

Optocoupler Tutorial

An **Optocoupler**, is an electronic components that interconnects two separate electrical circuits by means of a light sensitive optical interface.

We know from our tutorials about Transformers that they can not only provide a step-down (or step-up) voltage but they also provide “electrical isolation” between the higher voltage on the primary side and the lower voltage on the secondary side.

In other words, transformers isolate the primary input voltage from the secondary output voltage using electromagnetic coupling and this is achieved using the magnetic flux circulating within their laminated iron core.

ADVERTISING



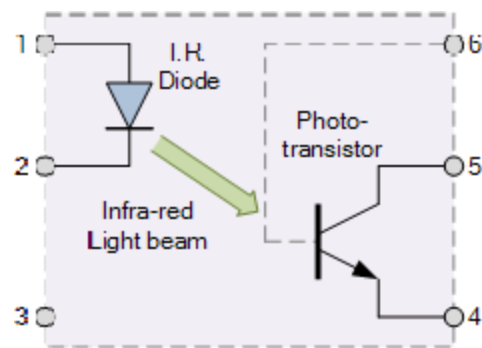
But we can also provide electrical isolation between an input source and an output load using just light by using a very common and valuable electronic component called an **Optocoupler**.

The basic design of an optocoupler, also known as an **Opto-isolator**, consists of an LED that produces infra-red light and a semiconductor photo-sensitive device that is used to detect the emitted infra-red beam. Both the LED and photo-sensitive device are enclosed in a light-tight body or package with metal legs for the electrical connections as shown.



An optocoupler or opto-isolator consists of a light emitter, the LED and a light sensitive receiver which can be a single photo-diode, photo-transistor, photo-resistor, photo-SCR, or a photo-TRIAC with the basic operation of an optocoupler being very simple to understand.

Phototransistor Optocoupler



Assume a photo-transistor device as shown. Current from the source signal passes through the input LED which emits an infra-red light whose intensity is proportional to the electrical signal.

This emitted light falls upon the base of the photo-transistor, causing it to switch-ON and conduct in a similar way to a normal bipolar transistor.

The base connection of the photo-transistor can be left open (unconnected) for maximum sensitivity to the LEDs infra-red light energy or connected to ground via a suitable external high value resistor to control the switching sensitivity making it more stable and resistant to false triggering by external electrical noise or voltage transients.

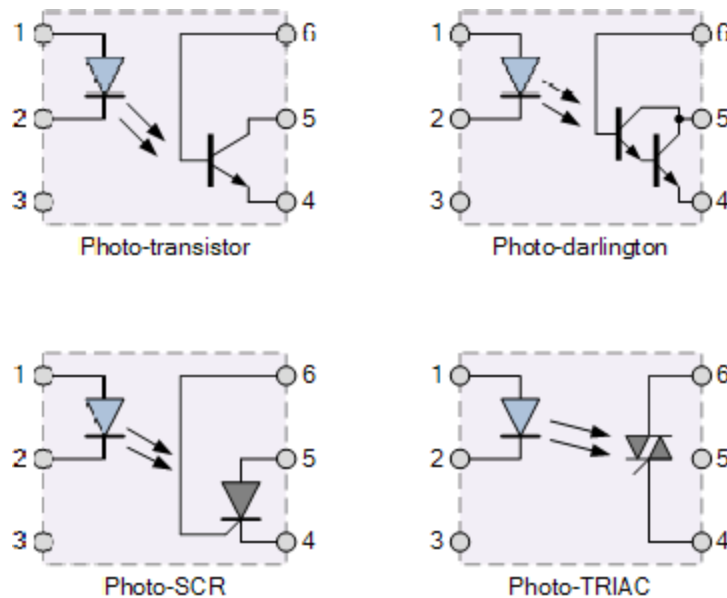
When the current flowing through the LED is interrupted, the infra-red emitted light is cut-off, causing the photo-transistor to cease conducting. The photo-transistor can be used to switch current in the output circuit. The spectral response of the LED and the photo-sensitive device are closely matched being separated by a transparent medium such as glass, plastic or air. Since there is no direct electrical connection between the input and output of an optocoupler, electrical isolation up to 10kV is achieved.

Optocouplers are available in four general types, each one having an infra-red LED source but with different photo-sensitive devices. The four optocouplers are called the: *Photo-transistor*, *Photo-darlington*, *Photo-SCR* and *Photo-triac* as shown below.

Optocoupler Types

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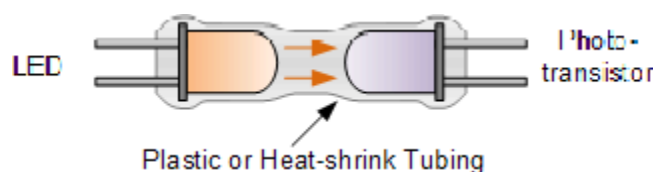




The photo-transistor and photo-darlington devices are mainly for use in DC circuits while the photo-SCR and photo-triac allow AC powered circuits to be controlled. There are many other kinds of source-sensor combinations, such as LED-photodiode, LED-LASER, lamp-photoresistor pairs, reflective and slotted optocouplers.

