

Oil-resistive, compact photoelectric sensor in metal housing

# E3S-C

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## Features

### Meets IP67/IP67G (oil tight) and NEMA 6P standards water/oil resistance

E3S-C meets the IP67 requirements of the IEC standards and 6P of the NEMA standards. E3S-C can be used worry-free in automotive assembly lines and other production lines where oil vapor exists. It can also be applied to food processing lines because it resists hydrogen peroxide, detergent and potassium hydroxide.

### High shock resistance of 1,000 m/s<sup>2</sup>

The industry's top-class photoelectric sensor features shock resistance of 1,000 m/s<sup>2</sup>, which is as high as that of a proximity sensor at rated values, and vibration resistance of as high as 10 to 2,000 Hz.

### Lineup of M12 metal connector joint type models

Lineup of water/oil/shock-resistant M12 metal connector joint type models are available. This series ensures ease of sensor replacement during maintenance.

### NPN/PNP output selector

The operation panel has the NPN/PNP output selector. You need not prepare two NPN and PNP models for export. You need not worry about malfunctions due to noise, either.



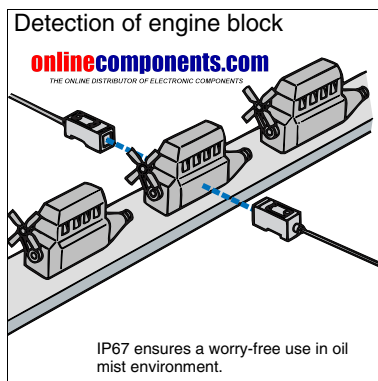
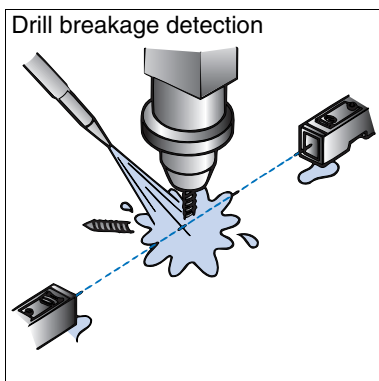
### Mutual interference prevention enhanced (Retroreflective, diffuse reflective models)

Fuzzy inference is introduced into the mutual interference prevention for the first time in the industry. This prevents a malfunction due to mutual interference, enabling two sensors to be mounted closely side by side.

### Easy optical axis alignment

OMRON's original "automatic position compensation system" minimizes misalignment of mechanical and optical axes to merely  $\pm 2^\circ$ . The optical axis is aligned perfectly by only installing the sensor.

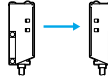
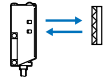
## Application



## Ordering Information

## Sensors

■ Red light    ■ Infrared light

| Sensor type            | Shape                                                                                                   | Connection method  | Sensing distance                            |    |     | Model        |
|------------------------|---------------------------------------------------------------------------------------------------------|--------------------|---------------------------------------------|----|-----|--------------|
| Through-beam           | Horizontal Model<br>   | Pre-wired          |                                             |    |     | E3S-CT11     |
|                        |                                                                                                         | Junction connector |                                             |    |     | E3S-CT11-M1J |
|                        |                                                                                                         | Plug-in connector  |                                             |    |     | E3S-CT16     |
|                        | Vertical Model<br>    | Pre-wired          |                                             |    | 30m | E3S-CT61     |
|                        |                                                                                                         | Junction connector |                                             |    |     | E3S-CT61-M1J |
|                        |                                                                                                         | Plug-in connector  |                                             |    |     | E3S-CT66     |
| Retroreflective Models | Horizontal Model<br> | Pre-wired          |                                             |    |     | E3S-CR11     |
|                        |                                                                                                         | Junction connector |                                             |    |     | E3S-CR11-M1J |
|                        |                                                                                                         | Plug-in connector  |                                             |    |     | E3S-CR16     |
|                        | Vertical Model<br>   | Pre-wired          |                                             | 3m |     | E3S-CR61     |
|                        |                                                                                                         | Junction connector |                                             |    |     | E3S-CR61-M1J |
|                        |                                                                                                         | Plug-in connector  |                                             |    |     | E3S-CR66     |
| Diffuse-reflective     | Horizontal Model<br> | Pre-wired          | <span style="color: blue;">■</span> 700mm   |    |     | E3S-CD11     |
|                        |                                                                                                         |                    | <span style="color: lightblue;">■</span> 2m |    |     | E3S-CD12     |
|                        |                                                                                                         | Junction connector | <span style="color: blue;">■</span> 700mm   |    |     | E3S-CD11-M1J |
|                        |                                                                                                         |                    | <span style="color: lightblue;">■</span> 2m |    |     | E3S-CD12-M1J |
|                        |                                                                                                         | Plug-in connector  | <span style="color: blue;">■</span> 700mm   |    |     | E3S-CD16     |
|                        |                                                                                                         |                    | <span style="color: lightblue;">■</span> 2m |    |     | E3S-CD17     |
|                        | Vertical Model<br>   | Pre-wired          | <span style="color: blue;">■</span> 700mm   |    |     | E3S-CD61     |
|                        |                                                                                                         |                    | <span style="color: lightblue;">■</span> 2m |    |     | E3S-CD62     |
|                        |                                                                                                         | Junction connector | <span style="color: blue;">■</span> 700mm   |    |     | E3S-CD61-M1J |
|                        |                                                                                                         |                    | <span style="color: lightblue;">■</span> 2m |    |     | E3S-CD62-M1J |
|                        |                                                                                                         | Plug-in connector  | <span style="color: blue;">■</span> 700mm   |    |     | E3S-CD66     |
|                        |                                                                                                         |                    | <span style="color: lightblue;">■</span> 2m |    |     | E3S-CD67     |

