OMRON

Safety Light Curtain

F3S-A

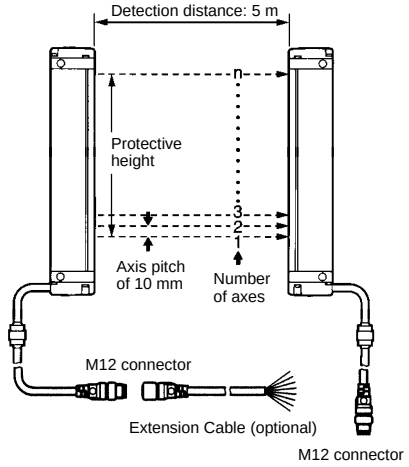
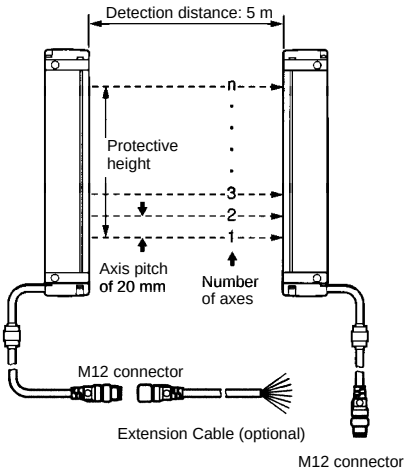
Safety Design of the Highest Level. Suitable for Detecting Human Bodies in a Dangerous Area.

- Compliance with IEC, EN, and UL standards. Applicable for use in USA, Canada, and Europe.
- Suitable for use with high-risk machines. Received certificates from Notified Bodies as Type 4 ESPE. Suitable for use with machines subject to OSHA and ANSI.
- Pursuing safety with the highest level of safety design and FMEA
- Flexible configuration: series connection of front, top, and rear sides
- No risk of mutual interference. Wire up to 4 sets in parallel.
- Axis pitch of 10 mm (finger protection) or 20 mm (hand protection), protective height of 140 to 940 mm
- Human body detection system without a dedicated control box
- M12 Connector adopted.
- F3S-A402P (40 optical-axis model) added to series.

Sense Different,
Make Difference!

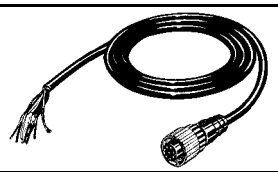
Ordering Information

■ Safety Light Curtains

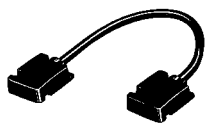
Shape, detection distance	Optical -axis pitch	Optical resolu-tion	No. of optical axes (n)	Protective height	Model
	10 mm	15 mm diameter	16	150 mm	F3S-A161P
			32	310 mm	F3S-A321P
			48	470 mm	F3S-A481P
	20 mm	25 mm diameter	8	140 mm	F3S-A082P
			16	300 mm	F3S-A162P
			24	460 mm	F3S-A242P
			32	620 mm	F3S-A322P
			40	780 mm	F3S-A402P
			48	940 mm	F3S-A482P

■ Accessories (Optional)

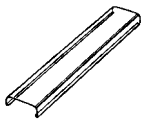
Extension Cable (Emitter and Receiver Set)

Appearance	Cable length	Specification	Model
	3 m	M12 connector	F39-JA1C
	7 m		F39-JA2C
	10 m		F39-JA3C

Series Connection Cable (Emitter and Receiver Cables, 1 Each Forms a Set)

Appearance	Cable length	Model
	200 mm	F39-JA1B

Protective Cover (includes two pieces for Emitter and Receiver)

Appearance	Applicable Models	Model
 Material: Acrylic	F3S-A161P, F3S-A082P	F39-HA1
	F3S-A321P, F3S-A162P	F39-HA2
	F3S-A481P, F3S-A242P	F39-HA3
	F3S-A322P	F39-HA4
	F3S-A482P	F39-HA5
	F3S-A402P	F39-HA6

Specifications

■ Ratings and Performance

Item	F3S-A161P	F3S-A321P	F3S-A481P	F3S-A082P	F3S-A162P	F3S-A242P	F3S-A322P	F3S-A402P	F3S-A482P
No. of optical axes	16	32	48	8	16	24	32	40	48
Protective height	150 mm	310 mm	470 mm	140 mm	300 mm	460 mm	620 mm	780 mm	940 mm
Optical-axis pitch	10 mm			20 mm					
Optical resolution	Opaque: 15 mm min. diameter			Opaque: 25 mm min. diameter					
Detection distance	0.2 to 5.0 m								
Response time	ON→OFF: 20 ms max. (release time), OFF→ON: 55 ms max. (with stable light incident)								
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)								
Effective aperture angle	Within±2° for the emitter and receiver at a detection distance of at least 3 m as provided by IEC61496-2.								
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 cable extension)								
Mutual interference interrupting function	Time-sharing light emitting system 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 optical axes: Up to 192 axes (with mixed serial and parallel connection)								
External diagnosis function (see note 1)	After power ON When external diagnosis input line is open or 9 to 24 V: Emitting OFF When external diagnosis input line is 0 to 1.5 V: Emitting ON (3 mA max. short-circuit current)								
Interference light search function (see note 1)	Prior to power ON When external diagnosis input line is open or 9 to 24 V: Interference light search When external diagnosis input line is 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. 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-mounted cable, Length: 400 mm								
Protection circuit	Output short-circuit protection								
Ambient temperature	During operation: –10° to 55°C (with no freezing) During storage: –30° to 70°C								
Ambient humidity	During operation: 35 to 85% RH (with no condensation) During storage: 35 to 95% RH								
Ambient light intensity	Incandescent lamps: 3,000 lx max. (receiver surface light intensity) Sunlight: 10,000 lx max. (receiver surface light intensity)								

