


# E3S-A









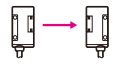



























 Be sure to read *Safety Precautions* on page 10.

## 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	Horizontal 	Pre-wired	 7 m			---	<b>E3S-AT11</b>	<b>E3S-AT31</b>			
		Connector (M12)				   	<b>E3S-AT21</b>	<b>E3S-AT41</b>			
	---	<b>E3S-AT16</b>				<b>E3S-AT36</b>					
	---	<b>E3S-AT61</b>				<b>E3S-AT81</b>					
	Vertical 	Pre-wired				 2 m (100 mm)			   	<b>E3S-AT71</b>	<b>E3S-AT91</b>
		Connector (M12)							<b>E3S-AT66</b>	<b>E3S-AT86</b>	
Retro-reflective Sensors	Horizontal 	Pre-wired	 2 m (100 mm)						   	<b>E3S-AR11</b>	<b>E3S-AR31</b>
		Connector (M12)							<b>E3S-AR21</b>	<b>E3S-AR41</b>	
	---	<b>E3S-AR16</b>							<b>E3S-AR36</b>		
	---	<b>E3S-AR61</b>							<b>E3S-AR81</b>		
	Vertical 	Pre-wired				 2 m (100 mm)			   	<b>E3S-AR71</b>	<b>E3S-AR91</b>
		Connector (M12)							<b>E3S-AR66</b>	<b>E3S-AR86</b>	

Sensing method	Appearance	Connection method	Sensing distance	Functions	Model	
					NPN output	PNP output
Diffuse-reflective Sensors	Horizontal 	Pre-wired	100 mm (wide view)	---	E3S-AD13 *2	E3S-AD33
			200 mm	Timer Self Diagnosis	E3S-AD23	E3S-AD43
			700 mm	---	E3S-AD11	E3S-AD31
			700 mm	Timer Self Diagnosis	E3S-AD21	E3S-AD41
		Connector (M12)	100 mm (wide view)	---	E3S-AD18	E3S-AD38
			200 mm	---	E3S-AD16	E3S-AD36
			700 mm	---	E3S-AD17	E3S-AD37
			700 mm	---	E3S-AD63 *2	E3S-AD83
	Vertical 	Pre-wired	100 mm (wide view)	Timer Self Diagnosis	E3S-AD73	E3S-AD93
			200 mm	---	E3S-AD61	E3S-AD81
			700 mm	Timer Self Diagnosis	E3S-AD71	E3S-AD91
			700 mm	---	E3S-AD62	E3S-AD82
		Connector (M12)	100 mm (wide view)	---	E3S-AD68	E3S-AD88
			200 mm	---	E3S-AD66	E3S-AD86
			700 mm	---	E3S-AD67	E3S-AD87
			700 mm	---	E3S-AD67	E3S-AD87

\*1. Values in brackets are the minimum required distance between the Sensor and Reflector.  
 \*2. 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.		1 of each for Emitter/Receiver (2 Slits total)	

### Mutual Interference Prevention Filters


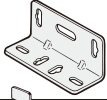
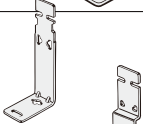




Sensing distance	Model	Quantity	Remarks
2.4 m	E39-E6	2 of each for Emitter/Receiver (4 Filters total)	Can be used with the E3S-AT□□ Through-beam Sensor. → Page 11

### Reflectors/Other Accessories

Name	Sensing distance (typical)	Model	Quantity	Remarks
Reflectors	2 m (100 mm) * (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
	<b>E39-L69</b>	1	Provided with E3S-A Horizontal Sensors.
	<b>E39-L70</b>	1	Provided with E3S-A Vertical Sensors.
	<b>E39-L59</b>	1	Provided with E3S-A Vertical Pre-wired Sensors.
	<b>E39-L81</b>	1	Provided with E3S-A Vertical Connector Sensors.
	<b>E39-L97</b>	1	Protective Cover for Horizontal Sensors Note: When mounting Sensors with Connectors, the Sensor I/O Connector will come into contact with the Bracket. Mount the Sensor with care.
	<b>E39-L98</b>	1	Protective Cover for Vertical Sensors Note: When mounting Sensors with Connectors, the Sensor I/O Connector will be longer. Mount the Sensor with care.
	<b>E39-L60</b>	1	Close Mounting Plate: 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
<b>E39-G2</b>	1	Provided with product.