## Accessories (Order Separately)

## Slits

| Slit width         | Sensing distance | Minimum sensing object (typical) | Model   | Quantity                                          | Remarks                                                                 |
|--------------------|------------------|----------------------------------|---------|---------------------------------------------------|-------------------------------------------------------------------------|
| Width 0.5 mmx11 mm | 1.8 m            | 0.5 mm dia.                      | E39-S61 | 1 each for emitter and receiver (total of 8 pcs.) | (Plug-in type long slit) Can be used with through-beam E3S-CT□1 (-M1J). |
| Width 1 mmx11 mm   | 3.5 m            | 1 mm dia.                        |         |                                                   |                                                                         |
| Width 2 mmx11 mm   | 7 m              | 2 mm dia.                        |         |                                                   |                                                                         |
| Width 4 mmx11 mm   | 15 m             | 2.6 mm dia.                      |         |                                                   |                                                                         |

## Reflectors

| Name            | Sensing distance (typical) | Model   | Quantity | Remarks                                          |
|-----------------|----------------------------|---------|----------|--------------------------------------------------|
| Reflectors      | 3 m (rated value)          | E39-R1  | 1        | Attached to the Retroreflective E3S-CR□1 (-M1J). |
|                 | 4 m                        | E39-R2  | 1        | ---                                              |
| Small reflector | 1.5 m                      | E39-R3  | 1        | ---                                              |
|                 | 750 mm                     | E39-R4  | 1        | ---                                              |
| Tape Reflector  | 700 mm (50 mm) *           | E39-RS1 | 1 pc.    | The M.S.R. function is available.                |
|                 | 1,100 mm (100 mm) *        | E39-RS2 | 1 pc.    |                                                  |
|                 | 1,400 mm (100 mm) *        | E39-RS3 | 1 pc.    |                                                  |

\* Values in parentheses indicate the minimum required distance between the sensor and reflector.

Note: 1. When the reflector used is other than the supplied one, set the sensing distance to about 0.7 times of the typical example as a guideline.

## Mounting Brackets

| Shape | Model    | Quantity | Remarks                                                                                 |
|-------|----------|----------|-----------------------------------------------------------------------------------------|
|       | E39-L102 | 1        | Attached to the horizontal model.                                                       |
|       | E39-L103 | 1        | Attached to the vertical model.                                                         |
|       | E39-L85  | 1        | Mounting bracket designed to switch from E3S-□□□□42, 44 to the vertical model of E3S-C. |
|       | E39-L86  | 1        | Mounting bracket designed to switch from E3S-□□□□43 to the vertical model of E3S-C.     |
|       | E39-L87  | 1        | ---                                                                                     |

Note: If a through-beam model is used, order two Mounting Brackets for the emitter and receiver respectively.

## Sensor I/O Connectors

| Cable          | Shape    | Cable length |             | Model           |
|----------------|----------|--------------|-------------|-----------------|
| Standard cable | Straight | 2 m          | 3-wire type | XS2F-D421-DC0-A |
|                |          | 5 m          |             | XS2F-D421-GC0-A |
|                | L-shaped | 2 m          |             | XS2F-D422-DC0-A |
|                |          | 5 m          |             | XS2F-D422-GC0-A |

