KEYENCE

NEW **Safety Light Curtain**

SL-C Series

EDGE-TO-EDGE **DETECTION ZONE**

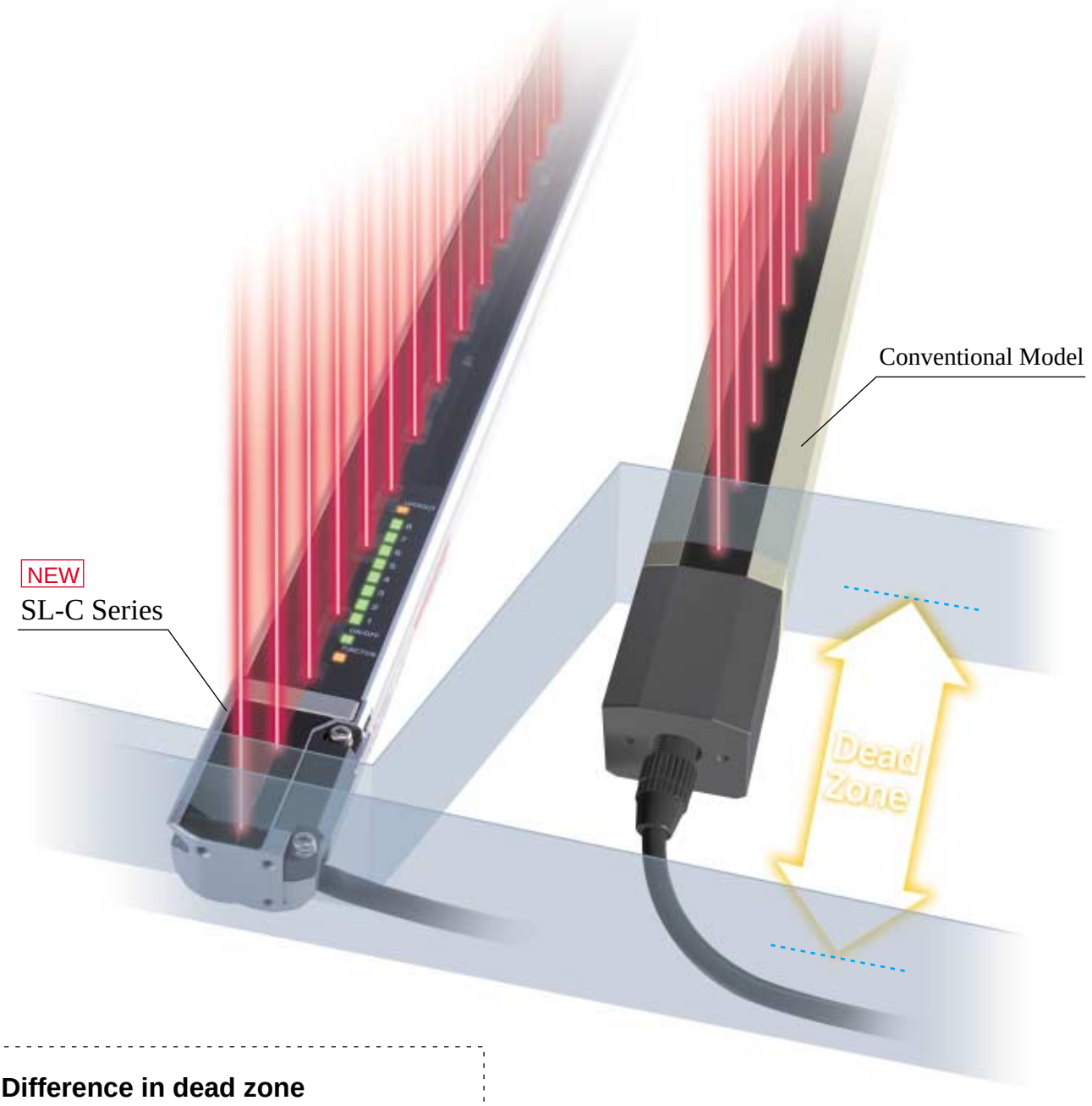
INDUSTRY FIRST!

Type4

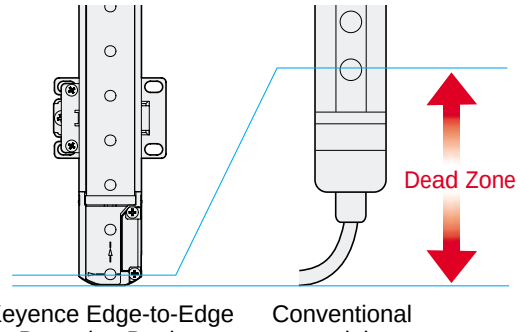
CE TÜV c UL us LISTED

Edge-to-Edge Detection Design Eliminates Any "DEAD Zone", Making the Most of Your...

Safety Light Curtain.



Difference in dead zone



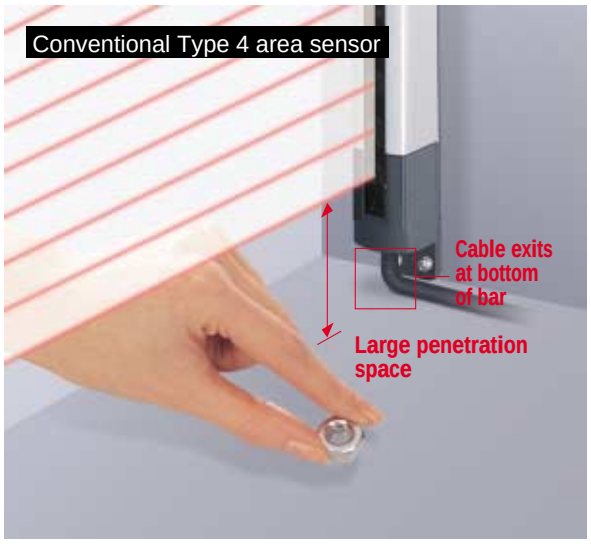
The first beam axis position:

Keyence's new optical design transmits light just 5 mm above the edge. Almost no dead space is left even at the end of the light curtain. Conventional light curtains have a large dead space at the end due to connecting parts or support structures and cables.

Edge-to-Edge detection zone makes a true fully guarded area

Eliminate Dead-zones at every part of the safety light curtain

- The top and bottom beam axes are positioned just 5 mm from the reference surfaces.
- Cables can be routed in any direction.



A hand can penetrate through the dead zone

Even a finger tip cannot penetrate the detection zone

Compliance with international safety standards and regulations

The SL-C Series line of **Type 4** safety light curtains complies with the following safety light curtain standards and satisfies the most stringent safety requirements as embodied in safety category 4.

ANSI | **OSHA** | **JIS** | **IEC**

International standards	EN standard	UL standards	JIS standards
IEC61496-1and IEC61496-2	EN61496-1	UL61496-1and UL61496-2	JIS B9704-1and JIS B9704-2

Certification for international and EN standards has been received from TUV-Product Service GmbH. Compliance is certified with EU directives (the Machinery, EMC, and Low-Voltage Directives), allowing the SL-C Series to be used with peace of mind in Europe.

UL certification also includes compliance with Canadian safety standards. Compliance with the requirements of the ANSI RIA R/15.06-1999 industrial robot standard has also been certified, and the devices can be safely used with machinery and other equipment that is subject to OSHA regulations and ANSI standards.

The SL-C Series also complies with JIS standards, so it can be safely used with safety and protective equipment as indicated in the “Guidelines for Comprehensive Safety Standards of Machinery”, June 1, 2001, number 501 issued by Ministry of Health, Labour, and Welfare in Japan.

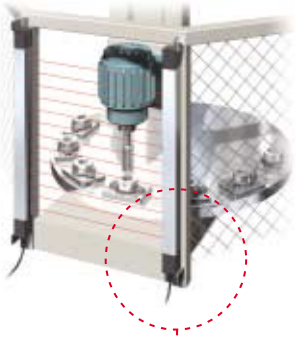
Solving every common problem when installing safety light curtains

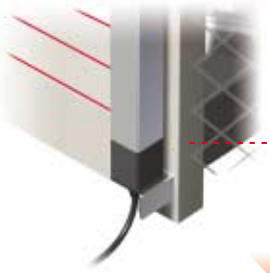
1 Normal access protection

Conventional models

Impossible to flush-mount

The conventional light curtain must be mounted outside of the entrance due to the dead zone at the bottom the sensor and connector. This results in an extra protrusion around the machine and makes the safety area setting more complex.





Light curtain mounted outside is obstructed

Keyence SL-C Solution

Flush-mounting saves space

The SL-C has almost no dead zone at the top or bottom and can be mounted just inside of the entrance without any extra work protrusion.

2 Inside mounting

Conventional models

Extra protective shield required

When the conventional light curtain is mounted inside of the entrance, it requires an additional protective shield in order to cover the dead zone.

Extra protective shield for covering the dead zone

Keyence SL-C Solution

No protective shield required

The SL-C can be mounted just inside of the entrance and requires no additional shield because there is no dead zone.

Achieves the shortest possible safety distance

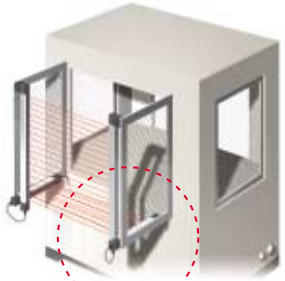
With conventional area sensors, the influence of mounting brackets and cable connectors made achieving the safety distance indicated in the specifications difficult. With the SL-C Series, the first beam axis is positioned just 5 mm above the edge, preventing any part of the body from penetrating into a hazardous zone. The system is able to achieve the shortest possible safety distance because there is no space loss caused by mounting brackets or cable connectors. Since the cable exits at the side of the frame rather than at its base, the bottom of the sensor bar can be firmly attached to the base surface. The cable can be routed freely in any direction.

