Unit 2 – Bipolar Junction Transistor

Class 1

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Fundamentals of BJT

Common Base Configuration

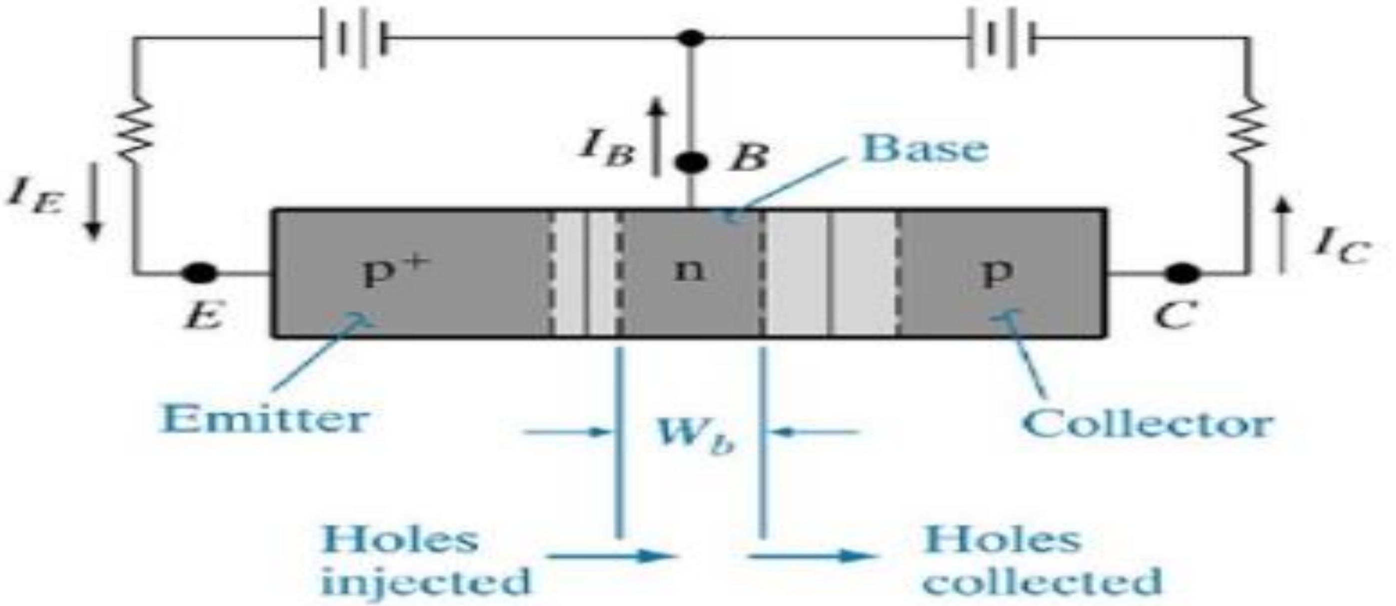

Figure
A p-n-p transistor: (a) schematic representation of a p-n-p device with a forward-biased emitter junction and a reverse-biased collector junction;

Fundamentals of BJT

Requirements of Good transistor

$W_b \ll L_p \qquad W_b = Length\ of\ base$

$L_p = \sqrt{D_p * \tau_p}$

$L_p = Diffusion\ Length$

$\tau_p = hole\ lifetime$

$D_p = Diffusion\ constant$

- The minority carrier "*lifetime*" τ_p

  measures how long a carrier is likely to stay around for before recombining,
- The *diffusion length* L_p