Simple home made opto-couplers can be constructed by using individual components. An Led and a photo-transistor are inserted into a rigid plastic tube or encased in heat-shrinkable tubing as shown. The advantage of this home-made optocoupler is that tubing can be cut to any length you want and even bent around corners. Obviously, tubing with a reflective inner would be more efficient than dark black tubing.

Home-made Optocoupler



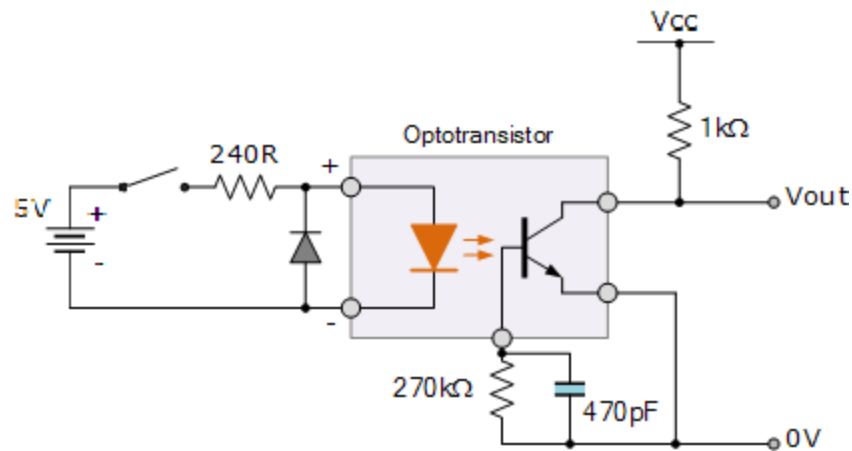
Optocoupler Applications

Optocouplers and opto-isolators can be used on their own, or to switch a range of other larger electronic devices such as transistors and triacs providing the required electrical isolation between a lower voltage control signal, for example one from an Arduino or micro-controller, and a much higher voltage or mains current output signal.

Common applications for opto-couplers include microprocessor input/output switching, DC and AC power control, PC communications, signal isolation and power supply regulation which suffer from current ground loops, etc. The electrical signal being transmitted can be either analogue (linear) or digital (pulses).

In this application, the optocoupler is used to detect the operation of the switch or another type of digital input signal. This is useful if the switch or signal being detected is within an electrically noisy environment. The output can be used to operate an external circuit, light or as an input to a PC or microprocessor.

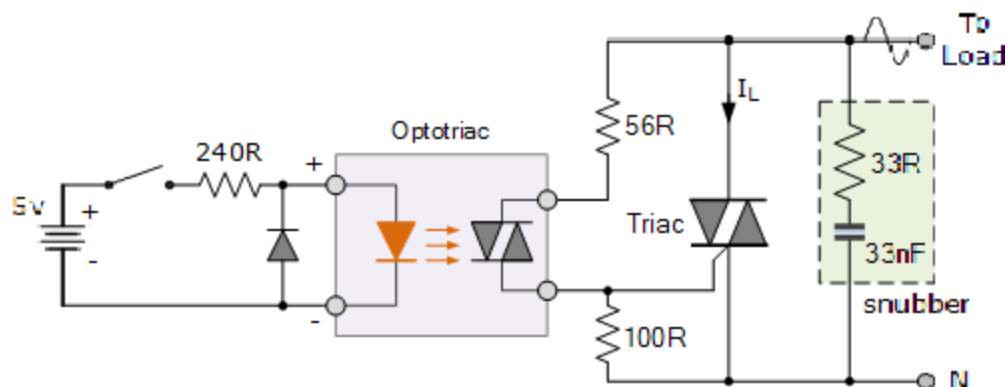
An Optotransistor DC Switch



Here in this example, the externally connected 270kΩ resistor is used to control the sensitivity of the photo-transistors base region. The value of the resistor can be chosen to suit the selected photo-coupler device and the amount of switching sensitivity required. The capacitor stops any unwanted spikes or transients from false triggering the opto-transistors base.

As well as detecting DC signals and data, Opto-triac isolators are also available which allow AC powered equipment and mains lamps to be controlled. Opto-coupled triacs such as the MOC 3020, have voltage ratings of about 400 volts making them ideal for direct mains connection and a maximum current of about 100mA. For higher powered loads, the opto-triac may be used to provide the gate pulse to another larger triac via a current limiting resistor as shown.

