Photomicrosensor Application Guide

～Solution proposal for user's challenges～

Summary

A built-in type Photomicrosensor, also known as a photointerrupter, is a compact optical sensor that senses objects or object positions. The best fit sensors to your applications can be chosen from a wide variety of available options.
Photomicrosensors (photointerrupters) are commonly used for object presence and absence detection, disk rotation counting, positioning of moving objects and rotating direction detection. In order to effectively use a Photomicrosensor, this Application Guide

explains the principles, the types and the differences in usage of Photomicrosensors, and introduces actual application cases in detail.

What is a Photomicrosensor (photointerrupter)?

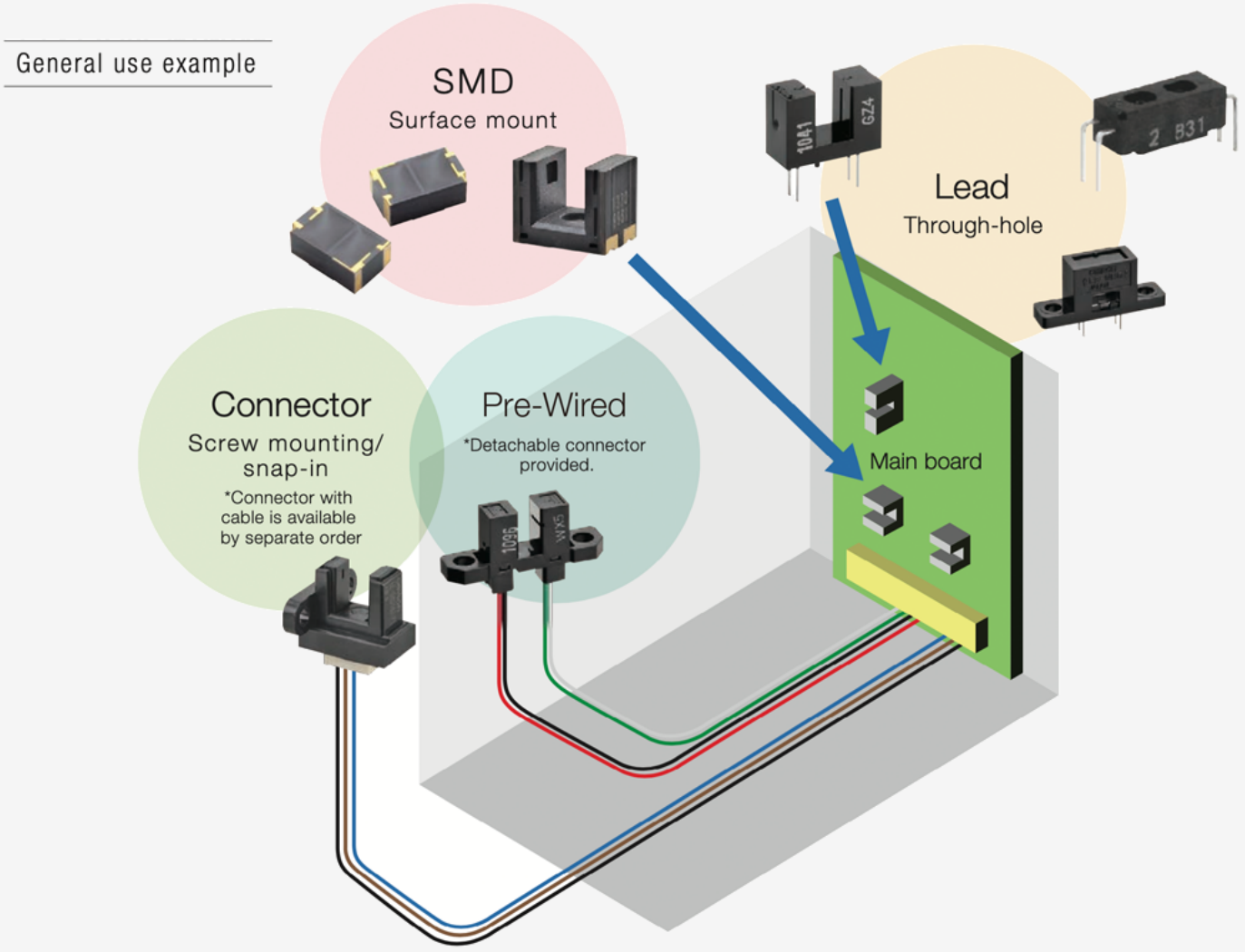
A Photomicrosensor (photointerrupter) is a compact optical sensor that senses objects or object positions with an optical beam. Photomicrosensors are used in consumer equipment (e.g. multifunction printers, IP cameras, robotic cleaners) and commercial devices (e.g. ATMs, copy machines, amusement machines, smart gas meters, machines for pharmaceutical products), which requires high reliability.
For more details, see "**Fundamentals of Photomicrosensors**"

