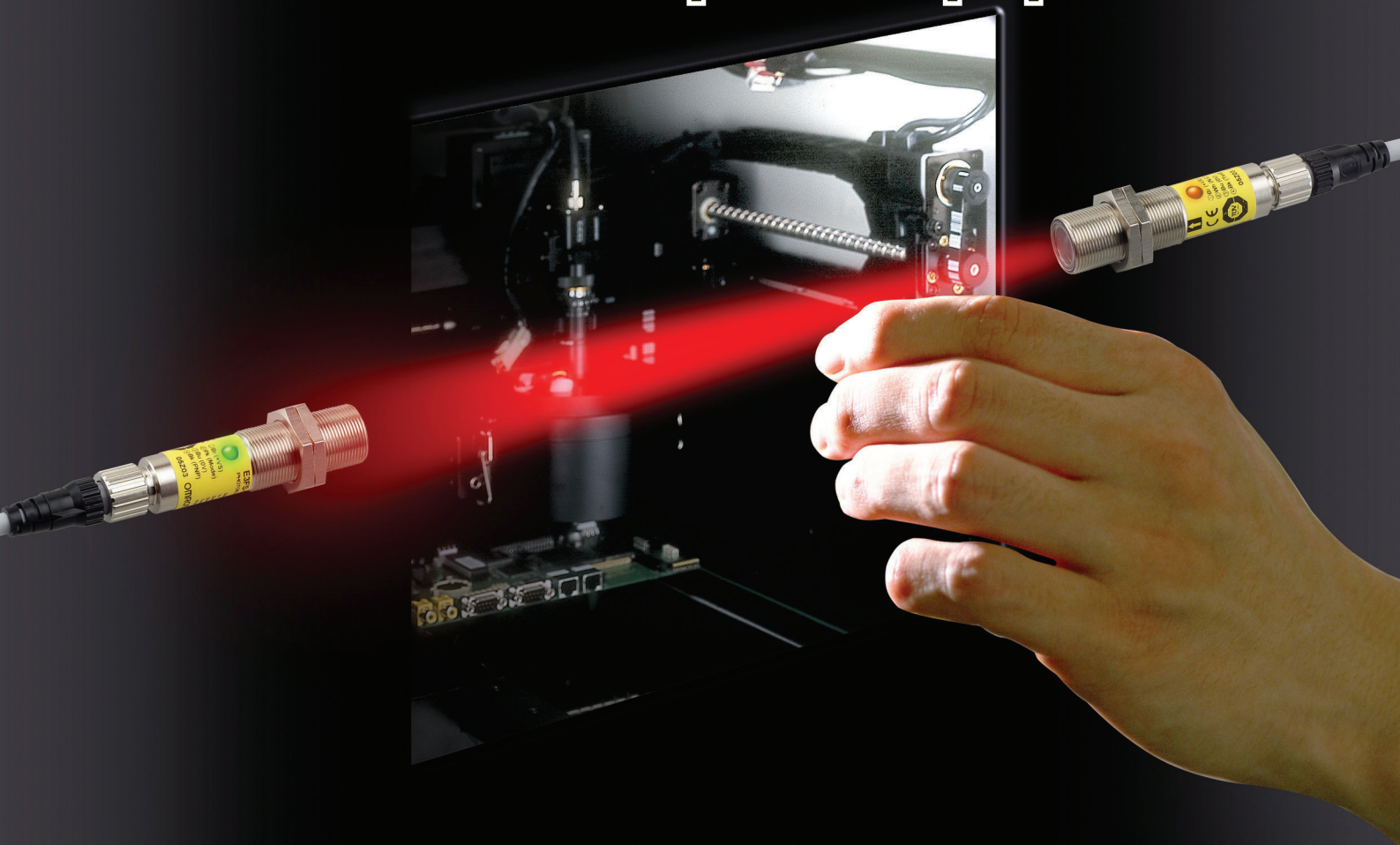


NEW

OMRON

Single-beam Safety Sensor
E3FS

Type 2 Safety Photoelectric Sensor for Hazardous Gaps in Equipment



Pending approval





For Hazardous Gaps in Equipment...

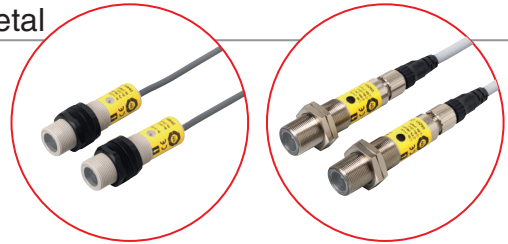
E3FS Features

- Type 2 Human Body Sensor for production equipment

- Be sure to use the E3FS Sensor with the F3SX Safety Controller.

- Sensor heads available in two types: ABS resin and metal

- Both types conform to IEC standards with IP67 degree of protection.



- Maximum sensing distance of 10 m



- Connect up to 4 E3FS Sensors per B1 Module to the F3SX Safety Controller

Note: The B1 Module is an input module for E3FS Sensors. It is made specifically for the F3SX Safety Controller. The safety output turns OFF when light is interrupted or when an error occurs for one or more E3FS Sensors connected to the B1 Module. T



