Oil-resistant, Long-range Photoelectric Sensor with Metal Housing

# E3S-C

CSM_E3S-C_DS_E_6_1

## Water- and Oil-resistant Photoelectric Sensor with Metal Housing Used for Long-range Sensing

- Excellent resistance against the water and oil. Easy application in locations with oil mist.
- Long-range sensing up to 30 m with Through-beam models.
- Shock resistance rated at 1,000m/s$^2$.
- Product lineup includes metal M12 pre-wired connector models.
- NPN/PNP selector switch output.

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

## Ordering Information

### Sensors (Refer to *Dimensions* on page 8.)

Red light / Infrared light

| Sensing method | Appearance | Connection method | Sensing distance | Model |
|---|---|---|---|---|
| Through-beam (Emitter + Receiver) * | Horizontal | Pre-wired | 30 m | **E3S-CT11 2M**<br>Emitter E3S-CT11-L 2M<br>Receiver E3S-CT11-D 2M |
| | | Pre-wired Connector (M12) | | **E3S-CT11-M1J 0.3M**<br>Emitter E3S-CT11-L-M1J 0.3M<br>Receiver E3S-CT11-D-M1J 0.3M |
| | Vertical | Pre-wired | | **E3S-CT61 2M**<br>Emitter E3S-CT61-L 2M<br>Receiver E3S-CT61-D 2M |
| | | Pre-wired Connector (M12) | | **E3S-CT61-M1J 0.3M**<br>Emitter E3S-CT61-L-M1J 0.3M<br>Receiver E3S-CT61-D-M1J 0.3M |
| Retro-reflective | Horizontal | Pre-wired | 3 m | **E3S-CR11 2M** |
| | | Pre-wired Connector (M12) | | **E3S-CR11-M1J 0.3M** |
| | Vertical | Pre-wired | | **E3S-CR61 2M** |
| | | Pre-wired Connector (M12) | | **E3S-CR61-M1J 0.3M** |
| Diffuse-reflective | Horizontal | Pre-wired | 700 mm | **E3S-CD11 2M** |
| | | | 2 m | **E3S-CD12 2M** |
| | | Pre-wired Connector (M12) | 700 mm | **E3S-CD11-M1J 0.3M** |
| | | | 2 m | **E3S-CD12-M1J 0.3M** |
| | Vertical | Pre-wired | 700 mm | **E3S-CD61 2M** |
| | | | 2 m | **E3S-CD62 2M** |
| | | Pre-wired Connector (M12) | 700 mm | **E3S-CD61-M1J 0.3M** |
| | | | 2 m | **E3S-CD62-M1J 0.3M** |

* Through-beam Sensors are normally sold in sets that include both the Emitter and Receiver. Orders for individual Emitters and Receivers are accepted.

## Accessories (Order Separately)

### Slits (A Slit is not provided with Through-beam Sensors. Order a Slit separately if required.) (Refer to *Dimensions* on page 10.)

| Slit width | Sensing distance | Minimum detectable object (typical) | Model | Quantity | Remarks |
|---|---|---|---|---|---|
| 0.5 mm × 11 mm | 1.8 m | 0.5-mm dia. | **E39-S61** | 1 set each for Emitter and Receiver (8 Slits total) | (Snap-in Long Slit) Can be used with the E3S-CT□1(-M1J) Through-beam Sensor. Refer to page 10. |
| 1 mm × 11 mm | 3.5 m | 1-mm dia. | | | |
| 2 mm × 11 mm | 7 m | 2-mm dia. | | | |
| 4 mm × 11 mm | 15 m | 2.6-mm dia. | | | |

### Reflectors (Reflector required for Retroreflective Sensors)

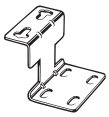
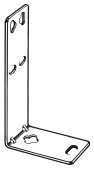
**A Reflector is provided with the E39-R1 Sensor. For other Sensors, order a reflector separately if required.** (Refer to *Dimensions* on *E39-L/F39-L/E39-S/E39-R*.)

| Name | Sensing distance (typical) | Model | Quantity | Remarks |
|---|---|---|---|---|
| Reflectors | 3 m (rated value) | **E39-R1** | 1 | Provided with the E3S-CR□1 (-M1J) Retro-reflective Sensor. |
| | 4 m | **E39-R2** | 1 | --- |
| Small Reflectors | 1.5 m | **E39-R3** | 1 | --- |
| | 750 mm | **E39-R4** | 1 | --- |
| Tape Reflectors | 700 mm (50 mm)* | **E39-RS1** | 1 | Enables MSR function. |
| | 1,100 mm (100 mm)* | **E39-RS2** | 1 | |
| | 1,400 mm (100 mm)* | **E39-RS3** | 1 | |

Note: 1. When using any reflector other than the provided one, use a sensing distance of approximately 0.7 times the typical value as a guide.
2. Refer to *Reflectors* on *E39-L/F39-L/E39-S/E39-R* for details.
* Values in parentheses indicate the minimum distance required between the Sensor and Reflector.