**Sensors I/O Connectors**

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

## Ratings and Specifications

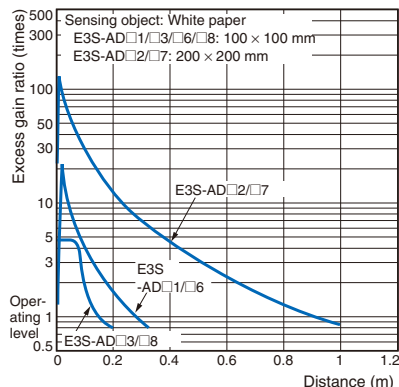
Sensing method		Through-beam Sensors	Retro-reflective Sensors (with MSR function)	Diffuse-reflective Sensors		
Item	Model	E3S-AT11, 16, 21, 31, 36, 41, 61, 66, 71, 81, 86, 91	E3S-AR11, 16, 21, 31, 36, 41, 61, 66, 71, 81, 86, 91	E3S-AD13, 18, 23, 33, 38, 43, 63, 68, 73, 83, 88, 93	E3S-AD11, 16, 21, 31, 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 (When using E39-R1)	100 mm (wide view) (white paper 100 × 100 mm)	10 to 200 mm (white paper 100 × 100 mm)	700 mm (white paper 200 × 200 mm)
Standard sensing object		Opaque: 10-mm dia. min.	Opaque: 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. (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.) 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., Load current: 50 mA max. (residual voltage: 1 V max.), Open-collector output (NPN or PNP depending on model)				
External diagnostic input (Only on Sensors with external diagnostic outputs)	Input voltage	NPN with Emitter OFF: 0 V short-circuit or 1.5 V max. (source current: 1 mA max.) with Emitter ON: Open (leakage current: 0.1 mA max.) PNP with Emitter OFF: +DC short-circuit or -1.5 VDC max. (sink current: 3 mA max.) with Emitter ON: Open (leakage current: 0.1 mA max.)		---		
	Response time	0.5 ms max.				
Protection circuits		Power supply reverse polarity protection, 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. Sunlight: 10,000 lx max.				
Ambient temperature		Operating: -25°C to 55°C (with no icing or condensation) Storage: -40°C to 70°C (with no icing or condensation)				
Ambient humidity		Operating: 35% to 85% (with no condensation) 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/s <sup>2</sup> , 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: Approx. 150 g Connector: Approx. 70 g	Pre-wired cable: Approx. 110 g Connector: Approx. 60 g	Pre-wired cable: Approx. 90 g 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

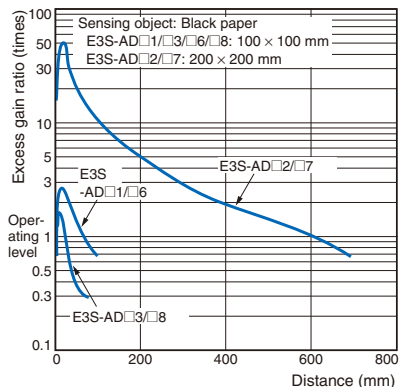
## Diffuse-reflective Sensor

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



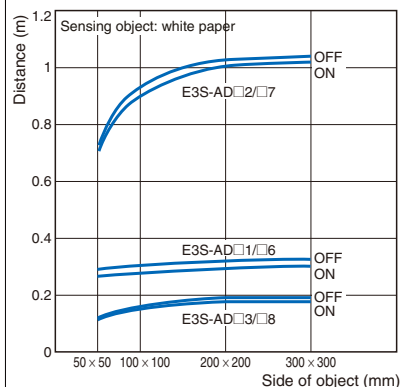
## Diffuse-reflective Sensor

### 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



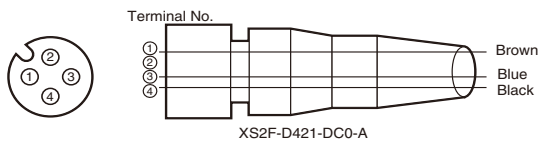
## I/O Circuit Diagrams

### NPN Output

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

Model	Operation mode	Timing charts	Mode selector switch	Output circuit
E3S-AT21 E3S-AT71  E3S-AD21 E3S-AD71 E3S-AD22 E3S-AD72 E3S-AD23 E3S-AD73	Light-ON	<p>Incident light</p> <p>No incident light</p> <p>Light indicator (red) ON OFF</p> <p>Output transistor ON 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>	L Side (LIGHT ON)	<p>Through-beam Receivers, Diffuse-reflective Sensors</p>
	Dark-ON	<p>Incident light</p> <p>No incident light</p> <p>Light indicator (red) ON OFF</p> <p>Output transistor ON 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 (DARK ON)	
	---	<p>External diagnostic input ON OFF</p> <p>(Between blue and pink)</p> <p>Emitter LED ON OFF</p> <p>Indicator (red) ON OFF</p>	---	
E3S-AR21 E3S-AR71	Light-ON	<p>Incident light</p> <p>No incident light</p> <p>Light indicator (red) ON OFF</p> <p>Output transistor ON 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>	L Side (LIGHT ON)	<p>Retro-reflective Sensors</p>
	Dark-ON	<p>Incident light</p> <p>No incident light</p> <p>Light indicator (red) ON OFF</p> <p>Output transistor ON 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 (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 No. 2 is not used.

