

Safety Light Curtain

F3SG-4RA□□□□-25-02TS Series

User's Manual



Original instructions

Introduction

Thank you for purchasing the F3SG-4RA□□□□-25-02TS Series Safety Light Curtain (hereinafter referred to as the "F3SG-4RA-25-02TS" or "F3SG-R").

This is the instruction Manual describing the use of F3SG-R.

Always heed the following points when using the F3SG-R:

- Be sure to have F3SG-R be handled by a "Responsible Person" who is well aware of and familiar with the machine to be installed.
- The term "Responsible Person" used in this Instruction Manual means the person qualified, authorized and responsible to secure "safety" in each process of the design, installation, operation, maintenance services and disposition of the machine.
- It is assumed that F3SG-R will be used properly according to the installation environment, performance and function of the machine. Responsible Person should conduct risk assessment on the machine and determine the suitability of this product before installation.
- Read this Manual thoroughly to understand and make good use of the descriptions before installing and operating the product.
- Keep this Manual at the place where the operator can refer to whenever necessary.

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Legislation and Standards

1. The F3SG-R does not receive type approval provided by Article 44-2 of the Industrial Safety and Health Act of Japan. When using the F3SG-R in Japan as a "safety system for pressing or shearing machines" prescribed in Article 42 of that law, the machine control system must receive type approval.
2. The F3SG-R is electro-sensitive protective equipment (ESPE) in accordance with European Union (EU) Machinery Directive Annex V, Item 2.
3. EC/EU Declaration of Conformity
 OMRON declares that the F3SG-R is in conformity with the requirements of the following EC/EU Directives:
 Machinery Directive 2006/42/EC
 EMC Directive 2014/30/EU
4. Conforming Standards
 - (1) European standards
 EN61496-1 (Type 4 ESPE), EN 61496-2 (Type 4 AOPD), EN61508-1 through -4 (SIL 3),
 EN ISO 13849-1:2015 (PL e, Category 4)
 - (2) International standards
 IEC61496-1 (Type 4 ESPE), IEC61496-2 (Type 4 AOPD), IEC61508-1 through -4 (SIL 3),
 ISO 13849-1:2015 (PL e, Category 4)
 - (3) JIS standards
 JIS B 9704-1 (Type 4 ESPE), JIS B 9704-2 (Type 4 AOPD)
 - (4) North American standards
 UL61496-1 (Type 4 ESPE), UL61496-2 (Type 4 AOPD), UL508, UL1998,
 CAN/CSA C22.2 No.14, CAN/CSA C22.2 No.0.8
5. Third-Party Certifications
 - (1) TÜV SÜD
 - EC Type-Examination certificate:
 EU Machinery Directive, Type 4 ESPE (EN61496-1), Type 4 AOPD (EN 61496-2)
 - Certificate:
 Type 4 ESPE (EN61496-1), Type 4 AOPD (EN61496-2), EN 61508-1 through -4 (SIL 3),
 EN ISO 13849-1:2015 (PL e, Category 4)
 - (2) UL
 - UL Listing:
 Type 4 and ESPE (UL61496-1), Type 4 AOPD (UL61496-2), UL508, UL1998, CAN/CSA C22.2 No.14,
 CAN/CSA C22.2 No.0.8

6. Other Standards

The F3SG-R is designed according to the standards listed below. To make sure that the final system complies with the following standards and regulations, you are asked to design and use it in accordance with all other related standards, laws, and regulations. If you have any questions, consult with specialized organizations such as the body responsible for prescribing and/or enforcing machinery safety regulations in the location where the equipment is to be used.

- European Standards: EN415-4, EN691-1, EN692, EN693, IEC/TS 62046
- U.S. Occupational Safety and Health Standards: OSHA 29 CFR 1910.212
- U.S. Occupational Safety and Health Standards: OSHA 29 CFR 1910.217
- American National Standards: ANSI B11.1 to B11.19
- American National Standards: ANSI/RIA R15.06
- Canadian Standards Association CSA Z142, Z432, Z434
- SEMI Standards SEMI S2
- Japan Ministry of Health, Labour and Welfare "Guidelines for Comprehensive Safety Standards of Machinery", Standard Bureau's Notification No. 0731001 dated July 31, 2007.rms and Conditions Agreement

Terms and Conditions Agreement

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- (c) Buyer Remedy. Omron's sole obligation hereunder shall be, at Omron's election, to (i) replace (in the form originally shipped with Buyer responsible for labor charges for removal or replacement thereof) the non-complying Product, (ii) repair the non-complying Product, or (iii) repay or credit Buyer an amount equal to the purchase price of the non-complying Product; provided that in no event shall Omron be responsible for warranty, repair, indemnity or any other claims or expenses regarding the Products unless Omron's analysis confirms that the Products were properly handled, stored, installed and maintained and not subject to contamination, abuse, misuse or inappropriate modification. Return of any Products by Buyer must be approved in writing by Omron before shipment. Omron Companies shall not be liable for the suitability or unsuitability or the results from the use of Products in combination with any electrical or electronic components, circuits, system assemblies or any other materials or substances or environments. Any advice, recommendations or information given orally or in writing, are not to be construed as an amendment or addition to the above warranty.
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Omron Companies shall not be responsible for conformity with any standards, codes or regulations which apply to the combination of the Product in the Buyer's application or use of the Product. At Buyer's request, Omron will provide applicable third party certification documents identifying ratings and limitations of use which apply to the Product. This information by itself is not sufficient for a complete determination of the suitability of the Product in combination with the end product, machine, system, or other application or use. Buyer shall be solely responsible for determining appropriateness of the particular Product with respect to Buyer's application, product or system. Buyer shall take application responsibility in all cases.

NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT(S) IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

Programmable Products.

Omron Companies shall not be responsible for the user's programming of a programmable Product, or any consequence thereof.

Performance Data.

Data presented in Omron Company websites, catalogs and other materials is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of Omron's test conditions, and the user must correlate it to actual application requirements. Actual performance is subject to the Omron's Warranty and Limitations of Liability.

Change in Specifications.

Product specifications and accessories may be changed at any time based on improvements and other reasons. It is our practice to change part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the Product may be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.

Errors and Omissions.



Information presented by Omron Companies has been checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.

Safety Precautions




Indications and Meanings for Safe Use

The precautions listed in this document indicated by alert symbols and statements must be followed for the safe use of the F3SG-R. Failure to follow all precautions and alerts may result in an unsafe use or operation. The following word and symbols are used in this document.

Meaning of Signal Word

 DANGER	Indicates an imminently hazardous situation which, if not avoided, is likely to result in serious injury or may result in death. Additionally there may be severe property damage.
 WARNING	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally there may be significant property damage.

Meanings of Alert Symbols

	Indicates prohibited actions.
	Indicates mandatory actions.
	Indicates the risk of electric shock.

Alert Statements in this Manual

DANGER

Stop the machine immediately if the F3SG-R and the machine installed with the F3SG-R does not operate as intended.



Make sure to test the operation of the F3SG-R after setting with Rotary Switch and/or End Cap to verify that the F3SG-R operates as intended. Make sure to stop the machine until the test is complete. Unintended settings may cause a person to go undetected, resulting in serious injury or death.



For users

WARNING

The F3SG-R must be installed, configured, and incorporated into a machine control system by a sufficiently trained and qualified person. An unqualified person may not be able to perform these operations properly, which may cause a person to go undetected, resulting in serious injury.



For machines

 **WARNING**

Do not use this sensor for machines that cannot be stopped by electrical control. For example, do not use it for a pressing machine that uses full-rotation clutch. Otherwise, the machine may not stop before a person reaches the hazardous part, resulting in serious injury.



To use F3SG-R in PSDI mode (initiation of cycle operations by a presence sensing device), you must configure an appropriate circuit between F3SG-R and the machine. For details about PSDI, refer to OSHA1910.217, IEC61496-1, and other relevant standards and regulations.



For installation

 **WARNING**

Make sure Responsible Person tests the operation of the F3SG-R after installation to verify that the F3SG-R operates as intended. Make sure to stop the machine until the test is complete. Unintended installation, wiring or function settings may cause a person to go undetected, resulting in serious injury.



Make sure to install the F3SG-R at the safety distance from the hazardous part of the machine. Otherwise, the machine may not stop before a person reaches the hazardous part, resulting in serious injury.



Install a protective structure so that the hazardous part of a machine can only be reached by passing through the sensor's detection zone. If access to the hazardous part by reaching over the detection zone of a vertically mounted F3SG-R cannot be excluded, the height of the detection zone and the safety distance shall be determined in consideration of such a risk. Install the sensors so that part of the person is always present in the detection zone when working in a machine's hazardous zones. If a person is able to step into the hazardous zone of a machine and remain behind the F3SG-R's detection zone, configure the system with restart interlock function. Failure to do so may result in serious injury due to unexpected startup.



Install the reset switch in a location that provides a clear view of the entire hazardous zone and where it cannot be activated from within the hazardous zone.



The F3SG-R cannot protect a person from a projectile exiting the hazardous zone. Install protective cover(s) or fence(s).



Install F3SG-R so that it is not affected by reflective surfaces. Failure to do so may hinder detection, resulting in serious injury. For an installation distance from reflective surfaces, see 4-1-3. *Distance from Reflective Surfaces*.



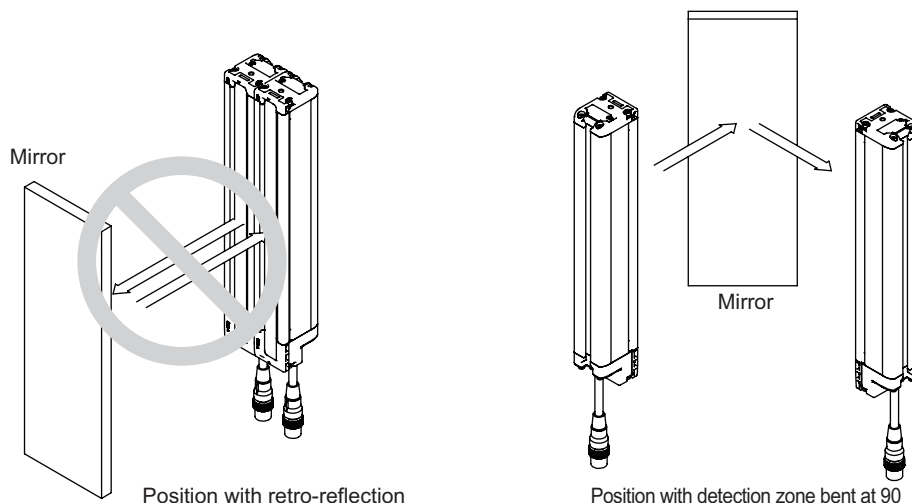
When using more than 1 set of F3SG-R in adjacent areas, the emitter of one F3SG-R may interfere with the receiver of the other, causing the safety functions to stop working properly. Install, configure and maintain them so that mutual interference does not occur.



Make sure that foreign material such as water, oil, or dust does not enter the F3SG-R or the connector while the cap is removed.



Do not use the sensor system with mirrors in a retro-reflective configuration as shown below. Doing so may hinder detection. It is possible to use mirrors to alter the detection zone to a 90-degree angle.



Perform an inspection for all F3SG-R as described in *Chapter 6 Checklists*. When using cascade connections, perform inspections for every connected F3SG-R.



For wiring

WARNING

Connect the load between the output and 0 V line. Connecting the load between the output and a different power supply line from the above will result in a dangerous condition because the operation mode of safety output is reversed to "Dark-ON".



Do not ground +24 VDC line. Otherwise, a ground fault may turn the safety output ON, resulting in a failure of stopping the machine.



Configure the system by using the optimal number of safety outputs that satisfy the requirements of the necessary safety category.



Do not connect each line of F3SG-R to a DC power supply of higher than 24 VDC+20%. Also, do not connect it to an AC power supply. Failure to do so may result in electric shock.



Make sure to perform wiring while the power supply is OFF.



Do not use the auxiliary output for safety applications. Failure to do so may result in serious injury when the F3SG-R fails.



For the F3SG-R to comply with IEC 61496-1 and UL 508, the DC power supply unit must satisfy all of the following conditions:

- Must be within the rated power voltage (24 VDC \pm 20%)
- Must have tolerance against the total rated current of devices if it is connected to multiple devices
- Must comply with EMC directives (industrial environment)
- Double or reinforced insulation must be applied between the primary and secondary circuits
- Automatic recovery of overcurrent protection characteristics
- Output holding time must be 20ms or longer
- Must satisfy output characteristic requirements for class 2 circuit or limited voltage current circuit defined by UL508. Refer to 4-5-2. *Power Supply Unit*.
- Must comply with laws and regulations, regarding EMC and electrical equipment safety, of the country or region where the F3SG-R is used (For example, in EU, the power supply must comply with the EMC Directive and the Low Voltage Directive.)



Double or reinforced insulation from hazardous voltage must be applied to all input and output lines. Failure to do so may result in electric shock.



Extension of the cable must be within a specified length. If it isn't, safety function may not work properly, resulting in danger.



Other

 **WARNING**

Do not try to disassemble, repair, or modify this product. Doing so may cause the safety functions to stop working properly.



Do not use the F3SG-R in environments where flammable or explosive gases are present. Doing so may result in explosion.



Perform daily and 6-month inspections for the F3SG-R as described in *Chapter 6 Checklists*. Otherwise, the system may fail to work properly, resulting in serious injury.




Do not use the F3SG-R in environments where strong electromagnetic field may be produced. Doing so may cause the safety functions to stop working properly.



Precautions for Safe Use

Make sure to observe the following precautions that are necessary for ensuring safe use of the product.

Do not install, use, or store the F3SG-R in the following types of environments:

- Areas exposed to intense interference light, such as direct sunlight
 - Areas with high humidity where condensation is likely to occur
 - Areas where corrosive gases are present
 - Areas exposed to vibration or shock levels higher than in the specification provisions
 - Areas where the pollution degree is harsher than 3, such as outdoor environment
 - Areas where the product may get wet with oil that can solve adhesive
 - Areas where foreign material such as spatter adheres to the F3SG-R
- Loads must satisfy both of the following conditions:
 - Not short-circuited
 - Not used with a current that is higher than the rating
 - Do not drop the product.
 - Dispose of the product in accordance with the relevant rules and regulations of the country or area where the product is used.
 - Make sure that the F3SG-R is securely mounted and its cables and connectors are properly secured with the torque recommended in this document.
 - Do not apply excessive force (0.2 N·m or more) to the Rotary Switch when operating it. Doing so may damage and make the Rotary Switch inoperable. Do not operate the Rotary Switch with tools that may damage the product.
 - Bending radii of cables must be equal to or higher than specified minimum values.
 - When replacing the cable connectors with other types of connectors, use connectors that provide a protection grade of IP54 or higher.
 - Be sure to route the input/output lines for the F3SG-R separate from high-potential power lines or through an exclusive conduit.
 - To extend a cable length with a cable other than the dedicated cable, use a cable with the same or superior specifications.
-  Refer to 4-5-3-6. *Extending Cable Length with Commercially Available Cable*
- Use the F39-JD□RA cables in environment where the product may be exposed to oil. Using the other cables in such an environment may cause cutting oils or other substances to enter the cables, resulting in a risk of damaging or burning the product.
 - Interface Unit F39-GIF-1 is dedicated to F3SG-RA-02TS and F3SG-RR series. Do not use it for other F3SG-RA series than F3SG-RA-02TS, F3SJ-A or F3SJ-E/B series.
 - When powering on the F3SG-R with the Interface Unit being connected to the F3SG-R, the PC COM lines must be open. Otherwise the F3SG-R goes to the Lockout state or does not send the safety outputs (OSSDs).
 - Read and understand this document for setting with the Rotary Switch and End Cap.
 - The rated life of the LEDs used for this product is 6 years.
 - Some cutting oils may affect the product. Before using cutting oils, make sure that the oils should not cause deterioration or degradation of the product.
 - Do not use the product with degraded protective structure such as swelling and crack in housing and/or sealing components. Otherwise cutting oil or other substance may enter the product, resulting in a risk of corruption or burning.

Precautions for Correct Use

Observe the precautions described below to prevent operation failure, malfunctions, or undesirable effects on product performance.

■ Storage conditions and installation environment

- Do not install, use, or store the F3SG-R in the following types of environments:
 - For a long time at a temperature or humidity out of the specified range
 - Areas submerged in water or subject to rain water
- This is a class A product. In residential areas it may cause radio interference, in which case the Responsible Person may be required to take adequate measures to reduce interference.

■ Wiring and installation

- Properly perform the wiring after confirming the signal names of all the terminals.
- Be sure that there is nothing in the detection zone and the stable-state indicator is turned ON after power is turned ON.
- Do not operate the control system until 2 seconds or more after turning ON the power of the F3SG-R.
- When using a commercially available switching regulator power supply, make sure to ground the PE terminal (protective earth terminal).
- Install the emitter and receiver to the same vertical direction.
- Use brackets of specified quantities and locations according to the dimensions.
If the brackets described above are not used, ratings and performance cannot be met.
- Do not install the F3SG-R close to a device that generates high-frequency noise. Otherwise, take sufficient blocking measures.
- Sharing the power supply with other devices may cause the F3SG-R to be affected by noise or voltage drop. It is recommended that the F3SG-R use a power supply dedicated for safety components, not shared with other devices.

■ Cleaning

- Do not use thinner, benzene, or acetone for cleaning. They affect the product's resin parts and paint on the housing.
- Use a soft cloth which is dry or wetted with clean water for cleaning. Do not use solvents.

■ Object detection

- The F3SG-R cannot detect transparent and/or translucent objects.

■ Settings

- Do not operate the Rotary Switch during normal operation of the F3SG-R. Otherwise, the F3SG-R enters the Lockout state.

Oil resistance

The F3SG-R passed the testing for the resistance to the oils listed in the table below. Refer to the table for selection of lubricant or cutting oils to be used.

Test Oil Type	JIS Type	Product Name	Manufacturer	
Water-soluble cutting oils	A1	Yushiroken EC50T3	Yushiro Chemical Industry Co., Ltd.	
		Yushiroken FGE366		
		Yushiroken FX90		
		Yushiroken FGE180		
		Yushiroken EC980		
	A2	Yushiroken FGM427		
		Yushiroken FGS700		Kyodo Yushi Co., Ltd.
		Yushiroken GTS-100		
		Yushiroken Synthetic #770TG		
		Multicool CSF-9000		
		Multicut SGV		
A3	Yushiroken FGC950PR	Yushiro Chemical Industry Co., Ltd.		
	Yushiroken SC46TY			
Non-water-soluble cutting oils	N1	Yushiron Oil CG5	Yushiro Chemical Industry Co., Ltd.	
	N3	Yushiron Cut ABAS BZ224K		
	N4	Yushiron Cut ABAS KZ440		

Note 1. The product passed the 240-hour immersion test at 55°C to the listed oils, maintaining the insulation resistance of 20 MΩ and preventing the ingress of the oils.

Note 2. When using the other oils than listed, make sure that the oils should not cause deterioration or degradation of the product.

Visual Aids

The following symbols appear in this document to help you locate different types of information.



CHECK!

Indicates important information or advice on a function or operation of the product.



Indicates page numbers or chapter title of related information.

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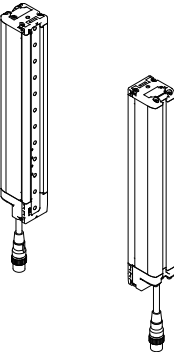
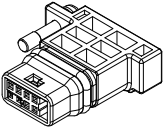
Chapter 1 Overview and Specifications

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1-1. What is Included

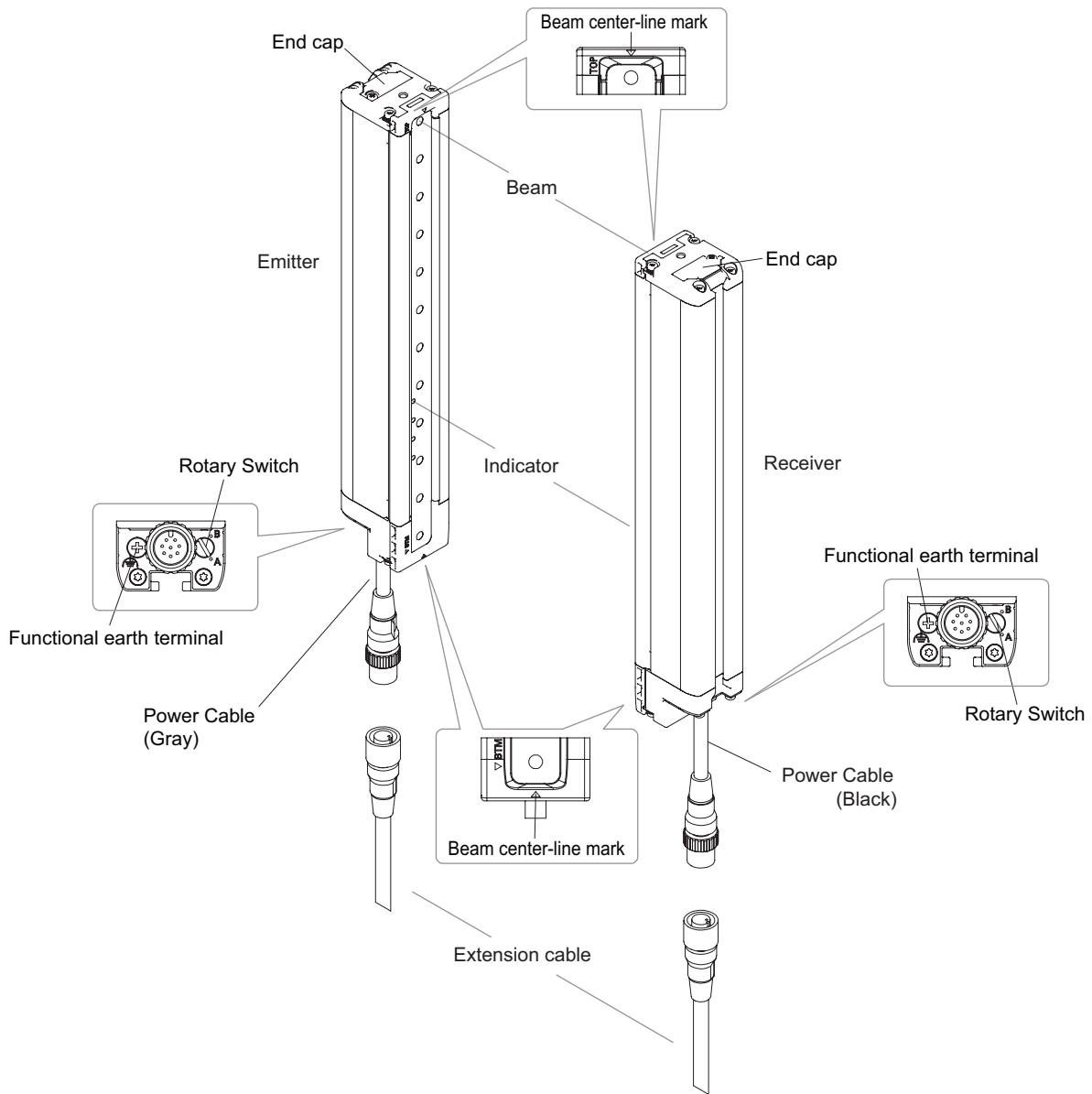
Before use, confirm that the items below are included with the product.

If you find that an item is missing, please contact your local branch office or distributor.

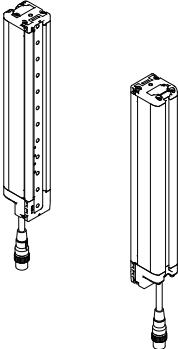
Product	Quantity
<p>F3SG-4RA□□□□-25-02TS main unit</p> 	<p>Emitter x 1, Receiver x 1</p>
<p>Troubleshooting Guide Sticker</p>	<p>1</p>
<p>Safety Precautions</p>	<p>1</p>
<p>Quick Installation Manual</p>	<p>1</p>
<p>End Cap (for External Test Input Selection) (Color: White)</p> 	<p>1</p>

1-2. System Components

This section describes the system components and part names of the F3SG-R system.



1-2-1. Basic Components

Component	Model name	Description
<p>Emitter, receiver</p> 	<p>F3SG-4RA□□□□-25-02TS-□</p>	<p>Select a model name based on the required protective height.</p> <p>The model name can be understood as follows:</p> <div style="text-align: center;"> <p>F3SG-4RA□□□□-25-02TS-□</p> <p style="margin-left: 100px;"> </p> <p style="margin-left: 100px;">1 2 3 4</p> </div> <p>1: ESPE type (4: Type 4) 2: Protective height (mm) 3: Object resolution (25: 25mm) 4: L: Emitter, D: Receiver, blank: Emitter and receiver.</p>



To distinguish between the emitter and receiver, find the labels attached to the front of the F3SG-R. The label on the emitter reads "EMITTER" and the label on the receiver reads "RECEIVER".

CHECK!

1-3. List of Features

1-3-1. Model Overview

The F3SG-R series is an advance model, allowing you to configure the safety light curtain to fit your application.

Refer to the List of Features below for available features.

1-3-2. List of Features

The F3SG-4RA-25-02TS safety light curtain family has the following features. Some of the features are selectable by the Rotary Switch or End Cap on the body of the safety light curtain.

Feature	Setting	Factory default setting	Page
Optical Synchronization	--	--	p.15
Scan Code Selection	with Rotary Switch	Code A	p.16
Self-Test	--	--	p.17
External Test	with End Cap	24 V Active	p.19
Lockout Reset	--	--	p.20
External Device Monitoring (EDM)	Changing settings not available	Enable	p.21
Auxiliary Output	Changing settings not available	Inverted signal of safety output information	p.22
Lamp	Changing settings not available	Red (ON): Inverted signal of safety output information Orange (blink once): Inverted signal of stable-state information Green (ON): Safety output information	p.23
Light Level Monitoring	Only reading data from sensor available	--	p.24
Error Log/Warning Log	Only reading data from sensor available	--	p.25
Power-ON Time	Only reading data from sensor available	--	p.25
Load Switching Frequency	Only reading data from sensor available	--	p.25
Operating Status Monitoring	Only reading data from sensor available	--	p.26

1-4-1. LED Indicator Status

Shown below are the of factory default indication statuses of F3SG-R LED indicators.

Emitter

Location	Name of Indicator		Color	Illuminated	Blinking
1	Test	TEST	Green	-	External Test is being performed
2	Operating range	LONG	Green	Always illuminated	Lockout state due to Scan code setting error
3	Power	POWER	Green	Power is ON	Error due to noise
4	Lockout	LOCKOUT	Red	-	Lockout state due to error in emitter

Receiver

Location	Name of Indicator		Color	Illuminated	Blinking
1	Top-beam-state	TOP	Blue	The top beam is unblocked	Lockout state due to Cap error or Other sensor error
2	NPN	NPN	Green	Always illuminated	-
3	Configuration	CFG	Green	-	Lockout state due to Parameter error or Cascading Configuration error
4	External device monitoring	EDM	Green	EDM input is in ON state *	Lockout state due to EDM error
5	Internal error	INTERNAL	Red	-	Lockout state due to Internal error, or error due to abnormal power supply or noise
6	Lockout	LOCKOUT	Red	-	Lockout state due to error in receiver
7	Stable-state	STB	Green	Incident light level is 170% or higher of ON-threshold	Safety output is instantaneously turned OFF due to ambient light or vibration
8	ON/OFF	ON/OFF	Green	Safety output is in ON state	-
			Red	Safety output is in OFF state	Lockout state due to Safety Output error, or error due to abnormal power supply or noise
9	Communication	COM	Green	Synchronization between emitter and receiver is maintained	Lockout state due to Communication error, or error due to abnormal power supply or noise
10	Bottom-beam-state	BTM	Blue	The bottom beam is unblocked	Lockout state due to Scan code setting error




* The EDM indicator is illuminated when the EDM input is in the ON state regardless of the use of the EDM function.









Refer to 7-3. *Glossary* for definitions of terms used in the table above.

1-5. Ratings/Specifications

The □□□□ in the model names indicate the protective heights in millimeters.

		F3SG-4RA□□□□-25-02TS
Performance		
Object Resolution (Detection Capability)	Opaque objects, 25-mm dia.	
Beam Gap	20 mm	
Number of Beams	12 to 96	
Lens Size	6.0 × 5.0 (W × H) mm	
Protective Height	240 to 1920 mm	
Operating Range	0.3 to 17.0 m	
Response Time	ON to OFF	Normal mode: 8 to 13 ms *
	OFF to ON	Normal mode: 40 to 90ms (synchronized), 140 to 190ms (not synchronized) *
	* . Response time when used in one segment system or in cascaded connection.  1-6. List of Models for more information.	
Effective Aperture Angle (EAA) (IEC 61496-2)	±2.5° max., emitter and receiver at operating range of 3 m or greater	
Light Source	Infrared LEDs, Wavelength: 870 nm	
Startup Waiting Time	2 s max.	
Electrical		
Power Supply Voltage (Vs)	SELV/PELV 24 VDC±20% (ripple p-p 10% max.)	
Current Consumption	 1-6. List of Models	
Safety Outputs (OSSD)	Two PNP transistor outputs	
	Load current of 300 mA max., Residual voltage of 2 V max. (except for voltage drop due to cable extension), Capacitive load of 1 μF max., Inductive load of 2.2 H max. *1 Leakage current of 1 mA max. *2	
	*1. The load inductance is the maximum value when the safety output frequently repeats ON and OFF. When you use the safety output at 4 Hz or less, the usable load inductance becomes larger. *2. These values must be taken into consideration when connecting elements including a capacitive load such as a capacitor.	
Auxiliary Output	One PNP transistor output	
	Load current of 100 mA max., Residual voltage of 2 V max .	
Output Operation Mode	Safety Output	Light-ON (Safety output is enabled when the receiver receives an emitting signal.)
	Auxiliary Output	Reverse output of safety output
Input Voltage	External device monitoring input (Lockout reset input)	ON voltage: Vs-3 V to Vs (short circuit current: approx. 6.5 mA) * OFF voltage: 0 V to 1/2 Vs, or open (short circuit current: approx. 8.0 mA) *
	Test input	24 V Active setting: ON voltage: 9 V to Vs (short circuit current: approx. 2.5 mA) * OFF voltage: 0 to 3 V or open (short circuit current: approx. 2.0 mA)
		0 V Active setting: ON voltage: 0 to 3 V (short circuit current: approx. 2.0 mA) OFF voltage: 9 V to Vs or open (short circuit current: approx. 2.5 mA) *
* The Vs indicates a supply voltage value in your environment.		
Overvoltage Category (IEC 60664-1)	II	
Indicators	 1-4-1. LED Indicator Status	
Protective Circuit	Output short protection, Power supply reverse polarity protection	
Insulation Resistance	20 MΩ or higher (500 VDC megger)	
Dielectric Strength	1,000 VAC, 50/60 Hz (1 min)	

		F3SG-4RA□□□□-25-02TS
Functional		
Mutual Interference Prevention (Scan Code)	This function prevents mutual interference in up to two F3SG-R systems.  4-1-4. Mutual Interference Prevention	
Cascade Connection	Number of cascaded segments: 3 max. (only among F3SG-4RA□□□□-25-02TS's)	
	Total number of beams: 255 max. Cable length between sensors: 10 m max. (not including cascading cable (F39-JGR2WTS) and power cable)	
Test Function	Self-test (at power-on, and during operation) External test (light emission stop function by test input)	
Safety-Related Functions	External device monitoring (EDM) Scan code selection	
Environmental		
Ambient Temperature	Operating	-10 to 55°C (14 to 131°F) (non-icing)
	Storage	-25 to 70°C (-13 to 158°F)
Ambient Humidity	Operating	35% to 85% (non-condensing)
	Storage	35% to 95%
Ambient Illuminance	Incandescent lamp: 3,000 lx max. on receiver surface Sunlight: 10,000 lx max. on receiver surface	
Degree of Protection (IEC 60529)	IEC 60529: IP65 and IP67, JIS C 0920 Annex 1: IP67G	
Vibration Resistance (IEC 61496-1)	10 to 55 Hz, Multiple amplitude of 0.7 mm, 20 sweeps for all 3 axes	
Shock Resistance (IEC 61496-1)	100 m/s ² , 1000 shocks for all 3 axes	
Pollution Degree (IEC 60664-1)	Pollution Degree 3	
Connections		
Power cable	Type of Connection	M12 connectors: 8-pin emitter and receiver. Cables prewired to the sensors. IP67 and IP67G (JIS C 0920 Annex 1)* rated when mated. *F3SG-R meets the degree of protection when it is correctly connected with an F39-JD□□RA-□ Oil-resistant cable.
	Number of Wires	Emitter: 5, Receiver: 8
	Cable Length	0.3 m
	Cable Diameter	6 mm
	Minimum Bending Radius	R36 mm
Cascading cable	Type of Connection	M12 connectors: 8-pin emitter and receiver. IP67 rated when mated.
	Number of Wires	Emitter: 5, Receiver: 8
	Cable Length	0.3 m
	Cable Diameter	6 mm
	Minimum Bending Radius	R5 mm

		F3SG-4RA□□□□-25-02TS
F39-JD□RA-□ Oil-resistant cable - Single-ended cable	Type of Connection	M12 connectors: 8-pin emitter and receiver. Cables prewired to the sensors. IP67 and IP67G (JIS C 0920 Annex 1)* rated when mated. *F3SG-R meets the degree of protection when it is correctly connected with the power cable. The degree of protection is not satisfied with the part where cable wires are uncovered.
	Number of Wires	Emitter: 5, Receiver: 8
	Cable Length	 4-5-3-1. <i>Single-Ended Cable (Oil-Resistant Cable)</i>
	Cable Diameter	6 mm
	Minimum Bending Radius	R36 mm
Extension cable - Single-ended cable (F39- JD□A) - Double-ended cable (F39- JD□B)	Type of Connection	M12 connectors: 8-pin emitter and receiver. IP67 rated when mated.
	Number of Wires	Emitter: 8, Receiver: 8
	Cable Length	 4-5-3-2. <i>Single-Ended Cable</i>  4-5-3-3. <i>Double-Ended Cable</i>
	Cable Diameter	6.6 mm
	Minimum Bending Radius	R36 mm
Extension of Power Cable	100 m max. (Emitter/Receiver)	
Material		
Material	Housing: Aluminum alloy Cap: PBT resin Front window: Acrylic resin Cable: Fluororesin cable FE plate: Stainless steel	
Weight	 1-6. <i>List of Models</i>	
Included Accessories	Safety Precautions, Quick Installation Manual, Troubleshooting Guide Sticker, End Cap (for switching External Test Input function)	
Conformity		
Conforming standards	 <i>Legislation and Standards</i>	
Performance Level (PL)/ Safety category	PL e/Category 4 (EN ISO 13849-1:2015)	
PFF _h	1.1 × 10 ⁻⁸ (IEC 61508)	
Proof test interval T _M	Every 20 years (IEC 61508)	
SFF	99% (IEC 61508)	
HFT	1 (IEC 61508)	
Classification	Type B (IEC 61508-2)	

1-6. List of Models

1-6-1. List of Models/Response Time/Current Consumption/Weight

Model	Number of Beams	Protective Height [mm] (Overall length)	Response Time[ms] *1			Current Consumption [mA]		Weight [kg]	
			ON→OFF *2	OFF (Synchronized) →ON *3	OFF (Not synchronized) →ON *3	Emitter	Receiver	Net *4	Gross *5
F3SG-4RA0240-25-02TS	12	240	8	40	140	35	75	0.7	1.5
F3SG-4RA0320-25-02TS	16	320	8	40	140	40	75	0.9	1.7
F3SG-4RA0400-25-02TS	20	400	8	40	140	45	75	1.1	2.0
F3SG-4RA0480-25-02TS	24	480	8	40	140	50	75	1.3	2.3
F3SG-4RA0560-25-02TS	28	560	8	40	140	50	75	1.5	2.5
F3SG-4RA0640-25-02TS	32	640	8	40	140	55	75	1.7	2.8
F3SG-4RA0720-25-02TS	36	720	8	40	140	60	80	1.9	3.1
F3SG-4RA0800-25-02TS	40	800	8	40	140	65	80	2.1	3.4
F3SG-4RA0880-25-02TS	44	880	13	65	165	50	80	2.4	3.6
F3SG-4RA0960-25-02TS	48	960	13	65	165	50	80	2.6	3.9
F3SG-4RA1040-25-02TS	52	1040	13	65	165	55	80	2.8	4.2
F3SG-4RA1120-25-02TS	56	1120	13	65	165	55	85	3.0	4.4
F3SG-4RA1200-25-02TS	60	1200	13	65	165	55	85	3.2	4.7
F3SG-4RA1280-25-02TS	64	1280	13	65	165	60	85	3.4	5.0
F3SG-4RA1360-25-02TS	68	1360	13	65	165	60	85	3.6	5.3
F3SG-4RA1440-25-02TS	72	1440	13	65	165	65	85	3.8	5.5
F3SG-4RA1520-25-02TS	76	1520	13	65	165	65	90	4.0	5.8
F3SG-4RA1600-25-02TS	80	1600	13	65	165	70	90	4.2	6.1
F3SG-4RA1680-25-02TS	84	1680	13	65	165	70	90	4.4	6.3
F3SG-4RA1760-25-02TS	88	1760	13	65	165	70	90	4.6	6.6
F3SG-4RA1840-25-02TS	92	1840	13	65	165	75	90	4.8	6.9
F3SG-4RA1920-25-02TS	96	1920	13	65	165	75	95	5.0	7.2

*1. The maximum speed of movement of a test rod up to which the detection capability is maintained is 2.0 m/s.

