Separate Amplifier Proximity Sensor with Adjustment Potentiometer

E2C/E2C-H

Separate Amplifier Sensor with Sensitivity Adjustment

- Compact design with smaller Sensor Head.
- Heat-resistance model available for application between –10 and 200°C.

Be sure to read *Safety Precautions* on page 15.

Ordering Information

Sensors

Standard Models

Sensor				Combination	Amplifier Units			
Appearance		Stable sensing area *1	Model		Model	Power supply/ Output	Timer function	Self-diagnostic output
Unshielded *2	2 dia.	0.5 (1.2) mm	E2C-CR5B		E2C-GE4B	DC/ (NPN)	---	---
Shielded	3.5 dia.	0.8 (1.8) mm	E2C-CR8A		E2C-GF4B	DC/ (PNP)	---	---
	3.8 dia.	0.8 (1.8) mm	E2C-CR8B		E2C-GE4A	DC/ (NPN)	---	---
	M5	1 (2) mm	E2C-X1A		E2C-GF4A	DC/ (PNP)	---	---
	5.4 dia.	1 (2) mm	E2C-C1A		E2C-WH4A	DC/ (NPN / PNP)	---	---
	M8	1.5 (3) mm	E2C-X1R5A		E2C-JC4AP *	DC/ (NPN)	Yes	Yes
	M12	2 (5) mm	E2C-X2A		E2C-JC4A	DC/ (NPN)	Yes	---
	M18	5 (10) mm	E2C-X5A		E2C-AM4A	DC/ (NPN / PNP)	---	---
	M30	10 (18) mm	E2C-X10A		E2C-AK4A	AC	---	---
Unshielded	40 dia.	20 (50) mm	E2C-C20MA					

*1. Values in parentheses are for the maximum sensing distances at 23°C.
*2. Although the E2C-CR5B has a shielded structure, it cannot be embedded in metal.

* Self-diagnostic output, timer, and DIN Track mounting.

Heat-resistant Model

Sensor				Combination	Amplifier Unit
Appearance		Stable sensing area	Model		Model
Shielded	M8	1.5 mm	E2C-X1R5AH		E2C-JC4CH
	M12	2 mm	E2C-X2AH		E2C-JC4DH
	M18	5 mm	E2C-X5AH		E2C-JC4EH

Note: Characteristics will change if the cable length changes. Do not cut or extend the cable.

Accessories (Order Separately)

Mounting Brackets

Name	Model	Applicable Sensors	Remarks
Mounting Brackets	**Y92E-F3R5**	E2C-CR8A, for 3.5 dia.	---
	Y92E-F5R4	E2C-C1A, for 5.4 dia.	

Connection Sockets

Name	Model	Applicable Amplifier Unit	Remarks
Front Connection Sockets	**PYF08A**	E2C-GE4A E2C-GE4B E2C-GF4A E2C-GF4B	Hold-down Clips (Order Separately) PYC-A1 Sold as a set.
	P2CF-08	E2C-AM4A	---
	P2CF-11	E2C-AK4A	
Back Connection Sockets	**P3G-08**	E2C-AM4A	
	P3GA-11	E2C-AK4A	

Adapters

Name	Model	Applicable Amplifier Unit	Remarks
Embedded Adapters	**Y92F-30**	E2C-AM4A/-AK4A	---
	Y92F-70		
	Y92F-71		

For details on *Mounting Brackets, Protective Covers, and Sputter Protective Covers*, refer to Y92□.

Ratings and Specifications

Standard Models

Sensors

Item \ Model		E2C-CR5B	E2C-CR8A/ -CR8B	E2C-X1A/ -C1A	E2C-X1R5A	E2C-X2A	E2C-X5A	E2C-X10A	E2C-C20MA
Sensing distance (at 23°C)		1.2 mm	1.8 mm	2 mm	3 mm	5 mm	10 mm	18 mm	50 mm
Stable sensing area	Ambient temperature	0 to 0.5 mm	0 to 0.8 mm	0 to 1 mm	0 to 1.5 mm	0 to 2 mm	0 to 5 mm	0 to 10 mm	0 to 20 mm
	At 0 to 40°C	0 to 0.7 mm	0 to 1.2 mm	0 to 1.5 mm	0 to 2 mm	0 to 2.5 mm	0 to 7 mm	0 to 15 mm	0 to 28 mm
Differential travel		Refer to *Ratings and Specifications* on page 4 for Amplifier Unit specifications.							
Detectable object		Ferrous metal (The sensing distance decreases with non-ferrous metal. Refer to *Engineering Data* on page 7.)							
Standard sensing object		Iron, 5 × 5 × 1 mm			Iron, 8 × 8 × 1 mm	Iron, 12 × 12 × 1 mm	Iron, 18 × 18 × 1 mm	Iron, 30 × 30 × 1 mm	Iron, 50 × 50 × 1 mm
Response frequency *1		1 kHz			800 Hz		350 Hz	100 Hz	50 Hz
Ambient temperature range		Operating: –10 to 55°C	Operating/Storage: –25 to 70°C (with no icing or condensation)						
Ambient humidity range		Operating/Storage: 35% to 95% (with no condensation)							
Temperature influence		±25% max. of sensing distance at 23°C in the temperature range of –10 to 55°C	15% max. of sensing distance at 23°C in the temperature range of –25 to 70°C						
Vibration resistance		Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X and Y directions							
Shock resistance		Destruction: 500 m/s^2 3 times each in X and Y directions							
Degree of protection		IEC 60529 IP64	IEC 60529 IP67, in-house standards: oil-resistant						
Connection method *2		Pre-wired Models							
		Shielded cable (Cable length: 3 m)	High-frequency coaxial cable (Standard cable length: 3 m)						
Weight (packed state)		Approx. 10 g	Approx. 40 g	Approx. 45 g	Approx. 50 g	Approx. 60 g	Approx. 140 g	Approx. 270 g	Approx. 300 g
Materials	Case	Stainless steel		Brass					
	Sensing surface	ABS resin							
	Cable	Polyethylene							
	Clamping nut	---		Brass, nickel-plated (except E2C-C1A)					
	Toothed washer	---		Brass, zinc-plated (except E2C-C1A)					
Accessories		---							

*1. The minimum value when using the solid-state control output on the Amplifier Unit.
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. Refer to 6 for cable lengths when combining Amplifier Units and Sensors.
The characteristic impedance of the high-frequency coaxial cable is 50 Ω.

Amplifier Units

Item \ Model		E2C-GE4□	E2C-GF4□	E2C-JC4A E2C-JC4AP	E2C-WH4A	E2C-AM4A	E2C-AK4A
Power supply voltage (operating voltage range)		12 to 24 VDC (10 to 30 VDC), ripple (p-p): 10% max. *1					100 to 240 VAC (90 to 264 VAC) 50/60 Hz
Current consumption		25 mA max.		45 mA max.	25 mA max.	50 mA max.	55 mA max.
Sensing distance adjustment range *2		20% min. of rated sensing distance with 4-turn potentiometer		20% to 100% of rated sensing distance with 4-turn potentiometer			
Differential travel adjustment range		Differential travel fixed (10% max. of sensing distance)				1% to 5% of rated sensing distance *3	
Response time	Solid-state	(Refer to the response frequency of the Proximity Sensor.)					
	Relay	---					20 ms max.
Control outputs	Solid-state	NPN Load resistance: 4.7 kΩ, 100 mA max. (40 VDC max.) (Residual voltage: 1.5 V max.)	PNP Load resistance: 4.7 kΩ, 100 mA max. (40 VDC max.) (Residual voltage: 1.5 V max.)	NPN Open-collector output 100 mA max. (40 VDC max.) (Residual voltage: 0.7 V max.) (E2C-JC4AP: 1 V max.)	NPN/PNP output Open-collector output 200 mA max. (40 VDC max.) (Residual voltage: 1.5 V max.)		Transistor/photocoupler 50 mA max. (40 VDC max.) (Residual voltage: 2 V max.)
	Relay	---					Relay output, SPDT 2 A at 250 VAC, cosϕ = 1 (resistive load) *4
Indicators		Detection indicator (red) (OPERATION)		Detection indicator (red) (OPERATION) Stability indicator (green) (STABILITY)	Detection indicator (red) (OPERATION)	Detection indicator (red) (OPERATION) Stability indicator (green) (STABILITY)	
Operation mode		Changed with NO/NC switch.					
Self-diagnostic output		---		(E2C-JC4AP only) Output transistor turns ON when Sensor open circuit or unstable sensing is detected; solid-state NPN open-collector 50 mA max. (40 VDC max.) (Residual voltage: 1 V max.)	---		
Timer function		---		OFF-delay: 40 ±10 ms	---		
Cable length compensation between Sensor and Amplifier Unit		---		(E2C-JC4AP only) 3 m/5 m, terminals Short-plate switching Shorted: 1 to 3 m Open: 3 to 5 m	Switched between 3 and 5 m.	Mode switched with 4-position switch.	
Ambient temperature range		Operating/storage: −10 to 55°C (with no icing or condensation)					
Ambient humidity range		Operating/Storage: 35% to 85% (E2C-JC4AP: 35% to 95%) (with no condensation)					
Temperature influence		10% max. of sensing distance at 23°C in the temperature range of −10 to 55°C					
Voltage influence		DC Models: ±1% max. of sensing distance at rated voltage in the rated voltage ±20% range AC Models: ±1% max. of sensing distance at rated voltage in the rated voltage ±10% range					
Insulation resistance		50 MΩ min. (at 500 VDC) between current-carrying parts and case					
Dielectric strength		DC Models: 1,000 VAC, 50/60 Hz for 1 min between current-carrying parts and case AC Models: 1,500 VAC, 50/60 Hz for 1 min between current-carrying parts and case					
Vibration resistance		Destruction: 10 to 25 Hz, 2-mm double amplitude for 2 hours each in X, Y, and Z directions		Destruction: 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions	Destruction: 10 to 25 Hz, 2-mm double amplitude for 2 hours each in X, Y, and Z directions		

Item \ Model	E2C-GE4□	E2C-GF4□	E2C-JC4A E2C-JC4AP	E2C-WH4A	E2C-AM4A	E2C-AK4A
Shock resistance	Destruction: 100 m/s² 3 times each in X, Y, and Z directions					
Life expectancy	---					Mechanical: 10,000,000 operations min. Electrical: 100,000 operations min.
Connection method	Terminal block		Pre-wired Models (Standard cable length: 2 m)	Terminal block		
Weight (packed state) *5	Approx. 20 g		E2C-JC4A: Approx. 50 g E2C-JC4AP: Approx 80 g	Approx. 80 g	Approx. 140 g	Approx. 250 g
Accessories	Instruction manual		Caution labels, Mounting Bracket, instruction manual	Instruction manual		

*1. A full-wave rectification power supply of 24 VDC ±10% (average value) can be used (except for the E2C-GE4□).
*2. The sensing distance range required to maintain performed is given for using the Amplifier Unit in combination with the Sensor.
*3. E2C-CR5B: 1% to 20% of rated sensing distance.
*4. Internal relay: G2R-14 DC 12V
*5. The weight of the Connection Socket is not included.

Heat-resistant Models

Sensors

Item \ Model		E2C-X1R5AH	E2C-X2AH	E2C-X5AH
Detectable object		Ferrous metal (The sensing distance decreases with non-ferrous metal, refer to *Engineering Data* on page 7.)		
Standard sensing object		Iron, 8 × 8 × 1 mm	Iron, 12 × 12 × 1 mm	Iron, 18 × 18 × 1 mm
Stable sensing area		0 to 1.5 mm	0 to 2 mm	0 to 5 mm
Differential travel		0.04 mm max.		0.1 mm max.
Response frequency *1		300 Hz		
Ambient temperature range		Operating/Storage: −10 to 200°C (with no icing or condensation)		
Ambient humidity range		Operating/Storage: 35% to 95% (with no condensation)		
Temperature influence		±0.2%/°C		
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/s² 3 times each in X, Y, and Z directions		
Degree of protection		IEC 60529 IP60 *2		
Connection method		Pre-wired Models (Cable length: 3 m) Heat-resistant, high-frequency coaxial cable		
Weight (packed state)		Approx. 50 g	Approx. 60 g	Approx. 140 g
Materials	**Case**	Brass		
	Sensing surface	PEEK (polyether ether ketone)		
	Cable	Fluorine resin		
	Clamping nut	Brass, nickel-plated		
	Toothed washer	Iron, zinc-plated		

Note: Ratings and characteristic are given for 50% of the stable sensing area.
*1. 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. Do not operate the Sensor in areas exposed to water vapor because the enclosure is not waterproof.

