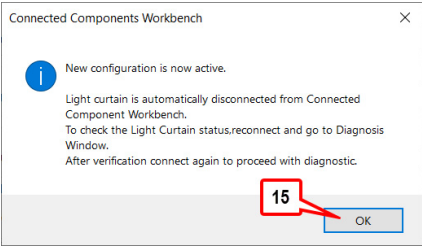
14. In [Figure 142](#), click Lock to confirm the configuration. The safety light curtain cycles power, and the new configuration is ready for use.

Figure 142 - Confirm Configuration by Locking



15. [Figure 143](#), the configuration is now active. Click OK.

Figure 143 - New Configuration Is Now Active



Floating Blanking

Floating blanking allows an object to move within the specified lens range without causing the light curtain OSSD outputs to turn off. The safety light curtain monitors the presence of the blanking; therefore, the object must always be within the specified lens range. If the object height is less than the minimum or more than the maximum number of lenses, the safety light curtain outputs turn OFF.

Settings

[Figure 144](#) shows the settings for Floating Blanking. Up to eight zones can be configured for floating blanking. The Teach Blanking Zones are disabled for floating blanking. [Table 65](#) describes the settings. Select the values appropriate for the application.

Figure 144 - Floating Blanking Settings

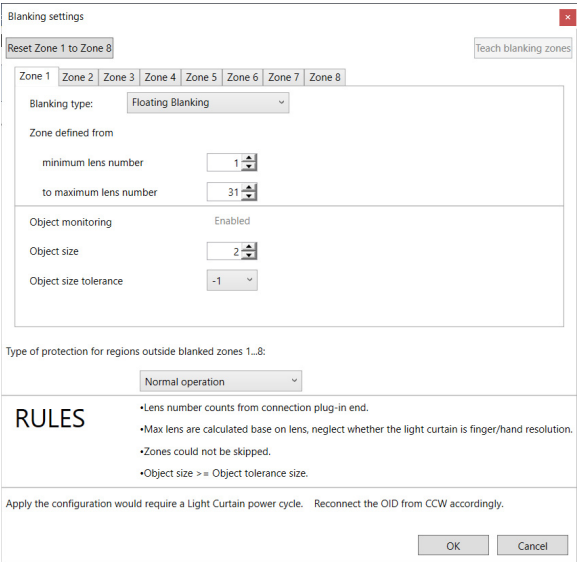


Table 65 - Floating Blanking Settings

Setting	Description
Blanking type	Select Floating Blanking.
Minimum lens number	This setting is the first that participates in the range of lenses.
Maximum lens number	This setting is the last lens that participates in the range of lenses.
Object monitoring	Always enabled for floating blanking.
Object size	Select the number of lenses typically blocked by the object. The number is subject to certain rules (see Table 66).
Object size tolerance	The safety light curtain allows the object size to be smaller by either 1 or 2 lenses for finger resolution and 1 lens for hand resolution. Select the number of lenses that accommodate the variation in object size. The number is subject to certain rules (see Table 66).
Other zones	Select normal operation, reduced resolution one object, or reduced resolution two objects for the other zones.

Floating Blanking Rules

[Table 66](#) shows the rules for floating blanking for the minimum object size. The Connected Components Workbench software enforces these blanking rules automatically. Since the transceiver sticks are synchronized with either the first or last beams, only one end of the stick can be blocked (not both ends).

Table 66 - Floating Blanking Rules

Resolution	Object Size (Min)	Object Size Tolerance	Include/Exclude Lens 1	Min Lens Value	Max Lens Value	Rules
Finger (14 mm [0.55 in.])	2	-1	Include	1	6,7,8...n-1	Since lens 1 is blanked, the last lens cannot be blanked. Max lens must be at least equal to or greater than min lens by a value of 5.
			Exclude	3,4,5...n-5	8,9,10...n	Since lens 1 is not blanked, lens 2 cannot be blanked. Max lens must be at least equal to or greater than min lens by a value of 5.
	3	-2	Include	1	7,8,9...n-1	Since lens 1 is blanked, the last lens cannot be blanked. Max lens must be at least equal to or greater than min lens by a value of 6.
			Exclude	3,4,5...n-6	9,10,11...n	Since lens 1 is not blanked, lens 2 cannot be blanked. Max lens must be at least equal to or greater than min lens by a value of 6.
Hand (30 mm [1.18 in.])	4	-1	Include	1	13, 15...n-3	Since lens 1 is blanked, the last lens cannot be blanked. Max lens must be an odd number at least equal to or greater than the min lens by a value of 12.
			Exclude	4,6,8...n-8	15,17...n-1	Since lens 1 is not blanked, lens 2 cannot be blanked. Min lens number must be an even number with a value at least equal or greater than 4. Max lens must be an odd number at least equal to or greater than min lens by a value of 11.

Object Height

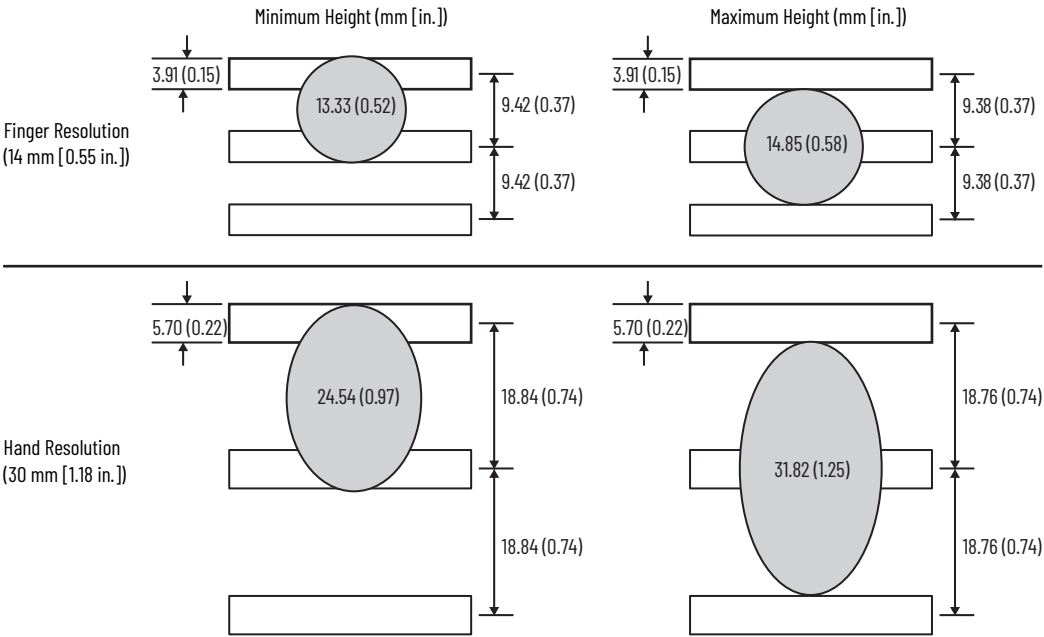
[Table 67 on page 150](#) shows the formulas for calculating the minimum and maximum object height. The height of the object must be maintained between the minimum and maximum values for the OSSD outputs to remain ON.

[Figure 145 on page 150](#) shows an example of a maximum object size selection of 2 and tolerance of -1 for both finger and hand resolution. For finger resolution, the beam width is 3.91 mm (0.15 in.). The worst-case tolerance of beam spacing is 9.42 mm (0.37 in.) for minimum and 9.38 mm (0.37 in.) for maximum. An object that has a height larger than 13.33 mm (0.52 in.) and less than 14.85 mm (0.58 in.) does not cause the OSSD outputs to turn OFF. If the object height falls below 13.33 mm (0.52 in.) or exceeds 14.85 mm (0.58 in.), the OSSD outputs turn OFF.

Table 67 - Object Height Formulas

Resolution	Max/Min	Formula
Finger (14 mm [0.55 in.])	Min	Min object height is $> (\text{Object Size} + \text{Object Size Tolerance}) \times 9.42 + 3.91$ Example with Object Size = 2 and Tolerance = -1 $>(2 - 1) \times 9.42 + 3.91$ $>13.33 \text{ mm (0.52 in.)}$
	Max	Max object height is $< \text{Object Size} \times 9.38 - 3.91$ Example with Object Size = 2 $<2 \times 9.38 - 3.91$ $<14.85 \text{ mm (0.58 in.)}$
Hand (30 mm [1.18 in.])	Min	Min object height is $> (\text{Object Size} + \text{Object Size Tolerance}) \times 18.84 + 5.70$ Example with Object Size = 2 and Tolerance = -1 $>(2 - 1) \times 18.84 + 5.70$ $>24.54 \text{ mm (0.97 in.)}$
	Max	Max object height is $< \text{Object Size} \times 18.76 - 5.70$ Example with Object Size = 2 $<2 \times 18.76 - 5.70$ $<31.82 \text{ mm (1.25 in.)}$

Figure 145 - Object Height Example - Object Size = 2, Object Tolerance = -1



Reduced Resolution Blanking

Reduced resolution is similar to floating blanking with this exception: The object does not need to be in the reduced resolution zone. Reduced resolution blanking is not monitored blanking.

Settings

[Figure 146 on page 151](#) shows the setting for reduced resolution blanking. [Table 68 on page 151](#) describes the settings.

Figure 146 - Reduced Resolution Settings

Table 68 - Reduced Resolution Settings

Setting	Description
Blanking type	Select Reduced Resolution.
Minimum lens number	This setting is the first lens that participates in the range of lenses.
Maximum lens number	This setting is the last lens that participates in the range of lenses.
Object monitoring	Always disabled for reduced resolution.
Number of objects	Select single or multiple objects. Single - The height of the single object must be less than the maximum object size. Multiple - The sum of the heights of all objects must be less than the maximum object size.
Maximum object size	Select the maximum height of the object or objects. The height is subject to certain rules (see Object Height on page 152).
Other zones	Select normal operation, reduced resolution one object, or reduced resolution two objects.

Reduced Resolution Blanking Rules

[Table 69 on page 152](#) shows the rules for reduced resolution blanking. The Connected Components Workbench software enforces these blanking rules automatically. Since the transceiver sticks are synchronized with either the first or last lens, only one end of the stick can be blocked (not both ends).

Table 69 - Reduced Resolution Rules

Resolution	Object Size, Max	Include/Exclude Lens 1	Lens Value, Min	Lens Value, Max	Rules
Finger (14 mm [0.55 in.])	1...31	Include	1	5...n-1	Since lens 1 is blanked, the last lens cannot be blanked. Max Object Size <= Max Lens - Min Lens - 3 Examples: Max Object Size = 1 and Min = 1, then Max = 5...n-1 Max Object Size = 4 and Min = 1, then Max = 8...n-1
		Exclude	3	n	Since lens 1 is not blanked, lens 2 cannot be blanked. Max Object Size <= Max Lens - Min Lens - 3 Examples: Max Object Size = 1 and Min = 3, then Max = 7...n Max Object Size = 4 and Min = 5, then Max = 12...n
Hand (30 mm [1.18 in.])	2,4,6...n-12	Include	1	11,13,15...n-3	Since lens 1 is blanked, the last lens cannot be blanked. Max Object Size <= Max Lens - Min Lens - 8 Examples: Max Object Size = 2 and Min = 1, then Max = 11...n-3 Max Object Size = 4 and Min = 1, then Max = 13...n
		Exclude	4	13,15,17...n-1	Since lens 1 is not blanked, lens 3 cannot be blanked. Max Object Size <= Max Lens - Min Lens - 7 Examples: Max Object Size = 2 and Min = 4, then Max = 13...n-1 Max Object Size = 4 and Min = 6, then Max = 17...n-1

Object Height

Figure 147 shows an example of a maximum object size selection of two for both finger and hand resolution. For finger resolution, the beam width is 3.91 mm (0.15 in.), and the worst-case tolerance for beam spacing is 9.38 mm (0.37 in.). An object that has a height of 14.85 mm (0.58 in.) never blocks more than two beams. If the third beam is blocked, the OSSD outputs turn OFF. Therefore, the maximum height remains less than the formulas in Table 70 to avoid nuisance tripping.

Table 70 - Formulas for Max Object Height

Resolution	Formula
Finger (14 mm [0.55 in.])	Max object height is < Max Object Size Selection x 9.38 - 3.91 Example with Max Object Size = 2 < 2 x 9.38 - 3.91 < 14.85 mm (0.58 in.)
Hand (30 mm [1.18 in.])	Max object height is < Max Object Size Selection x 18.76 - 5.70 Example with Max Object Size = 2 < 2 x 18.76 - 5.70 < 31.82 mm (1.25 in.)

Figure 147 - Max Object Height Example (mm [in.])