## PNP Output

Model	Operation mode	Timing charts	Mode selector switch	Output circuit
E3S-AT31 E3S-AT36 E3S-AT81 E3S-AT86	Light-ON		L Side (LIGHT ON)	<p>Through-beam Receivers, Retro-reflective Sensors, Diffuse-reflective Sensors</p> <p><b>Connector Pin Arrangement</b></p> <p>Note: Pin 2 is not used.</p>
E3S-AR31 E3S-AR36 E3S-AR81 E3S-AR86		Dark-ON		
E3S-AD31 E3S-AD36 E3S-AD81 E3S-AD86 E3S-AD32 E3S-AD37 E3S-AD82 E3S-AD87 E3S-AD33 E3S-AD38 E3S-AD83 E3S-AD88	Light ON		<p>T: OFF-delay timer (0 to 100 ms)</p>	L Side (LIGHT ON)
E3S-AT41 E3S-AT91		Dark ON	<p>T: OFF-delay timer (0 to 100 ms)</p>	
E3S-AD41 E3S-AD91 E3S-AD42 E3S-AD92 E3S-AD43 E3S-AD93	---			---

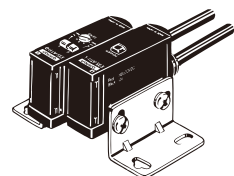
## Dimensions

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

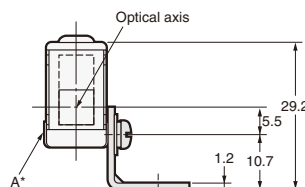
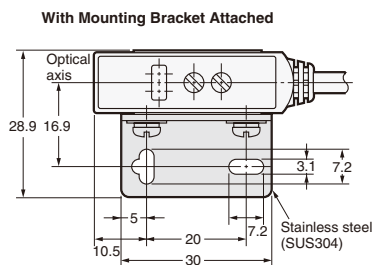
#### Through-beam Sensors (Horizontal)

#### Pre-wired Sensors

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

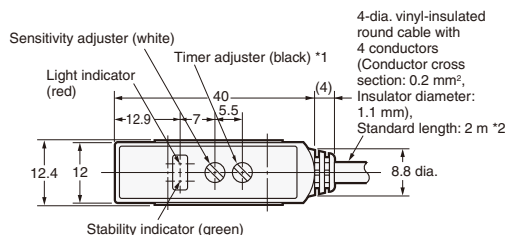


Emitter: E3S-AT□□-L  
Receiver: E3S-AT□□-D

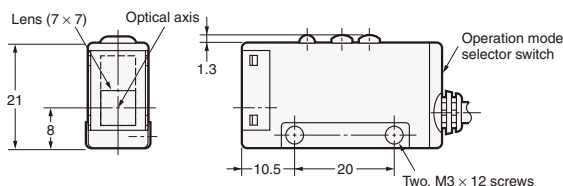


\*The Mounting Bracket can be attached to side A.

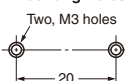
Two, M3 × 12 screws



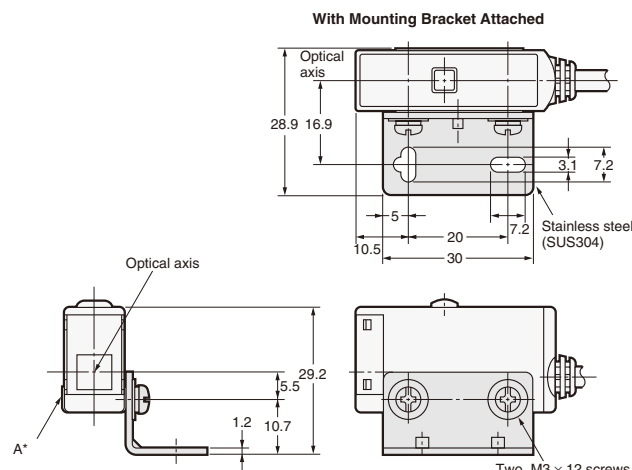
\*1. Not applicable to Sensors with timer adjusters (E3S-AT11 and E3S-AT31).  
\*2. The E3S-AT11 or E3S-AT31 has three conductors.



#### Mounting Holes

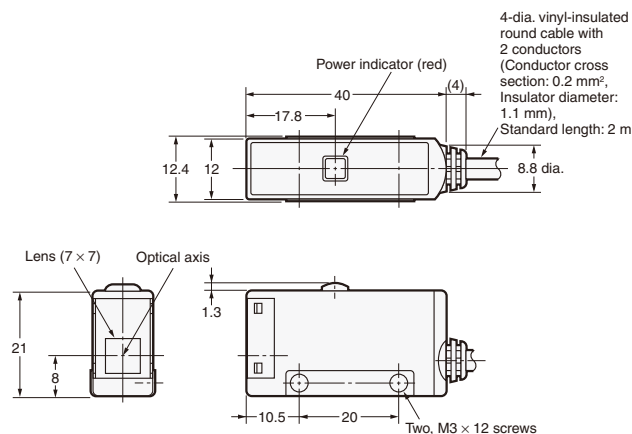


#### E3S-AT11/31 (Emitter)

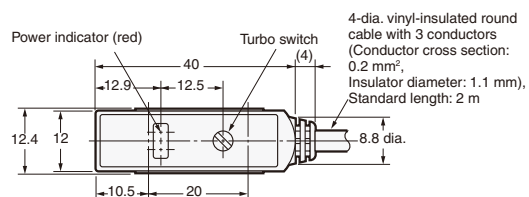
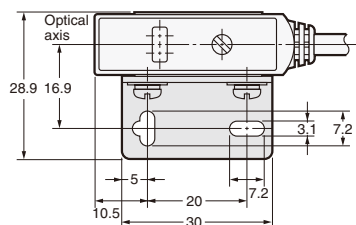


\*The Mounting Bracket can be attached to side A.