Amplifier Units

Item \ Model		E2C-JC4CH	E2C-JC4DH	E2C-JC4EH
Power supply voltage *1 (operating voltage range)		12 to 24 VDC (10 to 30 VDC), ripple (p-p): 10% max.		
Current consumption		45 mA max.		
Sensing distance adjustment range *2		20% to 100% of rated sensing distance 4-turn potentiometer		
Control outputs	**Load current**	NPN open collector, 100 mA max. (40 VDC max.)		
	Residual voltage	0.8 V max.		
Indicators		Detection indicator (red)		
Operation mode		Changed with NO/NC switch.		
Cable length compensation		Switched between 3 and 5 m.		
Ambient temperature range		Operating/storage: −10 to 55°C (with no icing or condensation)		
Ambient humidity range		Operating/storage: 35% to 85% (with no condensation)		
Temperature influence		±0.08%/°C		
Voltage influence		±2% max. of sensing distance at rated voltage in the rated voltage ±20% 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 min 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: 100 m/s² 3 times each in X, Y, and Z directions		
Degree of protection		IEC 60529 IP20		
Connection method		Pre-wired Models (Cable length: 2 m)		
Weight (packed state)		Approx. 80 g		
Accessories		Caution labels, Mounting Bracket, instruction manual		

*1. A full-wave rectification power supply of 24 VDC ±10% (average value) can be used.
*2. The sensing distance range required to maintain performed is given for using the Amplifier Unit in combination with the Sensor.

Cable Lengths for Sensor-Amplifier Unit Combinations

Standard Models

Sensor / Amplifier Units	E2C-CR5B	E2C-CR8A	E2C-CR8B	E2C-X1A	E2C-C1A	E2C-X1R5A	E2C-X2A	E2C-X5A	E2C-X10A	E2C-C20MA
E2C-GE4B	Restricted to 3 m.	---	---	---	---	---	---	---	---	---
E2C-GF4B		---	---	---	---	---	---	---	---	---
E2C-GE4A	---	Restricted to 3 m.					---	---	---	---
E2C-GF4A	---						---	---	---	---
E2C-WH4A	---	Restricted to 3 m or 5 m. Set cable length switch to desired position. *					---	---	---	---
E2C-JC4AP	---	1 to 3 m: Short cable length terminals * 3 to 5 m: Open cable length terminals *						---	---	---
E2C-JC4A	---	Restricted to 3 m.						---	---	---
E2C-AM4A	Restricted to 3 m or 5 m. All pins set to left.	0 to 5 m Set cable length switch to desired position. *					0 to 10 m Set cable length switch to desired position. *			
E2C-AK4A										

Note: The standard cable length is 3 m. Models with 5-m or 10-m are manufactured upon order.
* Refer to page 14 for the operation of cable length switching.

Heat-resistant Models

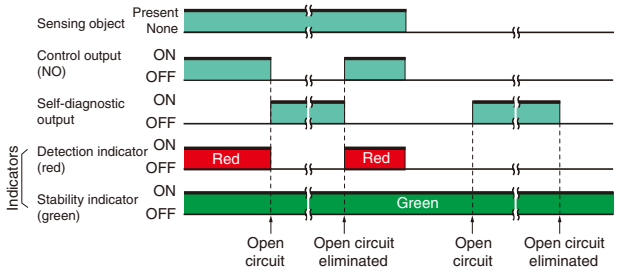
Sensor / Amplifier Units	E2C-X1R5AH	E2C-X2AH	E2C-X5AH
E2C-JC4CH	Set 3 m/5 m cable length switch to desired position.		
E2C-JC4DH			
E2C-JC4EH			

Note: The standard cable length is 3 m. Models with 5-m are manufactured upon order.

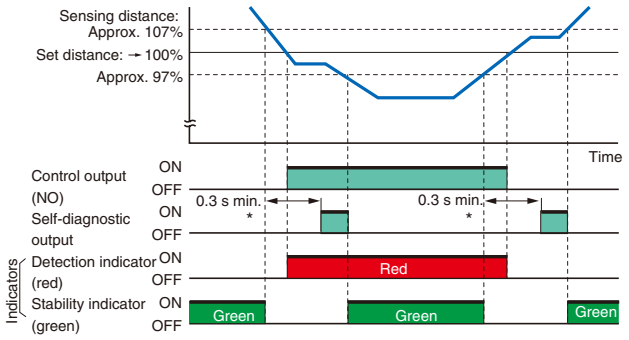
Self-diagnostic Function

The self-diagnostic output transistor will turn ON in the following cases. (The output will turn ON for any of these conditions individually.)
(1) Sensor open circuit: Transistor will turn ON the instance there is an open circuit for the Sensor (including the cable).

Sensor Open Circuit



Sensor Connected

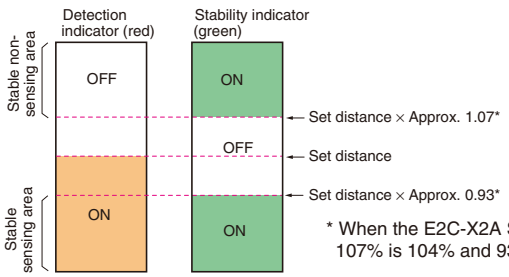


Note: When the E2C-X2A Sensor is used, 93% is 96% and 107% is 104%.
* The self-diagnostic output may turn ON if the sensing objects moves a low speed. In actual application, include an ON-delay timer circuit or other suitable measure.

(2) Detection: The output will turn ON if a sensing object is within 93% to 100% of the sensing distance continuously for 0.3 s or longer (e.g., for sensing object position offset).
(3) No detection: The output will turn ON if a sensing object is within 100% to 107% of the sensing distance continuously for 0.3 s or longer (e.g., when background is influencing detection).

Indicators

- The detection indicator lights when a sensing object approaches the sensing distance to indicate that a sensing object has been detected.
- The stability indicator lights when the sensing object approaches within 93% of the sensing distance or moves away from 107% of the sensing distance to indicate a stable sensing or non-sensing condition.

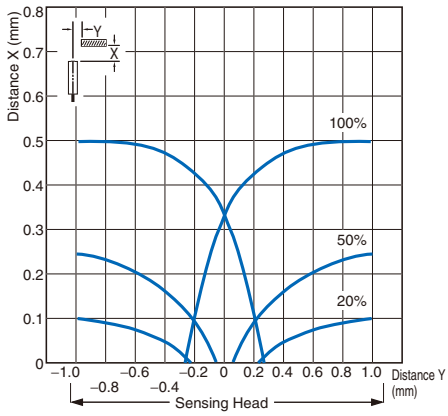


* When the E2C-X2A Sensor is used, 107% is 104% and 93% is 96%.

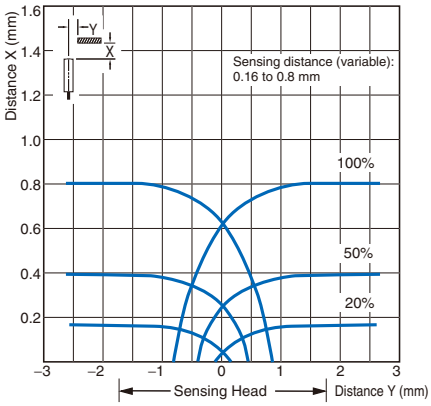
Engineering Data (Typical)

