

LED Light Working Process & its Pros & Cons

As the name indicates, a LED(Light Emitting Diode) is a small light producing device that comes beneath the “active” semiconductor electronic components. It emits light when an electric current is passing through it. Light is delivered when the particles that carry the current (holes & electrons) combine inside the semiconductor material. It's commonly compared to the typical general-purpose diode, with the only distinction being its capability to emit light in a different color by nature. When the two terminals (anode & cathode) of a LED are connected to a voltage source in the proper polarity, may deliver the lights of diverse colors according to semiconductor substance used within it. LEDs are portrayed as a solid-state device since the light is produced within the semiconductor material. The term solid-state lighting, which also includes natural LEDs differentiates the lighting innovation from other sources that use heated filaments or gas discharge such as incandescent lamps, tungsten halogen lamps and fluorescent lamps.

How LED Lights Work & Produce Colors

- Like a typical diode, the LED comprises a chip of semiconducting material impregnated or doped with impurities to form a p-n junction.
- In the n-type materials, atoms have excessive electrons & holes in the p-type materials.
- The atoms are pushed towards the junction by applying current. When they get close to each other, the atoms(n-type) donate their extra electrons to the atoms(p-type) which got accepted by them.
- A negative charge to the n - end permits current to flow from the (ve-) charged area to the (ve+) charged area. This is known as ‘forward bias’.
- When the additional electrons in the n-type elements fall into the holes in the p-type elements, they release energy in the form of photons. The substance in an LED is selected so that the wavelength of the photons falls within the visible portion of the spectrum.
- Visible light may be characterized as waves and particles moving in a vacuum at a constant speed. Basically, light is made up of particles having zero mass and is energy discharged as a by-product by an electron travelling inside the orbits of an atom.
- The intensity of light emitted from a LED will rely on the energy level of the emitted photons which in turn will rely on the energy discharged by the electrons jumping in between the atomic shells of the semiconductor material.
- It is known that to make an electron move from lower shell to higher shell; its energy level is needed to be lifted. On the other hand, if the electrons are made to fall from the higher to the lower shells, energy should be released in the process.
- In LEDs, the above phenomena are well executed. In response to the P-type of doping, electrons in LEDs travel by falling from the higher orbits to the lower ones releasing energy in the form of photons, i.e. light. The farther these orbits are maintaining distance from each other, the greater the intensity of the emitted light.

- Different elements produce photons at different wavelengths/color. Different wavelengths involved in the process of defining the different colors delivered from the LEDs. Modern technology has been successfully able to dimension shorter wavelengths in them to produce a large variety of numerous colored LEDs.
- Illuminator-Type LEDs use systems which can control the necessary heat, current, and humidity to deliver high-brightness blue, green and cyan, (InGaN), and high-brightness red and amber, (AlGaInP).
- InGaN & AlGaInP cover almost the entire spectrum.

Pros & Cons

The following points will illustrate the advantage & disadvantage of LED lights:

Advantage

- LEDs effuse more lumens per watt than incandescent light bulbs. The efficacy of LED lighting fixtures is not determined by shape and size, unlike fluorescent tubes or light bulbs.
- Fixtures are directional, allowing for more prominent optics.
- Lights up very fast, even LEDs used in communication devices can have a faster response rate.
- LED can emanate the light of an intended color without using any color filters as conventional lighting methods require.
- Remarkable longer Useful life.
- LEDs can easily be attached to the printed circuit board as they are very small
- Mercury-free.
- No UV rays & no infrared, IR radiation.
- Fully functional in cold environments.
- LEDs are perfect for uses subject to frequent on-off cycling, not like incandescent and fluorescent lamps that fail faster during cycled often, or high-intensity (HID lamps) that take a long time before restarting.
- LEDs are tough to damage with external shock.
- Inherently digital for ease of control.
- A growing trend to modularity.

Disadvantage

- LEDs lighting is a more costly investment than conventional light sources. But, it is important to understand that LEDs have a longer lifespan than regular light bulbs and at the same time, it consumes significantly less energy than the traditional type of lighting.
- Quality of diodes' lighting very much relies on the ambient operating temperature. At high temperature, there are massive changes in the parameters of passing the current through the semiconductor materials, which tend to burn out of the LED module.
- As the electric current increases, the efficiency of LEDs decreases. Moreover, heating also increases with higher currents, which determines the LED lifetime. These effects put a practical limitation on the current through an LED in powerful applications.
- Many LEDs have spectra that distinct significantly from a black body radiator as the sun or incandescent light.
- Another drawback to LEDs is that they do not deliver a spherical distribution of light; that's why they are not ideal to use in large open fields.
- LEDs emit proportionately more blue light than the traditional light of any color. This can lead to harmful effects like UV poisoning if there is prolonged exposure.
- Insects have some attractions with LED lighting, which can result in some undesirable effects and disruptions occurred at your residence.
- As we know that LEDs do not produce much heat, as a result in frost or snow covering them completely, becoming them useless in freezing climates.

The topic regarding how LEDs work, including its pros & cons, is so vast that it can have volumes of information which is difficult to contain in one article. But the above discussions hopefully fill your curiosity a little bit & may enlighten you to know the further details.