

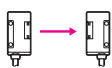
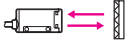


Be sure to read *Safety Precautions* on page 10.

## Ordering Information

### Built-in Amplifier Photoelectric Sensors

Red light    Infrared light

| Sensing method           | Appearance                                                                                        | Connection method | Sensing distance                                                                                       | Functions                                                                                                                                                                                                     | Model                                                        |                                                              |
|--------------------------|---------------------------------------------------------------------------------------------------|-------------------|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|
|                          |                                                                                                   |                   |                                                                                                        |                                                                                                                                                                                                               | NPN output                                                   | PNP output                                                   |
| Through-beam Sensors *1  | Horizontal<br> | Pre-wired         |  7 m                | ---                                                                                                                                                                                                           | <b>E3S-AT11</b><br>Emitter E3S-AT11-L<br>Receiver E3S-AT11-D | <b>E3S-AT31</b><br>Emitter E3S-AT31-L<br>Receiver E3S-AT31-D |
|                          |                                                                                                   | Connector (M12)   |                                                                                                        |  <br>Self Diagnosis External Diagnosis | <b>E3S-AT21</b><br>Emitter E3S-AT21-L<br>Receiver E3S-AT21-D | <b>E3S-AT41</b><br>Emitter E3S-AT41-L<br>Receiver E3S-AT41-D |
|                          | Vertical<br>   | Pre-wired         |                                                                                                        | ---                                                                                                                                                                                                           | <b>E3S-AT16</b><br>Emitter E3S-AT16-L<br>Receiver E3S-AT16-D | <b>E3S-AT36</b><br>Emitter E3S-AT36-L<br>Receiver E3S-AT36-D |
|                          |                                                                                                   | Connector (M12)   |                                                                                                        |  <br>Self Diagnosis External Diagnosis | <b>E3S-AT61</b><br>Emitter E3S-AT61-L<br>Receiver E3S-AT61-D | <b>E3S-AT81</b><br>Emitter E3S-AT81-L<br>Receiver E3S-AT81-D |
|                          |                                                                                                   | Pre-wired         |                                                                                                        | ---                                                                                                                                                                                                           | <b>E3S-AT71</b><br>Emitter E3S-AT71-L<br>Receiver E3S-AT71-D | <b>E3S-AT91</b><br>Emitter E3S-AT91-L<br>Receiver E3S-AT91-D |
|                          |                                                                                                   | Connector (M12)   |                                                                                                        | ---                                                                                                                                                                                                           | <b>E3S-AT66</b><br>Emitter E3S-AT66-L<br>Receiver E3S-AT66-D | <b>E3S-AT86</b><br>Emitter E3S-AT86-L<br>Receiver E3S-AT86-D |
| Retro-reflective Sensors | Horizontal<br> | Pre-wired         |  2 m<br>(100 mm) *2 |  <br>Self Diagnosis External Diagnosis | <b>E3S-AR11</b>                                              | <b>E3S-AR31</b>                                              |
|                          |                                                                                                   | Connector (M12)   |                                                                                                        | ---                                                                                                                                                                                                           | <b>E3S-AR21</b>                                              | <b>E3S-AR41</b>                                              |
|                          | Vertical<br>   | Pre-wired         |                                                                                                        | ---                                                                                                                                                                                                           | <b>E3S-AR16</b>                                              | <b>E3S-AR36</b>                                              |
|                          |                                                                                                   | Connector (M12)   |                                                                                                        |  <br>Self Diagnosis External Diagnosis | <b>E3S-AR61</b>                                              | <b>E3S-AR81</b>                                              |
|                          |                                                                                                   | Pre-wired         |                                                                                                        | ---                                                                                                                                                                                                           | <b>E3S-AR71</b>                                              | <b>E3S-AR91</b>                                              |
|                          |                                                                                                   | Connector (M12)   |                                                                                                        | ---                                                                                                                                                                                                           | <b>E3S-AR66</b>                                              | <b>E3S-AR86</b>                                              |

\*1. Through-beam Sensors are normally sold in sets that include both the Emitter and Receiver.  
Orders for individual Emitters and Receivers are accepted.

\*2. Values in brackets are the minimum required distance between the Sensor and Reflector.

| Sensing method             | Appearance                                                                                      | Connection method | Sensing distance   | Functions                  | Model       |            |
|----------------------------|-------------------------------------------------------------------------------------------------|-------------------|--------------------|----------------------------|-------------|------------|
|                            |                                                                                                 |                   |                    |                            | NPN output  | PNP output |
| Diffuse-reflective Sensors | Horizontal<br> | Pre-wired         | 100 mm (wide view) | ---                        | E3S-AD13 *3 | E3S-AD33   |
|                            |                                                                                                 |                   | 200 mm             | Timer Self Diagnosis       | E3S-AD23    | E3S-AD43   |
|                            |                                                                                                 |                   | 700 mm             | ---                        | E3S-AD11    | E3S-AD31   |
|                            |                                                                                                 |                   | 200 mm             | Timer Turbo Self Diagnosis | E3S-AD21    | E3S-AD41   |
|                            |                                                                                                 |                   | 700 mm             | ---                        | E3S-AD12    | E3S-AD32   |
|                            |                                                                                                 |                   | 200 mm             | Timer Turbo Self Diagnosis | E3S-AD22    | E3S-AD42   |
|                            |                                                                                                 | Connector (M12)   | 100 mm (wide view) | ---                        | E3S-AD18    | E3S-AD38   |
|                            |                                                                                                 |                   | 200 mm             |                            | E3S-AD16    | E3S-AD36   |
|                            |                                                                                                 |                   | 700 mm             |                            | E3S-AD17    | E3S-AD37   |
|                            | Vertical<br>   | Pre-wired         | 100 mm (wide view) | ---                        | E3S-AD63 *3 | E3S-AD83   |
|                            |                                                                                                 |                   | 200 mm             | Timer Self Diagnosis       | E3S-AD73    | E3S-AD93   |
|                            |                                                                                                 |                   | 700 mm             | ---                        | E3S-AD61    | E3S-AD81   |
|                            |                                                                                                 |                   | 200 mm             | Timer Turbo Self Diagnosis | E3S-AD71    | E3S-AD91   |
|                            |                                                                                                 |                   | 700 mm             | ---                        | E3S-AD62    | E3S-AD82   |
|                            |                                                                                                 |                   | 200 mm             | Timer Self Diagnosis       | E3S-AD72    | E3S-AD92   |
|                            |                                                                                                 | Connector (M12)   | 100 mm (wide view) | ---                        | E3S-AD68    | E3S-AD88   |
|                            |                                                                                                 |                   | 200 mm             |                            | E3S-AD66    | E3S-AD86   |
|                            |                                                                                                 |                   | 700 mm             |                            | E3S-AD67    | E3S-AD87   |

\*3. The following models are available with 200-mm sensing distances: E3S-AD14 and E3S-AD64.

## Accessories (Order Separately)

### Insert-type Long Slit

| Slit width       | Sensing distance | Minimum sensing object (typical) | Model   | Quantity                                       | Remarks                                                            |
|------------------|------------------|----------------------------------|---------|------------------------------------------------|--------------------------------------------------------------------|
| 0.5 mm × 11.1 mm | 500 mm           | 0.2-mm dia.                      | E39-S46 | 1 of each for Emitter/Receiver (4 Slits total) | Slits can be used with the E3S-AT□□ Through-beam Sensor. → Page 10 |
| 1 mm × 11.1 mm   | 1.1 m            | 0.4-mm dia.                      |         | 1 of each for Emitter/Receiver (2 Slits total) |                                                                    |
| 2 mm × 13.6 mm   | 2.5 m            | 0.8-mm dia.                      |         |                                                |                                                                    |

### Mutual Interference Prevention Filters

| Sensing distance | Model  | Quantity                                         | Remarks                                                      |
|------------------|--------|--------------------------------------------------|--------------------------------------------------------------|
| 2.4 m            | E39-E6 | 2 of each for Emitter/Receiver (4 Filters total) | Can be used with the E3S-AT□□ Through-beam Sensor. → Page 10 |

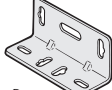
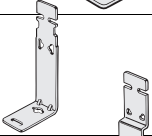
### Reflectors/Other Accessories

| Name                                | Sensing distance (typical)      | Model   | Quantity | Remarks                                                          |
|-------------------------------------|---------------------------------|---------|----------|------------------------------------------------------------------|
| Reflectors                          | 2 m (100 mm) *<br>(rated value) | E39-R1  | 1        | Provided with E3S-AR□□ Retro-reflective Sensor.                  |
| Small Reflectors                    | 1.3 m (100 mm) *                | E39-R3  | 1        | ---                                                              |
|                                     | 600 mm (70 mm) *                | E39-R4  | 1        | ---                                                              |
| Tape Reflectors                     | 450 mm (100 mm) *               | E39-RS1 | 1        | Enables MSR function.                                            |
|                                     | 700 mm (100 mm) *               | E39-RS2 | 1        |                                                                  |
|                                     | 900 mm (100 mm) *               | E39-RS3 | 1        |                                                                  |
| Optical Axis Confirmation Reflector | ---                             | E39-R5  | 1        | Used to check optical axis for the E3S-AT□□ Through-beam Sensor. |

Note: When using any Reflector other than the provided one, use a sensing distance of approximately 0.7 times the typical value as a guide.

\* Values in brackets are the minimum required distance between the Sensor and Reflector.

### Mounting Brackets/Other

| Appearance                                                                         | Model   | Quantity | Remarks                                                                                                                                                                               |
|------------------------------------------------------------------------------------|---------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | E39-L69 | 1        | Provided with E3S-A Horizontal Sensors.                                                                                                                                               |
|   | E39-L70 | 1        | Provided with E3S-A Vertical Sensors.                                                                                                                                                 |
|   | E39-L59 | 1        | Provided with E3S-A Vertical Pre-wired Sensors.                                                                                                                                       |
|   | E39-L81 | 1        | Provided with E3S-A Vertical Connector Sensors.                                                                                                                                       |
|   | E39-L97 | 1        | Protective Cover for Horizontal Sensors<br>Note: When mounting Sensors with Connectors, the Sensor I/O Connector will come into contact with the Bracket. Mount the Sensor with care. |
|   | E39-L98 | 1        | Protective Cover for Vertical Sensors<br>Note: When mounting Sensors with Connectors, the Sensor I/O Connector will be longer. Mount the Sensor with care.                            |
|  | E39-L60 | 1        | Close Mounting Plate:<br>Provided with E3S-A Connector Sensors.                                                                                                                       |

Note: If a Through-beam Model is used, order two Mounting Brackets, one for the Emitter and one for the Receiver.

### Sensors I/O Connectors

| Model  | Quantity | Remarks                |
|--------|----------|------------------------|
| E39-G2 | 1        | Provided with product. |

### Sensors I/O Connectors

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

Note: When using Through-beam models, order one connector for the Receiver and one for the Emitter.

