Single-beam Safety Sensor

E3FS/E3ZS

Type 2 Safety Photoelectric Sensor for Hazardous Gaps in Machines

Note: Be sure to read the “Safety Precautions”

International standards: IEC61496-1 (type 2 ESPE)
IEC61496-2 (type 2 AOPD)
European standards: EN61496-1 (type 2 ESPE)
peEN61496-2 (type 2 AOPD)

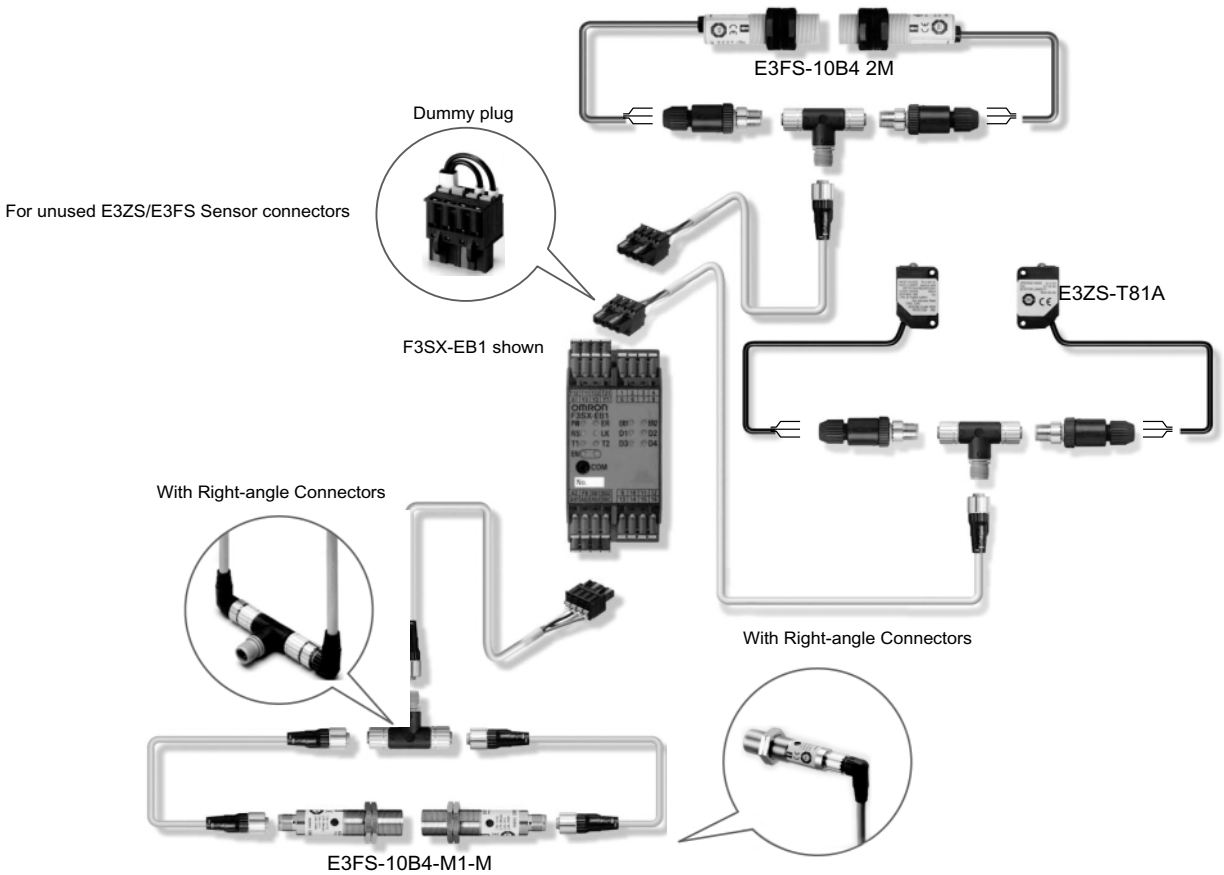
NEW

Connect up to 4 sets of E3ZS/E3FS per B1 Module for F3SX Safety Controller

Note: The B1 Module is designed specifically for E3ZS/E3FS input of the F3SX.
- The safety output turns OFF when light is interrupted or when an error occurs with one or more of the E3ZS/E3FS Sensors connected to the B1 Module.

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

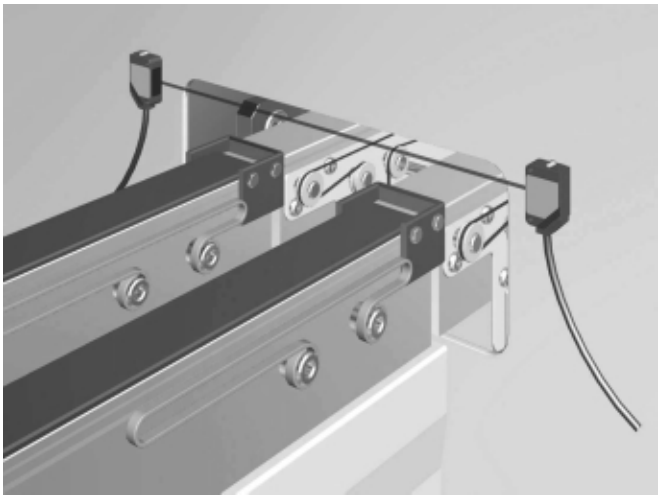
Connects simply and easily using a wide range of accessories.



