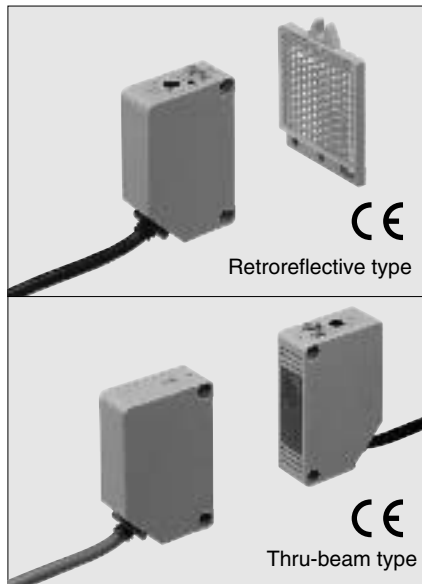
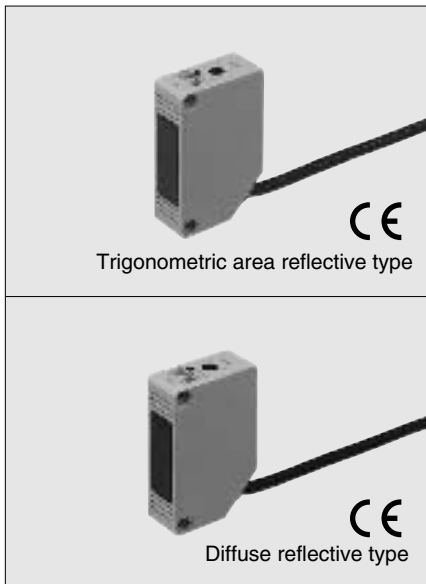


# KA1 SERIES

## General Purpose Photoelectric Sensor

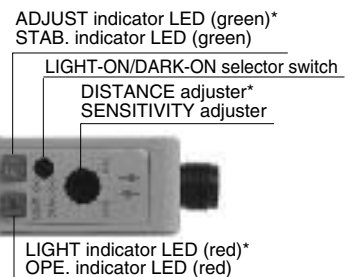
Responding to all requirements for long range applications, the KA1 photoelectric sensors offer every available sensing method in an efficient package



Immersion protected construction (equivalent to IEC IP67)  
Rotary connector types available for easy maintenance and installation maintenance



Sensitivity adjuster and indication LED are equipped  
Thru-beam type can detect even a translucent target by lowering the sensitivity.



\*: Indication of Trigonometric area reflective type

### FEATURES

#### Various outputs selectable

Two outputs are provided for the DC type, NPN and PNP output, so that a single photoelectric sensor can match either of both polarities. The output section of the AC/DC type is compact 1 Form A relay contact rated 1 A, 250 V AC and 2 A, 30 V DC (resistive).

#### Wide operating voltage range

The DC type operated by 12 to 24 V DC and the AC/DC type by 12 to 240 V DC or 24 to 240 V AC, 50/60 Hz power supply. This allows operation voltages world wide.

#### Protection circuit incorporated

Protection circuit is provided for the transistor output type (DC type) against erroneous reverse wiring and short-circuit.

#### Accurate detection, regardless of colors, materials, or shapes

Area reflective type permits the detection of white and black targets at almost the same distance. Also targets with mixed colors, that are difficult to detect with standard diffuse reflective type, can be detected.

#### Unaffected by background objects

Area reflective type does not detect objects beyond the set range.

#### Polarization filter;

**Standardized for Retroreflective type,** even a shiny target detectable.

**Optionally for Thru-beam type,** cross-talk prevention function is available.

#### Light-ON/Dark-ON selectable

### APPLICATIONS

Detection of small to large targets. Large product assembly lines, automated vertical warehouses, personnel detection, etc.

### SENSING RANGES

	Sensing range (m ft.)			
	0.1 .328	0.7 2.297	1 3.281	10 32.81
Trigonometric area reflective type*	[Bar chart showing range from 0.1 to 1 m]			
Diffuse reflective type	[Bar chart showing range from 0.1 to 0.7 m]			
Retroreflective type	[Bar chart showing range from 0.1 to 10 m]			
Thru-beam type	[Bar chart showing range from 0.1 to 32.81 m]			

\*Detectable distance of area reflective type can be adjusted 0.2 to 1 m .656 to 3.281 ft.

