

BJT Bias Feedback Bias (H.20)

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References

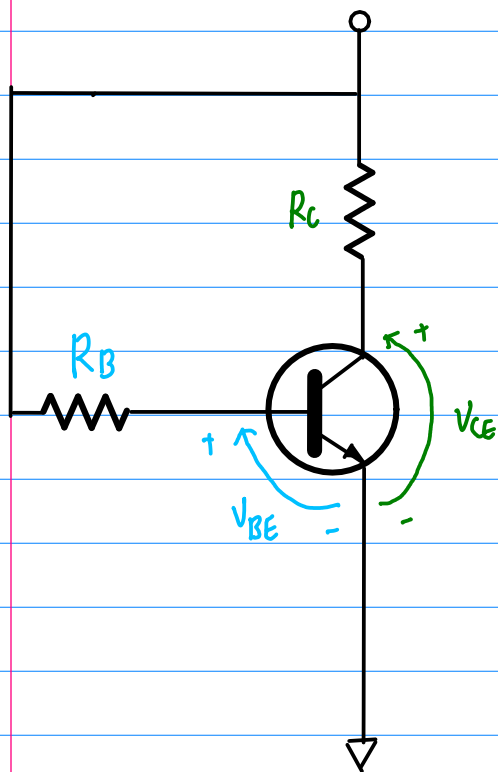
Based

[1] Floyd, Electronic Devices 7th ed

[2] Cook,

[2] en.wikipedia.org

Base Bias



Q point values $I_C \cong I_E$

$$I_C = \beta_{DC} \left(\frac{V_{CC} - V_{BE}}{R_B} \right)$$

$$V_{CE} = V_{CC} - I_C R_C$$

Fixed Bias :

fixed base current I_B

I_B : fixed

$I_C = \beta I_B$: change as β changes

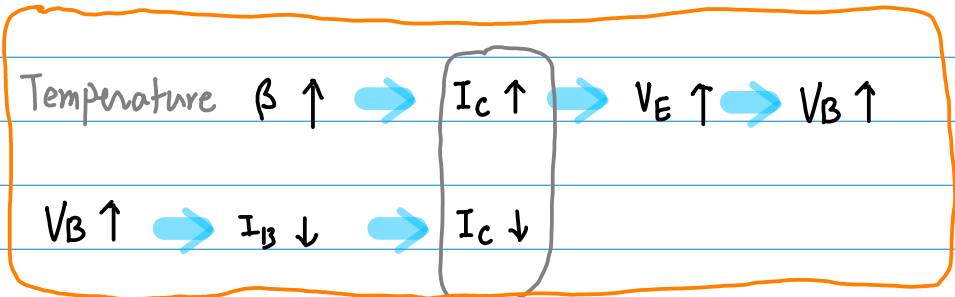
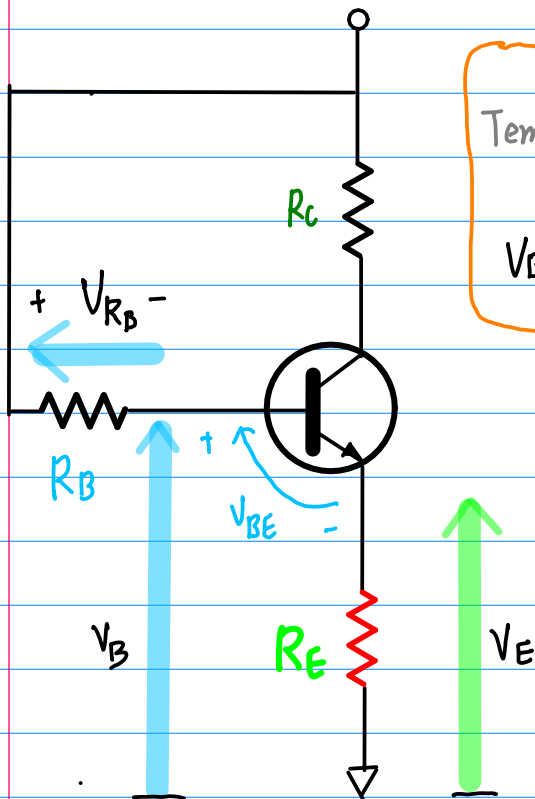
Temperature

