Installation Instructions

Original Instructions

Allen-Bradley
by **ROCKWELL AUTOMATION**

Guardmaster®

GuardShield Micro 400 Safety Light Curtains

Catalog Numbers 445L-P4*x*FP, 445L-C4*x*FP, 445L-P4*x*KD

Summary of Changes

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

About This Manual

This manual covers the operation and installation of the:

- GuardShield™ Micro 400 Safety Light Curtain POC, see POC on page 3
- GuardShield Micro 400 Safety Light Curtain PAC, see Perimeter Systems (PAC) on page 20
- GuardShield Micro 400 Safety Light Curtain PAC IP69K Systems, see Micro 400 Safety Light Curtain IP69K Option on page 3
- GuardShield Micro 400 Safety Light Curtain Specials on page 2

IMPORTANT   Save these instructions for future use.

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

Follow this technical description when you install and commission the GuardShield Micro 400 safety light curtain. You must be qualified to conduct the inspection and commissioning.

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Introduction

The GuardShield Micro 400 safety light curtain is an economical three-box (transmitter, receiver, and controller) Type 4 safety light curtain, offered in a small profile [15 x 20 mm (0.59 x 0.79 in.)] housing.

The protective heights are offered from 50…1200 mm (1.97…47.24 in.) in 50 mm (1.97 in.) increments. The compact housing size allows the GuardShield Micro 400 safety light curtain to mount in areas where standard safety light curtains cannot mount due to space constraints. You can also recess the GuardShield Micro 400 safety light curtain transmitter and receiver into machine frames.

Micro 400 Safety Light Curtain System

The Micro 400 safety light curtain requires a dedicated controller, either an MSR41 safety module, which has on/off functionality, or an MSR42 safety module, which offers an advanced functionality of fixed and floating blanking, manual restart and muting. The MSR42 safety module can also be used as a multifunction safety module, which allows the connection of additional safety light curtains, safety laser scanner, or any safety device with PNP type outputs.

The Micro 400 safety light curtain transmitter and receiver are offered with 8-pin M12 connectors at the end of 500 mm (20 in.) pigtail cables. The two patchcords to connect the transmitter and receiver to the controller are the same part number and are offered in various lengths. These patchcords are configured on one end with M12 connectors, which mate to the integrated pigtail connectors of the safety light curtain. The RJ45 connectors on the opposite end plug into to the MSR41 or MSR42 safety module.

Rockwell Automation

Micro 400 Safety Light Curtain Cascading

The GuardShield Micro 400 safety light curtain is also offered in a cascadable configuration. GuardShield Cascadable Micro 400 safety light curtains allow the interconnection of multiple segments of the Micro 400 safety light curtain with a common pair of safety outputs. The cascadable configurability of the GuardShield Micro 400 safety light curtain reduces overall system wiring. The cascadable configurability allows the series connection of multiple protective fields, for example, the front and the backside of an application or a combined horizontal and vertical protection area.

A GuardShield Cascadable Micro 400 safety light curtain system is composed of one or two pairs of Cascadable Micro 400 safety light curtains.

IMPORTANT	The standard GuardShield Micro 400 safety light curtain must always be the last segment in a Cascaded Micro 400 safety light curtain system.

GuardShield Micro 400 safety light curtain cascaded pairs are offered in both 14 mm (0.55 in.) and 30 mm (1.18 in.) resolutions in limited protected heights. You can mix 14 mm (0.55 in.) and 30 mm (1.18 in.) resolution pairs in a Cascaded Micro 400 safety light curtain system.

A cascadable pair of GuardShield Micro 400 safety light curtains has two 500 mm (20 in.) pigtails at each stick with a concave (bottom) and a convex (top) M12 quick disconnect.

The GuardShield Cascadable Micro 400 safety light curtain system operates as one safety light curtain pair with a common set of OSSDs. Each segment pair connects in series. The complete system response time is the sum of each segment pair, plus the response time of the MSR41 or MSR42 safety module and other safety devices in the stop circuit.

When you connect two cascadable segments together, the resultant cable length between segments is 1000 mm (40 in.).

If you require an additional length between segment pairs, M12 patchcords in 1 m, 3 m, and 5 m (3.3 ft, 9.8 ft, and 16.4 ft) lengths (catalog number 445L-AC8PC1 or 445L-AC8PC3) are offered.

IMPORTANT	The maximum cascaded Micro 400 safety light curtain system length cannot exceed 10 m (32.8 ft). This distance is measured between the RJ45 connection at the MSR 41 or MSR 42 safety module to the last beam in the standard Micro 400 safety light curtain (including all cable lengths). The maximum number of beams in a cascaded Micro 400 safety light curtain system cannot exceed 255 beams.

Micro 400 Safety Light Curtain Washdown Option

The GuardShield Micro 400 safety light curtain is offered with the transmitter and receiver that is sealed in clear polycarbonate tubes with an environmental rating of IP69K. These IP69K Micro 400 safety light curtains are factory sealed and are ordered as pairs. They are offered in a 14 mm (0.55 in.) resolution in protected heights from 150…1200 mm (5.9…47.2 in.). See <u>Table 13 on page 16</u> for available models.

The required MSR41 or MSR42 safety modules maintain the IP20 rating and must be mounted in a suitable enclosure.

The Micro 400 safety light curtain IP69K transmitter and receiver are both offered with 8-pin M12 connectors at the end of 500 mm (20 in.) integrated cables. The patchcords to connect the transmitter and receiver to the controller are offered in 1 m, 2 m, 3 m, 5 m, and 8 m (3.3 ft, 6.6 ft, 9.8 ft, 16.4 ft, and 26.2 ft) lengths.

These patchcords are configured on one end with M12 connectors for the safety light curtain pigtail and RJ45 connectors on the opposite end for the MSR41 or MSR42 safety module.

Micro 400 Safety Light Curtain Specials

The GuardShield Micro 400 safety light curtain is also offered in special configurations as described in <u>GuardShield Micro 400 Safety Light Curtain Products on page 15</u>.

The GuardShield Micro 400 safety light curtains are general-purpose presence sensing devices, providing point of operation (POC) and perimeter (PAC) detection.

IMPORTANT	These installation instructions are designed to address the technical personnel of the machine manufacturer and or the installer of the safety system. These instructions describe the proper mounting, configuration, electrical installation, commissioning, operation, and maintenance of the GuardShield Micro 400 safety light curtain. These installation instructions do not provide instruction for the operation of machinery to which the GuardShield Micro 400 safety light curtain is integrated. Only qualified personnel can install this equipment.

Important Requirements

The GuardShield Micro 400 safety light curtain requires a dedicated controller. The MSR41 safety module is used for on/off applications. The MSR42 safety module can also be used as a multi-functional safety module and allows these connections:

- Additional safety light curtains
- Safety laser scanner
- Safety devices with two Output Signal Switch Devices (OSSD) outputs
- Safety switch with two contacts (E-stops and enabling switches)

There are a number of operating modes that you can configure with the MSR42 safety module. EDM, Start/Restart Interlock, Fixed and Floating Blanking, and Muting modes are possible.

Safety Precautions — Principles for Safe Use and Symbols Used

The following instructions are preventive warnings to confirm the safe and proper operation of the GuardShield Micro 400 safety light curtains. These instructions are an essential part of the safety precautions and therefore you must always observe.

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

⚠	**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 consequences.

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

⚠	**ATTENTION:** Do not use the GuardShield Micro 400 safety light curtain with machines that cannot be stopped electrically in an emergency. The safety distance between the GuardShield Micro 400 safety light curtain and a dangerous machine movement must be maintained always. Additional mechanical protective devices must be installed in a way that hazardous machine elements cannot be reached without passing through the protective field. The GuardShield Micro 400 safety light curtain must be installed in a way that operators can only access the hazard through the sensing field of the Micro 400 safety light curtain. Improper installation can result in serious injury. Never connect the outputs to +24V DC. If the outputs are connected to +24V DC, they are in the on-state and cannot stop hazardous spots at the machine/application. Never expose the GuardShield Micro 400 safety light curtain to flammable or explosive gases. Regular safety inspections are imperative (see <u>Safety Instructions—Maintenance on page 13</u>).

Specialist Personnel

A qualified person must install, commission, and service the GuardShield Micro 400 safety light curtain. A qualified person is defined as a person who:

- Has undergone the appropriate technical training
- Is instructed in the operation of the machine and the currently valid safety guidelines
- Has read and has ongoing access to these installation instructions

Range of Uses of the Device

The GuardShield Micro 400 safety light curtain is classified as electro-sensitive protective equipment (ESPE). These devices fulfill the requirements of a Type 4 ESPE defined by IEC 61496-1 and CLC/TS 61496-2 and are, therefore, allowed for use with controls in safety category Type 4 in compliance with EN ISO 13849, SIL CL 3 in accordance with EN62061 or up to PLe in accordance with EN ISO 13849.

These devices are suitable for:

- Point of operation protection (finger and hand protection)
- Hazardous area protection

Access to the hazardous point must only be allowed through the protective field. The machine/system is not allowed to start as long as personnel are within the hazardous area. See the Examples of Range of Use on page 4 for an illustration of the protective modes.

Depending on the application, mechanical protection devices can be required along with the safety light curtain.

POC

The GuardShield Micro 400 safety light curtain POC is available in the following physical resolutions:

- 14 mm (0.55 in.)
- 30 mm (1.18 in.)

The protective field height of the standard GuardShield Micro 400 safety light curtain is 50...1200 mm (1.97...47.2 in.).

The maximum protective field width is 0...5 m (16.4 ft).

Cascadable Micro 400 Safety Light Curtain

The cascadable GuardShield Micro 400 safety light curtain POC is available in the following physical resolutions.

- 14 mm (0.55 in.)
- 30 mm (1.18 in.)

The protective field height of the cascadable GuardShield Micro 400 safety light curtain is 300...1200 mm (11.82...47.2 in.). The maximum protective field width is 0...5 m (16.4 ft).

Micro 400 Safety Light Curtain IP69K Option

The physical resolution of the GuardShield Micro 400 safety light curtain IP69K is 14 mm (0.55 in.). The protective field height of the GuardShield Micro 400 safety light curtain IP69K is 150...1200 mm (5.9...47.2 in.). See Table 13 on page 16 for available models. The maximum protective field width is 0...5 m (16.4 ft).

The Micro 400 safety light curtain IP69K option is factory sealed in polycarbonate enclosures.

The GuardShield Micro 400 safety light curtain requires a controller to operate with one of the following safety modules.

- MSR41 - on/off functionality
- MSR42 - multifunction

IMPORTANT	The operating range can degrade by up to 50% in the polycarbonate enclosure.

Proper Use

Only use the GuardShield Micro 400 safety light curtain as defined in the Range of Uses of the Device. Only qualified personnel can use this safety light curtain, and only on the machine that the device was installed and initialized by qualified personnel.

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

General Protective Notes and Protective Measures

IMPORTANT	Observe the following items to maintain the proper and safe use of the GuardShield Micro 400 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:

- Machinery Directive 2006/42/EC
- Low Voltage Directive 2014/35/EU
- Use of Work Directive 2009/104/EC
- The work safety regulations/safety rules
- Other relevant health and safety regulations

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

Observe the notices, in particular the test regulations of these installation instructions (for example, on use, mounting, installation, or integration into the existing machine controller).

Specialist personnel or specially qualified and authorized personnel must conduct, record, and document the tests to confirm that the tests can be reconstructed and retraced at any time.

The installation instructions must be made available to the user of the machine where the GuardShield Micro 400 safety light curtain is installed. Specialist personnel must instruct the machine operator on the use of the device and to read the installation instructions.

Product Description

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

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

Special Features

- Slim design 15 x 20 mm (0.59 x 0.79 in.)
- Built-in diagnostic status indicators
- HW configurable with MSR41 safety module
- HW and SW configurable with MSR42 safety module
- M12 connector on 508 mm (20 in.) pigtails
- Low maintenance and cost-effective

Principle of Operation

The GuardShield Micro 400 safety light curtain consists of a nonmatched pair of optic units, for example, transmitter and receiver with the same protected height and resolution. The controller functionality of the Micro 400 safety light curtains is through a separate safety module:

- MSR41 - on/off functionality
- MSR42 - multifunction

The maximum distance between transmitter and receiver is referred to as the protective field width or range. The protective field height is the distance between the first and last beam in the device.

The transmitter emits sequential pulses of infrared light, which the GuardShield Micro 400 safety light curtain receives and the connected controller processes. The connected MSR controller synchronizes the timing of the emission and reception of the infrared light pulses.

The connected controller has safety outputs [Output Signal Switching Devices (OSSDs)] and nonsafety auxiliary outputs. When the GuardShield Micro 400 safety light curtain transmitter and receiver are properly connected and aligned, the OSSDs of the connected controller are current sourcing +24V DC. Interruption of the sensing field causes the controller to switch off the sourced current (0V DC).

When you restore the GuardShield Micro 400 safety light curtain sensing field (in guard only configuration), the safety outputs (OSSDs) of the controller switch to the active high state (resume current sourcing +24V DC).

IMPORTANT	The connected safety controller (for example, the MSR42 safety module) control operating modes such as Manual or Automatic Restart (reset), EDM (external device monitoring), blanked beams, or overriding of the GuardShield Micro 400 safety light curtain. For details, see the user manual of the connected safety controller.

GuardShield Safety Light Curtain

The GuardShield Micro 400 safety light curtain consists of a transmitter and a receiver.

Figure 1 - Components of the GuardShield Micro 400 Safety Light Curtain

Receiver (blue cable marking)
Transmitter (white cable marking)
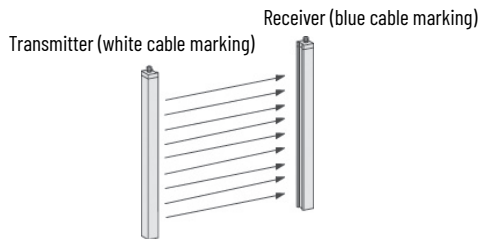
The protective field is between the bottom of the top end cap and the area above the status indicators.

The width of the protective field is derived from the distance between transmitter and receiver. The distance must not exceed the maximum rated width of the protective field 0…5 m (0…16.4 ft).