Types of Photomicrosensors (photointerrupters)

A Photomicrosensor (photointerrupter) is categorized into 2 main types. One is a transmissive (slot) type, the other is a reflective type. The illustration below is a general example of the connection/mounting method of different Photomicrosensors. PCB mounting is the most popular method of sensor attachment. Surface mount (SMD) is

effective for downsizing and allows fewer man-hours of assembly. Pre-wired, or connector style is convenient for wiring and maintenance, and is ideal for detecting an object placed far from the main PCB. Omron advises users to choose a sensor that best matches the mechanical structure of the target device/equipment.

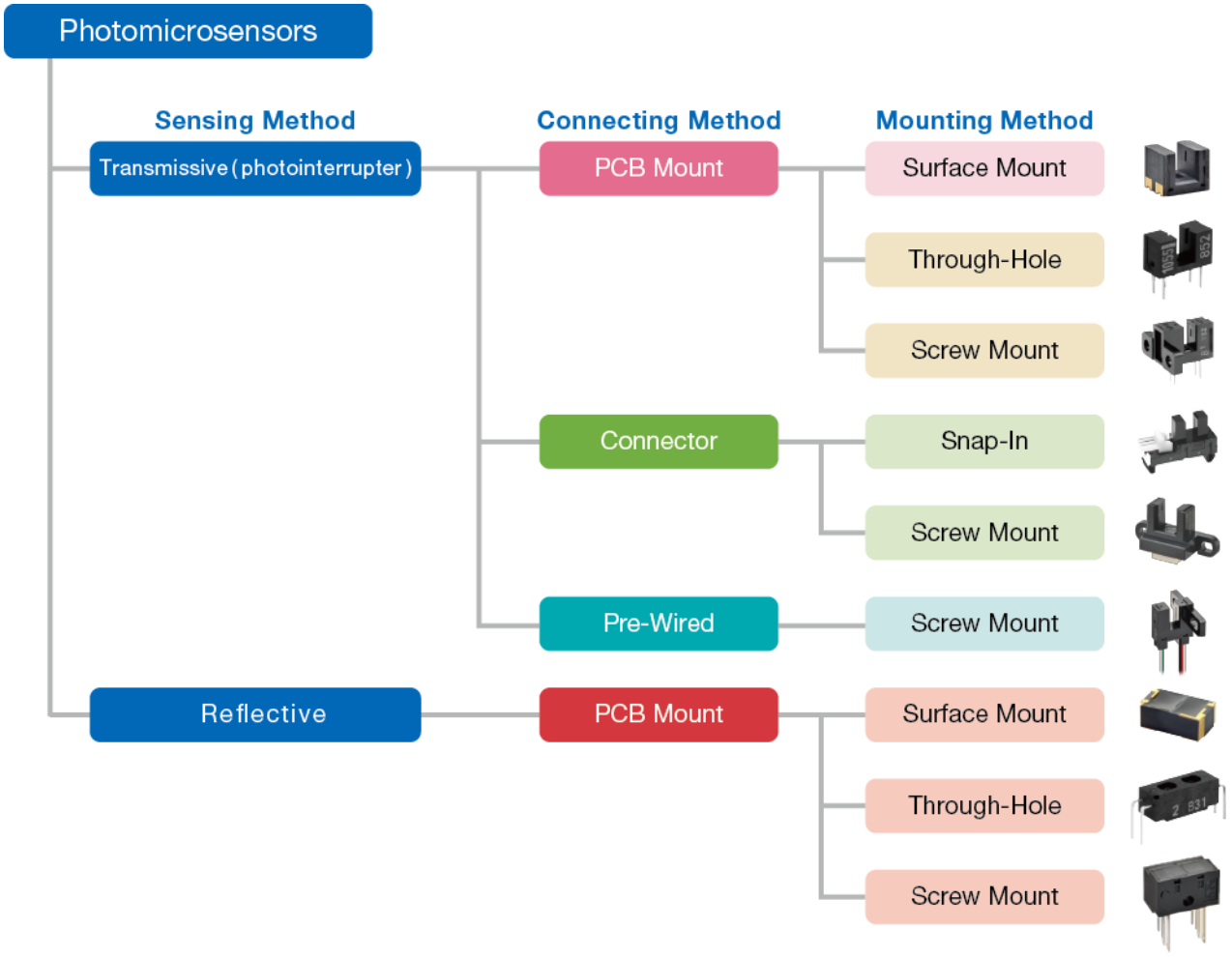
SMD | Connector | Lead | Pre-Wired **Connection / Mounting**