*2. The response times are values when Scan Code is set at Code B. The response times for Code A are 1 ms shorter than these values.

*3. Refer to 2-2. *Optical Synchronization* for more information.

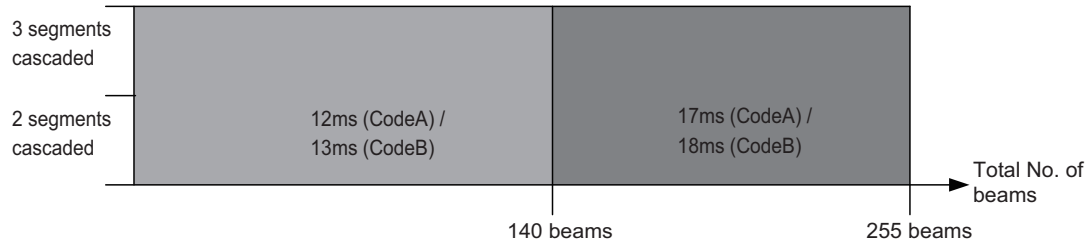
*4. The net weight is the weight of an emitter and a receiver.


*5. The gross weight is the weight of an emitter, a receiver, included accessories and a package.


1-6-2. Calculation of Response Time of Cascaded Segments

The F3SG-4RA-25-02TS can be used in cascade connection among F3SG-4RA-25-02TS's. In case of a cascade connection, a response time is determined by the total number of beams. If the total number of beams of all F3SG-R in a cascade connection is 140 or less, its response time is 12 ms (Code A)/13 ms (Code B).

The diagram below summarizes the relation described above.



 2-3. Scan Code Selection

 4-2. Cascade Connection

Chapter 2 System Operation and Functions

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2-10. Light Level Monitoring	24
2-11. Maintenance Information	25
2-12. Operating Status Monitoring	26

2-1. Operating States

The operating condition of a F3SG-R system is described in terms of states. The following operating states exist for a F3SG-R system.

2-1-1. Machine Run State

The two receiver safety outputs are in the ON state, the green ON/OFF indicator is illuminated. The protected machine is allowed to operate. Pressing and releasing the reset switch has no effect.

2-1-2. Machine Stop State

The two receiver safety outputs are in the OFF state, the red ON/OFF indicator is illuminated. The protected machine is not allowed to operate.

2-1-3. Lockout State

The two receiver safety outputs are in the OFF state, the red Lockout indicator is blinking, and another indicator is blinking showing an error. The Lockout state does not allow the protected machine to operate. The F3SG-R system will remain in the Lockout state until the cause of the error is corrected, regardless of power cycling or an external reset switch press and release.

2-2. Optical Synchronization

2-2-1. Overview

Synchronization is required between an emitter and a receiver for normal operation of F3SG-R. F3SG-R uses a specific beam for Synchronization. The beam is hereinafter called synchronization beam.

Depending on sensor configuration, the synchronization beam is either of the followings:

- One segment system: End beams (Top or Bottom beam)
- Cascaded system* : End beams (Top or Bottom beam) of the primary sensor

For an emitter and a receiver to synchronize, at least one synchronization beam must be unblocked.

The synchronization process is performed when:

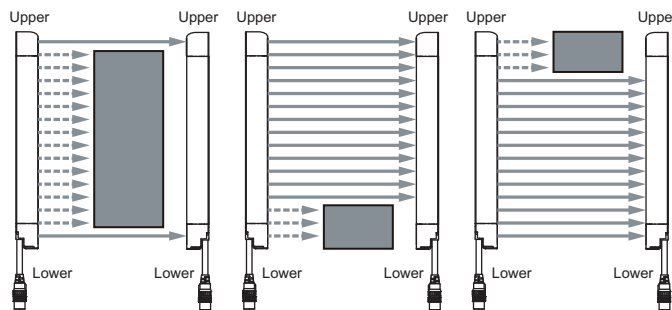
- (1) The power is turned on for an emitter and a receiver
- (2) All beams of the primary sensor are blocked and then unblocked
- (3) Synchronization is lost due to an error such as noise and ambient light



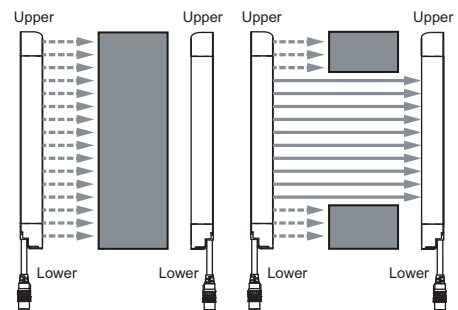
The sensor can maintain the synchronization in other cases than those described above and it is not necessary to keep the synchronization beam unblocked all the time.

CHECK!

■ Conditions to establish synchronization



■ Conditions to fail synchronization



■ Response time of “OFF (Synchronized) → ON” and “OFF (Not synchronized) → ON”

Response time of “OFF (Synchronized) → ON” is the response time from when the F3SG-R is in the OFF state and the emitter and receiver are synchronized to when the F3SG-R is turned to the ON state.


Response time of “OFF (Not synchronized) → ON” is the response time from when the F3SG-R is in the OFF state and the emitter and receiver are not synchronized to when the F3SG-R is turned to the ON state. This response time is longer since the F3SG-R evaluates if it is blocked or unblocked, after the synchronization is established.

2-3. Scan Code Selection

2-3-1. Overview

The F3SG-R has two scan codes (Code A and Code B). These scan codes have different internal processing time. The use of different scan codes allows for placement of systems in close proximity and in line with each other and minimize mutual interference.


The response time for Code A is 1 ms shorter than that for Code B.

 1-6-1. List of Models/Response Time/Current Consumption/Weight for more information on the response time.

 Refer to 4-1-4. Mutual Interference Prevention for how to mitigate mutual interference.

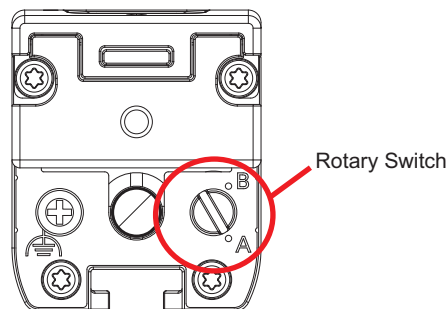
2-3-2. Factory Default Setting


The factory default setting is Code A.

 Both the emitter and receiver units must be set to the same code.
CHECK!

2-3-3. Setting

The user can select the scan code from Code A or Code B by the Rotary Switch.



 Refer to *Chapter 3 Setting with Rotary Switch and End Cap* for more information on setting this function by the Rotary Switch or End Cap Switch.

2-4. Self-Test

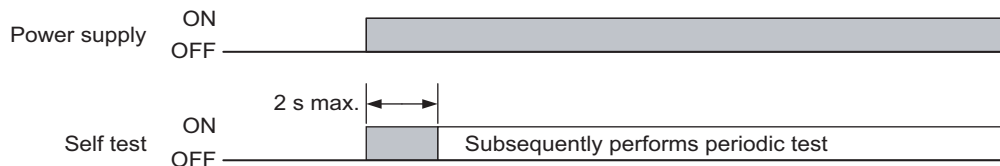
2-4-1. Overview

The F3SG-R performs the Self-Test when power is turned ON (within 2 seconds) to check for errors.

Also, it regularly performs the Self-Test (within a response time) while operating.

This function cannot be cancelled.

■ Timing chart



If an error is found in the Self-Test, the F3SG-R enters the Lockout state, keeps the safety output in the OFF state, and indicates the error at the same time.

2-4-1-1. Self-Test details

The Self-Test detects such error as described below.

Emitter

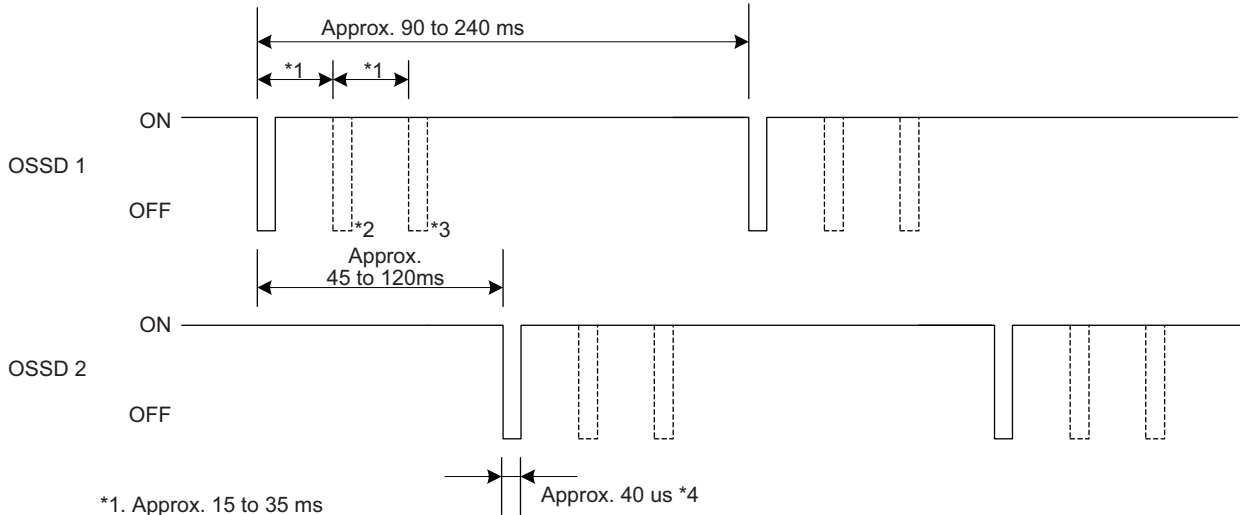
- Failure of emitter unit or circuit
- CPU failure
- Memory failure
- Failure of Rotary Switch*
- Failure of End Cap

Receiver

- Abnormal external power supply voltage
- Failure of internal power supply circuit
- Failure of receiver unit or detection circuit
- CPU failure
- Memory failure
- Failure of safety output circuit
- Disconnected or short-circuited cable
- Failure of Rotary Switch*
- Failure of End Cap

2-4-1-2. Waveform of safety outputs

When the safety outputs are in the ON state, they are cyclically turned OFF as shown below to test the output circuit. When this OFF signal is fed back, the output circuit is diagnosed as normal. If the output signal does not include an OFF pulse signal due to short-circuit, etc, the receiver diagnoses a failure in the output circuit or wiring, and it enters the Lockout state.



- *1. Approx. 15 to 35 ms
- *2. Signal when in 2-segment or 3-segment cascade.
- *3. Signal when in 3-segment cascade.
- *4. An OFF pulse signal of safety output may extend to about 100 μ s due to the effect of the connected load (mostly capacitive load).

2-5. External Test

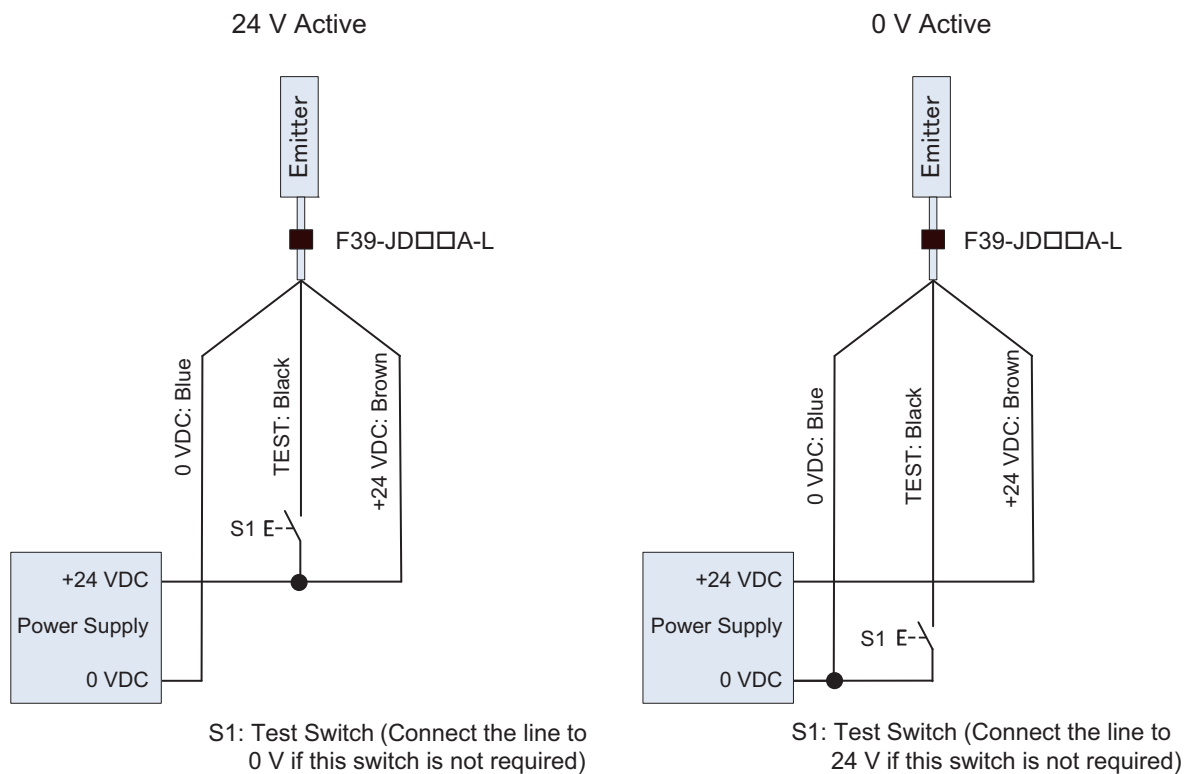
2-5-1. Overview

This function stops the emission using an external signal. It can be used to verify that a safety system should properly stop (safety output turns OFF) when F3SG-R is blocked.

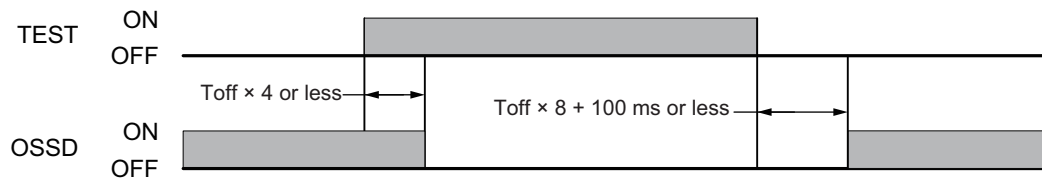
To stop the emission, apply the following voltage to the emitter's TEST input line according to the End Cap settings of the emitter.

End Cap settings	24 V Active	0 V Active
Input voltage	9 V to Vs	0 to 3 V
End Cap	Black	White

Basic wiring diagram



Timing chart



Toff: Response time ON to OFF

2-5-2. Factory Default Setting

The factory default setting is 24 V Active with the black End Cap attached to the F3SG-R.

2-5-3. Setting

The user can select the setting from 24 V Active or 0 V Active by switching the End Cap.

Refer to Chapter 3 Setting with Rotary Switch and End Cap for more information on setting this function by the Rotary Switch.

2-6. Lockout Reset

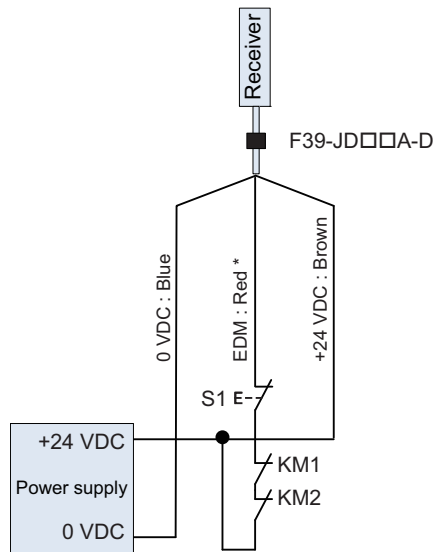
2-6-1. Overview

When the cause of the Lockout is removed, you can release the Lockout state of the F3SG-R by using either of the following methods.

- Cycle the power back ON
- Lockout reset input

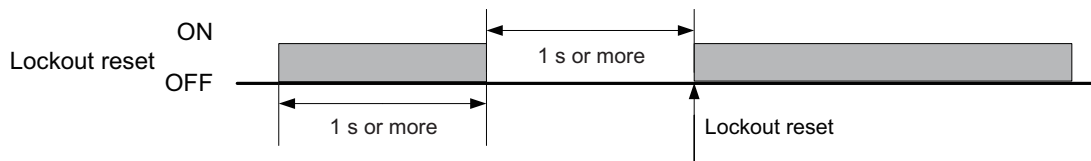
Open or apply 0 V to 1/2 Vs to the EDM line (red) for 1 s or longer, and then apply a voltage of Vs-3 V to Vs again.

■ Basic wiring diagram



S1: Lockout reset switch
 KM1, KM2: External device
 *Also used as lockout reset line

■ Timing chart



The table below shows the relation between the ON/OFF states and external lines.

Input	External Connection
ON	Vs-3 V to Vs
OFF	0 V to 1/2 Vs, or open

2-7. External Device Monitoring (EDM)

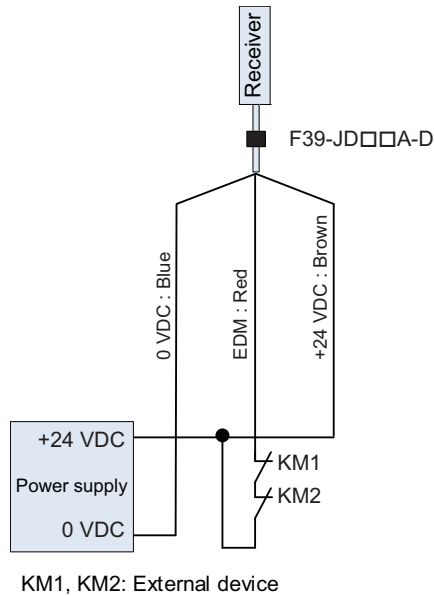
2-7-1. Overview

This function monitors if external relays (or contactors) operate normally to detect malfunctions, such as welding, in the external relays. When the N.C. contact of the external relays is open before the safety outputs switch from OFF to ON, the safety outputs remain in the OFF state. When the N.C. contact is not open within the allowable delay time after the safety outputs switch from OFF to ON, the F3SG-R enters the Lockout state.

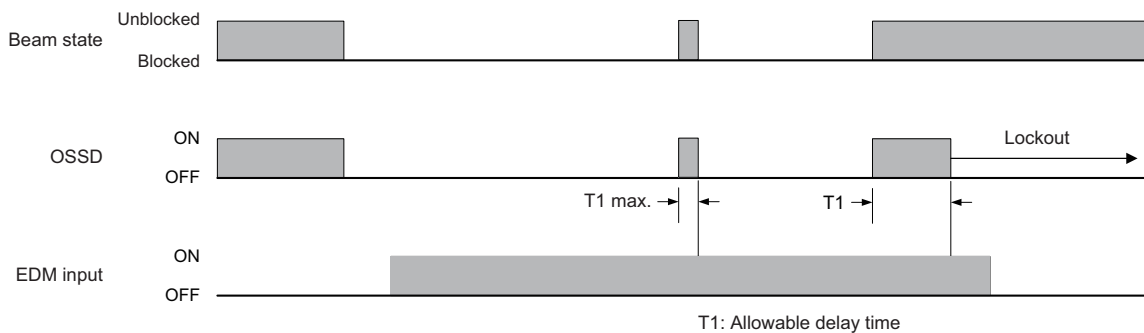
Perform wiring so that the specified voltage ($V_s - 3\text{ V}$ to V_s) is applied to the EDM line via the N.C. contact of the external relays.

The external relays or contactors must have the direct opening mechanism or be force-guided ones. When the EDM is not used, apply the auxiliary output signal to the EDM line.

Basic wiring diagram



Timing chart



2-8. Auxiliary Output



WARNING

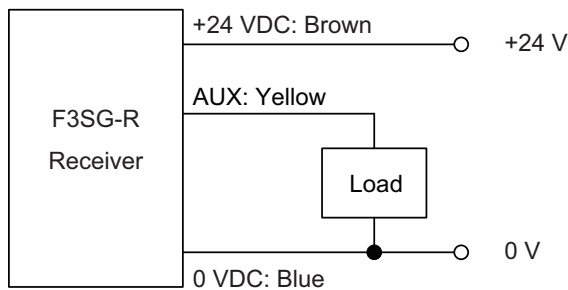
Do not use the auxiliary output for safety applications.
Failure to do so may result in serious injury when the F3SG-R fails.



2-8-1. Overview

The auxiliary output is used to monitor the status of F3SG-R. This output can be connected to a device such as an indication lamp, programmable controller, etc.

Basic wiring diagram

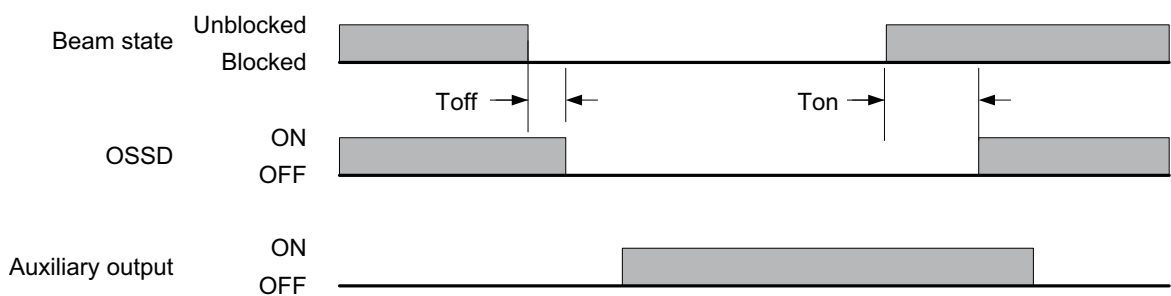


The load current of the auxiliary output is 100 mA max.

CHECK!

2-8-2. Factory Default Setting

The factory default setting is inverted signal of the safety output.



Ton: Response time OFF to ON
Toff: Response time ON to OFF

2-9. Lamp

2-9-1. Overview

A lamp (F39-LP and F39-BTLP, sold separately) can be connected to a receiver and turned ON based on the operation of F3SG-R. When there are several illumination conditions, the priority of the colors to illuminate or blink is red > orange > green.



Refer to the instruction sheet of the Lamp for more information.

CHECK!

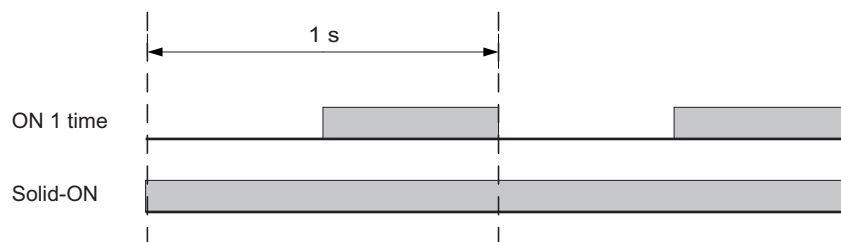


The lamp is not intended to be used for the emitter. Do not connect the lamp to the emitter.

CHECK!

Lamp output	Function	Description
Red (Priority 1)	Output operation mode	Inverted signal of safety output information
	Output pattern	ON
Orange (Priority 2)	Output operation mode	Inverted signal of stable-state information
	Output pattern	ON 1 time
Green (Priority 3)	Output operation mode	Safety output information
	Output pattern	ON

■ Output pattern chart



2-10. Light Level Monitoring

2-10-1. Incident Light Level Information

2-10-1-1. Overview

The user can use the Configuration Tool to read incident light level of the F3SG-R and view on a PC screen. This function allows beam adjustment while checking receiving incident light level.

2-10-1-2. Setting with Configuration Tool

The user can enable this function to retrieve incident light level information. Making any changes to the function is not possible. (When the F3SG-R is in the cascade connection, incident light level of each segment can be retrieved.)

2-10-2. Ambient Light Level Information

2-10-2-1. Overview

The user can use the Configuration Tool to read incident light level of ambient light from a photoelectric sensor or another F3SG-R unit in a close area and view it on a PC screen. This function allows the user to identify a photoelectric sensor radiating ambient light or beams being affected by the light.

2-10-2-2. Setting with Configuration Tool

The user can enable this function to retrieve ambient light level information. Making any changes to the function is not possible. (When the F3SG-R is in the cascade connection, ambient light level of each segment can be retrieved.)



Refer to *Safety Light Curtain Configuration Tool for Model F3SG (SD Manager 2) User's Manual* for more information on the Configuration Tool.

2-11. Maintenance Information

2-11-1. Overview

You can use the Configuration Tool to read the maintenance information of F3SG-R to view on a PC screen. The maintenance information indicates the following information:

- Error Log
- Warning Log
- Power-On Time
- Load Switching Frequency



Refer to *Safety Light Curtain Configuration Tool for Model F3SG (SD Manager 2) User's Manual* for more information on the Configuration Tool.

2-11-2. Error Log

The user can view details of errors occurred in the past. The error information is recorded in the F3SG-R main unit every 15 minutes. The displayed information is useful for troubleshooting. Up to 50 past errors can be recorded.

2-11-3. Warning Log

The user can view details of the following warnings occurred in the past. The warning information is recorded in the F3SG-R main unit every 15 minutes. The displayed information can be used for troubleshooting. Up to 50 past warnings can be recorded.

- Interference/vibration information

2-11-4. Power-ON Time

The user can view the power-on time of F3SG-R. The power-on time information is recorded in the F3SG-R main unit every 15 minutes. This information is useful to better understand when to schedule of F3SG-R.

2-11-5. Load Switching Frequency

The user can view the number of switching operations of the load connected to F3SG-R. The load switching frequency information is recorded in the F3SG-R main unit every 15 minutes. This information is useful to understand the switching frequency of relays and contactors connected to F3SG-R.

2-12. Operating Status Monitoring

2-12-1. Overview

I/O information and the state of F3SG-R can be read out with the Configuration Tool. This function is only for F3SG-R Configuration Tool.



Refer to *Safety Light Curtain Configuration Tool for Model F3SG (SD Manager 2) User's Manual* for more information on the Configuration Tool.

2-12-2. Readout Information

The user can view the following information related to a receiver.

The information is displayed in a block in case of a cascade connection.

Information Name		Description
External wiring information	Power Supply	Displays a supply voltage being supplied
	OSSD 1 (Black)	Linked to safety output 1
	OSSD 2 (White)	Linked to safety output 2
	RESET (Red)	Linked to External Device Monitoring (EDM)
	AUX (Yellow)	Linked to auxiliary output
Sensor Information	Scan code	Displays Scan Code setting
	EDM	Displays EDM setting
Operating Status	Safety output information	Linked to safety output

Chapter 3 Setting with Rotary Switch and End Cap

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3-1. List of Features Configurable by Rotary Switch

For the F3SG-R, the following function is configurable by the Rotary Switch.

Feature	Page
Scan Code Selection	p.16

3-2. Rotary Switch

⚠ DANGER

Make sure to test the operation of the F3SG-R after setting with Rotary Switch to verify that the F3SG-R operates as intended. Make sure to stop the machine until the test is complete. Unintended settings may cause a person to go undetected, resulting in serious injury or death.



F3SG-R series has the Rotary Switches to configure functions near the power cable. Configure functions with the Rotary Switches before installing F3SG-R in your site. Make sure to turn the power of the F3SG-R on after the setting with the Rotary Switches is complete.

Cascaded sensors are operated based on the Rotary Switches setting of the primary sensor. The Rotary Switch setting of a secondary sensor does not affect the operation.

For F3SG-R series, the following functional settings are available by the Rotary Switch on the emitter and receiver.

Function	Position	Description	Refer to
Scan Code Selection		Code A (factory default setting)	2-3
		Code B	2-3



- Operate the Rotary Switches before turning the power of the F3SG-R on.
- Both the emitter and receiver units must be set to the same code.
- A change of the Rotary Switches setting is activated upon power-on or lockout reset.

CHECK! - If the Rotary Switch is operated during operation of the F3SG-R, the F3SG-R transitions to lockout.

3-3. List of Features Configurable by End Cap

For F3SG-R series, the following functional setting is available by replacing the End Cap on the emitter with the supplied white End Cap.

