E2E2

Proximity Sensor with a Long Screw Length

- Increased tightening strength. Cable protectors provided as a standard feature.
- Increased indicator visibility. A milled section for wrench grip on all models.

Be sure to read *Safety Precautions* on page 9.

Ordering Information

Sensors

DC 2-Wire Models

Appearance		Sensing distance	Model Operation mode NO	Model Operation mode NC
Shielded	M12	3 mm	E2E2-X3D1 *	E2E2-X3D2
	M18	7 mm	E2E2-X7D1 *	E2E2-X7D2
	M30	10 mm	E2E2-X10D1 *	E2E2-X10D2
Unshielded	M12	8 mm	E2E2-X8MD1 *	E2E2-X8MD2
	M18	14 mm	E2E2-X14MD1 *	E2E2-X14MD2
	M30	20 mm	E2E2-X20MD1 *	E2E2-X20MD2

*Models with different frequencies are also available. The model numbers are E2E2-X☐D15 (example: E2E2-X3D15).

DC 3-Wire Models

Appearance		Sensing distance	Model Operation mode NO	Model Operation mode NC
Shielded	M12	2 mm	E2E2-X2C1	E2E2-X2C2
	M18	5 mm	E2E2-X5C1	E2E2-X5C2
	M30	10 mm	E2E2-X10C1	E2E2-X10C2
Unshielded	M12	5 mm	E2E2-X5MC1	E2E2-X5MC2
	M18	10 mm	E2E2-X10MC1	E2E2-X10MC2
	M30	18 mm	E2E2-X18MC1	E2E2-X18MC2

AC 2-Wire Models

Appearance		Sensing distance	Model Operation mode NO	Model Operation mode NC
Shielded	M12	2 mm	E2E2-X2Y1	E2E2-X2Y2
	M18	5 mm	E2E2-X5Y1	E2E2-X5Y2
	M30	10 mm	E2E2-X10Y1	E2E2-X10Y2
Unshielded	M12	5 mm	E2E2-X5MY1	E2E2-X5MY2
	M18	10 mm	E2E2-X10MY1	E2E2-X10MY2
	M30	18 mm	E2E2-X18MY1	E2E2-X18MY2

Accessories (Order Separately)

Mounting Brackets
Protective Covers
Sputter Protective Covers

Ratings and Specifications

E2E2-X□D□ DC 2-Wire Models

Item / Size	M12		M18		M30	
Shielding	Shielded	Unshielded	Shielded	Unshielded	Shielded	Unshielded
Model	E2E2-X3D□	E2E2-X8MD□	E2E2-X7D□	E2E2-X14MD□	E2E2-X10D□	E2E2-X20MD□
Sensing distance	3 mm±10%	8 mm±10%	7 mm±10%	14 mm±10%	10 mm±10%	20 mm±10%
Set distance *1	0 to 2.4 mm	0 to 6.4 mm	0 to 5.6 mm	0 to 11.2 mm	0 to 8 mm	0 to 16 mm
Differential travel	10% max. of sensing distance					
Sensing object	Ferrous metal (The sensing distance decreases with non-ferrous metal. Refer to *Engineering Data* on page 5.)					
Standard sensing object	Iron, 12 × 12 × 1 mm	Iron, 30 × 30 × 1 mm	Iron, 18 × 18 × 1 mm	Iron, 30 × 30 × 1 mm	Iron, 30 × 30 × 1 mm	Iron, 54 × 54 × 1 mm
Response frequency *2	1 kHz	800 Hz	500 Hz	400 Hz		100 Hz
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: Switching capacity	3 to 100 mA					
Control output: Residual voltage	3 V max. (Load current: 100 mA, Cable length: 2 m)					
Indicators	D1 Models: Operation indicator (red) and setting indicator (green) D2 Models: Operation indicator (red)					
Operation mode (with sensing object approaching)	D1 Models: NO D2 Models: NC Refer to the timing charts under *I/O Circuit Diagrams* on page 8 for details.					
Protection circuits	Surge absorber, Load short-circuit protection					
Ambient temperature	Operating/Storage: –25 to 70°C (with no icing or condensation)					
Ambient humidity	Operating/Storage: 35% to 95% (with no condensation)					
Temperature influence	±10% 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	1000 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 IP67, in-house standard for oil resistance					
Connection method	Pre-wired Models (Standard cable length: 2 m)					
Weight (packed state)	Approx. 65 g		Approx. 150 g		Approx. 210 g	
Materials: Case	Brass					
Materials: Sensing surface	PBT					
Materials: Clamping nuts	Nickel-plated brass					
Materials: Toothed washer	Zinc-plated iron					
Accessories	Instruction sheet					

*1. Use the E2E2 within the range in which the setting indicator (green LED) is ON (except D2 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.

E2E2-X□C□ DC 3-Wire Models

Item / Size / Shielding / Model		M12		M18		M30	
	Shielding	Shielded	Unshielded	Shielded	Unshielded	Shielded	Unshielded
Item	Model	E2E2-X2C□	E2E2-X5MC□	E2E2-X5C□	E2E2-X10MC□	E2E2-X10C□	E2E2-X18MC□
Sensing distance		2 mm±10%	5 mm±10%	5 mm±10%	10 mm±10%	10 mm±10%	18 mm±10%
Set distance		0 to 1.6 mm	0 to 4 mm	0 to 4 mm	0 to 8 mm	0 to 8 mm	0 to 14 mm
Differential travel		10% max. of sensing distance					
Sensing object		Ferrous metal (The sensing distance decreases with non-ferrous metal. Refer to *Engineering Data* on page 5.)					
Standard sensing object		Iron, 12 × 12 × 1 mm	Iron, 15 × 15 × 1 mm	Iron, 18 × 18 × 1 mm	Iron, 30 × 30 × 1 mm	Iron, 30 × 30 × 1 mm	Iron, 54 × 54 × 1 mm
Response frequency *1		1.5 kHz	400 Hz	600 Hz	200 Hz	400 Hz	100 Hz
Power supply voltage (operating voltage range) *2		12 to 24 VDC (10 to 55 VDC), ripple (p-p): 10% max.					
Leakage current		13 mA max.					
Control output	Load current	NPN open-collector output, 200 mA max. (55 VDC max.)					
	Residual voltage	2 V max. (Load current: 200 mA, Cable length: 2 m)					
Indicators		Operation indicator (red)					
Operation mode (with sensing object approaching)		C1 Models: NO C2 Models: NC	Refer to the timing charts under *I/O Circuit Diagrams* on page 8 for details.				
Protection circuits		Reverse polarity protection, Surge absorber, Load short-circuit protection					
Ambient temperature		Operating/Storage: –40 to 85°C (with no icing or condensation)					
Ambient humidity		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					
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 carry 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 IP67, in-house standard for oil resistance					
Connection method		Pre-wired Models (Standard cable length: 2 m) and Connector Models					
Weight (packed state)		Approx. 75 g		Approx. 160 g		Approx. 220 g	
Materials	Case	Brass					
	Sensing surface	PBT					
	Clamping nuts	Nickel-plated brass					
	Toothed washer	Zinc-plated iron					
Accessories		Instruction sheet					

*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. A full-wave rectification power supply of 24 VDC ±20% (average value) can be used.

