

### Omron's Next Generation of Miniature Photoelectric Sensors

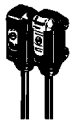




- Utilizes Omron's "Hyper LED" technology to achieve the industry's smallest visible red beam
- Self-contained sensor ideal for compact applications
- "Pin-point" beam for detecting extremely small objects
- Offered in both flat and rectangular body styles
- Retroreflective model employs Omron's Free-Angle Optics technology (FAO) to detect objects as small as 2 mm dia
- Convergent-beam model spot diameter is 0.15 mm
- Through-beam model is capable of sensing distances of 1 meter with a 2 mm target dia
- CE conformance



Note: See definition of special terms, page 3.

## Ordering Information

### ■ PHOTOELECTRIC SENSORS

Sensor type			Sensing method					
			Through-beam		Retroreflective	Diffuse reflective	Convergent-beam	
Appearance			Side-view 	Flat 	Side-view 	Flat 	Side-view 	
Sensing distance			1 m	500 mm	10 to 200 mm	5 to 30 mm	5 to 15 mm	5 to 30 mm
Part number	Light-ON	NPN	E3T-ST11	E3T-FT11	E3T-SR11	E3T-FD11	E3T-SL11	E3T-SL21
		PNP	E3T-ST13	E3T-FT13	E3T-SR13	E3T-FD13	E3T-SL13	E3T-SL23
	Dark-ON	NPN	E3T-ST12	E3T-FT12	E3T-SR12	E3T-FD12	E3T-SL12	E3T-SL22
		PNP	E3T-ST14	E3T-FT14	E3T-SR14	E3T-FD14	E3T-SL14	E3T-SL24

Note: All through-beam models are packaged and sold as pairs (one transmitter and one receiver).

## ■ ACCESSORIES (ORDER SEPARATELY)

### Slits (Apertures)

Slits for Sensor models	Slit width	Sensing distance	Minimum sensing object (typical)	Comments	Part number
E3T-ST1□	0.5 dia.	50 mm	0.5 mm wide	One each for Emitter and Receiver	E39-S63
	1 dia.	100 mm	1 mm wide		

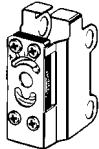
Slits for Sensor models	Slit width	Sensing distance	Minimum sensing object (typical)	Comments	Part number
E3T-FT1□	0.5 dia.	50 mm	0.5 mm wide	One each for Emitter and Receiver	E39-S64
	1 dia.	100 mm	1 mm wide		E39-R37

### Reflectors

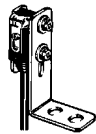


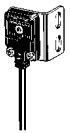
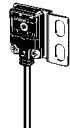
Item	Sensing distance	Minimum sensing object (typical)	Part number
Compact retroreflective model	10 to 200 mm	2 mm wide	E39-R4 (See Note.)
	10 to 100 mm		E39-R37

Note: E39-R4 reflector included with the E3T-SR1□ (can also be ordered separately).

### Adjustable Aperture

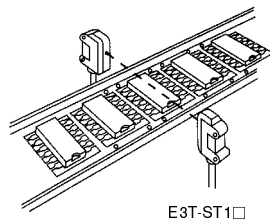
For Sensor models	Appearance	Part number
E3T-ST1□		E39-E10

### Mounting Brackets

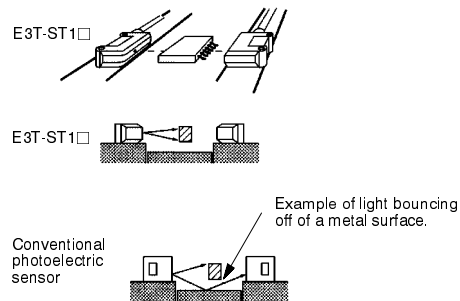
For Sensor models	Appearance	Comments	Part number
E3T-S□		Two mounting brackets are required for through-beam models.	E39-L116
			E39-L117
			E39-L118
E3T-F□		E39-L119	
		E39-L120	

## Application Examples

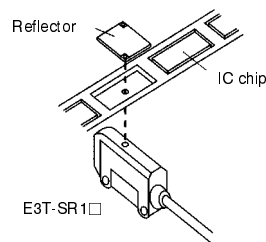
### ■ DETECTION OF LEAD FRAME RISE (PRESSURE MACHINES)



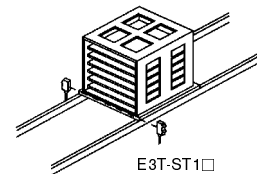
### ■ CHECKING OF IC SET (HANDLER)



### ■ DETECTION OF IC CHIPS ON TAPE (TAPING MACHINES)



### ■ DETECTION OF CASSETTE OR MAGAZINE ON THE CONVEYOR



## Terms

- Aperture (slits)**  
 Photo accessory that is placed in front of the lens, partially obscuring (blocking) the sensing beam. The aperture (opening in the aperture plate) is smaller than the sensor lens, partially blocking the beam. The sensing range is reduced, but the ability to detect small objects is enhanced. A small object will obscure more of the sensing beam (which is now smaller with the aperture in place). Typical applications include detection of a broken thread, filament, or wire which would pass through the smaller optical path created by the aperture.
- Convergent Beam**  
 A type of diffuse reflective photoelectric sensor that focuses the emitter and receiver at a focal point in front of the sensor. The focal point may be either fixed or adjustable. Objects appearing in the areas before and beyond the focal point will typically be ignored.
- Dark-ON Operation**  
 A control output mode that will result in the output turning on when light from the emitter is not received by the receiver.
- Diffuse Reflective**  
 Detection method with emitter (light source) and receiver in a common housing. Light from the emitter is aimed at the target and reflected by the target back to the receiver.
- Free Angle Optics**  
 Free Angle Optics (FAO), as used in a single-LED photoelectric sensor (e.g., the E3T Retroreflective Series), is an optical arrangement where the emitter and receiver use the same lens (thus the same optical axis). A special advanced multi-layer polarized filter separates the outgoing beam and the returning beam.
- Hyper LED Technology**  
 Special high efficiency (ratio of light output to current consumption) LED and precision optics that allow high power light emission using a smaller beam diameter.
- Light-ON Operation**  
 A control output mode that will result in the output switching device turning on when light from the emitter is incident upon the receiver.
- NPN**  
 Refers to a junction transistor having an n-type semiconductor as its emitter and collector and a p-type semiconductor as its base. Commonly referred to as a sinking-type device.
- PNP**  
 Refers to a junction transistor having a p-type semiconductor as its emitter and collector and a n-type semiconductor as its base. Commonly referred to as a sourcing-type device.

- **Retroreflective**  
Detection method with emitter (light source) and receiver in a common housing. Light from the emitter is aimed at a retroreflective target and reflected back to the receiver. The object being detected passes between the emitter/receiver housing and the retroreflective target (reflector).
- **Sensing Distance (Detecting Distance)**  
For retro, polar and through-beam units, the maximum distance between the unit and reflector, or emitter and receiver, for stable operation. For diffuse and convergent beam units, the distance at which the unit will reliably detect the standard target.

