KEYENCE

96M13258

96M13258-1

Safety Light Curtain

SL-V Series

Ver.3

Instruction Manual

Introduction

This instruction manual describes handling, operation, and precautionary information for the SL-V Series Safety Light Curtain ("SL-V").
Read this instruction manual thoroughly before operating the SL-V in order to understand the device features, and keep this instruction manual readily available for reference. Ensure that the end user of this product receives this manual.
In this instruction manual, "SL-VF" represents the finger protection type with the detection capability of ϕ14 mm, "SL-VH" represents the hand protection type with the detection capability of ϕ25 mm, "SL-VL" represents the body protection type with the detection capability of ϕ45 mm, "SL-VFM" represents the finger protection and rigid enclosure type with the detection capability of ϕ14 mm, "SL-VHM" represents the hand protection and rigid enclosure type with the detection capability of ϕ25 mm, "SL-VLM" represents the body protection and rigid enclosure type with the detection capability of ϕ45 mm, and "SL-V" represents all the models including the SL-VF, SL-VH, SL-VL, SL-VFM, SL-VHM, and SL-VLM.

Safety headings

This instruction manual uses the following headings to display important safety information. Strict adherence to the instructions next to these heading is required at all times.

⚠ Danger Failure to follow the instruction results in a significant harm to the machine operators including serious injury or death.

⚠ Caution Failure to follow the instruction may result in damage to the SL-V or to the machine on which it is installed.

NOTE Provides additional information for proper operation.

Reference Provides advanced and useful information for operation.

Safety Precautions

General precautions

- You must verify that the SL-V is operating correctly in terms of functionality and performance before the start of machine and the operation of the SL-V.
- KEYENCE does not guarantee the function or performance of the SL-V if it is used in a manner that differs from the SL-V specifications contained in this instruction manual or if the SL-V is modified by the customer.
- When using the SL-V to protect machine operators against a hazard or hazardous zone or using the SL-V as a safety component for any purpose, always follow the applicable requirements of the laws, rules, regulations and standards in the country or region where the SL-V is used. For such regulations, you should contact directly to the regulatory agency responsible for occupational safety and health in your country or region.
- Depending on the type of machine on which the SL-V is to be installed, there may be special safety regulations related to the use, installation, maintenance, and operation of the safety component. In such a case, you must fulfill such safety regulations. The responsible personnel must install the SL-V in strict compliance with such safety regulations.
- The responsible personnel must do the training to the assigned personnel for the correct use, installation, maintenance, and operation of the SL-V. "Machine operators" refers to personnel who have received appropriate training from the responsible personnel and are qualified to operate the machine correctly.
- Machine operators must have specialized training for the SL-V, and they must understand and fulfill the safety regulations in the country or region in which they are using the SL-V.
- When the SL-V fails to operate, machine operators must immediately stop the use of the machine and the SL-V and report this fact to the responsible personnel.
- The SL-V is designed with the assumption that it would be correctly installed in accordance with the installation procedures described in this instruction manual and correctly operated according to the instructions in this instruction manual. You must perform an appropriate installation of the SL-V after performing a sufficient risk assessment for the target machine.
- The SL-V should be processed as an industrial waste product when being disposed.

Precaution on use

■ Operators

⚠ Danger

- In order to operate the SL-V correctly, the responsible personnel and machine operators must fulfill all of the procedures described in this instruction manual.
- No person other than the responsible personnel and machine operators should be allowed to install or test the SL-V.
- When performing electrical wiring, always fulfill the electrical standards and regulations for the country or region in which the SL-V is used.

■ Environment of use

⚠ Danger

- Do not use the SL-V in an environment (temperature, humidity, interfering light, etc.) that does not conform to the specifications contained in this instruction manual.
- Be sure to confirm that the SL-V keeps normal operation when electromagnetic radiation is generated by wireless devices. (If you use wireless devices such as cellular phones or transceivers in the vicinity of the SL-V.)
- The SL-V is not designed to be explosion-proof. Never use it in the presence of flammable or explosive gases or elements.
- Be sure to confirm no deterioration in product quality if you use the SL-V in the presence of substances, such as heavy smoke, particulate matter, or corrosive chemical agents.
- Do not install the SL-V in areas where the SL-V is exposed to intense interference light such as direct sunlight, and direct or indirect light from inverter-type fluorescent lamp (rapid-start type lamp, high-frequency operation type lamp, etc).
- Be sure to absolutely confirm that there is nobody in the hazardous zone, before the interlock is released (i.e. the machine system restarts) by the interlock reset mechanism. Failure to follow this warning results in a significant harm to the machine operators, including serious injury or death.
- Be sure to absolutely confirm that there is nobody in the hazardous zone, before the override function is activated. Failure to follow this warning results in a significant harm to the machine operators, including serious injury or death.

■ Target machine

⚠ Danger

- The SL-V has not undergone the model certification examination in accordance with Article 44-2 of the Japanese Industrial Safety and Health Law. The SL-V, therefore, cannot be used in Japan as a "Safety Device for Press and Shearing machines" as established in Article 42 of that law.
- The machine on which the SL-V is to be installed must be susceptible to an emergency stop at all operating points during its operation cycle. Do not use the SL-V for machines with irregular stop times.
- Do not use the SL-V for power presses equipped with full-revolution clutches.
- The SL-V cannot be used as a PSDI because it does not fulfill the requirements of OSHA 1910.217(h). Refer to OSHA 1910.217 for the PSDI mode.
- Do not use the SL-V to control (stop forward motion, etc.) trains, cars and other transportation vehicles, aircraft, equipment for use in space, medical devices, or nuclear power generation systems.
- The SL-V is designed to protect the people or objects going into/approaching detection zone against machine's hazard or hazardous zone. It cannot provide protection against objects or materials that are expelled from the machine's hazard or hazardous zone, so you must establish additional safety measures such as installing safeguards when there is the possibility of such projectiles.

■ Installation

⚠ Danger

- The SL-V must be installed only after ensuring the minimum safety distance between the SL-V and the hazardous zone or hazard as established by the applicable regulations in the country or region in which the SL-V is used. (e.g.EN ISO13855(ISO 13855) in EU countries)
- Choose locations for the installation of the SL-V transmitters and receivers so that they are not subject to the effects of light reflected from glossy surfaces in the area.
- Correct operation and detection is not possible if the receiver has a different number of beam axes from that of the transmitter. You must verify that the number of beam axes is the same between the transmitter and the receiver when installing the SL-V.
- Correct operation and detection is not possible if the receiver has a different beam axis spacing (detection capability) from that of the transmitter. You must verify that the beam axis spacing (detection capability) is the same between the transmitter and the receiver when installing the SL-V.
- The SL-V must be installed so that the machine operator is able to go into or approach the hazardous zone or hazards only by passing through the detection zone of the SL-V. Strictly avoid installation that allows the machine operator or a part of the machine operator's body to go into or approach the hazardous zone or hazards without passing through the detection zone of the SL-V or to remain in a position between the detection zone of the SL-V and the hazardous zone or hazard. In case where you install the SL-V units in series (series connection), you always must check the installation carefully whether you follow this warning, especially after installation and maintenance.
  Even if you forget to install the SL-V unit to be connected in series, or if the series connection cable is disconnected, the SL-V does not detect such a missing or disconnection. (It means the SL-V starts the normal operation.) This causes a dangerous situation because there is no protection at the area to be protected.
- You must always perform the pre-check tests after installing the SL-V in accordance with the pre-check test procedures, such as items specified in this instruction manual, in order to verify that the test pieces can be detected in all of the detection zones.
- Interlock reset mechanisms (such as switches) must be installed so that the whole hazardous zone can be checked by the responsible personnel. Interlock reset mechanisms should not be accessible from within the hazardous zone.
- Muting is a function to allow a temporary automatic suspension of the SL-V safety functions while the SL-V is receiving a signal from muting devices (such as sensors or switches). Therefore, additional safety measures are required for the machine on which the SL-V is installed in order to ensure safety while the muting is activated.
- Muting devices, the installation of those devices and the procedure to activate the muting function must fulfill the conditions specified in this instruction manual and the requirements of the laws, rules, regulations and standards in the country or region in which the SL-V and those devices are used. Failure to follow this warning may result in significant harm to the machine operators, including serious injury or death.
- When you install muting devices (such as sensors or switches) for muting, the following conditions must be fulfilled.
  (1) Muting devices must be installed so that the muting cannot be activated if the hazardous zone of the machine is in an unsafe condition or cycle.
  (2) Muting devices must be installed so that the muting cannot be activated even if the personnel is accidentally approaching the detection zone of the SL-V.
- The muting device must be installed such that only responsible personnel have access to that device to change its installation or orientation. Special tools must be required to ensure that only responsible personnel are capable of installation, orientation or change of muting device.
- Only the responsible personnel may be allowed to install or wire the devices to activate the muting function.
- The installation of muting lamp may be required by the laws, rules, regulations, and standards in the country or region in which the SL-V is used if you apply the muting function. It depends on the machine application and/or the result of your risk assessment. If it is necessary for you to provide the muting lamp, you must fulfill the requirements because you are fully responsible for installation of muting lamp.
- When the reduced resolution function is applied, the detection capability varies according to your configuration. Make sure to accurately calculate the safety distance according to the detection capability, and install the SL-V at a distance greater than or equal to the minimum safety distance away from the hazardous zone or hazard. The installation of additional safety measures, such as a safeguarding, may be required if the detection capability varies due to the configuration of the reduced resolution function. On your own responsibility, you must perform the risk assessment based on your configuration of the reduced resolution function in order to reduce the risk.
- When the fixed blanking function is applied, a hazardous clearance that is not protected by the SL-V may be generated between the obstacle and the SL-V. You must install an additional safety measure such as a safeguard for this clearance.
- The override is a function to allow a temporary manual suspension of the safety functions of the SL-V. Therefore, additional safety measures are required for the whole machine system on which the SL-V is installed in order to ensure safety while the override is activated.

