

Zener Diode:

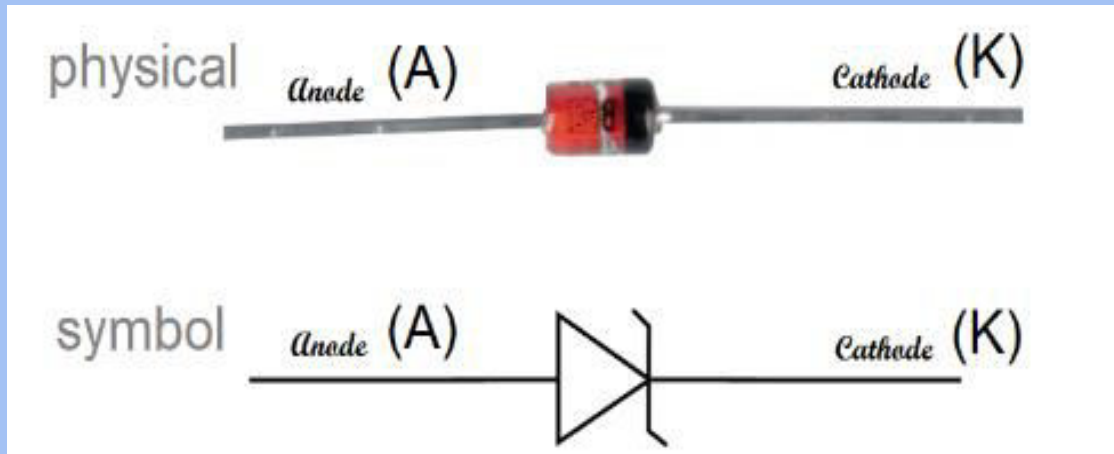
Introduction, Working, V-I Characteristics

Elementrix Classes

Introduction

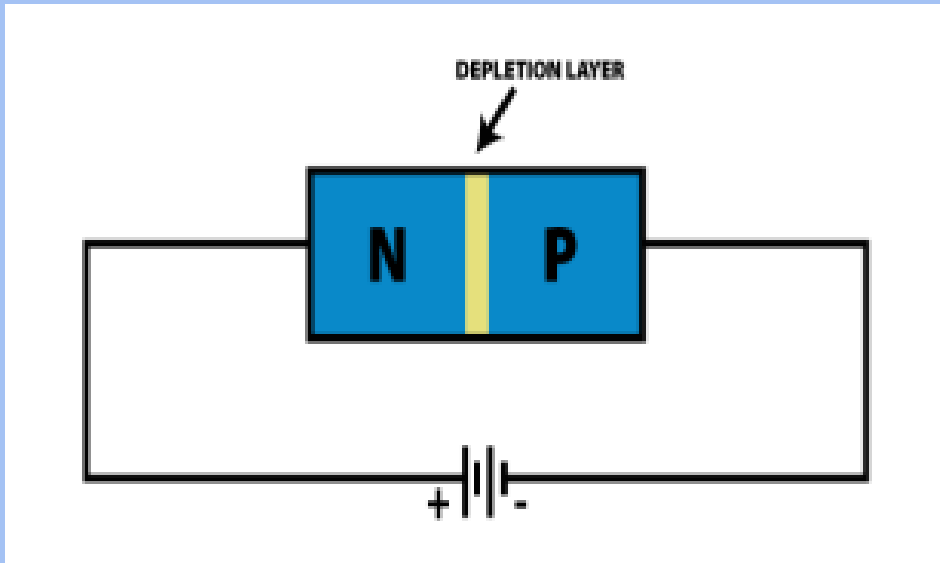
- ❑ Zener diode is defined as the semiconductor which is heavily doped to operate in reverse direction or in breakdown region.
- ❑ The Zener diode behaves just like a normal general-purpose diode consisting of a silicon PN junction and when biased in the forward direction, that is Anode positive with respect to its Cathode, it behaves just like a normal signal diode passing the rated current.

- However, unlike a conventional diode that blocks any flow of current through itself when reverse biased, that is the Cathode becomes more positive than the Anode, as soon as the reverse voltage reaches a predetermined value, the zener diode begins to conduct in the reverse direction.