## PRODUCT TYPE

Detection type	Sensing range	Rated operating voltage	Control output	Terminal	Part number
Trigonometric area reflective type	1 m 3.281 ft.	12 to 24 V DC	Transistor (NPN and PNP)	Cable	AKA15110
				Connector	AKA15120
		12 to 240 V DC 24 to 240 V AC	1 Form A relay (1 A, 250 V AC/2 A 30 V DC)	Cable	AKA15118
				Connector	AKA15128
Diffuse reflective type	0.7 m 2.297 ft.	12 to 24 V DC	Transistor (NPN and PNP)	Cable	AKA14710
				Connector	AKA14720
		12 to 240 V DC 24 to 240 V AC	1 Form A relay (1 A, 250 V AC/2 A 30 V DC)	Cable	AKA14718
				Connector	AKA14728
Retroreflective type	0.1 to 5 m .328 to 16.405 ft.	12 to 24 V DC	Transistor (NPN and PNP)	Cable	AKA13510
				Connector	AKA13520
		12 to 240 V DC 24 to 240 V AC	1 Form A relay (1 A, 250 V AC/2 A 30 V DC)	Cable	AKA13518
				Connector	AKA13528
Thru-beam type	10 m 32.81 ft	12 to 24 V DC	Transistor (NPN and PNP)	Cable	AKA10010 (Set)
					AKA11010 (Projector)
					AKA12010 (Receiver)
				Connector	AKA10020 (Set)
					AKA11020 (Projector)
					AKA12020 (Receiver)
		12 to 240 V DC 24 to 240 V AC	1 Form A relay (1 A, 250 V AC/2 A 30 V DC)	Cable	AKA10018 (Set)
					AKA11018 (Projector)
					AKA12018 (Receiver)
				Connector	AKA10028 (Set)
					AKA11028 (Projector)
					AKA12028 (Receiver)

## ACCESSORIES

Items		Part number
Reflector* <sup>1</sup>		AKA81101
Blacket		AKA82101
Polarization filter* <sup>2</sup>	Horizontal	AKA83101
	Vertical	AKA83102
Slit* <sup>2</sup>		AKA84101

\*<sup>1</sup> A reflector is contained in same package of all retroreflective type.

\*<sup>2</sup> 2 pieces as one set.

## SPECIFICATIONS

### DC type

#### 1) Ratings

		Trigonometric area reflective type	Diffuse reflective type	Retroreflective type	Thru-beam type (Receiver)	Thru-beam type (Projector)
Operating side	Rated operating voltage	12 to 24 V DC				
	Rated power consumption	50 mA or less	40 mA or less	35 mA or less	25 mA or less	25 mA or less
Load side	Output current capacity	100 mA or less (PNP side), 100 mA or less (NPN side)				

#### 2) Performance

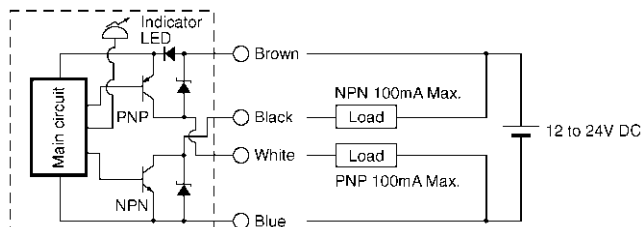
Detection principle		Triangulation range measurement method	Reflected light volume detection method		Light volume detection method
Detection method		Trigonometric area reflective type	Diffuse reflective type	Retroreflective type	Thru-beam type
Type					
Amplifier self-contained DC type					
Part number	Cable type	AKA15110	AKA14710	AKA13510	AKA10010
	Connector type	AKA15120	AKA14720	AKA13520	AKA10020
Sensing range		1 m 3.281 ft.	0.7 m 2.297 ft.	0.1 to 5 m .328 to 16.405 ft.	10 m 32.81 ft.
Detectable distance		0.2 to 1 m .656 to 3.281 ft.	—		
Standard target		20×20 cm 7.874×7.874 inch white drawing paper		Opaque target more than 70 mm 2.756 inch dia.	Opaque target more than 20 mm .787 inch dia.
Detectable target		Opaque, translucent	Opaque, transparent	Opaque, translucent	Opaque, translucent
Operation angle		—		At least 2°	At least 2°
Hysteresis		20Ω or less of the set range		—	
Operating voltage range		9.6 to 30 V DC ripple (P-P) included			
Response time (freq.)		1 ms or less (500 times per second or less)	0.5 ms or less (1000 times per second or less)		2 ms or less (250 times per second or less)
Initial insulation resistance		20 MΩ or more between input/output and external housing (at 500 V DC)			
Initial breakdown voltage		Between input/output and external housing: 500 Vrms for 1 min			
Vibration resistance	Functional	10 to 55 Hz (1 cycle/min), double amplitude 1.5 mm .059 inch (10 min each on 3 axes)			
	Destructive	10 to 55 Hz (1 cycle/min), double amplitude 1.5 mm .059 inch (2 hours each on 3 axes)			
Shock resistance	Functional	980 m/s <sup>2</sup> (approx. 100 G) (3 times each on 3 axes)			
	Destructive	980 m/s <sup>2</sup> (approx. 100 G) (3 times each on 3 axes)			
Protective construction		Plastic case, immersion protected (equivalent to IEC IP67)			
Usable ambient light level	Incandescent lamp	3,000 lux or less			
	Sunlight	10,000 lux or less			
Ambient temperature		-25 to +60°C -13 to +140°F (non-icing condition)			
Ambient humidity		35 to 85% RH (non-condensing condition)			
Storage temperature		-30 to +70°C -22 to +158°F			
Indicator		LIGHT (Light incident) indicator: red LED ADJUST indicator: green LED	OPE. (operation) indicator: red LED STAB. (stability) indicator: green LED (No indication for projector of Thru-beam type)		
Light source		Infrared LED		Red LED	

Unless otherwise specified, the detection condition comprise rated operating voltage, 20°C 68°F ambient temperature, standard target and 200 lux or less illuminance on the receiver surface.