Cascading

The GuardShield Micro 400 safety light curtain POC is also available in cascading segments, which allow a number of GuardShield Micro 400 safety light curtain transmitters and receivers to interconnect. This product configurability allows the GuardShield Micro 400 safety light curtain to help protect multiple sides of a machine, or simply adds flexibility when positioning the GuardShield Micro 400 safety light curtain in various applications.

Up to three GuardShield Micro 400 safety light curtain segments can interconnect.

Figure 2 - Three GuardShield Micro 400 Safety Light Curtain Segments

Patchcord

The last segment pair must be a standard Micro 400 safety light curtain pair
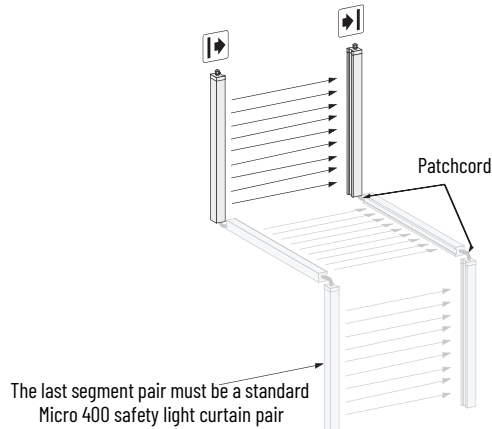
Standard GuardShield Micro 400 cascading segments are offered in protective heights from 150…1200 mm (5.91…47.2 in.) in both 14 mm (0.55 in.) and 30 mm (1.18 in.) resolutions.

A maximum of three GuardShield Micro 400 safety light curtains can interconnect (maximum two cascades plus one standard GuardShield Micro 400 safety light curtain). The maximum number of beams in a cascading system is 255 beams. The individual segments can have mixed resolutions as long as the pairs have the same protective heights and resolutions. The maximum cable length from the control unit to the last beam can be 10 m (32.8 ft).

Cascading segments cannot be used as standalone safety light curtain pairs. However, whether you use multiple cascaded pairs or only one, the last pair in the cascaded system must be a standard GuardShield Micro 400 safety light curtain.

Consider the following limitations.

- A maximum of 255 light beams per controller
- 10 m (32.8 ft) maximum total length for safety light curtains, extension modules, and connection cable combined (Figure 2)
- Only use a Rockwell Automation® patchcord (catalog number 445L-AC8xxx) between the safety light curtains and the controller. A patchcord is required to connect the M12 connector of the Micro 400 safety light curtain to either the MSR41 or MSR42 safety module. The patchcord has an 8-pin M12 on one end and an RJ45 connector on the opposite end.

Examples of Range of Use

The GuardShield Micro 400 safety light curtain operates as a proper protective device only if the following conditions are met.

- The control of the machine must be electrical.
- The controlled machine must be able to stop anywhere in the machines stroke or cycle.
- The transmitter and receiver must be mounted so access to the hazard is only through the safety light curtain protective field.
- If used as an access device, the Restart button must be outside the hazardous area. This location helps to prevent the startup of machinery while personnel are inside the hazardous area.
- Observe the statutory and local rules and regulations when you install and use the device.

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

Safety Functions

The GuardShield Micro 400 safety light curtain offers various functions, which are integral to the system.

Operating modes, functions, and features of the GuardShield system are activated through the hardware or software of the corresponding connected MSR41 or MSR42 safety module. For details, see the manual of the attached controller.

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

Response Time

The standard response time of the safety light curtain (see Table 1 on page 5) is dependent on the physical resolution and the protective height and is shown on the product label. The actual response time depends on the connected control unit and its configuration. The response time can be faster and can be taken from the corresponding configuration control document, created from the configuration software of the corresponding safety controller (for example, the MSR42 safety module).

The total safety light curtain system response time for a cascaded system is the sum of the response times of each cascade plus the response time of the standard safety light curtain. The declared response times are worst case values.

A worst case response time is printed on the product label or in the GuardShield Micro 400 safety light curtain products section:

t_{LC}	Response time of the standard Micro 400 safety light curtain
t_C	Response time of the control unit (for example, MSR42 safety module), including any connected MSR45 relay modules
t_{Nx}	Sum of response times t_{Nx} of all additional connected GuardShield Micro 400 safety light curtain cascades (x = 1 or 2)

Table 1 shows an example of the total response time of a cascaded safety light curtain.

Table 1 - Total Response Time

Description	Length/Resolution [mm (in.)]	Response Time
Cascade 1 (t_{N1})	1200/14 (47.24/0.55)	41.9 ms
Cascade 2 (t_{N2})	300/14 (11.8/0.55)	18.5 ms
Standard (t_{LC})	600/14 (23.62/0.55)	26.3 ms
System (t_{LC} + t_C + t_N)	1200/14 - 300/14 - 600/14 (47.24/0.55 - 11.8/0.55 - 23.62/0.55)	86.7 ms + t_C

The response time that is printed on the product label reflects the Double Scan mode of the MSR41 and MSR42 safety module.

IMPORTANT	The response time of the GuardShield Micro 400 safety light curtain system is dependent on the operating mode of the connected safety controller. With the help of optical interface 445L-AF6150, you can delay the response time of the connected safety light curtain system when the GuardShield Micro 400 safety light curtain is connected to the MSR42 safety module.
	If a controller unit is reconfigured, print a new configuration control document and kept the document close to the controller. Also mark the corresponding control unit with the provided label.

A detailed explanation, including the corresponding safety information, for configuring an MSR42 safety module can be found in publication SAFETY-UM001.

Parameters that can lead to an increased response time:
- Stop delay time
- Blanking
- Muting
- Use of an MSR45E extension module

IMPORTANT	When you change the configuration of the GuardShield Micro 400 safety light curtain system, recalculate the safety distance and potentially relocate the GuardShield Micro 400 safety light curtains at the proper distance from the hazard.

Blanking

There are some industrial applications where material must feed through the protective field (for example, textile machines or small assembly machines). This movement of material through the GuardShield Micro 400 safety light curtain sensing field in the standard Safety mode can result in an interruption and therefore bring the machine to an unwanted stop. To avoid stoppage, blank out certain beams (Fixed Blanking mode). Blanking functionality is available with the MSR42 safety module and requires the optical interface module to program this functionality.

IMPORTANT	The device can operate in a Fixed and/or Floating Blanking mode, if an MSR42 safety module is used. The resolution increases according to the configuration control document. The safety light curtain stick must be clearly labeled with the configured resolution.

With an MSR42 safety module and optical interface 445L-AF6150, authorized personnel can activate different blanking modes. Blanking modes are broken down into the following categories.
- Fixed blanking
- Floating blanking

IMPORTANT	With the blanking function, the resolution and the response time of the GuardShield Micro 400 safety light curtain system changes. If the blanking function is activated, apply the new, longer response time, and the new, larger resolution to the calculation of the safety distance. Always adapt the minimal safety distance of the safety light curtain to the actual operating mode. The corresponding reaction time of a safety light curtain without blanking is stated on the label of each system. If blanking is configured, enter the new reaction time and the new resolution, according to the configuration control document, in the appropriate spaces on the supplied label. Attach the label on the receiver portion of the safety light curtain and confirm that the label is clearly visible (see Figure 3). The labels are provided with the GuardShield Micro 400 safety light curtain mounting kit.

Figure 3 - Additional Label for Blanking

☐ Fixed blanking	From beam....................to beam.........................
☐ Floating blanking	Resolution ....mm
☐ Reduced resolution	Reaction time ....ms

IMPORTANT	Further information on blanking can be found in publication SAFETY-UM001.

Determine the Safety Distance

The safety light curtain must mount with a proper safety distance:
- From the point of danger
- From reflective surfaces

US Safety Distance Formula

IMPORTANT	The GuardShield Micro 400 safety light curtains must mount at a sufficient distance from the pinch point or point of operation hazard. The machine must stop before a finger, hand, arm, or body reaches the hazard.

This distance, referred to as the safety distance, must be properly calculated before you determine the safety light curtain protective height and mount the safety light curtains on the machine. Failure to calculate this safety distance can result in operator injury.

IMPORTANT	Never mount GuardShield Micro 400 safety light curtains closer than 152.4 mm (6 in.) from the point of operation or pinch point hazard, regardless of the calculated safety distance.

There are two formulas in the United States that are used to calculate the safety distance. The first, the OSHA formula, is the minimum requirement for the calculation of the safety distance. The second formula, which we recommend, is the ANSI formula that incorporates additional factors to consider when you calculate the safety distance.

OSHA Safety Distance Calculation Formula

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

$$D_s = 63 \times T_s$$

D_s	Safety distance in inches.
63	The OSHA recommended hand speed constant in inches per second.
T_s	The total stop time of all devices in the safety circuit, which is measured in seconds. This value must include all components that are involved in to stop the hazardous motion of the machinery. For a mechanical power press, it is the stopping time that is measured at approximately the 90° position of the crankshaft rotation.

The T_s number must include the response times of all devices. For example:

- Safety light curtain
- Safety light curtain controller (if used),
- Machine control circuit
- Any other devices that react to stop the hazardous motion of the machinery.

> **IMPORTANT** The measurement of stopping time (T_s) must include the stopping times of all devices in the stop circuit. Not including all device and control system elements when you calculate T_s results in an inaccurate and insufficient safety distance calculation. This insufficient distance can result in operator injury.

ANSI Safety Distance Formula

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

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

D_s	Minimum safety distance between the safeguarding device and the nearest point of operation hazard, in inches.
K	Hand speed is 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.
T_s	Stop time of the machine tool that is measured at the final control element.
T_{cs}	Response time of the control system A stop time device measures T_s and T_{cs}
T_r	Response time of the presence sensing device (safety light curtain) and its interface (MSR4x safety module and MSR45E extension module). The device manufacturer states this value or you can measure it.
T_{bm}	Additional time that is allowed for the brake monitor to compensate for variations in normal stopping time.
D_{pf}	Depth penetration factor. This 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 always detected anywhere in the sensing field.

> **IMPORTANT** ANSI B11.19 1990 E4.2.3.3.5 states: The value of the hand speed constant, K, is determined by various studies, and although these studies indicate speeds of 63 inches/second to over 100 inches/second, they are not conclusive determinations. The employer must consider all factors, including the physical ability of the operator, when determining the value of K to be used.

Example

In safeguarding, such as a perpendicular safety light curtain application with object sensitivity (effective resolution) less than 63.5 mm (2.5 in.), the D_{pf} can be approximated based on the following formula:

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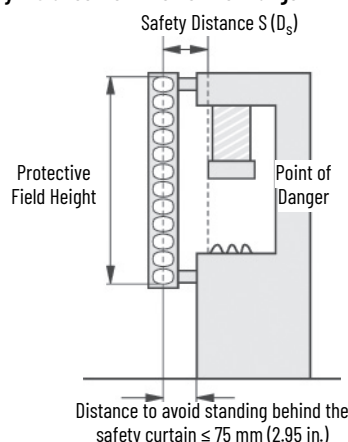
European Safety Distance Formula

A safety distance must be maintained between the safety light curtain and the point of danger. This safety distance confirms that the point of danger can only be reached after the dangerous state of the machine is removed.

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

- Stopping/run-down time of the machine or system. The stopping/run-down time is shown in the machine documentation or must be determined by taking a measurement.
- Response time of the protective device, for example, GuardShield Micro 400 safety light curtain (see).
- Reach or approach speed.
- Resolution of the safety light curtain and/or beam separation.

Figure 4 – Safety Distance from the Point of Danger

Safety Distance S (D_s)

Protective Field Height

Point of Danger

Distance to avoid standing behind the safety curtain ≤ 75 mm (2.95 in.)

Calculate the Safety Distance S

Calculation is according to EN ISO 13855 and EN ISO 13857.

First, use the following formula to calculate S.

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

> T = stopping/run-down time of the machine
+ response time of the protective device [s]
d = resolution of the safety light curtain [mm]
S = safety distance [mm]
The reach/approach speed is already included in the formula.

If the result S is ≤ 500 mm (19.6 in.), then use the determined value as the safety distance.

If the result S is > 500 mm (19.6 in.), then recalculate S as follows.
$$S = 1600 \times T + 8 \times (d - 14) \, [\text{mm}]$$

Example

Stopping/run-down time of the machine = 290 ms
Response time = 30 ms
Resolution of the safety light curtain = 14 mm (0.55 in.)
T = 290 ms + 30 ms = 320 ms = 0.32 s
S = 2000 × 0.32 + 8 × (14 − 14) = 640 mm (25.1 in.)
S > 500 mm (19.6 in.)

therefore:
S = 1600 × 0.32 + 8 × (14 − 14) = 512 mm (20.1 in.)

Minimum Distance from Reflecting Surfaces

The infrared light from the transmitter can reflect off shiny surfaces and be received by the system receiver. This condition can cause an object not to be detected when it enters the GuardShield Micro 400 safety light curtain sensing field.

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

Figure 5 - Minimum Distance from Reflecting Surfaces
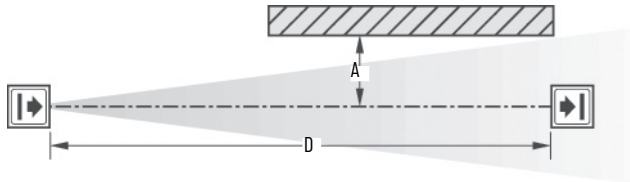
Determine the Minimum Distance from the Reflective Surfaces

- Determine the distance D [m] transmitter-receiver.
- Read the minimum distance A [mm] from Figure 6.

Figure 6 - Minimum Distance from Reflecting Surfaces
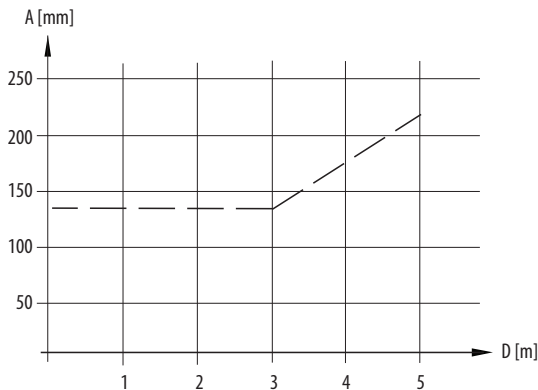
The effective aperture angle for the GuardShield Micro 400 safety light curtain system is
± 2.5° at a mounting distance of > 3.0 m (9.8 ft). Calculate the minimum distance to reflective surfaces depending on the distance between the transmitter and the receiver. Use an aperture angle of ± 2.5° or take the appropriate value from Table 2.