Danger

- The override devices, the installation of those devices and the procedures to activate the override must fulfill the conditions specified in this manual as well as the requirements of the laws, rules, regulations and standards in the country or region in which the SL-V and those devices are used. Failure to follow this warning may result in significant harm to the machine operators, including serious injury or death.
- The override devices, which are used for activation of override, must be manual operating device. When installing the devices to activate the override, those devices must be installed so that the whole hazardous zone can be checked by the responsible personnel and so that it is not possible for machine operators to operate those devices in the hazardous zone.
- The installation of the indication for override may be required by the laws, rules, regulations, and standards in the country or region in which the SL-V is used if you apply the override function. It depends on the machine application and/or the result of your risk assessment. If it is necessary for you to provide the indication for override, you must fulfill the requirements because you are fully responsible for installation of the indication for override.
- The customer is fully responsible for complying with the requirements for the muting and/or override. Those who use muting and/or override must fulfill all of the requirements related to muting and/or override. KEYENCE accepts NO responsibility or NO liability for any damage or any injury due to the unauthorized installation, usage or maintenance, which are not specified in this instruction manual, and/or due to noncompliance with the laws, rules, regulations and standards in the country or region in which the SL-V is used.
- Securely tighten mounting brackets and cable connectors used for the installation of the SL-V in accordance with the torque values specified in this instruction manual.

■ Circuit design and wiring

Danger

- Always turn off the power to the SL-V when performing electrical wiring.
- You must fulfill the electrical standards and regulations in the country or region in which the SL-V is being used when you perform the electrical wiring.
- To avoid the risk of electric shock, do not connect any of the SL-V inputs to DC power sources outside of the range of 24 V DC + 10% or to any AC power source.
- To avoid the risk of electric shock, be sure that the hazardous voltage is isolated from all wiring of the SL-V with reinforced insulation or double insulation.
- In order to fulfill the requirements in IEC61496-1, UL61496-1, EN61496-1 and UL508, power supply for the SL-V must fulfill the conditions listed below.
  (a) A rated output voltage of 24 V DC (SELV, Overvoltage Category II) within +10% and -20%.
  (b) Double insulation or reinforced insulation between the primary and secondary circuits.
  (c) Output holding time of 20 ms or more.
  (d) A power supply must fulfill the requirements of the electrical safety and electromagnetic compatibility (EMC) regulations or standards in all countries and/or regions where the SL-V is used.
  (e) A secondary circuit of power supply (output) must fulfill the requirements for Class 2 Circuits or Limited Voltage/Current Circuits specified in UL508, if the SL-V is used in the United States or Canada.
- Do not install the electric wiring of the SL-V together with or in parallel with high-voltage electrical or power lines.
- Both OSSD outputs provided on the SL-V must be used to establish a safety-related machine control system. Establishing a safety-related machine control system with just one of the OSSD outputs cannot stop the machine due to an OSSD output malfunction and may result in significant harm to the machine operators, including serious injury or death.
- When using a PNP output type cable, do not cause short-circuit between the OSSD and +24V. Otherwise, the OSSDs keep staying at the ON-state and it causes a dangerous situation.
- When using a PNP output type cable, be sure to connect the load between the OSSD and 0V to avoid a dangerous situation. If the load is incorrectly connected between the OSSD and +24V, the logic of the OSSD operation will be reversed and the OSSD will change to an ON state when the SL-V detects the interruption in the detection zone. This is a dangerous situation.
- When using NPN output type cables, do not cause short-circuit between the OSSD and 0V. Otherwise, the OSSDs keep staying at the ON-state and it causes a dangerous situation.
- When using an NPN output type cable, be sure to connect the load between the OSSD and +24V to avoid a dangerous situation. If the load is incorrectly connected between the OSSD and 0V, the logic of the OSSD operation will be reversed and the OSSD will change to an ON state when the SL-V detects the interruption in the detection zone. This is a dangerous situation.
- In case of wiring, regardless of PNP or NPN output type cables, you must fulfill the requirements of Clause 9.4.3 in IEC60204-1: 2005 in order for the protection against maloperation due to earth fault.
- The Alert output, AUX output, Clear/Blocked Output, state information output and interlock-reset-ready output are not allowed to be used as safety outputs for safety-related machine control systems. Usage of these functions as safety outputs may result in a significant harm to the machine operators, including serious injury or death.
- The wait input is not allowed to be connected to the output from any components comprising a part of the safety-related machine control system. If the wait input is connected to the output of a safety component it may result in a significant harm to the machine operators, including serious injury or death.
- The transmitter and receiver cables must be within the lengths specified in this instruction manual. Usage of cables longer than the specified length may cause the improper operation of safety functions and may cause a dangerous situation.

Testing and maintenance

- You must always perform the pre-check test in accordance with the pre-check test procedures, after maintenance, adjustment or alignment of the target machine or the SL-V and before the machine startup.
- If the SL-V does not operate properly when you perform pre-check test in accordance with the pre-check test procedures specified in this instruction manual, do not operate the machine.
- You must periodically examine the machine to verify that all brakes, other stop mechanisms, and control devices operate reliably and correctly in addition to checking the SL-V.
- The responsible personnel must perform maintenance procedures as specified in this instruction manual to ensure safety to the machine and SL-V.

Standards and regulations

1 The SL-V is a "Safety Part" specified in the EU Machinery Directive (2006/42/EC) Annex V.
The SL-V complies with the following EU Directives and EN Standards and has been certified by TÜV SÜD Product Service GmbH.

EU Directives
- Machinery Directive (2006/42/EC)
- EMC Directive (2004/108/EC)

EN Standards
- EN61496-1 Type 4 ESPE
- EN61496-2 Type 4 AOPD
- EN55011 ClassA
- EN50178
- EN61508, Part 1 to 4 SIL3
- EN62061 SIL3
- EN ISO13849-1 Category 4, PLe

2 The SL-V complies with the following UL (Underwriters Laboratories Inc.) and IEC standards and has been certified by UL. (CCN :NIPF/NIPF7)
- UL61496-1 Type 4 ESPE
- UL61496-2 Type 4 AOPD
- UL508
- UL1998

The SL-V also complies with the following regulations.
- FCC Part 15B Class A Digital Device
- ICES-003 Class A Digital Apparatus

3 The SL-V has not obtained the model certification examination in accordance with Article 44-2 of the Japanese Industrial Safety and Health Law. Therefore, the SL-V cannot be used in Japan as a "Safety Devices for Presses and Shearing Machines" as established in Article 42 of that law.

4 The SL-V has 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
- EN60204-1
- 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
- "Guidelines for Comprehensive Safety Standards of Machinery", July 31, 2007, number 0731001 issued by Ministry of Health, Labor, and Welfare in Japan.

Checking the Package Contents

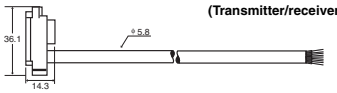
SL-V transmitter x1
SL-V receiver x1
Instruction Manual (this document) x1
Ferrite core x1 (SL-VF, VH, VL and VLM only)
Test piece x1
(Test piece with diameter of 25 mm and length of 200 mm for SL-VH and VHM and test piece with diameter of 14 mm and length of 200 mm for SL-VF and VFM)
*** The test piece (diameter: 45 mm) for the SL-VL and VLM is not supplied. Please prepare by yourself.**
Ferrite core x2 (SL-VFM only)

Cables

NOTE

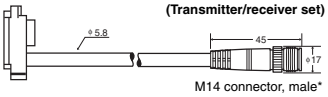
- There are two types of cable: simple function type and multi-function type. The type of cable used determines the function that can be used. (The number of conductors is different from each other.) Therefore, the two types of cables cannot be mixed at the same time. Make sure to use the appropriate type of cable for your application.
- Cables with different output types cannot be combined. Be sure to match the PNP or NPN output type especially when using the unit connection cable (for extension).

■ Unit connection cable

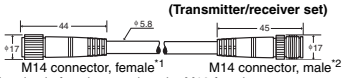
Shape	Type	Model	Output type	Length
(Transmitter/receiver set)  8-wire shielded cable Brown and blue: AWG24 (nominal cross-sectional area of 0.22 mm²) Others: AWG26 (nominal cross-sectional area of 0.14 mm²)	Simple function	SL-VP7P	PNP	7 m
		SL-VP15P		15 m
		SL-VP7N	NPN	7 m
		SL-VP15N		15 m
	Multi-function	SL-VP7PM	PNP	7 m
		SL-VP15PM		15 m
		SL-VP7NM	NPN	7 m
		SL-VP15NM		15 m

■ Unit connection cable (for extension use)

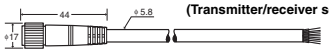
Used together with the junction cable or extension cable.

Shape	Type	Model	Output type	Length
(Transmitter/receiver set)  M14 connector, male* * The simple function type has the M12 male connector.	Simple function	SL-VPC03P	PNP	0.3 m
		SL-VPC5P		5 m
		SL-VPC10P		10 m
		SL-VPC03N	NPN	0.3 m
		SL-VPC5N		5 m
	Multi-function	SL-VPC03PM	PNP	0.3 m
		SL-VPC5PM		5 m
		SL-VPC10PM		10 m
		SL-VPC03NM	NPN	0.3 m
		SL-VPC5NM		5 m

■ Junction cable

Shape	Type	Model	Output type	Length
(Transmitter/receiver set)  M14 connector, female*1 M14 connector, male*2 *1 The simple function type has the M12 female connector. *2 The simple function type has the M12 male connector.	Simple function	SL-VCC10P	PNP	10 m
		SL-VCC10N	NPN	10 m
	Multi-function	SL-VCC10PM	PNP	10 m
		SL-VCC10NM	NPN	10 m

■ Extension cable

Shape	Type	Model	Output type	Length
(Transmitter/receiver set)  M14 connector, female* Brown and blue: AWG24 (nominal cross-sectional area of 0.22 mm²) Others: AWG26 (nominal cross-sectional area of 0.14 mm²) * The simple function type has the M12 female connector.	Simple function	SL-VC5P	PNP	5 m
		SL-VC10P		10 m
		SL-VC5N	NPN	5 m
		SL-VC10N		10 m
	Multi-function	SL-VC5PM	PNP	5 m
		SL-VC10PM		10 m
		SL-VC5NM	NPN	5 m
		SL-VC10NM		10 m

Series connection cable

Shape	Model	Length
(Transmitter/receiver set)  	SL-VS0	0.08 m
	SL-VS01	0.15 m
	SL-VS05	0.5 m
	SL-VS1	1 m
	SL-VS3	3 m
	SL-VS10	10 m

Cable specification

(1) Cable length

When using the unit connection cable, junction cable, and extension cable together, the sum of the length for all type of cables must be 30 m or less. This limitation is applicable to each the transmitter and receiver respectively. Since up to 3 SL-V units can be connected in series, up to 2 sets of series connection cables are required. Two sets of the SL-VS10 (cable length: 10 m) cables can be used. In this case, the sum of the length of all type of cables, including the series connection cable, must be 50 m or less. This limitation is also applicable to each transmitter and receiver respectively.