Applications

E3ZS/E3FS

• For gaps in small-sized equipment **E3ZS**



Protect personnel from the hazards of gaps in small-sized equipment or of semi-automated machinery.

The E3ZS is a Human Body Detection Sensor (Type 2) for production equipment. Make sure to use it in combination with an F3SX Safety Controller. When used by itself, the E3ZS conforms to EN954-1 (Category 1). No particular safety restrictions apply to the E3ZS when used by itself, except the inability to use in human detection safety applications. We recommend using it in Light ON mode with error detection via test input.

* Test input
Use this function to enable the E3ZS to be turned ON/OFF from outside the emitter. It is possible to detect a number of E3ZS errors by monitoring the status of the test input and the E3ZS output signal.

• For gaps in small to medium-sized equipment **E3FS**

Use as a safety measure for protection from hazardous gaps or as guards for medium-sized equipment.

The E3FS is a Human Body Detection Sensor (Type 2) for production equipment. Make sure to use it in combination with a F3SX Safety Controller. A combination of E3FS and E3ZS Sensors can be connected to the B1 Module of the F3SX.

* Since the E3FS has not received any safety certification for use by itself, make sure to connect it with an F3SX for use in safety applications.

Ordering Information

Sensors

Red light Infrared light

Sensing method	Appearance	Case material	Connection method	Sensing distance	Output	Model
Through-beam		Polybutylene terephthalate	Pre-wired cable (2m)	0.2 to 3m	PNP	E3ZS-T81A
		ABS		10m		E3FS-10B4 2M
		Brass	M12 connector	10m		E3FS-10B4-M1-M

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 devices. Custom models are also available. Refer to the F3SX Safety Controller catalog provided separately, and consult with your OMRON representative.

Accessories

Branch Connector

Appearance	Model
	F39-CN3

Dummy

Appearance	Model
	F39-CN4

Mounting Bracket

Appearance	Model
	Y92E-B18

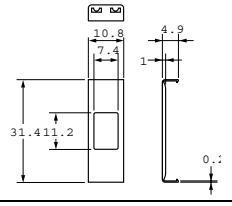
Sensor Mounting Bracket (For E3ZS)

Appearance	Model	Standard price (yen)
	E39-L104	325

Cables with Connectors on Both Ends for Branch Connector

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

Mutual Interference Prevention Filter (For E3ZS)

Appearance/Dimensions	Model	Quantity	Remarks
	E39-E11	2 per emitter and receiver (4 total)	For use with E3ZS-T81A. This filter prevents mutual interference by changing the direction of polarized light of the 2 adjacent emitter/ receivers. However, when the filter is attached, the maximum sensing distance of the E3ZS is reduced to 1.5 m.

Cables with Connectors (Socket and Plug) on Both Ends

Type	Cable connection direction	Cable length L (m)	DC Model	UL standard
Standard cable	Straight/straight	1	XS2W-D421-C81-A	I
		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 Model	UL standard
Standard cable	Straight	1	XS2F-D421-C80-A	I
		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.

