E2EM

CSM_E2EM_DS_E_3_2

No-polarity 2-Wire Proximity Sensor with a 30-mm Sensing Distance

- Detection at up to 30 mm to reduce problems with workpiece collisions.
- No-polarity for easy wiring.
- Cable protector provided as a standard feature.

⚠ Be sure to read *Safety Precautions* on page 6.

Ordering Information

Sensors [Refer to *Dimensions* on page 7.]

DC 2-Wire, Pre-wired Models

Appearance		Sensing distance	Model	
			NO	NC
Shielded	M12	4 mm	E2EM-X4X1 2M *	E2EM-X4X2 2M
	M18	8 mm	E2EM-X8X1 2M *	E2EM-X8X2 2M
	M30	15 mm	E2EM-X15X1 2M *	E2EM-X15X2 2M
Unshielded	M18	16 mm	E2EM-X16MX1 2M	E2EM-X16MX2 2M
	M30	30 mm	E2EM-X30MX1 2M	E2EM-X30MX2 2M

* Pre-wired M12 Connector Models with a cable length of 300 mm are also available. Add -M1J to the end of the model number (example: E2EM-X4X1-M1J).

DC 3-Wire, Pre-wired Models

Appearance		Sensing distance	Model	
			Output configuration: NPN NO	Output configuration: NPN NC
Shielded	M8	2 mm	E2EM-X2C1 2M	E2EM-X2C2 2M
	M12	4 mm	E2EM-X4C1 2M	E2EM-X4C2 2M
	M18	8 mm	E2EM-X8C1 2M	E2EM-X8C2 2M
	M30	15 mm	E2EM-X15C1 2M	E2EM-X15C2 2M

DC 3-Wire, M12 Connector Models

Appearance		Sensing distance	Output configuration	Model
Shielded	M8	2 mm	NPN NO	E2EM-X2C1-M1
	M12	4 mm		E2EM-X4C1-M1
	M18	8 mm		E2EM-X8C1-M1
	M30	15 mm		E2EM-X15C1-M1

Note: Models with NPN NC output configurations are also available for all of the above models.

Accessories (Order Separately)

Sensor I/O Connectors (M12) [Refer to *XS2*.]

Appearance	Cable length	Sensor I/O Connector model number	Applicable Proximity Sensor model number
Straight 	2 m	XS2F-D421-DC0-A	E2EM-X□C□-M1
		XS2F-D421-D80-A	
	5 m	XS2F-D421-GC0-A	
		XS2F-D421-G80-A	
L-shape 	2 m	XS2F-D422-DC0-A	
		XS2F-D422-D80-A	
	5 m	XS2F-D422-GC0-A	
		XS2F-D422-G80-A	

Note: Refer to *Introduction to Sensor I/O Connectors* for details.
Use the XS2F-D42□-□CO-A for the E2EM-X□X1-M1J. (Terminal 3: 0 V (+V), Terminal 4: +V (0 V))