Table 2 - Minimum Distance to Reflective Surface

Distance between Transmitter and Receiver (Range D) [m (ft)]	Minimum Distance a [mm (in.)]
0…3.0 m (0…9.8 ft)	135 (5.31)
4.0 m (13.1 ft)	175 (6.88)
5.0 m (16.4 ft)	220 (8.66)

Formula: a = tan 2.5° x D [mm]

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

Installation and Mounting

This section describes the installation of the GuardShield Micro 400 safety light curtain.

A rigid and flat base, which is isolated against shock and vibration, is selected to mount the GuardShield Micro 400 safety light curtain. This selection, in combination with the standard mounting bracket set, keeps the initial alignment during operation even in harsh industrial environments.

The GuardShield Micro 400 safety light curtain is suitable for most benign operating environments (IP54). Observe proper safety distance and adequate protective height. For the installation height and safety distance, refer to Determine the Safety Distance on page 5 and Figure 9 on page 8.

IMPORTANT	Install the GuardShield Micro 400 safety light curtain so access to the hazard is only possible through the sensing field of the GuardShield (see Figure 7). Installation of the GuardShield Micro 400 safety light curtain can require auxiliary safeguarding to meet this requirement.

Determine if the machinery on which the GuardShield Micro 400 safety light curtain is to be mounted meets the requirements as specified in Table on page 2. For example, machinery must be able to stop anywhere in its stroke or cycle, consistently and repeatedly.
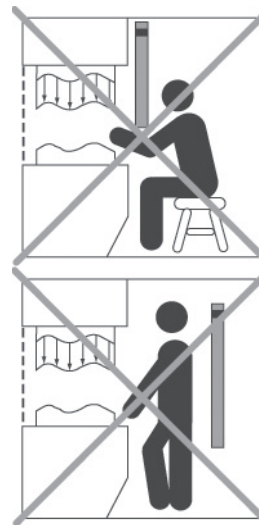
Figure 7 - Correct Installation
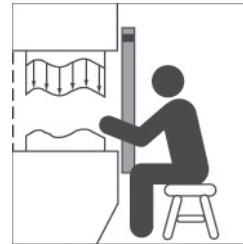
Operators cannot reach hazardous machine parts without passing through the protective field.
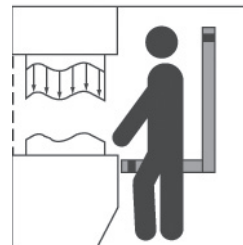
Operators must not step between the protective field and hazardous machine parts (bypass prevention).

Figure 8 - Incorrect Installation

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

Operators can step between the protective field and hazardous machine parts.

The GuardShield Micro 400 safety light curtain must mount at the proper distance from the point of operation hazard. This distance is referred to as the Safety Distance.

Figure 9 - Determine Machine Stopping Time and Safety Distance

Figure 10 - Layout of the Transmitter/Receiver
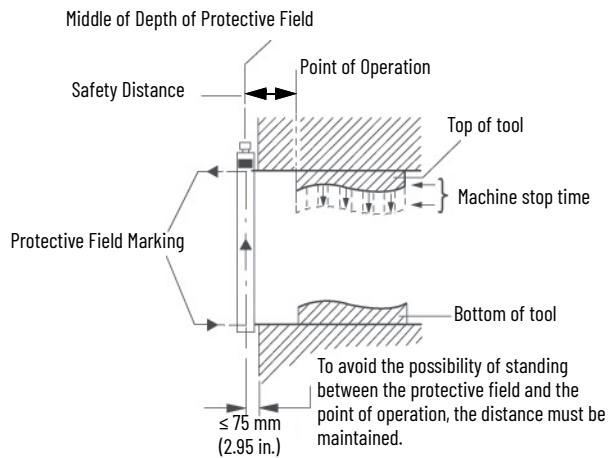
Installation and Alignment Procedure

Status indicators make the alignment procedure easier for the standard GuardShield Micro 400 safety light curtain (see Table 6 on page 10).

Mount the transmitter and receiver with the brackets (see Figure 11). Confirm that the longitudinal axes of both are oriented parallel to each other. Use a vertical or horizontal mounting level to find the correct position.

Confirm that the receiver and transmitter are oriented in the same direction; both connection ends must be at the same end of the protective field and the status indicators are opposite one another. Do not mount the GuardShield Micro 400 safety light curtain systems that are rotated at 180° (see Figure 10).

Connect the transmitter and receiver to the controller and power up. Align according to Multiple GuardShield Micro 400 Safety Light Curtains. The status indicators aid in alignment.

After you align the longitudinal axis of the transmitter and receiver, rotate the receiver along the longitudinal axis to find the receiving angle. During rotation, the green status indicator indicates a free protective field. If the green status indicator flashes, the amount of light is not sufficient for stable operation. After you realign the safety light curtain, briefly interrupt the protective field. After you remove the object from the protective field, the green status indicator indicates a sufficient intensity level.

Adjust and mount the receiver at the center of this operating angle.

After you align the receiver, rotate the transmitter to find the transmitting angle. During rotation, the green status indicator indicates the transmitting angle of the GuardShield Micro 400 safety light curtain.

Adjust and mount the transmitter at the center of this operating angle.

Use a test rod to test the protective function of the GuardShield Micro 400 safety light curtain, according to Figure 19 on page 13. The insertion of this rod into the protective field at any position must interrupt the protective field (illumination of the red status indicator on the GuardShield Micro 400).
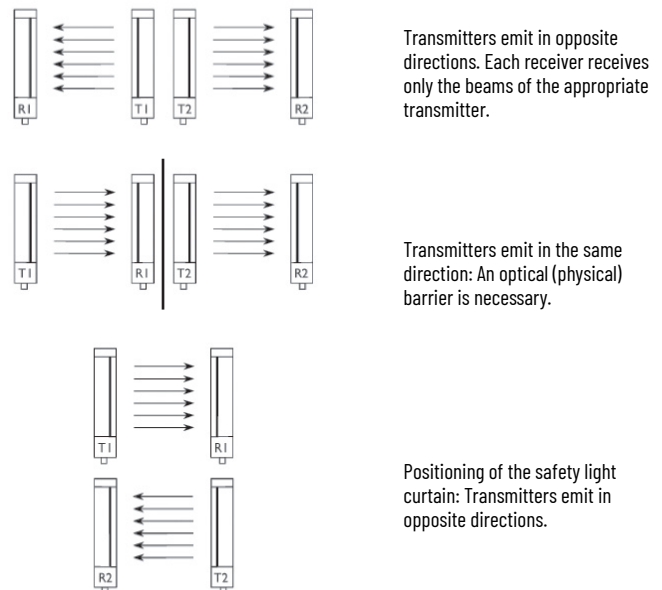
Cycle power to confirm that the system powers up and goes to the on state.
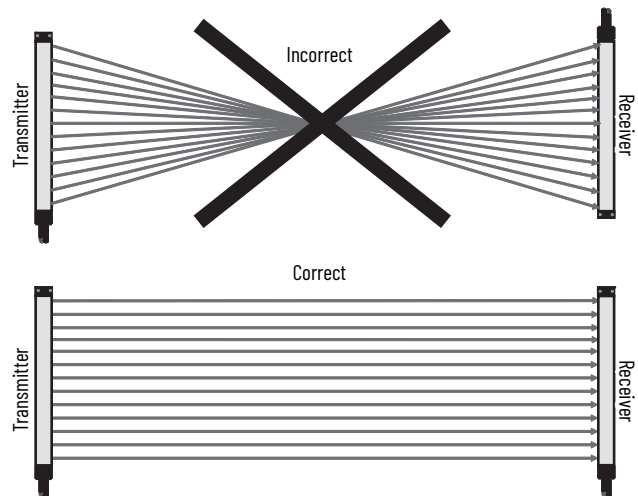
Multiple GuardShield Micro 400 Safety Light Curtains

When two or more GuardShield Micro 400 safety light curtains mount close to one another, it is possible for the receiver of one GuardShield Micro 400 safety light curtain pair to receive infrared light from the transmitter of another GuardShield Micro 400 safety light curtain pair.

There are various techniques to help prevent or reduce the possibility of optical interference from safety light curtains that mount in the same plane. The simplest method is to alternate the transmitter and receiver pairs so that the receiver from a second pair is facing away from the transmitter of another safety light curtain pair nearby. It is also possible to place a physical barrier between pairs to help prevent the infrared light from reaching another safety light curtain pair.

Figure 11 - Multiple GuardShield Micro 400 Safety Light Curtain Alignment Options

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

Transmitters emit in the same direction: An optical (physical) barrier is necessary.

Positioning of the safety light curtain: Transmitters emit in opposite directions.

Cascaded GuardShield Micro 400 Safety Light Curtain

Configuration of Operating Modes in Cascading Systems

You can configure the operating modes of a cascaded GuardShield Micro 400 safety light curtain at the MSR42 safety module.
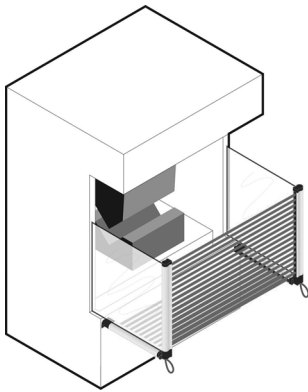
Two Segment Cascading GuardShield Systems

Operators must not be able to step between the protective field and hazardous machine parts (bypass prevention), see Figure 7 on page 7.

There are a few methods of detecting the presence of a person standing in front of the machine hazard but inside of the safety light curtain. The most cost-effective solution is to interconnect an additional safety light curtain in series to the vertical pair (see Figure 12). This solution is accomplished with a cascading pair of GuardShield Micro 400 safety light curtains with a protective height and resolution that are based on the risk assessment. You must select the horizontal protected height of the pair of GuardShield Micro 400 safety light curtains. This pair provides detection from the vertical pair to the front of the machine hazard. In most cases, this horizontal pair of GuardShield Micro 400 safety light curtains is 30 mm (1.18 in.) resolution, as their purpose is to detect the presence of a person, not fingers.

The next step is to select the interconnect patchcords for the transmitter and receiver. We offer these patchcords in various lengths (see Table 5 on page 10). The final cascading segment, which is not connected to another pair of GuardShield Micro 400 safety light curtains, is a standard GuardShield Micro 400 safety light curtain.

L-shaped, two-segment GuardShield Micro 400 safety light curtain cascading systems offer protection when it is possible to stand between the vertical safety light curtain and the machine hazard (see Figure 7 on page 7 and Figure 12).

**Figure 12 - Two-segment, L-shaped Cascaded System**

Three-segment GuardShield Cascading Systems

When the use of corner mirrors is not practical or possible, three-sided guarding of a machine hazard is possible using cascading GuardShield Micro 400 safety light curtains.

Figure 13 shows the top and bottom mounting of three GuardShield Micro 400 safety light curtain segments, which provides three-sided machine guarding without the use of corner mirrors.

Figure 13 - Three-segment, U-shaped Cascaded System
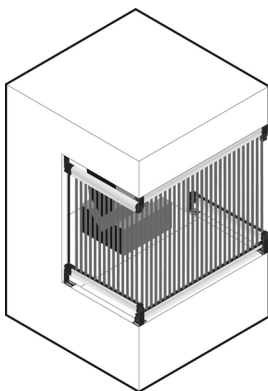
Mounting and Alignment of Cascading GuardShield Safety Light Curtains

IMPORTANT	Align the cascading segments in a particular order. First connect the last segment (the segment with one connector) closest to the control unit. Once the status indicator on the edge is green, secure the mounting brackets of that pair. Next connect the middle segment to the last segment and connect to the controller. When the status indicator of the middle segment receiver is green, secure those brackets. Finally connect the closest segment to the other segments and connect all together to the controller. Only the diagnosis status indicator of the first segment displays the protective field status. The status indicators of other segments stay off. The optical interface module (see Accessories on page 18) can aid in the alignment of a cascaded system.

In a cascading system, only the status indicators of the segment closest to the controller function. Status indicators of other segments do not function.

Micro 400 Safety Light Curtain IP69K

The GuardShield Micro 400 safety light curtain IP69K meets the requirements of Protection Classes IP65, IP66, IP67, IP68, and IP69K to IEC 60529 standards.

The tubes around the GuardShield Micro 400 safety light curtain have no influence on class as per IEC/EN 61496-1, operating range can degrade by up to 50%.

Mounting kits are provided that attach to the connection and end module of the tube. The Micro 400 safety light curtain IP69K is supplied with the two mounting brackets. Do not rotate the end or connection cap (danger of bending the safety light curtain).

Clean the polycarbonate enclosure regularly and when dirty.
- Do not use any powerful cleansing materials.
- Do not use any abrasive cleansing materials.
- Due to static charge, dust particles remain attached to the polycarbonate enclosure. Use an anti-static plastic cleansing agent that is applied with an anti-static cloth.
- Clean the polycarbonate enclosure as follows:
  - Use an ample quantity of water to remove dirt on the enclosure so you avoid scratching the surface.
  - Then wipe off with a clean, slightly damp cloth.
  - Finally, dry the plastic tube with a clean cloth.
- Short time (max 2 min) with 80 °C (176 °F) warm water washable.

After every cleaning process:
- Remove water residues on the enclosure.
- Wipe the tubes with a clean cloth.
- Check the position of the transmitter and the receiver to confirm that an excessively loose or excessively tight grip, or movement to the back by the safety device, is not possible.
- Check the safety function of the protective device.

The connection plug must mount away from high-pressure water.