Function	Page
External Test Input Selection	p.19

3-4. End Cap

⚠ DANGER

Make sure to test the operation of the F3SG-R after setting with End Cap to verify that the F3SG-R operates as intended. Make sure to stop the machine until the test is complete. Unintended settings may cause a person to go undetected, resulting in serious injury or death.



⚠ WARNING

Connect the load between the output and 0 V line. Connecting the load between the output and a different power supply line from the above will result in a dangerous condition because the operation mode of safety output is reversed to "Dark-ON".

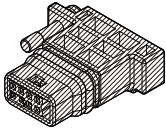
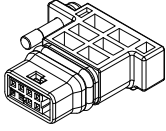


Do not ground +24 VDC line. Otherwise, a ground fault may turn the safety output ON, resulting in a failure of stopping the machine.



F3SG-R series has End Cap to configure the function at the opposite end from the power cable of the emitter. Configure the function before installing the F3SG-R in your site. Make sure to turn the power off the F3SG-R before replacing the End Cap.

For F3SG-R series, the following functional setting is available by replacing the End Cap on the emitter.

Function	End Cap	Description	Refer to
External Test Input Selection	 Black	24 V Active (factory default setting)	2-5
	 White	0 V Active	2-5



- The End Cap is not intended to be used for the receiver. Do not connect the End Cap to the receiver.
- Do not remove the insulating rubber attached to the End Cap. Failure to do so may cause deterioration of the protective functions.
- When attaching the End Cap, tightly fasten the screw (M2.5, recommended torque: 0.35N·m). Failure to do so may cause the End Cap to come loose, leading to deterioration of the protective functions.
- The insulating rubber attached to connector of the End Cap may come off when removing the End Cap. If the rubber comes off, place it back to the groove of the connector and insert the connector to the sensor body.

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4-1. Installation Considerations

4-1-1. Detection Zone and Approach

⚠ WARNING

Install a protective structure so that the hazardous part of a machine can only be reached by passing through the sensor's detection zone. If access to the hazardous part by reaching over the detection zone of a vertically mounted F3SG-R cannot be excluded, the height of the detection zone and the safety distance shall be determined in consideration of such a risk. Install the sensors so that part of the person is always present in the detection zone when working in a machine's hazardous zones. If a person is able to step into the hazardous zone of a machine and remain behind the F3SG-R's detection zone, configure the system with Restart Interlock function. Failure to do so may result in serious injury due to unexpected startup.



Do not use this sensor for machines that cannot be stopped by electrical control. For example, do not use it for a pressing machine that uses a full-rotation clutch. Otherwise, the machine may not stop before a person reaches the hazardous part, resulting in serious injury.



To use the F3SG-R in PSDI mode (Reinitiation of cyclic operation by the protective equipment), you must configure an appropriate circuit between the F3SG-R and the machine. For details about PSDI, refer to OSHA1910.217, IEC61496-1, and other relevant standards and regulations.



Install the reset switch in a location that provides a clear view of the entire hazardous zone and where it cannot be activated from within the hazardous zone.



Do not use the F3SG-R in environments where flammable or explosive gases are present. Doing so may cause an explosion.



The F3SG-R cannot protect a person from an object flying from a hazardous zone. Install protective cover(s) or fence(s).



Correct installation

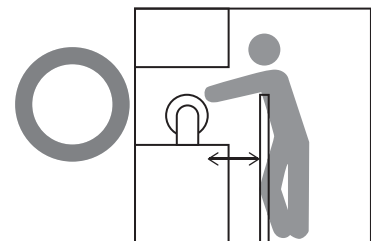
The hazardous zone of a machine can be reached only by passing through the sensor's detection zone.



While working, a person is inside the sensor's detection zone.



Safety distance reflects the possible access to the hazardous zone by reaching over the detection zone.



Incorrect installation

It is possible to reach the hazardous zone of a machine without passing through the sensor's detection zone.



A person is between the sensor's detection zone and the hazardous zone of a machine.



It is possible to access the hazardous zone by reaching over the detection zone.



4-1-2. Safety Distance

The safety distance is the distance that must be set between the F3SG-R and a machine's hazardous part to stop the hazardous part before a person or object reaches it. The safety distance varies according to the standards of each country and the individual specifications of each machine. Always refer to the relevant standards.

⚠ WARNING

Make sure to secure the safety distance (S) between the F3SG-R and the hazardous part. Otherwise, the machine may not stop before a person reaches the hazardous part, resulting in serious injury.



The response time of a machine is the time period from when the machine receives a stop signal to when the machine's hazardous part stops. Measure the response time on the actual system. Also, periodically check that the response time of the machine has not changed.

CHECK!

4-1-2-1. Safety Distance Formulas according to ISO 13855/EN ISO 13855

Detection Zone Orthogonal to Direction of Approach

$S = K \times T + C$. . . Formula (1)

- S: Safety distance
- K: Approach speed to the detection zone
- T: Total response time of the machine and F3SG-R
- C: Additional distance calculated by the detection capability (or object resolution) of the F3SG-R

Calculation Example for Systems with a Detection Capability of ≤ 40 mm

Use $K = 2,000$ mm/s and $C = 8 \times (d - 14$ mm) in formula (1) for the calculation.

$$S = 2,000 \text{ mm/s} \times (T_m + T_s) + 8 \times (d - 14 \text{ mm})$$

- S = Safety distance (mm)
- T_m = Machine's response time (s)
- T_s = Response time of the F3SG-R from ON to OFF (s)
- d = Detection capability (or object resolution) of the F3SG-R (mm)

[Calculation example]

When $T_m = 0.05$ s, $T_s = 0.008$ s, and $d = 25$ mm:

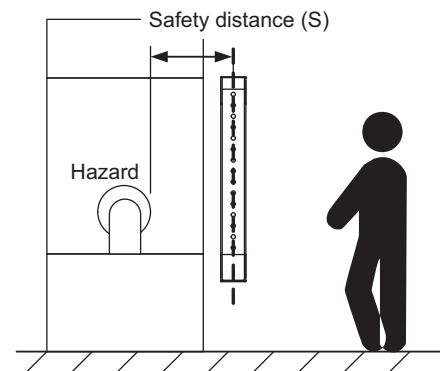
$$S = 2,000 \text{ mm/s} \times (0.05 \text{ s} + 0.008 \text{ s}) + 8 \times (25 \text{ mm} - 14 \text{ mm}) = 204 \text{ mm} \text{ . . . Formula (2)}$$

If the result < 100 mm, use $S = 100$ mm.

If the result exceeds 500 mm, use the following expression where $K = 1,600$ mm/s.

$$S = 1,600 \text{ mm/s} \times (T_m + T_s) + 8 \times (d - 14 \text{ mm}) \text{ . . . Formula (3)}$$

If the result of this formula (3) < 500 mm, use $S = 500$ mm.



Calculation Example for Systems with Larger Detection Capability than 40 mm

Use $K = 1,600 \text{ mm/s}$ and $C = 850 \text{ mm}$ in formula (1) for calculation.

$$S = 1,600 \text{ mm/s} \times (T_m + T_s) + 850 \dots \text{Formula (4)}$$

- S = Safety distance (mm)
- T_m = Machine's response time (s)
- T_s = Response time of the F3SG-R from ON to OFF (s)

[Calculation example]

When $T_m = 0.05 \text{ s}$ and $T_s = 0.008 \text{ s}$:

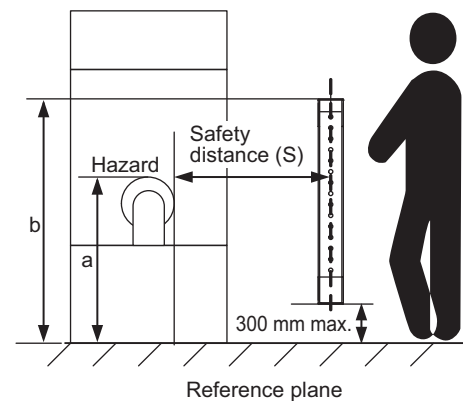
$$\begin{aligned} S &= 1,600 \text{ mm/s} \times (0.05 \text{ s} + 0.008 \text{ s}) + 850 \text{ mm} \\ &= 942.8 \text{ mm} \end{aligned}$$

Possible Circumventing by Reaching Over the Detection Zone

If access to the hazardous zone by reaching over the detection zone of vertically mounted F3SG-R cannot be excluded, the height and the safety distance, S , of the F3SG-R shall be determined. S shall be determined by comparison of the calculated values in *Detection Zone Orthogonal to Direction of Approach*. The greater value resulting from this comparison shall be applied.

$$S = (K \times T) + C \dots \text{Formula (4)}$$

- S : Safety distance
- K : Approach speed to the detection zone
- T : Total response time of the machine and F3SG-R
- C : Approach distance based on the distance which personnel can move towards the hazardous zone of a machine by reaching over the detection zone. The distance is determined in the table below based on the height of the hazardous zone, a , and the height of the upper edge of the detection zone, b .



Note: Lower edge of the detection zone above 300 mm in relation to the reference plane does not offer sufficient protection against crawling below.

First, use $K = 2,000 \text{ mm/s}$ in formula (4) for the calculation. If the result of this calculation is less than 100 mm, use $S = 100 \text{ mm}$.

If the result exceeds 500 mm, use $K = 1,600 \text{ mm/s}$ to recalculate it. If the result of the recalculation is less than 500 mm, use $S = 500 \text{ mm}$.

Height of hazardous zone, a	Height of upper edge of detection zone, b											
	900	1000	1100	1200	1300	1400	1600	1800	2000	2200	2400	2600
	Additional distance to hazardous zone, Cro											
2600	0	0	0	0	0	0	0	0	0	0	0	0
2500	400	400	350	300	300	300	300	300	250	150	100	0
2400	550	550	550	500	450	450	400	400	300	250	100	0
2200	800	750	750	700	650	650	600	550	400	250	0	0
2000	950	950	850	850	800	750	700	550	400	0	0	0
1800	1100	1100	950	950	850	800	750	550	0	0	0	0
1600	1150	1150	1100	1000	900	850	750	450	0	0	0	0
1400	1200	1200	1100	1000	900	850	650	0	0	0	0	0
1200	1200	1200	1100	1000	850	800	0	0	0	0	0	0
1000	1200	1150	1050	950	750	700	0	0	0	0	0	0
800	1150	1050	950	800	500	450	0	0	0	0	0	0
600	1050	950	750	550	0	0	0	0	0	0	0	0
400	900	700	0	0	0	0	0	0	0	0	0	0
200	600	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

Note 1. Upper edge of the detection zone below 900 mm is not included since they do not offer sufficient protection against circumventing or stepping over.

Note 2. When determining the values of this table, it shall not be interpolated. If the known values a, b or Cro are between two values of this table, the greater safety distance shall be used.

[Calculation example]

- T: $T_m + T_s$ (s)
- T_m : Machine's response time (s)
- T_s : Response time of the F3SG-R from ON to OFF (s)
- a: Height of machine hazardous zone (mm)
- b: Height of upper edge of detection zone (mm)

When $T_m = 0.05$ s, $T_s = 0.008$ s, $a = 1,400$ mm, $b = 1,500$ m:


From the table above, $C_{ro} = 850$ mm. Since b is between 1,400 mm and 1,600 mm, $b = 1,400$ mm which has the greater C_{ro} value, shall be used.

$$S = 2,000 \text{ mm/s} \times (0.05 \text{ s} + 0.008 \text{ s}) + 850 \text{ mm} \\ = 966 \text{ mm}$$

Since 966 mm is greater than 500 mm, use $K = 1,600$ mm/s and recalculate it.

$$S = 1,600 \text{ m/s} \times (0.05 \text{ s} + 0.008 \text{ s}) + 850 \text{ mm} \\ = 942.8 \text{ mm}$$

Since $S = 942.8$ mm is greater than $S = 204$ mm calculated by the calculation example of *Detection Zone Orthogonal to Direction of Approach*, the required safety distance S is 942.8 mm.

 Refer to *Detection Zone Orthogonal to Direction of Approach* under 4-1-2-1. *Safety Distance Formulas according to ISO 13855/EN ISO 13855.*

Detection Zone Parallel to Direction of Approach

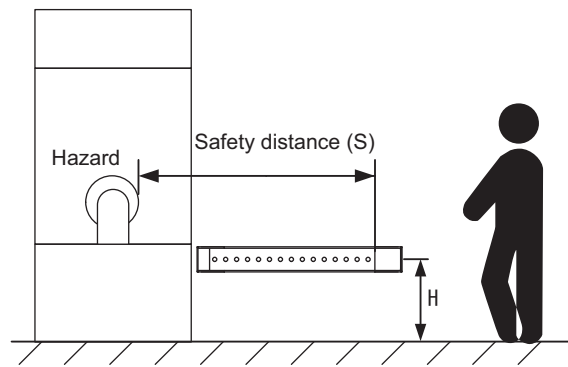
Use $K = 1,600 \text{ mm/s}$ and $C = (1200 - 0.4 \times H)$ in formula (1) for calculation. Note that C must not be less than 850 mm.

$$S = 1,600 \text{ mm/s} \times (T_m + T_s) + 1200 - 0.4 \times H$$

- S = Safety distance (mm)
- T_m = Machine's response time (s)
- T_s = Response time of F3SG-R from ON to OFF (s)
- H = Installation height (mm)

Note that H must satisfy:

$$1000 \geq H \geq 15 \quad (d - 50 \text{ mm}) \geq 0 \text{ mm}$$



Also, you must include a hazardous condition under which a person may go through under a detection zone if H exceeds 300 mm (200 mm for other purpose than industrial use) into risk assessment.

[Calculation example]

When $T_m = 0.05 \text{ s}$, $T_s = 0.008 \text{ s}$, and $d = 14 \text{ mm}$:

$$\begin{aligned} S &= 1,600 \text{ mm/s} \times (0.05 \text{ s} + 0.008 \text{ s}) + 1200 - 0.4 \times 500 \text{ mm} \\ &= 1092.8 \text{ mm} \end{aligned}$$

4-1-2-2. Safety Distance Formulas according to ANSI B11.19

If a person approaches the detection zone of the F3SG-R orthogonally, calculate the safety distance as shown below.

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

- S : Safety distance
- K : Approach speed to the detection zone (the value recommended by OSHA standard is 1,600 mm/s)

Approach speed K is not specified in the ANSI B.11.19 standard. To determine the value of K to apply, consider all factors, including the operator's physical ability.

- T_s = Machine's stopping time (s)
- T_r = Response time of the F3SG-R from ON to OFF (s)
- T_c = Machine control circuit's maximum response time required to activate its brake (s)
- T_{bm} = Additional time (s)

If a machine has a brake monitor, " $T_{bm} = \text{Brake monitor setting time} - (T_s + T_c)$ ". If it has no brake monitor, we recommend using 20% or more of $(T_s + T_c)$ as additional time.

- D_{pf} = Additional distance

According to ANSI's formula, D_{pf} is calculated as shown below:

$$D_{pf} = 3.4 \times (d - 7.0): \text{ Where } d \text{ is the detection capability (or object resolution) of the F3SG-R (unit: mm)}$$

[Calculation example]

When $K = 1,600 \text{ mm/s}$, $T_s + T_c = 0.06 \text{ s}$, brake monitor setting time = 0.1 s,

$T_r = 0.008 \text{ s}$, and $d = 25 \text{ mm}$:

$$T_{bm} = 0.1 - 0.06 = 0.04 \text{ s}$$

$$D_{pf} = 3.4 \times (25 - 7.0) = 61.2 \text{ mm}$$

$$S = 1,600 \times (0.06 + 0.008 + 0.04) + 61.2 = 234 \text{ mm}$$

4-1-3. Distance from Reflective Surfaces

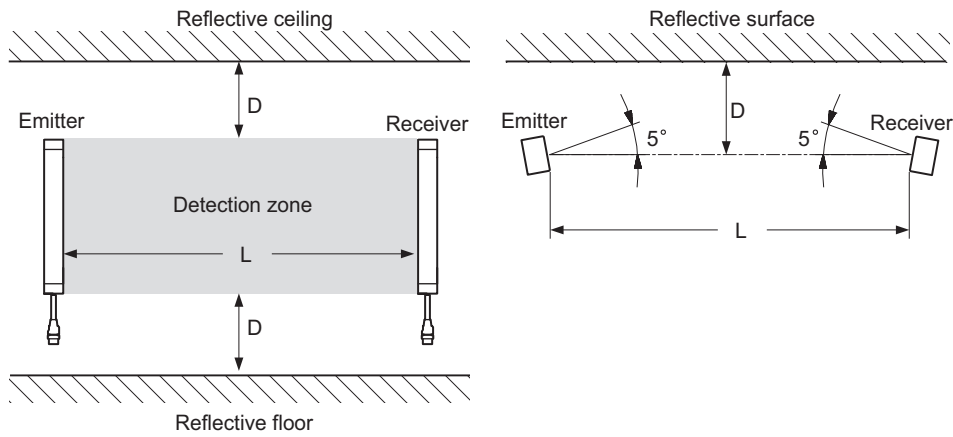
⚠ WARNING

Install the sensor system so that it is not affected by reflective surfaces. Failure to do so may hinder detection, resulting in serious injury.



4-1-3-1. Type 4 ESPE

Install the sensor system at distance D or further from highly reflective surfaces such as metallic walls, floors, ceilings, or workpieces, as shown below.



Distance between an emitter and a receiver (operating range L)	Allowable installation distance D
0.3 to less than 3 m	0.13 m
3 m or more	$L/2 \times \tan 5^\circ = L \times 0.044$ m

4-1-4. Mutual Interference Prevention

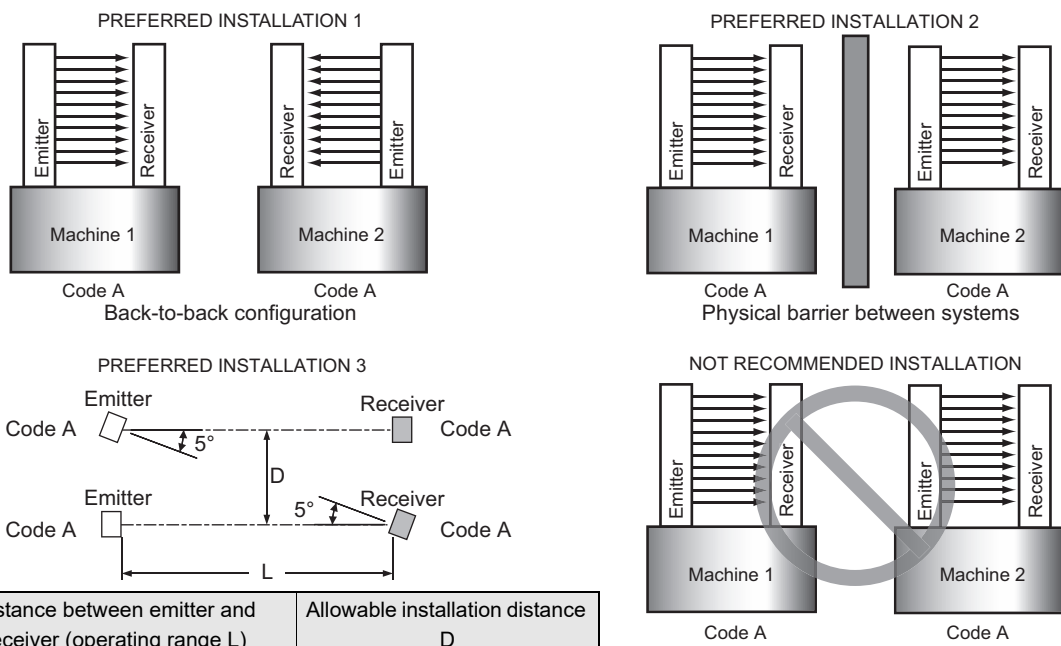
⚠ WARNING

Do not use the sensor system with mirrors in a retro-reflective configuration. Doing so may hinder detection. It is possible to use mirrors to alter the detection zone to a 90-degree angle.

When using more than 1 set of F3SG-R in adjacent areas, the emitter of one F3SG-R may interfere with the receiver of the other, causing the safety functions to stop working properly. Install and configure them so that mutual interference does not occur.

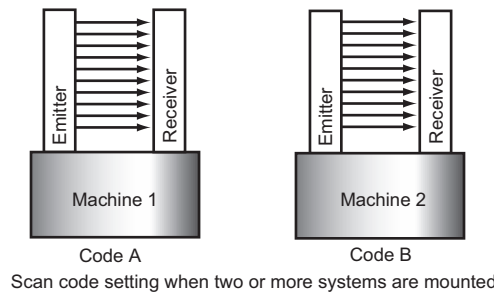
When two or more F3SG-R systems are mounted in close proximity to each other, precautions should be taken to avoid one system interfering with another, such as by back-to-back configuration, physical barrier, Scan Code Selection and adjustment of distance between adjacent sensors.

■ **Example**



Distance between emitter and receiver (operating range L)	Allowable installation distance D
For 0.2 to 3m	0.26m
For 3m or more	$L \times \tan 5^\circ = L \times 0.088$ (m)

The scan code feature of the F3SG-R system allows for placement of systems in close proximity and in line with each other. The distinctive coding of the beams provide for unique operation of a system while in view of another system with a different scan code. Two unique codes are available on the F3SG-R.



The emitter and receiver units must be set to the same scan code for the receiver to enter the Machine Run state. The scan code is selectable by the Rotary Switch on the emitter and receiver units.

Refer to 2-3. *Scan Code Selection* for more information on the scan code feature.


Refer to 3-2. *Rotary Switch* for more information on setting the scan code by the Rotary Switch.

4-2. Cascade Connection

4-2-1. Overview

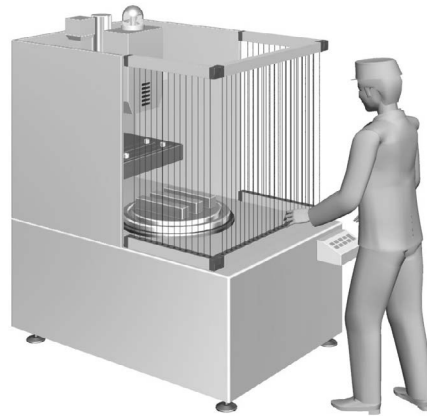
Up to 3 sets of F3SG-R can be series-connected. Cascade connection allows them to be used as a safety light curtain, requiring only 1 set to be wired to a controller and preventing mutual interference. If any 1 set of series-connected F3SG-R is blocked, both of the safety outputs turn OFF.

- Number of connections: Up to 3 sets
- Total number of beams: Up to 255 beams
- Response time: Varies according to the number of beams of cascaded F3SG-R segments.

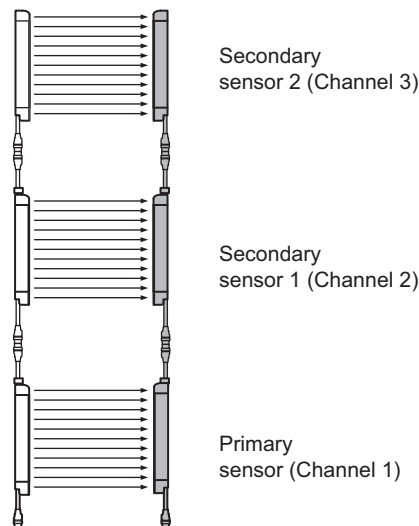
 1-6-2. Calculation of Response Time of Cascaded Segments

- Cable length between sensors: Up to 10 m (not including cascading cable (F39-JGR2WTS) and power cable)

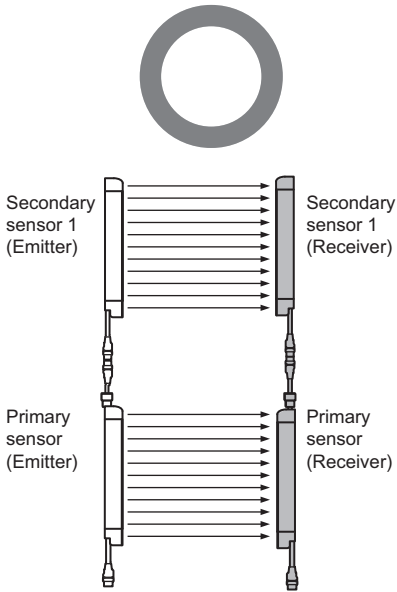
Example: Configuring an U-shaped detection zone



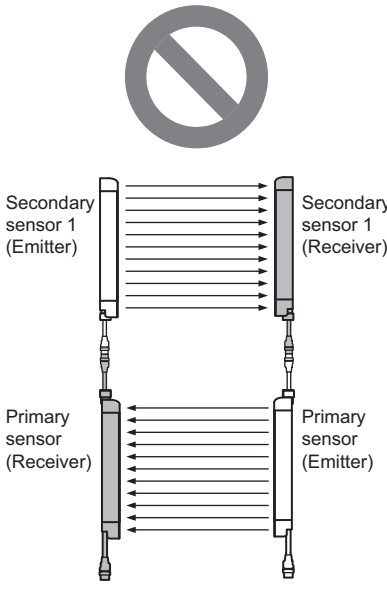
The sensor segments in a cascade connection are called as follows:



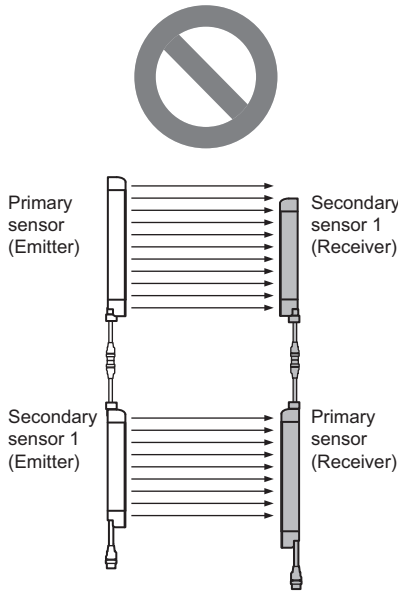
Properly connect an emitter to another emitter, and a receiver to another receiver, as shown below.



Do not series-connect an emitter and receiver. They will enter lockout state.



Do not face different models of emitters and receivers toward each other. They will enter lockout state or will be unable to detect objects.

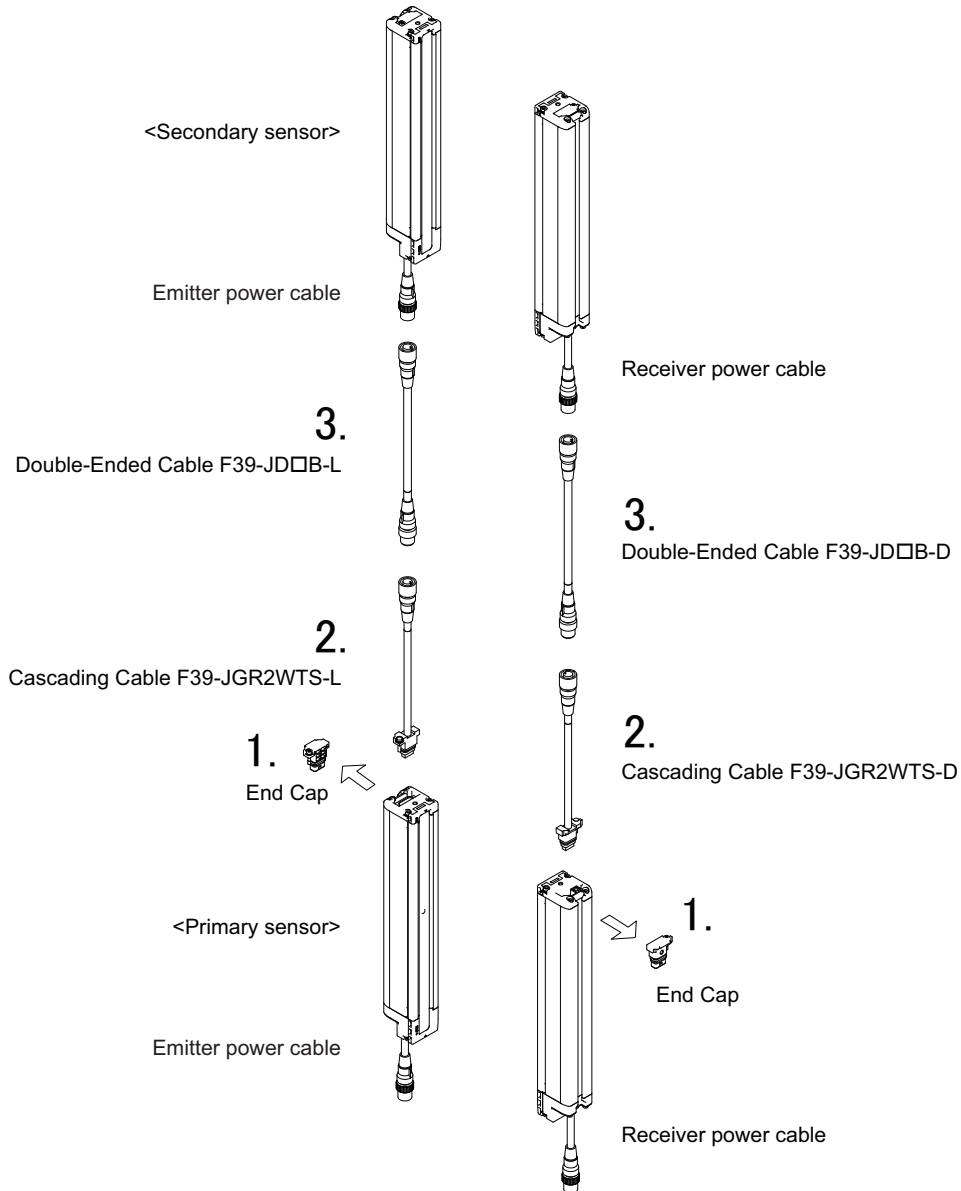


If caps and Cascading Cables are not connected properly, the F3SG-R enters lockout (when power is turned ON).

CHECK!

4-2-2. Connection Procedure

1. Remove the caps from the primary sensor. Loosen the screw (M2.5 cross-shaped) to remove the cap.
2. Connect the the the primary sensor and the secondary sensor with the F39-JGR2WTS Cascading Cable (sold separately).
3. If the length of the Cascading Cable is insufficient, connect the F39-JD□B-□ Double-Ended Cable (sold separately) between the Cascading Cable and the power cable of the secondary sensor, as required. (Cable length between sensors: 10 m max. (not including cascading cable (F39-JGR2WTS) and power cable))



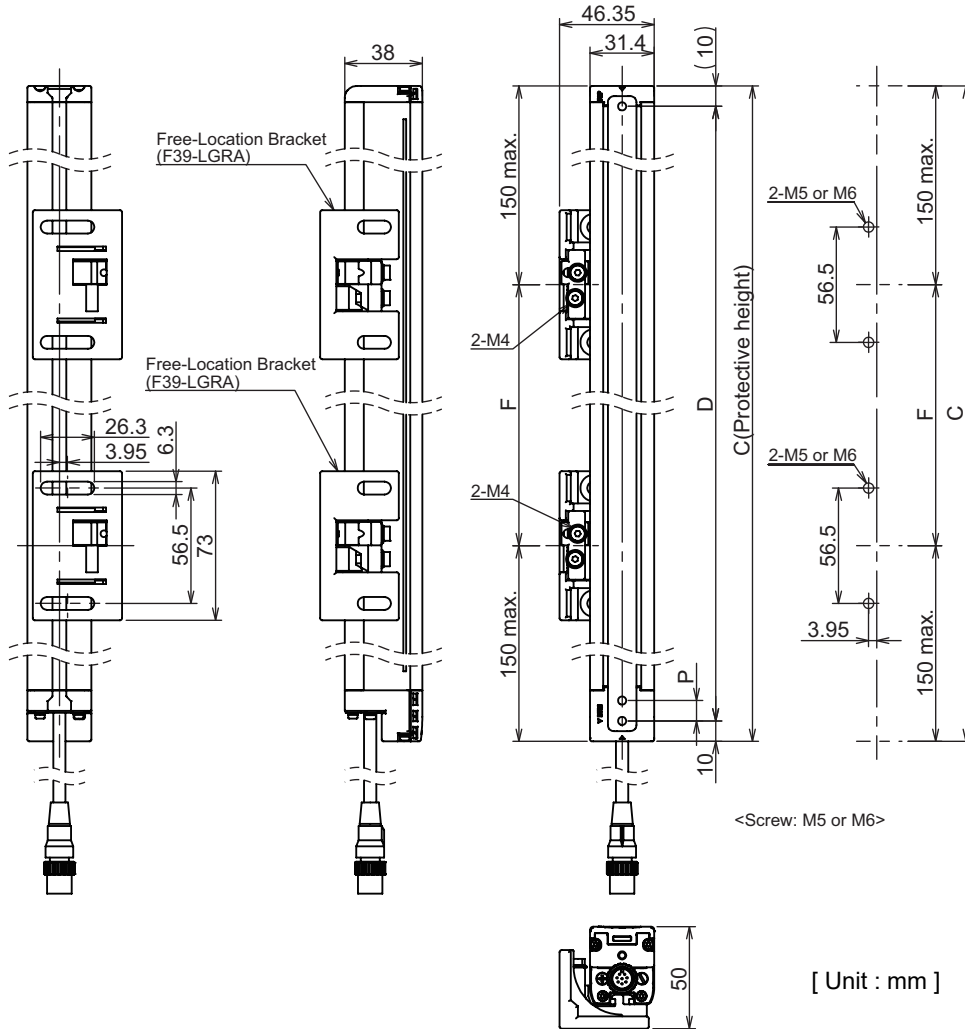
CHECK!

