ELECTRONICS DEVICES AND CIRCUITS

SECTION - B

Semiconductors, Construction & Characteristics of Devices

OBJECTIVE

DRIFT AND DIFFUSION CURRENTS

❖ Drift and Diffusion

- Now, we have some idea of the number density of charge carriers (electrons and holes) present in a semiconductor material from the work we covered in the last chapter.

- Since current is the rate of flow of charge, we shall be able calculate currents flowing in real devices since we know the number of charge carriers.

- There are two current mechanisms which cause charges to move in semiconductors. The two mechanisms we shall study in this chapter are *drift and diffusion*.

❖ Carrier Drift

- Electron and holes will move under the influence of an applied electric field since the field exert a force on charge carriers (electrons and holes).

$$F = qE$$

- These movements result a current of I_d;

$$I_d = nqV_d A$$

I_d : drift current

V_d : drift velocity of charge carrier

A : area of the semiconductor

n : number of charge carriers per unit volume

q : charge of the electron

❖ Carrier Mobility , μ

$$V_d = \mu E$$

E : applied field
μ : mobility of charge carrier

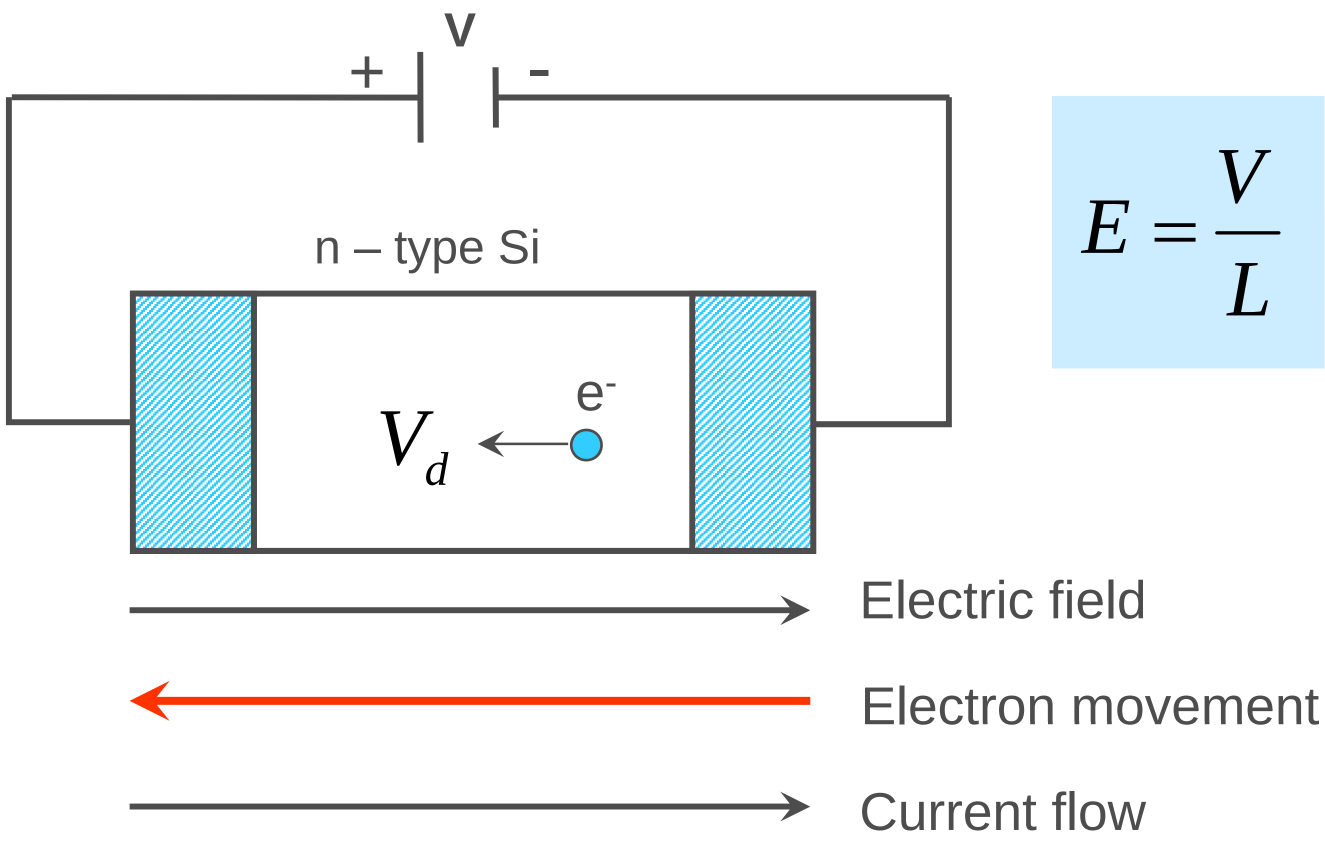
$$[\mu] = \left[\frac{cm^2}{V-Sec}\right]$$

μ is a proportionality factor

$$\mu = \left[\frac{V_d}{E}\right]$$

❖ So μ is *a measure how easily charge carriers move* under the influence of an applied field or μ determines *how mobile the charge carriers* are.

