Introduction

What Is a Photomicrosensor?

A Photomicrosensor is a small photoelectronic sensor with an amplifier built into it that is used primarily as a component for building into equipment. Like any ordinary photoelectric sensor with a built-in amplifier, it is used, for example, in applications to detect passing objects or in positioning applications. The sensing object is most often a piece of metal called a "dog". When the dog enters the sensing area, it is optically detected by the Photomicrosensor, which outputs a signal.

Features

Photomicrosensors have the following advantages over ordinary photoelectric sensors with built-in amplifiers

1. Many Different Shapes in One Model Series

The EE-SX67 Series, for example, has models with eight different slot configurations, allowing the customer to choose the best configuration for the installation position.

2. Low Price

Ratings and performances are limited to those required for building into equipment, and the required IP degree of protection is easier to achieve, making prices very reasonable.

3. Downsizing Is Possible with the Sensing Distances Required for Building into Equipment

The standard sensing distances (slot width) are specifically intended to be used for building into equipment. Slot-type Sensors, for example, have a 3.6 mm or 5 mm sensing distance. Diffuse-reflective and Limited Reflective Sensors have a sensing distance of less than 5 mm, and Retroreflective and Through-beam Sensors, less than 1 m.

4. Indicator Lighting Mode

The indicator on many Photomicrosensors lights when light is incident. Some Photomicrosensors have specific models on which the indicator lights when light is interrupted. When lighting the indicator for position adjustment applications of Slot-type Sensors, for example, it may be more convenient to use a model that lights the indicator when light is interrupted. When using the indicator to check the power supply status, on the other hand, it may be convenient to use a model that lights the indicator when light is incident.

5. Other Specifications: Degree of Protection and Output Current

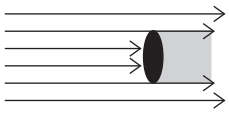
A waterproof structure is not required because it is assumed the Photomicrosensors will be built into other equipment, and the output current rating can be kept low. Also, most models can operate on a 5-VDC power supply.

Operating Principles

1. Properties of Light

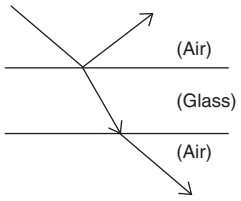
Rectilinear Propagation

When light travels through air or water, it always travels in a straight line. The slit on the outside of a Through-beam Sensor that is used to detect small objects is an example of how this principle is applied to practical use.



Refraction

Refraction is the phenomenon of light being deflected as it passes obliquely through the boundary between two media with different refractive indices.



Refractive index: 1

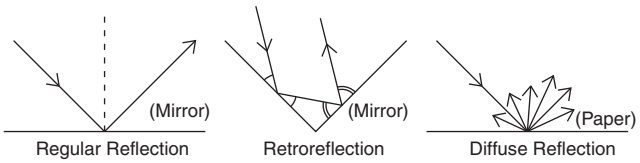
Refractive index: 1.5

Refractive index: 1

Reflection (Regular Reflection, Retroreflection, and Diffuse Reflection)

A flat surface, such as glass or a mirror, reflects light at an angle equal to the incident angle of the light. This kind of reflection is called regular reflection. Retroreflectors (also called a corner cube) take advantage of this principle by arranging three flat surfaces perpendicular to each other. "Retro" means "to return toward the source." The light reflected off the reflectors travels back towards the emitter, thus the term "retroreflective".

Matte surfaces, such as white paper, reflect light in all directions. This scattering of light is called diffuse reflection. This principle is the sensing method used by Diffuse-reflective Sensors.