- When attaching a cable or cap, securely fasten the screws (M2.5, recommended torque: 0.35 N·m). Failure to do so may cause the cable/cap to come loose, leading to deterioration of the protective functions.
- Attaching/detaching of the cap and the Cascading Cable may cause misalignment of rubber grommet in the connector assembly. Press the grommet to the bottom of the connector and attach the connector to the sensor again.

4-3. Dimensions

4-3-1. Mounted with Free-Location Brackets (F39-LGRA)

4-3-1-1. Backside Mounting



Dimension C	4-digit number of the type name (Protective height)
Dimension D	C-20
Dimension P	20

Protective height (C)	Number of Free-Location Brackets *1	Dimension F
0240 to 1200	2 *2	1000 mm max.
1280 to 1920	3	1000 mm max.

*1. The number of brackets required to mount either one of emitter and receiver.

*2. Mounting an emitter or receiver with one bracket is possible for the model of protective height of 0240. In this case, locate this bracket at half the Dimension C (or at the center of the sensor length).

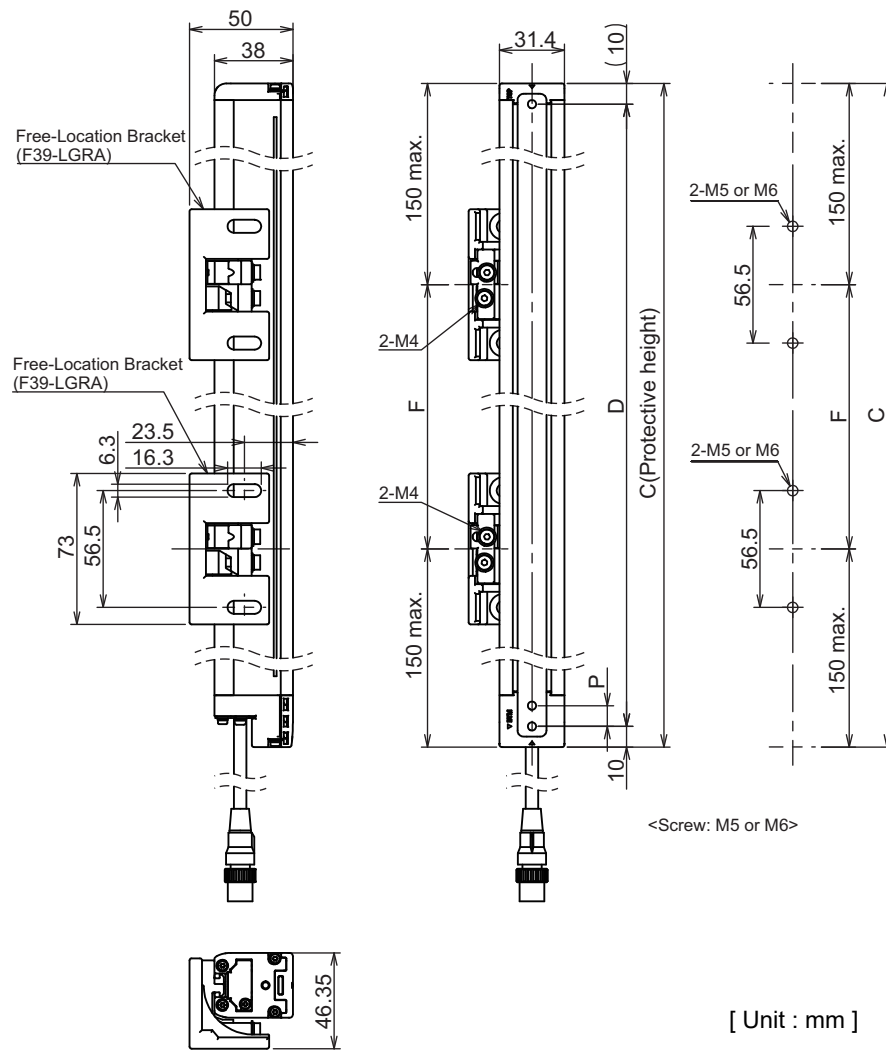
4-4-3-1. Mounting with Free-Location Brackets (F39-LGRA)



CHECK!

- Use the brackets of specified quantities and locations according to the dimensions. The other brackets than described above may not meet the specified ratings and performance.
- When you use the sensor in a situation where the sensor is under a load, increase the number of the brackets used.
- This bracket allows beam alignment after fixing the bracket to a wall surface. The angle adjustment range of the bracket is $\pm 15^\circ$.

4-3-1-2. Side Mounting



Dimension C	4-digit number of the type name (Protective height)
Dimension D	C-20
Dimension P	20

Protective height (C)	Number of Free-Location Brackets *1	Dimension F
0240 to 1200	2 *2	1000 mm max.
1280 to 1920	3	1000 mm max.

*1. The number of brackets required to mount either one of emitter and receiver.

*2. Mounting an emitter or receiver with one bracket is possible for the model of protective height of 0240. In this case, locate this bracket at half the Dimension C (or at the center of the sensor length).

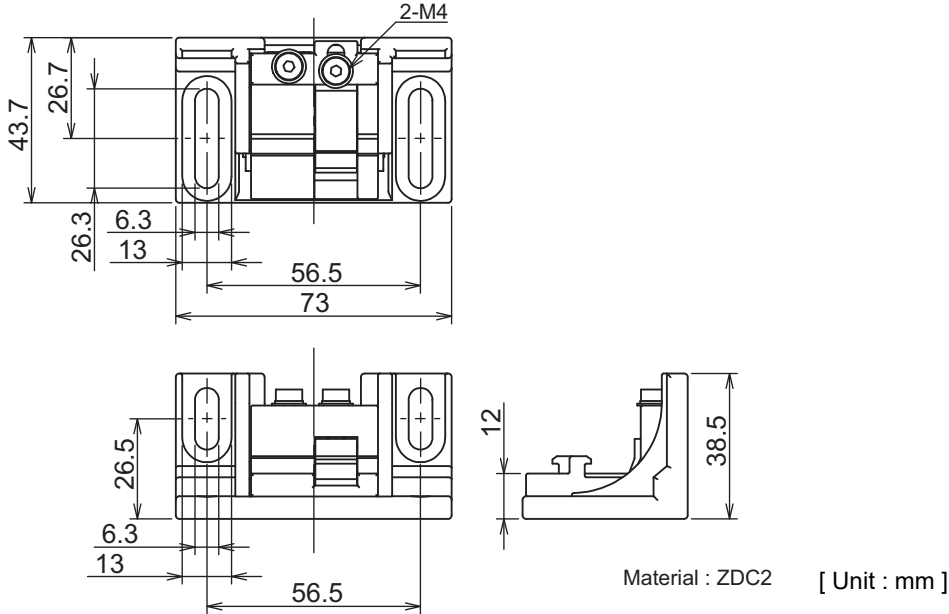
4-4-3-1. Mounting with Free-Location Brackets (F39-LGRA)

- Use the brackets of specified quantities and locations according to the dimensions. The other brackets than described above may not meet the specified ratings and performance.

CHECK! - When you use the sensor in a situation where the sensor is under a load, increase the number of the brackets used.

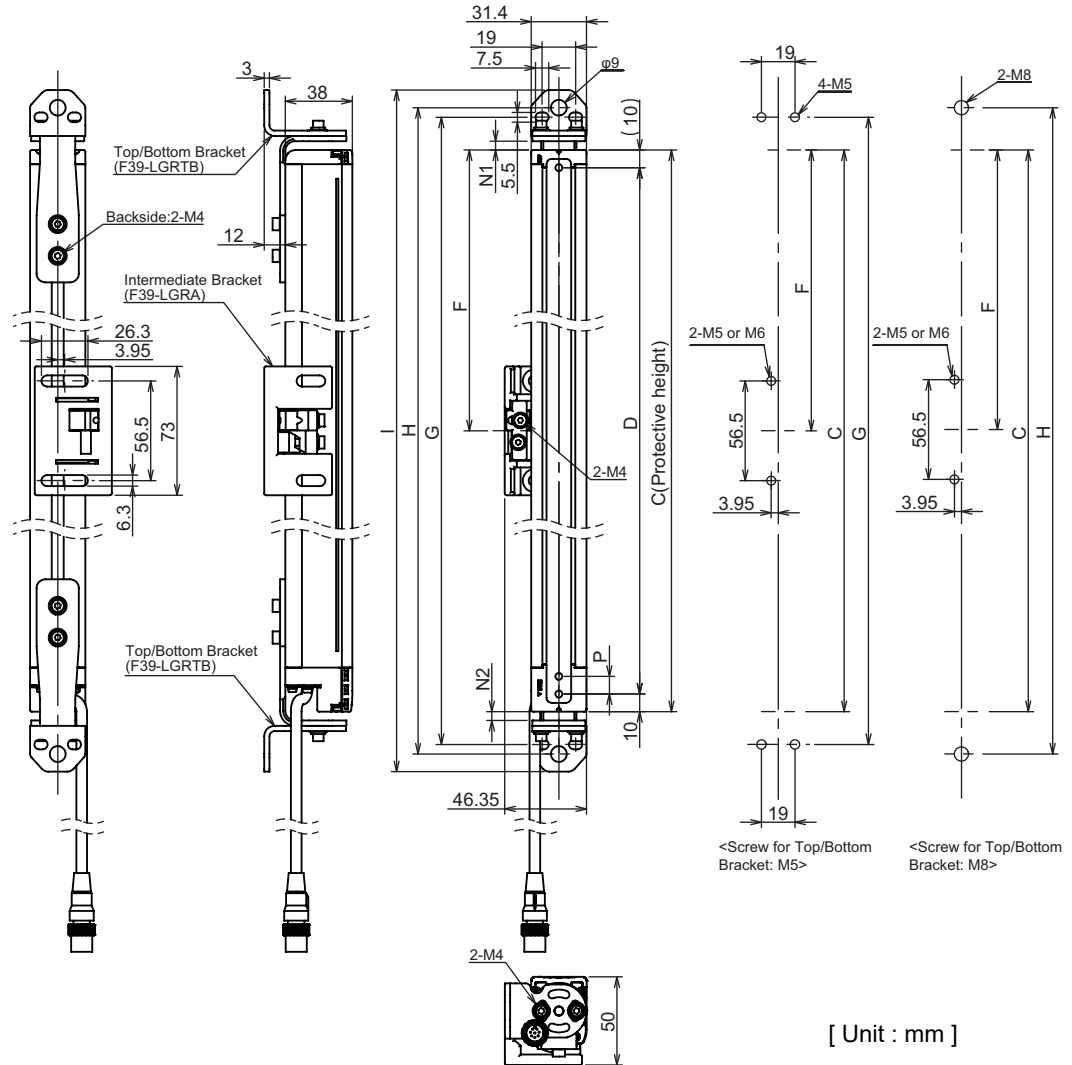
- This bracket allows beam alignment after fixing the bracket to a wall surface. The angle adjustment range of the bracket is $\pm 15^\circ$.

4-3-1-3. Free-Location Bracket / Intermediate Bracket (F39-LGRA)



4-3-2. Mounted with Top/Bottom Brackets (F39-LGRTB) and Intermediate Bracket (F39-LGRA)

4-3-2-1. Backside Mounting



Dimension C	4-digit number of the type name (Protective height)
Dimension D	C-20
Dimension G	$C+27.2+N1+N2$
Dimension H	$C+38+N1+N2$
Dimension I	$C+58+N1+N2$
Dimension N1	0 to 30
Dimension N2	0 to 13
Dimension P	20

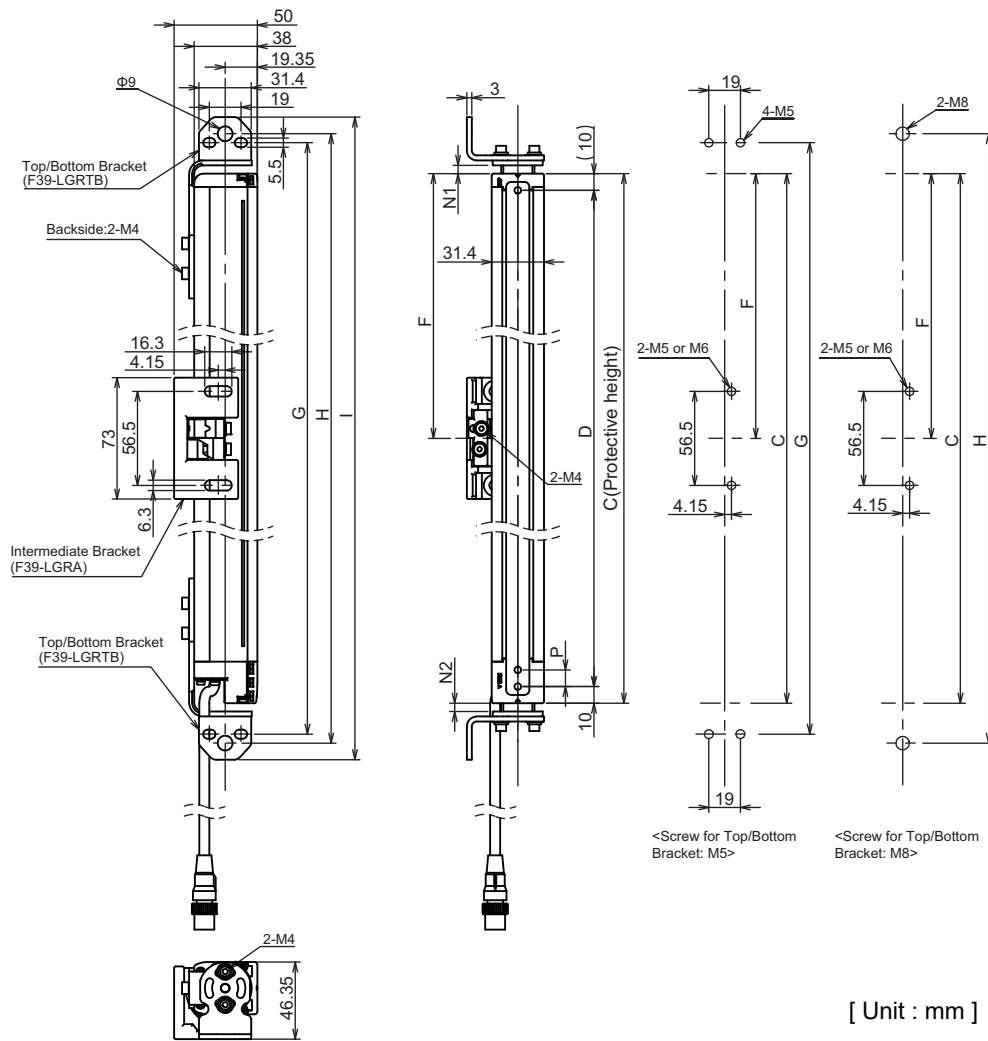
Protective height (C)	Number of Top/Bottom Brackets *	Number of Intermediate Brackets *	Dimension F
0240 to 1040	2	0	-
1120 to 1920	2	1	1000 mm max.

*The number of brackets required to mount either one of emitter and receiver.

4-4-3-2. Mounting with Top/Bottom Bracket (F39-LGRTB-□) and Intermediate Bracket (F39-LGRA)

- Use the brackets of specified quantities and locations according to the dimensions. The other brackets than described above may not meet the specified ratings and performance.
- When you use the sensor in a situation where the sensor is under a load, increase the number of the brackets used.
- CHECK!** - This bracket allows beam alignment after fixing the bracket to a wall surface.
- The angle adjustment range is $\pm 22.5^\circ$ when using the Top/Bottom Brackets only. The angle adjustment range is $\pm 15^\circ$ when using the Top/Bottom Brackets and Intermediate Bracket together.

4-3-2-2. Side Mounting



Dimension C	4-digit number of the type name (Protective height)
Dimension D	C-20
Dimension G	$C+27.2+N1+N2$
Dimension H	$C+38+N1+N2$
Dimension I	$C+58+N1+N2$
Dimension N1	0 to 30
Dimension N2	0 to 13
Dimension P	20

Protective height (C)	Number of Top/Bottom Brackets *	Number of Intermediate Brackets *	Dimension F
0240 to 1040	2	0	-
1120 to 1920	2	1	1000 mm max.

*The number of brackets required to mount either one of emitter and receiver.

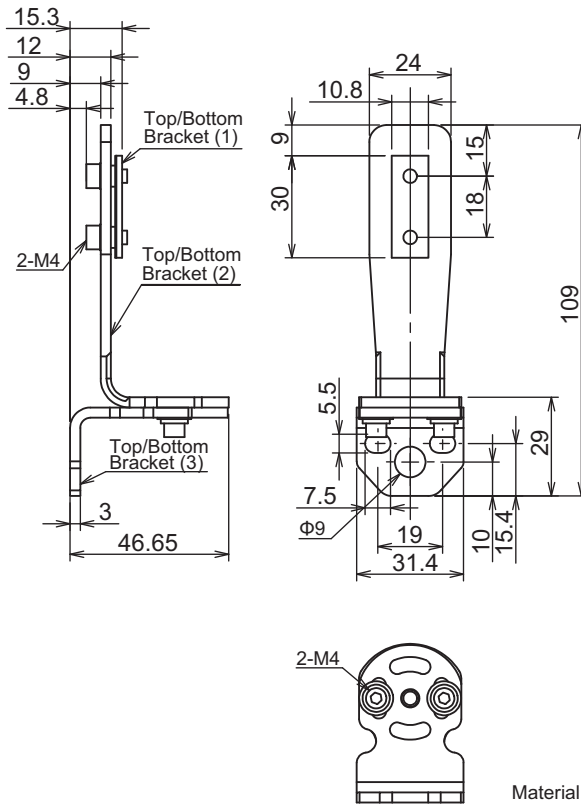


4-4-3-2. Mounting with Top/Bottom Bracket (F39-LGRTB-□) and Intermediate Bracket (F39-LGRA)



- Use the brackets of specified quantities and locations according to the dimensions. The other brackets than described above may not meet the specified ratings and performance.
- When you use the sensor in a situation where the sensor is under a load, increase the number of the brackets used.
- This bracket allows beam alignment after fixing the bracket to a wall surface.
- The angle adjustment range is $\pm 22.5^\circ$ when using the Top/Bottom Brackets only. The angle adjustment range is $\pm 15^\circ$ when using the Top/Bottom Brackets and Intermediate Bracket together.

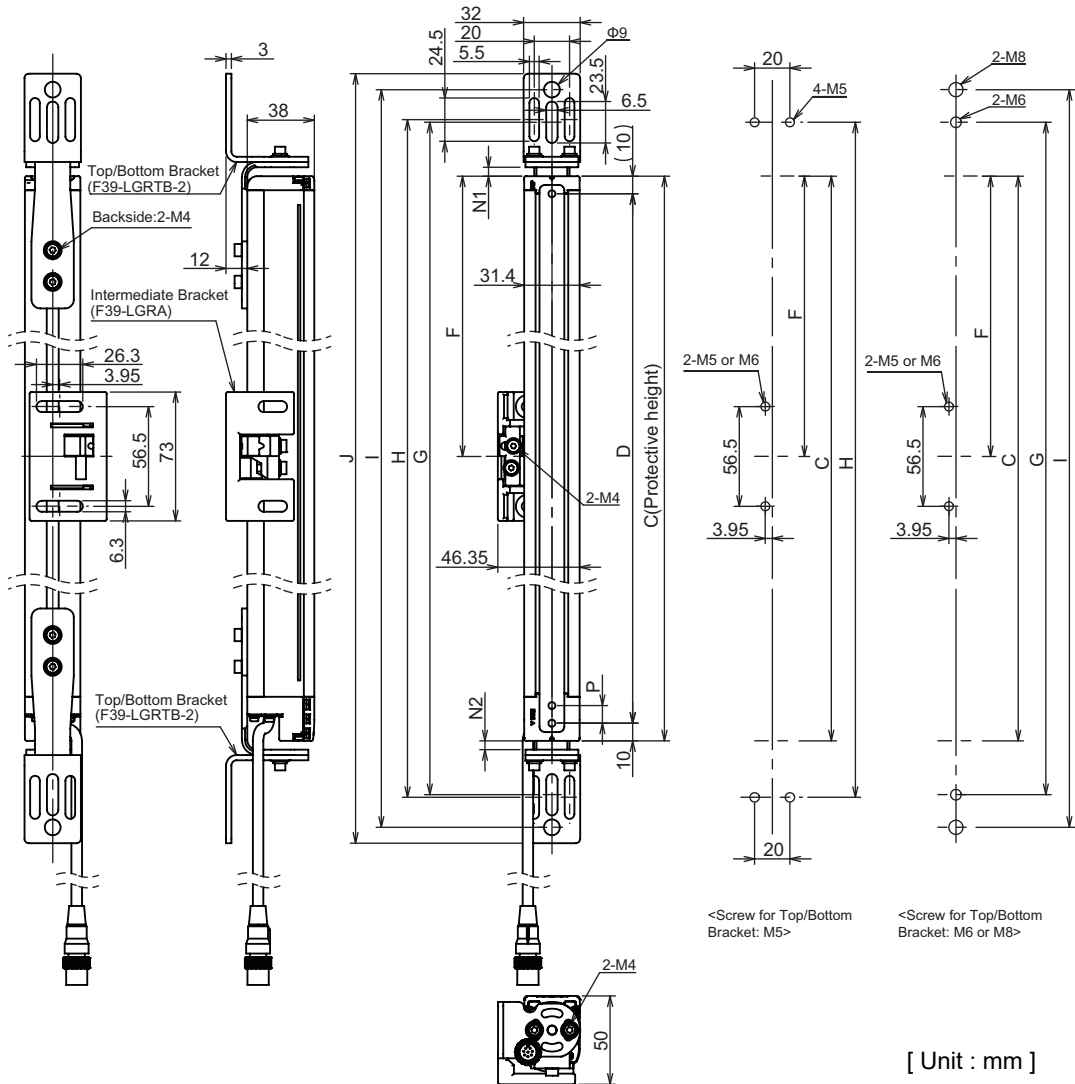
4-3-2-3. Top/Bottom Bracket (F39-LGRTB)



Material: SUS304 [Unit : mm]

4-3-3. Mounted with Top/Bottom Brackets (F39-LGRTB-2) and Intermediate Bracket (F39-LGRA)

4-3-3-1. Backside Mounting



<Screw for Top/Bottom Bracket: M5>
<Screw for Top/Bottom Bracket: M6 or M8>

[Unit : mm]

Dimension C	4-digit number of the type name (Protective height)
Dimension D	C-20
Dimension G	C+51+N1+N2
Dimension H	C+54+N1+N2
Dimension I	C+88+N1+N2
Dimension J	C+106+N1+N2
Dimension N1	0 to 30
Dimension N2	0 to 13
Dimension P	20

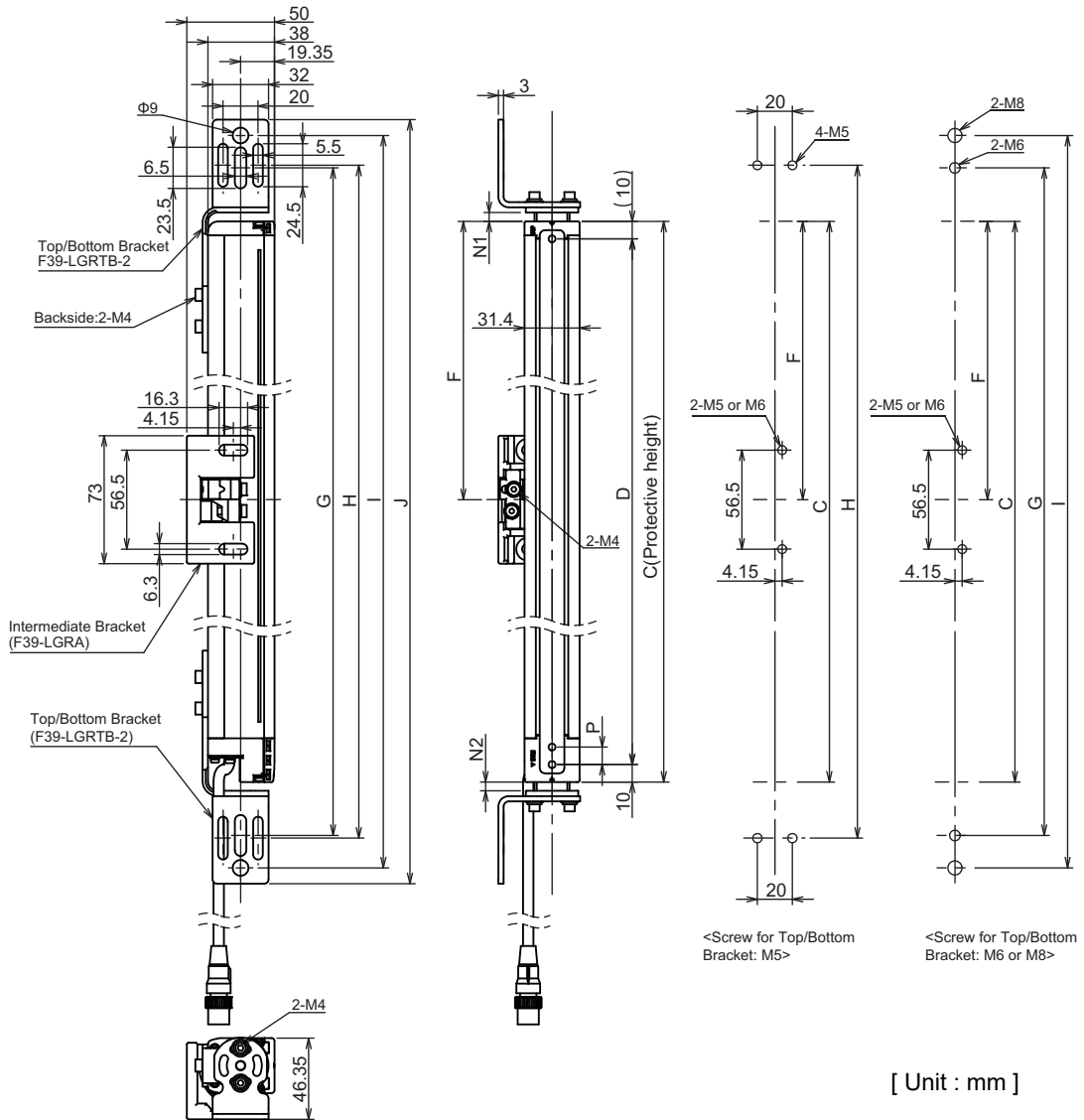
Protective height (C)	Number of Top/Bottom Brackets *	Number of Intermediate Brackets *	Dimension F
0240 to 1040	2	0	-
1120 to 1920	2	1	1000 mm max.

*The number of brackets required to mount either one of emitter and receiver.

4-4-3-2. Mounting with Top/Bottom Bracket (F39-LGRTB-□) and Intermediate Bracket (F39-LGRA)

- Use the brackets of specified quantities and locations according to the dimensions. The other brackets than described above may not meet the specified ratings and performance.
 - When you use the sensor in a situation where the sensor is under a load, increase the number of the brackets used.
- CHECK! - This bracket allows beam alignment after fixing the bracket to a wall surface.
- The angle adjustment range is $\pm 22.5^\circ$ when using the Top/Bottom Brackets only. The angle adjustment range is $\pm 15^\circ$ when using the Top/Bottom Brackets and Intermediate Bracket together.

4-3-3-2. Side Mounting



Dimension C	4-digit number of the type name (Protective height)
Dimension D	C-20
Dimension G	C+51+N1+N2
Dimension H	C+54+N1+N2
Dimension I	C+88+N1+N2
Dimension J	C+106+N1+N2
Dimension N1	0 to 30
Dimension N2	0 to 13
Dimension P	20

Protective height (C)	Number of Top/Bottom Brackets *	Number of Intermediate Brackets *	Dimension F
0240 to 1040	2	0	-
1120 to 1920	2	1	1000 mm max.

*The number of brackets required to mount either one of emitter and receiver.



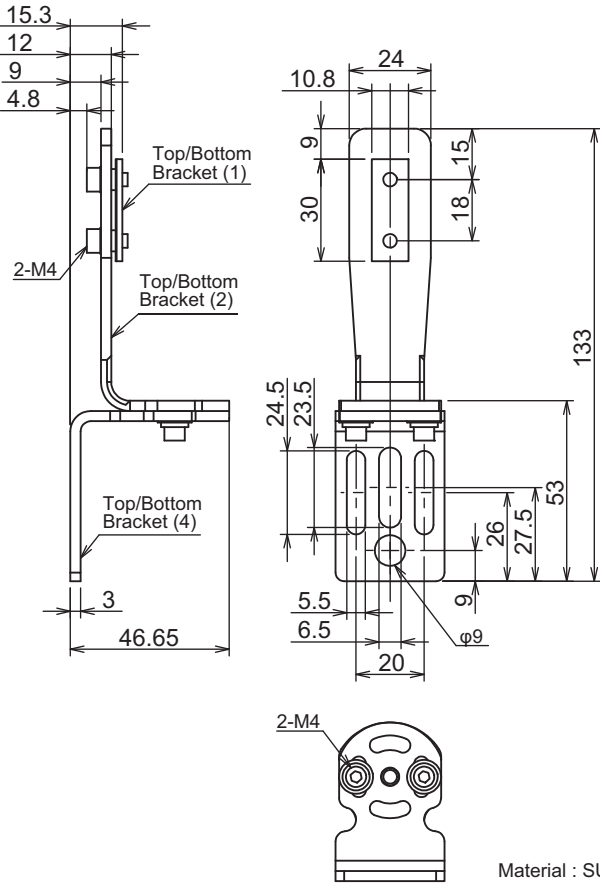
4-4-3-2. Mounting with Top/Bottom Bracket (F39-LGRTB-□) and Intermediate Bracket (F39-LGRA)



CHECK!

- Use the brackets of specified quantities and locations according to the dimensions. The other brackets than described above may not meet the specified ratings and performance.
- When you use the sensor in a situation where the sensor is under a load, increase the number of the brackets used.
- This bracket allows beam alignment after fixing the bracket to a wall surface.
- The angle adjustment range is $\pm 22.5^\circ$ when using the Top/Bottom Brackets only. The angle adjustment range is $\pm 15^\circ$ when using the Top/Bottom Brackets and Intermediate Bracket together.

