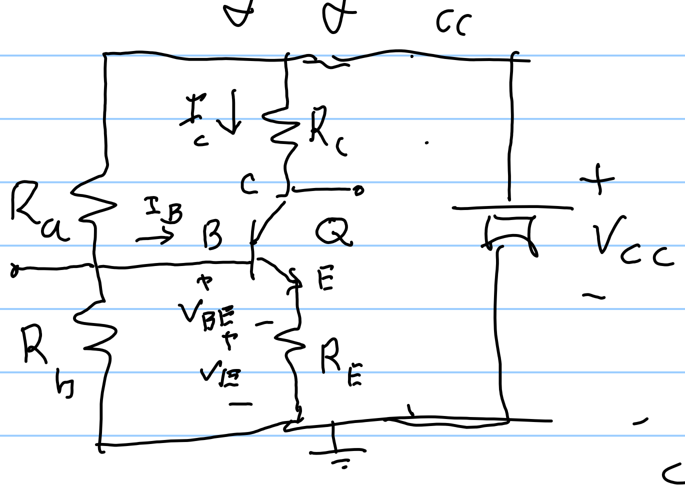
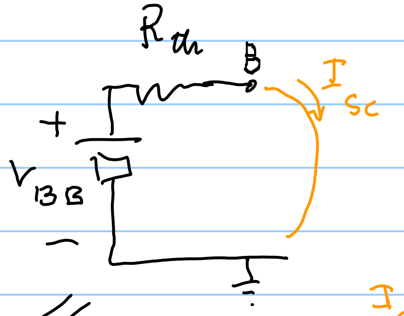
EE307
02/19/18

Biasing of BJT





$I_{oc} = 0$

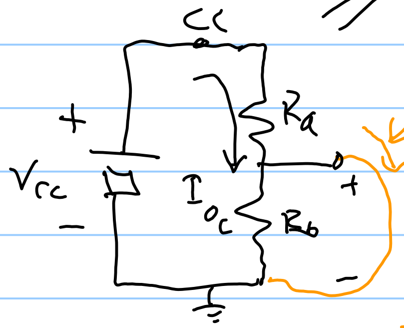
+

$V_{oc} = V_{th}$

−

$I_{sc} = \frac{V_{oc} = V_{BB}}{R_{th}}$

//



for I_{sc}

$V_{oc} = R_b \cdot I_{oc} = R_b \cdot \frac{V_{cc}}{R_a + R_b} = \frac{V_{cc}}{1 + \frac{R_a}{R_b}}$

$I_{ss} = V_{cc}/R_a$

$$R_{th} = \frac{V_{OC}}{I_{SS}} = \frac{\frac{R_b V_{CC}}{R_a+R_b}}{V_{CC}/R_a} = \frac{R_a R_b}{R_a+R_b} \Rightarrow R_{Th} = R_a \| R_b$$

$$V_{BB} = V_{OC} = \frac{R_b}{R_a+R_b} \cdot V_{CC}$$

the bias problem is to find R_a, R_b given V_{CC}, I_C from $g_m = \frac{I_C}{V_T}$

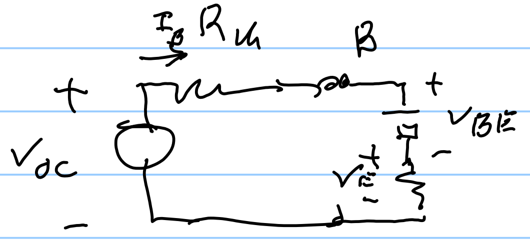
R_E, & the BJT Q (β)

$\Rightarrow$ given the Q point

$V_{BE} \approx 0{,}7\,V$

we know $V_E = R_E \frac{I_C}{\alpha}$

$$\beta = h_{FE} = \frac{\alpha}{1-\alpha} \Rightarrow \alpha = \frac{\beta}{1+\beta}$$



$$V_{Base} = V_{BE} + R_E \cdot \frac{I_C}{\alpha}$$

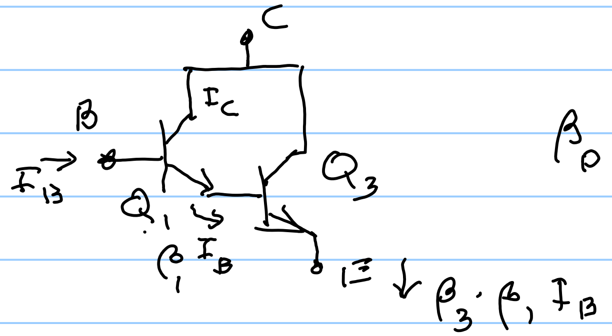
$$V_{Rth} = R_{th} \cdot I_B = R_{th} \frac{I_C}{\beta} = (V_{OC} - V_B)$$

gives one eq. in two unknowns R_a, R_b

$$\frac{R_a R_b}{R_a+R_b}\cdot\frac{I_C}{\beta} = \underbrace{\frac{R_b}{R_a+R_b}\cdot V_{CC} - V_{BB} - R_E\frac{I_C}{\alpha}}_{\text{constrains the range of } R_a \,\&\, R_b}$$ needs to hold

also desire R_a & R_b large to prevent biasing from loading signal circuit feeding this amplifier [($R_a \parallel R_b$) loads]

Darlington



$\beta_D \approx \beta_1 \cdot \beta_2$