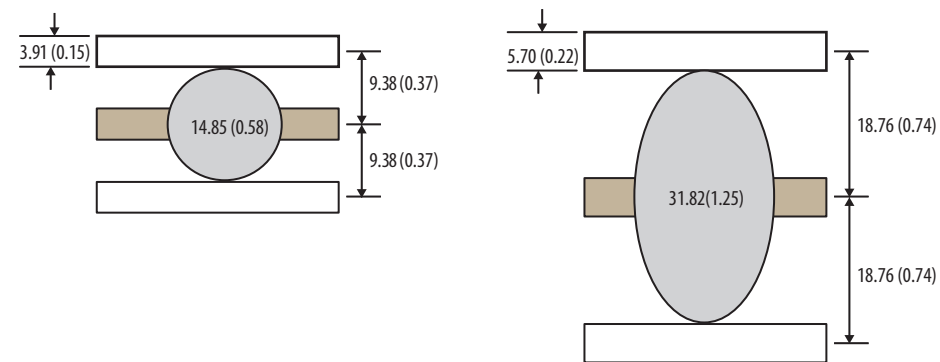


Table 71 on page 153 shows maximum object size for selections 1...10. Use the appropriate formula in Table 71 on page 153 for larger values.

Table 71 - Maximum Object Size Table

Select Maximum Object Size	If the object height is smaller than...	
	Finger Resolution [mm (in.)]	Hand Resolution [mm (in.)]
1	5.47 (0.22)	13.06 (0.51)
2	14.85 (0.58)	31.82 (1.25)
3	24.23 (0.95)	50.58 (1.99)
4	33.61 (1.32)	69.34 (2.73)
5	42.99 (1.69)	88.10 (3.47)
6	52.37 (2.06)	106.86 (4.21)
7	61.75 (2.43)	125.62 (4.95)
8	71.13 (2.80)	144.38 (5.68)
9	80.51 (3.17)	163.14 (6.42)
10	89.89 (3.54)	181.90 (7.16)

Download and Upload Configurations

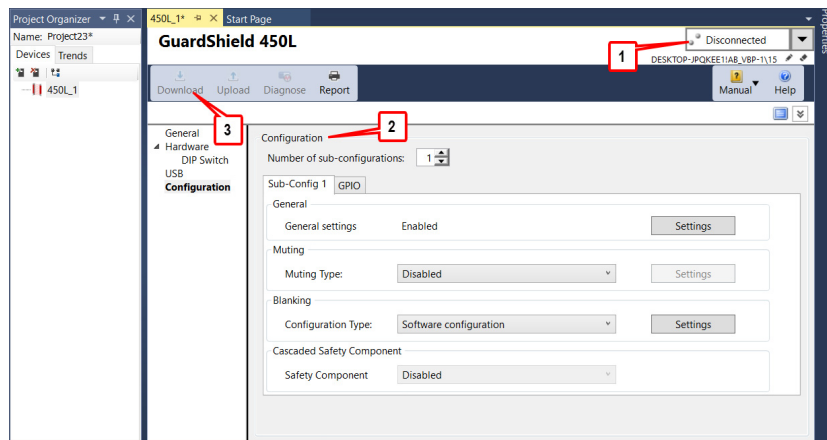
Three essential steps are required to change a configuration in the light curtain:

1. Download the project to the light curtain.
2. Upload the project from the light curtain.
3. Lock the configuration.

[Figure 148](#) starts the step-by-step process for changing the configuration in the light curtain.

1. Go offline (disconnected).
2. Complete the configuration.
3. Click Download.

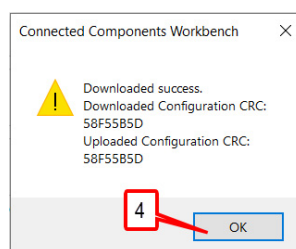
Figure 148 - Configure Light Curtain Offline



[Figure 149](#) shows that the download was a success. The downloaded and uploaded CRC are identical.

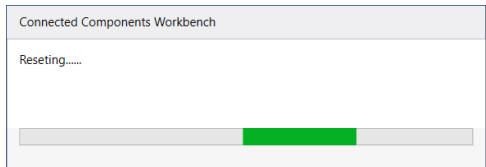
4. Click OK.

Figure 149 - Download Successful



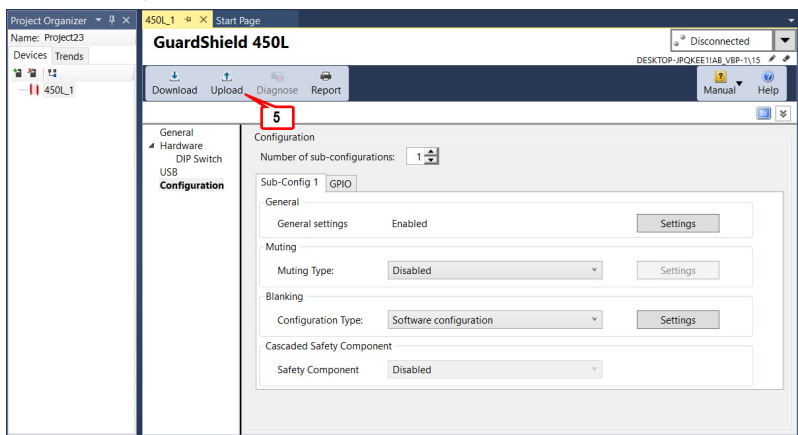
In [Figure 150](#), the Connected Components Workbench software generates a progress window during the resetting process.

Figure 150 - Resetting Progress



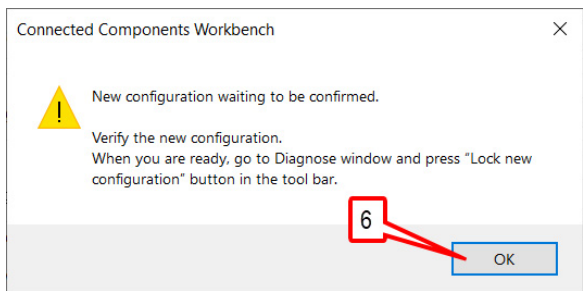
5. In [Figure 151](#), click Upload to transfer the project from the light curtain back to the Connected Components Workbench software.

Figure 151 - Upload Project into the Connected Components Workbench Software



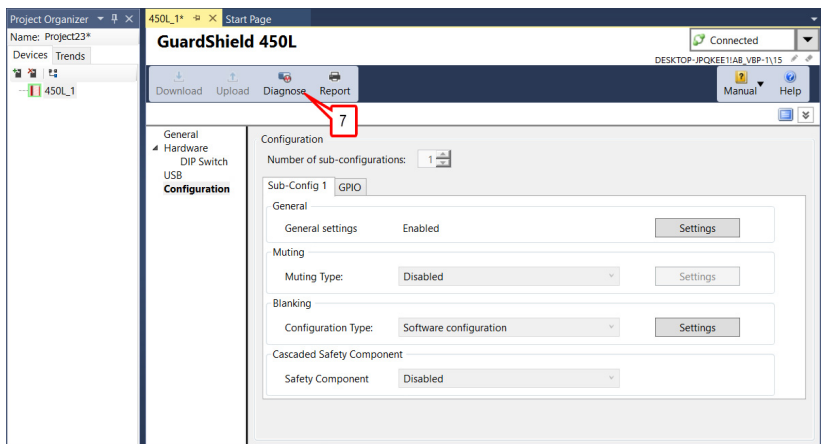
6. [Figure 152](#) shows the waiting to confirm message. Click OK.

Figure 152 - Waiting for Confirmation



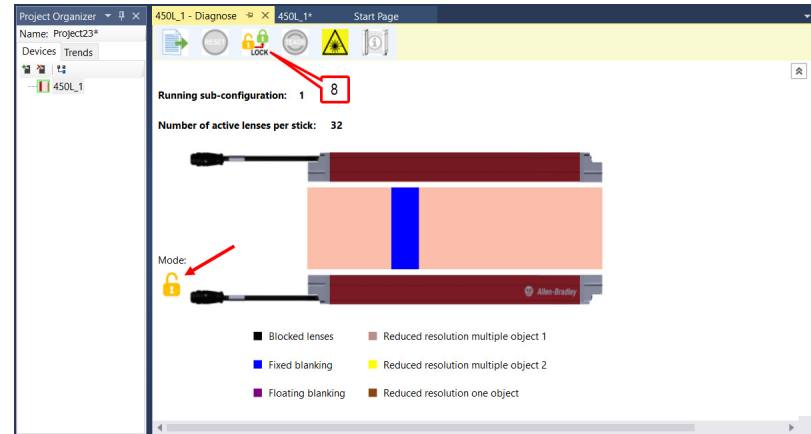
7. In [Figure 153](#), click Diagnose.

Figure 153 - Diagnose



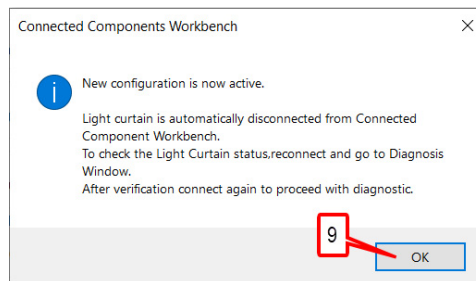
8. [Figure 154](#) shows the unlocked Mode icon. Click Lock.

Figure 154 - Lock to Confirm Configuration



9. In [Figure 155](#), the configuration is now active, and the safety light curtain is ready for use. Click OK.

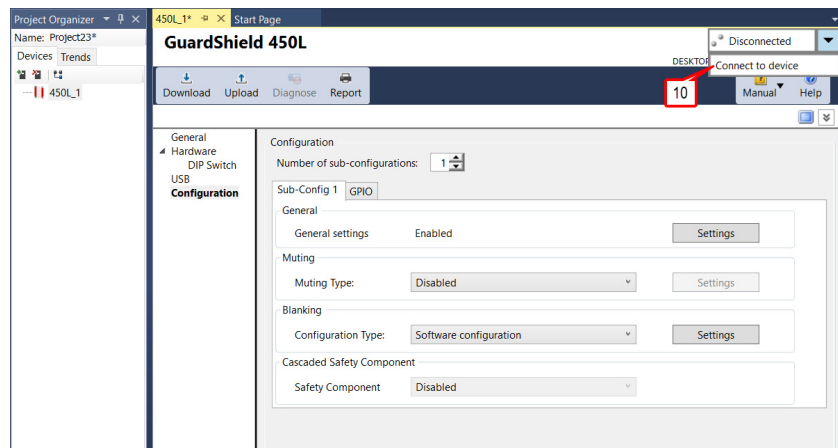
Figure 155 - Configuration Active



The following steps are optional. These steps can be used to monitor the performance of the safety light curtain through the Connected Components Workbench software.

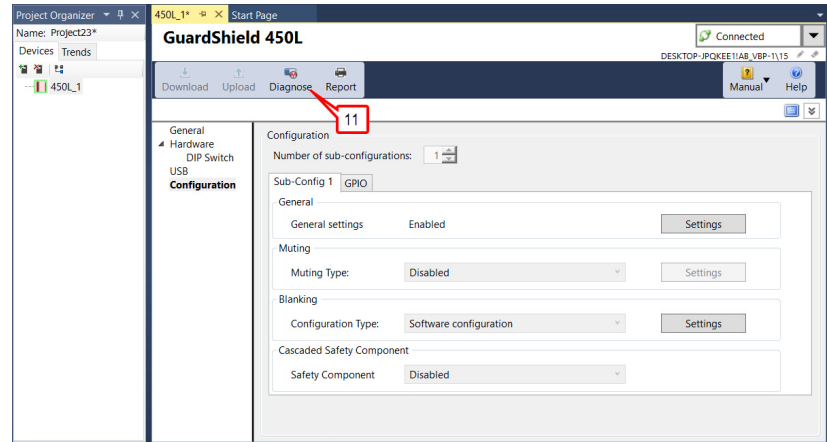
10. In [Figure 156](#), select Connect to device.

Figure 156 - Connect to Device



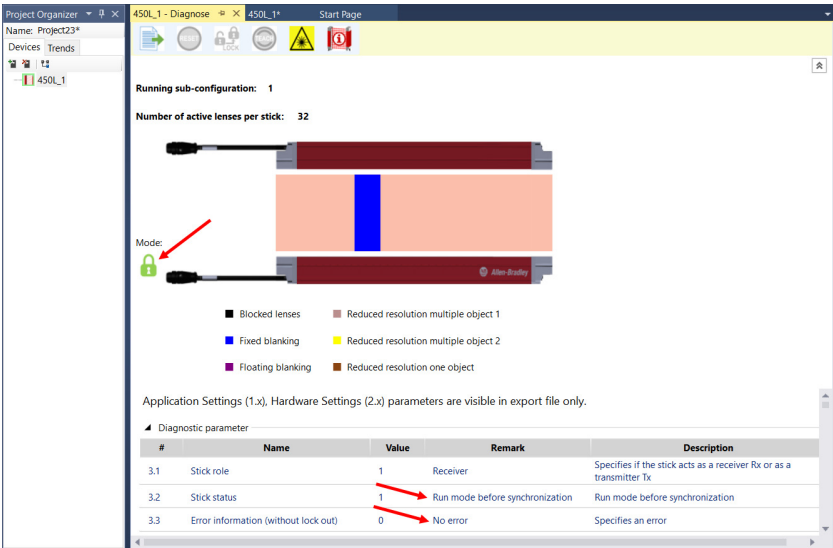
11. In [Figure 157](#), click Diagnose.