### Mounting Brackets

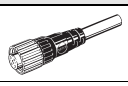
**Some Mounting Brackets are provided with the Sensor. Order other Mounting Brackets separately if required.** (Refer to *Dimensions* on *E39-L/F39-L/E39-S/E39-R*.)

| Appearance | Model | Quantity | Remarks |
|---|---|---|---|
|  | **E39-L102** | 1 | Provided with Horizontal Models. |
|  | **E39-L103** | 1 | Provided with Vertical Models. |
|  | **E39-L85** | 1 | Mounting bracket for changing from E3S-□□□□□42/44 to E3S-C Vertical Models. |
|  | **E39-L86** | 1 | Mounting bracket for changing from E3S-□□□□□43 to E3S-C Vertical Models. |
|  | **E39-L87** | 1 | --- |

Note: 1. When using a Through-beam Sensor, order one Connector for the Receiver and one for the Emitter.
2. Refer to *Mounting Brackets* on *E39-L/F39-L/E39-S/E39-R* for details.

### Sensor I/O Connectors

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

| Cable | Appearance | Cable type | | Model |
|---|---|---|---|---|
| Standard | Straight  | 2 m | 3-wire | **XS2F-D421-DC0-A** |
| | | 5 m | | **XS2F-D421-GC0-A** |
| | L-shape  | 2 m | | **XS2F-D422-DC0-A** |
| | | 5 m | | **XS2F-D422-GC0-A** |

Note: 1. When using a Through-beam Sensor, order one Connector for the Receiver and one for the Emitter.
2. For details on Sensor I/O Connectors and cables such as vibration-proof robot cables, refer to *Introduction to Sensor I/O Connectors*.

## Ratings and Specifications

| Item \ Sensing method | Through-beam | Retro-reflective (with M.S.R. function) *1 | Diffuse reflective | |
|---|---|---|---|---|
| Model | Horizontal E3S-CT11(-M1J) | Horizontal E3S-CR11(-M1J) | Horizontal E3S-CD11(-M1J) | Horizontal E3S-CD12(-M1J) |
| | Vertical E3S-CT61(-M1J) | Vertical E3S-CR61(-M1J) | Vertical E3S-CD61(-M1J) | Vertical E3S-CD62(-M1J) |
| **Sensing distance** | 30 m | 3 m (when using E39-R1) | 700 mm (300 × 300 mm white paper) | 2 m (300 × 300 mm white paper) |
| **Standard sensing object** | Opaque, 15-mm dia. min. | Opaque, 75-mm dia. min. | --- | |
| **Differential travel** | --- | | 20% max. of sensing distance | |
| **Directional angle** | Emitter and Receiver: 3° to15° | 3° to 10° | --- | |
| **Light source (wavelength)** | Infrared LED (880 nm) | Red LED (700 nm) | Infrared LED (880 nm) | |
| **Power supply voltage** | 10 to 30 VDC including 10% (p.p) ripple | | | |
| **Current consumption** | 50 mA max. (Emitter 25 mA max. Receiver 25 mA max.) | 40 mA max. | | |
| **Control output** | Load power supply voltage: 30 VDC max.<br>Load current: 100 mA max. (Residual voltage: NPN output: 1.2 V max., PNP output: 2.0 V max.)<br>Open controller output (NPN/PNP selectable)<br>Light-ON/Dark-ON selectable | | | |
| **Protection circuits** | Power supply reverse polarity circuit protection, Output short-circuit protection | Power supply reverse polarity protection, Output short-circuit protection, Mutual interference prevention | | |
| **Response time** | Operate or reset: 1 ms max. | | | Operate or reset 2 ms max. |
| **Sensitivity adjustment** | One-turn adjuster | | Two-turn endless adjuster with an indicator | |
| **Ambient illumination (Receiver side)** | Incandescent lamp: 5,000 lx max.<br>Sunlight: 10,000 lx max. | | | |
| **Ambient temperature range** | Operating: −25°C to 55°C, Storage: −40°C to 70°C (with no icing or condensation) | | | |
| **Ambient humidity range** | Operating: 35% to 85%, Storage: 35% to 95% (with no condensation) | | | |
| **Insulation resistance** | 20 MΩ min. (at 500 VDC) | | | |
| **Dielectric strength** | 1,000 VAC, 50/60 Hz for 1 min | | | |
| **Vibration resistance** | Destruction: 10 to 2,000 Hz, 1.5-mm double amplitude or 300 $m/s^2$ for 0.5 hours each in X, Y, and Z directions | | | |
| **Shock resistance** | Destruction: 1,000 $m/s^2$ 3 times each in X, Y, and Z directions | | | |
| **Degree of protection** | IEC 60529: IP67 (in-house standards: oil-resistant), NEMA: 6P (indoors only) *2 | | | |
| **Connection method** | Pre-wired (standard cable length: 2 m) or Pre-wired M12 Connector (standard cable length: 0.3 m) | | | |
| **Weight (packed state)** | Approx. 270 g (Pre-wired cable)<br>Approx. 230 g (Pre-wired Connector (M12)) | Approx. 160 g (Pre-wired cable)<br>Approx. 130 g (Pre-wired Connector (M12)) | Approx. 150 g (Pre-wired cable)<br>Approx. 110 g (Pre-wired Connector (M12)) | |
| **Material** — **Case** | Zinc die-cast | | | |
| **Material** — **Operation panel cover** | PES (polyether sulfone) | | | |
| **Material** — **Lens** | Methacrylic resin | | | |
| **Material** — **Mounting Bracket** | Stainless steel (SUS304) | | | |
| **Accessories** | Mounting Bracket (with screws), Adjustment screwdriver, Instruction manual, and Reflector (only for Retro-reflective Sensors) | | | |