## Rating/performance

| Sensor type<br><br>Model   |                       | Through-beam                                                                                                                                                                                                          | Retroreflective model<br>(with M.S.R. function)                                              | Diffuse-reflective                                                  |                                                        |
|----------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------|
|                            |                       | Horizontal E3S-CT11 (-M1J)<br>Vertical E3S-CT61 (-M1J)                                                                                                                                                                | Horizontal E3S-CR11 (-M1J)<br>Vertical E3S-CR61 (-M1J)                                       | Horizontal E3S-CD11 (-M1J)<br>Vertical E3S-CD61 (-M1J)              | Horizontal E3S-CD12 (-M1J)<br>Vertical E3S-CD62 (-M1J) |
| Item                       |                       |                                                                                                                                                                                                                       |                                                                                              |                                                                     |                                                        |
| Sensing distance           |                       | 30 m                                                                                                                                                                                                                  | 3 m (When using the E39-R1)                                                                  | 700 mm (White paper 300 x 300 mm)                                   | 2 m (White paper 300 x 300 mm)                         |
| Standard sensing object    |                       | Opaque, 15dia. min.                                                                                                                                                                                                   | Opaque: 75 mm dia. min.                                                                      | ---                                                                 |                                                        |
| Differential distance      |                       | ---                                                                                                                                                                                                                   |                                                                                              | 20% max. of sensing distance                                        |                                                        |
| Directional angle          |                       | Both emitter and receiver: 3° to 15°                                                                                                                                                                                  | 3° to 10°                                                                                    | ---                                                                 |                                                        |
| Light source (wave length) |                       | Infrared LED (880 nm)                                                                                                                                                                                                 | Red LED (700 nm)                                                                             | Infrared LED (880 nm)                                               |                                                        |
| Supply voltage             |                       | 10 to 30 VDC [ripple (p-p) 10% included]                                                                                                                                                                              |                                                                                              |                                                                     |                                                        |
| Current consumption        |                       | Both emitter and receiver: 25 mA max.                                                                                                                                                                                 | 40 mA max.                                                                                   |                                                                     |                                                        |
| Control output             |                       | Load supply voltage 30 VDC max., load current 100 mA max. (residual voltage NPN output: 1.2 V max., PNP output: 2.0 V max.) Open collector output type (NPN/PNP switch selectable) Light-ON/Dark-ON switch selectable |                                                                                              |                                                                     |                                                        |
| Protective circuits        |                       | Reverse polarity protection, output short-circuit protection                                                                                                                                                          | Reverse polarity protection, output short-circuit protection, mutual interference prevention |                                                                     |                                                        |
| Response time              |                       | Operation or reset: 1 ms max.                                                                                                                                                                                         |                                                                                              |                                                                     | Operation/reset: 2 ms max. each                        |
| Sensitivity adjustment     |                       | Single-turn adjustment                                                                                                                                                                                                |                                                                                              | 2-turn endless adjuster (with indicator)                            |                                                        |
| Ambient illuminance        |                       | (on Receiver lens) Incandescent lamp: 5,000 lux max. Sunlight: 10,000 lux max.                                                                                                                                        |                                                                                              |                                                                     |                                                        |
| Ambient temperature        |                       | Operating: -25°C to 55°C, Storage: -40°C to 70°C (with no icing or condensation)                                                                                                                                      |                                                                                              |                                                                     |                                                        |
| Ambient humidity           |                       | Operating: 35% to 85%RH, Storage: 35% to 95%RH (with no condensation)                                                                                                                                                 |                                                                                              |                                                                     |                                                        |
| Insulation resistance      |                       | 20 M    min. at 500 VDC                                                                                                                                                                                               |                                                                                              |                                                                     |                                                        |
| Dielectric strength        |                       | 1,000 VAC at 50/60 Hz 1 minute                                                                                                                                                                                        |                                                                                              |                                                                     |                                                        |
| Vibration resistance       |                       | 10 to 2,000 Hz double amplitude 1.5 mm or 300 m/s <sup>2</sup> for 0.5 h in each of X, Y, Z directions                                                                                                                |                                                                                              |                                                                     |                                                        |
| Shock resistance           |                       | 1000 m/s <sup>2</sup> (approx.- 100G) 3 times each in X, Y, and Z directions                                                                                                                                          |                                                                                              |                                                                     |                                                        |
| Protective structure       |                       | IEC Standard IP67, NEMA 6P (limited to indoors use) *                                                                                                                                                                 |                                                                                              |                                                                     |                                                        |
| Connection method          |                       | Pre-wired (standard length: 2 m), Junction connector (standard length: 300 mm)                                                                                                                                        |                                                                                              |                                                                     |                                                        |
| Weight (Packed state)      |                       | About 270 g (pre-wired type) About 230 g (M12 connector joint type)                                                                                                                                                   | About 160 g (pre-wired type) About 130 g (M12 connector joint type)                          | About 150 g (pre-wired type) About 110 g (M12 connector joint type) |                                                        |
| Material                   | Case                  | Zinc diecast                                                                                                                                                                                                          |                                                                                              |                                                                     |                                                        |
|                            | Operation panel cover | Polyethyl sulfon                                                                                                                                                                                                      |                                                                                              |                                                                     |                                                        |
|                            | Lens                  | Acrylics                                                                                                                                                                                                              |                                                                                              |                                                                     |                                                        |
|                            | Mounting Brackets     | Stainless steel (SUS304)                                                                                                                                                                                              |                                                                                              |                                                                     |                                                        |
| Accessories                |                       | Mounting bracket (with screws), adjusting screwdriver, instruction manual, reflector (Retroreflective model only)                                                                                                     |                                                                                              |                                                                     |                                                        |