## Specifications

### ■ RATINGS/CHARACTERISTICS FOR E3T

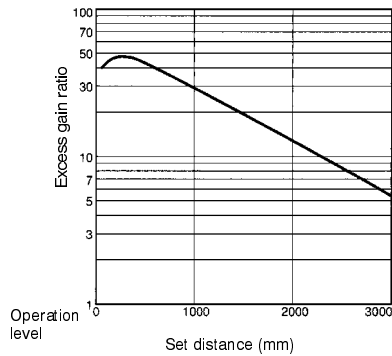
Item	Through-beam				Retroreflective		Convergent beam				Diffuse reflective	
	Side-view		Flat		Side-view						Flat	
	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
Light-ON	-ST11	-ST13	-FT11	-FT13	-SR11	-SR13	-SL11	-SL13	-SL21	-SL23	-FD11	-FD13
Dark-ON	-ST12	-ST14	-FT12	-FT14	-SR12	-SR14	-SL12	-SL14	-SL22	-SL24	-FD12	-FD14
Sensing distance	1 m (adjustable aperture is available)		500 mm		10 to 200 mm (with the E39-R4)		5 to 15 mm (50 x 50 mm Kodak white card)		5 to 30 mm (50 x 50 mm Kodak white card)		5 to 30 mm (50 x 50 mm Kodak white card)	
Standard sensing target	2 mm dia. min.				10 mm dia. min.		---					
Min. sensing target (typical)	2 mm dia. min.				2 mm dia. (sensing distance at 100 mm)		0.15 mm dia. (sensing distance at 10 mm)					
Differential travel	---						2 mm max.		6 mm max.		6 mm max.	
Optical angle	Emitter	3° to 10°		3° to 13°		2° to 5°		---				
	Receiver	3° to 70°		3° to 70°		---						
Light source (wave length)	Red LED ("Pin-point" LED) ( $\lambda=670$ nm)											
Power supply voltage	12 to 24 VDC $\pm 10\%$ , ripple (p-p) 10% max.											24 VDC $\pm 10\%$
Current consumption	12 mA max. emitter/receiver				20 mA max.							
Output	Open collector, load current: 50 mA max. at 24 VDC, residual voltage: 1 V max., operation mode: Light ON or Dark ON (separate models)											
Circuit protection (See Precautions Section.)	Protection from reversed and output short-circuit				Protection from reversed polarity, output short-circuit, and mutual interference							
Response time	1 ms max. each for on and off											
Ambient light immunity	Incandescent lamp	5,000 lux										
	Sunlight	10,000 lux										
Ambient temperature	Operating	-25°C to 55°C (-13°F to 131°F)										
	Storage	-40°C to 70°C (-40°F to 158°F) with no icing or condensation										
Ambient humidity	Operating	35% to 85% R.H.										
	Storage	35% to 95% R.H. (with no condensation)										
Insulation resistance	20 M $\Omega$ min. (at 500 VDC)											
Dielectric strength	1,000 VAC, 50/60 Hz for 1 min											
Vibration resistance	10 to 2,000 Hz, 1.5-mm double amplitude or 300 m/s <sup>2</sup> (approx. 30G) for 0.5 hrs each in X, Y, and Z directions											
Shock resistance	1,000 m/s <sup>2</sup> (approx. 100G) 3 times each in X, Y, and Z directions											
Enclosure rating	IEC60529: IP67											
Connection method	Prewired (standard length: 2 m)											
Weight (with packaging)	Approx. 40 g				Approx. 20 g							

Item	Through-beam				Retroreflective		Convergent beam				Diffuse reflective	
	Side-view		Flat		Side-view						Flat	
	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
Light-ON	-ST11	-ST13	-FT11	-FT13	-SR11	-SR13	-SL11	-SL13	-SL21	-SL23	-FD11	-FD13
Dark-ON	-ST12	-ST14	-FT12	-FT14	-SR12	-SR14	-SL12	-SL14	-SL22	-SL24	-FD12	-FD14
Materials	Case	PBT										
	Lens and cover	Polycarbonate										
Accessories included	Two each of M2 mounting screws, spring washers, and flat washers, and reflector (E39-R4: retroreflective model only)											

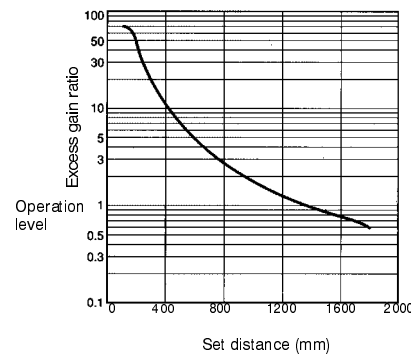
## Engineering Data

### EXCESS GAIN VS. SET DISTANCE (TYPICAL)

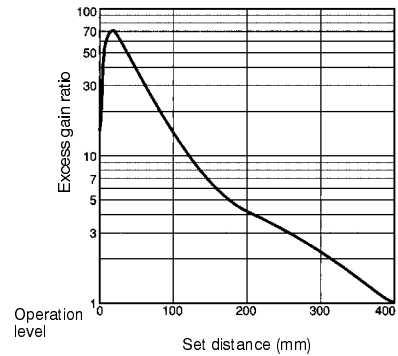
E3T-ST1□ (Through-beam)



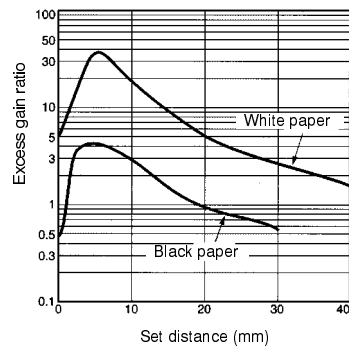
E3T-FT1□ (Through-beam)



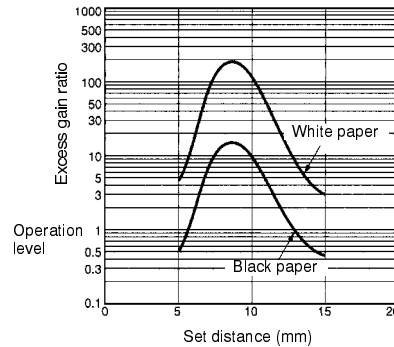
E3T-SR1□ with E39-R4 (Retroreflective)



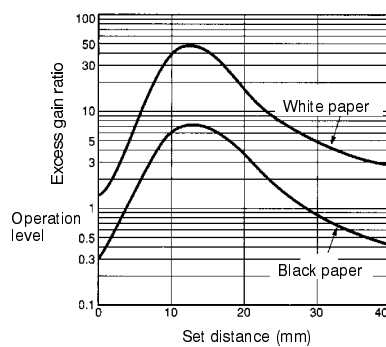
E3T-FD1□ (Diffuse Reflective)



E3T-SL1□ (Convergent Beam)