## Ratings and Specifications

| Sensing method                                                               |                  | Through-beam Sensors                                                                                                                                                                                                                                                                          | Retro-reflective Sensors (with MSR function)                                                              | Diffuse-reflective Sensors                               |                                                      |                                                      |
|------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|----------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|
| Item                                                                         | Model            | E3S-AT11, 16, 21, 31, 36, 41, 61, 66, 71, 81, 86, 91                                                                                                                                                                                                                                          | E3S-AR11, 16, 21, 31, 36, 41, 61, 66, 71, 81, 86, 91                                                      | E3S-AD13, 18, 23, 33, 38, 43, 63, 68, 73, 83, 88, 93     | E3S-AD11, 16, 21, 31, 36, 41, 61, 66, 71, 81, 86, 91 | E3S-AD12, 17, 22, 32, 37, 42, 62, 67, 72, 82, 87, 92 |
| Sensing distance                                                             |                  | 7 m                                                                                                                                                                                                                                                                                           | 2 m (100 mm) *1<br>(When using E39-R1)                                                                    | 100 mm (wide view)<br>(white paper 100 × 100 mm)         | 10 to 200 mm<br>(white paper 100 × 100 mm)           | 700 mm<br>(white paper 200 × 200 mm)                 |
| Standard sensing object                                                      |                  | Opaque:<br>10-mm dia. min.                                                                                                                                                                                                                                                                    | Opaque:<br>75-mm dia. min.                                                                                | ---                                                      |                                                      |                                                      |
| Differential travel                                                          |                  | ---                                                                                                                                                                                                                                                                                           |                                                                                                           | 20% max. of sensing distance                             | 10% max. of sensing distance                         | 20% max. of sensing distance                         |
| Directional angle                                                            |                  | Both Emitter and Receiver: 3° to 15°                                                                                                                                                                                                                                                          | 3 to 10°                                                                                                  | ---                                                      |                                                      |                                                      |
| Light source (wavelength)                                                    |                  | Red LED (700 nm)                                                                                                                                                                                                                                                                              |                                                                                                           | Infrared LED (880 nm)                                    | Red LED (700 nm)                                     | Infrared LED (880 nm)                                |
| Power supply voltage                                                         |                  | 10 to 30 VDC, including ripple (p-p) 10%                                                                                                                                                                                                                                                      |                                                                                                           |                                                          |                                                      |                                                      |
| Current consumption                                                          |                  | Both Emitter and Receiver: 20 mA max.<br>(plus approx. 15 mA with turbo function)                                                                                                                                                                                                             | 30 mA max. (plus approx. 15 mA with turbo function)                                                       | 35 mA max.                                               | 30 mA max. (plus approx. 15 mA with turbo function)  | 35 mA max.                                           |
| Control output                                                               |                  | Load power supply voltage: 30 VDC max., Load current: 100 mA max. (residual voltage: 1 V max.)<br>Open-collector output (NPN or PNP depending on model), Light-ON/Dark-ON selectable                                                                                                          |                                                                                                           |                                                          |                                                      |                                                      |
| Self-diagnostic output (Only on Sensors with self-diagnostic outputs)        |                  | (Only Sensors with self-diagnostic function) Load power supply voltage: 30 VDC max.,<br>Load current: 50 mA max. (residual voltage: 1 V max.),<br>Open-collector output (NPN or PNP depending on model)                                                                                       |                                                                                                           |                                                          |                                                      |                                                      |
| External diagnostic input (Only on Sensors with external diagnostic outputs) | Input voltage    | NPN<br>with Emitter OFF: 0 V short-circuit or 1.5 V max. (source current: 1 mA max.)<br>with Emitter ON: Open (leakage current: 0.1 mA max.)<br>PNP<br>with Emitter OFF: +DC short-circuit or -1.5 VDC max. (sink current: 3 mA max.)<br>with Emitter ON: Open (leakage current: 0.1 mA max.) |                                                                                                           | ---                                                      |                                                      |                                                      |
|                                                                              | Response time    | 0.5 ms max.                                                                                                                                                                                                                                                                                   |                                                                                                           |                                                          |                                                      |                                                      |
| Protection circuits                                                          |                  | Power supply reverse polarity protection,<br>Output short-circuit protection                                                                                                                                                                                                                  | Power supply reverse polarity protection, Output short-circuit protection, Mutual interference prevention |                                                          |                                                      |                                                      |
| Response time                                                                |                  | Operation or reset: 0.5 ms max.                                                                                                                                                                                                                                                               |                                                                                                           |                                                          |                                                      |                                                      |
| Sensitivity adjustment                                                       |                  | Two-turn endless adjuster with an indicator                                                                                                                                                                                                                                                   |                                                                                                           |                                                          |                                                      |                                                      |
| Timer function (Only on Sensors with the timer function)                     |                  | 0 to 100 ms OFF-delay variable adjuster                                                                                                                                                                                                                                                       |                                                                                                           |                                                          |                                                      |                                                      |
| Turbo function (Only on Sensors with the turbo function)                     |                  | Yes (with turbo switch)                                                                                                                                                                                                                                                                       |                                                                                                           |                                                          |                                                      | ---                                                  |
| Ambient illumination (Receiver side)                                         |                  | Incandescent lamp: 5,000 lx max.<br>Sunlight: 10,000 lx max.                                                                                                                                                                                                                                  |                                                                                                           |                                                          |                                                      |                                                      |
| Ambient temperature                                                          |                  | Operating: -25°C to 55°C (with no icing or condensation)<br>Storage: -40°C to 70°C (with no icing or condensation)                                                                                                                                                                            |                                                                                                           |                                                          |                                                      |                                                      |
| Ambient humidity                                                             |                  | Operating: 35% to 85% (with no condensation)<br>Storage: 35% to 95% (with no condensation)                                                                                                                                                                                                    |                                                                                                           |                                                          |                                                      |                                                      |
| Insulation resistance                                                        |                  | 20 MΩ min. at 500 VDC between current-carrying parts and case                                                                                                                                                                                                                                 |                                                                                                           |                                                          |                                                      |                                                      |
| Dielectric strength                                                          |                  | 1,000 VAC, 50/60 Hz for 1 min. between current-carrying parts and case                                                                                                                                                                                                                        |                                                                                                           |                                                          |                                                      |                                                      |
| Vibration resistance (destruction)                                           |                  | 10 to 55 Hz, 1.5-mm double amplitude for 2 hours each in X, Y, and Z directions                                                                                                                                                                                                               |                                                                                                           |                                                          |                                                      |                                                      |
| Shock resistance (destruction)                                               |                  | Destruction: 500m/s², 3 times each in X, Y, and Z directions                                                                                                                                                                                                                                  |                                                                                                           |                                                          |                                                      |                                                      |
| Degree of protection                                                         |                  | IEC IP67; NEMA: 4X (indoors only) *2                                                                                                                                                                                                                                                          |                                                                                                           |                                                          |                                                      |                                                      |
| Connection method                                                            |                  | Pre-wired (standard length: 2 m) or M12 connector                                                                                                                                                                                                                                             |                                                                                                           |                                                          |                                                      |                                                      |
| Weight (packed state)                                                        |                  | Pre-wired cable:<br>Approx. 150 g<br>Connector: Approx. 70 g                                                                                                                                                                                                                                  | Pre-wired cable:<br>Approx. 110 g<br>Connector: Approx. 60 g                                              | Pre-wired cable: Approx. 90 g<br>Connector: Approx. 50 g |                                                      |                                                      |
| Material                                                                     | Case             | PBT                                                                                                                                                                                                                                                                                           |                                                                                                           |                                                          |                                                      |                                                      |
|                                                                              | Lens             | Denatured polyallylate                                                                                                                                                                                                                                                                        |                                                                                                           |                                                          |                                                      |                                                      |
|                                                                              | Mounting Bracket | Stainless steel (SUS304)                                                                                                                                                                                                                                                                      |                                                                                                           |                                                          |                                                      |                                                      |
| Accessories                                                                  |                  | Mounting bracket (with screws), Sensitivity adjustment driver, Sensitivity adjusting knob, Instruction sheet, Close mounting plate (only for Sensors with connectors), and Reflector (only for Retro-reflective Sensors)                                                                      |                                                                                                           |                                                          |                                                      |                                                      |

\*1. Values in brackets are the minimum required distance between the Sensor and Reflector.

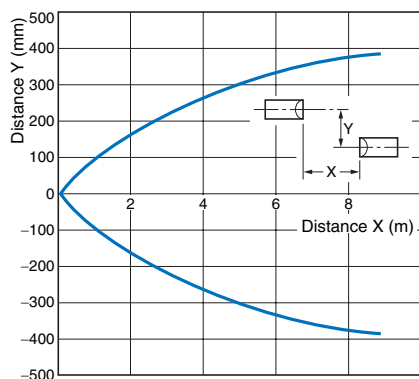
\*2. National Electrical Manufacturers Association

## Engineering Data (Typical)

### Parallel Sensing Range

#### Through-beam Sensors

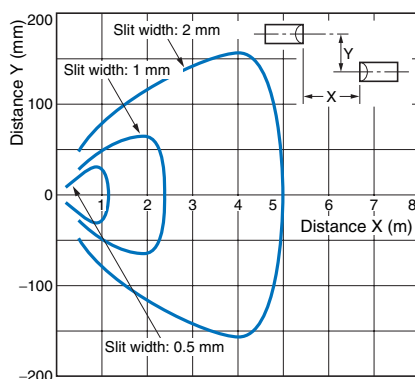
E3S-AT□□



#### Through-beam Sensors

E3S-AT□□ + E39-S46

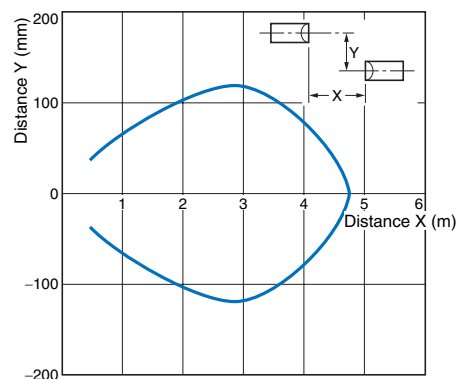
(Slit Sold Separately)



#### Through-beam Sensors

E3S-AT□□ + E39-E6

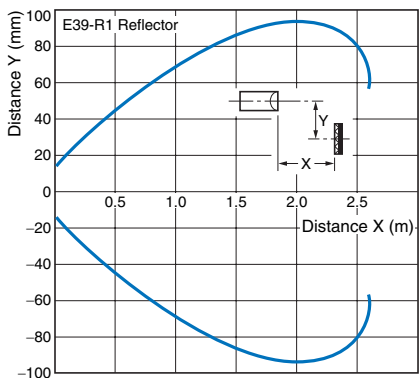
(Filter Sold Separately)



### Parallel Sensing Range

#### Retro-reflective Sensors

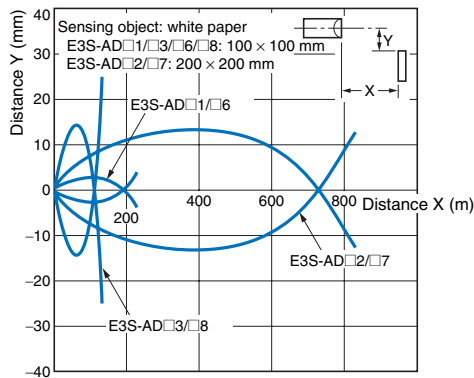
E3S-AR□□ + E39-R1 (with Reflector)