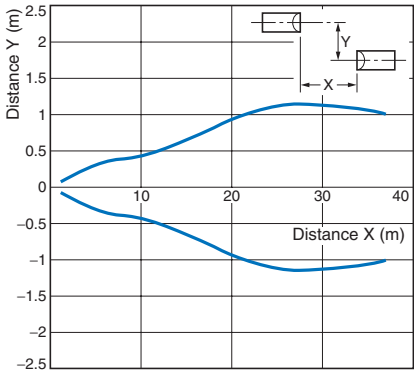
*1. Refer to *MSR function* of *Technical Guide (Technical version)*.
*2. NEMA: National Electrical Manufactures Association

# Engineering Data (Typical)

## Parallel Operating Range

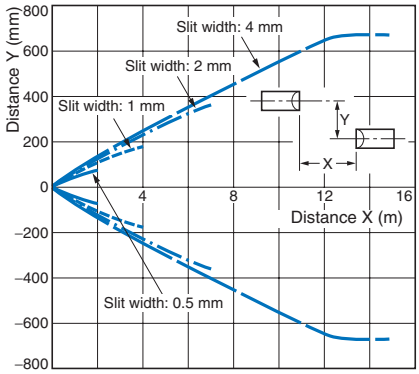
**Through-beam**

**E3S-CT□ (-M1J)**



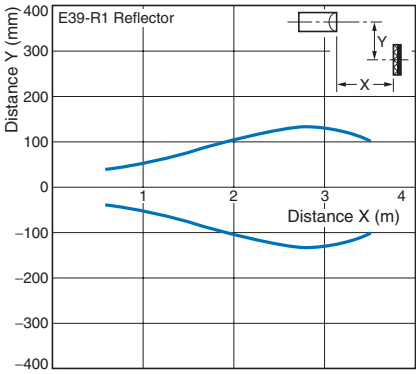

**Through-beam**

**E3S-CT□ (-M1J) + E39-S61 Slit (Order Separately)**




**Retro-reflective**

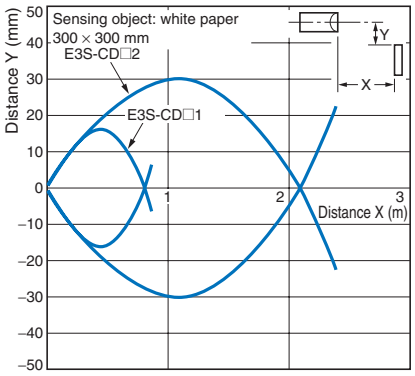
**E3S-CR□1 (-M1J) + E39-R1 Reflector (Provided)**




