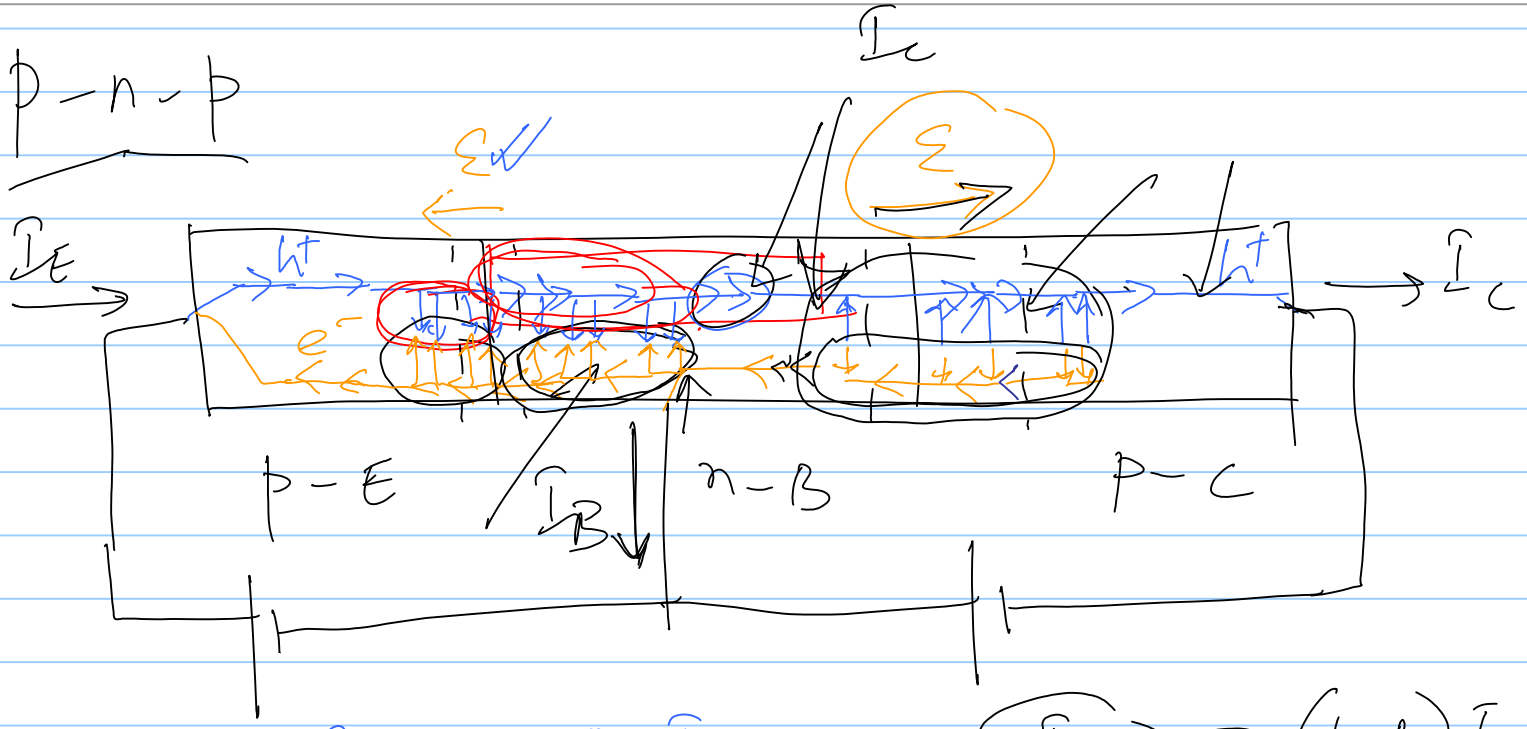
Bipolar Transistor (BJT)