#### 3) Output circuit diagram

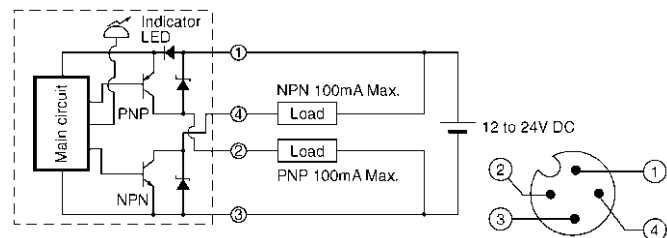
Cable type: Area reflective type, Diffuse reflective type, Retroreflective type, Thru-beam type (receiver)

Circuit diagram



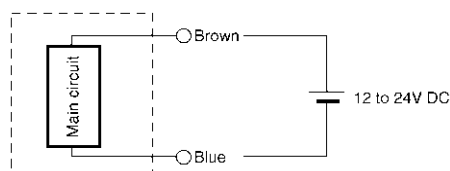
Connector type: Area reflective type, Diffuse reflective type, Retroreflective type, Thru-beam type (receiver)

Circuit diagram



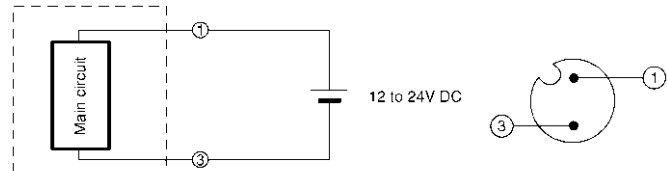
Cable type: Thru-beam type (projector)

Circuit diagram



Connector type: Thru-beam type (projector)

Circuit diagram



## AC/DC type

### 1) Ratings

		Trigonometric area reflective type	Diffuse reflective type	Retroreflective type	Thru-beam type (Receiver)	Thru-beam type (Projector)
Operating side	Rated operating voltage	24 V to 240 V AC 50/60 Hz or 12 to 24 V DC				
	Rated power consumption	5.5 VA or less AC, 4 W or less DC				1 VA or less AC 1 W or less DC
Load side	Output current capacity	1 A 250 V AC, 2 A 30 V DC (resistive)				

### 2) Performance

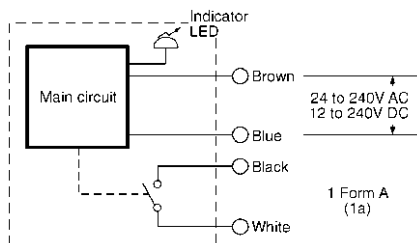
Detection principle		Triangulation range measurement method	Reflected light volume detection method		Light volume detection method
Detection method		Trigonometric area reflective type	Diffuse reflective type	Retroreflective type	Thru-beam type
Type		Amplifier selfcontained AC/DC type			
Part number	Cable type	AKA15118	AKA14718	AKA13518	AKA10018
	Connector type	AKA15128	AKA14728	AKA13528	AKA10028
Sensing range		1 m 3.281 ft.	0.7 m 2.297 ft.	0.1 to 5 m .328 to 16.405 ft.	10 m 32.81 ft.
Detectable distance		0.2 to 1 m .656 to 3.281 ft.	—		
Standard target		20×20 cm 7.874×7.874 inch white drawing paper		Opaque target more than 70 mm 2.756 inch dia.	Opaque target more than 20 mm .787 inch dia.
Detectable target		Opaque, translucent	Opaque, transparent	Opaque, translucent	Opaque, translucent
Operation angle		—		At least 2°	At least 2°
Hysteresis		20% or less of the set range		—	
Operating voltage range		10.8 to 264 V DC/21.6 to 264 V AC			
Response time (freq.)		10 ms or less (50 times per second or less)			20 ms or less (25 times per second or less)
Initial insulation resistance		20 MΩ or more between power source/output and external housing (at 500 V DC)			
Initial breakdown voltage		Between power source and output: 1000 Vrms for 1 min Between relay contacts: 500 Vrms for 1 min Between power source/output and external housing: 1500 Vrms for 1 min			
Vibration resistance	Functional	10 to 55 Hz (1 cycle/min), double amplitude 1.5 mm .059 inch (10 min each on 3 axes)			
	Destructive	10 to 55 Hz (1 cycle/min), double amplitude 1.5 mm .059 inch (2 hours each on 3 axes)			
Shock resistance	Functional	98 m/s <sup>2</sup> {approx. 10 G} (3 times each on 3 axes)			
	Destructive	980 m/s <sup>2</sup> {approx. 100 G} (3 times each on 3 axes)			
Protective construction		Plastic case, immersion protected (equivalent to IEC IP67)			
Usable ambient light level	Incandescent lamp	3,000 lux or less			
	Sunlight	10,000 lux or less			
Ambient temperature		-25 to +55°C -13 to +131°F (non-icing condition)			
Ambient humidity		35 to 85% RH (non-condensing condition)			
Storage temperature		-30 to +70°C -22 to +158°F			
Indicator		LIGHT (Light incident) indicator: red LED ADJUST indicator: green LED	OPE. (operation) indicator: red LED STAB. (stability) indicator: green LED (No indication for projector of Thru-beam type)		
Light source		Infrared LED		Red LED	

Unless otherwise specified, the detection condition comprise rated operating voltage, 20°C 68°F ambient temperature, standard target and 200 lux or less illuminance on the receiver surface.