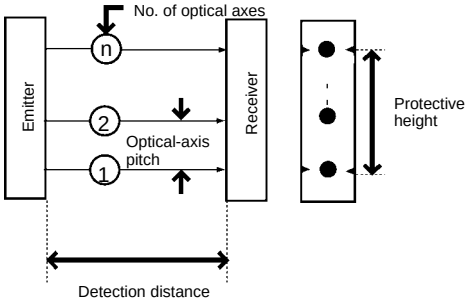
Item	F3S-A161P	F3S-A321P	F3S-A481P	F3S-A082P	F3S-A162P	F3S-A242P	F3S-A322P	F3S-A402P	F3S-A482P
Insulation resistance	20 MΩ min. (at 500 VDC)								
Dielectric strength voltage	1,000 VAC 50/60 Hz for 1 min								
Degree of protection	IEC60529 IP64								
Vibration resistance	Durability: 10 to 55 Hz, double-amplitude: 1.5 mm, X, Y and Z directions: 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, X, Y and Z directions: 3 times Operation limit: 100 m/s^2, X, Y and Z directions: 1,000 times (see note 3)								
Cable (see note 4)	Emitter and receiver: 8 cores (0.3 mm^2 x 4 cores, 0.2 mm^2 x 4 cores), external dimension: 6 mm in diameter with spiral shield, allowable bend radius R36 mm								
Materials	Case: Aluminum Front cover: PMMA (acrylic resin) Cable: PVC								
Accessories	Test rod, mounting brackets (top and bottom), mounting brackets (intermediate) for the F3S-A322P and F3S-A482P only, Instruction Manual								
Applicable standard	IEC61496-1 ESPE TYPE 4 EN61496-1 ESPE TYPE 4 IEC61496-2 AOPD TYPE 4								

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 IEC61496-1

4. The optional extension cable provides the same performance.
(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.



■ Standards Applicable to the Use of F3S-A

US Standards

OSHA 29 CFR 1910.212
OSHA 29 CFR 1910.217
ANSI B11.1 to B11.19
ANSI/RIA 15.06

EN Standard

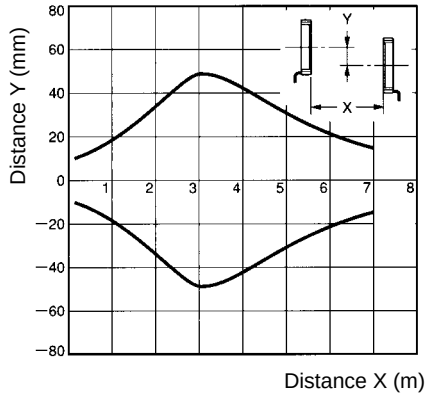
EN954-1 Category B, 1, 2, 3, 4

Engineering Data

■ Operating Range

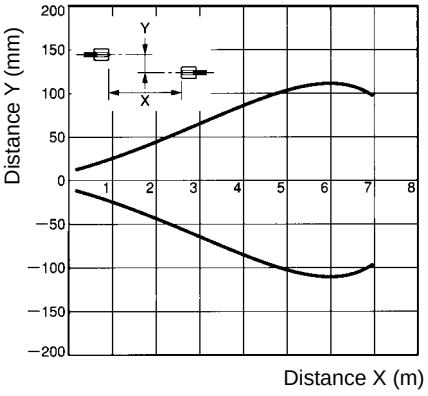
F3S-A481P (10-mm pitch)

(Parallel to Center Line of Lenses)



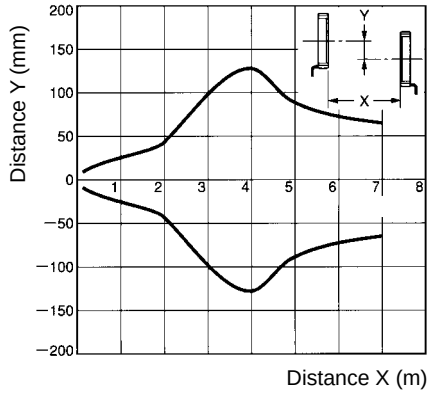
F3S-A481P (10-mm pitch)

(Perpendicular to Center Line of Lenses)



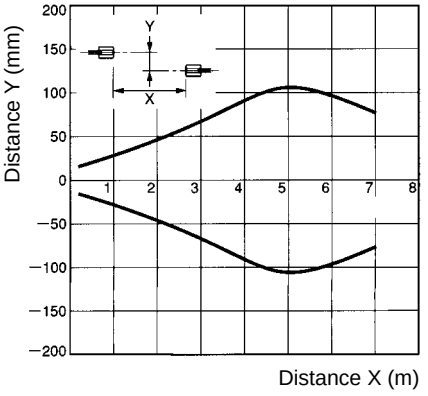
F3S-A482P (20-mm pitch)

(Parallel to Center Line of Lenses)



F3S-A482P (20-mm pitch)