Q moves all over the load line

Can not be used in the
fixed Q circuits

\Rightarrow use R_E as a feedback

Emitter Feedback Bias



Negative feedback

$$\begin{cases} V_E = I_C R_E \cong I_E \cdot R_E \\ V_B = V_E + V_{BE} \\ V_{R_B} = V_{CC} - V_B \end{cases}$$

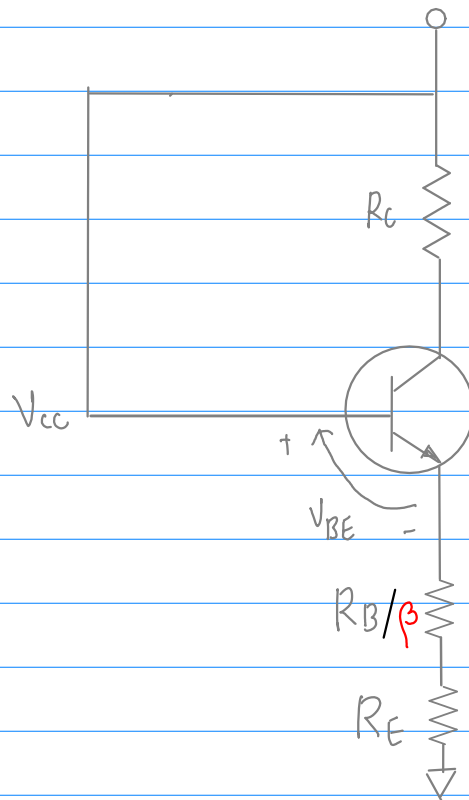
Still Q moves a lot

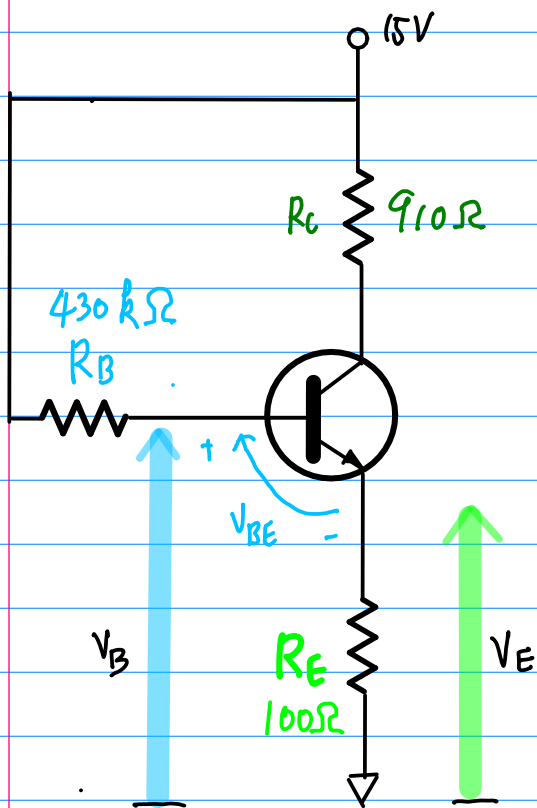
$$I_E = \frac{V_{CC} - V_{BE}}{R_E + R_B/\beta_{dc}}$$

$$V_E = I_E R_E$$

$$V_B = V_E + V_{BE}$$

$$V_C = V_{CC} - I_C R_C$$





$$I_E = \frac{V_{CC} - V_{BE}}{R_E + R_B/\beta_{dc}}$$

$$R_E \gg R_B/\beta_{dc}$$

$$I_E = \frac{V_{CC} - V_{BE}}{R_E}$$

not practical

But cannot select large R_E in practice.

$$I_E = \frac{V_{CC} - V_{BE}}{R_E + R_B/\beta_{dc}} = \frac{15 - 0.7}{100 + 430000/\beta_{dc}}$$

