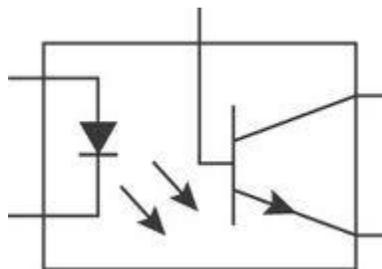


# Understanding and testing opto-isolators

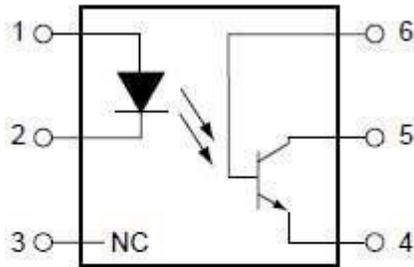


## Understanding opto-isolators:

The opto-isolator is simply a package that contains both a light emitting diode (LED) and a photo-detector such as a photosensitive silicon diode, transistor, Darlington pair, or silicon controlled rectifier (SCR). The most common type uses an infrared LED and a phototransistor. Other circuitry, for example an output amplifier, may be integrated into the package. An opto-isolator is usually thought of as a single integrated package, but opto-isolation can also be achieved by using separate devices as well. Opto-isolators are very common in many devices especially in the feedback section of SMPS circuits found in LCD and Plasma TVs and most other consumer electronics as well. You will typically see 4 and 6 pin opto-isolators, 4 pin definitely being the most common. Some opto-isolator ICs will also have multiple opto-isolators in one package.

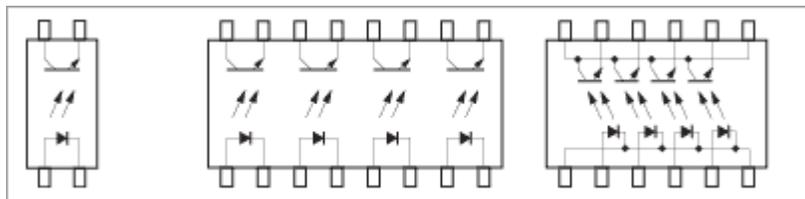


**Symbol for 4 pin LED/Phototransistor type opto-isolator IC.**



- PIN 1. ANODE
- 2. CATHODE
- 3. NO CONNECTION
- 4. EMITTER
- 5. COLLECTOR
- 6. BASE

**Symbol for 6 pin opto-isolator IC.**



**Picture showing multiple opto-isolators in one package.**

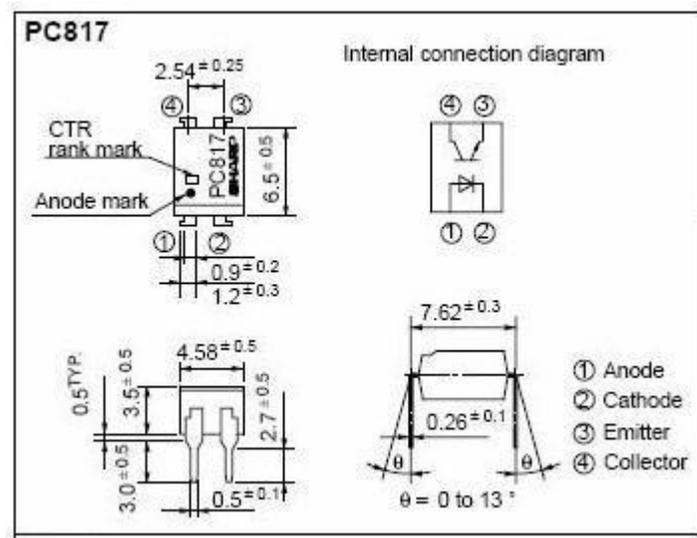
An opto-isolator also called an opto-coupler or photo-coupler allows a signal to pass from one circuit to another but allows the two circuits to remain electrically isolated. The most common opto-isolator which comes in IC package consists of an LED which shines onto the base of a photo-transistor (usually an npn transistor) and allows current to flow between collector and emitter until the LED is turned off. When a signal is applied to the LED it then shines light that is varied in brightness with the same amplitude as the input signal, this light lands upon the photo-transistor (the resistance of the collector/emitter junction now changes with the varying light) which passes the signal onto the next circuit.