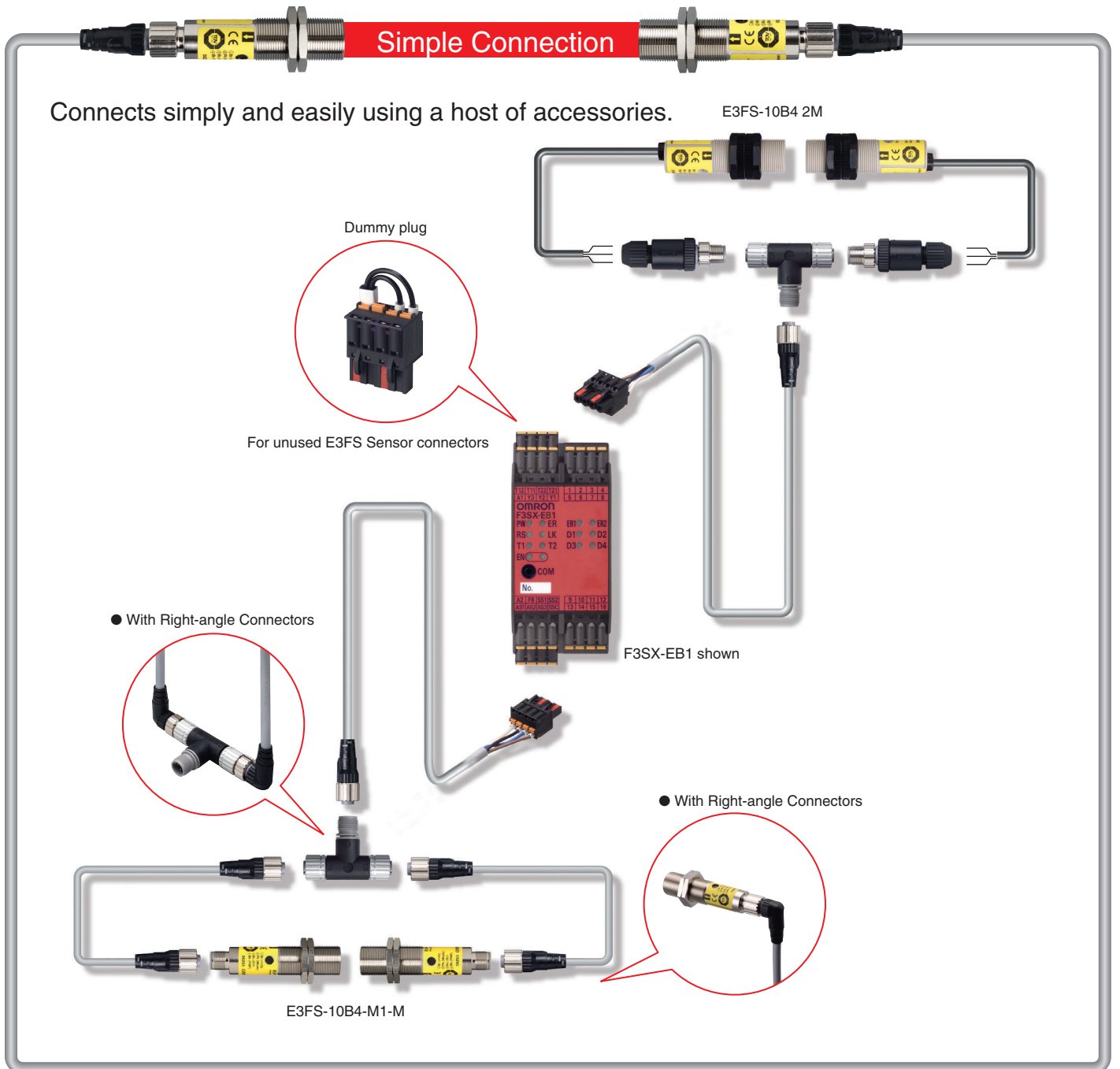
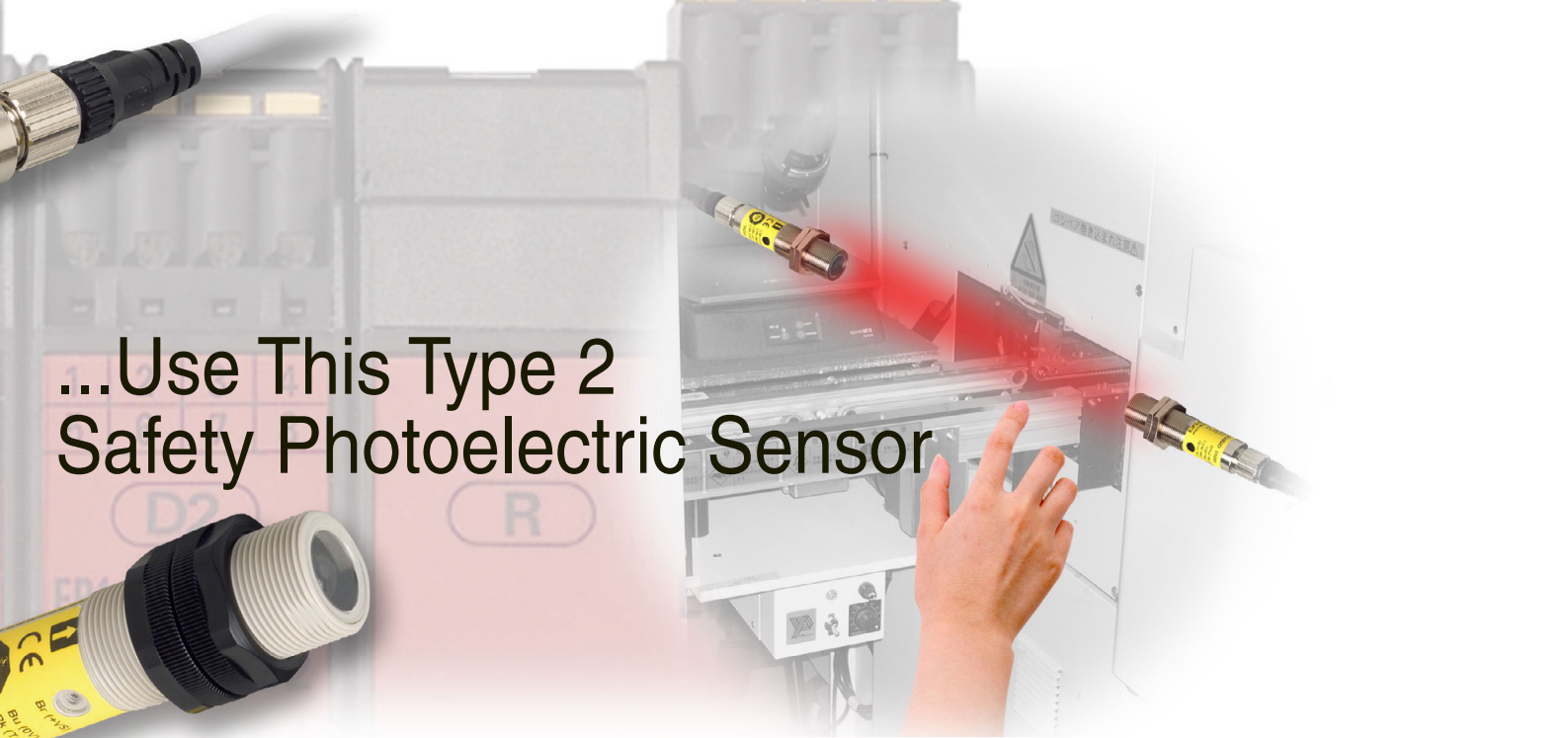
B1 Module for the F3SX
(F3SX-EB1 shown here)

- Connect up to 16 E3FS Sensors per Controller

- This is achieved using an F3SX-E-B1B1B1B1 (customized product).

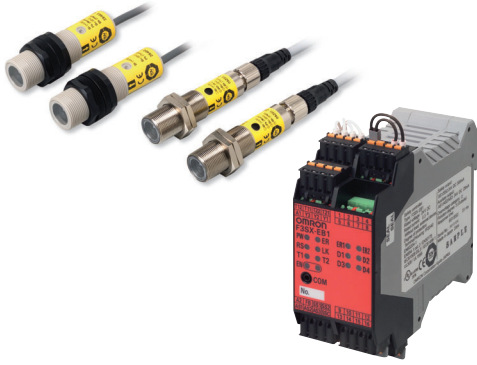
- Can be used in combination with Light Curtains, Door Switches, and other safety equipment

...Use This Type 2 Safety Photoelectric Sensor



Safety

Connects to the B1 Module of an F3SX Safety Controller to create a Type 2 Safety Sensor.



Conforms to IEC, EN, and other international safety standards for worry-free use in machinery and equipment headed for Europe.

Applicable Standards -----

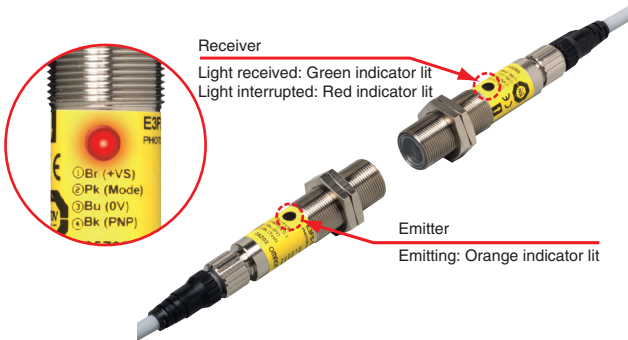
International standards: IEC61496-1 (type 2 ESPE)
IEC61496-2 (type 2 AOPD)
European standards: EN 61496-1 (type 2 ESPE)
prEN61496-1 (type 2 AOPD)



Easy to read

Conveniently located LED indicators are easier to read.