### 3) Output circuit diagram

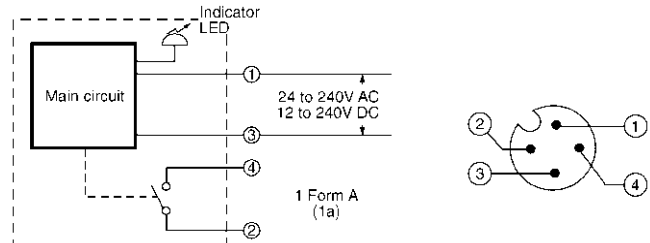
Cable type: Area reflective type, Diffuse reflective type, Retroreflective type, Thru-beam type (receiver)

Circuit diagram



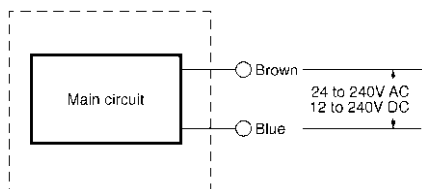
Connector type: Area reflective type, Diffuse reflective type, Retroreflective type, Thru-beam type (receiver)

Circuit diagram



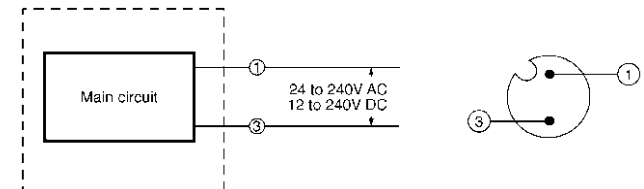
Cable type: Thru-beam type (projector)

Circuit diagram



Connector type: Thru-beam type (projector)

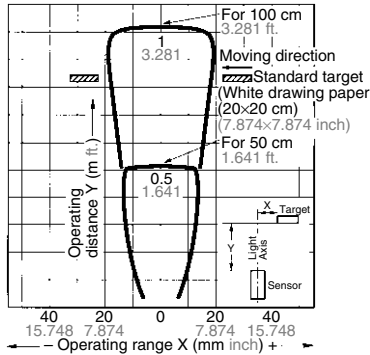
Circuit diagram



## DATA (Condition: SENSITIVITY AND DISTANCE adjuster set at max.; Target: Standard target)

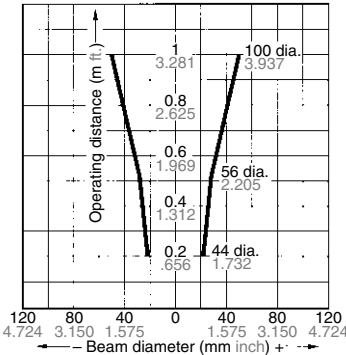
### 1. Trigonometric area reflective type

#### 1) Operating range characteristics

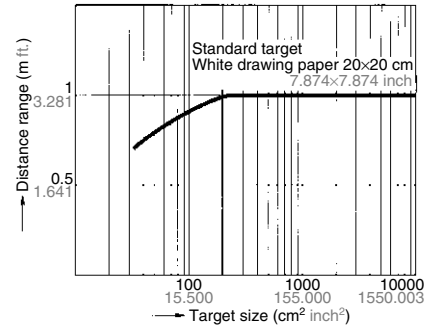


#### 2) Projector beam diameter characteristics

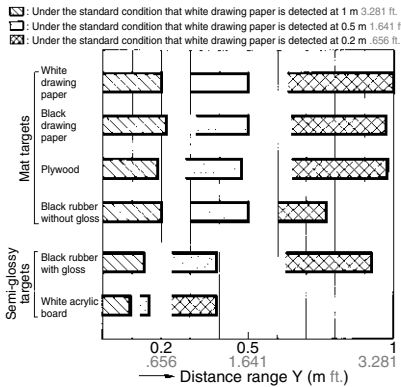
The beam diameter is regarded as the diameter which attenuates at  $1/e^2$  (Here  $e \approx 2.72$ )



#### 3) Detectable target characteristics

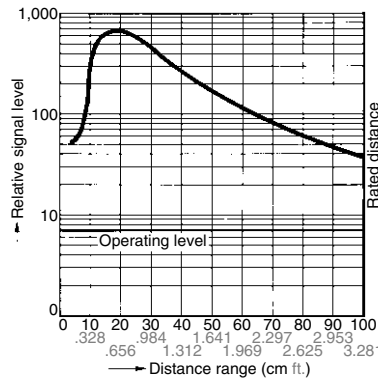


#### 4) Material characteristics



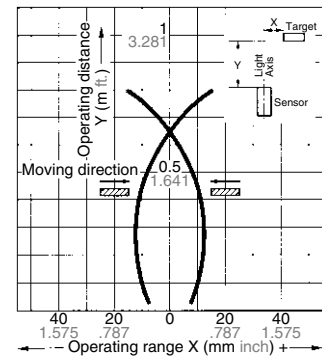
#### 5) Received signal level and distance characteristics