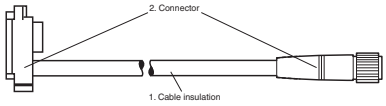
⚠ Danger

- Cables must be within the lengths specified. Failure to follow this specification may cause improper operation of safety function, and may cause dangerous situation.
- The series connection cable cannot be cut or extended. If the cable is cut or extended, safety features may not operate properly. Do not allow this to happen as it is extremely dangerous.

(2) Minimum cable bending radius : 5 mm

(3) Identification of connector cables

Cables can be identified by the colors of their connectors and their cable insulation.



1. Cable Insulation colors
   - Cables for Transmitter : Cable insulation in grey
   - Cables for Receiver : Cable insulation in black
2. Connector colors
   - PNP output type cables : Black connectors
   - NPN output type cables : Grey connectors
   - Series connection cables : Black connectors

NOTE

Be sure to connect the unit connection cable for receiver to the SL-V receiver and the unit connection cable for transmitter to the SL-V transmitter.

Connector pin assignment

■ Simple function type

Transmitter			Receiver		
Pin No.	Wire color	Assigned function	Pin No.	Wire color	Assigned function
1	Pink	Interlock mode selection input	1	White	OSSD 2
2	Brown	+24 V	2	Brown	+24 V
3	Violet	Wait input	3	Black	OSSD 1
4	Green	Interlock-reset-ready output	4	Yellow	RESET input
5	Orange	Communication cable 1 (RS485_+)	5	Orange	Communication cable 1 (RS485_+)
6	Orange/ Black	Communication cable 2 (RS485_-)	6	Orange/ Black	Communication cable 2 (RS485_-)
7	Blue	0 V	7	Blue	0 V
8	Red	AUX (auxiliary) output	8	Red	EDM input

■ Multi-function type

Transmitter			Receiver		
Pin No.	Wire color	Assigned function	Pin No.	Wire color	Assigned function
1	Pink	Interlock mode selection input	1	White	OSSD 2
2	Brown	+24 V	2	Brown	+24 V
3	Violet	Wait input	3	Black	OSSD 1
4	Green	Interlock-reset-ready output	4	Yellow	RESET input
5	Orange	Communication cable 1 (RS485_+)	5	Orange	Communication cable 1 (RS485_+)
6	Orange/ Black	Communication cable 2 (RS485_-)	6	Orange/ Black	Communication cable 2 (RS485_-)
7	Blue	0 V	7	Blue	0 V
8	Red	AUX (auxiliary) output	8	Red	EDM input
9	Grey	State information output 1	9	Red/Black	Override input
10	Grey/Black	State information output 2	10	Yellow/ Black	Muting lamp output
11	Pink/Black	Alert output	11	Light blue	Muting input 1
12	White/ Black	Clear/Blocked Output	12	Light blue/ Black	Muting input 2

When the muting bank function is used, the pin assignment changes as follows.
Pink: muting bank input 3, purple: muting bank input 1, red/black: muting bank input 2

Reference **M12 connector male pin assignment**

M14 connector male pin assignment

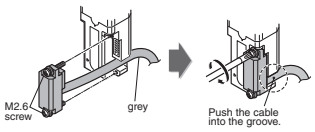
Cable connection

1 **The unit connection cable for transmitter (cable insulation is grey) must be connected to the transmitter as shown below. Similarly, the unit connection cable for receiver (cable insulation is black) must be connected to the receiver as shown below.**

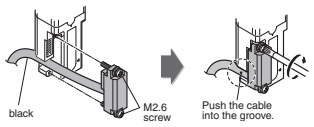
Recommended tightening torque : 0.3 N·m
Minimum cable bending radius : 5 mm

For SL-VF, VH, and VL

Transmitter

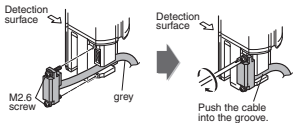


Receiver

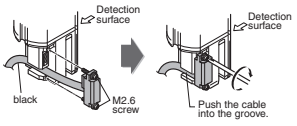


For SL-VFM, VHM, and VLM

Transmitter



Receiver

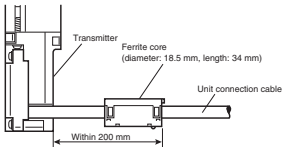


⚠ Caution

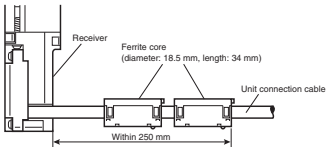
- Do not remove the grey gasket installed on the connector. This gasket is necessary to fulfill the requirement of IP65 or IP67.
- Connect the unit connection cable to the connector receptacle on the lower part of the SL-V. Removing the connector cover on the upper part of the SL-V and connecting the unit connection cable may result in an SL-V failure.

2 **For the SL-VHM, ferrite core is not required. However, for the SL-VF, SL-VH, SL-VL, or SL-VLM, one ferrite core must be put on the SL-V unit connection cable for the transmitter. On the other hand, for the SL-VFM, two ferrite core must be put on the SL-V unit connection cable for the receiver.**

For SL-VF, SL-VH, SL-VL, SL-VLM (Ferrite core x 1)
Attach to the transmitter

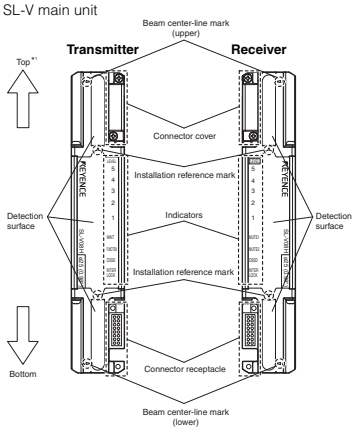


For SL-VFM (Ferrite core x 2)
Attach to the receiver

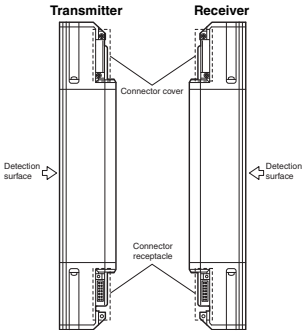


Part Description

SL-V main unit



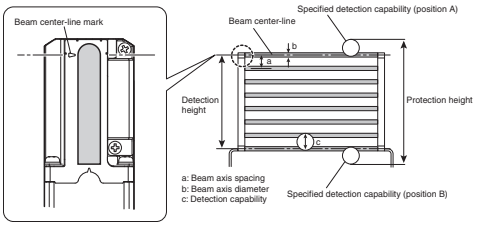
The connector and connector cover for the SL-VFM, VHM, and VLM are located on the back side.



*1 The side where the connector cover has already been installed at shipment is the top side.

Beam center-line : An optical path joining the optical center of the emitting element on the transmitter to the optical center of the corresponding receiving element on the receiver. the SL-V must be installed so that the beam center-line mark on the transmitter and that on the receiver face one another and are located at the same height.
Detection height : The height from the top beam center-line to the bottom beam center-line (length).
Protection height : An object approaching the detection zone from the top of the detection height is first detected at point A, which is the distance of the detection capability from the top of the detection height. The equivalent position on the bottom is called point B. The height from the top edge of the specified detection capability that exists at point A to the bottom edge of the specified detection capability that exists at point B is called a "protection height". The following calculation formula can be defined:
Protection height = "Detection height" + 2 x "the specified detection capability"–"beam axis diameter".

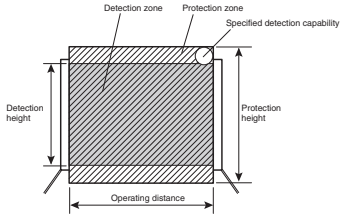
* Refer to the following diagram for an explanation of beam center-line, detection height and protection height.



Detection zone : The zone in which the specified detection capability can be detected. The detection zone of the SL-V indicates a square area formed with the detection height and the operating distance. When a part or whole of the specified detection capability is present in this area, the light of the SL-V is blocked, and then the OSSD goes to OFF state.

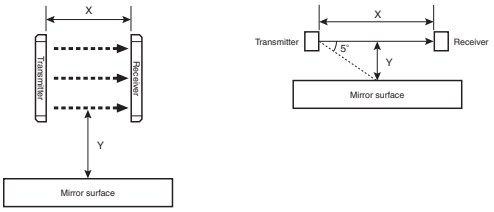
Protection zone : The square area formed with the protection height and the operating distance, which is broader than the detection zone. When a whole of the specified detection capability is present in this area, the light of the SL-V is blocked, and then the OSSD goes to OFF state.

* Refer to the following diagram for detection zone and protection zone.



Installation measures against glossy surface

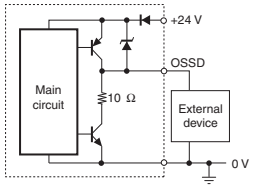
When determining a specific installation distance, refer to the following values including the installation tolerance.