Table 3 - Material Specifications

Attribute	Value
Protection Class (IEC 60529)	• Tube: IP65, IP66, IP67, IP68, IP69K • Plug: IP65
Material (connector and closure caps)	POM (Polyoxymethylene)
Plastic tube	Polycarbonate
Cable screw fitting	PA6 (Polyamide 6)
O-rings (seals)	NBR (Nitril-Butadien-Rubber)
Mounting brackets	V2A [1.4301 (X5CrNi18-10)]
Pigtail cable	PVC
M12 Plug	Nickel-plated brass copper

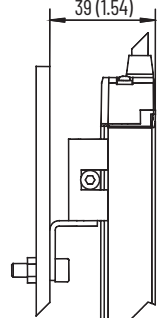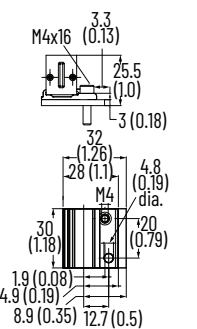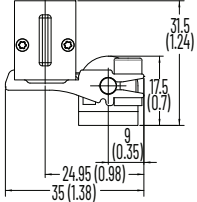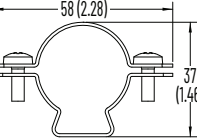| IMPORTANT	Do not rotate the end or connection cap as there is a danger of bending the safety light curtain.
	Do not mount brackets on the transparent tube. Excessive force can damage the tube. Consider the materials listed in Table 3 on page 9 when you use cleaning solutions.

Mounting Brackets

The GuardShield Micro 400 safety light curtain mounts using brackets, which attach to the side of both transmitter and receiver. Use additional brackets, if necessary, to mount the GuardShield Micro 400 safety light curtain at a proper safety distance from the machinery hazard. The backside of the safety light curtain profile has continuous grooves to fix the mounting brackets at any position along the safety light curtain housing.

Additional brackets are available to mount on the side or in the center.

Table 4 – Brackets

Bracket	Dimensions [mm (in.)]	Cat. No. and Description
	39 (1.54)	445L-AF6143 Adjustable 180° bracket kit (two per kit) supplied with each pair.
	M4x16 3.3 (0.13) 25.5 (1.0) 3 (0.18) 32 (1.26) 4.8 (0.19) 28 (1.1) M4 dia. 30 (1.18) 20 (0.79) 1.9 (0.08) 4.9 (0.19) 8.9 (0.35) 12.7 (0.5)	445L-AF6145 Flat bracket kit (two per kit). Two kits are required per pair.
	31.5 (1.24) 17.5 (0.7) 9 (0.35) 24.95 (0.98) 35 (1.38)	445L-AF6149 Adjustable flat bracket (two per kit). Two kits are required per pair.
	58 (2.28) 37 (1.46)	445L-AF6160 IP69K mounting bracket kit (two kits per pair supplied with each pair).

Electrical Installation — Connections

Connect a GuardShield Micro 400 safety light curtain to a machine controller with an MSR41 or MSR42 series safety module. Only use a prefabricated cable (catalog number 445L-AC8xxx) provided by Rockwell Automation between the safety light curtain and the controller (see Table 5 and Table 6).

The Micro 400 safety light curtain requires two patchcords, one for the transmitter and one for the receiver. Use the M12 8-pin connector to connect the safety light curtain, while the RJ45 connector plugs to the controller. Use the M12 to M12 patchcords to extend the cable, especially between cascades of the Micro 400 safety light curtain.

The connection cables are offered with color-coded rings that attach to each cable. Remove one color ring from the cable as necessary. The following color code is defined.

- White – Transmitter (Tx)
- Blue – Receiver (Rx)

Table 5 - Connection Cables

Description [m (ft)]	Cat. No.
Patchcord, PVC jacket, 1 (3.3) M12 to RJ45	445L-AC8RJ1
Patchcord, PVC jacket, 2 (6.6) M12 to RJ45	445L-AC8RJ2
Patchcord, PVC jacket, 3 (9.8) M12 to RJ45	445L-AC8RJ3
Patchcord, PVC jacket, 5 (16.8) M12 to RJ45	445L-AC8RJ5
Patchcord, PVC jacket, 8 (26.2) M12 to RJ45	445L-AC8RJ8

Table 6 - Extension Cables

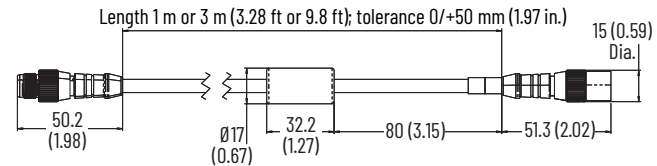| Description [m (ft)]	Cat. No.
Patchcord, PVC jacket, 1 (3.3) M12 to M12	445L-AC8PC1
Patchcord, PVC jacket, 3 (9.8) M12 to M12	445L-AC8PC3
Patchcord, PVC jacket, 5 (16.8) M12 to M12	445L-AC8PC5

Figure 14 shows the RJ45 connector/M12 8-pin connector convex (shielded cable), connection cable from the MSR41 or MSR42 safety module to the safety light curtain.

Figure 14 - GuardShield Micro 400 Safety Light Curtain Connection Cable Dimensions [mm (in.)]

Cable Ø6.3 (0.25) 17 (0.67) Ferrite 150 (5.91) 32.5 (1.28)
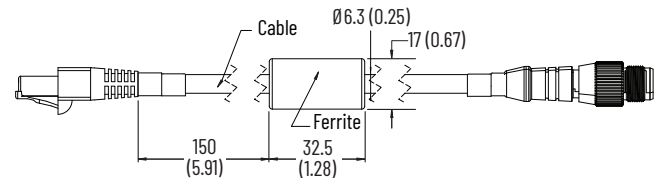
Figure 15 shows the M12 connector convex/M12 8-pin connector concave (shielded cable), extension connection cable or to use between safety light curtain cascades.

Figure 15 - GuardShield Micro 400 Safety Light Curtain Extension Patchcord Cable Dimensions [mm (in.)]

Length 1 m or 3 m (3.28 ft or 9.8 ft); tolerance 0/+50 mm (1.97 in.) 15 (0.59) Dia. 50.2 (1.98) Ø17 (0.67) 32.2 (1.27) 80 (3.15) 51.3 (2.02)

Power supply, inputs, safety outputs, and status outputs connect to the terminal block of the MSR41, MSR42 safety module, or a MSR45E extension module (see Figure 16 and Figure 17 on page 11).

The interface of the safety light curtain with the machine control must be control reliable. For example, a correct interface with a safety PLC or safety relays with positive guided relay contacts.

IMPORTANT	The safety devices and the interconnection to the machinery must comply with the basic safety requirements as mentioned in the current regulations and standards.
	Direct interface of a safety light curtain to a machine control that does not meet the necessary safety integrity level, can result in injury to personnel. For instance, the use of general-purpose PLCs or relays can cause injury to personnel.

Figure 16 - Wiring Diagram for Connection of MSR42 safety module to Contactors
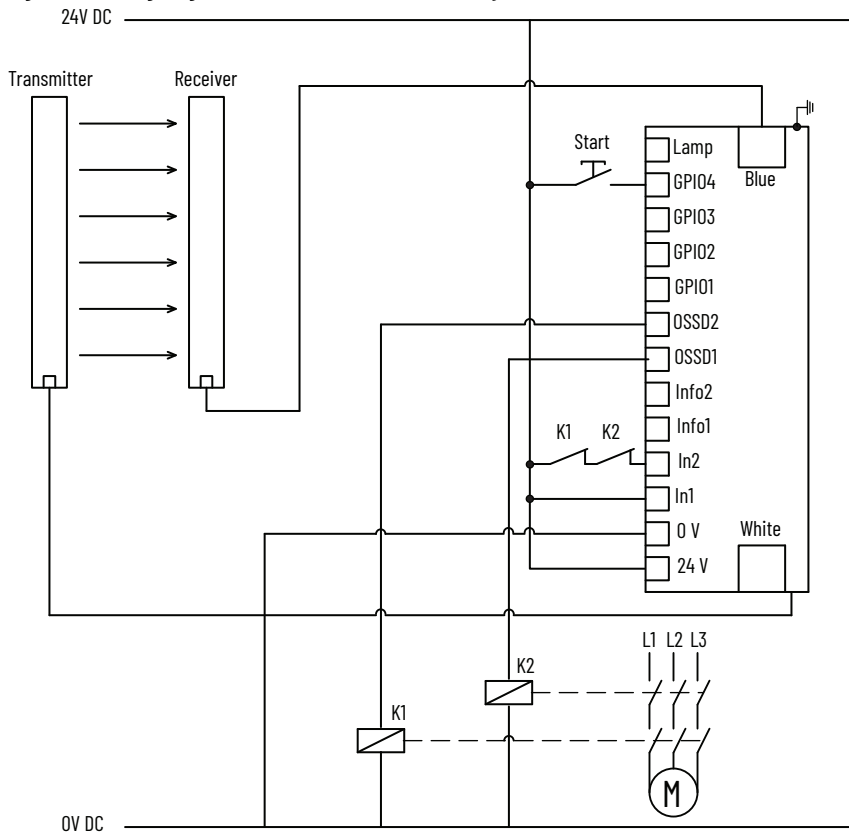
Figure 17 - Wiring Diagram for Connection to MSR45E Extension Module and External Contactor Using Start Release
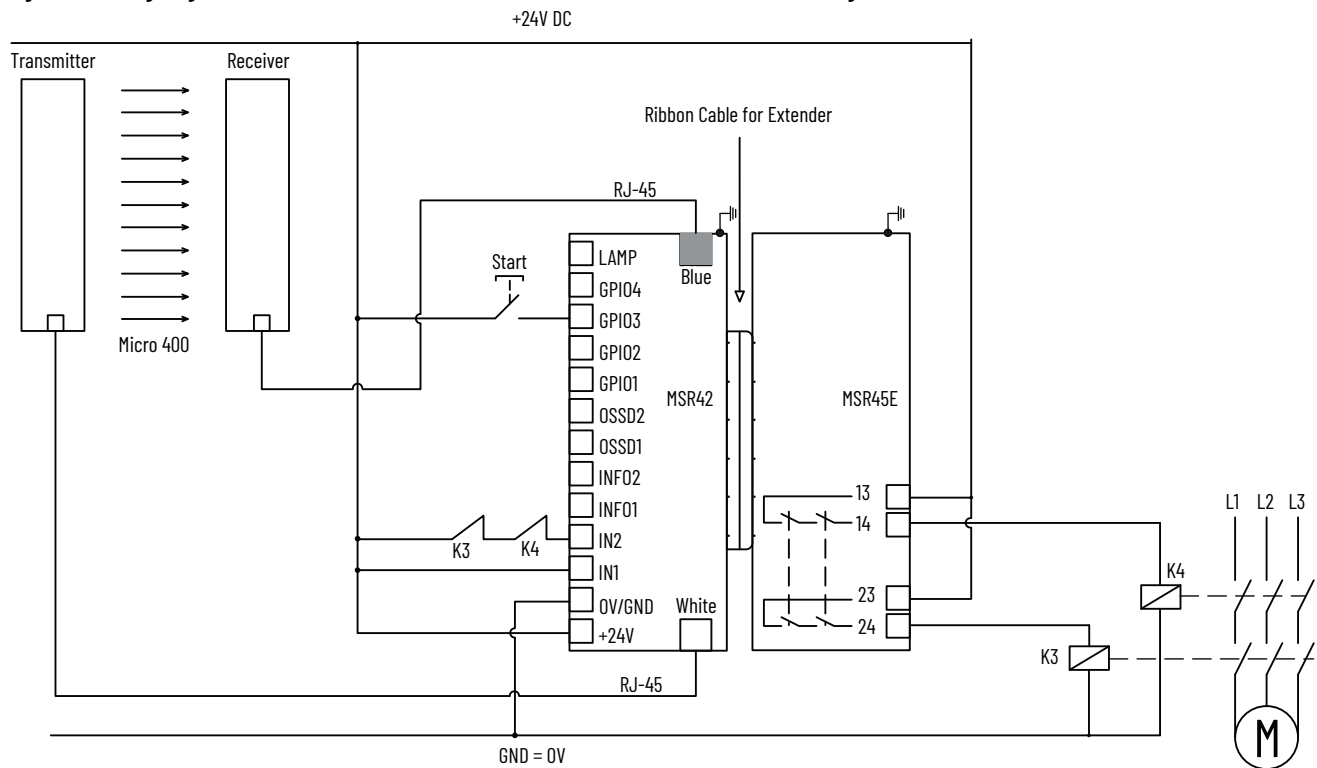
External Test Signal

If the risk analysis of the application requires an external test signal (according to EN 13849-1), see publication 440R-UM008.

Power Supply

You can only conduct the power supply and the evaluation of the protective field of a GuardShield Micro 400 safety light curtain through an MSR41 or MSR42 series safety module.

Bringing Into Operation

The transmitter and receiver units must connect to an MSR41 or MSR42 safety module. Then the supply voltage can connect to the control unit. After power-up, there is an automatic self-test (duration < 5 s) of all system components.

If the protective field is free and the transmitter and receiver are correctly aligned, the green status indicators on the GuardShield Micro 400 safety light curtains illuminate.

If after a successful power-up the safety light curtain detects an interruption of the protection field, the red status indicators on the GuardShield Micro 400 safety light curtains illuminate.

Outputs

A GuardShield Micro 400 safety light curtain pair always connects to a safety controller. Every connection to a machine controller or a safety circuit is done through an MSR41 or MSR42 safety module. Each controller provides two redundant semiconductor OSSD (Output Signal Switching Device) safety outputs. One or more MSR45E extension modules.

Each MSR41 or MSR42 safety module also provides two status outputs (Info1 and Info2). These controller outputs can only be connected to the machine controller for information purposes.

> ⚠️ **ATTENTION:** The status outputs (Info1 and Info2) of the MSR41 or MSR42 safety modules are not safety related. Do not use within the safety circuit of the machine.
> Review the Checklist before first power-up or after a machine setting change.

Checklist

Complete the following checklist before the initiation or a changed machine setting (for example, a rewiring) of the GuardShield Micro 400 safety light curtain.

1. The power supply is a 24V DC device that must comply with all applicable standards of the Machinery Directive 2006/42/EC, and the product standard (IEC61496), for example 1606-XLP series. No connection to a conventional power supply.
2. Proper polarity of the power supply at the controller of the GuardShield Micro 400 safety light curtain.
3. The transmitter connection cable is properly connected to the transmitter, the receiver connection cable properly connects to the receiver. All plugs are connected.
4. The OSSD outputs do not connect to +24V DC.
5. The connected switching elements (load) do not connect to 24V DC.
6. If two or more GuardShield Micro 400 safety light curtains are in use, confirm that each system is properly installed to avoid optical interference.