Figure 157 - Go to Diagnose Window



[Figure 158](#) shows the diagnostic window and the light curtain is locked in run mode with no errors.

Figure 158 - Run Mode



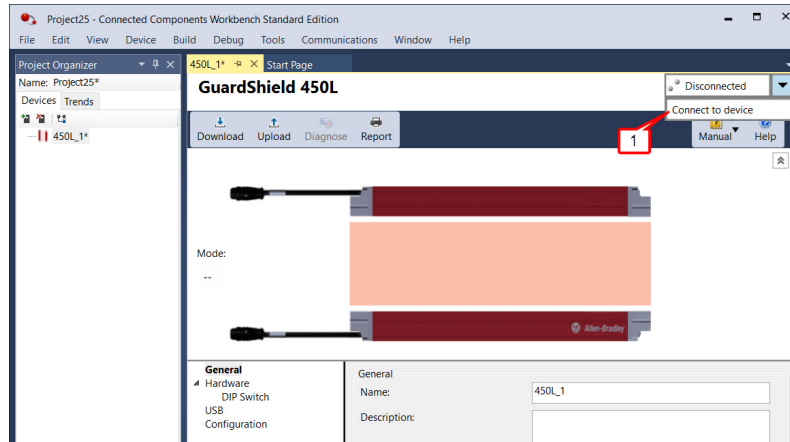
Change Hardware

The Connected Components Workbench software must know the actual hardware setup before downloading a new configuration. If the hardware is changed, for instance you add a cascading plug-in or change from a muting to a blanking plug-in, then the following steps synchronize the hardware with the Connected Components Workbench software.

After changing the hardware, apply power to the safety light curtain.

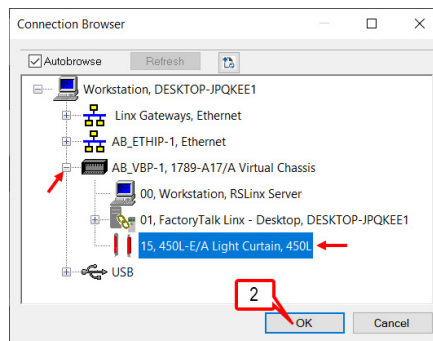
1. In [Figure 159](#), click Connect to device.

Figure 159 - Connect to Device



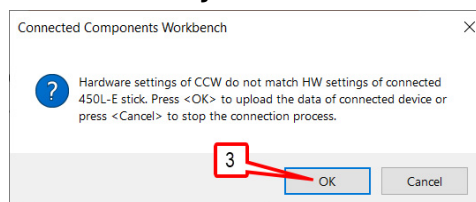
2. In [Figure 160](#), expand the AB_VPN-1 connection, click Bulletin 450L, and click OK.

Figure 160 - Connection Browser



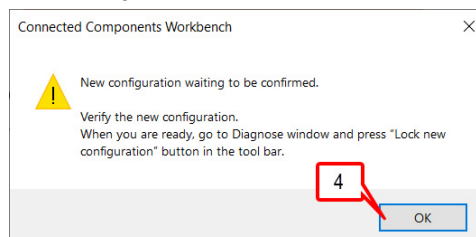
3. [Figure 161](#) shows that the hardware settings do not match. Click OK.

Figure 161 - Hardware Settings Do Not Match



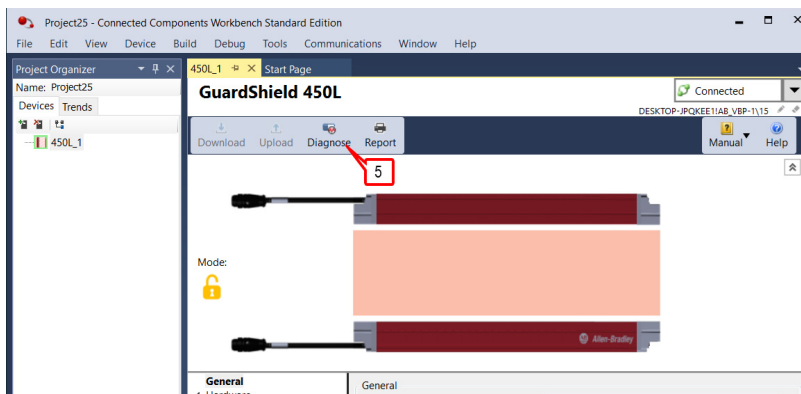
4. [Figure 162](#) shows the new configuration waiting to be confirmed. Click OK.

Figure 162 - Awaiting Confirmation



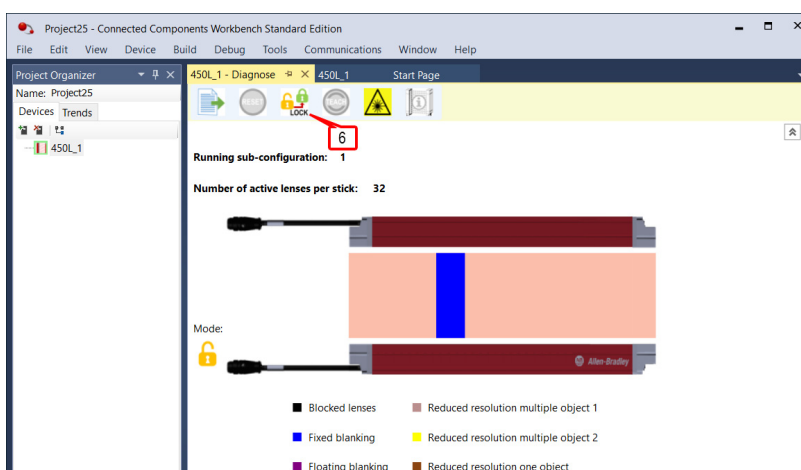
- In [Figure 163](#), click Diagnose.

Figure 163 - Diagnose



- In [Figure 164](#), click Lock.

Figure 164 - Lock



The safety light curtain can now be configured using the new hardware.

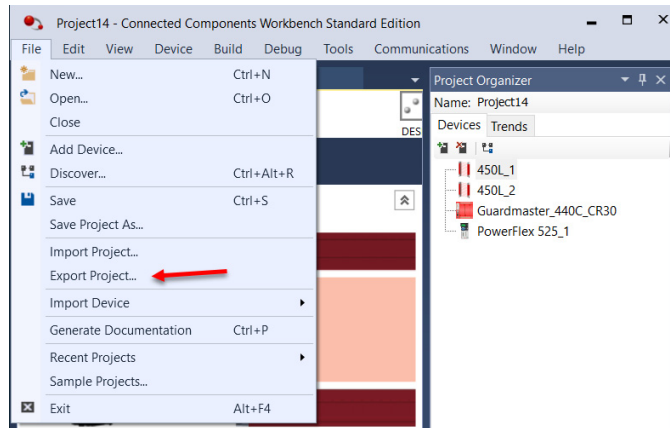
Share Your Project (Export/Import)

Projects and devices can be easily shared with other users by using the Import and Export routines. Complete projects can be exported to a Connected Components Workbench software archive file. Individual devices can be exported to a zip file.

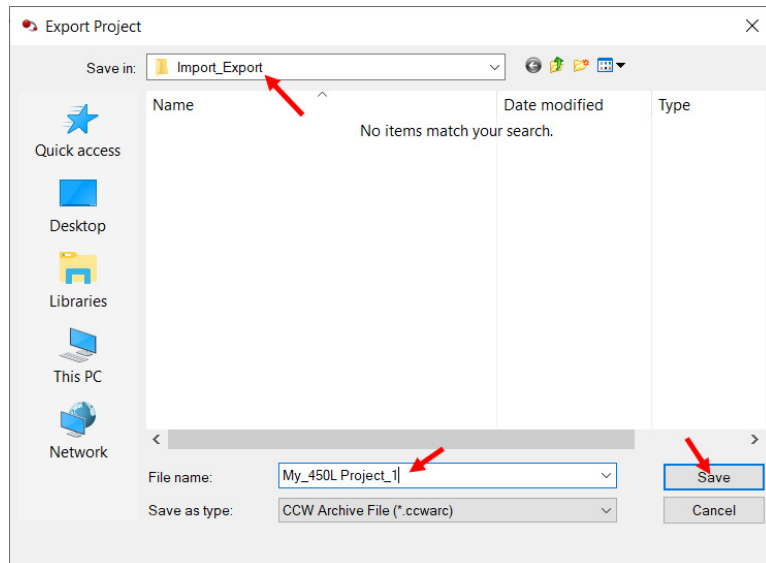
Export Project to a Connected Components Workbench Software Archive

- Select File > Export Project, as shown in [Figure 165 on page 159](#).

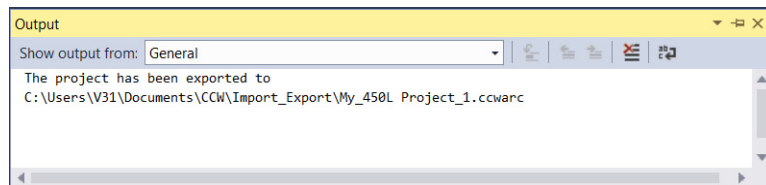
This approach creates a small file that can be imported into the Connected Components Workbench software. This method can be used when you have only one device or when multiple devices are included in one project. In [Figure 165 on page 159](#), all four devices are included in the archive file.

Figure 165 - File > Export Project

2. The Connected Components Workbench software exports the archive file in the default directory Import_Export, as shown in [Figure 166](#). Type in a filename and click Save. The only file type is *.ccwarc.

Figure 166 - Export Directory and Filename

3. The Connected Components Workbench software generates a confirmation and displays the message in the Output window, as shown in [Figure 167](#). The message shows the file path and filename.

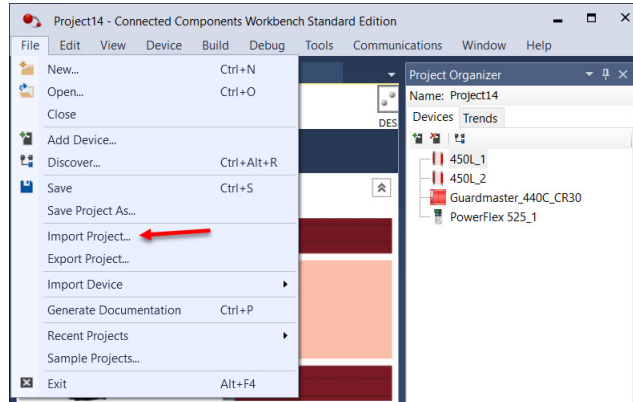
Figure 167 - Export Confirmation

Import Project from a Connected Components Workbench Software Archive

When an archive file is imported into the Connected Components Workbench software, the current project is closed, without saving, and replaced by the imported project.

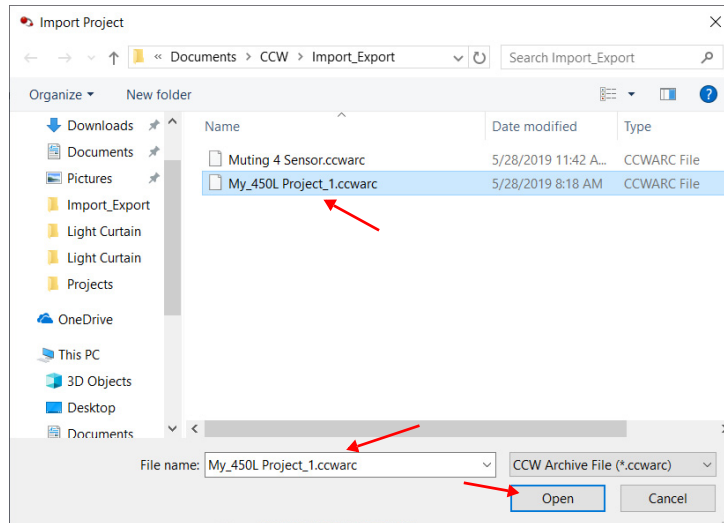
1. In [Figure 168](#), click File > Import Project on the main menu. The Connected Components Workbench software opens the default Import_Export directory.