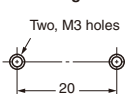
Two, M3 × 12 screws



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



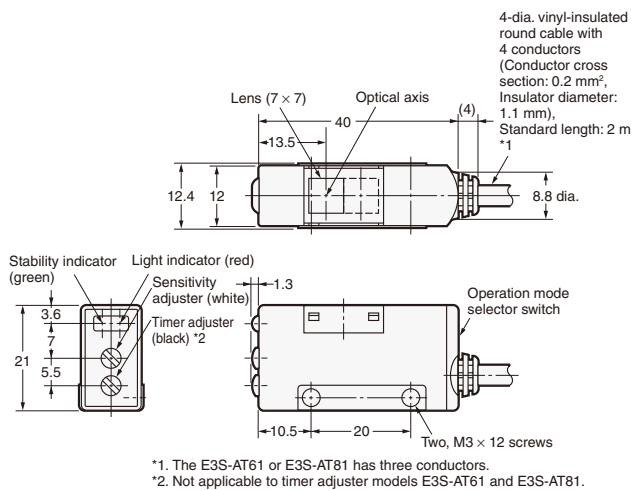
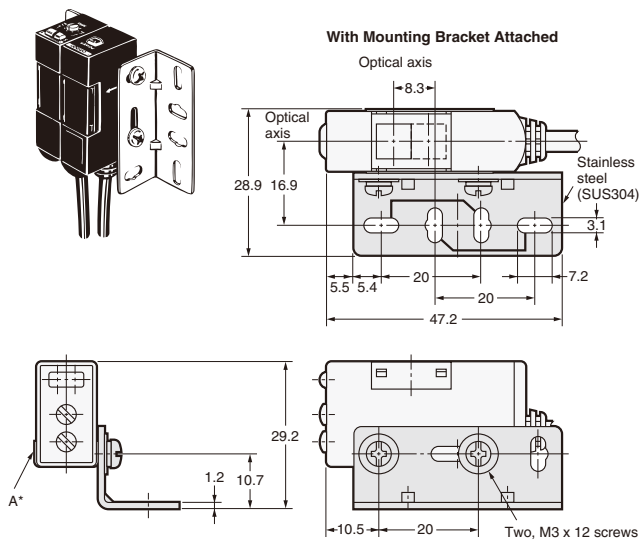
#### Mounting Holes



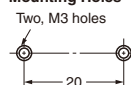


## Through-beam Sensors (Vertical) Pre-wired Sensors

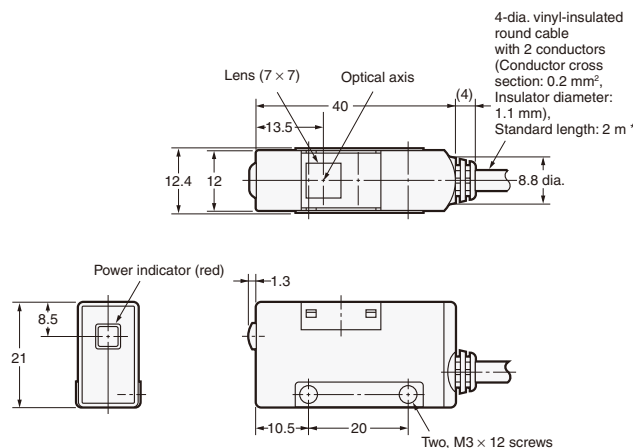
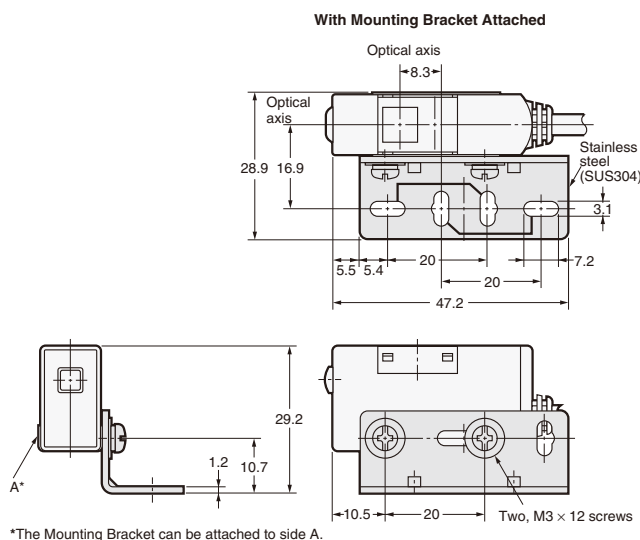
### E3S-AT61/71/81/91 (Receiver)