100 ~ 300

$$I_C \cong I_E$$

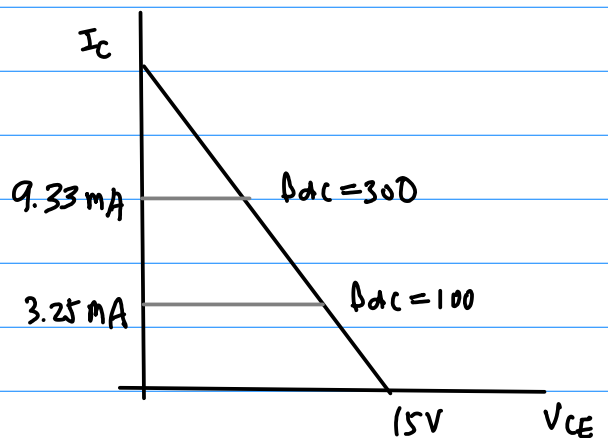
$$\beta = 100$$

$$I_C = \frac{14.3}{100 + 4300} = 3.25 \text{ mA}$$

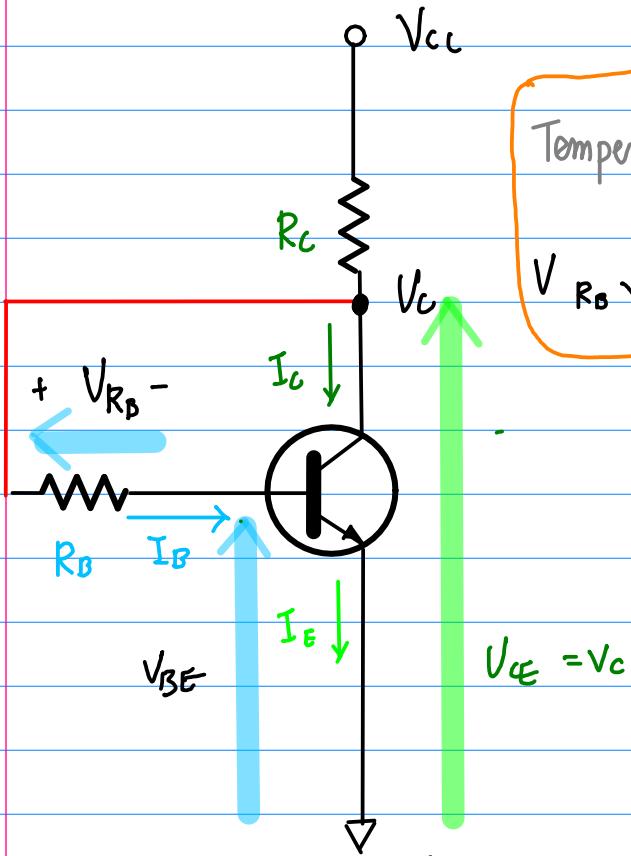
$$\beta = 300$$

$$I_C = \frac{14.3}{100 + 4300/3} = 9.32 \text{ mA}$$

3:1 variation



Collector Feedback Bias (Self Bias)



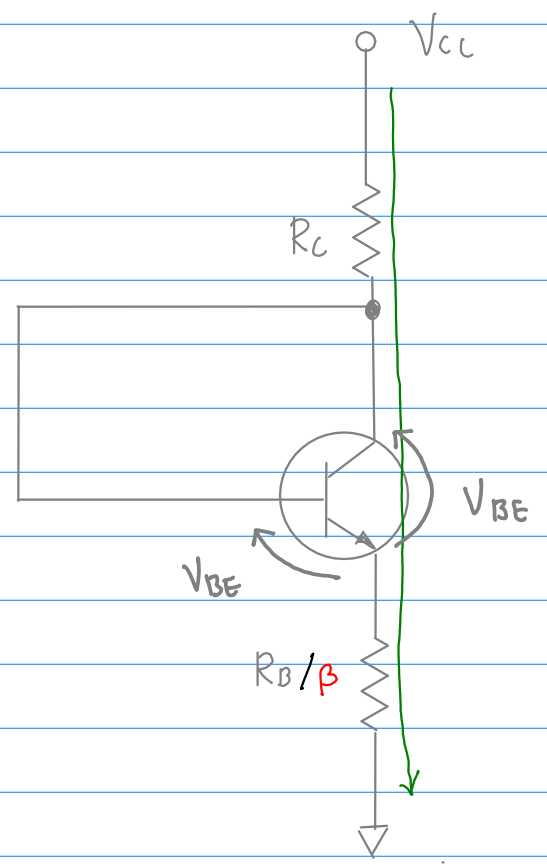
Temperature $\beta \uparrow \Rightarrow I_C \uparrow \Rightarrow V_C \downarrow \Rightarrow V_{R_B} \downarrow$
 $V_{R_B} \downarrow \Rightarrow I_B \downarrow \Rightarrow I_C \downarrow$

