OMRON

Safety Light Curtain

F3S-A

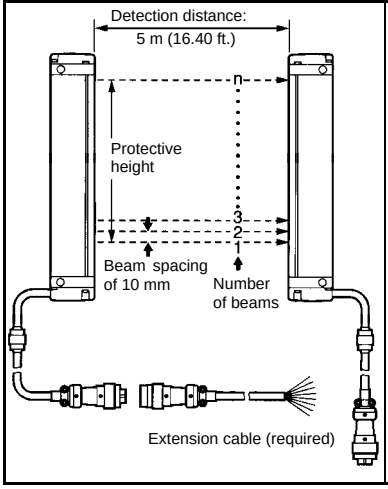
Space-saving, Self-contained Design Requires No Control Box



- Meets OSHA, Canadian, and worldwide standards for safeguarding personnel from moving machinery
- Self-contained design with no control box
- UL and CSA Listed
- Beam spacing of 10 or 20 mm (0.39 or 0.79 in)
- Protective height ranges from 140 to 940 mm (5.51 to 37.0 in)
- Connect multiple units for a larger protected zone

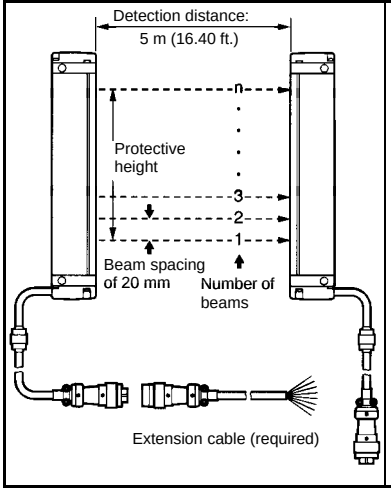
Ordering Information

■ SAFETY LIGHT CURTAINS

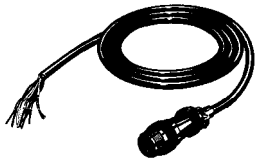
Shape, detection distance	Beam spacing	Minimum detectable object	No. of beams (n)	Protective height	Part number
	10 mm (0.39 in)	15 mm in diameter (0.59 in)	16	150 mm (5.9 in)	**F3S-A161**
			32	310 mm (12.2 in)	**F3S-A321**
			48	470 mm (18.5 in)	**F3S-A481**

(This table continues on the next page.)

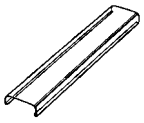
Ordering Information Table – continued from previous page

Shape, detection distance	Beam spacing	Minimum detectable object	No. of beams (n)	Protective height	Part number
	20 mm	25 mm in diameter	8	140 mm (5.5 in)	**F3S-A082**
			16	300 mm (11.8 in)	**F3S-A162**
			24	460 mm (18.1 in)	**F3S-A242**
			32	620 mm (24.4 in)	**F3S-A322**
			48	940 mm (37 in)	**F3S-A482**

■ CABLES (ORDER SEPARATELY)

Type	Appearance	Cable length	Part number		
			Set of 2 cables	Emitter cable only	Receiver cable only
Extension cable (1 pair required)		3 m (9.8 ft)	**F39-JA1A**	**F39-JA1A-L**	**F39-JA1A-D**
		7 m (23.0 ft)	**F39-JA2A**	**F39-JA2A-L**	**F39-JA2A-D**
		10 m (32.8 ft)	**F39-JA3A**	**F39-JA3A-L**	**F39-JA3A-D**
Series connection cable (required for multiple units connected together)		200 mm (7.87 in)	**F39-JA1B**		

■ ACCESSORIES

Type	Description	Specifications	Part number
Protective covers 	Acrylic cover set for emitter and receiver	For F3S-A161, F3S-A02	**F39-HA1**
		For F3S-A321, F3S-A162	**F39-HA2**
		For F3S-A481, F3S-A242	**F39-HA3**
		For F3S-A322	**F39-HA4**
		For F3S-A482	**F39-HA5**
Safety relays with force-guided contacts	Plug-in replaceable relay	6 contacts, 3PST-NO + 3PST-NC, 24 VDC	**G7S-3A3B-DC24**
	Socket for G7S relay	DIN track mounting socket	**P7S-14F**
		Solder terminals	**P7S-14A**
		PCB terminals	**P7S-14P**
	Multiple relay unit	3 contacts, 3PST-NO + SPST-NC, 24 VDC	**G9S-301-DC24**
		120 VAC	**G9S-301-AC120**
		240 VAC	**G9S-301-AC240**

Specifications

■ RATINGS AND PERFORMANCE

Part number		F3S-A161	F3S-A321	F3S-A481	F3S-A082	F3S-A162	F3S-A242	F3S-A322	F3S-A482
No. of beams		16	32	48	8	16	24	32	48
Protective height		150 mm (5.91 in)	310 mm (12.2 in)	470 mm (18.5 in)	140 mm (5.51 in)	300 mm (11.81 in)	460 mm (18.11 in)	620 mm (24.41 in)	940 mm (37.01 in)
Beam spacing		10 mm (0.39 in)			20 mm (0.79 in)				
Optical resolution		Non-transparent: 15 mm (0.59 in) in diameter			Non-transparent: 25 mm (0.98 in) in diameter				
Sensing range		0.2 to 5.0 m (7.87 in to 16.40 ft)							
Response time	ON→OFF	20 ms max.							
	OFF→ON	55 ms max. (with stable light)							
Supply voltage		24 VDC±10% (ripple range (p-p): 10% max.)							
Current consumption		200 mA max. (under no-load conditions)							
Light source		Infrared LED (860-nm wavelength)							
Angle of divergence		Within ±2° for the emitter and receiver at a detection distance of at least 3 m as provided by prEN50100-2.							
Operating mode		Light ON							
Control output		Two PNP transistor outputs, 300 mA max. load current, and 2 V max. residual voltage (except for voltage drop due to cord extension)							
Multiplex circuitry		Using sync line connection (between an emitter and a receiver and between multiple Light Curtains) No. of serial connections: Up to 3 sets No. of parallel connections: Up to 4 sets Total no. of beams: Up to 192 (with mixed serial and parallel connection)							
External diagnosis function (See Note 1.)		After power ON External diagnosis input line: Open or 9 to 24 V: Emitting OFF External diagnosis input line: 0 to 1.5 V: Emitting ON (3 mA max. short-circuit current)							
Interference light search function (See Note 1.)		Prior to power ON External diagnosis input line: Open or 9 to 24 V: Interference light search External diagnosis input line: 0 to 1.5 V: Emitting ON (3 mA max. short-circuit current)							
Indicator	Emitter	Light indicator (orange LED): Lit when emitting, flashing during external diagnosis and interference light search. Fault indicator (yellow LED): Lit with emitter lock-out, flashing during emitter OFF-hold and interference light search. (See Note 2.)							
	Receiver	ON-state indicator (green LED): Lit when receiving light. OFF-state indicator (red LED): Lit with interrupted light or failure, flashing during interference light search. (See Note 2.) Instability indicator (orange LED): Lit with an insufficient light margin and interference light search. Fault indicator (yellow LED): Lit with receiver lock-out, flashing during receiver OFF hold and interference light search. (See Note 2.)							
Connection method		Connector on 400 mm (15.75 in) cables; use extension cables							
Protection circuit		Output short circuit protection							
Ambient temperature	Operation	–10° to 55°C (14°F to 131°F) with no freezing							
	Storage	–30° to 70°C (–22°F to 158°F) with no freezing							
Ambient humidity	Operation	35 to 85% RH (with no condensation)							
	Storage	35 to 95% RH							

