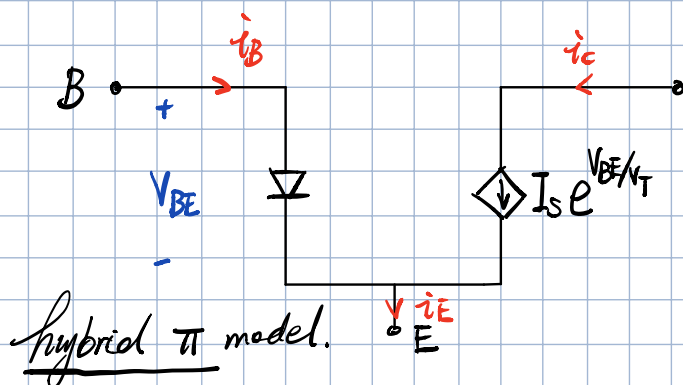
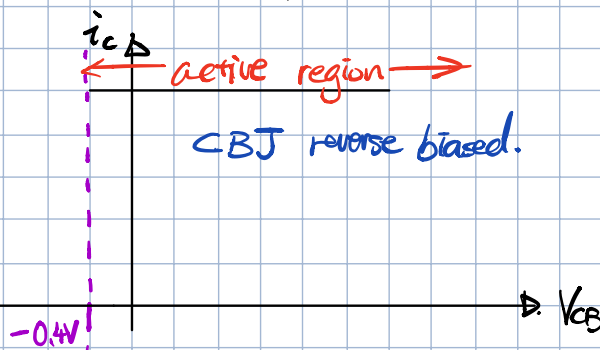


$i_B = i_C / \beta$  ← related to doping and base width. (50-200)

$$= \frac{I_S}{\beta} e^{V_{BE}/V_T}$$



BJT in active mode.

$$i_B + i_C = i_E$$

$V_{BE} \sim 0.7V$  (EBJ forward biased)

$V_{CB} > -0.4V$  (CBJ reverse biased)

$$i_C = I_S e^{V_{BE}/V_T}$$

$$i_B = \frac{i_C}{\beta}$$

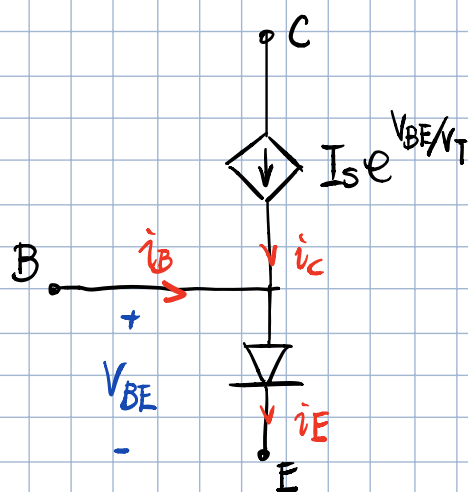
$$i_E = i_C + i_B = i_C + \frac{i_C}{\beta}$$

$$i_E = \frac{\beta + 1}{\beta} i_C$$

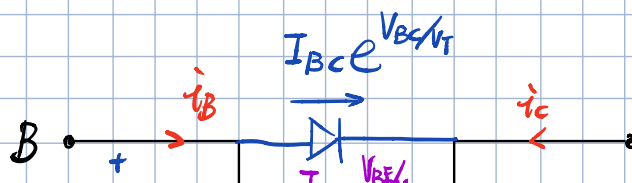
$$\left( i_E = \frac{i_C}{\alpha}, \alpha = \frac{\beta}{\beta + 1} \right)$$

" $\alpha \approx 1$ "

I-model



Saturation. mode

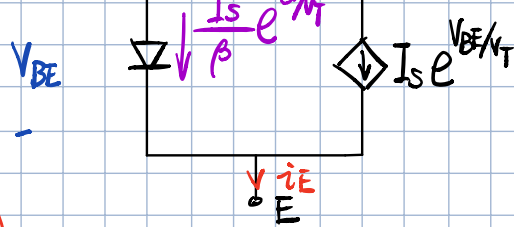


forward bias CBJ

$$i_B = \frac{I_S}{\beta} e^{V_{BE}/V_T} + I_{BC} e^{V_{BE}/V_T}$$

$$i_C = I_S e^{V_{BE}/V_T} - I_{BC} e^{V_{BE}/V_T}$$

$$i_E = i_B + i_C$$

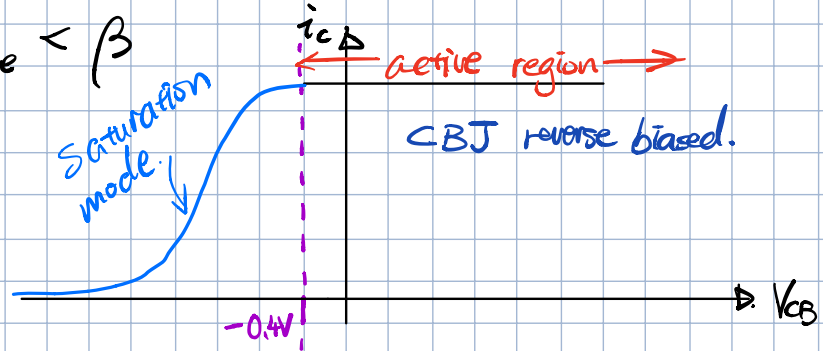
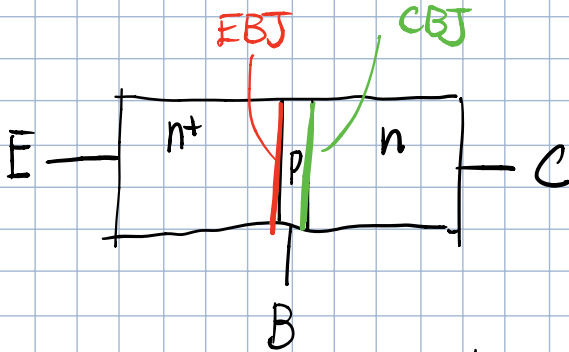