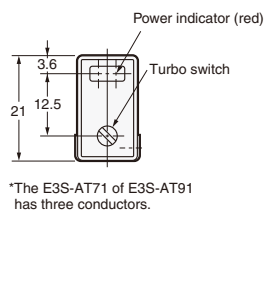
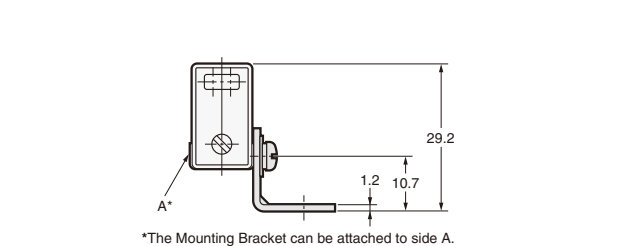
#### Mounting Holes



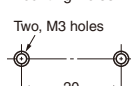
### E3S-AT61/81 (Emitter)



### E3S-AT71/91 (Emitter)



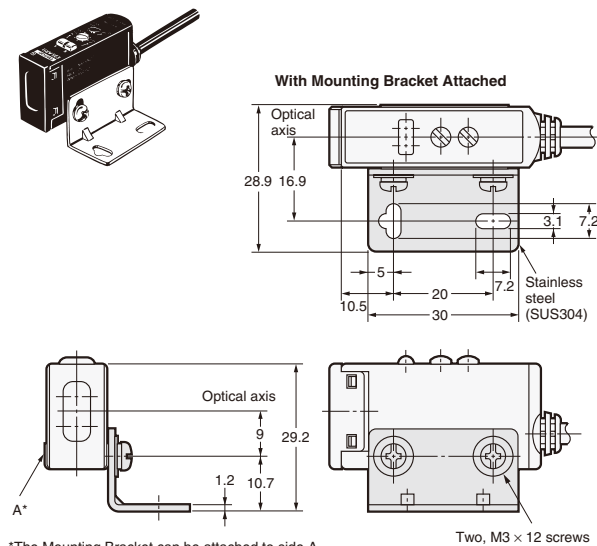
#### Mounting Holes



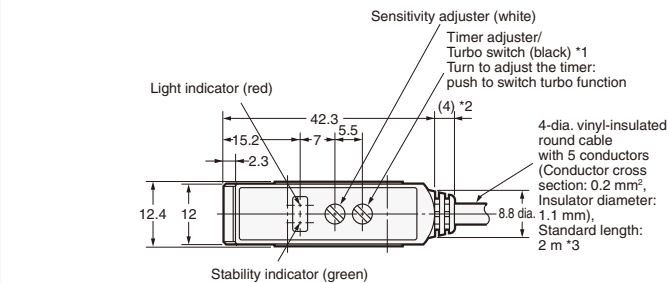
## Retro-reflective Sensors (Horizontal)

### Pre-wired Sensors

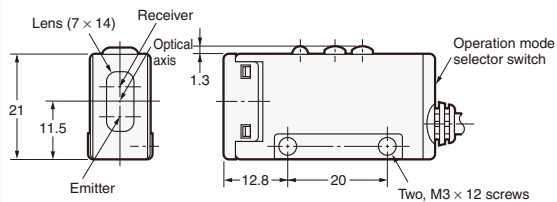
#### E3S-AR11/21/31/41



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



\*1. For E3S-AR21 and E3S-AR41 only.  
\*2. 9.7 mm for E3S-AR21 and E3S-AR41.  
\*3. The E3S-AR11 or E3S-AR31 has three conductors.

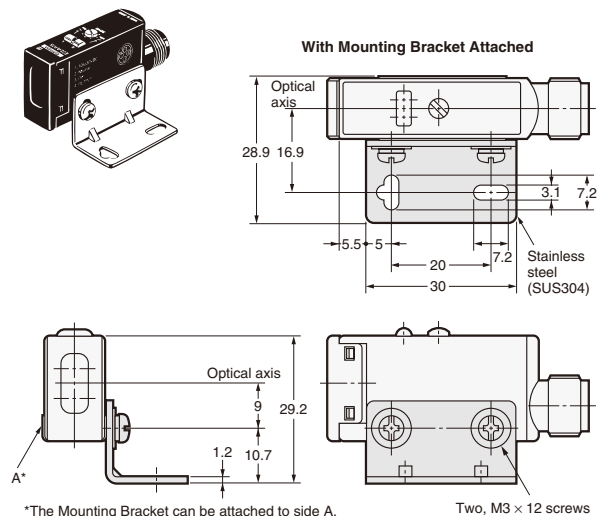


#### Mounting Holes

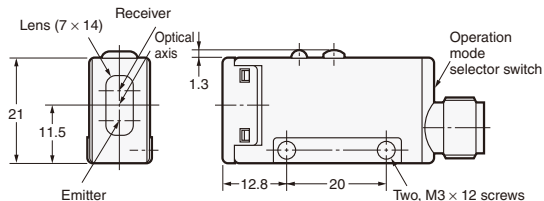
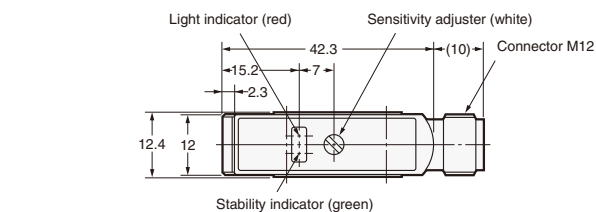


