SA1E
Miniature Photoelectric Switches (Built-in Amplifier Type)
SA1E Sensing Methods

• Through-beam (with/without sensitivity adjustment)
• Polarized Retroreflective (with/without sensitivity adjustment)
• Diffuse-reflective (with sensitivity adjustment)

1 Applicable for Hosedown Requirements

3 Wide Variety

A wide variety for material

SA1E Miniature Photoelectric Switches

Tape Type Reflector IAC-RS2 (80 × 70mm)

(07/03/06)
of global advantages handling and manufacturing!

Superior Interference Prevention

Hosedown, IP67 protection
The waterproof, integral molding structure is ideal for food processing and other applications that require frequent water hosedowns. The mounting brackets are made of rust-free stainless steel.

Superior interference prevention
Because two switches can be mounted closely (except for the through-beam type), moving direction of objects can be detected within a narrow space. Outputs from two sensors can be ANDed together easily.

Simple design, wide variety
• Choice of light ON or dark ON models
• Units without sensitivity adjustment control available (through-beam type, polarized retroreflective type)
• Red LED type available for easy alignment in long distance applications (through-beam type, polarized retroreflective type, small-beam reflective type, BGS type)
• Two connection methods:
  Cable: 1, 2, and 5m
  Connector: Straight and right angle (2- or 5-m connector cables)
• Available in six sensing versions:
  Through-beam type:
  Ideal for long distance detection (with sensitivity adjustment: 10m, without sensitivity adjustment: 15m)
  Diffuse-reflective type (sensing range: 700 mm with white mat paper): Can detect light-reflecting transparent objects
  Polarized retroreflective type (sensing range: 2.5 m with sensing adjustment, 3.0 m without sensing adjustment):
  Mirror-like objects can also be detected.
  Small-beam reflective type:
  Ideal for detecting small objects with red LED beam (50 to 150 mm)
  Background suppression type (BGS)
  (sensing range: 20 mm to preset distance)
  (adjustable sensing range: 40 to 200 mm)
  Ideal for detecting objects with a background
  Convergent reflective type (sensing range: 5 to 35 mm):
  Detects objects at a short distance ignoring the background.

Accessories
• Small-beam Reflective
  (with sensitivity adjustment)
• Background Suppression
  (with sensing range adjustment)
• Convergent Reflective
  (with sensitivity adjustment)
SA1E
Built-in Amplifier Type
Back Ground Suppression Type (BGS)

Detections object. Ignores background.

**Principle of the BGS Type**

The principle of triangulation is utilized. The position of a light-receiving spot depends on the distance between the photoelectric switch and the object. The receiving element consists of dual-element photodiode. ON/OFF status is determined by comparing the amount of light received by the photo diodes (A>B: ON, A<B: OFF). By adjusting the sensing range, the background suppression sensor ignores the background of the object, such as conveyors.

Sensing range can be set by moving the light-receiving lens vertically using the control knob. The light-receiving spot moves along with the light receiving lens. Slide up the light-receiving lens for longer sensing range, and slide down for a shorter sensing range.

**Comparison**

**Background Suppression (BGS) Type**

<table>
<thead>
<tr>
<th>ON (incident)</th>
<th>OFF (interrupt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyor</td>
<td>Object</td>
</tr>
</tbody>
</table>

**Diffuse-reflective Type**

<table>
<thead>
<tr>
<th>ON (incident)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conveyor</td>
</tr>
</tbody>
</table>

Because a photoelectric switch of diffused reflective type determines ON/OFF status with the amount of light, the switch may turn ON by detecting the background, such as a conveyor. The background suppression type depends on the distance to determine ON/OFF status and therefore detects the object only, ignoring the background.
Detecting objects on a conveyor belt, ignoring the conveyor belt.

Detecting objects of different colors, ignoring workers in the background.

Detecting objects on a roller conveyor, ignoring other objects below.

Detecting PC boards in an inspection line, ignoring other objects above the PC boards.

Retrieval system in a production line to detect whether or not correct objects have been retrieved.

Determining objects by length.

Checking whether the pre-determined volume of a substance has been dispensed.

Detecting objects between doors.