### 3 methods for testing opto-isolators:

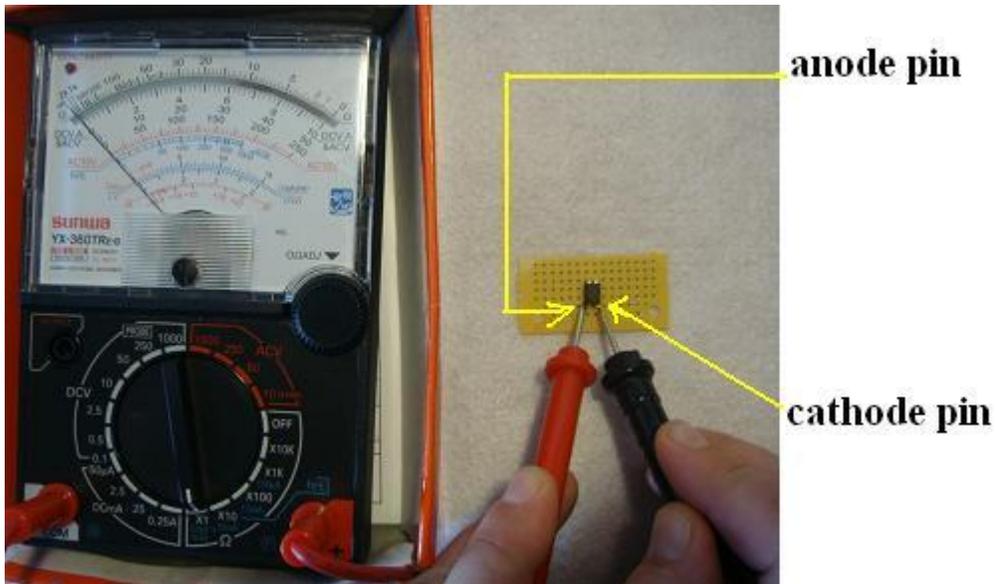
These methods will cover testing the most common opto-isolators found in electronics equipment, 4 pin LED/phototransistor opto-isolators.

#### Method 1:

Remove the opto-isolator from circuit or at least de-solder and lift the emitter and cathode pins from the circuit to get accurate readings. If you completely remove the opto-isolator from the circuit you can use a piece of PCB prototype board to hold it in place, do not solder it to the board only stick the leads through the holes. Using your analogue meter set to the x1 ohm range test the LED side of the opto-isolator. Which will be found by looking up the part number online or referring to the circuit's schematic diagram. A common opto-isolator found in LCD TVs is the 817 type for instance the PC817.

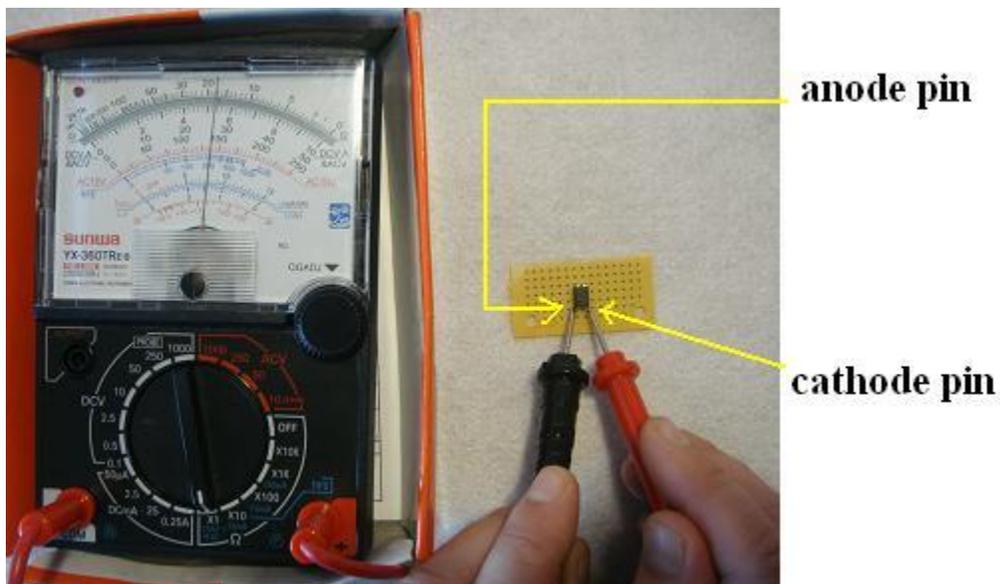


Place the red test lead on the anode pin and the black test lead on the cathode pin, the reading should be infinite.



