

SA1E

Miniature Photoelectric Switches (Built-in Amplifier)

Through-beam, Polarized retro-reflective, Diffuse-reflective, Background suppression (BGS), Small-beam reflective, Convergent reflective, Coaxial polarized retro-reflective



Improved for easier, more convenient usage!



Through-beam



Polarized Retro-reflective



Diffuse-reflective



Background Suppression (BGS)

SA1E

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(Built-in Amplifier)

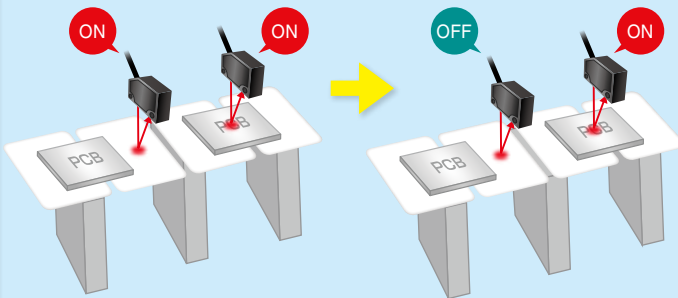


Background Suppression (BGS)

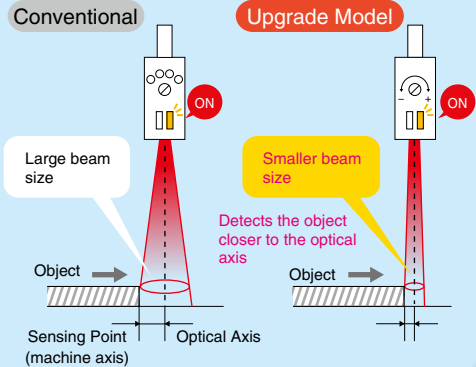
Ignores the background and detects the objects only. Smaller beam makes it possible to detect small objects and narrow gaps between the objects. The upgraded model is also less affected by the object colors.

Diffuse-reflective

Background Suppression (BGS)



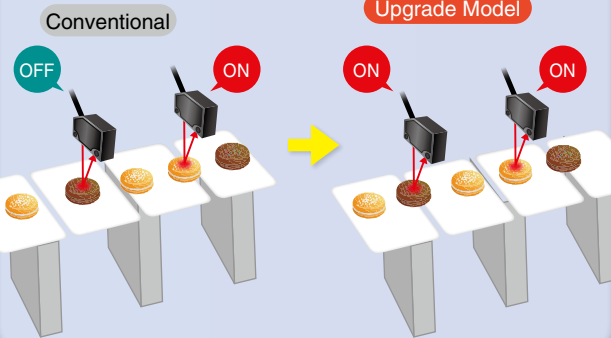
Background Suppression (BGS)



Detects objects of different colors

The improved sensing ability detects objects of different colors such as black and white more accurately.

Background Suppression (BGS)

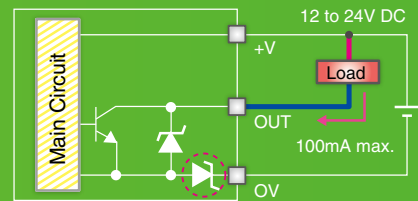


Output reverse-polarity protection circuit

Several SA1E models are protected from incorrect wiring:

- Through-beam with infrared LED sensitivity adjustment
- Polarized retro-reflective with sensitivity adjustment
- Diffuse-reflective
- Background Suppression (BGS)
- Small-beam Reflective

Upgrade Model



Protected!



Application Examples

Through-beam

Polarized Retro-reflective

Diffuse-reflective

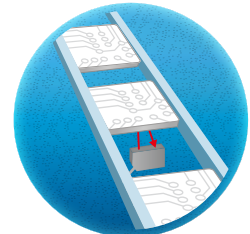
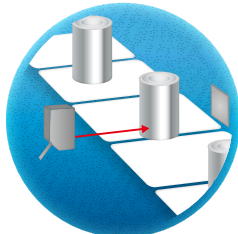
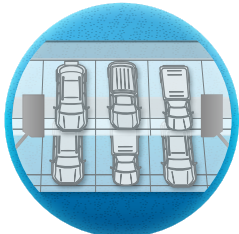
Background Suppression (BGS)

Multi-story parking lot

Mirror-like objects

Automatic faucet

PCB line



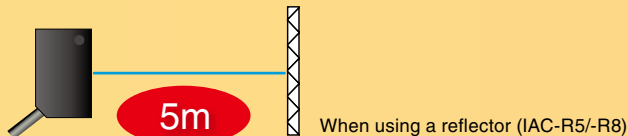
Upgraded SA1E

Long Distance Detection

Through-beam with infrared LED sensitivity adjustment

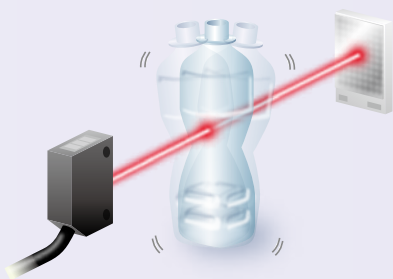


Polarized retro-reflective with sensitivity adjustment



Coaxial Polarized Retro-reflective (Transparent Object Sensing)

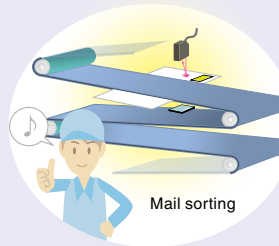
Coaxial optical structure and narrow beam ensure stable detection; unaffected by narrowing, inclination or shaking of a bottle.



Unaffected by object shapes.

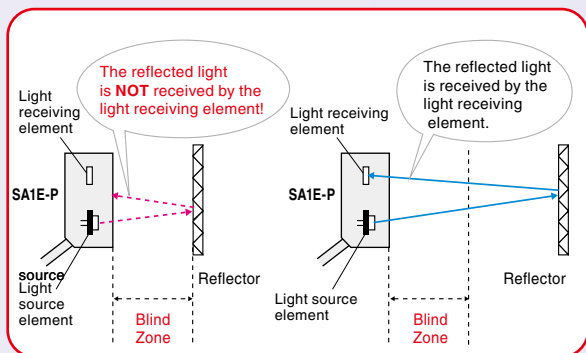


Application Example

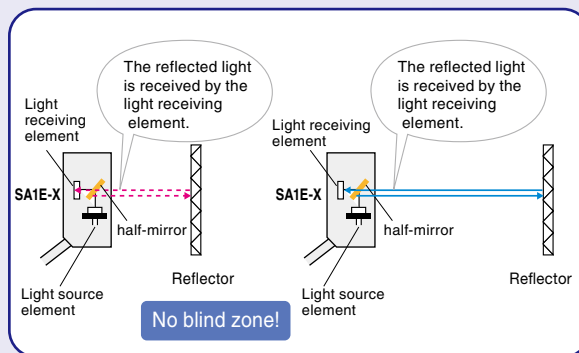


Because the SA1E-X co-axial polarized retroreflective model does not have blind zone, where the reflected light misses the light receiving element, like the SA1E-P polarized retro-reflective type, the SA1E-X can be used in applications where objects pass near the sensor.

Polarized Retro-reflective (non-coaxial)

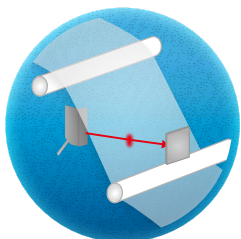


Coaxial Polarized Retro-reflective

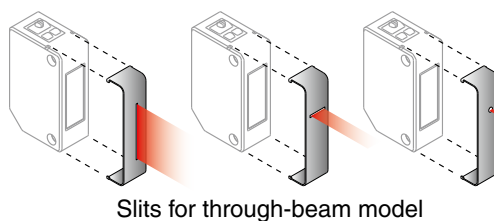


Coaxial Polarized Retro-reflective

Transparent film edge detection



Various accessories



Slits for through-beam model



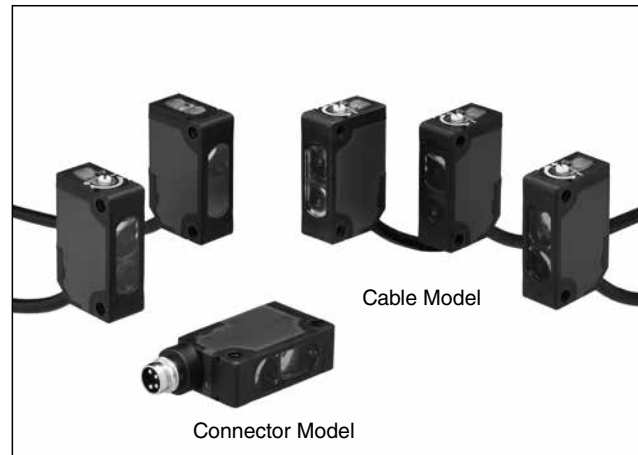
Mounting brackets

- 9 types of slits for through-beam model
- 4 types of mounting brackets
- 8 types of reflectors for coaxial polarized retro-reflective model
- Air blower mounting block

SA1E Miniature Photoelectric Switches (Built-in Amplifier)

Simple, compact design for world-wide usage.

- Seven sensing methods
- Cable model (three cable lengths) and M8 connector models are available.
- NPN output, PNP output, light ON, dark ON can be selected.
- Sensing range doubled with SA1E-T through-beam (infrared LED/ with sensitivity adjustment) and SA1E-P polarized retro-reflective models (with sensitivity adjustment).
- Highly stable with excellent resistance against vibration and shock resistance.
- Coaxial polarized retro-reflective model (SA1E-X) ensures stable detection, unaffected by construction, inclination or shaking of the object, and a high-speed response and small beam ensure reliable counting of target objects moving at high speed.
- Air blower mounting block for installing an air blower to clean the lens surface. Ideal to maintain a clean lens surface and sensor performance.
- Nine types of slits for through-beam models available.
- CE marked, UL listed.

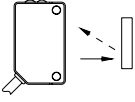
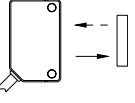
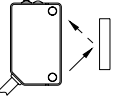
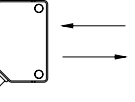