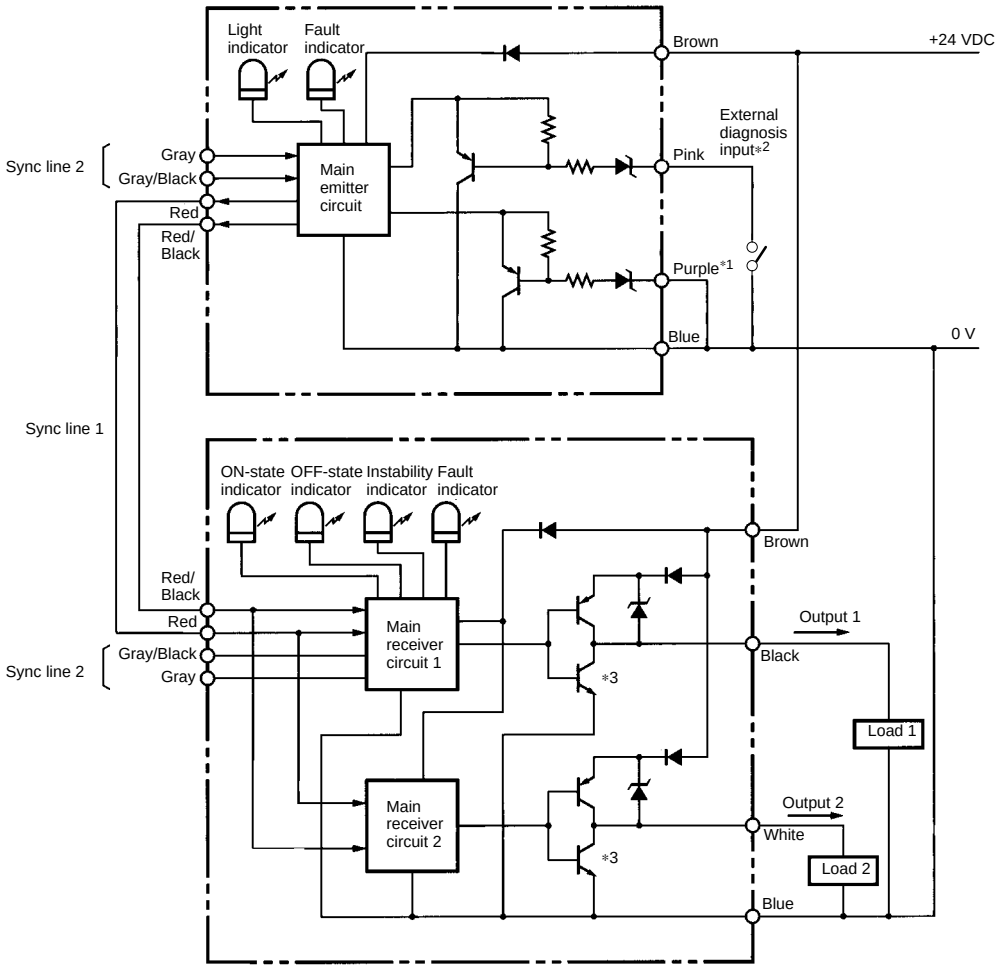
(Perpendicular to Center Line of Lenses)



Operation

■ I/O Circuit

Circuit Diagram



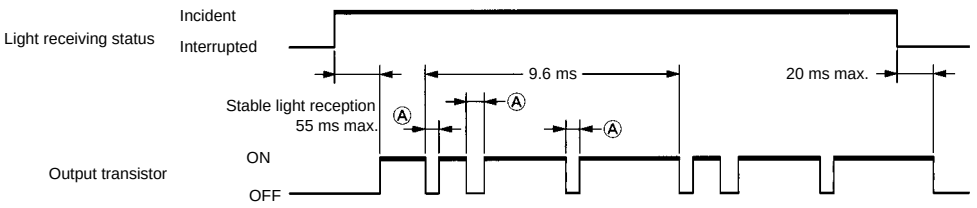
*1 Master: Connect to 0V
Slave: Open
*2 Short: Normal light emission
Open: External diagnosis function or interference light search function
*3 Cannot be used as NPN output

■ 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.