Application Examples

Background Suppression Type (BGS)

Other Types

Setting the sensing distance. Only objects are detected.
### Types

**Photoelectric Switches**

<table>
<thead>
<tr>
<th>Sensing Method</th>
<th>Sensing Range</th>
<th>Connection</th>
<th>Cable Length</th>
<th>Operation Mode</th>
<th>Type No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through-beam</td>
<td>10m</td>
<td>Cable</td>
<td>1m</td>
<td>Light ON</td>
<td>SA1E-TN1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-TN2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connector</td>
<td></td>
<td>Light ON</td>
<td>SA1E-TN1C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-TN2C</td>
</tr>
<tr>
<td>Infrared LED</td>
<td>15m</td>
<td>Cable</td>
<td>1m</td>
<td>Light ON</td>
<td>SA1E-TN1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-TN2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connector</td>
<td></td>
<td>Light ON</td>
<td>SA1E-TN1C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-TN2C</td>
</tr>
<tr>
<td>Red LED w/Sensitivity Adjustment</td>
<td>10m</td>
<td>Cable</td>
<td>1m</td>
<td>Light ON</td>
<td>SA1E-TN1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-TN2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connector</td>
<td></td>
<td>Light ON</td>
<td>SA1E-TN1C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-TN2C</td>
</tr>
<tr>
<td>Polarized Retroreflective Red</td>
<td></td>
<td>Cable</td>
<td>1m</td>
<td>Light ON</td>
<td>SA1E-TN1</td>
</tr>
<tr>
<td>LED w/Sensitivity Adjustment</td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-TN2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connector</td>
<td></td>
<td>Light ON</td>
<td>SA1E-TN1C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-TN2C</td>
</tr>
</tbody>
</table>

### Characteristics

- Six sensing methods
- Cable type (three cable lengths) and M8 connector type are available.
- NPN output, PNP output, light ON, dark ON can be selected.
- Background suppression (BGS) type detects objects only, ignoring the background.
- Red LED type available for easy alignment in long distance applications (through-beam type, polarized retroreflective type, small-beam reflective type, BGS type)
- Convergent reflective type is ideal for detecting objects at a short distance with a background.
- Also available without sensitivity adjustment (through-beam, polarized retroreflective types)
- Air blower mounting block for installing an air blower to clean the lens surface. Ideal to maintain a clean lens surface and sensor performance.
- CE marked

See the characteristics on page 15.

See the characteristics on page 16.

See the characteristics on page 17.

(07/03/06)

(Note) 1.5m (100 mm) When using IAC-R6
1.3m (150 mm) When using IAC-RS2
1.0m (150 mm) When using IAC-RS1
0.8m (100 mm) When using IAC-R7

Note: Maintain at least the distance shown in () between the SA1E photoelectric switch and reflector. Reflectors are not supplied and must be ordered separately.

Reflectors are not supplied and must be ordered separately.

See the characteristics on page 17.
## Types

**Photoelectric Switches**

<table>
<thead>
<tr>
<th>Sensing Method</th>
<th>Sensing Range</th>
<th>Connection</th>
<th>Cable Length</th>
<th>Operation Mode</th>
<th>Type No.</th>
<th>PNP Output</th>
<th>NPN Output</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diffuse-reflective</strong></td>
<td>Infrared LED w/Sensitivity Adjustment</td>
<td>700 mm</td>
<td>Cable</td>
<td>1m</td>
<td>Light ON</td>
<td>SA1E-DN1</td>
<td>SA1E-DP1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-DN2</td>
<td>SA1E-DP2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2m</td>
<td>Light ON</td>
<td>SA1E-DN1-2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-DN2-2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5m</td>
<td>Light ON</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
</tr>
<tr>
<td><strong>Small-beam Reflective</strong></td>
<td>Red LED w/Sensitivity Adjustment</td>
<td>50 to 150 mm</td>
<td>Cable</td>
<td>1m</td>
<td>Light ON</td>
<td>SA1E-NN1</td>
<td>SA1E-NP1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-NN2</td>
<td>SA1E-NP2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2m</td>
<td>Light ON</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-NN2-2M</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5m</td>
<td>Light ON</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
</tr>
<tr>
<td><strong>Background Suppression</strong></td>
<td>Red LED w/Sensing Range Adjustment</td>
<td>40 to 200 mm</td>
<td>Cable</td>
<td>1m</td>
<td>Light ON</td>
<td>SA1E-BN1</td>
<td>SA1E-BP1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-BN2</td>
<td>SA1E-BP2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Convergent Reflective</strong></td>
<td>Infrared LED w/Sensitivity Adjustment</td>
<td>5 to 35 mm</td>
<td>Cable</td>
<td>1m</td>
<td>Light ON</td>
<td>SA1E-GN1</td>
<td>SA1E-GP1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Dark ON</td>
<td>SA1E-GN2</td>
<td>SA1E-GP2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5m</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Accessories (optional)