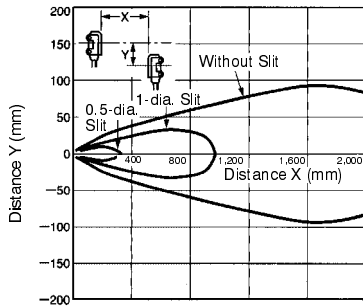


E3T-SL2□ (Convergent Beam)

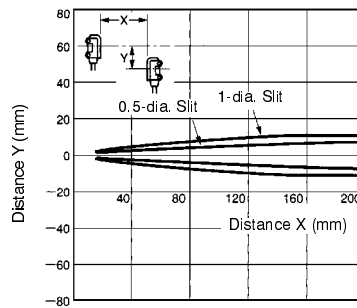


**PARALLEL OPERATING RANGE (TYPICAL)**

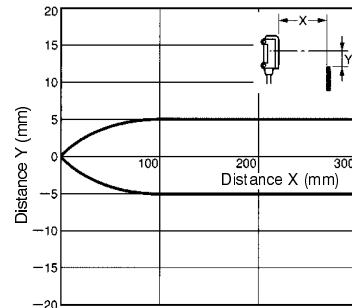
**E3T-ST1 □ with Slit (Aperture)**  
(Through-beam)



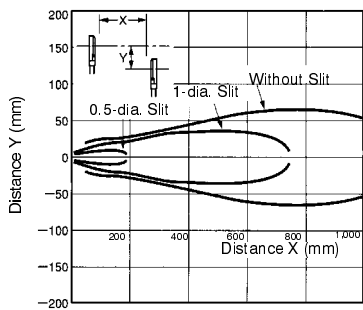
**E3T-ST1 □ with Slit (Enlarged graph)**  
(Through-beam)



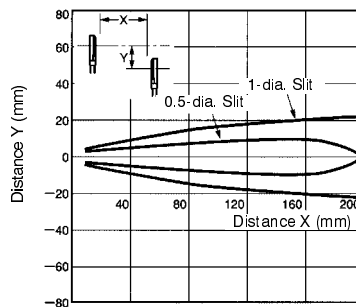
**E3T-SR1 □ with E39-R4**  
(Retroreflective)



**E3T-FT1 □ with Slit (Through-beam)**

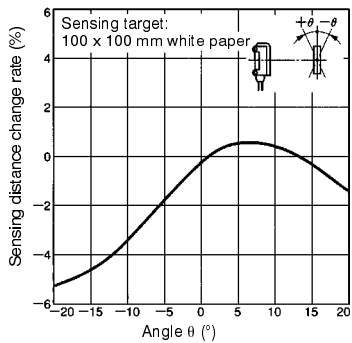


**E3T-FT1 □ with Slit (Enlarged graph)**  
(Through-beam)

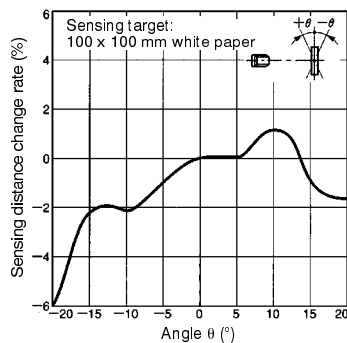


**ANGLE CHARACTERISTICS (TYPICAL)**

**E3T-SL1 □**  
(Up and Down)

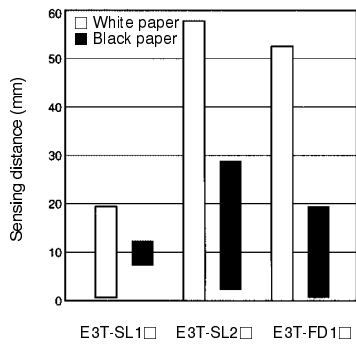


**E3T-SL1 □**  
(Left and Right)



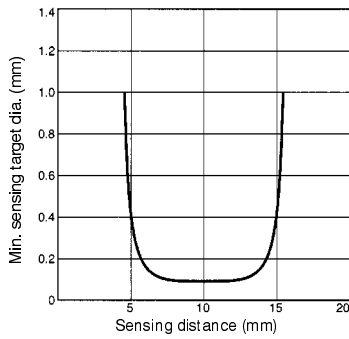
**■ CLOSE-DISTANCE SENSING CAPABILITY (TYPICAL)**

E3T-SL1□, E3T-SL2□, E3T-FD1□

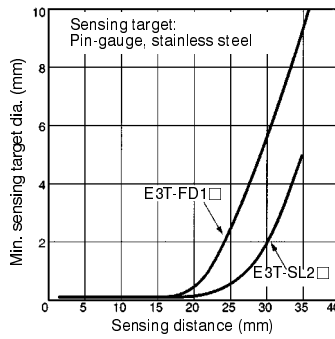


**■ SENSING TARGET SIZE VS. SENSING DISTANCE (TYPICAL)**

E3T-SL1□

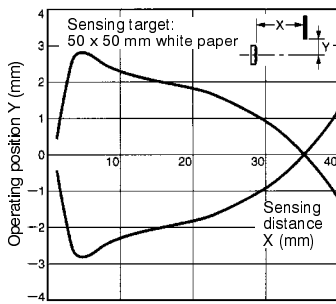


E3T-FD1□, E3T-SL2□

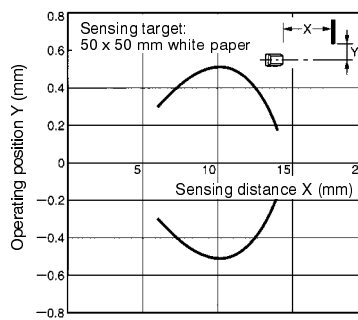


**■ OPERATION RANGE (TYPICAL)**

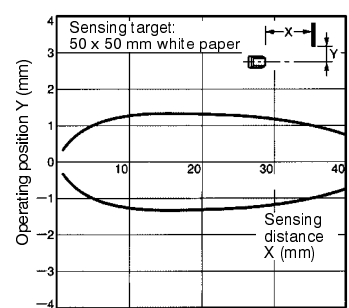
E3T-FD1□ (Diffuse Reflective)



E3T-SL1□ (Convergent Beam)

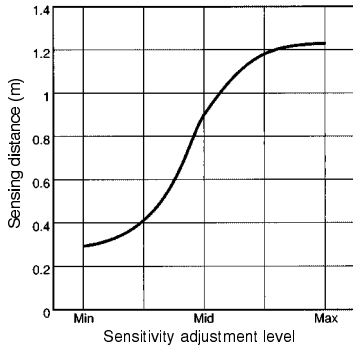


E3T-SL2□ (Convergent Beam)