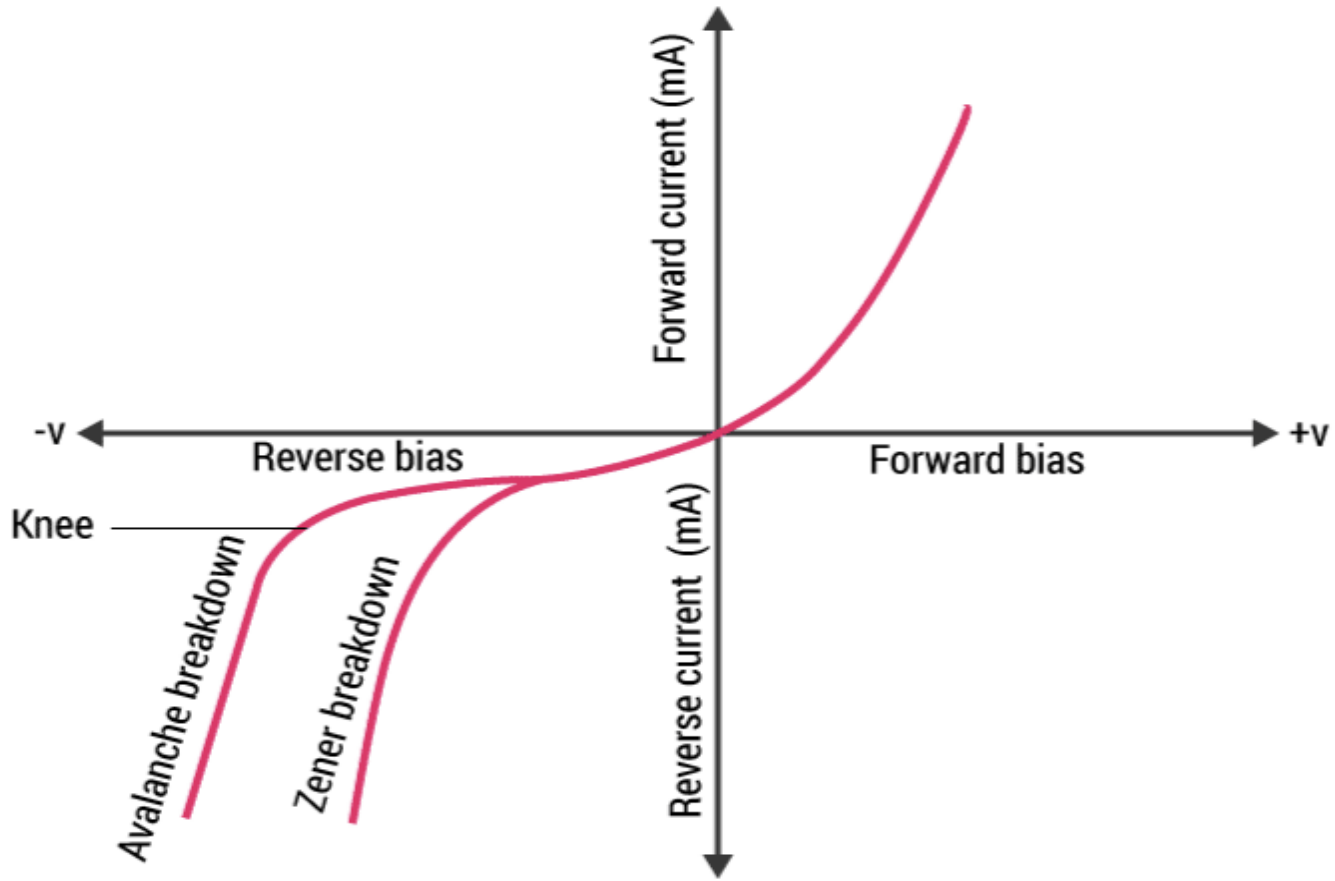
Zener Diode Circuit

We can define Zener diode as a single diode connected in a reverse bias. It can be connected in reverse bias positive as in the circuit shown below:



V-I Characteristics of Zener Diode

- ❑ The diagram given shows the V-I characteristics of the Zener diode.
- ❑ When the Zener diode is connected, in forward bias, diode acts as a normal diode. But Zener breakdown voltage occurs when the reverse bias voltage is greater than a predetermined voltage.