Figure 168 - File > Import Project



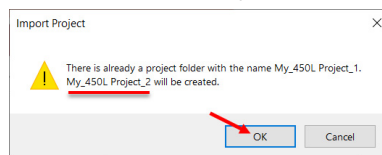
2. In [Figure 169](#), click the file that you want to import; the file type must be a CCWARC type of file. The name appears in the File name field. Click Open.

Figure 169 - Import Archive Filename



3. If the filename exists, the Connected Components Workbench software creates a project by incrementing a number at the end of the filename. As shown in [Figure 170](#), My_450L Project_2 is created. Click OK.

Figure 170 - Import as a New Project

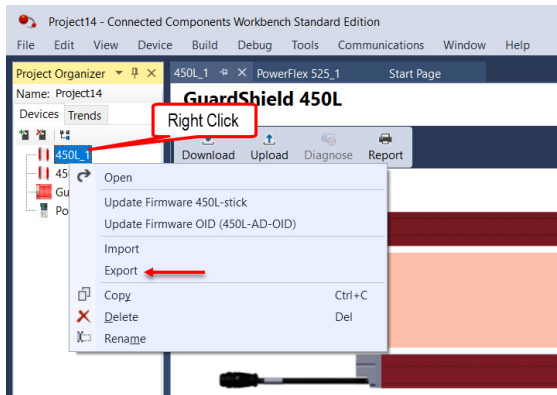


Export Device to Zip File

Use this method if you have multiple devices in one project and want to share the configuration of only one device. This approach creates a 7-Zip (free software) directory of files. After expanding the files, the files can be imported into the Connected Components Workbench software.

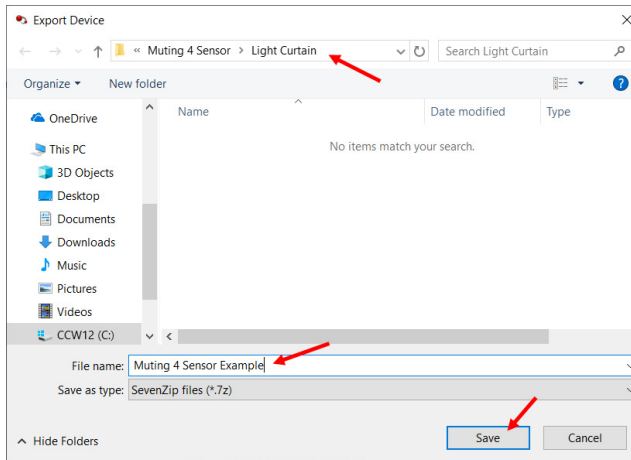
1. In [Figure 171](#), right-click the device in the Project Organizer and select export.

Figure 171 - Device > Export



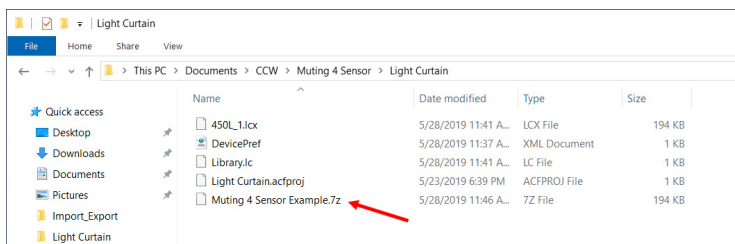
2. In [Figure 172](#), select the directory; type in a filename and click Save.

Figure 172 - Export to Zip File



3. The Connected Components Workbench software does not provide a confirmation message. To confirm the export, follow the export file path. [Figure 173](#) shows the single zipped file.

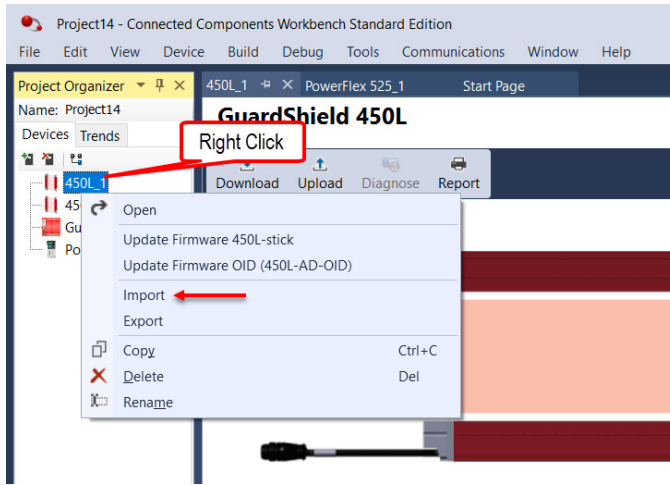
Figure 173 - Zip File Confirmation



Import a Zip File

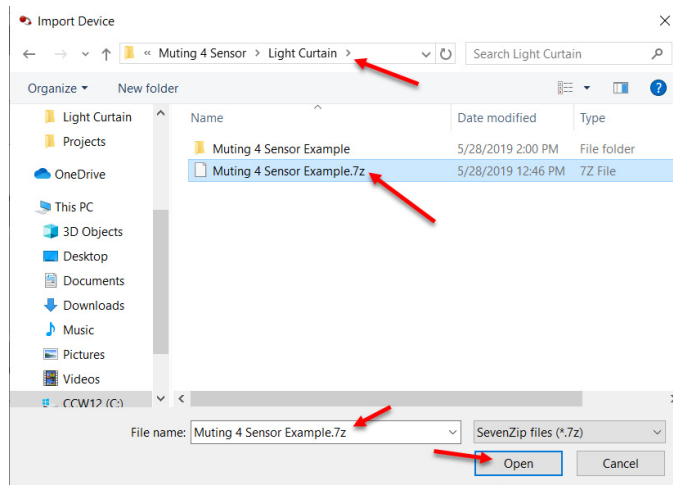
1. In [Figure 174](#), right-click the device in the Project Organizer. Then click Import. This process replaces the configuration of the selected device with the imported configuration.

Figure 174 - Device > Import



In [Figure 175](#), search for the directory that contains the desired file. The file type must be 7z. Highlight the filename and click Open. The configuration is imported into the selected Connected Components Workbench software device.

Figure 175 - Import a Zip File

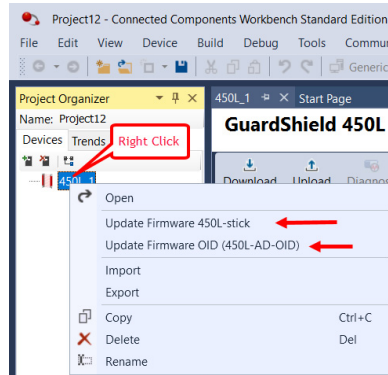


Update Firmware

Each release of the Connected Components Workbench software includes updated versions of the firmware. Both the Optical Interface Device and the light curtain contain firmware. The firmware can also be updated using ControlFLASH software.

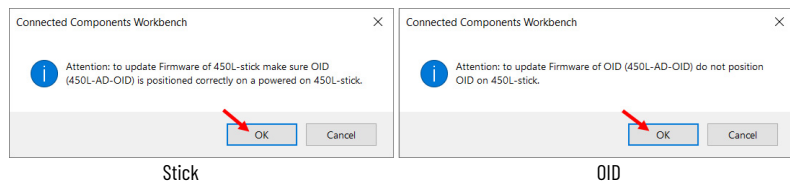
1. In the Project Organizer (see [Figure 176](#)), right-click the device name or its icon (450L_1). Then select either Update Firmware 450K-stick or Update Firmware OID (450L-AD-OID).

Figure 176 - Project Organizer: Device > Update Firmware



2. Follow the instructions in the message box (see [Figure 177](#)). If you are updating the firmware in the OID, then the OID must not be mounted on the light curtain. If you are updating the firmware in the light curtain, then the OID must be mounted on the light curtain with the light curtain powered. Click OK.

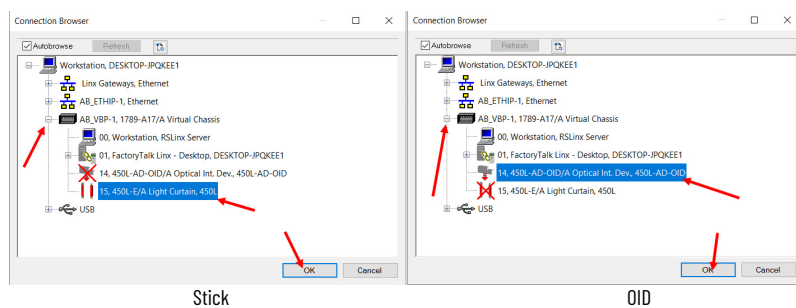
Figure 177 - Stick or OID Connection



[Figure 178](#) shows the Connection Browser with connections to the Stick and the OID.

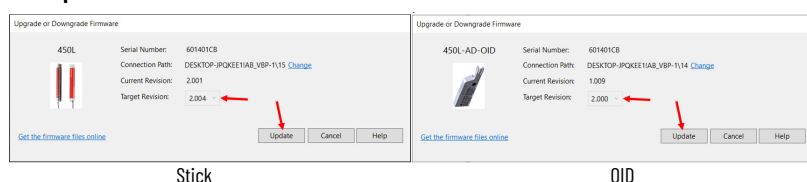
3. In the Connection Browser, expand the AB_VBP-1. Both the OID and the safety light curtain are shown. One of the two always have an X over its icon. If you are updating the safety light curtain, the OID is not available. If you are updating the OID, the safety light curtain is not available. Click the Bulletin 450L to select it. Click OK.

Figure 178 - Connection Browser

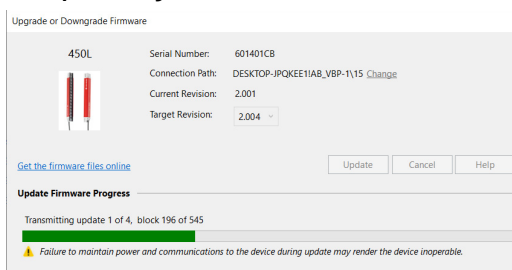


4. In [Figure 179](#), verify the target revision or select a revision from the pull-down menu and click Update.

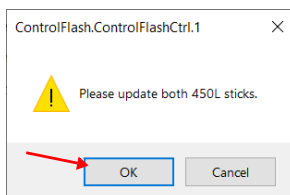
Figure 179 - Update Hardware



Progress of the update is shown on [Figure 180](#) on page 164.

Figure 180 - Update Progress Bar

5. [Figure 181](#) shows a courtesy message. If you are updating the sticks, you must update both sticks. Click OK.

Figure 181 - Update Both Sticks

If both sticks are powered and properly aligned, both sticks are updated simultaneously. If both sticks are slightly misaligned, the update can fail. If your update fails, block the top and bottom synchronization beams and update the sticks individually.

Best practice is to mount the OID on the other stick. Check the revision. If the current revision is not the same as the target revision, then repeat the update procedure.

Specifications

This appendix provides the specifications for 450L-B and 450L-E safety light curtains.

Safety Ratings

Table 72 - Safety Ratings

Attribute	Value
Standards	IEC 61508, EN/ISO 13849-1, IEC 62061, UL 508 (see rok.auto/certifications for the latest Declaration of Conformity)
Safety classification	Type 4 according to IEC 61496-1/-2 Up to PLe (Category 4) per ISO 13849-1, SIL 3 per IEC 61508 SIL CL 3 per IEC 62061 Laser alignment of 450L-E safety light curtain: Laser class 2 according to IEC 60285-1.
Functional safety data	450L-B; Pair (including any connection plug-in) <ul style="list-style-type: none"> • PFHD: $12.7 \cdot 10^{-9}$ • Mission time/PTI: 20 years • Mode of operation: High demand mode 450L-E; Pair (including any connection plug-in) <ul style="list-style-type: none"> • Pair: PFHD: $12.7 \cdot 10^{-9}$ • Cascading plug-in PFHD: $0.96 \cdot 10^{-9}$ • Mission time/PTI: 20 years • Mode of operation: High demand mode 450L PAC; Pair (including any connection plug-in) <ul style="list-style-type: none"> • 1-beam pair: $2.44 \cdot 10^{-9}$ • 2-beam pair: $3.87 \cdot 10^{-9}$ • 3-beam pair: $4.81 \cdot 10^{-9}$ • 4-beam pair: $5.27 \cdot 10^{-9}$ • Cascading plug-in PFHD: $0.96 \cdot 10^{-9}$ • Mission time/PTI: 20 years • Mode of operation: High demand mode