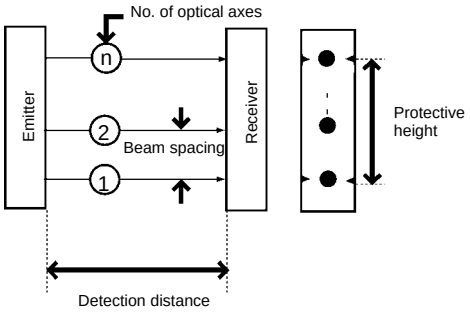
(This table continues on the next page.)

Note: 1. The logic (ON/OFF) may differ from that normally used because a safety circuit is used. Be sure to check this carefully.
2. Lock-out: Output status OFF due to unrecoverable failure. OFF-hold: Output status OFF due to temporary failure.
3. In accordance with prEN50100-1
4. The optional extension cord provides the same cable specifications.
(Reference) Resistance: Power line and output line: 66.3 Ω/Km
Sync line: 94.0 Ω/Km
Use a cable of at least the same performance to extend the cable length. The total cable length must be 100 m or less.

Specifications Table – continued from previous page

Part number		F3S-A161	F3S-A321	F3S-A481	F3S-A082	F3S-A162	F3S-A242	F3S-A322	F3S-A482
Ambient light intensity	Incandescent lamps	3,000 lx max. (receiver surface light intensity)							
	Sunlight	10,000 lx max. (receiver surface light intensity)							
Insulation resistance		20 MΩ min. at 500 VDC							
Stabilization on powerup		5 seconds							
Dielectric strength voltage		1,000 VAC 50/60 Hz for 1 min							
Degree of protection		IEC60529 IP64							
Vibration resistance		Durability: 10 to 55 Hz, double-amplitude: 1.5 mm, X, Y and Z axes: For 2 hours Operation limit: 10 to 55 Hz, double-amplitude: 0.7 mm, X, Y and Z directions: For 50 min. (See Note 3.)							
Shock resistance		Durability: 300 m/s^2 [30 G], X, Y and Z directions: 3 times Operation limit: 100 m/s^2 [10 G], X, Y and Z directions: 1,000 times (See Note 3.)							
Cable (See Note 4.)		Emitter and receiver: 8 conductors (0.3 mm^2 x 4 conductors, 0.2 mm^2 x 4 conductors), external dimension: 6 mm in diameter with spiral shield, allowable bend radius R36 mm, attached cable: 400 mm length							
Materials		Case: Aluminum Front cover: PMMA (acrylic resin) Cable: PVC							
Accessories		Test rod, mounting brackets (top and bottom), mounting brackets (intermediate) for the F3S-A32 and F3S-A482 only, Instruction Manual							
Applicable standard		prEN50100-1 TYPE 4 ESPE and prEN50100-2 TYPE 4 AOPD							

Note: 1. The logic (ON/OFF) may differ from that normally used because a safety circuit is used. Be sure to check this carefully.
2. Lock-out: Output status OFF due to unrecoverable failure. OFF-hold: Output status OFF due to temporary failure.
3. In accordance with prEN50100-1
4. The optional extension cord provides the same cable specifications.
(Reference) Resistance: Power line and output line: 66.3 Ω/Km
Sync line: 94.0 Ω/Km
Use a cable of at least the same performance to extend the cable length. The total cable length must be 100 m or less.

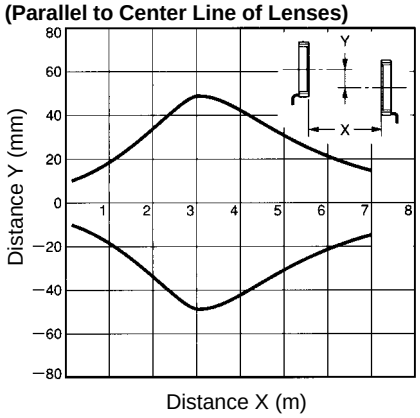


Engineering Data

■ OPERATING RANGE

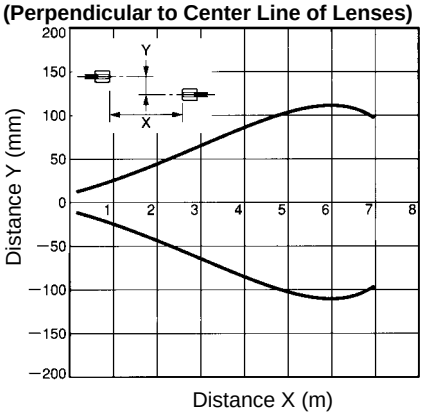
F3S-A481 (10-mm beam spacing)

(Parallel to Center Line of Lenses)



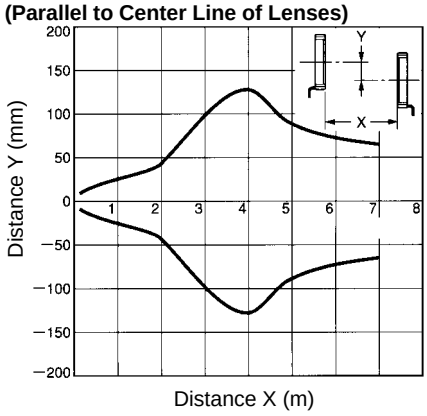
F3S-A481 (10-mm beam spacing)

