APPLICATIONS OF DIODE

Applications

Radio demodulation

The first use for the diode was the demodulation of amplitude modulated (AM) radio broadcasts. The history of this discovery is treated in depth in the **radio** article. In summary, an AM signal consists of alternating positive and negative peaks of voltage, whose amplitude or "envelope" is proportional to the original audio signal, but whose average value is zero. The diode (originally a crystal diode) rectifies the AM signal, leaving a signal whose average amplitude is the desired audio signal. The average value is extracted using a simple filter and fed into an audio transducer, which generates sound.

Power conversion

Rectifiers are constructed from diodes, where they are used to convert alternating current (AC) electricity into direct current (DC). Automotive alternators are a common example, where the diode provides better performance than the commutator of earlier dynamo.

Similarly, diodes are also used in **Cockcroft–Walton voltage multipliers** to convert AC into higher DC voltages.

Over-voltage protection

Diodes are frequently used to conduct damaging high voltages away from sensitive electronic devices. They are usually reverse-biased (non-conducting) under normal circumstances. When the voltage rises above the normal range, the diodes become forward-biased (conducting). For example, diodes are used in (stepper motor and H-bridge) motor controller and relay circuits to de-energize coils rapidly without the damaging voltage spikes that would otherwise occur. (Any diode used in such an application is called a flyback diode). Many integrated circuits also incorporate diodes on the connection pins to prevent external voltages from damaging their sensitive transistors. Specialized diodes are used to protect from over-voltages at higher power (see above).

Logic gates

Diodes can be combined with other components to construct AND and OR logic gates. This is referred to as diode logic.

Ionising radiation detectors

In addition to light, mentioned above, semiconductor diodes are sensitive to more energetic radiation. In electronics, cosmic rays and other sources of ionising radiation cause noise pulses and single and multiple bit errors. This effect is sometimes exploited by particle detectors to detect radiation. A single particle of radiation, with thousands or millions of electron volts of energy, generates many charge carrier pairs, as its energy is deposited in the semiconductor material. If the depletion layer is large enough to catch the whole shower or to stop a heavy particle, a fairly accurate measurement of the particle's energy can be made, simply by measuring the charge conducted and without the complexity of a magnetic spectrometer or etc. These semiconductor radiation detectors need efficient and uniform charge collection and low leakage current. They are often cooled by liquid nitrogen. For longer range (about a centimetre) particles they need a very large depletion depth and large area. For short range particles, they need any contact or un-depleted semiconductor on at least one surface to be very thin. The back-bias voltages are near breakdown (around a thousand volts per centimetre). Germanium and silicon are common materials. Some of these detectors sense position as well as energy. They have a finite life, especially when detecting heavy particles, because of radiation damage.

Silicon and germanium are quite different in their ability to convert gamma rays to electron showers.

Semiconductor detectors for high energy particles are used in large numbers. Because of energy loss fluctuations, accurate measurement of the energy deposited is of less use.

Temperature measuring

A diode can be used as a temperature measuring device, since the forward voltage drop across the diode depends on temperature. From the Shockley ideal diode equation given above, it appears the voltage has a positive temperature coefficient (at a constant current)but depends on doping concentration and operating temperature. The temperature coefficient can be negative as in typical thermistors or positive for temperature sense diodes down to about 20 degrees Kelvin.

Current steering

Diodes will prevent currents from flowing in unintended directions. To supply power to an electrical circuit during a power failure, the circuit can draw current from a battery. An Uninterruptible power supply built in this may use diodes to ensure that current is only drawn from the battery when necessary.

Similarly, small boats typically have two circuits each with their own battery/batteries: one used for engine starting; one used for domestics. Normally both are charged from a single alternator, and a heavy duty split charge diode is used to prevent the higher charge battery (typically the engine battery) from discharging through the lower charged battery when the alternator is not running.

Source: http://www.juliantrubin.com/encyclopedia/electronics/diode.html