E2E2-X□Y□ AC 2-Wire Models

Item	Size	M12		M18		M30	
	Shielding	Shielded	Unshielded	Shielded	Unshielded	Shielded	Unshielded
Item	Model	E2E2-X2Y□	E2E2-X5MY□	E2E2-X5Y□	E2E2-X10MY□	E2E2-X10Y□	E2E2-X18MY□
Sensing distance		2 mm±10%	5 mm±10%	5 mm±10%	10 mm±10%	10 mm±10%	18 mm±10%
Set distance		0 to 1.6 mm	0 to 4 mm	0 to 4 mm	0 to 8 mm	0 to 8 mm	0 to 14 mm
Differential travel		10% max. of sensing distance					
Sensing object		Ferrous metal (The sensing distance decreases with non-ferrous metal. Refer to *Engineering Data* on page 5.)					
Standard sensing object		Iron, 12 × 12 × 1 mm	Iron, 15 × 15 × 1 mm	Iron, 18 × 18 × 1 mm	Iron, 30 × 30 × 1 mm	Iron, 30 × 30 × 1 mm	Iron, 54 × 54 × 1 mm
Response frequency		25 Hz					
Power supply voltage (operating voltage range) *1		24 to 240 VAC (20 to 264 VAC), 50/60 Hz					
Leakage current		1.7 mA max.					
Control output	Load current *2	5 to 200 mA		5 to 300 mA			
	Residual voltage	Refer to *Engineering Data* on page 5.					
Indicators		Operation indicator (red)					
Operation mode (with sensing object approaching)		Y1 Models: NO Y2 Models: NC	Refer to the timing charts under *I/O Circuit Diagrams* on page 8 for details.				
Ambient temperature *1, 2		Operating/Storage: –40 to 85°C (with no icing or condensation)					
Ambient humidity		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					
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		4,000 VAC, 50/60 Hz for 1 minute between current carry 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 IP67, in-house standard for oil resistance					
Connection method		Pre-wired Models (Standard cable length: 2 m) and Connector Models					
Weight (packed state)		Approx. 65 g		Approx. 150 g		Approx. 210 g	
Materials	Case	Brass					
	Sensing surface	PBT					
	Clamping nuts	Nickel-plated brass					
	Toothed washer	Zinc-plated iron					
Accessories		Instruction sheet					

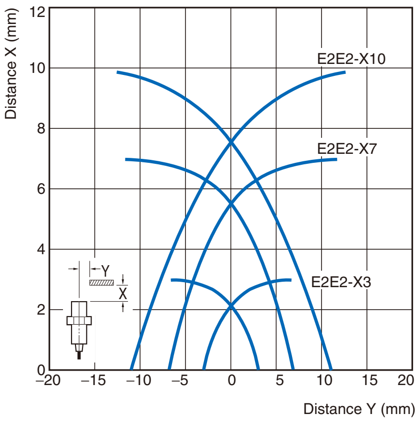
*1. When supplying 24 VAC to any of the above models, make sure that the operating ambient temperature range is at least –25°C to 85°C.
*2. When using an M18 or M30 Connector Model at an ambient temperature between 70 and 85°C, make sure that the Sensor has a control output (load current) of 5 to 200 mA max.

Engineering Data (Typical)