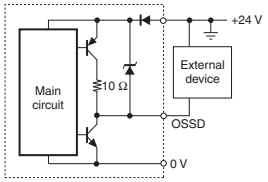
Operating distance "X"	Minimum installation distance "Y"
Less than 3 m	0.13 m
3 m or more	X/2 x tan5° = 0.0437 X

OSSD circuit Diagram

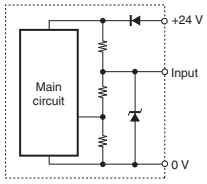
OSSD PNP output circuit



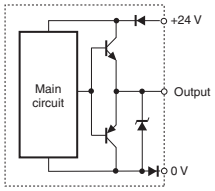
OSSD NPN output circuit



Input circuit



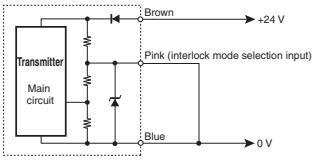
Output circuit



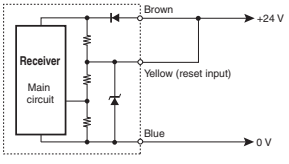
Wiring and Function

■ Wiring for automatic start/automatic reset mode

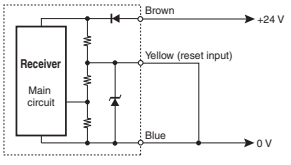
Common for a PNP/NPN output type cable



When using a PNP output type cable

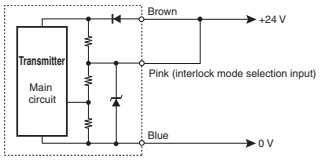


When using an NPN output type cable

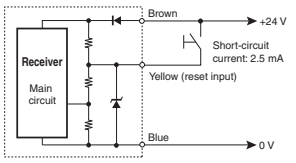


■ Wiring other than automatic start/automatic reset mode

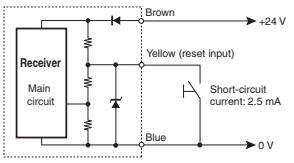
Common for a PNP/NPN output type cable



When using a PNP output type cable

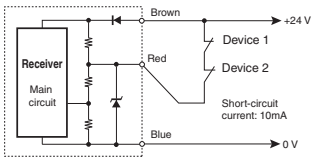


When using an NPN output type cable

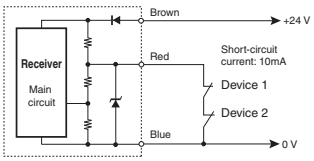


■ Wiring for EDM function

When using a PNP output type cable



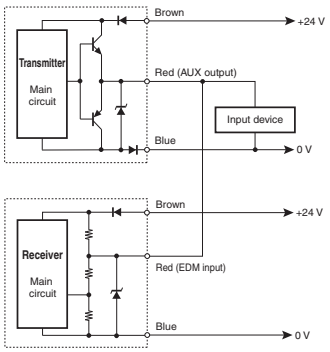
When using an NPN output type cable



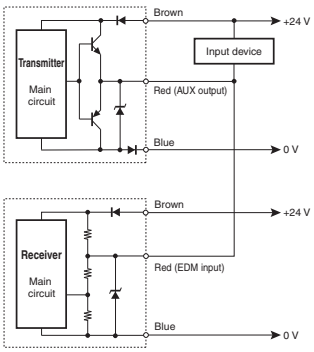
■ Wiring unless EDM function is applied

When the EDM is not applied through the SL-V Configurator (SL-VH1S), the EDM input should not be connected to the AUX output (keep open-circuit).

When using a PNP output type cable

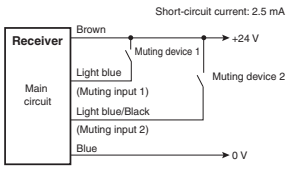


When using an NPN output type cable

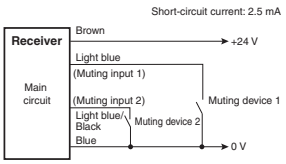


■ Wiring for muting device

When using a PNP output type cable

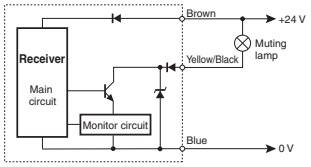


When using an NPN output type cable



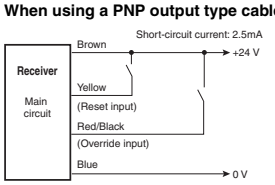
■ Wiring for muting lamp

Common for a PNP/NPN output type cable

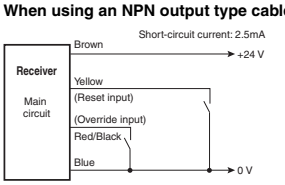


■ Wiring for Override function

When using a PNP output type cable

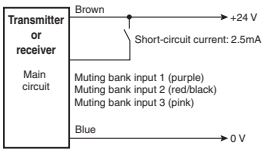


When using an NPN output type cable

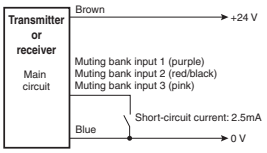


■ **When using the muting bank function**

When using a PNP output type cable



When using an NPN output type cable



Example for Wiring

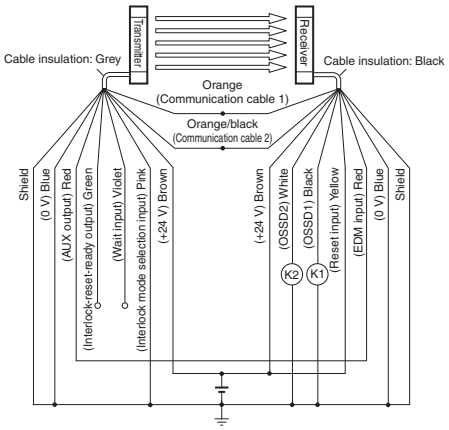
⚠ Caution

- The shielding wire of the PNP output type cable is connected to 0 V line in the SL-V. Do not connect the shielding wire to +24 V line.
- The shielding wire of the NPN output type cable is connected to +24 V line in the SL-V. Do not connect the shielding wire to 0 V line.
- When not using a non safety-related output, insulate the wires.

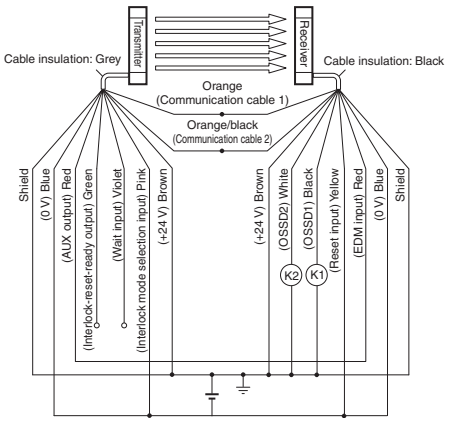
■ **When using a simple function type cable (Automatic start/reset mode, When not using the EDM function)**

Meaning of symbols
K1, K2: External device (Safety relay unit, magnet contactor, etc.)

PNP output type cable



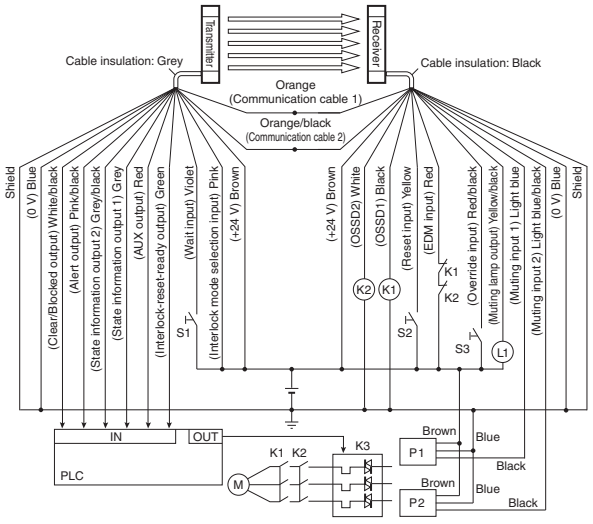
NPN output type cable



■ **When using a multi-function type cable (Other than automatic start/reset mode, When using the EDM function)**

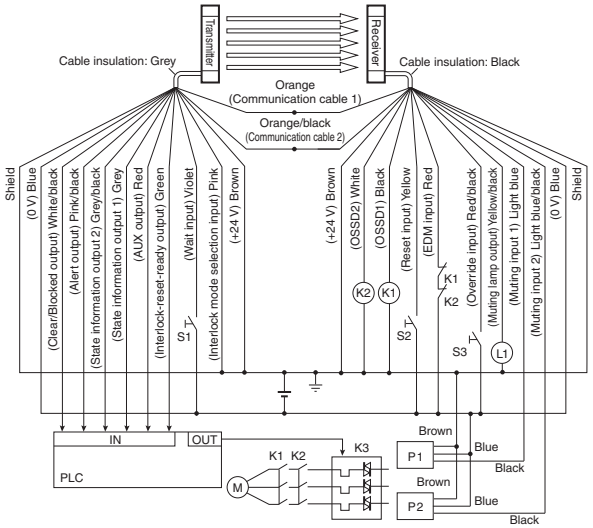
Meaning of symbols
K1, K2: External device (Safety relay unit, magnet contactor, etc.)
K3 : Solid state contactor*1
S1 : The switch for wait input (N.O.)*1
The violet wire needs to be capped it is not used. (Open circuit : completely disconnected)
S2 : The switch for reset input (N.O.)
S3 : The switch for override input (N.O.)
L1 : Muting lamp (Incandescent lamp or LED lamp)
P1, P2 : Muting device (PZ self-contained photoelectric sensors, etc.)
M : 3-phase motor
PLC : For the monitoring use*1
*1 These are NON SAFETY-RELATED system.

PNP output type cable



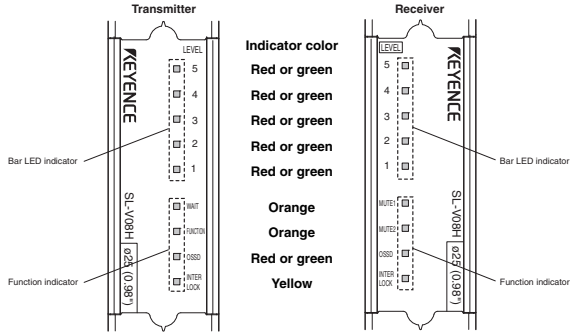
Use PNP output type for P1 and P2.

NPN output type cable



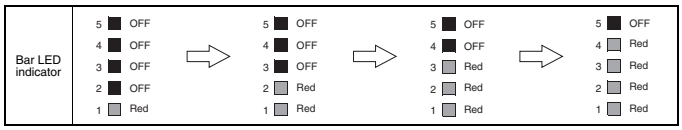
Use NPN output type for P1 and P2.

Bar LED Indicator



■ Start-up after turning on power

The bar LEDs 1 to 4 light up in the following sequence during start-up (approx. 4.5 s). The other indicators are all off. The indicators show the same indication between the transmitter and receiver.



■ During normal operation

- **When the interruption is present in the detection zone (one or more beam axis is blocked.)**

The state of bar LEDs No.1 to No. 5 means as follows.

No. 5 : It lights in red when no interruption is present in the top beam axis. (clear)

No. 2 to No. 4 : It does not light when the interruption is present in either the top or bottom beam axis (blocked). On the other hand, it lights in red when no interruption is present in both the top and bottom beam axes (clear) and the interruption is present in any other beam axis. (blocked)

No. 1 : It lights in red when no interruption is present in the bottom beam axis. (clear)

The display is the same for the transmitter and the receiver.