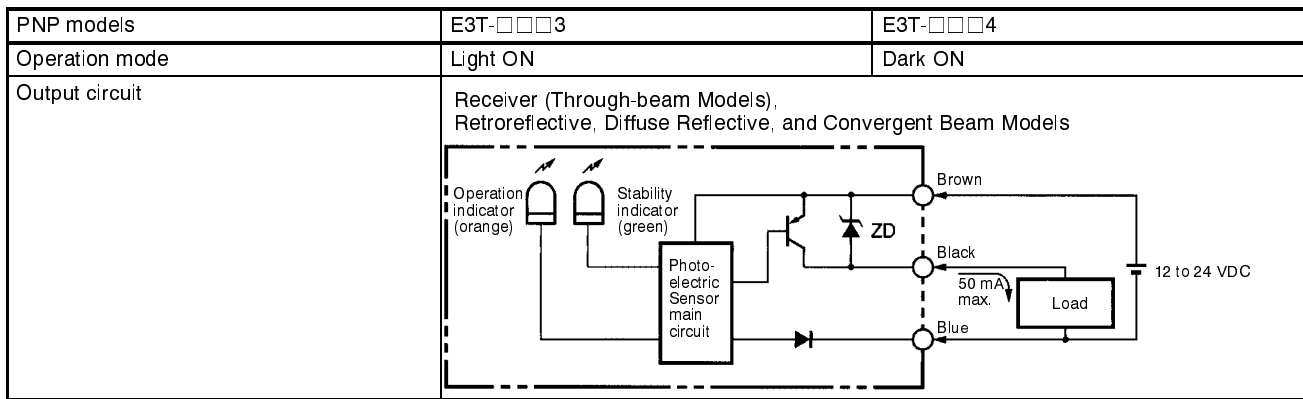
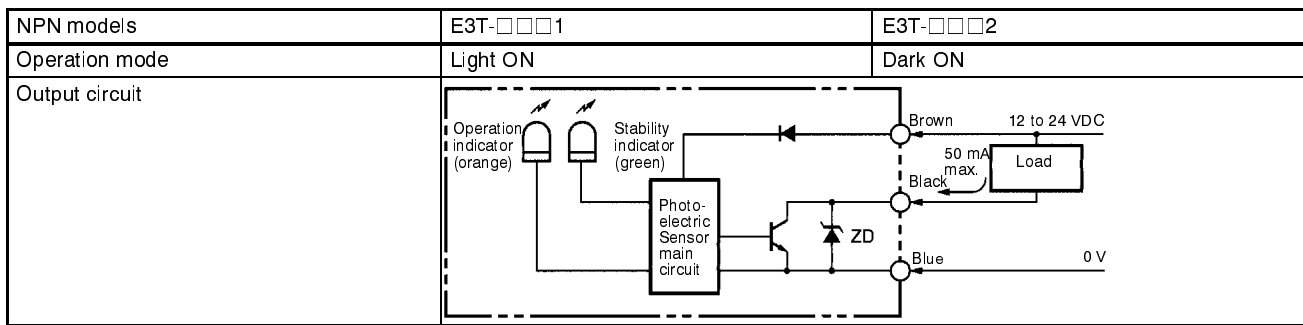
**SENSING DISTANCE CHARACTERISTICS OF ADJUSTABLE APERTURE  
(WHEN COMPLETING OPTICAL AXIS ADJUSTMENT)**

E3T-SL1□ with E39-E10



**Operation**

**OUTPUT CIRCUITS**

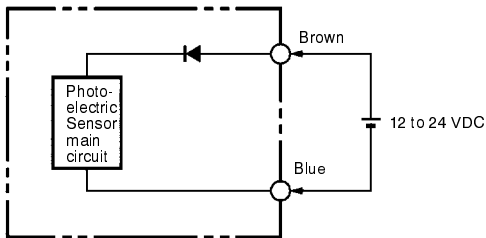




■ TIMING CHART

Diffuse and convergent beam	Light ON		Dark ON	
	Target present Target not present Operation indicator (orange) ON OFF Output transistor ON OFF Load Energized De-energized			Target present Target not present Operation indicator (orange) ON OFF Output transistor ON OFF Load Energized De-energized
Retroreflective/through-beam	Light ON		Dark ON	
	Target present Target not present Operation indicator (orange) ON OFF Output transistor ON OFF Load Energized De-energized			Target present Target not present Operation indicator (orange) ON OFF Output transistor ON OFF Load Energized De-energized

■ EMITTER (THROUGH-BEAM MODELS)



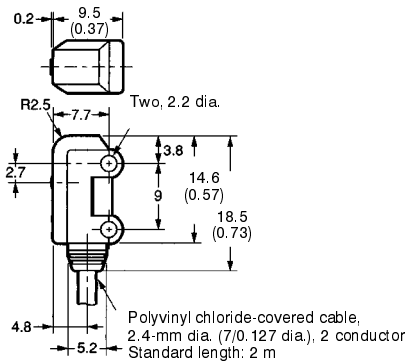
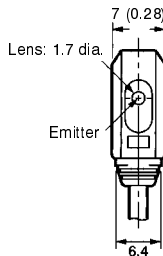
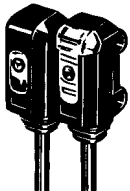
Dimensions

Unit: mm (inch)

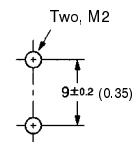
■ PHOTOELECTRIC SENSORS

Through-beam Models (Side-view Type)

Emitter  
 E3T-ST11  
 E3T-ST12  
 E3T-ST13  
 E3T-ST14

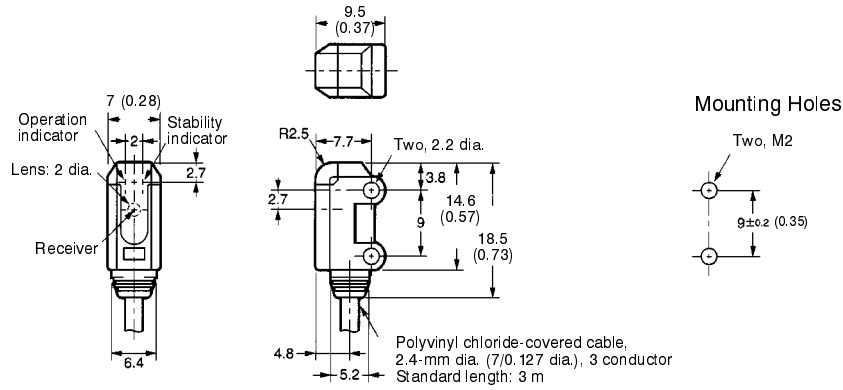


Mounting Holes



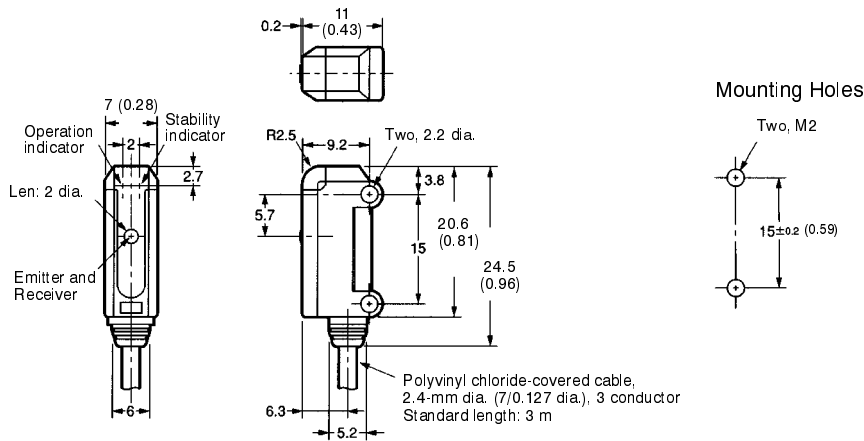
Unit: mm (inch)