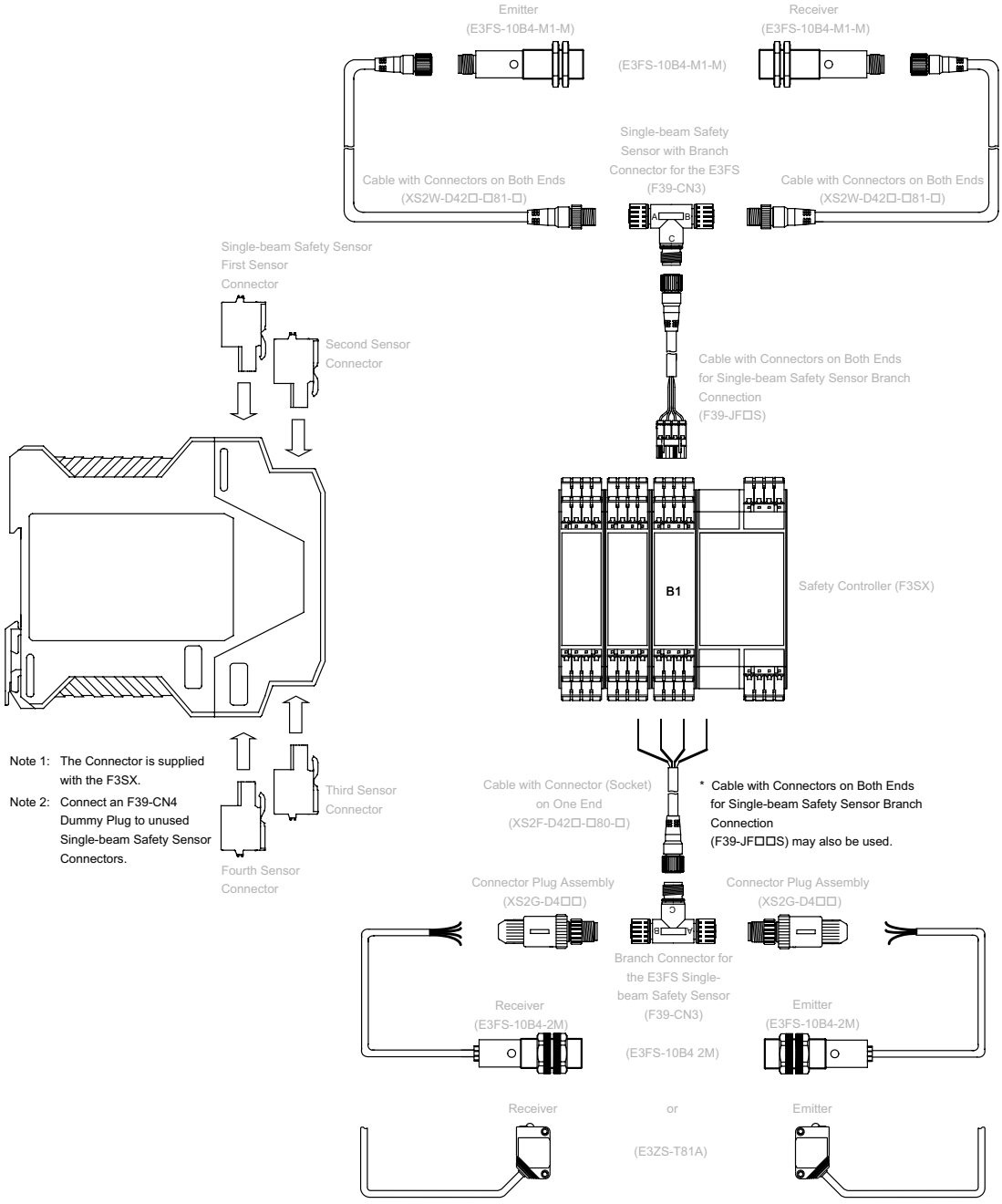
Connector Plug Assemblies, Solder Type

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



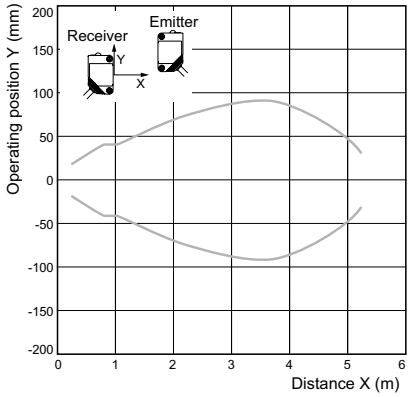
Ratings and Performance

Item / Model		E3ZS-T81A	E3FS-10B4 2M	E3FS-10B4-M1-M
Sensing method		Through-beam		
Case material		Polybutylene terephthalate	ABS	Brass
Connection method		Pre-wired cable (2 m)		M12 connector
Controller		F3SX Series		
Supply voltage		12 to 24 VDC ± 10% (ripple p-p 10% max.) *1	24 VDC ± 10% (ripple p-p 10% max.) *1	
Effective aperture angle (EAA)		±5° (at 3 m)		
Current consumption		Emitter: 15 mA max. Receiver: 20 mA max.	Emitter:50 mA max. Receiver:25 mA max.	
Sensing distance		0.2 to 3m	0 to 10m	
Standard sensing object		Opaque object: Min. 18 mm diameter	Opaque object: Min. 11 mm diameter	
Response time		1.0 ms (E3ZS only) *2	2.0 ms (E3FS only) *2	
Control output		PNP transistor output, load current: 100 mA max. Residual voltage: 1 V max. (when load current is less than 10 mA) Residual voltage: 2 V max. (when load current is between 10 and 100 mA) (except for voltage drop due to cable extension) *1	PNP transistor output, load current: 100 mA max. Residual voltage: 2 V max. (except for voltage drop due to cable extension) *1	
Switching element category (from IEC60947-5-3)		DC13 (control of electromagnetic load)	-----	
Test input (Emitter)		22.5 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.) *1	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.) *1	
Startup time after power ON		100ms		
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: -10 to +70°C (with no icing or condensation)	Operating: -20 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		Red LED (660 nm)	Infrared LED (870 nm)	
Operation indicators		Emitter: Emitting (orange) Receiver: Operating (orange), Stable (green)	Emitter: Emitting (orange) Receiver: Output ON (green), Output OFF (red)	
Protection		Power supply/output reverse connection protection, load short-circuit protection	Output reverse connection protection, load short-circuit protection	
Weight (in packaging)		Approx. 120 g (1 set, including 2-m cable)	Approx. 150 g (1 set, including 2-m cable)	Approx. 125 g (1 set, Sensor only)
Applicable standard	Sensor only	IEC60947-5-3 (PDF-D) EN954-1 (Category 1)	-----	
	When connected with F3SX	IEC (EN) 61496-1 Type 2 ESPE *3 IEC (prEN) 61496-2 Type 2 AOPD *4 EN954-1 (Category 2)	IEC (EN) 61496-1 Type 2 ESPE *3 IEC (prEN) 61496-2 Type 2 AOPD *4	
Accessories		Operation manual (*5)	Operation manual (*5), nuts for mounting emitter/receiver (2 each)	

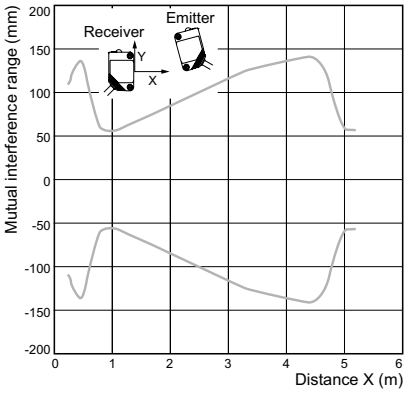
*1. Connect the Sensor to an F3SX to use it as a safety device or as part of a safety system.
*2. *2: This may vary according to the F3SX model connected to the Sensor. For details, refer to the F3SX operation manual.
*3. Electro-Sensitive Protective Equipment
*4. Active Opto-electronic Protective Device
*5. The F3SX operation manual is not included.