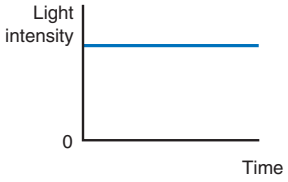


2. Light Sources

Light Generation

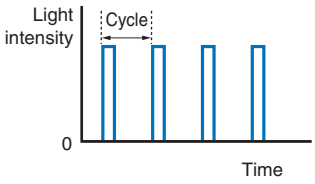
Non-modulated Light

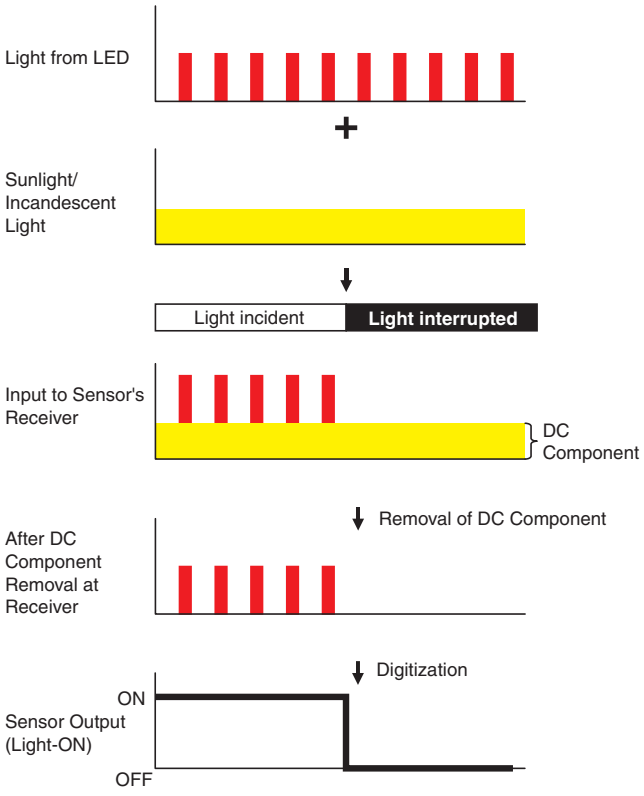
Non-modulated light facilitates high-speed response by continuously radiating a constant amount of light. There is the drawback, however, of susceptibility to external light interference.



Modulated Light

Modulated light is not affected by sunlight, light from incandescent bulbs, and other external light interference. An LED emitter is pulse-lighted, and the received signal is processed to remove the DC component.





Classification

1. Classification by Sensing Method

For information on the configuration of each method, refer to the sensing distance reference diagram in *Explanation of Terms*.

(1) Slot Sensors
Slot Sensors are suitable for applications using a thin sensing object, or "dog," that require a highly precise sensing position. Setup is easy because no optical axis adjustment is needed. There are many product variations. The necessary configuration, connection method, and other items can be selected from a wide array of models.

(2) Through-beam Sensors
Through-beam Sensors are suitable for applications that require relatively long sensing distances.

(3) Retroreflective Sensors
Retroreflective Sensors are suitable for applications that require relatively long sensing distances. They have the advantage of requiring less work for wiring and optical axis adjustment when compared to Through-beam Sensors.

(4) Diffuse-reflective Sensors
Diffuse-reflective Sensors are suitable for applications where the sensing object is thick and won't fit into the slot of a Slot Sensor.

(5) Limited-reflective Sensors
Limited-reflective Sensors are basically the same as Diffuse-reflective Sensors, but they are suitable when background objects are present. (With Diffuse-reflective Sensors, the presence of a background object with a higher reflectivity than the sensing object (e.g., metals with mirror finishing) may cause sensing instability.)