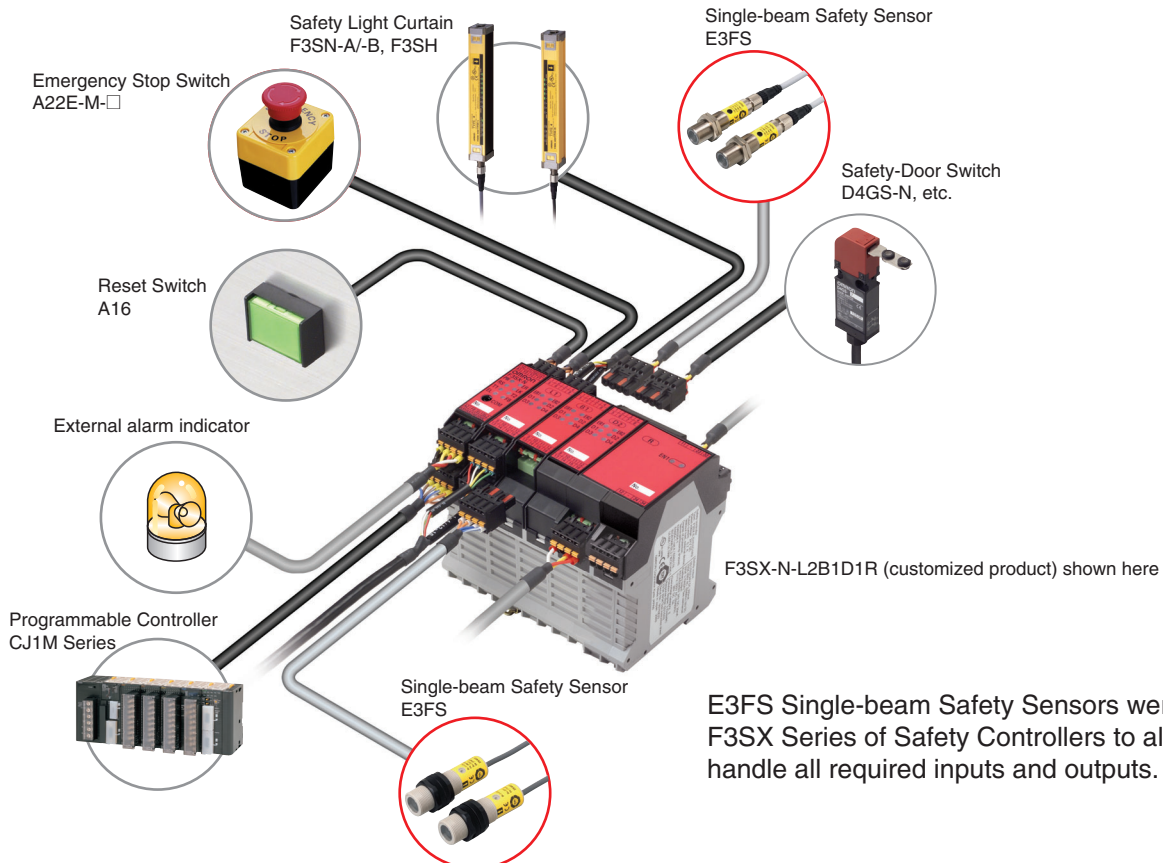
- Operating status can be verified from LED indicators on the Sensor.
- Operating status can be checked from LED indicators on the Controller.



ER1, ER2: Various error indications
Note: Refer to the F3SX operation manual for details on the lighting pattern of the error indicators.
D1: Lit when the first E3FS Sensor receives light
D2: Lit when the second E3FS Sensor receives light
D3: Lit when the third E3FS Sensor receives light
D4: Lit when the fourth E3FS Sensor receives light

An F3SX Dummy Plug (F39-CN4) must be connected to unused F3SX connectors. When a Dummy Plug is connected, the corresponding LED will be lit.

Configuration Example



E3FS Single-beam Safety Sensors were added to the F3SX Series of Safety Controllers to allow one unit to handle all required inputs and outputs.

Ordering Information

Sensors

Model	Output	Case material	Terminal
E3FS-10B4 2M	PNP	ABS resin	2-m cable
E3FS-10B4-M1-M		Brass	Connector

Controller

Instant Breaking Models

F3SX-N-□□□R (with Relay Safety Output)

Input types				Model	Width (W)	Weight
E3FS Safety Sensors	F3SN/F3SH Safety Light Curtains	Emergency Stop Switches	Door Switches			
4	---	1	---	F3SX-N-B1R	90.0 mm	Approx. 0.5 kg
4	---	1	2	F3SX-N-B1D1R	112.5 mm	Approx. 0.6 kg
4	---	1	4	F3SX-N-B1D1D1R	135.0 mm	Approx. 0.7 kg
4	2	1	---	F3SX-N-L2B1R	112.5 mm	Approx. 0.6 kg

Instant Breaking Models

F3SX-E-□□□ (with DC Solid-state Safety Output)

Input types				Model	Width (W)	Weight
E3FS Safety Sensors	F3SN/F3SH Safety Light Curtains	Emergency Stop Switches	Door Switches			
4	---	1	---	F3SX-EB1	45.0 mm	Approx. 0.3 kg
8	---	1	---	F3SX-E-B1B1	67.5 mm	Approx. 0.4 kg
4	---	1	2	F3SX-E-B1D1	67.5 mm	Approx. 0.4 kg
4	2	1	---	F3SX-E-L2B1	67.5 mm	Approx. 0.4 kg

Instant Breaking Models

F3SX-E-□□□R (with Relay Safety Output and DC Solid-state Safety Output)

Input types				Model	Width (W)	Weight
E3FS Safety Sensors	F3SN/F3SH Safety Light Curtains	Emergency Stop Switches	Door Switches			
4	---	1	---	F3SX-E-B1R	90.0 mm	Approx. 0.5 kg

OFF-delay Time Setting Models (Using Function Setup Software for the F3SX)

F3SX-N-□□□RR2 (with Relay Safety Output and DC Solid-state Safety Output)

Input types				Model	Width (W)	Weight
E3FS Safety Sensors	F3SN/F3SH Safety Light Curtains	Emergency Stop Switches	Door Switches			
4	---	1	2	F3SX-N-B1D1RR2	157.5 mm	Approx. 0.7 kg
4	2	1	---	F3SX-N-L2B1RR2	157.5 mm	Approx. 0.7 kg

OFF-delay Time Setting Models (Using Function Setup Software for the F3SX)


F3SX-E-□□□R2 (with Relay Safety Output and DC Solid-state Safety Output)

Input types				Model	Width (W)	Weight
E3FS Safety Sensors	F3SN/F3SH Safety Light Curtains	Emergency Stop Switches	Door Switches			
4	---	1	---	F3SX-E-B1R2	90.0 mm	Approx. 0.5 kg
4	---	1	2	F3SX-E-B1D1R2	112.5 mm	Approx. 0.6 kg
4	2	1	---	F3SX-E-L2B1R2	112.5 mm	Approx. 0.6 kg


The F3SX-series Safety Controller is a multiple input/single output Controller. This is useful for individual control over the safety output when using multiple safety input devices. Custom models are also available. Refer to the F3SX Safety Controller catalog (Cat. No. Z196) provided separately, and consult with your OMRON representative.

Accessories


Relay Connector for E3FS

Appearance	Model
	F39-CN3


Cables with Connectors on Both Ends for Relay Connector

Appearance	Model	Cable length
	F39-JF1S	1 m
	F39-JF2S	2 m
	F39-JF5S	5 m
	F39-JF10S	10 m

Dummy Plug for E3FS

Appearance	Model
	F39-CN4

Mounting Bracket

Appearance	Model
	Y92E-B18

Cables with Connectors (Socket and Plug) on Both Ends

Type	Cable connection direction	Cable length L (m)	DC	UL standard
			Model	
Standard cable	Straight/straight	1	XS2W-D421-C81-A	●
		2	XS2W-D421-D81-A	
		5	XS2W-D421-G81-A	
		10	XS2W-D421-J81-A	
	Right angle/right angle	2	XS2W-D422-D81-A	
		5	XS2W-D422-G81-A	
	Straight/right angle	2	XS2W-D423-D81-A	
		5	XS2W-D423-G81-A	
Right angle/straight	2	XS2W-D424-D81-A		
	5	XS2W-D424-G81-A		
Robot cable (vibration resistant)	Straight/straight	1	XS2W-D421-C81-R	---
		2	XS2W-D421-D81-R	
		5	XS2W-D421-G81-R	
		10	XS2W-D421-J81-R	

Note. Overall cable length for an E3FS Receiver connected to an E3FS Emitter through an F3SX must be within 50 m.