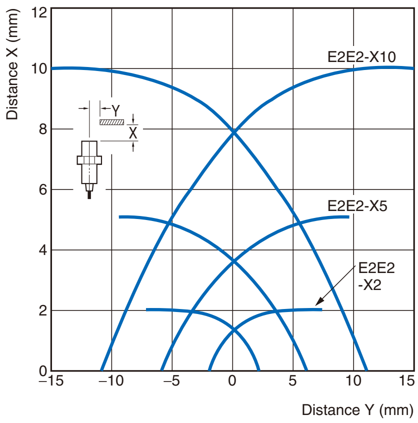
Sensing Area

Shielded Models

E2E2-X□D□

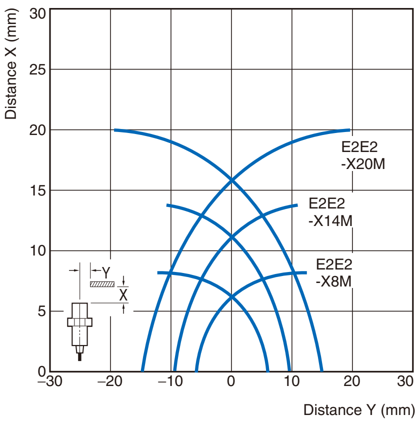


E2E2-X□C□/-X□Y□

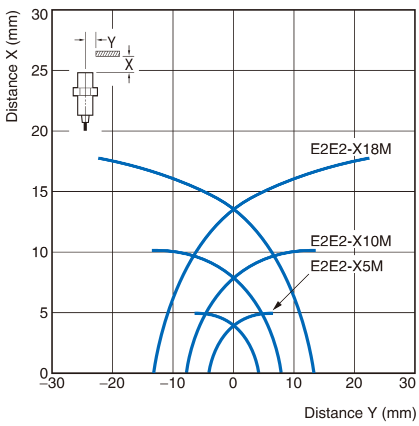


Unshielded Models

E2E2-X□MD□

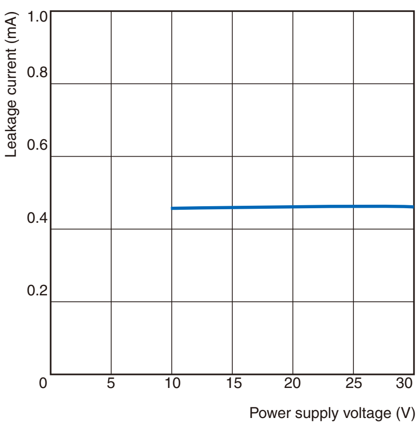


E2E2-X□MC□/-X□MY□

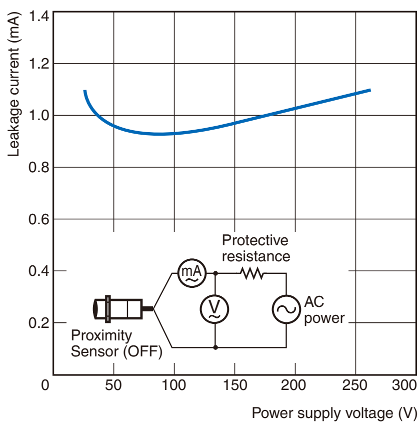


Leakage Current

E2E2-X□D□

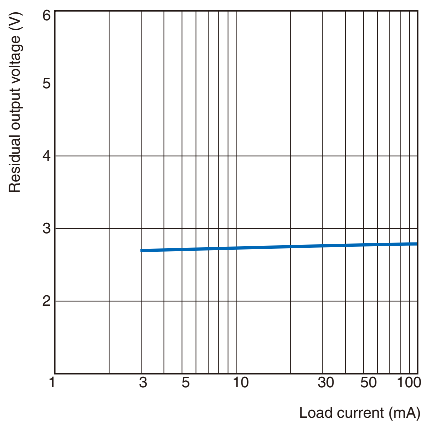


E2E2-X□Y□

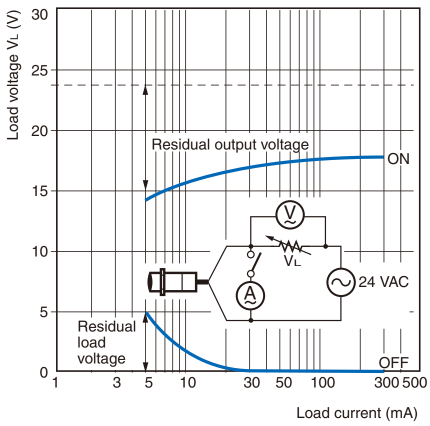


Residual Output Voltage

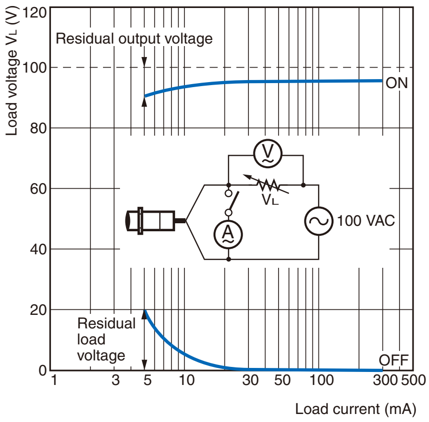
E2E2-X□D□



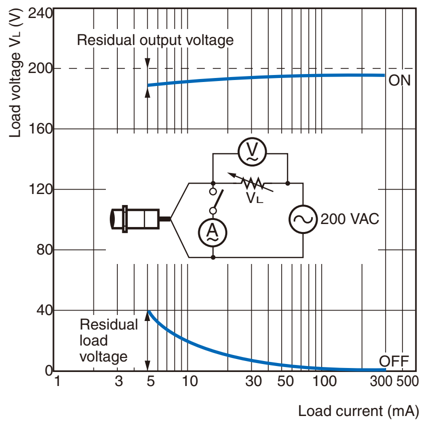
E2E2-X□Y□ at 24 VAC



E2E2-X□Y□ at 100 VAC

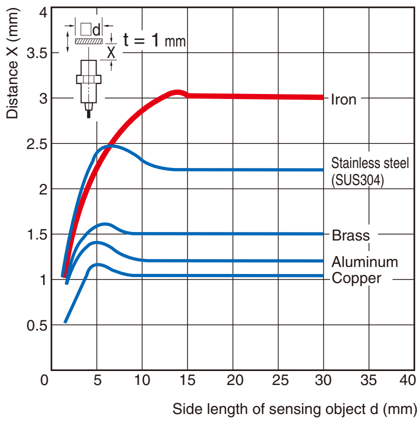


E2E2-X□Y□ at 200 VAC

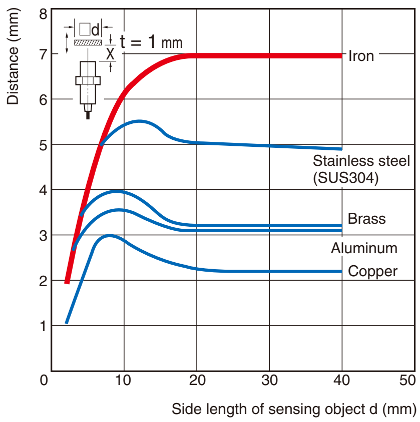


Influence of Sensing Object Size and Material

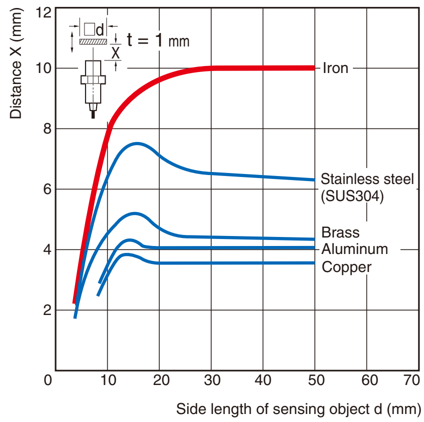
E2E2-X3D□



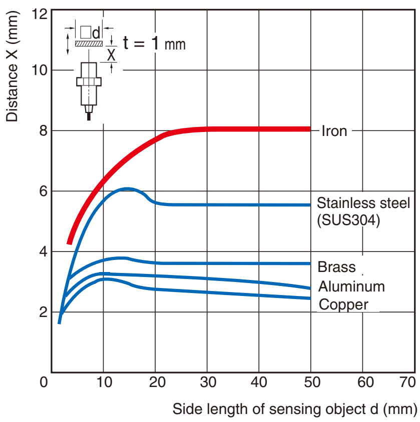
E2E2-X7D□



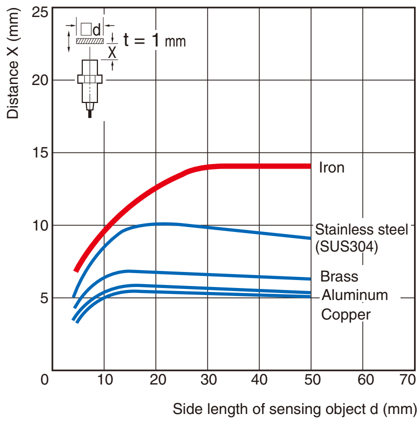
E2E2-X10D□



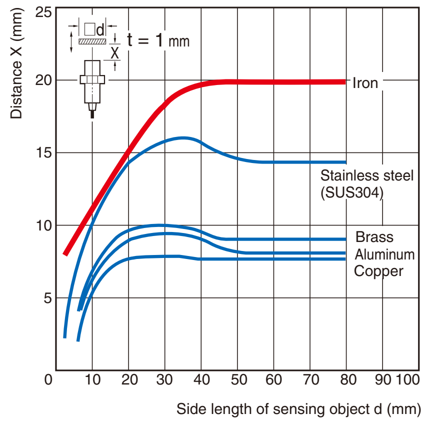
E2E2-X8MD□



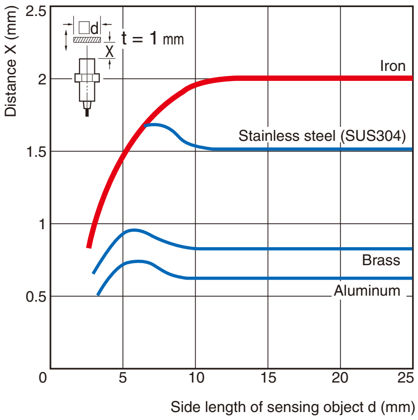
E2E2-X14MD□



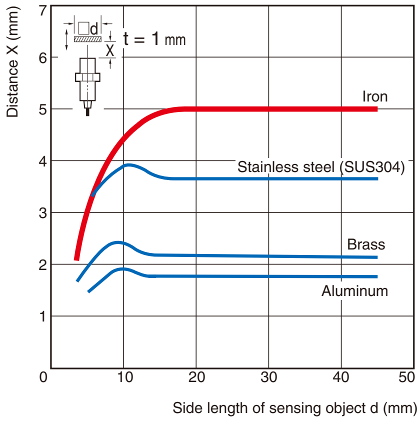
E2E2-X20MD□



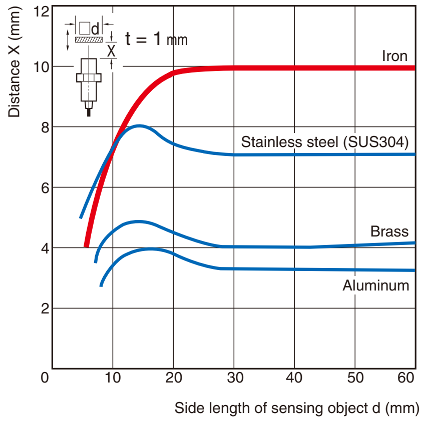
E2E2-X2C□/-X2Y□



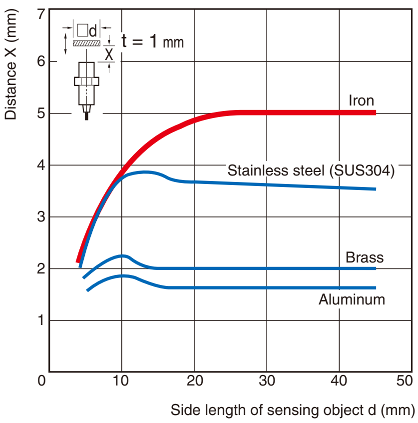
E2E2-X5C□/-X5Y□



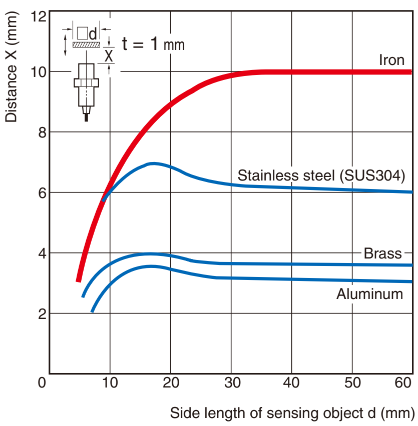
E2E2-X10C□/-X10Y□



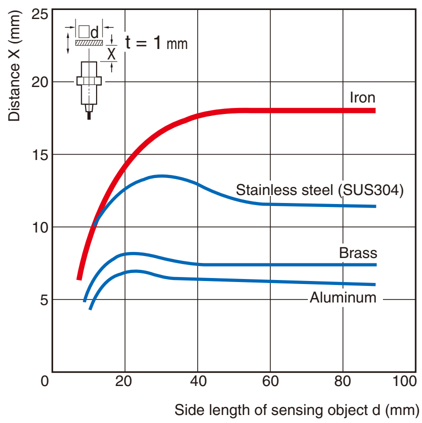
E2E2-X5MC□/-X5MY□



E2E2-X10MC□/-X10MY□

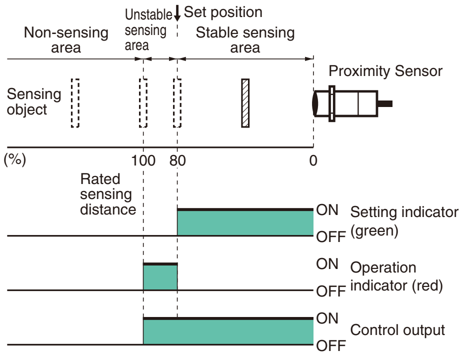
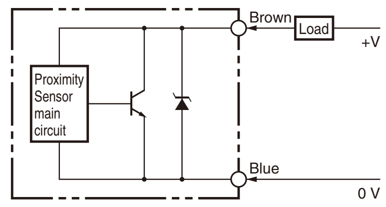
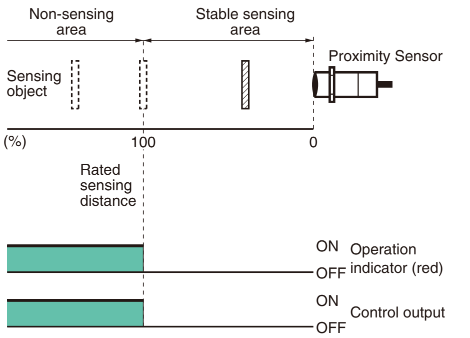