Sensing Area

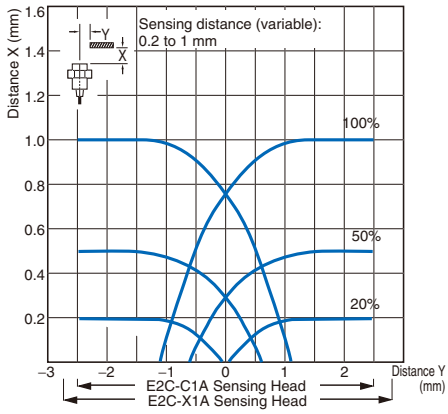
E2C-CR5B



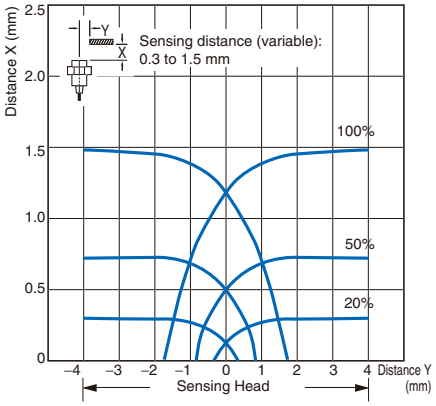
E2C-CR8□



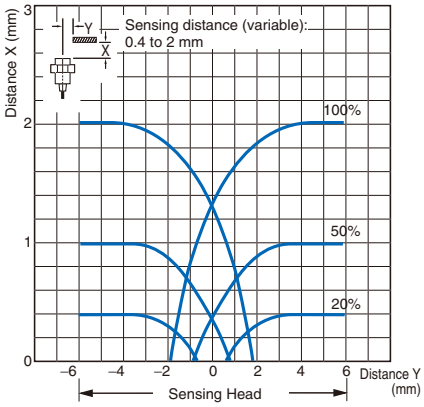
E2C-X1A/-C1A



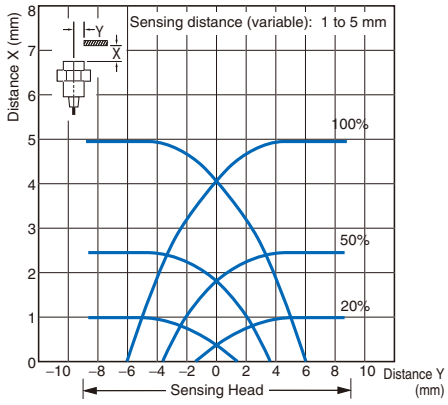
E2C-X1R5A



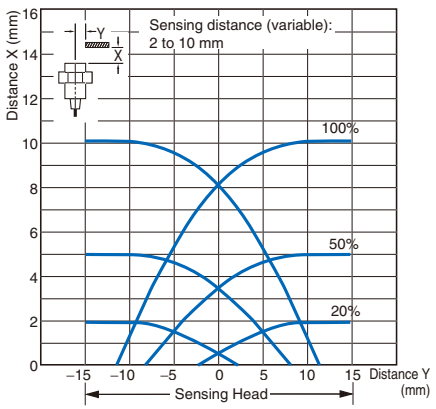
E2C-X2A



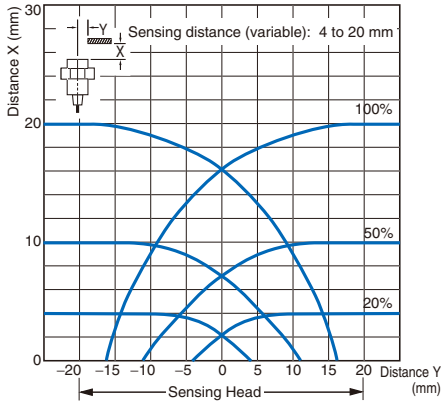
E2C-X5A



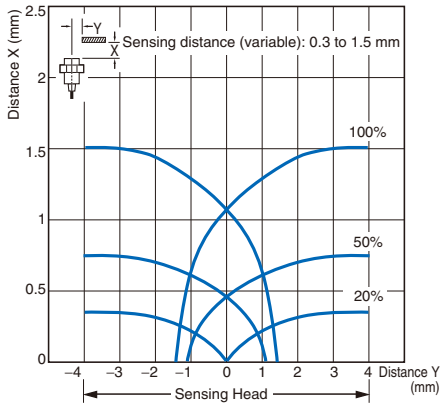
E2C-X10A



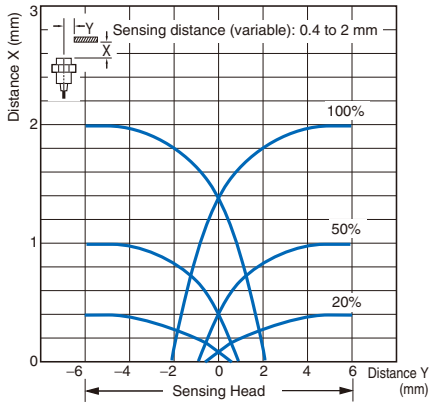
E2C-C20MA



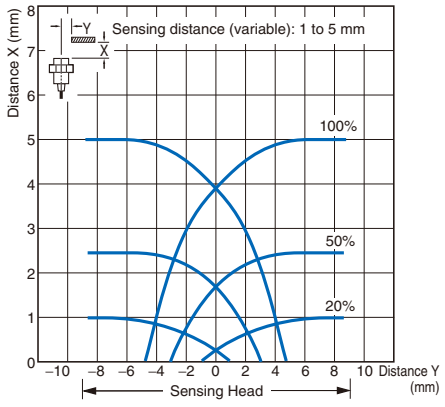
E2C-X1R5AH + E2C-JC4CH



E2C-X2AH + E2C-JC4DH

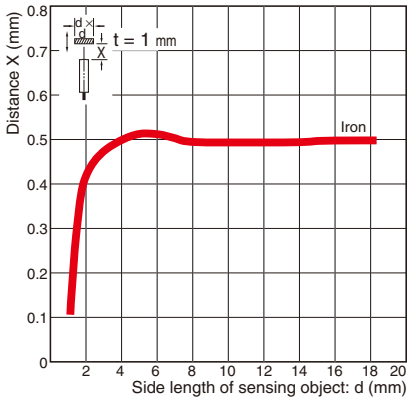


E2C-X5AH + E2C-JC4EH

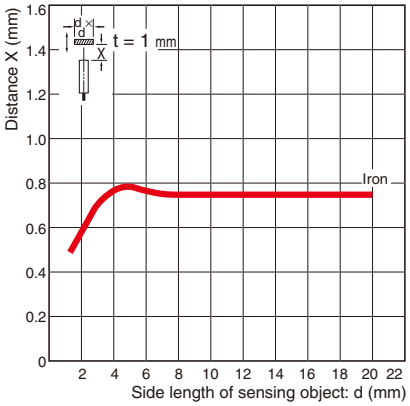


Influence of Sensing Object Size and Material

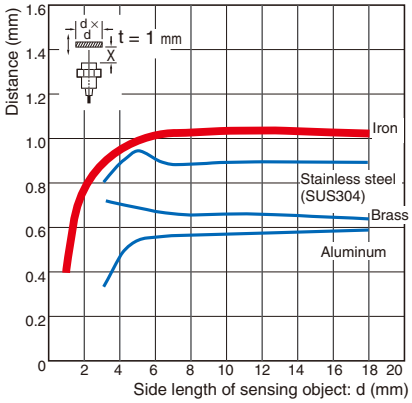
E2C-CR5B



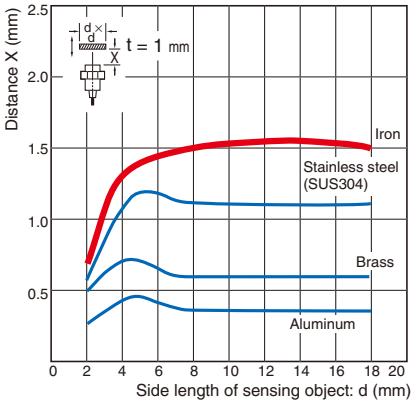
E2C-CR8□



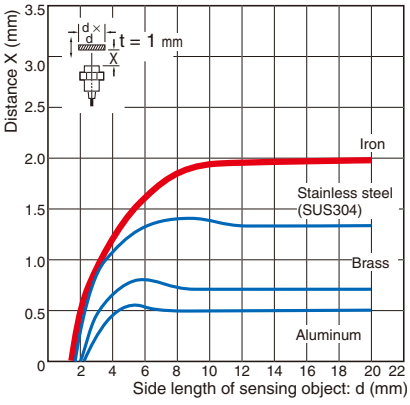
E2C-X1A/-C1A



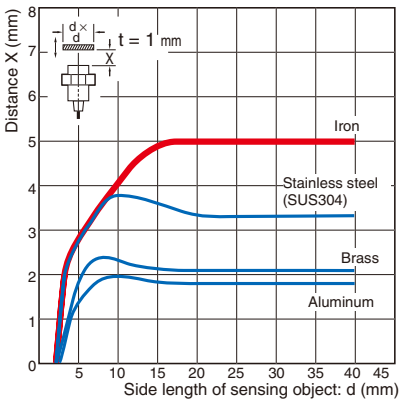
E2C-X1R5A



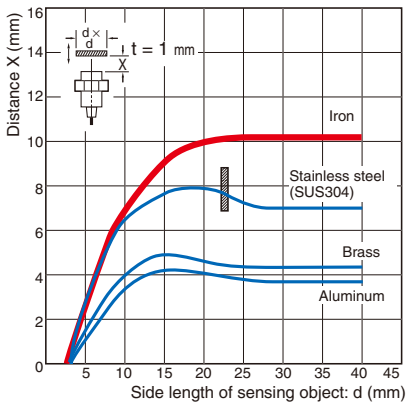
E2C-X2A



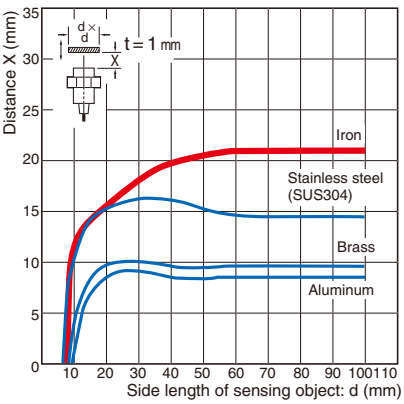
E2C-X5A



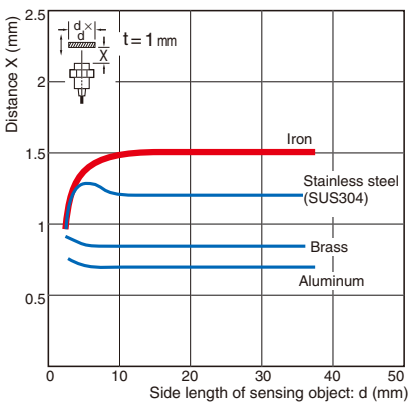
E2C-X10A



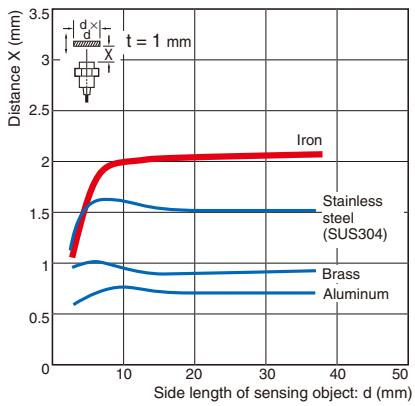
E2C-C20MA



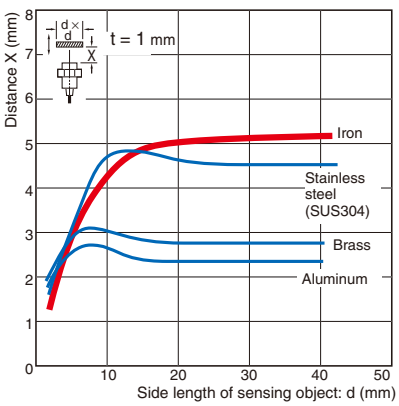
E2C-X1R5AH + E2C-JC4CH



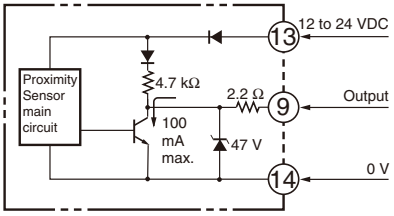
E2C-X2AH + E2C-JC4DH

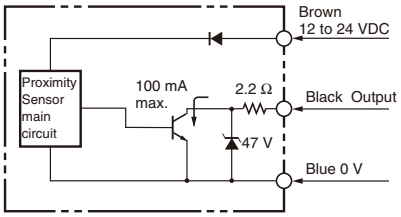
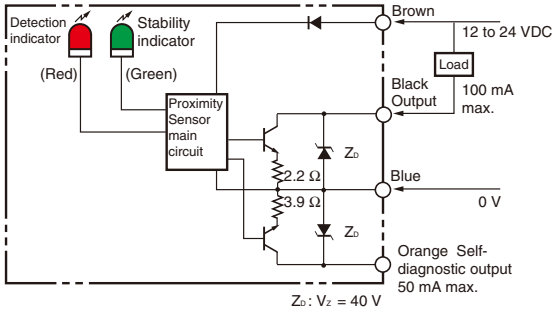
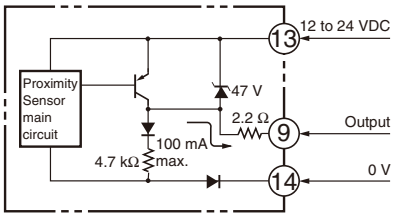
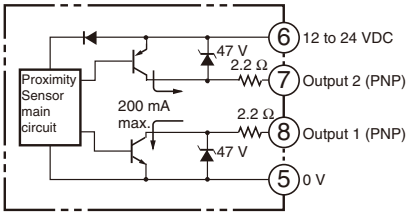
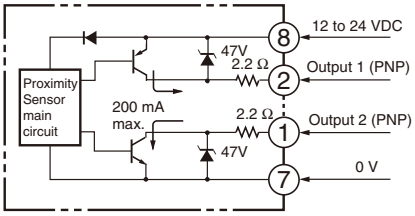


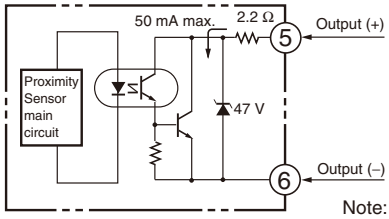
E2C-X5AH + E2C-JC4EH



I/O Circuit Diagrams

<table>
<tr><th>Output configuration</th><th>E2C-GE4□ *</th><th>E2C-JC4A, E2C-JC4CH, E2C-JC4DH, E2C-JC4EH</th></tr>
<tr><td>NPN output</td><td> 

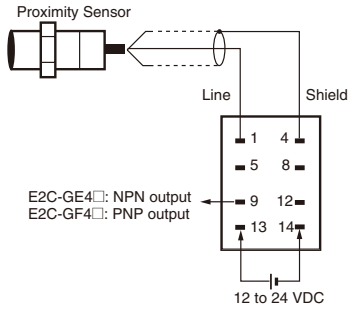
* A voltage output can be used if the NO/NC switch on the E2C-GE4□ is set to NC, but an approximately 60-ms pulse will be generated when the power supply is turned ON. An initial reset will thus be required.
If the E2C-GF4□ (model for PNP output) is used, the initial pulse will not occur.</td><td> 
</td></tr>
<tr><td>NPN output Self-diagnosis Function</td><td colspan="2">E2C-JC4AP
 
</td></tr>
<tr><td>PNP Output</td><td colspan="2">E2C-GF4□
 
</td></tr>
<tr><td>Both NPN and PNP outputs</td><td>E2C-WH4A
 
</td><td>E2C-AM4A
 
</td></tr>
<tr><td>Transistor/ photocoupler

Relay output</td><td colspan="2">E2C-AK4A
 

Note: Terminals 1, 2, and 3 are the relay contact output (SPDT).</td></tr>
</table>

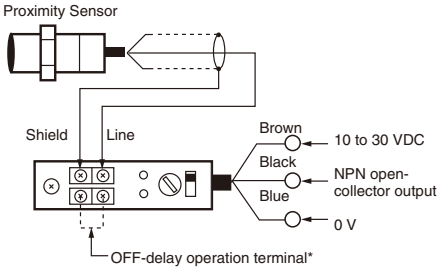
Connections between Amplifier Unit and Sensor

E2C-G□4



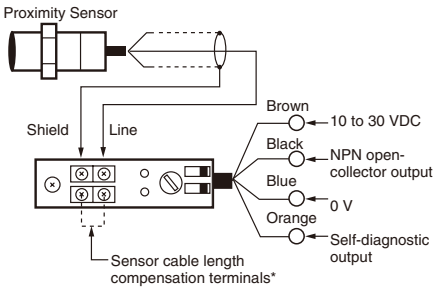
Applicable Socket:
PYF08A

E2C-JC4A



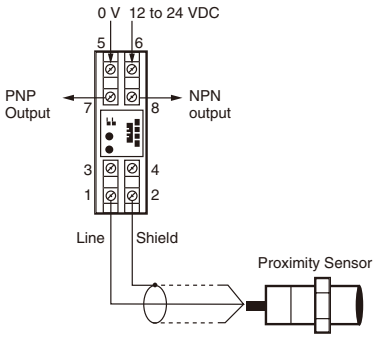
* OFF-delay timer setting
If the OFF-delay operation terminals are shorted, a 40-ms OFF-delay timer will start.