2. Considerations when Choosing a Sensing Method

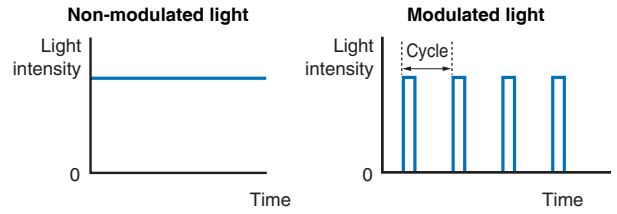
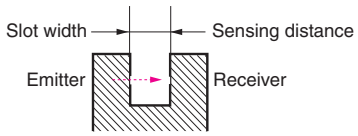
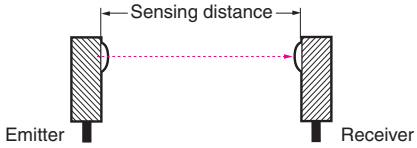
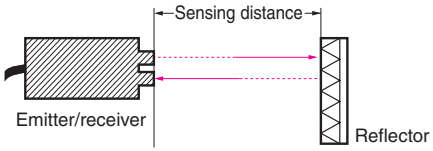
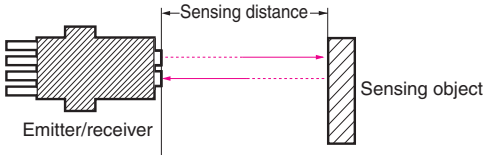
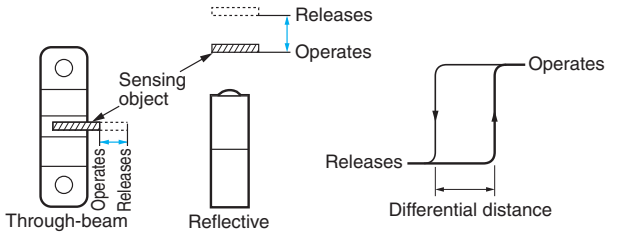
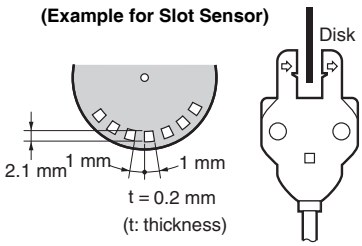
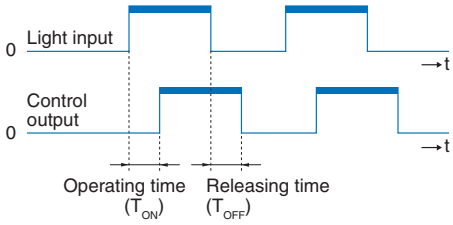
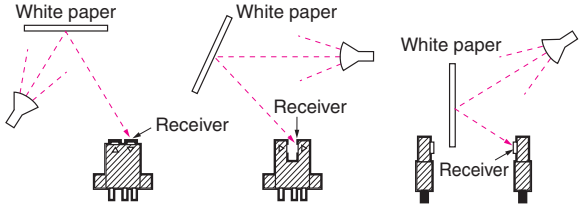
(1) Slot Sensors
- Shape, slot width, connection (pre-wired/connector)
- Presence or absence of external light interference (non-modulated light/modulated light)
- Output configuration (Light-ON/Dark-ON, NPN/PNP)
- Indicator (Light-ON/Dark-ON)

(2) Through-beam Sensors
- Shape, sensing distance
- Output configuration (Light-ON/Dark-ON)

(3) Retroreflective Sensors
- Sensing distance
- Output configuration (Light-ON/Dark-ON)

(4) Diffusive/Limited-reflective Sensors
- Shape, sensing distance
- Presence or absence of background objects (Diffuse-reflective/Limited-reflective Sensors)
- External light interference (non-modulated light/modulated light)
- Output configuration (Light-ON/Dark-ON)

Explanation of Terms

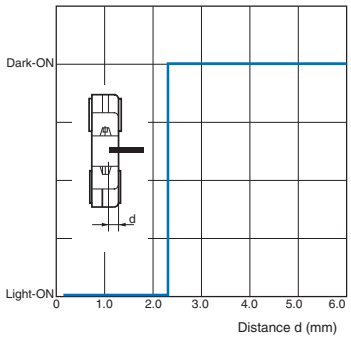
Term		Reference diagram	Explanation
Non-modulated light **Modulated light**			**Non-modulated light**: Method used to detect light steadily emitted by the emitter element. **Modulated light**: Method used to detect light emitted in pulses by the emitter element.
Sensing distance	**Through-beam Sensors (with slot)**		The slot width, i.e., the distance between the opposing faces of the emitter and receiver, is the sensing distance.
	Through-beam Sensors		The minimum distance that can be set considering factors such as the variation between products and fluctuations in temperature. **Note:** The actual value under standard conditions for each method is longer than the rated sensing distance.
	Retroreflective Sensors		
	Diffuse-reflective Sensors **Limited-reflective Sensors**		The minimum distance that can be set for a standard sensing object (white paper) considering factors such as the variation between products and fluctuations in temperature. **Note:** The actual value under standard conditions for each method is longer than the rated sensing distance.
Differential distance			The difference in distance between the operating point and releasing point.
Response frequency			The frequency at which an object satisfying specified conditions (size, transparency rate, reflection factor, sensing distance, and power supply voltage) can be repeatedly detected.
Response time			The delay from the light input turning ON/OFF until the control output operation or release operation. The following equation generally applies. Operating time (Ton) ≈ Releasing time (Toff)
Ambient illumination			The level of illumination on the sensing surface that enables stable operation of the Sensor.