(Perpendicular to Center Line of Lenses)



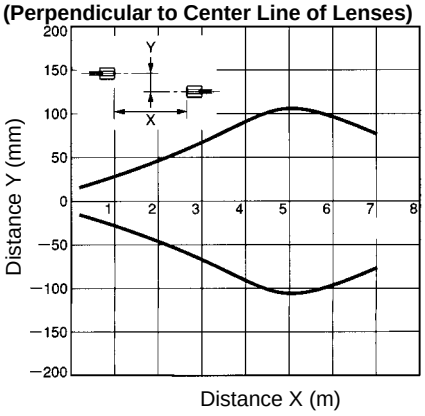
F3S-A482 (20-mm beam spacing)

(Parallel to Center Line of Lenses)



F3S-A482 (20-mm beam spacing)

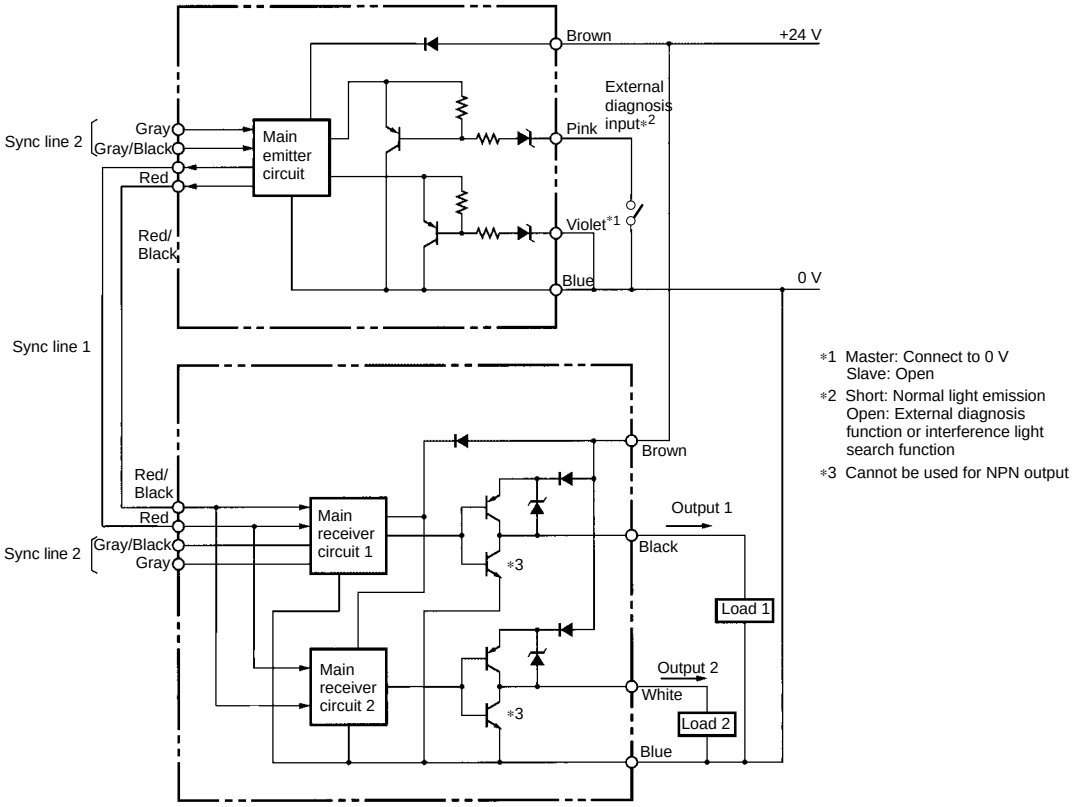
(Perpendicular to Center Line of Lenses)



Operation

■ CIRCUIT DIAGRAM

This reference diagram focuses on internal circuitry. External device connections indicate functions available, and are not to be used for installation.

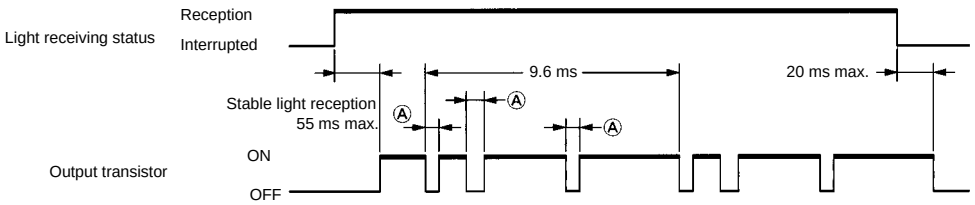


■ TIME CHART

The output transistor will be OFF for a maximum of 210 μs, as shown in the following table, in order to perform output circuit self-diagnosis when the Light Curtain is receiving light.

The width and number of OFF signals are determined by the number of Light Curtains connected in series. (See the table below.)

Check the input response time of a machine connected to the F3S-A carefully to ensure the machine will not malfunction due to the OFF signal.