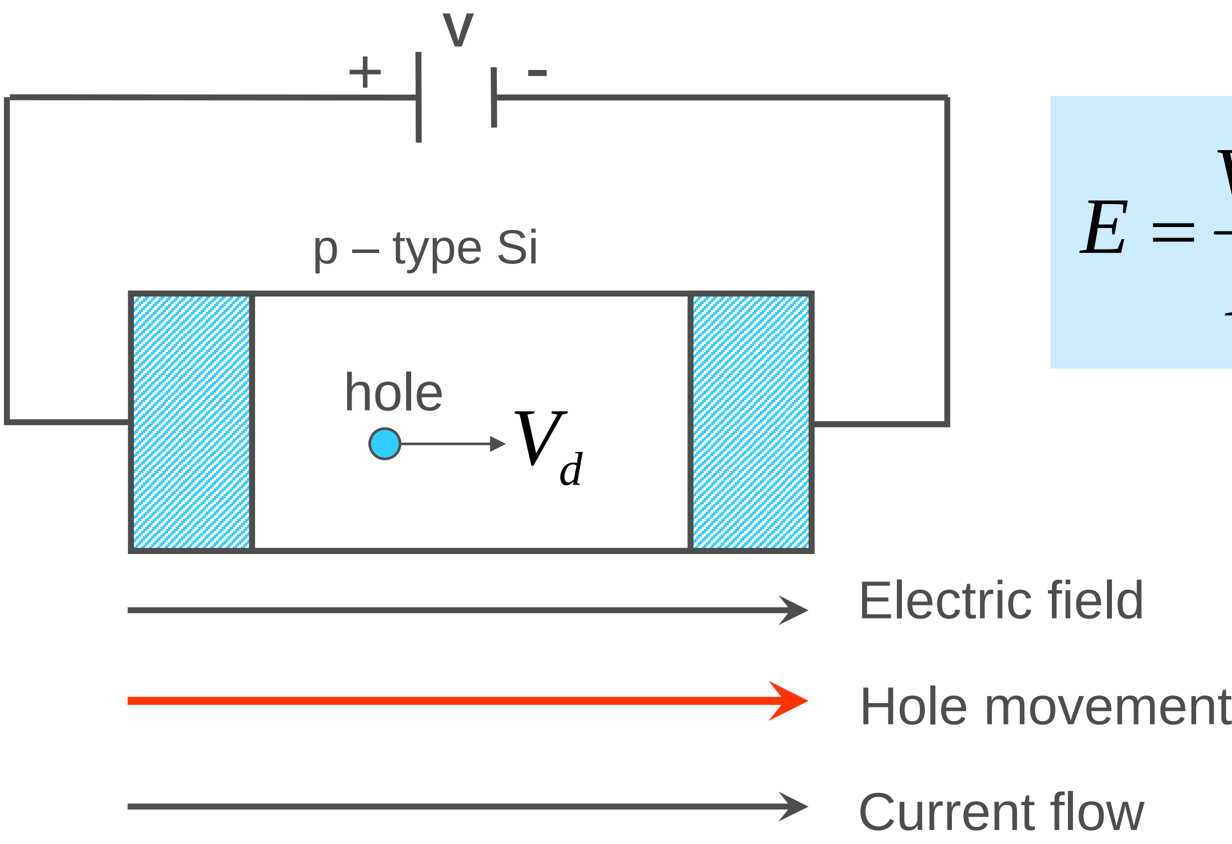
❖ n - type Si



$$E = \frac{V}{L}$$

Current carriers are mostly electrons.

❖ p - type Si



$$E = \frac{V}{L}$$

Current carriers are mostly holes.

❖ Carrier Mobility

Macroscopic understanding

$$\mu = \frac{V_d}{E}$$

In a perfect Crystal

$$\rho = 0$$

$$\sigma \rightarrow \infty$$

It is a superconductor

Microscopic understanding? (what the carriers themselves are doing?)

$$\mu = \frac{q\tau}{m^*}$$

$$m_e^* \langle m_h^* \quad in \ general$$

$$m_e^*; n - type$$

$$m_h^*; p - type$$