E2C-JC4AP

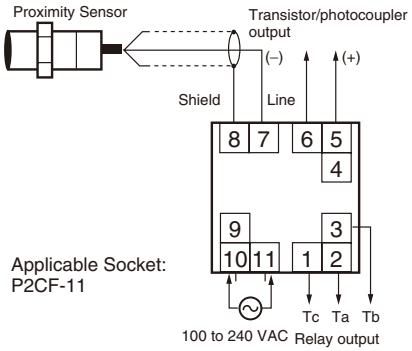


* Sensor Cable Length Compensation
These terminals can be use to switch the cable length.
Terminals shorted: 1 to 3 m
Terminals open: 3 to 5 m

E2C-WH4A

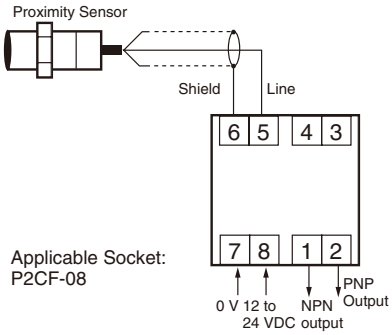


E2C-AK4A



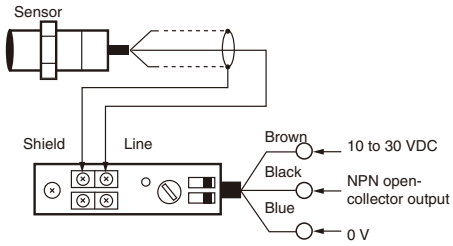
Applicable Socket:
P2CF-11

E2C-AM4A



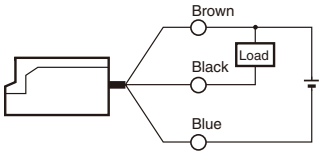
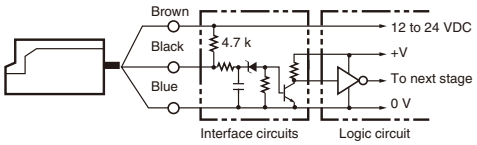
Applicable Socket:
P2CF-08

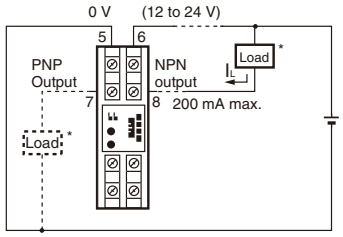
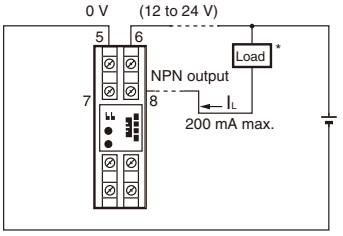
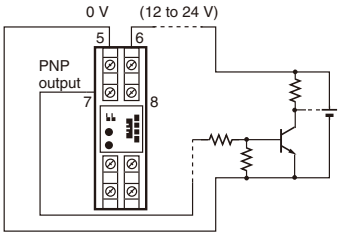
E2C-JC4□H



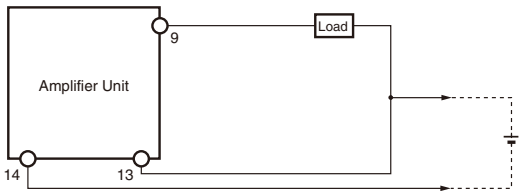
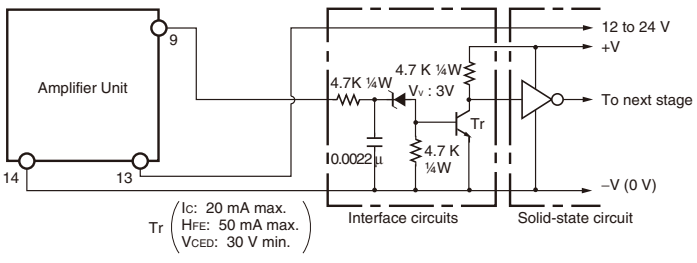
Note: Characteristics will change if the cable length changes. Do not cut or extend the cable.

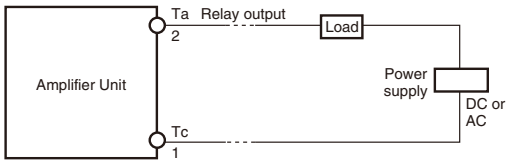
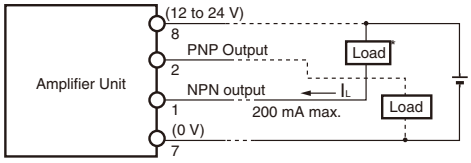
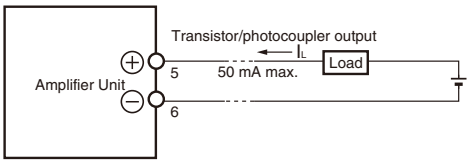
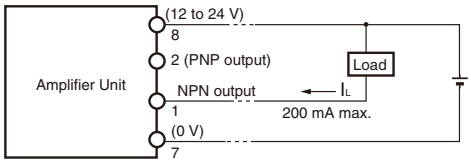
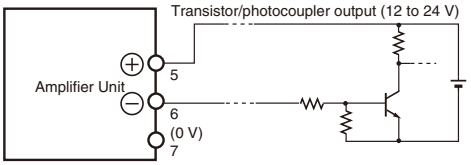
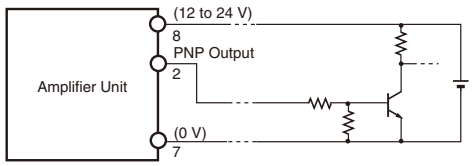
Load Connections

Model / Load	E2C-JC4A, E2C-JC4□H
DC load • Relay • Solenoid **Current-sinking load** • Programmable Controller • Sensor Controller	
Voltage load (logic circuit)	

Model / Load	E2C-WH4A
DC load • Relay • Solenoid	 * Use 40 V maximum when connecting the load to a separate power supply.
Solid-state load • Programmable Controller • Sensor Controller (S3D8)	 * For a current-sourcing load, connect the PNP output.
Voltage load (logic circuit)	

Note: The E2C-WH4A supports both NPN and PNP open-collector output. It can be connected to a wide variety of load types and power polarities.

Model / Load	E2C-GE4□
DC load • Relay • Solenoid	
Solid-state load • Programmable Controller • Sensor Controller	
Voltage load (logic circuit)	
Remarks	When connecting to a CMOS IC or TLL, provide an interface circuit as shown above and connect to the solid-state circuit in the next stage.

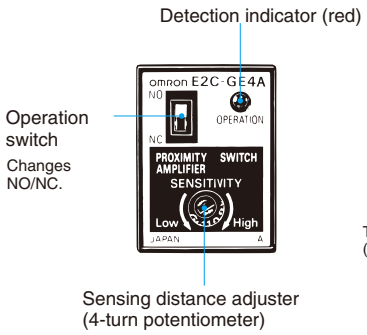
Load \ Model	E2C-AK4A	E2C-AM4A
DC load • Relay • Solenoid		 * Use 40 V maximum when connecting the load to a separate power supply.
Solid-state load **Current-sinking load (photocoupler)** • Programmable Controller • Sensor Controller	 * For a current-sourcing load, connect to the negative side of the transistor/photocoupler output.	 * For a current-sourcing load, connect the PNP output.
Voltage loads (logic circuit)		

The E2C-AK4A supports relay and transistor/photocoupler outputs, and the E2C-AM4A supports both NPN and PNP open-collector output. They can be connected to a wide variety of load types and power polarities.

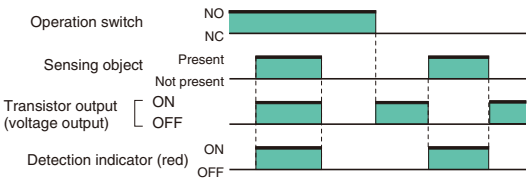
Nomenclature and Timing Charts

Amplifier Units

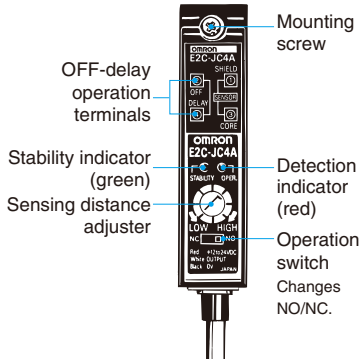
E2C-G□4□



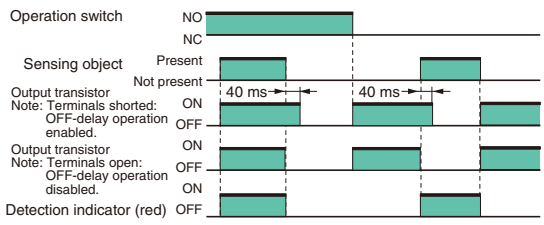
Timing Chart



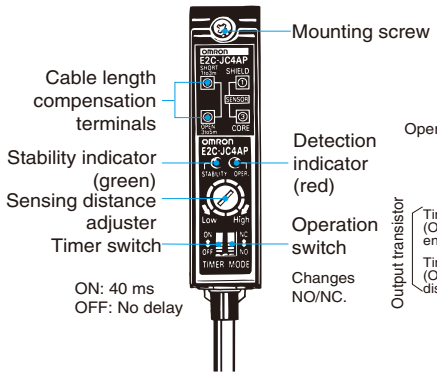
E2C-JC4A



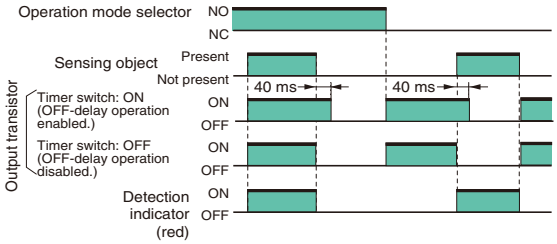
Timing Chart



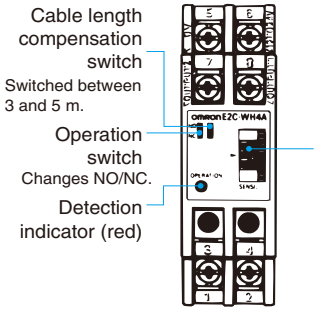
E2C-JC4AP



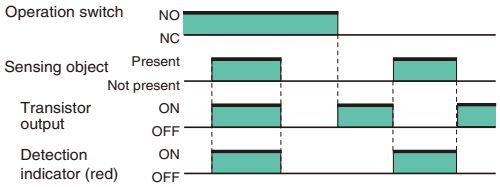
Timing Chart



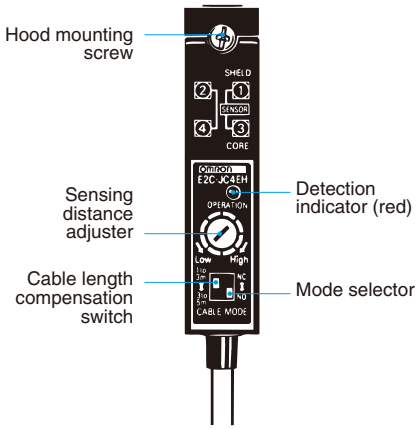
E2C-WH4A



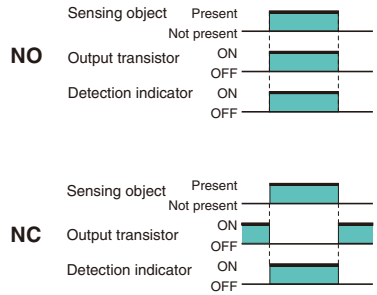
Timing Chart



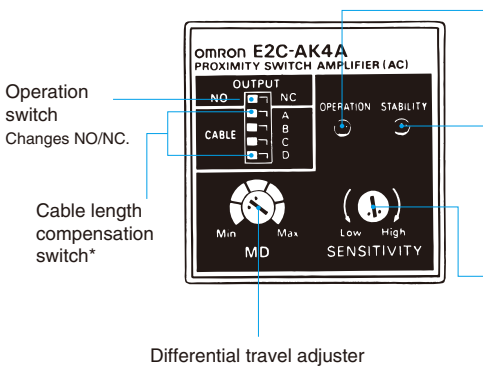
E2C-JC4CH, E2C-JC4DH, E2C-JC4EH



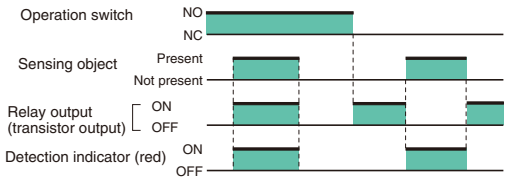
Timing Chart



E2C-A□4A



Timing Chart



* Cable Length Compensation Switching
Set this switch to the proper setting depending on whether the standard cable length is being used or the cable has been cut shorter.