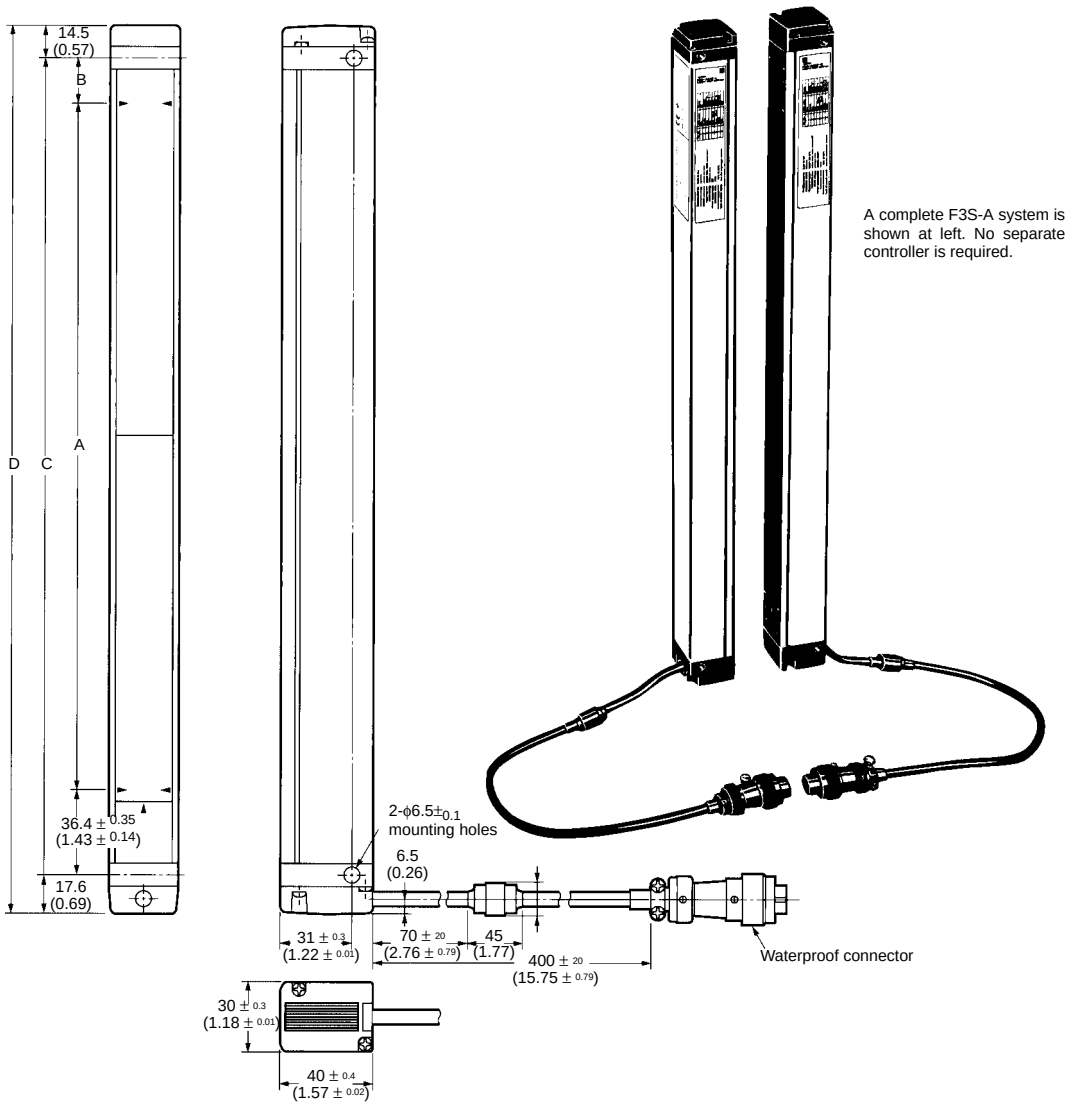
Number of Light Curtains connected in series	1	2	3
Number of pulses per 9.6 ms (number of **A**)	3 to 4	6 to 8	9 to 12
Pulses width at **A** (μs)	35 to 70	35 to 140	35 to 210
Total sum of pulse widths per 9.6 ms (sum of **A**: μs)	200 max.	400 max.	600 max.

Dimensions

Unit: mm (inch)