Cables with Connector (Socket) on One End

Type	Cable connection direction	Cable length L (m)	DC	UL standard
			Model	
Standard cable	Straight	1	XS2F-D421-C80-A	●
		2	XS2F-D421-D80-A	
		5	XS2F-D421-G80-A	
		10	XS2F-D421-J80-A	
	Right angle	1	XS2F-D422-C80-A	
		2	XS2F-D422-D80-A	
		5	XS2F-D422-G80-A	
		10	XS2F-D422-J80-A	
Robot cable (vibration resistant)	Straight	1	XS2F-D421-C80-R	---
		2	XS2F-D421-D80-R	
		5	XS2F-D421-G80-R	
		10	XS2F-D421-J80-R	
	Right angle	1	XS2F-D422-C80-R	
		2	XS2F-D422-D80-R	
		5	XS2F-D422-G80-R	
		10	XS2F-D422-J80-R	

Note. Overall cable length for an E3FS Receiver connected to an E3FS Emitter through an F3SX must be within 50 m.

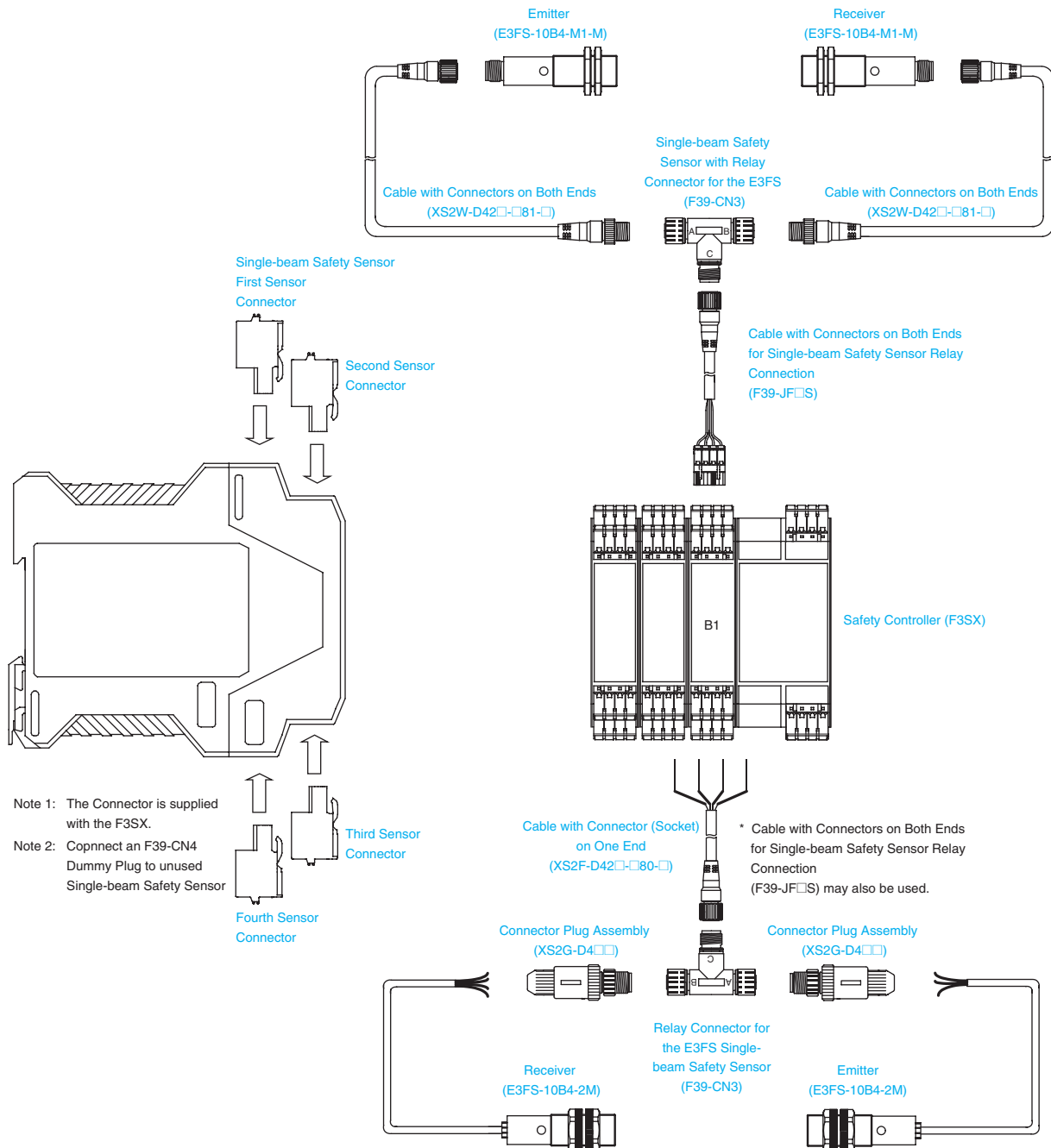
Connector Plug Assemblies, Solder Type

Applicable cable diameter (mm)	Cable connection direction	Connection method	Model
3 dia. (3 to 4 dia.)	Straight	Solder	XS2G-D425
	Right angle		XS2G-D426

Connector Plug Assemblies, Screw-on Type

Applicable cable diameter (mm)	Cable connection direction	Connection method	Model
3 dia. (3 to 4 dia.)	Straight	Screw-on	XS2G-D4S5
	Right angle		XS2G-D4S6

Accessory Connection Example



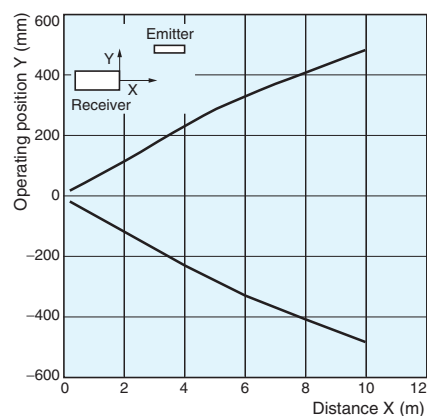
Ratings and Performance

E3FS-10B4 2M/E3FS-10B4-M1-M

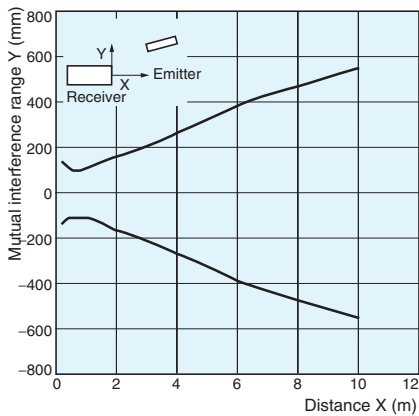
Sensing method	Through-beam	
Controller	F3SX Series	
Supply voltage	24 VDC±10% (ripple p-p 10% max.) (Connect the Sensor to an F3SX to use it as a safety device or as part of a safety system.)	
Effective aperture angle (EAA)	±5° (at 3 m)	
Current consumption	Emitter: 50 mA max. Receiver: 25 mA max.	
Sensing distance	10 m	
Standard sensing object	Opaque object: 11 mm min. in diameter	
Response time	2.0 ms (E3FS only) (Depends on the F3SX model when the Sensor is connected to an F3SX. Refer to the F3SX operation manual for details.)	
Control output	PNP transistor output, load current: 100 mA max., residual voltage: 2 V max. (except for voltage drop due to cable extension) (Connect the Sensor to an F3SX to use it as a safety device or as part of a safety system.)	
Test input (Emitter)	21.5 to 24 VDC: Emitter OFF (source current: 3 mA max.) Open or 0 to 2.5 V: Emitter ON (leakage current: 0.1 mA max.) (Connect the Sensor to an F3SX to use it as a safety device or as part of a safety system.)	
Power supply reset time	100 ms	
Ambient light intensity	Incandescent lamp: 3000 lx max. (light intensity on the receiver surface) Sunlight: 10,000 lx max. (light intensity on the receiver surface)	
Ambient temperature	Operating: -10 to 55°C, storage: -30 to 70°C (with no icing or condensation)	
Ambient humidity	Operating: 35% to 85%, storage: 35% to 95% (with no icing or condensation)	
Insulation resistance	20 MΩ min. (at 500 VDC)	
Dielectric strength	1000 VAC 50/60 Hz 1 min	
Vibration resistance	Malfunction	10 to 55 Hz, double amplitude: 1.5 mm, 2 h each in the X, Y, and Z directions
	Operating limit	10 to 55 Hz, double amplitude: 0.7 mm, 50 min each in the X, Y, and Z directions
Shock resistance	Malfunction	500 m/s ² (approx. 50 G), 3 times each in the X, Y, and Z directions
	Operating limit	100 m/s ² (approx. 10 G), 1000 times in the X, Y, and Z directions
Degree of protection	IP67 (IEC standard)	
Light source	Infrared LED	
Operation indicators	Emitter: Emitting (orange) Receiver: Output ON (green), Output OFF (red)	
Protection	Output short-circuit protection, reverse polarity protection	
Weight (in packaging)	E3FS-10B4 2M (ABS resin case): approx. 150 g for 1 set (weight without cable: approx. 55 g) E3FS-10B4-M1-M (metal case): approx. 125 g for 1 set	
Applicable standard	IEC61496-1, EN61496-1 Type 2 ESPE (Electro-Sensitive Protective Equipment) IEC61496-2, prEN61496-2 Type 2 AOPD (Active Opto-electronic Protective Devices)	
Accessories	Emitter, two nuts for mounting the Receiver, and an instruction manual	