### Slits (for through-beam type)

<table>
<thead>
<tr>
<th>Item</th>
<th>Slit Size</th>
<th>Type No.</th>
<th>Ordering Type No.</th>
<th>Package Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Slit</td>
<td>0.5 mm x 18 mm</td>
<td>SA9Z-S06</td>
<td>SA9Z-S06PN02</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1.0 mm x 18 mm</td>
<td>SA9Z-S07</td>
<td>SA9Z-S07PN02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0 mm x 18 mm</td>
<td>SA9Z-S08</td>
<td>SA9Z-S08PN02</td>
<td></td>
</tr>
<tr>
<td>Horizontal Slit</td>
<td>0.5 mm x 6.5 mm</td>
<td>SA9Z-S09</td>
<td>SA9Z-S09PN02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.0 mm x 6.5 mm</td>
<td>SA9Z-S10</td>
<td>SA9Z-S10PN02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.0 mm x 6.5 mm</td>
<td>SA9Z-S11</td>
<td>SA9Z-S11PN02</td>
<td></td>
</tr>
<tr>
<td>Round Slit</td>
<td>ø0.5 mm</td>
<td>SA9Z-S12</td>
<td>SA9Z-S12PN02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ø1.0 mm</td>
<td>SA9Z-S13</td>
<td>SA9Z-S13PN02</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ø2.0 mm</td>
<td>SA9Z-S14</td>
<td>SA9Z-S14PN02</td>
<td></td>
</tr>
</tbody>
</table>

### Mounting Brackets

<table>
<thead>
<tr>
<th>Item</th>
<th>Type No.</th>
<th>Package Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical Mounting</td>
<td>SA9Z-K01</td>
<td>1</td>
</tr>
<tr>
<td>Horizontal Mounting</td>
<td>SA9Z-K02</td>
<td></td>
</tr>
</tbody>
</table>

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

### Reflectors (for polarized retroreflective type)

<table>
<thead>
<tr>
<th>Type No.</th>
<th>Package Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>1</td>
</tr>
<tr>
<td>Small</td>
<td>1</td>
</tr>
<tr>
<td>Large</td>
<td>1</td>
</tr>
<tr>
<td>Narrow (rear/side mounting)</td>
<td>1</td>
</tr>
<tr>
<td>Narrow (rear mounting)</td>
<td>1</td>
</tr>
<tr>
<td>Narrow (side mounting)</td>
<td>1</td>
</tr>
<tr>
<td>Tape Type (40 x 35 mm)</td>
<td>1</td>
</tr>
<tr>
<td>Tape Type (80 x 70 mm)</td>
<td>1</td>
</tr>
</tbody>
</table>

### Reflectors

<table>
<thead>
<tr>
<th>Reflector</th>
<th>Type No.</th>
<th>Package Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>For IAC-R5</td>
<td>IAC-L2</td>
<td></td>
</tr>
<tr>
<td>For IAC-R6</td>
<td>IAC-L3</td>
<td></td>
</tr>
<tr>
<td>For IAC-R8</td>
<td>IAC-L5</td>
<td></td>
</tr>
</tbody>
</table>

- The IAC-L2 is not supplied with mounting screws and nuts. Use commercially available M4 screws and nuts for mounting the IAC-R6 reflector.
- The IAC-L3 is supplied with two mounting screws (M3 x 6 mm sems screws).
- The IAC-L5 is supplied with two mounting screws (M4 x 10 mm sems screws).
- The IAC-R7M and IAC-R7S are supplied with two M3 x 8 mm self-tapping screws, two flat washers, and two spring washers.
- The IAC-R7B is supplied with an M3 x 8 mm self-tapping screw, a flat washer, and a spring washer.