■ SAFETY LIGHT CURTAINS

F3S-A

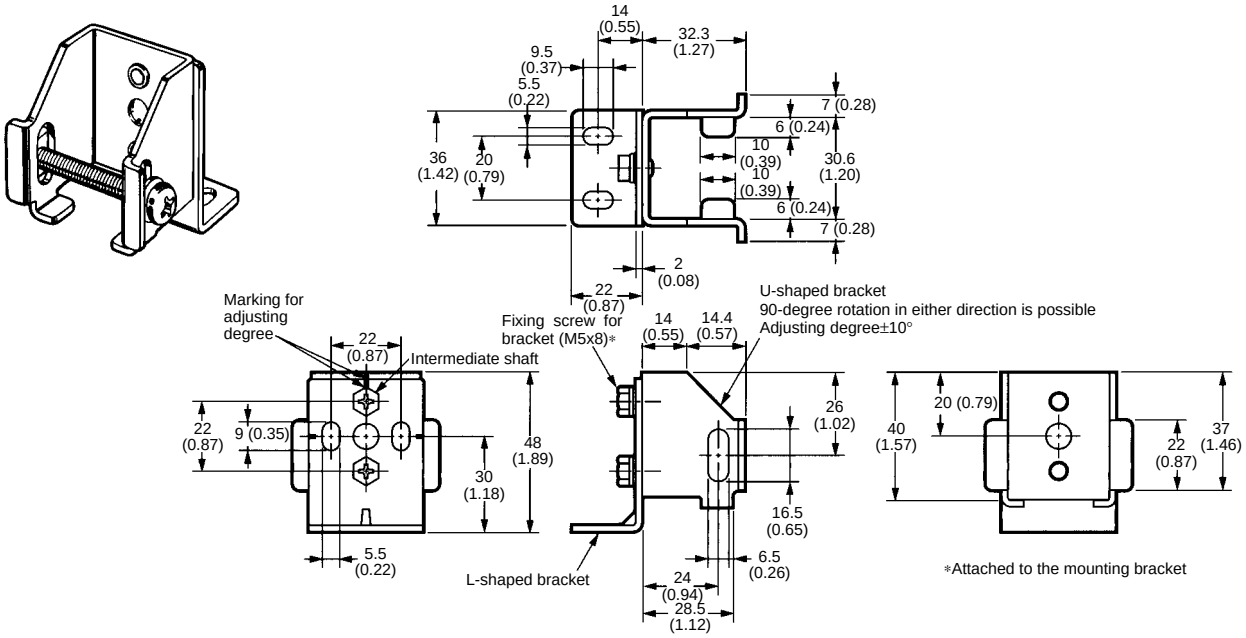


Part number	A (Protective height)	B	C (Light Curtain mounting hole center width)	D (Full length)
F3S-A161	150 ±0.3 (5.91)	10 ±0.5 (0.39 ±0.02)	196.4 ±0.55 (7.73 ±0.02)	228.5 ±1.15 (9.00 ±0.05)
F3S-A321	310 ±0.4 (12.20)		356.4 ±0.65 (14.03 ±0.03)	388.5 ±1.25 (15.30 ±0.05)
F3S-A481	470 ±0.5 (18.50)		516.4 ±0.75 (20.33 ±0.03)	548.5 ±1.35 (21.60 ±0.05)
F3S-A082	140 ±0.3 (5.51)	20 ±0.5 (0.79 ±0.02)	196.4 ±0.55 (7.73 ±0.2)	228.5 ±1.15 (9.00 ±0.05)
F3S-A162	300 ±0.4 (11.81)		356.4 ±0.65 (14.03 ±0.03)	388.5 ±1.25 (15.30 ±0.05)
F3S-A242	460 ±0.5 (18.11)		516.4 ±0.75 (20.33 ±0.03)	548.5 ±1.35 (21.60 ±0.05)
F3S-A322	620 ±0.6 (24.41)		676.4 ±0.85 (26.63 ±0.03)	708.5 ±1.45 (27.89 ±0.06)
F3S-A482	940 ±0.6 (37.01)		996.4 ±0.95 (39.23 ±0.04)	1,028.5 ±1.55 (40.49 ±0.06)

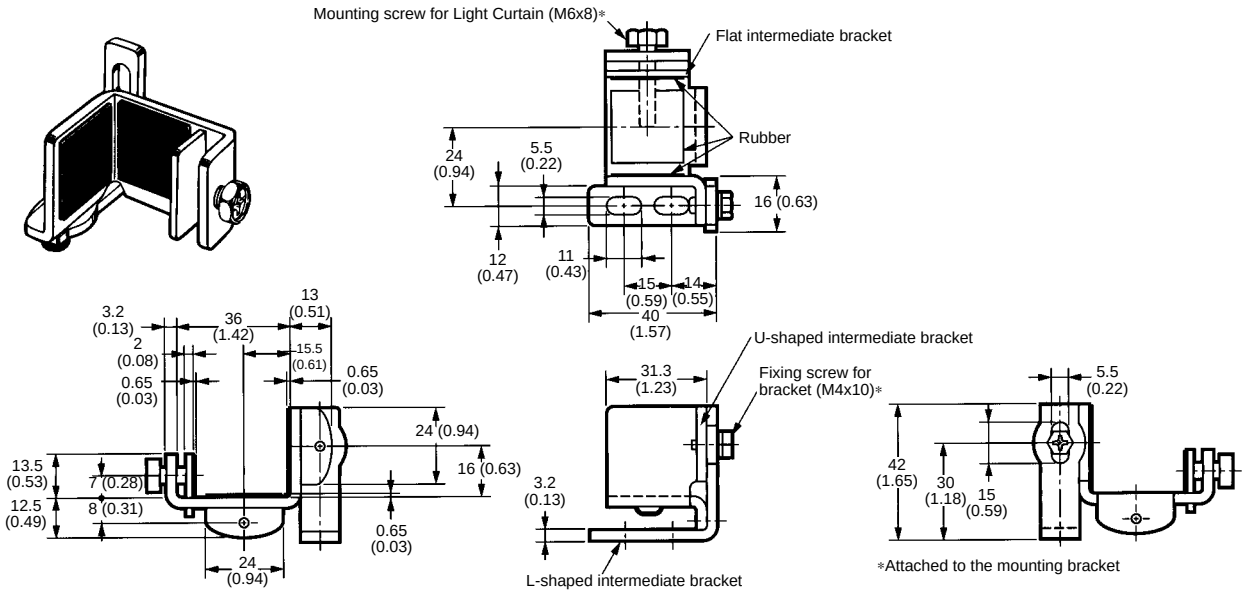
Unit: mm (inch)

■ MOUNTING BRACKETS

Mounting Brackets (Top and Bottom)



Mounting Brackets (Intermediate)
(Used with the F3S-A322 and F3S-A482 only)



Installation

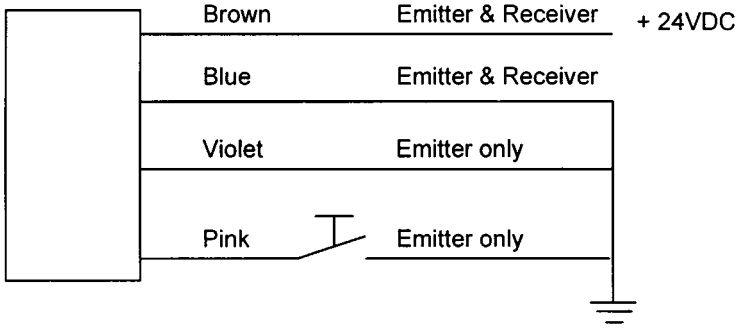
⚠ DANGER Before installing safety light curtain, read and follow directions in Installation Manual provided with product. If you do not have an installation Manual, do not proceed with installation until you have obtained it from Omron Electronics, Inc.

■ WIRING

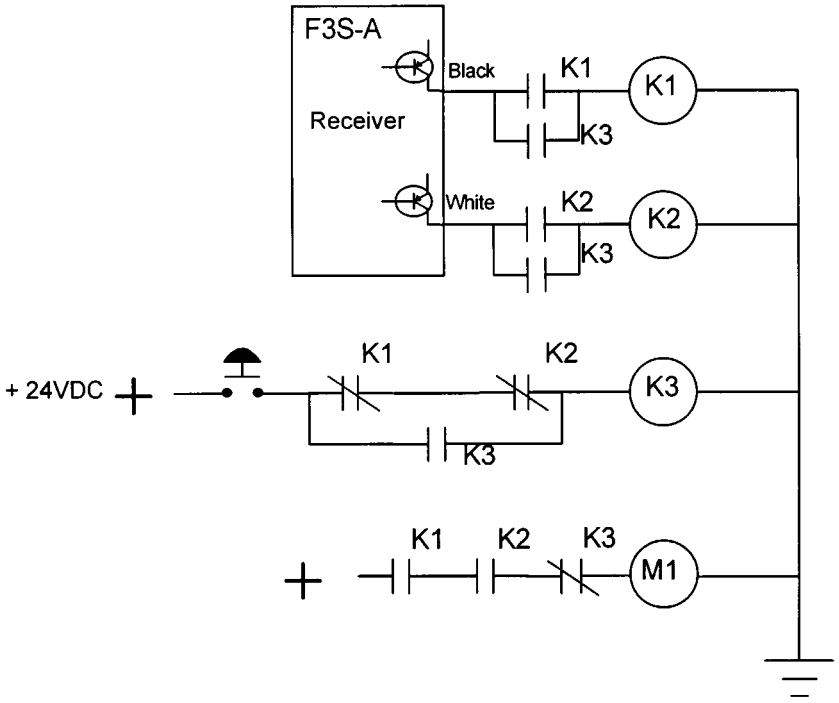
Use the following diagram to wire an interface to the light curtain.