Package Quantity: 1

| Sensing Method | | | Sensing Range | Connection | Cable Length | Operation Mode | Part No. | |
|----------------------------|--|----------|---|------------|--------------|----------------|--------------|--------------|
| | | | | | | | NPN Output | PNP Output |
| Through-beam | Infrared LED w/Sensitivity Adjustment | | | Cable | 1m | Light ON | SA1E-TN1 | SA1E-TP1 |
| | | | | | | Dark ON | SA1E-TN2 | SA1E-TP2 |
| | | | | | 2m | Light ON | SA1E-TN1-2M | SA1E-TP1-2M |
| | Dark ON | | | | | SA1E-TN2-2M | SA1E-TP2-2M | |
| | 5m | | | | Light ON | SA1E-TN1-5M | SA1E-TP1-5M | |
| | | | | | Dark ON | SA1E-TN2-5M | SA1E-TP2-5M | |
| Through-beam | Red LED w/Sensitivity Adjustment | | | Cable | 1m | Light ON | SA1E-TAN1 | SA1E-TAP1 |
| | | | | | | Dark ON | SA1E-TAN2 | SA1E-TAP2 |
| | | | | | 2m | Light ON | SA1E-TAN1-2M | SA1E-TAP1-2M |
| | | | | | | Dark ON | SA1E-TAN2-2M | SA1E-TAP2-2M |
| | | | | | 5m | Light ON | SA1E-TAN1-5M | SA1E-TAP1-5M |
| | | | | | | Dark ON | SA1E-TAN2-5M | SA1E-TAP2-5M |
| Polarized Retro-reflective | Red LED w/Sensitivity Adjustment | | <p>5.0m (50mm) When using IAC-R5/R8</p> <p>3.0m (50mm) When using IAC-R6</p> <p>2.0m (150mm) When using IAC-RS2</p> <p>1.3m (150mm) When using IAC-RS1</p> <p>1.6m (100mm) When using IAC-R7□</p> <p>Note: Maintain at least the distance shown in the () between the SA1E photoelectric switch and reflector. Reflectors are not supplied and must be ordered separately.</p> | Cable | 1m | Light ON | SA1E-PN1 | SA1E-PP1 |
| | | | | | | Dark ON | SA1E-PN2 | SA1E-PP2 |
| | | | | | 2m | Light ON | SA1E-PN1-2M | SA1E-PP1-2M |
| | | | | | | Dark ON | SA1E-PN2-2M | SA1E-PP2-2M |
| | | | | | 5m | Light ON | SA1E-PN1-5M | SA1E-PP1-5M |
| | | | | | | Dark ON | SA1E-PN2-5M | SA1E-PP2-5M |
| Diffuse-reflective | Infrared LED w/Sensitivity Adjustment | | | Cable | 1m | Light ON | SA1E-DN1 | SA1E-DP1 |
| | | | | | | Dark ON | SA1E-DN2 | SA1E-DP2 |
| | | | | | 2m | Light ON | SA1E-DN1-2M | SA1E-DP1-2M |
| | | | | | | Dark ON | SA1E-DN2-2M | SA1E-DP2-2M |
| | | | | | 5m | Light ON | SA1E-DN1-5M | SA1E-DP1-5M |
| | | | | | | Dark ON | SA1E-DN2-5M | SA1E-DP2-5M |
| M8 Connector | — | Light ON | SA1E-DN1C | SA1E-DP1C | | | | |
| | | Dark ON | SA1E-DN2C | SA1E-DP2C | | | | |

SA1E Miniature Photoelectric Switches (Built-in Amplifier)

Package Quantity: 1

| Sensing Method | | Sensing Range | Connection | Cable Length | Operation Mode | Part No. | |
|------------------------------------|--|---|------------|--------------|----------------|-------------|-------------|
| | | | | | | NPN Output | PNP Output |
| Background Suppression | Red LED w/Sensitivity Adjustment |  <p>20 to 200 mm 40 to 200 mm Adjustable Sensing Range See the characteristics on page 17.</p> | Cable | 1m | Light ON | SA1E-BN1 | SA1E-BP1 |
| | | | | | Dark ON | SA1E-BN2 | SA1E-BP2 |
| | | | | 2m | Light ON | SA1E-BN1-2M | SA1E-BP1-2M |
| | | | | | Dark ON | SA1E-BN2-2M | SA1E-BP2-2M |
| | | | | 5m | Light ON | SA1E-BN1-5M | SA1E-BP1-5M |
| | | | | | Dark ON | SA1E-BN2-5M | SA1E-BP2-5M |
| M8 Connector | — | Light ON | SA1E-BN1C | SA1E-BP1C | | | |
| Dark ON | SA1E-BN2C | SA1E-BP2C | | | | | |
| Small-beam Reflective | Red LED w/Sensitivity Adjustment |  <p>50 to 150 mm See the characteristics on page 17.</p> | Cable | 1m | Light ON | SA1E-NN1 | SA1E-NP1 |
| | | | | | Dark ON | SA1E-NN2 | SA1E-NP2 |
| | | | | 2m | Light ON | SA1E-NN1-2M | SA1E-NP1-2M |
| | | | | | Dark ON | SA1E-NN2-2M | SA1E-NP2-2M |
| | | | | 5m | Light ON | SA1E-NN1-5M | SA1E-NP1-5M |
| | | | | | Dark ON | SA1E-NN2-5M | SA1E-NP2-5M |
| M8 Connector | — | Light ON | SA1E-NN1C | SA1E-NP1C | | | |
| Dark ON | SA1E-NN2C | SA1E-NP2C | | | | | |
| Convergent Reflective | Infrared LED w/Sensitivity Adjustment |  <p>5 to 35 mm See the characteristics on page 18</p> | Cable | 1m | Light ON | SA1E-GN1 | SA1E-GP1 |
| | | | | | Dark ON | SA1E-GN2 | SA1E-GP2 |
| | | | | 2m | Light ON | SA1E-GN1-2M | SA1E-GP1-2M |
| | | | | | Dark ON | SA1E-GN2-2M | SA1E-GP2-2M |
| | | | | 5m | Light ON | SA1E-GN1-5M | SA1E-GP1-5M |
| | | | | | Dark ON | SA1E-GN2-5M | SA1E-GP2-5M |
| M8 Connector | — | Light ON | SA1E-GN1C | SA1E-GP1C | | | |
| Dark ON | SA1E-GN2C | SA1E-GP2C | | | | | |
| Coaxial Polarized Retro-reflective | Red LED With Sensitivity Adjustment |  <p>Note: Reflector is not supplied and must be ordered separately.</p> <p>2.0m (when using IAC-R9) 1.0m [100 mm] (when using IAC-R10) 1.0m [100 mm] (when using IAC-R11) See the characteristics on page 18.</p> | Cable | 1 | Light ON | SA1E-XN1 | SA1E-XP1 |
| | | | | | Dark ON | SA1E-XN2 | SA1E-XP2 |
| | | | | 2 | Light ON | SA1E-XN1-2M | SA1E-XP1-2M |
| | | | | | Dark ON | SA1E-XN2-2M | SA1E-XP2-2M |
| | | | | 5 | Light ON | SA1E-XN1-5M | SA1E-XP1-5M |
| | | | | | Dark ON | SA1E-XN2-5M | SA1E-XP2-5M |
| M8 Connector | — | Light ON | SA1E-XN1C | SA1E-XP1C | | | |
| Dark ON | SA1E-XN2C | SA1E-XP2C | | | | | |

SA1E Miniature Photoelectric Switches (Built-in Amplifier)

Accessories (optional)

Slits (for through-beam)

| Item | Slit Size | Part No. | Ordering No. | Package Quantity |
|-----------------|-----------------|----------|--------------|------------------|
| Vertical Slit | 0.5 mm × 18 mm | SA9Z-S06 | SA9Z-S06PN02 | 2 |
| | 1.0 mm × 18 mm | SA9Z-S07 | SA9Z-S07PN02 | |
| | 2.0 mm × 18 mm | SA9Z-S08 | SA9Z-S08PN02 | |
| Horizontal Slit | 0.5 mm × 6.5 mm | SA9Z-S09 | SA9Z-S09PN02 | |
| | 1.0 mm × 6.5 mm | SA9Z-S10 | SA9Z-S10PN02 | |
| | 2.0 mm × 6.5 mm | SA9Z-S11 | SA9Z-S11PN02 | |
| Round Slit | ø0.5 mm | SA9Z-S12 | SA9Z-S12PN02 | |
| | ø1.0 mm | SA9Z-S13 | SA9Z-S13PN02 | |
| | ø2.0 mm | SA9Z-S14 | SA9Z-S14PN02 | |

Reflectors (for polarized retro-reflective)

| Item | Part No. | Package Quantity | |
|----------------------------|-----------------------------|------------------|---|
| Reflector | Standard | IAC-R5 | 1 |
| | Small | IAC-R6 | |
| | Large | IAC-R8 | |
| | Narrow (rear/side mounting) | IAC-R7M | |
| | Narrow (rear mounting) | IAC-R7B | |
| | Narrow (side mounting) | IAC-R7S | |
| | Tape Type (40 × 35 mm) | IAC-RS1 | |
| | Tape Type (80 × 70 mm) | IAC-RS2 | |
| Reflector Mounting Bracket | For IAC-R5 | IAC-L2 | |
| | For IAC-R6 | IAC-L3 | |
| | For IAC-R8 | IAC-L5 | |

- See page R-12 for dimensions.
- The IAC-L2 is not supplied with mounting screws and nuts. Use commercially available M4 screws and nuts for mounting the IAC-R5 reflector.
- The IAC-L3 is supplied with two mounting screws (M3 × 8 mm sems screws).
- The IAC-L5 is supplied with two mounting screws (M4 × 10 mm sems screws).
- The IAC-R7M and IAC-R7S are supplied with two M3 × 8 mm self-tapping screws, two flat washers, and two spring washers.
- The IAC-R7B is supplied with an M3 × 8 mm self-tapping screw, a flat washer, and a spring washer.

Sensor Mounting Brackets

| Item | Part No. | Package Quantity | |
|-----------------------------|---------------------|------------------|---|
| Main Unit Mounting Brackets | Vertical Mounting | SA9Z-K01 | 1 |
| | Horizontal Mounting | SA9Z-K02 | |
| | Cover type | SA9Z-K03 | |
| | Back Mounting | SA9Z-K04 | |

- Two mounting screws (M3 × 12 mm sems screws) are supplied with the SA9Z-K01 and SA9Z-K02.
- Two mounting screws (M3 × 14 mm sems screws) are supplied with the SA9Z-K03.
- The through-beam model requires two mounting brackets, one each for the projector and the receiver.
- The SA9Z-K02 cannot be used for the connector models.
- Contact IDEC about mounting brackets for the connector.

Connector Cable (for M8 connector model)

| Number of Core Wires | Style & Length | Part No. | Package Quantity |
|----------------------|-----------------|---------------|------------------|
| 4 | Straight, 2m | SA9Z-CM8K-4S2 | 1 |
| | Right angle, 2m | SA9Z-CM8K-4L2 | |
| | Straight, 5m | SA9Z-CM8K-4S5 | |
| | Right angle, 5m | SA9Z-CM8K-4L5 | |

Reflectors (used only for coaxial polarized retro-reflective)

| Item | Part No. | Package Quantity | |
|----------------------------|-------------|------------------|---|
| Reflector | Standard | IAC-R9 | 1 |
| | Small | IAC-R10 | |
| | Ultra-small | IAC-R11 | |
| Reflector Mounting Bracket | For IAC-R9 | IAC-L3 | |

Air Blower Mounting Block

| Item | Part No. | Package Quantity |
|---------------------------|----------|------------------|
| Air Blower Mounting Block | SA9Z-A02 | 1 |

- Two mounting screws (M3 × 20 mm sems screws), one M5 × 6 mm screw for plugging the air supply port, and one gasket (0.5 mm thick) are supplied.
- The air tube fitting and mounting bracket are not supplied and must be ordered separately (recommended mounting bracket: SA9Z-K01).
- Material: Anodized aluminum surface

Sensitivity Control Screwdriver

| Item | Part No. | Package Quantity |
|---------------------------------|-----------|------------------|
| Sensitivity Control Screwdriver | SA9Z-AD01 | 1 |



SA1E Miniature Photoelectric Switches (Built-in Amplifier)