\* NEMA (National Electrical Manufacturers Association) Standards

# Output Circuit Diagram

## NPN output

| Model                                                                                                                                                | Operating status of output transistor | Timing chart | Mode selection switch | Output circuit                                                                                                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| E3S-CT11(-M1J)<br>E3S-CT61(-M1J)<br><br>E3S-CR11(-M1J)<br>E3S-CR61(-M1J)<br><br>E3S-CD11(-M1J)<br>E3S-CD12(-M1J)<br>E3S-CD61(-M1J)<br>E3S-CD62(-M1J) | Light ON                              |              | L ON (LIGHT ON)       | <p>Receiver (Through-beam Models)<br/>Retroreflective, Diffuse Reflective, and Limited Reflective Models</p> <p>* Note: Set the NPN and PNP output selector to NPN.</p> <p>Connector Pin Arrangement</p> <p>Note: Terminal 2 is not used.</p> |
|                                                                                                                                                      | Dark ON                               |              | D ON (DARK ON)        | <p>Emitter (Through-beam Models)</p> <p>Connector Pin Arrangement</p> <p>Note: Terminal 2 and 4 are not used.</p>                                                                                                                             |

## PNP output

| Model                                                                                                                                                | Operating status of output transistor | Timing chart | Mode selection switch | Output circuit                                                                                                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| E3S-CT11(-M1J)<br>E3S-CT61(-M1J)<br><br>E3S-CR11(-M1J)<br>E3S-CR61(-M1J)<br><br>E3S-CD11(-M1J)<br>E3S-CD12(-M1J)<br>E3S-CD61(-M1J)<br>E3S-CD62(-M1J) | Light ON                              |              | L ON (LIGHT ON)       | <p>Receiver (Through-beam Models)<br/>Retroreflective, Diffuse Reflective, and Limited Reflective Models</p> <p>* Note: Set the NPN and PNP output selector to PNP.</p> <p>Connector Pin Arrangement</p> <p>Note: Terminal 2 is not used.</p> |
|                                                                                                                                                      | Dark ON                               |              | D ON (DARK ON)        | <p>Emitter (Through-beam Models)</p> <p>Connector Pin Arrangement</p> <p>Note: Terminal 2 and 4 are not used.</p>                                                                                                                             |

## Connectors (Sensor I/O connectors)

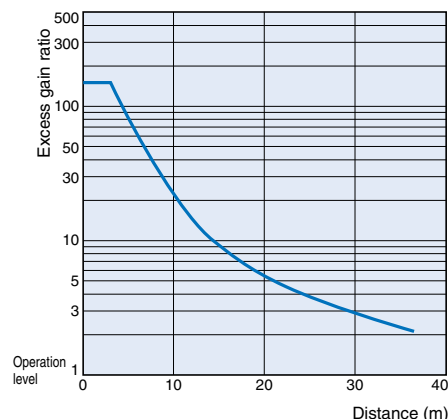
| Class  | Wire, outer jacket color | Connector pin No. | Application |
|--------|--------------------------|-------------------|-------------|
| For DC | Brown                    | ①                 | +V          |
|        | ---                      | ②                 | ---         |
|        | Blue                     | ③                 | 0V          |
|        | Black                    | ④                 | Output      |

Note: Pin 2 is open.

## Characteristic data (typical)

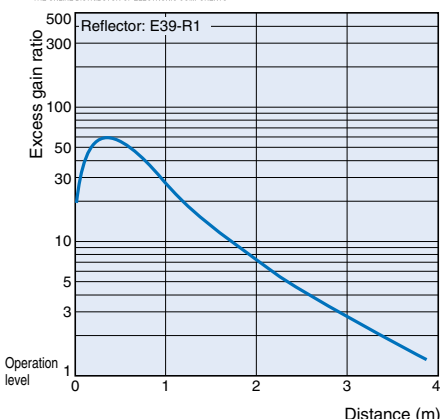
### Operating Range

Through-beam  
E3S-CT□1(-M1J)