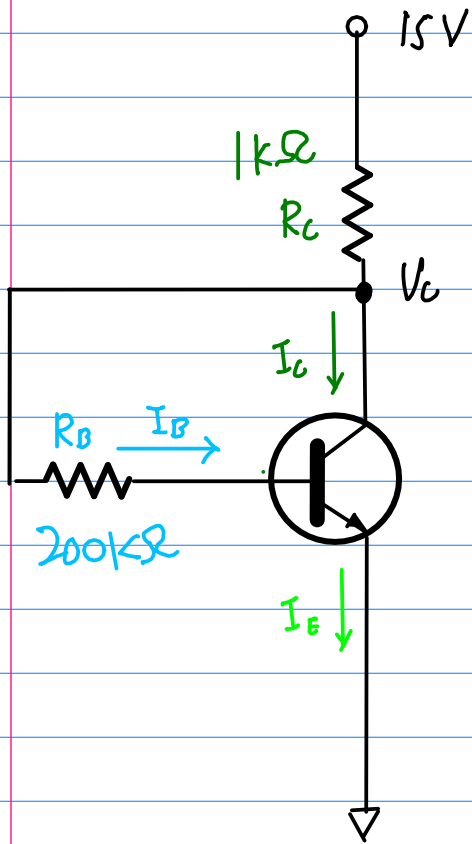
Negative feedback

$$I_E = \frac{V_{CC} - V_{BE}}{R_C + R_B/\beta_{DC}}$$

$$V_B = V_E + V_{BE}$$

$$V_C = V_{CC} - I_C R_C$$





$$I_E = \frac{V_{CC} - V_{BE}}{R_C + R_B/\beta_{DC}} = \frac{15 - 0.7}{1000 + 200000/\beta_{DC}}$$