### Sensing Range

#### Diffuse-reflective Sensors

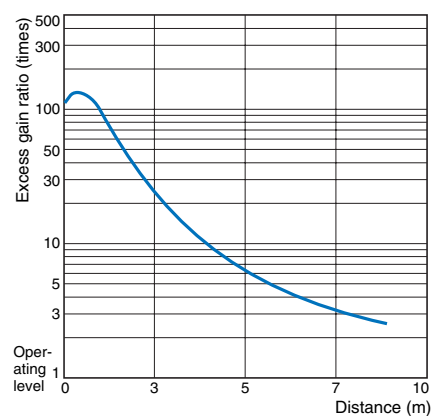
E3S-AD□1/AD□2/AD□3/AD□6/AD□7/AD□8



### Excess Gain vs. Set Distance

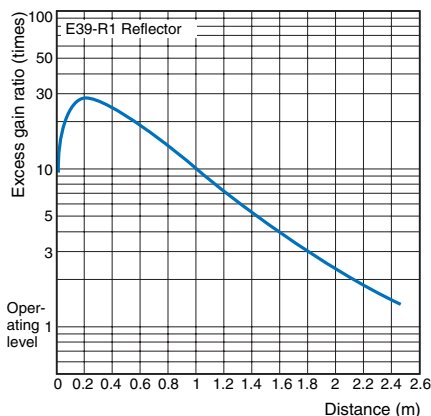
#### Through-beam Sensors

E3S-AT□□

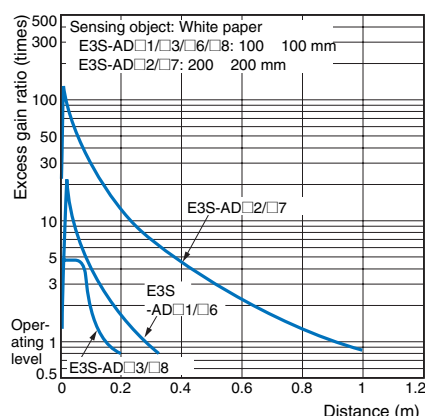


#### Retro-reflective Sensors

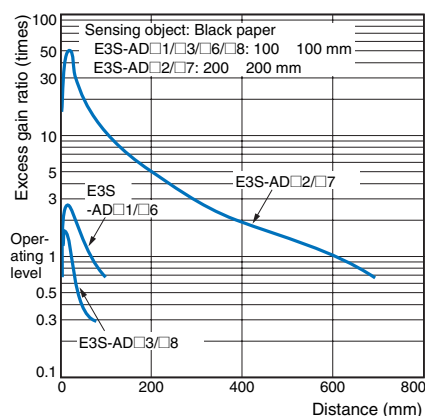
E3S-AR□□ + E39-R1 (with Reflector)



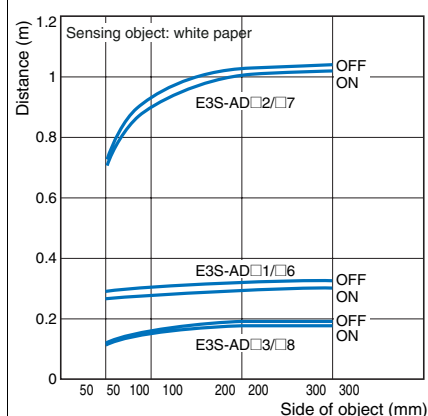
## Diffuse-reflective Sensor

E3S-AD□1/AD□2/AD□3/AD□6/AD□7/  
AD□8 (Detection of White Paper)

## Diffuse-reflective Sensor

E3S-AD□1/AD□2/AD□3/AD□6/AD□7/  
AD□8 (Detection of Black Paper)

## Sensing Object Size vs. Sensing Distance

E3S-AD□1/AD□2/AD□3/AD□6/AD□7/  
AD□8

## I/O Circuit Diagrams

## NPN Output

| Model      | Operation mode        | Timing charts                                    | Mode selector switch                                              | Output circuit                                                                   |
|------------|-----------------------|--------------------------------------------------|-------------------------------------------------------------------|----------------------------------------------------------------------------------|
| E3S-AT11 * | Light-ON              | Incident light: ON (green bar)                   | L Side (LIGHT ON)                                                 | Through-beam Receivers, Retro-reflective Sensors, Diffuse-reflective Sensors<br> |
| E3S-AT16 * |                       | No incident light: OFF (green bar)               |                                                                   |                                                                                  |
| E3S-AT61 * |                       | Light indicator (red): OFF (green bar)           |                                                                   |                                                                                  |
| E3S-AT66 * |                       | Output transistor: OFF (green bar)               |                                                                   |                                                                                  |
| E3S-AR11   |                       | Load Operate: ON (green bar)                     |                                                                   |                                                                                  |
| E3S-AR16   | Dark-ON               | Reset (Between brown and black): OFF (green bar) | D Side (DARK ON)                                                  | Connector Pin Arrangement<br><br>Note: Pin 2 is not used.                        |
| E3S-AR61   |                       | Incident light: ON (green bar)                   |                                                                   |                                                                                  |
| E3S-AR66   |                       | No incident light: OFF (green bar)               |                                                                   |                                                                                  |
| E3S-AD11   |                       | Light indicator (red): ON (green bar)            |                                                                   |                                                                                  |
| E3S-AD16   |                       | Output transistor: ON (green bar)                |                                                                   |                                                                                  |
| E3S-AD61   | Through-beam Emitters | Load Operate: OFF (green bar)                    | Connector Pin Arrangement<br><br>Note: Pins 2 and 4 are not used. | Connector Pin Arrangement<br><br>Note: Pins 2 and 4 are not used.                |
| E3S-AD66   |                       | Reset (Between brown and black): OFF (green bar) |                                                                   |                                                                                  |
| E3S-AD12   |                       | Incident light: ON (green bar)                   |                                                                   |                                                                                  |
| E3S-AD17   |                       | No incident light: OFF (green bar)               |                                                                   |                                                                                  |
| E3S-AD62   |                       | Light indicator (red): ON (green bar)            |                                                                   |                                                                                  |
| E3S-AD67   |                       | Output transistor: ON (green bar)                |                                                                   |                                                                                  |
| E3S-AD13   |                       | Load Operate: OFF (green bar)                    |                                                                   |                                                                                  |
| E3S-AD18   | Through-beam Emitters | Reset (Between brown and black): OFF (green bar) | Connector Pin Arrangement<br><br>Note: Pins 2 and 4 are not used. | Connector Pin Arrangement<br><br>Note: Pins 2 and 4 are not used.                |
| E3S-AD63   |                       | Incident light: ON (green bar)                   |                                                                   |                                                                                  |
| E3S-AD68   |                       | No incident light: OFF (green bar)               |                                                                   |                                                                                  |

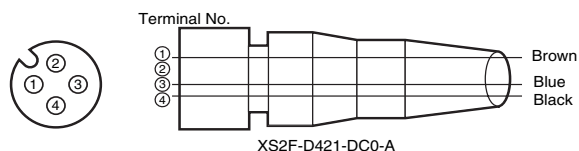
\* Models numbers for Through-beam Sensors (E3S-AT□□) are for sets that include both the Emitter and Receiver.

The model number of the Emitter is expressed by adding "-L" to the set model number (example: E3S-AT11-L 2M), the model number of the Receiver, by adding "-D" (example: E3S-AT11-D 2M). Refer to *Ordering Information* to confirm model numbers for Emitter and Receivers.

| Model                                                                                            | Operation mode | Timing charts | Mode selector switch | Output circuit                                     |
|--------------------------------------------------------------------------------------------------|----------------|---------------|----------------------|----------------------------------------------------|
| E3S-AT21 *<br>E3S-AT71 *<br>E3S-AD21<br>E3S-AD71<br>E3S-AD22<br>E3S-AD72<br>E3S-AD23<br>E3S-AD73 | Light-ON       |               | L Side (LIGHT ON)    | Through-beam Receivers, Diffuse-reflective Sensors |
|                                                                                                  | Dark-ON        |               | D Side (DARK ON)     |                                                    |
|                                                                                                  | ---            |               | ---                  | Through-beam Emitters                              |
| E3S-AR21<br>E3S-AR71                                                                             | Light-ON       |               | L Side (LIGHT ON)    | Retro-reflective Sensors                           |
|                                                                                                  | Dark-ON        |               | D Side (DARK ON)     |                                                    |

\* Models numbers for Through-beam Sensors (E3S-AT□1) 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-AT21-L 2M), the model number of the Receiver, by adding "-D" (example: E3S-AT21-D 2M). Refer to *Ordering Information* to confirm model numbers for Emitter and Receivers.

## Structure of Sensor I/O Connector



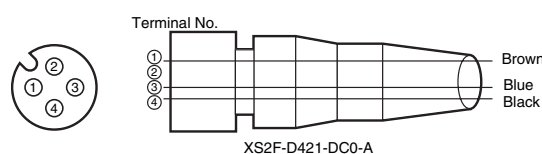
| Classification | Wire color | Connection Pin No. | Application |
|----------------|------------|--------------------|-------------|
| For DC         | Brown      | 1                  | +V          |
|                | ---        | 2                  | ---         |
|                | Blue       | 3                  | 0 V         |
|                | Black      | 4                  | Output      |

Note: Pin No. 2 is not used.



| Model                | Operation mode | Timing charts                                                                                                                                                                                                                                     | Mode selector switch | Output circuit                  |
|----------------------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------------|
| E3S-AR41<br>E3S-AR91 | Light-ON       | <p>Incident light</p> <p>No incident light</p> <p>Light indicator (red) ON</p> <p>OFF</p> <p>Output transistor ON</p> <p>OFF</p> <p>Load Operate (e.g., relay) Reset</p> <p>(Between blue and black)</p> <p>T: OFF-delay timer (0 to 100 ms)</p>  | L Side<br>(LIGHT ON) | <p>Retro-reflective Sensors</p> |
|                      | Dark-ON        | <p>Incident light</p> <p>No incident light</p> <p>Light indicator (red) ON</p> <p>OFF</p> <p>Output transistor ON</p> <p>OFF</p> <p>Load Operate (e.g., relay) Reset</p> <p>(Between brown and black)</p> <p>T: OFF-delay timer (0 to 100 ms)</p> | D Side<br>(DARK ON)  |                                 |

### Structure of Sensor I/O Connector



| Classification | Wire color | Connection Pin No. | Application |
|----------------|------------|--------------------|-------------|
| For DC         | Brown      | 1                  | +V          |
|                | ---        | 2                  | ---         |
|                | Blue       | 3                  | 0 V         |
|                | Black      | 4                  | Output      |

Note: Pin 2 is not used.

## Adjustment Methods

### Sensitivity Adjustment for Diffuse-reflective Sensors Set to Light ON

| Item          | Sensing condition | Sensitivity adjuster | Indicators                                                                                      | Procedure                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------|-------------------|----------------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1) Position A |                   |                      | <p>ON → OFF</p> <p>OFF → ON</p> <p>Stability indicator (green)</p> <p>Light indicator (red)</p> | Locate a sensing object at the sensing distance, set the sensitivity adjuster to the minimum scale position, and gradually increase sensitivity by turning the sensitivity adjuster clockwise until the incident light indicator (red LED) is ON. Position A is where the indicator has turned ON.                                                                                             |
| 2) Position B |                   |                      | <p>ON → OFF</p> <p>ON → OFF</p> <p>Stability indicator (green)</p> <p>Light indicator (red)</p> | Position B is when the sensing object is removed and the sensitivity adjuster is turned clockwise until the incident light indicator (red LED) is ON. Position C is where the adjuster is turned counterclockwise (reducing the sensitivity) from position B until the incident light indicator (red LED) is OFF. When there are no background objects, the maximum sensitivity is position C. |
| 3) Setting    | ---               |                      | <p>ON</p> <p>ON → OFF</p> <p>Stability indicator (green)</p> <p>Light indicator (red)</p>       | Set the sensitivity adjuster to halfway between (A) and (C) (at the optimum sensitivity). Check that the stability indicator (green LED) turns ON according to whether the sensing object is there or not. There is not sufficient margin if it does not turn ON. If this is the case, reconsider the detection method.                                                                        |

Unlike conventional Photoelectric Sensors, the variation in the sensitivity of E3S-A Photoelectric Sensors is minimal. This means the sensitivity can be adjusted on only a single Photoelectric Sensor, and then the adjusters on the other Photoelectric Sensors can be set to the same scale position. There is no need to adjust the sensitivity of each Photoelectric Sensor individually.