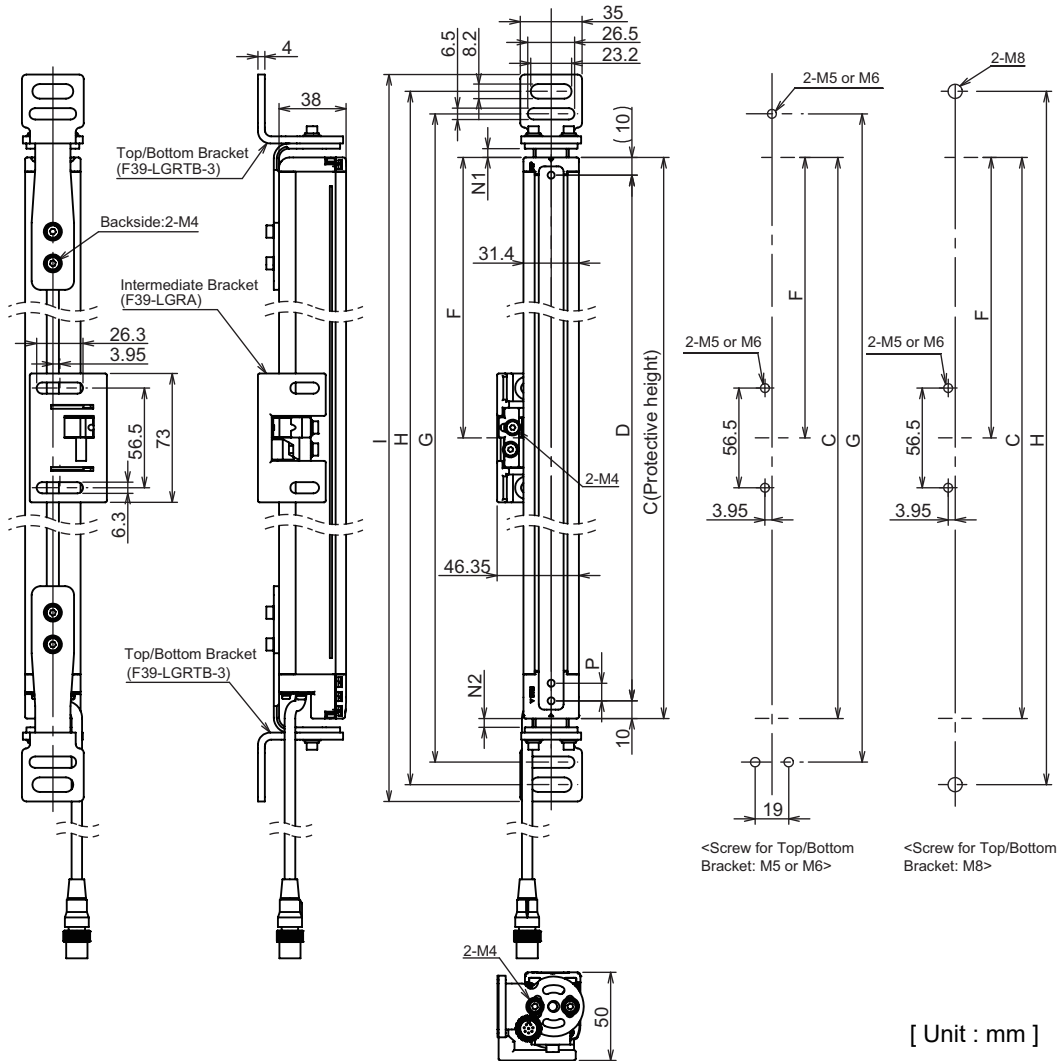
4-3-3-3. Top/Bottom Bracket (F39-LGRTB-2)



Material : SUS304 [Unit : mm]

4-3-4. Mounted with Top/Bottom Brackets (F39-LGRTB-3) and Intermediate Bracket (F39-LGRA)

4-3-4-1. Backside Mounting



Dimension C	4-digit number of the type name (Protective height)
Dimension D	C-20
Dimension G	$C+39.5+N1+N2$
Dimension H	$C+65+N1+N2$
Dimension I	$C+84+N1+N2$
Dimension N1	0 to 30
Dimension N2	0 to 13
Dimension P	20

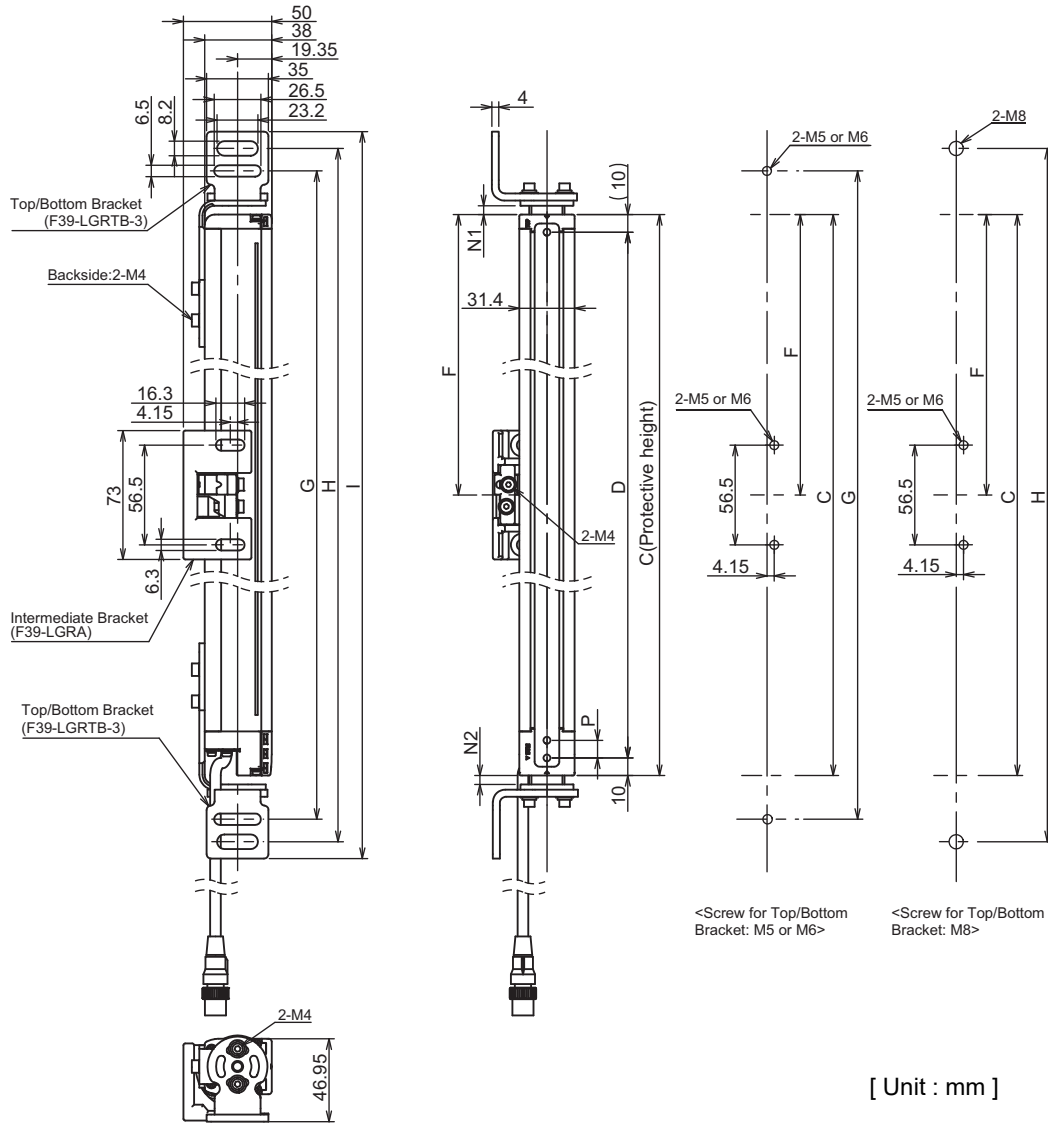
Protective height (C)	Number of Top/Bottom Brackets *	Number of Intermediate Brackets *	Dimension F
0240 to 1040	2	0	-
1120 to 1920	2	1	1000 mm max.

*The number of brackets required to mount either one of emitter and receiver.

4-4-3-2. Mounting with Top/Bottom Bracket (F39-LGRTB-□) and Intermediate Bracket (F39-LGRA)

- Use the brackets of specified quantities and locations according to the dimensions. The other brackets than described above may not meet the specified ratings and performance.
- When you use the sensor in a situation where the sensor is under a load, increase the number of the brackets used.
- CHECK!** - This bracket allows beam alignment after fixing the bracket to a wall surface.
- The angle adjustment range is $\pm 22.5^\circ$ when using the Top/Bottom Brackets only. The angle adjustment range is $\pm 15^\circ$ when using the Top/Bottom Brackets and Intermediate Bracket together.

4-3-4-2. Side Mounting



Dimension C	4-digit number of the type name (Protective height)
Dimension D	C-20
Dimension G	$C+39.5+N1+N2$
Dimension H	$C+65+N1+N2$
Dimension I	$C+84+N1+N2$
Dimension N1	0 to 30
Dimension N2	0 to 13
Dimension P	20

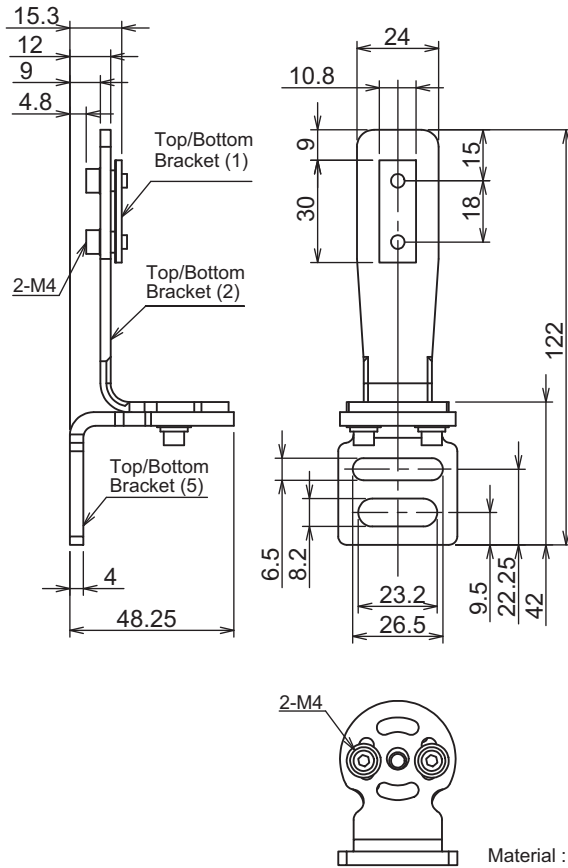
Protective height (C)	Number of Top/Bottom Brackets *	Number of Intermediate Brackets *	Dimension F
0240 to 1040	2	0	-
1120 to 1920	2	1	1000 mm max.

*The number of brackets required to mount either one of emitter and receiver.

4-4-3-2. Mounting with Top/Bottom Bracket (F39-LGRTB-□) and Intermediate Bracket (F39-LGRA)

- Use the brackets of specified quantities and locations according to the dimensions. The other brackets than described above may not meet the specified ratings and performance.
- When you use the sensor in a situation where the sensor is under a load, increase the number of the brackets used.
- CHECK!** - This bracket allows beam alignment after fixing the bracket to a wall surface.
- The angle adjustment range is $\pm 22.5^\circ$ when using the Top/Bottom Brackets only. The angle adjustment range is $\pm 15^\circ$ when using the Top/Bottom Brackets and Intermediate Bracket together.

4-3-4-3. Top/Bottom Bracket (F39-LGRTB-3)



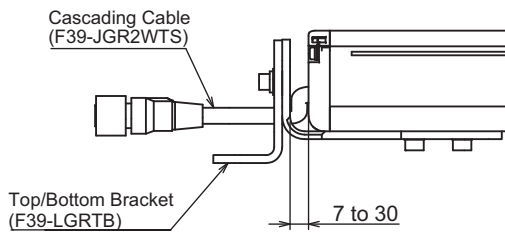
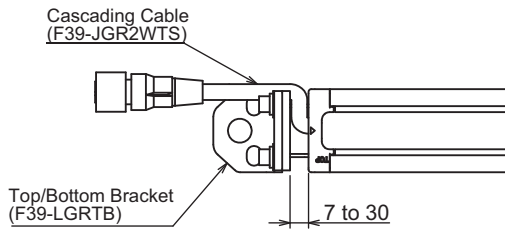
Material : SUS304

[Unit : mm]

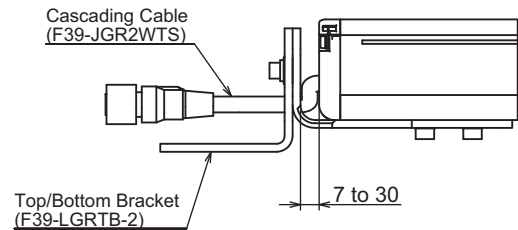
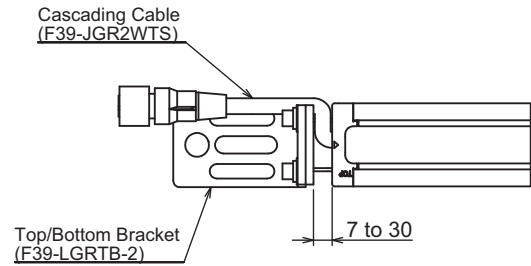
4-3-5. Mounted with Top/Bottom Brackets (F39-LGRTB-□) and Accessories

4-3-5-1. Connected with Cascading Cable (F39-JGR2WTS)

[Top/Bottom Brackets (F39-LGRTB)]

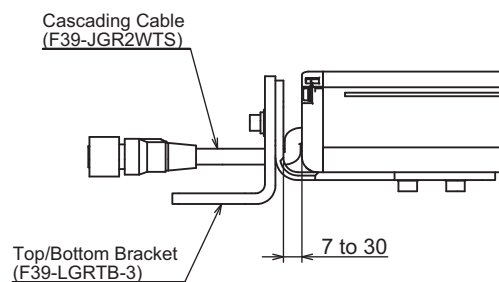
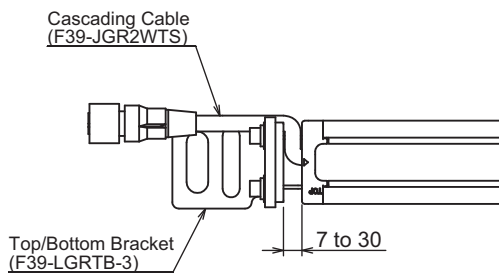


[Top/Bottom Brackets (F39-LGRTB-2)]



[Unit : mm]

[Top/Bottom Brackets (F39-LGRTB-3)]



[Unit : mm]



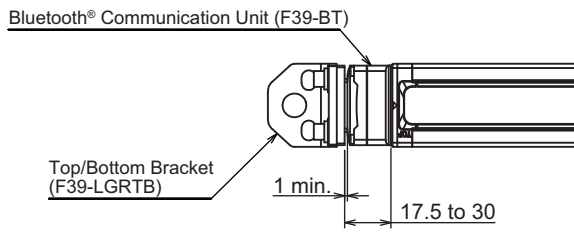
The F3SG-R meets IP67* (IEC 60529) when it is correctly connected with the F39-JGR2WTS Cascading Cable.

*When the accessory is used, protect it from cutting oil.

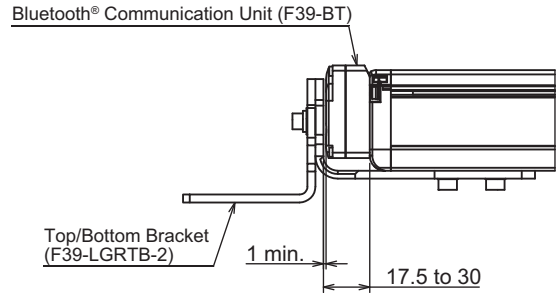
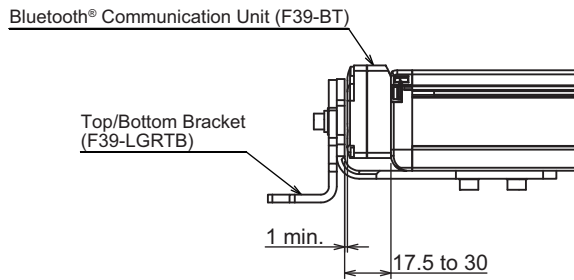
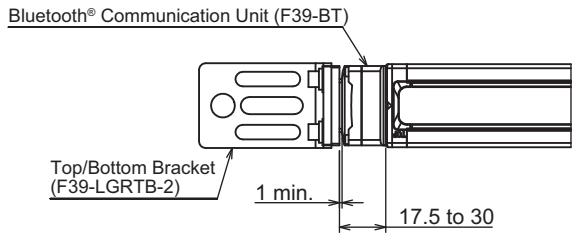
CHECK!

4-3-5-2. Connected with Bluetooth® Communication Unit (F39-BT)

[Top/Bottom Brackets (F39-LGRTB)]
Receiver

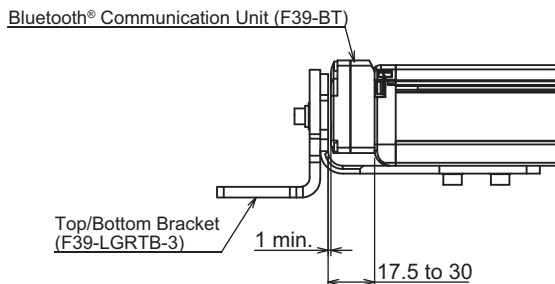
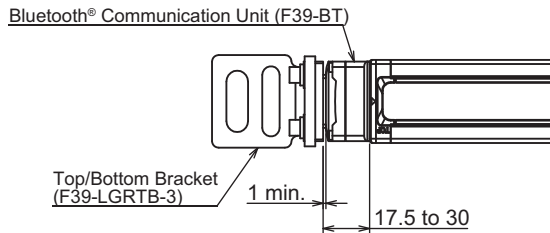


[Top/Bottom Brackets (F39-LGRTB-2)]
Receiver



[Unit : mm]

[Top/Bottom Brackets (F39-LGRTB-3)]
Receiver



[Unit : mm]



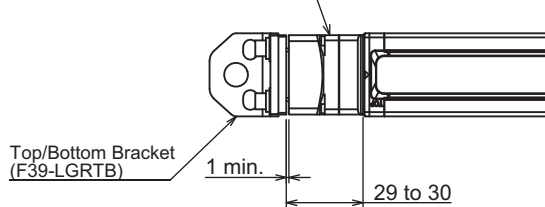
- Make sure to connect the F39-BT Bluetooth® Communication Unit to the receiver.
- The F3SG-R meets IP67* (IEC 60529) when it is correctly connected with the F39-BT Bluetooth® Communication Unit.

CHECK! *When the accessory is used, protect it from cutting oil.

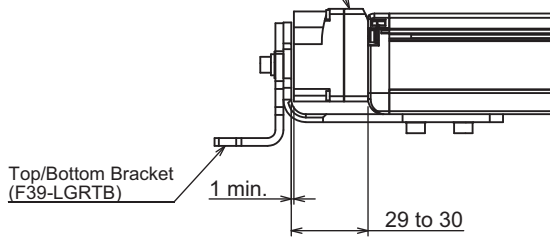
4-3-5-3. Connected with Lamp (F39-LP) or Lamp and Bluetooth® Communication Unit (F39-BTLP)

[Top/Bottom Brackets (F39-LGRTB)]
Receiver

Lamp (F39-LP) /
Lamp and Bluetooth® Communication Unit (F39-BTLP)

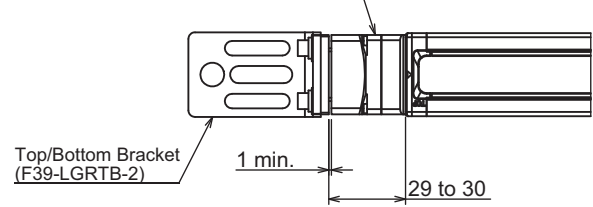


Lamp (F39-LP) /
Lamp and Bluetooth® Communication Unit (F39-BTLP)

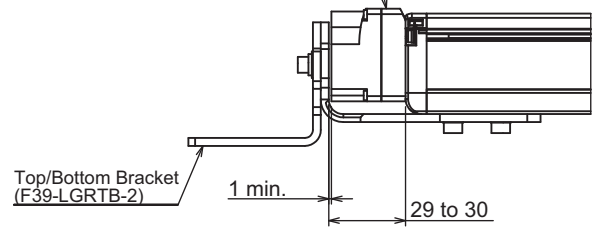


[Top/Bottom Brackets (F39-LGRTB-2)]
Receiver

Lamp(F39-LP)/
Lamp and Bluetooth® Communication Unit (F39-BTLP)



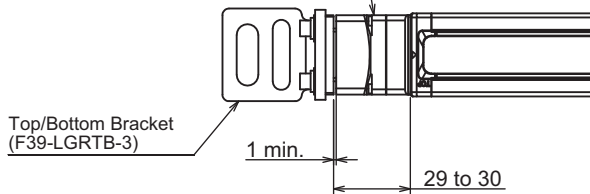
Lamp(F39-LP)/
Lamp and Bluetooth® Communication Unit (F39-BTLP)



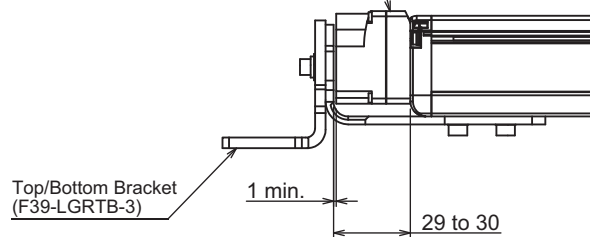
[Unit : mm]

[Top/Bottom Brackets (F39-LGRTB-3)]
Receiver

Lamp(F39-LP)/
Lamp and Bluetooth® Communication Unit (F39-BTLP)



Lamp(F39-LP)/
Lamp and Bluetooth® Communication Unit (F39-BTLP)



CHECK!

- Make sure to connect the F39-LP Lamp or F39-BTLP Lamp and Bluetooth® Communication Unit to the receiver.
- The F3SG-R meets IP67* (IEC 60529) when it is correctly connected with the F39-LP Lamp or F39-BTLP Bluetooth® Communication Unit.

*When the accessory is used, protect it from cutting oil.

4-4. Mounting

4-4-1. Mounting Method

You can mount the F3SG-R with Free-Location Brackets and Top/Bottom Brackets. Any of these mounting methods allows the user to use the same bracket for the backside mounting and side mounting.

4-4-2. Number of Brackets Required

The numbers of brackets required according to the protective heights of the sensor are as follows:

- Mounting with Free-Location Brackets Only

Protective height	Number of Free-Location Brackets *1
0240 to 1200	2 *2
1280 to 1920	3

- Mounting with Top/Bottom Brackets (F39-LGRTB-□) and Intermediate Bracket (F39-LGRA)

Protective height	Number of Top/Bottom Brackets *1	Number of Intermediate Brackets *1
0240 to 1040	2	0
1120 to 1920	2	1

*1. The number of brackets required to mount either one of emitter and receiver.

*2. Mounting an emitter or receiver with one bracket is possible for the model of protective height of 0240. In this case, locate this bracket at the center of the sensor length.



CHECK!

Make sure that the F3SG-R is securely mounted and its cables and connectors are properly connected.

[Unit : mm]

4-4-3. Mounting Procedure

■ Before mounting

When it is required to configure the following functions, do so before installing the F3SG-R in your site, according to the respective procedures.

- Scan Code Selection: 2-3. Scan Code Selection
- External Test Input Selection: 2-5. External Test

4-4-3-1. Mounting with Free-Location Brackets (F39-LGRA)

1. Securely tighten the screws to fix the Free-Location Bracket to the mounting position of the wall surface. (Fig. 1)

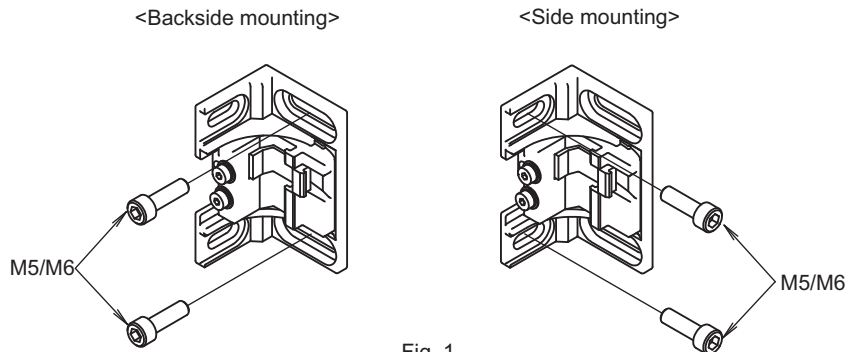


Fig. 1



CHECK!

Screws to mount the brackets to the wall are not included.

2. Fully loosen the Mounting Screws (hexagon socket head cap screw (M4×22)). Fit the backside of the F3SG-R housing to the Brackets (1) and (2) so that the groove of the backside of the housing receives the hooks of the Brackets (1) and (2). (Fig. 2)

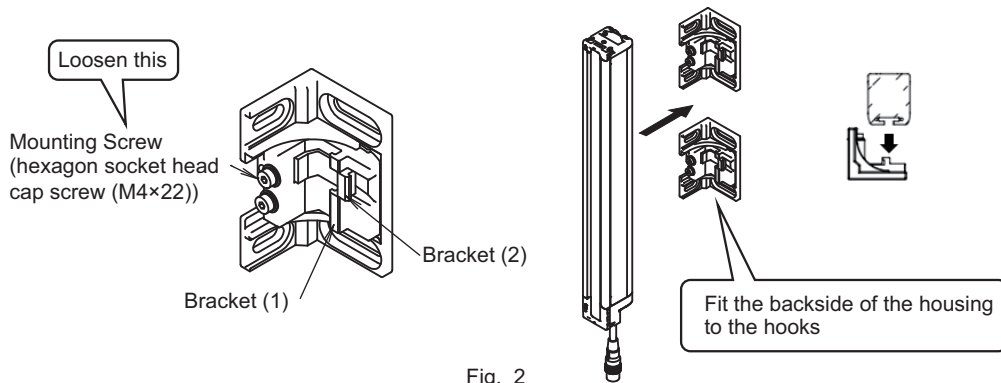


Fig. 2



CHECK!

The width across flat of the hexagon socket of the Mountng Screws is S=3.

- Securely tighten the Mounting Screws to fix the Free-Location Bracket to the F3SG-R housing. The recommended torque to tighten the Mounting Screws is 3.0 N•m. Then loosen the Alignment Screws (hexagon socket head cap screws (M4×22)). (Fig. 3)

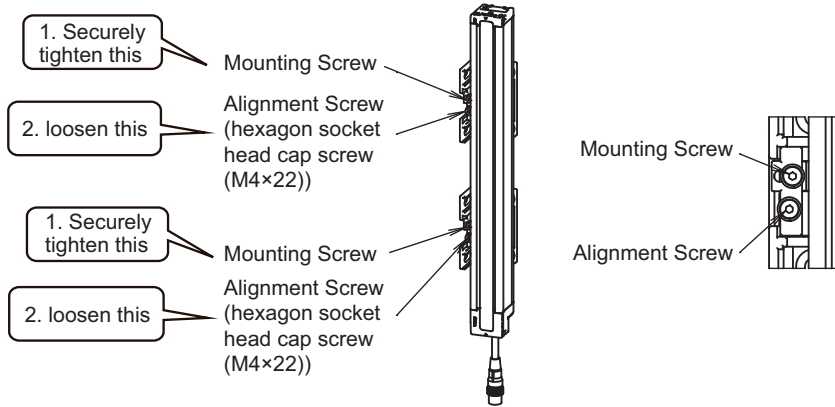


Fig. 3



CHECK!

- Tightening screws with a torque that considerably exceeds the recommended torque may cause failure.
- The width across flat of the hexagon socket of the Alignment Screws is S=3.

- Power the F3SG-R on to perform beam alignment.

Move the emitter and receiver from side to side (Fig. 4) to align them to a center position where the Stable-state indicator (STB, green) of the receiver is illuminated while checking the state of the top and bottom beams with the Top-beam-state indicator (TOP, blue) and Bottom-beam-state indicator (BTM, blue) of the receiver. (Fig. 6)

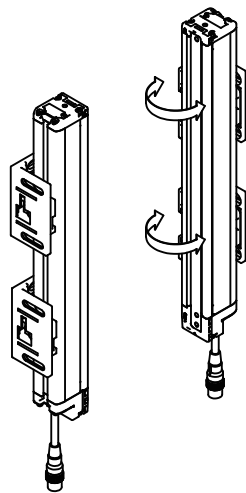


Fig. 4

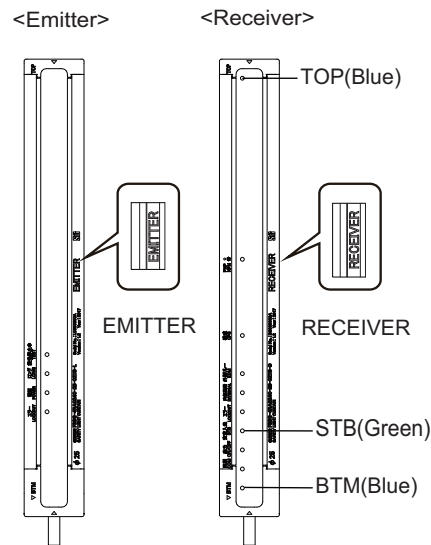


Fig. 5



CHECK!

- The angle adjustment range of the Free-Location Brackets is $\pm 15^\circ$.
- It is recommended to use the Light Level Monitoring with the Configuration Tool for beam alignment. Refer to *Safety Light Curtain Configuration Tool for Model F3SG (SD Manager 2) User's Manual* for more information.

5. Securely tighten the Alignment Screws to fix the Free-Location Bracket to the F3SG-R housing. The recommended torque to tighten the Alignment Screws is 3.0 N•m. (Fig. 6)

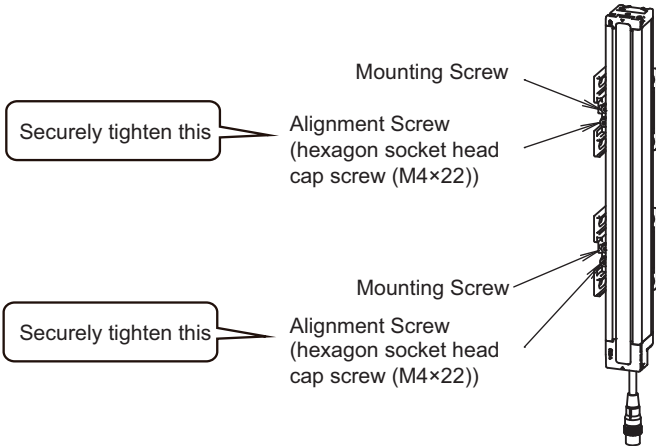


Fig. 6



Tightening screws with a torque that considerably exceeds the recommended torque may cause failure.

CHECK!

4-4-3-2. Mounting with Top/Bottom Bracket (F39-LGRTB-□) and Intermediate Bracket (F39-LGRA)

The mounting procedure below shows the procedure using the F39-LGRTB, but this procedure is also applicable to the F39-LGRTB-2 and F39-LGRTB-3.

1. Loosen the Alignment Screws (hexagon socket head cap screw (M4×7)) of the Top/Bottom Bracket (3) and change the angle of the Top/Bottom Bracket (3) according to its mounting direction. Then loosen the Mounting Screws (low head hexagon socket head cap screw (M4×7)) of Top/Bottom Bracket (2). (Fig. 1)

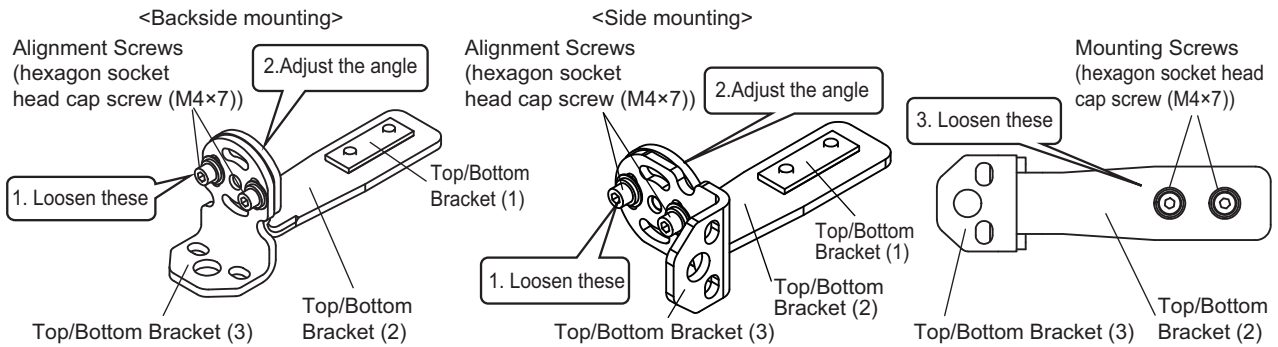


Fig. 1



The width across flat of the hexagon socket of the Alignment Screws and Mounting Screws is S=3.

2. Slide the Top/Bottom Bracket (1) in the grooves of the F3SG-R housing. Adjust the Top/Bottom Bracket to the mounting position of the wall surface. Make sure to position the whole body of the Top/Bottom Bracket (1) within the golden area of the housing. Securely tighten the Mounting Screws to fix the Top/Bottom Bracket to the housing of the F3SG-R. The recommended torque to tighten the Mounting Screws is 3.0 N•m. (Fig. 2)

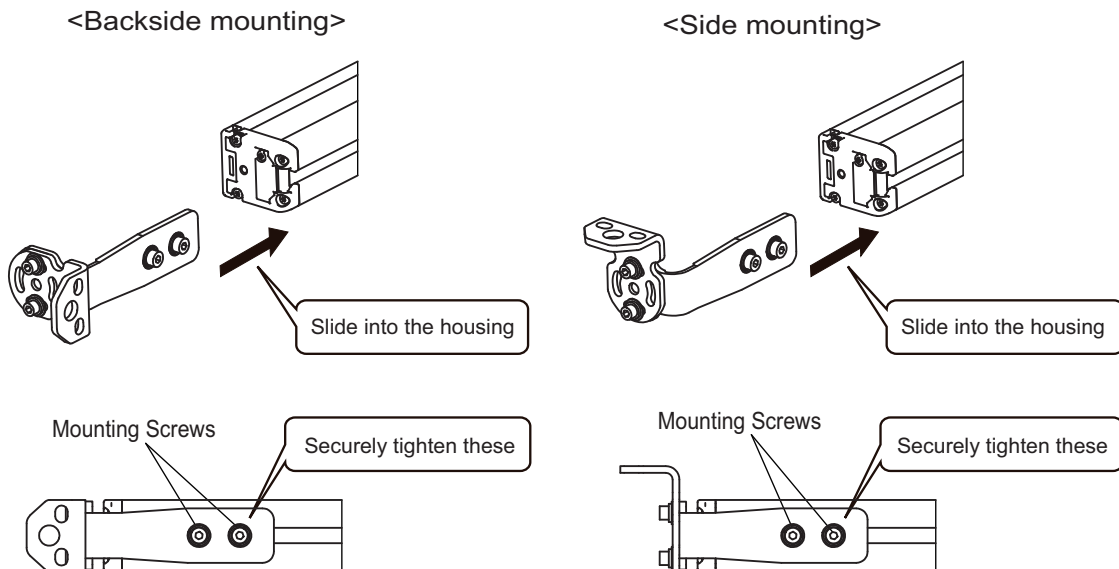


Fig. 2



Tightening screws with a torque that considerably exceeds the recommended torque may cause failure.

