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## How LEDs Work

### *What makes a light emitting diode shine light*

Light emitting diodes, or most commonly known as LEDs, are solid-state electronic devices used to produce light. Practically LEDs are a special type of diodes encased into tiny transparent plastic bulbs, which emit light when powered. Unlike traditional light bulbs and fluorescent tubes, LEDs do not use metal filaments, do not heat up to considerable temperatures, nor do they burn out. The semiconductor p-n junction is solely responsible for the light emissions determined by the LED. In order to fully understand the principle on which LEDs work, one must first know what is a diode. Diodes are the simplest solid-state electronic devices, able to vary their electrical conductivity according to the polarity of the electrical current flowing through them. As you already probably know, solid-state devices are mostly built out of semiconductor materials, such as silicon and germanium or gallium. **Diodes** Usually, semiconductors have poor electrical properties, that's why they are doped with so-called impurities. Depending on the type of impurity used to dope a particular semiconductor, the material can become either an N-type material or a P-type material, meaning that it has an excess of electrons. Basically, a diode consists of an N-type material bonded to a P-type one, which forms a so-called p-n junction. As soon as the p-n junction is created, electrostatic forces create a depletion zone between the two materials through electron migration from the N-type material to the junction and to the P-type material. Once the depletion area is created all current flow through the junction stops, since it acts as an insulator layer. Both N-type and P-type materials of the junction are connected through metal connectors to the negative and the positive terminal of the device. A diode connected in parallel with a battery, with the positive terminal to that of the positive electrode of the battery and the negative terminal to the negative electrode, would experience a flow of electrons from the N-type material towards the P-type material, thus narrowing the depletion area to allow electric current flow. If the connection is reversed, electrons from the N-type material are drained towards the positive electrode of the battery, widening the depletion area and minimizing the current flow through the junction. **Light emitting diodes** LEDs always function in a forward bias, in order to allow electric current flow through the diode. Electrons traveling from the N-type material of the junction to the P-type material will eventually encounter holes, or positively charged atoms due to lack of electrons, which will absorb them. However, the electron bears too much energy and needs to drop to a lower more stable orbital configuration. They do so by emitting photons of light, either infrared or visible, depending on the material from which the junction was constructed. Visible light emitting diodes, or VLEDs, are constructed out of materials with a wide gap between the conduction band and the low orbital, which also determines the color of the emitted light.