Indication pattern

Indication	5 OFF 4 OFF 3 OFF 2 OFF 1 OFF	5 OFF 4 OFF 3 OFF 2 OFF 1 Red	5 Red 4 OFF 3 OFF 2 OFF 1 OFF	5 Red 4 Red 3 Red 2 Red 1 Red
Top beam axis	Blocked (Interrupted)	Blocked (Interrupted)	Clear (Not interrupted)	Clear (Not interrupted)
Bottom beam axis	Blocked (Interrupted)	Clear (Not interrupted)	Blocked (Interrupted)	Clear (Not interrupted)
OSSD state	OFF	OFF	OFF	OFF

- **When no interruption is present in the detection zone**

The bar LEDs No.1 to No. 5 means as follows. They indicate the number of beam axes with the amount of receiving light of 140% or greater. The display is the same for the transmitter and the receiver.

Indication pattern

Indication	5 OFF 4 OFF 3 OFF 2 Green 1 Green ⇔ 5 OFF 4 OFF 3 OFF 2 OFF 1 OFF	5 OFF 4 OFF 3 Green 2 Green 1 Green	5 OFF 4 Green 3 Green 2 Green 1 Green	5 Green 4 Green 3 Green 2 Green 1 Green
Description	The amount of receiving light for all beam axes are 100% or more, but less than 140%. This state is not stable for operation.	The amount of receiving light for all beam axes are 100% or more, and that of any one beam axis is 140% or more.	The amount of receiving light for all beam axes are 100% or more, and that of any two beam axes are 140% or more.	The amount of receiving light for almost all beam axes are 140% or more.
OSSD state	ON	ON	ON	ON

For the definition of the amount of receiving light of 100%, 100% means a threshold between OSSD-ON and OSSD-OFF.

In case of around 100%, the light curtain easily goes to ON state or OFF state due to environmental or installation factor, such as dust, pollution, angle, vibration or the like.

- **During lockout condition**

If the SL-V detects an error, the OSSD keeps the OFF-state (Lockout condition). Bar LEDs 1 through 5 indicate the cause of the problem and the center indicator blinks in red. Additionally, the number of pulses output from state information output 2 indicates the cause of the problem. In order to terminate the lockout condition, you must perform the reset operation (reset input) or restore the power to the SL-V after removing the cause of that problem.

Bar LED indicators and the identified number of pulses on state information output 2

When using multiple SL-Vs in series, the SL-V which triggers the lockout condition will indicate using Bar LEDs 1-3 while the other SL-Vs will only use Bar LED 1.

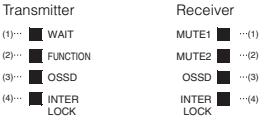
Indicators on the transmitter	Indicators on the receiver	The identified number of pulses on the output 2	Error name	Cause and corrective action
Indicator 2	(1)0.5s (2)0.5s (3)0.5s	2	OSSD error	• OSSD is short-circuited to 0 V or 24 V of power supply. • OSSD are short-circuited to each other. • Unit cable for transmitter is connected to receiver ---vice versa. • OSSD is affected by external noise. Check the connections.
				There is a voltage surge affecting the OSSD due to an inductive load. Use a load with a surge absorption function.
				Too much current is flowing through the OSSD. Make sure the load does not consume more current than the OSSD can handle.
				OSSD is broken. Replace the receiver.
Indicators 1 & 2	(1)0.5s (2)0.5s (3)0.5s	3	EDM error	There is a welded contact on the external device. Replace the external device.
				• The EDM input is not connected to the external device correctly. • When the EDM function is not used, the EDM input and AUX are not connected correctly. Check the wiring for the EDM input.
Indicator 3	(1)0.5s (2)0.5s (3)0.5s	4	Communication error*1*2	• The communication cable is not connected correctly. • The communication cable is disconnected. • The communication cable is affected by external noise. Check the connections.
				The connection to the SL-V connected in series is not correct. Check the connections.
				The SL-V connected in series is damaged. Replace the SL-V.
				The power voltage has lowered temporarily or continually. Replace the power supply, increase the power supply capacity, or prepare the power supply dedicated for the SL-V.
Indicators 1 & 3	(1)0.5s (2)0.5s (3)0.5s	5	Receiver error	The receiver is not attached to the connector cable correctly. Perform the wiring correctly. Check that the pin of the SL-V connector is not bent.
				The receiver is affected by ambient light. Shield the receiver from ambient light.
(1)0.5s (2)0.5s (3)0.5s	Indicators 2 & 3	6	Transmitter error	The transmitter is not attached to the connector cable correctly. Perform the wiring correctly. Check that the pin of the SL-V connector is not bent.
Indicators 1, 2 & 3	(1)0.5s (2)0.5s (3)0.5s	7	Muting lamp error*3	The muting lamp is out of specification or broken. Replace the muting lamp.
				The muting lamp is not connected correctly. Check the connections.
Indicator 4	(1)0.5s (2)0.5s (3)0.5s	8	Interlock error	Interlock mode selection input and reset input are wired incorrectly. Check the connections.
				There is a welded contact on the external device. Replace the external device.
				• The EDM input is not connected to the external device correctly. • When EDM function is not used, the EDM input and AUX are not connected correctly. Check the wiring for the EDM input.
(1)0.5s (2)0.5s (3)0.5s	Indicators 1 & 4	9	System error 1*1	Transmitter and receiver are not the same model. Check that all transmitter and receiver models are paired correctly.
				The SL-V connected in series is not correctly connected. Check the connections.
				The SL-V connected in series is damaged. Replace the SL-V.
Indicators 1 & 4 All indicators may turn OFF.	(1)0.5s (2)0.5s (3)0.5s	9	System error 2*2	• The SL-V is affected by external noise. • The communication cable is not connected correctly. • The communication cable is disconnected. Check the connections.
				The SL-V is broken. Replace the SL-V.

*1 Blinking cycle of each indicator and the pulse output time of state information output may be longer.

*2 All indicators on the transmitter may turn OFF.

*3 This error occurs only when it is set that the muting lamp error causes lock out condition.

■ Function Indicators



Transmitter

Indicators			Description	
(1)	WAIT	Wait input indicator	Blinking in orange Light OFF	: Wait input ON : Wait input OFF
(2)	FUNCTION	Fixed blanking indicator	Blinking in orange Light OFF	: Fixed blanking function is applied : Fixed blanking function is not applied
(3)	OSSD	OSSD indicator	Light in green Light in red Light OFF	: OSSD ON : OSSD OFF : Power turned OFF
(4)	INTER LOCK	Interlock indicator	Light in yellow Blinking in yellow Light OFF	: Interlock condition : Lockout condition : Neither interlock condition nor lockout condition

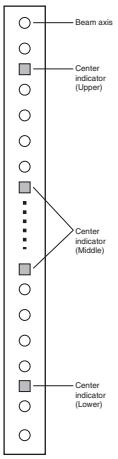
Receiver

Indicators			Description		
(1)	MUTE 1	Muting indicator 1	Blinking in orange Light OFF	: Muting device 1 ON : Muting device 1 OFF	Both MUTE1 and MUTE2 light in orange during muted condition. Both MUTE1 and MUTE2 slowly blink[*1] in orange during the override condition.
(2)	MUTE 2	Muting indicator 2	Blinking in orange Light OFF	: Muting device 2 ON : Muting device 2 OFF	
(3)	OSSD	OSSD indicator	Light in green Light in red Light OFF	: OSSD ON : OSSD OFF : Power turned OFF	
(4)	INTER LOCK	Interlock indicator	Light in yellow Blinking in yellow Light OFF	: Interlock condition : Lockout condition : Neither interlock condition nor lockout condition	

*1 For the interval of blinking, lights for 2 seconds, and turns off for 0.3 seconds. In other cases, lights for 0.3 seconds and also turns off for 0.3 seconds.

Center Indicator

SL-VH



Center indicator (Upper) : indicates whether interruption is present in the top beam axis or not. (clear or blocked)
Center indicator (Middle) : indicates whether the middle axis beams are interrupted or not. The SL-V08H(S) and SL-V04L do not have this indicator.
Center indicator (Lower) : indicates whether interruption is present in the bottom beam axis or not. (clear or blocked)

Center indicator	Light OFF	red light	green light	Blinking red light
Upper	Top beam axis is blocked	Although the top beam axis is unblocked, the others are blocked	No interruption is present in detection zone of the SL-V. (clear)	Lockout condition
Middle	Middle beam axis are blocked	Although the top and bottom beam axis are unblocked, the middle beams are blocked		
Lower	Bottom beam axis is blocked	Although the bottom beam axis is unblocked, the others are blocked		

SL-V Configurator (SL-VH1S)

When the SL-V Configurator is used, the following setting changes and functions are available.

Items	Description
Muting function[*1]	You can select the beam axes to be muted. The muting conditions can also be changed.
Muting bank function[*1]	You can change the setting whether or not to use the Muting bank function. When the muting bank function is used, the override function is disabled. Set the interlock function with the SL-V Configurator because setting of the interlock function with wiring is disabled.
Override function[*1]	You can change the override condition.
Interlock function[*2]	The Interlock function enables OSSD to hold the OFF-state if no interruptions are present in the detection zone upon startup (when the power turns on or the lockout error condition is terminated by the reset input) or upon restart (when the SL-V is interrupted and the OSSD becomes the OFF-state). This state is called "interlock ". To recover from the interlock condition, the reset input must be switched ON to OFF while no interruptions are present in the detection zone. Automatic or manual can be selected individually for start and restart. Automatic start : The OSSD automatically enters the ON-state when no interruptions are present in the detection zone. Manual start : Enters interlock condition upon startup. Automatic reset : The OSSD automatically returns to the ON-state when no interruptions are present in the detection zone. Manual reset : Enters interlock condition upon restart.
Fixed blanking function	This function is enabled only for the specified beam axes. The OSSD can hold the ON-state even when an interruption is present in the area. A desired area can be set as an effective zone of this function on a pair of transmitter and the receiver as well as on the all beam axes including the SL-V connected in series. The area where this function is enabled can be set as desired not only between a transmitter-receiver pair, but also on all the beam axes including the SL-V connected in series.
Reduced resolution function	The OSSD holds the ON-state when the object is blocking only a specified number of beam axes (one beam axis to the half of all axes can be set), and the OSSD turns OFF only when the object is blocking more beam axes than the specified number. This function is effective not only for a transmitter-receiver pair, but also all the beam axes including the SL-V connected in series.
Center indicator	You can change the conditions for the center indicator to turn on, off, or blink.
EDM function	You can change the setting whether or not to use the EDM function. The tolerance time of the EDM input can also be changed.
State information output	You can change the output methods and the pulse time of the state information output.
Emitting cycle change	You can change the laser emission cycle. The SL-V units with different laser emission cycle can reduce the chance of mutual interference.
Alert output monitoring time change	You can change for how many seconds the unstable clear state can continue before issuing an alert output (alert output monitoring time).
Monitor function	You can monitor the received light intensity of each beam axis on the SL-V.