E3ZS

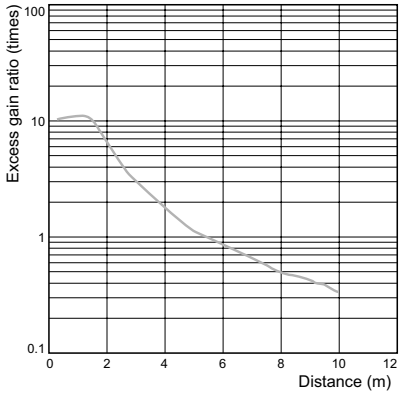
Parallel Operating Range



Mutual Interference Range

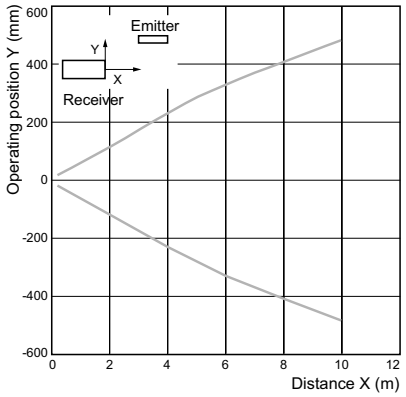


Excess Gain Ratio

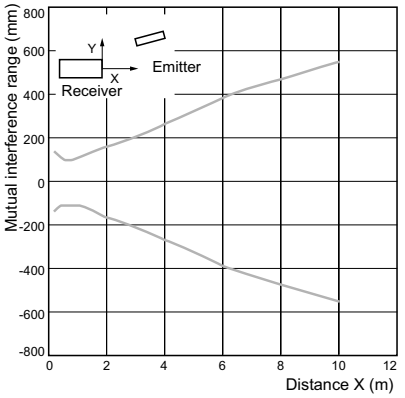


E3FS

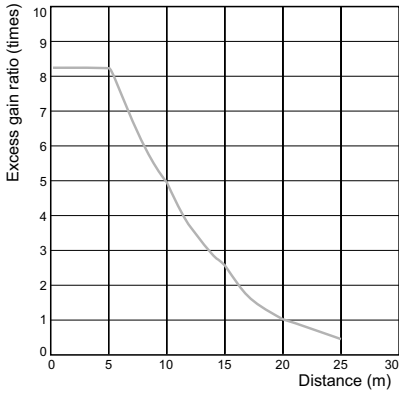
Parallel Operating Range



Mutual Interference Range



Excess Gain Ratio

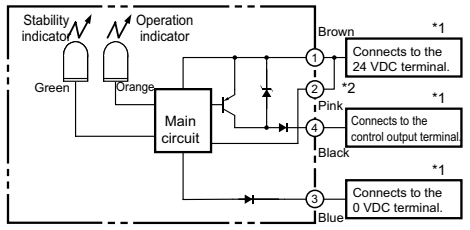
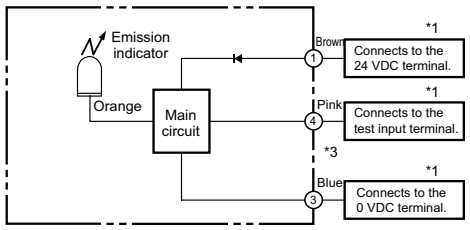


I/O Circuit Diagrams

E3ZS

Circuit Diagrams (E3ZS-T81A with PNP Output)

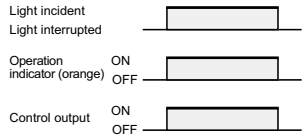
Output mode: ON when light is incident (Light ON)

	I/O circuit
Receiver	
Emitter	

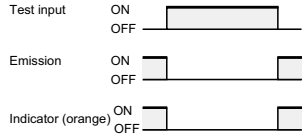
*1. When using in Safety Category 2 configurations, make sure all terminals on the B1 Module of the F3SX are properly connected. Do not connect the terminals to another module. See the F3SX operation manual for details.
*2. Make sure to connect the pink wire (mode selection input 2) to 24 VDC.
*3. Make sure to connect to the 0V terminal when the E3ZS is not connected to an F3SX and the test input is not used.

Timing Charts

Output Modes and Timing Chart



Emitter Timing Chart

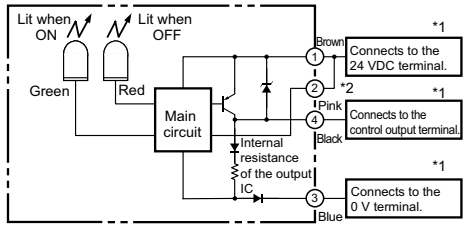
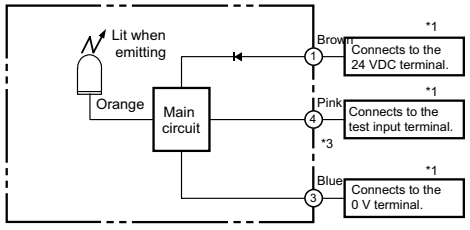


Note: The F3SX performs a self-diagnosis every 20 ms.