## Sensors with Connectors

#### E3S-AR16/36



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



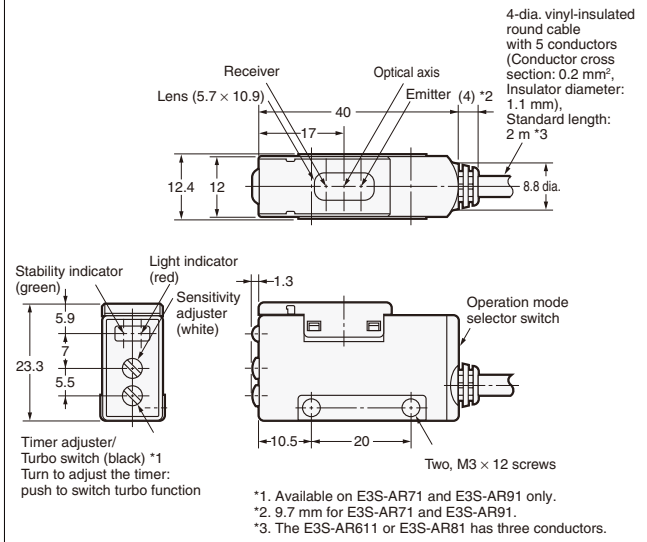
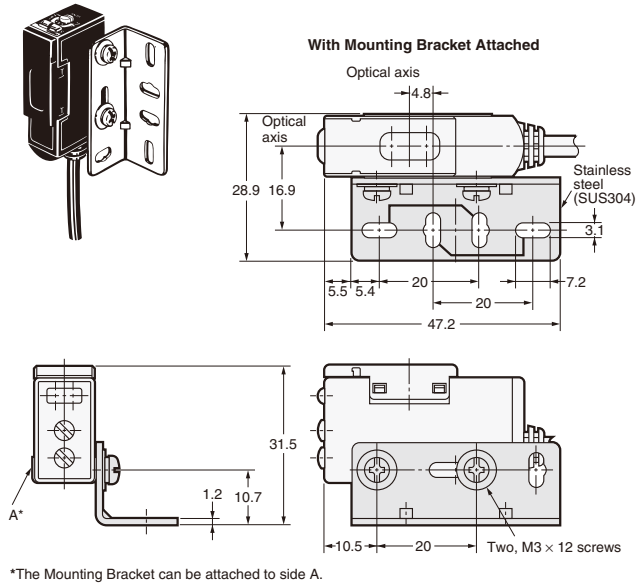
#### Mounting Holes



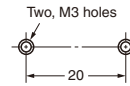
Retro-reflective Sensors (Vertical)

Pre-wired Sensors

E3S-AR61/71/81/91

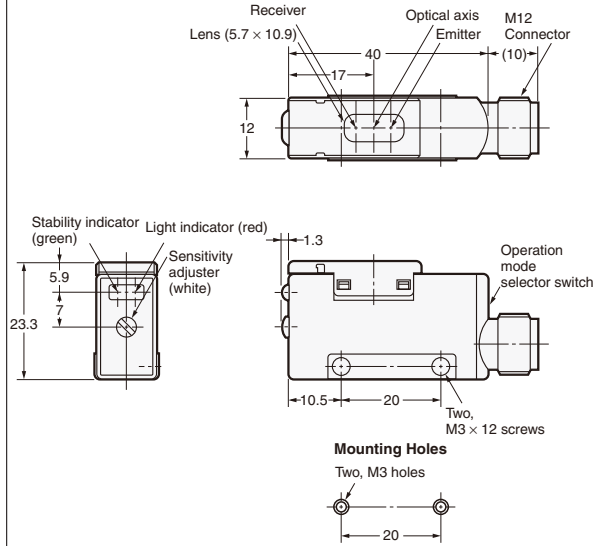
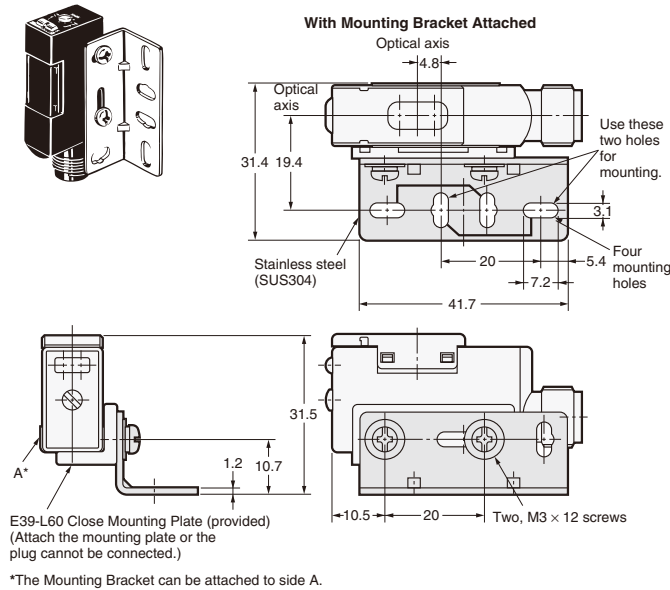