Triac Optocoupler Application



This type of optocoupler configuration forms the basis of a very simple solid state relay application which can be used to control any AC mains powered load such as lamps and motors. Also unlike a thyristor (SCR), a triac is capable of conducting in both halves of the mains AC cycle with zero-crossing detection allowing the load to receive full power without the heavy inrush currents when switching inductive loads.

Optocouplers and **Opto-isolators** are great electronic devices that allow devices such as power transistors and triacs to be controlled from a PC's output port, digital switch or from a low voltage data signal such as that from a logic gate. The main advantage of opto-couplers is their high electrical isolation between the input and output terminals allowing relatively small digital signals to control much large AC voltages, currents and power.

An optocoupler can be used with both DC and AC signals with optocouplers utilizing a SCR (thyristor) or triac as the photo-detecting device are primarily designed for AC power-control applications. The main advantage of photo-SCRs and photo-triacs is the complete isolation from any noise or voltage spikes present on the AC power supply line as well as zero-crossing detection of the sinusoidal waveform which reduces switching and inrush currents protecting any power semiconductors used from thermal stress and shock.



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Ahmad

Hi, thanks

Posted on July 16th 2021 | 11:37 am

← Rep



Leonardo m.pineda

Any application of photo coupler

Posted on June 18th 2021 | 4:43 am

← Rep



Richard Principle

Very interesting whenever I have used a opto-coupler or seen them in a circuit the transistor base pin has been left disconnected, of course early on as a electronics trades person, I found the the base emitter resistor is good to have, with out it strange results happens. (270K Ohms in circuit above)



shaikbilal

Sir i need information about opto couplers which can use instead of other

Posted on May 06th 2021 | 4:45 pm

← Rep



Midi dibo

Very good applications

Posted on May 04th 2021 | 3:14 am

← Rep



Ben Bako

Very interesting info. Thanks

Posted on April 30th 2021 | 10:32 pm

← Rep



ZafarImam

Excellent Tutorial. I have made both the units for DC and AC applications and find it good.
I will now try your ideas with TLP250 and TLP350.
Thanks a lot and Regards.

Posted on March 29th 2021 | 11:39 am

← Rep



Mr.Wyatt

why are there so many gosh dang Indians on here?!?!?!?

Posted on October 19th 2020 | 6:56 pm

← Rep



Artemio

Because China and India are a large share of the population. In India access to the global internet is less restricted than in China. Hence, a huge population with limited spending capability generates lots of noise on free resources.

Posted on April 05th 2021 | 6:22 am

← Rep



JoGusto

They are really smart?

Posted on December 07th 2020 | 6:03 am

← Rep



Levi

yo this website bussin

Posted on October 19th 2020 | 6:31 pm

← Rep



Silverio Gibertas Jr.

Good day every one,

First of all , I would to thanks this is page or web to write the fundamentals and relation of electronics. This is very helpful and useful now even you are students or have a business like technical services. My name silverio from philippines, im electronics graduate and now i having business technical services. During my

past time of colleges days. they are not teaching about optocoupler functions but this tutorials is helpful
Thanks a lot of good guides and knowledges.

Posted on August 15th 2020 | 1:53 pm

← Rep



D panindra

Excellent tutorials, provide practical ckt live ckt.

Posted on August 12th 2020 | 1:57 am

← Rep



PRASANNA KUMAR K

Do Optocouplers necessary require 5 volt power supply connected to collector for it to work as a switch?

Posted on July 20th 2020 | 9:45 am

← Rep



Moses

Good explanation

Posted on July 14th 2020 | 1:19 pm

← Rep



johan

hi i am using a 555 timer with 3082 optocoupler with 3 scr in parallel but can,t get the scr to switch may be you can asist

Posted on May 29th 2020 | 6:56 am

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✕ ← Rep



engr_rezaul_islam

nice presentation

Posted on May 20th 2020 | 10:09 pm

← Rep



Boamah Augustina

Thanks

Posted on October 28th 2019 | 6:48 am

← Rep



Kanor David

Such an understandable and easy tutorial.I like it. But how would you identify an optocoupler

Posted on October 01st 2019 | 11:18 am

← Rep



jeevan

I used pc 817 opto-coupler to drive 60 volts DC light with Arduino for colour switching I given 5volts power supply for opto-coupler and other side I connected input and load but it was directly switched without given any input in Arduino please give any

Posted on September 26th 2019 | 12:29 pm

← Rep



IS TRIAC changes shape of input AC voltage:

Posted on August 05th 2019 | 11:29 am

← Rep



Ayush Sagar

Hello, Can you explain why there is need of 100R resistor between Gate pin and Terminal 1(Neural line in the CRT) of triac?

Won't the ac line affect the Gate of Traic?

Posted on July 02nd 2019 | 4:14 pm

← Rep

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