Engineering Data

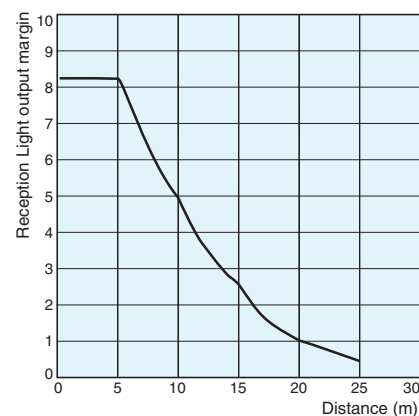
Parallel Operating Range



Mutual Interference Range



Reception Light Output Margin

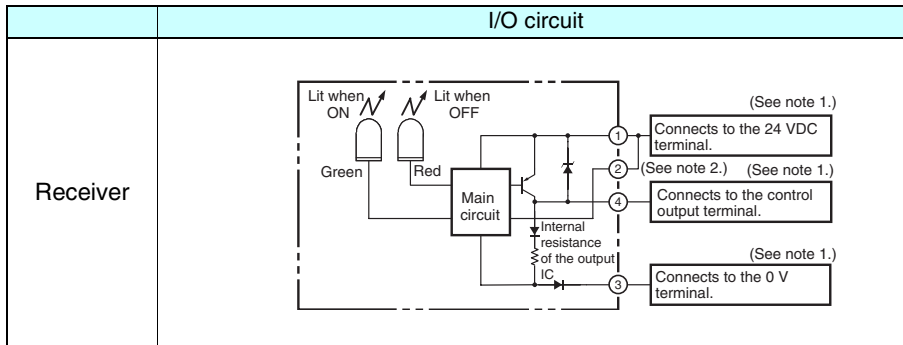


I/O Circuit Diagrams

Circuit Diagrams (E3FS-10B4□□□□ with PNP Output)

Output mode: ON when light is received (Light ON).

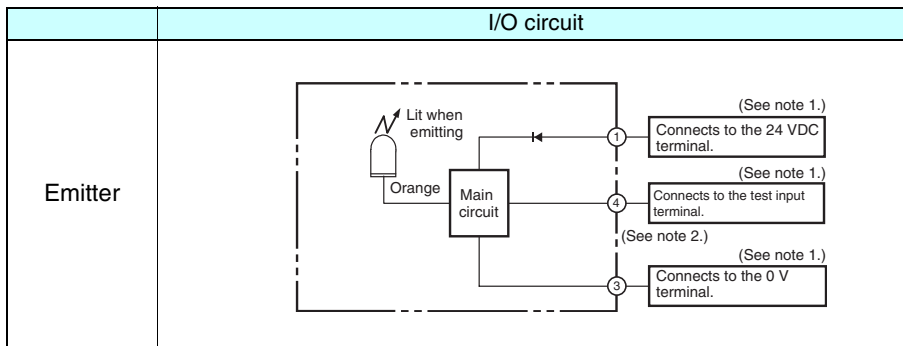
Receiver



Note1. Make sure all terminals on the B1 Module of the F3SX are properly connected. Do not connect the terminals to another Module. See the F3SX operation manual for details.

2. Be sure to connect mode selection input (2) to 24 VDC.

Emitter

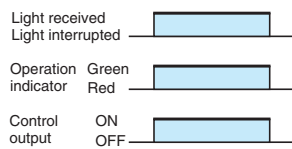


Note1. Make sure all terminals on the B1 Module of the F3SX are properly connected. Do not connect the terminals to another Module. See the F3SX operation manual for details.

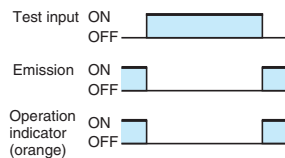
2. Connect to the 0 V terminal when using the E3FS Sensor alone.

Timing Charts

Output Modes and Timing Chart



Emitter Timing Chart

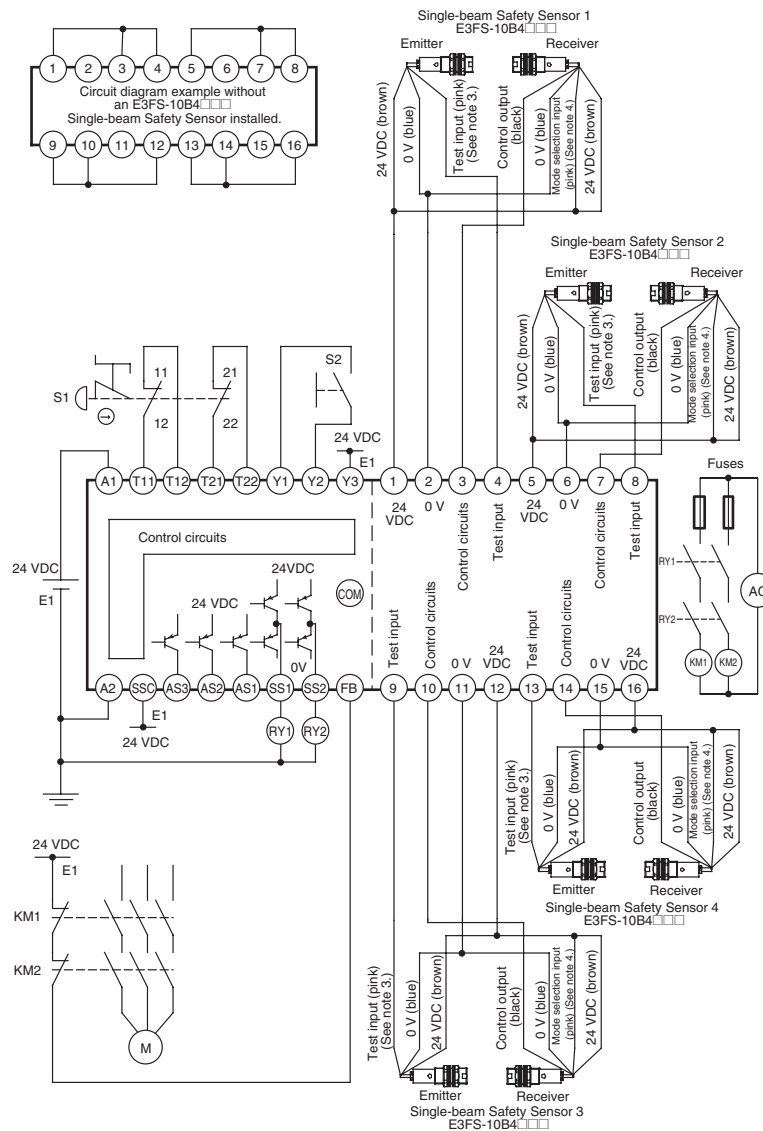


Note. The E3FS-10B4□□□□ functions as a standalone Sensor when it is connected as shown in the wiring diagram above. However, it is certified a Type 2 Safety Sensor when it is properly connected to the B1 Module of the F3SX. This also means it must be properly connected to an F3SX to use it as part of a safety system.