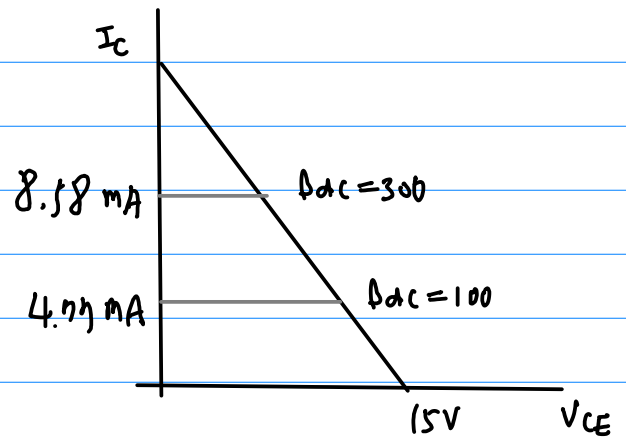
$\beta = 100$

$$I_E = \frac{14.3}{1000 + 200000} = 4.77 \text{ mA}$$

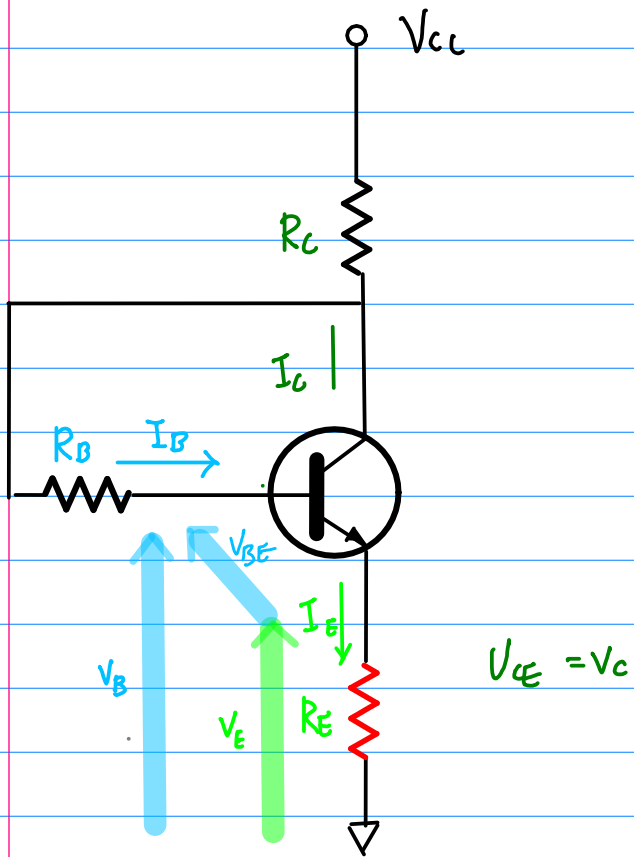
$\beta = 300$

$$I_E = \frac{14.3}{1000 + 200000/3} = 8.58 \text{ mA}$$

2:1



Collector - Emitter Feedback



Emitter Feedback
 (+) Collector Feedback

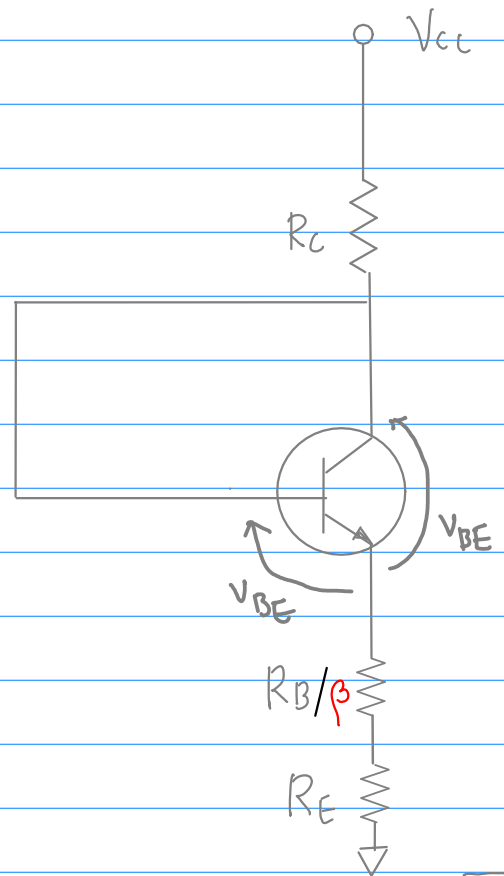
Still not enough feedback to stabilize.