Specifications

| Sensing Method | Through-beam | | Polarized Retro-reflective |
|---------------------------|--|---|--|
| | Infrared LED With sensitivity adjustment | Red LED With sensitivity adjustment | With sensitivity adjustment |
| Part No. | SA1E-T□ | SA1E-TA□ | SA1E-P□ |
| Power Voltage | 12 to 24V DC (Operating range: 10 to 30V DC) equipped with reverse-polarity protection | | |
| Current Draw | Projector: 15 mA Receiver: 20 mA | 30 mA | |
| Sensing Range | 20m | 10m | 5.0m (IAC-R5/R8) 3.0m (IAC-R6) 2.0m (IAC-RS2) 1.3m (IAC-RS1) 1.6m (IAC-R7□) (Note 1) |
| Adjustable Sensing Range | — | | |
| Detectable Object | Opaque | | |
| Hysteresis | — | | |
| Response Time | 1 ms maximum | | |
| Sensitivity Adjustment | Adjustable using a potentiometer (approx. 240°) Through-beam and polarized retro-reflective models are also available without sensitivity adjustment. | | |
| Sensing Range Adjustment | — | | |
| Light Source Element | Infrared LED | Red LED | |
| Operation Mode | Light ON/Dark ON | | |
| Control Output | NPN open collector or PNP open collector (30V DC, 100 mA maximum, short-circuit protection) | | |
| | Voltage drop: 2V max. (30V DC, 100 mA max) 1.2V max. (30V DC, 10 mA max) With output reverse connection protection control circuit | Voltage drop: 1.2V max. Voltage drop: 2V max. (30V DC, 100 mA max) 1.2V max. (30V DC, 10 mA max) With output reverse connection protection control circuit | |
| LED Indicators | Operation LED: Yellow Stable LED: Green Power LED: Green (Through-beam model projector) | | |
| Interference Prevention | — | | Two units can be mounted in close proximity. |
| Degree of Protection | IP67 (IEC 60529) | | |
| Extraneous Light Immunity | Sunlight: 10,000 lux maximum, Incandescent lamp: 5,000 lux maximum (at receiver) | | |
| Operating Temperature | -25 to +55°C (no freezing) | | |
| Operating Humidity | 35 to 85% RH (no condensation) | | |
| Storage Temperature | -40 to +70°C (no freezing) | | |
| Insulation Resistance | Between live part and mounting bracket: 20 MΩ maximum (500V DC megger) | | |
| Dielectric Strength | Between live part and mounting bracket: 1000V AC, 50/60 Hz, 1 minute | | |
| Vibration Resistance | Damage limits: 10 to 500 90 Hz, 1 cycle 5 mins, in each of 3 axes | Damage limits: 10 to 55 Hz, double amplitude 0.75 mm, 20 cycles in each of 3 axes | Damage limits: 10 to 500 90 Hz, 1 cycle 5 mins, in each of 3 axes |
| Shock Resistance | Damage limits: 1000 m/s ² , 6 shocks in each of 3 axes | Damage limits: 500 m/s ² , 10 shocks in each of 3 axes | Damage limits: 1000 m/s ² , 6 shocks in each of 3 axes |
| Material | Case | PC/PBT | |
| | Lens | PMMA | PC |
| | Indicator Model | PC | |
| Weight (approx.) | Cable Model | Projector: 30g, Receiver: 30g (Note 2) | 30g (Note 2) |
| | Connector Model | Projector: 10g, Receiver: 10g | 10g |
| Connection Method | Cable Model | ø3.5 mm, 3-core, 0.2 mm ² cable (2-core for the projector of through-beam model) | |
| | Connector Model | M8 connector (4-pin) | |

Note 1: Maintain at least the distance shown below between the SA1E photoelectric switch and reflector.

IAC-R5/R6/R8: 50 mm

IAC-R7: 100 mm

IAC-RS1/RS2: 150 mm

The detection distance cannot be guaranteed if the reflector is deformed or the tape type reflector is applied on uneven surface.

Note 2: Cable length: 1m (50g when the cable length is 2m. 110g when the cable length is 5m.)

SA1E Miniature Photoelectric Switches (Built-in Amplifier)

Specifications

| Sensing Method | Diffuse-reflective | Background Suppression (BGS) | Small-beam Reflective | Convergent Reflective | Coaxial Polarized Retro-reflective |
|---------------------------|--|--|--|---|---|
| Part No. | SA1E-D□ | SA1E-B□ | SA1E-N□ | SA1E-G□ | SA1E-X□ |
| Power Voltage | 12 to 24V DC (Operating range: 10 to 30V DC), equipped with reverse-polarity protection | | | | |
| Current Draw | 30 mA | | | | 20 mA |
| Sensing Range | 700 mm (using 200 × 200 mm white mat paper) | 20 mm to preset (using 200 × 200 mm white mat paper) | 50 to 150 mm (using 100 × 100 mm white mat paper) | 5 to 35 mm (using 100 × 100 mm white mat paper) | 2 m (using IAC-R9) |
| Adjustable Sensing Range | — | 40 to 200 mm | — | | |
| Detectable Object | Opaque/Transparent | Opaque | Opaque/Transparent | | Opaque, transparent and mirror-like objects |
| Hysteresis | 20% maximum | 10% maximum | 20% maximum | | — |
| Response Time | 1 ms maximum | | | | 500 μs maximum |
| Sensitivity Adjustment | Adjustable using a potentiometer (approx. 240°) | — | Adjustable using a potentiometer (approx. 240°) | | |
| Sensing Range Adjustment | — | 6-turn control knob | — | | |
| Light Source Element | Infrared LED | Red LED | Infrared LED | | Red LED |
| Operation Mode | Light ON/Dark ON | | | | |
| Control Output | NPN open collector or PNP open collector (30V DC, 100 mA maximum with short circuit protection circuit) | | | | |
| | Voltage drop: 2V max. (30V DC, 100 mA) 1.2V max. (30V DC, 100 mA) Output reverse-polarity protection circuit | Voltage drop: 2V max. (30V DC, 100 mA) Output reverse-polarity protection circuit | Voltage drop: 2V max. (30V DC, 100 mA) 1.2V max. (30V DC, 100 mA) Output reverse-polarity protection circuit | Voltage drop: 1.2V max. (30V DC, 100mA) | Voltage drop: 2V max. (30V DC, 100mA) |
| LED Indicators | Operation LED: Yellow Stable LED: Green | Operation LED: Yellow | Operation LED: Yellow Stable LED: Green | | Operation LED: Yellow |
| Interference Prevention | Two units can be mounted in close proximity. | | | | |
| Degree of Protection | IP67 (IEC 60529) | | | | |
| Extraneous Light Immunity | Sunlight: 10,000 lux maximum, Incandescent lamp: 5,000 lux maximum (at receiver) | | | | |
| Operating Temperature | -25 to +55°C (no freezing) | | | | |
| Operating Humidity | 35 to 85% RH (no condensation) | | | | |
| Storage Temperature | -40 to +70°C (no freezing) | | | | |
| Insulation Resistance | Between live part and mounting bracket: 20 MΩ maximum (500V DC megger) | | | | |
| Dielectric Strength | Between live part and mounting bracket: 1000V AC, 50/60 Hz, 1 minute | | | | |
| Vibration Resistance | Damage limits: 10 to 500 Hz, 1 cycle 5 mins in each of 3 axes | | Damage limits: 10 to 55 Hz, double amplitude 1.5mm, 20 cycles in each of 3 axes | | |
| Shock Resistance | Damage limits: 1000 m/s ² , 6 shocks in each of 3 axes | | Damage limits: 500 m/s ² , 10 shocks in each of 3 axes | | |
| Material | Housing | PC/PBT | | PBT | PC/PBT |
| | Lens | PMMA | | | PC |
| | Indicator cover | PC | | | |
| Weight (approx.) | Cable Model | 30g (Note 1) | 35g (Note 2) | 30g (Note 1) | |
| | Connector Model | 10g | 25g | 10g | |
| Connection Method | Cable Model | ø3.5 mm, 3-core, 0.2 mm ² cable | | | |
| | Connector Model | M8 connector (4-pin) | | | |

Note 1: Cable length: 1m (50g when the cable length is 2m. 110g when the cable length is 5m.)

Note 2: Cable length: 1m (55g when the cable length is 2m. 120g when the cable length is 5m.)

SA1E Miniature Photoelectric Switches (Built-in Amplifier)

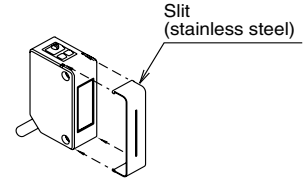
Slit and Sensing Range

A slit, which changes the beam size of through-beam sensors, can easily be attached to the sensing side of the through-beam projector and receiver. Three different slit widths are available.

| Slit | | w/Sensitivity Adjustment | | | |
|--------------|----------------------------|--------------------------|--------------------|---|--------------------|
| | | Sensing Range (m) | | Minimum Detectable Object Width (mm) (Note 1) | |
| Attached on: | | | | | |
| Part No. | Slit Width: A (see page 9) | Receiver | Receiver/Projector | Receiver | Receiver/Projector |
| SA9Z-S06 | 0.5 mm | 2.5 | 1.0 | 0.5 | 0.5 |
| SA9Z-S07 | 1.0 mm | 3.5 | 1.5 | 1.0 | 1.0 |
| SA9Z-S08 | 2.0 mm | 6.0 | 3.5 | 2.0 | 2.0 |
| SA9Z-S09 | 0.5 mm | 2.0 | 0.7 | 0.5 | 0.5 |
| SA9Z-S10 | 1.0 mm | 3.0 | 1.5 | 1.0 | 1.0 |
| SA9Z-S11 | 2.0 mm | 5.5 | 3.0 | 2.0 | 2.0 |
| SA9Z-S12 | 0.5 mm | 0.8 | 0.08 | 0.5 | 0.5 |
| SA9Z-S13 | 1.0 mm | 1.5 | 0.3 | 1.0 | 1.0 |
| SA9Z-S14 | 2.0 mm | 2.5 | 1.2 | 2.0 | 2.0 |

Note 1: At 1mm from receiver surface.

Note 2: The slit can be installed onto the front easily (see the figure at right).

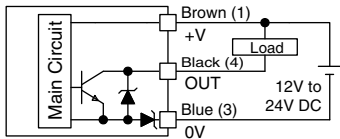


Horizontal slits and round slits have an orientation. Make sure that the TOP marking comes on top of the sensor (LED side).

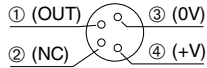
Output Circuit & Wiring Diagram

Through-beam (infrared LED w/sensitivity adjustment)
 Polarized reflective (w/sensitivity adjustment)
 Diffuse-reflective
 Background suppression
 Small-beam reflective

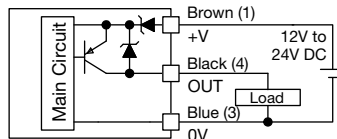
NPN Output



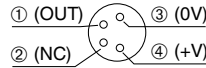
Connector Pin Assignment



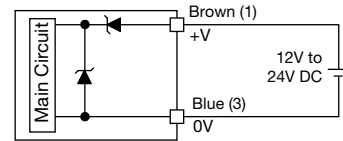
PNP Output



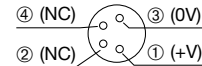
Connector Pin Assignment



Through-beam Projector

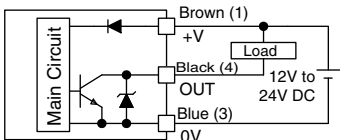


Connector Pin Assignment

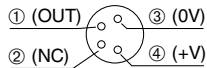


Through-beam (infrared/red LED)
 Convergent reflective
 Coaxial polarized retro-reflective

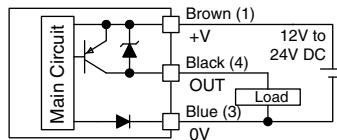
NPN Output



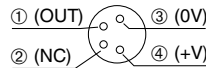
Connector Pin Assignment



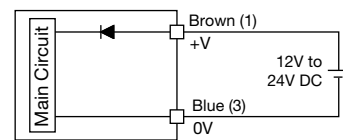
PNP Output



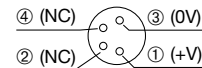
Connector Pin Assignment



Through-beam Projector



Connector Pin Assignment



SA1E Miniature Photoelectric Switches (Built-in Amplifier)