**Infinite reading with red test lead on anode and black test lead on cathode.**

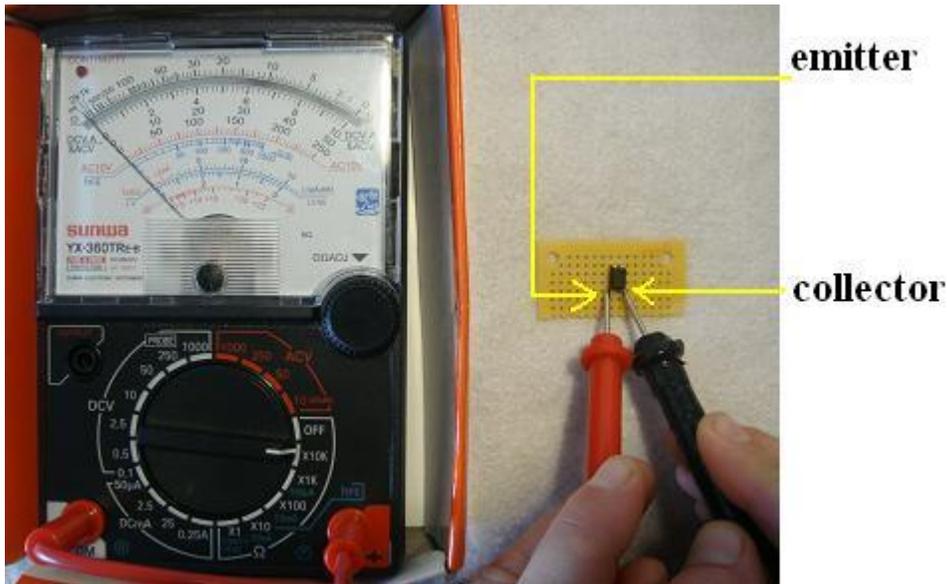
Next place the black test lead on the anode and the red test lead on the cathode, now you should get a resistance reading that is low, typically around 20 ohms or so.



**Meter indicates a low resistance reading of 17 ohms with black test lead on anode and red test lead on cathode.**

If you get a low resistance or 0 ohms reading in both directions the the LED is considered shorted and the opto-isolator must be replaced. If you get a reading of infinity in both directions the LED is considered open and again the opto-isolator must be replaced.

Now to test the phototransistor side of the opto-isolator. Set your analogue meter to the x10k ohm range. Place the black test lead on the collector pin and the red test lead on the emitter pin of the opto-isolator, you should get a resistance reading of infinity.



**Infinite reading with black test lead on collector and red test lead on emitter.**

Next place the red test lead on the collector and the black test lead on the emitter. You should get a large resistance reading, typically around 500k ohms or so. If you get a 0 ohms or low resistance reading in both directions the collector/emitter junction of the phototransistor is shorted and the opto-isolator must be replaced.

Note: Testing shown is on a 4 pin opto-isolator , when testing a 6 pin opto-isolator use the same procedure, but double check the pin configurations for the particular opto-isolator.

## Method two:

De-solder and remove the opto-isolator you want to test from the circuit it is in. Using alligator clips or some other method attach a DMM (digital multimeter) test leads to the collector and emitter pins of the opto-isolator, polarity does not matter. Set the DMM to the resistance or ohms setting. The meter should read O.L (Over Limit), infinity or something that indicates the resistance is beyond the range of the meter.



**Attach test leads to the emitter and collector pins, polarity does not matter.**



**Set the DMM to the resistance setting, reading should be O.L.**

Now using you analogue meter set to x1 ohm range, place the red test lead on the cathode pin and the black test lead on the anode pin, you should get a low resistance reading on the analogue meter and also if you look at the digital multimeter it will now also show a low resistance reading.