E2E2-X18MC□/-X18MY□

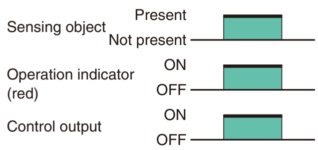
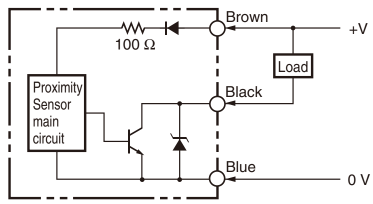
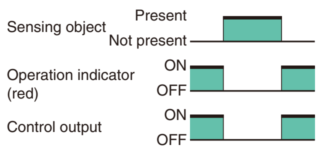


I/O Circuit Diagrams

DC 2-Wire Models

Operation mode	Model	Timing Charts	Output circuit
NO	E2E2-X3D1 E2E2-X7D1 E2E2-X10D1 E2E2-X8MD1 E2E2-X14MD1 E2E2-X20MD1		 Note: The load can be connected to either the +V or 0 V side.
NC	E2E2-X3D2 E2E2-X7D2 E2E2-X10D2 E2E2-X8MD2 E2E2-X14MD2 E2E2-X20MD2		

DC 3-Wire Models

Operation mode	Model	Timing Charts	Output circuit
NO	E2E2-X2C1 E2E2-X5C1 E2E2-X10C1 E2E2-X5MC1 E2E2-X10MC1 E2E2-X18MC1		
NC	E2E2-X2C2 E2E2-X5C2 E2E2-X10C2 E2E2-X5MC2 E2E2-X10MC2 E2E2-X18MC2		

AC 2-Wire Models

<table>
<tr><th>Operation mode</th><th>Model</th><th>Timing Charts</th><th>Output circuit</th></tr>
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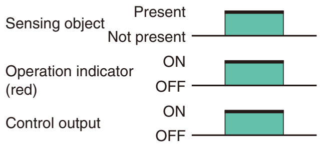
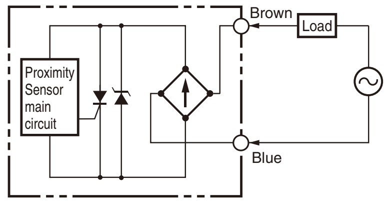
E2E2-X10Y1
E2E2-X5MY1
E2E2-X10MY1
E2E2-X18MY1</td><td>
</td><td rowspan="2">
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E2E2-X10Y2
E2E2-X5MY2
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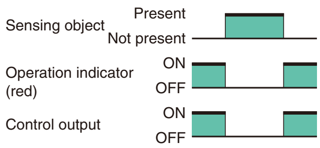
E2E2-X18MY2</td><td>
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Safety Precautions

WARNING

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

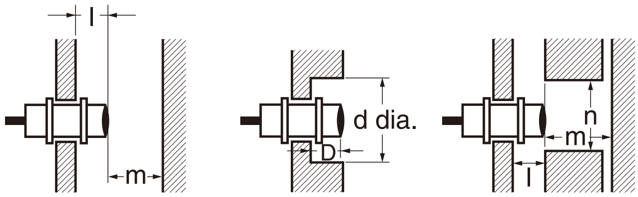
Precautions for Correct Use

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.

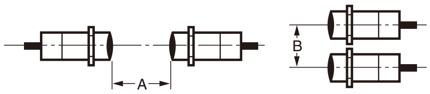


(Unit: mm)

Model		Item	M12	M18	M30
DC 2-Wire Models E2E2-X☐D☐	Shielded	l	0	0	0
		d	12	18	30
		D	0	0	0
		m	8	20	40
		n	18	27	45
	Unshielded	l	15	22	30
		d	40	70	90
		D	15	22	30
		m	20	40	70
		n	40	70	90
DC 3-Wire Models E2E2-X☐C☐ AC 2-Wire Models E2E2-X☐Y☐	Shielded	l	0	0	0
		d	12	18	30
		D	0	0	0
		m	8	20	40
		n	18	27	45
	Unshielded	l	15	22	30
		d	40	55	90
		D	15	22	30
		m	20	40	70
		n	36	54	90

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)

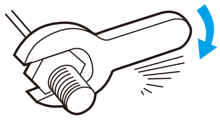
Model		Item	M12	M18	M30
DC 2-Wire Models E2E2-X□D□	Shielded	A	30 (20)	50 (30)	100 (50)
		B	20 (12)	35 (18)	70 (35)
	Unshielded	A	120 (60)	200 (100)	300 (100)
		B	100 (50)	110 (60)	200 (100)
DC 3-Wire Models E2E2-X□C□ AC 2-Wire Models E2E2-X□Y□	Shielded	A	30	50	100
		B	20	35	70
	Unshielded	A	120	200	300
		B	100	110	200

Note: Values in parentheses apply to Sensors operating at different frequencies.

● Mounting

Tightening Torque

Do not tighten the nut with excessive force.
A washer must be used with the nut.
The following strengths assume washers are being used.



Model	Torque
M12	30 N·m
M18	70 N·m
M30	180 N·m

Relationship between Sizes and Models

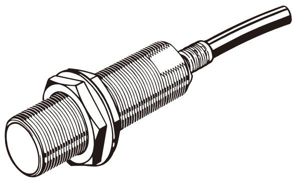
Size		Model
M12	Shielded	E2E2-X3D□ E2E2-X2C□ E2E2-X2Y□
	Unshielded	E2E2-X8MD□ E2E2-X5MC□ E2E2-X5MY□
M18	Shielded	E2E2-X7D□ E2E2-X5C□ E2E2-X5Y□
	Unshielded	E2E2-X14MD□ E2E2-X10MC□ E2E2-X10MY□
M30	Shielded	E2E2-X10D□ E2E2-X10C□ E2E2-X10Y□
	Unshielded	E2E2-X20MD□ E2E2-X18MC□ E2E2-X18MY□

Dimensions

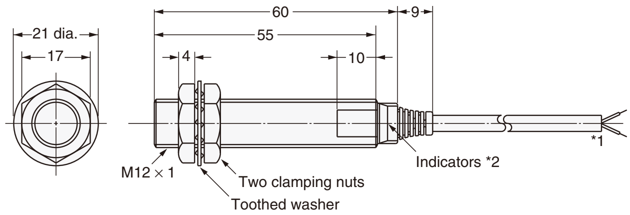
(Unit: mm)

Unless otherwise specified, the tolerance class IT16 is used for dimensions in this data sheet.