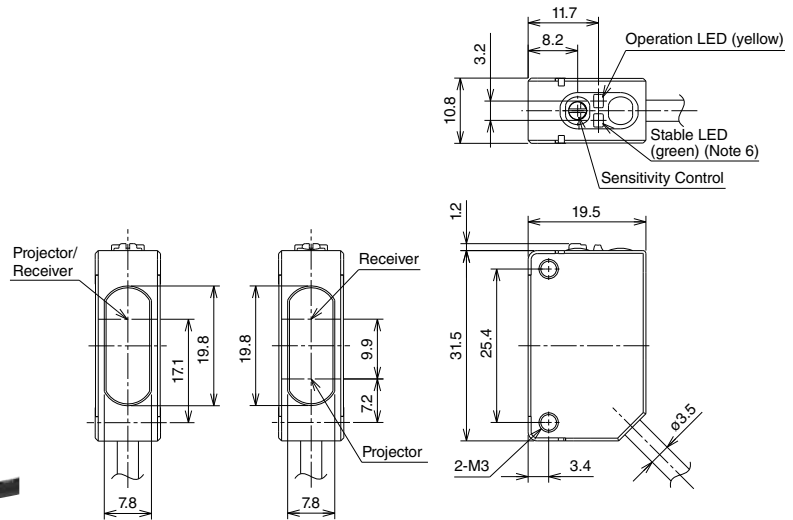
Dimensions

Cable Model

Through-beam
(infrared LED w/sensitivity adjustment)



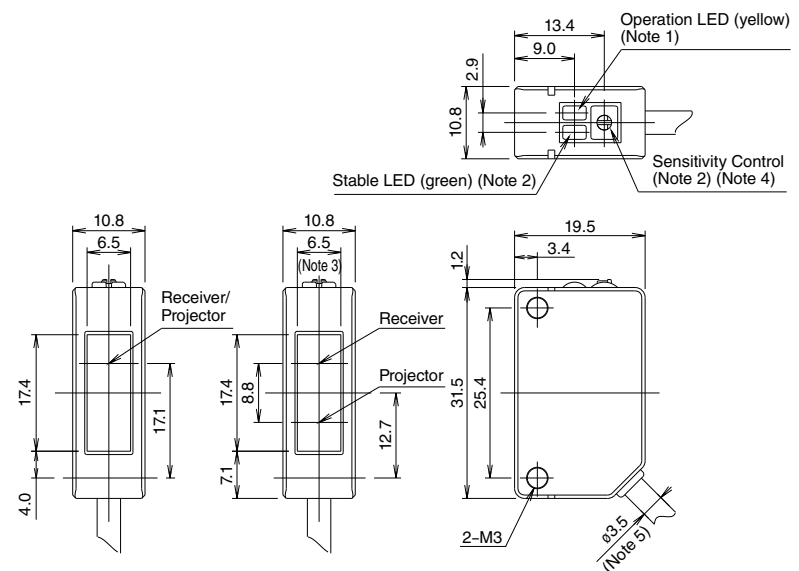
Polarized retro-reflective
(with sensitivity adjustment)
Diffuse-reflective
Background Suppression (BGS)
Small-beam reflective



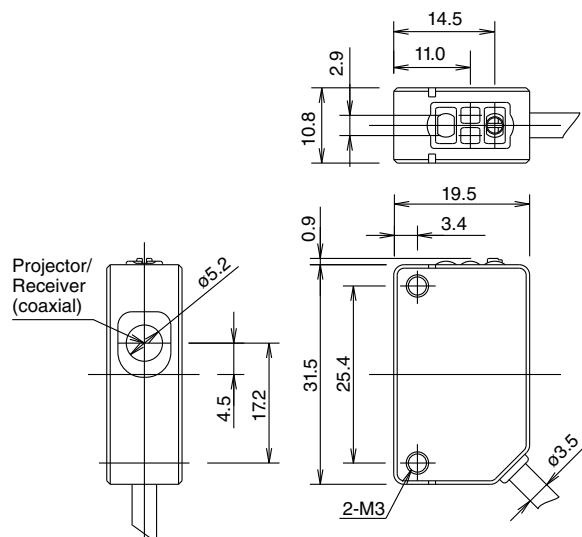
Through-beam
(infrared LED without/sensitivity adjustment)
(red LED with sensitivity adjustment)



Polarized retro-reflective
(without sensitivity adjustment)
Convergent reflective



Coaxial polarized retro-reflective



SA1E Miniature Photoelectric Switches (Built-in Amplifier)

Dimensions

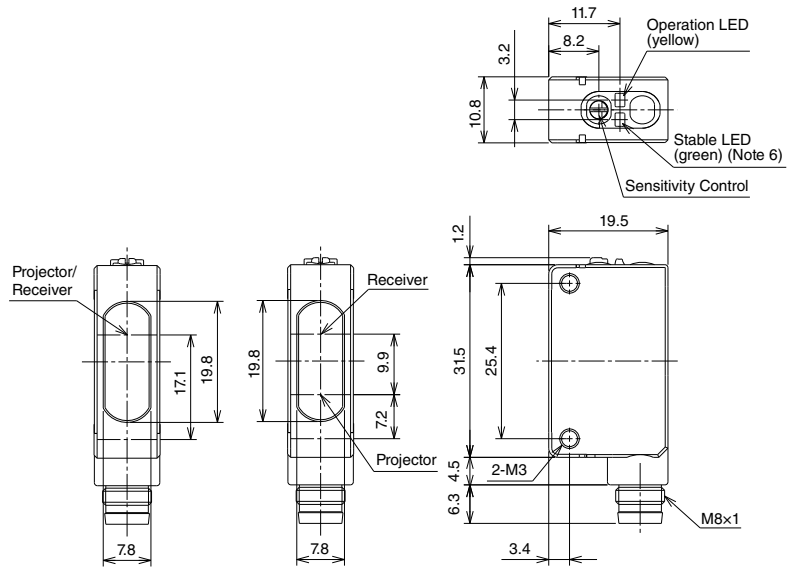
Connector Model

Through-beam
(infrared LED w/sensitivity adjustment)



(with right angle connector)

Polarized retro-reflective
(with sensitivity adjustment)
Diffuse-reflective
Background Suppression (BGS)
Small-beam reflective

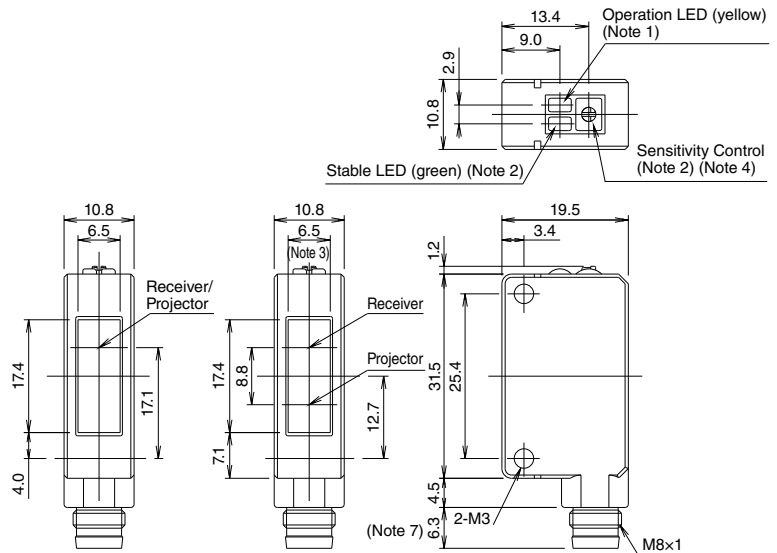


Through-beam (red LED with sensitivity adjustment)

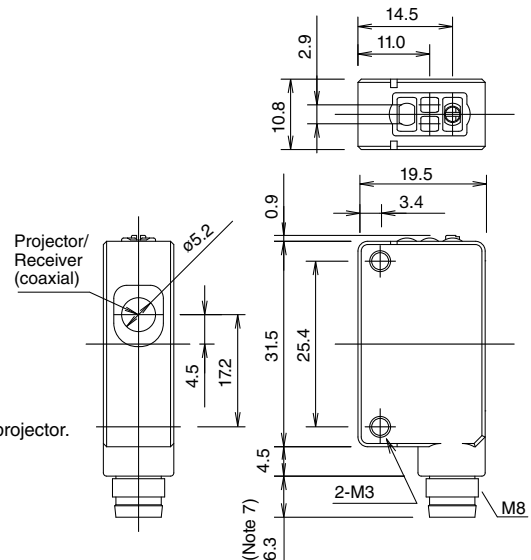


(with right angle connector)

Convergent reflective



Coaxial polarized retro-reflective



Note 1: Power ON LED (green) for through-beam projector

Note 2: No sensitivity control and stable LED are attached on the through-beam projector.

Note 3: 5.2 mm for polarized retro-reflective model

Note 4: Cable length depends on model.

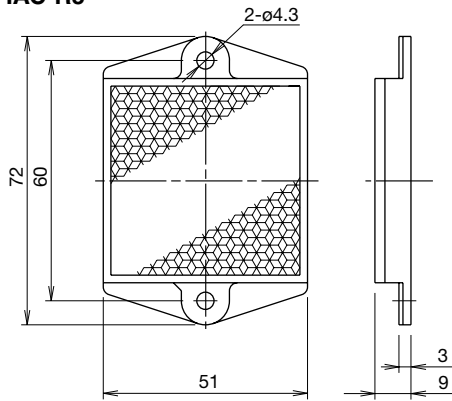
Note 5: Stable LED is not provided on the background suppression model.

Note 6: The connector length is 18 mm when a right-angle connector cable (SA9Z-CM8K-4L*) is attached.

SA1E Miniature Photoelectric Switches (Built-in Amplifier)

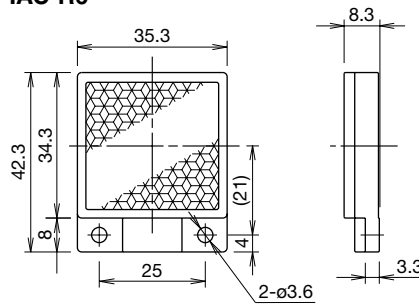
Reflectors

IAC-R5



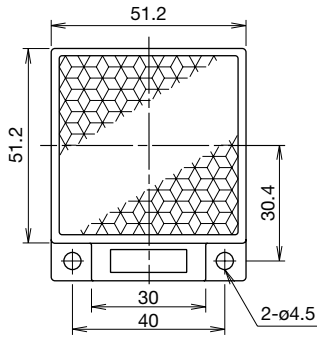
(Effective reflecting area: 47.2 × 47.2)

IAC-R6



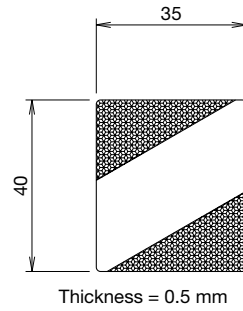
(Effective reflecting area: 30 × 31)

IAC-R8



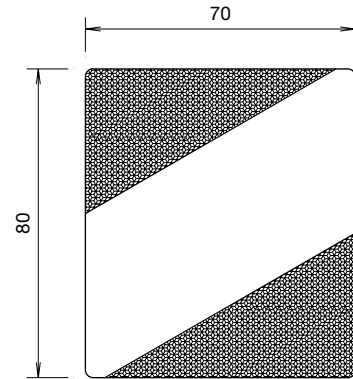
(Effective reflecting area: 47 × 47)