Ratings and Specifications

E2EM-X□X□ DC 2-Wire Models

Item \ Size		M12	M18		M30	
	Shielded	Shielded	Shielded	Unshielded	Shielded	Unshielded
Item \ Model		E2EM-X4X□	E2EM-X8X□	E2EM-X16MX□	E2EM-X15X□	E2EM-X30MX□
Sensing distance		4 mm ±10%	8 mm ±10%	16 mm ±10%	15 mm ±10%	30 mm ±10%
Set distance *1		0 to 3.2 mm	0 to 6.4 mm	0 to 12.8 mm	0 to 12 mm	0 to 24 mm
Differential travel		15% max. of sensing distance				
Detectable object		Ferrous metal (The sensing distance decreases with non-ferrous metal. Refer to *Engineering Data* on page 4.)				
Standard sensing object		Iron, 12 × 12 × 1 mm	Iron, 18 × 18 × 1 mm	Iron, 45 × 45 × 1 mm	Iron, 30 × 30 × 1 mm	Iron, 70 × 70 × 1 mm
Response frequency *2		1 kHz	0.5 kHz	0.4 kHz	0.25 kHz	0.1 kHz
Power supply voltage (operating voltage range)		12 to 24 VDC (10 to 30 VDC), ripple (p-p): 10% max.				
Leakage current		0.8 mA max.				
Control output	Load current	3 to 100 mA				
	Residual voltage *3	5 V max. (Load current: 100 mA, Cable length: 2 m)				
Indicators		X1 Models: Operation indicator (red), Setting indicator (green) X2 Models: Operation indicator (red)				
Operation mode (with sensing object approaching)		X1 Models: NO X2 Models: NC Refer to the timing charts under *I/O Circuit Diagrams* on page 5 for details.				
Protection circuits		Surge suppressor, Load short-circuit protection				
Ambient temperature range		Operating: –25 to 70°C, Storage: –40 to 85°C (with no icing or condensation)				
Ambient humidity range		Operating/Storage: 35% to 95% (with no condensation)				
Temperature influence		±15% max. of sensing distance at 23°C in the temperature range of –25 to 70°C				
Voltage influence		±1% max. of sensing distance at rated voltage in the rated voltage ±15% range				
Insulation resistance		50 MΩ min. (at 500 VDC) between current-carrying parts and case				
Dielectric strength		1,000 VAC, 50/60 Hz for 1 minute between current-carrying parts and case				
Vibration resistance		Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions				
Shock resistance		Destruction: 1,000 m/s^2 10 times each in X, Y, and Z directions				
Degree of protection		IEC 60529 IP67, in-house standards: oil-resistant				
Connection method		Pre-wired Models (Standard cable length: 2 m)				
Weight (packed state)		Approx. 60 g	Approx. 130 g	Approx. 150 g	Approx. 180 g	Approx. 210 g
Materials	Case	Nickel-plated brass				
	Sensing surface	PBT				
	Clamping nuts	Nickel-plated brass				
	Toothed washer	Zinc-plated iron				
Accessories		Instruction manual				

*1. Use the Sensor within the range in which the setting indicator (green LED) is ON (except X2 Models).
*2. The response frequency is an average value.
Measurement conditions are as follows: standard sensing object, a distance of twice the standard sensing object, and a set distance of half the sensing distance.
*3. The residual voltage is 5 V. Make sure that the device connected to the Sensor can withstand the residual voltage. (Refer to page 6 for details.)

E2EM-X□C□ DC 3-Wire Models

Item		Size	M8	M12	M18	M30
		Shielded	Shielded	Shielded	Shielded	Shielded
		Model	E2EM-X2C□(-M1)	E2EM-X4C□(-M1)	E2EM-X8C□(-M1)	E2EM-X15C□(-M1)
Sensing distance			2 mm ±10%	4 mm ±10%	8 mm ±10%	15 mm ±10%
Set distance			0 to 1.6 mm	0 to 3.2 mm	0 to 6.4 mm	0 to 12 mm
Differential travel			10% max. of sensing distance			
Detectable object			Ferrous metal (The sensing distance decreases with non-ferrous metal. Refer to *Engineering Data* on page 4.)			
Standard sensing object			Iron, 8 × 8 × 1 mm	Iron, 12 × 12 × 1 mm	Iron, 18 × 18 × 1 mm	Iron, 30 × 30 × 1 mm
Response frequency *1			1.5 kHz	0.5 kHz	0.3 kHz	0.1 kHz
Power supply voltage (operating voltage range) *2			12 to 24 VDC (10 to 40 VDC), ripple (p-p): 10% max.			
Current consumption			13 mA max.			
Control output	Load current *2		200 mA max.			
	Residual voltage		2 V max. (Load current: 200 mA, Cable length: 2 m)			
Indicators			Operation indicator (yellow)			
Operation mode (with sensing object approaching)			C1 Models: NO C2 Models: NC Refer to the timing charts under *I/O Circuit Diagrams* on page 5 for details.			
Protection circuits			Reverse polarity protection, Load short-circuit protection, Surge suppressor			
Ambient temperature range *1			Operating/Storage: –40 to 85°C (with no icing or condensation)			Operating: –25 to 70°C Storage: –40 to 85°C (with no icing or condensation)
Ambient humidity range			Operating/Storage: 35% to 95% (with no condensation)			
Temperature influence			±15% max. of sensing distance at 23°C in the temperature range of –40 to 85°C ±10% max. of sensing distance at 23°C in the temperature range of –25 to 70°C			±15% max. of sensing distance at 23°C in the temperature range of –25 to 70°C
Voltage influence			±1% max. of sensing distance at rated voltage in the rated voltage ±15% range			
Insulation resistance			50 MΩ min. (at 500 VDC) between current-carrying parts and case			
Dielectric strength			1,000 VAC, 50/60 Hz for 1 minute between current-carrying parts and case			
Vibration resistance			Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions			
Shock resistance			Destruction: 500 m/s^2 10 times each in X, Y, and Z directions	Destruction: 1,000 m/s^2 10 times each in X, Y, and Z directions		
Degree of protection			Pre-wired Models: IEC 60529 IP67, in-house standards: oil-resistant Connector Models: IEC 60529 IP67			
Connection method			Pre-wired Models (Standard cable length: 2 m) Connector Models			
Weight (packed state)	Pre-wired Models		Approx. 65 g	Approx. 75 g	Approx. 150 g	Approx. 195 g
	Connector Models		Approx. 15 g	Approx. 25 g	Approx. 40 g	Approx. 90 g
Materials	Case		Stainless steel (SUS303)	Nickel-plated brass		
	Sensing surface		PBT			
	Clamping nuts		Nickel-plated brass			
	Toothed washer		Zinc-plated iron			
Accessories			Instruction manual			

