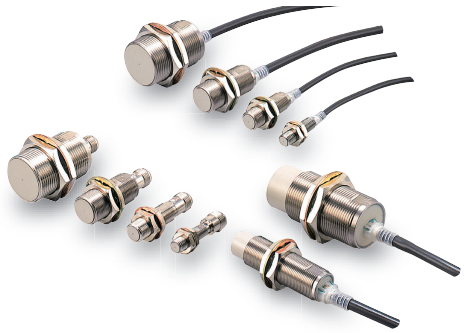
CSM_E2EM_DS_E_10_2

# Long-distance Proximity Sensor

- Long-distance detection at up to 30 mm enables secure mounting with reduced problems due to workpiece collisions.
- No polarity for easy wiring with DC 2-wire models.
- Cable protector provided as a standard feature.



For the most recent information on models that have been certified for safety standards, refer to your OMRON website.

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

## Ordering Information

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

#### DC 2-Wire, Pre-wired Models

| Appearance | | Sensing distance | Model | |
|---|---|---|---|---|
| | | | NO | NC |
| Shielded *1 | M12 | 4 mm | E2EM-X4X1 2M *2 | E2EM-X4X2 2M |
| | M18 | 8 mm | E2EM-X8X1 2M *2 | E2EM-X8X2 2M |
| | M30 | 15 mm | E2EM-X15X1 2M *2 | E2EM-X15X2 2M |
| Unshielded | M18 | 16 mm | E2EM-X16MX1 2M | E2EM-X16MX2 2M |
| | M30 | 30 mm | E2EM-X30MX1 2M | E2EM-X30MX2 2M |

*1. There are installation restrictions that apply to Shielded Sensors. Refer to Reference *Influence of Surrounding Metal* in *Safety Precautions* on page 6.
*2. Pre-wired M12 Connector Models with a cable length of 300 mm are also available. Add -M1J to the end of the model number (example: E2EM-X4X1-M1J).

#### DC 3-Wire, Pre-wired Models

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

* There are installation restrictions that apply to Shielded Sensors. Refer to Reference *Influence of Surrounding Metal* in *Safety Precautions* on page 6.

#### DC 3-Wire, M12 Connector Models

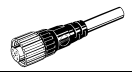
| Appearance | | Sensing distance | Model | |
|---|---|---|---|---|
| | | | Output configuration: NPN NO | Output configuration: NPN NC |
| Shielded * | M8 | 2 mm | E2EM-X2C1-M1 | E2EM-X2C2-M1 |
| | M12 | 4 mm | E2EM-X4C1-M1 | E2EM-X4C2-M1 |
| | M18 | 8 mm | E2EM-X8C1-M1 | E2EM-X8C2-M1 |
| | M30 | 15 mm | E2EM-X15C1-M1 | E2EM-X15C2-M1 |

* There are installation restrictions that apply to Shielded Sensors. Refer to Reference *Influence of Surrounding Metal* in *Safety Precautions* on page 6.

## Accessories (Order Separately)

### Sensor I/O Connectors (M12, Sockets on One Cable End)

**(Models for Connectors and with Pre-wired Connectors: A Connector is not provided with the Sensor. Be sure to order a Connector separately.)** **[Refer to *XS2*.]**

| Appearance | Cable length | Sensor I/O Connector model number | Applicable Proximity Sensor model number |
|---|---|---|---|
| Straight  | 2 m | **XS2F-D421-DC0-F** | E2EM-X□C1-M1 |
| | 5 m | **XS2F-D421-GC0-F** | |
| | 2 m | **XS2F-D421-D80-F** | E2EM-X□C□-M1 |
| | 5 m | **XS2F-D421-G80-F** | |
| L-shape | 2 m | **XS2F-D422-DC0-F** | E2EM-X□C1-M1 |
| | 5 m | **XS2F-D422-GC0-F** | |
| | 2 m | **XS2F-D422-D80-F** | E2EM-X□C□-M1 |
| | 5 m | **XS2F-D422-G80-F** | |