## Safety Precautions

### ⚠ WARNING

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



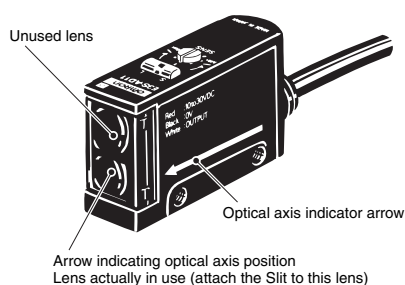
### Precautions for Correct Use

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

#### Mounting

##### Position of Optical Axis of Through-beam Model

Unlike conventional through-beam sensors, the E3S-A Through-beam Photoelectric Sensor incorporates 2 lenses. The lens actually in use is the one marked with an arrow indicating the position of the optical axis. When using a Slit, attach it to the lens marked with the arrow.

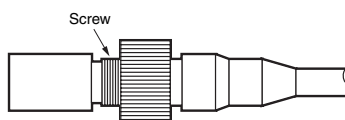


##### Position of Arrow Indicating Optical Axis

| Model                         | Position of lens in use |
|-------------------------------|-------------------------|
| E3S-A<br>(Vertical Sensors)   | Top                     |
| E3S-A<br>(Horizontal Sensors) | Bottom                  |

#### Tightening the Connector

Manually tighten the connector until the threads have completely disappeared. If tightening is insufficient, the degree of protection may not be maintained, or the connector may become loose when it is subjected to vibration. Using pliers to tighten the connector may damage it.

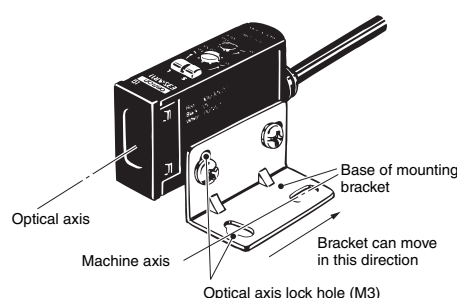


Use the E39-L60 Close Mounting Plate (provided) if the Sensor is mounted using mounting brackets or if it is mounted directly. (Refer to *Dimensions*.)

#### Mounting Bracket (Provided)

The direction of the optical axis coincides with the machine axis of the E3S-A when the mounting screw is inserted into the lock hole of the Mounting Bracket. If the mounting surface and the screw hole are correctly aligned toward the sensing object (or toward the Retroreflector for a Through-beam Sensor), the mechanical axis and optical axis will be aligned when the screw is inserted into the hole. Incident light will be detected, and time-consuming adjustment will not be necessary. (If, however, the mounting surface is not flat, adjustment of the optical axis may still be required.) Adjust the position of the Sensor so that incident light points at the center. Make sure that the incident light is at a fixed position.

The maximum tightening torque of the screw is 0.53 N.m max.



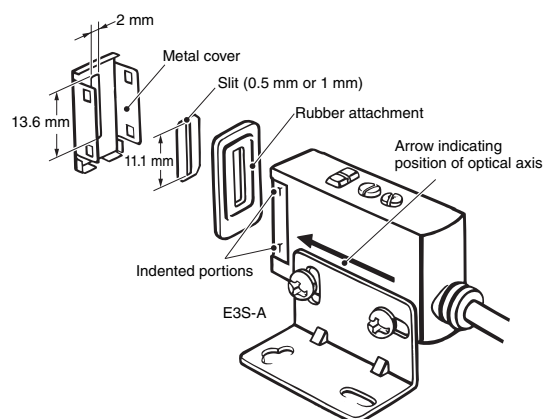
#### ● Adjustments

##### E39-S46 Through-beam Slits

(Accessory, order separately)

Use the rubber attachment with the metal cover if a slit width of 2 mm is required. (A Slit is not required in this case.) Insert the 0.5- or 1-mm Slit between the metal cover and rubber attachment if a slit width of 0.5 or 1 mm is desired.

These Slits fit into the rubber attachment.



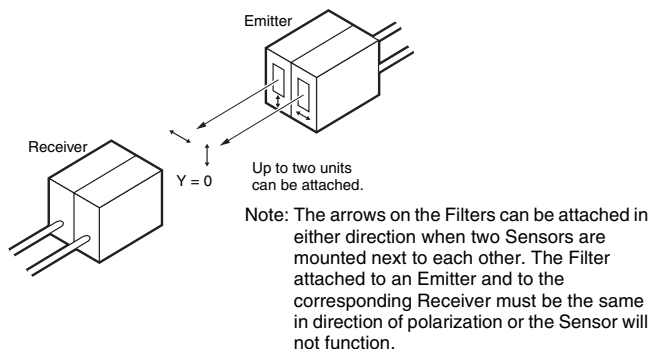
Apply the Slit to the lens of the Photoelectric Sensor marked with an arrow indicating the position of the optical axis (apply it to the bottom lens of Horizontal Sensors and the top lens of Vertical Sensors).

### E39-E6 Polarized Mutual Interference Prevention Filters for Through-beam Sensors

(Accessory, order separately)

A set of 4 Filters are sold together for two Through-beam Sensors (for 2 each for Emitters and Receivers). Order one for every two sets of Photoelectric Sensors.

For mounting, refer to the figure of the Through-beam Slits.

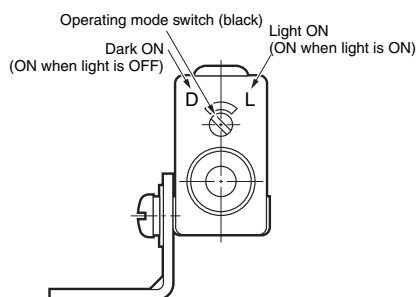


The arrow printed on the cover indicates the direction of polarization. By attaching the Filters opposite to each other in polarization to the Emitters and the Receivers in rows, mutual interference can be prevented (in any case, the Filter attached to an Emitter and to the corresponding Receiver must be the same in direction of polarization or the Photoelectric Sensor will not function).

### Operating Mode Selection

As shown in the following illustration, the E3S-A has an operating mode selector on the panel where the Receiver connector is located.

With this operating mode selector, the E3S-A is in either Dark-ON or Light-ON mode.



The default operating mode is shown in the following table.

| Sensing method             | Default switch setting |
|----------------------------|------------------------|
| Through-beam Sensors       | Dark-ON                |
| Retro-reflective Sensors   | Dark-ON                |
| Diffuse-reflective Sensors | Light-ON               |

### Timer and Turbo Switch

The Emitter of the Through-beam Sensor with the self-diagnostic feature incorporates a turbo switch. When this switch is ON, the intensity of the red LED light source can be increased to make a brighter spot.

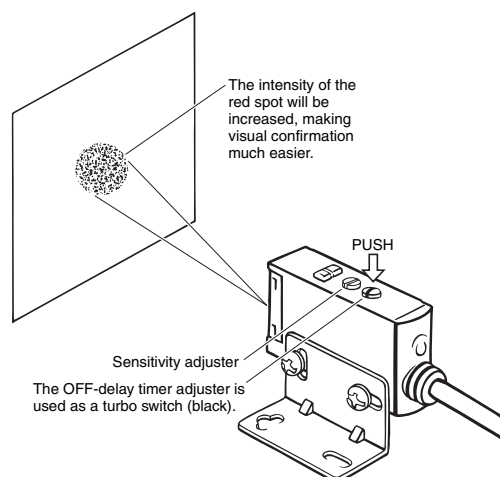
### Turbo Function ( Turbo Switch)

The turbo function is effective with the turbo switch pressed, and the function is reset automatically when released.

With the turbo function switched ON, the light spot is visible even at a distance of 200 mm, making it easy to check the sensing position and the angle of the optical axis.

#### Precautions

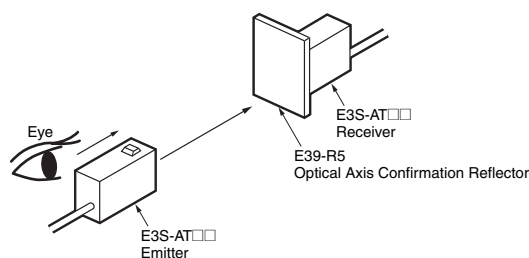
- (1) Do not keep the turbo switch pressed for longer than 3 minutes. (It will not break even if it is pressed for an extended period.)
- (2) Pressing the switch may change the timer delay settings. Set the timer after using the turbo function to check the optical axis.
- (3) To press the switch, use a force of 9.8 N max.



### Using the E39-R5 Optical Axis Reflector for Through-beam Sensors

(Accessory, order Separately)

Use this attachment when the set distance is long and adjustment is mechanically difficult with a sensing object.



Attach the Reflector to the Receiver.

Look at the Reflector from right behind the Emitter. The Reflector should be bright with red light when the optical beam strikes the Reflector. If the Emitter has a turbo function, the Reflector looks brighter with the function switched ON.

When the Reflector is removed, the light beam strikes the Receiver.

## Dimensions

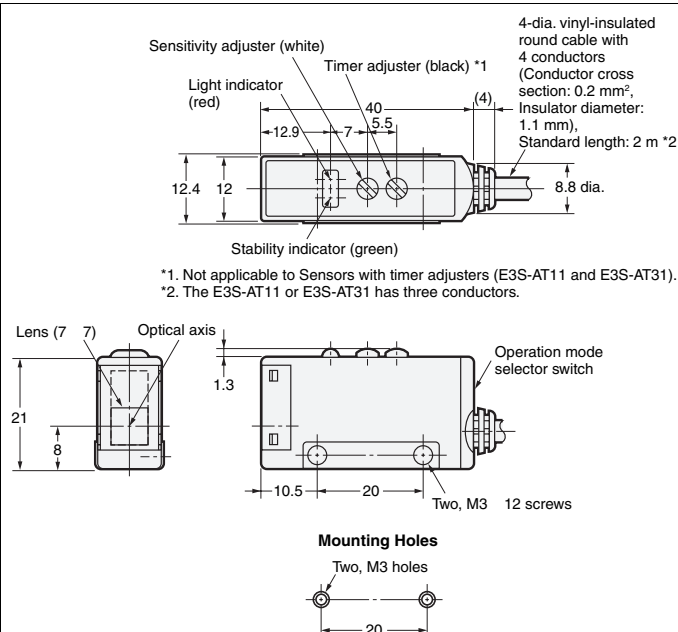
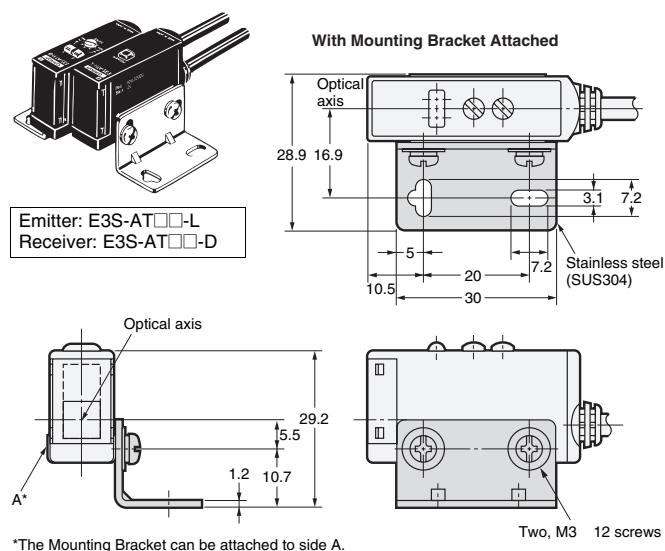
Unless otherwise specified, the tolerance class IT16 is used for dimensions in this data sheet.