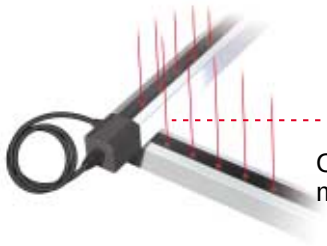
3 Perpendicular mounting of multiple light curtains

Conventional models

Overlapped mounting

To configure a protection area using two or more light curtains, light curtains must be mounted with ends crossed to suppress the dead zone. This requires extra work and special brackets.





Overlapping and cables make a large protrusion

Keyence SL-C Solution

Just mount contacting ends

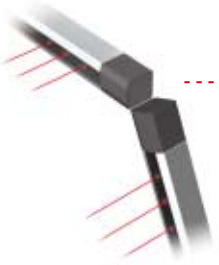
Two SL-C light curtains can be mounted on the same plane whilst touching. This builds a protection area without a dead zone. Wiring is very simple.

4 Angled mounting of multiple light curtains

Conventional models

Inevitable dead zone

When two or more light curtains must be mounted in series, there will be a dead space between them. Some additional protection work should be prepared.



A large dead zone is inevitable

Keyence SL-C Solution

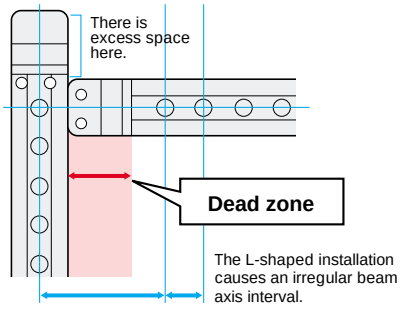
No dead zone with simple wiring

Two SL-C light curtains can be mounted in series. This builds a protection area with no dead zone.

Same safety distance, even with L-shaped installations

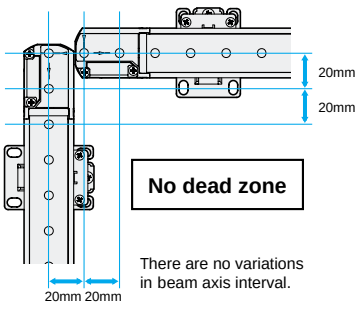
With a conventional area sensor L-shaped installation:

The safety distance increases since the minimum detectable object capability becomes larger.



With a SL-C L-shaped installation using the E-to-E brackets:

No variations in the minimum detectable object means no variations in safety distance.



Status indicators accurately transmit the current sensor status to operators

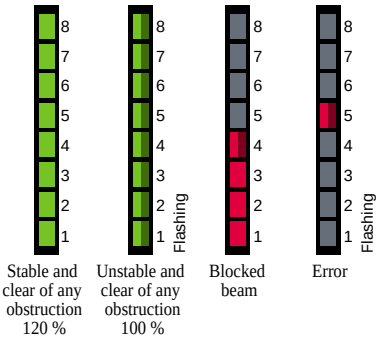
The safety light curtain incorporates an 11-light LED indicator that notifies operators of the unit's current output, light input, and error status.

Lockout indicator

When the SL-C's control circuit detects a system error, it puts the system into lockout mode, and the indicator turns orange.

Bar LED (8 lights)

During normal operation: Indicates light received.
When an error occurs: Position of flashing light notifies operator of the nature of the error.



Output status indicator

Indicates the OSSD output status. The indicator turns green when the OSSD output is ON.
The indicator turns red when the OSSD output is OFF to indicate that the machine has been stopped.

Sensor bar plug outlet

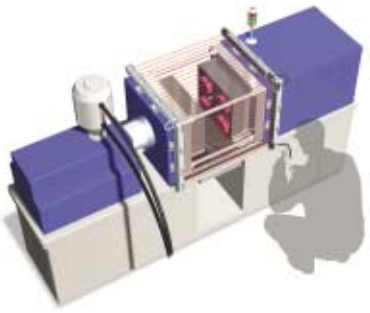
No. 1 beam axis

Functions that keep you safe

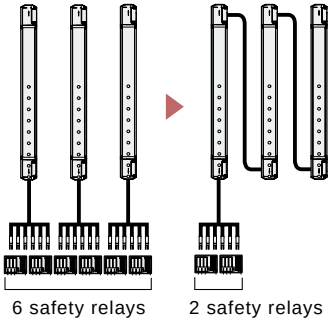
Multiple safety light curtains as a single sensor

Serial connection

Serial connection cables can be used to connect up to 4 safety light curtain pairs in series, so that 4 sets of wiring are replaced by a single set of wiring. Since the system requires only a single safety circuit, this approach can help you achieve significant cost reductions in addition to the savings from reduced wiring. (Max. 192 beam axes)



Serial connection diagram



In order to use 3 SL-C Series pairs, 36 wiring connections (12 transmitter and receiver wires X 3 pairs) are required. In addition, the installation will require 6 safety relays (2 outputs X 3 pairs). On the other hand, if the 3 SL-C pairs are connected in series they will function electrically as a single light curtain, reducing total cost by requiring only one-third the wiring and parts.

Built-in-Controller [TYPE 4] Safety Light Curtain

A controller circuit is built in the safety light curtain itself. A conventional large controller box is not required, yet the SL-C Series provides Type 4 performance.

Conventional products

The light curtain, itself, conforms to the type 4 standards

SL-C Series

For safety use

If the light curtain is to be used as a Category 4 Safety Device, just connect the SL-C Series to the Safety Relay Module.

PLUS

CATEGORY 4

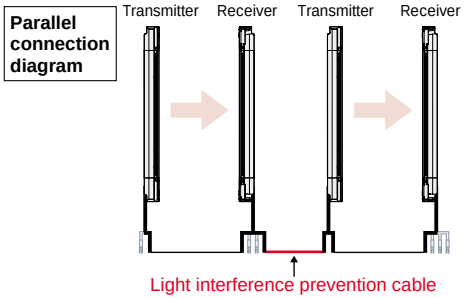
SL-C Series Light Curtain **Safety Relay Module**

Preventing light interference among multiple safety light curtains

Parallel connection

Light interference can be prevented using up to 4 SL-C pairs by connecting their light interference prevention cables. This approach is effective in installations where separate SL-C sensors are likely to interfere with one another, such as when light curtains are to be deployed in rows or when the beams are made to intersect. (Max. 192 beam axes)

Worker penetration is prevented at a row of parallel pickup windows.



Light interference between SL-C Series units requires only the connection of the light interference prevention cables of the master unit's receiver and the sub unit's transmitter. This connection has no effect on response time.

* See the SL-C Instruction Manual for information about the number of units that can be deployed in mixed serial and parallel environments.

Safety relay

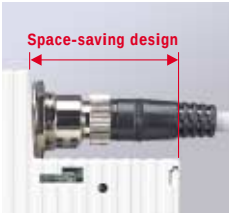
SL-R11 Intelligent Safety Relay Unit

The SL-R11 brings together all of the features necessary in order to build a safety Category 4 compatible safety circuit into a single unit. This makes possible a dramatic reduction in the amount of time and labour required by complex circuit design processes. The unit also boasts quick connectors that simplify the wiring process involved in connecting the relay to the light curtain itself. The SL-R11 eliminates the need for special knowledge about safety circuits.

Safety Relay Unit

Quick Connector

The safety light curtain is connected via a connector, reducing the amount of time and labour required by wiring and eliminating the danger of wiring mistakes.



Space-saving

A convenient case design ensures that the connectors do not extend outside of the unit's footprint, helping to save space inside control panels.

Replaceable Relay

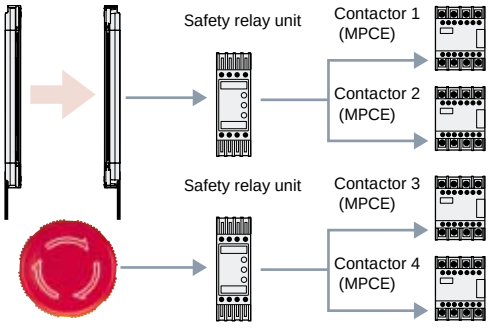
The relay board (OP-42372) can be replaced without removing any wiring, eliminating time loss and potential connection mistakes during board rewiring.

*The terminal unit can also be removed separately.

This compact safety circuit retains compatibility with safety category 4 while allowing “E-STOP” emergency stop switch inputs.

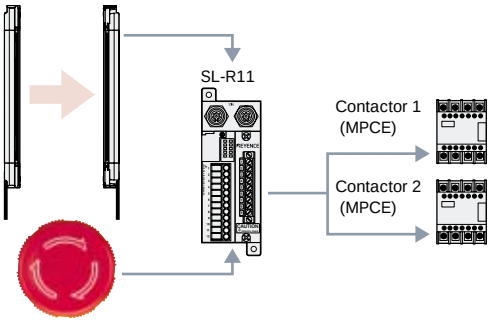
Most manufacturing equipment provides an emergency stop switch. Such a switch can also be wired directly to the SL-R11. This allows single SL-R11 units to be used for Category 4 safety circuits, which require the redundant protection of a safety light curtain combined with an emergency stop switch.

Conventional setup



In order to combine an emergency stop button with a safety light curtain for safety category 4 applications, you must create 2 safety circuits - even when using safety relay units.

SL-R11 with E-STOP input



By using the SL-R11 Intelligent Safety Relay Unit's E-STOP input feature, you can create a simple safety circuit. This approach cuts down on the number of parts as well as the time and labour required for system wiring, helping to trim the overall project cost.