Target: White drawing paper 20x20 cm 7.874x7.874 inch

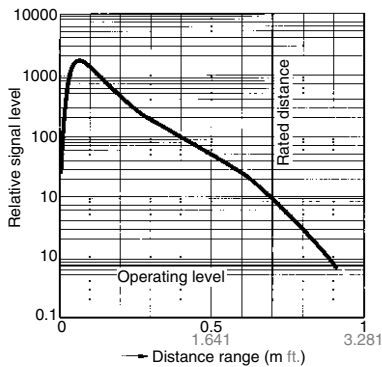


### 2. Diffuse reflective type

#### 1) Operating range characteristics

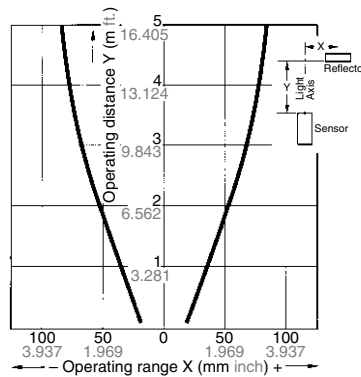


#### 2) Received signal level and distance characteristics

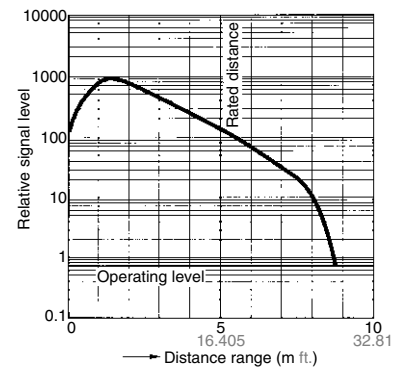


### 3. Retroreflective type

#### 1) Operating range characteristics

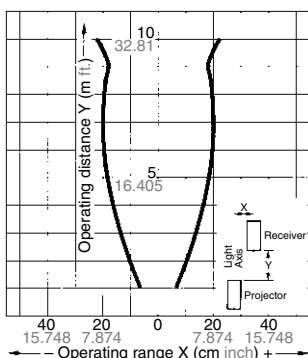


#### 2) Received signal level and distance characteristics

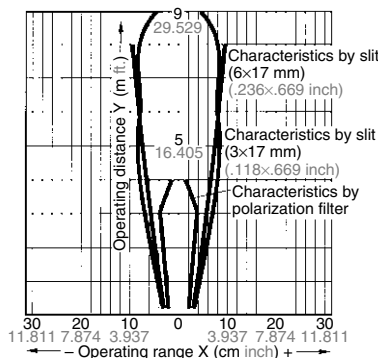


### 4. Thru-beam type

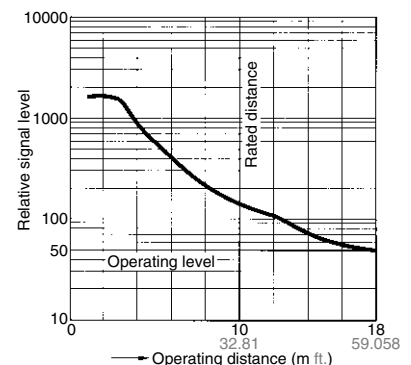
#### 1) Operating range characteristics



#### 2) Operating range characteristics with slit and polarization filter



#### 3) Received signal level and distance characteristics



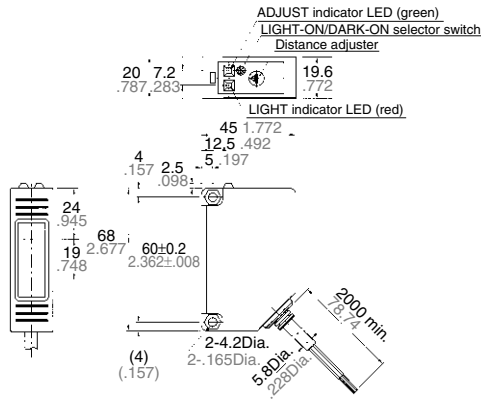
## DIMENSIONS

mm inch General tolerance  $\pm 1.0 \pm .039$

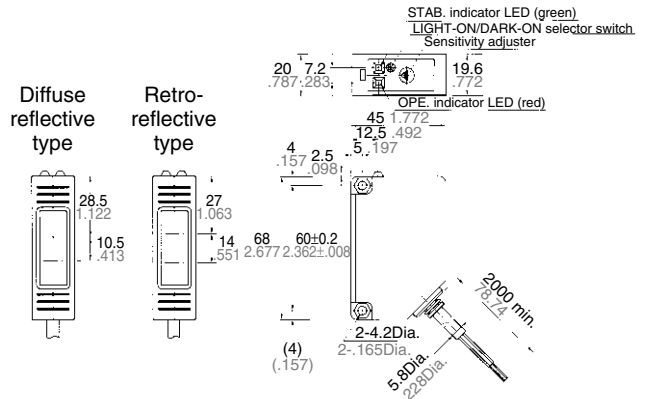
(Dimensions of DC type and AC/DC type are common)