E3FS

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

Output mode: ON when light is incident (Light ON)

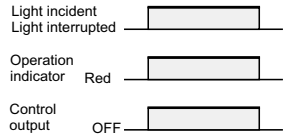
	I/O circuit
Receiver	
Emitter	

*1. 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. Make sure to connect the pink wire (mode selection input 2) to 24 VDC.
*3. Make sure to connect to the 0V terminal when the E3FS is not connected to an F3SX and the test input is not used.

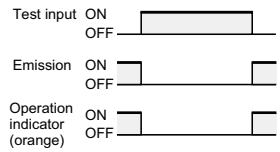
Note: The E3FS-10B4□□□ functions as a standalone Sensor when it is connected as shown in the wiring diagram above. However, it is certified a Type 2 Safety Sensor when it is properly connected to the B1 Module of the F3SX. This also means it must be properly connected to an F3SX to use it as part of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

Timing Charts

Output Modes and Timing Chart



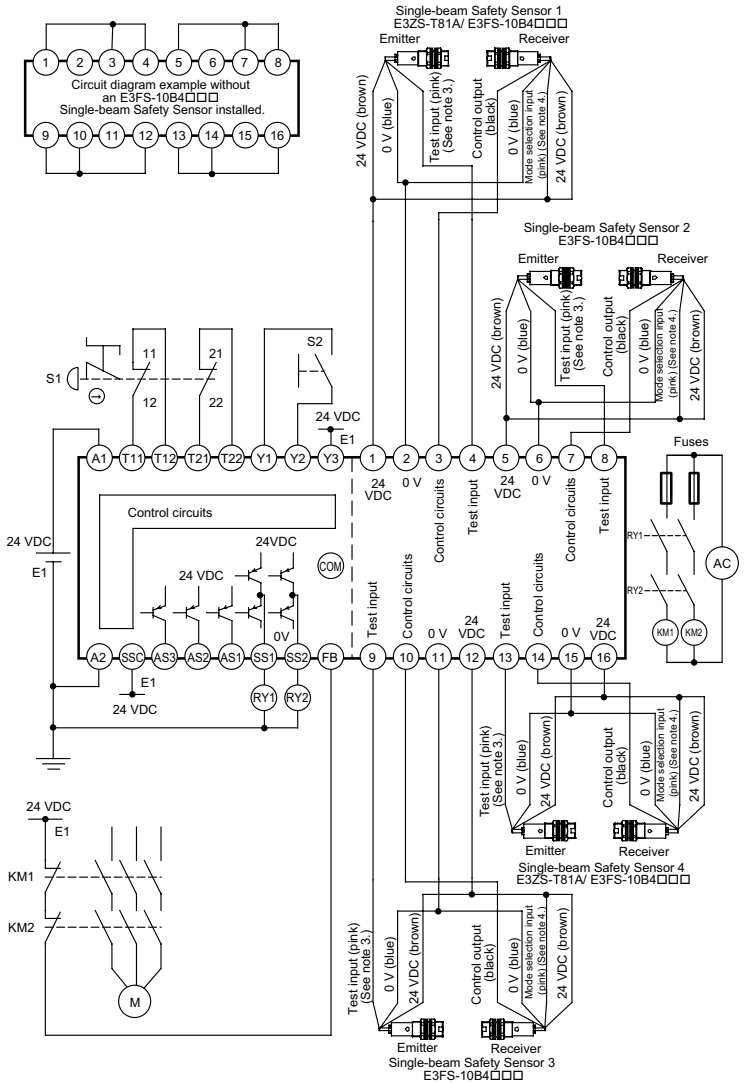
Emitter Timing Chart



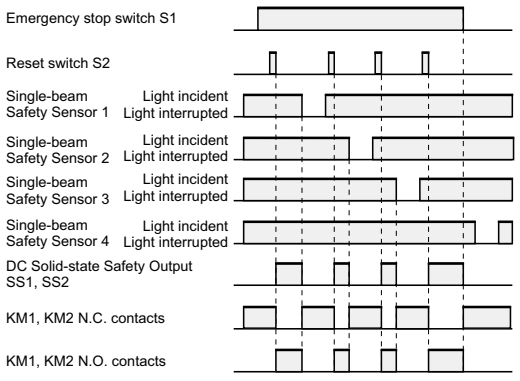
Connections

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.
Note 5 When the FB (feedback input) function of the F3SX is not used, make setting changes with the F3SX function setup software (F3SX-CD100).

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 E3ZS-T81A/ 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 incident (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.

Safety distance (S) = Intrusion speed into the detection zone (K)
x Total response time for the machine and Sensor
+ 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 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.

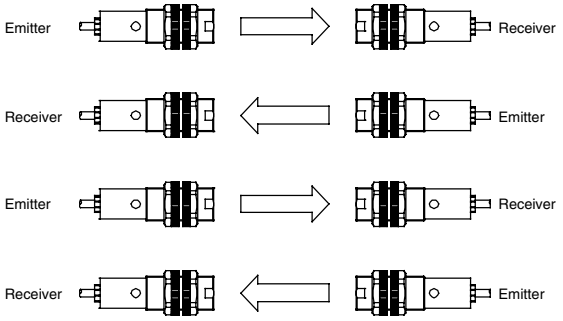
No. of beams	Height from the reference surface (example: the floor)
2	400 mm, 900 mm
3	300 mm, 700 mm, 1100 mm
4	300 mm, 600 mm, 900 mm, 1200 mm

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 E3ZS/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

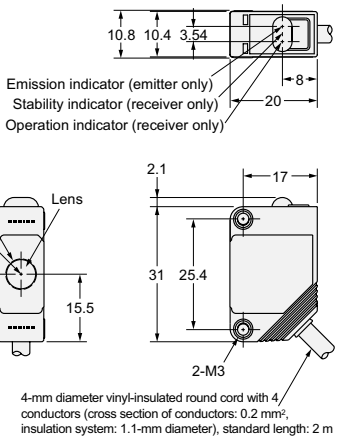
CAD Data The ÅgCAD DataÅh mark indicates 2D CAD drawings and 3D CAD data are available for the model.
CAD data can be downloaded from the Omron Industrial Web site (http://www.fa.omron.co.jp).