(07/03/06)
SA1E Miniature Photoelectric Switches (Built-in Amplifier Type)

**Specifications**

<table>
<thead>
<tr>
<th>Sensing Method</th>
<th>Through-beam</th>
<th>Polarized Retroreflective</th>
<th>Diffuse-reflective</th>
<th>Small-beam Reflective</th>
<th>Background Suppression (BGS)</th>
<th>Convergent Reflective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type No.</td>
<td>SA1E-T</td>
<td>SA1E-P</td>
<td>SA1E-D</td>
<td>SA1E-N</td>
<td>SA1E-B</td>
<td>SA1E-G</td>
</tr>
</tbody>
</table>

- **Power Voltage**
  - Projector: 15 mA
  - Receiver: 20 mA
  - 30 mA
- **Current Draw**
  - Projector: 15 mA
  - Receiver: 20 mA
- **Sensing Range**
  - 10 mm (with sensitivity adjustment)
  - 15 mm (without sensitivity adjustment)
- **Response Time**
  - 1 ms maximum
- **Hysteresis**
  - 20% maximum
- **Adjustable Sensing Range**
  - 40 to 200 mm
- **Detectable Object**
  - Opaque
  - Opaque/Transparent
  - Opaque
  - Opaque/Transparent
- **Light Source Element**
  - Infrared LED
  - Red LED
  - Infrared LED
  - Red LED
  - Red LED
  - Infrared LED
- **Operation Mode**
  - Light ON/Dark ON
- **Control Output**
  - NPN open collector or PNP open collector
  - 30V DC, 100 mA maximum
  - Voltage drop: 1.2V maximum (BGS type: 2V maximum)
  - Short-circuit protection
- **LED Indicators**
  - Operation LED: Yellow
  - Stable LED: Green
  - Power LED: Green (Through-beam type projector)
  - Operation LED: Yellow
  - Stable LED: None
  - Operation LED: Yellow
  - Stable LED: Green
- **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 minimum (500V DC megger)
- **Dielectric Strength**
  - Between live part and mounting bracket: 1000V AC, 50/60 Hz, 1 minute
- **Vibration Resistance**
  - Damage limits: 10 to 55 Hz, Amplitude 0.75 mm, 20 cycles in each of 3 axes
- **Shock Resistance**
  - Damage limits: 500 m/s², 10 shocks in each of 3 axes
- **Material**
  - Housing: PC/PBT, Lens: PC (Polarized retroreflective type: PMMA), Indicator cover: PC

**Attachments**
- Instruction sheet, Sensitivity control screwdriver

**Weight (approx.)**

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Projector: 30g</th>
<th>Receiver: 30g (Note 2)</th>
<th>30g (Note 2)</th>
<th>30g (Note 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector Type</td>
<td>Projector: 10g</td>
<td>Receiver: 10g</td>
<td>10g</td>
<td>20g</td>
</tr>
</tbody>
</table>

**Connection Method**

| Cable Type | a3.5 mm, 3-core, 0.2 mm², 1-m vinyl/ cable type cable (2-core for the projector of through-beam type) |
| Connector Type | M8 connector (4-pin) |

**Notes:**
1. Maintain at least the distance shown below between the SA1E photoelectric switch and reflector.
2. Cable length: 1m (50g when the cable length is 2m. 110g when the cable length is 5m.)
3. Cable length: 1m (55g when the cable length is 2m. 120g when the cable length is 5m.)
SA1E Miniature Photoelectric Switches (Built-in Amplifier Type)

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.