## Operating Range

**Diffuse-reflective**

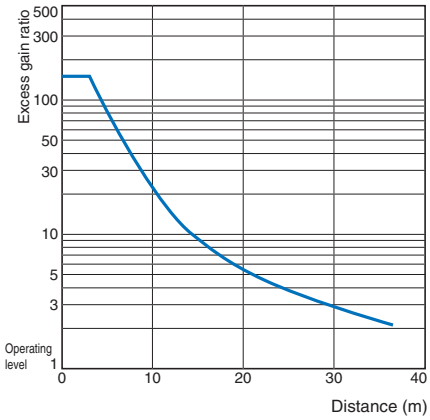
**E3S-CD□□ (-M1J)**




## Excess Gain vs. Set Distance

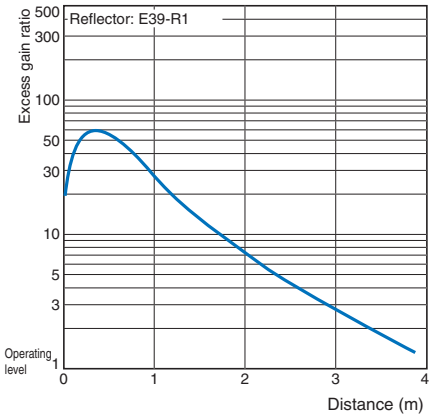
**Through-beam**

**E3S-CT□1 (-M1J)**



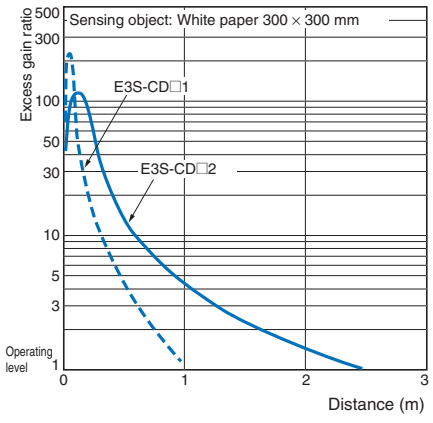

**Retro-reflective**

**E3S-CR□1 (-M1J) + E39-R1 Reflector (Provided)**



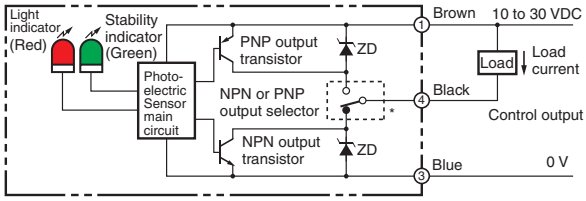
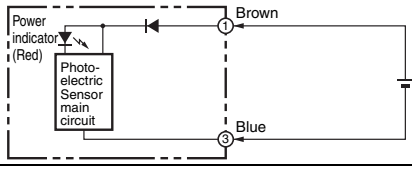

**Diffuse-reflective**

**E3S-CD□□ (-M1J)**

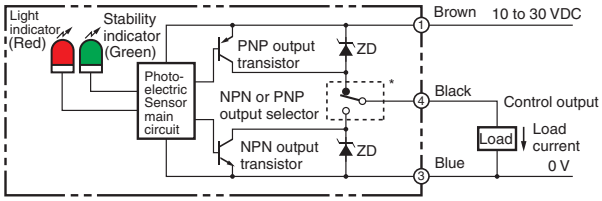
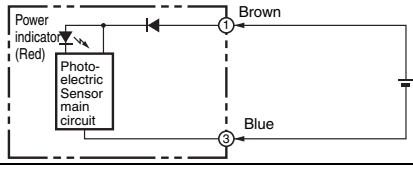


# I/O Circuit Diagrams

## NPN Output

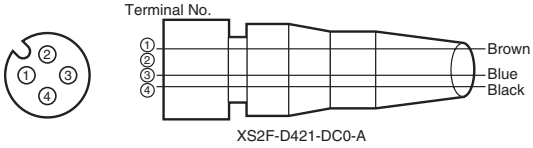
| Model | Operation mode | Timing charts | Operation selector | Output circuits |
|---|---|---|---|---|
| E3S-CT11(-M1J) *<br>E3S-CT61(-M1J) *<br>E3S-CR11(-M1J)<br>E3S-CR61(-M1J)<br>E3S-CD11(-M1J)<br>E3S-CD12(-M1J)<br>E3S-CD61(-M1J)<br>E3S-CD62(-M1J) | Light-ON | Incident light<br>No incident light<br>Light indicator (Red) ON / OFF<br>Output transistor ON / OFF<br>Load (e.g. relay) Operate / Reset<br>(Between brown and black leads) | L side (LIGHT ON) | Through-beam Model Receivers: Retro-reflective Models, Reflective Models<br>  <br>* Set the NPN or PNP selector to NPN.<br>Connector Pin Arrangement<br>  <br>Pin 2 is not used. |
| | Dark-ON | Incident light<br>No incident light<br>Light indicator (Red) ON / OFF<br>Output transistor ON / OFF<br>Load (e.g. relay) Operate / Reset<br>(Between brown and black leads) | D side (DARK ON) | |
| | Through-beam Model Emitters<br>  | | | Connector Pin Arrangement<br>  <br>Note: Pins 2 and 4 are not used. |

## PNP Output

| Model | Operation mode | Timing charts | Operation selector | Output circuits |
|---|---|---|---|---|
| E3S-CT11(-M1J) *<br>E3S-CT61(-M1J) *<br>E3S-CR11(-M1J)<br>E3S-CR61(-M1J)<br>E3S-CD11(-M1J)<br>E3S-CD12(-M1J)<br>E3S-CD61(-M1J)<br>E3S-CD62(-M1J) | Light-ON | Incident light<br>No incident light<br>Light indicator (Red) ON / OFF<br>Output transistor ON / OFF<br>Load (e.g. relay) Operate / Reset<br>(Between blue and black leads) | L side (LIGHT ON) | Through-beam Model Receivers: Retro-reflective Models, Reflective Models<br>  <br>* Set the NPN or PNP selector to NPN.<br>Connector Pin Arrangement<br>  <br>Pin 2 is not used. |
| | Dark-ON | Incident light<br>No incident light<br>Light indicator (Red) ON / OFF<br>Output transistor ON / OFF<br>Load (e.g. relay) Operate / Reset<br>(Between blue and black leads) | D side (DARK ON) | |
| | Through-beam Model Emitters<br>  | | | Connector Pin Arrangement<br>  <br>Note: Pins 2 and 4 are not used. |

* Models numbers for Through-beam Sensors (E3S-CT□1(-M1J)) are for sets that include both the Emitter and Receiver.
The model number of the Emitter is expressed by adding "-L" to the set model number (example: E3S-CT11-L 2M), the model number of the Receiver, by adding "-D" (example: E3S-CT11-D 2M.) Refer to *Ordering Information* to confirm model numbers for Emitter and Receivers.

