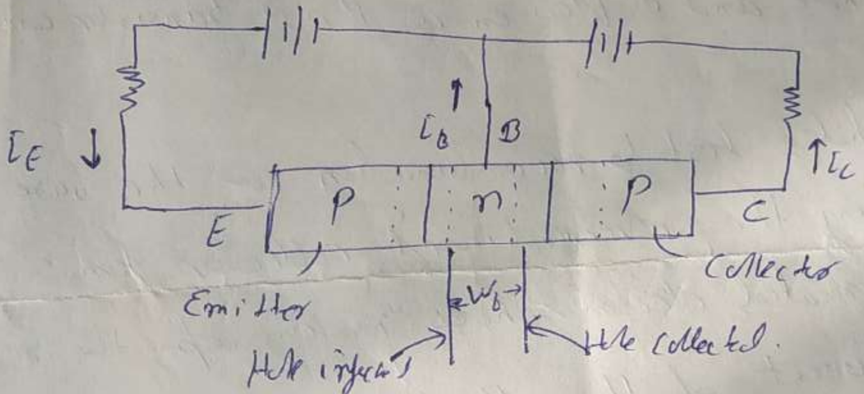
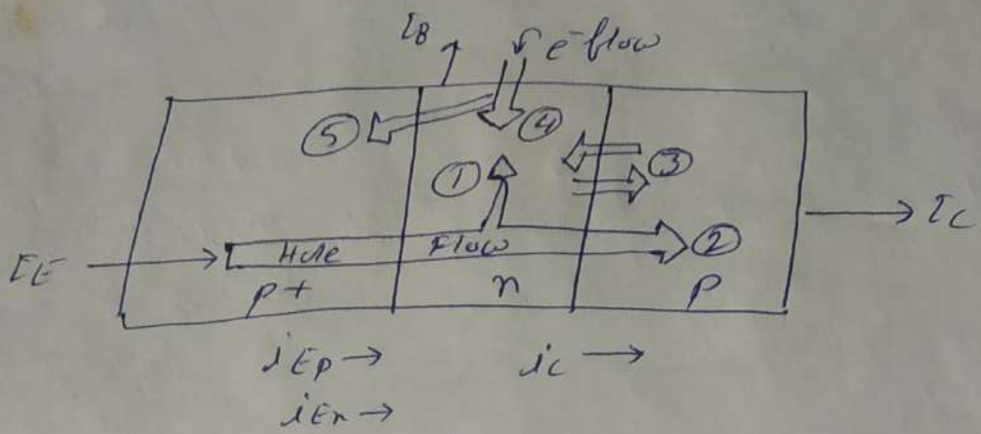
Bipolar Junc^n Transistor   Module 4 / ED — 1

- The reverse current due to holes being swept from n to P is independent of size of junc^n. E field hence is independent of reverse bias.
- Hole current depends upon how often minority holes are generated by EHP creation within a diffusion length of the junc^n not upon how fast a particular hole swept across the depletion layer of the field.



- The forward biased junc^n that injects holes into the center n region is called as emitter junc^n whereas the reverse biased junc^n that collects the injected holes is the collector junc^n.
- p^+ region which ~~emi~~ act as source of injected holes is emitter and P region into which the holes get swept is called collector
- For base should be thinner also $W_b << L_p$
- I_E crossing the emitter junc^n should be composed almost entirely of holes injected into base, rather than e^- crossing from base to emitter. For this base is lightly doped.



Summary of hole and e^- flow in a pnp transistor with proper biasing.

① Injected holes lost to recombination in the base
② Holes reaching the reverse-biased collector junc^n.
③ Thermally generated electron & holes making up the reverse saturation current of the collector junc^n
④ Electrons supplied by the base contact for recombination with holes.
⑤ Electrons injected across the fwd biased emitter junc^n.

e dominant source of base current are (i_B is generally one hundredth of i_E).
i) Recombination in the base.
) Injection into the emitter region.

Amplific
i_C
B

Amplification with BJTs

$j_c \propto i_{Ep}$
$j_c = B\, i_{Ep}$

$B \rightarrow$ Base transport factor. Proportionality const. B is simply the fraction of injected holes which make it across the base to the collector.

The emitter injection efficiency $\gamma = \dfrac{i_{Ep}}{i_{Ep} + i_{En}}$

e^- component base to emitter

B & γ should be near to unity for a std efficient transistor

Hence $\dfrac{i_C}{i_E} = \dfrac{B\, i_{Ep}}{i_{En} + i_{Ep}} = B\gamma \equiv \alpha$

current transfer ratio.

α indicates E to C current amplification.
$\alpha < 1$

Base current $i_B = i_{En} + (1-B)\, i_{Ep}$ neglecting collector saturation current.

Now $\dfrac{i_C}{i_B} = \dfrac{B\, i_{Ep}}{i_{En} + (1-B)\, i_{Ep}}$

$$= \frac{B\left[i_{Ep}/(i_{En} + i_{Ep})\right]}{1 - B\left[i_{Ep}/(i_{En} + i_{Ep})\right]} = \frac{B\gamma}{1 - B\gamma} = \frac{\alpha}{1-\alpha} = \beta$$

$\beta \rightarrow$ Base to collector current amplification factor.

For a good transistor $\alpha \Rightarrow 1$ & $\beta \rightarrow \infty$

Again $\frac{i_C}{i_B} = \beta = \frac{T_p}{T_t}$

where $T_t \to$ transit time, the avg. excess holes spends a time from E to C.

$T_t << T_p$