Switch on the GuardShield Micro 400 safety light curtain. The system is functional if after 2 seconds switching on, the system starts to work properly if the protection field is free of obstructions.

Troubleshooting

Two status indicators signal system conditions and faults of the GuardShield Micro 400 safety light curtain systems.

A red and a green status indicator are integrated in the end-cap connection module of each profile (near the cable), which clearly signals the status of the protective field. The status indicator display indicates system conditions and faults of the GuardShield Micro 400 safety light curtain systems.

Figure 18 - Status Indicators

Table 7 - Status Indicator Meanings

Status Indicator	Color	Meaning
Green	On	Protective field is free
	Flashing	Intensity is inadequate
Red	Off	Protective field is free
	On	Protective field is interrupted
	Flashing	Error (lock out condition)

You can also obtain the conditions that the status indicators signal from the status outputs of the connected MSR41 or MSR42 safety module (see publications 440R-UM006 and 440R-UM008 of the corresponding control unit).

Continuous red status indicator - Check the alignment of the status indicator of the GuardShield Micro 400 safety light curtain. Use the 445L-AF6150 optical interface to display the individual beam status on a laptop with a USB interface.

Red status indicator flashes (lockout condition) - The following conditions can cause the fault:

1. Inadequate supply voltage to the MSR41 or MSR42 safety module.
2. Transmitter and/or receiver cables do not correctly plug into the MSR41 or MSR42 safety module.
3. Transmitter and receiver safety light curtains connect to the incorrect locations in the controller (transmitter plugged into receiver connection).
4. Incorrect assembly of cascaded systems (transmitter and receiver mixed).
5. Cable connector makes poor contact.
6. Error in the EDM feedback channel at the safety control (only if EDM).
7. Short circuit at the OSSD outputs.
8. A foreign light source affects the receiving unit.
9. Blanking configured and wrong safety light curtain length or resolution connected (only if blanking).

Corrective Steps

1. Examine connections, cables, and plugs of transmitter and receiver.
2. Turn the supply voltage off and on again.

Use the optical interface to display the lockout information on a laptop with a USB interface.

If the status indicator of the safety light curtain still flashes red, contact Rockwell Automation technical support.

> **IMPORTANT** In cascaded systems, only the status indicator in the first safety light curtain illuminates (closest to the safety controller).

Safety Instructions—Maintenance

> ⚠️ **ATTENTION:** Never operate the GuardShield Micro 400 safety light curtain before you conduct the following inspection. Improper inspection can lead to operator injury.

For safety reasons, record all inspection results.

Only conduct an inspection if you clearly understand the functioning of the GuardShield Micro 400 safety light curtain and of the machine.

If the installer, planning engineer and operator are different people, confirm that they have sufficient information available to conduct the inspection.

Regular Inspection

Conduct the following inspections:
- Daily
- According to the risk assessment.
- Whenever the machine setting is changed (electrical or mechanical).
- Whenever a safety 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.

For the inspection, confirm:
1. Approach to hazardous machine parts must only be possible through the protective field of the GuardShield Micro 400 safety light curtain.
2. Operators cannot step through the sensing area while working on dangerous machine parts.
3. The safety distance of the application is bigger than the calculated value.
4. The optic front cover is not scratched or dirty.

Operate the machine and check if the hazardous movement stops under the following circumstances.
5. The protective field is interrupted.
6. Hazardous machine movement stops immediately when the test interrupts the protective field:
   - Directly in front of the transmitter.
   - Directly in front of the receiver.
   - In the middle between transmitter and receiver.
7. No hazardous machine movement while the test rod is anywhere within the protective field.
8. If the blanking function is active, check all sections of the protective field with the appropriate test piece.

> **IMPORTANT** If any of the previously listed conditions do not stop the hazardous motion of the machine, do not allow the machine to operate.

Figure 19 - Proper Testing of Protective Field Using Test Rod
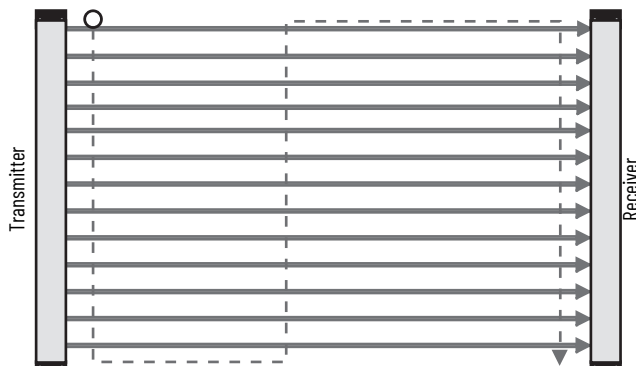
Additionally, conduct a more detailed inspection:
- Whenever a machine setting changes.
- The local regulation or an application-specific standard requires an inspection.
- According to the inspection instruction and the risk assessment of the application.
- Frequently, for example, every 6 months.

For the detailed inspection, confirm:
9. The machine stops or does not obstruct any safety function.
10. The latest machine or connection modifications have no effect on the control system.
11. The outputs of the controller of the GuardShield Micro 400 safety light curtain properly connect to the machine.
12. The total response time of the machine is shorter than the calculated value.
13. Cables and plugs of the GuardShield Micro 400 safety light curtain are in good condition.
14. Mounting brackets, caps and cables are properly secured.

Cleaning

If the optic front cover of the GuardShield Micro 400 safety light curtain is dirty or scratched, the outputs turn off. Use a clean, soft cloth to rub without pressure. Do not apply aggressive or abrasive agents, which attack the surface.

Product Label

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

Figure 20 - Example Labels

Date Code Explanation

As illustrated in Figure 20, the date code is a four-digit number in the format of YYMM (YY = last two digits of the year, WW = the week of the year). This example shows 2213: Year 2022, week 13.

Explanation of Terminology

Abbreviation/Terminology	Definition
Rx	Receiver
Tx	Transmitter
Cat. No.	Catalog number
Ser	Series number
Rev	Revision number
HW	Hardware version
AOPD type	Active opto-electronic protective equipment type 4 based on IEC 61496-1, -2
Type 4	Type 4 based on IEC 61496-1, -2
Operating range	Maximum operating range
Protective height	Protective height
Resolution	Resolution for the protective device (without blanking)
Enclosure rating	IP – enclosure rating
Response time (no blanking)	Response time (see MSR42 safety module) for the protective device, see Response Time on page 4.
	19 ms — Response time t_{LC} of the safety light curtain cascade
	t_c — Response time of the control unit including any connected relay modules
	t_N — Sum of response times t_{LC} of all additional connected GuardShield Micro 400 safety light curtain cascades

Specifications

Table 8 - Specifications

Attribute	Standard	IP69K
Safety Ratings		
Standards	IEC/EN 61496 Parts 1 and 2, UL61496 Parts 1 and 2, UL1998	
Safety classification	Type 4 per IEC/EN61496. Category 4 device per EN 13849-1 SIL 3 per IEC 61508, PLe per EN/ISO 13849-1	
Probability of a dangerous failure per hour PFH	• 6.0 E-9 1/h MSR42 or MSR41 safety module, and MSR45E extension module • 4.0 E-9 1/h Micro 400 safety light curtain	
Certifications	cULus Listed, TÜV, CE Marked for all applicable EU directives, and UKCA marked for all applicable regulations	
Outputs		
Micro 400 safety light curtain outputs	Data output to controller (MSR41 or MSR42 safety module)	
MSR41/MSR42 safety module outputs	Two 400 mA OSSD	
Non-safety outputs	Auxiliary outputs from MSR41 or MSR42 safety module 2 configurable 100 mA, outputs	
Switching current at voltage, max	400 mA at 24V DC	
Operating Characteristics		
Response time	• 14 mm (0.55 in.): 12…42 ms, varies by protective height and resolution, protective height 150…1200 mm (5.95…47.24 in.) • 30 mm (1.18 in.); 11…23 ms, varies by protective height and resolution, protective height 150…1200 mm (5.95…47.24 in.)	
Status indicators	On-state, Off-state, Intensity, lockout	
Protected height	• Standard slim profile: 50…1200 mm (1.97…47.2 in.) in 50 mm (1.97 in.) increments • Reinforced profile: Up to 2200 mm (86.6 in.)	
Resolution	14 mm (0.55 in.), 30 mm (1.18 in.), or PAC (perimeter)	
Scanning range/resolution	• 14 mm (0.55 in.) resolution: 0…5 m (16.4 ft) • 30 mm (1.18 in.) resolution: 0…5 m (16.4 ft)	• 14 mm (0.55 in) resolution: 0…2.5 m (8.2 ft) minimum • 30 mm (0.55 in) resolution: 0…2.5 m (8.2 ft) minimum
Synchronization	Electrical through MSR41 or MSR42 safety module	
Wave length	940 nm	
Time for self-check when switching on U_{sp}	< 5 s	

Table 8 - Specifications (Continued)

Attribute	Standard	IP69K
Environmental		
Enclosure type rating	• Micro 400 safety light curtain: IP54 • Micro 400 safety light curtain IP69K: IP65, IP66, IP67, IP68, IP69K • Plug: IP65	
Relative humidity	15…95% (noncondensing)	
Operating temperature	0…55 °C (14…131 °F)	
Storage temperature	-20…+70 °C (4…158 °F)	
Vibration [1]	Per IEC 61496-1 Edition 4 (Class 3M7), IEC 60068-2-29, frequency 10…150 Hz; amplitude 10 mm (0.39 in.), acceleration 3 g	
Shock [1]	Per IEC 61496-1 Edition 4 (Class 3M7), IEC 60068-2-27, acceleration 25 g, duration 6 ms	
Power supply	Input power from MSR41 or MSR42 safety module	
Input power, max	24V DC ±15% (MSR41 or MSR42 safety module)	
Maximum residual ripple	5% of Vss	
Power consumption	0.07 A max (no load)	
Equipment class	III (VDE 0106 part 100)	
EMC	IEC 61496 part 1	
Physical Characteristics		
Number of beams, max	255	
Standard mounting	180° adjustable mounting brackets supplied (two sets 445L-AF6143)	
Weight	Varies by protective height	
Housing cross section	• Slim profile (standard): 15 mm x 20 mm (0.59 x 0.79 in.) • Reinforced profile (special): 30 mm x 40 mm (1.18 x 1.57 in.)	
Optical window	Polycarbonate	
Enclosure and enclosure treatment	Aluminum, polyester powder coated, silicon free	
Connection type	Transmitter/receiver: 8-pin M12 micro QD	
Cable length	1 m, 2 m, 3 m, 5 m, and 8 m (3.3 ft, 6.6 ft, 9.8 ft, 16.4 ft, and 26.2 ft) cable M12 to RJ45 for MSR41 or MSR42 safety module. Max total system length cannot exceed 10 m (32.8 ft).	
Patchcords	1 m, 3 m, and 5 m (3.3 ft, 9.8 ft, and 16.4 ft) M12 to M12 patchcords. Total system length cannot exceed 10 m (32.8 ft) including protective height of Micro 400 safety light curtain, integrated cables, and patchcords from M12 connector to MSR41 or MSR42 safety module.	

(1) MSR41/42/45E tested to Class 3M4

Catalog Number Explanation

445L	-	P	4	C	0150	F	P
		a		b	c	d	e

a	
Unit Type	
Code	**Description**
C	Cascade
E	Cascade receiver
G	Cascade transmitter
P	Pair
R	Receiver
T	Transmitter

b	
Resolution [mm (in.)]	
Code	**Description**
C	14 (0.55)
E	30 (1.18)

c	
Protected Height [mm (in.)]	
Code	**Description**
0050	50 (1.95)
0100	100 (3.9)
0150	150 (5.9)
0200	200 (7.8)
0250	250 (9.85)
0300	300 (11.8)
0350	350 (14.75)
0400	400 (15.7)
0450	450 (17.7)
0500	500 (19.7)
0550	550 (21.65)
0600	600 (23.6)
0650	650 (25.6)
0700	700 (27.6)
0750	750 (29.5)
0800	800 (31.5)
0850	850 (33.5)
0900	900 (35.4)
0950	950 (37.5)
1000	1000 (39.4)
1050	1050 (41.3)
1100	1100 (43.3)
1200	1200 (47.2)

d	
Environmental Rating	
Code	**Description**
F	IP54
K	IP69K

e	
Connection Option	
Code	**Description**
P	Pigtail (micro QD)
D	M12, 8-pin QD

GuardShield Micro 400 Safety Light Curtain Products

The response times in Table 9 are maximum values with no blanking configured. If blanking is configured in the Micro 400 safety light curtain controller, the response time values can be higher. The times depend on the controller type and the configuration. The real response time can be faster. Go to the Download section of rok.auto/pcdc and search for MSR42 safety module.

IMPORTANT	GuardShield Micro 400 safety light curtain products are only sold as pairs. Table 9…Table 13 on page 16 provide the previous catalog numbers for one transmitter and one receiver. However, these numbers are no longer available as single sticks (for example, for replacement purposes). If a replacement is needed, order a complete sensor pair.
	Table 9…Table 13 on page 16 provide an extract of the Rockwell Automation offering. A complete list of all lengths and resolutions is available at rok.auto/systemtools. The response time of each pair can be evaluated in the Configuration Tool software or is provided on the product label.

Table 9 - GuardShield Micro 400 Safety Light Curtain, Standard, Profile 20 x 15 mm, Resolution 14 mm (0.55 in.)

Sensor Pair	Transmitter	Receiver	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-P4C0150FP	445L-T4C0150FP	445L-R4C0150FP	150 (5.91)	14.6	0.8 (28.2)
445L-P4C0300FP	445L-T4C0300FP	445L-R4C0300FP	300 (11.81)	18.5	0.9 (31.7)
445L-P4C0450FP	445L-T4C0450FP	445L-R4C0450FP	450 (17.71)	22.4	0.9 (31.7)
445L-P4C0600FP	445L-T4C0600FP	445L-R4C0600FP	600 (23.62)	26.3	1.0 (35.27)
445L-P4C0750FP	445L-T4C0750FP	445L-R4C0750FP	750 (29.52)	30.2	1.1 (38.8)
445L-P4C0900FP	445L-T4C0900FP	445L-R4C0900FP	900 (35.43)	34.1	1.3 (45.86)
445L-P4C1050FP	445L-T4C1050FP	445L-R4C1050FP	1050 (41.33)	38.0	1.3 (45.86)
445L-P4C1200FP	445L-T4C1200FP	445L-R4C1200FP	1200 (47.24)	41.9	1.3 (45.86)

(1)   Includes packaging.