Receiver



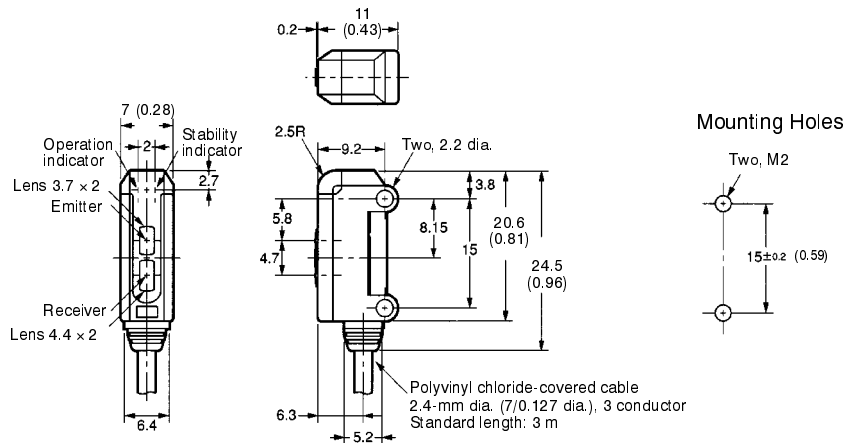
Retroreflective Models (Side-view Type)

- E3T-SR11
- E3T-SR12
- E3T-SR13
- E3T-SR14



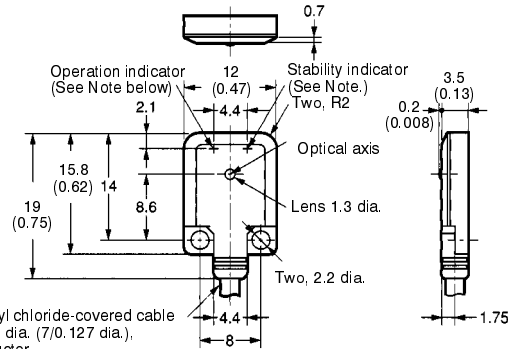
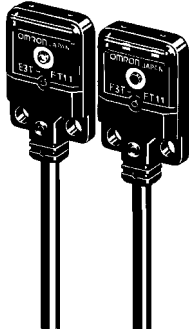
Convergent-beam Models (Side-view Type)

- E3T-SL11
- E3T-SL12
- E3T-SL13
- E3T-SL14
- E3T-SL21
- E3T-SL22
- E3T-SL23
- E3T-SL24

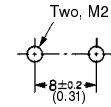


**Through-beam Emitter and Receiver Models (Flat Type)**

E3T-FT11  
E3T-FT12  
E3T-FT13  
E3T-FT14



**Mounting Holes**

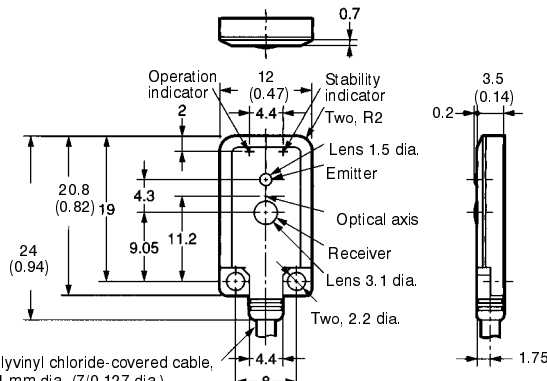
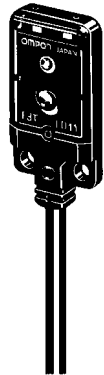


Polyvinyl chloride-covered cable  
2.4-mm dia. (7/0.127 dia.),  
3 conductor  
Standard length: 2 m

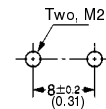
Note: For E3T-FT11 and E3T-FT12 Receivers only.

**Diffuse Reflective Models (Flat Type)**

E3T-FD11  
E3T-FD12  
E3T-FD13  
E3T-FD14



**Mounting Holes**

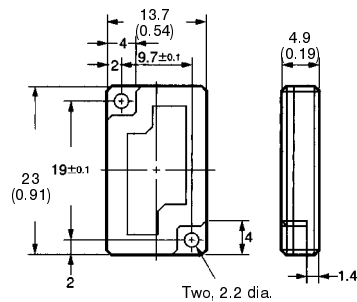
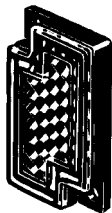


Polyvinyl chloride-covered cable,  
2.4-mm dia. (7/0.127 dia.),  
3 conductor  
Standard length: 2 m

**ACCESSORIES (ORDER SEPARATELY)**

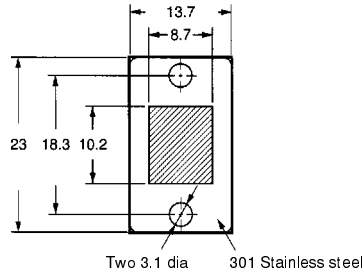
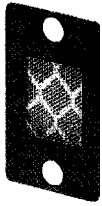
**Retroreflector**

E39-R4 (Provided with the E3T-SR1 □)

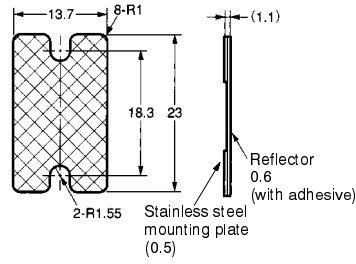


Unit: mm (inch)

**E39-R37**



**Reflector**



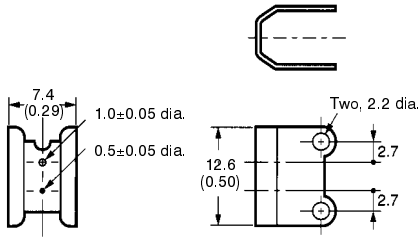
Note: A reflector and a stainless steel mounting plate are supplied together as a set.