- Securely tighten screws to fix the Intermediate Bracket to the mounting position of the wall surface. (Fig. 3)

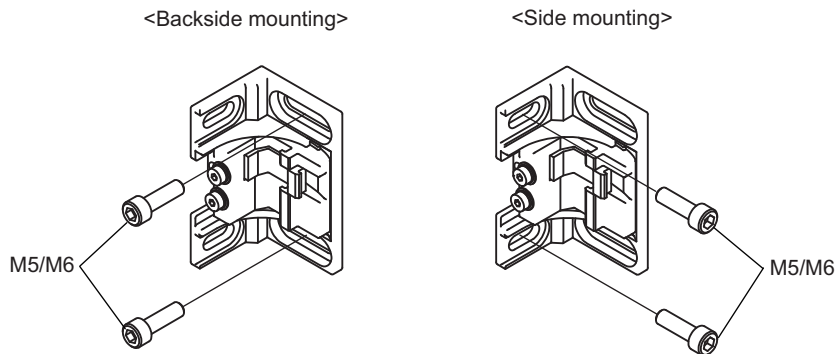


Fig. 3



CHECK!

- Screws to mount the brackets to the wall are not included.
- This step is not needed for the F3SG-R of the protective height of 1040 mm or less.

- Fully loosen the Mounting Screw (hexagon socket head cap screw (M4×22)) of the Intermediate Bracket. (Fig. 4) Then slide the hooks of the Brackets (1) and (2) in the groove of the backside of the F3SG-R housing. (Fig. 5)

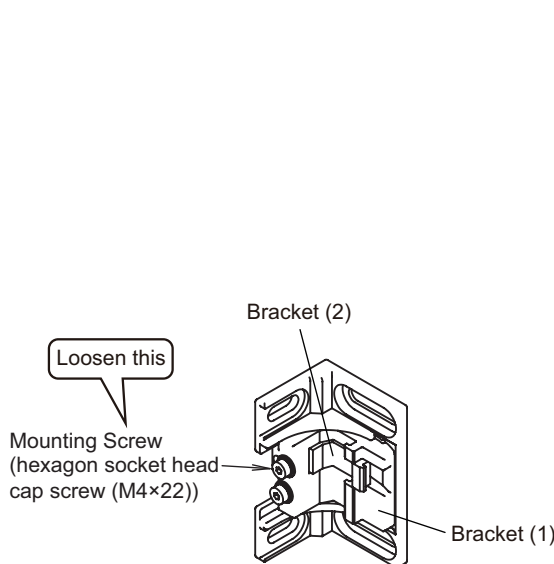


Fig. 4

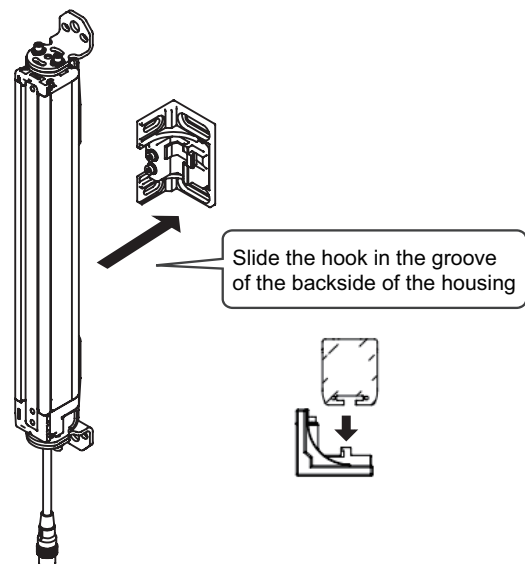


Fig. 5



CHECK!

- This step is not needed for the F3SG-R of the protective height of 1040 mm or less.

- Securely tighten the Mounting Screw to fix the Intermediate Bracket to the F3SG-R housing. The recommended torque to tighten the Mounting Screw is 3.0 N·m. Then loosen the Alignment Screw (hexagon socket head cap screw (M4×22)) of the Intermediate Bracket. (Fig. 6)

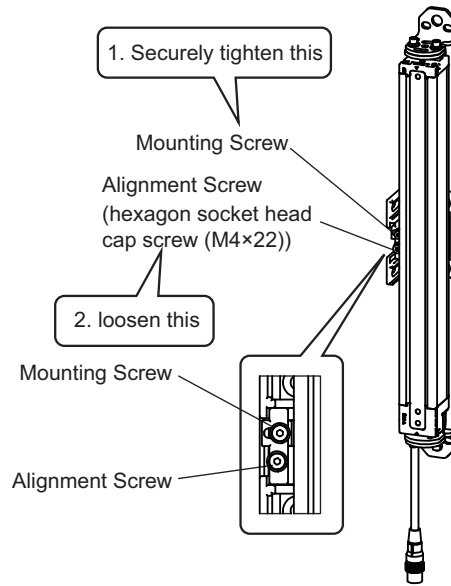


Fig. 6



Tightening screws with a torque that considerably exceeds the recommended torque may cause failure.

CHECK!

- Securely tighten screws to fix the Top/Bottom Bracket to the mounting position of the wall surface. (Fig. 7)

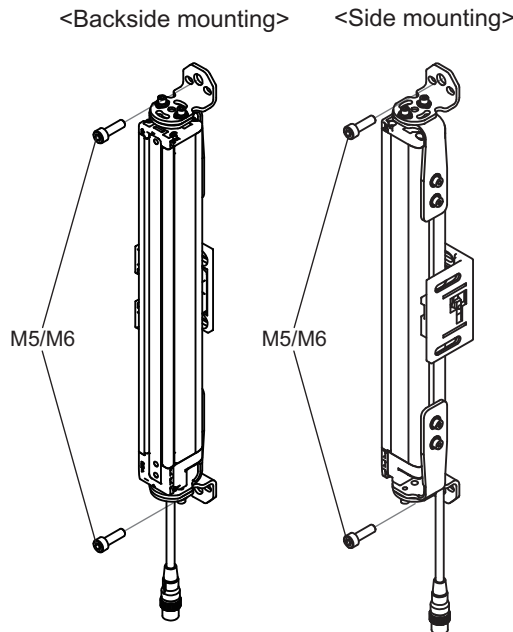


Fig. 7



- One screw at upper and lower positions, respectively, is sufficient to fix the F3SG-R to the wall surface.
- Screws to mount the brackets to the wall are not included.

CHECK!

7. Power the F3SG-R on to perform beam alignment.

Move the emitter and receiver from side to side (Fig. 8) to align them to a center position where the Stable-state indicator (STB, green) of the receiver is illuminated while checking the state of the top and bottom beams with the Top-beam-state indicator (TOP, blue) and Bottom-beam-state indicator (BTM, blue) of the receiver. (Fig. 9)

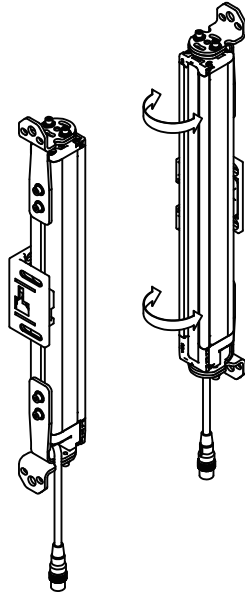


Fig. 8

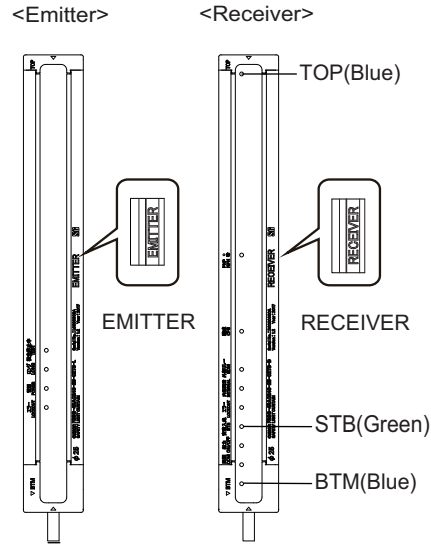


Fig. 9



CHECK!

- The angle adjustment range is $\pm 22.5^\circ$ when using the Top/Bottom Brackets only.
- The angle adjustment range is $\pm 15^\circ$ when using the Top/Bottom Brackets and Intermediate Bracket together.
- It is recommended to use the Light Level Monitoring with the Configuration Tool for beam alignment. Refer to *Safety Light Curtain Configuration Tool for Model F3SG (SD Manager 2) User's Manual* for more information.

8. Securely tighten the Alignment Screws of the Top/Bottom Bracket and Intermediate Bracket to fix the bracket to the F3SG-R housing. The recommended torque to tighten the Alignment Screws is 3.0 N•m. (Fig. 10)

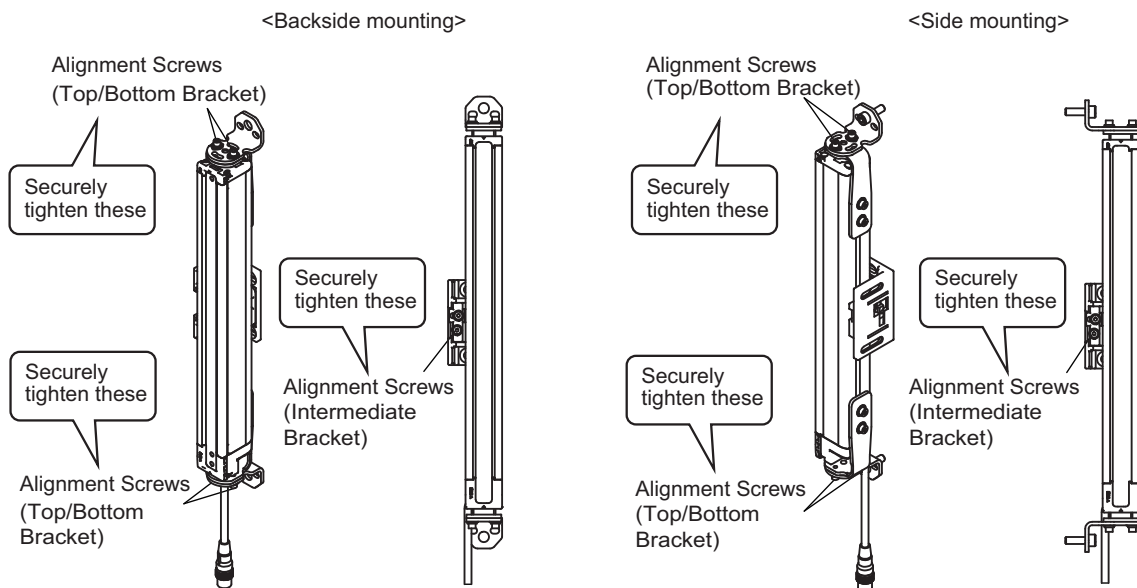


Fig. 10



CHECK!

Tightening screws with a torque that considerably exceeds the recommended torque may cause failure.

4-4-4. Beam Alignment Procedure



CHECK!

The Free-Location Bracket and Top/Bottom Bracket allow beam alignment after fixing the bracket to a wall surface.

1. Verify the following points:
 - The optical surfaces of the emitter and receiver are clean.
 - There is no interrupting object in the detection zone of the F3SG-R.

2. Align the beams of the emitter and receiver:

Move the emitter and receiver from side to side to align each of these to the center position where the Stable-state indicator (STB, green) of the receiver is illuminated while checking the state of the top and bottom beams with the Top-beam-state indicator (TOP, blue) and Bottom-beam-state indicator (BTM, blue) of the receiver.



1-4. LED Indicators



CHECK!

Perform beam alignment to the primary sensor first, when using the F3SG-R in a cascade connection.

3. Verify that all the three indicators of the receiver, Top-beam-state (TOP, blue), Bottom-beam-state (BTM, blue) and Stable-state (STB, green) indicators are illuminated.

4. Make sure to keep the beams aligned and tightly fasten all screws.

The table below shows the recommended tightening torques for the included screws.

Mounting bracket type	Nominal diameter x length of screw (mm)	Tightening torque (recommended)
Free-Location Bracket (Intermediate Bracket)	M4 × 22	3.0 N•m
Top/Bottom Bracket	M4 × 7	3.0 N•m



CHECK!







- If any of the Top-beam-state (TOP, blue), Bottom-beam-state (BTM, blue) and Stable-state (STB, green) indicators are not illuminated, check if the emitter and receiver are mounted parallel and at the same height.

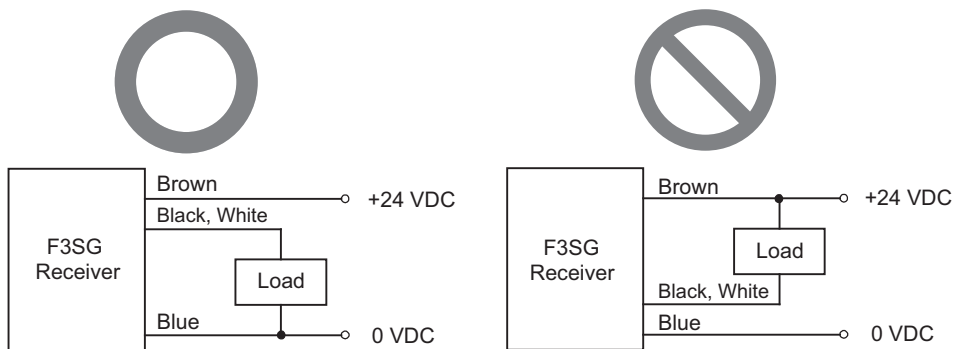
- Tightening screws with a torque that considerably exceeds the recommended torque may cause failure.

- It is recommended to use the Light Level Monitoring with the Configuration Tool for beam alignment. Refer to *Safety Light Curtain Configuration Tool for Model F3SG (SD Manager 2) User's Manual* for more information.

4-5. Wiring

4-5-1. Wiring Precautions

⚠ WARNING	
Double or reinforced insulation from hazardous voltage must be applied to all input and output lines. Failure to do so may result in electric shock.	
Connect the load between the output and 0 V line. Connecting between the output and a different power supply line from the above line will result in dangerous condition because the operation mode of safety output is reversed to "Dark-ON".	
Do not ground +24 VDC line. Otherwise, a ground fault may turn the safety output ON, resulting in a failure of stopping the machine.	
Configure the system by using the optimal number of safety outputs that satisfy the requirements of the necessary safety category.	
Do not connect each line of F3SG-R to a DC power supply higher than 24 VDC+20%. Also, do not connect it to an AC power supply. Failure to do so may result in electric shock.	
Make sure to perform wiring while the power supply is OFF.	



4-5-2. Power Supply Unit

WARNING

For the F3SG-R to comply with IEC 61496-1 and UL 508, the DC power supply unit must satisfy all of the following conditions:



- Must be within the rated power voltage (24 V DC \pm 20%)
- Must have tolerance against the total rated current of devices if it is connected to multiple devices
- Must comply with EMC directives (industrial environment)
- Double or reinforced insulation must be applied between the primary and secondary circuits
- Automatic recovery of overcurrent protection characteristics
- Output holding time must be 20ms or longer
- Must satisfy output characteristic requirements for class 2 circuit or limited voltage current circuit defined by UL508 (Refer to Note below.)
- **Must comply with laws and regulations, regarding EMC and electrical equipment safety, of the country or region where the F3SG-R is used (For example, in EU, the power supply must comply with the EMC Directive and the Low Voltage Directive.)**

Note:

To prevent a fire, the secondary circuit of the power supply must satisfy either of the following conditions in accordance with UL 508:

- As with secondary winding of isolation transformer, there must be a limited current voltage circuit to which isolated power supply provides power, and the "current is limited to 8 A max. (including short-circuit)" or "circuit protection such as a fuse is used to limit the current, which has a rating of 4.2A max." (24 VDC power supply).

Recommended power supply: OMRON S8VS (30 W or 60 W) or S8VK-G (15W, 30W or 60W)

These products are UL-Listed (UL508, class 2 power supply), CE marking compatible (EMC/Low Voltage Directive).

- Class 2 power supply unit complying with UL 1310, or a circuit using 2 transformers complying with UL 1585 as a power supply.



CHECK!

Sharing the power supply with other devices may cause the F3SG-R to be affected by noise or voltage drop. It is recommended that the F3SG-R use a power supply dedicated for safety components, not shared with other devices.

4-5-3. Cable Connections

⚠ WARNING

Extension of the cable must be within a specified length. If it isn't, safety function may not work properly, resulting in danger.

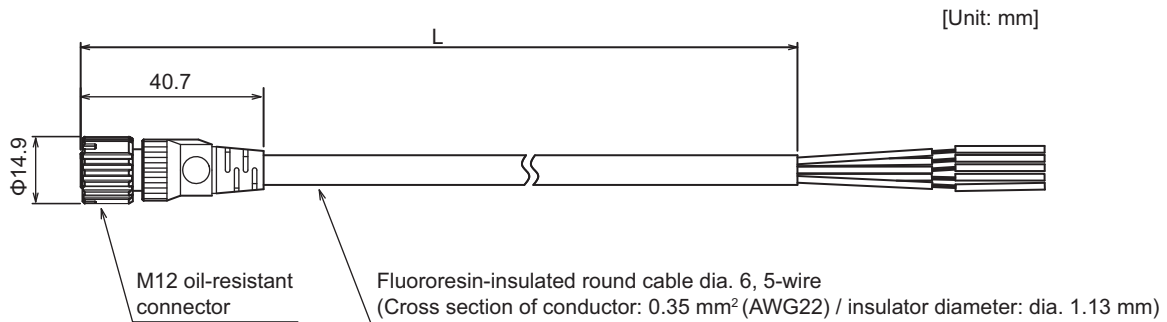


Perform wiring according to the following procedure.

1. Connect an emitter cable (F39-JD□□□-L, gray, sold separately) to the emitter-side power cable (gray).
2. Connect a receiver cable (F39-JJD□□□-D, black, sold separately) to the receiver-side power cable (black).

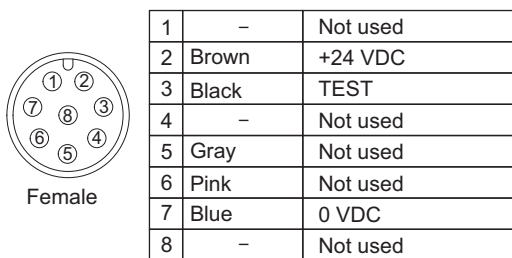
4-5-3-1. Single-Ended Cable (Oil-Resistant Cable)

- Single-Ended Cable for Emitter (F39-JD□RA-L, sold separately)

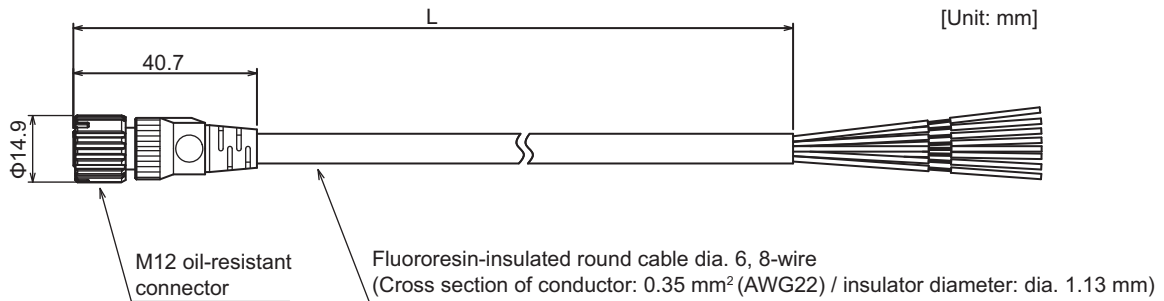


<Internal wiring diagram>

Connected to Power Cable or Double-Ended Cable



- Single-Ended Cable for Receiver (F39-JD□RA-D, sold separately)



<Internal wiring diagram>

Connected to Power Cable or Double-Ended Cable



Female

1	White	OSSD 2
2	Brown	+24 VDC
3	Black	OSSD 1
4	Yellow	AUX
5	Gray	PC COM (+)
6	Pink	PC COM (-)
7	Blue	0 VDC
8	Red	EDM

Emitter cable (Gray)	Receiver cable (Black)	L (m)
F39-JD3RA-L	F39-JD3RA-D	3
F39-JD7RA-L	F39-JD7RA-D	7

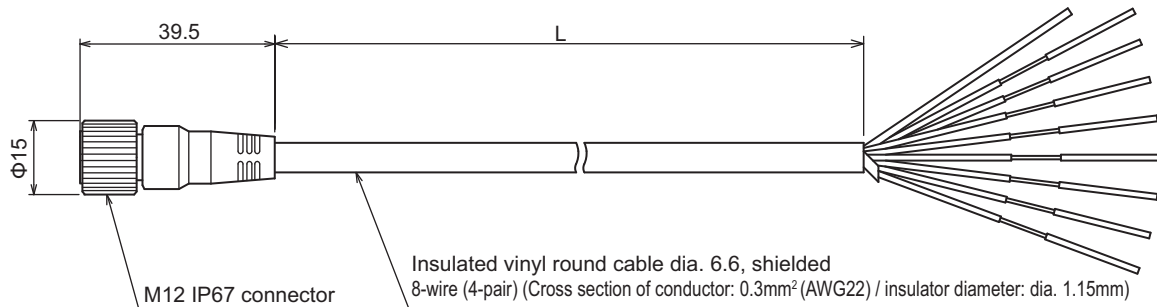
IP67 and IP67G (JIS C 0920 Annex 1)* rated when mated. *1

* F3SG-R meets the degrees of protection when it is correctly connected with the power cable. The degree of protection is not satisfied with the part where cable wires are uncovered.

4-5-3-2. Single-Ended Cable

- Single-Ended Cable for Emitter (F39-JD□A-L, sold separately)

[Unit: mm]



<Internal wiring diagram>

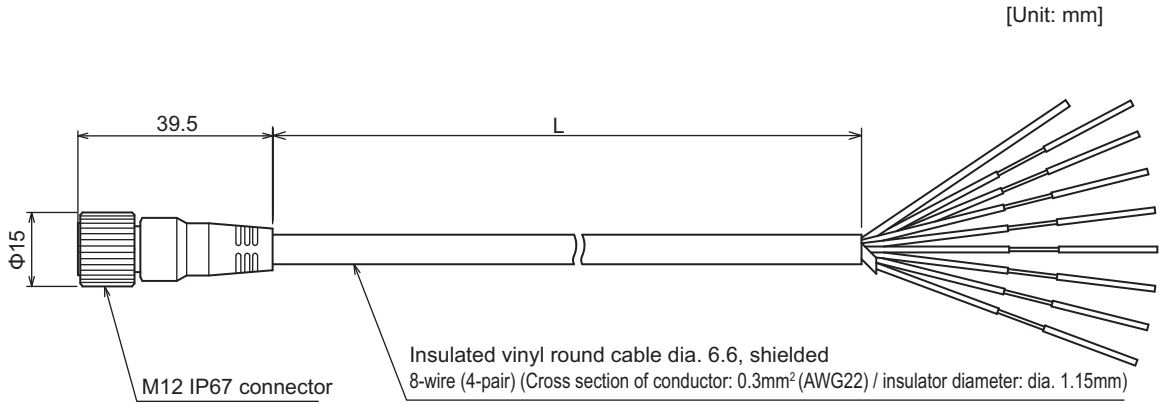
Connected to Power Cable or Double-Ended Cable



Female

1	White	Not used
2	Brown	+24 VDC
3	Black	TEST
4	Yellow	Not used
5	Gray	Not used
6	Pink	Not used
7	Blue	0 VDC
8	Red	Not used
Shield		

▪ Single-Ended Cable for Receiver (F39-JD□A-D, sold separately)



<Internal wiring diagram>

Connected to Power Cable or Double-Ended Cable



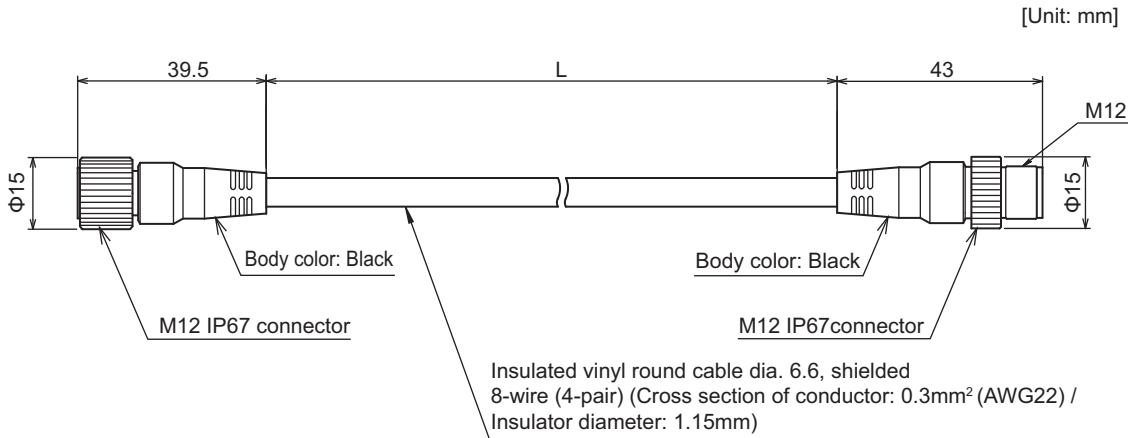
Female

1	White	OSSD 2
2	Brown	+24 VDC
3	Black	OSSD 1
4	Yellow	AUX
5	Gray	PC COM (+)
6	Pink	PC COM (-)
7	Blue	0 VDC
8	Red	EDM
Shield		

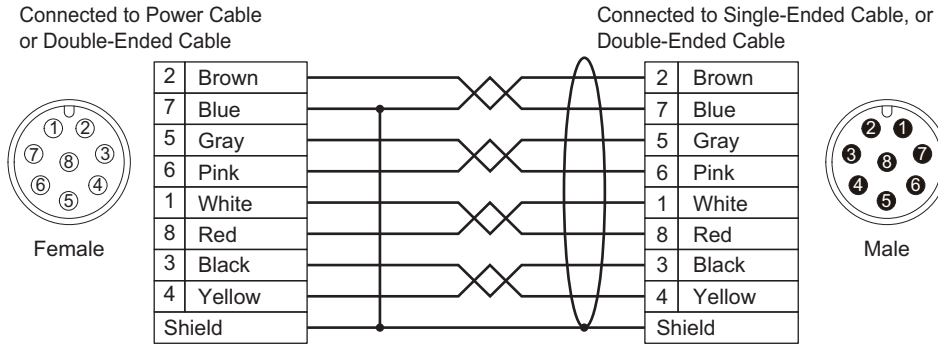
Emitter cable (Gray)	Receiver cable (Black)	L (m)
F39-JD3A-L	F39-JD3A-D	3
F39-JD7A-L	F39-JD7A-D	7
F39-JD10A-L	F39-JD10A-D	10
F39-JD15A-L	F39-JD15A-D	15
F39-JD20A-L	F39-JD20A-D	20

4-5-3-3. Double-Ended Cable

▪ Double-Ended Cable for Emitter: Cable for extension (F39-JD□B-L, sold separately)



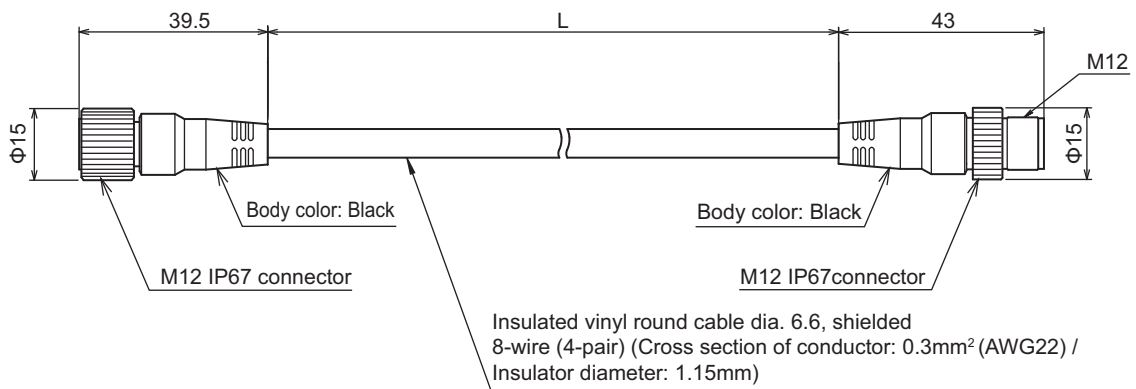
<Internal wiring diagram>



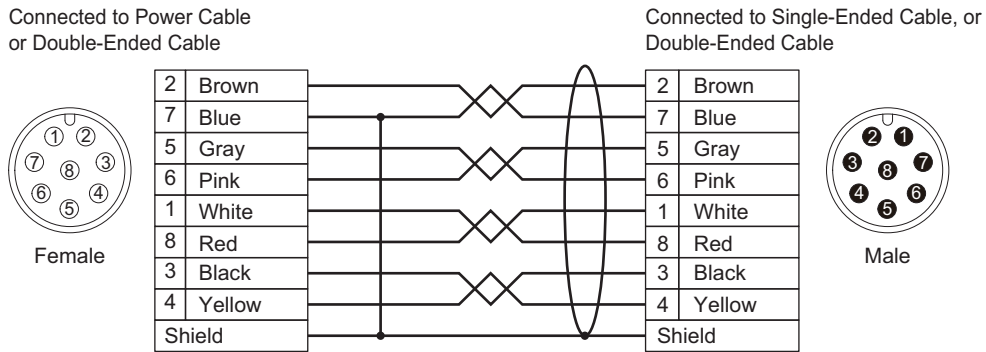
Twisted pair wires are brown and blue, gray and pink, white and red, and black and yellow.

- Double-Ended Cable for Receiver: Cable for extension (F39-JD□B-D, sold separately)

[Unit: mm]



<Internal wiring diagram>

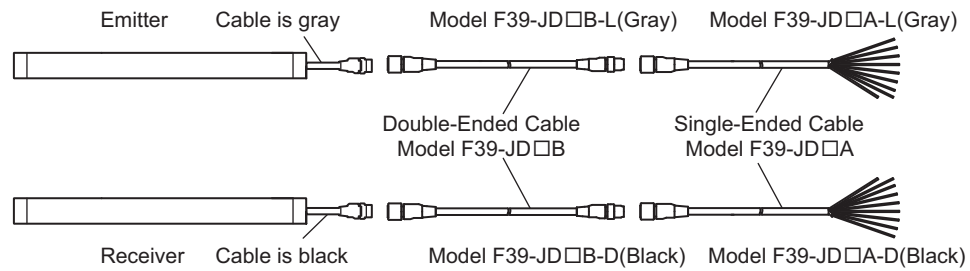


Twisted pair wires are brown and blue, gray and pink, white and red, and black and yellow.

Emitter cable (Gray)	Receiver cable (Black)	L (m)
F39-JDR5B-L	F39-JDR15B-D	0.5
F39-JD1B-L	F39-JD1B-D	1
F39-JD3B-L	F39-JD3B-D	3
F39-JD5B-L	F39-JD5B-D	5
F39-JD7B-L	F39-JD7B-D	7
F39-JD10B-L	F39-JD10B-D	10
F39-JD15B-L	F39-JD15B-D	15
F39-JD20B-L	F39-JD20B-D	20

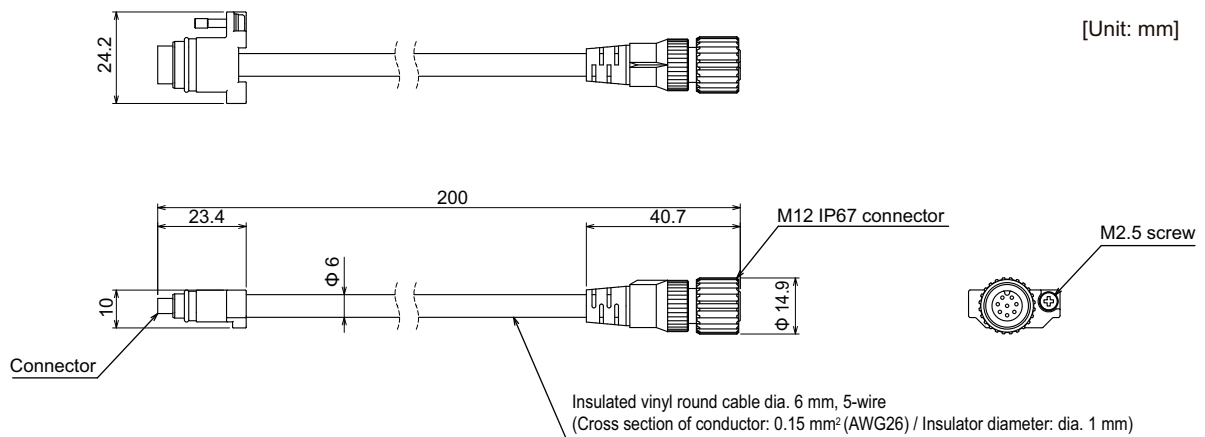
If the length of the F39-JD□□A Single-Ended Cable is insufficient, use 1 or more F39-JD□□B Double-Ended Cables to extend the length, as required. The total cable extension length of the power cable must be 100 m max.