SMD	Surface mount
Connector	Screw mounting/snap-in *Connector with cable is available by separate order
ad	Through-hole

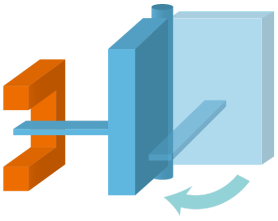
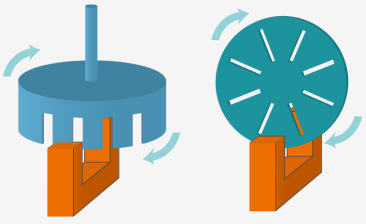
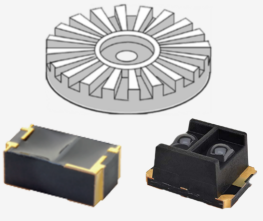
Pre-Wired	*Detachable connector provided.

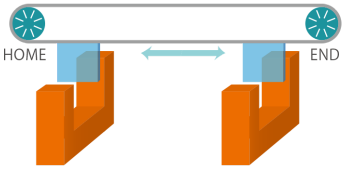
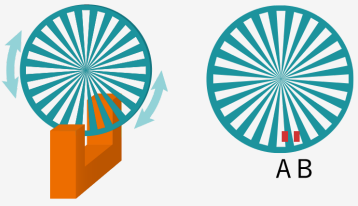
Photomicrosensor Types & Classifications



Typical applications of Photomicrosensors (photointerrupters)

Photomicrosensors (photointerrupters) are commonly used for 1) Object presence and absence detection, 2) Disk rotation counting, 3) Positioning of moving objects and 4) Rotating direction detection (for encoder use).
Here are some examples of typical applications using each of the two types of Photomicrosensors: transmissive (slot) type and reflective type.

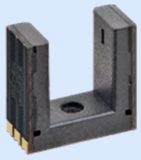
Application examples	Transmissive (Slot) Type	Reflective Type
Presence/absence detection	**Typical application:** Open/closed detection for door/cover on the machine  * Detects the shielding plate added to the door/cover that blocks the light path.	**Typical application:** Paper detection and mark detection (e.g. white objects with a black mark) * Detects the object without a shielding plate.
Count	**Typical application:** Disk rotation count  * Photo-IC output type is effective for high-speed	**Typical application:** Disk rotation count  * Compact and suitable for space-saving

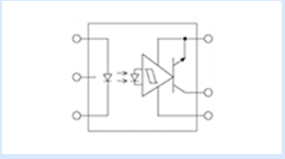
Application examples	Transmissive (Slot) Type	Reflective Type
	rotation.	designs
Position detection (Origin point detection)	**Typical application:** Home/End position detection for linear motion  * Origin point detection for rotating disk (rotary motion)	**Typical application:** Paper pass detection (e.g. cash machines) * Detects the object without a shielding plate.
Rotating direction detection	**Typical application:** Robot motor control (for encoder use)  * Transmissive type is commonly used for this type of application as high accuracy is required.	

The difference in usage between a Photomicrosensor (photointerrupter) and a basic switch?

A basic switch is made of open and closed contacts whereas a Photomicrosensor (photointerrupter) is non-contact switching using an optical beam. A basic switch is available for AC and DC supplies. Since a basic switch does not emit LED, it is ideally suited for applications that require low current consumption such as battery-powered equipment. A Photomicrosensor is superior in durability, sensing position accuracy and response speed.