**Apertures—Order Separately**

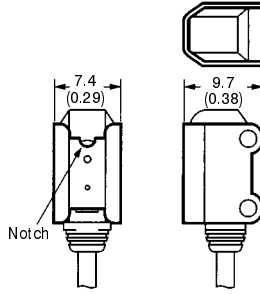
**E39-S63 (use with E3T-ST1□)**

**Shown with sensor**

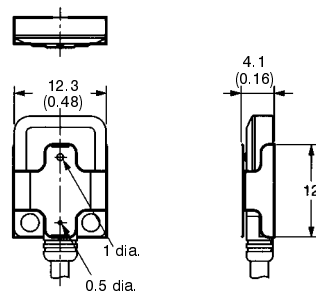
**E39-S64 (use with E3T-FT1□)**



Material:  
0.2-mm-thick stainless steel  
(301 Stainless)



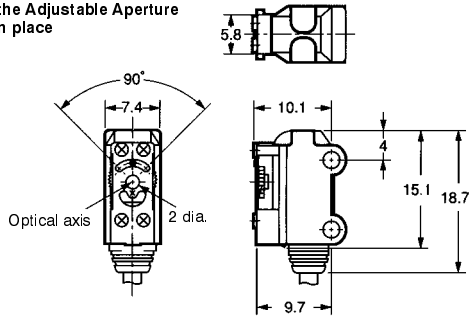
Note: Align the notch direction of the slit when installing on the Emitter and Receiver.



**Adjustable Aperture**

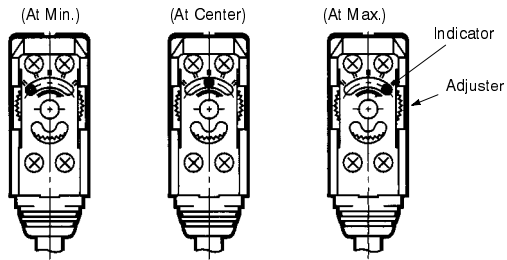
**E39-E10 (use with E3T-ST1□)**

With the Adjustable Aperture Unit in place



## ■ USE OF E39-E10 ADJUSTABLE APERTURE

(Example Dark ON: E3T-ST12/ST14)



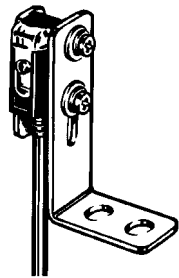
For Dark ON:

1. Mount the unit on the receiver.
2. Set the adjuster of the Unit to Max (factory setting is at Max).
3. Adjust the optical axis (align) and tighten mounting hardware.
4. Place a target between emitter and receiver and gradually turn the adjuster counterclockwise toward the Min side. Stop turning the adjuster when the operation indicator and stability indicator (green) turn ON.
5. Remove the target and confirm that the operation indicator is OFF and the stability indicator (green) is ON.

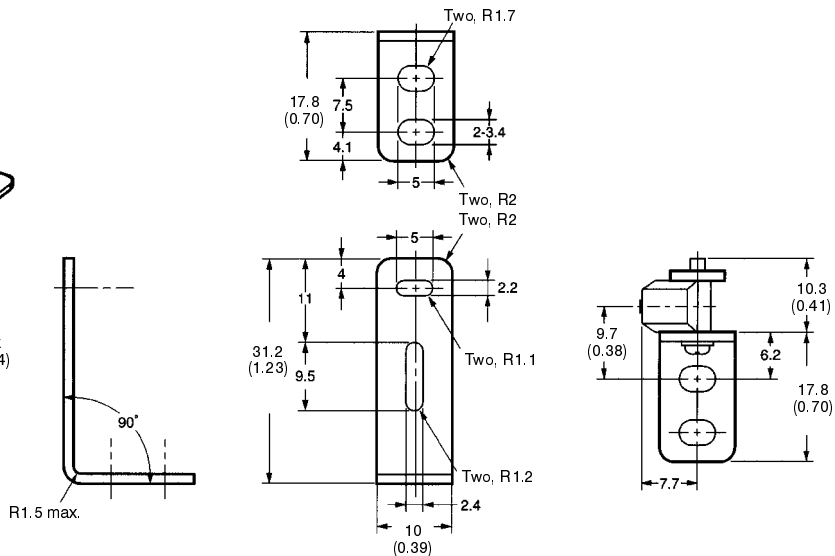
Note: For Light ON, adjustment is similar, except that indicators would operate in opposite manner as with Dark ON.

### Mounting Brackets E39-L116 (Order Separately)

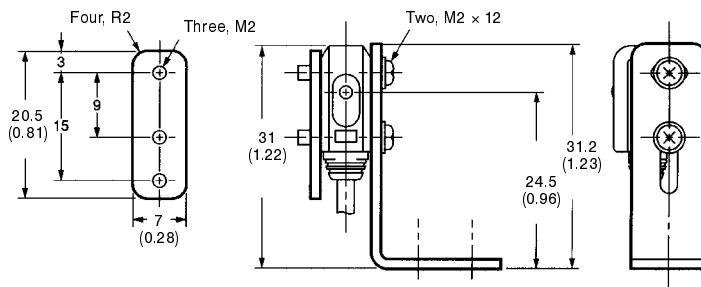
E39-L116 (use with E3T-S□□□)



Material: 1.2-mm-thick stainless steel (SS 304)



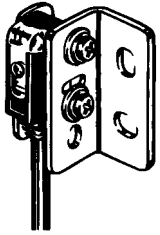
E39-L116 (use with E3T-ST1□)



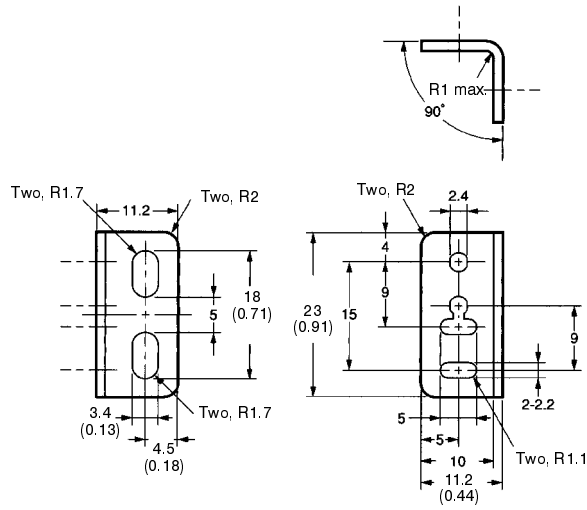
Unit: mm (inch)

Order brackets separately.