### Cable type

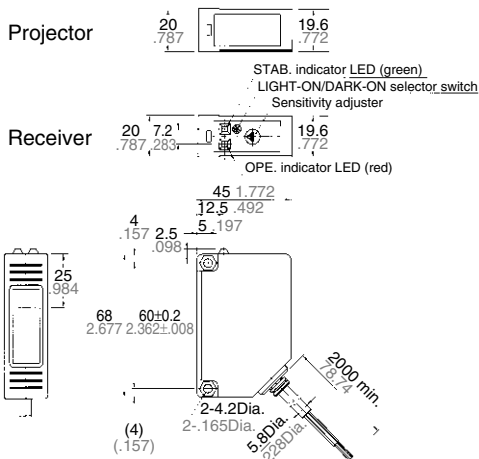
#### 1) Trigonometric area reflective type



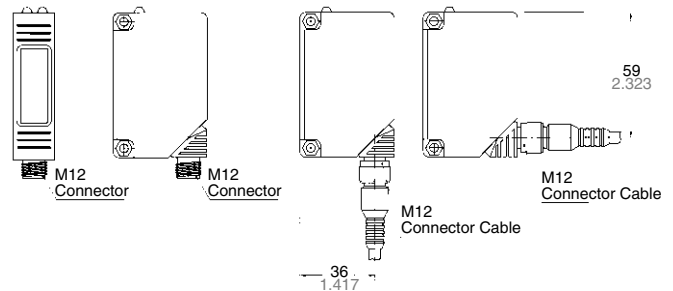
#### 2) Retroreflective type and Diffuse reflective type



#### 3) Thru-beam type

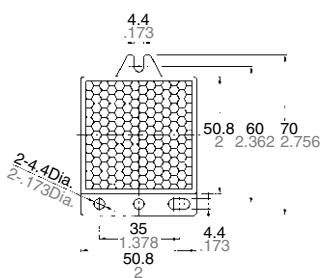


### Connector type (descriptions different from cable types)

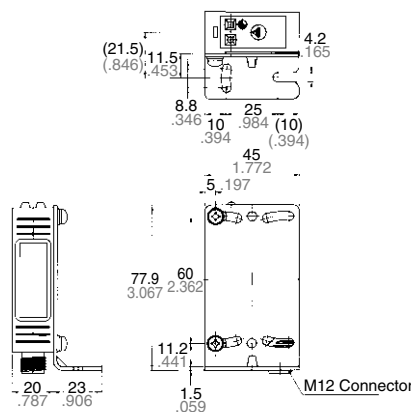


### Option

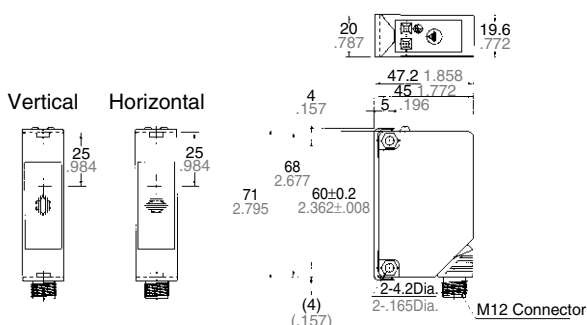
#### 1) Reflector (for Retroreflective type)