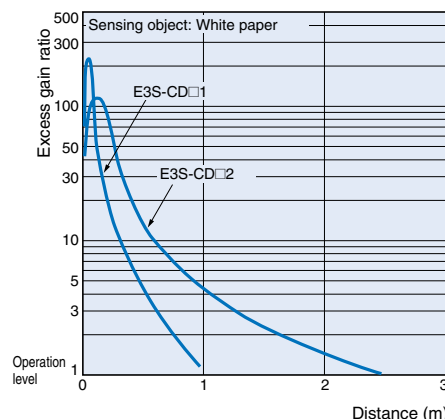
### Retroreflective Models

E3S-CD□□□□□1 (supplied reflector)



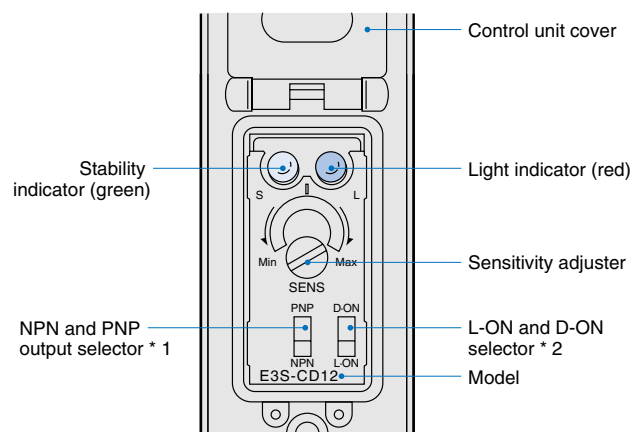
### Diffuse-reflective

E3S-CD□□(-M1J)

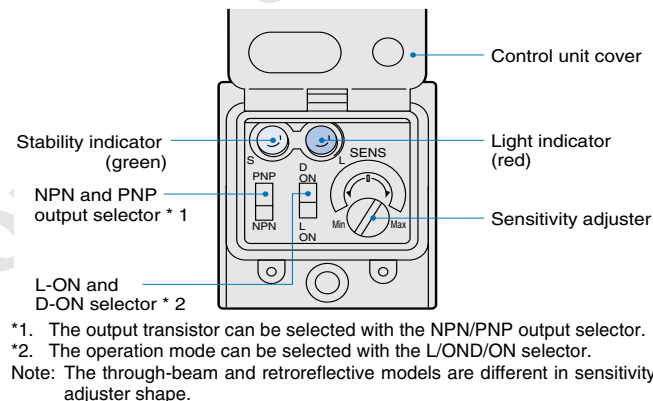


## Nomenclature:

(Horizontal type)



(Vertical type)



## Operation

### Sensitivity adjustment (diffuse reflective model, light-ON)

| Sequence  | Detection state                                   | Sensitivity adjuster | Indicator state                                                    | Adjustment procedure                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------|---------------------------------------------------|----------------------|--------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ① Point A | Photoelectric Sensor<br>Sensing object            | (A) Min Max          | ON→OFF OFF→ON<br>Stability indicator (green) Light indicator (red) | Place a sensing object in the predetermined position, turn the sensitivity adjuster clockwise (increase sensitivity) until the incident indicator (red) is turned ON, and define this position as (A).                                                                                                                                                                                                                                       |
| ② Point B | Photoelectric Sensor<br>Sensing object Background | (B) Min Max          | ON→OFF ON→OFF<br>Stability indicator (green) Light indicator (red) | Remove the sensing object, turn the sensitivity adjuster further clockwise until the incident indicator (red) is turned ON by a background object, and define this position as (B). Turn the sensitivity adjuster counterclockwise (decrease sensitivity) from (B) until the incident indicator (red) is turned OFF, and define this position as (C). When there is no background object, define the maximum adjuster position (Max) as (C). |
| ③ Setting | ---                                               | (A) (C) Min Max      | ON ON↔OFF<br>Stability indicator (green) Light indicator (red)     | Set the adjuster in the middle of positions (A) and (C) (optimum sensitivity setting). Also make sure that the stability indicator (green) is turned ON when there is an object and when there is no object.<br>When the indicator is not turned ON, recheck the detection method since there is a little allowance.                                                                                                                         |

Unlike the conventional models, the E3S-C scarcely has sensitivity variations between products. Therefore, you need to make the above adjustment on only one diffuse reflective model of E3S-CD that will be used for detection under the same conditions, and match the indicator points of the other diffuse reflective models of E3S-CD with the above adjusted one. (You need not match the sensitivity of each sensor.)

## Precautions

### Correct Use

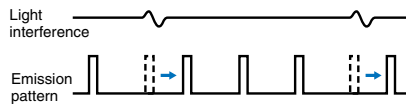
#### Design

##### Fuzzy mutual interference prevention

When reflective photoelectric sensors are installed side by side, one sensor may receive the light from the other sensor, which may disturb the incident signal, causing a malfunction. The fuzzy mutual interference prevention monitors interfering light for a predetermined period of time before light is emitted, and imports the interfering light level and incident frequencies as data. Using these values, fuzzy inference is made to find the risk of malfunction to control the light emitting timing, reducing the risk.