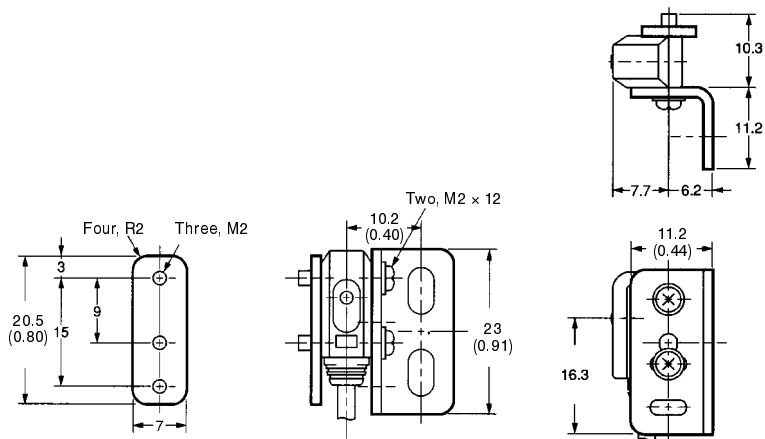
E39-L117 (use with E3T-S□□□)



Material: 1.2-mm-thick stainless steel (SS 304)

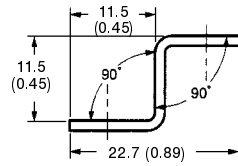
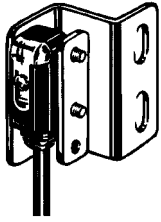


E39-L117 (shown with E3T-ST1□)

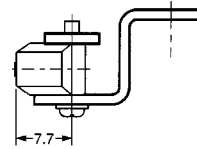
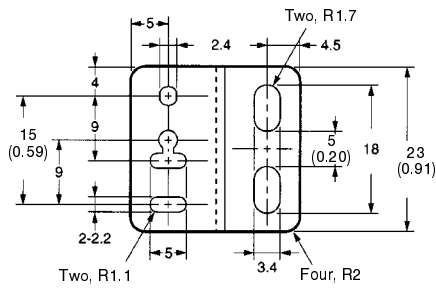


Order brackets separately.

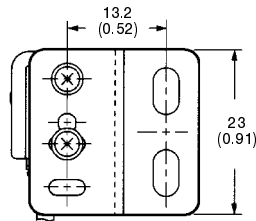
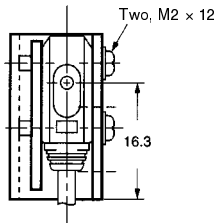
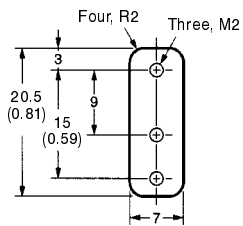
**E39-L118 (use with E3T-S□□□)**



Material: 1.2-mm-thick stainless steel (SS 304)



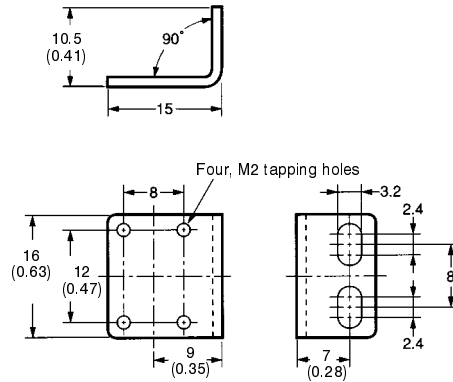
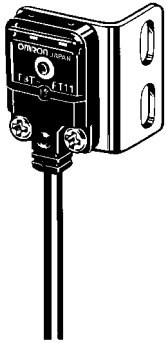
**E39-L118 (shown with E3T-ST1□)**



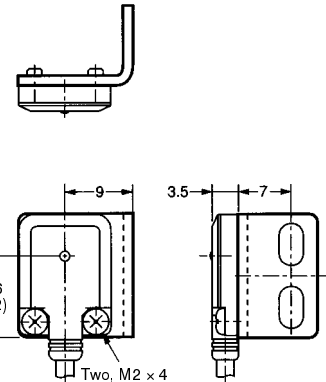
Unit: mm (inch)

**Mounting Brackets for E3T-FT1□/E3T-FD1□**

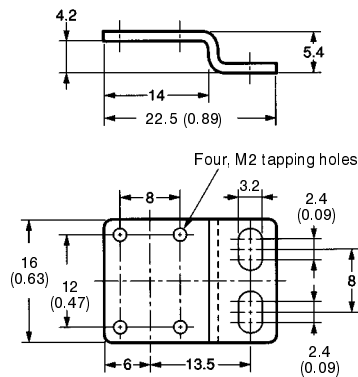
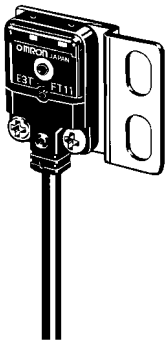
**E39-L119**



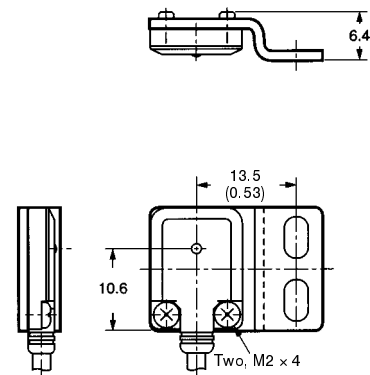
**E39-L119 shown with E3T-F□1□**



**E39-L120**



**E39-L120 shown with E3T-F□1□**



## Enclosure Ratings

### ■ NEMA VS. IEC CLASSIFICATION SYSTEMS

The table below compares NEMA (National Electrical Manufacturers Association) type numbers to IEC (International Electrotechnical Commission) classifications. The comparison is based on tests specified in IEC publication 529. It is important to note that this table cannot be used to convert IEC classifications to NEMA type numbers.

NEMA enclosure	IEC enclosure
1	IP10
2	IP11
3	IP64
4, 4X	IP66
6	IP67
12	IP62
13	IP64



## ■ NEMA AND IP DEFINITIONS

The critical reason to consider the differences between the two enclosure rating systems is water penetration to the switching circuit. The test procedures described here will help you evaluate the degree of protective sealing available when selecting a sensor.

Rating	Test	Method
NEMA 4	Hosedown	The enclosure is subjected to 65 gpm stream of water from a 1-inch nozzle for five minutes.
NEMA 4X	Hosedown	Same as NEMA 4.
NEMA 6	Submersion	The enclosure is immersed under 6 feet of water for 30 minutes. To meet this standard, water must not enter the enclosure. Hosedown test is same as NEMA 4.
NEMA 6P	Air pressure	The enclosure is held under 6 feet of water for 24 hours. Again, water must not enter the enclosure. Hosedown test is same as NEMA 4.
IP64	Splashing liquid	The enclosure is subjected to water falling as rain from a spray nozzle. Water that enters the enclosure should not interfere with satisfactory operation of the switch.
IP65	Water jets	The enclosure is subjected to a stream of water from a 1/2-inch nozzle with 14 psi pressure at a distance of 3 meters. No water can be near or in the cable, and any water that enters the enclosure cannot interfere with satisfactory operation of the switch.
IP66	Heavy seas	The enclosure is subjected to a stream of water from a 1/2-inch nozzle with 14 psi pressure at a distance of 1.5 meters. Water must not enter the enclosure.
IP67	Immersion	The enclosure is immersed under 1 meter of water for 30 minutes. No water may enter the enclosure.

## Precautions



### Caution

Avoid damage to the E3T. NEVER apply AC power to the E3T.

### ■ AVOID DAMAGE TO THE E3T

- Do not exceed the rated voltage on the E3T.
- Do not short-circuit the load connected to the E3T.
- When supplying power to the E3T, make sure that the polarity of the power is correct.

### ■ OPERATING ENVIRONMENT

To avoid malfunction, DO NOT install the E3T in the following environments:

- Locations where the E3T is exposed to intense sunlight.
- Locations with high humidity and where condensation may result.
- Locations with corrosive gas.
- Locations with vibration or shock affecting the E3T.