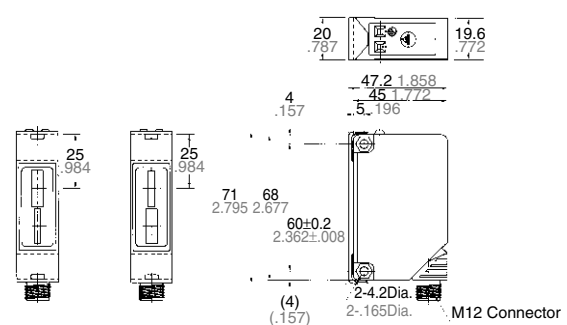
#### 2) Sensor with bracket attached



#### 3) Polarization filter (for Thru-beam type)

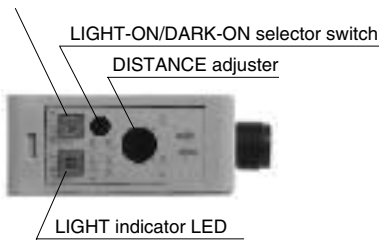


#### 4) Slit (for Thru-beam type)



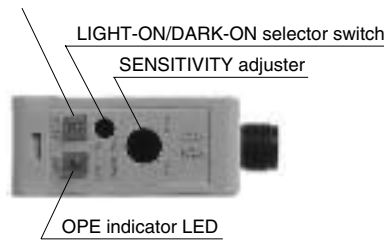
## Trigonometric area reflective type

ADJUST indicator LED



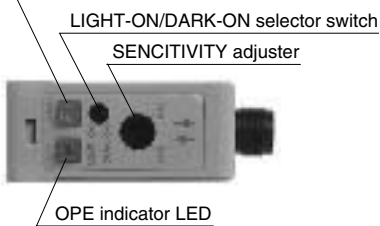
## Retroreflective type

STAB indicator LED



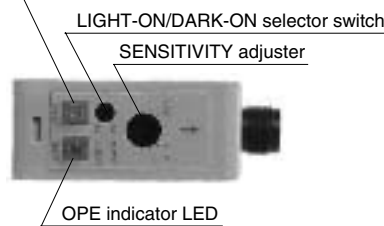
## Diffuse reflective type

STAB indicator LED



## Thru-beam type (receiver)

STAB indicator LED



### Notes:

1. Since the detectable distance depends on the material, color, size, shape and direction of targets, and the environmental conditions, check and adjust it using an actual target.
2. If the STAB. indicator LED does not come ON in step 4), reposition the detection face and repeat the procedure of steps 1) to 4) or pay attention to other factors such as ambient temperature variations, position of target, etc.
3. Please be careful not to apply excessive torque to the SENSITIVITY adjuster and the LIGHT-ON/DARK-ON selector switch.

### Light axis adjustment for Retroreflective type

- 1) Temporarily mount the reflector and the photoelectric sensor in proper alignment.
- 2) Move the photoelectric sensor left and right, up and down to find a position in the center of the range in which the OPE. indicator LED is ON.
- 3) Check the photoelectric sensor's operation when a target passes the carrying path.
- 4) If it does not operate, adjust the sensitivity.
- 5) Affix the reflector and photoelectric sensor in position firmly so that vibration or shock must not cause the light beam axis to shift out of alignment.

### Notes:

1. If the STAB. indicator LED does not come ON in step 3), reposition the reflector and repeat steps 1) to 3) or pay attention to other factors such as ambient temperature variations, position of target, etc.
2. Please be careful not to apply excessive torque to the SENSITIVITY adjuster and the LIGHT-ON/DARK-ON selector switch.

### Light axis adjustment for Thru-beam type

- 1) Swing the projector and receiver to left and right, and up and down to find a position around the middle of the OPE. indicator LED's ON range, and then secure them. At this time, confirm that the STAB. indicator LED is lit.
- 2) Sensitivity adjusting makes detection possible of translucent targets. For translucent targets, the SENSITIVITY adjuster is turned to the position where the target can be detected.

### Note:

1. If the STAB. indicator LED goes out during operation, the sensor detection does not work any longer. Check the situation and adjust the sensitivity again.
2. Please be careful not to apply excessive torque to the SENSITIVITY adjuster and the LIGHT-ON/DARK-ON selector switch.

### Distance adjustment for

#### Trigonometric area reflective type

- 1) Point the detection face of the photoelectric sensor towards the targets direction and temporarily fasten.
- 2) Set the DISTANCE adjuster to maximum position (FAR). If the LIGHT indicator LED does not turn ON at this position without surroundings towards detection direction, then recognize this position as "FAR" one. If the LIGHT indicator LED turns ON at this position detecting surroundings, turn the DISTANCE adjuster slowly counterclockwise to find a FAR position where the LIGHT indicator LED turns OFF.
- 3) Place a target at the detection position and set the DISTANCE adjuster to its minimum setting NEAR and slowly turn it clockwise and note the LIGHT indicator LED turns ON. The minimum position at which the LIGHT indicator LED turns ON is the NEAR position.
- 4) Set the DISTANCE adjuster to the middle of the two positions found in 2) and 3) above.
- 5) Fasten the photoelectric sensor. Mount securely so that the photoelectric sensor is not shifted from alignment by vibrations or impact.

### Notes:

1. If the ADJUST indicator LED does not turn ON in step 4), or if such a operation range acquainted by above 2) or 3) is less than 2 graduations, either change the position of the detection surface and repeat steps 1) to 4), or adjust external factors such as ambient temperature variations, position of target, etc.

2. The detection distance varies only slightly with the color of the target.

However, if the target has an extremely low reflection factor (dull black rubber), detection may not be possible, or if the target has an extremely high reflection factor (mirrors, glass, glossy paper and other specular reflection targets), adjustment of the detection distance may not be possible. Use the actual target to check operation.

3. Please be careful not to apply excessive torque to the DISTANCE adjuster and the LIGHT-ON/DARK-ON selector switch.

### Sensitivity adjustment for Diffuse reflective type

- 1) Facing the detection face in the detection direction, temporarily fasten it.
- 2) Set the SENSITIVITY adjuster to its maximum position (MAX.). If the OPE. indicator LED does not turn ON at this position without surroundings towards detection direction, then recognize this position as "MAX." one. If the OPE. indicator LED turns ON at this position detecting surroundings, turn the SENSITIVITY adjuster slowly counterclockwise to find a MAX. position where the OPE. indicator LED turns OFF.
- 3) Place a target at the detection position, and further turn the SENSITIVITY adjuster counterclockwise to find the position where the OPE. indicator LED goes out.
- 4) Fasten the SENSITIVITY adjuster at the middle point between the positions selected in steps 2) and 3).
- 5) Fasten the photoelectric sensor so securely as not to be displaced by vibration or shock.