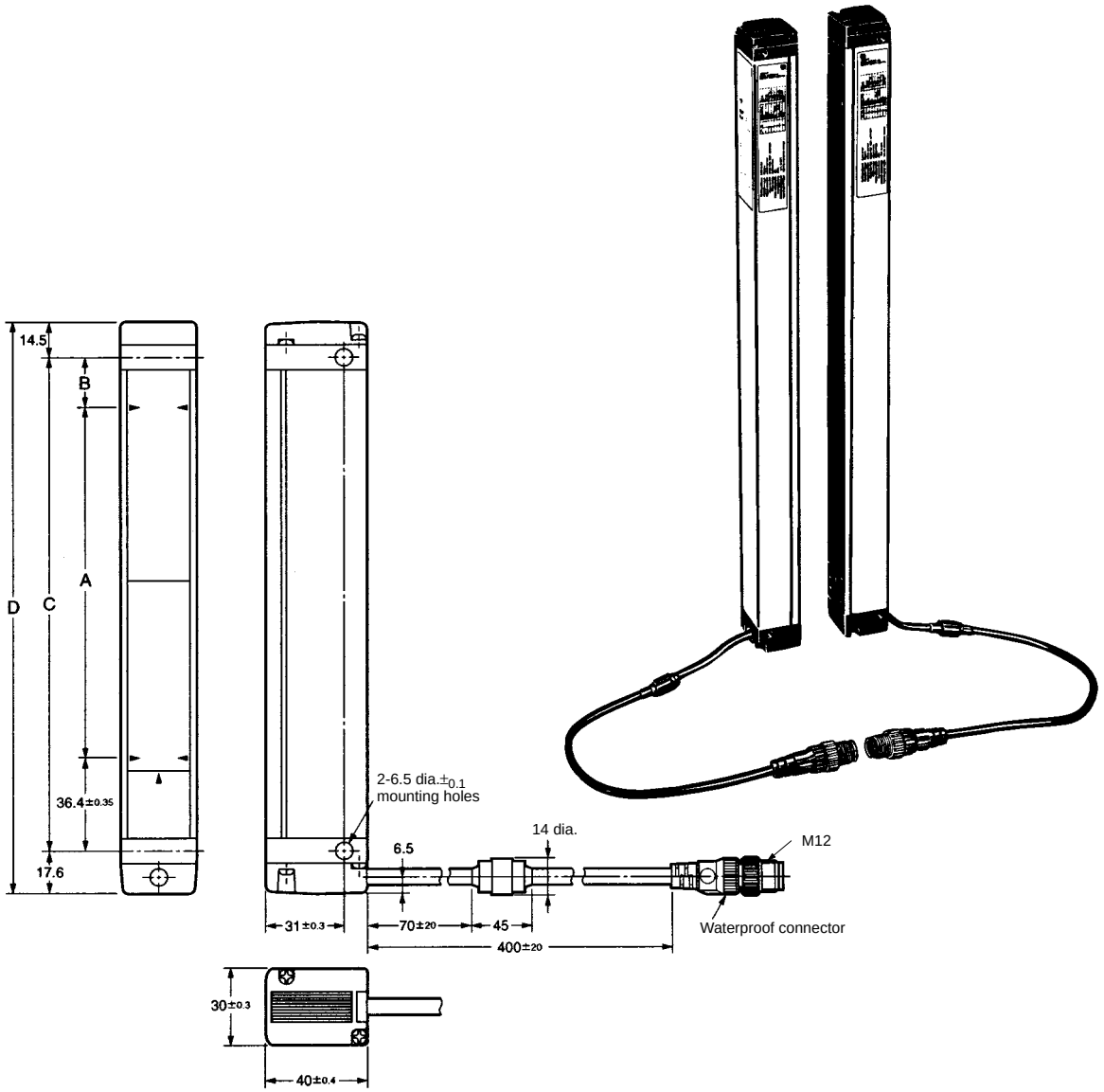
Number of Light Curtains connected in series	1	2	3
Number of pulses per 9.6 ms (number of Ⓐ)	3 to 4	6 to 8	9 to 12
Pulses width at Ⓐ (μs)	35 to 70	35 to 140	35 to 210
Total sum of pulse widths per 9.6 ms (sum of Ⓐ: μs)	200 max.	400 max.	600 max.

Dimensions

Note: All units are in millimeters unless otherwise indicated.