### E3S-A Built-in Amplifier Photoelectric Sensor

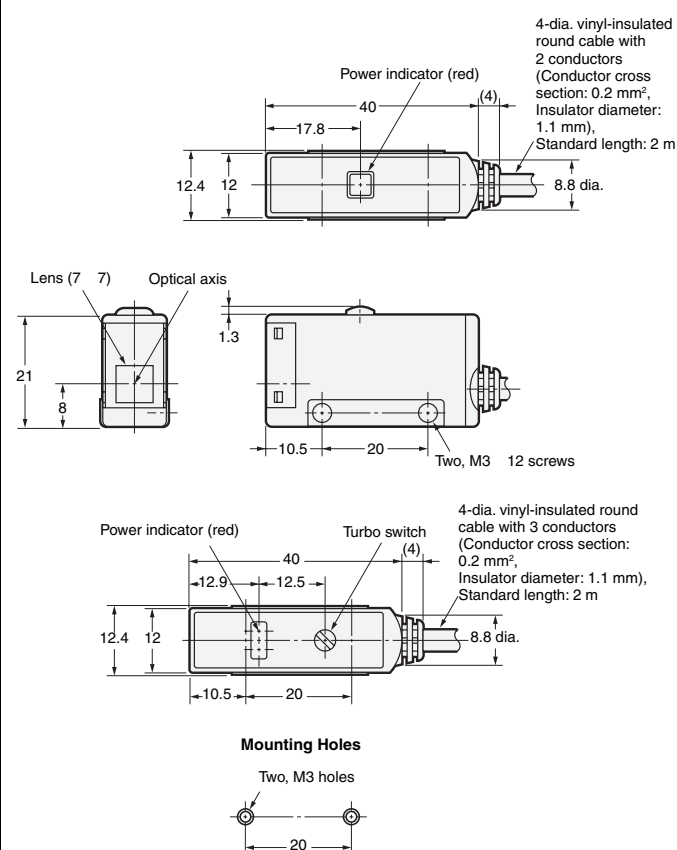
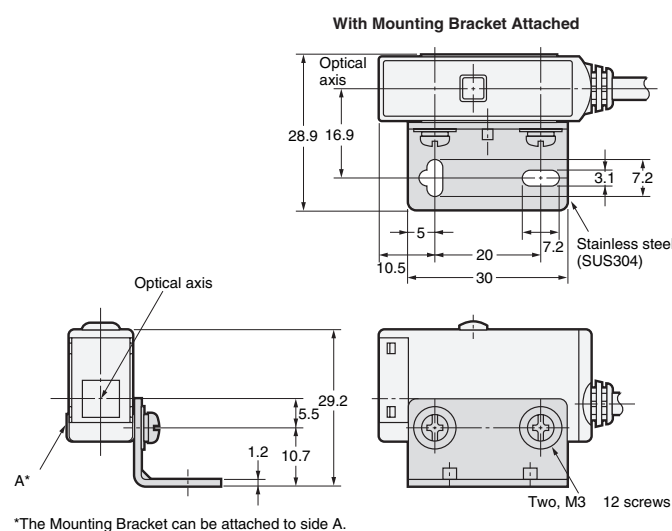
#### Through-beam Sensors (Horizontal)

#### Pre-wired Sensors

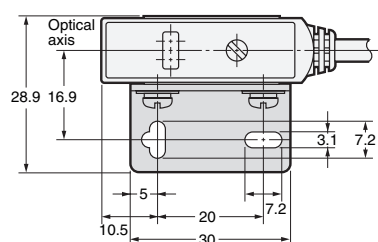
#### E3S-AT11/21/31/41 (Receiver)



#### E3S-AT11/31 (Emitter)



#### E3S-AT21/41 (Emitter)

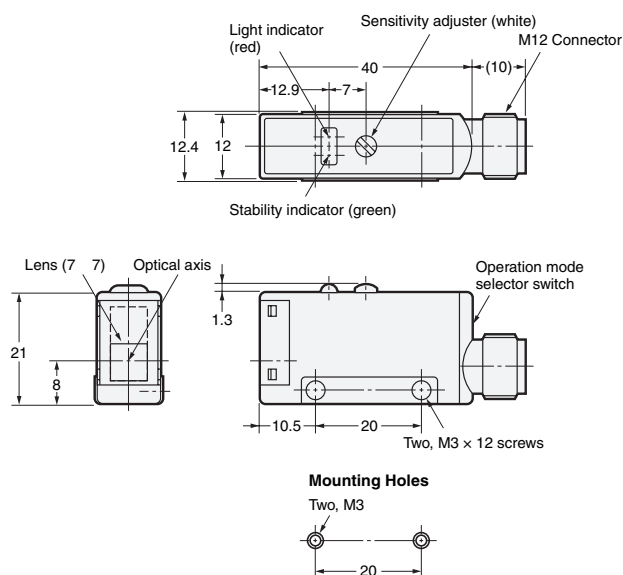
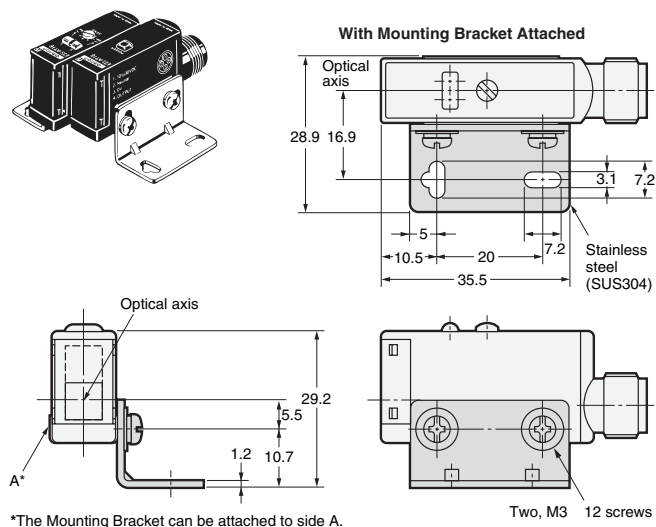


Note: Models numbers for Through-beam Sensors (E3S-AT□□) are for sets that include both the Emitter and Receiver.

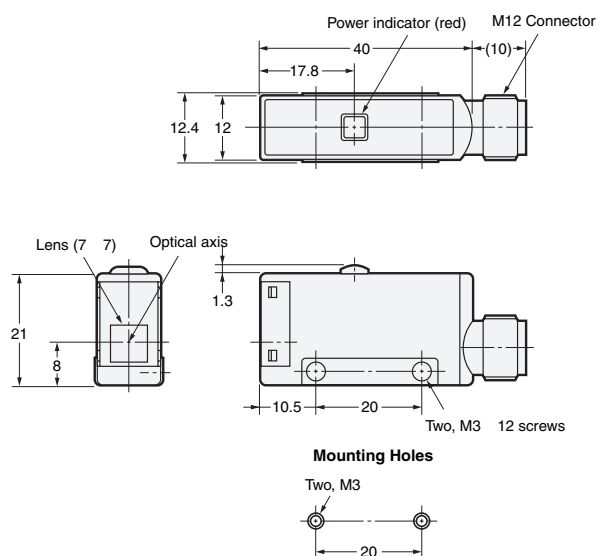
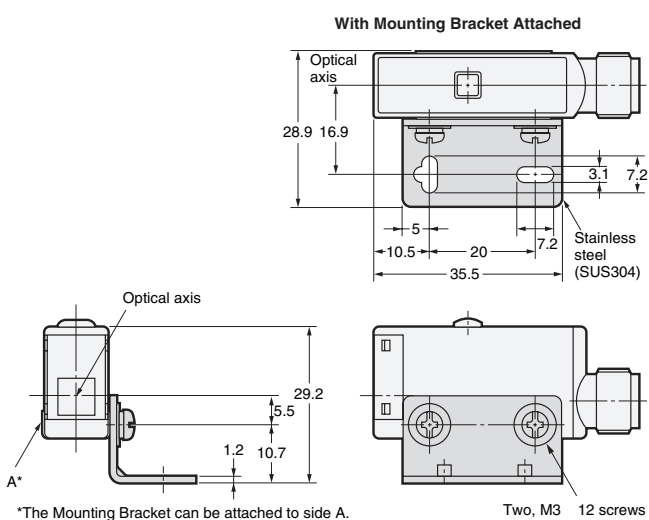
The model number of the Emitter is expressed by adding "-L" to the set model number (example: E3S-AT11-L 2M), the model number of the Receiver, by adding "-D" (example: E3S-AT11-D 2M). Refer to *Ordering Information* to confirm model numbers for Emitter and Receivers.

## Sensors with Standard Connectors

### E3S-AT16/36 (Receiver)



### E3S-AT16/36 (Emitter)



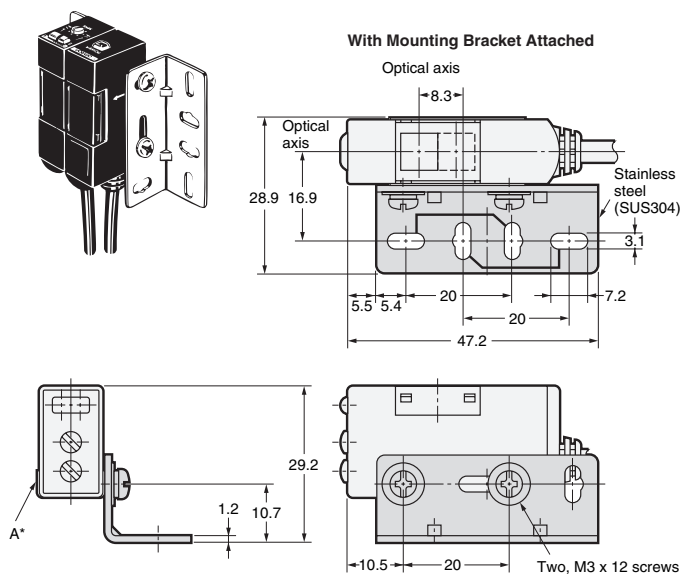
Note: Models numbers for Through-beam Sensors (E3S-AT□6) are for sets that include both the Emitter and Receiver.

The model number of the Emitter is expressed by adding "-L" to the set model number (example: E3S-AT16-L 2M), the model number of the Receiver, by adding "-D" (example: E3S-AT16-D 2M). Refer to *Ordering Information* to confirm model numbers for Emitter and Receivers.

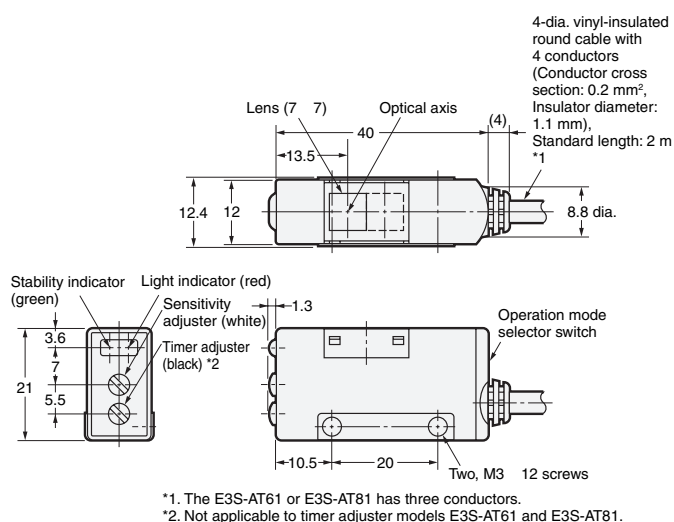
## Through-beam Sensors (Vertical)

## Pre-wired Sensors

## E3S-AT61/71/81/91 (Receiver)

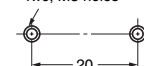


\*The Mounting Bracket can be attached to side A.

