

1.6. BREAKDOWN IN PN JUNCTION DIODES

When a PN junction is reversed biased it allows very small current to flow through it. This current is due to the movement of minority charge carriers and it is almost independent of the voltage applied.

If reverse bias is made too high, the current through PN junction increases abruptly and the voltage at which this phenomenon occurs is called breakdown voltage.

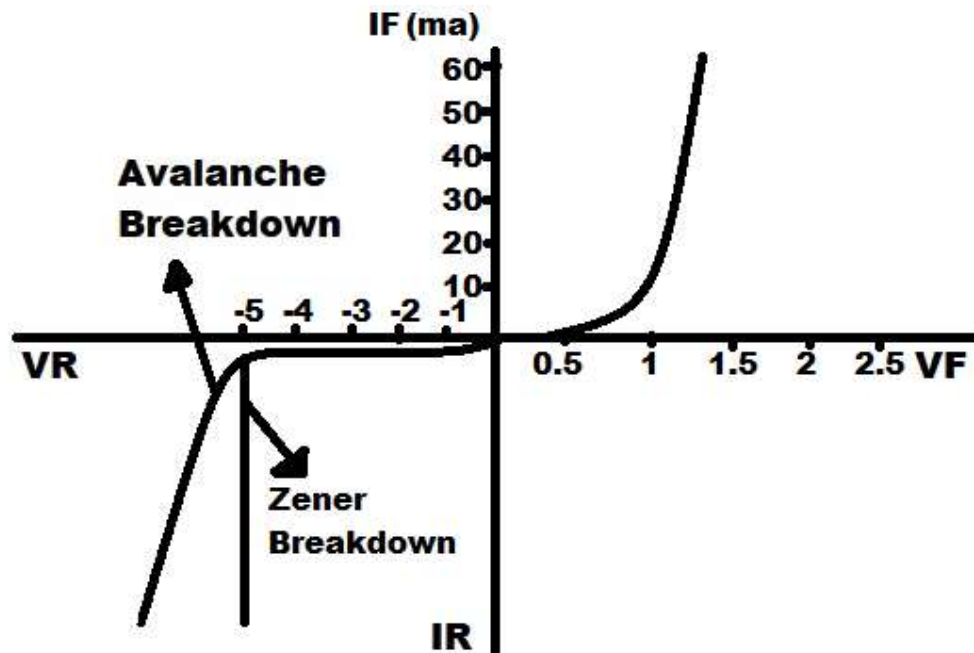


Fig:1.6.1 Avalanche Break down of Diode

At this breakdown voltage, the crystal structure breaks down. This crystal structure returns to the normal state when excess reverse bias is removed, provided that overheating has not permanently damaged the crystal.

There are two processes which causes junction breakdown. One is zener breakdown and another one is avalanche breakdown

Avalanche Breakdown

Avalanche breakdown is increased electric field causes increase in the velocities of the minority carriers. These high energy carriers break covalent bonds, thereby generating more carriers. Again these generated carriers are accelerated by electric field. They break more covalent bonds during their travel. A chain is thus established, creating a large number of carriers. This gives rise to a high reverse current. This mechanism of breakdown is called avalanche breakdown.

Zener Breakdown

When increase the reverse voltage across the pn junction diode, what really happens is that the electric field across the diode junction increases (both internal & external). This results in a force of attraction on the negatively charged electrons at junction. This force frees electrons from its covalent bond and moves those free electrons to conduction band. When the electric field increases (with applied voltage), more and more electrons are freed from its covalent bonds. This results in drifting of electrons across the junction and electron hole recombination occurs. So a net current is developed and it increases rapidly with increase in electric field.

Zener breakdown phenomena occurs in a pn junction diode with heavy doping & thin junction (means depletion layer width is very small). Zener breakdown does not result in damage of diode. Since current is only due to drifting of electrons, there is a limit to the increase in current as well.