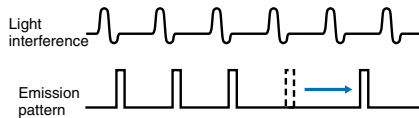
(When risk is low)

Light is emitted after interfering light is gone.



(When risk is high)

Light is emitted after shifting to a gap of interfering light.



#### Wiring Considerations

##### Cable

- An oil-resistance cable is used to ensure oil resistance.
- The bending radius should be 25 mm or more.

#### Installation

##### Sensor installation

- Note that during the E3S-C installation, hammering it will damage the water resistance function.
- Use an M4 screw, tightened to a torque of no more than 1.18 Nm.

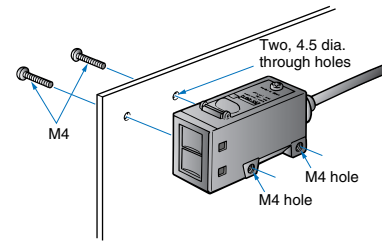
(When using the mounting bracket)

- To set the sensor on the mechanical axis, use the optical axis locking holes.
- When the sensor cannot be set on the mechanical axis, move the E3S-C vertically and/or horizontally and set it in the center of the area where the incident indicator is turned ON. Make sure that the stability indicator is ON.

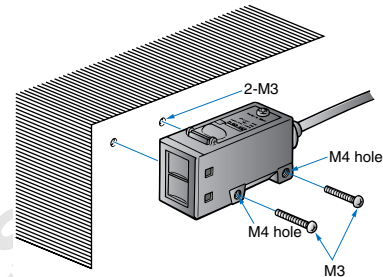
(Direct installation)

Install the E3S-C as shown below.

[M4 screwing]



[M3 screwing]

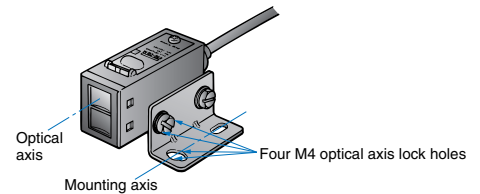


##### Optical axis adjustment

(Optical axis locking holes)

By fitting screws into the optical axis locking holes, the mounting bracket is set onto the mounting shaft of the mounting bracket.

For adjustment

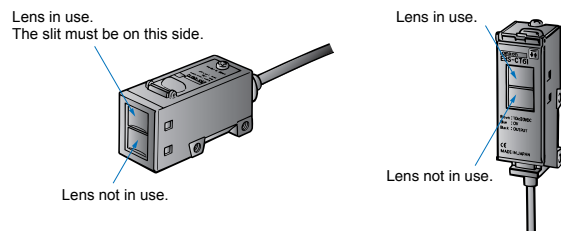




### Optical axis position of through-beam model

Unlike the conventional product, the through-beam model has two lenses, but the one actually used is a **redline component**. When fitting the slit, use it after matching the slit hole with the used lens.

(Horizontal model) (Vertical model)



## Water Resistance

To ensure water resistance, tighten the operation panel cover screws to 0.34 Nm to 0.54 Nm torque.

## Miscellaneous

### Oil resistance/chemical resistance

- Though E3S-C has a high oil resistance, it may not be able to exhibit its performance depending on the oil type. Use oil in compliance with the following table.
- Regarding the oil resistance of E3S-C, it has passed tests on the oils given in the following table. Refer to the table for examining the oil to be used.

| Testing oil classification | JIS classification | Product name         | Dynamic viscosity (mm <sup>2</sup> /s) at 40°C | PH       |
|----------------------------|--------------------|----------------------|------------------------------------------------|----------|
| Lubricant                  | ---                | Velocity No. 3       | 2.02                                           | ---      |
| Water-insoluble coolant    | Class 2 No. 5      | Daphne Cut           | Not less than 10 to less than 50               |          |
|                            | Class 2 No. 11     | Yushiron Oil No. 2ac | Less than 10                                   |          |
| Water-soluble coolant      | Class W1 No. 1     | Yushiroken EC50T-3   | ---                                            | 7 to 9.5 |
|                            |                    | Yushiron Lubic HWC68 |                                                | 7 to 9.9 |
|                            | Class W1 No. 2     | Gryton 1700D         |                                                | 7 to 9.2 |
|                            | Class W2 No. 1     | Yushiroken S50N      |                                                | 7 to 9.8 |

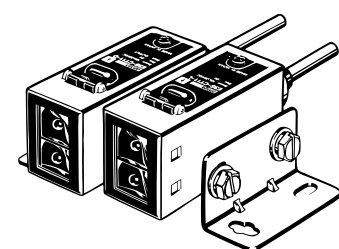
Note: 1. The E3S-C was immersed in the oils in the above table at 50°C for 240 hours, and passed the test of 100-M or more insulation resistance.  
2. For use in the environment where the E3S-C is exposed to the oil other than those in the above table, use the dynamic viscosity and PH in the above table. Pre-examine the oils since the sensor may be affected by additives and like in the oils.

