

BJT Bias Emitter Bias (H.7)

20170425

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References

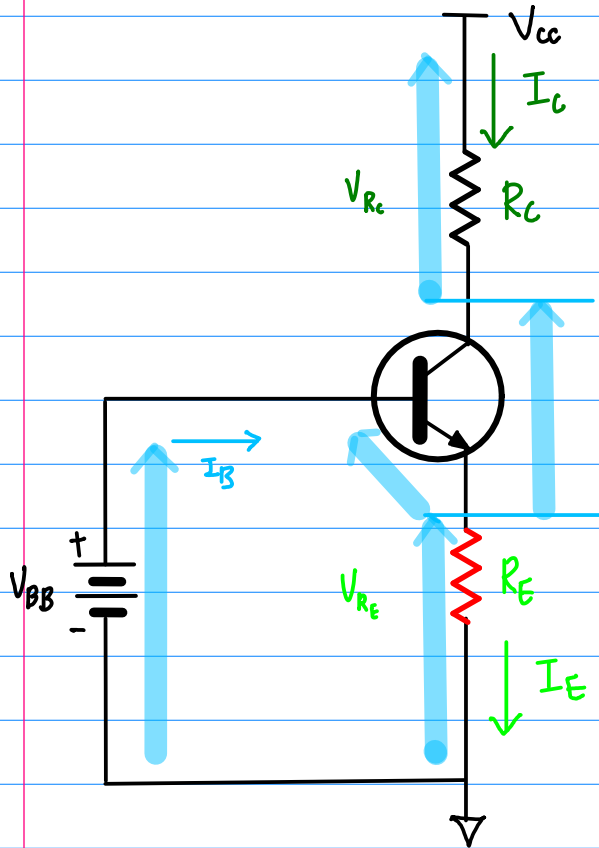
Based

[1] Floyd, Electronic Devices 7th ed

[2] Cook,

[2] en.wikipedia.org

Emitter Bias



$$V_{BB} = V_{BE} + V_{RE}$$

$$V_{RE} = V_{BB} - V_{BE} = V_{BB} - 0.7$$

$$I_E = \frac{V_{RE}}{R_E} = \frac{V_{BB} - V_{BE}}{R_E}$$

$$I_C \approx I_E = \frac{V_{BB} - V_{BE}}{R_E}$$

$$V_{RC} = I_C R_C$$

$$V_{CE} = V_{CC} - V_{RE} - V_{RC}$$

$$= V_{CC} - (R_C + R_E) I_E$$

$$= V_{CC} - (R_C + R_E) \frac{V_{BB} - V_{BE}}{R_E}$$

minor effect on current gain

$$\begin{aligned} I_E &= I_C + I_B \\ &= I_C + \frac{I_C}{\beta} \\ &= \left(\frac{\beta + 1}{\beta} \right) I_C \end{aligned}$$

$$I_C = \left(\frac{\beta}{\beta + 1} \right) I_E$$

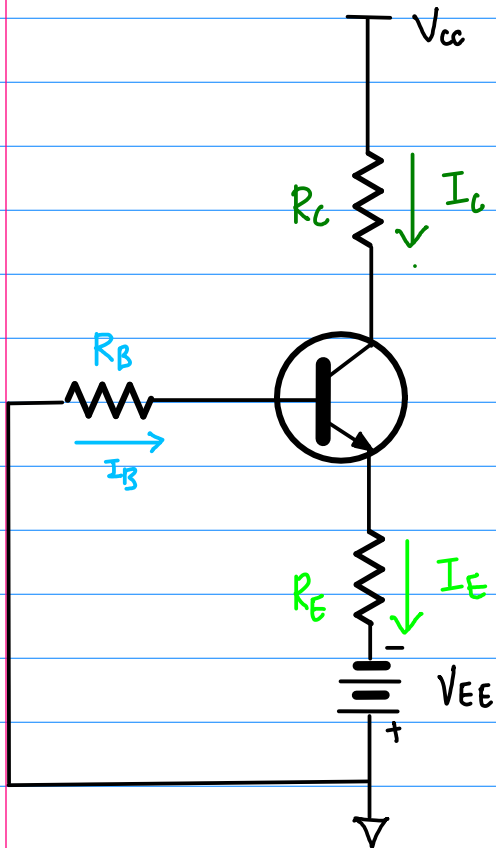
$$\left(\frac{\beta_{dc}}{\beta_{dc} + 1} \right) \quad \text{correction factor}$$

