Introduction
A photocoupler receiving lights by the phototransistor is usually called a standard type photocoupler and operates without any circuit connection to the base of the phototransistor.

Therefore, since the base of the phototransistor is “floating” state, unexpected noise is generated sometimes.

Such two typical noise phenomena are described in the following.

Noise due to change of potential difference between the light emitting side and light receiving side

In a photocoupler, signals are transferred by light (photons) from the light emitting side to light receiving side.

However, there is slight coupling capacitance as shown at “C₁-O” in figure 1.0.

Accordingly, by application of a step voltage signal (Vin) between the light emitting side and light receiving side, some signal may be sometimes output in the light receiving side, as shown in figure 2.0.

![Fig 1.0: Capacitance coupling between the light emitting side and light receiving side](image)

![Fig 2.0: Noise due to capacitance coupled between the light emitting side and light receiving side](image)

Naturally, in the photocoupler signals not transmitted by photons are defined as noise.

Basically, the complete elimination of such noise is difficult.

In general, as the countermeasure, the architecture is designed to avoid steep change of potential difference.

Otherwise, the noise can be reduced compromising with the operation speed by transmitting output signals through the integration circuit as shown in figure 3.0.
However, as figure 4.0 shows, there are photocouplers with an electrostatic shield incorporated between the light emitting side and light receiving side.

![Electrostatic Shield](image)

Fig 4.0: Photocouplers with a built-in electrostatic shield

In this, because the noise is induced not to the base but to the emitter, the transistor does not amplify the current caused by the noise, resulting in less output noise level.

This noise immunity is referred to as a specification of “Common mode transient immunity”.

**Noise due to power source rise at the light receiving side**

The phototransistor used for receiving lights has capacitance between the collector and base as shown at “\(C_{CB}\)” in the figure below.

![Coupling capacitance between the collector and base](image)

Fig 5.0: Coupling capacitance between the collector and base

Therefore, by voltage application with steep rise to the collector, a current which charges the capacitance “\(C_{CB}\)” flows into the base for an instant. By this current the collector current also flows and noise can be output as shown in figure 6.0.

![Noise due to capacitance coupled between the collector and base](image)

Fig 6.0: Noise due to capacitance coupled between the collector and base

In general, the voltage seldom rises as steeply as shown in this example, however an adequate evaluation should be made before operating a high output voltage photocoupler at high power supply voltage.

Basically, the power supply voltage should be controlled to rise gradually and the output signal is not evaluated until the power supply voltage stabilizes.