<table>
<thead>
<tr>
<th>Slit Width: A</th>
<th>Sensing Range (m)</th>
<th>Minimum Detectable Object Width (mm)</th>
<th>Sensing Range (m)</th>
<th>Minimum Detectable Object Width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used on one side</td>
<td>Used on both sides</td>
<td>Used on one side</td>
<td>Used on both sides</td>
<td>Used on one side</td>
</tr>
<tr>
<td>SA9Z-S06 0.5 mm</td>
<td>2.5</td>
<td>1.0</td>
<td>7.0</td>
<td>0.5</td>
</tr>
<tr>
<td>SA9Z-S07 1.0 mm</td>
<td>3.5</td>
<td>1.5</td>
<td>7.0</td>
<td>1.0</td>
</tr>
<tr>
<td>SA9Z-S08 2.0 mm</td>
<td>6.0</td>
<td>3.5</td>
<td>7.0</td>
<td>2.0</td>
</tr>
<tr>
<td>SA9Z-S09 0.5 mm</td>
<td>2.0</td>
<td>0.7</td>
<td>7.0</td>
<td>0.4</td>
</tr>
<tr>
<td>SA9Z-S10 1.0 mm</td>
<td>3.0</td>
<td>1.5</td>
<td>7.0</td>
<td>0.7</td>
</tr>
<tr>
<td>SA9Z-S11 2.0 mm</td>
<td>5.5</td>
<td>3.0</td>
<td>7.0</td>
<td>1.5</td>
</tr>
<tr>
<td>SA9Z-S12 0.5 mm</td>
<td>0.8</td>
<td>0.08</td>
<td>5.0</td>
<td>0.3</td>
</tr>
<tr>
<td>SA9Z-S13 1.0 mm</td>
<td>1.5</td>
<td>0.3</td>
<td>5.0</td>
<td>0.6</td>
</tr>
<tr>
<td>SA9Z-S14 2.0 mm</td>
<td>2.5</td>
<td>1.2</td>
<td>5.0</td>
<td>1.5</td>
</tr>
</tbody>
</table>

The slit can be pressed to snap onto the front easily.

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

Dimensions

- **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

All dimensions are in mm.

Output Circuit & Wiring Diagram

- **NPN Output**
  - (Connector Pin Assignment)
    - ➀ (+V)
    - ➁ (NC)
    - ➂ (OUT)
    - ➃ (0V)

- **PNP Output**
  - (Connector Pin Assignment)
    - ➀ (+V)
    - ➁ (NC)
    - ➁ (NC)

- **Through-beam Type Projector**
  - (Connector Pin Assignment)
    - ➀ (+V)
    - ➁ (NC)
    - ➁ (NC)

Material: Stainless Steel

(07/03/06)
SA1E Miniature Photoelectric Switches (Built-in Amplifier Type)

Dimensions

- **Cable Type**
  - Through-beam

- **Polarized retroreflective**
- **Diffuse-reflective**
- **Small-beam reflective**
- **Convergent reflective**

- **Stable LED (green) (Note 2)**
- **Operation LED (yellow) (Note 1)**
- **Sensitivity Control (Note 2) (Note 4)**

**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 retroreflective type

**Note 4:** No sensitivity control is installed on the type without sensitivity adjustment.

**Note 5:** Cable length depends on types.

Background Suppression (BGS)

**Note 6:** Stable LED is not provided on the background suppression type.

All dimensions in mm.
SA1E Miniature Photoelectric Switches (Built-in Amplifier Type)

**Connector Type**
- Through-beam

**Through-beam**
- Polarized retroreflective
- Diffuse-reflective
- Small-beam reflective
- Convergent reflective

**Polarized retroreflective**
**Diffuse-reflective**
**Small-beam reflective**
**Convergent 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 retroreflective type
**Note 4:** No sensitivity control is installed on the type without sensitivity adjustment.
**Note 5:** Cable length depends on types.

**Background Suppression (BGS)**

**Note 6:** Stable LED is not provided on the background suppression type.
**Note 7:** The connector length is 18 mm when a right-angle connector cable (SA9Z-CMBK-4L+) is attached.

All dimensions in mm.

(07/03/06)
SA1E Miniature Photoelectric Switches (Built-in Amplifier Type)

Dimensions

- Mounting Bracket
  SA9Z-K01

  [Diagram of SA9Z-K01 with dimensions]

  (Material: Stainless Steel)

  Note 1: Center of optical axis (through-beam type)
  Note 2: Center of optical axis (polarized retroreflective, diffuse reflective, small-beam reflective, and convergent reflective type)

SA9Z-K02

  [Diagram of SA9Z-K02 with dimensions]

  (Material: Stainless Steel)

  Note 1: Center of optical axis (through-beam type)
  Note 2: Center of optical axis (polarized retroreflective, diffuse reflective, small-beam reflective, and convergent reflective type)

SA9Z-K03

  [Diagram of SA9Z-K03 with dimensions]

  (Material: Stainless Steel)