how I_C differs from I_E

$$\beta_{dc} = 100$$

$$\frac{100}{101} = 0.99$$

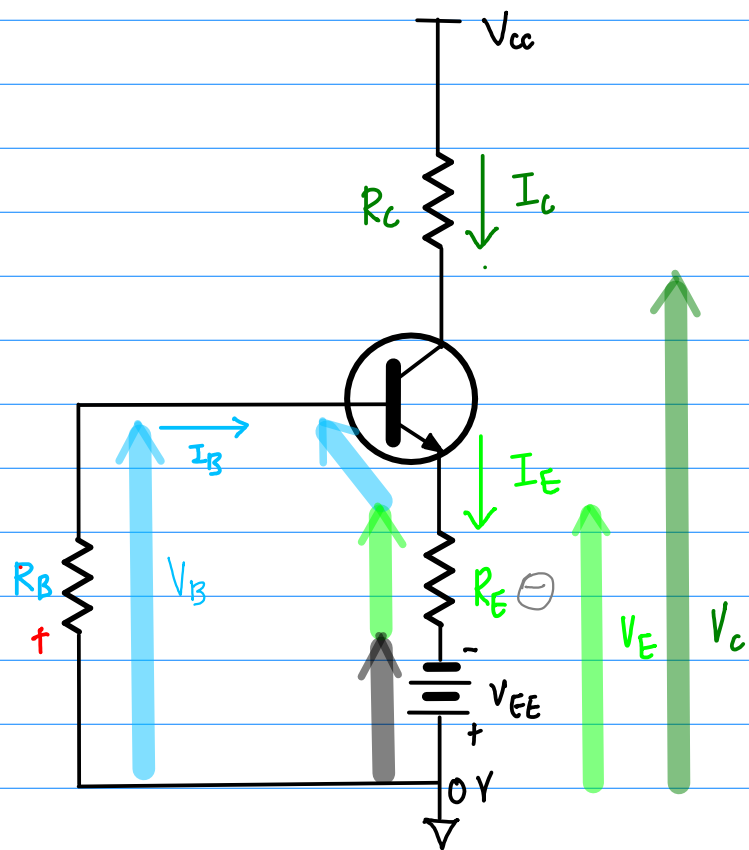
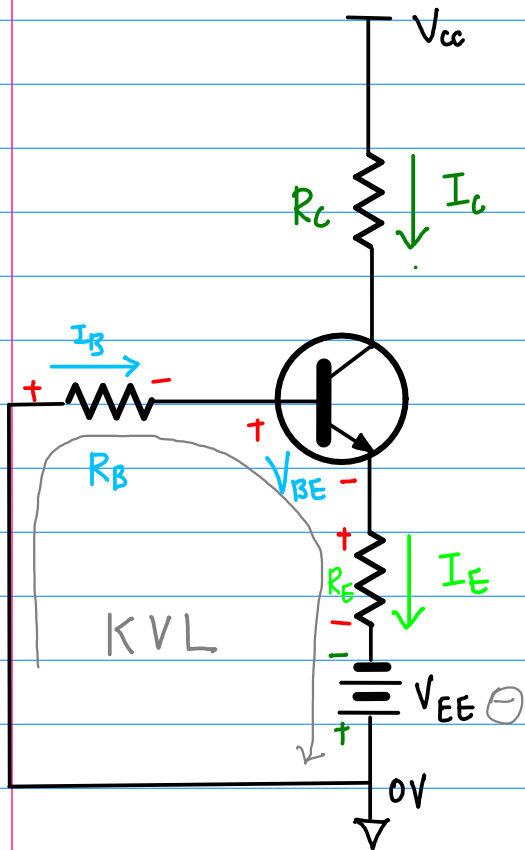
Two-Supply Emitter Bias (TSEB)