IAC-RS1



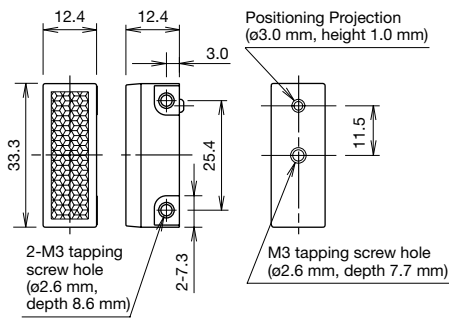
Thickness = 0.5 mm

IAC-RS2

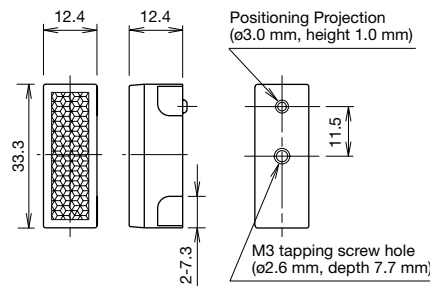


Thickness = 0.5 mm

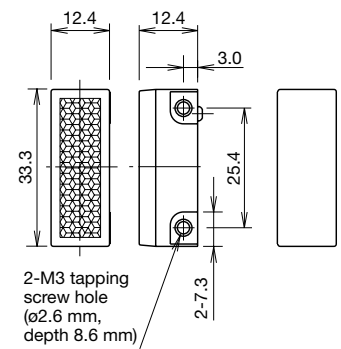
IAC-R7M (rear/side mounting)



IAC-R7B (rear mounting)



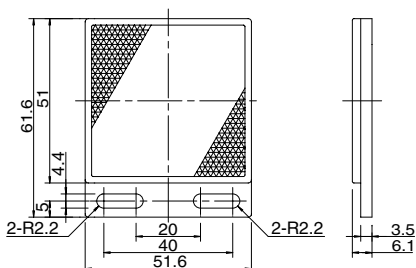
IAC-R7S (side mounting)



- Effective reflecting area: 8.6 × 29.5
- The mounting plate for reflector must be 0.8 to 2.5 mm in thickness.

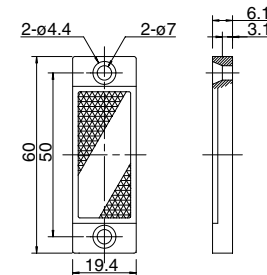
All dimensions in mm.

IAC-R9



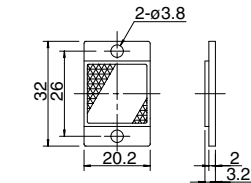
(Reflecting surface 47×47.6)

IAC-R10



(Reflecting surface 38.5×16)

IAC-R11



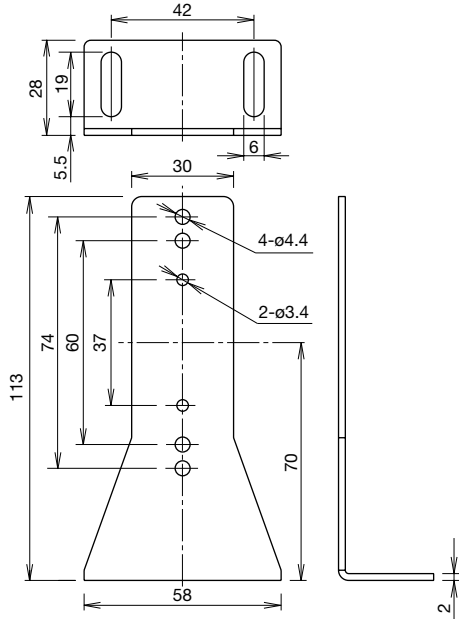
(Reflecting surface 18×18.2)

SA1E Miniature Photoelectric Switches (Built-in Amplifier)

Dimensions

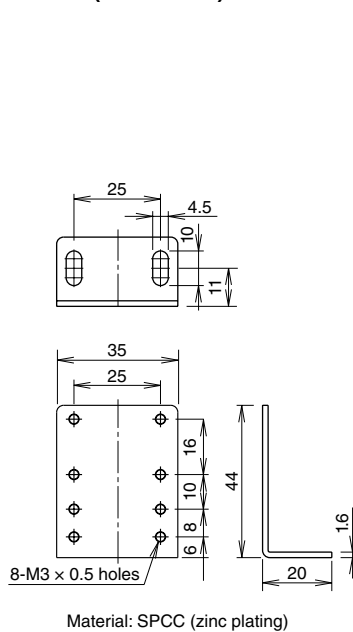
Reflector Mounting Brackets

IAC-L2 (for IAC-R5)



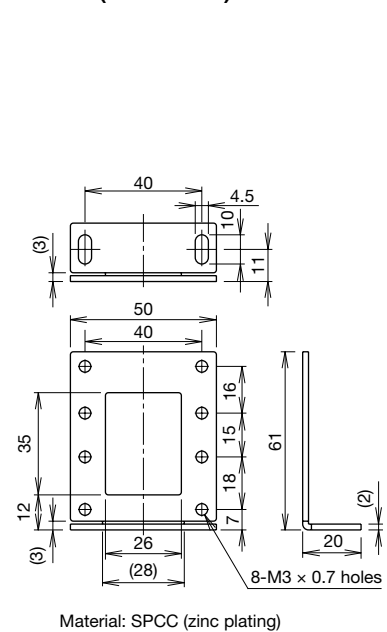
Material: SPCC (zinc chromate plating, black)

IAC-L3 (for IAC-R6)



Material: SPCC (zinc plating)

IAC-L5 (for IAC-R8)

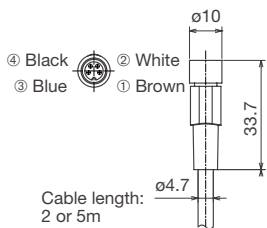


Material: SPCC (zinc plating)

Connector Cable (connector on one end)

Straight

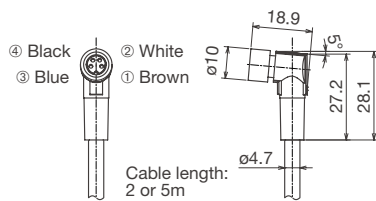
(SA9Z-CM8K-4S□)



- Dielectric strength when installed on the SA1E: 1000V AC (between live part and mounting bracket, except between live part and tightening ring)

Right-angle

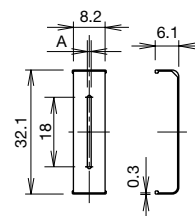
(SA9Z-CM8K-4L□)



Cable length:
2 or 5m

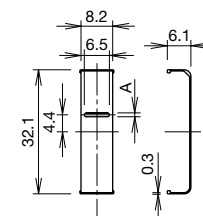
Vertical Slit

- SA9Z-S06
- SA9Z-S07
- SA9Z-S08



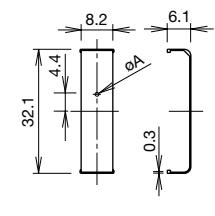
Horizontal Slit

- SA9Z-S09
- SA9Z-S10
- SA9Z-S11



Round Slit

- SA9Z-S12
- SA9Z-S13
- SA9Z-S14



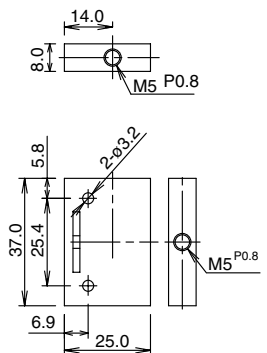
Material: Stainless Steel

Note: For slit width A, see page 9.

All dimensions in mm.

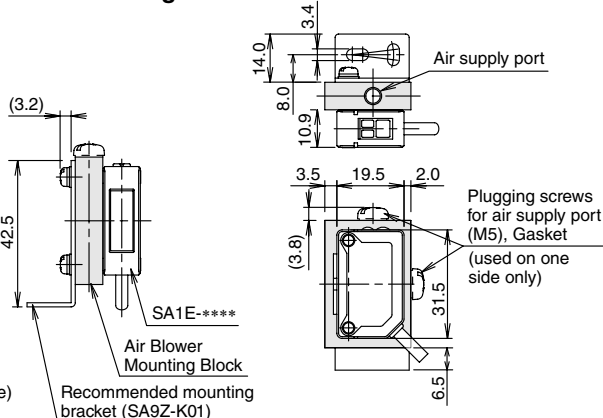
Air Blower Mounting Block

SA9Z-A02



(Material: Anodized aluminum surface)

With Mounting Bracket



- The SA9Z-A02 air blower mounting block is supplied with two mounting screws (M3 x 20 mm sems screws), one screw for plugging the air supply port (M5 x 6 mm), and one gasket for plugging the air supply port.
- An air tube fitting (M5) can be installed to either the top or side. Tighten the fitting to a torque of 0.5 N-m maximum.
- The air tube fitting and mounting bracket are not supplied and must be ordered separately (recommended mounting bracket: SA9Z-K01).

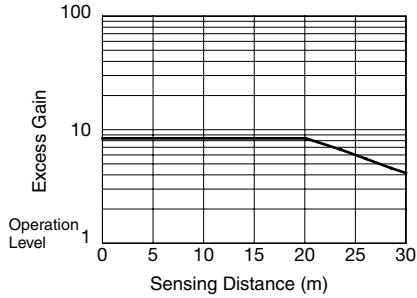
All dimensions in mm.

SA1E Miniature Photoelectric Switches (Built-in Amplifier)

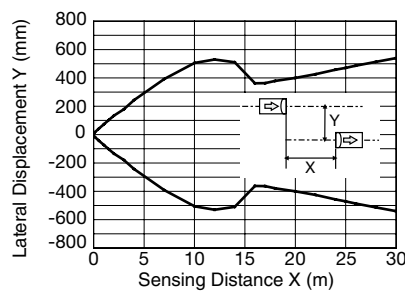
Characteristics (Typical)

1-1. Through-beam SA1E-T□ (Infrared LED w/sensitivity adjustment)

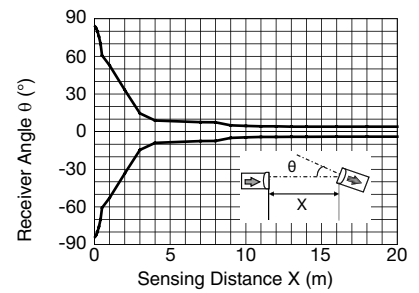
Excess Gain (Without slit)



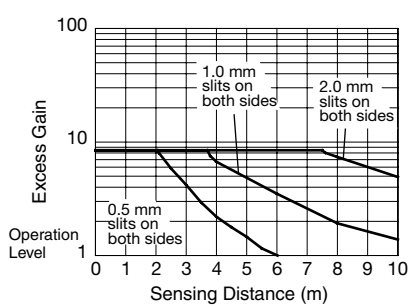
Lateral Displacement (Without slit)



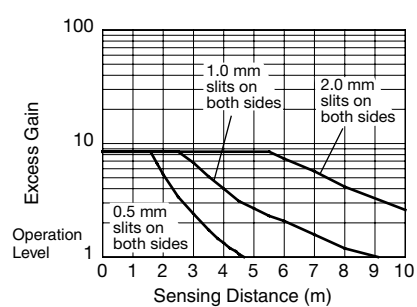
Angle (Without slit)



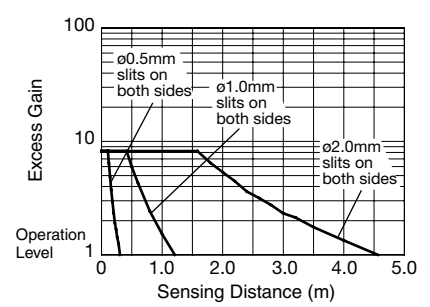
Excess Gain (With vertical slit)