## Plug (Sensor I/O Connector)



XS2F-D421-DC0-A

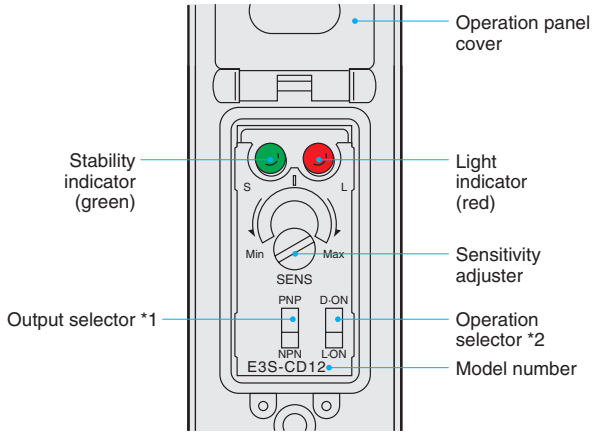
| Classification | Conductor | Connector pin No. | Application |
|---|---|---|---|
| DC | Brown | 1 | Power supply (+V) |
| | --- | 2 | --- |
| | Blue | 3 | Power supply (0 V) |
| | Black | 4 | Output |

Note: Pin 2 is not used.

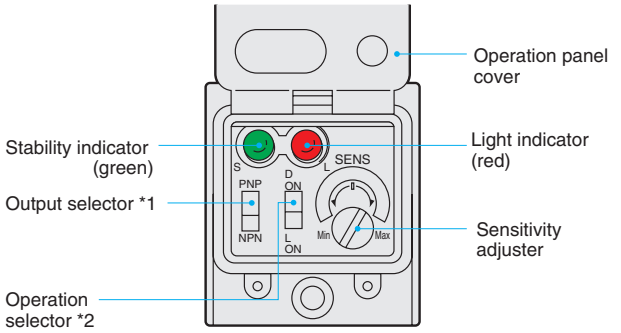
Refer to *Introduction to Sensor I/O connectors* for details.

## Nomenclature

**Horizontal Model**




**Vertical Model**




Note: The sensitivity adjuster on Through-beam and Retro-reflective Models is different.
*1. Use the output selector to select the type of output transistor, NPN or PNP.
*2. Use the operation selector to select the operation mode.

## 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

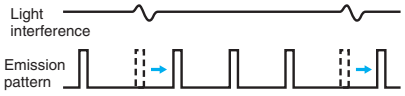
Do not use the product in atmospheres or environments that exceed product ratings.

#### ● Designing

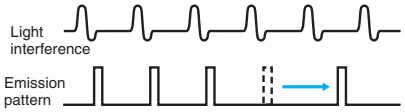
##### Fuzzy Mutual Interference Prevention Function

If Reflective Sensors are installed side by side, each Sensor may be influenced by the light emitted from the other Sensors.
The fuzzy mutual interference prevention function of the E3S-C enables the E3S-C to monitor any light interference for a certain period before the E3S-C starts emitting light so that the E3S-C can retrieve the intensity and frequency of the light interference as data. Using this data, the E3S-C estimates with fuzzy inference the risk of the malfunctioning of the E3S-C and controls the timing of the E3S-C's light emission.

**When the risk is low:**
The E3S-C waits until there is no light interference and emits light.




**When the risk is high:**
The E3S-C emits light between each period of light interference.




#### ● Wiring

##### Cable

- The E3S-C uses an oil-resistive cable to ensure oil resistivity.
- Do not allow the cable to be bent to a radius of less than 25 mm.

#### ● Mounting

##### Mounting

- When mounting the E3S-C, do not hit the E3S-C with a hammer, or the E3S-C will loose watertightness.
- Use M4 screws to mount the E3S-C. The tightening torque of each screw must be 1.18 N·m maximum.

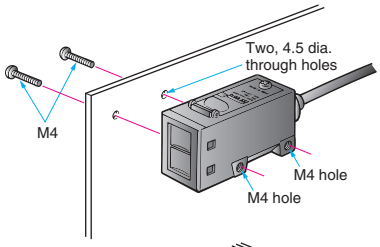
**Mounting Bracket**

- When mounting the E3S-C with the mounting bracket so that sensing objects will be in the direction of the mechanical axis, use the optical axis lock holes.
- If it is not possible to mount the E3S-C so that the sensing objects will be in the direction the mechanical axis, move the E3S-C upwards, downwards, to the left, or to the right and secure the E3S-C in the center of the range where the light indicator will be lit, at which time make sure that the stability indicator is lit.

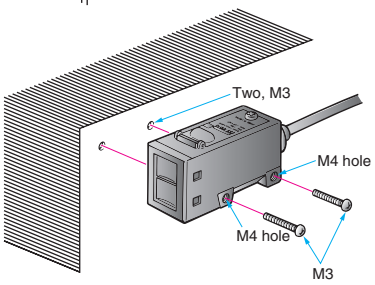
**Direct Mounting**

Mount the E3S-C as shown in the following illustration.