### Dimensions (Unit: mm)

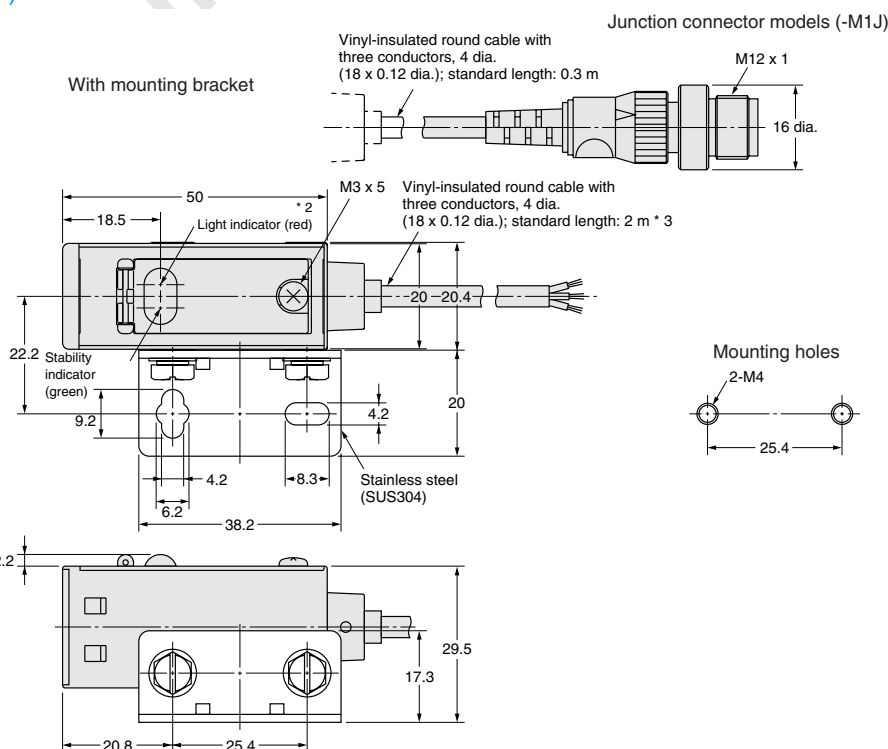
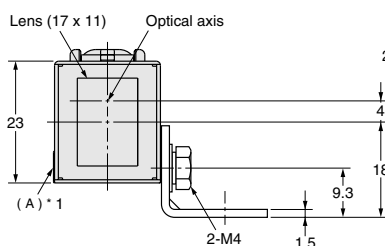
## Sensors

### Through-beam model (horizontal model)

E3S-CT11(-M1J)



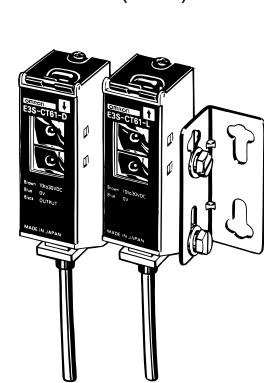
Emitter: E3S-CT□□-L  
Receiver: E3S-CT□□-D