F3S-A Safety Light Curtain Wiring Diagram

F3S-A Power Connections



Output connections

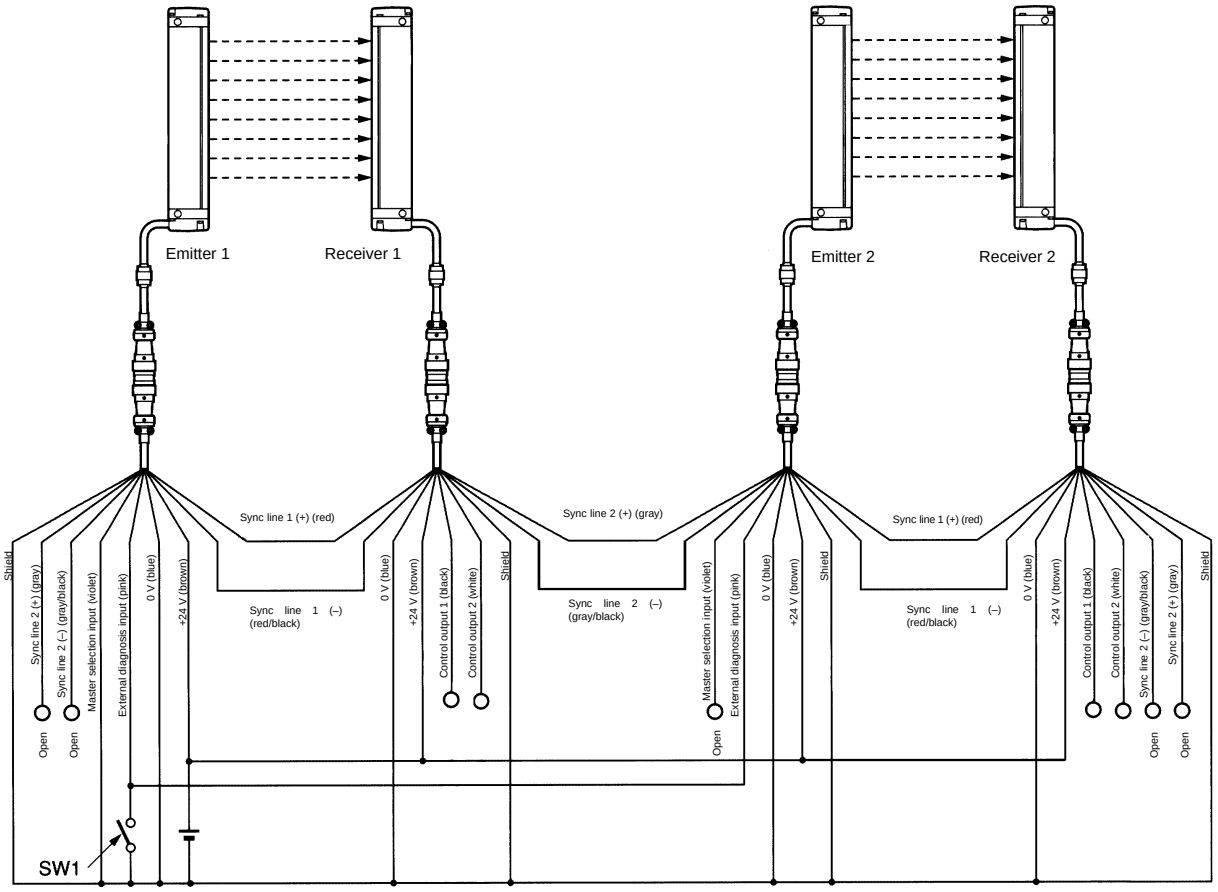


⚠ DANGER K1, K2 & K3 must be captive contact type safety relays. Serious injury or death may result if this type relay is not used.

Parallel Connection

⚠ DANGER Use the required interface with captive contact safety relays at the beginning of this section.

- When using 1 set only, connect F3S-A as shown as below. Emitter 1 and Receiver 1 (gray and gray/black are open).
- When connecting 3 sets or more in parallel, connect the gray and gray/black of Receiver 1 with those of Emitter 2, and connect others in the same way of Emitter 2 and Receiver 2 in the figure.
- When the external diagnosis input terminal (pink) is open, the external diagnosis function will be selected. When connecting it to 0 V, emission will begin.

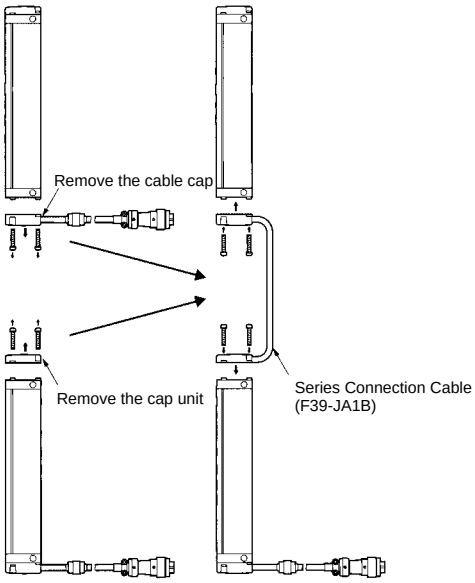


Note: SW1 is shorted for the normal operation and is open for the external diagnosis.

