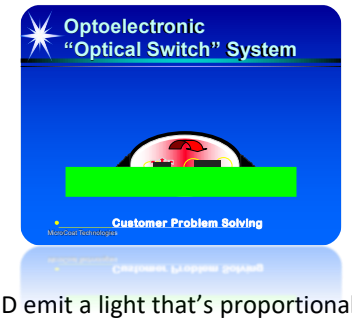
Application Note:

Reprint from Eagle Academy at AutoDesk

Let There Be Light! How an Optocoupler Works.

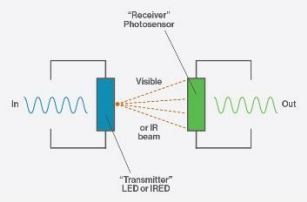
Need to protect sensitive, low-voltage components and isolate circuits on your PCB? An Optocoupler can do the job. Let there be light! This device allows you to transmit an electrical signal between two isolated circuits with two parts: an LED that emits infrared light and a photosensitive device that detects light from the LED. Both of these parts are contained within a traditional black box with a pair of pins for connectivity. At a glance, it's easy to mix up an Optocoupler with an integrated circuit (IC).



This Triac Optocoupler looks like an IC. (Image source)

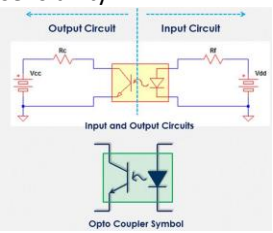
How It Works

A current is first applied to the Optocoupler, which makes the infrared LED emit a light that's proportional to the current. When the light hits the photosensitive device, it switches on and starts to conduct a current as any ordinary transistor might.



How an Optocoupler works. (Image source)

The photosensitive device is typically left unconnected by default to provide the highest sensitivity to infrared light. It can also be connected to ground with an external resistor for a higher degree of control over switching sensitivity.



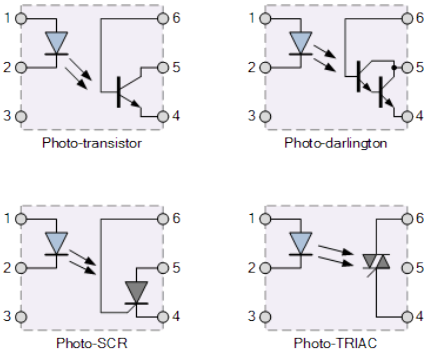
An Optocoupler effectively isolates an output and input circuit. (Image source)

This device works like a switch, connecting two isolated circuits on your PCB. When current stops flowing through the LED, the photosensitive device also stops conducting and turns off. All of this switching happens through a void of glass, plastic, or air with no electrical parts between the LED or photosensitive device. It's all about the light.

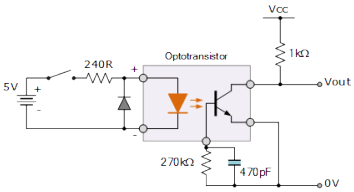
Benefits and Types

If you're designing an electronic device that will be susceptible to voltage surges, lightning strikes, power supply spikes, etc. then you'll need a way to protect low-voltage devices.

When used correctly, an Optocoupler can effectively:
Remove electrical noise from signals
Isolate low-voltage devices from high-voltage circuits
Allow you to use small digital signals to control larger AC voltages
Optocouplers come in four configurations. Each configuration shares the same infrared LED with a different photosensitive device. These include:
Photo-Transistor and Photo-Darlington, which are typically used in DC circuits, and Photo-SCR and Photo-TRIAC which are used to control AC circuits.



The four types of Optocouplers. (Image source)
Typical Applications
Optocouplers can either be used on their own as a switching device or used with other electronic devices to provide isolation between low and high-voltage circuits. You'll typically find these devices being used for:
Microprocessor input/output switching
DC and AC power control
Communications equipment protection
Power supply regulation
Within these applications, you'll encounter various configurations. Some examples include:
Opto Transistor DC Switch
This configuration will detect DC signals and also allows you to control AC-powered equipment. The MOC3020 is perfect for controlling a mains connection or providing a gate pulse to another Photo-Triac with a current limiting resistor.



(Image source)
Triac Optocoupler
This configuration will allow you to control AC-powered loads such as motors and lamps. It's also capable of conducting in both halves of an AC cycle with zero-crossing detection. This allows a load to receive full power without any major spikes in current when switching inductive loads.