(Unit: mm)

Sensors

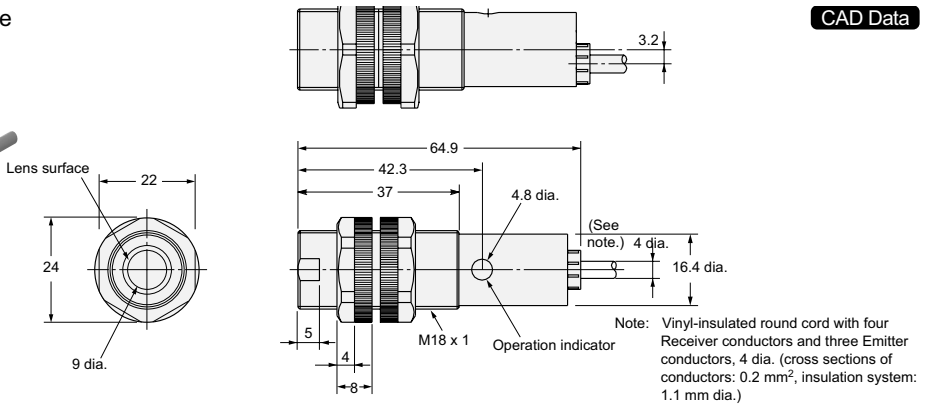
Pre-wired Cable with ABS Resin Case
E3ZS-T81A

CAD Data



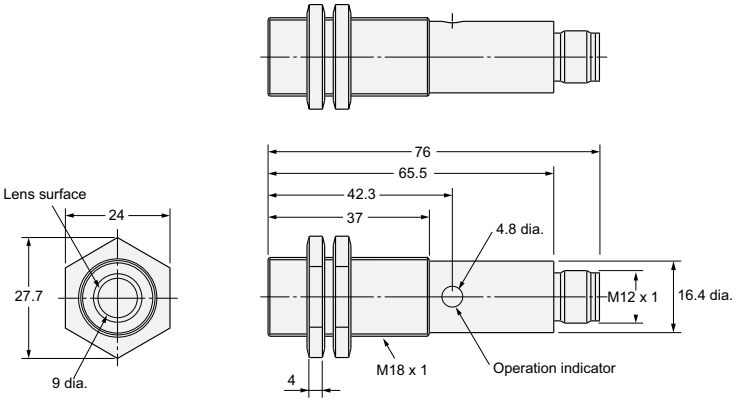
Pre-wired Cable with ABS Resin Case
E3FS-10B4 2M

CAD Data



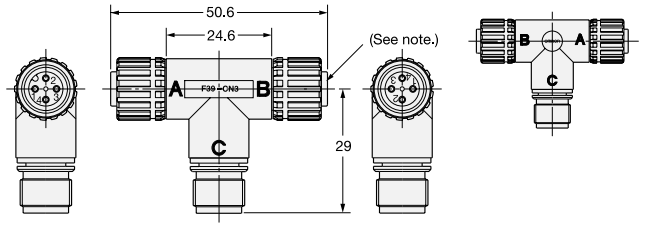
Connector with Metal Case
E3FS-10B4-M1-M

CAD Data

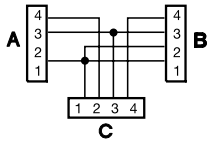


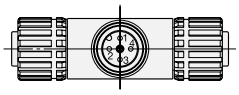
Branch Connector
F39-CN3

CAD Data



Wiring Diagram

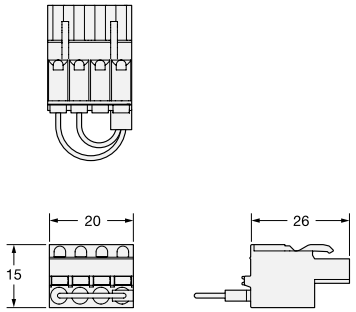




Note: The molded part of the Connector is black.