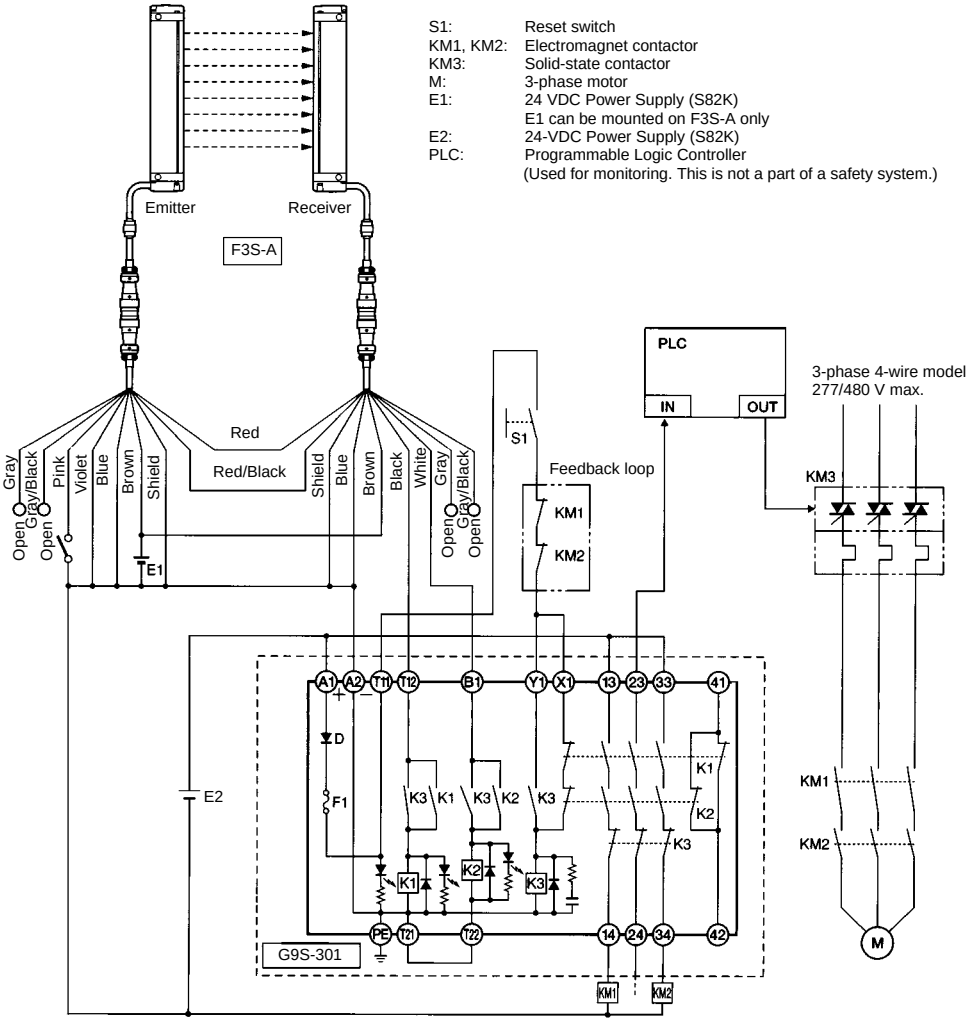
Series Connection

Connect the F3S-A as shown below with the optional Series Connection Cable (F39-JA1B).

⚠ DANGER Use the required interface with captive contact safety relays at the beginning of this section.

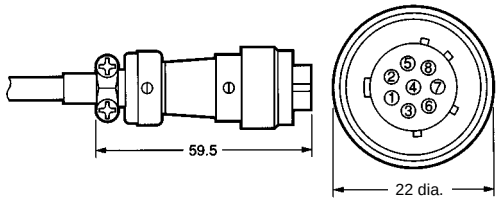


Connection Example with a G9S Safety Relay Unit



Note: When connecting, the Series Connection Cable (F39-JA□A) is useful.
Allocation of the pins of the main body is as shown below:

Connector



Pin no.	Signal name	
	Receiver	Emitter
1	0 V	0 V
2	24 V	24 V
3	Sync line 2 (+)	Sync line 2 (+)
4	Sync line 1 (+)	Sync line 1 (+)
5	Sync line 1 (–)	Sync line 1 (–)
6	Sync line 2 (–)	Sync line 2 (–)
7	Control output 2	Master selection input
8	Control output 1	External diagnosis input

Precautions

⚠ WARNING

Do not use the F3S-A on a machine that cannot be stopped by electrical control in an emergency.

■ CALCULATING THE SAFETY DISTANCE

⚠ WARNING

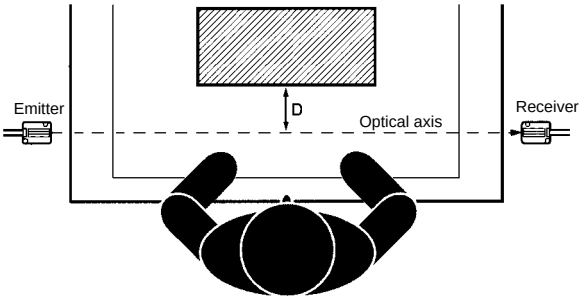
Always maintain a safety distance for industrial machines of prEN999 between the F3S-A and dangerous machine parts. Serious injury may result if equipment does not stop before someone reaches a dangerous part.

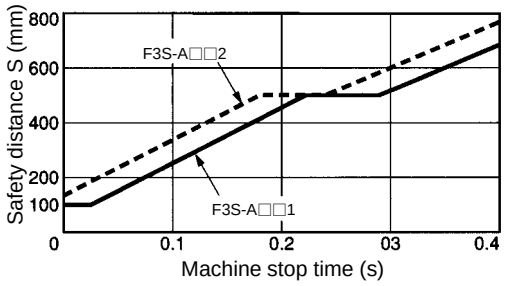
- Safety distance (D) is calculated by the following equations: The minimum distance is 100 mm (3.94 in).

  $D = 2{,}000 \times T + \alpha$ In the case of $D \leqq 500$ mm (19.69 in)

  $D = 1{,}600 \times T + \alpha$ In the case of $D > 500$ mm (19.69 in)

  Where, D = Safety distance (mm)
  T = Response time (Stop time of the machine + Response time of the F3S-A) (sec)
  α = 8 mm: 10 mm-pitch (Type F3S-A□□1)
  88 mm: 20 mm-pitch (Type F3S-A□□2)





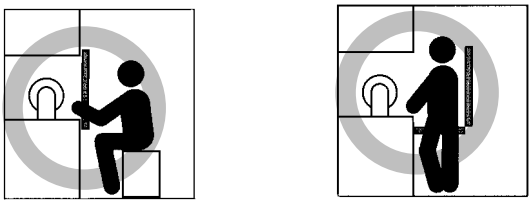
⚠ WARNING

Install the F3S-A so that you must pass through the detection zone to reach the dangerous machine parts.
Also install the F3S-A so that you must interrupt the axes to reach the dangerous machine parts.