Amplifier Unit Switch Settings

Applicable Sensors / Cable length	0 to 1 m	1 to 2 m	2 to 3 m	3 to 4 m	4 to 5 m	5 to 6 m	6 to 7 m	7 to 8 m	8 to 9 m	9 to 10 m
E2C-CR8A E2C-CR8B E2C-X1A E2C-C1A E2C-X1R5A						—	—	—	—	—
E2C-X2A E2C-X5A E2C-X10A E2C-C20MA										

Note: 1. Mutual Interference Prevention: When mounting Sensors with the same diameter and cable length in parallel, set the DIP switch to modes that differ by 1 m in cable length. Specifications, however, may not be sufficiently met, so always check operation before actual application. This method cannot be used for the E2C-C20MA.
2. When using the E2C-CR5B + E2C-AM4A (or AK4A), set all the pins on the Amplifier Unit DIP switch to the left.

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.

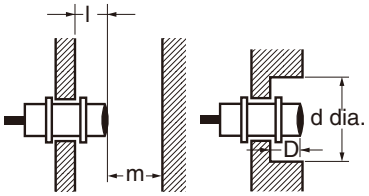
Precautions for Correct Use

Do not use the Encoder 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.



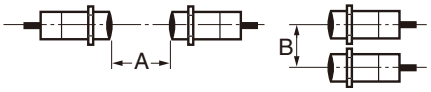
Influence of Surrounding Metal (Unit: mm)

Model / Distance	l	d	D	m
E2C-CR5B	2	6	2	1.5
E2C-CR8	0	(3.5)	0	2.4
E2C-X1A		(5)		3
E2C-C1A		(5.4)		
E2C-X1R5A(H)		(8)		4.5
E2C-X2A(H)		(12)		6
E2C-X5A(H)		(18)		15
E2C-X10A		(30)		30
E2C-C20MA	25	120	40	60

Note: Values in parentheses for diameter d are the outer diameters of Shielded Models.

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 can be prevented by using the cable length compensation switch, but doing so will also change coil characteristics. Specifications such as temperature specifications and sensing distance, may not be sufficiently met, so always check operation before actual application.
This method cannot be used for the E2C-G□4A, E2C-JC4A, E2C-CR5B, E2C-C20MA.



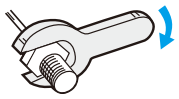
Mutual Interference (Unit: mm)

Model / Distance	A	B
E2C-CR5B	20	15
E2C-CR8		
E2C-X1A		
E2C-C1A		
E2C-X1R5A(H)		
E2C-X2A(H)	30	20
E2C-X5A(H)	50	35
E2C-X10A	100	70
E2C-C20MA	300	200

Note: The above values are for a differential travel setting of 5%.

Mounting

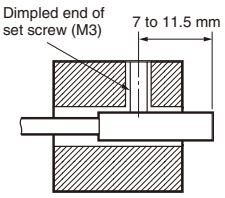
- Do not use excessive force when tightening the nuts on the E2C-X and E2C-C20MA. A washer must be used with the nut.



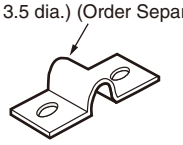
Model	Torque
E2C-X1A	0.98 N·m
E2C-X1R5A(H)	2.0 N·m
E2C-X2A(H)	5.9 N·m
E2C-X5A(H)	15 N·m
E2C-X10A	39 N·m
E2C-C20MA	15 N·m

Note: The above leeways in tighten torque assume that a toothed washer is being used.

- Mounting Unthreaded Cylindrical Models
  When using a set screw, tighten it to a torque of 0.2 N·m max.



Y92E-F3R5 Mounting Bracket (for 3.5 dia.) (Order Separately)



The Y92E-F5R4 (for 5.4 dia.) is also sold separately.

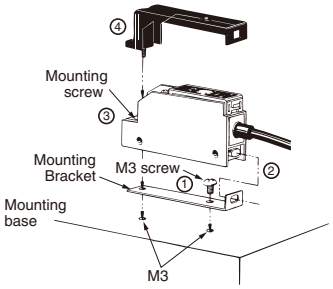
● Mounting

Mounting the Amplifier Unit

E2C-JC4A, E2C-JC4□H

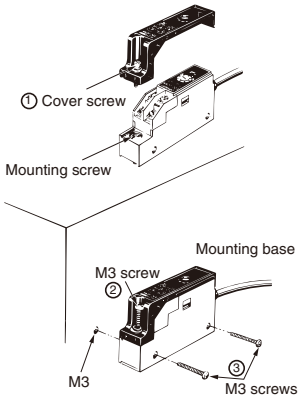
Lengthwise Mounting

(1)Secure the Mounting Bracket with the enclosed M3 screws.
(2)Slide the protrusion on the Amplifier Unit into the holes on the Mounting Bracket.
(3)Secure the Amplifier Unit with mounting screws.
(4)Secure the cover to the case.



Mounting to the Side

(1)Remove the cover screw and mounting screw.
(2)Attached the enclosed M3 screw to the cover and secure the cover to the case.
(3)Secure the Amplifier Unit with M3 screws from the side.

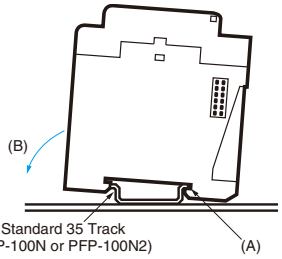


After completing adjustments, attach the enclosed caution label over the adjustment holes to prevent adjustment mistakes.

E2C-WH4A

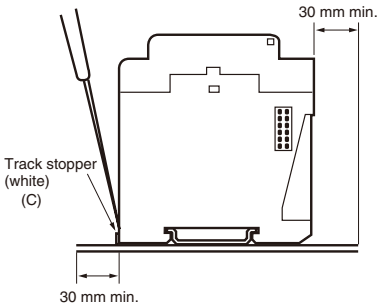
Mounting Method

(1)Mount to DIN Track as shown in the following diagram.
(2)Hook part (A) at the top of the Amplifier Unit on the DIN Track first and then press in on the Amplifier Unit in the direction indicated by (B).



Removing the Amplifier Unit

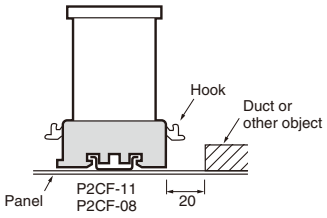
(3)Pull down on the track stopper (C) with a flat-blade screwdriver and then remove the Amplifier Unit from the DIN Track. When using DIN standard 35 track, keep other devices on the track separated from the Amplifier Unit by at least 30 mm to facilitate mounting and removal.



E2C-A□4A

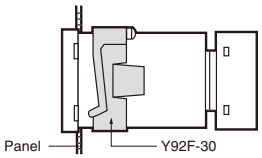
Using P2CF-11, P2CF-08

When aligning the Amplifier Unit vertically with the Socket, consider the space required for the hooks and allow a leeway of about 20 mm above and below the Amplifier Unit.

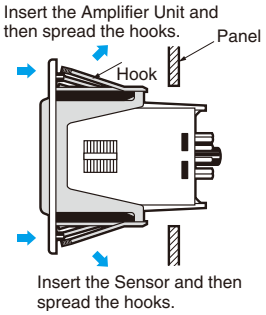


Mounting Embedded in a Panel

(1)When using the Y92F-30 Embedded Mounting Adapter, insert the Amplifier Unit into a square hold in the panel, attach the Adapter from the back and press in to reduce the gap with the panel. Then secure the Adapter with the screws.

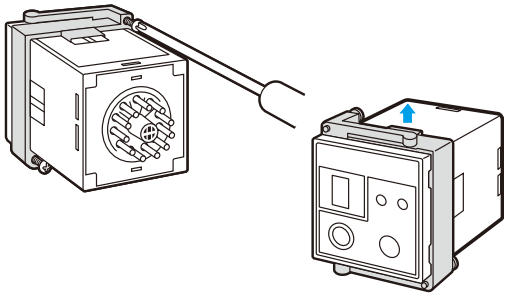


(2)When using the Y92F-70 or Y92F-71 Embedded Mounting Adapter, just press the Amplifier into a square hole in the panel. If the panel coating is too thick and the hooks do not lock in place, spread the hooks from the back by pushing in the directions of the arrows.

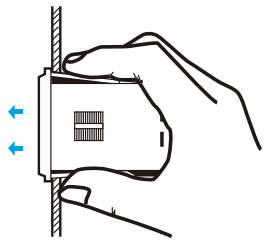


Removing the Amplifier Unit

- When the Amplifier Unit is mounted using the Y92F-30, loosen the screws on the adapter, spread the hooks at the top and bottom, and remove the Adapter.



- Using Y92F-70, Y92F-71
  Press in on the hooks with your thumb and forefinger and press forward on the Amplifier Unit.



● Wiring

Self-diagnostic Output

When not using the self-diagnostic output, connect the orange wire to 0 V or cut it and wrap it with insulation tape so that it does not come into contact with other terminals.

● Miscellaneous

The sensor does not have a water-resistant structure. Do not use it where it would be subjected to water or water vapor.

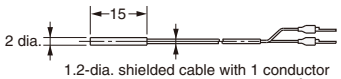
Dimensions

(Unit: mm)

Main Units

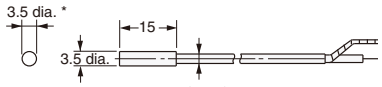
Sensor

E2C-CR5B



1.2-dia. shielded cable with 1 conductor (Conductor cross section: 0.03 mm^2), Standard length: 3 m

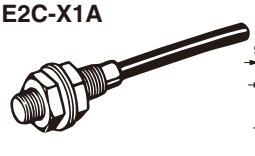
E2C-CR8A/-CR8B

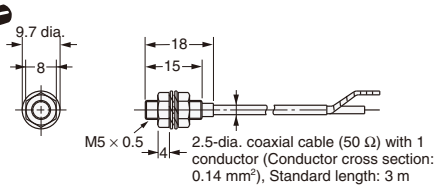


2.5-dia. coaxial cable (50 Ω) with 1 conductor (Conductor cross section: 0.14 mm^2), Standard length: 3 m

*E2C-CR8B: Diameter is 3.8.