Table 10 - GuardShield Micro 400 Safety Light Curtain, Standard, Profile 20 x 15 mm, Resolution 30 mm (1.81 in.)

Sensor Pair	Transmitter	Receiver	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-P4E0150FP	445L-T4E0150FP	445L-R4E0150FP	150 (5.91)	12.4	0.8 (28.2)
445L-P4E0300FP	445L-T4E0300FP	445L-R4E0300FP	300 (11.81)	13.9	0.9 (31.7)
445L-P4E0450FP	445L-T4E0450FP	445L-R4E0450FP	450 (17.71)	15.5	0.9 (31.7)
445L-P4E0600FP	445L-T4E0600FP	445L-R4E0600FP	600 (23.62)	17.0	1.0 (35.27)
445L-P4E0750FP	445L-T4E0750FP	445L-R4E0750FP	750 (29.52)	18.5	1.1 (38.8)
445L-P4E0900FP	445L-T4E0900FP	445L-R4E0900FP	900 (35.43)	20.2	1.2 (42.33)
445L-P4E1050FP	445L-T4E1050FP	445L-R4E1050FP	1050 (41.33)	21.7	1.3 (45.86)
445L-P4E1200FP	445L-T4E1200FP	445L-R4E1200FP	1200 (47.24)	23.3	1.3 (45.86)

(1)   Includes packaging.

Table 11 - GuardShield Micro 400 Safety Light Curtain, Cascaded, Profile 20 x 15 mm, Resolution 14 mm (0.55 in.)

Sensor Pair	Transmitter	Receiver	Protection Height A [mm (in.)]	Weight Per Pair [1] [kg (oz)]
445L-C4C0150FP	445L-G4C0150FP	445L-F4C0150FP	150 (5.91)	0.8 (28.2)
445L-C4C0300FP	445L-G4C0300FP	445L-F4C0300FP	300 (11.81)	0.9 (31.7)
445L-C4C0450FP	445L-G4C0450FP	445L-F4C0450FP	450 (17.71)	0.9 (31.7)
445L-C4C0600FP	445L-G4C0600FP	445L-F4C0600FP	600 (23.62)	1.0 (35.27)
445L-C4C0900FP	445L-G4C0900FP	445L-F4C0900FP	900 (35.43)	1.2 (42.33)
445L-C4C1200FP	445L-G4C1200FP	445L-F4C1200FP	1200 (47.24)	1.3 (45.86)

(1)   Includes packaging.

Table 12 - GuardShield Micro 400 Safety Light Curtain, Cascaded, Profile 20 x 15 mm, Resolution 30 mm (1.81 in.)

Sensor Pair	Transmitter	Receiver	Protection Height A [mm (in.)]	Weight Per Pair [1] [kg (oz)]
445L-C4E0150FP	445L-G4E0150FP	445L-F4E0150FP	150 (5.91)	0.8 (28.2)
445L-C4E0300FP	445L-G4E0300FP	445L-F4E0300FP	300 (11.81)	0.9 (31.7)
445L-C4E0600FP	445L-G4E0600FP	445L-F4E0600FP	600 (23.62)	1.0 (35.27)
445L-C4E0750FP	445L-G4E0750FP	445L-F4E0750FP	750 (29.52)	1.1 (38.8)
445L-C4E0900FP	445L-G4E0900FP	445L-F4E0900FP	900 (35.43)	1.2 (42.33)
445L-C4E1200FP	445L-G4E1200FP	445L-F4E1200FP	1200 (47.24)	1.3 (45.86)

(1)   Includes packaging.

Table 13 - GuardShield Micro 400 Safety Light Curtain, IP69K, Tube, Resolution 14 mm (0.55 in.)

| Sensor Pair [1]	Transmitter	Receiver	Protection Height A [mm (in.)]	System Length B [2] [mm (in.)]	Clamp Mounting C [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [3] [kg (oz)]
445L-P4C0150KD	445L-T4C0150KD	445L-R4C0150KD	150 (5.91)	262 (10.3)	240 (9.5)	14.6	1.45 (51.15)
445L-P4C0300KD	445L-T4C0300KD	445L-R4C0300KD	300 (11.81)	412 (16.2)	390 (15.4)	18.5	1.5 (52.9)
445L-P4C0600KD	445L-T4C0600KD	445L-R4C0600KD	600 (23.62)	712 (28.0)	690 (27.2)	26.3	1.7 (59.96)
445L-P4C0900KD	445L-T4C0900KD	445L-R4C0900KD	900 (35.43)	1012 (39.8)	990 (39.0)	34.1	2.3 (81.13)
445L-P4C1200KD	445L-T4C1200KD	445L-R4C1200KD	1200 (47.24)	1312 (51.7)	1290 (50.8)	41.9	2.4 (84.66)

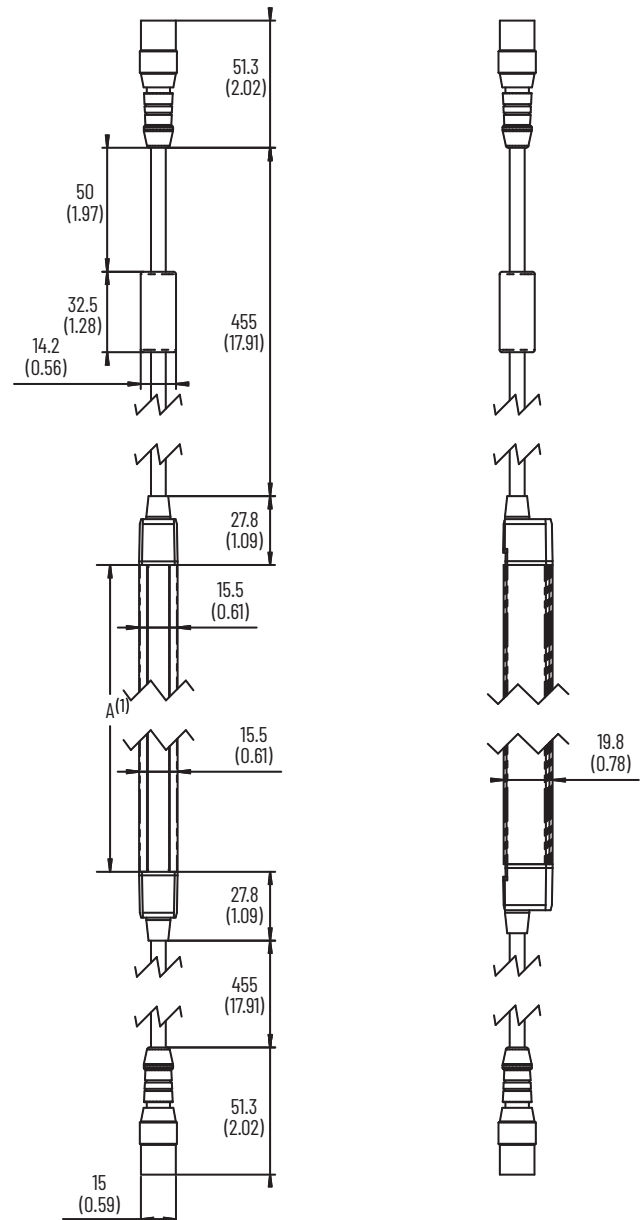(1)   Mounting kit included.
(2)   No cable.
(3)   Includes packaging.

Approximate Dimensions

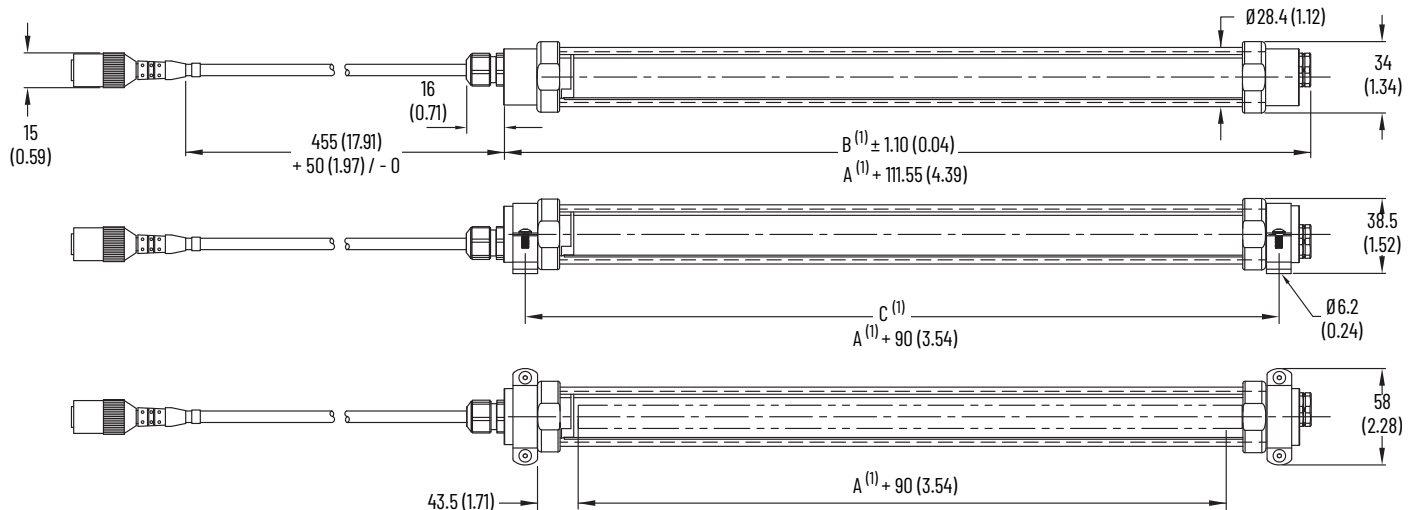**Figure 21 - GuardShield Micro 400 Safety Light Curtain, Standard, [mm (in.)]**

Figure 22 - GuardShield Micro 400 Safety Light Curtain, Cascaded, [mm (in.)]
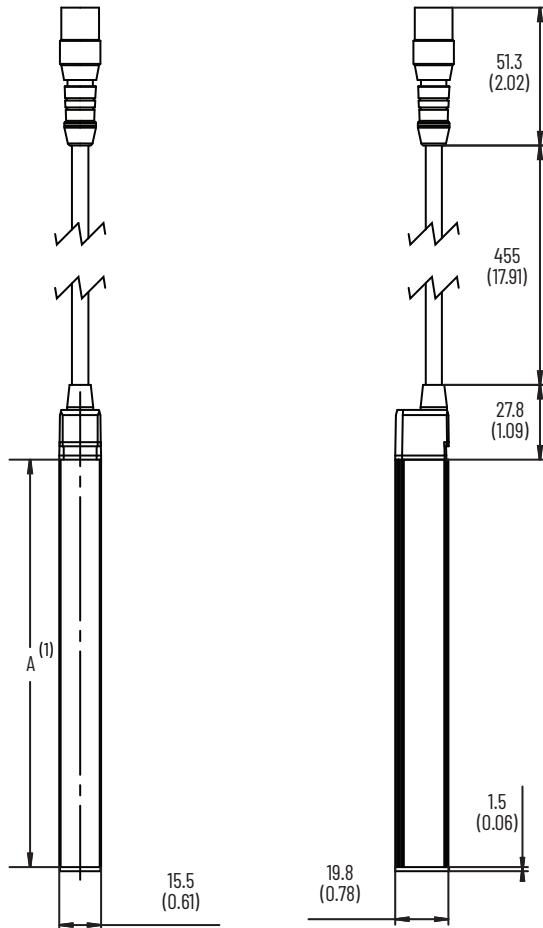
(1) Protection height, according to Table 9 on page 15 and Table 10 on page 16.

(1) Protection height, according to Table 11 and Table 12 on page 16.

Figure 23 - GuardShield Micro 400 Safety Light Curtain, IP69K [mm (in.)]

(1) See Table 13 on page 16 for A (protection height), B (system length), and C (clamp mounting).

Accessories

Table 14 - Required Safety Module — Select One

Description	Mounting	Size [mm (in.)]	Cat. No.
MSR41 On/Off	35 mm (1.38 in.) DIN rail	22.5 (0.89)	440R-P221AGS
MSR42 Multi-functional	35 mm (1.38 in.) DIN rail	22.5 (0.89)	440R-P226AGS-NNR

Table 15 - Optional Safety Relay Extension Module

Relay	Input Voltage	Reset	Outputs	Cat. No.
MSR45E	Supplied by MSR41 or MSR42 safety module	Determined by MSR41 or MSR42 safety module	2 N.O.	440R-P4NANS

The MSR41 or MSR42 safety module can have up to three MSR45E extension module interconnected. Each module requires a ribbon cable connector to make the interconnection. Table 16 shows the catalog number for each ribbon cable connector.

Table 16 - Safety Relay Interface Accessories for MSR41 or MSR42 Safety Module

Description	Cat. No.
Ribbon cable – for one MSR45E extension module	440R-ACABL1
Ribbon cable – for two MSR45E extension module	440R-ACABL2
Ribbon cable – for three MSR45E extension module	440R-ACABL3

Operation mode and parameters of the MSR42 safety module can be changed using the configuration software, which is available on rok.auto/pcdc and with the optical interface 445L-AF6150. Programming of the MSR42 safety module is only necessary for advanced operating modes (for example, Blanking, Muting) or for connection of additional devices (for example, enabling switch, E-stop button).
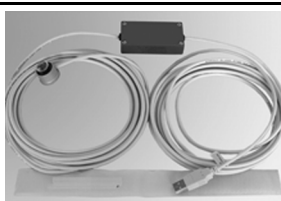
Table 17 - Optical Interface

Description	Cat. No.
	USB optical interface software configuration tool that is used to configure the MSR42 safety module	445L-AF6150

Table 18 - Optional Accessories

Description	Cat. No.
Adjustable 180° bracket kit (two per kit) Two kits are supplied with each pair.	445L-AF6143
Flat bracket kit (two per kit) Two kits are required per pair.	445L-AF6145
Adjustable flat bracket (two per kit) Two kits are required per pair.	445L-AF6149
IP69K mounting bracket kit (two per kit) Two kits are supplied with each IP69K pair.	445L-AF6160

Table 19 - Mirror 440L-AM075, [mm (in.)]