Shielded

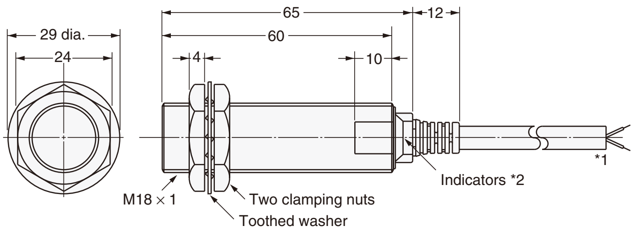


E2E2-X3D□/E2E2-X2C□/E2E2-X2Y□



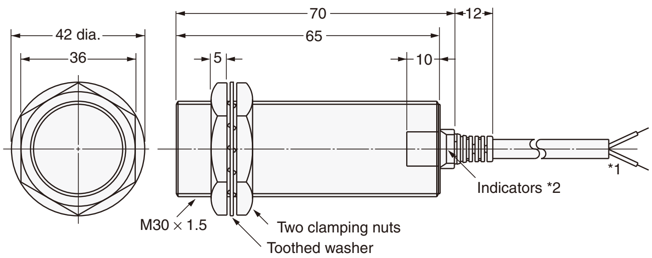
*1. 4-dia. vinyl-insulated round cable with 2 conductors (Conductor cross section: 0.3 mm², Insulator diameter: 1.3 mm), Standard length: 2 m
4-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.3 mm², Insulator diameter: 1.3 mm), Standard length: 2 m
The cable can be extended to up to 200 m (Separate metal conduit.)
*2. D Models: Operation indicator (red) and setting indicator (green), C/Y Models: Operation indicator (red)

E2E2-X7D□/E2E2-X5C□/E2E2-X5Y□



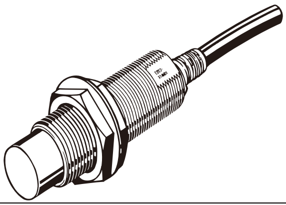
*1. 6-dia. vinyl-insulated round cable with 2 conductors (Conductor cross section: 0.5 mm², Insulator diameter: 1.9 mm), Standard length: 2 m
6-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.5 mm², Insulator diameter: 1.9 mm), Standard length: 2 m
The cable can be extended to up to 200 m (Separate metal conduit.)
*2. D Models: Operation indicator (red) and setting indicator (green), C/Y Models: Operation indicator (red)

E2E2-X10D□/E2E2-X10C□/E2E2-X10Y□

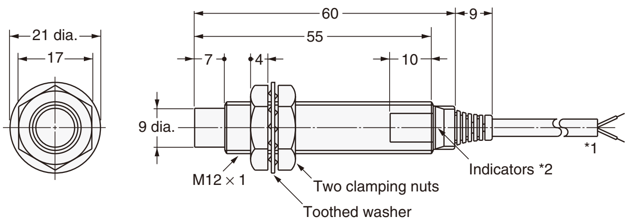


*1. 6-dia. vinyl-insulated round cable with 2 conductors (Conductor cross section: 0.5 mm², Insulator diameter: 1.9 mm), Standard length: 2 m
6-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.5 mm², Insulator diameter: 1.9 mm), Standard length: 2 m
The cable can be extended to up to 200 m (Separate metal conduit.)
*2. D Models: Operation indicator (red) and setting indicator (green), C/Y Models: Operation indicator (red)

Unshielded

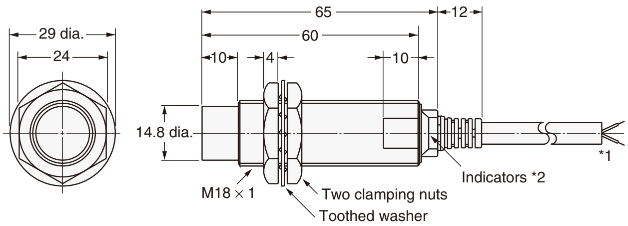


E2E2-X8MD□/E2E2-X5MC□/E2E2-X5MY□



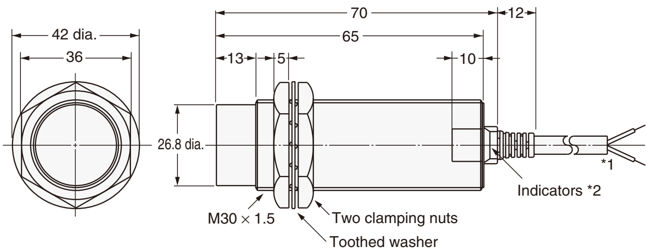
*1. 4-dia. vinyl-insulated round cable with 2 conductors (Conductor cross section: 0.3 mm², Insulator diameter: 1.3 mm), Standard length: 2 m
4-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.3 mm², Insulator diameter: 1.3 mm), Standard length: 2 m
The cable can be extended to up to 200 m (Separate metal conduit.)
*2. D Models: Operation indicator (red) and setting indicator (green), C/Y Models: Operation indicator (red)

E2E2-X14MD□/E2E2-X10MC□/E2E2-X10MY□



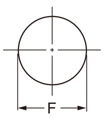
*1. 6-dia. vinyl-insulated round cable with 2 conductors (Conductor cross section: 0.5 mm², Insulator diameter: 1.9 mm), Standard length: 2 m
6-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.5 mm², Insulator diameter: 1.9 mm), Standard length: 2 m
The cable can be extended to up to 200 m (Separate metal conduit.)
*2. D Models: Operation indicator (red) and setting indicator (green), C/Y Models: Operation indicator (red)

E2E2-X20MD□/E2E2-X18MC□/E2E2-X18MY□



*1. 6-dia. vinyl-insulated round cable with 2 conductors (Conductor cross section: 0.5 mm², Insulator diameter: 1.9 mm), Standard length: 2 m
6-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.5 mm², Insulator diameter: 1.9 mm), Standard length: 2 m
The cable can be extended to up to 200 m (Separate metal conduit.)
*2. D Models: Operation indicator (red) and setting indicator (green), C/Y Models: Operation indicator (red)

Mounting Hole Dimensions



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

Note 1. Two clamping nuts and one toothed washer are provided with each Sensors.
2. The model number is laser-marked on the cable section and milled section.

In the interest of product improvement, specifications are subject to change without notice.

For precautions on individual products, refer to the *Safety Precautions* in individual product information.

General Precautions

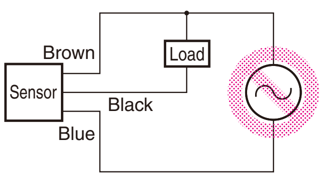
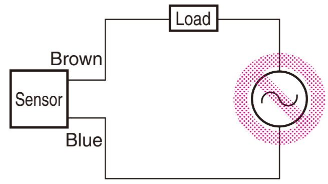
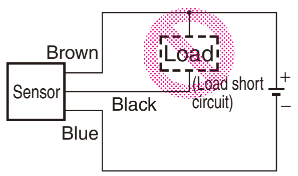
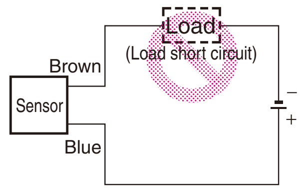
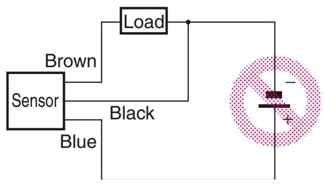
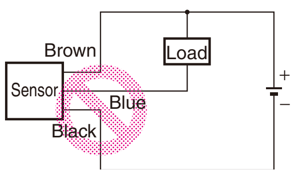
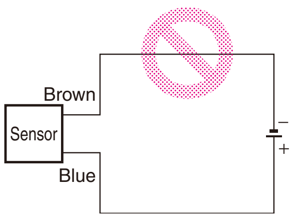
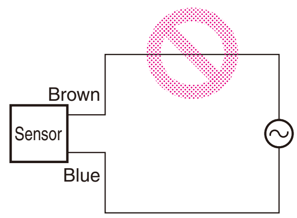
⚠ WARNING

These products cannot be used in safety devices for presses or other safety devices used to protect human life.
These products are designed for use in applications for sensing workpieces and workers that do not affect safety.

Precautions for Safe Use

To ensure safety, always observe the following precautions.