  Note 1: Center of optical axis (through beam type)
  Note 2: Center of optical axis (polarized retroreflective, diffuse reflective, small-beam reflective, and convergent reflective type)

All dimensions are in mm.
SA1E Miniature Photoelectric Switches (Built-in Amplifier Type)

- **Reflector**
  - **IAC-R5**
  - **IAC-R6**
    - (Effective reflecting area: 47.2 × 47.2)

- **IAC-R8**
  - (Effective reflecting area: 47 × 47)

- **IAC-RS1**
  - **IAC-RS2**
    - Thickness = 0.5 mm
    - (07/03/06)

- **IAC-R7M (rear/side mounting)**
  - **IAC-R7B (rear mounting)**
  - **IAC-R7S (side mounting)**
    - 2-M3 tapping screw hole (ø2.6 mm, depth 8.6 mm)
    - M3 tapping screw hole (ø2.6 mm, depth 7.7 mm)
    - Positioning Projection (ø3.0 mm, height 1.0 mm)
    - Thickness = 0.8 to 2.5 mm in thickness.

All dimensions are in mm.

(07/03/06)
SA1E Miniature Photoelectric Switches (Built-in Amplifier Type)

Dimensions

- Reflector Mounting Bracket

IAC-L2 (for IAC-R5)  
IAC-L3 (for IAC-R6)  
IAC-L5 (for IAC-R8)  

Material: SPCC (zinc chromate plating, black)  
Material: SPCC (zinc plating)  
Material: SPCC (zinc plating)

- Connector Cable (connector on one end)

Straight Type (SA9Z-CM8K-4S)  
Right-angle Type (SA9Z-CM8K-4L)  

Cable length: 2 or 5m  

- Air Blower Mounting Block

SA9Z-A02

With Mounting Bracket

- The SA9Z-A02 air blower mounting block is supplied with two mounting screws (M3 × 20 mm sems screws), one screw for plugging the air supply port (M5), 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 are in mm.

(07/03/06)
Characteristics (Typical)

1-1. Through-beam Type SA1E-T (Infrared LED w/sensitivity adjustment)
SA1E-TA (Red LED w/sensitivity adjustment)

- Excess Gain (Without slit)
- Lateral Displacement (Without slit)
- Angle (Without slit)
- Excess Gain (With vertical slit)
- Lateral Displacement (With vertical slit)
- Angle (With vertical slit)
- Excess Gain (With horizontal slit)
- Lateral Displacement (With horizontal slit)
- Angle (With horizontal slit)
- Excess Gain (With round 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)

![Graphs and diagrams showing characteristics and measurements for SA1E Miniature Photoelectric Switches (Built-in Amplifier Type).]
SA1E Miniature Photoelectric Switches (Built-in Amplifier Type)

Characteristics (Typical)

1-2. Through-beam Type SA1E-T-NA (Infrared LED w/o sensitivity adjustment)

- Excess Gain (Without slit)
- Lateral Displacement (Without slit)
- Angle (Without slit)

- Excess Gain (With vertical slit)
- Lateral Displacement (With vertical slit)
- Angle (With vertical slit)

- Excess Gain (With horizontal slit)
- Lateral Displacement (With horizontal slit)
- Angle (With horizontal slit)

- Excess Gain (With round slit)
- Lateral Displacement (With round slit)
- Angle (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)
Characteristics (Typical)

2-1. Polarized Retroreflective Type SA1E-P (Red LED w/sensitivity adjustment)

- Excess Gain
- Lateral Displacement
- Angle (when using IAC-R5/-R8)

2-2. Polarized Retroreflective Type SA1E-P-NA (Red LED w/o sensitivity adjustment)

- Excess Gain
- Lateral Displacement
- Angle (when using IAC-R5/-R8)

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

- Excess Gain
- Sensing Area
- Object Size vs. Sensing Distance

4. Small-beam Reflective Type SA1E-N (Red LED w/sensitivity adjustment)

- Excess Gain
- Sensing Area
- Object Size vs Sensing Distance

5. Background Suppression Type SA1E-B (Red LED w/sensitivity adjustment)

- Lateral Displacement (Preset 100 mm)
- Lateral Displacement (Preset 200 mm)
- Light Beam Diameter

(07/03/06)
• Sensing Distance vs. Hysteresis

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

- Excess Gain
- Lateral Displacement
- Object Size vs. Sensing Distance

- Brightness vs. Sensing Distance
- Color Mat Paper and Other Materials

Instructions

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

- 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.