15/10/2014



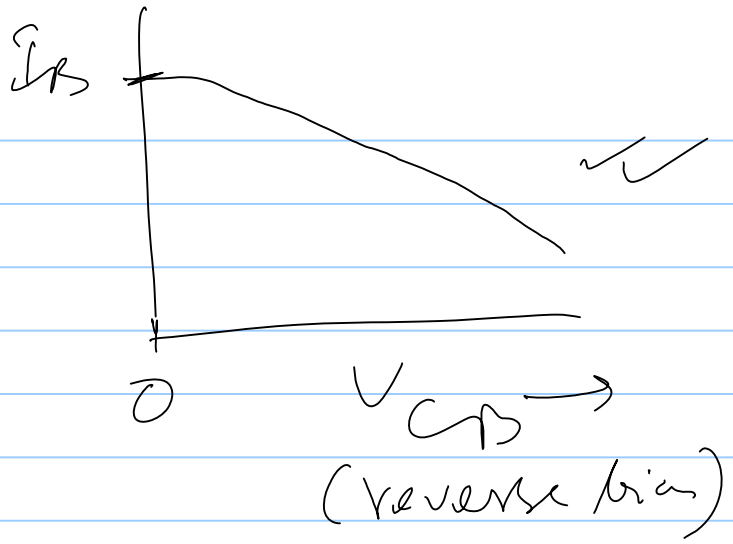
Base Current : I_B → $+I_{Br} = (1-\beta) I_{Ep}$

$+I_{BEp} = I_{En}$

$-I_{BCg}$ ~ negligible

Emitter current : I_E → $+I_{Ep}$ $+I_{En}$

Collector Current : I_C



$$I_E = I_{Ep} + I_{En}$$

I_{Br}

B = Base Transport factor = I_C / I_{Ep}

$$I_C = \underline{B}\, I_{Ep}$$

I_{Ep} → injected hole current from E to B

$$I_{Br} = (1 - B)\, I_{Ep}$$

$$\alpha = \frac{I_C}{I_E} = \frac{B I_{Ep}}{I_{En} + I_{Ep}} = B\gamma$$

α: current gain (common base)

γ = Emitter injection efficiency

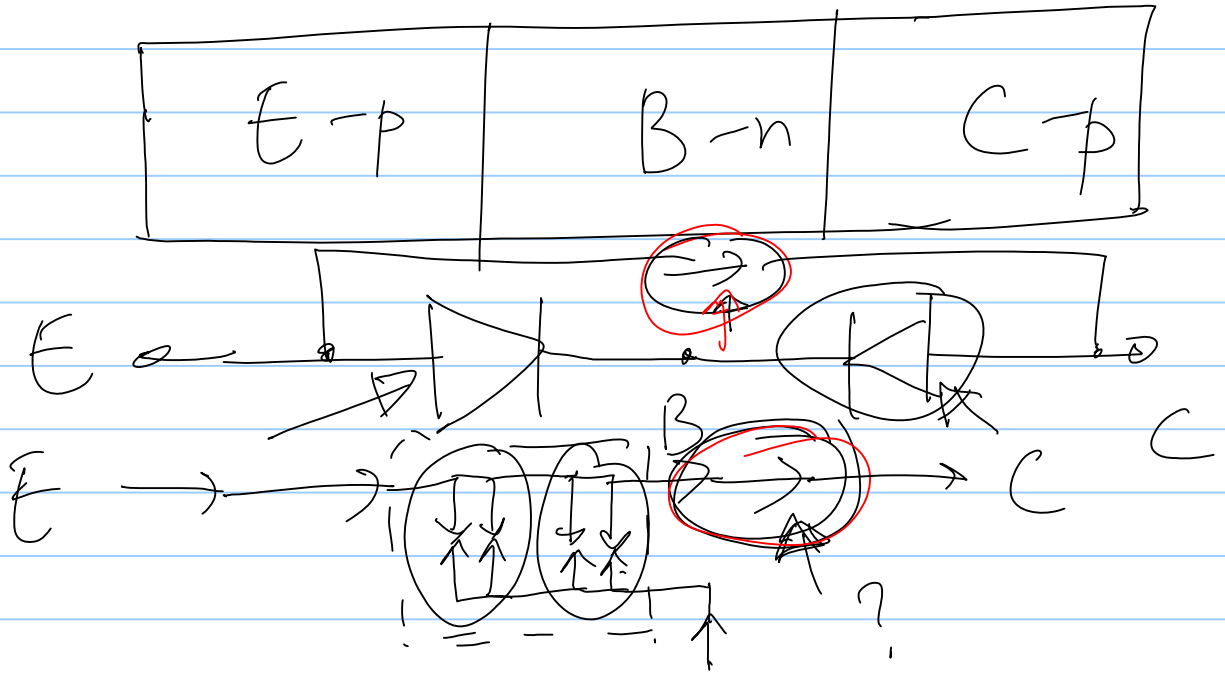
$$\gamma = \frac{I_{Ep}}{I_{En} + I_{Ep}}$$