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

# Ratings and Specifications

### E2EM-X□X□ DC 2-Wire Models

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

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

## E2EM-X□C□ DC 3-Wire Models

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

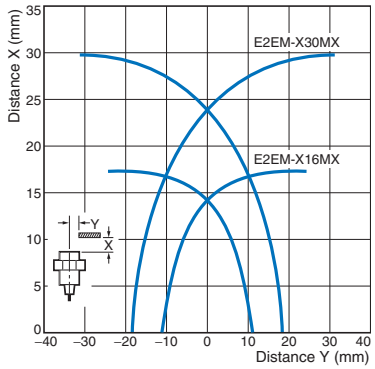
*1. The response frequency is an average value.
Measurement conditions are as follows: standard sensing object, a distance of twice the standard sensing object, and a set distance of half the sensing distance.
*2. When using an M8 Model at an ambient temperature between 70 and 85°C, supply 10 to 30 VDC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

# Engineering Data (Reference Value)

## Sensing Area

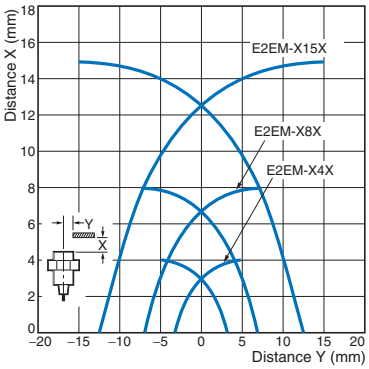
### Unshielded Models

#### E2EM-X□MX□

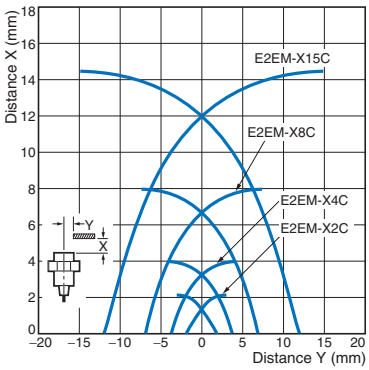



### Shielded Models

#### E2EM-X□X□

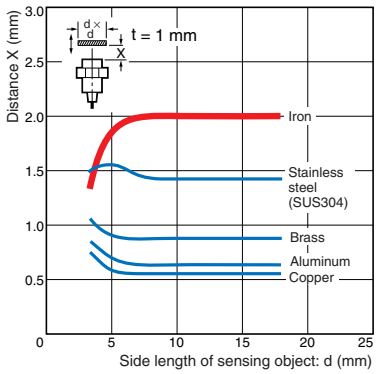



#### E2EM-X□C□

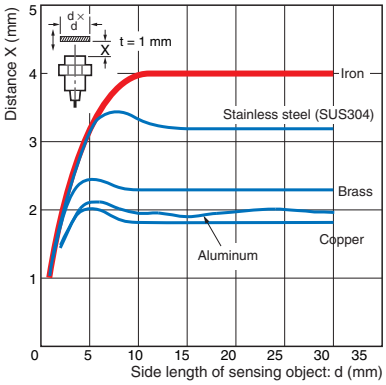



## Influence of Sensing Object Size and Material

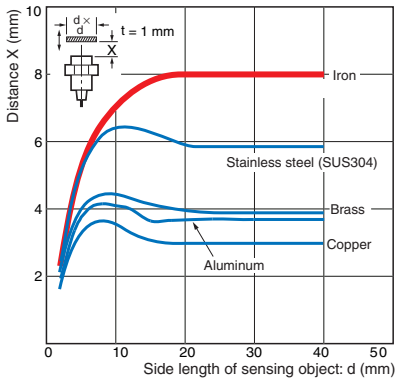
#### E2EM-X2□□(-M1)