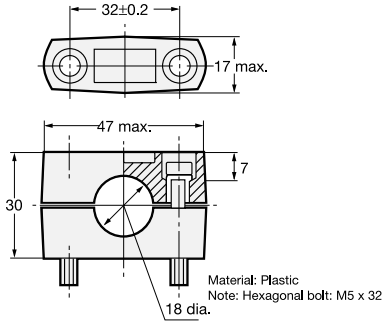
Dummy Plug
F39-CN4

CAD Data



Sensor Mounting Bracket (For E3FS)
Y92E-B18

CAD Data

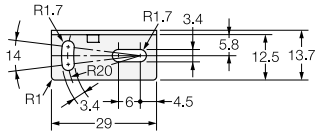


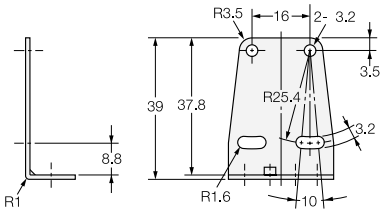
Material: Plastic
Note: Hexagonal bolt: M5 x 32

Sensor Mounting Bracket (For E3ZS)
E39-L104

CAD Data

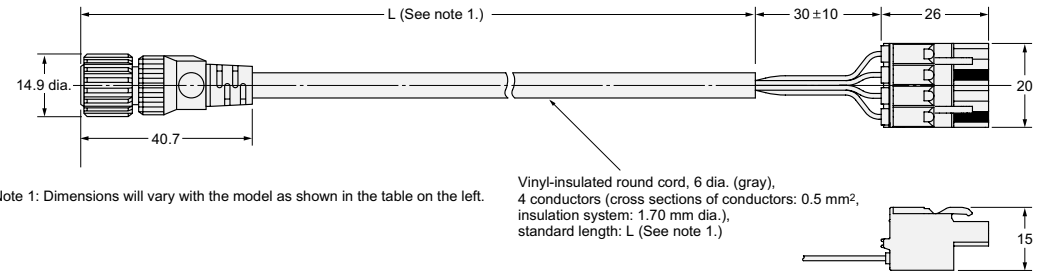
Material: Stainless steel (SUS304)





Cables with Connectors on Both Ends for Branch Connection

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



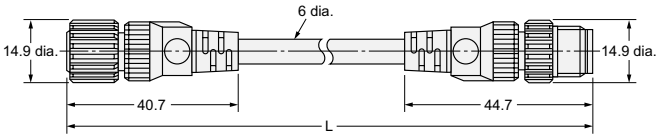
Model	L
F39-JF1S	1,000 $^{+150}_{0}$
F39-JF2S	2,000 $^{+150}_{0}$
F39-JF5S	5,000 $^{+300}_{0}$
F39-JF10S	10,000 $^{+300}_{0}$

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

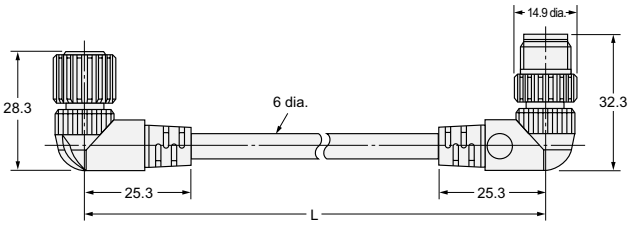
Cables with Connectors (Socket and Plug) on Both Ends

CAD Data

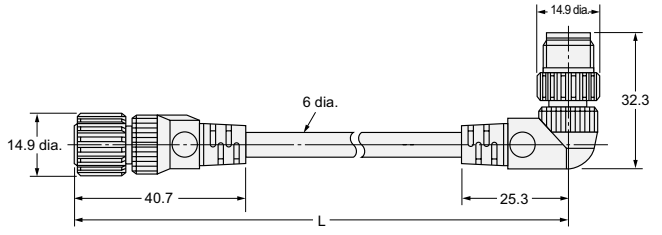
XS2W-D421-C81-A (L=1m)
XS2W-D421-D81-A (L=2m)
XS2W-D421-G81-A (L=5m)
XS2W-D421-J81-A (L=10m)
XS2W-D421-C81-R (L=1m)
XS2W-D421-D81-R (L=2m)
XS2W-D421-G81-R (L=5m)
XS2W-D421-J81-R (L=10m)



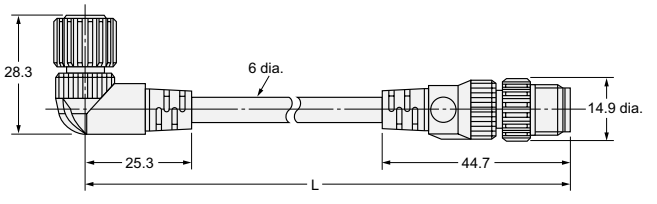
XS2W-D422-D81-A (L=2m)
XS2W-D422-G81-A (L=5m)



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

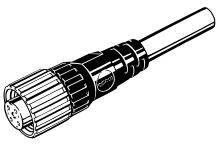


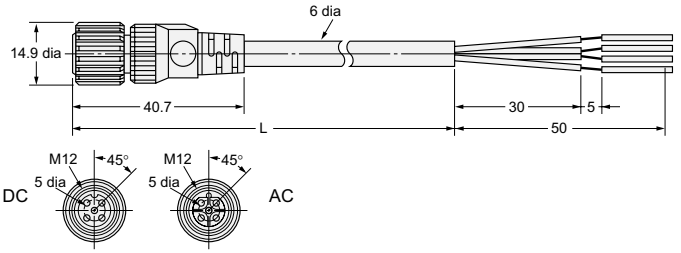
XS2W-D424-D81-A (L=2m)
XS2W-D424-G81-A (L=5m)



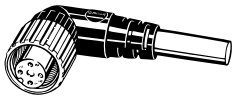
Cables with Connector (Socket) on One End