AC power supply

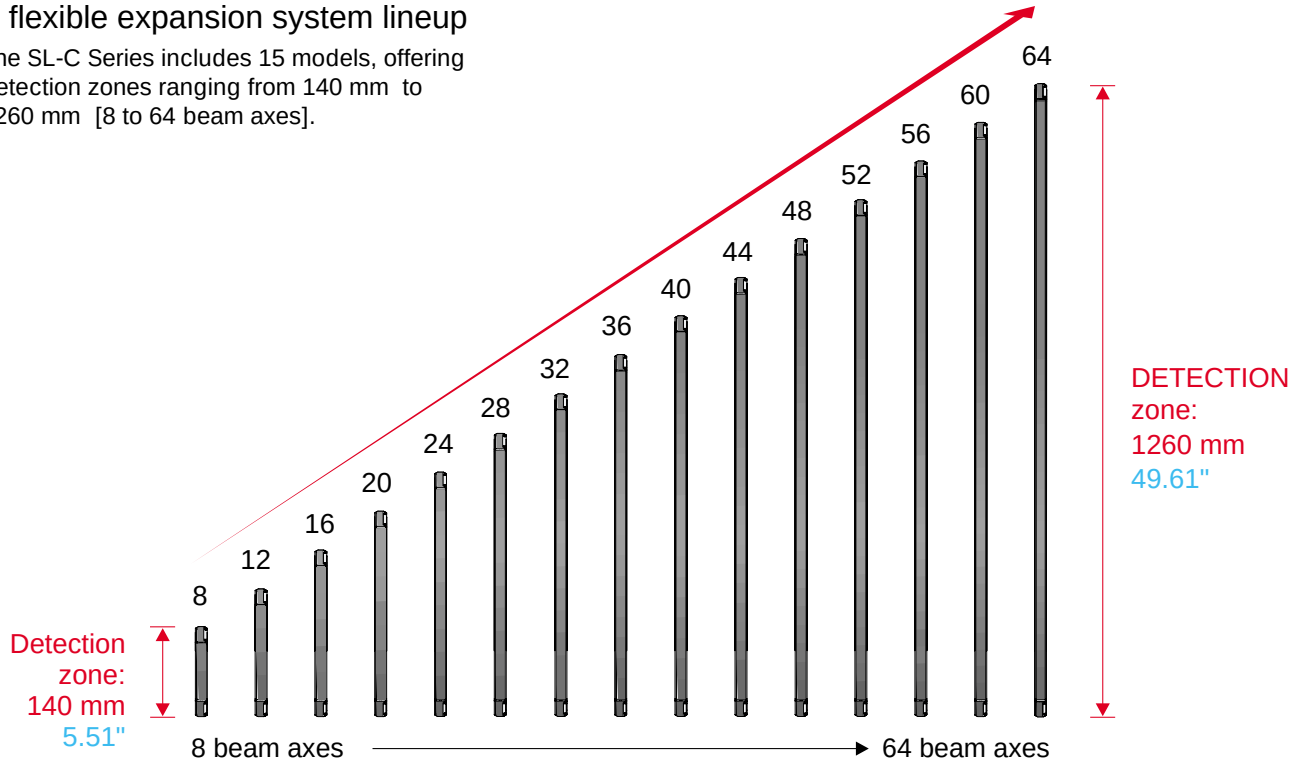
SL-C Series dedicated Class 2 power supply

In order to use the SL-C Series as a Type 4 light curtain, you will need a power supply that meets IEC/EN/UL61496-1 requirements. The SL-U2 is a dedicated power supply unit that meets all of these requirements.

The SL-U2 uses a direct connection, eliminating the need for external wiring.

A flexible expansion system lineup

The SL-C Series includes 15 models, offering detection zones ranging from 140 mm to 1260 mm [8 to 64 beam axes].



Safety Light Curtain

Model	Operating distance	No. of beam axes	Detection zone (mm)	Sensor length (mm)
SL-C08H	0.3 to 9 m 1.0' to 29.5'	8	140 5.51"	150 5.91"
SL-C12H		12	220 8.66"	230 9.06"
SL-C16H		16	300 11.81"	310 12.20"
SL-C20H		20	380 14.96"	390 15.35"
SL-C24H		24	460 18.11"	470 18.50"
SL-C28H		28	540 21.26"	550 21.65"
SL-C32H		32	620 24.41"	630 24.80"
SL-C36H		36	700 27.56"	710 27.95"
SL-C40H		40	780 30.71"	790 31.10"
SL-C44H		44	860 33.86"	870 34.25"
SL-C48H		48	940 37.01"	950 37.40"
SL-C52H		52	1020 40.16"	1030 40.55"
SL-C56H		56	1100 43.31"	1110 43.70"
SL-C60H		60	1180 46.46"	1190 46.85"
SL-C64H		64	1260 49.61"	1270 50.00"

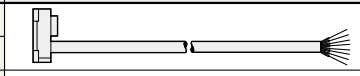
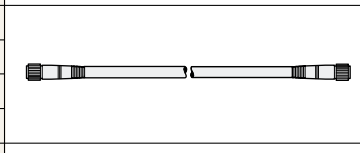
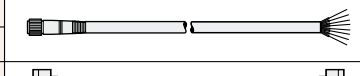
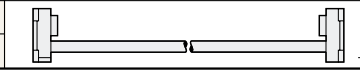
Safety Relay Unit

Model	Name	Output format
SL-R11	Intelligent Safety Relay Unit	Relay outputs, 2 control outputs, 1 auxiliary output

Power Supply Unit

Model	Name	Input rating	Output rating
SL-U2	SL-C/R Dedicated Power Supply	AC 100 to 240 V ±10%	DC 24 V ±10%, Class 2

Cables

Model	Configuration	Specifications	Included
SL-P7P		Main unit plug→Loose wires (7 m 23.0') PNP output	2 : For T and R
SL-P7N		Main unit plug→Loose wires (7 m 23.0') NPN output	2 : For T and R
SL-PC5P		Main unit plug→M12 connector (5 m 16.4') PNP output	2 : For T and R
SL-PC5N		Main unit plug→M12 connector (5 m 16.4') NPN output	2 : For T and R
SL-PC10P		Main unit plug→M12 connector (10 m 32.8') PNP output	2 : For T and R
SL-CC10PT		M12 connector→M12 connector (10 m 32.8') PNP output Transmitter	1 : For T only
SL-CC10PR		M12 connector→M12 connector (10 m 32.8') PNP output Receiver	1 : For R only
SL-CC10NT		M12 connector→M12 connector (10 m 32.8') NPN output Transmitter	1 : For T only
SL-CC10NR		M12 connector→M12 connector (10 m 32.8') NPN output Receiver	1 : For R only
SL-C5P		M12 connector→Loose wires (5 m 16.4') PNP output	2 : For T and R
SL-C5N		M12 connector→Loose wires (5 m 16.4') NPN output	2 : For T and R
SL-S1		Serial expansion cable (0.15 m 0.5')	2 : For T and R
SL-S3		Serial expansion cable (3 m 9.8')	2 : For T and R

*When using a connector cable as an extension, PNP and NPN type cables cannot be used in combination.

About cable models

SL-CC 10 P T

1 2 3 4

1. Indicates the cable's terminal connectors. P: Plug; C: Connector; None: Loose wires.
2. Indicates the cable's length.
3. Indicates the output acquired during use. P: PNP output; N: NPN output.
4. Indicates whether the cable is intended for use with the transmitter or the receiver. T: Transmitter; R: Receiver; None: Transmitter/receiver set.

Edge-to-Edge bracket

(OP-42370)

The SL-C is held in place from the sides of the frame, not with brackets installed at both ends of the device as with conventional models. This approach eliminates the space loss that is inevitably caused by these brackets. The mounting mechanism both allows rotation for fine-tuning of beam axis alignment and enables the beam axes to be installed diagonally.

L-shaped mounting bracket

(OP-42371)

Applications requiring that safety light curtains be installed in L- or U-shaped configurations are becoming increasingly common as part of efforts to improve equipment safety and ease of operation. The problem posed by such installations is the irregular beam axis interval variations that occur where the two safety light curtains meet. By using the specially designed L-shaped mounting bracket, you can avoid this irregular interval variation and easily maintain a uniform beam axis interval of 20 mm.

Normal A, B, and C mounting brackets with rotating mechanisms

In addition to the E-to-E bracket and L-shaped mounting bracket, KEYENCE also offers 3 types of mounting brackets with rotating mechanisms that enjoyed great popularity with the PJ-V Series. Use of a combination of these 3 brackets allows the SL-C Series to be used with mounting holes originally intended for KEYENCE PJ-V Series area sensors and other manufacturer's light curtains.

Three types of bracket can be used in combination.

The bracket's mechanism can be rotated. A convenient feature during beam axis adjustment.

Use the bracket in this orientation to reduce dead space.

Mounting brackets

Model	Name	Explanation
OP-42370	E-to-E bracket	Holds the sensor in place from the side. One set contains 2 brackets.
OP-42371	L-shaped mounting bracket	Useful in L-shaped installations. One set contains 2 brackets.
OP-42347	Standard mounting bracket A	Standard mounting brackets with rotating mechanisms. Select a model based on the position of the mounting holes.
OP-42348	Standard mounting bracket B	
OP-42349	Standard mounting bracket C	

Support tools provide protection for the light curtain

Protection bar

The protection bar protects the light curtain when workpieces are being removed or inserted. A lightweight construction ensures that bar installation imposes only a small burden on the setup. Models are available for all light curtain models, from 8 to 64 beam axes.

Protective bars

	Protection bar
Compatible model	Model
SL-C08H	**OP-42350**
SL-C12H	**OP-42351**
SL-C16H	**OP-42352**
SL-C20H	**OP-42353**
SL-C24H	**OP-42354**
SL-C28H	**OP-42355**
SL-C32H	**OP-42356**
SL-C36H	**OP-42357**
SL-C40H	**OP-42358**
SL-C44H	**OP-42359**
SL-C48H	**OP-42360**
SL-C52H	**OP-42361**
SL-C56H	**OP-42362**
SL-C60H	**OP-42363**
SL-C64H	**OP-42364**

Compatible with compact corner mirrors

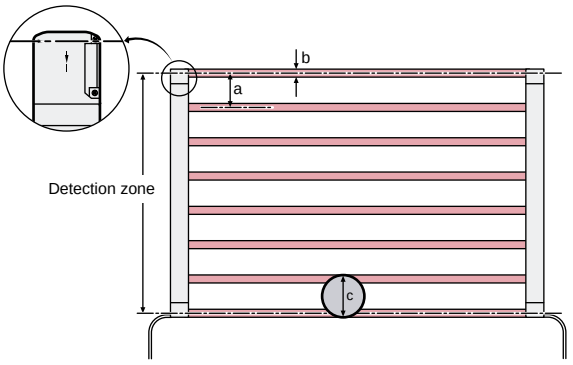
Three types of corner mirrors provide compatibility with 8 to 32 beam axes. A single safety light curtain pair can be used to establish 2 or 3 protection zones.