■ Safety Light Curtains

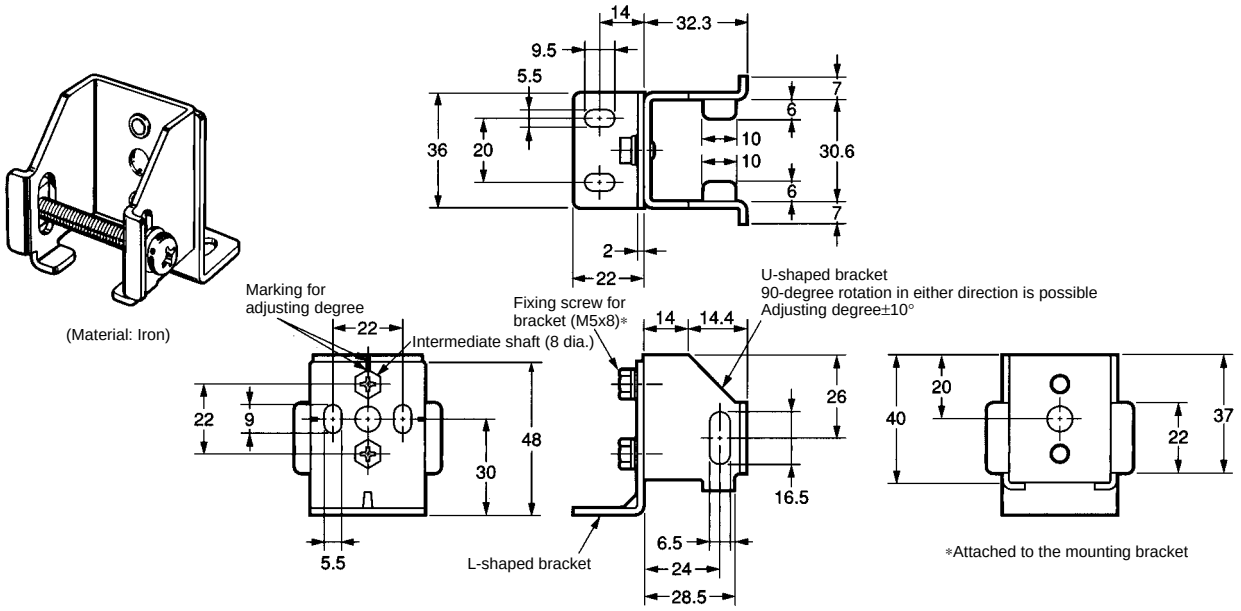
F3S-A



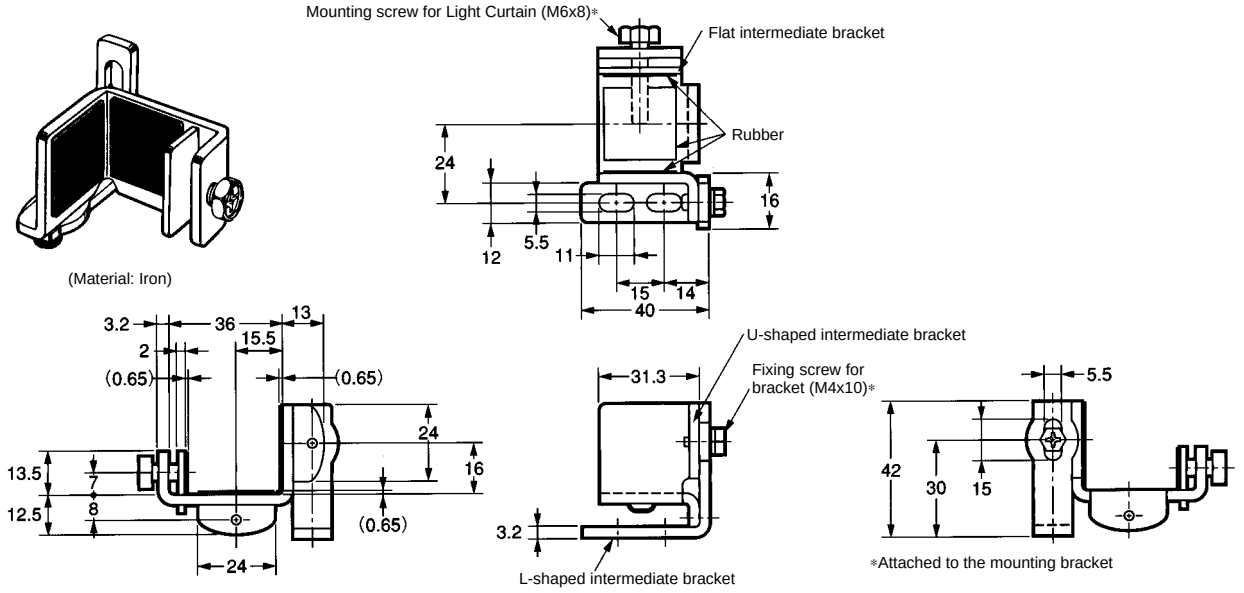
(Unit: mm)

Type	A (Protective height)	B	C (Light Curtain mounting hole center width)	D (Full length)
F3S-A161P	150±0.3	10±0.5	196.4±0.55	228.5±1.15
F3S-A321P	310±0.4		356.4±0.65	388.5±1.25
F3S-A481P	470±0.5		516.4±0.75	548.5±1.35
F3S-A082P	140±0.3	20±0.5	196.4±0.55	228.5±1.15
F3S-A162P	300±0.4		356.4±0.65	388.5±1.25
F3S-A242P	460±0.5		516.4±0.75	548.5±1.35
F3S-A322P	620±0.6		676.4±0.85	708.5±1.45
F3S-A402P	780±0.6		836.4±0.95	868.5±1.55
F3S-A482P	940±0.6		996.4±0.95	1,028.5±1.55

Mounting Brackets (Top and Bottom)

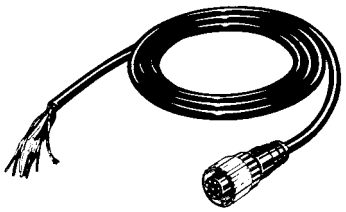


Mounting Brackets (Intermediate)
(Used with the F3S-A322P, F3S-A402P and F3S-A482P only)

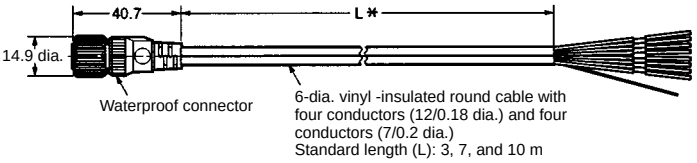


■ Accessories

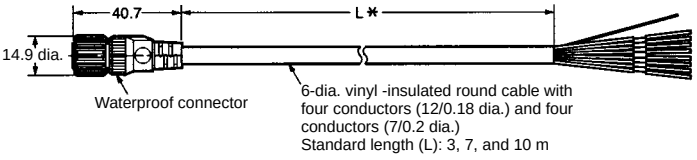
Extension Cables
F39-JA1C (L = 3 m)
F39-JA2C (L = 7 m)
F39-JA3C (L = 10 m)