<Connection example>

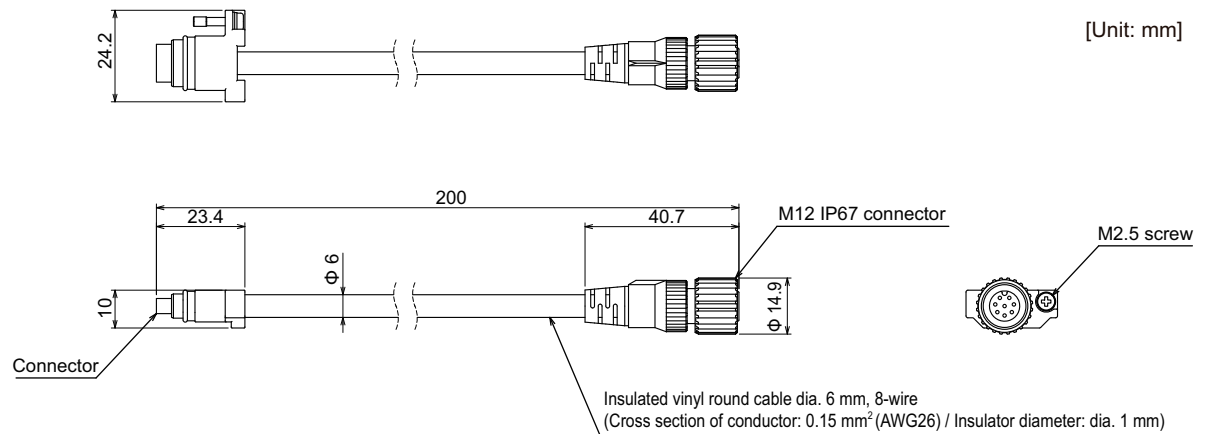


4-5-3-4. Cascading Cable

- Cascading Cable for Emitter (F39-JGR2WTS-L, sold separately)

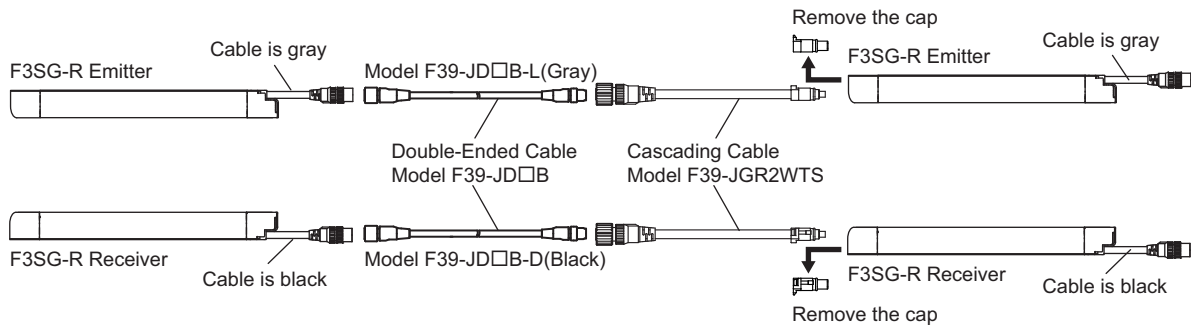


- Cascading Cable for Receiver (F39-JGR2WTS-D, sold separately)



Set model name	Emitter cable (Gray)	Receiver cable (Black)	L (m)
F39-JGR2WTS	F39-JGR2WTS-L	F39-JGR2WTS-D	0.2

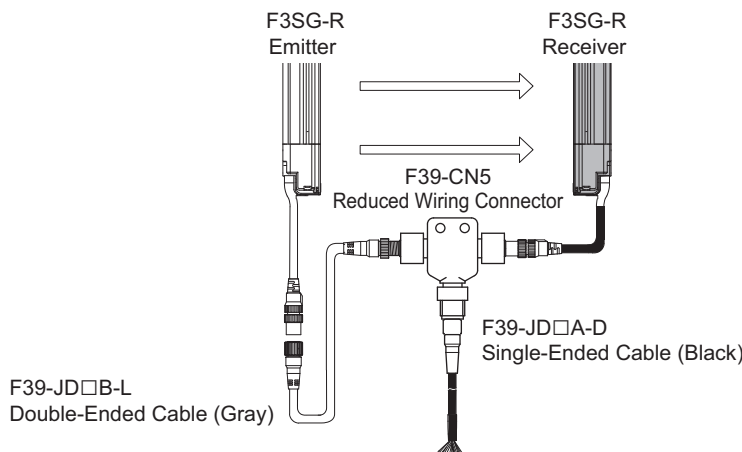
If the length of the Cascading Cable is insufficient, connect the F39-JD□B Double-Ended Cable between the power cable of the F3SG-R and the F39-JGR2WTS Cascading Cable, as required. (Cable length between sensors: 10 m max. (not including cascading cable (F39-JGR2WTS) and power cable))




4-5-3-5. Reduced Wiring Connector System

- Reduced Wiring Connector System

The reduced wiring system can be achieved by using the Double-Ended Cable for Emitter (F39-JD□B-L), the Single-Ended Cable for Receiver (F39-JD□A-D) and the Reduced Wiring Connector (F39-CN5).





 When using the Reduced Wiring Connector (F39-CN5), the following functions are not available.
 - External Device Monitoring
 - Auxiliary Output
CHECK!

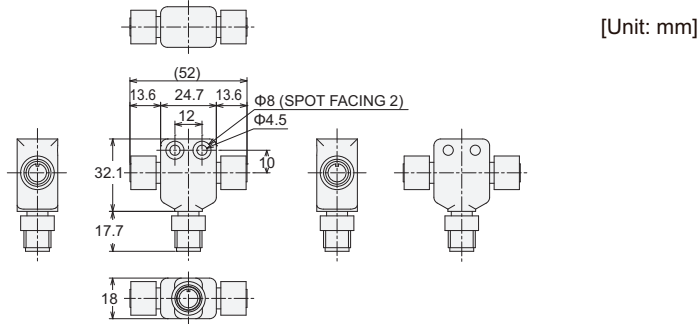
- Cable for Reduced Wiring (F39-JD□BA, sold separately)

A set of two cables; a Double-Ended Cable for Emitter (F39-JD□B) and a Single-Ended Cable for Receiver (F39-JD□A-D). Used in combination with a reduced wiring connector (F39-CN5, sold separately).

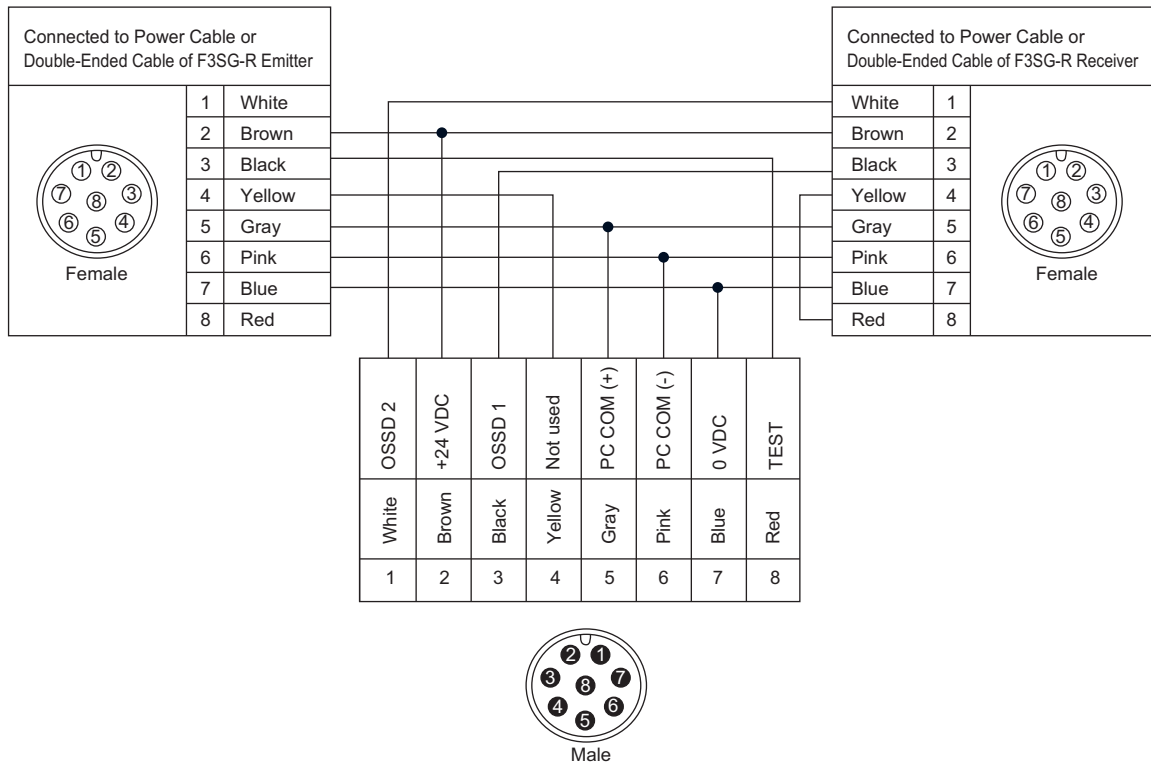
See the following pages for details of the Double-Ended Cable for Emitter (F39-JD□B) and the Single-Ended Cable for Receiver (F39-JD□A-D).

-  4-5-3-2. Single-Ended Cable
-  4-5-3-3. Double-Ended Cable

▪ Reduced Wiring Connector (F39-CN5, sold separately)




<Internal wiring diagram>



4-5-3-6. Extending Cable Length with Commercially Available Cable

When you need to use a cable that is not specified by OMRON, use a cable that satisfies the following specifications.

1. Emitter: 5-wire Receiver: 8-wire
2. 0.3 mm² or larger, conductor resistance 0.058 ohms/m max.
3. PC COM (+) and PC COM (-) lines, and 24 VDC and 0 VDC lines must be used as twisted-pair lines.

 Do not use cables in the same conduit as high voltage or electric power lines.
CHECK!

4-5-4. Functional Earth Connection

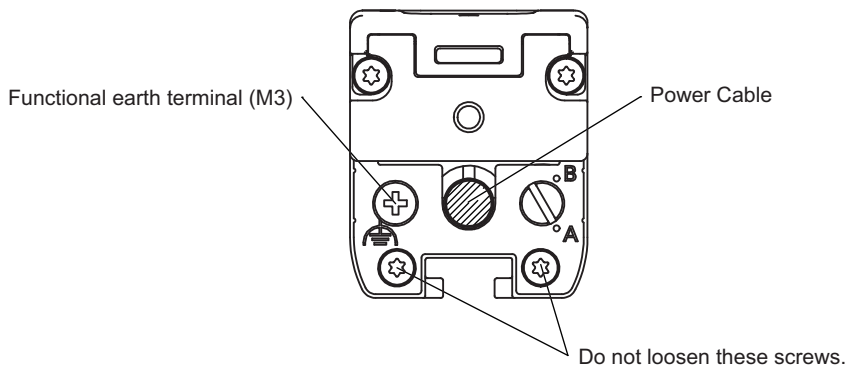
The F3SG-R operates properly without functional earth connection in a general industrial environment. If the F3SG-R fails due to electrical noise, connecting the F3SG-R to the functional earth may work to prevent the noise. It is recommended the functional earth terminal of the F3SG-R be connected to functional earth cables. Connection with protective earth cables may cause the F3SG-R to fail due to a noise level of the environment.

When you connect the F3SG-R with the functional earth, connect an earth cable to the functional earth terminals, as shown below.

The size of the screws of the terminals is M3. Make sure to use crimp terminals that fits the size.

The earth cable must have a cross section of 1 mm² or more with conductor resistance of 0.058 ohms/m or less and a length of 20 m or less.

Bottom view of F3SG-R



Chapter 5 Input/Output Circuit and Applications

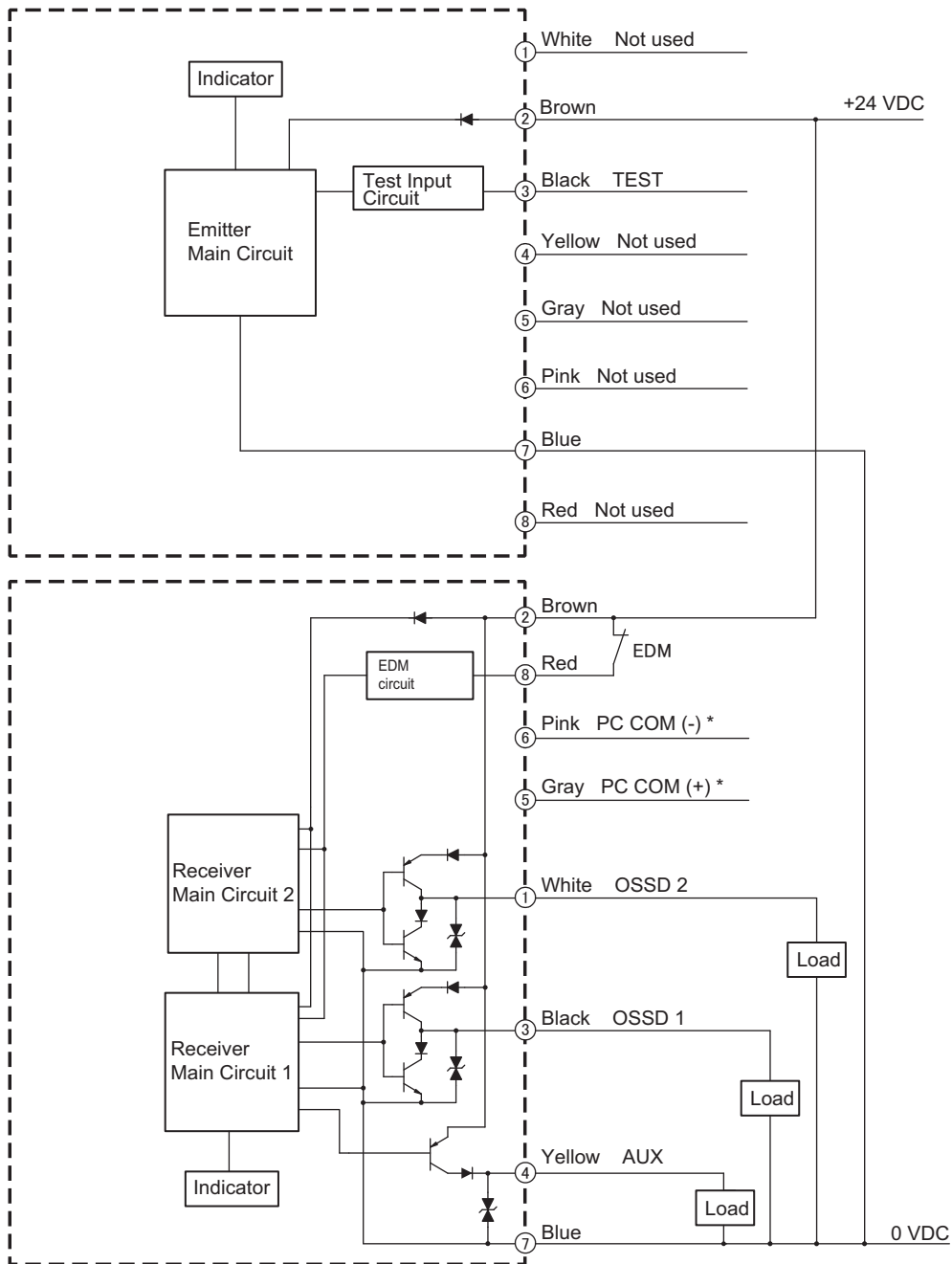
5-1. Input/Output Circuit	80
5-1-1. Entire Circuit Diagram	80
5-1-2. Input Circuit Diagram by Function	81
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5-1. Input/Output Circuit

5-1-1. Entire Circuit Diagram

The entire circuit diagram of the F3SG-R is shown below.

The numbers in the circles indicate the connector's pin numbers.

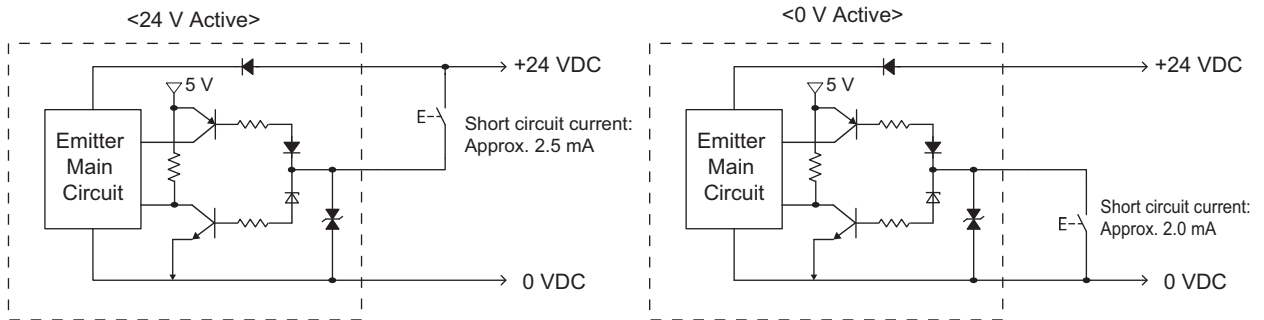


*This line is used for communication with a PC using the F39-GIF-1 Interface Unit.

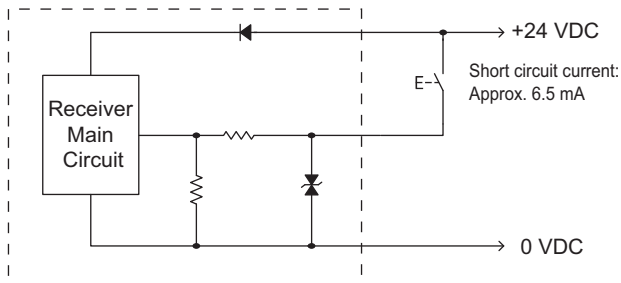
5-1-2. Input Circuit Diagram by Function

The input circuit diagrams of by function are shown below.

■ TEST



■ EDM



5-2. Wiring Examples

Examples of a motor control system using the F3SG-R are shown below. This chapter shows examples equivalent to up to PLe, Category 4 (ISO13849-1).

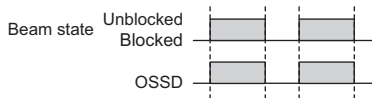
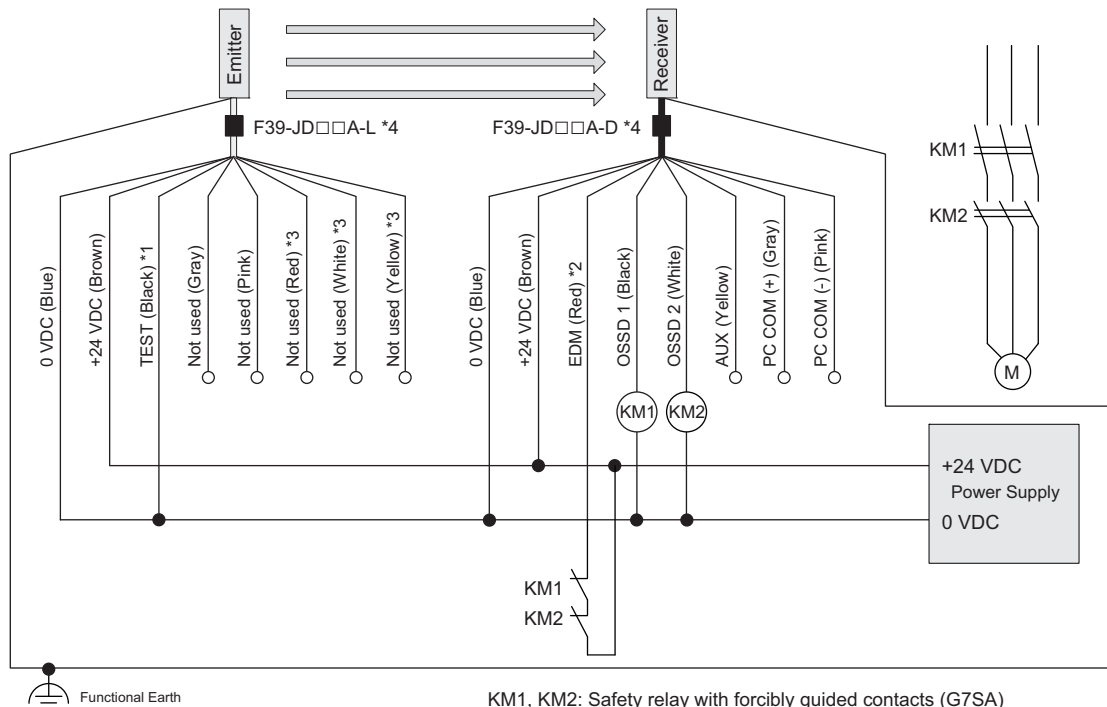
5-2-1. EDM used and External Test in 24V Active not used

The following is the example of External Device Monitoring used and External Test in 24 V Active (not used).

[Settings]

	Function
Receiver	EDM
Emitter	External Test: 24 V Active (End Cap: Black) (factory default setting)

[Wiring Example]



KM1, KM2: Safety relay with forcibly guided contacts (G7SA)
M: Motor

- *1. Connect the line to 24 V via a test switch (N.O. contact) if External Test is used.
- *2. Connect a lockout reset switch (N.C. contact) to this line in series with the KM1 and KM2 if Lockout Reset is used.
- *3. The F39-JD□□RA-L Single-Ended Cable for Emitter (Oil-Resistant Cable) does not have the red, white and yellow wires.
- *4. For the F39-JD□□A-□ Single-Ended Cable, connect the shield line to 0 V.



CHECK!

Functional earth connection is unnecessary when you use the F3SG-R in a general industrial environment where noise control or stable power supply is considered. However, when you use the F3SG-R in an environment where there may be excessive noise from surroundings or stable power supply may be interfered, it is recommended the F3SG-R be connected to functional earth.

The wiring examples in later pages do not indicate functional earth. To use functional earth, wire an earth cable according to the example above. Refer to 4-5-4. *Functional Earth Connection* for more information.

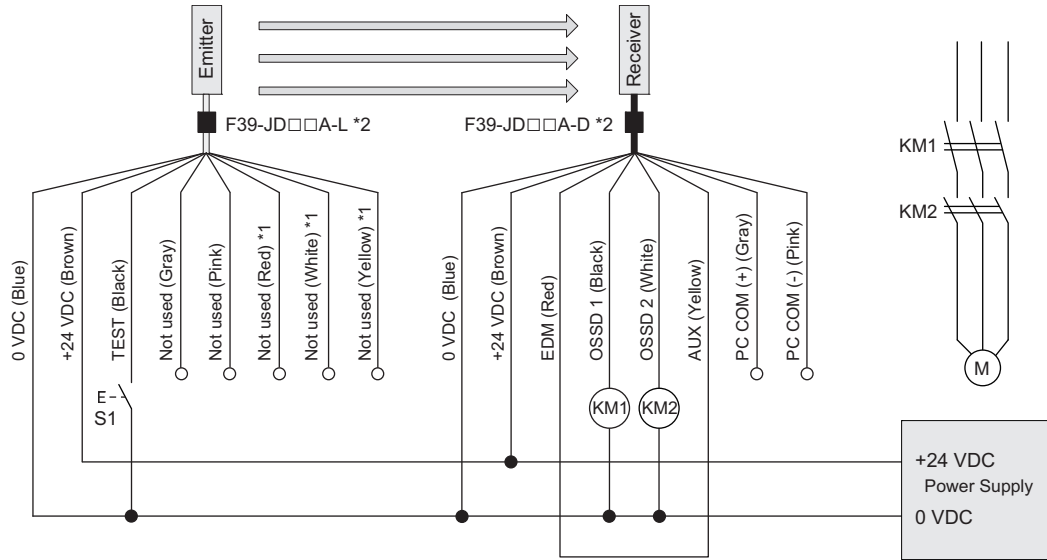
5-2-2. EDM not used and External Test in 0V Active used

The following is the example of External Device Monitoring not used and External Test in 0 V Active (used).

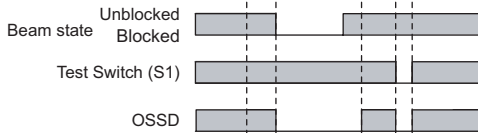
[Settings]

	Function
Emitter	External Test: 0 V Active (End Cap: White)

[Wiring Example]



S1: Test Switch (Connect the line to 24 V if this switch is not required)
 KM1, KM2: Safety relay with forcibly guided contacts (G7SA)
 M: Motor



*1. The F39-JD□□RA-L Single-Ended Cable for Emitter (Oil-Resistant Cable) does not have the red, white and yellow wires.
 *2. For the F39-JD□□A-□ Single-Ended Cable, connect the shield line to 0 V.



The wiring example does not indicate functional earth. To use functional earth, wire an earth cable according to the example in 5-2-1. *EDM used and External Test in 24V Active not used*. Also refer to 4-5-4. *Functional Earth Connection* for more information.

5-2-3. F3SG-R with Reduced Wiring Connector

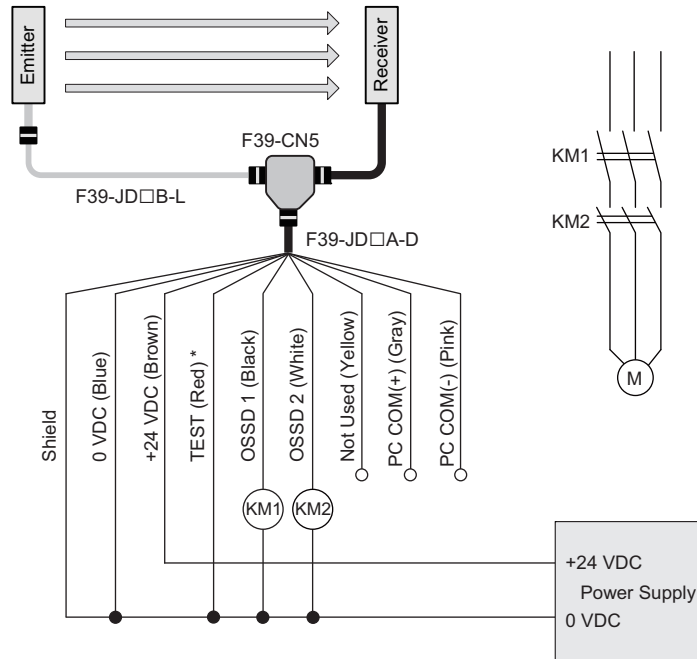
The following is the example of External Test in 24 V Active (not used).

[Settings]

	Function
Emitter	External Test: 24 V Active (End Cap: Black) (factory default setting)

The reduced wiring system can be achieved by using the Reduced Wiring Cables (F39-JD□BA) and the Reduced Wiring Connector (F39-CN5).

[Wiring Example]



KM1, KM2: Safety relay with forcibly guided contacts (G7SA)
M: Motor

*Connect the line to 24 V via a test switch (N.O. contact) if External Test is used.



When using the Reduced Wiring Connector (F39-CN5), the following functions are not available.
- External Device Monitoring
- Auxiliary Output

CHECK!



The wiring example does not indicate functional earth. To use functional earth, wire an earth cable according to the example in 5-2-1. EDM used and External Test in 24V Active not used. Also refer to 4-5-4. Functional Earth Connection for more information.

CHECK!

5-3. Connectable Safety Control Units

The F3SG-4RA-25-02TS can be connected to the safety control units listed in the table below.

Connectable Safety Control Units		
G9SA-301	G9SX-AD322-T	G9SP-N10S
G9SA-321-T□	G9SX-ADA222-T	G9SP-N10D
G9SA-501	G9SX-BC202	G9SP-N20S
G9SB-200-B	G9SX-GS226-T15	NE0A-SCPU01
G9SB-200-D		NE1A-SCPU01
G9SB-301-B		NE1A-SCPU02
G9SB-301-D		DST1-ID12SL-1
G9SE-201		DST1-MD16SL-1
G9SE-401		DST1-MRD08SL-1
G9SE-221-T□		NX-SIH400
		NX-SID800
		F3SP-T01

Chapter 6 Checklists

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6-1. Pre-Operation Checklists

WARNING

Make sure Responsible Person tests the operation of the F3SG-R after installation to verify that the F3SG-R operates as intended. Make sure to stop the machine until the test is complete. Unintended function settings may cause a person to go undetected, resulting in serious injury.



After installation, the highest level administrator must use the following checklist to verify the operation, placing a check mark in each of the boxes.

6-1-1. Checklists

6-1-1-1. Installation Condition Check

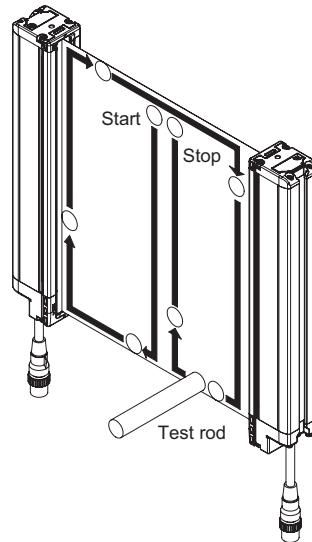
- The machine itself does not prevent the operation of safety functions such as stopping.
- The hazardous part of a machine cannot be reached without passing through the detection zone of the F3SG-R.
- The system is configured so that the F3SG-R can always detect a worker who is working in the hazardous zone.
- The reset switch is installed in a location that provides a clear view of the entire hazardous zone and it cannot be activated from within the hazardous zone.
- Safety distance has been calculated. Calculated distance: $S = (\quad)$ mm
- The actual distance is equal to or greater than the calculated distance. Actual distance = (\quad) mm
- Reflective surfaces are not installed in prohibited zones.
- Not installed in a retro-reflective configuration.
- It is not used in flammable or explosive atmosphere.

6-1-1-2. Wiring Check Before Power Is Turned ON

- When the power supply unit is connected to multiple devices, the power supply unit must have tolerance against total rated current of the devices.
- The power supply unit is a 24 VDC unit that conforms to the EMC Directive, Low-voltage Directive, and output holding time specifications.
- The power supply polarity is not connected in reverse.
- Emitter/receiver cables are properly connected to the respective emitters/receivers.
- Double insulation is used between I/O lines and the hazard potential (commercial power supplies, etc.).
- The outputs are not short-circuited to +24 VDC line.
- No loads are connected to +24 VDC line.
- All lines are not connected to commercial power source.
- F3SG-R's power supply connector and series connection connector must not be attached upside down.
- Model of emitter and receiver must be the same.
- When 2 or more F3SG-R systems are used, they are in cascade connection or prevented from mutual interference with each other.
- On a secondary sensor farthest from its power supply, either of the following is attached:
 - End Cap
 - Lamp (F39-LP and F39-BTLP, sold separately)
 - Bluetooth® Communication Unit (F39-BT, sold separately)
- Neither connector, cap, or bracket must be loose.
- Auxiliary output must not be used as safety output.
- +24 VDC line of the power supply must not be grounded.
- Wiring must not be bent, cracked, nor damaged.

6-1-1-3. Operation Check While the Machine Is Stopped

- The test rod is not deformed.
Use a test rod with an appropriate diameter for inspection. A test rod is not included in the F3SG-R product package.
- The sensor must detect a test rod wherever it is in the detection zone. In other words, when a test rod is inserted into the detection zone, the Stable-state indicator turns OFF and the ON/OFF indicator turns red.
To check detection, move the test rod as shown in the diagram below.



- When the external test function is used:
When 24 V Active is enabled, the ON/OFF indicator turns red when the TEST line is short-circuited to 9 V to V_s .
When 0 V Active is enabled, the ON/OFF indicator turns red when the TEST line is short-circuited to 0 to 3 V.
- When the external device monitoring function is used:
When the EDM line is open the ON/OFF indicator remains red regardless of the beam state of the F3SG-R.