<table>
<thead>
<tr>
<th>Receiving Light Intensity Level</th>
<th>Light Receiving Status</th>
<th>Stable LED (green)</th>
<th>Operation LED (yellow)/Control Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2 and over</td>
<td>Stable Incident</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>1.0</td>
<td>Unstable Incident</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>0.8 and below</td>
<td>Stable Interruption</td>
<td>ON</td>
<td>ON</td>
</tr>
</tbody>
</table>

2. Optical Axis Alignment (Light ON)

- Through-beam type
  - 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.
SA1E Miniature Photoelectric Switches (Built-in Amplifier Type)

- Polarized retroreflective type
  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 retroreflective type 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 type/Small-beam reflective type/Convergent reflective type
  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 type is a red LED, visual inspection is possible as well.

3. Sensitivity Adjustment
- Referring to the table below, adjust the sensitivity of the SA1E photoelectric switch when necessary, in such cases as the throughput beam type is used to detect small or translucent objects or the reflective type 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.

<table>
<thead>
<tr>
<th>Step</th>
<th>Photocell Switch Status</th>
<th>Sensitivity Control</th>
<th>Adjusting Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Receiving light</td>
<td>max. min.</td>
<td>Turn the control counter-clockwise to the minimum. Then turn clockwise until the operation LED turns on (turns off with dark ON type) (point A).</td>
</tr>
<tr>
<td></td>
<td>• Through-beam,</td>
<td></td>
<td>At interruption status, turn the control clockwise from point A, until the operation LED turns on (turns off with dark ON type) (point B).</td>
</tr>
<tr>
<td></td>
<td>polarized reflective:</td>
<td></td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>No object detected</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Diffuse reflective,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>small-beam reflective:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>convergent reflective:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Object detected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Light is interrupted</td>
<td>max. min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Through-beam,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>polarized reflective:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Object detected</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Diffuse reflective,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>small-beam reflective:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>convergent reflective:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No object detected</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Object detected</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Diffuse reflective,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>small-beam reflective:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>convergent reflective:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Object detected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Set the middle point</td>
<td>max. min.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>between point A and B</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>as point C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Adjustment of Sensing Range for Background Suppression (BGS) Type
- When adjusting the sensing range, follow the instruction below.

<table>
<thead>
<tr>
<th>Step</th>
<th>Distance Control</th>
<th>Adjusting Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>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).</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>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)</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Set the middle point between point A and B as point C. (Note 2)</td>
</tr>
</tbody>
</table>

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) type is not provided with a stable LED.

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 type: 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 the 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 type. 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.

(07/03/06)
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 type receiver away from intense extraneous light.

- Interference prevention allows two SA1E switches to be mounted close proximity. However, the through-beam type is not equipped with interference prevention. Maintain appropriate distance between the switches referring to the lateral displacement characteristics on pages 15 and 16.

- Because the SA1E photoelectric switches are IP67 waterproof, the switches are suitable for use in areas subjected to water, oil, chemicals, 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 reflector and M5 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.

- While optional reflector mounting bracket IAC-L2 is not supplied with mounting screws or nuts, the IAC-L3 and IAC-L5 are supplied with mounting screws for mounting the reflector on the bracket.

- Reflector IAC-R3 and IAC-R52 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 x 20 mounting screws and tighten to a torque of 0.5 N·m maximum.

- Do not use the mounting screw (M3 x 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 supplied air supply port plugging screw and gasket 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) type

- 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.

---

**Safety Precautions**

Turn off power to the SA1E Miniature Photoelectric Switches before installation, removal, wiring, maintenance, and inspection. Failure to turn off power may cause electrical shock or fire hazard.

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

---

**IDE Electric Corporation**

7-31, Nishi Miyahara 1-Chome, Yodogawa-ku, Osaka 532-8550, Japan
Tel: +81-6-6392-9731, Fax: +81-6-6392-9732
E-mail: produkts@idec.co.jp
---

**SA1E Miniature Photoelectric Switches (Built-in Amplifier Type)**

---

(07/03/06)