Mounting Holes

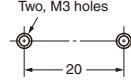


Sensors with Connectors

E3S-AR66/86



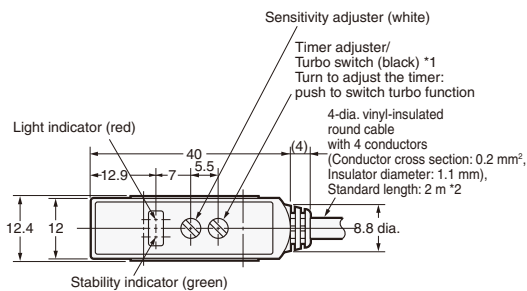
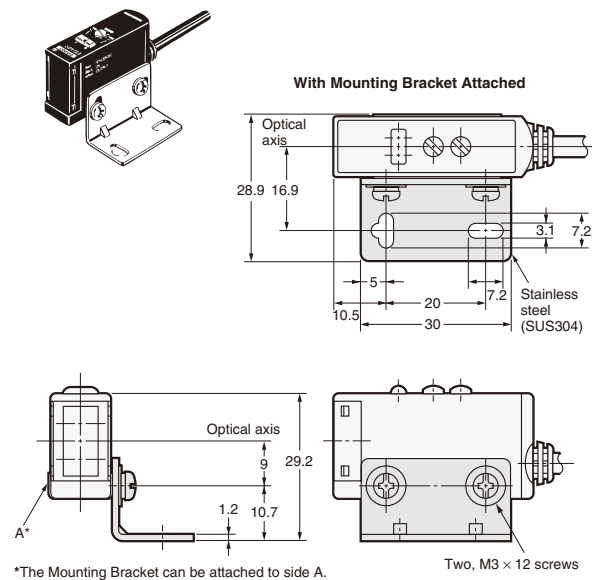
Mounting Holes



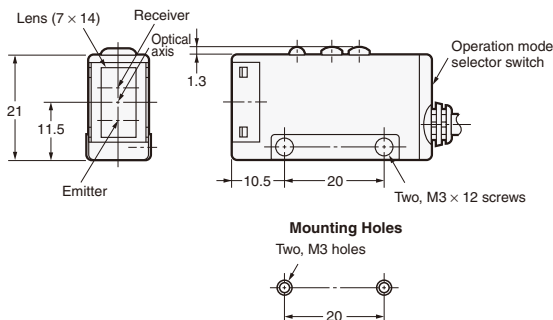
## Diffuse-reflective Sensors (Horizontal)

### Pre-wired Sensors

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

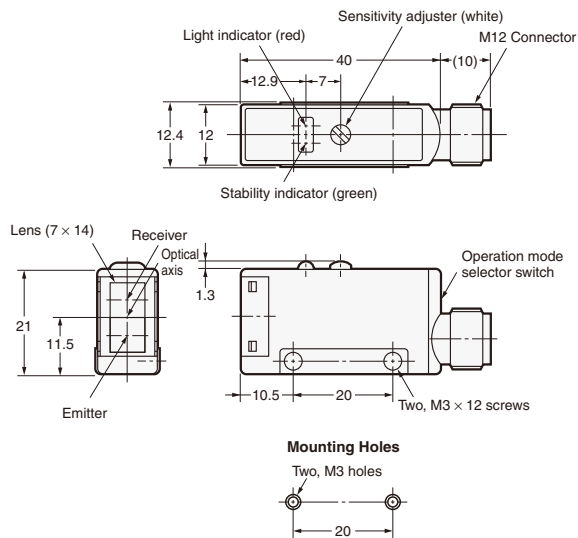
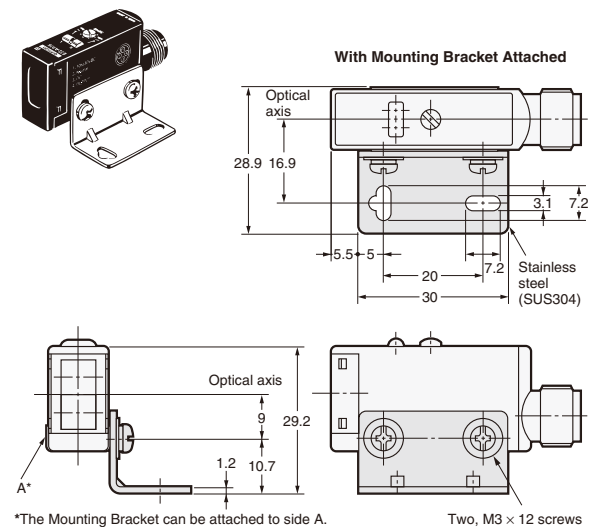