* System cannot be used as a retro-reflective type setup.

Other options

Model	Name	Explanation
OP-42365	SL-R11 light interference prevention connector	Makes a light interference prevention connection between 2 SL-R11 units.
OP-42372	Replacement relay board	Replacement SL-R11 relay board.
OP-42373	Intermediate support bracket	Included in models with at least 32 beam axes. One set contains 2 support brackets.
OP-35334	300 mm 11.81" slim corner mirror	Corner mirrors that can be used to create a 2- or 3-surface protection zone using mirror reflection.
OP-35335	460 mm 18.11" slim corner mirror	
OP-35336	620 mm 24.41" slim corner mirror	

Detection Zone and Installation



a: Beam axis interval (20 mm)
b: Beam axis width (5 mm dia.)
c: Be sure to use the 25mm diameter test piece provided by KEYENCE.

Can be safely exported and used in Africa and Europe.

Compliant with EU directives | TÜV certified | UL listed

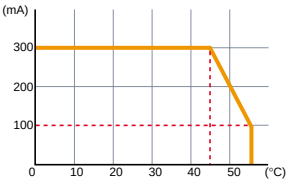
SL-C specifications by model

Model		SL-C08H	SL-C12H	SL-C16H	SL-C20H	SL-C24H	SL-C28H	SL-C32H	SL-C36H
No. of beam axes		8	12	16	20	24	28	32	36
Beam axis interval		20 mm							
Detection zone		140 mm	220mm	300 mm	380 mm	460 mm	540 mm	620 mm	700 mm
Current consumption	Transmitter	55 mA	58mA	61 mA	62 mA	68 mA	71 mA	74 mA	77 mA
	Receiver	67 mA	69mA	71 mA	73 mA	76 mA	78 mA	81 mA	83 mA
Weight	Transmitter	Approx. 165 g	Approx. 210 g	Approx. 255 g	Approx. 300 g	Approx. 345 g	Approx. 390 g	Approx. 435 g	Approx. 480 g
	Receiver	Approx. 180 g	Approx. 230 g	Approx. 280 g	Approx. 330 g	Approx. 380 g	Approx. 430 g	Approx. 480 g	Approx. 530 g

Model		SL-C40H	SL-C44H	SL-C48H	SL-C52H	SL-C56H	SL-C60H	SL-C64H
No. of beam axes		40	44	48	52	56	60	64
Beam axis interval		20 mm						
Detection zone		780 mm	860 mm	940 mm	1020 mm	1100 mm	1180 mm	1260 mm
Current consumption	Transmitter	81 mA	84 mA	87 mA	91 mA	94 mA	97 mA	100 mA
	Receiver	86 mA	88 mA	90 mA	93 mA	95 mA	97 mA	100 mA
Weight	Transmitter	Approx. 525 g	Approx. 570 g	Approx. 615 g	Approx. 660 g	Approx. 705 g	Approx. 750 g	Approx. 860 g
	Receiver	Approx. 575 g	Approx. 625 g	Approx. 675 g	Approx. 725 g	Approx. 775 g	Approx. 825 g	Approx. 945 g

Model			SL-C Series
Detection zone			140mm to 1,260 mm
No. of beam axes			8 to 64 beam axes
Beam axis interval			20mm / ø5.0mm
Operating distance/Beam width			0.3m to 9m
Detection capability			ø25 mm (when blanking function is not used)
Effective Aperture Angle			Max. ±2.5° (When operating distance is at least 3m)
Response time			15 ms*1
Light source			Infrared LED (850 nm)
Power voltage			24V DC ±10% (Ripple P-P 10% or less)
OSSD Output	Output type		2 outputs each for PNP and NPN, Can be switched using the connection connector cable
	Max. load current		300 mA*2
	OFF-state voltage		2.5 V (with a cable length of 7 m)
Environmental specifications	Protective structure		IP-65 (IEC60529)
	Ambient temperature		-10°C to 55°C (No condensation)
	Storage ambient temperature		-10°C to 60°C (No condensation)
	Relative humidity		35 % to 85 %RH (No condensation)
	Storage ambient humidity		35 % to 95 %
	Vibration		10 to 55 Hz, 0.7 mm compound amplitude, 20 sweeps each in X, Y, and Z directions
	Shock		100 m/s^2 (Approx. 10G) 16ms pulse, in X, Y, Z directions 1,000 times each axis
Material	Main unit case		Aluminum
	Upper case/Lower case		Zinc die-cast
	Overlay		Polycarbonate
Approved standards	EMC	EMS	IEC61496-1, EN61496-1, UL61496-1
		EMI	EN55011 Class A, FCC Part15 Class A
	Safety		IEC61496-1, EN61496-1, UL61496-1 (type 4 ESPE)
			IEC61496-2, prEN61496-2, UL61496-2 (type 4 AOPD)
			UL508

*1 OFF→ ON return time is 125 ms.
*2 Note the derating illustrated in the graph to the right when using PNP output.



Safety Relay Unit SL-R11

Model			SL-R11
Safety Light Curtain			SL-C Series
Rating	Power supply voltage		24V DC ±10% ripple (P-P) 10% max.
	Current consumption		150mA max. (for SL-R11 only)
Output	FSD1, 2		230 V AC 4 A, 30 V DC 2 A (resistive load) 230 V AC 2 A, 30 V DC 1 A (cos ø=0.3) (inductive load)
	AUX		125 V AC 0.5 A, 30 V DC 2 A (resistive load) 125 V AC 0.25 A, 30 V DC 1 A (cos ø=0.3) (inductive load)
	Lifespan		Mechanical life: 10 million min. Electrical life: 100,000 times min.
Response time	FSD1, 2, AUX		24ms (including sensor response time)*2
Response time during E-STOP input			20 ms
Environmental specifications	Protective structure		IP-20 (IEC60529) (Install in control panels which is equal to or greater than IP-54)
	Ambient temperature		-10 to +55 °C
	Storage ambient temperature		-10 to +60 °C
	Relative humidity		35 to 85% RH (No condensation)
	Storage ambient humidity		35% to 95%RH
	Vibration		10 to 55 Hz double amplitude width 0.7 mm, 20 sweeps each for X, Y, Z directions
	Shock		100 m/s^2 (Approx. 10G) 16ms pulse, in X, Y, Z directions 1,000 times each axis
Material			Polycarbonate
Weight			Approx. 380 g
Approved standards *1	EMC	EMS	IEC61496-1, EN61496-1, UL61496-1
		EMI	EN55011 Class A, FCC Part 15 Class A
	Safety		IEC61496-1, EN61496-1, UL61496-1 (type 4 ESPE)
			IEC61496-2, prEN61496-2, UL61496-2 (type 4 AOPD)
			EN50178, UL508

*1 Evaluated in combination with the SL-C Series
*2 The OFF→ON return time is 150 ms.

Power supply unit SL-U2

Model			SL-U2
System			Switching type
Input power supply voltage			AC 100 to 240 V ±10 % (50/60 Hz)
Overvoltage category			II
Output voltage			DC 24 V ±10 %, Class 2
Ripple/noise			240 mVp-p or less
Output capacity			1.8 A (total of supply to various units and service power supplies)
Environment	Ambient temperature		-10 °C to +55 °C
	Relative humidity		35 % to 85 % RH (non-condensation)
Pollution degree			2
Withstand voltage			AC 1,500 V, 1 min. (between all external terminals and case)
Vibration resistance			10 to 55 Hz, 0.7 mm compound amplitude, 20 sweeps each in X, Y, and Z directions
Shock resistance			100 m/s(Approx.10G), 1,000 iterations each in X, Y, and Z directions
Insulation resistance			At least 50 MW (DC 500 V mega, between all external terminals and case)
Power consumption			135 VA
Supply voltage interruption			10 ms or less
Weight (excluding dedicated brackets)			Approx. 240 g
Approved standards	EMC	EMS	IEC61496-1, EN61496-1, UL61496-1
		EMI	IEC61000-3-2, EN61000-3-2, EN55011 Class A, FCC Part15 Class A
	Safety		EN60950, EN50178, UL60950, UL508

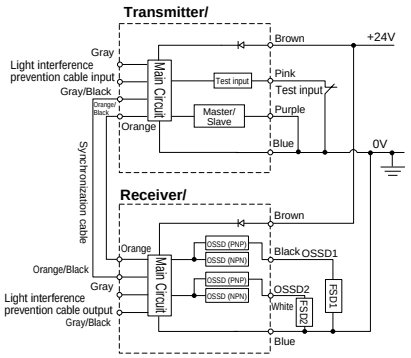
Slim corner mirrors

Model		OP-35334	OP-35335	OP-35336
Compatible number of beam axis		8 to 16 beam axes (SL-C08H to C16H)	20 to 24 beam axes (SL-C20H to C24H)	28 to 32 beam axes (SL-C28H to C36H)
Length of reflective surface		370 mm	530 mm	690 mm
Operating distance *1	With 1 mirror	6 m		
	With 2 mirrors	5.5 m		
	With 3 mirrors	5 m		
Detection capability		Non-transparent objects with diameters of at least 25 mm		
Environment	Operating ambient temperature	-10°C to +55°C		
	Operating ambient humidity	35% to 95% RH (non-condensation)		
Materials used		Mirrors, surface-coated mirrors, case: Aluminum Mounting brackets: Die-cast zinc		
Weight *2		Approx. 410g	Approx. 510 g	Approx. 610g
Accessories		Mounting brackets		

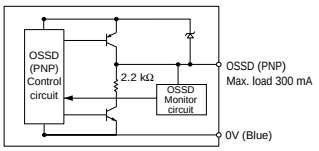
*1 The operating distance is the total distance light travels between the transmitter and receiver via the slim corner mirrors.
*2 Including about 100 g for the mounting brackets. *Note: Cannot be used with a retro-reflective type setup.