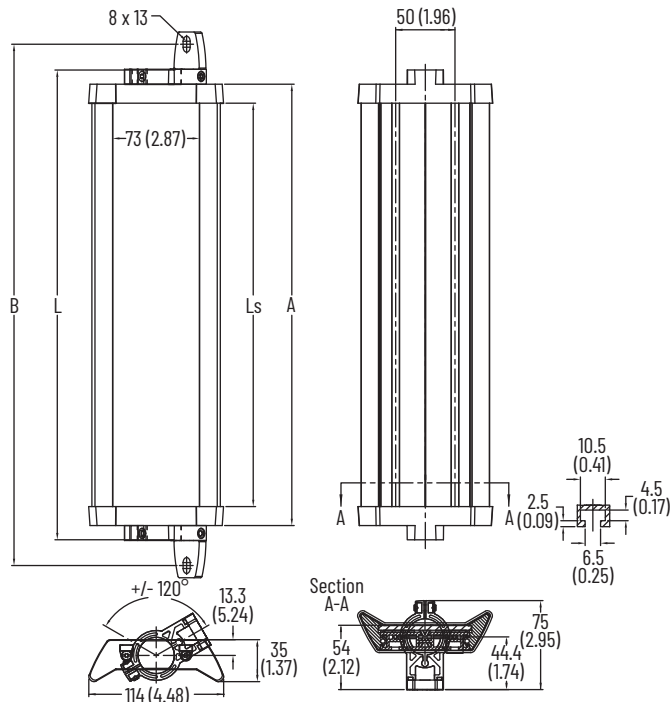| Cat. No.	Series	Description	L	L_S	A	B
440L-AM0750300	A	300 mm (11.8 in.), 4 m (13.12 ft)	396	340	372	440
440L-AM0750450	A	450 mm (17.7 in.), 4 m (13.12 ft)	546	490	522	590
440L-AM0750600	A	600 mm (23.6 in.), 4 m (13.12 ft)	696	640	672	740
440L-AM0750750	A	750 mm (29.5 in.), 4 m (13.12 ft)	846	790	822	890
440L-AM0750900	A	900 mm (35.4 in.), 4 m (13.12 ft)	996	940	972	1040
440L-AM0751050	A	1050 mm (41.3 in.), 4 m (13.12 ft)	1146	1090	1122	1190
440L-AM0751200	A	1200 mm (47.2 in.), 4 m (13.12 ft)	1296	1240	1272	1340
440L-AM0751350	A	1350 mm (53.15 in.), 4 m (13.12 ft)	1446	1390	1422	1490
440L-AM0751500	A	1500 mm (59.05 in.), 4 m (13.12 ft)	1596	1540	1572	1640
440L-AM0751650	A	1650 mm (64.96 in.), 4 m (13.12 ft)	1746	1690	1722	1790
440L-AM0751800	A	1800 mm (70.87 in.), 4 m (13.12 ft)	1896	1840	1872	1940

Table 20 shows specially constructed glass mirrors for 2 and 3-sided safeguarding applications. Each mirror reduces the maximum scan range by 10% per mirror. Each corner mirror is supplied with two end-cap mounting brackets.

Table 20 - Corner Mirror for Multi-sided Guarding

| Micro 400 Protected Height [mm (in.)]	Narrow Mirror Short-range 0...4 m (0...13.1 ft)	Mirror Height [(mm (in.)]	Cat. No.
150 (5.91) / 300 (11.8)		300 (11.8)	440L-AM0750300
450 (17.7)		450 (17.7)	440L-AM0750450
600 (23.6)		600 (23.6)	440L-AM0750600
750 (29.5)		750 (29.5)	440L-AM0750750
900 (35.4)		900 (35.4)	440L-AM0750900
1050 (41.3)		1050 (41.3)	440L-AM0751050
1200 (47.2)		1200 (47.2)	440L-AM0751200

GuardShield Micro 400 Special Safety Light Curtain Systems

Along with the GuardShield Micro 400 safety light curtain manual, this appendix offers some additional information for some GuardShield Micro 400 safety light curtain special systems.

Systems with Reinforced Profiles
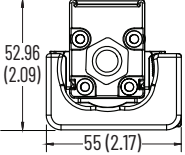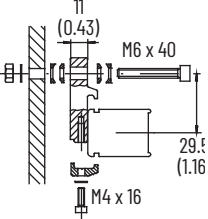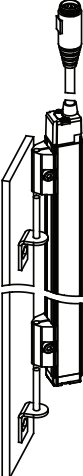
The GuardShield Micro 400 standard safety light curtains are offered in the slim profile with dimensions of 20 x 15 mm (0.79 x 0.59 in.). The maximum length is limited to 1200 mm (47.2 in.) to help prevent damage by twisting or bending. For longer lengths up to 2200 mm (86.61 in.), the systems are offered in a red reinforced profile. Standard and cascaded systems are available, based on the reinforced profile.

Figure 24 - Cross Section of the Robust (Reinforced) Profile [mm (in.)]
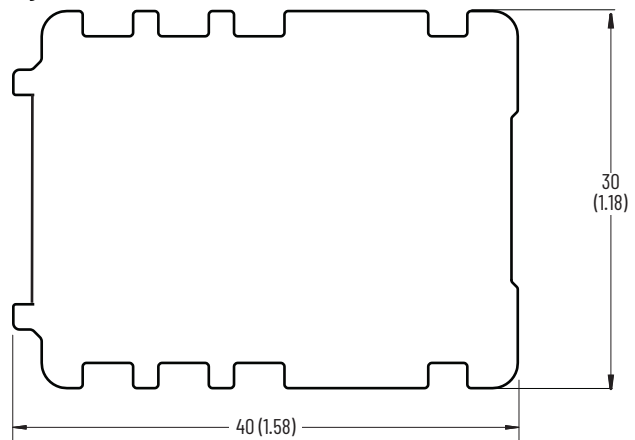
The default mounting kit that ships with a GuardShield Micro 400 safety light curtain in a reinforced profile is catalog number 450L-AM-SM. Drawings of this mounting kit are provided in publication 450L-IN002. Optional mounting kits (catalog number 445L-AF6140 or 445L-AF6141) are also available (for details, see publication 445L-UM001).

Table 21 - Mounting Accessories for Reinforced Profile

Accessory		Cat. No.
	Side mounting bracket kit for reinforce profile (two per kit) supplied with each pair.	450L-AM-SM
	Optional flat bracket kit for reinforce profile (two per kit). Two kits are required per pair.	445L-AF6140
	Optional adjustable 180° bracket kit (two per kit) for reinforced profile. Two kits are required per pair.	445L-AF6141

Perimeter Systems (PAC)

Perimeter systems are produced with several single-beam light barriers. The flexibility of the GuardShield Micro 400 safety light curtain system also allows the production of vertical entry safeguarding, according to the standard EN ISO 13855 [2010]. Such systems are composed of active and passive elements in one compact profile (see Table 30 and Table 31 on page 23. The element length of each is 50 mm (1.97 in.).

The GuardShield Micro 400 safety light curtain perimeter systems offer ease of mounting and uncomplicated operation startup. Time spent to connect and align the optics is reduced in comparison to standard perimeter systems that consist of single beam light barriers and mirrors.

The protective field and the active elements, respectively, are clearly recognized as surfaces with the integrated optical lenses. The not-monitored areas (passive elements) are also clearly indicated as black surfaces.

Calculate the System Safety Distance

For vertical mounted perimeter GuardShield Micro 400 PAC Systems or safety light curtains with horizontal approach and a resolution larger than > 40 mm (1.57 in.), the safety distance is calculated by:

S = 1.6 mm (0.06 in.)/ms x T + 850 mm (33.46 in.)

More detailed information regarding safety distance and safety heights is in standard EN 13855 (2010).

Figure 25 - Perimeter Systems (2-, 3-, and 4-beams)
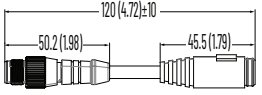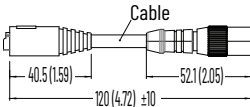
Installation According to EN ISO 13855 [2010]
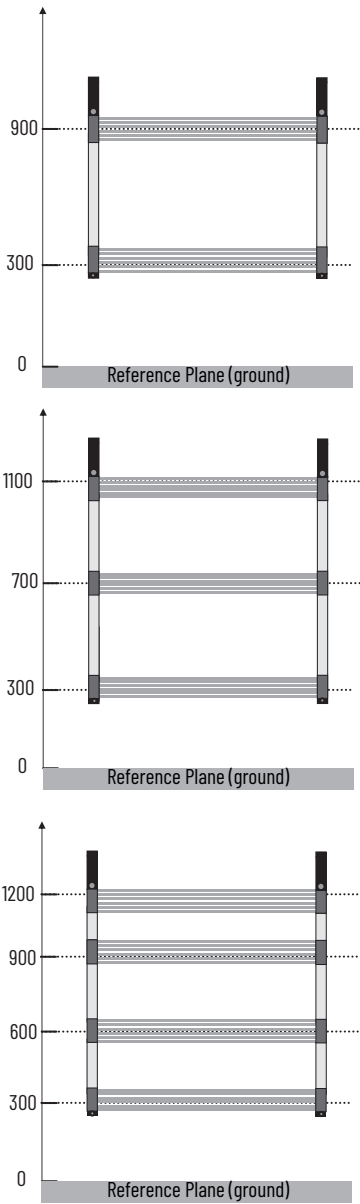
Special Patchcords

All GuardShield Micro 400 safety light curtains have a M12/8-pin connector. Special patchcords can be necessary to replace older connector versions.

Table 22 - Cordset Dimensions

Cordset [mm (in.)]	Cat. No.	Description
	445L-ACDN9M12	Patchcord, 8-pin, Din9/concave to M12/convex
	445L-109296	Patchcord, 8-pin, Din9/convex to M12/concave

Special Systems

Besides the standard lengths that are given in Specifications on page 14, Rockwell Automation also offers some special lengths and configurations. For those systems, expect longer lead times.

The mentioned response times in Table 23 are maximum values. The times depend on the controller type and the configuration. The actual response time can be faster. Obtain the exact response time from the MSR42 safety module configuration software. To download the configuration software, go to the Download section of rok.auto/pcdc and search for MSR42.

Table 23 - GuardShield Micro 400 Safety Light Curtain, Nonstandard Lengths, Profile 20 x 15 mm (0.79 x 0.59 in.), Resolution 14 mm (0.55 in.)

Sensor Pair	Transmitter	Receiver	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-P4C0050FP	445L-T4C0050FP	445L-R4C0050FP	50 (1.97)	12.0	0.6 (21.16)
445L-P4C0100FP	445L-T4C0100FP	445L-R4C0100FP	100 (3.94)	13.3	0.7 (24.69)
445L-P4C0200FP	445L-T4C0200FP	445L-R4C0200FP	200 (7.87)	15.9	0.8 (28.2)
445L-P4C0250FP	445L-T4C0250FP	445L-R4C0250FP	250 (9.84)	17.2	0.8 (28.2)
445L-P4C0350FP	445L-T4C0350FP	445L-R4C0350FP	350 (13.78)	19.8	0.9 (31.7)
445L-P4C0400FP	445L-T4C0400FP	445L-R4C0400FP	400 (15.75)	21.1	0.9 (31.7)
445L-P4C0500FP	445L-T4C0500FP	445L-R4C0500FP	500 (19.69)	23.7	0.9 (31.7)
445L-P4C0550FP	445L-T4C0550FP	445L-R4C0550FP	550 (21.65)	25.0	1.0 (35.27)
445L-P4C0650FP	445L-T4C0650FP	445L-R4C0650FP	650 (25.59)	27.6	1.0 (35.27)
445L-P4C0700FP	445L-T4C0700FP	445L-R4C0700FP	700 (27.56)	28.9	1.1 (38.8)
445L-P4C0800FP	445L-T4C0800FP	445L-R4C0800FP	800 (31.50)	31.5	1.2 (42.33)
445L-P4C0850FP	445L-T4C0850FP	445L-R4C0850FP	850 (33.46)	32.8	1.2 (42.33)
445L-P4C0950FP	445L-T4C0950FP	445L-R4-C0950FP	950 (37.4)	35.4	1.3 (45.86)
445L-P4C1000FP	445L-T4C1000FP	445L-R4C1000FP	1000 (39.37)	36.7	1.3 (45.86)
445L-P4C1100FP	445L-T4C1100FP	445L-R4C1100FP	1100 (43.31)	39.3	1.3 (45.86)

(1) Packaging included

Table 24 - GuardShield Micro 400 Safety Light Curtain, Nonstandard Lengths, Profile 20 x 15 mm (0.79 x 0.59 in.), Resolution 30 mm (1.18 in.)

