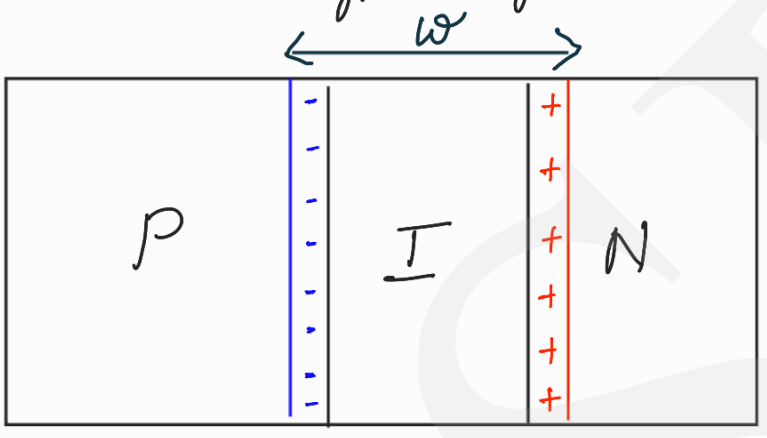
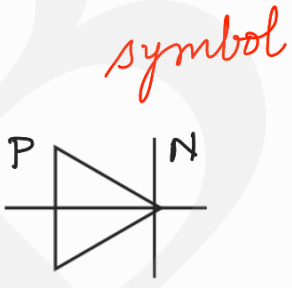
PIN DIODE

PIN diode is a device which consists of P-type and n type semiconductor region separated by undoped "intrinsic" semiconductor region.

P: P type region
I: Intrinsic region
N: N type region.

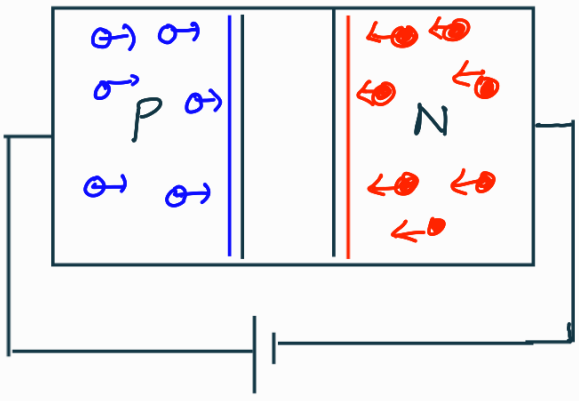




Before biasing is done, a depletion region is formed between P & I and I & N as shown in figure. In intrinsic semiconductor no of holes in VB is equal to no of electrons in CB. ∴ intrinsic semiconductor has no charge carriers to conduct electricity. However at room temperature a small no of charge carriers are generated.

In PIN diode, due to its construction, entire span "W" as shown in figure act as depletion region.

PIN diode under forward bias



Under forward bias, depletion region decreases, this causes change in potential developed between P & N region. This reduces the resistance offered by the built in potential barrier between P & N region and carrier starts to flow.

Let Q be the charge stored in intrinsic region due to forward biasing and τ be its recombination time then,

$$Q = I_F \tau \quad \text{—(1)}$$

I_F is forward current.

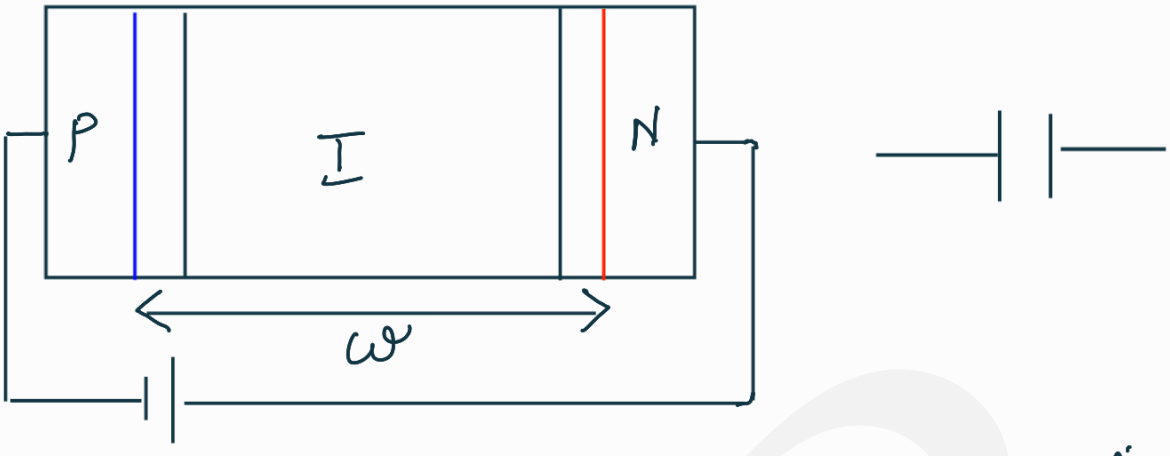
$$R_F = \frac{w}{(\mu_n + \mu_p) \cdot Q} \quad \text{—(2)}$$

μ_N & μ_p are e & hole mobility.

or $$R_F = \frac{w}{(\mu_n + \mu_p) I_F \tau}$$

w is the width of depletion region.

PIN diode under reverse bias



When reverse bias is applied across the diode, the width of the depletion increases. The thickness of the region increases until the entire mobile charge carriers of the I region are swept away from it.

The reverse voltage required for removing the complete charge carrier from the I region is known as SWEPT VOLTAGE.

In reverse bias diode behaves as CAPACITOR.

P region +ve plate.
N region −ve plate.
I region insulator between them

$$C = \frac{\varepsilon_0 \varepsilon_r A}{W}$$

W is depletion region thickness
A is cross section area.