Further Information

Interpreting Engineering Data

Sensing Position Characteristics

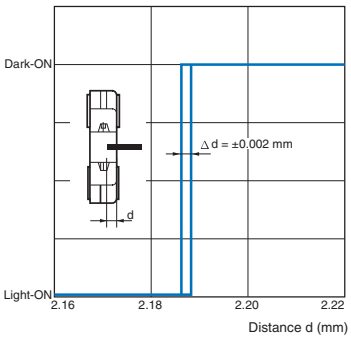
Sample characteristics for the EE-SX77



- Indicates whether or not the Sensor responds with respect to sensing object edge position. (Design the application so that light will be completely interrupted.)

Repeated Sensing Position Characteristics

Sample characteristics for the EE-SX77

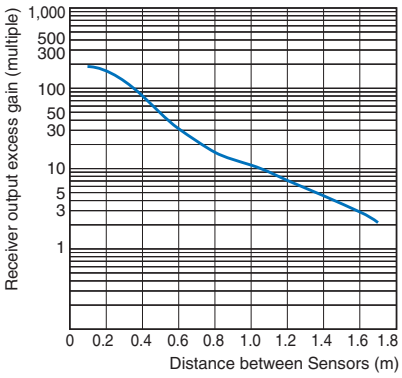


Vcc = 24V Number of repetitions: 20, Ta = 25°C

- Indicates the discrepancy in the edge position of the sensing object when the Sensor responds. It serves as a guide for the positioning accuracy of the sensing object.

Receiver Output Excess Gain vs. Sensing Distance Characteristics

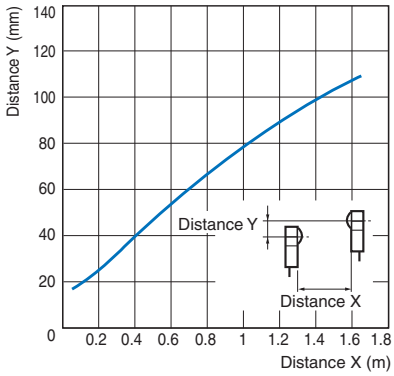
Sample characteristics for the EE-SPW311/411



- Values shown are for the receiver output excess gain when the sensitivity is set to the maximum value.
- The above example is for models with a rated sensing distance of 1 m. The receiver output excess gain can be thought of as being approximately 10 times the rated sensing distance.

Parallel Movement Characteristics

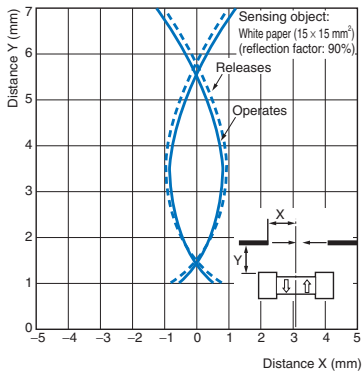
Sample characteristics for the EE-SPW311/411



- Through-beam Sensors: Indicates the receiver's sensing limit position when the emitter position is fixed.
- Retroreflective Sensor: Indicates the sensing limit position of the Retroreflector when the Sensor position is fixed.
- When setting up multiple Through-beam Sensors, 1.5 times the area shown is necessary to prevent mutual interference.

Operating Range Characteristics

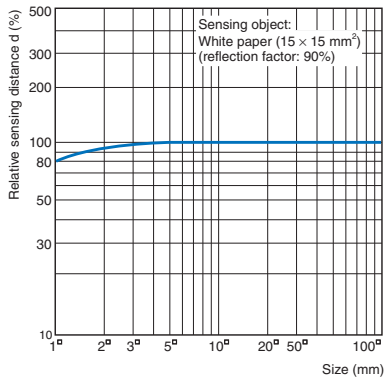
Sample characteristics for the EE-SPY311/411



- Indicates the starting sensing position when the standard sensing object is moved perpendicular to the optical axis. (These values apply to the standard sensing object. If the sensing object changes, the operating range and sensing distances also change.)

Sensing Distance vs. Object Area Characteristics

Sample characteristics for the EE-SPY□□□



- Indicates the change in the sensing distance when the area of a white piece of paper with a reflection factor of 90% of the standard sensing object is increased. (The sensing distance will change with the reflection factor.)