**Mounting with M4 Screws**

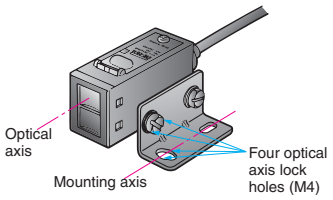



**Mounting with M3 Screws**




##### Optical Axis Adjustment

Optical Lock Holes
By inserting screws into the optical axis lock holes, the Mounting Bracket will be in the direction of the optical axis of the E3S-C.

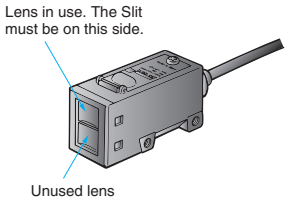


## ● Adjusting

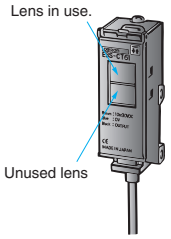
### Optical Axis of Through-beam Sensor

The E3S-C Through-beam Models incorporates two lenses, one of which will be used as shown in the following illustration. When using a Slit, the Slit must be on the side where the lens to be used is located.

**Horizontal Model**




**Vertical Model**




### Water Resistance

To ensure the water resistance of the E3S-C, tighten the screws of the operation panel cover to a torque of 0.34 N·m to 0.54 N·m.

## ● Others

### Oil and Chemical Resistance

- Although the E3S-C is oil-resistance, refer to the following table before using the E3S-C in places where oil may be sprayed on the E3S-C.
- Tests were carried out with the following oils and it was certified that the E3S-C resists these oils.

| Oil | Product name | Kinematic viscosity ($mm^2/s$ (cst)) at 40°C | PH |
|---|---|---|---|
| Lubricating oil | Velocite No.3 | 2.02 | --- |
| Water insoluble machining oil | Yushiron Oil No. 2 ac | Less than 10 | |
| Water soluble machining oil | Yushiroken EC50T-3 | --- | 7 to 9.5 |
| | Yushiron Lubic HWC68 | | 7 to 9.9 |
| | Griton 1700D | | 7 to 9.2 |
| | Yushiroken S50N | | 7 to 9.8 |

Note: 1. The E3S-C maintained a minimum insulation resistance of 100 MΩ after the E3S-C was dipped in all the above oils at a temperature of 50°C for 240 hours.

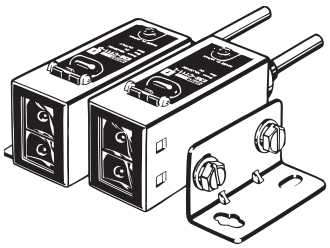
2. When using the E3S-C in a place where an oil other than the ones listed above is sprayed on the E3S-C, refer to the above kinematic viscosity and ph values. The location may be suitable for the E3S-C if the kinematic viscosity and pH values of the oil are close to the above kinematic viscosity and pH values, but make sure that the oil does not contain any additive that may have a negative influence on the E3S-C.