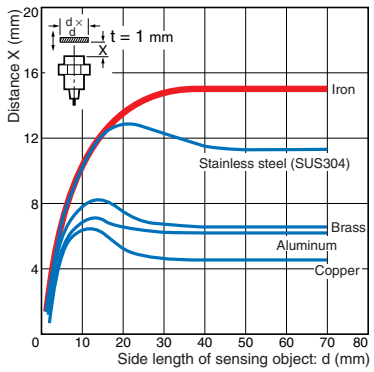

#### E2EM-X4□□(-M1)



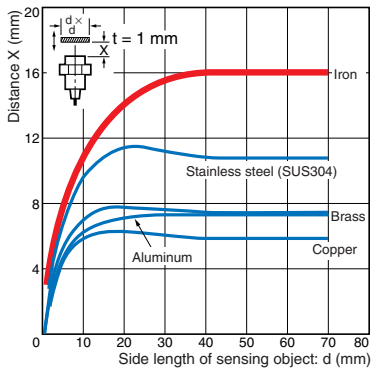

#### E2EM-X8□□(-M1)



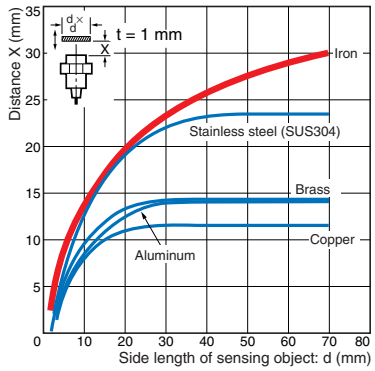

#### E2EM-X15□□(-M1)




#### E2EM-X16MX□

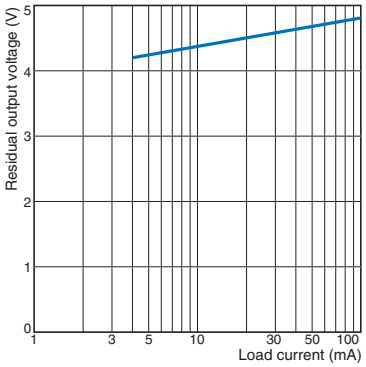



#### E2EM-X30MX□



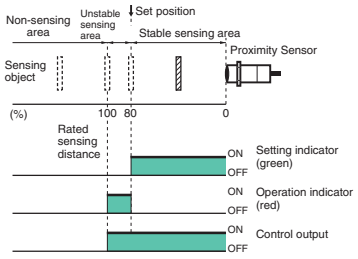
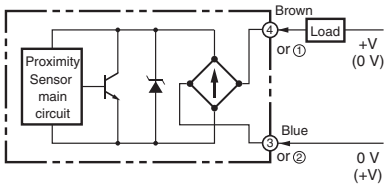
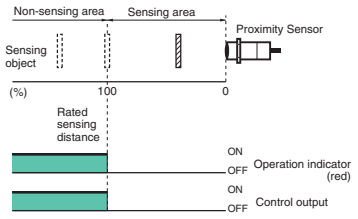

## Residual Output Voltage

#### E2EM-X□X□

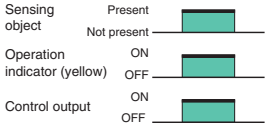
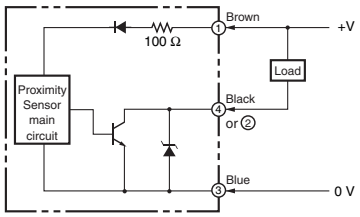
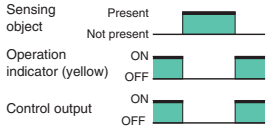


# I/O Circuit Diagrams

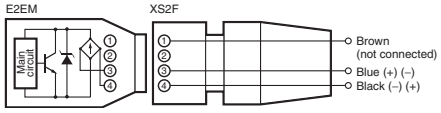
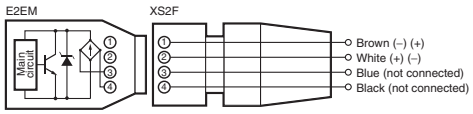
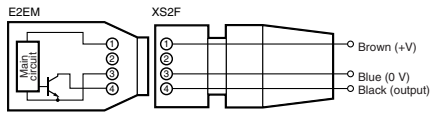
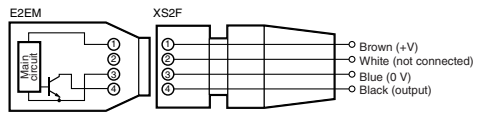
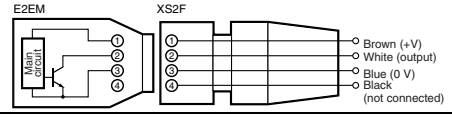
## E2EM-X□X□ DC 2-Wire Models