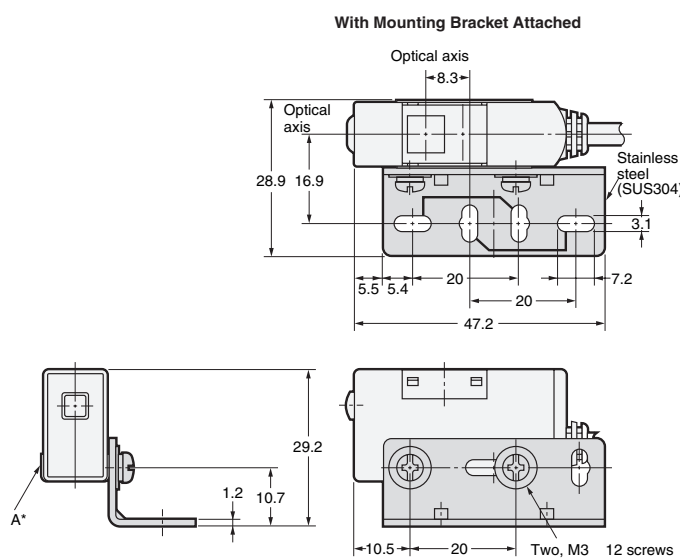


## Mounting Holes

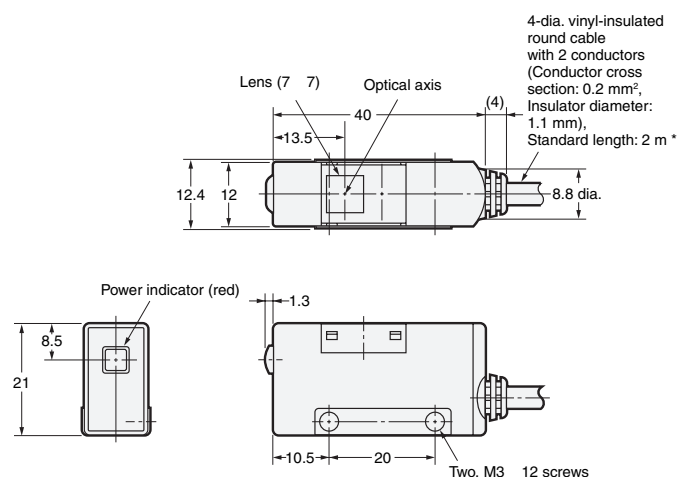
Two, M3 holes



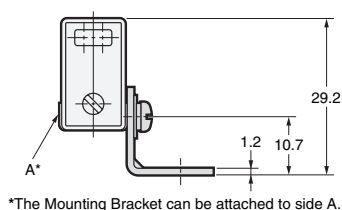
## E3S-AT61/81 (Emitter)



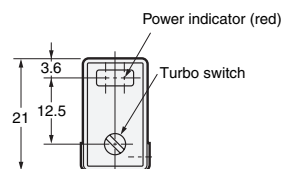
\*The Mounting Bracket can be attached to side A.



## E3S-AT71/91 (Emitter)



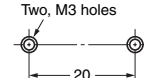
\*The Mounting Bracket can be attached to side A.



\*The E3S-AT71 of E3S-AT91 has three conductors.

## Mounting Holes

Two, M3 holes

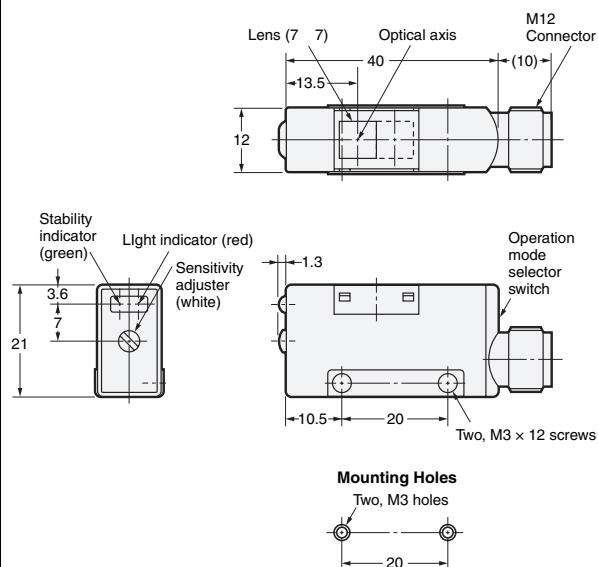
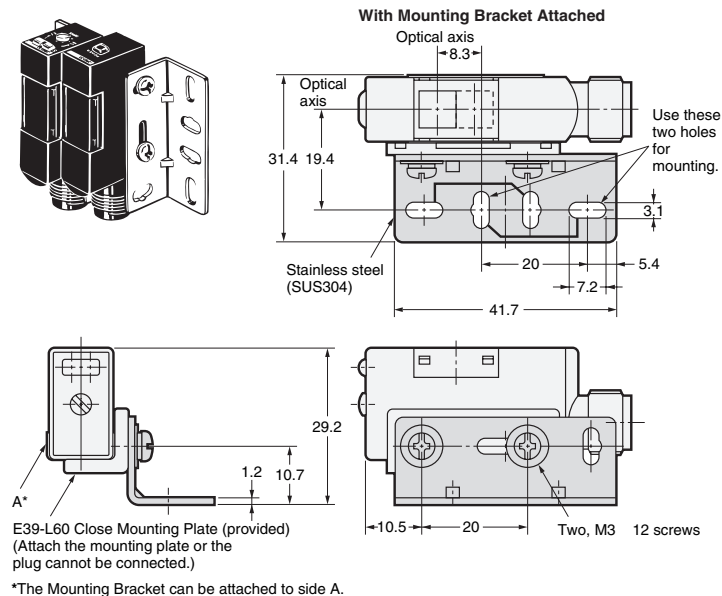


Note: Models numbers for Through-beam Sensors (E3S-AT□1) are for sets that include both the Emitter and Receiver.

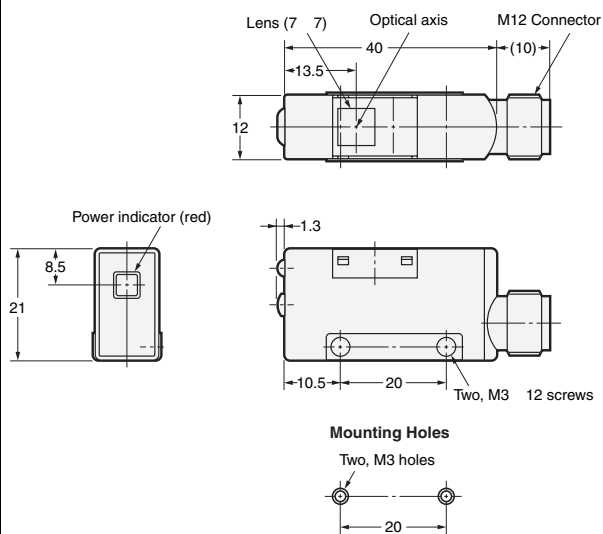
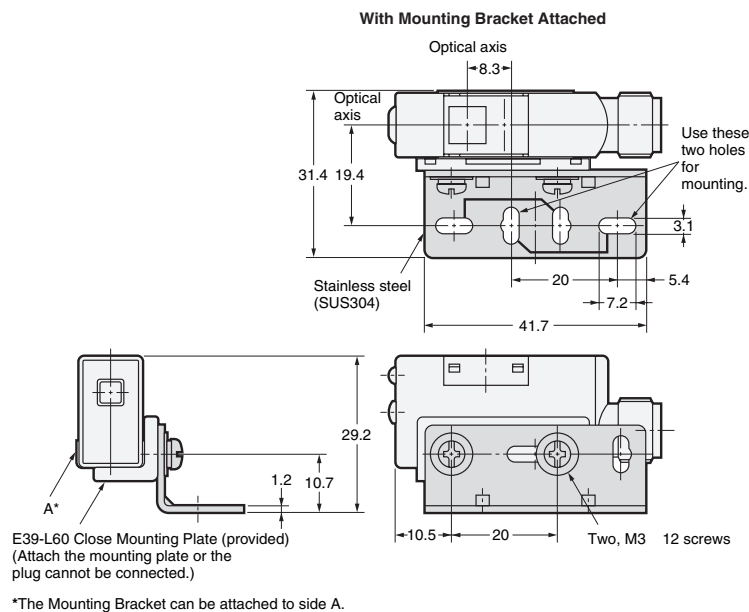
The model number of the Emitter is expressed by adding "-L" to the set model number (example: E3S-AT61-L 2M), the model number of the Receiver, by adding "-D" (example: E3S-AT61-D 2M). Refer to *Ordering Information* to confirm model numbers for Emitter and Receivers.

## Connector Sensors

## E3S-AT66/86 (Receiver)



## E3S-AT66/86 (Emitter)



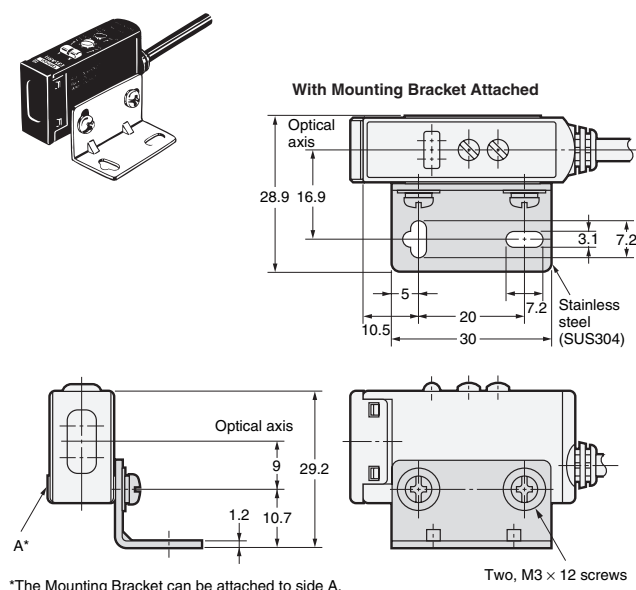
Note: Models numbers for Through-beam Sensors (E3S-AT□6) are for sets that include both the Emitter and Receiver.

The model number of the Emitter is expressed by adding "-L" to the set model number (example: E3S-AT66-L 2M), the model number of the Receiver, by adding "-D" (example: E3S-AT66-D 2M). Refer to *Ordering Information* to confirm model numbers for Emitter and Receivers.