*1 For details, refer to "Temporary Suspension of Safety Function".
*2 When setting the interlock function not with the SL-V Configurator but only with wiring, two types of settings are available: manual for both start and restart, or automatic for both start and restart.

Temporary Suspension of Safety Function

■ Muting Function

The muting function is used to temporarily suspend the SL-V's safety functions while the SL-V receives a signal from muting devices (such as sensors or switches). Before this function can be used, the outputs from the muting devices must be connected to the muting input terminal on the SL-V.
In addition, the SL-V Configurator (SL-VH1S) provides the user with the opportunity to select the beam axes to be muted condition. You can minimize the number of beam axes to be muted condition by using SL-VH1S. Therefore, you can reduce a risk of approaching into hazardous zone accordingly.

- **Muting device**
  When using the muting device, it must be met with the following conditions.
  - The muting device output must be N.O. (normal open).
  - Output of the muting device must be the output with contacts, and must be PNP output type if PNP output type cable is used, or NPN output type if NPN output type cable is used. Also, the muting device must be capable of 2 to 3mA current.
  - Do not use one muting device with multiple outputs in place of two or more muting devices. (Only one output per one muting device must be used.)
  - If the muting device has a timer function that can adjust the output timing, do not use that function.
- **Muting lamp**
  When using the muting lamp, it must meet the following conditions.

  For an incandescent lamp : rated 24 V DC, 1 to 7 W
  For LED indicator : rated current consumption must be 10 to 300 mA.

  If the incandescent lamp burns out, or if the lamp used does not meet the above conditions, the state information output shows a muting lamp error.
- **Conditions for initiation of muting**
  Muted condition is initiated if all of the following conditions are met.
  - Muting input 2 turns ON within 0.04 to 3 seconds after muting input 1 turns ON
  - SL-V detects no interruption in the detection zone
  - OSSD is ON state and keeps staying for 0.5 seconds or more.
- **Conditions for termination of muting**
  Muted condition is terminated if one of the following conditions is met.
  - Either of muting inputs goes to OFF state at least for more than 0.02 sec.
  - Light curtain goes to lockout condition
  - Wait input goes to ON state
  - The power supply is interrupted or restored.
  - Maximum muting period of approx. 5 minutes has been passed.

■ Changing of conditions for muting

The following muting conditions can be changed through the SL-V Configurator (SL-VH1S) or the special procedures.

- **Condition for Initiation of muting**
  1. Time period specification of 0.04s to 3s between muting input 1 and muting input 2 can be option.
  2. Sequence specification of muting inputs can be option. (Default sequence: muting input 1 is first, muting input 2 is second.)
- **Condition for termination of muting**
  3. Maximum muting period of approx. 5 minutes can be option.
- **Condition for muting lamp**
  4. Lockout condition can be initiated if muting lamp has some failure.

If you choose these options according to your machine application, password setting and/or password input is required as a special procedure.
The responsible personnel who intends to apply these options mentioned above from 1 to 3 have to perform the risk assessment based on the machine application.

■ Muting bank function

The muting bank function can be activated through the SL-V Configurator (SL-VH1S).
You can configure the muting bank, which is a group of the beam axes that will become muted condition in case of activation of muting.
SL-V can have three of muting banks.
In order to select the muting bank to be activated, you have to switch (ON and OFF) the muting bank input.

■ Override function

The OSSD goes to an OFF state if the muting function is deactivated and an interruption remains in the detection zone of the SL-V. The OSSD OFF state will remain until the obstruction is removed.

The override is a function to allow a temporary manual suspension of the SL-V safety functions. This makes it possible to remove the obstruction remaining in the detection zone of the SL-V. (Machine is able to be manually operated on a temporary basis because the safety function of the SL-V is temporarily suspended.)

- **Conditions for initiation of override**
  Override function is initiated if all of the following conditions are met and the reset input goes to ON state within 0.04s to 1s after override input turns ON state.
  - SL-V is not in the lockout condition.
  - SL-V detects interruption in the detection zone. (One or more beam axis is blocked.)
  - OSSD is OFF state. (including interlock condition)
  - Either of muting inputs, or both, turns ON state
- **Conditions for termination of override**
  Override function is terminated if one of the following conditions is met.
  - All of muting inputs turns OFF state.
  - Either override input or reset input, or both, turns OFF state.
  - Wait input turns ON state.
  - Light curtain goes to lockout condition
  - Maximum override period of approx. 60 seconds has been passed.

■ Changing of the condition for override

The following condition can be changed through the SL-V Configurator (SL-VH1S).

- **Conditions that deactivate the override condition**
  - Maximum override period of approx. 60 seconds can be option.

If you choose this option according to your machine application, password setting and/or password input is required. The responsible personnel must securely manage the password. The responsible personnel who intends to apply this option must perform the risk assessment based on the machine application.

Nomenclature

SL-V 12 H M - T
(1) (2) (3) (4) (5)

(1) Basic designation		: SL-V	
(2) The number of beam axes	Example	: "08" means → 8 axes, "64" means → 64 axes	
(3) Detection capability		F	: ϕ14 mm
		H	: ϕ25 mm
		L	: ϕ45 mm
(4) Enclosure type		No symbol	: General-purpose model
		M	: with rigid enclosure
(5) Unit type		T	: Transmitter
		R	: Receiver

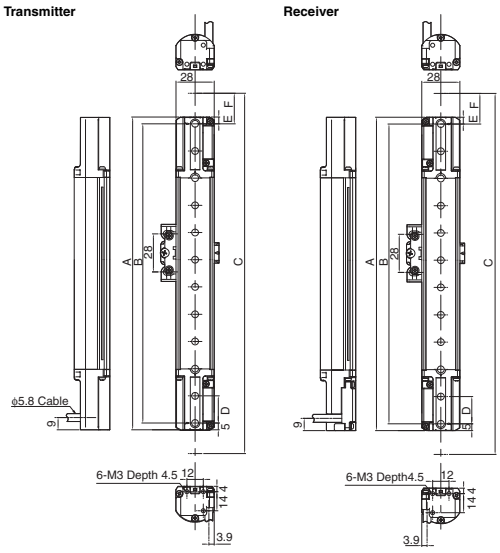
Dimensions and Specifications

NOTE

If the length for a single SL-V unit is 710 mm or greater, use a compact E-to-E mounting bracket or an E-to-E mounting bracket additionally as an intermediate support bracket. The following figures show the example for the use of one compact E-to-E bracket or space-saving bracket.

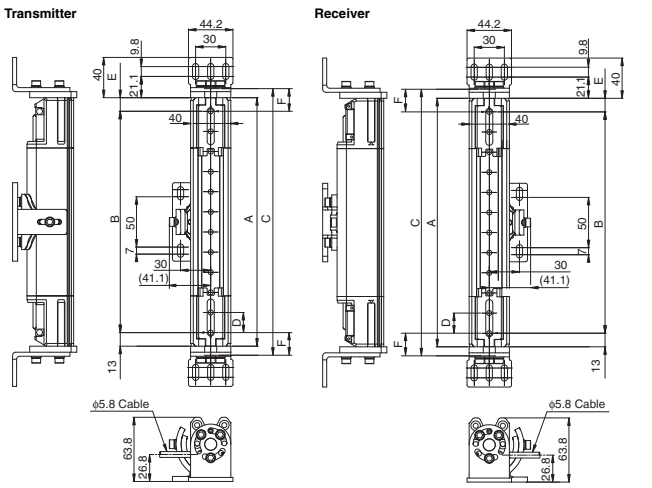
■ For SL-VF, SL-VH, and SL-VL

Units: mm



■ For SL-VFM, VHM, and VLM

Units: mm



■ SL-VF

Units: mm

Model	Beam axes	A: Length	B: Detection height	C: Protection height	D: Beam axis spacing	E	F
SL-V23F	23	230	220	244	10	5	12
SL-V31F	31	310	300	324			
SL-V39F	39	390	380	404			
SL-V47F	47	470	460	484			
SL-V55F	55	550	540	564			
SL-V63F	63	630	620	644			
SL-V71F	71	710	700	724			
SL-V79F	79	790	780	804			
SL-V87F	87	870	860	884			
SL-V95F	95	950	940	964			
SL-V103F	103	1030	1020	1044			
SL-V111F	111	1110	1100	1124			
SL-V119F	119	1190	1180	1204			
SL-V127F	127	1270	1260	1284			

■ SL-VFM

The following value is the dimension of SL-VFM.

A: Length Length of the SL-VF + 16mm E: 13mm

The remaining values (B: detection capability, C: protection height, D: beam axis spacing, and F) are identical with the dimension of SL-VF.

■ SL-VH

Units: mm

Model	Beam axes	A: Length	B: Detection height	C: Protection height	D: Beam axis spacing	E	F
SL-V08H	8	150	140	185	20	5	22.5
SL-V12H	12	230	220	265			
SL-V16H	16	310	300	345			
SL-V20H	20	390	380	425			
SL-V24H	24	470	460	505			
SL-V28H	28	550	540	585			
SL-V32H	32	630	620	665			
SL-V36H	36	710	700	745			
SL-V40H	40	790	780	825			
SL-V44H	44	870	860	905			
SL-V48H	48	950	940	985			
SL-V52H	52	1030	1020	1065			
SL-V56H	56	1110	1100	1145			
SL-V60H	60	1190	1180	1225			
SL-V64H	64	1270	1260	1305			
SL-V72H	72	1430	1420	1465			
SL-V80H	80	1590	1580	1625			
SL-V88H	88	1750	1740	1785			
SL-V96H	96	1910	1900	1945			
SL-V104H	104	2070	2060	2105			
SL-V112H	112	2230	2220	2265			
SL-V120H	120	2390	2380	2425			

■ SL-VHM

The following value is the dimension of SL-VHM.

A: Length Length of the SL-VH + 16mm E: 13mm

The remaining values (B: detection capability, C: protection height, D: beam axis spacing, and F) are identical with the dimension of SL-VH.