Operating Characteristics

Table 73 - Operating Characteristics

Attribute	Value
Switch function	OSSDs enable (on, high, 24V DC) when protective field not interrupted
Protective field length	150...1950 mm (5.91...76.77 in.) in 150 mm (5.91 in.) increments
Resolution	Finger: 14 mm (0.56 in.); Hand: 30 mm (1.19 in.) or PAC (Perimeter)
Number of active lenses (see Figure 11 on page 23)	Finger: 16 per 150 mm (5.91 in.) increment; Hand: 8 per 150 mm (5.91 in.) increment
Operating range	450L-B: <ul style="list-style-type: none"> • Resolution 14 mm (0.56 in.): 0.5...4 m (1.64...13.12 ft) • Resolution 30 mm (1.19 in.): 0.9...7.0 m (2.95...22.97 ft) • Reduced operating range (selected with DIP switch): <ul style="list-style-type: none"> - Resolution 14 mm (0.56 in.): 0.9...2 m (2.95...6.56 ft) - Resolution 30 mm (1.19 in.): 1.2...3.5 m (3.94...11.48 ft) 450L-E and 450L PAC ⁽¹⁾ <ul style="list-style-type: none"> • Resolution 14 mm (0.56 in.): 0.5...9 m (1.64...29.53 ft) • Resolution 30 mm (1.19 in.): 0.9...16.2 m (2.95...53.15 ft) • Reduced operating range (selected with DIP switch): <ul style="list-style-type: none"> - Resolution 14 mm (0.56 in.): 0.9...4.5 m (2.95...14.76 ft) - Resolution 30 mm (1.19 in.): 1.2...8.0 m (3.94...26.25 ft)

Table 73 - Operating Characteristics (Continued)

Attribute	Value
Response time	450L-B <ul style="list-style-type: none"> • OSSD - ON to OFF • Finger resolution <25 ms • Hand resolution < 15 ms (for details see Response Time on page 47) 450L-E <ul style="list-style-type: none"> • OSSD - ON to OFF (no blanking, muting, beam coding, or cascading functionality configured) • Finger resolution <20 ms • Hand resolution <13 ms (for detail see Response Time on page 47) 450L PAC <ul style="list-style-type: none"> • OSSD - ON to OFF (no muting, beam coding, or cascading functionality configured) • <20 ms (for detail see Response Time on page 47)
Power up time, max	5 s
OSSD restart time after clearance of the protective field if automatic reset	210 ms (see Response Time on page 47)
Power Supply	24V DC $\pm 15\%$; NEC Class 2 (U.S.). PELV per IEC 60204-1.
Power consumption (single stick)	450L-B Protective height: <ul style="list-style-type: none"> • 150 mm (5.91 in.): 64 mA maximum • 1950 mm (76.77 in.): 214 mA (outputs not loaded) 450L-E Protective height: <ul style="list-style-type: none"> • 150 mm (5.91 in.): 70 mA maximum • 1950 mm (76.77 in.): 221 mA (Output not loaded) 450L-APC-IO-8: additional 40 mA (with termination plug) 450L-PAC number of beams: <ul style="list-style-type: none"> • 1: 70 mA • 2: 108 mA • 3: 133 mA • 4: 145 mA (outputs not loaded) 450L-APC-IO-8: additional 40 mA (with termination plug)
Peak current during power-up cycle	800 mA maximum (outputs not loaded)
Duration of peak current during power-up cycle	100 ms
Power down time (OSSD<2V)	3000 ms
Transmitted infrared wave length	Infrared (wave length 855 nm)
Aperture angle	Within $\pm 2.5^\circ$ @ 3 m (9.8 ft)
Synchronization	Optical
DIP switch selectable functions	Depends on inserted plug-in: <ul style="list-style-type: none"> • 450L-B: start mode; external device monitoring (EDM); maximum operating range • 450L-E: start mode; external device monitoring (EDM); maximum operating range, beam coding, interference rejection, blanking, muting • 450L PAC: start mode; external device monitoring (EDM); maximum operating range, beam coding, muting
Lifetime expectancy	<ul style="list-style-type: none"> • DIP switch on plug-in: 1000 cycles • Plug-in on transceiver stick: 50 cycles
Ambient light	<ul style="list-style-type: none"> • Incandescent lamp: 3000 lux or less • Sunlight: 100,000 lux or less

(1) 450L PAC is based on 450L-E 30 mm hardware.

Inputs Receiver Plug-in, Cascading Plug-in, and Universal Plug-in

Table 74 - Inputs Receiver Plug-in, Cascading Plug-in, and Universal Plug-in

Attribute	Value
Input Manual start	Minimum duration 50 ms; maximum duration 5 seconds Voltage level for Logic Low/0: 0...5V DC Voltage level for Logic Hi/1: > 16V DC Current: 7 mA typical
Input EDM	300 ms after activation of OSSD Voltage level for Logic Low/0: 0...5V DC Voltage level for Logic Hi/1: > 16V DC Current: 7 mA typical
Input muting sensors	Voltage level for Logic Low/0: 0...5V DC Voltage level for Logic Hi/1: > 16V DC Current: 7 mA typical

Safety Outputs (OSSDs): Receiver Plug-in

Table 75 - Safety Outputs (OSSDs): Receiver Plug-in

Attribute	Value
Safety outputs (OSSDs)	Two solid-state outputs
Switching capacity	500 mA each, maximum
OFF-current, max	<2 mA
Residual voltage (drop from power supply)	2V (excl. voltage drop through cables), maximum
Connection cable length	100 m (330 ft) maximum with 22 AWG; Condition: power supply 24V and maximum load on outputs 50 mA total
Switching voltage to HIGH (Ueff)	11...30 V
Switching voltage to LOW	-3...2V
Load capacity	0.5 μ F maximum
Short circuit protection	Yes
Test pulse data	See OSSD Output on page 91
Short circuit detection	Yes
Galvanic isolation: I/O from Logic	No

Status Outputs

Table 76 - Status Outputs

Attribute	Value
Number of status outputs	Receiver plug-in: Up to three nonsafety solid-state outputs (depends on plug-in) I/O-cascading plug-in: Up to three solid-state outputs (depends on configuration)
Switching capacity	200 mA each, maximum
Residual voltage (drop from power supply)	2V (excl. voltage drop through cables), maximum
Short circuit protection	Yes
Galvanic isolation: I/O from Logic	No

Environmental and General Protection

Table 77 - Environmental and General Protection

Attribute	Value
Operating temperature	-10...+55 °C (14...131 °F)
Storage temperature	-25...+75 °C (-13...+167 °F)
Operating humidity	5... 95% (without condensation)
Enclosure rating	IP65
Vibration Resistance	450L-B/E: Per IEC 61496-1, IEC 60068-2-6 Frequency 5...150 Hz Amplitude 0.35 mm (0.01 in.) 450L PAC: Per IEC 61496-1 Edition 4 (Class 3M7), IEC 60068-2-6 Frequency 10...150 Hz Amplitude 10 mm (0.39 in.), Acceleration 3g
Shock	450L-B/E: Per IEC 61496-1, IEC 60068-2-29 Acceleration 10 g (0.35 oz), Duration 16 ms 450L PAC: Per IEC 61496-1 Edition 4 (Class 3M7), IEC 60068-2-27 Acceleration 25 g (0.88 oz), Duration 6 ms
Pollution level	2

Electrical Protection

Table 78 - Electrical Protection

Attribute	Value
Short circuit protection	Incorporated
Current limitation	Incorporated
Overload protection	Incorporated
Reverse polarity protection	Incorporated
Overvoltage protection	Incorporated (up to 60V max)
Thermal shutdown/restart	Incorporated

General

Table 79 - General

Attribute	Value
Materials	Transceiver stick (450L-B...) or 450L-E (incl. 450L PAC models): <ul style="list-style-type: none"> Profile: Extruded aluminum, powder coated End caps: Polyamide Front window: Polycarbonate Screws: Steel
	Plug-in (450L-AP...): <ul style="list-style-type: none"> Pig tail cable: Polyurethane M12 Connector: Bare copper, SR-PVC, PUR Body: Polyamide
	Top/Bottom (Cat. No. 450L-AM-TBM) mounting brackets: <ul style="list-style-type: none"> Bracket: Steel, powder coated Screws: Steel
	Side mounting brackets (Cat. No. 450L-AM-SM): <ul style="list-style-type: none"> Body: Polyamide Screws: Steel
	Replacement brackets (Cat. No. 450L-AM-RK): <ul style="list-style-type: none"> Bracket: Aluminum, black anodized Screws: Steel
	Laser-alignment tool bracket (Cat. No. 450L-ALAT-C): <ul style="list-style-type: none"> Bracket: Polyamide Test rod: Aluminum Optical Interface Device (Cat. No. 450L-AD-OID): Polyamide
Stick dimensions	<ul style="list-style-type: none"> Cross section: 30 x 30 mm (1.19 x 1.19 in.) Length: N x 150 mm (N x 5.9 in.) [N = 1 ... 13]
Screw type and maximum torque of top/bottom mounting bracket	M3 x 10; Phillips screw 0.7 N•m (6.2 lb•in) max
Screw type and maximum torque for M2 screws of plug-in	M2 x 8; Phillips screw 0.38 N•m (3.4 lb•in) max
Maximum torque for screws of side mounting bracket	<ul style="list-style-type: none"> M6 screws: 11 N•m (97.36 lb•in) M4 screws: 2.8 N•m (24.78 lb•in)
Indicators stick	450L-B, 450L-E, and 450L-PAC: Transceiver type (Rx or Tx) Status Intensity (for two regions) Start/Restart Output
	450L-E and 450L PAC only: Muting Blanking Cascading
Connection plug	Depending on installed plug-in: M12 5-pin (convex) or M12 8-pin (convex) fixed at pigtail with cable length: Connection plug-ins: 150 mm (11.81 in.) I/O cascading plug-in: 60 mm (2.36 in.) Minimum outer bend radius of pigtail: > 3xD: 5-pin: D = 4.4 mm (0.17 in.) 8-pin: D = 5.5 mm (0.22 in.)
Connection cable length	Maximum 100 m (330 ft) with wire section AWG 22 (Condition: Power supply 24V and maximum load on outputs 50 mA total)
Accessories included	Test rod, top/bottom mounting brackets and installation instruction
Silicon	The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops.

Certifications

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

- cULus Listed Industrial Control Equipment, which is certified for US and Canada
- CE Marked for all applicable directives (see [Compliance with European Union Directives on page 169](#))
- RCM marked (Australia)
- TÜV Rheinland-certified for functional safety up to SIL 3 Category 4 for use in safety applications up to and including SIL 3, in accordance with IEC 61508 and EN 62061, Performance Level e and Category 4 in accordance with ISO 13849-1, ESPE type 4 safety light curtain according

to EN IEC 61496. TÜV Rheinland confirmed that the laser class of the integrated laser alignment tool that is integrated in all 450L safety light curtain sticks conforms to laser class 2 of IEC 60825-1.

Compliance with European Union Directives

Rockwell Automation B.V. (address: Rivium Promenade 160, 2909 LM Capelle aan den IJssel, The Netherlands) declares that this product is in conformity with the provisions of the following EC directives (including all applicable amendments): 2014/30/EU Electromagnetic Compatibility Directive (EMC) and 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 <http://www.rockwellautomation.com/global/certification/overview.page>.

Approximate Dimensions

450L-B and 450L-E safety light curtain transceiver sticks have the same dimensions. The only difference is that the 450L-E safety light curtain sticks have an additional slot, which allows the insertion of a cascading plug-in and the connection plug-in. 450L PAC safety light curtain models are based on 450L-E safety light curtain hardware.