6-1-1-4. Checking that Hazardous Parts Stop While the Machine Operates

- The hazardous parts stop immediately when a test rod is inserted into the detection zone at 3 positions: "directly in front of the emitter", "directly in front of the receiver", and "between the emitter and receiver". (Use the appropriate test rod.)
- The hazardous parts remain stopped as long as the test rod is in the detection zone.
- The hazardous parts stop when the power of the F3SG-R is turned OFF.
- The actual response time of the whole machine is equal to or less than the calculated value.

6-2. Maintenance Checklists

WARNING

Perform daily and 6-month inspection for the F3SG-R. Otherwise, the system may fail to work properly, resulting in serious injury.



Do not try to disassemble, repair, or modify this product. Doing so may cause the safety functions to stop working properly.



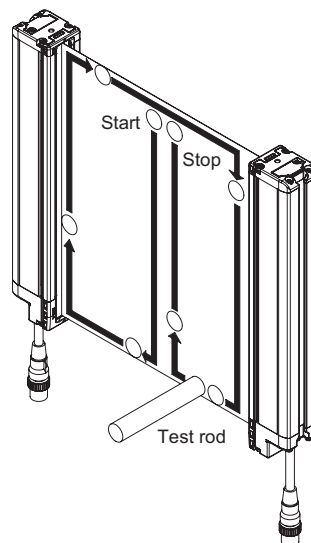
To ensure safety, keep a record of the inspection results.

When the user is a different person from those who installed or designed the system, he/she must be properly trained for maintenance.

6-2-1. Checklists

6-2-1-1. Inspection at Startup and When Changing Operators

- There is no approach route other than through the detection zone of the F3SG-R.
- Part of the operator's body always remains in the detection zone of the F3SG-R when working around the machine's hazardous part.
- The actual safety distance is equal to or greater than the calculated value.
- There must be no dirt on or damage to the optical surface of the F3SG-R.
- When 24 V Active is enabled, ON/OFF indicator turns red when the TEST line is short-circuited to 9 V to V_s . When 0 V Active is enabled, ON/OFF indicator turns red when the TEST line is short-circuited to 0 to 3 V.
- The test rod is not deformed.
- The test rod is detected when it is moved around in the detection zone as shown in the diagram below. In other words, when a test rod is inserted into the detection zone, the Stable-state indicator turns OFF and the ON/OFF indicator turns red. When fixed blanking function is used, you must ensure that all blanked zones in the detection zone are covered by a hard barrier guard and there must be no zone in the detection zone where the test rod goes undetected.



- Neither connector, cap, or bracket must be loose.

6-2-1-2. Checking that Hazardous Parts Stop While the Machine Operates

- The hazardous parts are movable when nothing is in the detection zone.
- The hazardous parts stop immediately when a test rod is inserted into the detection zone at 3 positions: "directly in front of the emitter", "directly in front of the receiver", and "between the emitter and receiver". (Use the appropriate test rod.)
- The hazardous parts remain stopped as long as the test rod is in the detection zone.
- The hazardous parts stop when the power of the F3SG-R is turned OFF while nothing is in the detection zone.

6-2-1-3. Items to Inspect Every 6 Months or When Machine Settings Are Changed

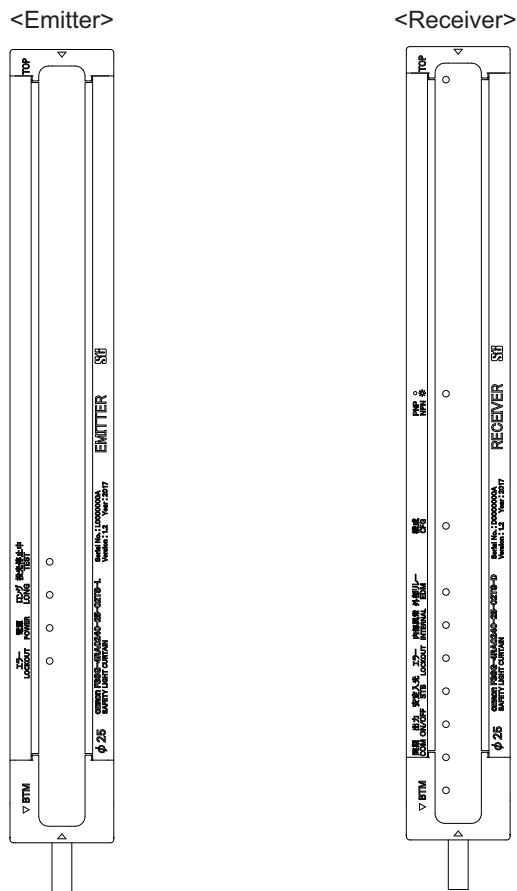
In addition to inspection item at operation start, following items must also be verified.

- The outputs of the F3SG-R and the machine are properly wired.
- The total number of times that the control relays/contactors have switched is significantly lower than their design lives.
- There is no ambient light.
- When the configuration of the cascade connection is changed, either of the following is attached on a secondary sensor farthest from its power supply:
 - End Cap
 - Lamp (F39-LP and F39-BTLP, sold separately)
 - Bluetooth® Communication Unit (F39-BT, sold separately)
- +24 VDC line of the power supply must not be grounded.
- Wiring must not be bent, cracked, nor damaged.

Chapter 7 Appendix

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7-1. Troubleshooting

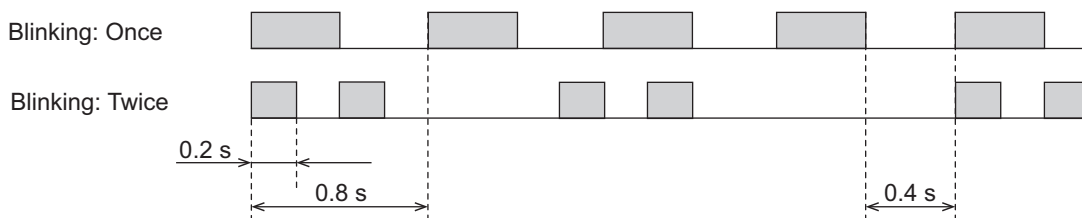


- 1. Test indicator (Green)
- 2. LONG indicator (Green)
- 3. Power indicator (Green)
- 4. Lockout indicator (Red)


- 1. TOP indicator (Blue)
- 2. NPN indicator (Green)
- 3. CFG indicator (Green)
- 4. EDM indicator (Green)
- 5. INTERNAL indicator (Red)
- 6. LOCKOUT indicator (Red)
- 7. STB indicator (Green)
- 8. ON/OFF indicator (Green/Red)
- 9. COM indicator (Green)
- 10. BTM indicator (Blue)

LED Blinking Pattern:

The timing chart below shows the blinking frequency of the LED blinking patterns (blinking once and twice) described in the following pages.



You can check error and warning logs by the Maintenance Information function of the Configuration Tool.

 Refer to *Safety Light Curtain Configuration Tool for Model F3SG (SD Manager 2) User's Manual* for more information on checking error and warning logs by the Configuration Tool.

7-1-1. Lockout State

7-1-1-1. Description

If F3SG-R detects any failure, it keeps safety output OFF and transitions to the Lockout state. Under lockout state, the Lockout indicators blink or are ON and other indicators blink based on the failure. Solve the problems based on the table below.

Eliminate the cause of the problem. Then turn the power ON again or reset the Lockout state by providing a lockout reset input to restart the F3SG-R.

7-1-1-2. Troubleshooting

Identify an error according to the combination of the indicators when the error occurs. See the following troubleshooting tables to take measures.



<Indicator status at lockout: Receiver>

Combination of Indicators and Error Description

[Error Description]






LOCKOUT Blinking Once	TOP	Cap error Other sensor error
	CFG	Cascading configuration error
	EDM	External device monitoring error
	INTERNAL	Internal error
	ON OFF	Safety output error
	COM	Communication error
	BTM	Scan code setting error
LOCKOUT Blinking Twice	ON OFF	Safety output error due to power supply voltage or noise
	COM	Communication error due to power supply voltage or noise
	INTERNAL	Internal error due to power supply voltage or noise


<Indicator status at lockout: Emitter>

Combination of Indicators and Error Description

[Error Description]

LOCKOUT Blinking Once	LONG	Scan code setting error
	POWER	Other sensor error Cascading configuration error Internal error Communication error
LOCKOUT Blinking Twice	POWER	Internal or Communication error due to noise

Description	Error code	Cause and measures
Cap error	4F	A cap may be detached. Attach the cap properly.
Other sensor error	38	Other sensor being cascaded caused an error. Check the indicator of the sensor.
Cascading configuration error	39, 3A, 3B	The cascading cable may be short-circuited, broken, or disconnected. Check that the cascading cable should be tightly connected. If the cascading cable is broken, replace it.
		The number of connected sensors or beams may have exceeded the maximum value due to cascading. Check the configuration.
External device monitoring error	52	Relay may be welded. Replace the relay.
		The relay and the EDM line may not be properly wired. Check the wiring with the relay.  Chapter 4 Wiring/Installation
		The relay response time may be exceeding the allowable delay time. Change the allowable delay time or replace the relay with one that has an appropriate response time.  2-7. External Device Monitoring (EDM)  Chapter 4 Wiring/Installation
Safety output error	60, 6B, 6C	Safety output lines may be short-circuited to each other or another signal line may be short-circuited to the safety output line. Wire the safety output lines properly.  Chapter 4 Wiring/Installation
Communication error	30, 31, 32	The communication line or other wiring may be broken or short-circuited. Check the cables for cascading or extension cables.
		If the wiring is extended with cables other than specified, the cables used for extension may not have performance equivalent or greater than the specified cables. Use cables with the same performance or more than the specified cables.  Chapter 4 Wiring/Installation
Scan code setting error	E7, E8	A scan code setting may have been changed during operation. Check if there is any change to the scan code setting.

Description	Error code	Cause and measures
Safety output error due to power supply voltage or noise	19	<p>The power supply voltage may have dropped temporarily when the F3SG-R is in operation. Check for temporary power supply voltage drop (by about 12 VDC) by the influence of the inductive load, etc. If the exclusive power supply is not used, check the power consumption of other connected devices for enough capacity.</p> <p>Power supply voltage may be outside the rated range. Connect the F3SG-R to a 24 VDC±20% power supply voltage.</p> <p>Voltage fluctuation may have occurred due to insufficient power supply capacity. Replace the power supply with one that has a larger capacity.</p> <p>Instantaneous break or instantaneous stop may have occurred due to power sharing with other devices. Do not share the power supply with other devices. Connect the F3SG-R to a power supply that is dedicated to electro-sensitive protective devices for electro-sensitive protective equipment such as the F3SG-R, safety controller, etc.</p>
	1A	<p>Effect of noise may be excessive.</p> <p>If other devices using the same power supply generate noise, do not share the same power supply with other devices, and use a separate power supply exclusively for the safety components.</p> <p>The inductive noise tends to be induced especially if the power supply line of the machine guarded and the power supply line of the F3SG-R are arranged in parallel. Arrange the exclusive power supply near the F3SG-R or lay the power supply line of the F3SG-R away from the power supply line of the machine guarded.</p> <p>If the power supply for the F3SG-R is located near the power supply of the machine guarded and it uses the same ground, it is subject to the influence of common mode noise from the ground. Separate the grounding point or use it as the exclusive ground.</p> <p> 4-5-4. Functional Earth Connection</p>
Communication error due to power supply voltage or noise	19	<p>The power supply voltage may have dropped temporarily when the F3SG-R is in operation. Check for temporary power supply voltage drop (by about 12 VDC) by the influence of the inductive load, etc. If the exclusive power supply is not used, check the power consumption of other connected devices for enough capacity.</p>
	1A	<p>Communication error may have occurred due to noise. Check the noise level in the environment.</p>
Internal error due to power supply voltage or noise	19, 1A	<p>The internal circuitry may be defective due to power supply voltage or noise. Check the noise level in the environment. Make sure that the power supply voltage is 24 VDC±20%. If the indicator still shows this error, replace the F3SG-R.</p>
Internal or communication error due to noise	--	<p>The internal circuitry may be defective due to noise. Check the noise level in the environment.</p>
		<p>Communication error may have occurred due to noise. Check the noise level in the environment.</p>
Internal error	Error code other than those above	<p>An error may have occurred in the internal circuit. Replace the F3SG-R.</p>

7-1-2. Warning

7-1-2-1. Description

If an error is detected that prevents the F3SG-R to continue normal operation, the STB indicator blinks to notify warning information according to the error. The F3SG-R continues normal operation. The F3SG-R automatically recovers from the warning status when the cause of the error is solved.

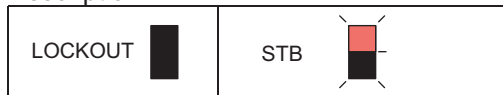
7-1-2-2. Troubleshooting

Identify an error according to the combination of the indicators when the error occurs. See the following troubleshooting tables to take measures.



<Indicator status at warning: Receiver>

Combination of Indicators and Error Description




[Warning Description]

➔ Malfunction due to ambient light or vibration

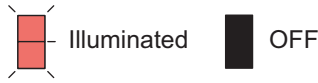
<Indicator status at warning: Emitter>

None

Description	Warning code	Cause and measures
Malfunction due to ambient light or vibration	11	Malfunction may have occurred due to ambient light or instantaneous beam misalignment from vibration. Check the installation condition. Take necessary measures against mutual interference according to "4-1-4. Mutual Interference Prevention".  4-1-4. Mutual Interference Prevention
Low incident light level	12	The incident light level may be low due to dirty optical surface or misaligned beams caused by vibration. Clean the optical surface and check the alignment of the beams. Take necessary measures for this according to 4-4-4. Beam Alignment Procedure.

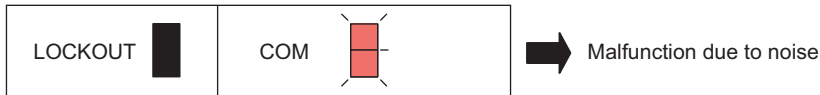
7-1-3. Troubles Other Than in Lockout State

Shown below are actions to take when F3SG-R does not work properly while no lockout occurred and no error is displayed.



<Indicator status: Receiver>

Combination of Indicators and Error Description




[Description]

<Indicator status: Emitter>



None

The COM indicator is illuminated with all beams of F3SG-R blocked or light emission stopped.

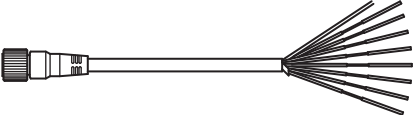
Description	Cause and Measures
Malfunction due to noise	<p>Effect of noise may be excessive.</p> <p>If other devices using the same power supply generate noise, do not share the same power supply with other devices, and use a separate power supply exclusively for the safety components.</p> <p>The inductive noise tends to be induced especially if the power supply line of the machine guarded and the power supply line of the F3SG-R are arranged in parallel. Arrange the exclusive power supply near the F3SG-R or lay the power supply line of the F3SG-R away from the power supply line of the machine guarded.</p> <p>If the power supply for the F3SG-R is located near the power supply of the machine guarded and it uses the same ground, it is subject to the influence of common mode noise from the ground. Separate the grounding point or use it as the exclusive ground.</p> <p> 4-5-4. Functional Earth Connection</p>

7-2. Optional Accessories(Sold Separately)

Single-Ended Cable (Oil-Resistant Cable)

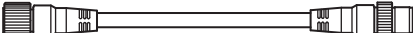
Appearance	Model	Cable length	Specifications
Emitter 	F39-JD3RA-L	3 m	Emitter cable (F39-JD□RA-L): M12 connector (8-pin), 5 wires Receiver cable (F39-JD□RA-D): M12 connector (8-pin), 8 wires IP67 and IP67G (JIS C 0920 Annex 1)* rated when mated. * F3SG-R meets the degree of protection when it is correctly connected with the power cable. The degree of protection is not satisfied with the part where cable wires are uncovered.
	F39-JD7RA-L	7 m	
Receiver 	F39-JD3RA-D	3 m	
	F39-JD7RA-D	7 m	

Single-Ended Cable (2 cables per set, one for emitter and one for receiver)

Appearance	Model	Cable length	Specifications
	F39-JD3A	3 m	M12 connector (8-pin), 8 wires + Shield wire IP67* rated when mated.
	F39-JD7A	7 m	
	F39-JD10A	10 m	
	F39-JD15A	15 m	
	F39-JD20A	20 m	

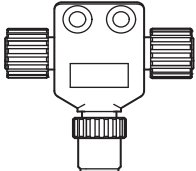
*When the accessory is used, protect it from cutting oil.

Double-Ended Cable (for extension) (2 cables per set, one for emitter and one for receiver)

Appearance	Model	Cable length	Specifications
	F39-JDR5B	0.5 m	M12 connector (8-pin) on both ends IP67* rated when mated.
	F39-JD1B	1 m	
	F39-JD3B	3 m	
	F39-JD5B	5 m	
	F39-JD7B	7 m	
	F39-JD10B	10 m	
	F39-JD15B	15 m	
	F39-JD20B	20 m	

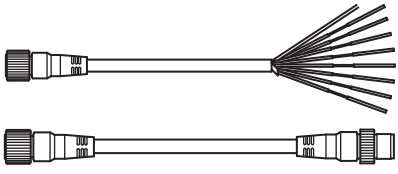
*When the accessory is used, protect it from cutting oil.

Reduced Wiring Connector

Appearance	Model	Remarks
	F39-CN5	IP67* rated when mated. Used for reduced wiring system. Use this connector in combination with Cables for Reduced Wiring.

*When the accessory is used, protect it from cutting oil.

Cable for Reduced Wiring*1 (2 cables per set, one for emitter and one for receiver)

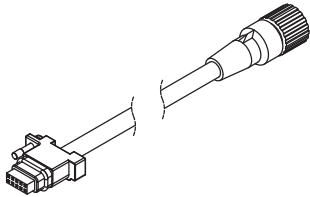
Appearance	Model	Cable length	Remarks
 IP67*2 rated when mated	F39-JD0303BA	Emitter : 3 m Receiver : 3 m	Double-Ended Cable : F39-JD3B-L Single-Ended Cable : F39-JD3A-D
	F39-JD0307BA	Emitter : 3 m Receiver : 7 m	Double-Ended Cable : F39-JD3B-L Single-Ended Cable : F39-JD7A-D
	F39-JD0310BA	Emitter : 3 m Receiver : 10 m	Double-Ended Cable : F39-JD3B-L Single-Ended Cable : F39-JD10A-D
	F39-JD0503BA	Emitter : 5 m Receiver : 3 m	Double-Ended Cable : F39-JD5B-L Single-Ended Cable : F39-JD3A-D
	F39-JD0507BA	Emitter : 5 m Receiver : 7 m	Double-Ended Cable : F39-JD5B-L Single-Ended Cable : F39-JD7A-D
	F39-JD0510BA	Emitter : 5 m Receiver : 10 m	Double-Ended Cable : F39-JD5B-L Single-Ended Cable : F39-JD10A-D
	F39-JD1003BA	Emitter : 10 m Receiver : 3 m	Double-Ended Cable : F39-JD10B-L Single-Ended Cable : F39-JD3A-D
	F39-JD1007BA	Emitter : 10 m Receiver : 7 m	Double-Ended Cable : F39-JD10B-L Single-Ended Cable : F39-JD7A-D
	F39-JD1010BA	Emitter : 10 m Receiver : 10 m	Double-Ended Cable : F39-JD10B-L Single-Ended Cable : F39-JD10A-D

Note: A combination of emitter and receiver cables of other lengths than the above is also available. For details, contact your Omron representative.

*1. Double-Ended Cable for emitter and Single-End Cable for receiver.

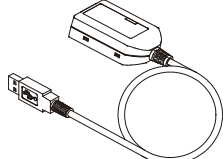
*2. When the accessory is used, protect it from cutting oil.

Cascading Cable (2 cables per set, one for emitter and one for receiver)

Appearance	Model	Cable length	Specifications
	F39-JGR2WTS	0.2 m	Cap (8-pin), M12 connector (8-pin) IP67* rated when mated.

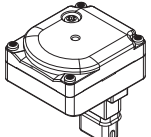
*When the accessory is used, protect it from cutting oil.

Interface Unit*

Appearance	Model	Remarks
	F39-GIF-1	Used to connect an F3SG-R receiver to a USB port of a PC. Accessories: F39-CN1 Branch Connector (1), Connector Cap (1), 2-m Dedicated Cable (1), Instruction Sheet

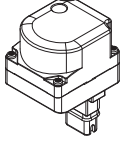
*When the accessory is used, protect it from cutting oil.

Bluetooth® Communication Unit

Appearance	Model	Remarks
	F39-BT	Used for the receiver. IP67* rated. Material: PBT

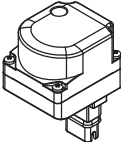
*When the accessory is used, protect it from cutting oil.

Lamp and Bluetooth® Communication Unit

Appearance	Model	Remarks
	F39-BTLP	Used for the receiver. IP67* rated. Material: PC (Lighting element) PBT (Other body parts)

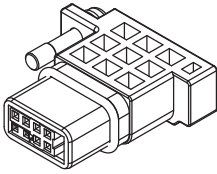
*When the accessory is used, protect it from cutting oil.

Lamp

Appearance	Model	Remarks
	F39-LP	Used for the receiver. IP67* rated. Material: PC (Lighting element) PBT (Other body parts)

*When the accessory is used, protect it from cutting oil.

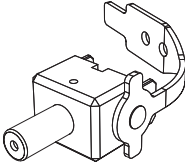
End Cap

Appearance	Model	Remarks
	F39-CNM	Housing color: Black For both emitter and receiver (The End Cap can be purchased if lost.) IP67 rated when mated*1 *2

*1 This accessory can also be used for F3SG-RA.

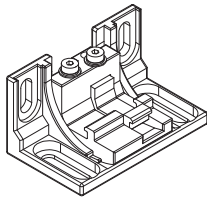
*2. When the accessory is used, protect it from cutting oil.

Laser Alignment Kit*

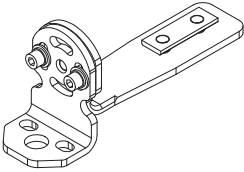
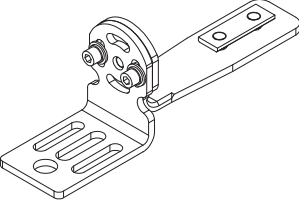
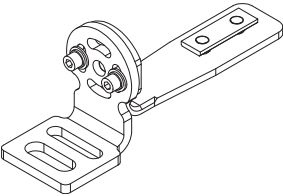
Appearance	Model	Application	Remarks
	F39-PTG	You can attach this to F3SG-R. The laser light assists coarse beam alignment.	Red semiconductor laser (wavelength 650 nm, 1 mW max., JIS Class 2, IEC Class 2, FDA Class II)

*When the accessory is used, protect it from cutting oil.

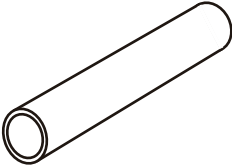
Free-Location Bracket (Also used as Intermediate Bracket)

Appearance	Model	Application	Remarks
	F39-LGRA	Beam alignment after mounting possible. The angle adjustment range is $\pm 15^\circ$. Side mounting and backside mounting possible.	2 brackets per set Protective height and number of brackets required: 0240 to 1200 mm: 2 sets 1280 to 2080 mm: 3 sets

Top/Bottom Bracket

Appearance	Model	Application	Remarks
	F39-LGRTB	Use this bracket at the top and bottom positions of the F3SG-R. Beam alignment after mounting possible. The angle adjustment range is $\pm 22.5^\circ$. Side mounting and backside mounting possible.	4 brackets per set. When it is necessary to use it with another bracket, only the combination with the Intermediate Bracket is possible.
	F39-LGRTB-2	Use this bracket at the top and bottom positions of the F3SG-R. The angle adjustment range is $\pm 22.5^\circ$. Side mounting and backside mounting possible. The part of this bracket to contact with a wall surface has a different shape from the F39-LGRTB Top/Bottom Bracket.	Protective height and number of brackets required: 1120 to 1920 mm: 1 set of Top/Bottom Bracket and 1 set of Intermediate Bracket 1040 mm or less: Intermediate Bracket is not required.
	F39-LGRTB-3	Use this bracket when replacing an existing safety light curtain with F3SG-R.	

Test Rod

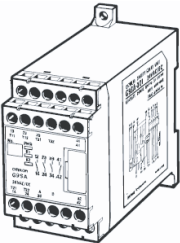
Appearance	Model	Diameter
	F39-TRD25	25 mm dia., Length: 250 mm, Material: ABS resin



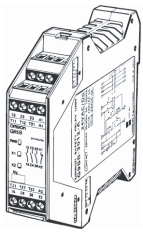
To check operation before use, purchase and use the test rod.

CHECK!

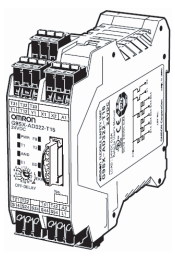
Control Unit

Appearance	Model	Output	Remarks
	G9SA-301 G9SA-321-T075 G9SA-321-T15 G9SA-321-T30	Safety output (relay): NO contact x 3 Auxiliary output (relay): NC contact x 1	• An F39-JD□A Single-Ended Cable is required.
	G9SA-501	Safety output (relay): NO contact x 5 Auxiliary output (relay): NC contact x 1	

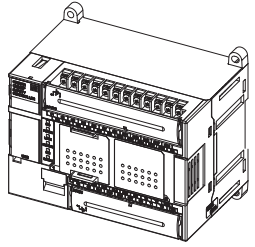
Control Unit

Appearance	Model	Output	Remarks
	G9SB-301-B	Safety output (relay): NO contact x 3 Auxiliary output (relay): NC contact x 1 Auto reset	<ul style="list-style-type: none"> • An F39-JD□A Single-Ended Cable is required. • Thickness of a type of three N.O. and one N.C. contacts is 22.5 mm. • Thickness of a type of two N.O. contacts is 17.5 mm.
	G9SB-301-D	Safety output (relay): NO contact x 3 Auxiliary output (relay): NC contact x 1 Manual reset	
	G9SB-200-B	Safety output (relay): NO contact x 2 Auto reset	
	G9SB-200-D	Safety output (relay): NO contact x 2 Manual reset	

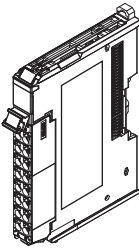
Control Unit

Appearance	Model	Output	Remarks
	G9SX-AD322-T15	Safety output (solid-state): source output (PNP) x 3 (instantaneous), source output (PNP) x 2 (OFF-delayed) Auxiliary output (solid-state): source output (PNP) x 2	<ul style="list-style-type: none"> • An F39-JD□A Single-Ended Cable is required. • 16 patterns of OFF-delayed output for up to 15 seconds can be set. • The OFF-delayed output can be used as instantaneous output by setting it to 0 second. • Can be configured for partial control and total control. • Can be extended to connect a relay unit.

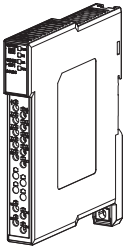
Control Unit

Appearance	Model	Output	Remarks
	G9SP-N10S	Safety output (solid-state): source output (PNP) x 4 Test output (solid-state): source output (PNP) x 4 Standard output (solid-state): source output (PNP) x 4	<ul style="list-style-type: none"> • An F39-JD□A Single-Ended Cable is required.
	G9SP-N10D	Safety output (solid-state): source output (PNP) x 16 Test output (solid-state): source output (PNP) x 6	
	G9SP-N20S	Safety output (solid-state): source output (PNP) x 8 Test output (solid-state): source output (PNP) x 6	

Control Unit

Appearance	Model	Application	Specifications
	NX-SIH400	Safety input (solid-state): sink input (PNP) x 4 Test output (solid-state): source output (PNP) x 2	<ul style="list-style-type: none"> An F39-JD□A Single-Ended Cable is required.
	NX-SID800	Safety input (solid-state): sink input (PNP) x 8 Test output (solid-state): source output (PNP) x 2	

Control Unit

Appearance	Model	Application	Specifications
	G9SE-201	Safety output (relay): NO contact x 2 (instantaneous) Auxiliary output (solid-state): source output (PNP) x 1	<ul style="list-style-type: none"> An F39-JD□A Single-Ended Cable is required. For G9SE-221-T□, 16 patterns of OFF-delayed output for up to 5 or 30 seconds can be set.
	G9SE-401	Safety output (relay): NO contact x 4 (instantaneous) Auxiliary output (solid-state): source output (PNP) x 1	
	G9SE-221-T□	Safety output (relay): NO contact x 2 (instantaneous), NO contact x 2 (OFF-delayed) Auxiliary output (solid-state): source output (PNP) x 1	

7-3. Glossary

	Term	Description
A	Auxiliary output	Function to give inverted signal of safety output information. This must not be used for safety applications.
C	Configuration Tool	Setting tool that allows the user to read statuses of the F3SG-R with a PC.
E	Effective aperture angle (EAA)	Range of angles in which the F3SG-R can operate.
	External device monitoring function (EDM)	Function to monitor the operation of an N.C. contacts of external relays (or contactors) that control the hazardous zone of a machine, for any malfunctions such as welding.
	External test	Function that stops emission at a specified time to check that the Safety outputs are being properly turned OFF.
I	Inverted signal output mode	In this mode, the logic of the Auxiliary output signal is reversed.
L	Light level monitoring	Function to read out the light level of incident light or ambient light on the F3SG-R.
	Load switching frequency	Function to display the number of operations of a load to be connected to the F3SG-R.
	Lockout	Function to keep the Safety outputs in the OFF state when an error is detected by the F3SG-R.
	Lockout reset	Function to release the Lockout state.
	Lower beam(s)	Beams located toward the Power Cable of the F3SG-R.
O	Object resolution (Detection capability)	Minimum size of an object that can be detected in the protective height of the F3SG-R.
	Operating status monitoring	Function to read out the I/O data and status of functions of the F3SG-R.
	Output operation mode	Information to be signaled to an output part (Safety output, Auxiliary output).
P	PELV	Protected Extra Low Voltage. A grounded circuit separated by double insulation or equivalent from hazardous voltage. It does not generate voltage that exceeds ELV under normal conditions and under single-fault conditions. Normally, protection against direct contact is required.
	Power-on time	Function to display the period of time when the F3SG-R is energized, starting from when the power-on time was last reset until the present time.
	Primary sensor	Name used for the F3SG-R to be connected nearest the power supply, when in cascade connection.
R	Response time from ON to OFF	Period of time from when the F3SG-R is blocked until the Safety outputs are turned from ON to OFF.
	Restart interlock	Function to turn the Safety outputs to the OFF state when the F3SG-R is blocked and keep this state until a reset signal is received.
S	Safety output (OSSD)	Output to be turned to the ON state when safety is ensured. This can be used for safety applications.
	SD Manager 2	Setting software that is used as the Configuration Tool for the F3SG-R. It allows the user to monitor the operation of the F3SG-R when the F3SG-R is connected to the PC via the Interface Unit or Bluetooth® Communication Unit.
	Secondary sensor	Name used for other segments of F3SG-R's than the primary sensor, when in cascade connection.
	SELV	Safety Extra Low Voltage. An ungrounded circuit separated by double insulation or equivalent from hazardous voltage. It does not generate voltage that exceeds ELV under normal conditions and under single-fault conditions. If the nominal voltage exceeds 25 VAC or 60 VDC, protection against direct contact is required.
U	Upper beam(s)	Beams located toward the terminal of the F3SG-R.
V	Vs	Power supply voltage value in your usage environment.

7-4. Revision History

A manual revision code appears as a suffix to the manual number at the bottom of the front and back covers of this manual.

Z391-E1-03



Revision No.

Revision symbol	Revision date	Revisions
01	January 2018	First edition
02	February, 2020	Added a precaution to <i>Safety Precautions</i> .
03	July 2020	Minor corrections.

OMRON Corporation Industrial Automation Company (Manufacturer)

Shiokoji Horikawa, Shimogyo-ku, Kyoto, 600-8530 JAPAN

Contact: www.ia.omron.com

Regional Headquarters

OMRON EUROPE B.V. (Importer in EU)

Wegalaan 67-69, 2132 JD Hoofddorp
The Netherlands
Tel: (31)2356-81-300/Fax: (31)2356-81-388

OMRON ASIA PACIFIC PTE. LTD.

No. 438A Alexandra Road # 05-05/08 (Lobby 2),
Alexandra Technopark,
Singapore 119967
Tel: (65) 6835-3011/Fax: (65) 6835-2711

OMRON ELECTRONICS LLC

2895 Greenspoint Parkway, Suite 200
Hoffman Estates, IL 60169 U.S.A.
Tel: (1) 847-843-7900/Fax: (1) 847-843-7787

OMRON (CHINA) CO., LTD.

Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
Tel: (86) 21-5037-2222/Fax: (86) 21-5037-2200

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