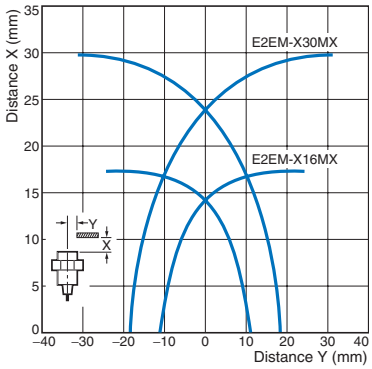
*1. The response frequency is an average value.
Measurement conditions are as follows: standard sensing object, a distance of twice the standard sensing object, and a set distance of half the sensing distance.
*2. When using an M8 Model at an ambient temperature between 70 and 85°C, supply 10 to 30 VDC to the Sensor and make sure that the Sensor has a control output of 100 mA maximum.

Engineering Data (Typical)

Sensing Area

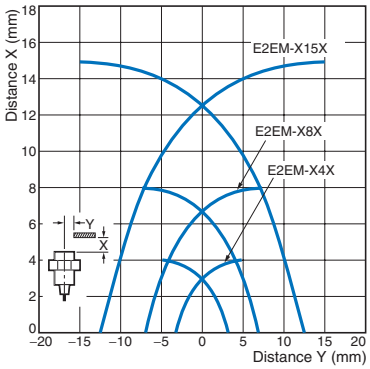
Unshielded Models

E2EM-X□MX□

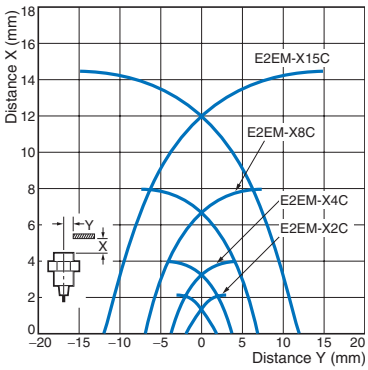


Shielded Models

E2EM-X□X□

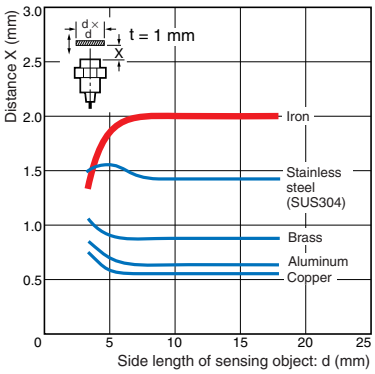


E2EM-X□C□

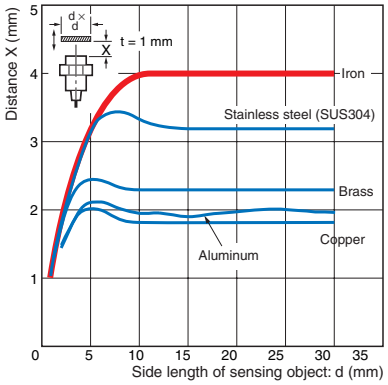


Influence of Sensing Object Size and Material

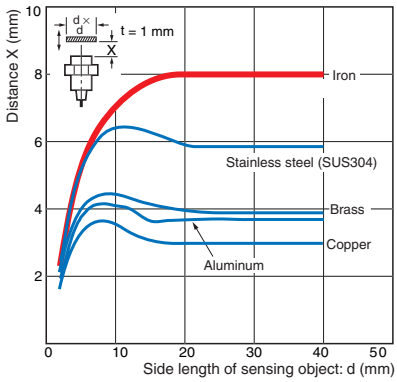
E2EM-X2□□(-M1)