  Is the average distance that the excess carriers can cover before they recombine

Fundamentals of BJT

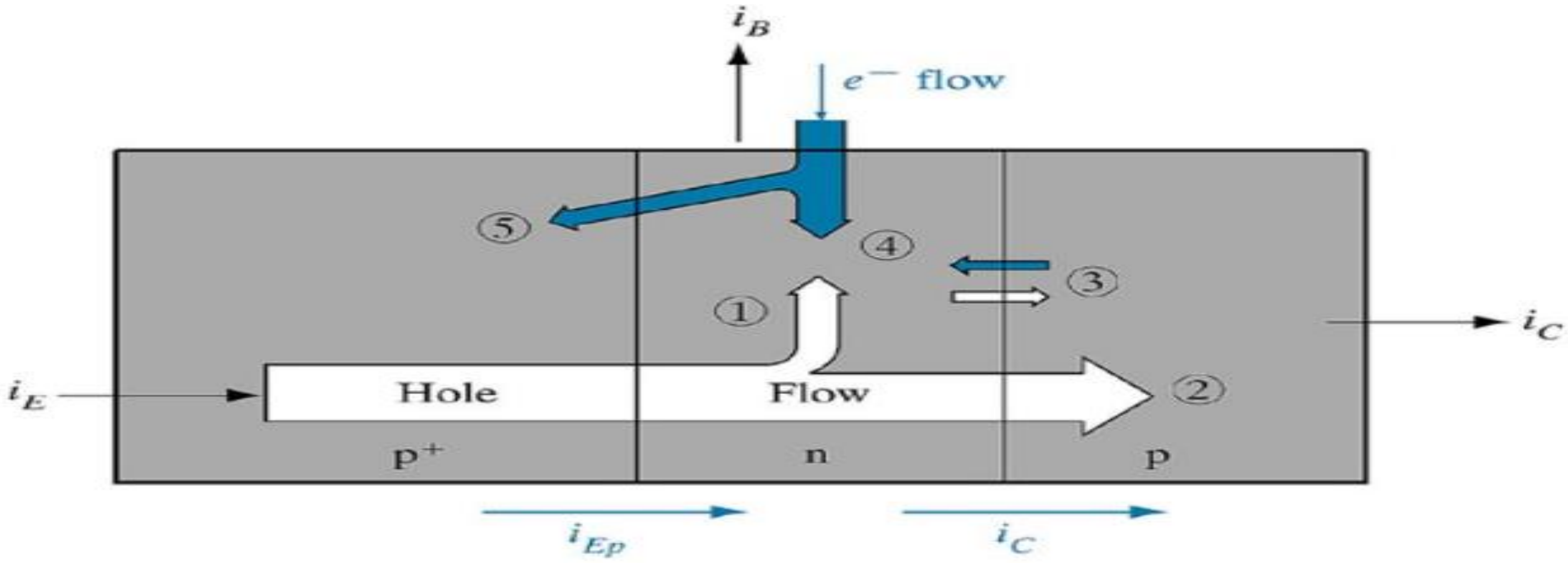

Figure
Summary of hole and electron flow in a p-n-p transistor with proper biasing: (1) injected holes lost to recombination in the base; (2) holes reaching the reverse-biased collector junction; (3) thermally generated electrons and holes making up the reverse saturation current of the collector junction; (4) electrons supplied by the base contact for recombination with holes; (5) electrons injected across the forward-biased emitter junction.

Fundamentals of BJT

Neglect saturation current at the collector and recombination in the transition regions.

$i_C = B i_{Ep}$ B is the base transport factor

$$\gamma = \frac{i_{Ep}}{i_{Ep} + i_{En}}$$

γ is the emitter injection efficiency

$$i_E = i_{Ep} + i_{En}$$

total emitter current

$$\frac{i_C}{i_E} = \frac{B i_{Ep}}{i_{Ep} + i_{En}} = B\gamma \equiv \alpha$$

α is the total current transfer ratio or the common-base current gain

Fundamentals of BJT

- Electron injection across the emitter junction (i_{En}) and electron recombination in the base must be included to account for the base current i_B

$$i_B = i_{En} + (1-B)i_{Ep}$$

- Neglect the collector saturation current

$$\frac{i_C}{i_B} = \frac{B i_{Ep}}{i_{En} + (1-B)i_{Ep}} = \frac{B[i_{Ep}/(i_{En}+i_{Ep})]}{1-B[i_{Ep}/(i_{En}+i_{Ep})]}$$

$$\frac{i_C}{i_B} = \frac{B\gamma}{1-B\gamma} = \frac{\alpha}{1-\alpha} \equiv \beta$$

β is the base-to-collector current amplification factor or the common-emitter current gain

→ Since α is near unity, β can be large for a good transistor

Thank You

HAVE A NICE DAY