Common emitter current gain

$$\beta = \frac{I_C}{I_B} = \frac{B I_{Ep}}{I_{En} + (1-B) I_{Ep}} = \frac{B \left(I_{Ep} / (I_{En} + I_{Ep}) \right)}{\frac{I_{En} + I_{Ep}}{I_{En} + I_{Ep}} - \frac{B I_{Ep}}{I_E}}$$

$$\beta = \frac{B\, I_{EP}/I_E}{1 - B\, I_{EP}/I_E} = \frac{B\gamma}{1 - B\gamma} = \frac{\alpha}{1-\alpha}$$

For near to unity value of α, one can get a very high β value.



→ One can get high 'B', i.e. transistor action if base width (W_b) is very small

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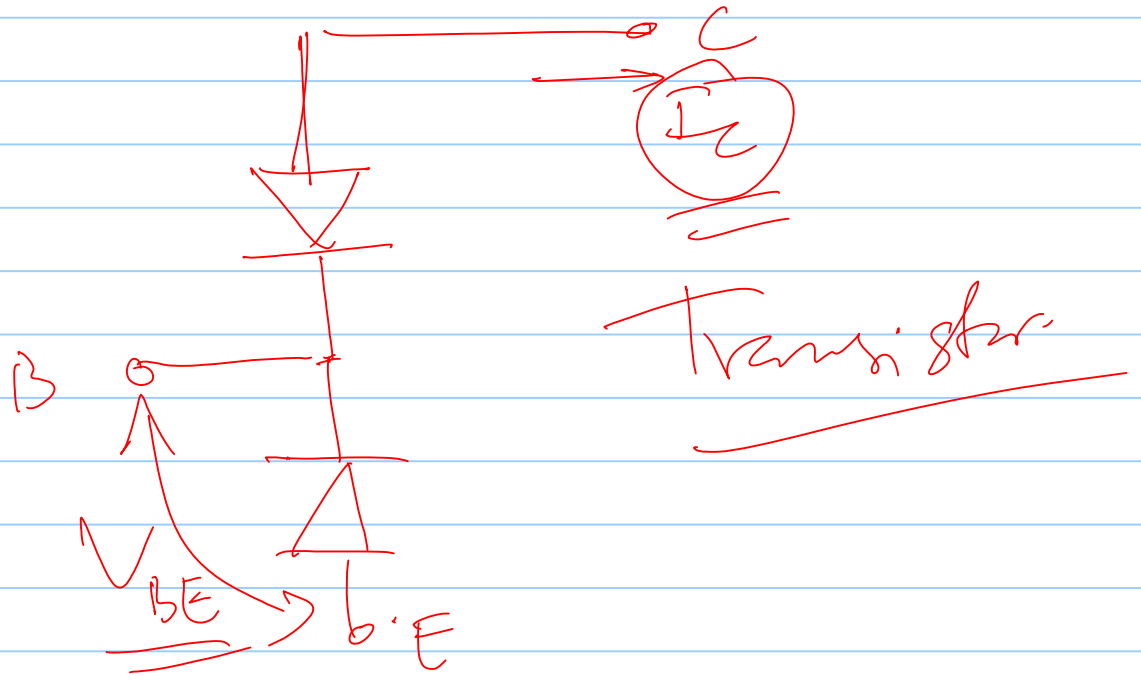
$W_b \ll L_p$



Transistor