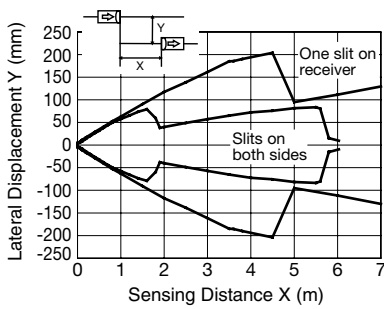
Excess Gain (With horizontal slit)



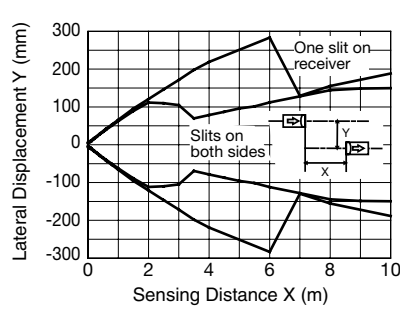
Excess Gain (With round slit)



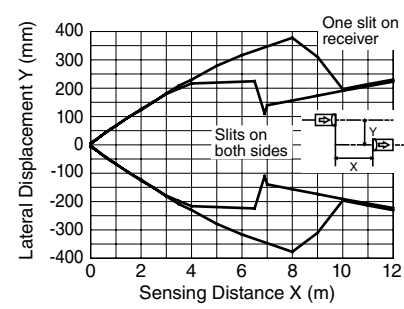
Lateral Displacement (With 0.5-mm vertical slit)



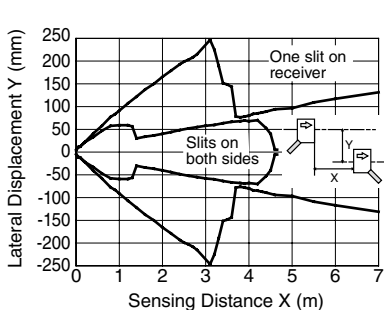
Lateral Displacement (With 1.0-mm vertical slit)



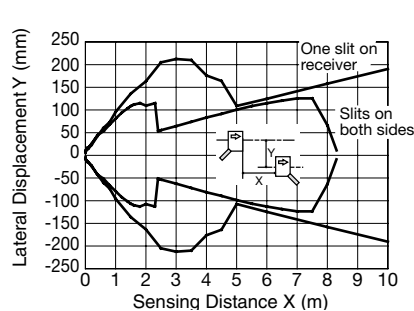
Lateral Displacement (With 2.0-mm vertical slit)



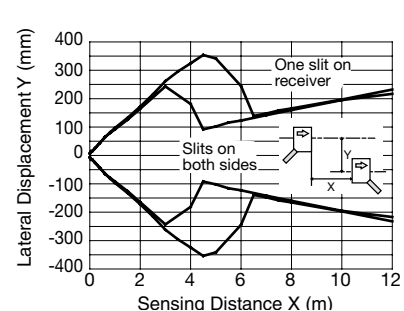
Lateral Displacement (With 0.5-mm horizontal slit)



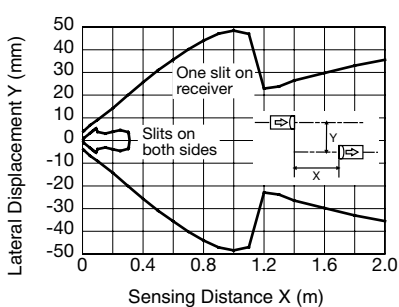
Lateral Displacement (With 1.0-mm horizontal slit)



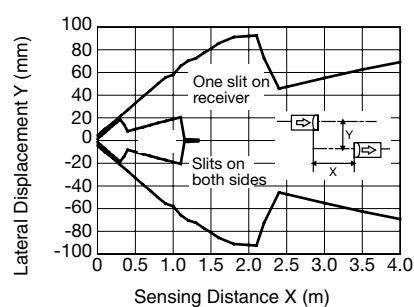
Lateral Displacement (With 2.0-mm horizontal slit)



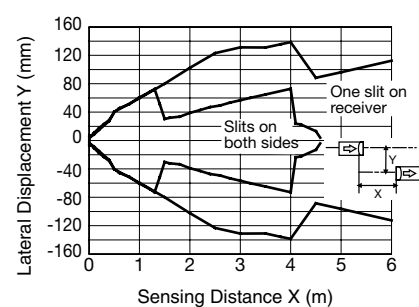
Lateral Displacement (With ø0.5-mm round slit)



Lateral Displacement (With ø1.0-mm round slit)



Lateral Displacement (With ø2.0-mm round slit)

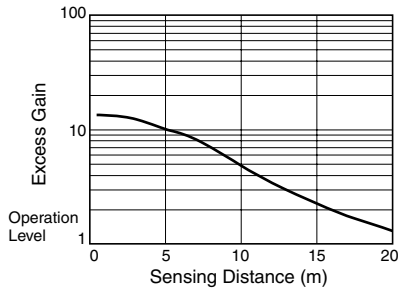


SA1E Miniature Photoelectric Switches (Built-in Amplifier)

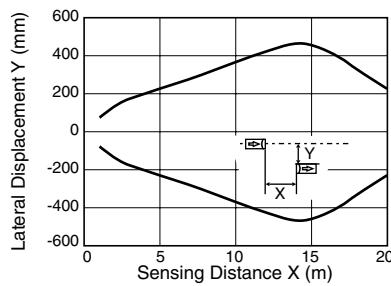
Characteristics (Typical)

1-3. Through-beam SA1E-TA□ (Red LED w/sensitivity adjustment)

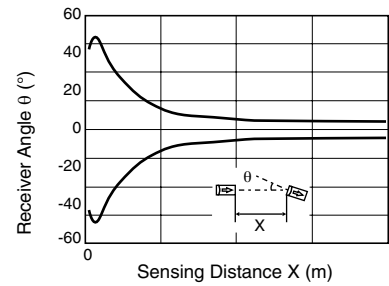
Excess Gain (Without slit)



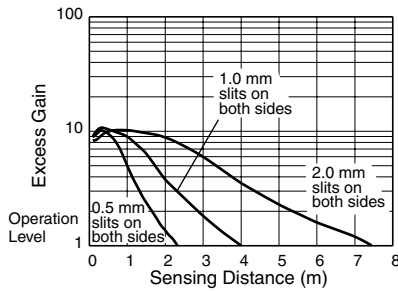
Lateral Displacement (Without slit)



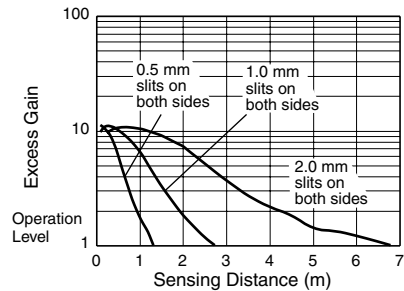
Angle (Without slit)



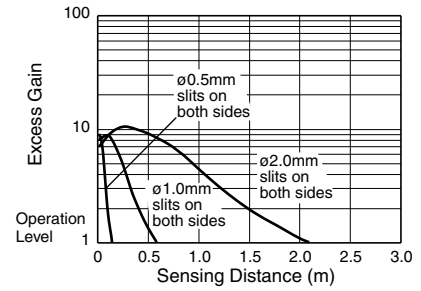
Excess Gain (With vertical slit)



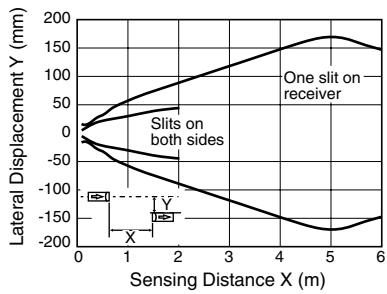
Excess Gain (With horizontal slit)



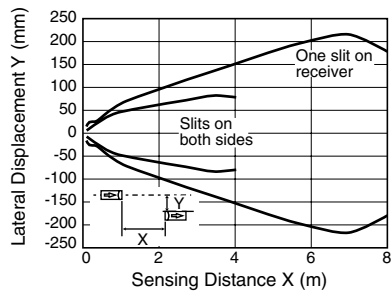
Excess Gain (With round slit)



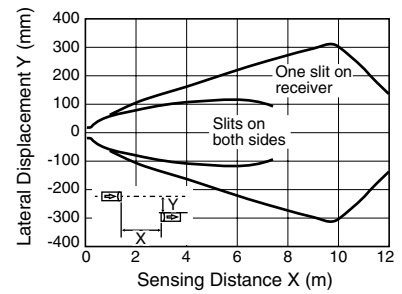
Lateral Displacement (With 0.5-mm vertical slit)



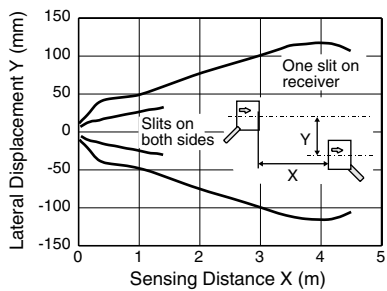
Lateral Displacement (With 1.0-mm vertical slit)



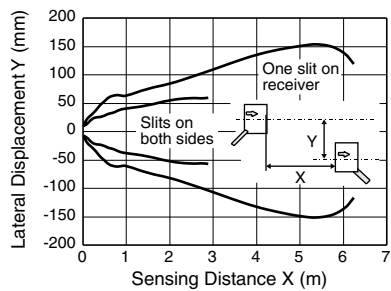
Lateral Displacement (With 2.0-mm vertical slit)



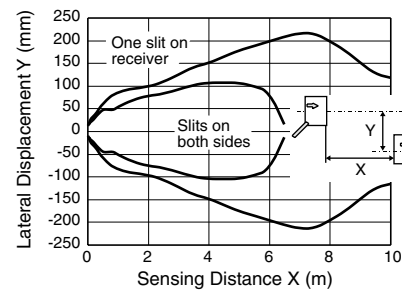
Lateral Displacement (With 0.5-mm horizontal slit)



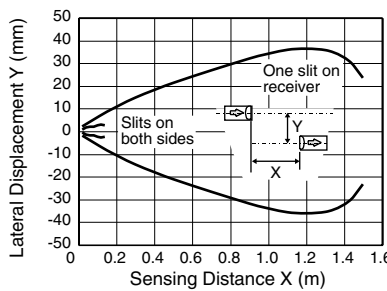
Lateral Displacement (With 1.0-mm horizontal slit)



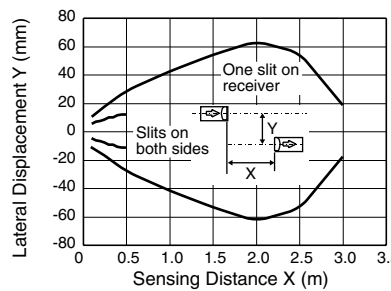
Lateral Displacement (With 2.0-mm horizontal slit)



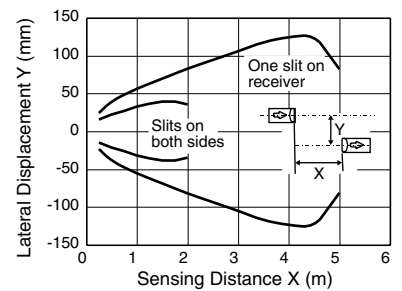
Lateral Displacement (With ø0.5-mm round slit)



Lateral Displacement (With ø1.0-mm round slit)



Lateral Displacement (With ø2.0-mm round slit)

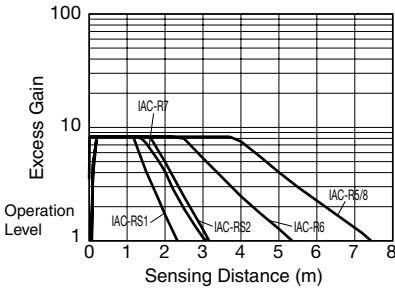


SA1E Miniature Photoelectric Switches (Built-in Amplifier)