Figure 182 - 450L Safety Light Curtain Stick Dimensions [mm (in.)], see dimensions in [Table 80 on page 170](#)

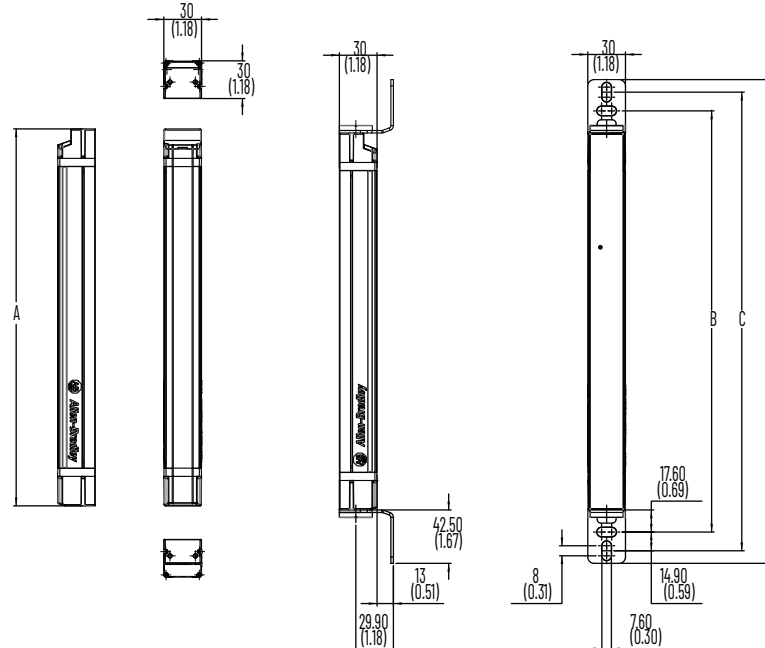
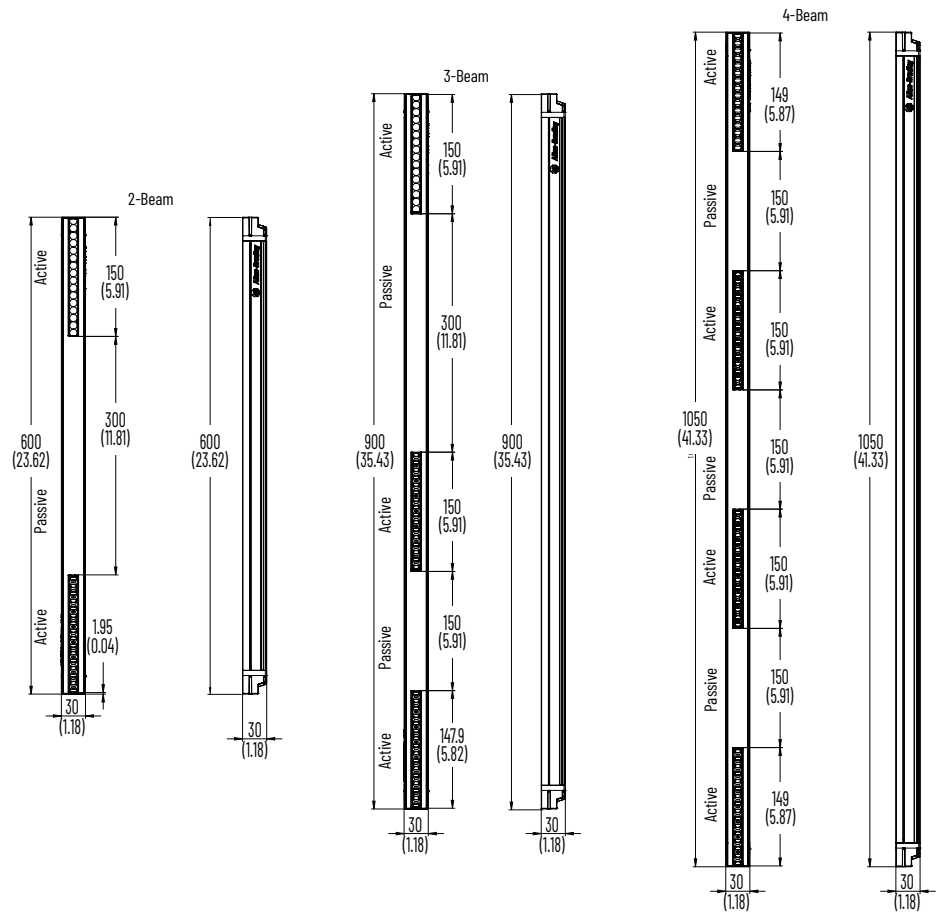


Table 80 - 450L POC and PAC Safety Light Curtain Stick Dimensions [mm (in.)]

Cat. No.	Type	A	B	C	D
		Protective Height	Mounting Value	Mounting Value	Total Length
450L-B4xN0150YD	POC	150 (5.91)	185.5 (7.3)	215 (8.46)	235 (9.25)
450L-E4xL0150YD					
450L-E4A1L0150YD	PAC 1-Beam	300 (11.81)	335.5 (13.21)	365 (14.37)	385 (15.16)
450L-B4xN0300YD	POC				
450L-E4xL0300YD	POC	450 (17.72)	485.5 (19.11)	515 (20.28)	535 (21.06)
450L-B4xN0450YD					
450L-E4xL0450YD	POC	600 (23.62)	635.5 (25.02)	665 (26.18)	685 (26.97)
450L-B4xN0600YD					
450L-E4xL0600YD	PAC 2-Beam	750 (29.53)	785.5 (30.93)	815 (32.09)	835 (32.87)
450L-B4xN0750YD	POC				
450L-E4xL0750YD	POC	900 (35.43)	935.5 (36.83)	965 (37.99)	985 (38.78)
450L-B4xN0900YD					
450L-E4xL0900YD	PAC 3-Beam	1050 (41.34)	1085.5 (42.74)	1115 (43.9)	1135 (44.68)
450L-B4xN1050YD	POC				
450L-E4xL1050YD	PAC 4-Beam	1200 (47.24)	1235.5 (48.64)	1265 (49.8)	1285 (50.59)
450L-B4xN1200YD					
450L-E4xL1200YD	POC	1350 (53.15)	1385.5 (54.55)	1415 (55.71)	1435 (56.5)
450L-B4xN1350YD					
450L-E4xL1350YD	POC	1500 (59.06)	1535.5 (60.45)	1565 (61.61)	1585 (62.4)
450L-B4xN1500YD					
450L-E4xL1500YD	POC	1650 (64.96)	1685.5 (66.36)	1715 (67.52)	1735 (68.31)
450L-B4xN1650YD					
450L-E4xL1650YD	POC	1800 (70.87)	1835.5 (72.26)	1865 (73.43)	1885 (74.21)
450L-B4xN1800YD					
450L-E4xL1800YD	POC	1950 (76.77)	1985.5 (78.17)	2015 (79.33)	2035 (80.12)
450L-B4xN1950YD					
450L-E4xL1950YD					

Figure 183 - 450L PAC Safety Light Curtain Stick Dimensions [mm (in.)]



Product Selection

Sticks

The catalog number refers to a stick, including top/bottom mounting kit and test rod.

450L - $\frac{B}{a}$ 4 $\frac{H}{b}$ $\frac{N}{c}$ - $\frac{0750}{d}$ - Y D

a	
Transceiver Stick Type	
Code	Description
B	Basic
E	Enhanced

b	
Resolution [mm (in.)]	
Code	Description
H	Hand (30 [1.19])
F	Finger (14 [0.56])

c	
Laser Alignment	
Code	Description
N	Not integrated
L	Integrated

d			
Protected Height [mm (in.)]			
Code	Description	Code	Description
0150	150 (5.91)	1200	1200 (47.28)
0300	300 (11.82)	1350	1350 (53.19)
0450	450 (17.73)	1500	1500 (59.1)
0600	600 (23.64)	1650	1650 (65.01)
0750	750 (29.55)	1800	1800 (70.92)
0900	900 (35.46)	1950	1950 (76.83)
1050	1050 (41.37)		

Protective Field Length [mm (in.)]	Cat. No. ⁽¹⁾⁽²⁾		Approximate Shipping Weight (With Packaging) [kg (lb)]	Shipping Dimensions [mm (in.)]
	Resolution 14 mm (0.56 in.)	Resolution 30 mm (1.19 in.)		
150 (5.90)	450L-x4Fy0150YD	450L-x4Hy0150YD	0.59 (1.3)	860 x 111 x 68 (33.86 x 4.37 x 2.68)
300 (11.81)	450L-x4Fy0300YD	450L-x4Hy0300YD	0.72 (1.59)	860 x 111 x 68 (33.86 x 4.37 x 2.68)
450 (17.72)	450L-x4Fy0450YD	450L-x4Hy0450YD	0.85 (1.87)	860 x 111 x 68 (33.86 x 4.37 x 2.68)
600 (32.62)	450L-x4Fy0600YD	450L-x4Hy0600YD	0.98 (2.16)	1310 x 111 x 68 (51.57 x 4.37 x 2.68)
750 (29.53)	450L-x4Fy0750YD	450L-x4Hy0750YD	1.11 (2.45)	1310 x 111 x 68 (51.57 x 4.37 x 2.68)
900 (35.43)	450L-x4Fy0900YD	450L-x4Hy0900YD	1.24 (2.73)	1310 x 111 x 68 (51.57 x 4.37 x 2.68)
1050 (41.34)	450L-x4Fy1050YD	450L-x4Hy1050YD	1.37 (3.02)	1760 x 111 x 68 (69.29 x 4.37 x 2.68)
1200 (47.24)	450L-x4Fy1200YD	450L-x4Hy1200YD	1.5 (3.3)	1760 x 111 x 68 (69.29 x 4.37 x 2.68)
1350 (53.15)	450L-x4Fy1350YD	450L-x4Hy1350YD	1.63 (3.59)	1760 x 111 x 68 (69.29 x 4.37 x 2.68)
1500 (59.05)	450L-x4Fy1500YD	450L-x4Hy1500YD	1.77 (3.90)	2360 x 111 x 68 (92.91 x 4.37 x 2.68)
1650 (64.96)	450L-x4Fy1650YD	450L-x4Hy1650YD	1.91 (4.21)	2360 x 111 x 68 (92.91 x 4.37 x 2.68)
1800 (70.86)	450L-x4Fy1800YD	450L-x4Hy1800YD	2.05 (4.52)	2360 x 111 x 68 (92.91 x 4.37 x 2.68)
1950 (76.77)	450L-x4Fy1950YD	450L-x4Hy1950YD	2.18 (4.81)	2360 x 111 x 68 (92.91 x 4.37 x 2.68)

(1) Replace x with B for 450L-B or E for 450L-E.
(2) Replace y with N for 450L-B or with L for 450L-E.

450L PAC Catalog Number Explanation

450L - E4 A1 L - 0150 - Y D
a b c d

a	b		c	d	
All versions based on 450L-E	Number of Beams		Integrated Laser Alignment System	Protected Height [mm (in.)]	
	Code	Description		Code	Description
	A1	1		0150	150 (5.91)
	A2	2		0600	600 (23.64)
	A3	3		0900	900 (35.46)
	A4	4		1050	1050 (41.37)

Plug-ins

450L - APR - ON - 5N
a b c

a		b		c	
Plug-in Type		Function		Number of Pins	
Code	Description	Code	Description	Code	Description
APR	Accessory plug-in receiver	PW	Power	5	5-pin
APT	Accessory plug-in transmitter	ON	On/Off	8	8-pin
APU	Accessory plug-in universal	ED	EDM		
APC	Accessory plug-in cascading	UN	Universal		
		BK	Blanking		
		MU	Muting		
		IO	I/O cascading		

Description	Cat. No.
450L plug-in Tx 5-pin	450L-APT-PW-5
450L plug-in Tx 8-pin	450L-APT-PW-8
450L plug-in Rx ON/OFF 5-pin	450L-APR-ON-5
450L plug-in Rx EDM 8-pin	450L-APR-ED-8
450L plug-in universal 8-pin	450L-APU-UN-8
450L plug-in blanking 5-pin	450L-APR-BL-5
450L plug-in muting 8-pin	450L-APR-MU-8
450L plug-in cascading 8-pin	450L-APC-IO-8

Figure 184 - 450L Connection Plug-in Dimensions [mm (in.)]

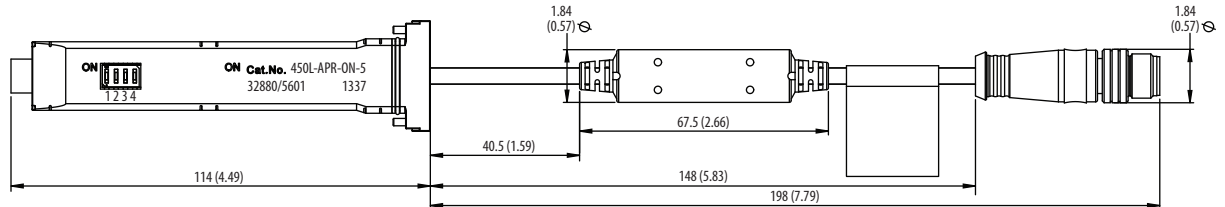
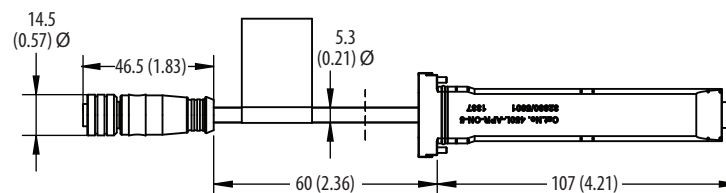


Figure 185 - 450L-APC-IO-8 Cascading Plug-in Dimensions [mm (in.)]