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

## E2EM-X□C□(-M1) DC 3-Wire Models

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

# Connections for Sensor I/O Connectors

| Proximity Sensor | | | Sensor I/O Connector model | Connections |
|---|---|---|---|---|
| Type | Operation mode | Model | | |
| DC 2-wire | NO | E2EM-X□X1-M1J | 1: Straight<br>2: L-shape<br>XS2F-D42□-□C0-F<br>D: 2-m cable<br>G: 5-m cable |  |
| | NC | E2EM-X□X2-M1J | 1: Straight<br>2: L-shape<br>XS2F-D42□-□80-F<br>D: 2-m cable<br>G: 5-m cable |  |
| DC 3-wire | NO | E2EM-X□C1-M1 | 1: Straight<br>2: L-shape<br>XS2F-D42□-□C0-F<br>D: 2-m cable<br>G: 5-m cable |  |
| | | | 1: Straight<br>2: L-shape<br>XS2F-D42□-□80-F<br>D: 2-m cable<br>G: 5-m cable |  |
| | NC | E2EM-X□C2-M1 | |  |

Refer to *Introduction to Sensor I/O Connectors/Sensor Controllers* for details.

# Safety Precautions

**Refer to *Warranty and Limitations of Liability*.**

**⚠ WARNING**

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

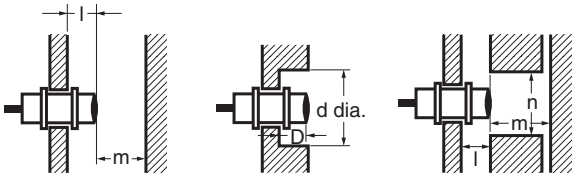
## Precautions for Correct Use

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

### ● Design

#### Influence of Surrounding Metal

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




**Influence of Surrounding Metal** (Unit: mm)

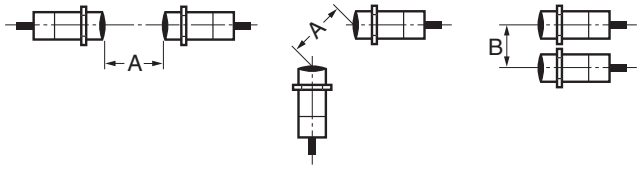
| Type | | Item | M8 | M12 | M18 | M30 |
|---|---|---|---|---|---|---|
| DC 2-wire E2EM-X□X□ | Shielded | l | --- | 2.4 | 3.6 | 6 |
| | | d | | 18 | 27 | 45 |
| | | D | | 2.4 | 3.6 | 6 |
| | | m | | 12 | 24 | 45 |
| | | n | | 18 | 27 | 45 |
| | Unshielded | l | --- | --- | 25 | 45 |
| | | d | | | 70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

#### AND/OR Connections

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

#### Mutual Interference

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




**Mutual Interference** (Unit: mm)

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

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

#### Required Conditions

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

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

#### Example

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

1. $V_{ON}$ (14.4 V) ≤ $V_{CC}$ (20.4 V) - $V_R$ (5 V) = 15.4 V: OK
2. $I_{OFF}$ (1.3 mA) ≥ $I_{leak}$ (0.8 mA): OK
3. $I_{ON}$ = [$V_{CC}$ (20.4 V) - $V_R$ (5 V) - $V_{PC}$ (4 V)] / $R_{IN}$ (3 kΩ)
   = Approx. 3.8 mA
   Therefore, $I_{OUT}$ (min.) (3 mA) ≤ $I_{ON}$ (3.8 mA): OK
   Connection is thus possible.