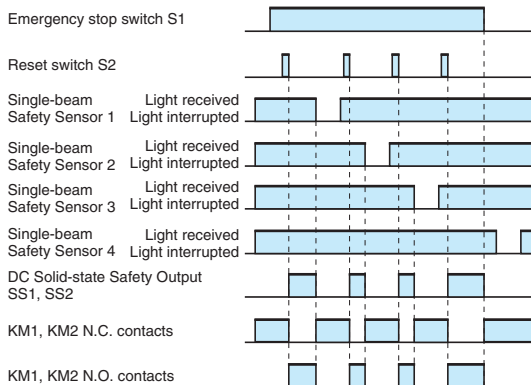
Connections

Circuit Diagram Example

F3SX-EB1 (Manual Reset)




Timing Chart



- S1: Emergency stop switch with positive opening mechanism (A165E or A22E) ⊕
- S2: Reset switch
- KM1, KM2: Magnetic contactor
- RY1, RY2: Relay
- M: Three-phase motor
- E1: 24-VDC power supply (S82K)

- Note 1. The above circuit diagram example conforms to Category 2.
- Note 2. The EN60204-1 stop function category is 0 (zero) for the example in the above circuit diagram.
- Note 3. The black wire is used when the Cable with Connector (Socket) on One End (XS2F-D42□-□80-□) is connected to an E3FS-10B4-M1-M Connector.
- Note 4. The white wire is used when the Cable with Connector (Socket) on One End (XS2F-D42□-□80-□) is connected to an E3FS-10B4-M1-M Connector.

Precautions for Correct Use

 Warning

OMRON's Single-beam Safety Sensor Input Module (B1 Module) from the F3SX Series is the only Controller that can be used for the E3FS-10B4□□□ (type 2). Normal operation may not be possible if another Single-beam Sensor Controller is used.



The Sensor cannot be used as part of a safety system when the mode selection input of the Single-beam Safety Sensor Receiver is connected to 0 V because the Sensor will turn ON when light is interrupted (Dark ON). Be sure to connect the mode selection input to 24 VDC if you want the Sensor to turn ON when light is received (Light ON).



Safety Distance

The safety distance is the minimum distance that must be maintained between the Sensor and a hazardous part of the machine in order to stop the machine before someone or something reaches it. The safety distance is calculated based on the following equation when a person moves perpendicular to the detection zone of the Sensor.

$$\text{Safety distance (S)} = \text{Intrusion speed into the detection zone (K)} \\ \times \text{Total response time for the machine and Sensor} \\ + \text{Additional distance calculated based on the detection capability of the Sensor (C)}$$


The safety distance varies with national standards and individual machine standards. The equation is also different if the direction of intrusion is not perpendicular to the detection zone of the Sensor. Be sure to refer to related standards.

Here $T = T1 + T2 + T3$

where

- T1 = Maximum machine stop time (s)
- T2 = Sensor response time (s)
(From ON to OFF: 2.0 ms for the E3FS)
- T3 = F3SX response time (s)
(From ON to OFF: Refer to Response Time.)

The maximum stop time for a machine is the time it takes to actually stop dangerous parts after the machine receives a stop signal from the F3SX.

 Warning

Measure the actual maximum stop time for the machine and then periodically check it to see if the time changes.



Reference: Method for Calculating Safety Distance as Defined in the European Standard EN999 (with Intrusion Perpendicular to the Detection Zone)

- K and C are as follows for Single-beam Safety Sensors.
- 1) When a Single-beam Safety Sensor is used alone (when the risk assessment indicates that a single optical beam is sufficient)
 - K = 1,600 mm/s
 - C = 1,200 mm

- Height of the beam from the ground or from a reference surface: 750 mm (EN999 recommendation)
- 2) When multiple Single-beam Safety Sensors are installed at different heights.
 - K = 1,600 mm/s
 - C = 850 mm

The beam heights in the following table are the EN999 recommendations.

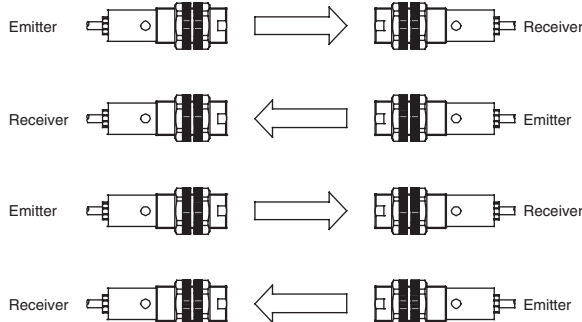
No. of beams	Height from the reference surface (example: the floor)
2	400 mm, 900 mm
3	300 mm, 700 mm, 1100 mm
4	300 mm, 600 mm, 900 mm, 1200 mm

Note. Refer to the F3SN/F3SH instruction manuals for details on Safety Light Curtains and Multi-beam Safety Sensors.


Preventing Mutual Interference

Observe the following items during installation to prevent Single-beam Safety Sensors from interfering with each other or with Safety Light Curtains.

- Leave adequate space between the Sensors during installation. (Refer to the instruction manuals for the E3FS and the F3SN/F3SH.)
- Use baffle plates to separate Sensors.
- Alternate Emitters and Receivers during installation. (See the figure below.)



Check for mutual interference between Single-beam Safety Sensors or Safety Light Curtains connected to the same or different Control Units before finalizing placement and starting normal operation.

 Warning

When installing multiple Safety Light Curtains, Multi-beam Safety Sensors, and Single-beam Safety Sensors, take necessary steps to prevent mutual interference. Otherwise detection may fail and serious injury may result.



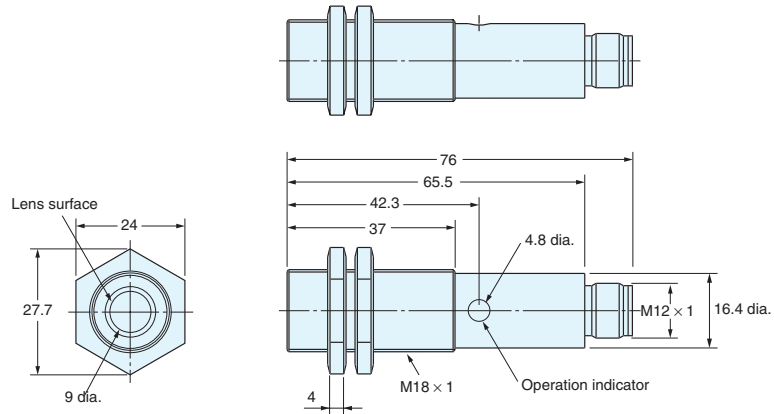
Dimensions

(Unit: mm)