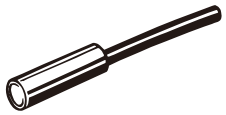
E2C-X1A

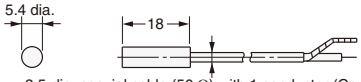




2.5-dia. coaxial cable (50 Ω) with 1 conductor (Conductor cross section: 0.14 mm^2), Standard length: 3 m

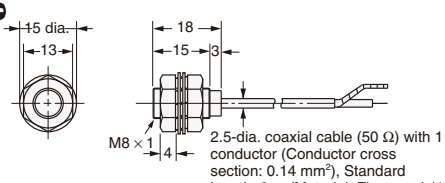
E2C-C1A





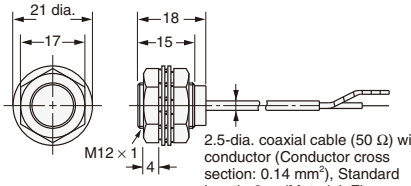
2.5-dia. coaxial cable (50 Ω) with 1 conductor (Conductor cross section: 0.14 mm^2), Standard length: 3 m

E2C-X1R5A
E2C-X1R5AH*



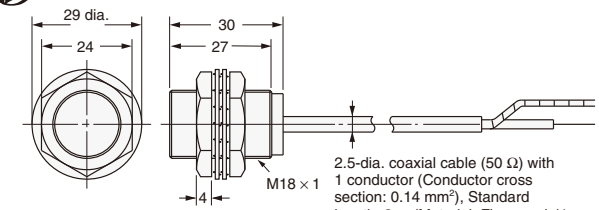
2.5-dia. coaxial cable (50 Ω) with 1 conductor (Conductor cross section: 0.14 mm^2), Standard length: 3 m (Material: Fluororesin)*

E2C-X2A
E2C-X2AH*



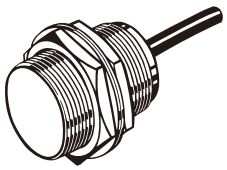
2.5-dia. coaxial cable (50 Ω) with 1 conductor (Conductor cross section: 0.14 mm^2), Standard length: 3 m (Material: Fluororesin)*

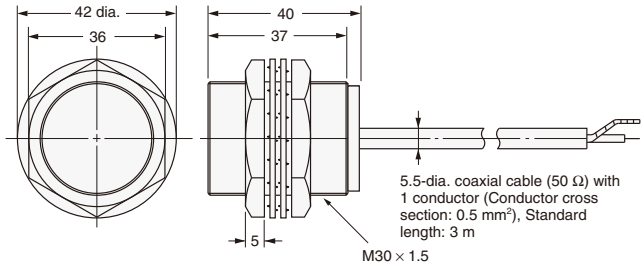
E2C-X5A
E2C-X5AH*



2.5-dia. coaxial cable (50 Ω) with 1 conductor (Conductor cross section: 0.14 mm^2), Standard length: 3 m (Material: Fluororesin)*

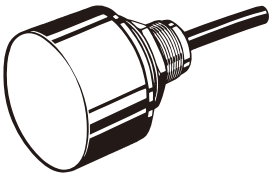
E2C-X10A

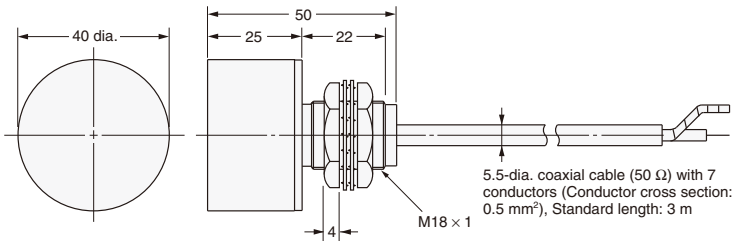




5.5-dia. coaxial cable (50 Ω) with 1 conductor (Conductor cross section: 0.5 mm^2), Standard length: 3 m

E2C-C20MA





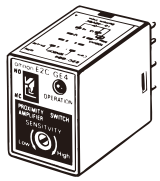
5.5-dia. coaxial cable (50 Ω) with 7 conductors (Conductor cross section: 0.5 mm^2), Standard length: 3 m

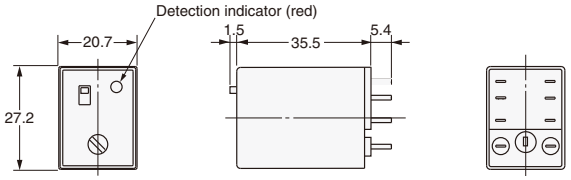
Mounting Hole Dimensions

Model	F (mm)	Model	F (mm)	Model	F (mm)
E2C-CR5B	2.2-dia. $^{+0.3}_{0}$	E2C-X1A	5.4-dia. $^{+0.5}_{0}$	E2C-X5A	18.5-dia. $^{+0.5}_{0}$
E2C-CR8A	3.7-dia. $^{+0.3}_{0}$	E2C-X1R5A	8.5-dia. $^{+0.5}_{0}$	E2C-X10A	30.5-dia. $^{+0.5}_{0}$
E2C-CR8B	4.0-dia. $^{+0.3}_{0}$	E2C-X2A	12.5-dia. $^{+0.5}_{0}$	E2C-C20MA	18.5-dia. $^{+0.5}_{0}$
E2C-C1A	5.7-dia. $^{+0.3}_{0}$				

Amplifier Units

E2C-GE4A, -GE4B
E2C-GF4A, -GF4B

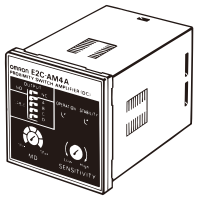


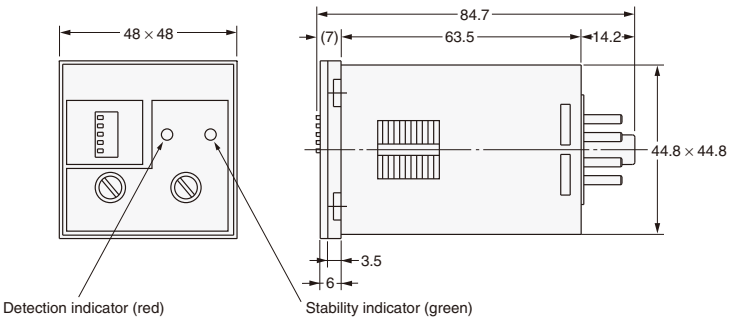


Applicable Sockets (Sold Separately)
- PYF08A

Hold-down Clip
- PYC-A1

E2C-AK4A (11-pin)
E2C-AM4A (8-pin)



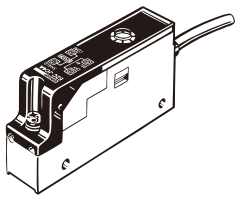


Applicable Sockets (Sold Separately)

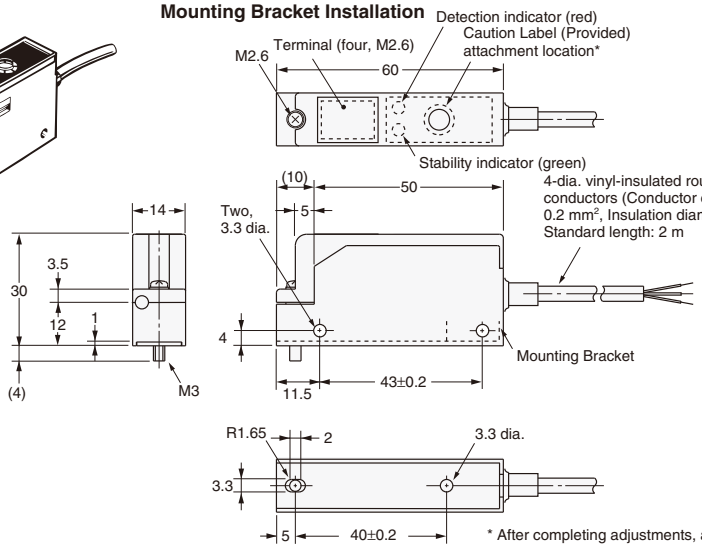
For E2C-AK4A (11-pin)
- P2CF-11
- P3GA-11

For E2C-AM4A (8-pin)
- P2CF-08
- P3G-08

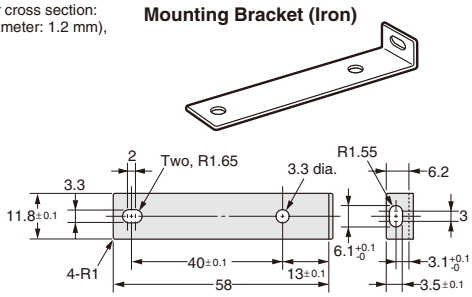
E2C-JC4A



Mounting Bracket Installation

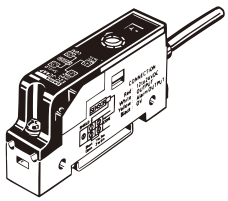


Mounting Bracket (Iron)

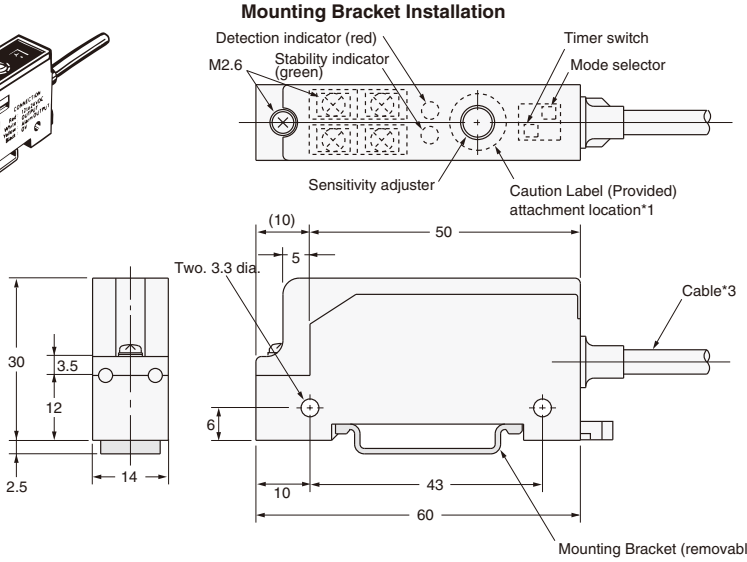


* After completing adjustments, attach the caution label to prevent adjustment mistakes.

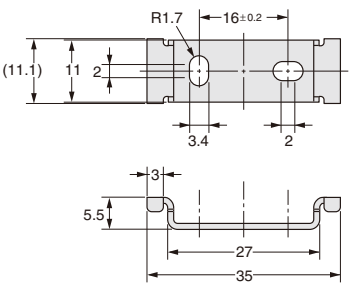
E2C-JC4AP



Mounting Bracket Installation

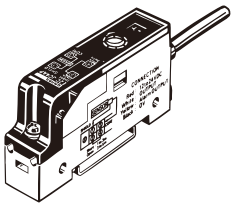


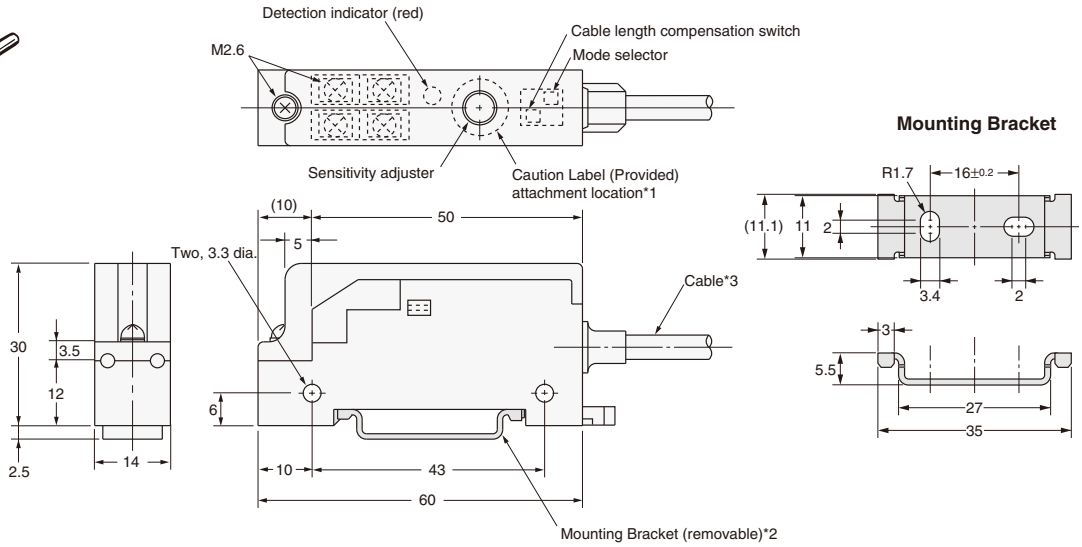
Mounting Bracket (Iron)



*1. After completing adjustments, attach the caution label to prevent adjustment mistakes.
*2. Not required when mounting to DIN Track.
*3: 4.5-dia. vinyl-insulated round cable with 4 conductors (Conductor cross section: 0.2 mm², Insulator diameter: 1.2 mm), Standard length: 2 m

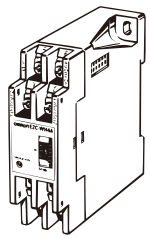
E2C-JC4□H

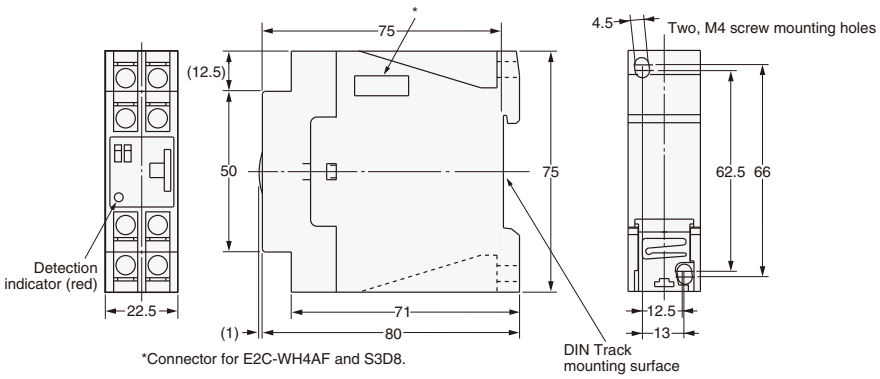




*1. After completing adjustments, attach the caution label to prevent adjustment mistakes
*2. Not required when mounting to DIN Track.
*3. 4-dia. vinyl-insulated round cable with 3 conductors (Conductor cross section: 0.2 mm^2, Insulator diameter: 1.2 mm), Standard length: 2 m
The cable can be extended up to 200 m (separate metal conduit).