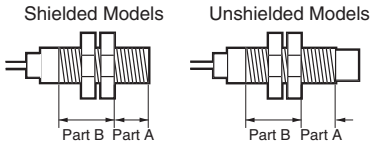
#### Connection Example (Reference)

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

## ● Mounting

### Tightening Force

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



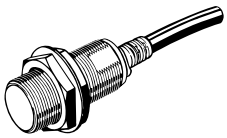

Note: 1. The allowable tightening strength depends on the distance from the edge of the head, as shown in the following table. (A is the distance from the edge of the head. B includes the nut on the head side. If the edge of the nut is in part A, the tightening torque for part A applies instead.)
2.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

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

# Dimensions

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

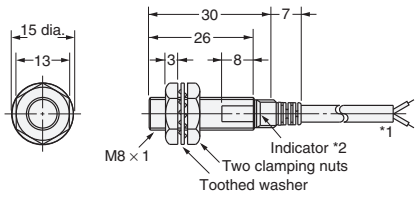
### Pre-wired Models (Shielded)



**Mounting Hole Dimensions**

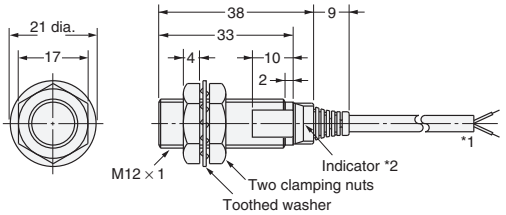
| Dimensions | M8 | M12 | M18 | M30 |
|---|---|---|---|---|
| F (mm) | $8.5^{+0.5}_{0}$ dia. | $12.5^{+0.5}_{0}$ dia. | $18.5^{+0.5}_{0}$ dia. | $30.5^{+0.5}_{0}$ dia. |

### E2EM-X2C□



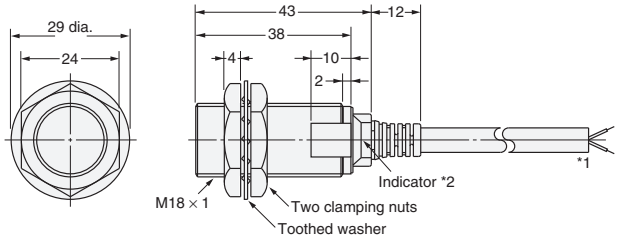

1. 4-dia. vinyl-insulated round cable with 2/3 conductors (Conductor cross section: 0.3 mm$^2$, Insulator diameter: 1.3 mm), Standard length: 2 m
The cable can be extended up to 200 m (separate metal conduit).
2. Operation indicator (yellow)

### E2EM-X4□□



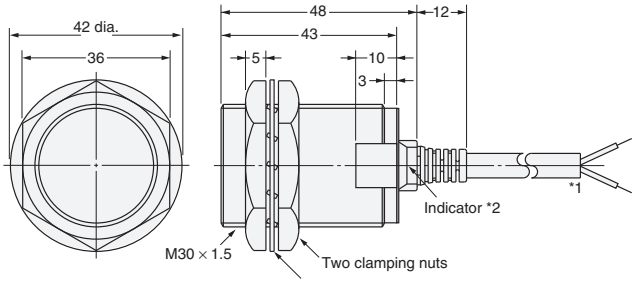

1. 4-dia. vinyl-insulated round cable with 2/3 conductors (Conductor cross section: 0.3 mm$^2$, Insulator diameter: 1.3 mm), Standard length: 2 m
2. X1 Models: Operation indicator (red) Setting indicator (green)
X2 Models: Operation indicator (red)
C Models: Operation indicator (yellow)

### E2EM-X8□□



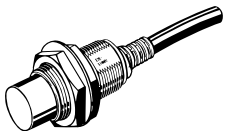

1. 6-dia. vinyl-insulated round cable with 2/3 conductors (Conductor cross section: 0.5 mm$^2$, Insulator diameter: 1.9 mm), Standard length: 2 m
2. X1 Models: Operation indicator (red) Setting indicator (green)
X2 Models: Operation indicator (red)
C Models: Operation indicator (yellow)

### E2EM-X15□□

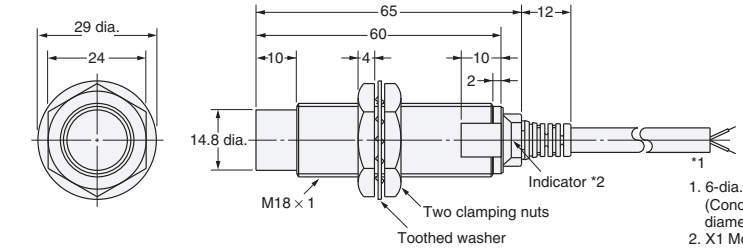



1. 6-dia. vinyl-insulated round cable with 2/3 conductors (Conductor cross section: 0.5 mm$^2$, Insulator diameter: 1.9 mm), Standard length: 2 m
2. X1 Models: Operation indicator (red) Setting indicator (green)
X2 Models: Operation indicator (red)
C Models: Operation indicator (yellow)