Photomicrosensor





Durability

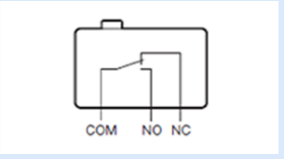
There is no limit on the number of switching actions.
Degradation of the light emitting diode (LED) takes place over time.

Sensing position accuracy

± 0.25 mm or below (= slit width)
*Repeated sensing position characteristics: 0.01 mm

sponse speed

Basic switch



Durability

Mechanical durability: More than 1 million times
Electrical durability: 1 to 100,000 times or more

Sensing position accuracy

± 0.3 - 1.5 mm or below

Response speed

3,000 times / sec. (photo-IC output type)

Voltage specification

DC 4.5 - 16 V (photo-IC output type)

Clicking sensation

No

Effects of external light interference

Yes (use something like a cover to avoid exposure to ambient light)

Applications

Non-contact switching using light eliminates the contact deterioration problem caused by wear and corrosion.
A suitable candidate for applications that require frequent switching and high reliability.
Also superior in detecting minute objects with excellent response speed and sensing position accuracy ideally suited for applications such as copy machines, ATMs (paper detection and sensing papers passing through) and cameras and robots (gear rotation detection).

100 - 200 times / min.

Voltage specification

DC 30 V or below
AC 125 V - 250 V or below

Clicking sensation

Yes

Effects of external light interference

No

Applications

A simple contact switching mechanism to open and close a circuit. Available for AC and DC supplies. Not affected by light, magnetic or noise interference.
Suitable for applications that require low current consumption such as in battery powered equipment and for devices in which a clicking sensation plays an important role (e.g. mouse, joystick).
Some models are suitable for high-capacity load switching applications.

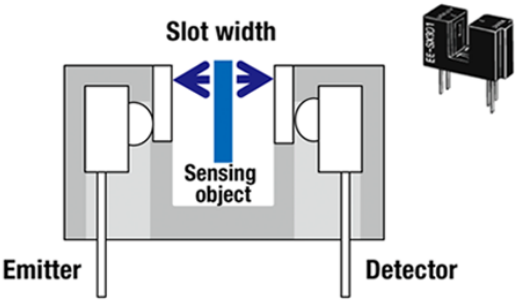
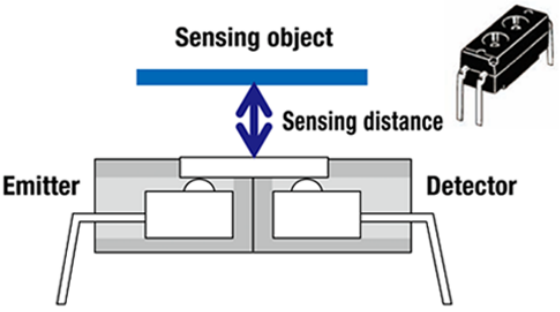
＊These differences do not necessarily apply to all the available product models. Be sure to check the specification datasheet for details of each product model.

A Photomicrosensor, with its non-contact switching technique, has the advantage of high reliability, eliminating the contact deterioration problem caused by wear and corrosion. For example, for a switch within machine internals that may remain closed for an extended period of time, the contacts may deteriorate from oxidation and sulphuration

due to the surrounding atmosphere, ultimately affecting the switching performance. Using the Photomicrosensor for such applications is ideal without worrying about contact deterioration.

The difference in usage between transmissive (slot) and reflective Photomicrosensors (photointerrupters)

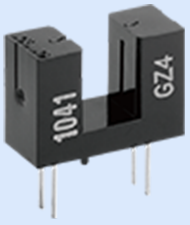
Below are the structural differences and principles of transmissive (slot type) and reflective Photomicrosensors.

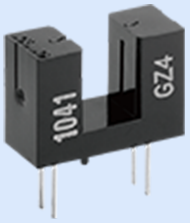
Transmissive (Photointerrupter)	Reflective (Photoreflector)
	
Objects are sensed as the light beam is blocked by an object. ・Stable sensing of opaque objects ・High accuracy in positioning	Objects are sensed by the reflected light on the object.

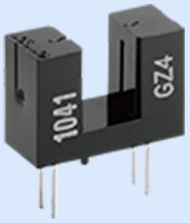
A transmissive(slot) Photomicrosensor(photointerrupter) detects objects by passing the target object through the emitted light beam from the aperture. This is ideal for

applications of small object detection or accurate position sensing. A reflective Photomicrosensor detects the presence and absence of objects but also detects marked objects. This type is effective for realizing a low-profile design of a device or piece of equipment.