Optional Accessories

Description	Cat. No.
L-shaped end-cap mounting bracket kit (two per package), shipped with each stick (see Standard Top/Bottom Mounting Kit on page 76)	450L-AM-TBM
Side mounting bracket (2 kits per pair) (see Side Mounting Bracket on page 78)	450L-AM-SM
Replacement mounting kit (see Replacement Mounting Kit on page 80)	450L-AM-RK
445L bracket (2 kits per pair)	445L-AF6140
445L bracket (180°) (2 kits per pair)	445L-AF6141
Shock mount kit (2 kits required per pair) (see Shock Mounting Kit on page 79)	445L-AF6142
Power supply Output—24V DC, 3 amps, 72 W (see Power Supply on page 89)	1606-XLP72E
Laser alignment tool (see Alignment Tool and Bracket on page 178)	440L-ALAT
450L-B laser alignment tool bracket (see Alignment Tool and Bracket on page 178)	450L-ALAT-C
Optical Interface Device (including USB cable) (see Optical Interface Device (OID) on page 106)	450L-AD-OID
450L stick slot cover (plug-in slot, one red slot cover shipped with each 450L-B stick; one red and one gray slot cover shipped with each 450L-E stick). (see Cascading on page 43 and Figure 7 on page 15)	450L-AS-1
Muting distribution block	450L-AMOD-MUT
Muting station	450L-AMUT-IL
Muting lamp	800F-MUT-2-MS
Mounting stand (column) (see Mounting Columns on page 177)	440L-AMSTD
Mounting stand (column) (See publication 445L-UM004)	445L-AMSTD2M
Corner mirror (xxxx = 0300...1800 mm [11.8...70.86 in.] in 150 mm [5.9 in.] increments) (see Mirrors on page 67)	440L-AM075xxxx
Corner mirror (xxxx = 0300...1800 mm [11.8...70.86 in.] in 150 mm [5.9 in.] increments) (see Mirrors on page 67)	440L-AM125xxxx
Mirror mounting bracket (see Corner Mirror on page 175)	442L-AF6106
Weld shield (xxxx = 0150...1950 mm [5.9...76.77 in.] in 150 mm [5.9 in.] increments) (see Weld Shields on page 179)	450L-AW-xxxx
T-connector (see T-connector on page 95)	1485P-RDR5
Guardmaster® SI safety relay (see Guardmaster SI Safety Relay on page 94)	440R-S12R2
Guardmaster CI safety relay	440R-S13R2
Guardmaster D safety relay	440R-D22R2
Guardmaster DIS safety relay	440R-D22S2
MSR42 safety relay	440R-P226AGS-NNR
CR30 software configurable safety relay	440C-CR30-22BBB
External contactor	100S:
	100S-C09QJ14BC,
	100S-C43QJ22BC
	700S:
	700S-CF530DJBC (or minor variations)
Test rod 14 mm (0.55 in.) (shipped with each stick that has finger resolution) (see Regular Inspection on page 109)	450L-AT-14
Test rod 30 mm (1.18 in.) (shipped with each stick that has hand resolution) (see Regular Inspection on page 109)	450L-AT-30
Test rod 40 mm (1.57 in.) (see Regular Inspection on page 109)	450L-AT-40
Termination plug, M12, 8 pin (see Cascading and Blanking on page 46)	898D-81CU-DM
Termination cap, M12, 8 pin (see Cascading and Blanking on page 46)	1485A-M12

Corner Mirror

Specially constructed glass mirrors for two-sided and three-sided safeguard applications (see [Mirrors on page 67](#) for installation).

IMPORTANT Each mirror reduces maximum scan range by 10%. Each corner mirror is supplied with two end-cap mounting brackets (Cat. No. 442L-AF6106).

Figure 186 - Dimensions of the Mirror (440L-AM075) (Width 75 mm [2.95 in.])

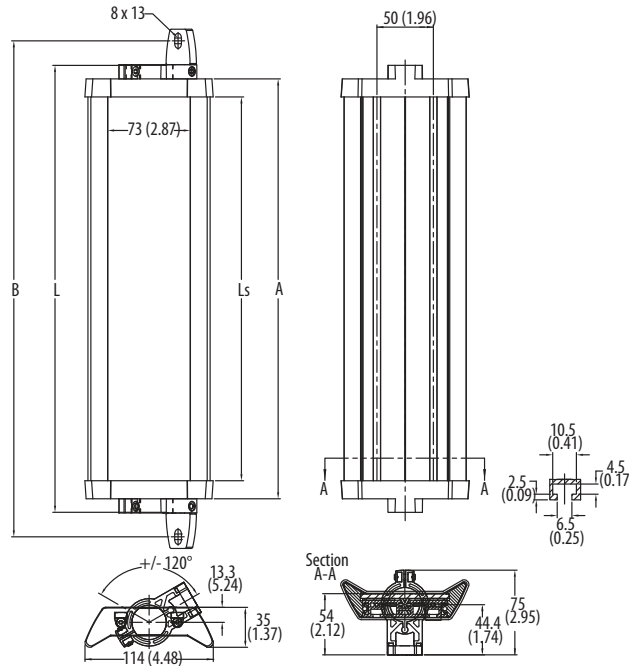


Table 81 - Narrow Mirror (Width 75 mm [2.95 in.]) Short Range (0...4 m [0...13.12 ft])

Cat. No.	Series	Description	L	LS	A	B	Protective Height 450L [mm]
440L-AM0750300	A	Mirror, 300 mm (11.81 in.), 0...4 m (0...13.12 ft)	396	340	372	440	300
440L-AM0750450	A	Mirror, 450 mm (17.72 in.), 0...4 m (0...13.12 ft)	546	490	522	590	450
440L-AM0750600	A	Mirror, 600 mm (23.62 in.), 0...4 m (0...13.12 ft)	696	640	672	740	600
440L-AM0750750	A	Mirror, 750 mm (29.53 in.), 0...4 m (0...13.12 ft)	846	790	822	890	750
440L-AM0750900	A	Mirror, 900 mm (35.43 in.), 0...4 m (0...13.12 ft)	996	940	972	1040	900
440L-AM0751050	A	Mirror, 1050 mm (41.34 in.), 0...4 m (0...13.12 ft)	1146	1090	1122	1190	1050
440L-AM0751200	A	Mirror, 1200 mm (47.24 in.), 0...4 m (0...13.12 ft)	1296	1240	1272	1340	1200
440L-AM0751350	A	Mirror, 1350 mm (53.15 in.), 0...4 m (0...13.12 ft)	1446	1390	1422	1490	1350
440L-AM0751500	A	Mirror, 1500 mm (59.05 in.), 0...4 m (0...13.12 ft)	1596	1540	1572	1640	1500
440L-AM0751650	A	Mirror, 1650 mm (64.96 in.), 0...4 m (0...13.12 ft)	1746	1690	1722	1790	1650
440L-AM0751800	A	Mirror, 1800 mm (70.86 in.), 0...4 m (0...13.12 ft)	1896	1840	1872	1940	1800

Figure 187 - Dimensions of the Mirror (440L-AM125) (Width 125 mm [4.92 in.])

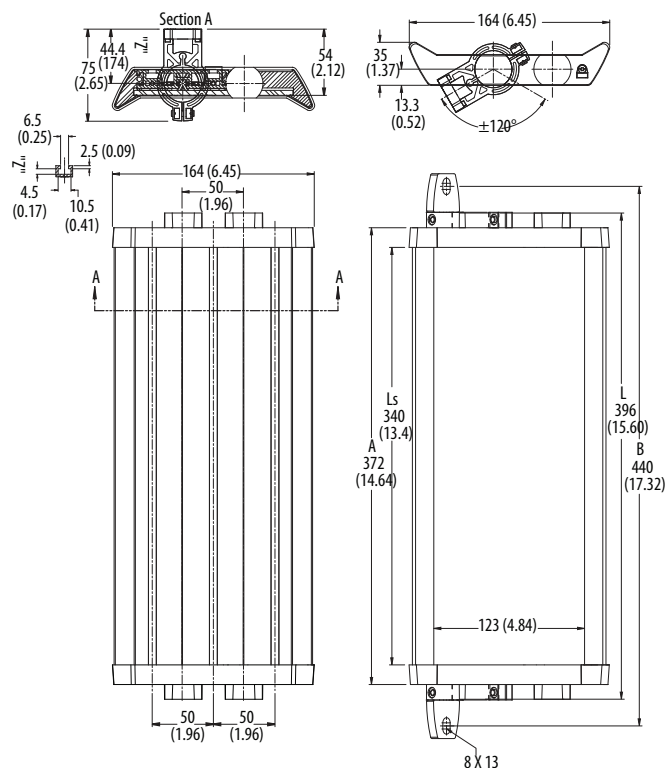


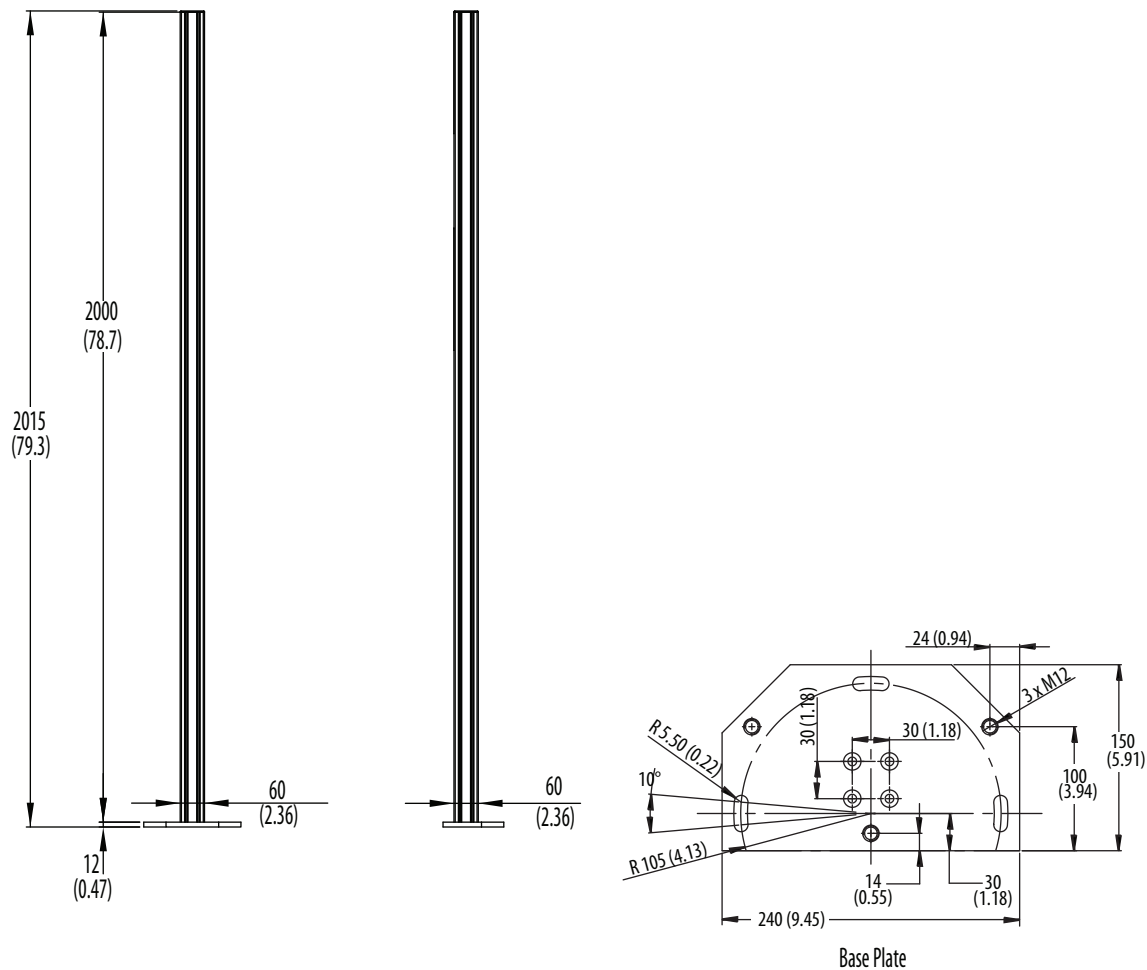
Table 82 - Wide Mirror (Width 125 mm [4.92 in.]) Long Range (4...15 m [13.12...49.21 ft])

Cat. No.	Series	Description	L	LS	A	B	Protective Height 450L [mm]
440L-AM1250300	A	Mirror, 300 mm (11.81 in.), 4...15 m (13.12...49.21 ft)	396	340	372	440	300
440L-AM1250450	A	Mirror, 450 mm (17.72 in.), 4...15 m (13.12...49.21 ft)	546	490	522	590	450
440L-AM1250600	A	Mirror, 600 mm (23.62 in.), 4...15 m (13.12...49.21 ft)	696	640	672	740	600
440L-AM1250750	A	Mirror, 750 mm (29.53 in.), 4...15 m (13.12...49.21 ft)	846	790	822	890	750
440L-AM1250900	A	Mirror, 900 mm (35.43 in.), 4...15 m (13.12...49.21 ft)	996	940	972	1040	900
440L-AM1251050	A	Mirror, 1050 mm (41.34 in.), 4...15 m (13.12...49.21 ft)	1146	1090	1122	1190	1050
440L-AM1251200	A	Mirror, 1200 mm (47.24 in.), 4...15 m (13.12...49.21 ft)	1296	1240	1272	1340	1200
440L-AM1251350	A	Mirror, 1350 mm (53.15 in.), 4...15 m (13.12...49.21 ft)	1446	1390	1422	1490	1350
440L-AM1251500	A	Mirror, 1500 mm (59.05 in.), 4...15 m (13.12...49.21 ft)	1596	1540	1572	1640	1500
440L-AM1251650	A	Mirror, 1650 mm (64.96 in.), 4...15 m (13.12...49.21 ft)	1746	1690	1722	1790	1650
440L-AM1251800	A	Mirror, 1800 mm (70.86 in.), 4...15 m (13.12...49.21 ft)	1896	1840	1872	1940	1800

3.8 (0.15) 44.4

Figure 100 Figure 99 1/01 AMSTR

Figure 190 - 440L-AMSTD2M



Alignment Tool and Bracket

Optional laser-alignment tool (laser class 2) and alignment tool bracket.