Circuits

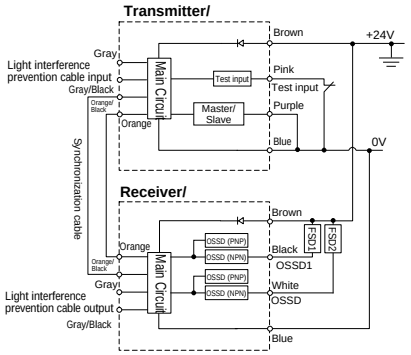
PNP



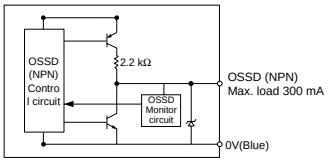
PNP output circuit



NPN

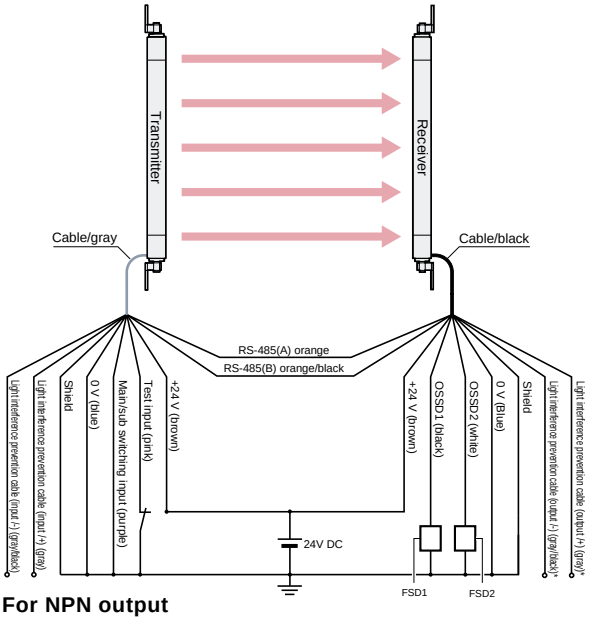


NPN output circuit

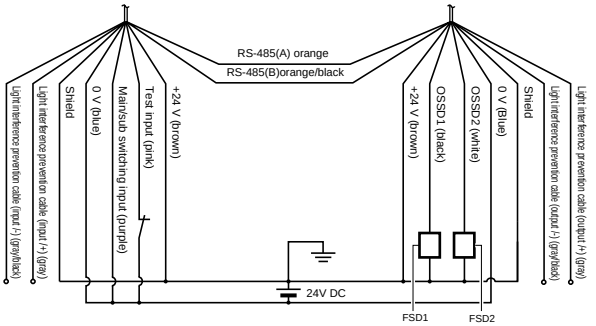


Light curtain connection diagram

For PNP output



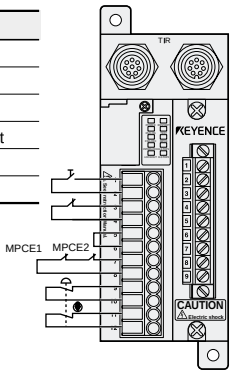
For NPN output



Wiring diagram for Category 4 compatibility (when using the SL-R11)

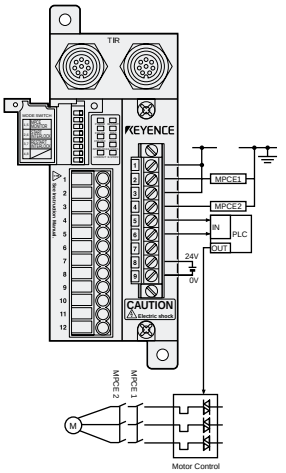
Input terminals

Terminal No.	Name
1, 2	Start / Restart input
3, 4	TEST input
5, 6	M/S SELECT input
7, 8	MPCE MONITOR input
9, 10	E-STOP1 input
11, 12	E-STOP2 input

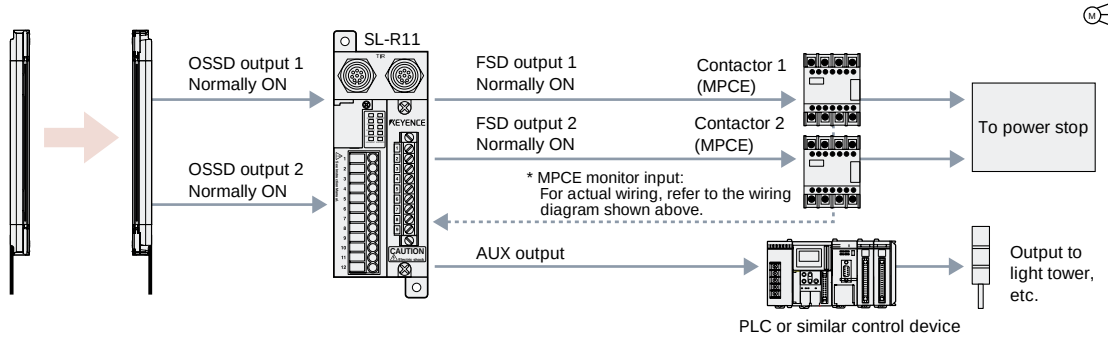


Output terminals

Terminal No.	Name
1, 2	FSD1
3, 4	FSD2
5, 6	AUX
7	Not used
8	+ 24V
9	0 V



Safety circuit example using the SL-R11



Use the safety light curtain properly.

Be sure to read the included instruction manual for detailed product usage information.

About Standards and Regulations

1 The SL-C/SL-R11 is a safety component as established by the European Union's Machinery Directive Annex IV Clause B.

The SL-C/SL-R11 complies with the following Directives and European Standards and has been certified by TÜV Product Service GmbH.

EU Directives

- EU Machinery Directive (98/37/EC)
- EU EMC Directive (89/336/EEC)
- EU Low-voltage Directive (73/23/EEC) *only when using the SL-R11

European Standards

- EN61496-1 (Type 4 ESPE - Electro-sensitive Protective Equipment)
- EN55011
- EN50178 *only when using the SL-R11

2 The SL-C Series/SL-R11 complies with the following International Standards and has been certified by TÜV Product Service GmbH.

- IEC61496-1(Type 4 ESPE - Electro-sensitive Protective Equipment)
- IEC61496-2 (Type 4 AOPD - Active Opto-electronic Protective Device)

3 The SL-C Series/SL-R11 complies with the following UL (Underwriters Laboratories Inc.) and international standards and has been certified for Canada-U.S. Listing by UL.

- UL61496-1 (Type 4 ESPE - Electro-sensitive Protective Equipment)
- UL61496-2 (Type 4 AOPD - Active Opto-electronic Protective Device)
- IEC61496-1 (Type 4 ESPE - Electro-sensitive Protective Equipment)
- IEC61496-2 (Type 4 AOPD - Active Opto-electronic Protective Device)

4 The SL-C Series/SL-R11 has not received the model certification examination in accordance with Article 44-2 of the Japanese Industrial Safety and Health Law. As a result, the SL-C Series/SL-R11 cannot be used in Japan as a “Safety Devices for Presses and Shearing Machines” as established in Article 42 of that law.

5 The SL-C Series and SL-R11 have been designed in consideration of the following standards and regulations. For details regarding the following standards, contact the third-party certification organization, such as UL or TÜV.

Corresponding standards

- EN954-1
- IEC/EN60204-1
- EN415-4
- prEN691
- EN692
- EN693
- OSHA 29 CFR 1910.212
- OSHA 29 CFR 1910.217
- ANSI B11.1 - B.11.19
- ANSI/RIA R15.06-1999
- SEMI S2-0200
- “Guidelines for Comprehensive Safety Standards of Machinery”, June 1, 2001, number 501 issued by Ministry of Health, Labor, and Welfare in Japan.

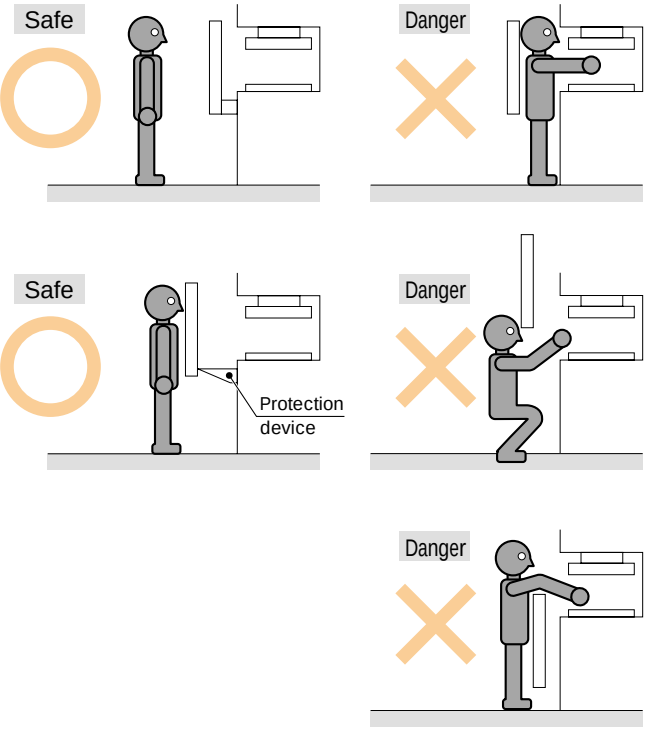
Installation and Assembly

Correct position

- The hazardous zone or hazards within the machine are accessible only through the SL-C detection zone.
- While machine is running, the machine operator's body always stays on the opposite side to the hazardous zone or hazard.