\*1. Timer adjuster: Not available on E3S-AD11, E3S-AD12, E3S-AD13, E3S-AD31, E3S-AD32 and E3S-AD33.  
Turbo switch: Available on E3S-AD21 and E3S-AD41 only.  
\*2. The E3S-AD11, E3S-AD12, E3S-AD13, E3S-AD31, E3S-AD32, or E3S-AD33 has three conductors.



## Sensors with Connectors

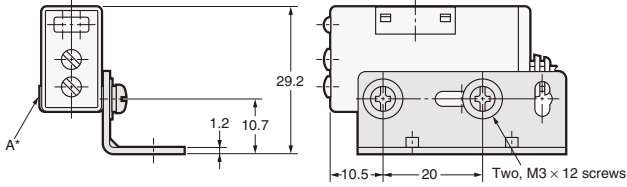
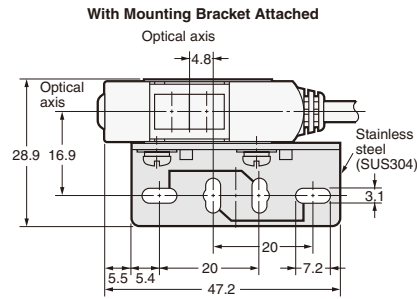
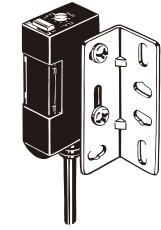
**E3S-AD16/17/18/36/37/38**



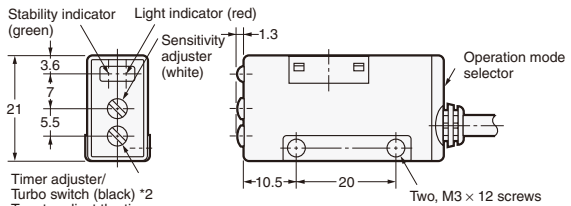
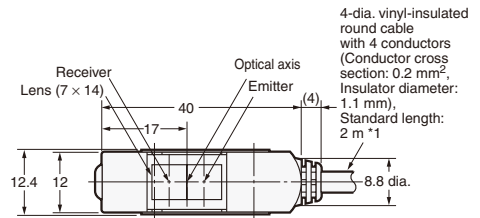
Diffuse-reflective Sensors (Vertical)

Pre-wired Sensors

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



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



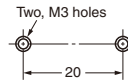
Timer adjuster/  
Turbo switch (black) \*2  
Turn to adjust the timer:  
push to switch turbo function

\*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.

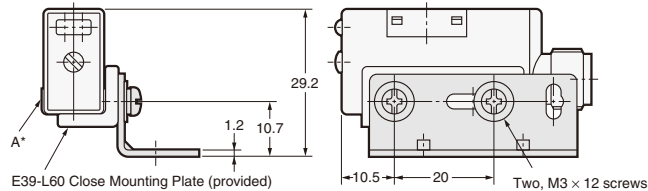
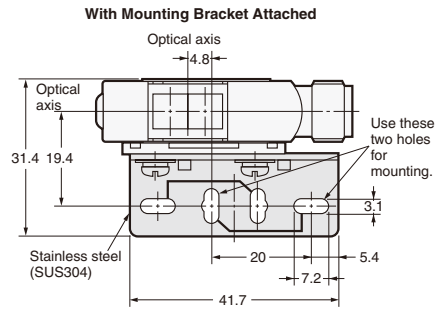
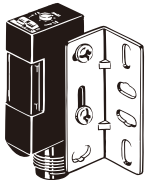
Turbo switch: Available on E3S-AD71 and E3S-AD91 only.

**Mounting Holes**



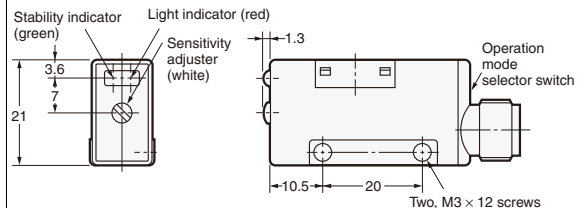
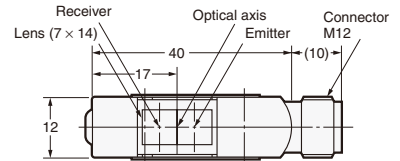
Sensors with Connectors

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



E39-L60 Close Mounting Plate (provided)  
(Attach the mounting plate or the plug cannot be connected.)

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



**Mounting Holes**