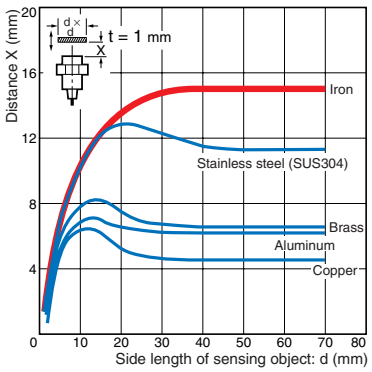
E2EM-X4□□(-M1)



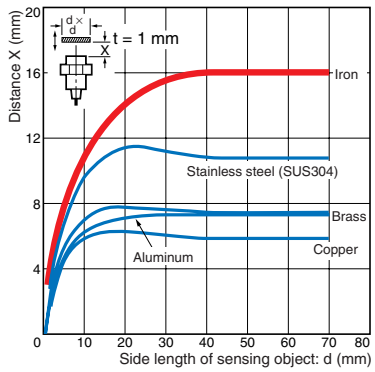
E2EM-X8□□(-M1)



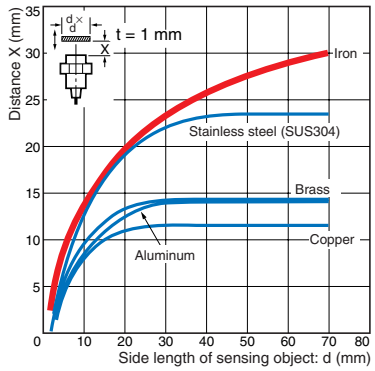
E2EM-X15□□(-M1)



E2EM-X16MX□

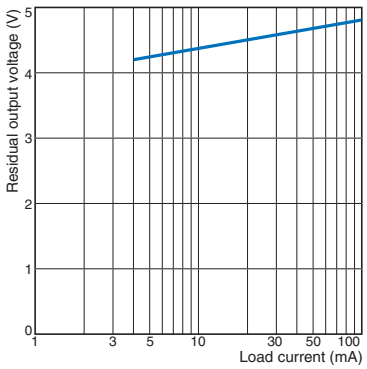


E2EM-X30MX□



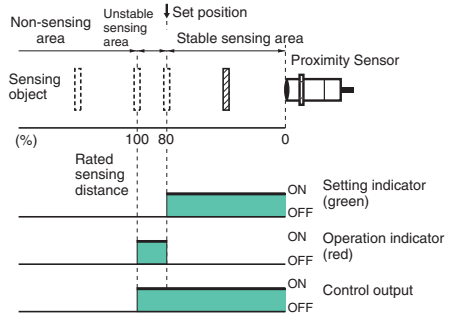
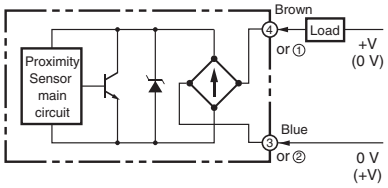
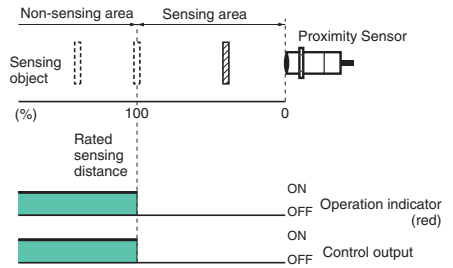
Residual Output Voltage

E2EM-X□X□

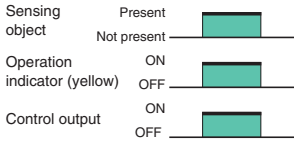
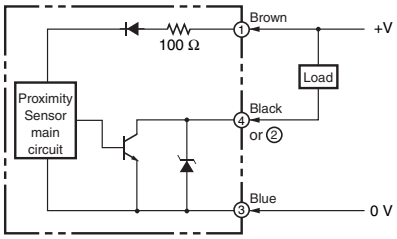
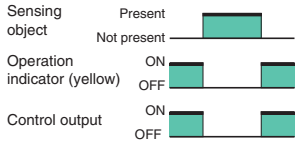