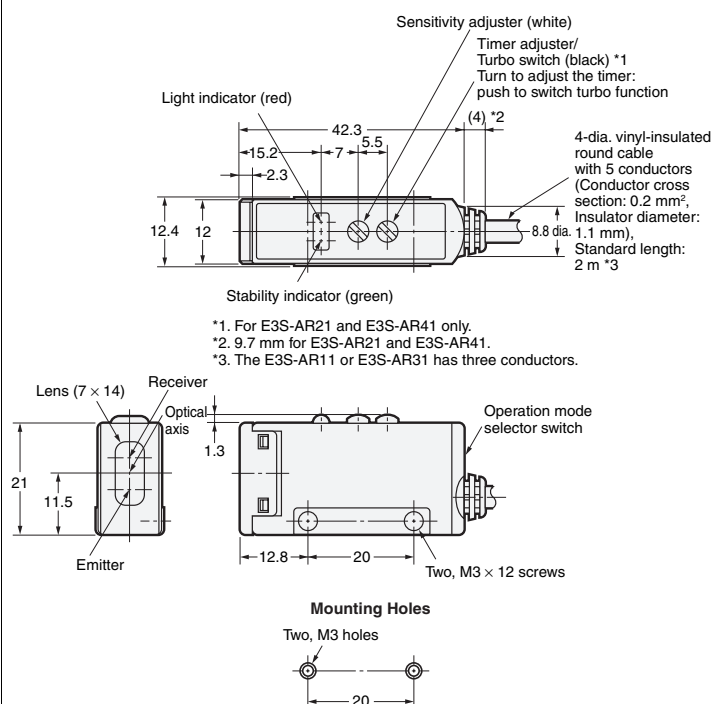
## Retro-reflective Sensors (Horizontal)

### Pre-wired Sensors

#### E3S-AR11/21/31/41

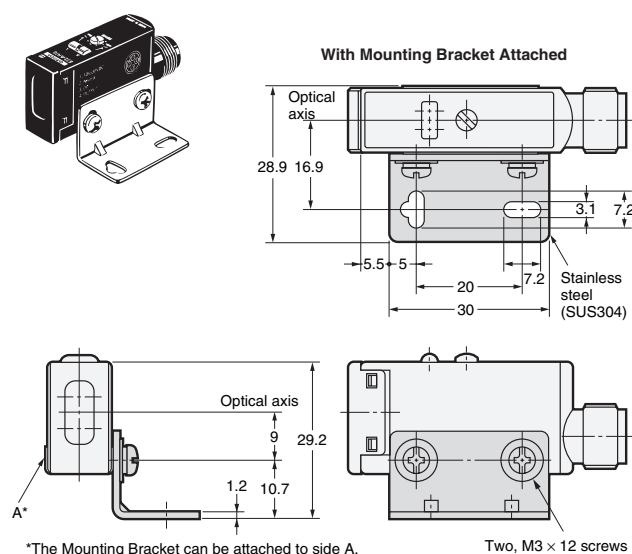


\*The Mounting Bracket can be attached to side A.

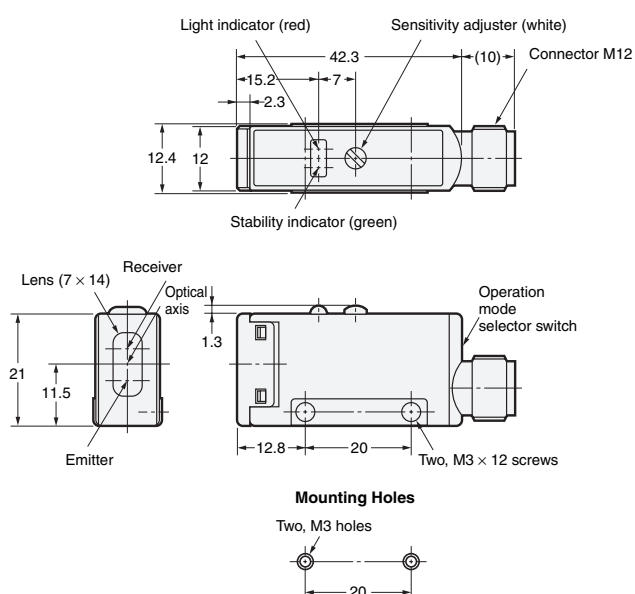


## Sensors with Connectors

#### E3S-AR16/36



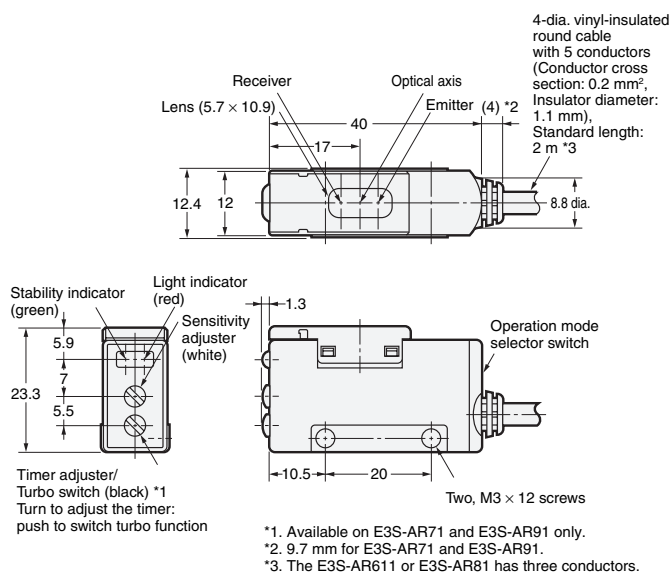
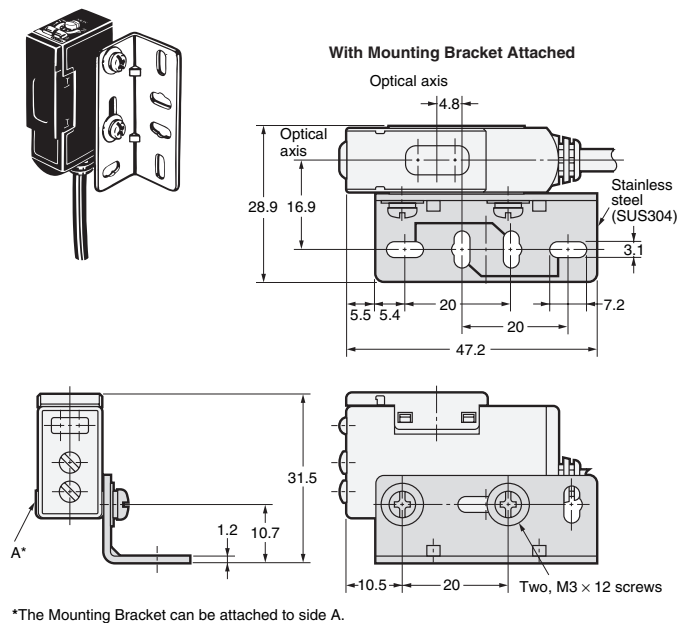
\*The Mounting Bracket can be attached to side A.



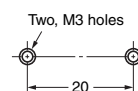
## Retro-reflective Sensors (Vertical)

### Pre-wired Sensors

#### E3S-AR61/71/81/91

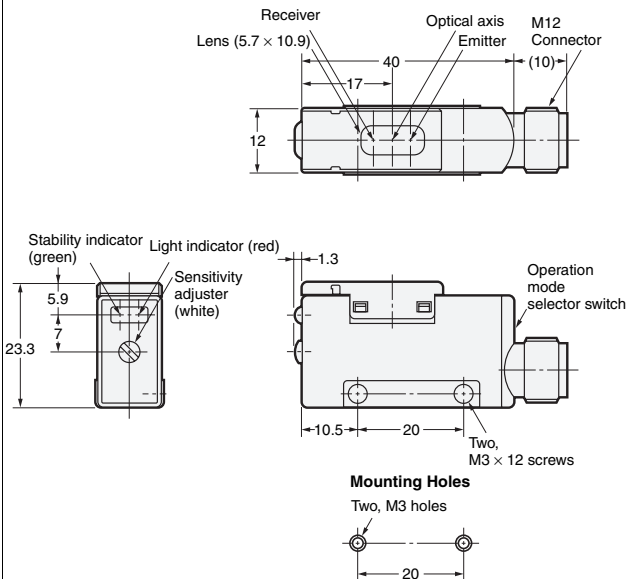
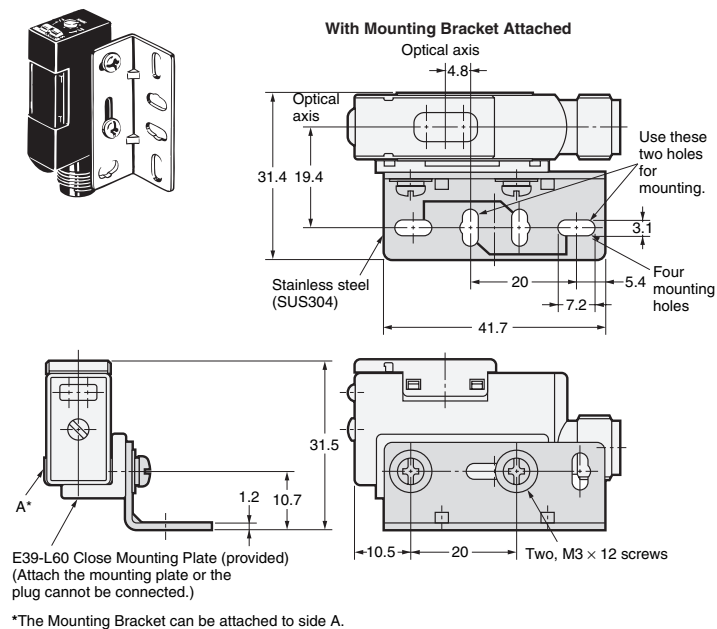


#### Mounting Holes



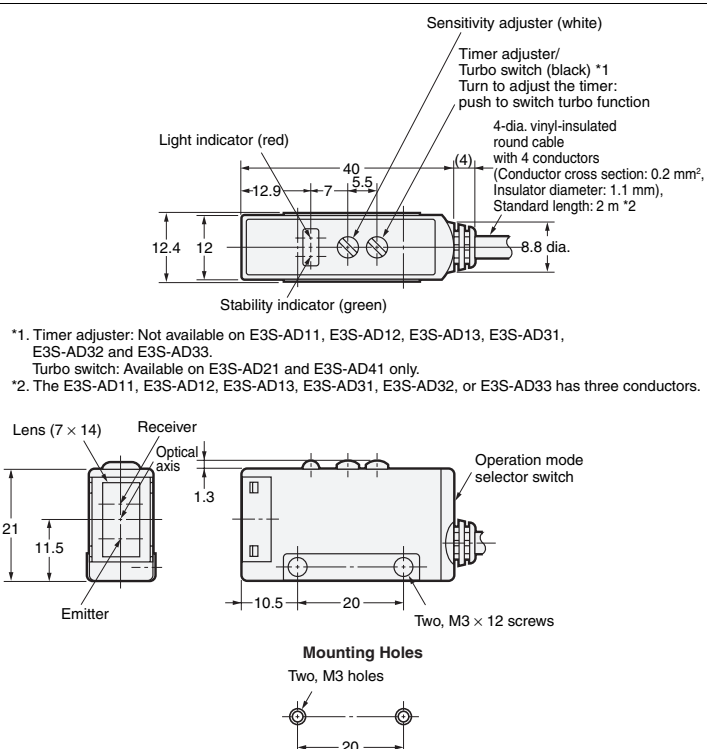
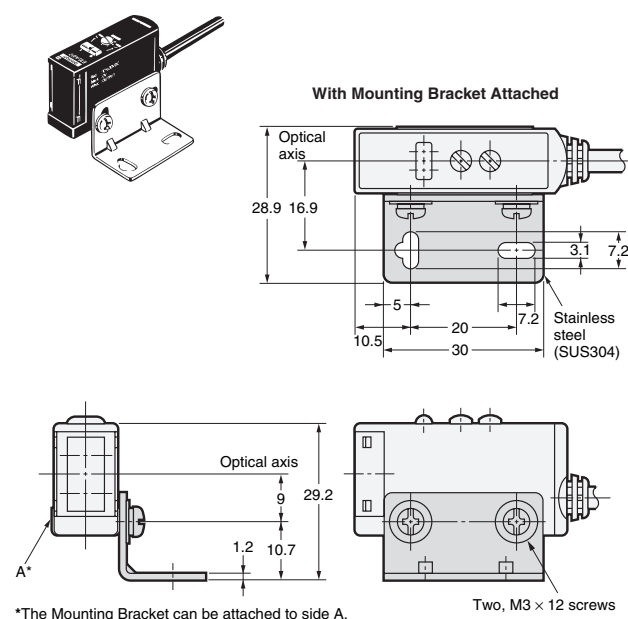
## Sensors with Connectors