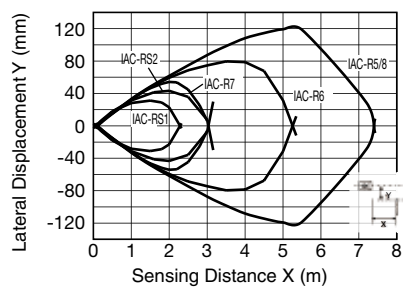
Characteristics (Typical)

2. Polarized Retro-reflective SA1E-P□ (Red LED w/sensitivity adjustment)

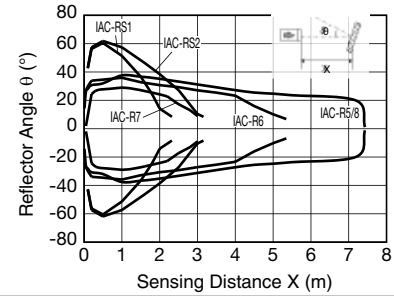
Excess Gain



Lateral Displacement

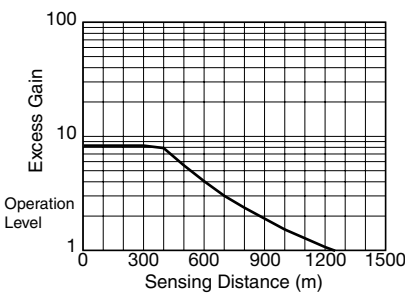


Angle (when using IAC-R5/-R8)

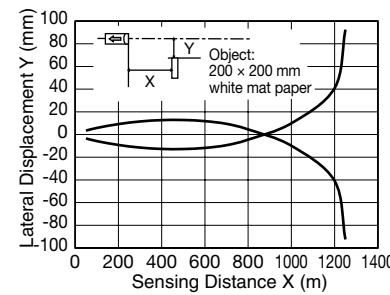


3. Diffuse-Reflective SA1E-D□ (Infrared LED w/sensitivity adjustment)

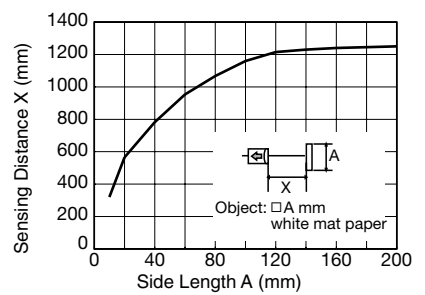
Excess Gain



Lateral Displacement

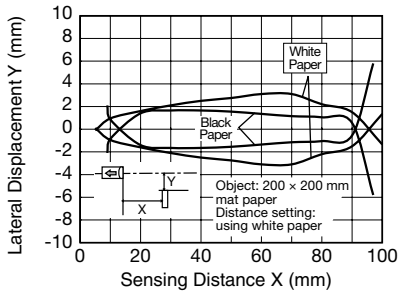


Angle (when using IAC-R5/-R8)

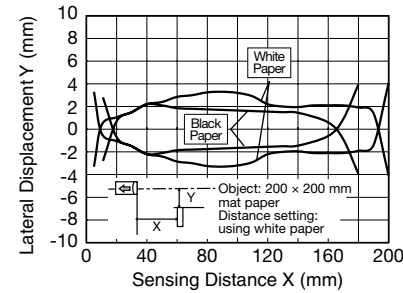


4. Background Suppression SA1E-B□ (Red LED w/sensitivity adjustment)

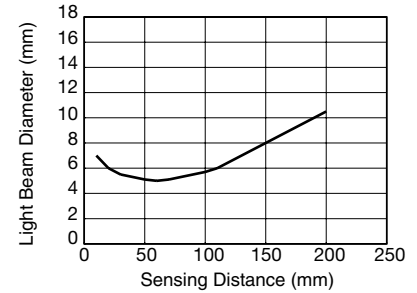
Lateral Displacement (Preset 100 mm)



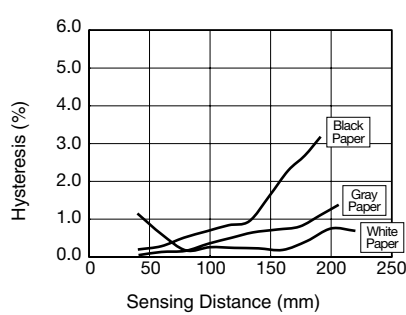
Lateral Displacement (Preset 200 mm)



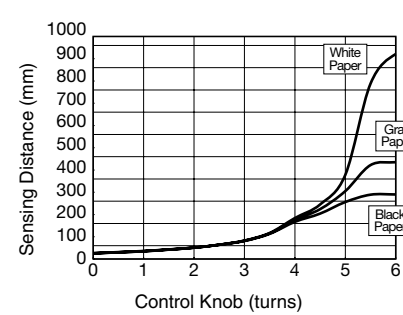
Light Beam Diameter



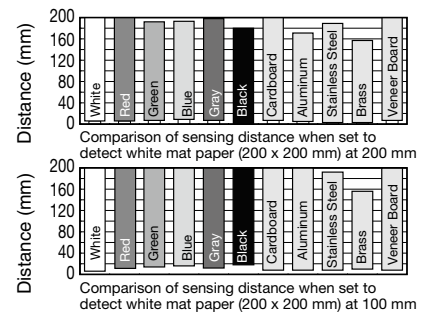
Sensing Distance vs. Hysteresis



Control Knob vs. Sensing Distance

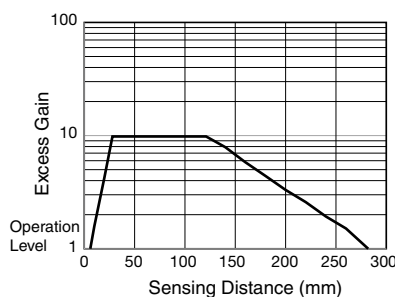


Color Matte Paper and Other Materials

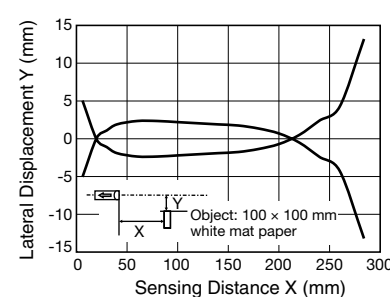


5. Small-beam Reflective SA1E-N□ (Red LED w/sensitivity adjustment)

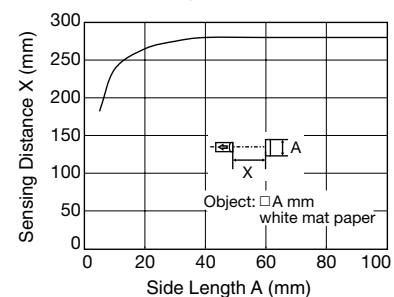
Excess Gain



Lateral Displacement



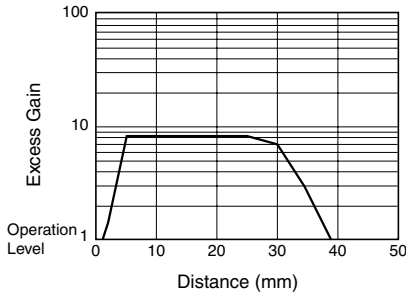
Object Size vs Sensing Distance



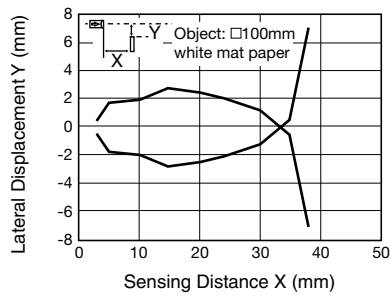
SA1E Miniature Photoelectric Switches (Built-in Amplifier)

6. Convergent Reflective SA1E-G□ (Infrared LED w/sensitivity adjustment)

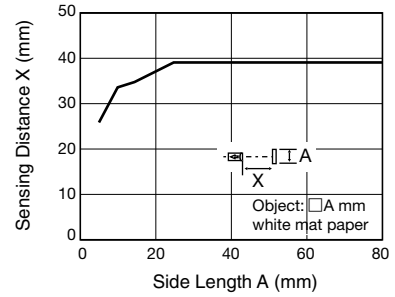
Excess Gain



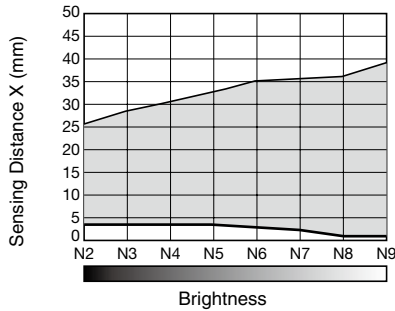
Lateral Displacement



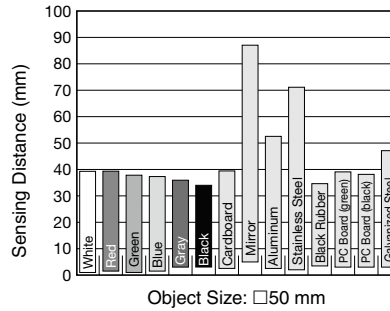
Object Size vs. Sensing Distance



Brightness vs. Sensing Distance



Color Matte Paper and Other Materials

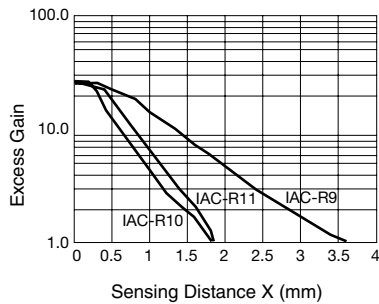


- The graph on the left shows the sensing distances for different colors and materials and can be used as a reference when setting the distance. Because sensing distance depends on the object's size and surface condition, provide a sufficient distance.
- Note that sensing may be affected by reflective object behind the sensing object.
- Referring to the graph on the left, provide a sufficient distance between the photoelectric switch and background.

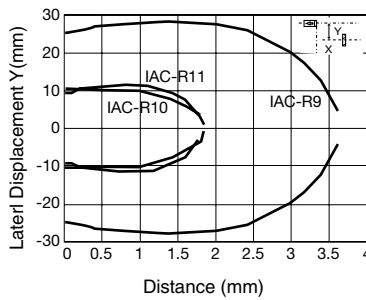
Object: Colour chips of colour standards according to JIS Z8721 (Non Glossy Edition)

7. Coaxial Polarized Retro-reflective SA1E-X□ (Infrared LED w/sensitivity adjustment)

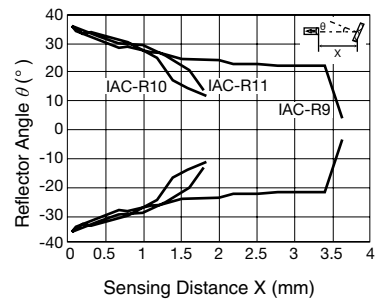
Excess Gain



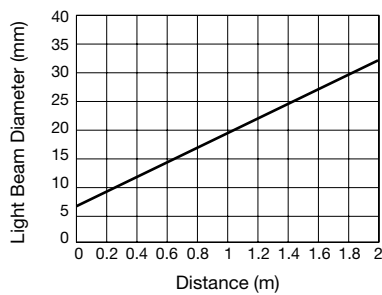
Lateral Displacement



Angle



Light Beam Diameter

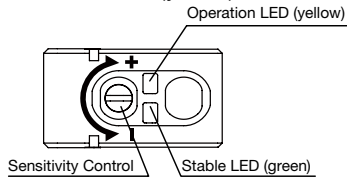


SA1E Miniature Photoelectric Switches (Built-in Amplifier)

Instructions

1. Indicator and Output Operation (except for background suppression model)

- The operation LED turns on (yellow) when the control output is on.



