Dynamic Resistance

Dynamic resistance is defined as the resistance offered by the diode semiconductor device when an AC supply biases it. A basic connection with an AC supply to the diode is shown in the below figure.

It is given as the voltage change ratio to change in current across the diode. It is mathematically given as.

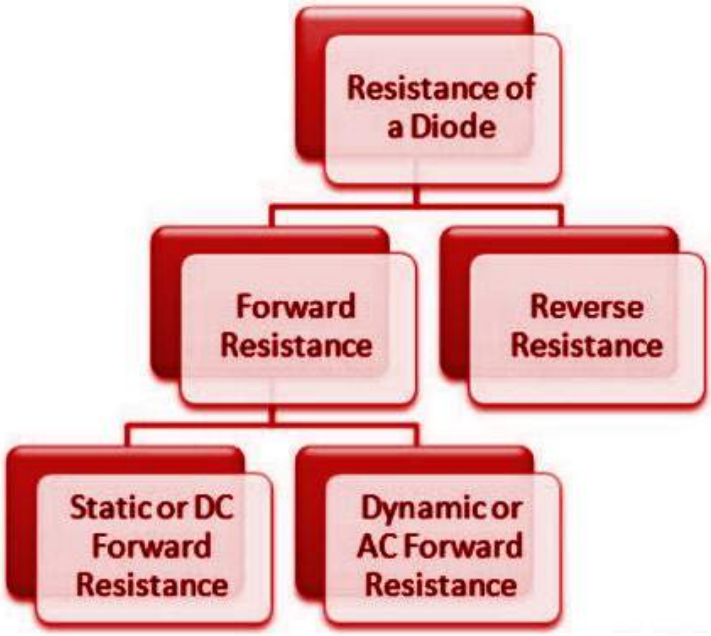
$$R_{AC} = \Delta V / \Delta I$$

Where ΔV is the small change in voltage and ΔI is the change in current.

Resistance in a Diode

Diode resistance can be defined as the effective opposition provided by the diode when forward current flows through it. Therefore, diode resistance can be defined as the effective resistance a diode offers when biased with a supply.

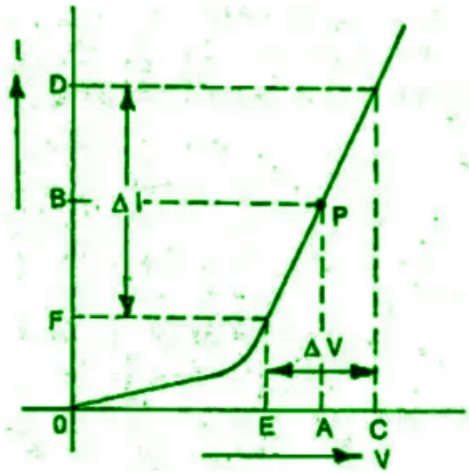
A diode's forward and reverse resistances can be determined by its forward and reverse bias characteristics. No device, however, can be considered ideal. Therefore, practically speaking, every diode will offer a small resistance when forward biased and a significant resistance in reverse bias.



The above flow chart shows the different resistances a diode offers.

Dynamic Resistance in Forward Bias

Dynamic resistance can be calculated from the p-n junction diode's V-I curve. It is defined as the ratio of a change in voltage to a change in current. The V-I curve of the p-n junction diode is given below.



Dynamic Resistance in Forward Bias Formula

Mathematically the dynamic forward resistance is given as-

$$R_{df}=(\Delta V/\Delta I) = \eta V_T/ I$$

Where V_T is the thermal voltage and is given by Einstein's equation equal to kT/q, where k is Boltzmann's constant (k=8.85 x 10-12 F/m)

Dynamic Resistance in Reverse Bias

A reverse bias increases p-n diode depletion layer width, which offers higher resistance to the flow of charge carriers. The reverse resistance of p-n diodes is in the Mega Ohm range. The reverse resistance is very large compared to the forward resistance of the diode.

Dynamic Resistance in Reverse Bias Formula

Mathematically the reverse dynamic resistance is given as-

$$R_{dr} = (\Delta V_r/ \Delta I_r)$$