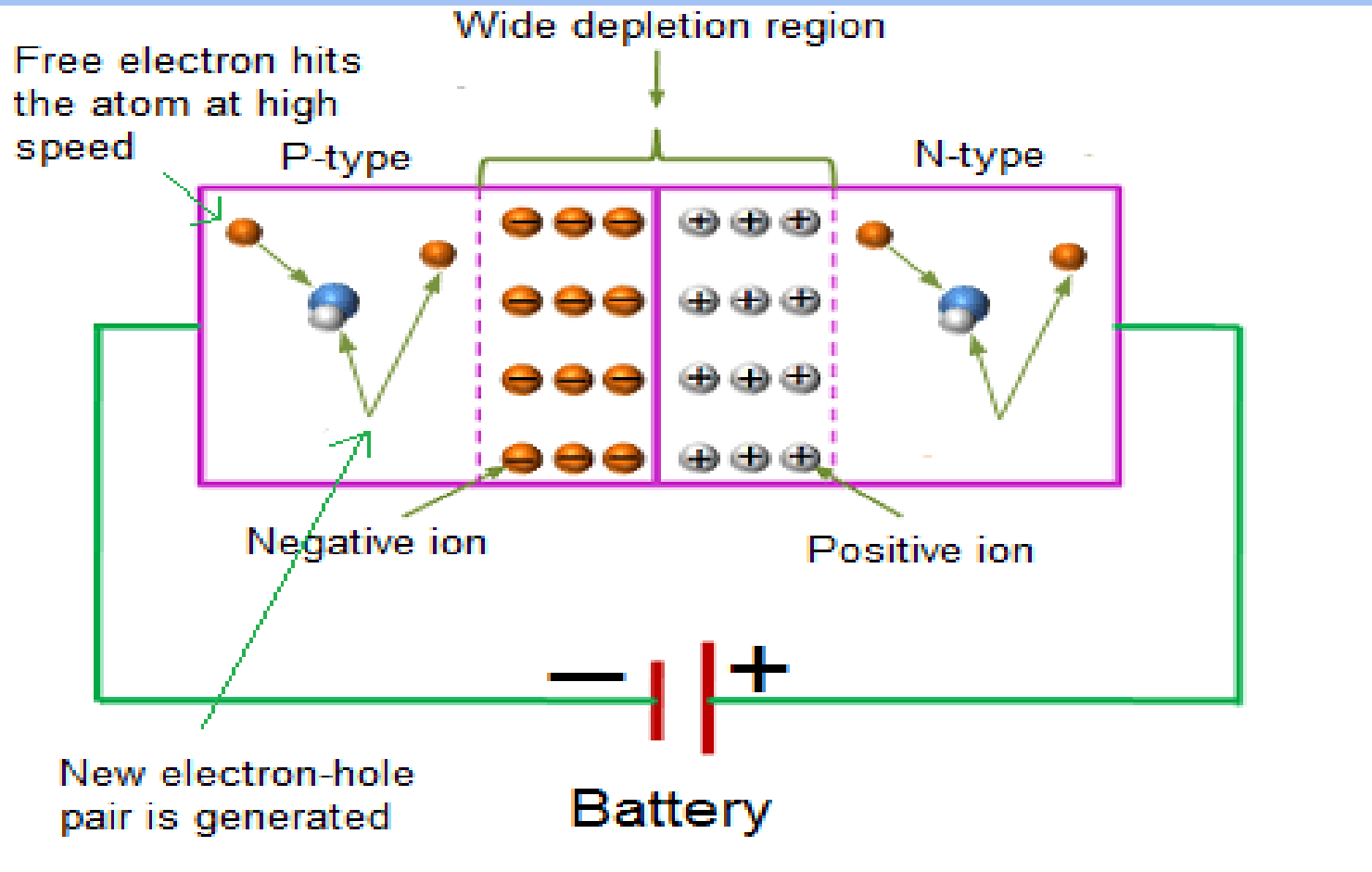
Working of Zener Diode

The basic principle behind Zener diode working is based on the cause of breakdown when the diode is in the reverse biased condition. For a Zener diode there are two types of breakdown:

- Zener breakdown
- Avalanche breakdown

❑ **Avalanche breakdown**

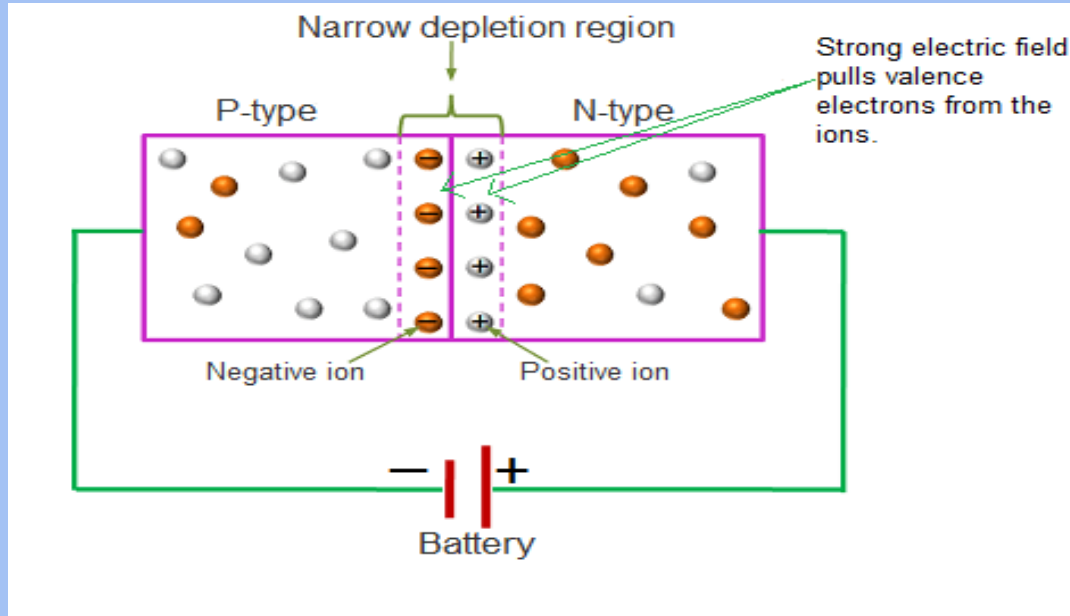
The avalanche breakdown occurs in both normal diodes and zener diodes at high reverse voltage. When high reverse voltage is applied to the p-n junction diode, the free electrons (minority carriers) gains large amount of energy and accelerated to greater velocities.



The free electrons moving at high speed will collide with the atoms and knock off more electrons. These electrons are again accelerated and collide with other atoms. Because of this continuous collision with the atoms, a large number of free electrons are generated. As a result, electric current in the diode increases rapidly. This sudden increase in electric current may permanently destroy the normal diode. However, avalanche diodes may not be destroyed because they are carefully designed to operate in avalanche breakdown region. Avalanche breakdown occurs in zener diodes with zener voltage (V_z) greater than 6V.

❑ Zener breakdown

The zener breakdown occurs in heavily doped p-n junction diodes because of their narrow depletion region. When reverse biased voltage applied to the diode is increased, the narrow depletion region generates strong electric field.



When reverse biased voltage applied to the diode reaches close to zener voltage, the electric field in the depletion region is strong enough to pull electrons from their valence band. The valence electrons which gains sufficient energy from the strong electric field of depletion region will breaks bonding with the parent atom. The valance electrons which break bonding with parent atom will become free electrons. This free electrons carry electric current from one place to another place. At zener breakdown region, a small increase in voltage will rapidly increases the electric current.

- Zener breakdown occurs at low reverse voltage whereas avalanche breakdown occurs at high reverse voltage.
- Zener breakdown occurs in zener diodes because they have very thin depletion region.

- Breakdown region is the normal operating region for a zener diode.
- Zener breakdown occurs in zener diodes with zener voltage (V_z) less than 6V.

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