Sensors

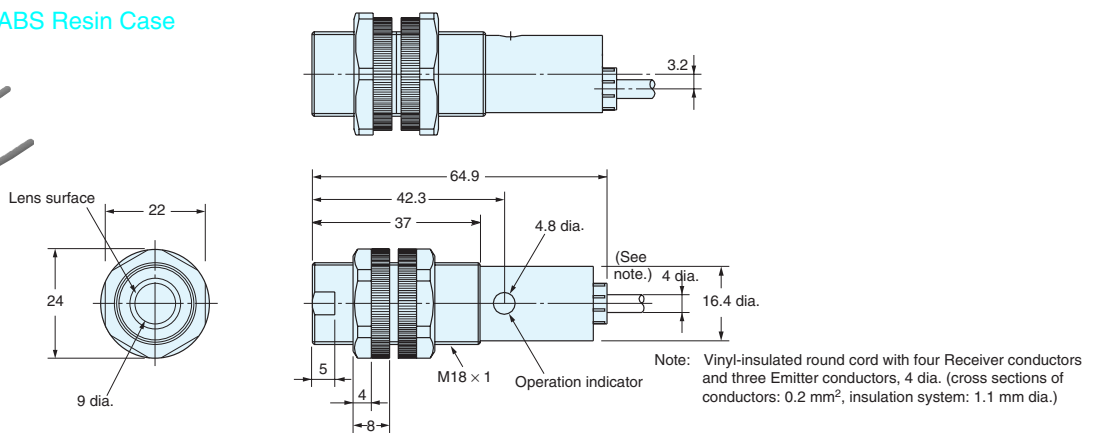
Connector with Metal Case

E3FS-10B4-M1-M



Retractable Cable with ABS Resin Case

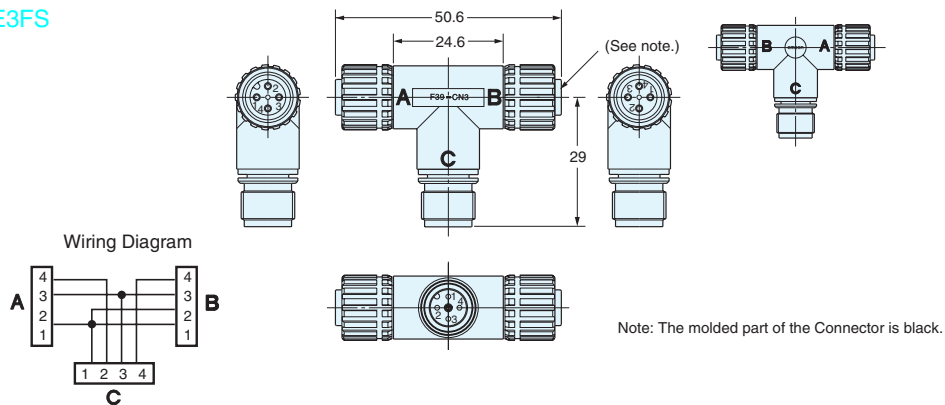
E3FS-10B4 2M



Accessories (Order Separately)

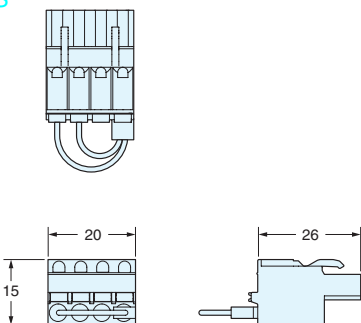
Relay Connector for E3FS

F39-CN3



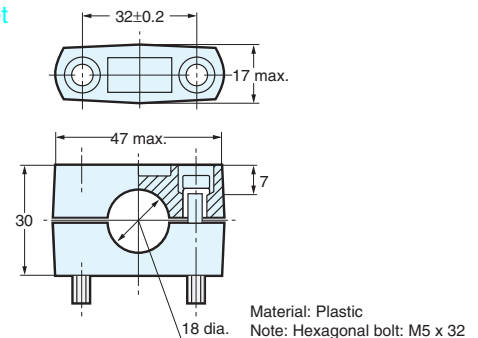
Dummy Plug for E3FS

E39-CN4



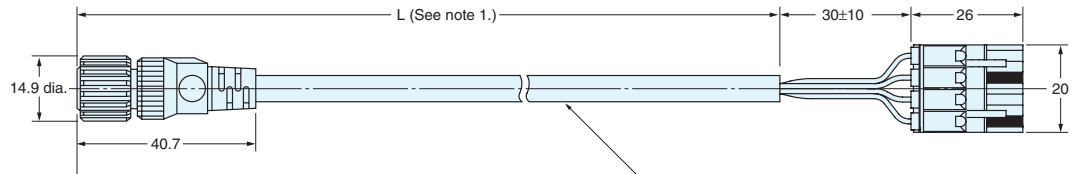
Mounting Bracket

Y92E-B18



Cables with Connectors on Both Ends for Relay Connection

- F39-JF1S
- F39-JF2S
- F39-JF5S
- F39-JF10S



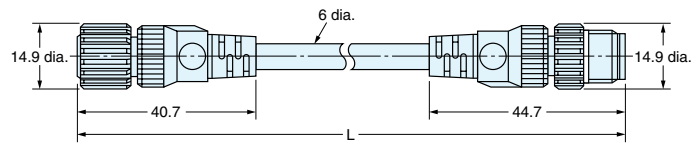
Model	L
F39-JF1S	1,000 ⁺¹⁵⁰ ₀
F39-JF2S	2,000 ⁺¹⁵⁰ ₀
F39-JF5S	5,000 ⁺³⁰⁰ ₀
F39-JF10S	10,000 ⁺³⁰⁰ ₀

Note 1: Dimensions will vary with the model as shown in the table on the left.

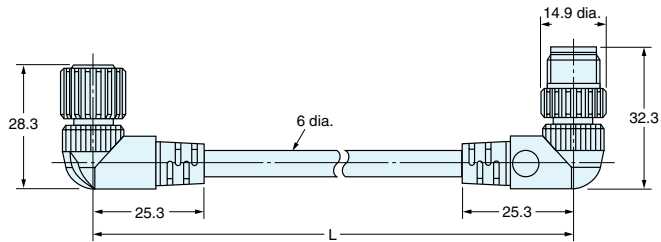
Vinyl-insulated round cord, 6 dia. (gray),
4 conductors (cross sections of conductors: 0.5 mm²,
insulation system: 1.70 mm dia.),
standard length: L (See note 1.)

Cables with Connectors (Socket and Plug) on Both Ends

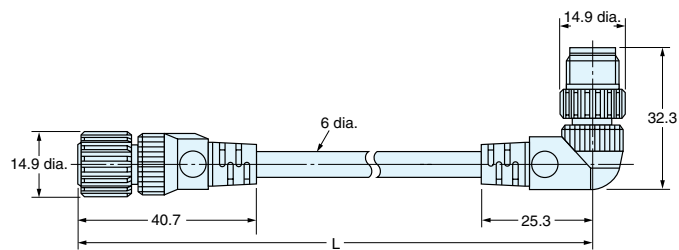
- XS2W-D421-C81-A (L=1m)
- XS2W-D421-D81-A (L=2m)
- XS2W-D421-G81-A (L=5m)
- XS2W-D421-J81-A (L=10m)
- XS2W-D421-C81-R (L=1m)
- XS2W-D421-D81-R (L=2m)
- XS2W-D421-G81-R (L=5m)
- XS2W-D421-J81-R (L=10m)



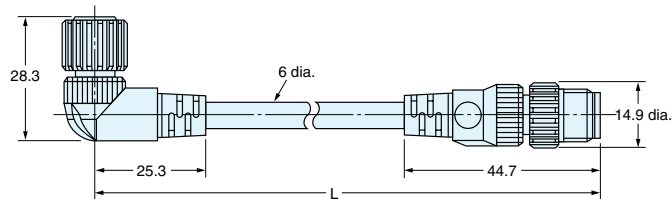
- XS2W-D422-D81-A (L=2m)
- XS2W-D422-G81-A (L=5m)



- XS2W-D423-D81-A (L=2m)
- XS2W-D423-G81-A (L=5m)