Incorrect installation

- A machine operator can access the hazardous zone or hazards without passing through the SL-C detection zone.
- The operator's body stays in between the SL-C detection zone and hazardous zone or hazard while machine is running.



WARNING

If operators are not protected from hazards by the SL-C in the entire hazardous zone, always add a safety protective equipment such as a safety guard to the portion of the hazardous zone that is not covered by the SL-C. Also, install the SL-C so that machine operators can access the hazardous zone or hazards only by passing through the SL-C’s detection zone or protection zone. In other words, do not install the SL-C in a layout that allows machine operators to enter between the SL-C and the machine’s hazardous zone or hazards without being detected by SL-C or access the machine’s hazardous zone or hazards by bypassing the SL-C’s detection zone. If these warnings are violated, it may result in a serious harm, such as an injury or death.

Installation

Be sure to separate the sensor and the hazardous zone by the safety distance (S) when installing the SL-C Series.

<Example 1: Safety distance calculation according to EN999-1999 (for normal approach into detection zone)>

Formula: S = K x T + C..... (A)

S: Safety distance (mm)
K: Approaching speed of the body or the parts of body into detection zone (mm/s)
T: Overall response time (s) (T= t1 + t2)
t1: SL-C Series maximum response time (15 ms)
t2: Maximum time required by machine to stop after receiving signal from protective equipment (SL-C)
C: Additional distance (mm) calculated from the SL-C Series detection capability.

Calculation example for a detection capability of 40 mm or less

The safety distance is calculated using Formula (A) and the parameters established in EN999 with K = 2,000 mm/s and C = 8 (d - 14 mm). C is a value determined from the d: SL-C Series detection capability diameter (mm) and must be equal or greater than 0.

S = 2,000 mm/s x (t1 + t2) + 8 (d - 14 mm)..... (B)
When t1 = 15 ms, t2 = 50 ms, d = 25 mm :
S = 2,000 mm/s x (0.015 s + 0.05 s) + 8 (25 mm - 14 mm)
= 218 mm

* The safety distance calculated using Formula (B) above must be greater than or equal to 100 mm and less than or equal to 500 mm. When the calculated safety distance is less than 100 mm, use a safety distance of S = 100 mm. Accordingly, the safety distance acquired from Formula (B) above is S = 218 mm. (From EN999 Clause 6.1.1)
If on the other hand the safety distance calculated using Formula (B) above exceeds 500 mm , set K = 1,600 mm/s and calculate the safety distance again using Formula (A).

S = 1,600 mm/s x (t1 + t2) + 8 (d - 14 mm)..... (C)
When t1 = 15 ms, t2 = 300 ms, d = 25 mm:
S = 1,600 mm/s x (0.015 s + 0.3 s) + 8 (25 mm - 14 mm)
= 592 mm

* The safety distance calculated using Formula C above must be greater than or equal to 500 mm. When the calculated safety distance is less than 500 mm , use a safety distance of S = 500 mm. Accordingly, the safety distance acquired from Formula (C) above is S = 592 mm. (From EN999 Clause 6.1.1)

* When the SL-C is being used in a non-industrial application, the minimum safety distance is calculated by adding 75 mm to the result from Formula (B). Formula (C) cannot be used in this situation. Accordingly, when the SL-C is used in a non-industrial application, a safety distance of S = 218 mm + 75 mm = 293 mm is required.

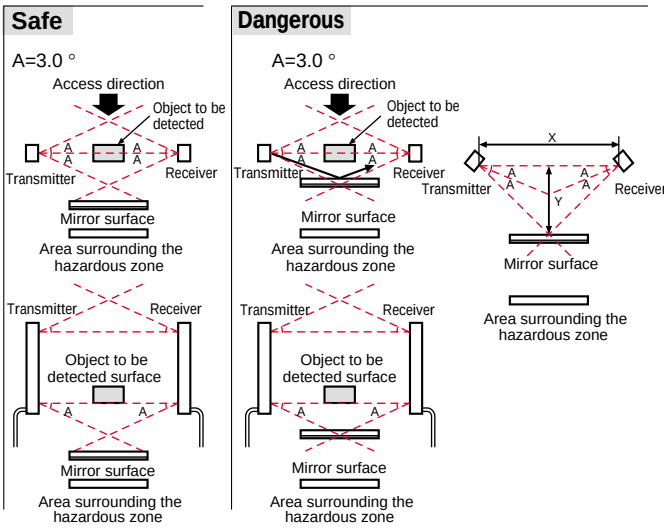
WARNING

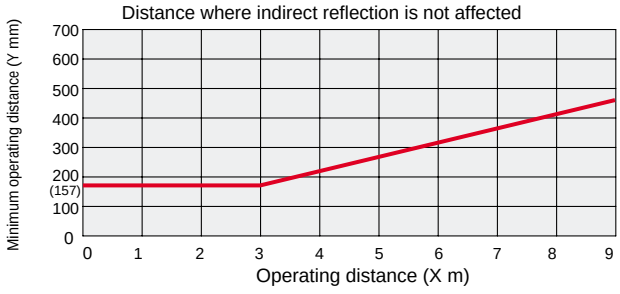
Calculate the safety distance accurately and be sure to position the SL-C so that it is separated from the machine s hazardous zone or hazard by at least the minimum safety distance. Installation of the SL-C closer to the hazardous zone or hazard than the minimum safety distance may result in significant harm to the machine operator, including death.

Installation distance from glossy surfaces

Installation Distance Not Affected by Glossy Surface

If the ambient light is reflected by glossy surfaces around the SL-C, the SL-C Series may not operate correctly and it may not detect an object approaching the SL-C detection zone. To avoid such a problem, check the followings during an SL-C installation.





* Although the SL-C has the effective aperture angle of ±2.5 degrees, use the value of ±3.0 degrees considering beam axis deviations and other errors that may occur during an installation.
The minimum distance (Y) from the detection zone to the reflection surface can be read from the above graph or determined using the following formula. The value Y of this formula is determined assuming the worst case scenario that beam axis misalignments occur both on the transmitter and the receiver.

Calculating the minimum distance Y

If X (operating distance (mm)) > 3000:
Y=X x tan3°=0.052X (Effective aperture angle) [X=Operating distance]
If X (operating distance (mm)) ≧ 3000:
Y=157

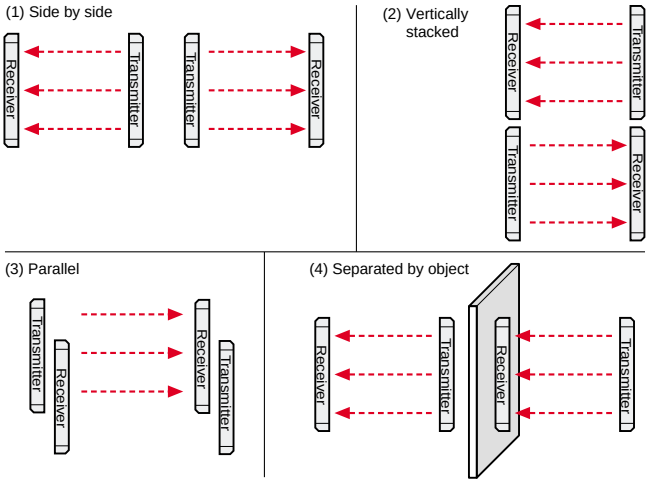
WARNING

The SL-C must be installed in a position not affected by reflections from glossy surfaces (Light Interference). If there is any glossy surface near the SL-C, cover such a surface with a black sheet or apply delustering. Make sure that no reflection light reaches the SL-C. Otherwise, the SL-C may malfunction due to light reflected by the glossy surface and serious harm, such as an injury or death of a machine operator, may result.

Light Interference Prevention Method

This section explains how to install multiple SL-C units without using the light interference prevention cables prescribed in the instruction manual.

Sensor installation location examples



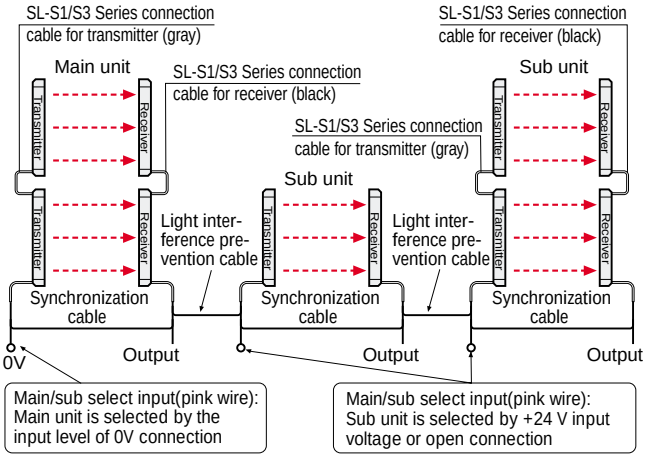
WARNING

To mount more than or equal to 2 sets of SL-C Series without using the light interference prevention cable specified in the instruction manual, install the SL-C Series as shown in the above diagrams, and then use Checklist provided in the instruction manual to make sure the SL-C Series operates properly. Not following this installation method could result in serious harm, such as serious injury or death of the machine operator.

Serial connections and light interference prevention connections

Both serial connections and light interference prevention connections can accommodate up to 4 units. In addition, serial connections and light interference prevention connections can be used in combination, as indicated in the diagram below.

This function is valid if the number of SL-C Series in series connection and connected via an light interference prevention cable is 12 or less, and if the total number of beam axes is 192 or less. The response time of the SL-C is not affected by this combination of series connections and light interference prevention connections.