I/O Circuit Diagrams

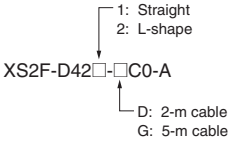
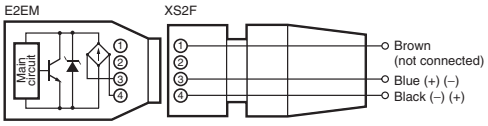
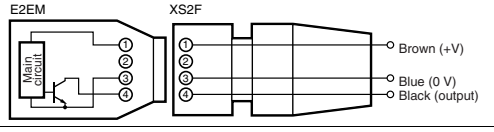
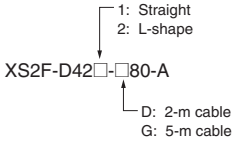
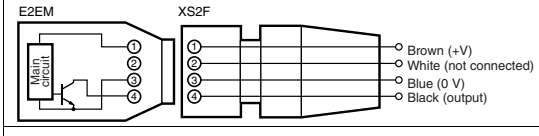
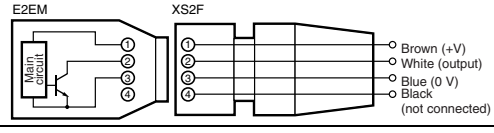
E2EM-X□X□ DC 2-Wire Models

Operation mode	Model	Timing chart	Output circuit
NO	E2EM-X4X1 E2EM-X8X1 E2EM-X15X1 E2EM-X16MX1 E2EM-X30MX1		
NC	E2EM-X4X2 E2EM-X8X2 E2EM-X15X2 E2EM-X16MX2 E2EM-X30MX2		Note 1. The load can be connected to either the +V or 0 V side. Note 2. There is no polarity. Therefore, the brown and blue lines have no polarity. Note 3. Use pins 4 and 3 for NO. Use pins 1 and 2 for NC.

E2EM-X□C□(-M1) DC 3-Wire Models

Operation mode	Output specifications	Model	Timing chart	Output circuit
NO	NPN Open-collector output	E2EM-X2C1(-M1) E2EM-X4C□1-M1) E2EM-X8C1(-M1) E2EM-X15C1(-M1)		
NC		E2EM-X2C2 E2EM-X4C2 E2EM-X8C2 E2EM-X15C2		Note: Use pin 4 for NO. Use pin 2 for NC.

Connections for Sensor I/O Connectors

Proximity Sensor			Sensor I/O Connector model	Connections
Type	Operation mode	Model		
DC 2-wire	NO	E2EM-X□X1-M1J		
DC 3-wire	NO	E2EM-X□C1-M1		
	NC	E2EM-X□C2-M1		
				

Refer to the *Sensor I/O Connector Group Catalog* (Cat. No. X073) for details.

Safety Precautions

Refer to *Warranty and Limitations of Liability*.

⚠ WARNING

This product is not designed or rated for ensuring safety of persons either directly or indirectly. Do not use it for such purposes.

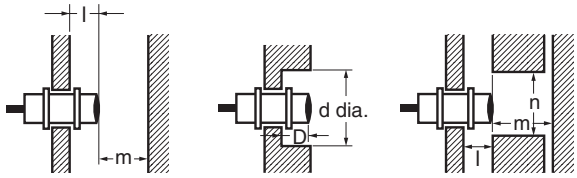
Precautions for Correct Use

Do not use this product under ambient conditions that exceed the ratings.

● Design

Influence of Surrounding Metal

When mounting the Sensor within a metal panel, ensure that the clearances given in the following table are maintained. Failure to maintain these distances may cause deterioration in the performance of the Sensor.