E2C-WH4A



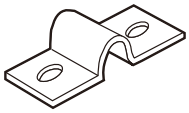


*Connector for E2C-WH4AF and S3D8.

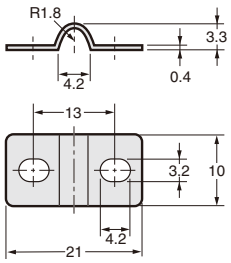
Accessories (Order Separately)

Mounting Bracket

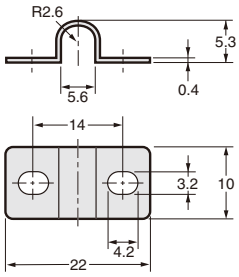
Mounting Bracket (for Unthreaded Cylindrical Models)
Y92E-F3R5 (for 3.5 dia.)
Y92E--F5R4 (for 5.4 dia.)



Y92E-F3R5

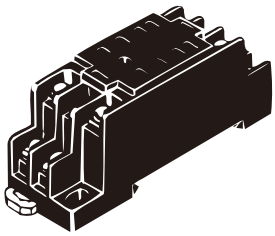


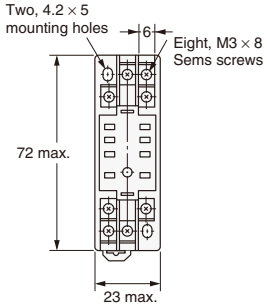
Y92E-F5R4



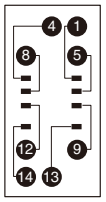
Front Connection Sockets

PYF08A

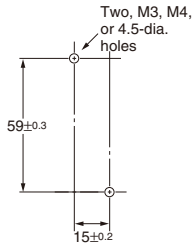




Terminal Arrangement and Internal Connections (Top View)

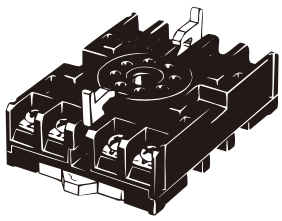


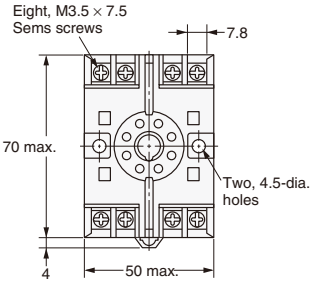
Mounting Hole Dimensions



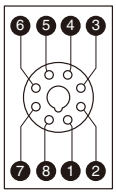
Note: Track mounting is also possible.

P2CF-08

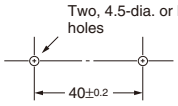




Terminal Arrangement and Internal Connections (Top View)

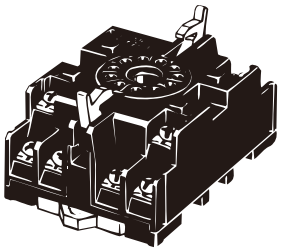


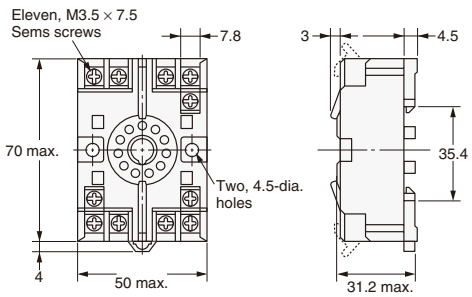
Mounting Hole Dimensions



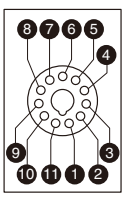
Note: Track mounting is also possible.

P2CF-11

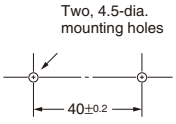




Terminal Arrangement and Internal Connections (Top View)



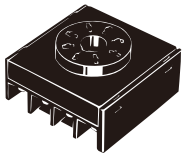
Mounting Hole Dimensions

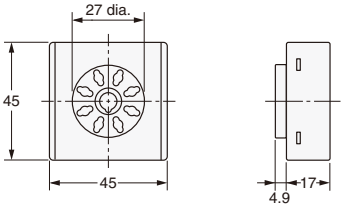


Note: Track mounting is also possible.

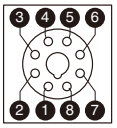
Back Connection Sockets

P3G-08

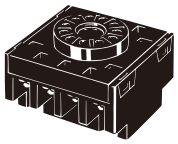


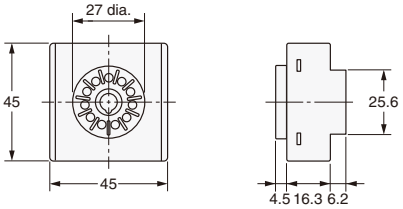


Terminal Arrangement and Internal Connections (Bottom View)

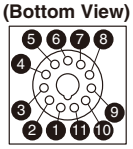


P3GA-11



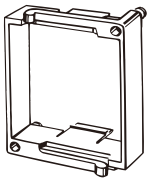


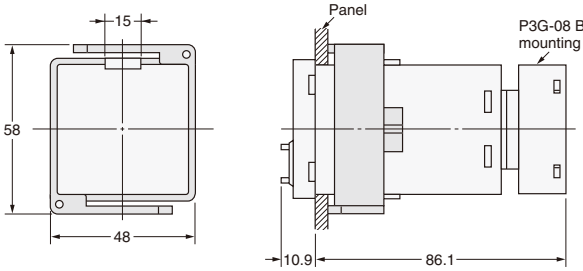
Terminal Arrangement and Internal Connections (Bottom View)



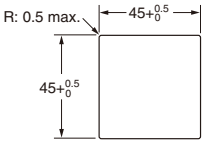
Embedded Mounting Adapter (for E2C-AK4A/E2C-AM4A Amplifier Unit)

Y92F-30



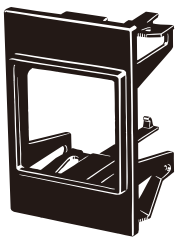


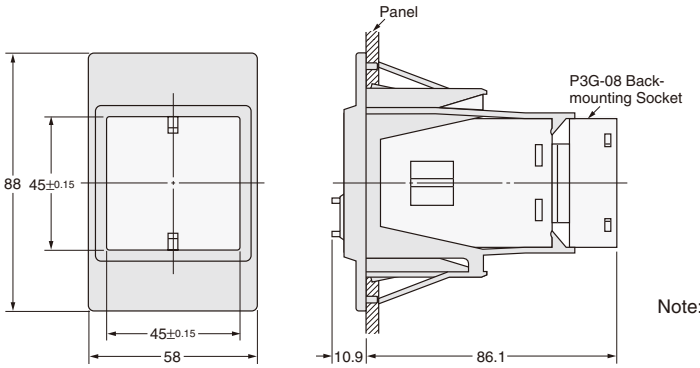
Mounting Hole Dimensions



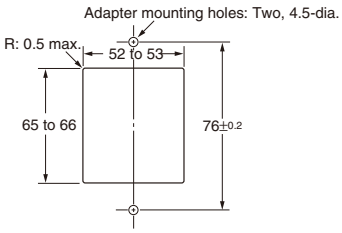
Note 1. Suitable mounting panel thickness: 1 to 5 mm
Note 2. Check the direction of the Adapter, which depends on whether Amplifier Units are arranged vertically or horizontally.

Y92F-70



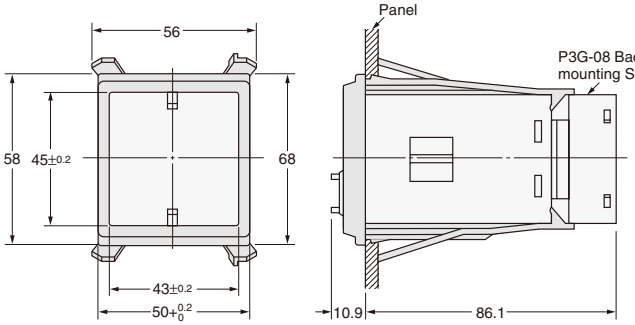


Mounting Hole Dimensions

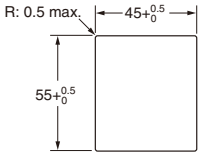


Note: Suitable mounting panel thickness: 1 to 3.2 mm

Y92F-71



Mounting Hole Dimensions



Note: Suitable mounting panel thickness: 1 to 3.2 mm

Cat. No. D815-E1-03

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

E2C/E2C-H

Amplifier Unit Initial Adjustment

Initial Adjustment after Turning ON the Power

After turning ON the Amplifier Unit, make the following adjustments according to the indicator status without a sensing object.

E2C-G□4□ Single-function Model/E2C-WH4A (F) Multi-function Model

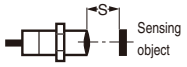
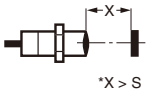
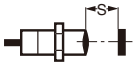
Status of Indicators: Detection indicator (red) (OPERATION)	Operation: Sensitivity adjuster
Lit	Turn the sensitivity adjuster counterclockwise until the operation indicator turns OFF.
Not lit	No adjustment is required.

E2C-JC4A Multi-function Model/E2C-A□4A Multi-function Model

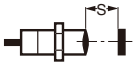
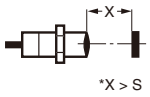
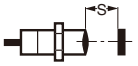
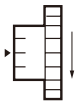
Status of Indicators: Mode indicator	Detection indicator (red)	Stability indicator (green)	Operation: Sensitivity adjuster
A	Lit	Lit	Turn the sensitivity adjuster counterclockwise to put the Amplifier Unit in mode D.
B	Lit	Not lit	
C	Not lit	Not lit	
D	Not lit	Lit	No adjustment is required.

Amplifier Unit Sensitivity Adjustment

E2C-G□4□ Single-function Model

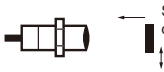
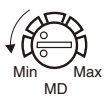
Item \ Step	(1)	(2)	(3)
Detection state			
Sensitivity adjuster	---		---
Operation	Obtain the sensing distance X from the set distance S divided by 0.8. Determine S so that X will be less than the maximum sensing distance.	Locate the Sensor so that the distance between the Sensor and sensing object is X. Turn the sensitivity adjuster toward High (clockwise) until the operation indicator is lit.	Return the Sensor to the previous position so that the distance between the Sensor and sensing object is S. Secure the position of the Sensor to complete the sensitivity adjustment.

E2C-WH4A(F) Multi-function Model

(1)	(2)	(3)
		
---		---
Obtain the sensing distance X from the set distance S divided by 0.8. Determine S so that X will be less than the maximum sensing distance.	Locate the Sensor so that the distance between the Sensor and sensing object is X. Turn the sensitivity adjuster in the direction of the arrow until the operation indicator is lit.	Return the Sensor to the previous position so that the distance between the Sensor and sensing object is S. Secure the position of the Sensor to complete the sensitivity adjustment.

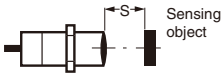
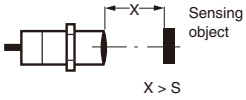
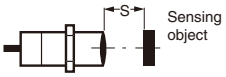
Note: If the Amplifier Unit malfunctions due to radical ambient temperature changes, further shorten the distance between the Sensor and sensing object to 80% maximum of the set distance.