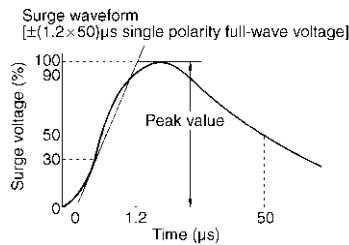
## CAUTIONS



These products are **not** safety sensors and are **not** designed or intended to be used to protect life and prevent bodily injury or property damage.

### 1. Operating Environment

- 1) The sensor should be used in an ambient temperature range of -25 to +60°C -13 to +140°F (DC type) or -25 to +55°C -13 to +131°F (AC/DC type)
- 2) Use an operating voltage in the range of 9.6V to 30V DC for the DC types and 21.6V to 264V AC or 10.8V to 264V DC for the AC/DC types.
- 3) The light intensity on the receiver surface should be less than 3,000 lux for an incandescent light source and



- less than 10,000 lux for sunlight.
- 4) Use a surge absorber as the internal circuit may be damaged if external surge voltages exceed 500V (for DC type)/4,000V (for AC/DC type) [±(1.2×50)µs single polarity full-wave voltage].
  - 5) Avoid use in locations with high concentrations of steam, dust, corrosive gases, etc.
  - 6) Use a load relay with a rated operating voltage of 12V DC or 24V DC for the DC types. The voltage applied to the load relay is the operating voltage of the photoelectric sensor minus the internal voltage drop (maximum 1.2V NPN side, 2V PNP side). Voltage fluctuations should be taken into account.
  - 7) The output circuit of the DC type contains a short-circuit protection circuit. However, be sure the inrush current does not exceed the maximum output current capacity for proper detection.

8) The sensor is immersion protected type, but this does not mean that it can be used in water or where there is direct impingement or rain for detecting targets.

### 2. Wiring

- 1) Check all wiring before applying power since incorrect wiring may damage the internal circuit.
- 2) Ground the frame ground (FG) terminal and ground (G) terminal when using a commercially available switching regulator. If a ground is not connected, switching noise from the power supply may result in faulty operation.
- 3) Wire 0.3 mm<sup>2</sup> .0005 inch<sup>2</sup> AWG22 or larger should be used for wiring up to a length of 100 m 328 ft.
- 4) Please use a fitting cable for wiring the connector type sensor to maintain the characteristic of protection structure.
- 5) Tighten the connector with a maximum torque of 0.8 Nm.

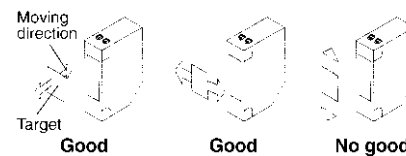
### 3. Detector

- 1) Keep the detector surface clean as excessive dust or dirt on the detector surface will decrease the margin of the sensing distance.
- 2) The front surface of the lens and case are made of polycarbonate resin (but the front surface of Retroreflective type is made of polymethylmethacrylate). Although it withstands water, weak acids and alkalines, aliphatic hydrocarbons, and oils and fats, it is not resistant to ketones, esters, halogenated hydrocarbons and aromatic hydrocarbons.

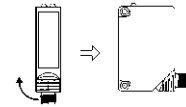
### 4. Moving Direction of the Target (for Trigonometric area reflective type)

Take care with the mounting direction of the photoelectric sensor with respect to the moving direction of the target.

### 5. Other cautions



- 1) When using the optional mounting bracket, tighten the mounting screws with a maximum torque of 0.8Nm. If the optional mounting bracket is not used, mount the sensor on a flat surface.
- 2) For the use UL and CSA approval KA1 photoelectric sensor, the connector and cable shall also bear the UL and CSA approval to use with.
- 3) The connector on the sensor's body side has a rotary structure. Be sure to rotate the connector according to the arrow mark on the sensor. The direction of connector must be determined before the sensor is mounted.
- 4) Rotate the connector with a maxi-

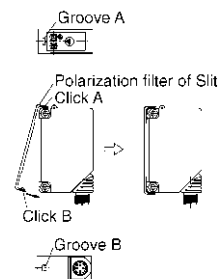


\*Rotating the connector in the reversed direction will damage the rotary structure.

mum torque of 0.2 Nm.

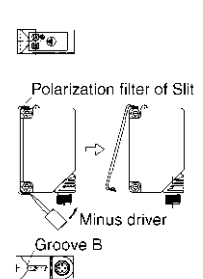
- 5) Handling for polarization filter and slit.

#### Installation



- ① Pull click A into groove A.
- ② Press the filter or slit on sensor to put click B into groove B.

#### Removal



- ① Insert minus driver to groove B.
- ② Move the minus driver to remove the click B from groove B.