Influence of Surrounding Metal (Unit: mm)

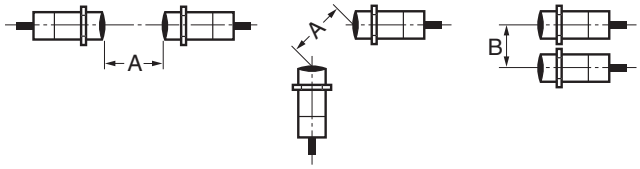
Type		Item	M8	M12	M18	M30
DC 2-wire E2EM-X□X□	Shielded	l		2.4	3.6	6
		d		18	27	45
		D	---	2.4	3.6	6
		m		12	24	45
		n		18	27	45
	Unshielded	l			25	45
		d			70	120
		D	---	---	25	45
		m			48	90
		n			70	120
DC 3-wire E2EM-X□C□	Shielded	l	0	2.4	3.6	6
		d	8	18	27	45
		D	0	2.4	3.6	6
		m	4.5	12	24	45
		n	12	18	27	45

AND/OR Connections

Error pulses and leakage current may prevent application in AND or OR circuits. Always confirm operation in advance to confirm if there are any problems in operation.

Mutual Interference

When installing Sensors face-to-face or side-by-side, ensure that the minimum distances given in the following table are maintained.



Mutual Interference (Unit: mm)

Type		Item	M8	M12	M18	M30
DC 2-wire E2EM-X□X□	Shielded	A		30	60	110
		B		20	35	90
	Unshielded	A	---	---	200	350
		B			120	300
DC 3-wire E2EM-X□C□	Shielded	A	20	30	60	110
		B	15	20	35	90

Connecting a DC 2-wire Proximity Sensor to a PLC (Programmable Controller)

Required Conditions

Connection to a PLC is possible if the specifications of the PLC and the Proximity Sensor satisfy the following conditions. (The meanings of the symbols are given below.)

1. The ON voltage of the PLC and the residual voltage of the Proximity Sensor must satisfy the following.
   $V_{ON} \leq V_{CC} - V_R$
2. The OFF current of the PLC and the leakage current of the Proximity Sensor must satisfy the following.
   $I_{OFF} \geq I_{leak}$
   (If the OFF current is not listed in the specifications, take it to be 1.3 mA.)
3. The ON current of the PLC and the control output (I_{OUT}) of the Proximity Sensor must satisfy the following.
   I_{OUT} (min.) $\leq I_{ON} \leq I_{OUT}$ (max.)
   The ON current of the PLC will vary, however, with the power supply voltage and the input impedance, as shown in the following equation.
   $I_{ON} = (V_{CC} - V_R - V_{PC})/R_{IN}$

V_{ON}: ON voltage of PLC (14.4 V)
I_{ON}: ON current of PLC (typ. 7 mA)
I_{OFF}: OFF current of PLC (1.3 mA)
RIN: Input impedance of PLC (3 kΩ)
V_{PC}: Internal residual voltage of PLC (4 V)
V_R: Output residual voltage of Proximity Sensor (5 V)
I_{leak}: Leakage current of Proximity Sensor (0.8 mA)
I_{OUT}: Control output of Proximity Sensor (3 to 100 mA)
V_{CC}: Power supply voltage (PLC: 20.4 to 26.4 V)

Values in parentheses apply to the following PLC model and Proximity Sensor model.
PLC: C200H-ID212
Sensor: E2EM-X8X1

Example

In this example, the above conditions are checked when the PLC Unit is the C200H-ID212, the Proximity Sensor is the E2EM-X8X1, and the power supply voltage is 24 V.

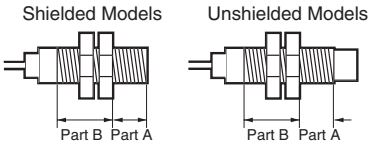
1. V_{ON} (14.4 V) $\leq V_{CC}$ (20.4 V) $- V_R$ (5 V) = 15.4 V: OK
2. I_{OFF} (1.3 mA) $\geq I_{leak}$ (0.8 mA): OK
3. $I_{ON} = [V_{CC}$ (20.4 V) $- V_R$ (5 V) $- V_{PC}$ (4 V)$]/R_{IN}$ (3 kΩ) = Approx. 3.8 mA

Therefore, I_{OUT}(min.) (3 mA) $\leq I_{ON}$ (3.8 mA): OK

● Mounting

Tightening Force

Do not tighten the nut with excessive force.
A washer must be used with the nut.



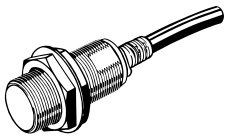
Note: 1. The allowable tightening strength depends on the distance from the edge of the head, as shown in the following table. (A is the distance from the edge of the head. B includes the nut on the head side. If the edge of the nut is in part A, the tightening torque for part A applies instead.)
2. The following strengths assume washers are being used.