E2C-A□4A and E2C-JC4A Multi-function Models, E2C-JC4□H Heat-resistance Model

Item \ Step	(1)	(2)	(3)	(4)
Detection state	---			
Sensitivity adjuster				---
Operation	Set the MD adjuster to the center between “Min” and “Max.”	Locate the sensing object in the adjustment range of sensing distance and turn the sensitivity adjuster toward High (clockwise) until the red operation indicator is lit.	Move the sensing object for a necessary differential travel distance (I.e., 1% to 5% of the rated sensing distance) and turn the MD adjuster slowly toward Min until the red operation indicator turns OFF. Then move the sensing object and check that the Sensor detects the object when the object is in the sensing distance range.	Shorten the distance between the Sensor and sensing object and fix the position of the Sensor where both the red operation indicator and green stability indicator are lit to complete the sensitivity adjustment.

Note: If the Amplifier Unit malfunctions due to radical ambient temperature changes, further shorten the distance between the Sensor and sensing object to 80% maximum of the set distance. The E2C-JC4A has no function to adjust differential travel. Therefore, perform steps 2 and 4 only.

E2C-JC4AP Self-diagnostic Output

Step / Item	(1)	(2)	(3)
Detection state			
Sensitivity adjuster	---		---
Operation	Obtain the sensing distance X from the set distance S divided by 0.8. Determine S so that X will be less than the maximum sensing distance.	Locate the Sensor so that the distance between the Sensor and sensing object is X. Turn the sensitivity adjuster clockwise or counterclockwise until the red operation indicator is lit.	Return the Sensor to the previous position so that the distance between the Sensor and sensing object is S. Secure the position of the Sensor to complete the sensitivity adjustment. The green stability indicator must be lit when the sensing object is located within the sensing distance, and the red stability indicator must be lit when the object is completely outside the sensing distance.

Note: If the Amplifier Unit malfunctions due to radical ambient temperature changes, further shorten the distance between the Sensor and sensing object to 80% maximum of the set distance.

A caution label is provided with the E2C Amplifier Unit. After adjusting the sensitivity, attach the caution label over the adjuster hole of the cover to prevent misoperation of the E2C Amplifier Unit. (E2C-JC4A, E2C-JC4AP, E2C-JC4□H only)

General Precautions

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

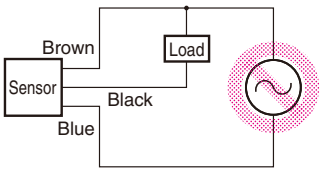
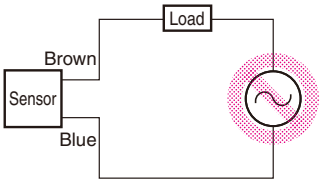
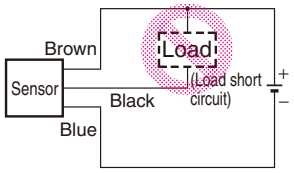
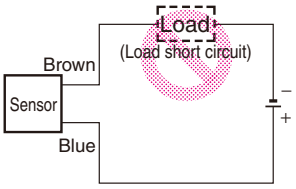
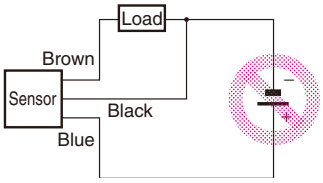
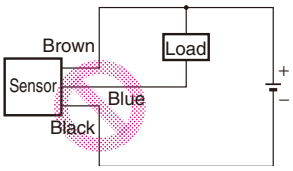
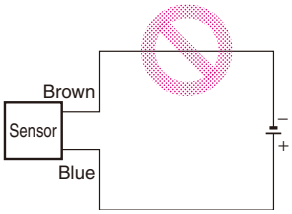
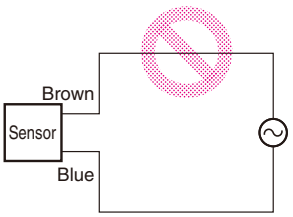
⚠ WARNING

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 

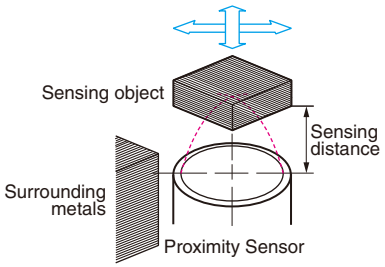
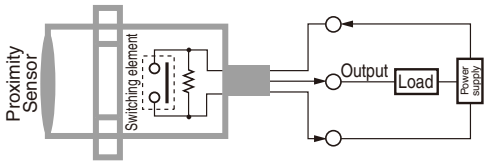
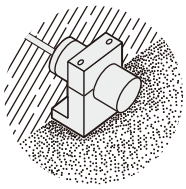
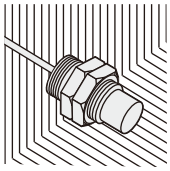
●Operating Environment

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.

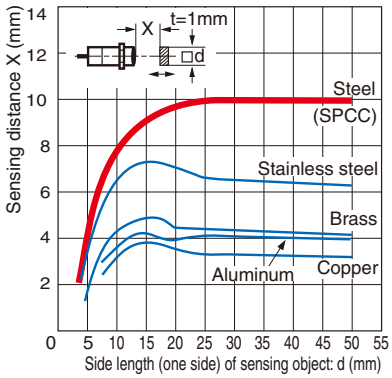
●Design

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.

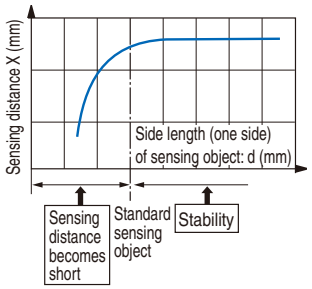
Example: E2-X10D□



Size of Sensing Object

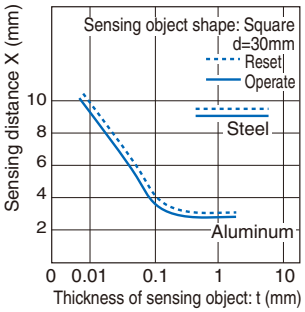
In general, if the object is smaller than the standard sensing object, the sensing distance decreases.

- 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.
- When the coating thickness is 0.01 mm or less, a sensing distance equivalent to a magnetic body can be obtained. 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.

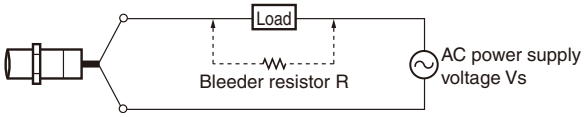
Examples of Timers that Use AC Half-wave Rectification
Timers: H3Y, H3YN, H3RN, H3CA-8, RD2P, and H3CR (-A, -A8, -AP, -F, -G)

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.

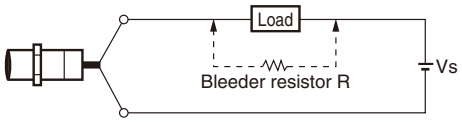
$$R \leq \frac{Vs}{10 - I}\ (k\Omega) \qquad P > \frac{Vs^2}{R}\ (mW)$$

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.

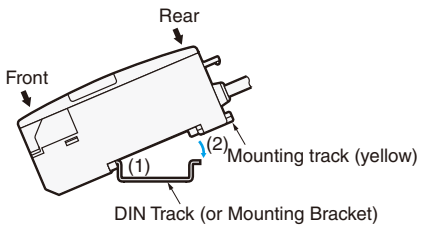
For details, refer to the mounting precautions in *Precautions for Correct Use* in individual product information.

Mounting/Removing Using DIN Track (Example for E2CY)

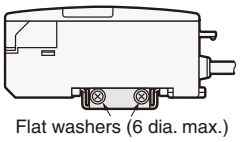
<Mounting>

(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.

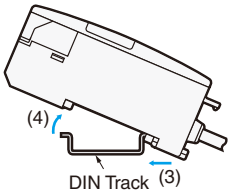


- When mounting the side of the Sensor using the special Mounting Bracket, first secure the Amplifier Unit to the special Mounting Bracket, and then mount the special Mounting Bracket with M3 screws and flat washers with a diameter of 6 mm maximum.



<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.

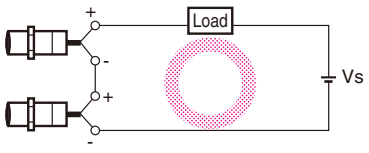
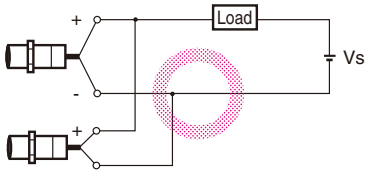
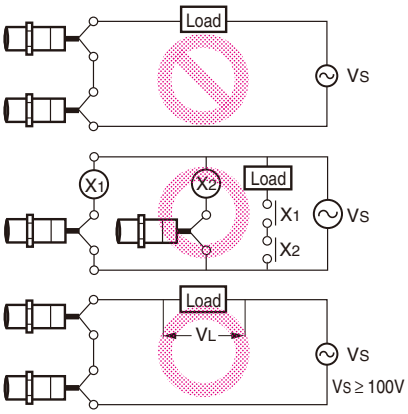
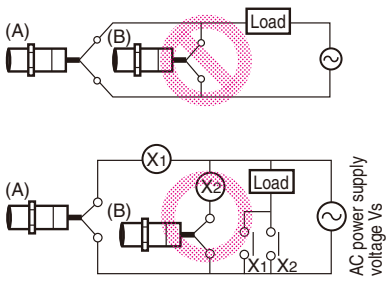


Set Distance

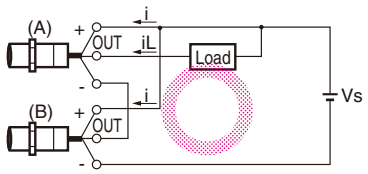
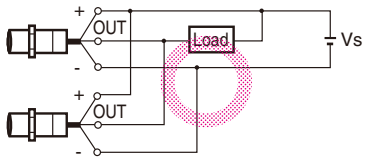
The sensing distance may vary due to fluctuations in temperature and voltage. When mounting the Sensor, it is recommend that installation be based on the set distance.

●Wiring Considerations

AND/OR Connections for Proximity Sensors

Model	Type of connection	Connection	Description
DC 2-Wire	AND (series connection)		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.
	OR (parallel connection)		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.
AC 2-wire	AND (series connection)		<TL-NY, TL-MY, E2K-□MY□, TL-T□Y> The above Proximity Sensors cannot be used in a sereis 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.)
	OR (parallel connection)		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.

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 Vs - N × VR ≥ Operating load voltage N : Number of Sensors that can be connected VR: Residual output voltage of Sensor Vs: 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

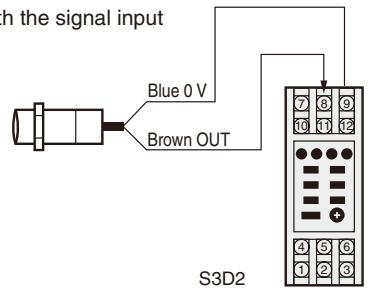
Using Metal Conduits
If a power line is to be located near the Proximity Sensor cable, use a separate metal conduit to prevent malfunction or damage. (Same for DC models.)

Example of Connection with S3D2 Sensor Controller

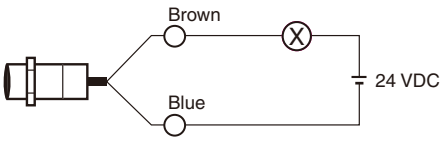
DC 2-Wire Sensors

Using the S3D2 Sensor Controller

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



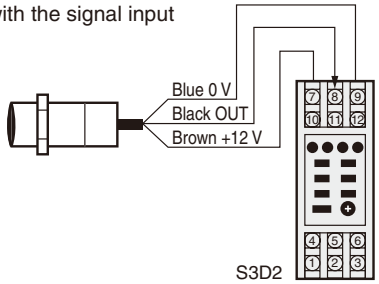
Connecting to a Relay Load



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.

Read and Understand This Catalog

Please read and understand this catalog before purchasing the products. Please consult your OMRON representative if you have any questions or comments.

Warranty and Limitations of Liability

WARRANTY
OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

LIMITATIONS OF LIABILITY
OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS, OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

Application Considerations

SUITABILITY FOR USE
OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the product.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this catalog.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

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