●Wiring Considerations

Item	Typical examples	
Power Supply Voltage Do not use a voltage that exceeds the operating voltage range. Applying a voltage that is higher than the operating voltage range, or using an AC power supply (100 VAC or higher) for a Sensor that requires a DC power supply may cause explosion or burning.	DC 3-Wire NPN Output Sensors 	DC 2-Wire Sensors 
Load short-circuiting • Do not short-circuit the load. Explosion or burning may result. • The load short-circuit protection function operates when the power supply is connected with the correct polarity and the power is within the rated voltage range.	DC 3-Wire NPN Output Sensors 	• DC 2-Wire Sensors • Even with the load short-circuit protection function, protection will not be provided when a load short circuit occurs if the power supply polarity is not correct. 
Incorrect Wiring Be sure that the power supply polarity and other wiring is correct. Incorrect wiring may cause explosion or burning.	DC 3-Wire NPN Output Sensors 	
Connection without a Load If the power supply is connected directly without a load, the internal elements may explode or burn. Be sure to insert a load when connecting the power supply.	• DC 2-Wire Sensors • Even with the load short-circuit protection function, protection will not be provided if both the power supply polarity is incorrect and no load is connected. 	AC 2-Wire Sensors 

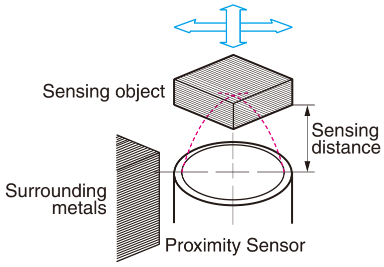
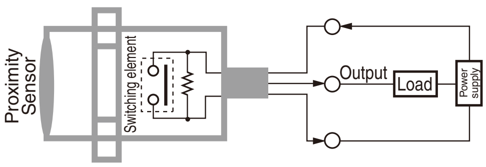
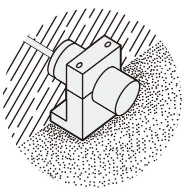
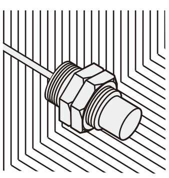
●Operating Environment

Do not use the Sensor in an environment where there are explosive or combustible gases.

Precautions for Correct Use

The following conditions must be considered to understand the conditions of the application and location as well as the relation to control equipment.

●Model Selection

Item	Points of consideration
Sensing object and operating condition of Proximity Sensor	Check the relation between the sensing object and the Proximity Sensor.  Specific conditions of object — Material, size, shape, existence of plating, etc. Direction of object movement — Transit interval, speed, existence of vibration, etc. Peripheral metal — Material, distance to Sensor, orientation, etc. Sensing distance — Fluctuation in transit point, allowable error, etc. Sensing (set) distance, shape of Sensor (rectangular, cylindrical, through-beam, grooved), influence of peripheral metal (Shielded Sensors, Non-shielded Sensors), response speed (response frequency), influence of temperature, influence of voltage, etc.
Electrical conditions	Verify the electrical conditions of the control system to be used and the electrical performance of the Proximity Sensor.  Power supply — DC (voltage fluctuation, current capacity value); AC (voltage fluctuation, frequency, etc.); Need for S3D2 Controller — Selecting the power supply type: DC / DC + S3D2 Controller / AC Load — Resistive load - Non-contact control system; Inductive load - Relay, solenoid, etc. • Steady-state current, inrush current • Operating, reset voltage (current); Lamp load • Steady-state current, inrush current; Open/close frequency — Selecting the power supply type: DC / DC + S3D2 Controller / AC; Control output: Maximum current (voltage); Leakage current; Residual load voltage
Environmental conditions	 The environmental tolerance of the Proximity Sensor is better than that of other types of Sensors. However, investigate carefully before using a Proximity Sensor under harsh temperatures or in special atmospheres. Temperature and humidity — Highest or lowest values, existence of direct sunlight, etc. — Temperature influence, high-temperature use, low temperature use, need for shade, etc. Atmosphere — Water, oil, iron powder, or other special chemicals — Need for water resistance or oil resistance, need for explosion-proof structure Vibration and shock — Size, duration — Need for strength, mounting method • Water Resistance Do not use the Sensor in water, rain, or outdoors. • Ambient Conditions To maintain reliability of operation, do not use the Sensor outside the specified temperature range or outdoors. Even though the Proximity Sensor has a water-resistant structure, it must be covered to prevent direct contact with water or water-soluble cutting oil. Do not use the Sensor in atmospheres with chemical vapors, in particular, strong alkalis or acids (nitric acid, chromic acid, or hot concentrated sulfuric acid). • Explosive Atmospheres Do not use the Sensor in atmospheres where there is a danger of explosion. Use an Explosion-proof Sensor.
Mounting conditions	 When deciding the mounting method, take into consideration not only restrictions due to mechanical devices, but also ease of maintenance and inspection, and interference between Sensors. Wiring method, existence of inductance surges — Wires; Wire type, length, oil-resistant cable, shielded cable, robot cable, etc. Connection — Conduits, ducts, pre-wired, terminal wiring, ease of maintenance and inspection Mounting procedure — Existence of mounting brackets, direct mounting, secured with bolts or screws Installation location — Ease of maintenance and inspection, mounting space
Influence of external electromagnetic fields	• The influence within a DC magnetic field is 20 mT* max. Do not use the Sensor at a level higher than 20 mT. • Sudden changes in the DC magnetic field may cause malfunction. Do not use the Sensor for applications that involve turning a DC electromagnet ON and OFF. • Do not place a transceiver near the Sensor or its wiring. Doing so may cause malfunction.
Other considerations	Cost feasibility: Price/delivery time Life: Power-ON time/frequency of use

* mT (millitesla) is a unit for expressing magnetic flux density. One tesla is the equivalent of 10,000 gauss.

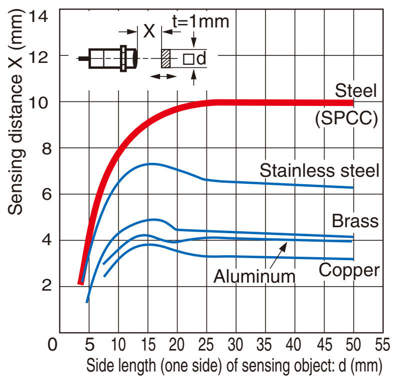
●Design

Sensing Object Material

The sensing distance varies greatly depending on the material of the sensing object. Study the engineering data for the influence of sensing object material and size and select a distance with sufficient leeway.

- In general, if the sensing object is a non-magnetic metal (for example, aluminum), the sensing distance decreases.

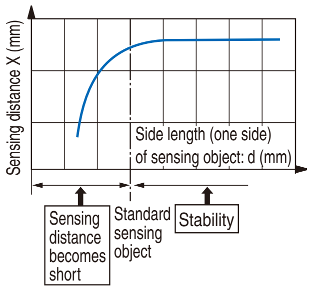
Example: E2-X10D□



Size of Sensing Object

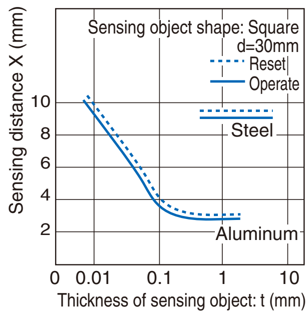
In general, if the object is smaller than the standard sensing object, the sensing distance decreases.

- Design the setup for an object size that is the same or greater than the standard sensing object size from the graphs showing the sensing object size and sensing distance.
- When the size of the standard sensing object is the same or less than the size of the standard sensing object, select a sensing distance with sufficient leeway.



Thickness of Sensing Object

- The thickness of ferrous metals (iron, nickel, etc.) must be 1 mm or greater.
- For non-magnetic metal, a sensing distance equivalent to a magnetic body can be obtained when the coating thickness is 0.01 mm or less. With pulse-response models (e.g., E2V), however, the characteristics may vary. Be sure to check the catalog information for the relevant model.
  When the coating is extremely thin and is not conductive, such as a vacuum deposited film, detection is not possible.



- Influence of Plating If the sensing object is plated, the sensing distance will change (see the table below).