### ■ HIGH-TENSION LINES

To avoid Sensor damage or malfunctioning due to induction noise, do not place the power supply lines of the Photoelectric Sensor within the same conduit as power lines or high-tension lines.

### ■ CABLE

The cable can be extended up to 100 m provided that cable thickness does not exceed the 0.3 mm<sup>2</sup> maximum.

### ■ POWER SUPPLIES

If a switching regulator is connected to the E3T, you must ground the FG (frame ground) and G (ground) terminals, or the switching noise of the switching regulator may cause the E3T to malfunction.

### ■ WATER RESISTANCE

- Do not use the E3T underwater, outdoors, or in the rain.
- Use M2 screws and washers to mount the E3T. When mounting the E3T, NEVER strike the E3T with a hammer, or the E3T will lose its watertight properties.

### ■ LOAD SHORT-CIRCUIT PROTECTION

The E3T incorporates a load short-circuit protection function. If the load short-circuits, the output of the E3T will be turned OFF. Recheck the wiring and turn on the E3T again to reset the load short-circuit protection function. The load short-circuit protection function will work if there is a current flow that is 2.4 times larger than the rated load current.

When using an inductance load, be sure that the inrush current will not exceed 2.4 times larger than the rated current.

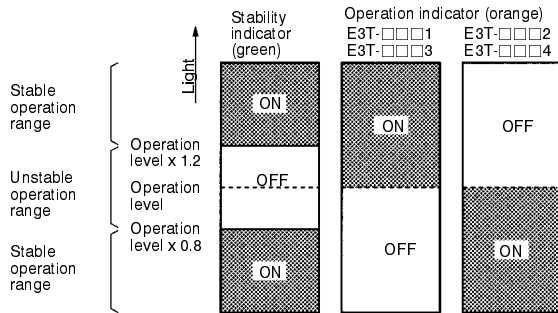
## ■ CLEANING

DO NOT apply paint thinner when cleaning the E3T. Paint thinner will damage the casing of the E3T.

## ■ INDICATORS

The following graphs indicate the status of each operation level.

Be sure to use the E3T within the stable operating range.



Note: When the E3T's operation level is set to the stable operation range, the E3T will be in its most reliable operation without being influenced by temperature, voltage fluctuation, dust, or mounting changes.

## ■ TURNING ON POWER SUPPLY

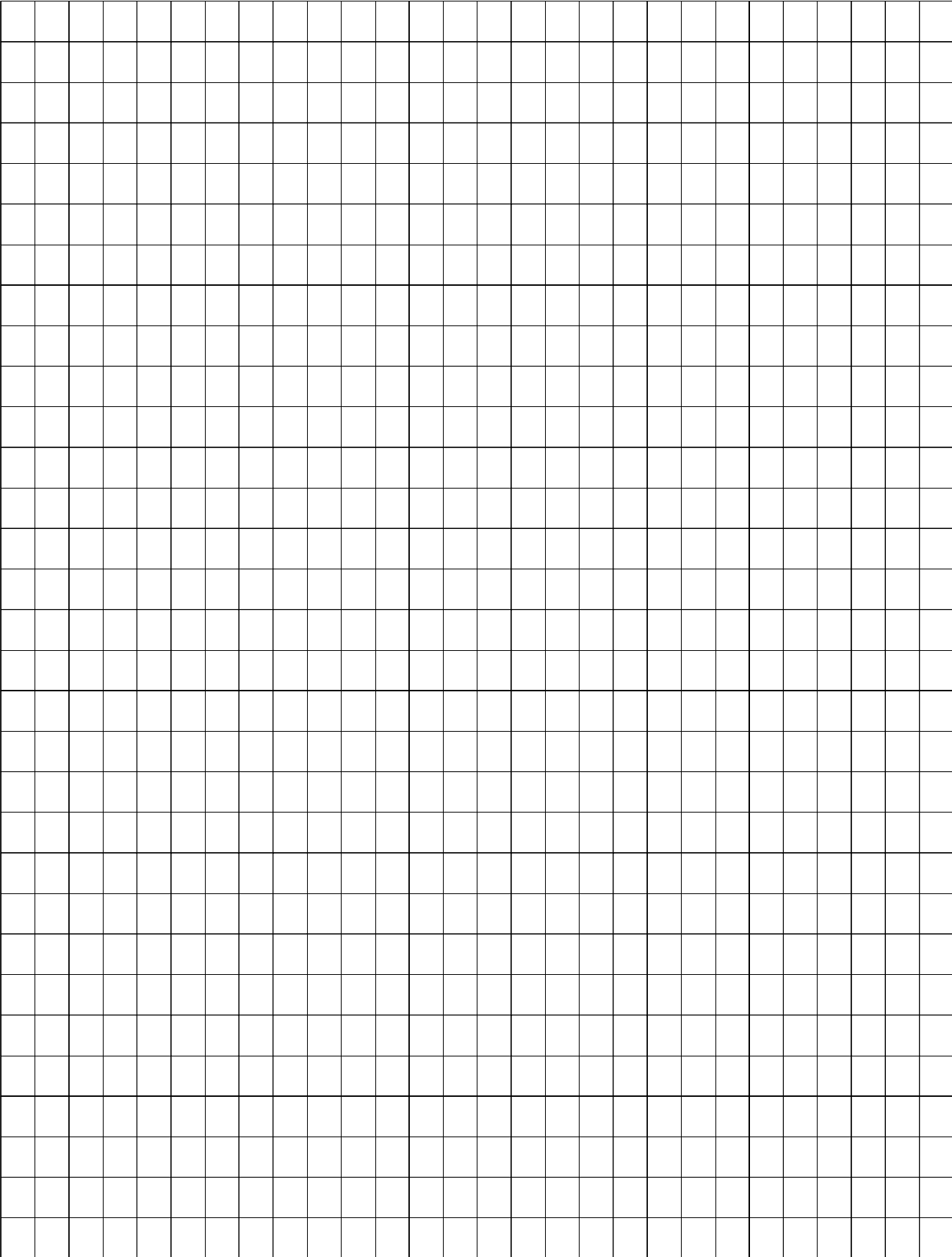
- The E3T will be ready for sensing 100 ms after the power is turned ON.
- If the E3T is connected to a power source different from one for loads, be sure to turn ON the power supply to the E3T first.

## AWG to Metric Wire Comparison Chart

### ■ WIRE COMPARISON CHART

Cross reference AWG to mm <sup>2</sup>			
AWG	mm <sup>2</sup>	AWG	mm <sup>2</sup>
30	0.05	16	1.5
28	0.08	14	2.5
26	0.14	12	4
24	0.25	10	6
22	0.34	8	10
21	0.38	6	16
20	0.5	4	25
18	0.75	2	35
17	1.0	1	50

Project Sketch



NOTE: DIMENSIONS SHOWN ARE IN MILLIMETERS. To convert millimeters to inches divide by 25.4.

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