Engineering Technology
Electricity / Electronics

Diodes

Introduction

Once you graduate from the simple, passive components that are resistors, capacitors, and inductors, it's time to step on up to the wonderful world of semiconductors. One of the most widely used semiconductor components is the diode.

Ideal Diodes

The key function of an **ideal** diode is to control the *direction* of current-flow. Current passing through a diode can only go in one direction, called the forward direction. Current trying to flow the reverse direction is blocked. They're like the one-way valve of electronics.

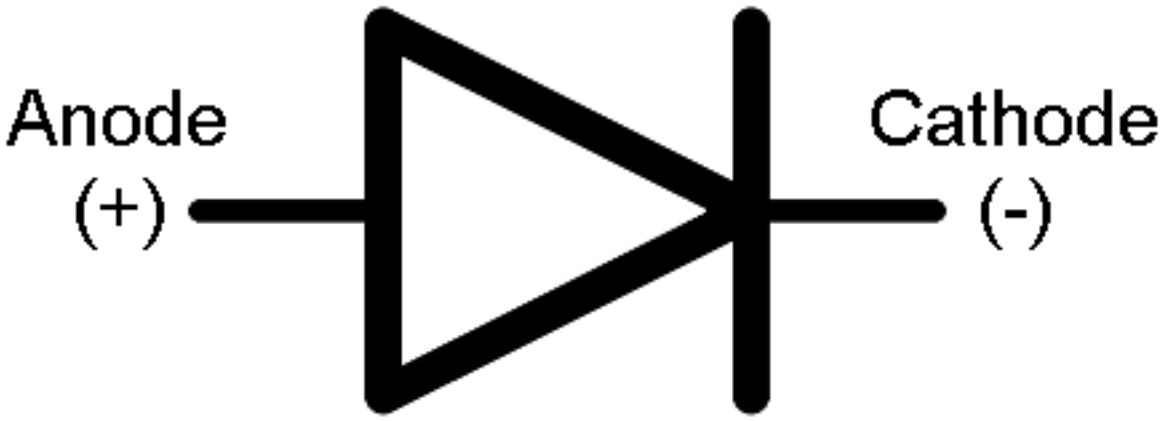
If the voltage across a diode is negative, no current can flow*, and the ideal diode looks like an open circuit. In such a situation, the diode is said to be *off* or **reverse biased**.

As long as the voltage across the diode isn't negative, it'll "turn on" and conduct current. Ideally* a diode would act like a short circuit (0V across it) if it was conducting current. When a diode is conducting current it's **forward biased**(electronics jargon for "on").

Circuit Symbol

Every diode has **two terminals** – connections on each end of the component – and those terminals are **polarized**, meaning the two terminals are distinctly different. It's important not to mix the connections on a diode up. The positive end of a diode is called the **anode**, and the negative end is called the **cathode**. Current can flow from the anode end to the cathode, but not the other direction. If you forget which way current flows through a diode, try to remember the mnemonic *ACID*: "anode current in diode" (also *anode cathode is diode*).

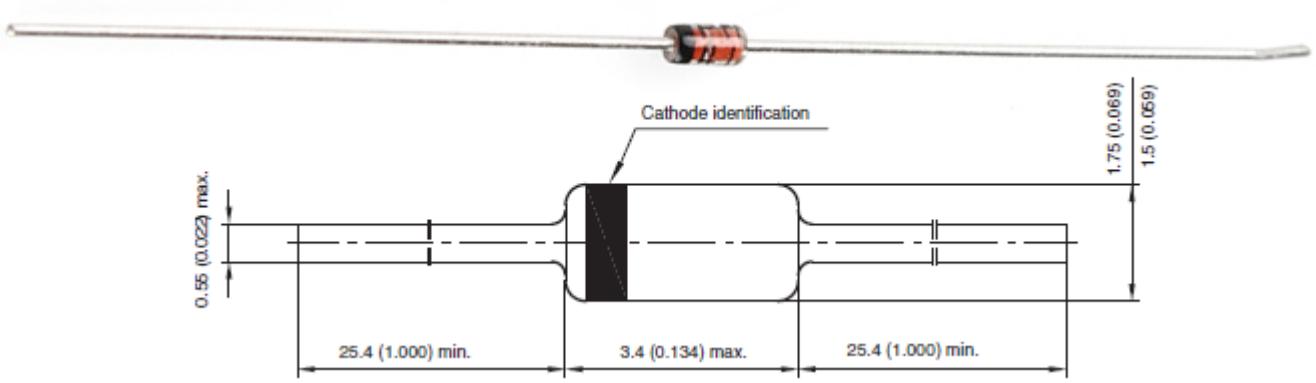
The **circuit symbol** of a standard diode is a triangle butting up against a line. There are a variety of diode types, but usually their circuit symbol will look something like this:



Types of Diodes

Normal Diodes

Standard **signal diodes** are among the most basic, average, no-frills members of the diode family. They usually have a medium-high forward voltage drop and a low maximum current rating. A common example of a signal diode is the 1N4148. Very general purpose, it's got a typical forward voltage drop of 0.72V and a 300mA maximum forward current rating.



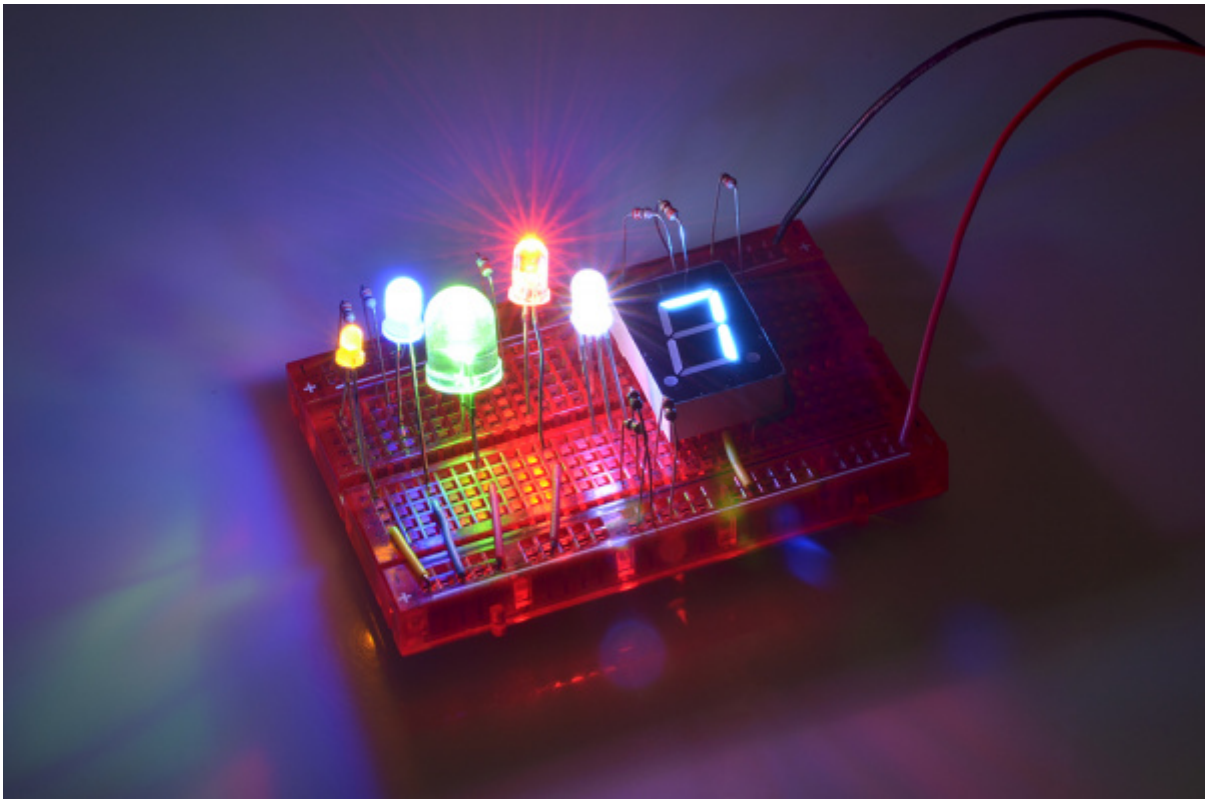
A small-signal diode, the 1N4148. Notice the black circle around the diode, that marks which of the terminals is the cathode.