Effect of Plating (Typical)
(Reference values: Percent of non-plated sensing distance)

Thickness and base material of plating	Steel	Brass
No plating	100	100
Zn 5 to 15 µm	90 to 120	95 to 105
Cd 5 to 15 µm	100 to 110	95 to 105
Ag 5 to 15 µm	60 to 90	85 to 100
Cu 10 to 20 µm	70 to 95	95 to 105
Cu 5 to 15 µm	-	95 to 105
Cu (5 to 10 µm) + Ni (10 to 20 µm)	70 to 95	-
Cu (5 to 10 µm) + Ni (10 µm) + Cr (0.3 µm)	75 to 95	-

Mutual Interference

- Mutual interference refers to a state where a Sensor is affected by magnetism (or static capacitance) from an adjacent Sensor and the output is unstable.
- One means of avoiding interference when mounting Proximity Sensors close together is to alternate Sensors with different frequencies. The model tables indicate whether different frequencies are available. Please refer to the tables.
- When Proximity Sensors with the same frequency are mounted together in a line or face-to-face, they must be separated by a minimum distance. For details, refer to *Mutual Interference* in the *Safety Precautions* for individual Sensors.

Power Reset Time

A Sensor is ready for detection within 100 ms after turning ON the power. If the load and Sensor are connected to separate power supplies, design the system so that the Sensor power turns ON first.

Turning OFF the Power

An output pulse may be generated when the power is turned OFF, so design the system so that the load or load line power turns OFF first.

Influence of Surrounding Metal

The existence of a metal object other than the sensing object near the sensing surface of the Proximity Sensor will affect detection performance, increase the apparent operating distance, degrade temperature characteristics, and cause reset failures. For details, refer to the influence of surrounding metal table in *Safety Precautions* for individual Sensors.
The values in the table are for the nuts provided with the Sensors. Changing the nut material will change the influence of the surrounding metal.

Power Transformers

Be sure to use an insulated transformer for a DC power supply. Do not use an auto-transformer (single-coil transformer).

Precautions for AC 2-Wire/DC 2-Wire Sensors

Surge Protection

Although the Proximity Sensor has a surge absorption circuit, if there is a device (motor, welder, etc.) that causes large surges near the Proximity Sensor, insert a surge absorber near the source of the surges.

Influence of Leakage Current

Even when the Proximity Sensor is OFF, a small amount of current runs through the circuit as leakage current.
For this reason, a small current may remain in the load (residual voltage in the load) and cause load reset failures. Verify that this voltage is lower than the load reset voltage (the leakage current is less than the load reset current) before using the Sensor.

Using an Electronic Device as the Load for an AC 2-Wire Sensor

When using an electronic device, such as a Timer, some types of devices use AC half-wave rectification. When a Proximity Sensor is connected to a device using AC half-wave rectification, only AC half-wave power will be supplied to the Sensor. This will cause the Sensor operation to be unstable. Also, do not use a Proximity Sensor to turn the power supply ON and OFF for electronic devices that use DC half-wave rectification. In such a case, use a relay to turn the power supply ON and OFF, and check the system for operating stability after connecting it.

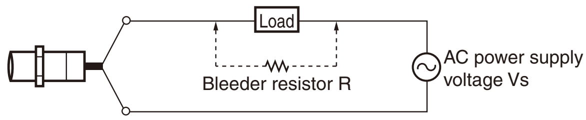
Examples of Timers that Use AC Half-wave Rectification
Timers: H3Y, H3YN, H3RN, H3CA-8, RD2P, and H3CR (-A, -A8, -AP, -F, -G)

Countermeasures for Leakage Current (Examples)

AC 2-Wire Sensors

Connect a bleeder resistor to bypass the leakage current flowing in the load so that the current flowing through the load is less than the load reset current.

(When using an AC 2-Wire Sensor, connect a bleeder resistor so that the Proximity Sensor current is at least 10 mA, and the residual load voltage when the Proximity Sensor is OFF is less than the load reset voltage.)



Calculate the bleeder resistance and allowable power using the following equation.

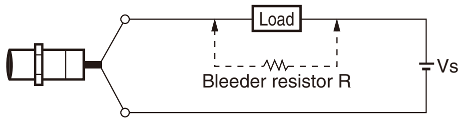
$$R \leq \frac{Vs}{10 - I} \ (k\Omega) \qquad P > \frac{Vs^2}{R} \ (mW)$$

P : Watts of bleeder resistance (the actual number of watts used should be several times this number)
I : Load current (mA)

It is recommend that leeway be included in the actual values used. For 100 VAC, use 10 kΩ or less and 3 W (5 W) or higher, and for 200 VAC, use 20 kΩ or less and 10 W (20 W) or higher. If the effects of heat generation are a problem, use the number of watts in parentheses ( ) or higher.

DC 2-Wire Sensors

Connect a bleeder resistor to bypass the leakage current flowing in the load, and design the load current so that (leakage current) × (load input impedance) < reset voltage.



Calculate the bleeder resistance and allowable power using the following equation.

$$R \leq \frac{Vs}{i_R - i_{OFFR}} \ (k\Omega) \qquad P > \frac{Vs^2}{R} \ (mW)$$

P : Watts of bleeder resistance (the actual number of watts used should be several times this number)
i_R : Leakage current of Proximity Sensor (mA)
i_{OFF} : Load reset current (mA)

It is recommend that leeway be included in the actual values used. For 12 VDC, use 15 kΩ or less and 450 mW or higher, and for 24 VDC, use 30 kΩ or less and 0.1 W or higher.

Loads with Large Inrush Current

Loads, such as lamps or motors, that cause a large inrush current* will weaken or damage the switching element. In this situation, use a relay.

* E2K, TL-N□Y: 1 A or higher

●Mounting

Mounting the Sensor

When mounting a Sensor, do not tap it with a hammer or otherwise subject it to excessive shock. This will weaken water resistance and may damage the Sensor. If the Sensor is being secured with bolts, observe the allowable tightening torque. Some models require the use of toothed washers.

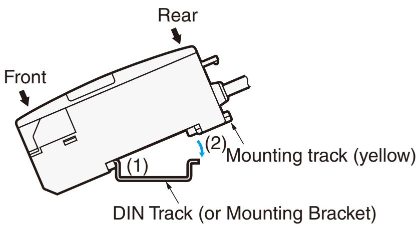
For details, refer to the mounting precautions in *Precautions for Correct Use* in individual product information.

Mounting/Removing Using DIN Track (Example for E2CY)

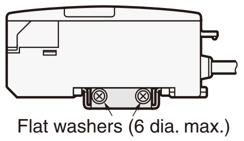
<Mounting>

(1)Insert the front of the Sensor into the special Mounting Bracket (included) or DIN Track.

(2)Press the rear of the Sensor into the special Mounting Bracket or DIN Track.

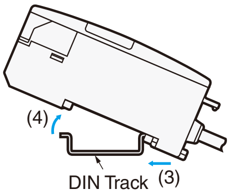


• When mounting the side of the Sensor using the special Mounting Bracket, first secure the Amplifier Unit to the special Mounting Bracket, and then mount the special Mounting Bracket with M3 screws and flat washers with a diameter of 6 mm maximum.



<Removing>

• While pressing the Amplifier Unit in the direction of (3), lift the fiber plug in the direction of (4) for easy removal without a screwdriver.

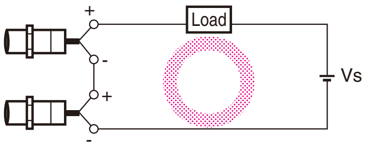
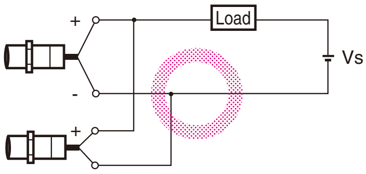
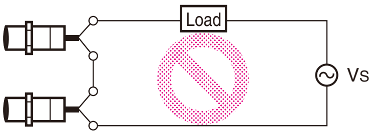


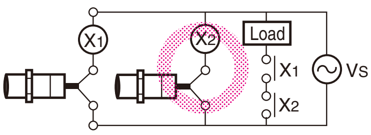
Set Distance

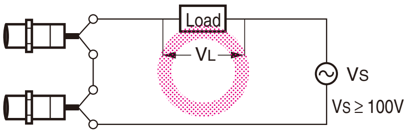
The sensing distance may vary due to fluctuations in temperature and voltage. When mounting the Sensor, it is recommend that installation be based on the set distance.