Model		Torque	Part A		Part B
			Dimension (mm)	Torque	Torque
M8	Shielded		9	9 N·m	12 N·m
M12				30 N·m	
M18				70 N·m	
M30				180 N·m	

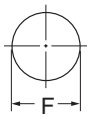
Dimensions

(Unit: mm)
Tolerance class IT16 applies to dimensions in this data sheet unless otherwise specified.

Pre-wired Models (Shielded)

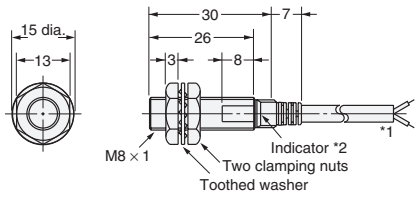


Mounting Hole Dimensions



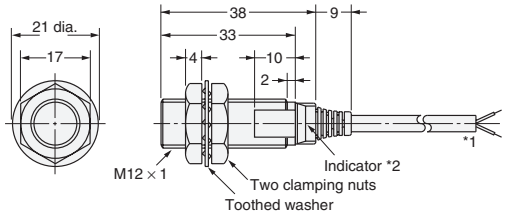
Dimensions	M8	M12	M18	M30
F (mm)	8.5 $^{+0.5}_{0}$ dia.	12.5 $^{+0.5}_{0}$ dia.	18.5 $^{+0.5}_{0}$ dia.	30.5 $^{+0.5}_{0}$ dia.

E2EM-X2C□



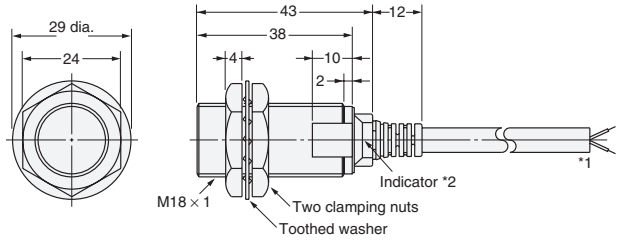
1. 4-dia. vinyl-insulated round cable with 2/3 conductors (Conductor cross section: 0.3 mm^2, Insulator diameter: 1.3 mm), Standard length: 2 m
The cable can be extended up to 200 m (separate metal conduit).
2. Operation indicator (yellow)

E2EM-X4□□



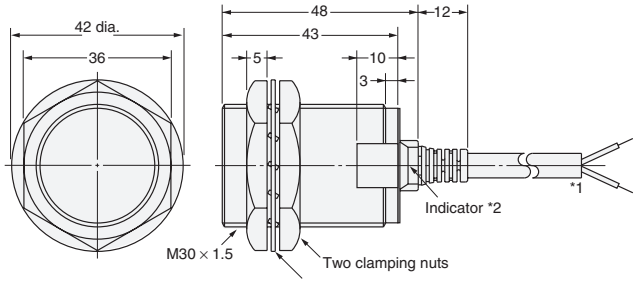
1. 4-dia. vinyl-insulated round cable with 2/3 conductors (Conductor cross section: 0.3 mm^2, Insulator diameter: 1.3 mm), Standard length: 2 m
2. X1 Models: Operation indicator (red) Setting indicator (green)
X2 Models: Operation indicator (red)
C Models: Operation indicator (yellow)

E2EM-X8□□



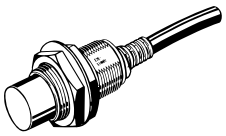
1. 6-dia. vinyl-insulated round cable with 2/3 conductors (Conductor cross section: 0.5 mm^2, Insulator diameter: 1.9 mm), Standard length: 2 m
2. X1 Models: Operation indicator (red) Setting indicator (green)
X2 Models: Operation indicator (red)
C Models: Operation indicator (yellow)

E2EM-X15□□

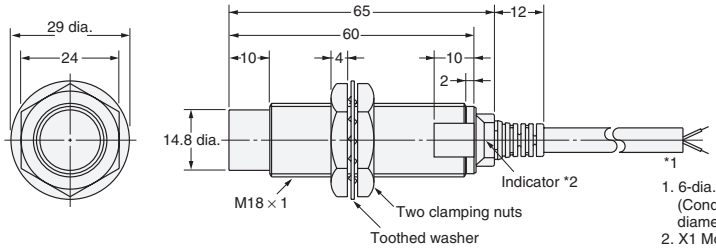


1. 6-dia. vinyl-insulated round cable with 2/3 conductors (Conductor cross section: 0.5 mm^2, Insulator diameter: 1.9 mm), Standard length: 2 m
2. X1 Models: Operation indicator (red) Setting indicator (green)
X2 Models: Operation indicator (red)
C Models: Operation indicator (yellow)