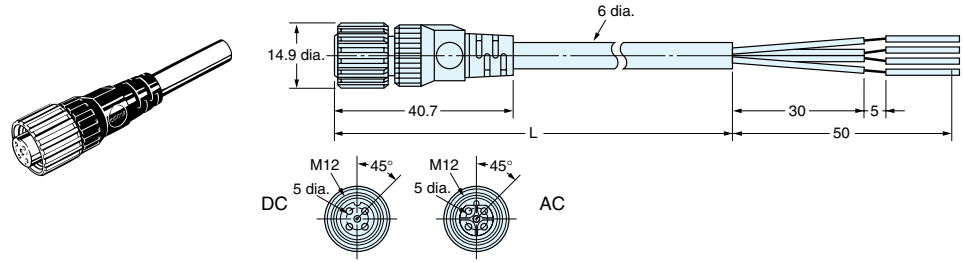


- XS2W-D424-D81-A (L=2m)
- XS2W-D424-G81-A (L=5m)

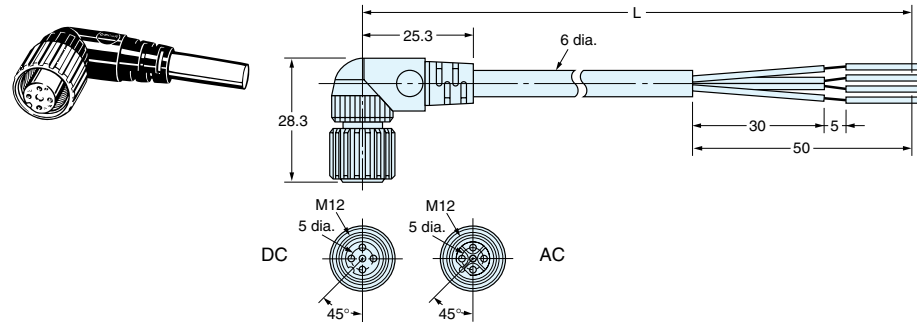


Cables with Connector (Socket) on One End

- XS2F-D421-C80-A (L=1m)
- XS2F-D421-D80-A (L=2m)
- XS2F-D421-G80-A (L=5m)
- XS2F-D421-J80-A (L=10m)
- XS2F-D421-C80-R (L=1m)
- XS2F-D421-D80-R (L=2m)
- XS2F-D421-G80-R (L=5m)
- XS2F-D421-J80-R (L=10m)

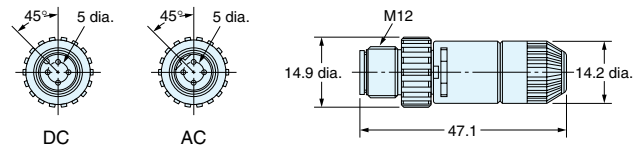
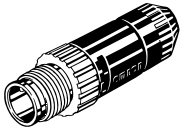


- XS2F-D422-C80-A (L=1m)
- XS2F-D422-D80-A (L=2m)
- XS2F-D422-G80-A (L=5m)
- XS2F-D422-J80-A (L=10m)
- XS2F-D422-C80-R (L=1m)
- XS2F-D422-D80-R (L=2m)
- XS2F-D422-G80-R (L=5m)
- XS2F-D422-J80-R (L=10m)

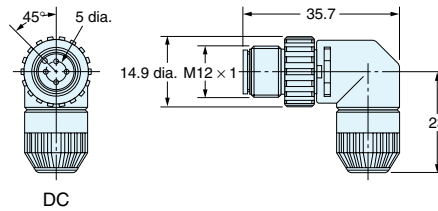
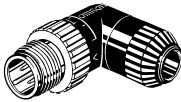


Connector Plug Assemblies, Solder Type

XS2G-D425

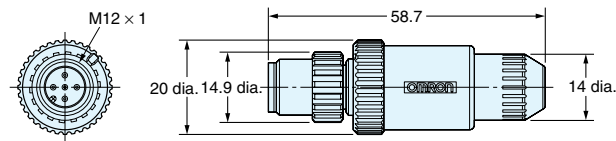
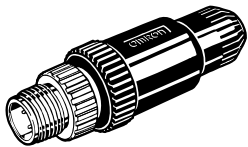


XS2G-D426

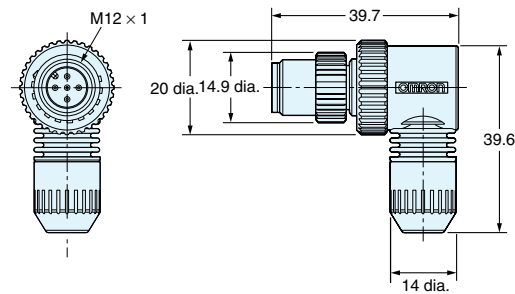
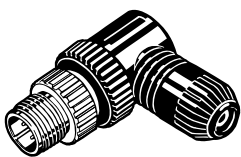


Connector Plug Assemblies, Screw-on Type

XS2G-D455

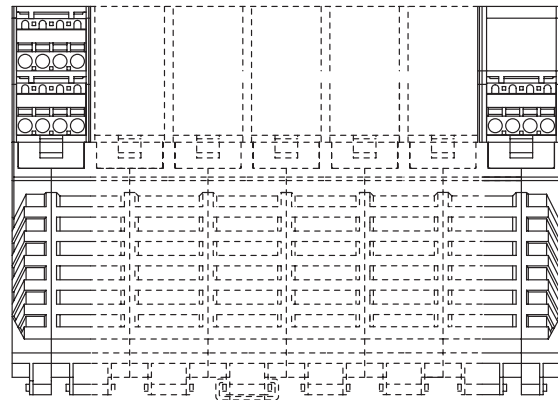
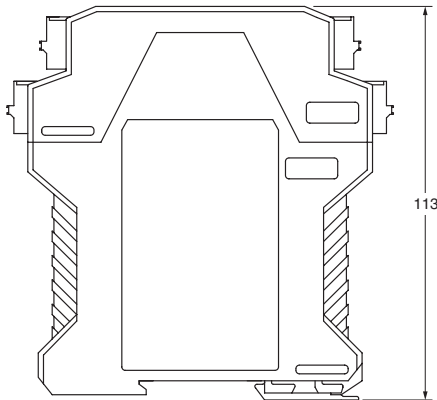
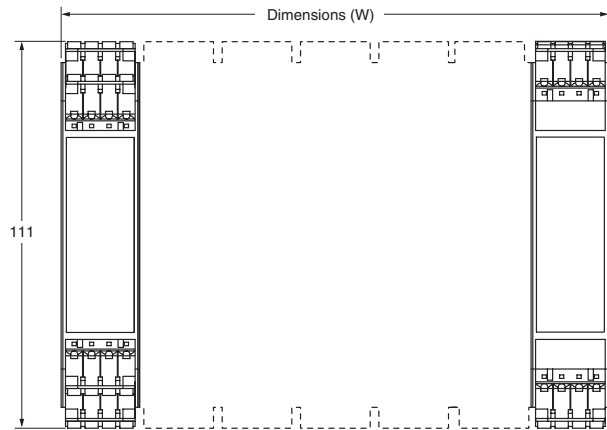


XS2G-D456



Controller

F3SX



Refer to Ordering Information on page 5 for dimension details.

Safety Component Catalogs



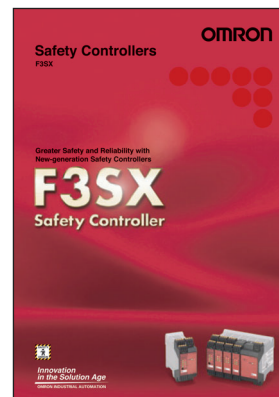
Safety Components
Series Catalog
Cat. No. Y106



Safety Technology
Safety Components
Cat. No. Y107



F3SN-A□SS
Short-range Safety Light
Curtain (Type 4)
Cat. No. E348



F3SX
Safety Controllers
Cat. No. Z196

This document provides information mainly for selecting suitable models. Please read the Instruction Sheet carefully for information that the user must understand and accept before purchase, including information on warranty, limitations of liability, and precautions.

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