Sensor Pair	Transmitter	Receiver	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-P4E0050FP	445L-T4E0050FP	445L-R4E0050FP	50 (1.97)	11.3	0.6 (21.16)
445L-P4E0100FP	445L-T4E0100FP	445L-R4E0100FP	100 (3.94)	11.8	0.6 (21.16)
445L-P4E0200FP	445L-T4E0200FP	445L-R4E0200FP	200 (7.87)	12.9	0.7 (24.69)
445L-P4E0250FP	445L-T4E0250FP	445L-R4E0250FP	250 (9.84)	13.3	0.7 (24.69)
445L-P4E0350FP	445L-T4E0350FP	445L-R4E0350FP	350 (13.78)	14.4	0.8 (28.2)
445L-P4E0400FP	445L-T4E0400FP	445L-R4E0400FP	400 (15.75)	15.0	0.8 (28.2)
445L-P4E0500FP	445L-T4E0500FP	445L-R4E0500FP	500 (19.69)	15.9	0.9 (31.7)
445L-P4E0550FP	445L-T4E0550FP	445L-R4E0550FP	550 (21.65)	16.5	1.0 (35.27)
445L-P4E0650FP	445L-T4E0650FP	445L-R4E0650FP	650 (25.59)	17.6	1.1 (38.8)
445L-P4E0700FP	445L-T4E0700FP	445L-R4E0700FP	700 (27.56)	18.1	1.2 (42.33)
445L-P4E0800FP	445L-T4E0800FP	445L-R4E0800FP	800 (31.5)	19.1	1.3 (45.86)
445L-P4E0850FP	445L-T4E0850FP	445L-R4E0850FP	850 (33.46)	19.6	1.3 (45.86)
445L-P4E0950FP	445L-T4E0950FP	445L-R4E0950FP	950 (37.4)	20.7	1.4 (49.38)
445L-P4E1000FP	445L-T4E1000FP	445L-R4E1000FP	1000 (39.37)	21.1	1.4 (49.38)
445L-P4E1100FP	445L-T4E1100FP	445L-R4E1100FP	1100 (43.31)	22.2	1.5 (52.9)

(1) Packaging included

Table 25 - GuardShield Micro 400 Safety Light Curtain, Nonstandard Lengths, Cascaded, Profile 20 x 15 mm (0.79 x 0.59 in.), Resolution 14 mm (0.55 in.)

Sensor Pair	Transmitter	Receiver	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-C4C0050FP	445L-G4C0050FP	445L-F4C0050FP	50 (1.97)	12.0	0.6 (21.16)
445L-C4C0100FP	445L-G4C0100FP	445L-F4C0100FP	100 (3.94)	13.3	0.6 (21.16)
445L-C4C0200FP	445L-G4C0200FP	445L-F4C0200FP	200 (7.87)	15.9	0.8 (28.2)
445L-C4C0250FP	445L-G4C0250FP	445L-F4C0250FP	250 (9.84)	17.2	0.9 (31.7)
445L-C4C0350FP	445L-G4C0350FP	445L-F4C0350FP	350 (13.78)	19.8	0.9 (31.7)

Table 25 - GuardShield Micro 400 Safety Light Curtain, Nonstandard Lengths, Cascaded, Profile 20 x 15 mm (0.79 x 0.59 in.), Resolution 14 mm (0.55 in.) (Continued)

Sensor Pair	Transmitter	Receiver	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-C4C0400FP	445L-G4C0400FP	445L-F4C0400FP	400 (15.75)	21.1	0.9 (31.7)
445L-C4C0500FP	445L-G4C0500FP	445L-F4C0500FP	500 (19.69)	23.7	0.9 (31.7)
445L-C4C0550FP	445L-G4C0550FP	445L-F4C0550FP	550 (21.65)	25.0	1 (35.27)
445L-C4C0650FP	445L-G4C0650FP	445L-F4C0650FP	650 (25.59)	27.6	1 (35.27)
445L-C4C0700FP	445L-G4C0700FP	445L-F4C0700FP	700 (27.56)	28.9	1 (35.27)
445L-C4C0800FP	445L-G4C0800FP	445L-F4C0800FP	800 (31.5)	31.5	1.1 (38.8)
445L-C4C0850FP	445L-G4C0850FP	445L-F4C0850FP	850 (33.46)	32.8	1.1 (38.8)
445L-C4C0950FP	445L-G4C0950FP	445L-F4C0950FP	950 (37.4)	35.4	1.1 (38.8)
445L-C4C1000FP	445L-G4C1000FP	445L-F4C1000FP	1000 (39.37)	36.7	1.3 (45.86)
445L-C4C1100FP	445L-G4C1100FP	445L-F4C1100FP	1100 (43.31)	39.3	1.3 (45.86)

(1)   Packaging included

Table 26 - GuardShield Micro 400 Safety Light Curtain, Nonstandard Lengths, Cascaded, Profile 20 x 15 mm (0.79 x 0.59 in.), Resolution 30 mm (1.18 in.)

Sensor Pair	Transmitter	Receiver	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-C4E0050FP	445L-G4E0050FP	445L-F4E0050FP	50 (1.97)	11.3	0.1 (3.53)
445L-C4E0150FP	445L-G4E0150FP	445L-F4E0150FP	150 (5.91)	12.4	0.2 (7.05)
445L-C4E0300FP	445L-G4E0300FP	445L-F4E0300FP	300 (11.81)	13.9	0.3 (10.58)
445L-C4E0350FP	445L-G4E0350FP	445L-F4E0350FP	350 (13.78)	14.4	0.4 (14.11)
445L-C4E0400FP	445L-G4E0400FP	445L-F4E0400FP	400 (15.75)	15.0	0.4 (14.11)
445L-C4E0450FP	445L-G4E0450FP	445L-F4E0450FP	450 (17.72)	15.5	0.4 (14.11)
445L-C4E0600FP	445L-G4E0600FP	445L-F4E0600FP	600 (23.62)	17.0	0.5 (17.64)
445L-C4E0750FP	445L-G4E0750FP	445L-F4E0750FP	750 (29.52)	18.5	0.6 (21.16)
445L-C4E0900FP	445L-G4E0900FP	445L-F4E0900FP	900 (35.43)	20.2	0.7 (24.69)
445L-C4E1200FP	445L-G4E1200FP	445L-F4E1200FP	1200 (47.24)	23.3	0.9 (31.7)

(1)   Packaging included

Table 27 - GuardShield Micro 400 Safety Light Curtain, Special Systems, Profile Reinforced 40 x 30 mm (1.57 x 1.18 in.), Resolution 14 mm (0.55 in.)

Sensor Pair	Transmitter	Receiver	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-110490-0001	445L-110119	445L-110118	150 (5.91)	14.6	1.1 (38.8)
445L-110490-0002	445L-110121	445L-110120	300 (11.81)	18.5	1.3 (45.86)
445L-110490-0003	445L-110123	445L-110122	400 (15.75)	21.1	1.5 (52.9)
445L-110490-0004	445L-110125	445L-110124	450 (17.72)	22.4	1.6 (56.44)
445L-110490-0024	445L-111391	445L-111390	500 (19.69)	23.7	1.3 (45.86)
445L-110490-0006	445L-110129	445L-110128	600 (23.62)	26.3	1.9 (67.02)
445L-110490-0008	445L-110133	445L-110132	750 (29.53)	30.2	2.2 (77.6)
445L-110490-0028	445L-112858	445L-112857	800 (31.5)	31.5	2.3 (81.13)
445L-110490-0009	445L-110135	445L-110134	900 (35.43)	34.1	2.5 (88.18)
445L-110490-0010	445L-110137	445L-110136	1000 (39.37)	36.7	2.8 (98.77)
445L-110490-0029	445L-112862	445L-112861	1050 (41.34)	38.0	2.9 (102.29)
445L-110490-0025	445L-111394	445L-111395	1100 (43.31)	39.3	3.0 (105.82)
445L-110490-0011	445L-110139	445L-110138	1200 (47.24)	41.9	3.1 (109.35)
445L-110490-0013	445L-110143	445L-110142	1350 (53.15)	45.8	3.4 (119.93)
445L-110490-0014	445L-110145	445L-110144	1500 (59.06)	49.7	3.7 (130.51)
445L-110490-0015	445L-110147	445L-110146	1600 (62.99)	52.3	4.1 (144.62)
445L-110490-0017	445L-110151	445L-110150	1650 (64.96)	53.6	4.1 (144.62)
445L-110490-0030	445L-112866	445L-112865	1700 (66.93)	54.9	4.2 (148.15)
445L-110490-0018	445L-110153	445L-110152	1800 (70.87)	57.5	4.3 (151.68)
445L-110490-0019	445L-110155	445L-110154	2000 (78.74)	62.7	4.3 (151.68)
445L-110490-0027	445L-111378	445L-111377	2100 (82.68)	65.3	4.4 (155.20)
445L-110490-0020	445L-110157	445L-110156	2200 (86.61)	67.9	4.6 (162.26)

(1)   Packaging included

Table 28 - GuardShield Micro 400 Safety Light Curtain, Special Systems, Profile Reinforced 40 x 30 mm (1.57 x 1.18 in.), Resolution 30 mm (1.18 in.)

Sensor Pair	Transmitter	Receiver	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-110490-0005	445L-110127	445L-110126	500 (19.69)	15.9	1.7 (59.96)
445L-110490-0012	445L-110141	445L-110140	1300 (51.18)	24.3	3.3 (116.4)
445L-110490-0016	445L-110149	445L-110148	1600 (62.99)	27.4	4.1 (144.62)

(1) Packaging included

Table 29 - GuardShield Micro 400 Safety Light Curtain, Special Systems, Cascaded, Profile Reinforced 40 x 30 mm (1.57 x 1.18 in.), Resolution 14 mm (0.55 in.)

Sensor Pair	Transmitter	Receiver	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-110491-0001	445L-110171	445L-110170	600 (23.62)	26.3	1.9 (67.02)
445L-110491-0002	445L-110173	445L-110172	750 (29.53)	30.2	2.2 (77.6)
445L-110491-0003	445L-110175	445L-110174	900 (35.43)	34.1	2.5 (88.18)
445L-110491-0004	445L-110177	445L-110176	1000 (39.37)	36.7	2.8 (98.77)
445L-110491-0015	445L-111399	445L-111398	1050 (41.34)	38.0	2.9 (102.29)
445L-110491-0005	445L-110179	445L-110178	1100 (43.31)	39.3	2.9 (102.29)
445L-110491-0006	445L-110181	445L-110180	1200 (47.24)	41.9	3.1 (109.35)
445L-110491-0007	445L-110183	445L-110182	1350 (53.15)	45.8	3.4 (119.93)
445L-110491-0008	445L-110185	445L-110184	1500 (59.06)	49.7	3.7 (130.51)
445L-110491-0009	445L-110187	445L-110186	1650 (64.96)	53.6	4.1 (144.62)
445L-110491-0010	445L-110189	445L-110188	1800 (70.87)	57.5	4.3 (151.68)

(1) Packaging included

Table 30 - GuardShield Micro 400 Safety Light Curtain, Special Systems, Profile Slim 20 x 15 mm (0.79 x 0.59 in.), PAC

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-110492-0002	445L-110161	445L-110160	2 Beam, 500 (19.68)	550 (21.65)	11.8	1.0 (35.27)
445L-110492-0004	445L-110165	445L-110164	3 Beam, 400 (15.75)	850 (33.46)	12.4	1.2 (42.33)
445L-110492-0006	445L-110169	445L-110168	4 Beam, 300 (11.81)	950 (37.40)	12.9	1.3 (45.86)

(1) Packaging included

Table 31 - GuardShield Micro 400 Safety Light Curtain, Special Systems, Profile Reinforced 40 x 30 mm (1.57 x 1.18 in.), PAC

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-110492-0001	445L-110159	445L-110158	2 Beam, 500 (19.68)	550 (21.65)	11.8	1.8 (63.49)
445L-110492-0003	445L-110163	445L-110162	3 Beam, 400 (15.75)	850 (33.46)	12.4	2.4 (84.66)
445L-110492-0005	445L-110167	445L-110166	4 Beam, 300 (11.81)	950 (37.40)	12.9	3.1 (109.35)

(1) Packaging included

Table 32 - Special GuardShield Micro 400 Safety Light Curtain, Special Systems, Profile 20 x 15 mm (0.79 x 0.59 in.)

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Protection Height A [mm (in.)]	Response Time, Max t_{LC} [ms]	Weight Per Pair [1] [kg (oz)]
445L-103567-0055	–	–	14 (0.55)	150…150 (5.91…5.91)	18.5	1.9 (67.02)
445L-109316	–	–	14 (0.55)	150 (5.91) cascaded	14.6	0.6 (21.16)
445L-109317	–	–	14 (0.55)	150 (5.91)	14. 6	0.6 (21.16)
445L-103567-0018	–	–	14 (0.55)	50…450 (1.97…17.72)	23.7	1.2 (42.33)
445L-103567-0065	–	–	14 (0.55)	50…400 (1.97…15.75)	22.4	1.1 (38.8)
445L-110490-0007	445L-110131	445L-110130	30 (1.18)	650 (25.59)	17.6	1.0 (35.27)
445L-108582-0002	445L-108578	445L-108579	30 (1.18)	900 (35.43)	20.2	1.3 (45.86)
–	445L-108670	445L-108671	30 (1.18)	800 (31.5)	19.1	1.2 (42.33)
445L-108582-0003	–	–	30 (1.18)	600 (23.62)	< 17.0	–
445L-108582-0001	–	–	30 (1.18)	650 (25.6)	< 18.0	–
445L-108582-0004	–	–	30 (1.18)	800 (31.5)	< 20.0	–

Table 32 - Special GuardShield Micro 400 Safety Light Curtain, Special Systems, Profile 20 x 15 mm (0.79 x 0.59 in.) (Continued)

Sensor Pair	Transmitter	Receiver	Resolution [mm (in.)]	Protection Height A [mm (in.)]	Response Time, Max t_LC [ms]	Weight Per Pair [1] [kg (oz)]
445L-108582-0002	–	–	30 (1.18)	900 (35.4)	< 21.0	–
445L-103663-0013	–	–	30 (1.18)	1300 (51.18)	< 25.0	–
445L-103663-0007	–	–	30 (1.18)	1550 (61.02)	< 27.0	–
445L-103663-0020	–	–	30 (1.18)	1800 (70.86)	< 30.0	–
445L-106317	–	–	14 (0.55)	700 (27.56)	< 29.0	–
445L-106316	–	–	14 (0.55)	700 (27.56)	< 29.0	–
445L-110130	–	–	30 (1.18)	650 (25.59)	< 17.5	–
445L-108671	–	–	30 (1.18)	800 (31.5)	< 19.1	–
445L-110131	–	–	30 (1.18)	650 (25.6)	< 17.5	–
445L-108670	–	–	30 (1.18)	800 (31.5)	< 19.1	–

(1) Packaging included

Declaration of Conformity

Certifications

- cULus Listed Industrial Control Equipment, which is certified for US and Canada
- CE Marked for all applicable EU directives
- UKCA Marked for all applicable regulations
- 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.

CE Conformity

Rockwell Automation declares that the products that are shown in this document conform with the 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.

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

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