Figure 191 - Laser Alignment Tool (Catalog Number 440L-ALAT)

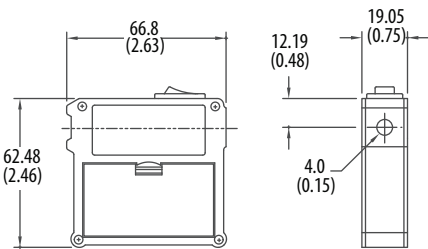
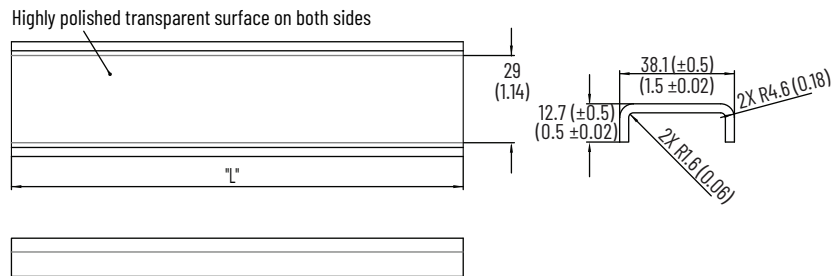


Figure 192 - Alignment Tool Bracket (Catalog Number 450L-ALAT-C)



Weld Shields

Figure 193 - Weld Shield Dimensions



The GuardShield™ safety light curtain weld shields are sold in the same lengths as the protective field heights of the GuardShield safety light curtains. These polycarbonate weld shields are designed as disposable devices whose purpose is to help protect the front window of the GuardShield safety light curtain from damage.

One weld shield reduces the operation range by approximately 10%. For a 450L safety light curtain with finger resolution with a weld shield that is installed on each stick, the maximum range of operation reduces to: 7.0 m (22.97 ft) x 90% x 90% = 5.67 m (18.61 ft). The installation of the weld shields does not affect the minimum operation range.

Table 83 - Weld Shield Kits

Description	Cat. No.
Weld Shield Kit, two pieces per kit Safety Light Curtain, Length xxxx mm [xxxx: 0150...1950 mm (5.9...76.77 in.) in 0150 mm (5.9 in.) increments]	450L-AW-xxxx

The weld shield is supplied with precut Velcro® tape strips. Position the strips on the front window and attach the weld shields. Additional information about the weld shields is provided in the publication [450L-IN001](#).

Cables

Depending on the plug-in, an M12 5-pin or a M12 8-pin connection cable is required to connect a transceiver stick.

Connection cables (also commonly referred to as cordsets) have an M12 plug (concave) at one end and the other end is free wires.

Extension cables (also commonly referred to as patchcords or interconnection cables) have one M12 plug at each end. They can be used to extend the length of the connection cables or can be used to extend the cascading distance. Only the M12 5-pin patchcords can be used to connect a safety light curtain directly to a GuardShield safety light curtain ArmorBlock® module.

[Table 84](#) lists cables that are required for connecting a light curtain stick (cable color black). Check ab.rockwellautomation.com/Connection-Devices/DC-Micro-Cordsets-and-Patchcords for additional lengths and/or cable jacket colors.

Table 84 - Connection Cables (Cordsets and Patchcords); Unshielded; Color: Black

Description	Cat. No.	
	Concave M12 5-pin ⁽¹⁾	Concave M12 8-pin ⁽¹⁾
No connector (cordset)	889D-F5BC-x	889D-F8AB-x
Convex M12 connector (patchcord)	889D-F5BCDM-x	889D-F8ABDM-x ⁽²⁾

(1) Replace the x with 2 (2 m [6.6 ft]), 5 (5 m [16.4 ft]), 10 (10 m [32.8 ft]), 15 (15 m [49.2 ft]), 20 (20 m [65.6 ft]), or 30 (30 m [98.4 ft]) for desired length.

(2) Use this cable to extend the cable length between cascades.

IMPORTANT For environments with high EMC (electromagnetic disturbances) influences, shielded cables are highly recommended.

Figure 194 - Patchcord Cable

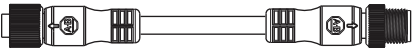
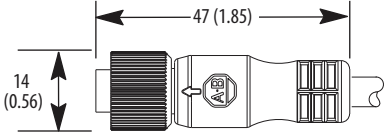


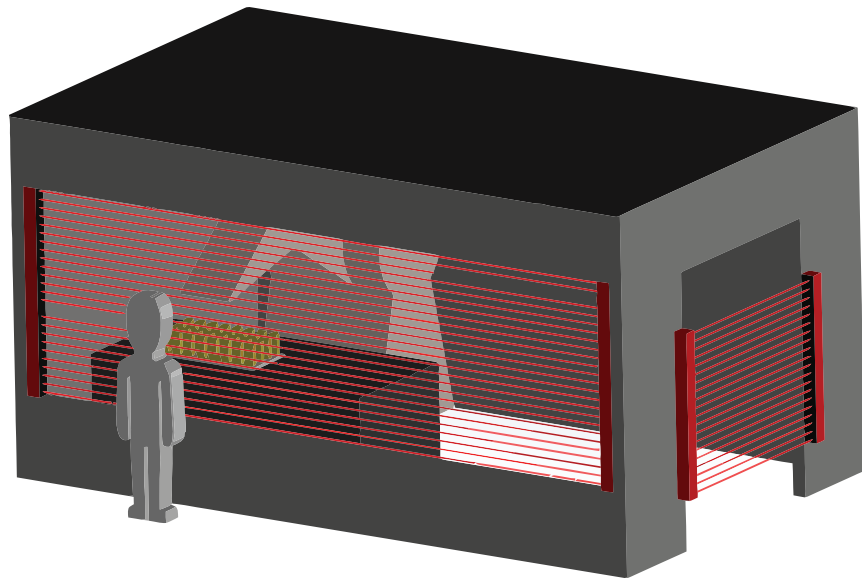
Figure 195 - M12 5-pin Plug Dimensions [mm (in.)]



Typical Installations

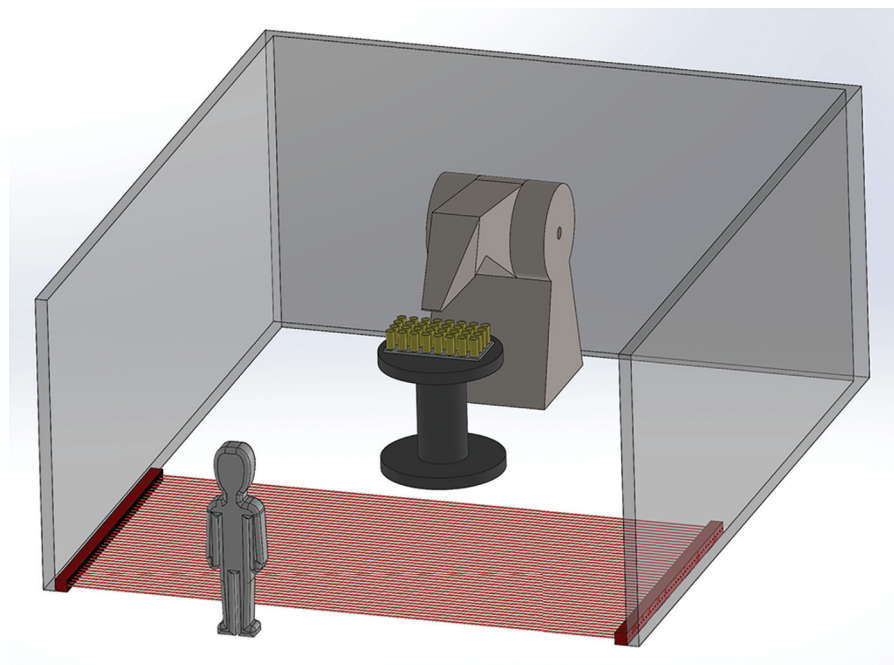
Safety Light Curtain Mounted Vertically

Figure 196 - Point of Operation Control (POC) and Parameter Access Control (PAC)



Safety Light Curtain Mounted Horizontally

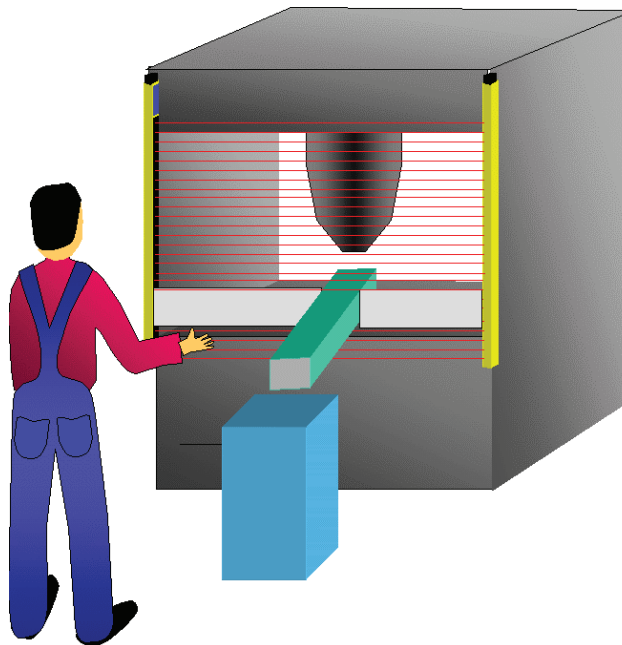
Figure 197 - Hazard Zone Safe Guard (Area Protection)



Fixed Blanking Application

This application can include a sheet of metal that passes through the light curtain before an operation is performed to form the material. The light curtain permits the material at a specific width without causing the safety outputs to turn off. Certain applications cannot be protected in any other way. If, for example, normal operation of a machine requires that material is permanently fed into the dangerous part of a machine, then a portion of the protective field is always interrupted, but the machine nevertheless continues to operate. The protection with blanking must come from a detailed risk analysis. Authorized personnel must confirm that in spite of blanking, the safety of the machine operator is adequately accounted for. When necessary, additional protective measures must be taken to shield the dangerous area. All Blanking modes can create “holes” in the protective field. These “holes” must be considered separately in the risk analysis.

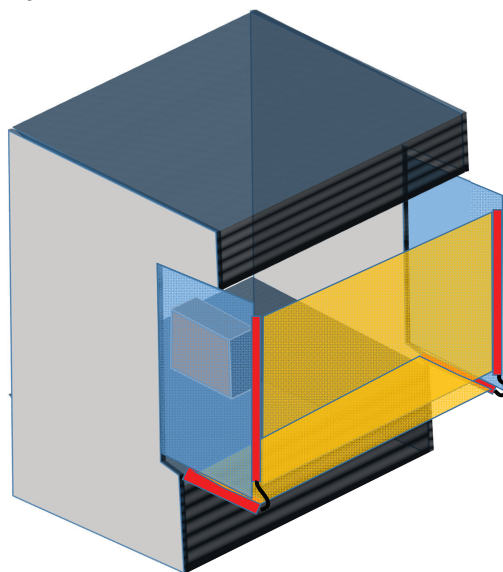
Figure 198 - Schematic Application for Fixed Teach-in Blanking



A typical example of fixed Teach-in blanking is the exit ramp on an automatic punch press. The punched part is transported out of the dangerous zone into a container. The ramp passes through the protective field, and without Blanking would cause the machine to stop. The position of this ramp is monitored. During a tool change, the position of this ramp can vary slightly. This new position must be reconfigured in order for the application to run smoothly. It is possible this new position needs reconfiguration in order for the application to run smoothly.

Cascading Application

Figure 199 - Example for a Setup with Two Cascaded Segments (L-shape Setup)



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- 450L-APR-MU-8**
 - connection plug-in 56
- 450L-APR-ON-5**
 - connection plug-in 55
- 450L-APR-UN-8**
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Publication 450L-UM001F-EN-P - March 2022

Supersedes Publication 450L-UM001E-EN-P - April 2020

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