The transmissive (slot type) Photomicrosensor provides stable detection regardless of the object's surface condition, position or angle. It is recommended to first check if the design of your device/equipment can apply the transmissive Photomicrosensor (for sensing opaque objects). Here are the advantages and disadvantages of the transmissive (slot type) and reflective Photomicrosensors:

Photomicrosensor	Transmissive (Slot Type) 	Reflective 
Advantage	• **Detect small objects** * Sensing objects that are opaque and larger than apertures (e.g. metal) • **High sensing position accuracy** * Precise ON/OFF switching point within the range of aperture width • **Less susceptible to ambient light with a small size aperture attached to the light receiving element**	• **Detect the presence/absence of objects without a light blocking plate (direct sensing) and enable simple, small-sized, low profile equipment design** • **Detect marks on the surface of an object** (e.g. detecting black markings on white backgroud tapes) • **Structurally, emitting and light receiving**

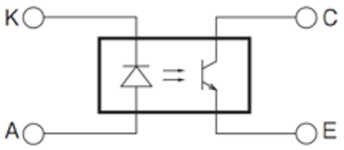
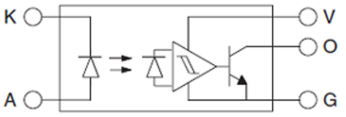
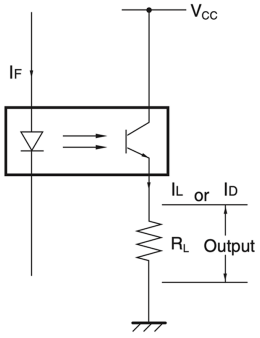
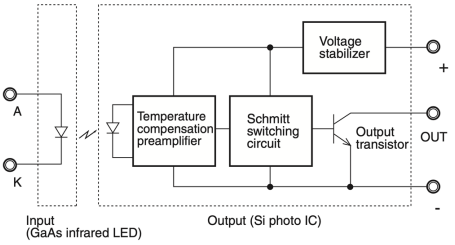
Photomicrosensor	Transmissive (Slot Type) 	Reflective 
		elements are faced in the same direction • **Offers lineup of small size sensors**
Disadvantage	• **Increased number of parts** Slot type structure adds a light blocking plate to the sensing object and works by detecting light blockage	• **Less accurate for sensing small objects and objects with low reflection rate** • **There are a number of variable factors including the size, color, surface condition and sensing distance/angle of the sensing object to consider and examine using the actual equipment** • **Low sensing position accuracy due to broad sensing area** • **With broad light receiving range, highly**

Photomicrosensor	Transmissive (Slot Type) 	Reflective 
		susceptible to ambient light

The difference in usage between a phototransistor output and Phot IC output for Photomicrosensors (photointerrupters)

With a phototransistor output, the threshold level to turn the sensor on or off is adjusted using an external circuit, whereas with photo IC output, the threshold level is fixed at an internal circuit board. Phototransistor outputs enable users to set an optimum threshold level according to the application. Photo IC output is ideal for applications requiring a fast response time.

The following table explains the differences between phototransistor output and photo IC output. Please use this as a guide when selecting your sensor and check the specification datasheet for product details.

Photomicrosensor	Phototransistor output	Photo IC output
Internal circuit		
Circuit configuration	The presence or absence of the sensing object is determined by comparing the light current IL (A) and IL (B) flowing through the phototransistor with (A) and without (B) the sensing object.  The threshold for judgment is set on the external circuit.	Shown below is the circuit configurations of photo IC output type.  Thus the threshold for output ON/OFF is fixed.

Photomicrosensor	Phototransistor output	Photo IC output
Differentiation	When the ratio of the light current IL (A) to the light current IL (B) is not sufficiently large in actual equipment, setting the optimum threshold value is the key to stable detection. In such a case, select the phototransistor output type for which the threshold can be set.	When the ratio of the light current IL (A) to the light current IL (B) is sufficiently large in actual equipment, photo IC type is recommended to make circuit design easier. It is also ideal for applications requiring high-speed response (3 kHz min.), such as the detection of the number of revolutions of a disk with slits.