#### E3S-AR66/86



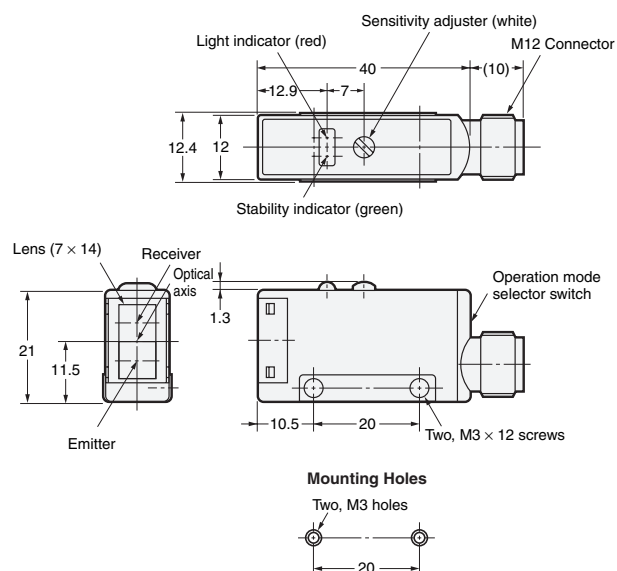
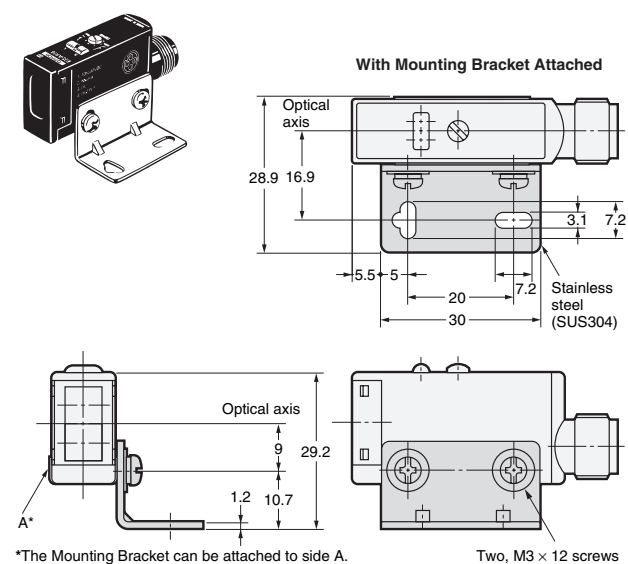
## Diffuse-reflective Sensors (Horizontal)

## Pre-wired Sensors

E3S-AD11/12/13/21/22/23  
-AD31/32/33/41/42/43

## Sensors with Connectors

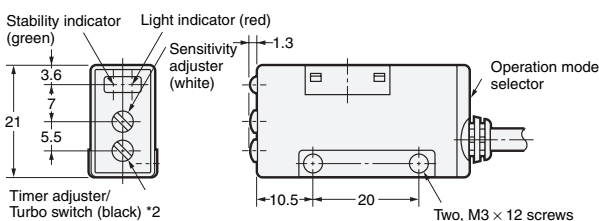
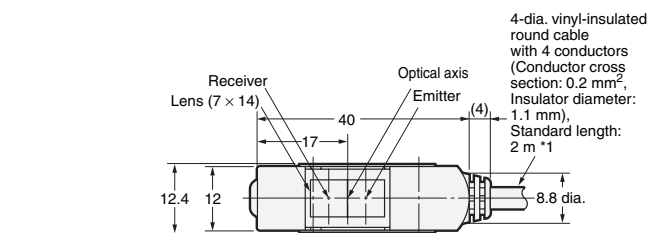
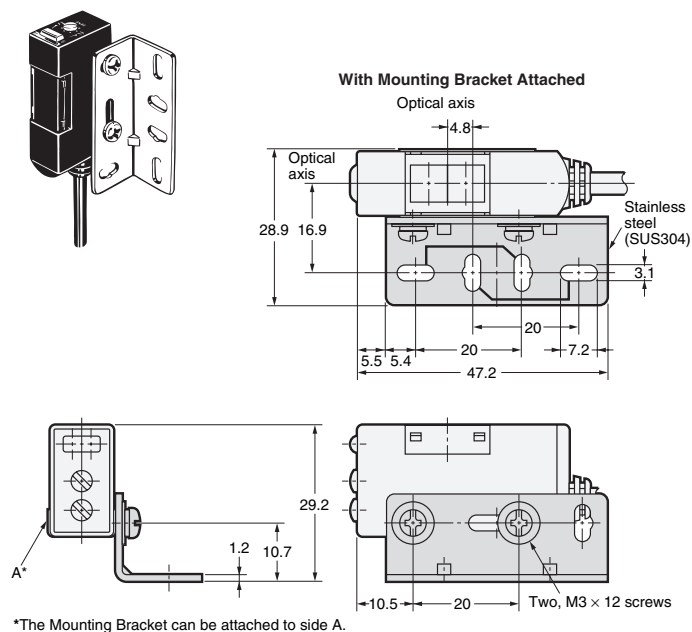
## E3S-AD16/17/18/36/37/38



### Diffuse-reflective Sensors (Vertical)

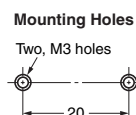
#### Pre-wired Sensors

**E3S-AD61/62/63/71/72/73  
-AD81/82/83/91/92/93**



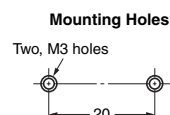
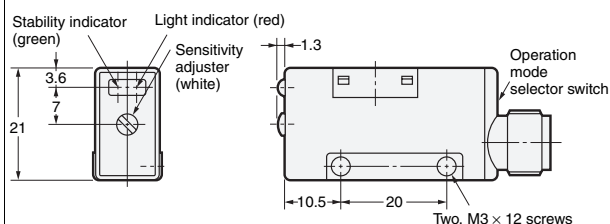
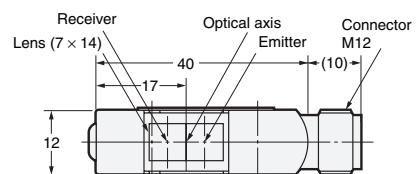
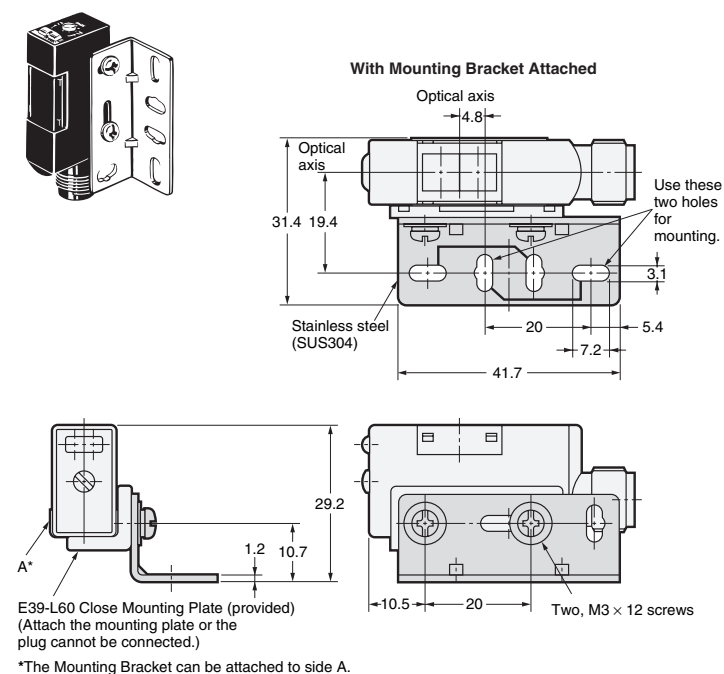
\*1. E3S-AD61, E3S-AD62, E3S-AD63, E3S-AD81, E3S-AD82, and E3S-AD83 have three conductors.

\*2. Timer adjuster: Not available on E3S-AD61, E3S-AD62, E3S-AD63, E3S-AD81, E3S-AD82 and E3S-AD83.  
Turbo switch: Available on E3S-AD71 and E3S-AD91 only.



## Sensors with Connectors

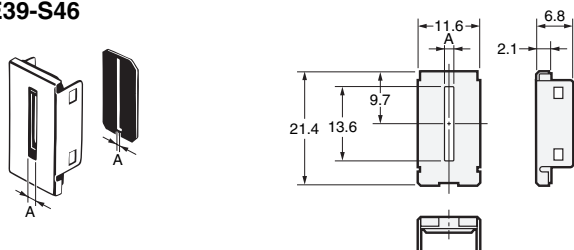
**E3S-AD66/67/68/86/87/88**



## Accessories (Order Separately)

### Insert-type Long Slit (For Through-beam Model)

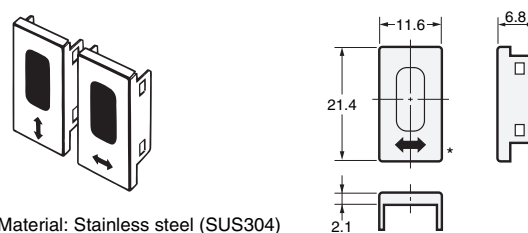
E39-S46



| Name      | Dimensions A | Material                 | Quantity                                       |
|-----------|--------------|--------------------------|------------------------------------------------|
| Supporter | 2 mm         | Stainless steel (SUS304) | One each for Emitter and Receiver (total of 2) |
| Slits     | 0.5 mm       | PVC                      | One each for Emitter and Receiver (total of 4) |
|           | 1 mm         |                          |                                                |

### Filters for Mutual Interference Prevention (For Through-beam Model)

E39-E6

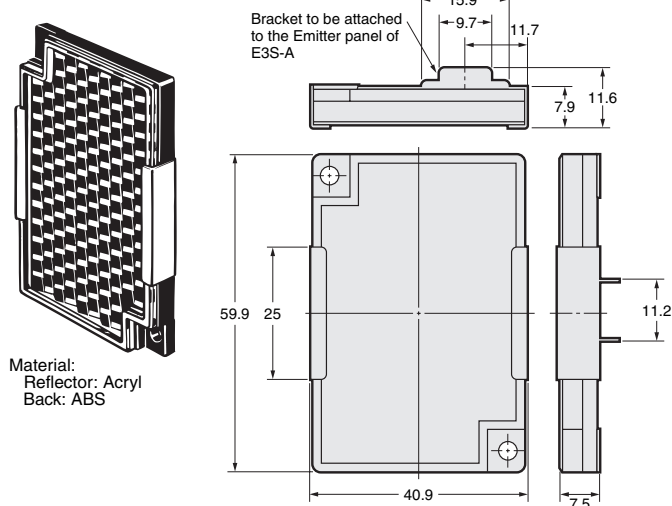


Material: Stainless steel (SUS304)

\* Two of each for the Emitter and Receiver (total of four)

### Optical Axis Confirmation Reflector (For Through-beam Model)

E39-R5



### Reflectors Mounting Brackets

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

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2010.9

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