- The stable LED turns on (green) either at stable incident or stable interruption. Make sure to use the photoelectric switch after the stable operation is ensured.
- In the light ON operation, the output turns on when the receiving light intensity level is 1.0 or over as shown on the right.
- In the dark-ON operation, the output turns on when the receiving light intensity level is 1.0 or less as shown on the right.

| Receiving Light Intensity Level | Light Receiving Status | Stable LED (green) | Operation LED (yellow)/ Control Output | |
|---------------------------------|------------------------|-----------------------|--|---------|
| | | | Light ON | Dark ON |
| Operation Level | 1.2 and over | Stable Incident | ON | OFF |
| | 1.0 | Unstable Incident | | |
| | | Unstable Interruption | OFF | |
| 0.8 and below | Stable Interruption | ON | OFF | ON |

2. Optical Axis Alignment (Light ON)

Through-beam

Fasten the receiver temporarily. Place the projector to face the receiver. Move the projector up, down, right and left to find the range where the operation LED turns on. Fasten the projector in the middle of the range. Next, move the receiver up, down, right and left in the same manner and fasten in the middle of the range where the operation LED turns on. Make sure that stable LED turns on at stable incident and stable interruption.

Polarized retro-reflective

Install the reflector perpendicularly to the optical axis. Move the SA1E photoelectric switch up, down, right and left to find the range where the operation LED turns on. Fasten the switch in the middle of the range. Polarized retro-reflective model can be installed also by finding the position where the reflection of projected red light is most intense, while observing the reflection on the reflector from behind the switch. Make sure that stable LED turns on at stable incident and stable interruption.

Diffuse-reflective/Small-beam reflective/ Convergent reflective

Place the SA1E photoelectric switch where the switch can detect the object. Move the switch up, down, right and left to find the range where the operation LED turns on. Fasten the switch in the middle of the range. Make sure that stable LED turns on at stable incident and stable interruption. Because the light source element of small-beam reflective model is a red LED, visual inspection is possible as well.

3. Sensitivity Adjustment

Referring to the table at right, adjust the sensitivity of the SA1E photoelectric switch when necessary, in such cases as the through-beam model is used to detect small or translucent objects or the reflective model is affected by background. The table explains the status of operation LED when the operation mode is set to light ON.

- After adjusting the sensitivity, make sure that stable LED turns on at stable incident and stable interruption. For detecting objects too small to turn on the stable LED, use an optional slit.
- Sensitivity is set to the maximum (+) at the factory before shipment. When adjusting the sensitivity, use the screwdriver supplied with the SA1E photoelectric switch to turn the control as shown below, to a torque of 0.05 N·m maximum.

| Step | Photoelectric Switch Status | Sensitivity Control | Adjusting Procedure |
|------|--|---------------------|--|
| 1 | Receiving light • Through-beam, polarized reflective: No object detected • Diffuse reflective, small-beam reflective, convergent reflective: Object detected | | Turn the control counterclockwise to the minimum (-). Then turn clockwise (toward +) until the operation LED turns on (turns off with dark ON type) (point A). |
| 2 | Light is interrupted • Through-beam, polarized reflective: Object detected • Diffuse reflective, small-beam reflective, convergent reflective: No object detected | | At interruption status, turn the control clockwise (toward +) from point A, until the operation LED turns on (turns off with dark ON type) (point B). If the operation LED does not turn on (turn off with dark ON type) even though the control has reached the maximum (+), set the maximum position (+) as point B. |
| 3 | — | | Set the middle point between point A and B as point C. |

4. Adjustment of Sensing Range for Background Suppression (BGS) Model

- When adjusting the sensing range, follow the instruction below.

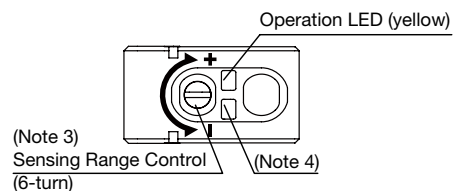
| Step | Distance Control | Adjusting Procedure |
|------|------------------|---|
| 1 | | Install the photoelectric switch and the object firmly. Turn the control counterclockwise until the operation LED turns off (turns on with dark ON type). From this point, turn the control clockwise until the operation LED turns on (turns off with dark ON type) (point A). |
| 2 | | Remove the object, and confirm that the operation LED turns off (turns on with dark ON type). Turn the control clockwise until the operation LED turns on (detecting the background) (turns off with dark ON type) (point B). (Note 1) |
| 3 | | Set the middle point between point A and B as point C. (Note 2) |

Note 1: When the background is far off and not detected, turn the control 360°, and set the point as point C.

Note 2: Because the control is multi-turn, it may take more than one turn to move from point A to point B.

Note 3: Turning the control clockwise lengthens the sensing distance.

Note 4: Background suppression (BGS) model is not provided with a stable LED.



SA1E Miniature Photoelectric Switches (Built-in Amplifier)

5. Power Supply and Wiring

- Do not use the SA1E photoelectric switch at the transient status immediately after turning on the power (approx. 100 ms, background suppression model: 200 ms). When the load and switch use different power supplies, make sure to power up the switch first.
- Use a power supply with little noise and inrush current, and use the photoelectric switch within the rated voltage range. Make sure that ripple factor is within the allowable limit. Do not apply AC voltage, otherwise the switch may blow out or burn.
- When using a switching power supply, make sure to ground the FG (frame ground) terminal, otherwise high-frequency noise may affect the photoelectric switch.
- Turn power off before inserting/removing the connector on photoelectric switch. Make sure that excessive mechanical force is not applied to the connector. Connect the connector cable to a tightening torque of 0.5 N·m maximum.
- To ensure the degree of protection, use the applicable connector cable for the connector model. Connector cables are ordered separately.
- Avoid parallel wiring with high-voltage or power lines in the same conduit, otherwise noise may cause malfunction and damage. When wiring is long, use a separate conduit for wiring.
- Use a cable of 0.3 mm² minimum core wires, then the cable can be extended up to 100m.

6. Installation

Installing the Photoelectric Switch

- Do not install the SA1E photoelectric switches in an area where the switches are subject to the following conditions, otherwise malfunction and damage may be caused.
 - * Inductive devices or heat source
 - * Extreme vibration or shock
 - * Large amount of dust
 - * Toxic gases
 - * Water, oil, chemicals
 - * Outdoor
- Make sure to prevent sunlight, fluorescent light, and especially the fluorescent light of inverters from entering the receiver of the photoelectric switch directly. Keep the through-beam model receiver away from intense extraneous light.
- Interference prevention allows two SA1E switches to be mounted in close proximity. However, the through-beam model is not equipped with interference prevention. Maintain appropriate distance between the switches referring to the lateral displacement characteristics.
- Because the SA1E photoelectric switches are IP67 waterproof, the SA1E can be exposed to water. However, wipe water drops and smears from the lens and slit using a soft cloth to make sure of the best detecting performance.
- Polycarbonate or acrylic resins are used for optical elements. Do not use ammonia or caustic soda for cleaning, otherwise optical elements will be dissolved. To remove dust and moisture build-up, use soft dry cloth.
- Tighten the mounting screws (M3) to a torque of 0.5 N·m. Do not tighten the mounting screws excessively or hit the switch with a hammer, otherwise the protection degree cannot be maintained.

Installing the Reflector

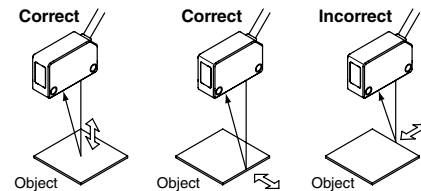
- Use M4 mounting screws for the IAC-R5 and IAC-R8 reflector, and M3 mounting screws for the IAC-R6 reflector. Tighten the mounting screws to a tightening torque of 0.5 N·m maximum. Mounting screws are not supplied with the switch.
- Use the M3 self-tapping screw, flat washer, and spring washer to tighten the IAC-R7 reflector to a torque of 0.5 to 0.6 N·m.
- Optional reflector mounting bracket IAC-L2 is not supplied with mounting screws or nuts.
- IAC-L3 and IAC-L5 are supplied with mounting screws for mounting the reflector on the bracket.
- Reflector IAC-RS1 and IAC-RS2 can be installed directly on a flat surface using the adhesive tape attached to the back of the reflector. Before attaching the reflector, clean the board surface to ensure secure attachment.

Installing the air blower mounting block SA9Z-A02

- When installing the SA9Z-A02 on the SA1E photoelectric switch, use the attached M3 × 20 mounting screws and tighten to a torque of 0.5 N·m maximum.
- Do not use the mounting screw (M3 × 12) supplied with the mounting bracket (SA9Z-K01) to mount the SA1E photoelectric switches.
- The SA9Z-A02 cannot be used with the through-beam slits (SA9Z-S06 to S14).
- The air tube fitting (M5) can be installed to either the top or side. The air tube is not supplied.
- Close the unused port using the air supply port plugging screw and gasket (supplied with SA1E) to a tightening torque of 1 to 2 N·m maximum. The recommended air pressure is 0.1 to 0.3 MPa.

Installing the background suppression (BGS) model

- This sensor can detect objects correctly when the sensor head is installed perpendicular to the moving object. Install the sensor head as shown below to minimize sensing errors.



- If the sensor is used in a place subject to a large variations in the ambient temperature, the characteristics may change depending on the target object. Be sure to check the operation under the actual operating conditions.

Specifications and other descriptions in this brochure are subject to change without notice.



IDEC CORPORATION

6-64, Nishi-Miyahara 2-Chome, Yodogawa-ku, Osaka 532-0004, Japan
Tel: +81-6-6398-2527, Fax: +81-6-6398-2547
E-mail: marketing@idec.co.jp

IDEC CORPORATION (USA)
Tel: +1-408-747-0550 / (800) 262-IDEC (4332)
Fax: +1-408-744-9055 / (800) 635-6246
E-mail: opencontact@idec.com

IDEC CANADA LIMITED
Tel: +1-905-890-8561, Toll Free: (888) 317-IDEC (4332)
Fax: +1-905-890-8562
E-mail: sales@ca.idec.com

IDEC AUSTRALIA PTY. LTD.
Tel: +61-3-8523-5900, Toll Free: 1800-68-4332
Fax: +61-3-8523-5999
E-mail: sales@au.idec.com

IDEC ELEKTROTECHNIK GmbH
Tel: +49-40-25 30 54 - 0, Fax: +49-40-25 30 54 - 24
E-mail: service@eu.idec.com

IDEC (SHANGHAI) CORPORATION
Tel: +86-21-6135-1515
Fax: +86-21-6135-6225 / +86-21-6135-6226
E-mail: idec@cn.idec.com

IDEC (BEIJING) CORPORATION
Tel: +86-10-6581-6131, Fax: +86-10-6581-5119

IDEC (SHENZHEN) CORPORATION
Tel: +86-755-8356-2977, Fax: +86-755-8356-2944

IDEC IZUMI (H.K.) CO., LTD.
Tel: +852-2803-8989, Fax: +852-2565-0171
E-mail: info@hk.idec.com

IDEC TAIWAN CORPORATION
Tel: +886-2-2698-3929, Fax: +886-2-2698-3931
E-mail: service@tw.idec.com

IDEC IZUMI ASIA PTE. LTD.
Tel: +65-6746-1155, Fax: +65-6844-5995
E-mail: info@sg.idec.com

IDEC ASIA (THAILAND) CO., LTD.
Tel: +662-392-9765, Fax: +662-392-9768
E-mail: sales@th.idec.com