# Dimensions

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

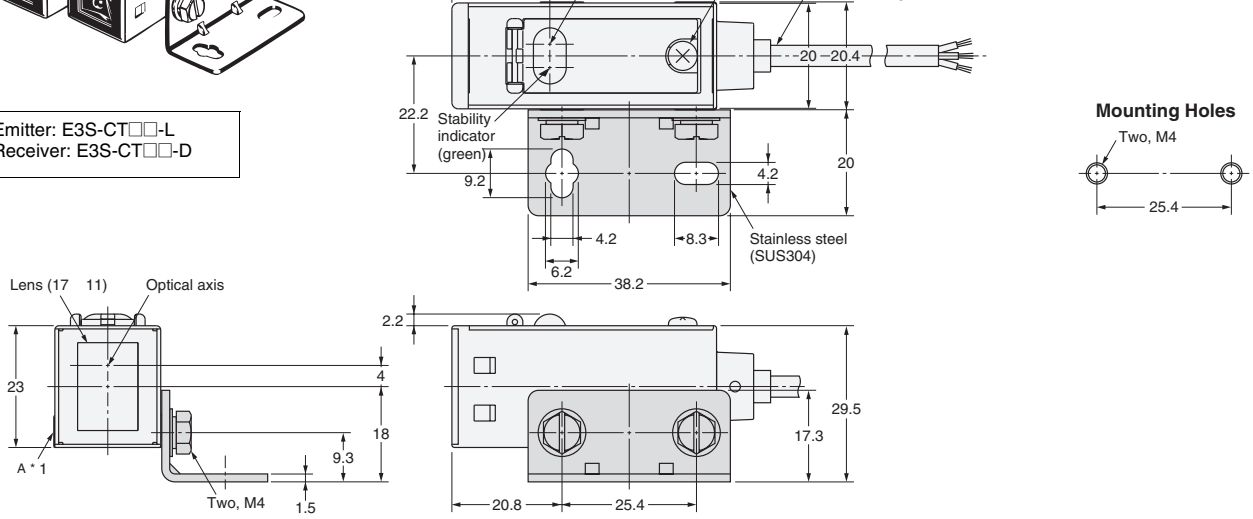
## Sensors

### Through-beam (Horizontal)
**E3S-CT11(-M1J)**



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

**With Mounting Bracket Attached**




**Pre-wired Connector (-M1J)**

**Mounting Holes**

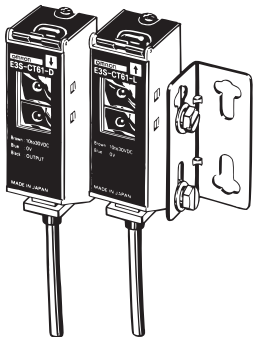



*1. The Mounting Bracket can be attached to side A.
*2. The Emitters for Through-beam Sensors only have the power indicator (red).
*3. The Emitter cable is 4-dia.vinyl-insulated round cable with 2 conductors (conductor cross section: 0.3 mm², insulator diameter: 1.3 mm) and a standard length of 2 m.

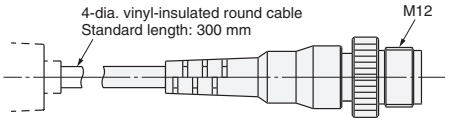
Note: Models numbers for Through-beam Sensors (E3S-CT11(-M1J)) are for sets that include both the Emitter and Receiver. The model number of the Emitter is expressed by adding "-L" to the set model number (example: E3S-CT11-L 2M), the model number of the Receiver, by adding "-D" (example: E3S-CT11-D 2M.) Refer to *Ordering Information* to confirm model numbers for Emitter and Receivers.

## Through-beam (Vertical)

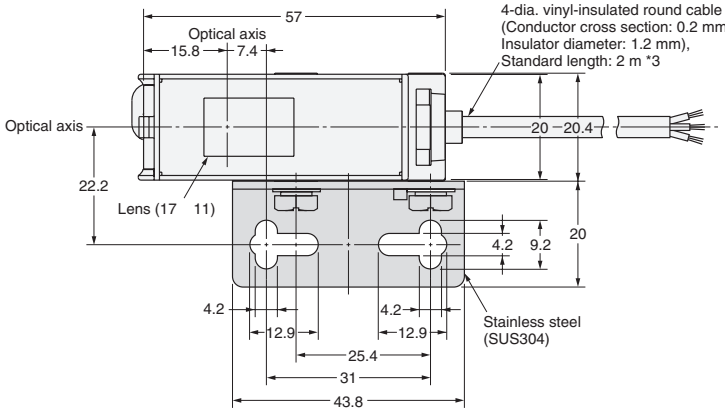
**E3S-CT61(-M1J)**



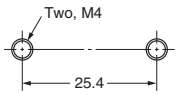
**Pre-wired Connector (-M1J)**

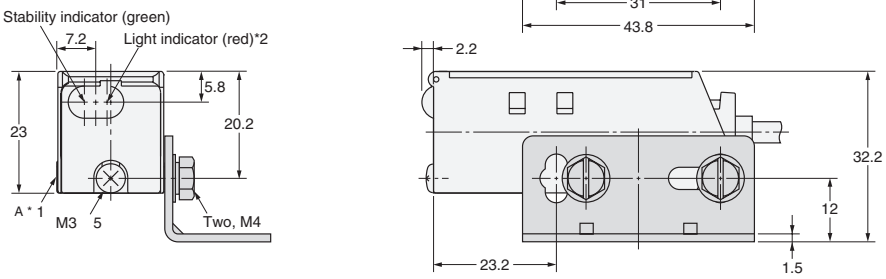



**With Mounting Bracket Attached**




**Mounting Holes**

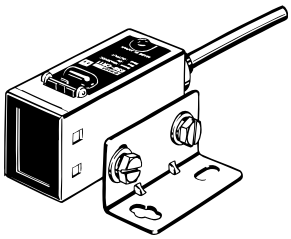


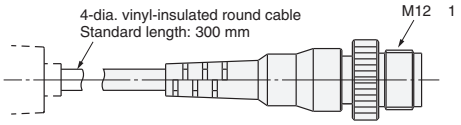

*1. The Mounting Bracket can be attached to side A.
*2. The Emitters for Through-beam Sensors only have the power indicator (red).
*3. The Emitter cable is 4-dia.vinyl-insulated round cable with 2 conductors (conductor cross section: 0.3 mm$^2$, insulator diameter: 1.3 mm) and a standard length of 2 m.

## Retro-/Diffuse-reflective (Horizontal)

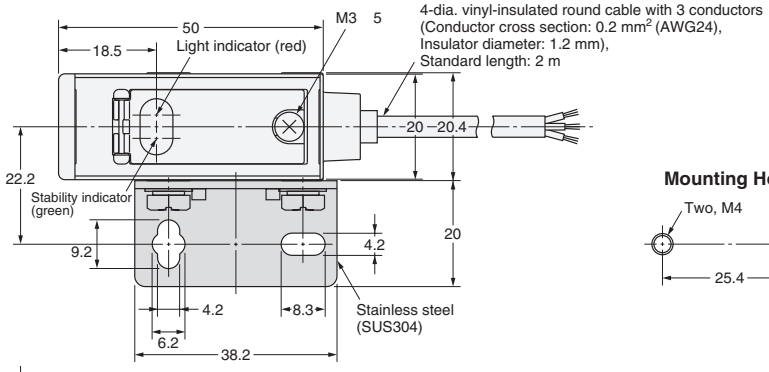
**E3S-CR11(-M1J)**
**E3S-CD11(-M1J)**
**E3S-CD12(-M1J)**