## Pre-wired Models (Unshielded)

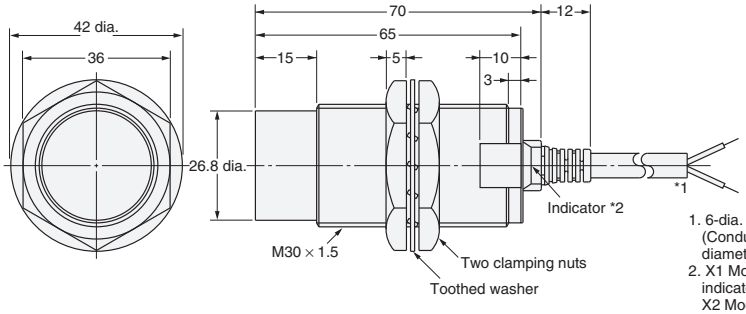


### E2EM-X16MX□



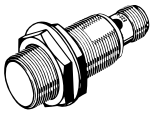

1. 6-dia. vinyl-insulated round cable with 2 conductors (Conductor cross section: 0.5 mm$^2$, Insulator diameter: 1.9 mm), Standard length: 2 m
2. X1 Models: Operation indicator (red), Setting indicator (green)
   X2 Models: Operation indicator (red)

### E2EM-X30MX□




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

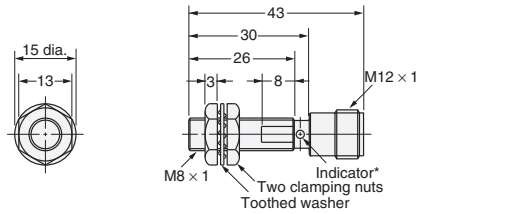
## Connector Models (Shielded)



**Mounting Hole Dimensions**

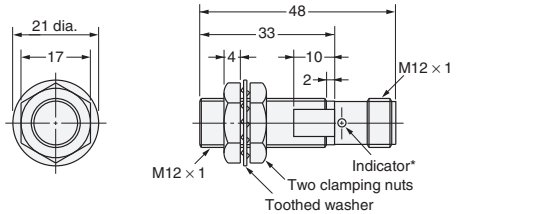
| Dimensions | M8 | M12 | M18 | M30 |
|---|---|---|---|---|
| F (mm) | 8.5 $^{+0.5}_{0}$ dia. | 12.5 $^{+0.5}_{0}$ dia. | 18.5 $^{+0.5}_{0}$ dia. | 30.5 $^{+0.5}_{0}$ dia. |

### E2EM-X2C□-M1



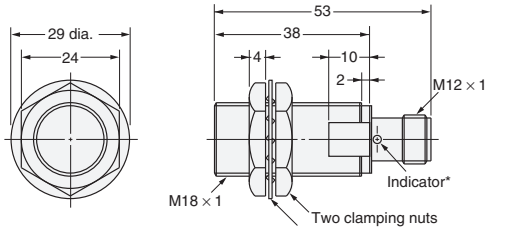

* Operation indicator (yellow)

### E2EM-X4C□-M1



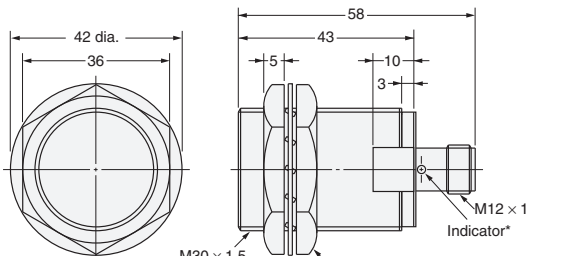

* Operation indicator (yellow)

### E2EM-X8C□-M1




* Operation indicator (yellow)

### E2EM-X15C□-M1




* Operation indicator (yellow)

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