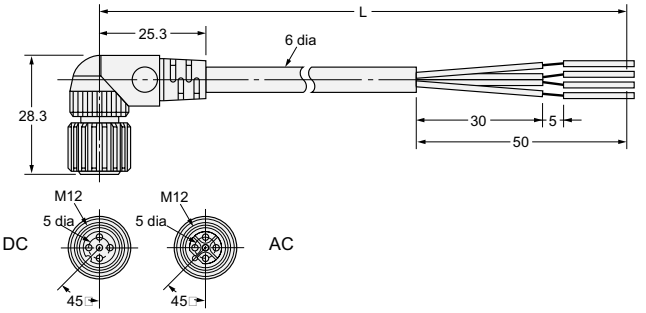
XS2F-D421-C80-A (L=1m)
XS2F-D421-D80-A (L=2m)
XS2F-D421-G80-A (L=5m)
XS2F-D421-J80-A (L=10m)
XS2F-D421-C80-R (L=1m)
XS2F-D421-D80-R (L=2m)
XS2F-D421-G80-R (L=5m)
XS2F-D421-J80-R (L=10m)





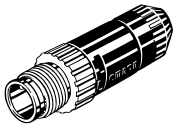
XS2F-D422-C80-A (L=1m)
XS2F-D422-D80-A (L=2m)
XS2F-D422-G80-A (L=5m)
XS2F-D422-J80-A (L=10m)
XS2F-D422-C80-R (L=1m)
XS2F-D422-D80-R (L=2m)
XS2F-D422-G80-R (L=5m)
XS2F-D422-J80-R (L=10m)

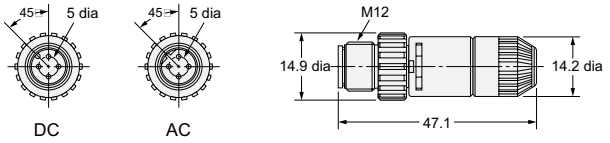




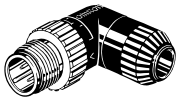
Connector Plug Assemblies, Solder Type

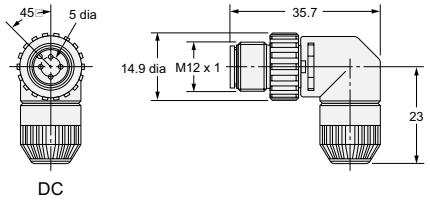
XS2G-D425





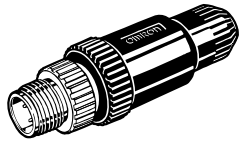
XS2G-D426

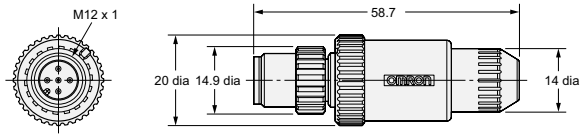




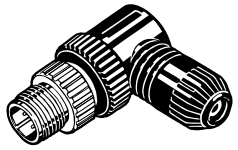
Connector Plug Assemblies, Screw-on Type

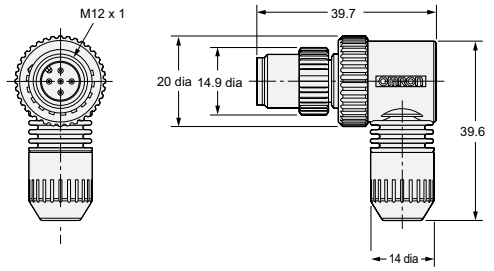
XS2G-D4S5





XS2G-D4S6

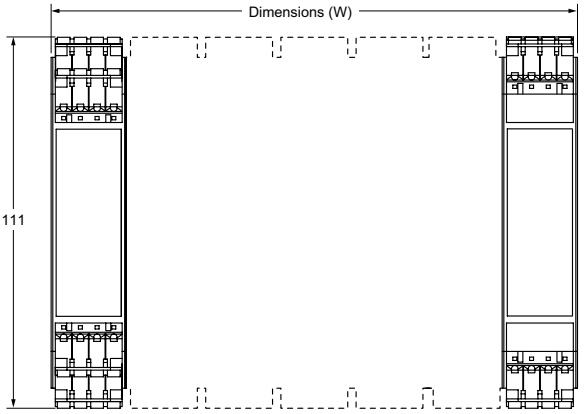


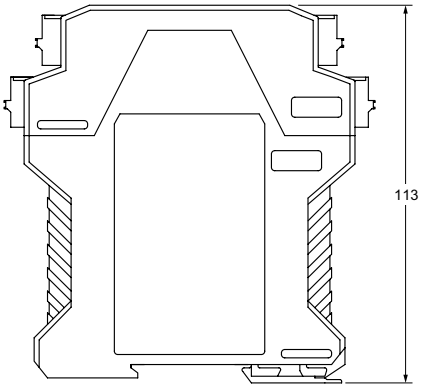


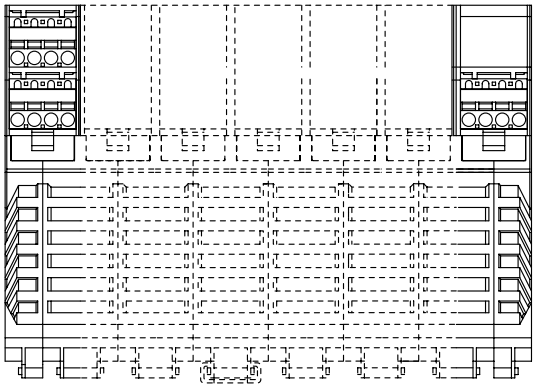
Controller

F3SX

CAD Data







Refer to Ordering Information on page BB-127 for dimension details.

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