■ INSTALL CORRECTLY

Correct Installation

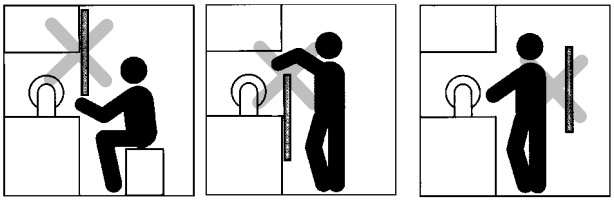
Dangerous machine parts can be reached only by passing through the F3S-A detection zone.



Incorrect Installation

Dangerous machine parts can be reached without passing through the F3S-A detection zone.

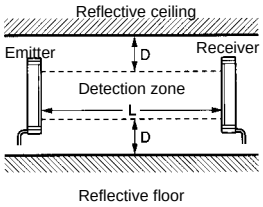
A worker is between the F3S-A detection zone and dangerous machine parts.



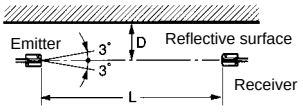
⚠ WARNING

Be sure to install the F3S-A to minimize the effects of reflections from reflective surfaces.
Failure to do so will cause detection to fail and may result in serious injury.

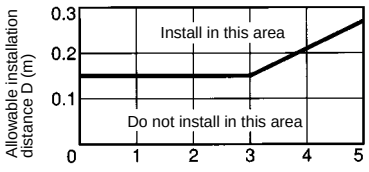
Side View



Top View



Allowable Distance from F3S-A to Reflective Surface



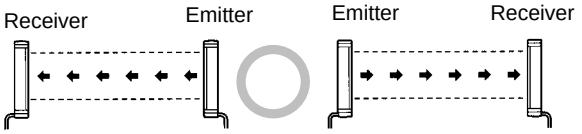
Distance between the emitter and receiver (detection distance L)	Allowable installation distance D
0.2 to 3 m (7.87 in to 9.84 ft)	0.16 m (6.30 in)
3 to 5 m (9.84 ft to 16.40 ft)	L x tan3° = L x 0.052 (m) (2.05 in)

■ CONFIGURATION WITHOUT CONNECTION

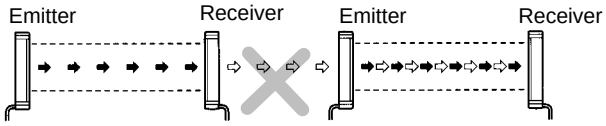
⚠ WARNING

When using multiple sets of the F3S-A, install them so that mutual interference is not incurred by connecting them with sync line or using a barrier.

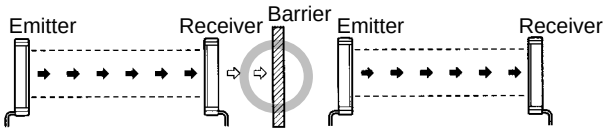
Correct Configuration



Interference from Another F3S-A



Countermeasure to Prevent Interference



■ INSTALLATION CONDITIONS

For your safety, always heed the following:

DC Power Supply Units Must Satisfy All These Conditions

- The power supply is connected to the F3S-A only and not to other devices or equipment.
- The power supply voltage is within the rating (24 VDC±10%).
- Wiring is conducted only after confirming polarities of the power supply.
- The power supply conforms to EMC Directive (industrial environment).
- The power supply conforms to Low-voltage Directive.
- The power supply uses double or reinforced insulation between the primary and secondary circuits.
- The power supply automatically resets overcurrent protection characteristics (voltage drop).
- The power supply maintains an output holding time of at least 20 ms.
- When using a commercially available switching regulator, make sure FG (frame ground terminal) is connected to PE (protective earth). Faulty operation caused by switching noise may result if the terminal is not connected.
- Use one of the following wiring configurations to reduce noise terminal voltage to the primary side of the power supply:
  - Connect the 0V line to PE (protective earth).
  - Mount a capacitor with a minimum 47-nF capacity and minimum 630 V voltage rating between the 0V line and PE.
- Recommended Power Supplies: S82K, S82J, S82F or S82-P made by OMRON.

Load Must Satisfy All These Conditions

- Is not shorted.
- Does not use current higher than the rating.
- Is double insulated to protect the load from hazardous voltage levels when the load is a relay.

Correct Use

Failure to observe the following items may result in F3S-A damage, deterioration, or improper operation.

Installation Environment

Do not install the F3S-A in the following environments:

- Areas exposed to intense interference light such as direct sunlight.
- Areas with high-humidity where condensation is likely to occur.
- Areas exposed to corrosive gases.
- Areas exposed vibration or shock levels higher than specification provisions.
- Areas exposed to contact with water.

Do not use cellular phones or transceivers near the F3S-A.

Wiring and Mounting

- Be sure to turn OFF the power prior to wiring, or the diagnostic function may prevent the F3S-A from operating.
- Be sure to use shielded twisted-pair cables (cross-section at least 0.2 mm^2 in diameter) when extending the sync line without using an F39-JA□A Series Connection Cable. Connect the shield to 0 V line.
- When using resin or other connectors in place of the unit's metal connector, make sure the conductor path in the connector is rated IP54 or higher.
- Check signal names for all terminals and wire terminals correctly.
- When using two or more F3S-A sets, be sure to connect a sync line and turn ON all power supplies at the same time (within 0.5 s). Never exceed specifications for the total number of sets and total number of the optical beams (up to 192 beams).
- The F3S-A will start operating in five seconds after the power is turned ON. Make sure that no faulty operation will occur in the control system.
- Once power is turned ON, do not turn it OFF again before the F3S-A becomes operational (LED indicator lights).
- Be sure to route F3S-A wires separated from high-potential power lines or to route through an exclusive conduit.
- Make sure the emitter and receiver are facing the proper direction.
- Use the interference light search function for no longer than 8 hours from startup, or the F3S-A will switch to OFF-hold condition (stop due to temporary failure).
- Use the emitter and receiver packed with the F3S-A and install them opposite to each other.

NOTE: DIMENSIONS SHOWN ARE IN MILLIMETERS. To convert millimeters to inches divide by 25.4.

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