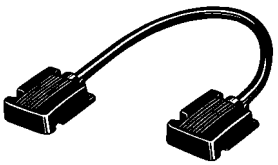
For Emitter

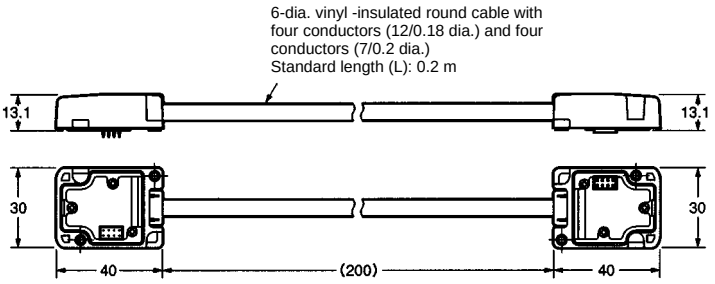


For Receiver

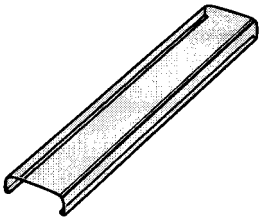


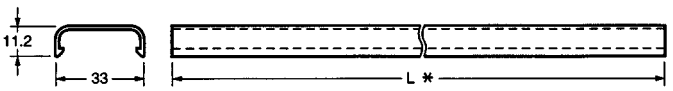
Series Connection Cable
F39-JA1B





Protective Covers
F39-HA1
F39-HA2
F39-HA3
F39-HA4
F39-HA5
F39-HA6





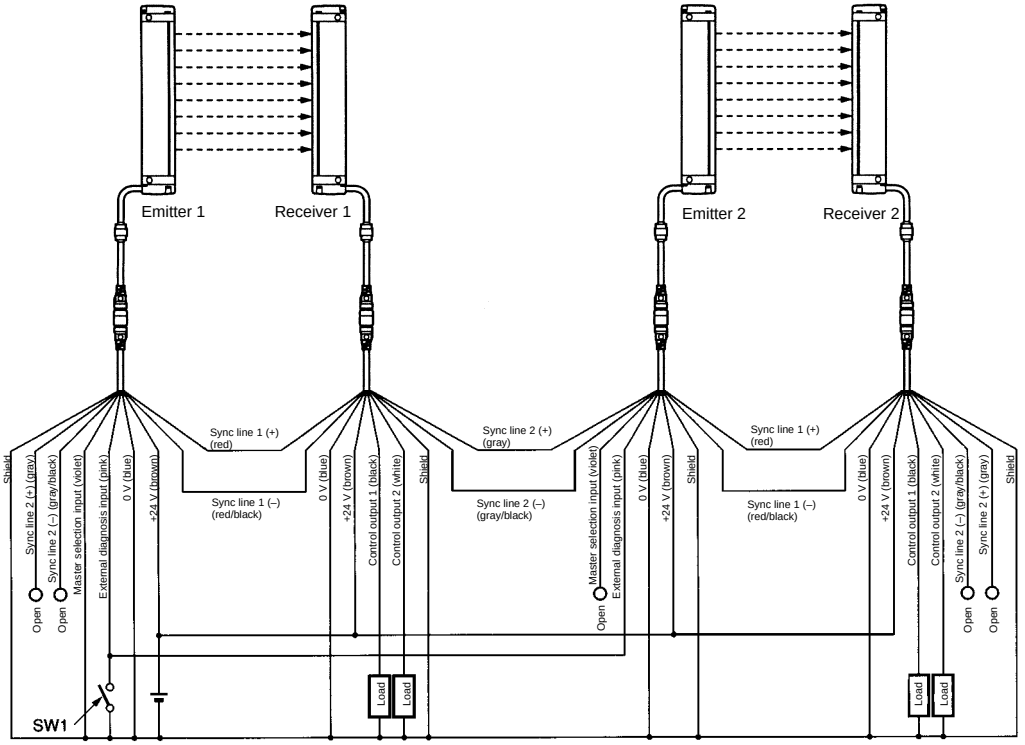
* L = 185 (F39-HA1)
L = 345 (F39-HA2)
L = 505 (F39-HA3)
L = 664 (F39-HA4)
L = 984 (F39-HA5)
L = 824 (F39-HA6)

Installation

■ Wiring

Parallel Connection

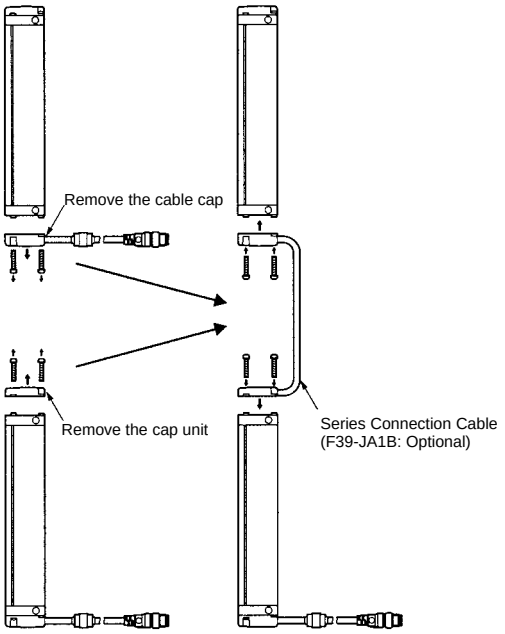
- When using 1 set only, connect F3S-A as shown as below, Emitter 1 and Receiver 1 (gray and gray/black are open).
- When connecting 3 sets or more in parallel, connect the gray and gray/black of Receiver 1 with these of Emitter 2, and connect others in the same way of Emitter 2 and Receiver 2 in the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



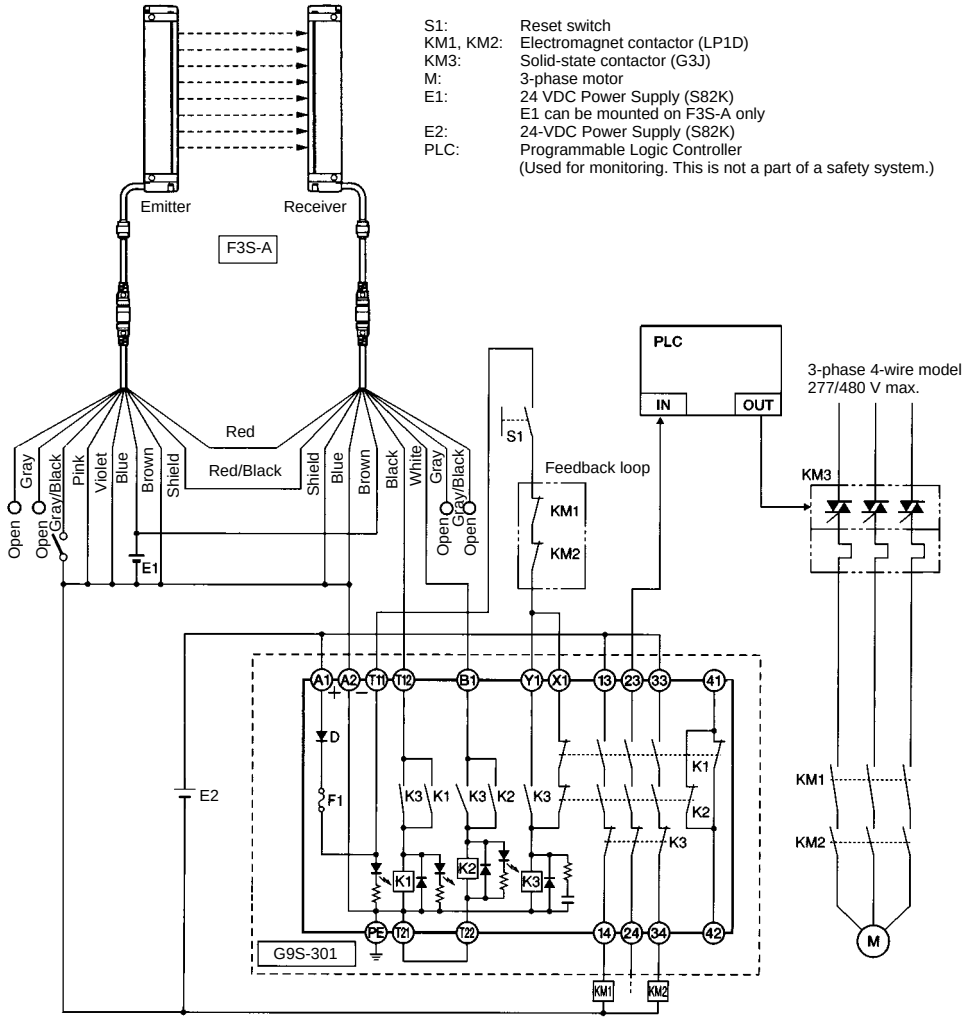
Note: SW1 is shorted for the normal operation and is open for the external diagnosis.