base current increases

collector current reduces.

$$\frac{i_C}{i_B} < \beta$$

$$\frac{i_C}{i_B} = \beta_{force} < \beta$$



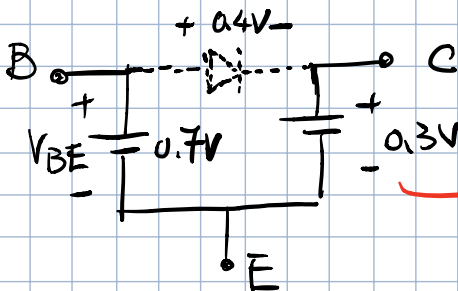
- for transistor to conduct, EBJ forward biased ( $V_{BE} \approx 0.7V$ )

- for transistor to be in active mode, CBJ reverse biased ( $V_{CB} > -0.4V$ )

$$\frac{i_C}{i_B} = \beta$$

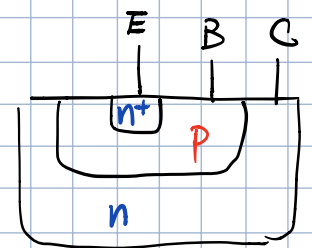
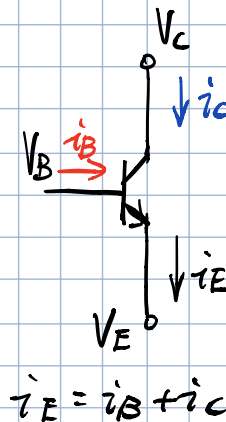
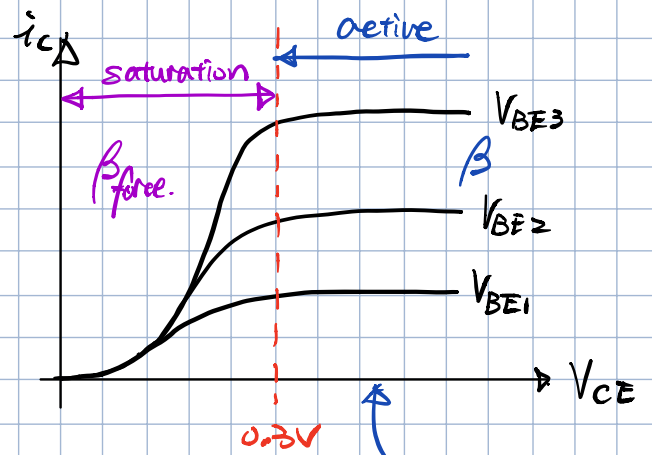
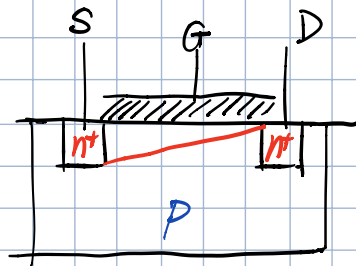
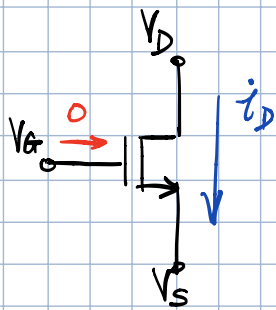
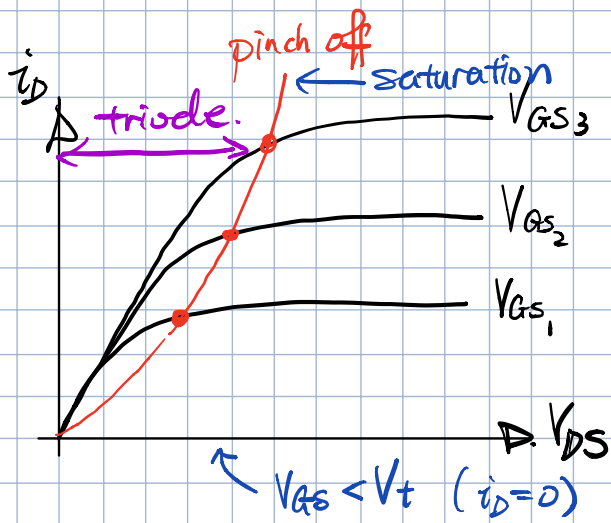
- for transistor to be in saturation mode, CBJ forward biased ( $V_{CB} < -0.4V$ )

$$\frac{i_C}{i_B} = \beta_{force} < \beta$$



on set of saturation.

0.2V for deep in saturation.



BJT regions of operation.