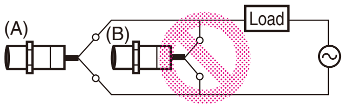
●Wiring Considerations

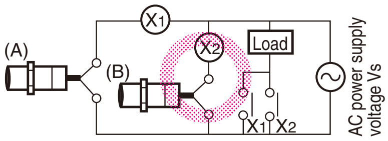
AND/OR Connections for Proximity Sensors

<table>
<tr><th>Model</th><th>Type of connection</th><th>Connection</th><th>Description</th></tr>
<tr><td rowspan="2">DC 2-Wire</td><td>AND (series connection)</td><td>
</td><td>Keep the number of connected Sensors (N) within the range of the following equation.
$V_S - N \times V_R \geq$ Operating load voltage
N : Number of Sensors that can be connected
V_R: Residual output voltage of Proximity Sensor
V_S: Power voltage
It is possible, however, that the indicators may not light correctly and error pulses (of approximately 1 ms) may be generated because the rated power supply voltage and current are not supplied to individual Proximity Sensors. Verify that this is not a problem before operation.</td></tr>
<tr><td>OR (parallel connection)</td><td>
</td><td>Keep the number of connected Sensors (N) within the range of the following equation.
$N \times i \leq$ Load reset current
N: Number of Sensors that can be connected
i: Leakage current of Proximity Sensor
Example: When an MY (24-VDC) Relay is used as the load, the maximum number of Sensors that can be connected is 4.</td></tr>
<tr><td rowspan="2">AC 2-wire</td><td>AND (series connection)</td><td>




</td><td><TL-NY, TL-MY, E2K-□MY□, TL-T□Y>
The above Proximity Sensors cannot be used in a series connection. If needed, connect through relays.

<E2E-X□Y>
For the above Proximity Sensors, the voltage VL that can be applied to the load when ON is $V_L = V_S$ - (Output residual voltage × Number of Sensors), for both 100 VAC and 200 VAC.
The load will not operate unless V_L is higher than the load operating voltage. This must be verified before use.
When using two or more Sensors in series with an AND circuit, the limit is three Sensors. (Be careful of the VS value in the diagram at left.)</td></tr>
<tr><td>OR (parallel connection)</td><td>

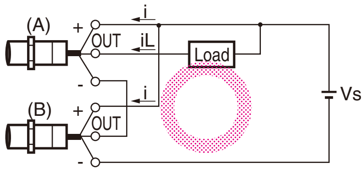
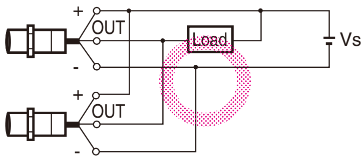

</td><td>In general it is not possible to use two or more Proximity Sensors in parallel with an OR circuit.

A parallel connection can be used if A and B will not be operated simultaneously and there is no need to hold the load. The leakage current, however, will be n times the value for each Sensor and reset failures will frequently occur.
("n" is the number of Proximity Sensors.)

If A and B will be operated simultaneously and the load is held, a parallel connection is not possible.
If A and B operate simultaneously and the load is held, the voltages of both A and B will fall to about 10 V when A turns ON, and the load current will flow through A causing random operation. When the sensing object approaches B, the voltage of both terminals of B is too low at 10 V and the switching element of B will not operate. When A turns OFF again, the voltages of both A and B rise to the power supply voltage and B is finally able to turn ON.

During this period, there are times when A and B both turn OFF (approximately 10 ms) and the loads are momentarily restored. In cases where the load is to be held in this way, use a relay as shown in the diagram at left.</td></tr>
</table>

Note: When AND/OR connections are used with Proximity Sensors, the effects of erroneous pulses or leakage current may prevent use. Verify that there are no problems before use.

Model	Type of connection	Connection	Description
DC 3-wire	AND (series connection)		Keep the number of connected Sensors (N) within the range of the following equation. iL + (N - 1) × i ≤ Upper limit of Proximity Sensor control output V_S - N × V_R ≥ Operating load voltage N : Number of Sensors that can be connected V_R: Residual output voltage of Sensor V_S: Power supply voltage i : Current consumption of Sensor iL: Load current Example: A maximum of two Sensors can be used when an MY (24-VDC) Relay is used for the load. Note: When an AND circuit is connected, the operation of Proximity Sensor B causes power to be supplied to Proximity Sensor A, and thus erroneous pulses (approximately 1 ms) may be generated in A when the power is turned ON. For this reason, take care when the load has a high response speed because malfunction may result.
	OR (parallel connection)		For Sensors with a current output, a minimum of three OR connections is possible. Whether or not four or more connections is possible depends on the model.

Note: When AND/OR connections are used with Proximity Sensors, the effects of erroneous pulses or leakage current may prevent use. Verify that there are no problems before use.

Extending Cable Length

The cable of a Built-in Amplifier Sensor can be extended to a maximum length of 200 m with each of the standard cables (excluding some models).
For Separate Amplifier Sensors (E2C-EDA, E2C, E2J, E2CY), refer to the specific precautions for individual products.

Bending the Cable

If you need to bend the cable, we recommend a bend radius that is at least 3 times the outer diameter of the cable (with the exception of coaxial and shielded cables).

Cable Tensile Strength

In general, do not subject the cable to a tension greater than that indicated in the following table.

Cable diameter	Tensile strength
Less than 4 mm	30 N max.
4 mm min.	50 N max.

Note: Do not subject a shielded cable or coaxial cable to tension.

Separating High-voltage Lines

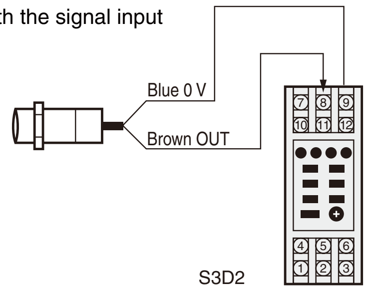
Using Metal Conduits
If a power line is to be located near the Proximity Sensor cable, use a separate metal conduit to prevent malfunction or damage. (Same for DC models.)

Example of Connection with S3D2 Sensor Controller

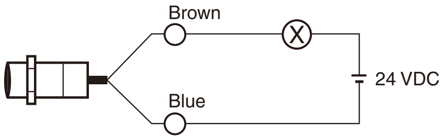
DC 2-Wire Sensors

Using the S3D2 Sensor Controller

Operation can be reversed with the signal input switch on the S3D2.



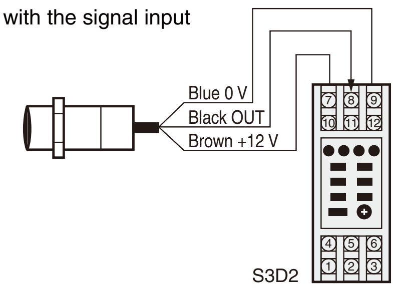
Connecting to a Relay Load



Note: DC 2-Wire Sensors have a residual voltage of 3 V. Check the operating voltage of the relay before use.
The residual voltage of the E2E-XD-M1J-T is 5 V.

DC 3-Wire Sensors

Operation can be reversed with the signal input switch on the S3D2.



●Operating Environment

Water Resistance

Do not use the Sensor in water, rain, or outdoors.

Ambient Conditions

Do not use the Sensor in the following environments.
Doing so may cause malfunction or failure of the Sensor.

1. To maintain operational reliability and service life, use the Sensor only within the specified temperature range and do not use it outdoors.
2. The Sensor has a water resistant structure, however, attaching a cover to prevent direct contact with water will help improve reliability and prolong product life.
3. Avoid using the Sensor where there are chemical vapors, especially strong alkalis or acids (nitric acid, chromic acid, or hot concentrated sulfuric acid).

●Maintenance and inspection

Periodic Inspection

To ensure long-term stable operation of the Proximity Sensor, inspect for the following on a regular basis. Conduct these inspections also for control devices.

1. Shifting, loosening, or deformation of the sensing object and Proximity Sensor mounting
2. Loosening, bad contact, or wire breakage in the wiring and connections
3. Adherence or accumulation of metal powder
4. Abnormal operating temperature or ambient conditions
5. Abnormal indicator flashing (on setting indicator types)

Disassembly and Repair

Do not under any circumstances attempt to disassemble or repair the product.

Quick Failure Check

You can conveniently check for failures by connecting the E39-VA Handy Checker to check the operation of the Sensor.

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