**Pre-wired Connector (-M1J)**

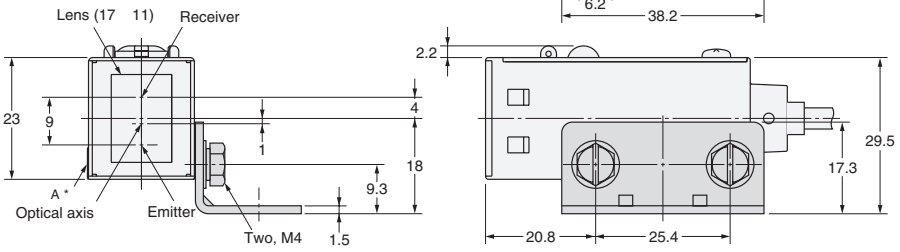



**With Mounting Bracket Attached**




**Mounting Holes**



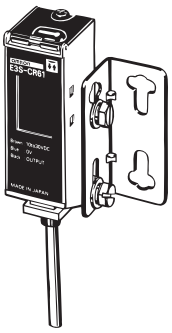




*The Mounting Bracket can be attached to side A.

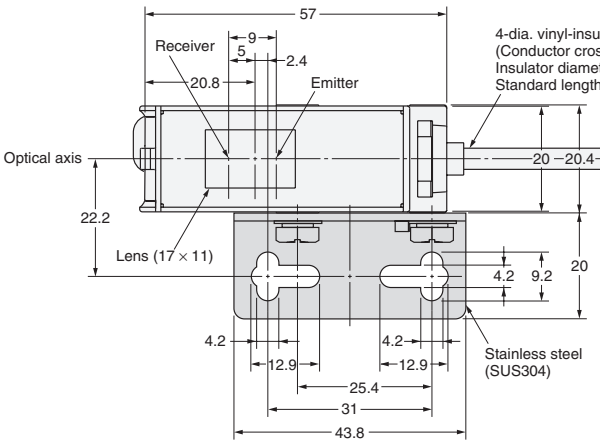
Note: Models numbers for Through-beam Sensors (E3S-CT61(-M1J)) are for sets that include both the Emitter and Receiver.
The model number of the Emitter is expressed by adding "-L" to the set model number (example: E3S-CT61-L 2M), the model number of the Receiver, by adding "-D" (example: E3S-CT61-D 2M.) Refer to *Ordering Information* to confirm model numbers for Emitter and Receivers.

### Retro-/Diffuse-reflective (Vertical)

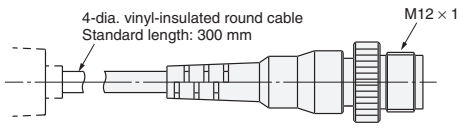
**E3S-CR61(-M1J)**
**E3S-CD61(-M1J)**
**E3S-CD62(-M1J)**



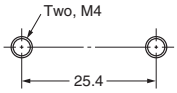
**With Mounting Bracket Attached**

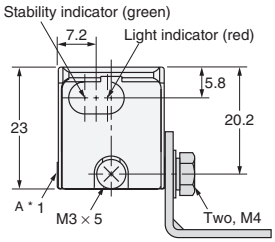



**Pre-wired Connector (-M1J)**

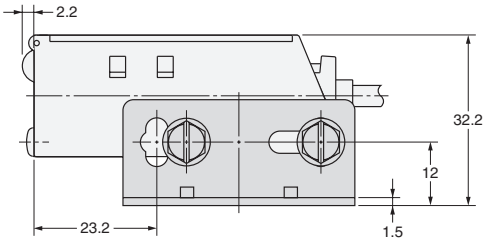



**Mounting Holes**



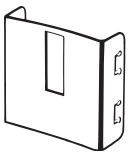

*The Mounting Bracket can be attached to side A.

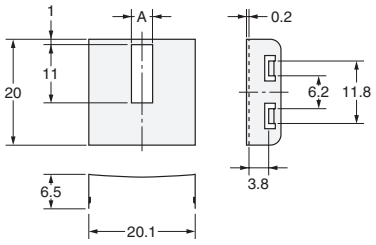



## Accessories (Order Separately)

### Snap-in Long Slit (For Through-beam Models)

**E39-S61**






| Dimension A (mm) | Material | Quantity |
|---|---|---|
| 0.5 | Stainless steel | 1 set each for Emitter/Receiver (8 Slits total) |
| 1 | | |
| 2 | | |
| 4 | | |

### Reflectors

Refer to *E39-L/F39-L/E39-S/E39-R* for details.

### Mounting Brackets

Refer to *E39-L/F39-L/E39-S/E39-R* for details.

## Read and Understand This Catalog

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Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

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2010.9

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