$$I_C \cong I_E$$

$$I_C = \frac{V_{BB} - V_{BE}}{R_E + R_B / \beta_{DC}}$$

$$V_{CE} = V_{CC} + V_{EE} - I_C(R_C + R_E)$$



$$V_{R_B} + V_{BE} + V_{R_E} + V_{EE} = 0$$

$$V_E = V_{EE} + I_E R_E$$

$$I_B R_B + V_{BE} + I_E R_E + V_{EE} = 0$$

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

$$I_B R_B + V_{BE} + I_E R_E = -V_{EE}$$

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

$$I_E \cong I_C = \beta_{DC} I_B \quad I_B \cong \frac{I_E}{\beta_{DC}}$$

$$\frac{I_E}{\beta_{DC}} R_B + V_{BE} + I_E R_E = -V_{EE}$$

$$I_E \left(\frac{R_B}{\beta_{DC}} + R_E \right) + V_{BE} = -V_{EE}$$

$$I_E = \frac{-V_{EE} - V_{BE}}{R_E + R_B/\beta_{DC}} \cong I_C$$

Q-point Stability

$$I_E = \frac{-V_{EE} - V_{BE}}{R_E + R_B/\beta_{DC}} \approx I_C$$

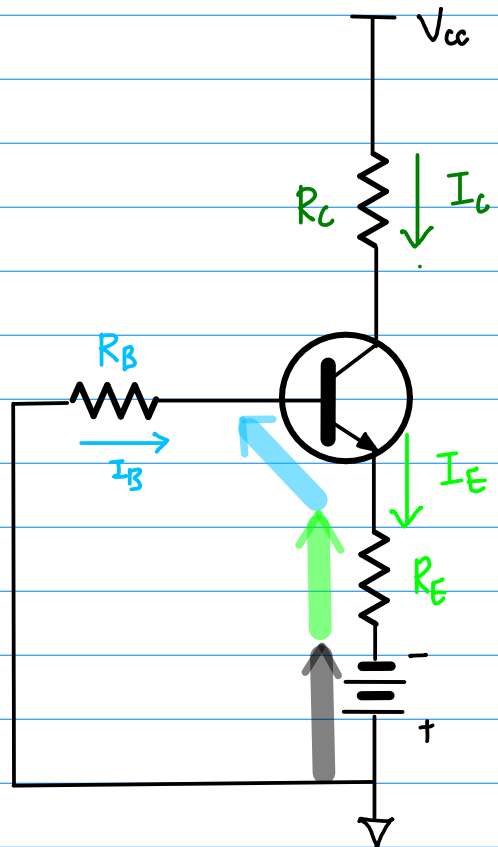
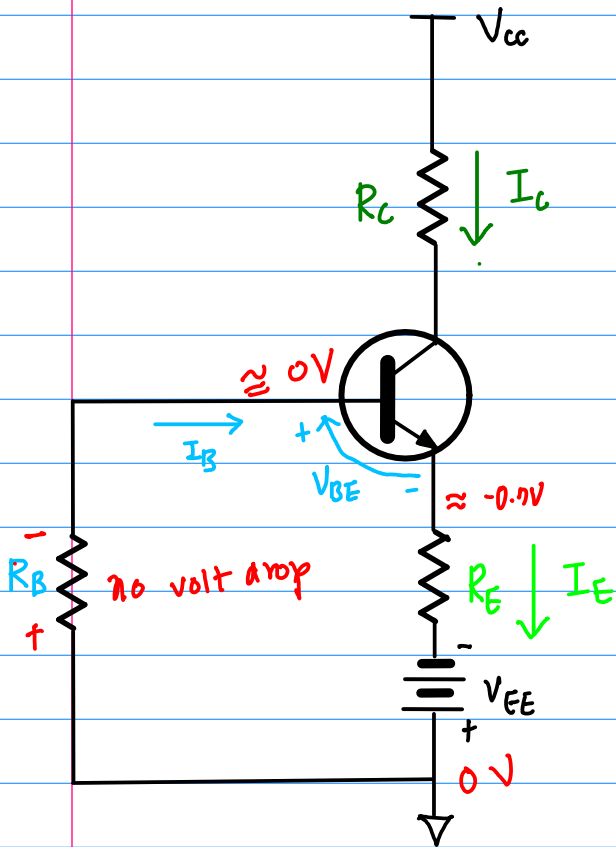
$$R_E \gg R_B/\beta_{DC}$$

$$I_E = \frac{-V_{EE} - V_{BE}}{R_E} \approx I_C$$

$$-V_{EE} \gg V_{BE}$$

$$I_E = \frac{-V_{EE}}{R_E} \approx I_C$$

I_E independent of V_{BE} and β_{DC} \rightarrow stable Q point



$$V_B \approx 0V$$

$$V_{RE} = -V_{EE} - V_{BE}$$

$$I_E = \frac{V_{RE}}{R_E}$$

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

$$V_{CE} = V_C + V_{BE}$$