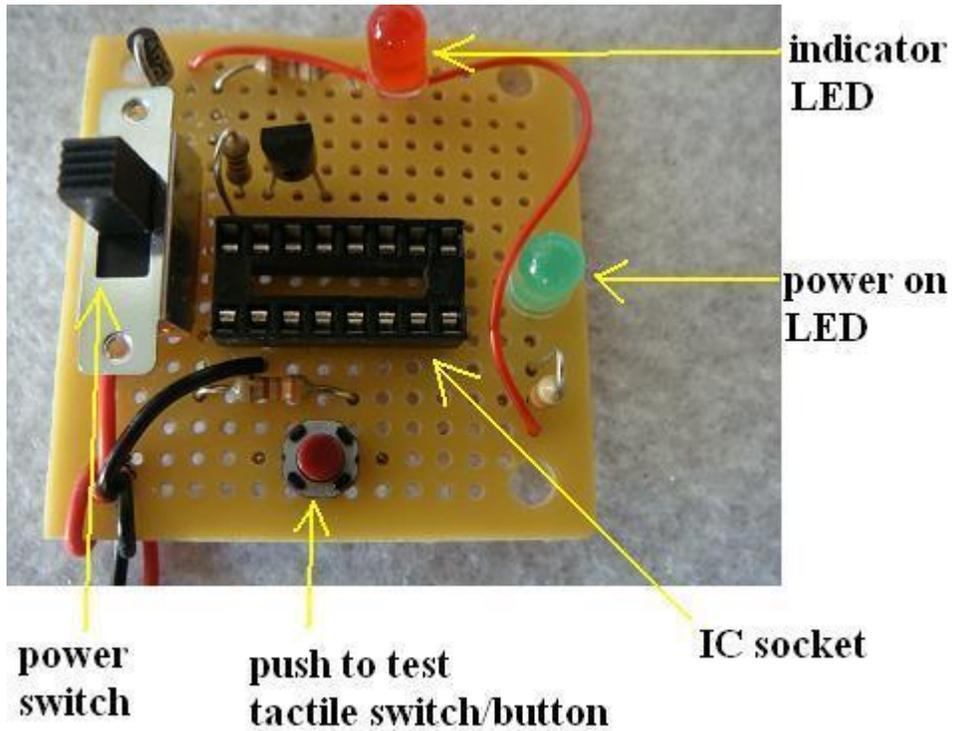


**With analogue meters black test lead on the anode pin and the red test lead on the cathode pin the DMM now shows a low resistance of 16.3 ohms between the collector and emitter.**

This is the characteristics of a good opto-isolator.

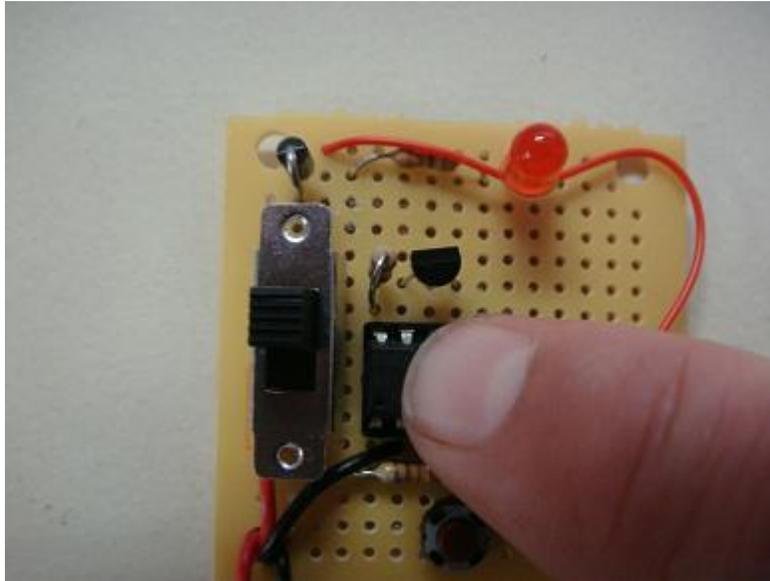
### Method three:

The third method requires assembling an easy to make opto-isolator tester.