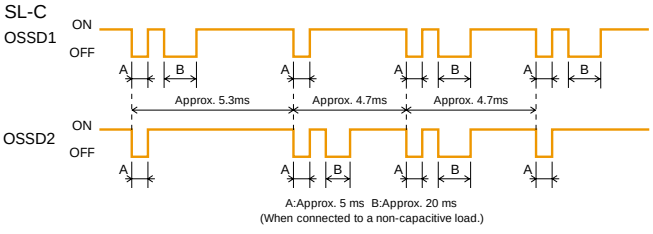


WARNING

- Use the series connection cables provided by KEYENCE only. Otherwise, the SL-C Series may not operate normally and serious harm, such as an injury or death of a machine operator may result.
- Use 2-wire shielded cable that is at least AWG #22 (nominal cross-sectional area of 0.3mm^2) for interference prevention connections. Also, use shielded that has the same electric potential as that being used for the SL-C itself) Otherwise, the SL-Cs may not operate normally and a serious harm, such as an injury or death of machine operator, may result.
- When using 2 or more sets of SL-C Series without using the above-mentioned series connection, a light interference prevention connection, or a combination of both, see Light Interference Prevention Method and install the SL-Cs correctly to prevent light interference.
  Responsible personnel shall perform an operational -check after the SL-C Series has been installed to ensure the absence of light interference.
  If the SL-C Series are not connected in accordance with the provisions in instruction manual, the SL-C Series will not operate normally without light interference, which could result in a serious harm, including serious injury or death.

Waveforms of control output OSSD

The SL-C performs a self-diagnosis test for the output circuit when all beam axes are clear of any obstruction and the OSSD is in the ON-state. This self-diagnosis function periodically turns OFF the OSSD output.
The OSSD output is monitored by the SL-C Series and, if the OFF state signal is fed back, the SL-C determines that the output circuit operates normally.
On the other hand, if the OFF state signal is not fed back, the SL-C determines that an error has occurred in the output circuit or wirings and goes to lockout condition.
For this reason, all the other devices used to receive the SL-C Series OSSD output must be of the type that does not respond to this periodic off state.

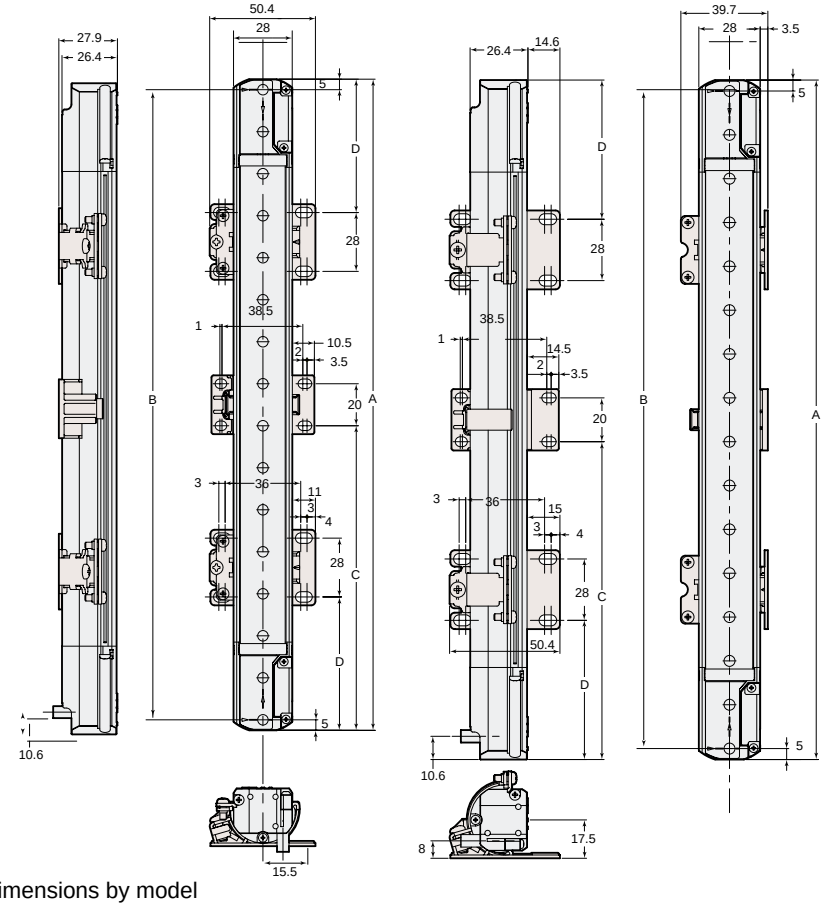


Compatible power supply units other than the SL-U2

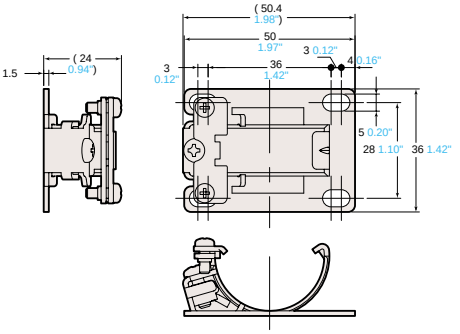
In order for the SL-C Series and the SL-R11 to meet the requirements of IEC61496-1, UL61496-1, and EN61496-1, use a power supply that meets all of the following conditions.

- Rated output voltage must be DC 24 V ±10%.
- The power supply being used must be dedicated to the SL-C Series and SL-R11 and must not be used to supply power to other devices or equipment.
- The power supply output must meet the conditions for a Class 2 Circuit or a Limited Voltage/Current Circuit as stipulated by UL508.
- The power supply must comply with all laws, regulations, and standards relating to electric safety and electromagnetic emissions (EMC) in each country or area where the SL-C Series and SL-R11 are being used.
- The output hold time is 20 ms min.

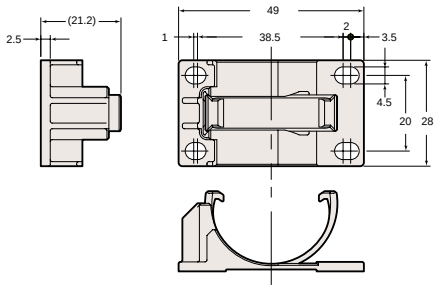
With the E-to-E mounting bracket installed



E-to-E mounting bracket



Intermediate support brackets

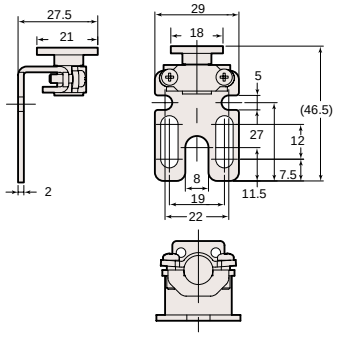


Dimensions by model

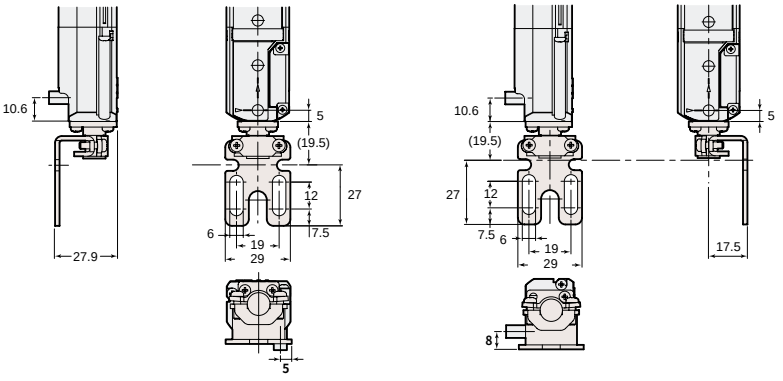
Model	No. of beam axes	Sensor length A	Detection zone B	Intermediate support bracket position C*	Intermediate support bracket position C1*	Intermediate support bracket position C2*	D
SL-C08H	8	150	140	—	—	—	43
SL-C12H	12	230	220	—	—	—	43 to 63
SL-C16H	16	310	300	—	—	—	43 to 89
SL-C20H	20	390	380	—	—	—	43 to 116
SL-C24H	24	470	460	—	—	—	43 to 143
SL-C28H	28	550	540	—	—	—	43 to 169
SL-C32H	32	630	620	—	—	—	43 to 196
SL-C36H	36	710	700	345±80	—	—	43 to 197
SL-C40H	40	790	780	385±80	—	—	
SL-C44H	44	870	860	425±80	—	—	
SL-C48H	48	950	940	465±80	—	—	
SL-C52H	52	1030	1020	505±80	333±80	677±80	
SL-C56H	56	1110	1100	545±80	360±80	730±80	
SL-C60H	60	1190	1180	585±80	387±80	783±80	
SL-C64H	64	1270	1260	625±80	413±80	837±80	

* The use of two intermediate support brackets is required for installations using Normal mounting brackets A, B, C, or the L-shaped mounting bracket and having 52 or more beam axes.
For such installations, attach intermediate support brackets at dimensional positions C1 and C2. For other installations, attach one intermediate support bracket at dimensional position C.