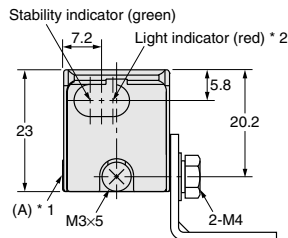
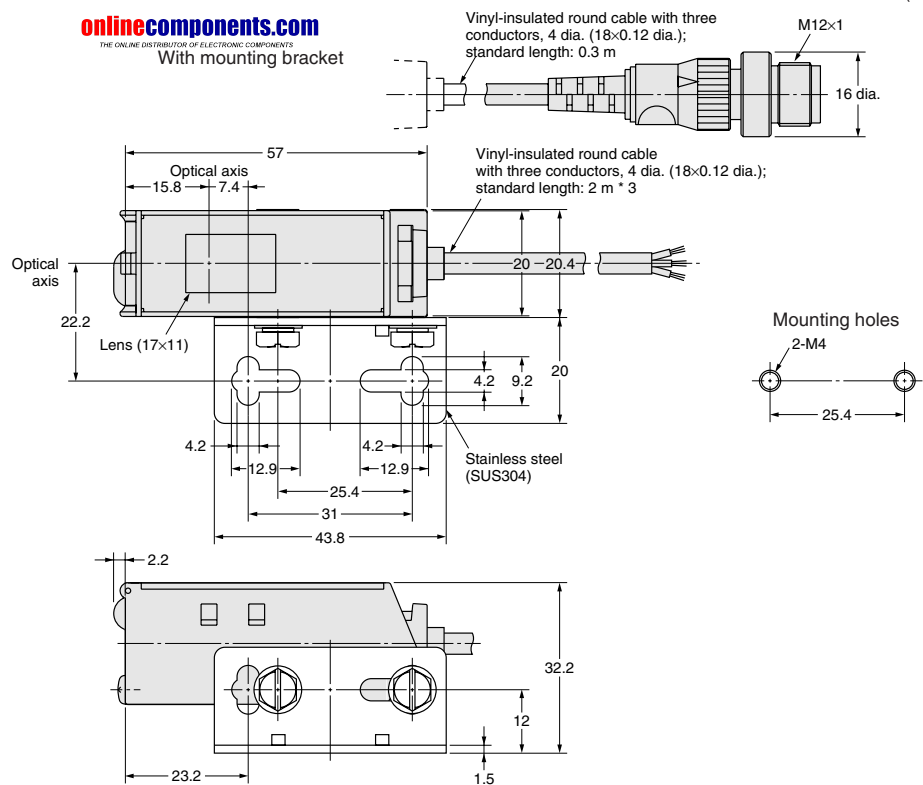
- \* Note: 1. Mounting bracket can be attached to side A.  
2. The emitter for through-beam sensors have only the power supply indicator.  
3. The cable for emitters for through-beam sensors is two-conductor, 4 dia. (27 x 12 dia.).



# Through-beam model (vertical model) E3S-CT61(-M1J)



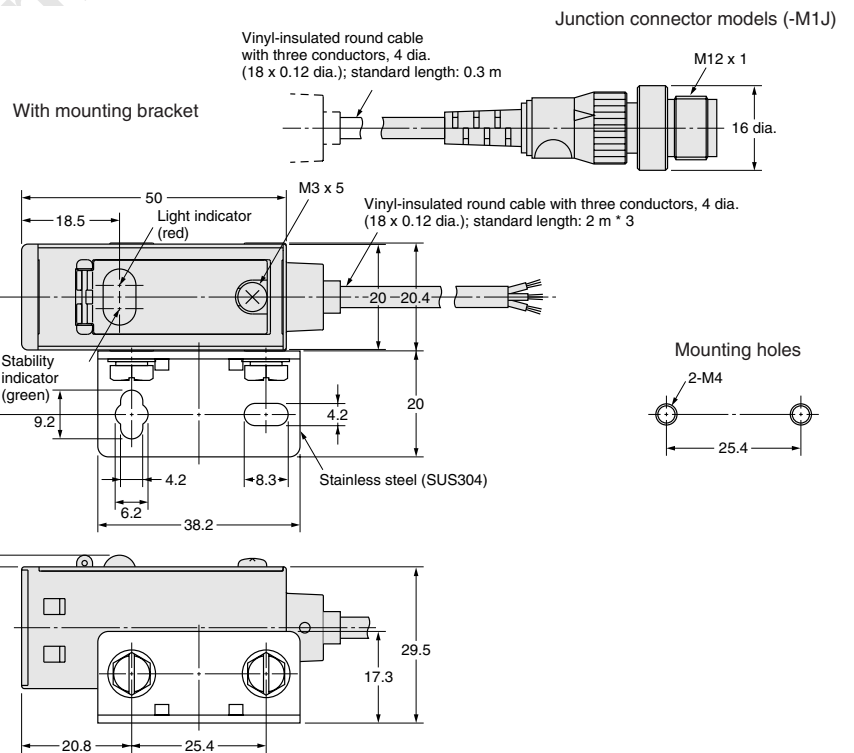
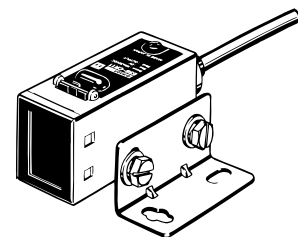
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With mounting bracket



- \* 1. Mounting bracket can be attached to side A.
- \* 2. The emitter for through-beam sensors have only the power supply indicator.
- \* 3. The cable for emitters for through-beam sensors is two-conductor, 4 dia. (27x12 dia.).

## Retro/diffuse reflective model (horizontal model)

E3S-CR11(-M1J)  
E3S-CD11(-M1J)  
E3S-CD12(-M1J)



\* Note: Mounting bracket can be attached to side A.