Series Connection

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

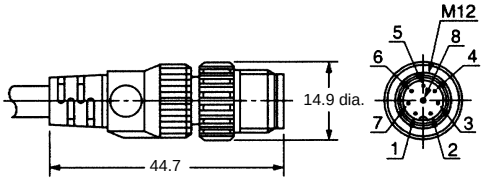


Connection Example with a G9S-301 Safety Relay Unit (Conforms to Category 4)



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

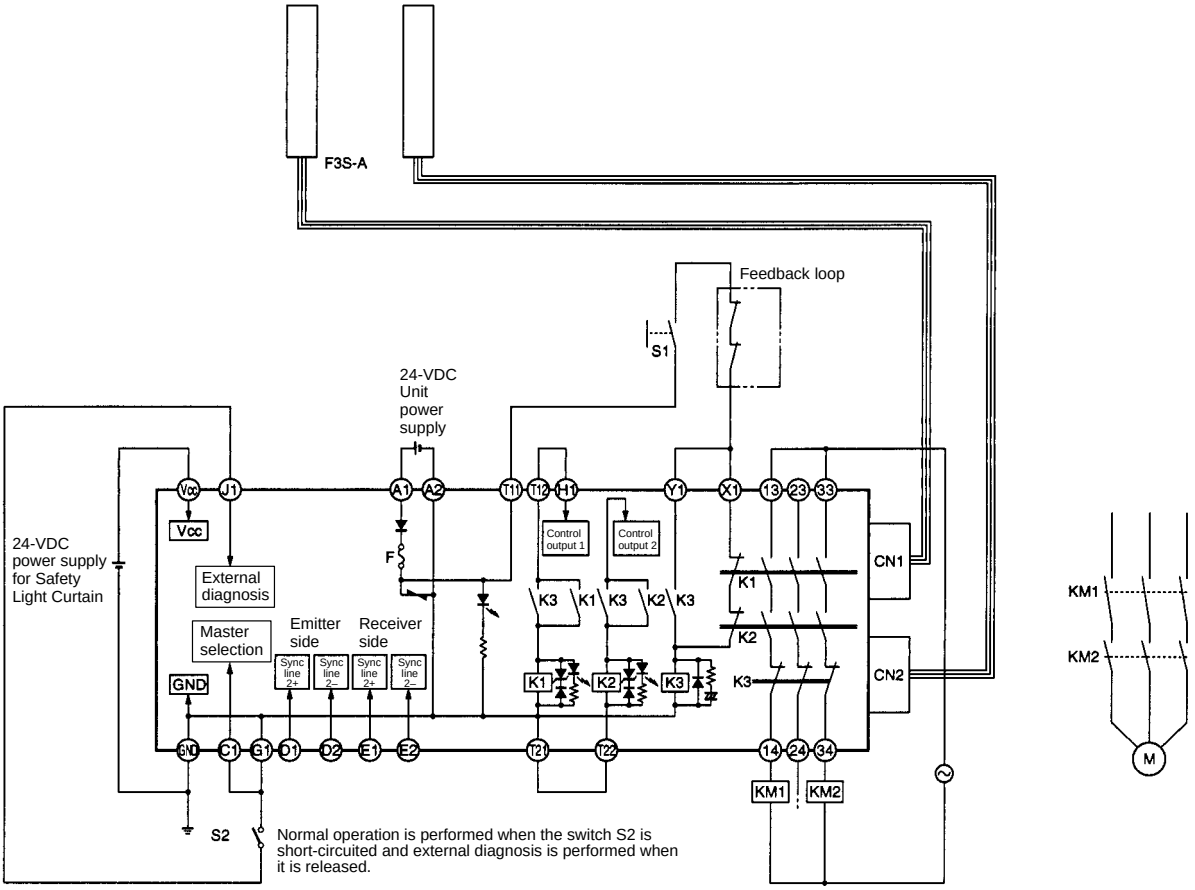
Connector (Main Unit End)



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

Note: Use the Extension Cable (F39-JA□C) that matches the connector connected to the F3S-A.