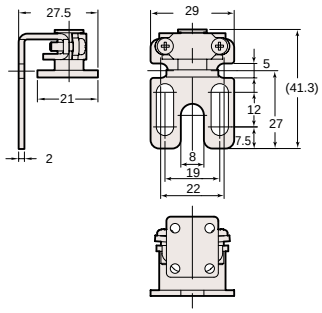
Normal mounting bracket A, outward-facing



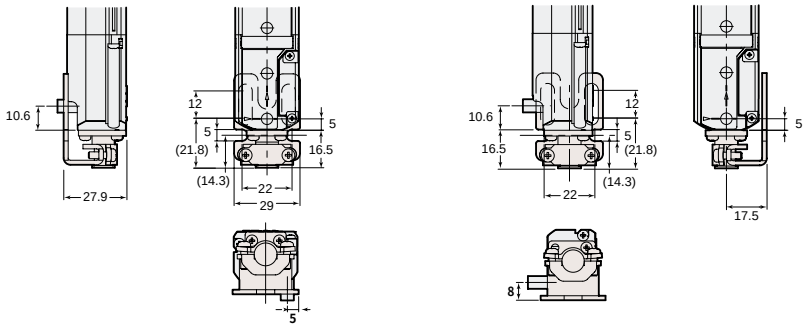
With Normal mounting bracket A installed



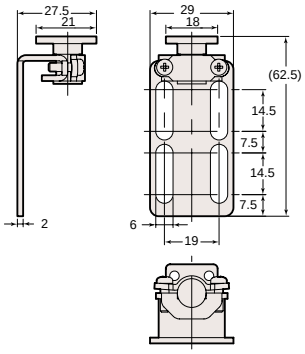
Normal mounting bracket A, inward-facing



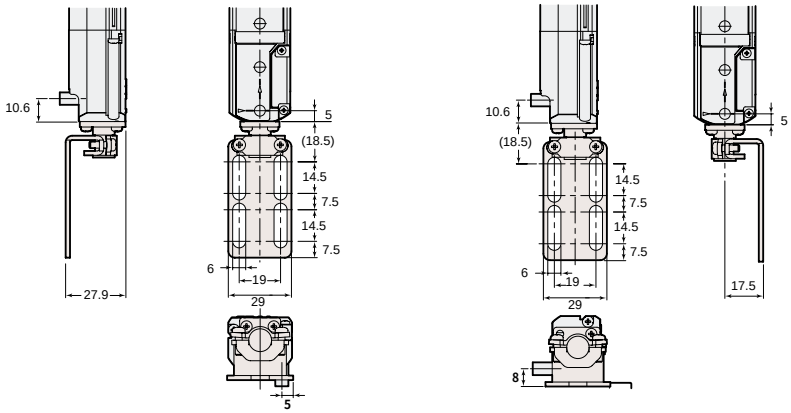
With Normal mounting bracket A installed



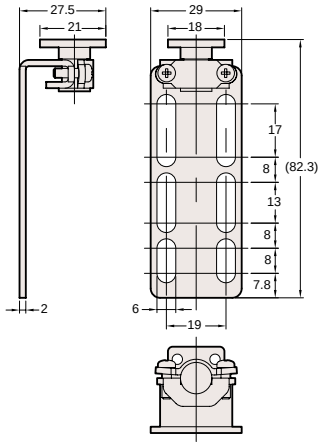
Normal mounting bracket B



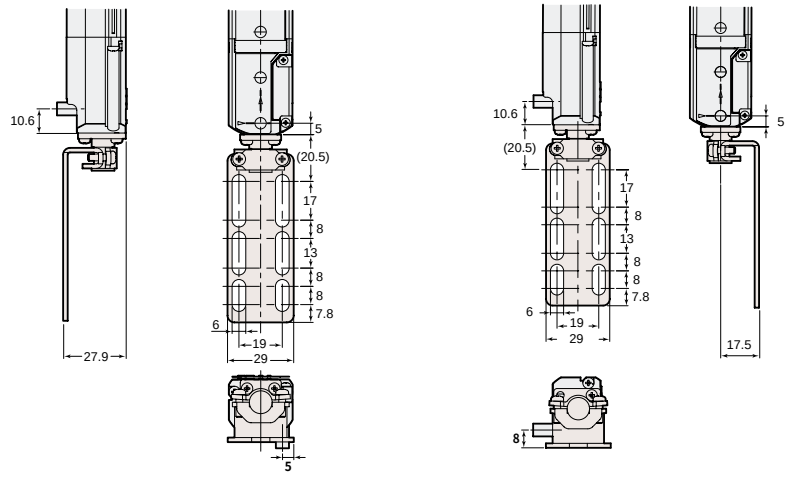
With Normal mounting bracket B installed



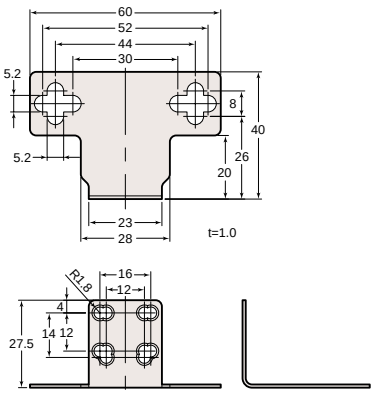
Normal mounting bracket C



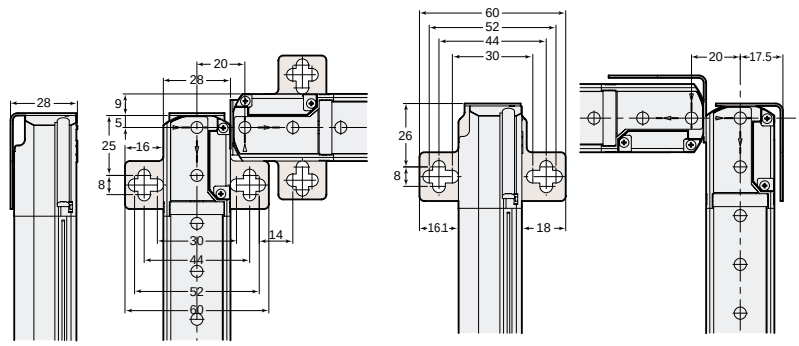
With Normal mounting bracket C installed



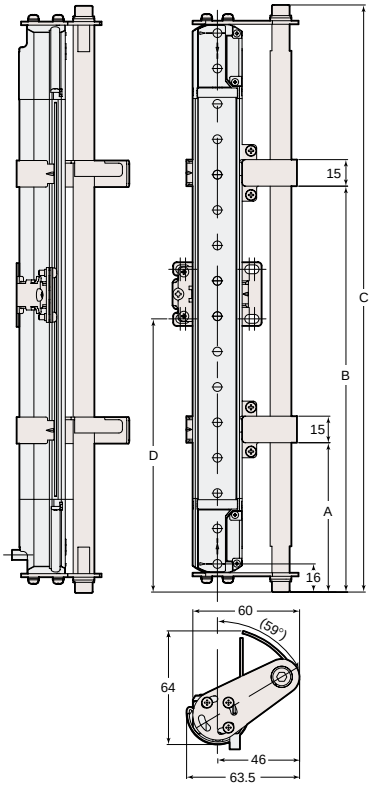
L-shaped mounting bracket



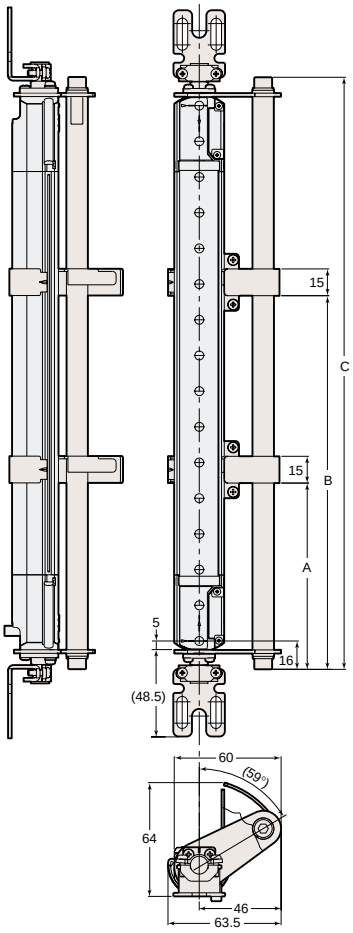
With the L-shaped mounting bracket installed



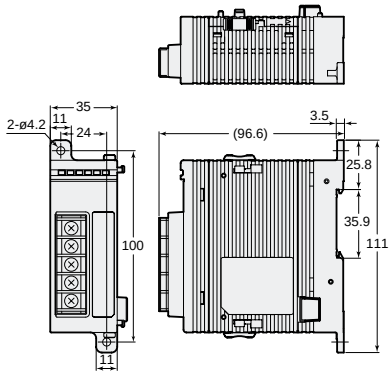
With the protection bar installed



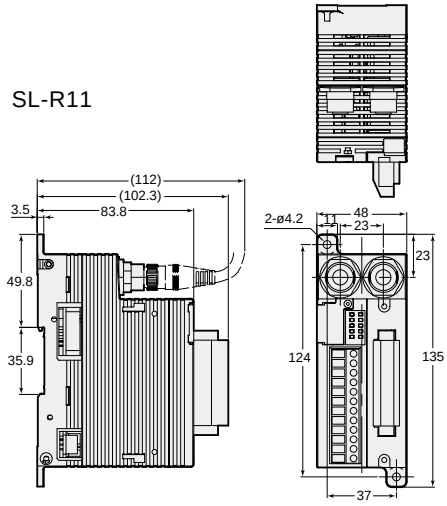
Example standard mounting bracket installation



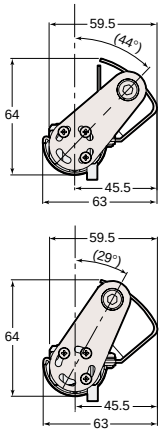
SL-U2



SL-R11



With the protection bar installed



Dimensions by model

Model	No. of beam axes	Bar support bracket position A	Bar support bracket position B	Length C	Intermediate support bracket position D
SL-C08H	8	—	—	172	—
SL-C12H	12	—	—	252	—
SL-C16H	16	—	—	332	—
SL-C20H	20	—	—	412	—
SL-C24H	24	—	—	492	—
SL-C28H	28	207±50	350±50	572	—
SL-C32H	32	234±50	403±50	652	—
SL-C36H	36	260±50	457±50	732	352±50
SL-C40H	40	287±50	510±50	812	392±50
SL-C44H	44	314±50	563±50	892	432±50
SL-C48H	48	340±50	617±50	972	472±50
SL-C52H	52	367±50	670±50	1052	512±50
SL-C56H	56	394±50	723±50	1132	552±50
SL-C60H	60	420±50	777±50	1212	592±50
SL-C64H	64	447±50	830±50	1292	632±50

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