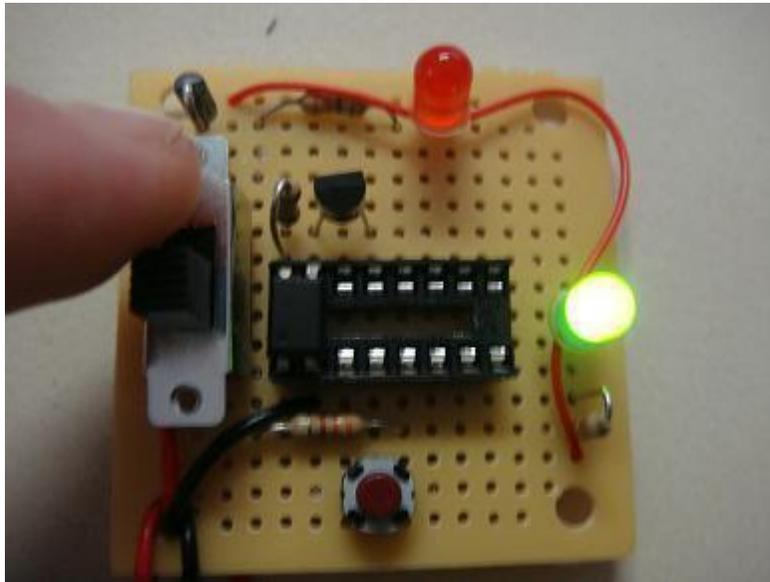


**4 pin, LED/phototransistor opto-isolator tester**

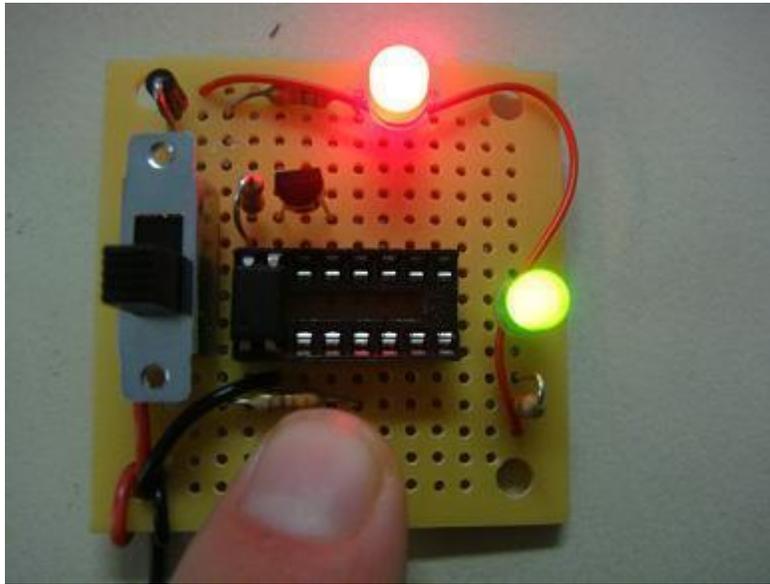
The idea is simple, with the power on and an opto-isolator placed in the proper section of the IC socket, pressing the push to test button will cause the red indicator LED to light otherwise the opto-isolator is no good and must be replaced.



**Place opto-isolator into proper section of the IC socket.**

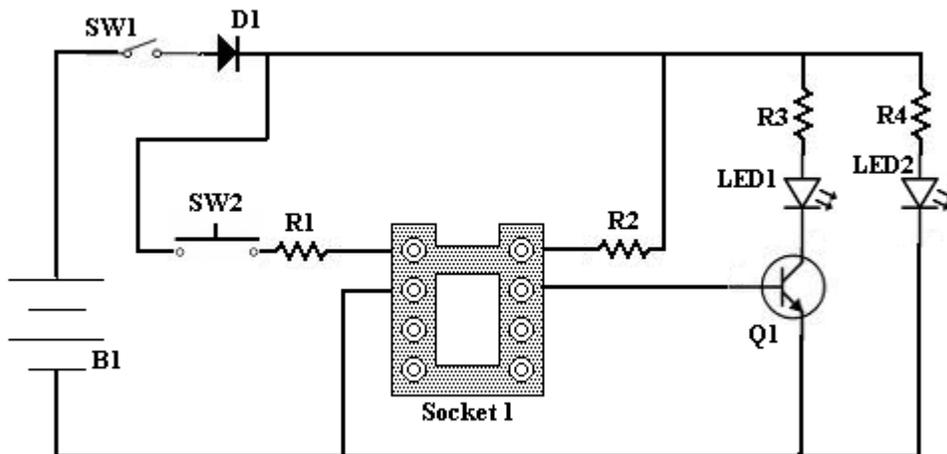


**Turn tester power on, the "power on" LED is now illuminated.**



If the opto-isolator is good when the “push to test” button is pressed the red “indicator” LED will light.

This tester is good for testing many different 4 pin LED/phototransistor type opto-isolators like the PC817, PC123, 817B, EL817 and more. You can also make one that will test 6 pin opto-isolators or both 4 and 6 pin. You can also design testers for other types of opto-isolators besides the LED/phototransistor type.



Schematic for opto-isolator tester used in this article

## **Parts list for opto-isolator tester used in this article:**

SW1, SPST slide switch.

SW2, SPST momentary contact push to make tactile switch.

B1, 9V battery.

D1, 1N4001 PN diode.

R1,R3 and R4, 330 ohm ¼ watt carbon film resistors.

R2, 1k ohm ¼ watt carbon film resistor.

Q1, 2N3904 NPN bipolar junction transistor.

LED1, 5mm red LED.

LED2, 5mm green LED.

Socket1, any size IC socket will do, the one used in this article was a 16 pin IC socket only because that is what I had on hand.

Hope you enjoyed this repair article and remember if you ever have any electronics related questions you can always email me [john@preher-tech.com](mailto:john@preher-tech.com). Also don't forget to visit our website, [www.preher-tech.com](http://www.preher-tech.com).

## **Recommended Books:**

[Troubleshooting & Repairing LCD TVs](#)

[LCD TV Repair Case Histories](#)

[LCD Monitor Repair](#)

[Troubleshooting & Repairing Switch Mode Power Supplies](#)

[Testing Electronic Components](#)

[How To Find Burnt Resistor Value](#)

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