■ SL-VL

Units: mm

Model	Beam axes	A: Length	B: Detection height	C: Protection height	D: Beam axis spacing	E	F
SL-V04L	4	150	120	205	40	25	42.5
SL-V06L	6	230	200	285			
SL-V08L	8	310	280	365			
SL-V10L	10	390	360	445			
SL-V12L	12	470	440	525			
SL-V14L	14	550	520	605			
SL-V16L	16	630	600	685			
SL-V18L	18	710	680	765			
SL-V20L	20	790	760	845			
SL-V22L	22	870	840	925			
SL-V24L	24	950	920	1005			
SL-V26L	26	1030	1000	1085			
SL-V28L	28	1110	1080	1165			
SL-V30L	30	1190	1160	1245			
SL-V32L	32	1270	1240	1325			
SL-V36L	36	1430	1400	1485			
SL-V40L	40	1590	1560	1645			
SL-V44L	44	1750	1720	1805			
SL-V48L	48	1910	1880	1965			
SL-V52L	52	2070	2040	2125			
SL-V56L	56	2230	2200	2285			
SL-V60L	60	2390	2360	2445			

■ SL-VLM

The following value is the dimension of SL-VLM.

A: Length Length of the SL-VL+ 16mm E: 33mm

The remaining values (B: detection capability, C: protection height, D: beam axis spacing, and F) are identical with the dimension of SL-VL.

■ Parameter for IEC61508

T1 (Proof test interval)	20 years
PFHd (average frequency of a dangerous failure per hour)*1	With no series connection: 8.2×10^{-9} or less With series connection: 1.7×10^{-8} or less
Hardware fault tolerance	1
Type of element	Type B
Failure response time	Within a response time
Safe state	OSSDs are in OFF-state

*1 For PFHd of each SL-V, contact your nearest KEYENCE office.

■ Response time

Units: ms

Model	Response time (OSSD)	
	ON to OFF	OFF to ON*1
SL-V23F/FM	9.1	49.1
SL-V31F/FM	10.2	50.2
SL-V39F/FM	11.3	51.3
SL-V47F/FM	12.4	52.4
SL-V55F/FM	13.5	53.5
SL-V63F/FM	14.6	54.6
SL-V71F/FM	15.7	55.7
SL-V79F/FM	16.8	56.8
SL-V87F/FM	17.9	57.9
SL-V95F/FM	19	59
SL-V103F/FM	20.1	60.1
SL-V111F/FM	21.2	61.2
SL-V119F/FM	22.3	62.3
SL-V127F/FM	23.4	63.4

Units: ms

Model	Response time (OSSD)	
	ON to OFF	OFF to ON*1
SL-V08H	7	47
SL-V12H/HM	7.6	47.6
SL-V16H/HM	8.1	48.1
SL-V20H/HM	8.7	48.7
SL-V24H/HM	9.2	49.2
SL-V28H/HM	9.8	49.8
SL-V32H/HM	10.3	50.3
SL-V36H/HM	10.9	50.9
SL-V40H/HM	11.4	51.4
SL-V44H/HM	12	52
SL-V48H/HM	12.5	52.5
SL-V52H/HM	13.1	53.1
SL-V56H/HM	13.6	53.6
SL-V60H/HM	14.2	54.2
SL-V64H/HM	14.7	54.7
SL-V72H/HM	15.8	55.8
SL-V80H/HM	16.9	56.9
SL-V88H/HM	18	58
SL-V96H/HM	19.1	59.1
SL-V104H	20.2	60.2
SL-V112H	21.3	61.3
SL-V120H	22.4	62.4

Units: ms

Model	Response time (OSSD)	
	ON to OFF	OFF to ON*1
SL-V04L	6.5	46.5
SL-V06L/LM	6.8	46.8
SL-V08L/LM	7	47
SL-V10L/LM	7.3	47.3
SL-V12L/LM	7.6	47.6
SL-V14L/LM	7.8	47.8
SL-V16L/LM	8.1	48.1
SL-V18L/LM	8.4	48.4
SL-V20L/LM	8.7	48.7
SL-V22L/LM	8.9	48.9
SL-V24L/LM	9.2	49.2
SL-V26L/LM	9.5	49.5
SL-V28L/LM	9.8	49.8
SL-V30L/LM	10	50
SL-V32L/LM	10.3	50.3
SL-V36L/LM	10.9	50.9
SL-V40L/LM	11.4	51.4
SL-V44L/LM	12	52
SL-V48L/LM	12.5	52.5
SL-V52L	13.1	53.1
SL-V56L	13.6	53.6
SL-V60L	14.2	54.2

*1 If the interruption is present in the detection zone for less than 80 ms, the response time (OFF to ON) is to be 80ms or more to ensure that the OSSD keeps OFF state for more than 80 ms.

Reference When connecting the SL-V units in series, the response time (ON to OFF) is the sum of the response times of all the individual SL-V units.
When connecting the SL-V32H (32 beam axes), SL-V24H (24 beam axes), and SL-V12L (12 beam axes) in series, the response time of each unit is 10.3 ms, 9.2 ms, and 7.6 ms respectively, and the response time (ON to OFF) is 10.3 ms + 9.2 ms + 7.6 ms = 27.1 ms.
the response time (OFF to ON) is 27.1 ms + 40ms = 67.1 ms.

NOTE

1.6 m/s is the maximum speed of movement of the test piece to which the detection capability is maintained.

■ Current consumption

Unit: mA

Model	When the center indicator is ON		When the center indicator is OFF	
	Transmitter	Receiver	Transmitter	Receiver
SL-V23F/FM	83	78	80	74
SL-V31F/FM	93	80	90	75
SL-V39F/FM	103	82	99	77
SL-V47F/FM	112	85	107	78
SL-V55F/FM	121	87	115	80
SL-V63F/FM	129	89	122	82
SL-V71F/FM	136	92	129	83
SL-V79F/FM	142	94	135	85
SL-V87F/FM	148	97	140	87
SL-V95F/FM	154	99	145	88
SL-V103F/FM	159	101	149	90
SL-V111F/FM	163	104	152	92
SL-V119F/FM	166	106	156	93
SL-V127F/FM	169	109	158	95

Unit: mA

Model	When the center indicator is ON		When the center indicator is OFF	
	Transmitter	Receiver	Transmitter	Receiver
SL-V08H	56	70	52	65
SL-V12H/HM	63	72	58	66
SL-V16H/HM	69	74	64	67
SL-V20H/HM	75	75	70	68
SL-V24H/HM	81	77	76	69
SL-V28H/HM	87	79	81	69
SL-V32H/HM	93	80	86	70
SL-V36H/HM	98	82	91	71
SL-V40H/HM	103	84	96	72
SL-V44H/HM	108	85	100	73
SL-V48H/HM	113	87	104	74
SL-V52H/HM	117	88	109	74
SL-V56H/HM	122	90	112	75
SL-V60H/HM	126	91	116	76
SL-V64H/HM	130	93	120	77
SL-V72H/HM	137	96	126	78
SL-V80H/HM	144	98	132	80
SL-V88H/HM	149	101	136	81
SL-V96H/HM	154	104	140	83
SL-V104H	159	107	143	84
SL-V112H	162	109	146	86
SL-V120H	165	112	147	87

Unit: mA

Model	When the center indicator is ON		When the center indicator is OFF	
	Transmitter	Receiver	Transmitter	Receiver
SL-V04L	48	70	45	66
SL-V06L/LM	53	71	50	67
SL-V08L/LM	59	72	55	67
SL-V10L/LM	64	74	59	67
SL-V12L/LM	69	75	64	68
SL-V14L/LM	74	76	68	68
SL-V16L/LM	79	77	72	69
SL-V18L/LM	84	78	76	69
SL-V20L/LM	88	80	80	70
SL-V22L/LM	93	81	84	70
SL-V24L/LM	97	82	88	71
SL-V26L/LM	101	83	92	71
SL-V28L/LM	105	84	95	71
SL-V30L/LM	109	86	98	72
SL-V32L/LM	113	87	102	72
SL-V36L/LM	120	89	108	73
SL-V40L/LM	126	91	113	74
SL-V44L/LM	132	93	119	75
SL-V48L/LM	137	95	123	75
SL-V52L	142	97	127	76
SL-V56L	146	99	131	77
SL-V60L	150	101	134	78

Common specifications

Model			SL-VF/SL-VFM	SL-VH/SL-VHM	SL-VL/SL-VLM
Beam axis spacing/Lens diameter			10 mm/ϕ4 mm	20 mm/ϕ5 mm	40 mm/ϕ5 mm
Detection capability			ϕ14 mm	ϕ25 mm	ϕ45 mm
Operating distance			0.1m to 7.0m	0.1m to 9.0m (detection height of 1,260mm or less) 0.1m to 7.0m (detection height of 1,400mm or more)	
Effective aperture angle			Max. ±2.5° (When operating distance is 3 m (9.84 ft.) or more)		
Light source			Infrared LED (850 nm)		
Operation form			Turns on when no interruptions are present in the detection zone		
Rating	Power voltage		24 VDC +10%, -20% (Ripple P-P 10% or less), Class 2		
OSSD	Output		2 outputs each for PNP and NPN. Can be changed by using the connector cable		
	Max. load current		500 mA*1		
	Residual voltage (during ON)		Max. 2.5 V (with a cable length of 7 m (22.97 ft.))		
	OFF state voltage		Max. 2.0 V (with a cable length of 7 m (22.97 ft.))		
	Leakage current		Max. 100 μA*2		
	Max. capacitive load		1 μF (with a load resistance of 100 Ω)		
	Load wiring resistance		Max. 2.5 Ω*3		
Non safety-related output	AUX		Output with automatic PNP/NPN switching function, 50 mA max.		
	Interlock-reset-ready output				
	Alert output				
	Clear/Blocked Output				
	State information output 1, 2				
	Muting lamp output		Incandescent lamp (24 VDC, 1 to 7 W) or LED lamp (load current :10 to 300 mA)*4 can be connected		
Input	EDM input		Short-circuit current 10 mA		
	Wait input		Short-circuit current 2.5 mA		
	Reset input				
	Muting input 1, 2				
	Override input				
Protection circuit			Reverse current protection, short-circuit protection for each output, surge protection for each output		
Environmental condition	Enclosure protection		IP65 (IEC60529), IP65/67 (only for SL-VFM,SL-VHM and SL-VLM)		
	Overvoltage Category		II		
	Operating ambient temperature		-10 to +55°C (No freezing)		
	Storage ambient temperature		-25 to +60°C (No freezing)		
	Operating relative humidity		15% to 85%RH (No condensation)		
	Storage relative humidity		15% to 95%RH		
	Surrounding light		Incandescent lamp: 5,000 lx or less. Sunlight: 20,000 lx or less		
	Vibration		10 to 55 Hz, 0.7 mm compound amplitude, 20 sweeps each in X, Y, and Z directions		
	Shock		100 m/s² (Approx. 10 G) 16 ms pulse, in X, Y, Z directions 1,000 times each axis		
Material	Main unit case		Aluminum		
	Upper case/Lower case		Zinc die-cast		
	Front cover		Polycarbonate, SUS304		
Approved standards	EMC	EMS	IEC61496-1, EN61496-1, UL61496-1		
		EMI	EN55011 ClassA, FCC Part15B ClassA, ICES-003 Class A		
	Safety		IEC61496-1, EN61496-1, UL61496-1 (Type 4 ESPE)		
			IEC61496-2, UL61496-2, EN61496-2 (Type 4 AOPD)		
			IEC61508, EN61508 (SIL3), IEC62061, EN62061 (SIL3)		
			EN ISO13849-1:2008 (Category 4, PL e)		
			UL508, UL1998		