A **rectifier or power diode** is a standard diode with a much higher maximum current rating. This higher current rating usually comes at the cost of a larger forward voltage. The 1N4001, for example, has a current rating of 1A and a forward voltage of 1.1V.

A 1N4001 PTH diode. This time a gray band indicates which pin is the cathode.

Light-Emitting Diodes (LEDs!)

The flashiest member of the diode family must be the light-emitting diode (LED). These diodes quite literally light up when a positive voltage is applied.



A handful of through-hole LEDs. From left to right: a yellow 3mm, blue 5mm, green 10mm, super-bright red 5mm, an RGB 5mm and a blue 7-segment LED.

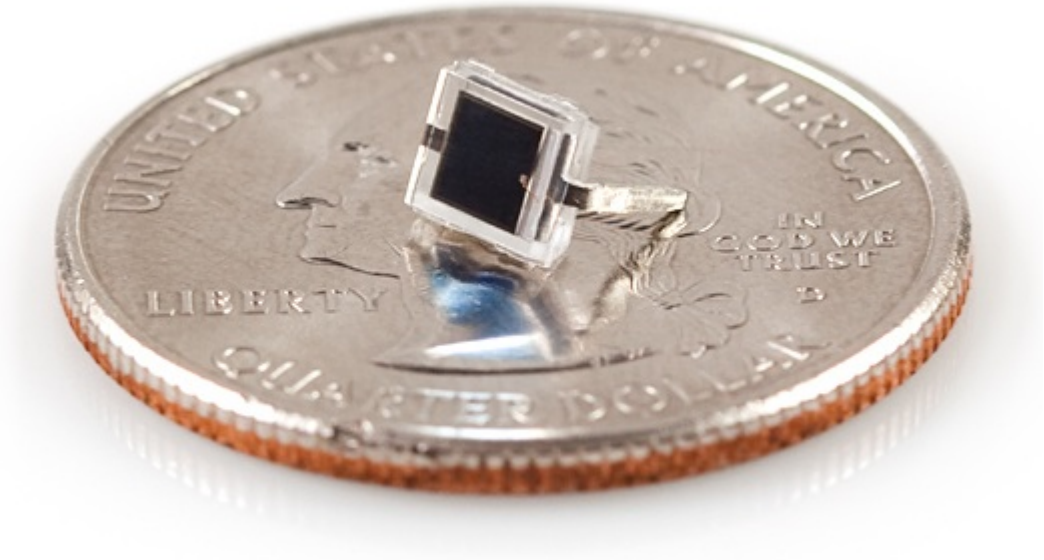
Like normal diodes, LEDs only allow current through one direction. They also have a forward voltage rating, which is the voltage required for them to light up. The V_F rating of an LED is usually larger than that of a normal diode (1.2~3V), and it depends on the color the LED emits. For example, the rated forward voltage of a Super Bright Blue LED is around 3.3V, while that of the equal size Super Bright Red LED is only 2.2V.

You'll obviously most-often find LEDs in lighting applications. They're blinky and fun! But more than that, their high-efficiency has lead to widespread use in street lights, displays, backlighting, and

much more. Other LEDs emit a light that is not visible to the human eye, like infrared LEDs, which are the backbone of most remote controls. Another common use of LEDs is in optically isolating a dangerous high-voltage system from a lower-voltage circuit. Opto-isolators pair an infrared LED with a photosensor, which allows current to flow when it detects light from the LED. Below is an example circuit of an opto-isolator. Note how the schematic symbol for the diode varies from the normal diode. LED symbols add a couple arrows extending out from the symbol.

Photodiodes

Photodiodes are specially constructed diodes, which capture energy from photons of light (see Physics, quantum) to generate electrical current. Kind of operating as an anti-LED.



A BPW34 photodiode (not the quarter, the little thing on top of that). Get it under the sun and it can generate about few µW's of power!.

Solar cells are the main benefactor of photodiode technology. But these diodes can also be used to detect light, or even communicate optically.