$$I_E = \frac{V_{CC} - V_{BE}}{R_C + R_E + R_B/\beta}$$

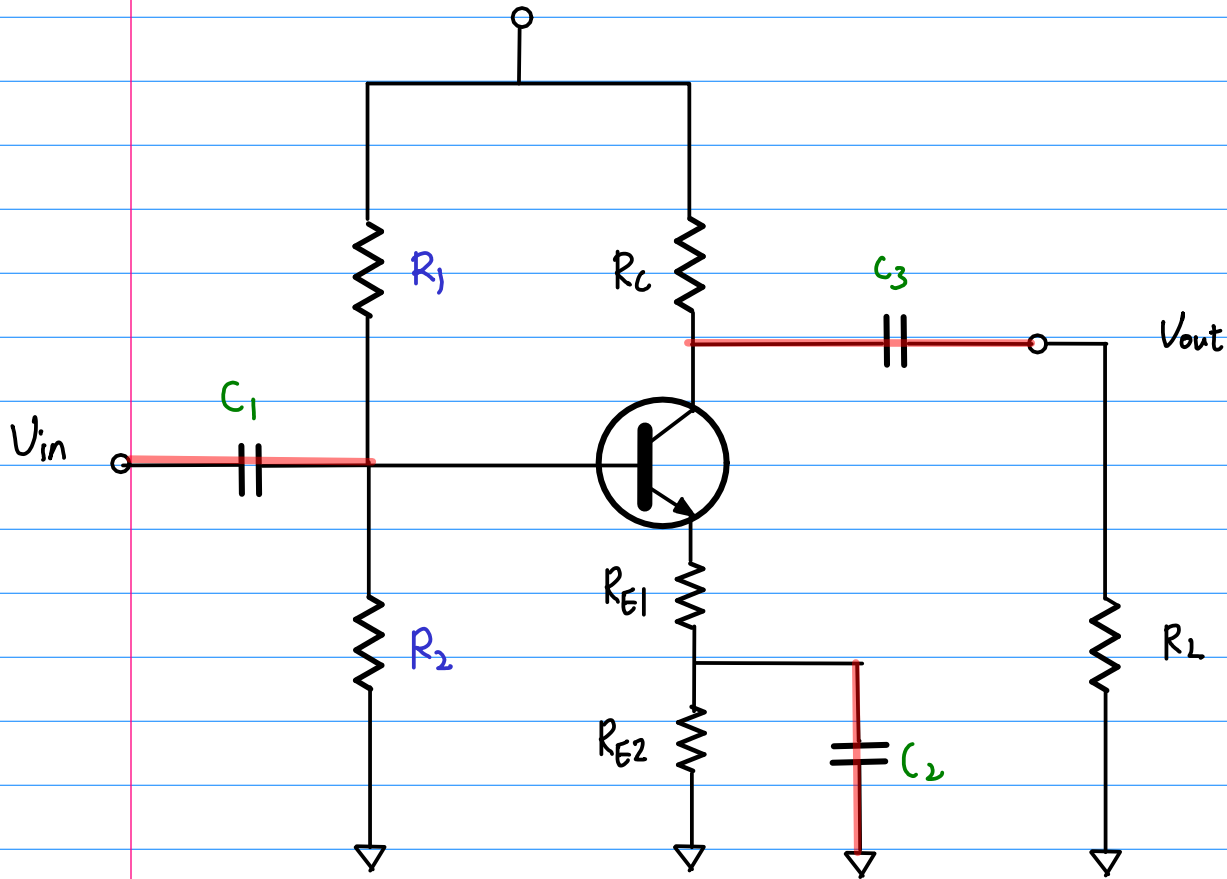
$$V_E = I_E R_E$$

$$V_B = V_E + V_{BE}$$

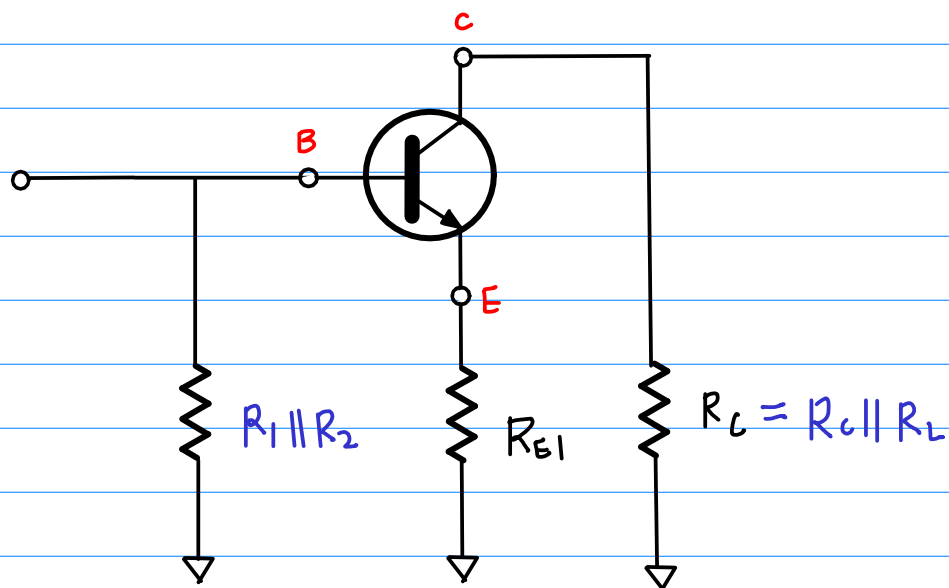
$$V_C = V_{CC} - I_C R_C$$



AC Emitter Feedback



AC equivalent circuit



R_{E1} : feedback resistor