Connection Example with a G9SA-300-SC Safety Relay Unit (Conforms to Category 4)



F3S-A:	Safety Light Curtain
S1:	Reset switch (momentary action switch)
KM1 and KM2:	Magnetic Contactor
M:	3-phase motor

Precautions

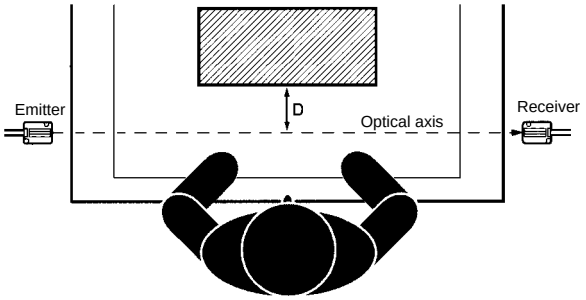
⚠ WARNING

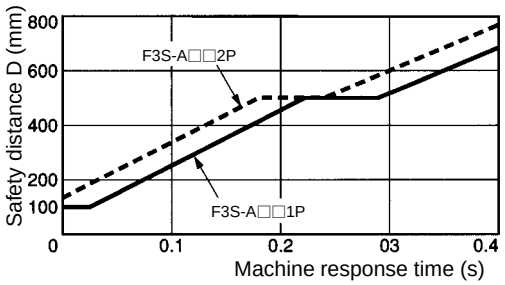
Do not use the F3S-A a machine that cannot be stopped by electrical control in an emergency.

⚠ WARNING

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

- The formula to calculate the safety distance varies with national regulations and individual machine standards.
  See related standards for details.
  One example of calculation using prEN999 is shown below.
  D = 2,000 x T + α (In the case of D ≦ 500 mm)
  D = 1,600 x T + α (In the case of D > 500 mm)
  (Minimum safety distance is 100 mm.)
  Where, D = Safety distance (mm)
  T = Response time (Response time of the machine + Response time of the F3S-A) (sec)
  α = 8 mm: 10 mm-pitch (Type F3S-A□□1P)
  88 mm: 20 mm-pitch (Type F3S-A□□2P)



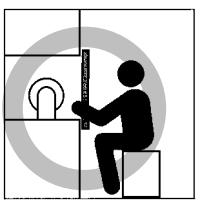


⚠ WARNING

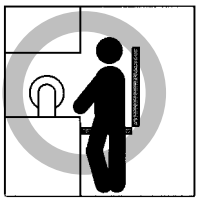
Install the F3S-A so that you must pass through the detection zone to reach the dangerous machine parts.
Also install the F3S-A so that you must interrupt the axes to reach the dangerous machine parts.

Correct Installation

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

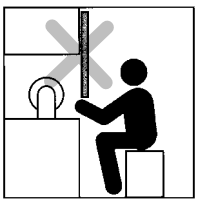


Some part of the operator's body remains in the detection zone while they are working.

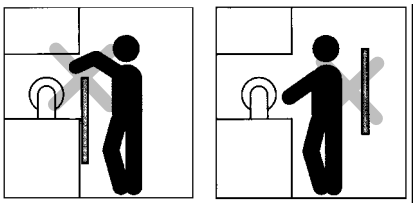


Incorrect Installation

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



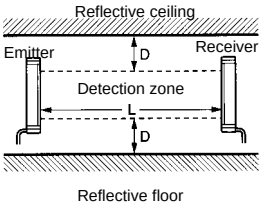
A worker is between the F3S-A detection zone and dangerous machine parts.



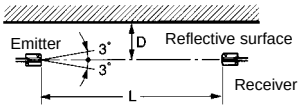
⚠ WARNING

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.

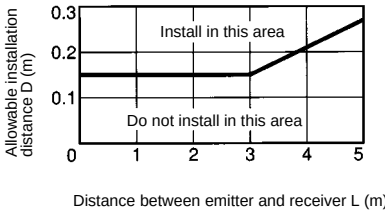
Side View



Top View



Allowable Distance from F3S-A to Reflective Surface



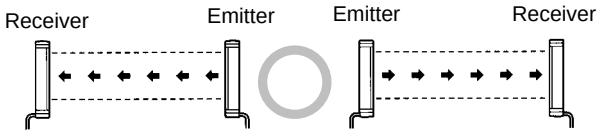
Distance between the emitter and receiver (detection distance L)	Allowable installation distance D
0.2 to 3 m	0.16 m
3 to 5 m	L x tan3° = L x 0.052 (m)

⚠ WARNING

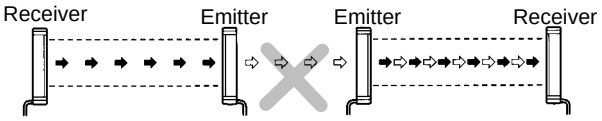
When using multiple sets of the F3S-A, install them so that mutual interference is not incurred by connecting them with sync line or using a barrier.

Configuration Without Connection

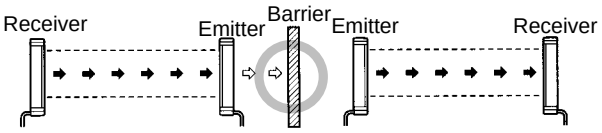
Correct Configuration



Interference from Another F3S-A



Countermeasure to Prevent Interference



Precautionary Notes

For your safety, always heed the following:

1. DC power supply units must satisfy all the conditions below.
   - 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 last 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.
2. Load must satisfy all the conditions below.
   - 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. Otherwise 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□C Extension Cable. Connect the shield to 0V 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 axes (up to 192 axes).

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 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, otherwise 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.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. D081-E1-3 **In the interest of product improvement, specifications are subject to change without notice.**

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