Pre-wired Models (Unshielded)

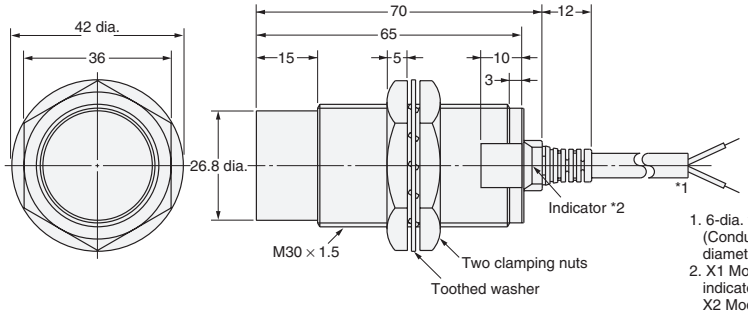


E2EM-X16MX□



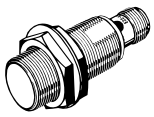
1. 6-dia. vinyl-insulated round cable with 2 conductors (Conductor cross section: 0.5 mm^2, Insulator diameter: 1.9 mm), Standard length: 2 m
2. X1 Models: Operation indicator (red), Setting indicator (green)
   X2 Models: Operation indicator (red)

E2EM-X30MX□



1. 6-dia. vinyl-insulated round cable with 2 conductors (Conductor cross section: 0.5 mm^2, Insulator diameter: 1.9 mm), Standard length: 2 m
2. X1 Models: Operation indicator (red), Setting indicator (green)
   X2 Models: Operation indicator (red)

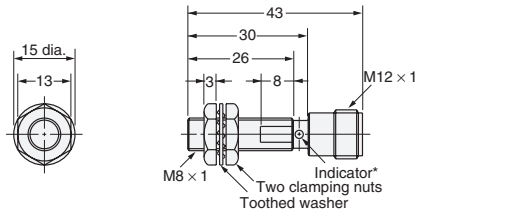
Connector Models (Shielded)



Mounting Hole Dimensions

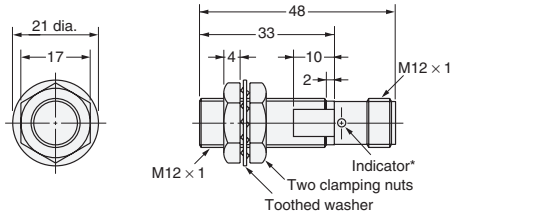
Dimensions	M8	M12	M18	M30
F (mm)	8.5 $^{+0.5}_{0}$ dia.	12.5 $^{+0.5}_{0}$ dia.	18.5 $^{+0.5}_{0}$ dia.	30.5 $^{+0.5}_{0}$ dia.

E2EM-X2C□-M1



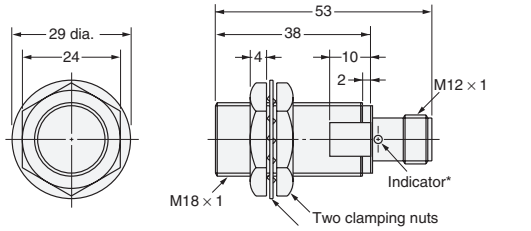
* Operation indicator (yellow)

E2EM-X4C□-M1



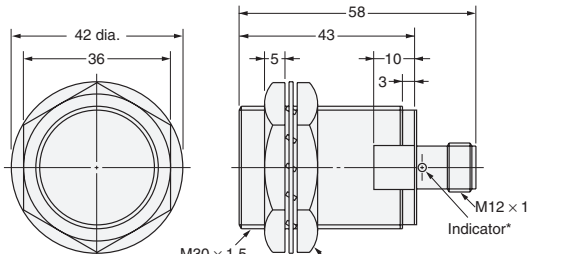
* Operation indicator (yellow)

E2EM-X8C□-M1



* Operation indicator (yellow)

E2EM-X15C□-M1



* Operation indicator (yellow)

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