*1 When the SL-V is used under surrounding air temperatures between 45 to 55°C, the Maximum load current should not exceed 300 mA.
*2 Applies to situations when power is either off or disconnected.
*3 The wiring resistance between the OSSD output and the connected equipment (excluding the resistance of the cable) must be 2.5 ohms or less to ensure operation. If the cable length is 15 m or more and the load's current consumption is 200 mA or more, the wire resistance must be 1 ohm or less.
*4 When operating in surrounding air temperatures ranging from 45 to 55°C, use incandescent lamps (24 VDC, 1 to 3 W) or LED lamps (load current:10 to 100 mA)

Checklist

You are fully responsible for performing the risk assessment on your machine application, taking into account performing maintenance and inspections, which are critical factor for appropriate risk assessment. In addition, it is a responsibility for the responsible personnel to train the machine operators regarding inspection and maintenance of the machine and the SL-V.

■ Inspection before operation (Initial inspection)

When the installation of the SL-V is completed, the responsible personnel must verify the operation of the SL-V in accordance with the checklist shown below. Note that the following inspection items comprise only a bare minimum inspection. KEYENCE Corporation strongly recommends including the necessary checking items into this checklist based on the judgment of the responsible personnel since additional criteria may be necessary depending on both the machine to which the SL-V is installed and the laws, rules, regulations and standards in the country or region in which the SL-V is used/installed.

(1) Pre-check for installation condition

- The machine under SL-V control can be caused to stop running by the OFF-state of OSSD.
- The SL-V is installed so that the machine operator cannot go into or approach the hazardous area without passing through the detection zone.
- The interlock reset mechanism is installed so that it cannot be operated if there are any personnel within the hazardous area.
- The device to activate the override is installed so that it cannot be operated if there are any personnel within the hazardous area.
- The SL-V has been installed at a distance greater than or equal to the minimum safety distance required.
- If there are glossy surfaces nearby, move them so that they are beyond the minimum installation distance according to "Installation Distance From Glossy Surfaces".
- The SL-V is installed at a location free from light interference, for example fluorescent lamps.
- The transmitters and receivers are paired correctly.
- The beam axis spacing (detection capability) is the same between the transmitter and the receiver when installing the SL-V.
- The muting devices fulfill the conditions specified in this instruction manual and the requirements of the laws, rules, regulations and standards in the country or region in which the SL-V and those devices are used.
- The devices used to activate the override fulfill the conditions specified in this manual and requirements of the laws, rules, regulations and standards in the country or region in which the SL-V and those devices are used.

- When the reduced resolution function is applied, the safety distance is accurately calculated based on the detection capability, and the SL-V is installed at a distance greater than or equal to the minimum safety distance away from the hazardous zone or hazard.
- When the fixed blanking function is applied, a hazardous clearance that is not protected by the SL-V may be generated between the obstacle and the SL-V. When such a hazardous clearance is generated, an additional protective device such as a safeguard is installed.
- Risk assessment was performed on your own responsibility based on your machine application, and then the installation of SL-V was also based on its result.

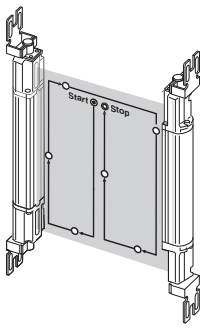
(2) Pre-check for wiring

- The SL-V power supply is 24 V DC, fulfill the conditions for the power supply as specified in this instruction manual.
- The transmitter and receiver cables are installed correctly.
- The two of OSSD outputs provided in the SL-V are both used as a safety-related machine control system.
- The polarity is not reversed with the connection to the power supply.
- In case of using PNP output type cable, the OSSD is not short-circuited to +24V, and the load is between the OSSD and 0V.
- In case of using NPN output type cable, the OSSD is not short-circuited to 0V, and the load is between the OSSD and +24V.
- When two or more SL-V are connected in series, they are connected using the dedicated series connection cable, which is not cut or extended.
- Alert output, AUX output, Clear/Blocked Output, state information output, and Interlock-reset-ready output are not used as safety output for safety systems.
- The cable sheaths are not damaged. The protection against the disconnection or short-circuit of cable, which might be caused by crushing or being caught in a machine, is taken into account.
- If two or more sets of the SL-V units are used in the vicinity of each other, the protection measures against light interference is done through a series connection method or light interference prevention method.
- All of NON-SAFETY-RELATED functions described in this instruction manual are not a part of / whole of safety-related machine control system.

(3) Pre-check test while the machine is stopped

You should do the following pre-check test with the test piece in order to make sure the operation of the SL-V while the machine is stopped. In case of the detection capability of 45mm, you should use the test piece with a diameter of 45mm.
When the reduced resolution function is enabled, prepare the test piece whose size corresponds to the enlarged minimum detection size.

- The OSSD indicator on the SL-V lights in red and the OSSD turns OFF while the test piece is present in the detection zone. The following figure shows the movement procedure of the test piece.



- The OSSD indicator and all bar LEDs light in green if no test piece is present in the detection zone.
- When the EDM function is applied, the SL-V goes to a lockout condition and the OSSD indicator on the SL-V lights in red if the EDM input opens while the test piece is present in the detection zone.
- The bar LEDs lights in green, the OSSD indicator continues to light in red, and the interlock indicator lights in yellow, if the test piece is removed from the detection zone. This is only applicable in case of manual reset mode.
- The OSSD indicator lights in green and the interlock indicator lights OFF if the reset input is activated. This is only applicable in case of manual reset mode.

(4) Pre-check test while the machine is operating

The purpose of this pre-check test is to make sure that the machine (hazards) stops its operation. This test must be done after you completely make sure that there is nobody in the hazardous zone.

- The machine stops if the test piece is present in the detection zone. It is recommended to try three locations of test piece: near the transmitter, near the receiver, and in the central area of the detection zone.
- The machine (hazard) still stops its operation as long as the test piece is present in the specified protection zone. This test should be done for the whole detection zone.
- The machine (hazard) stops its operation when the power for the SL-V is disconnected.
- Minimum safety distance is ensured, which has been calculated according to the laws, regulations, and standards of the country and region in which the SL-V is installed.

■ Inspection prior to daily operation (Daily inspection)

You should check the SL-V operation and the machine operation according to the following checklist prior to daily operation. Note that the following inspection items comprise only a bare minimum inspection. KEYENCE Corporation strongly recommends including the necessary checking items into this checklist based on the judgment of the responsible personnel since additional criteria may be necessary depending on both the machine to which the SL-V is installed and the laws, rules, regulations and standards in the country or region in which the SL-V is used/installed.
The result of this inspection must be kept on record along with the machine log.

(1) Pre-check for installation condition

- The SL-V is installed so that the machine operator cannot go into or approach the hazardous area without passing through the detection zone.
- The SL-V has been installed at a distance greater than or equal to the minimum safety distance required.
- When the reduced resolution function is applied, the safety distance is accurately calculated based on the detection capability, and the SL-V is installed at a distance greater than or equal to the minimum safety distance away from the hazardous zone or hazard.
- When the fixed blanking function is applied, a hazardous clearance that is not protected by the SL-V may be generated between the obstacle and the SL-V. When such a hazardous clearance is generated, an additional protective device such as a safeguard is installed.
- The SL-V is installed at a location free from light interference, for example fluorescent lamps.
- The cable sheaths are not damaged. The protection against the disconnection or short-circuit of cable, which might be caused by crushing or being caught in a machine, is taken into account. Additionally, you should perform the following inspections as described in "Inspection before operation".
  (3) Pre-check test while the machine is stopped
  (4) Pre-check test while the machine is operating
- There is no change of installation that would influence the result of your original risk assessment.

■ Regular (periodical) inspection

The responsible personnel must perform a regular inspection.
It is recommended to perform a regular inspection at least once every six months.
Note that the following inspection items comprise only a bare minimum inspection. KEYENCE Corporation strongly recommends including the necessary checking items into this checklist based on the judgment of the responsible personnel since additional criteria may be necessary depending on both the machine to which the SL-V is installed and the laws, rules, regulations and standards in the country or region in which the SL-V is used/installed.
The result of this inspection must be kept on record along with the machine log.

(1) Additional inspection items

- The actual distance between the hazardous zone or hazards and the SL-V still keeps greater than the calculated safety distance.
- When the reduced resolution function is applied, the safety distance is accurately calculated based on the enlarged detection capability, and the SL-V is installed at a distance greater than or equal to the minimum safety distance away from the hazardous zone or hazard.
- When the fixed blanking function is applied, a hazardous clearance that is not protected by the SL-V may be generated between the obstacle and the SL-V. When such a hazardous clearance is generated, an additional protective device such as a safeguard is installed.
- The stop time of the machine connected to the SL-V has not increased.
- There are no loose screws in the mounting bracket.
- The unit connection cable or the series connection cable is fastened tightly to the SL-V with no loose screws.
- The OSSD is connected correctly to the machine.
- There is no damage to the SL-V that may influence IP65 structure.
- The surface of the SL-V is not polluted or damaged.
- Beam axes must be aligned. If it is out of alignment, beam axes are aligned.
- There is no change of installation that would influence the result of your original risk assessment.

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