05.04.2017

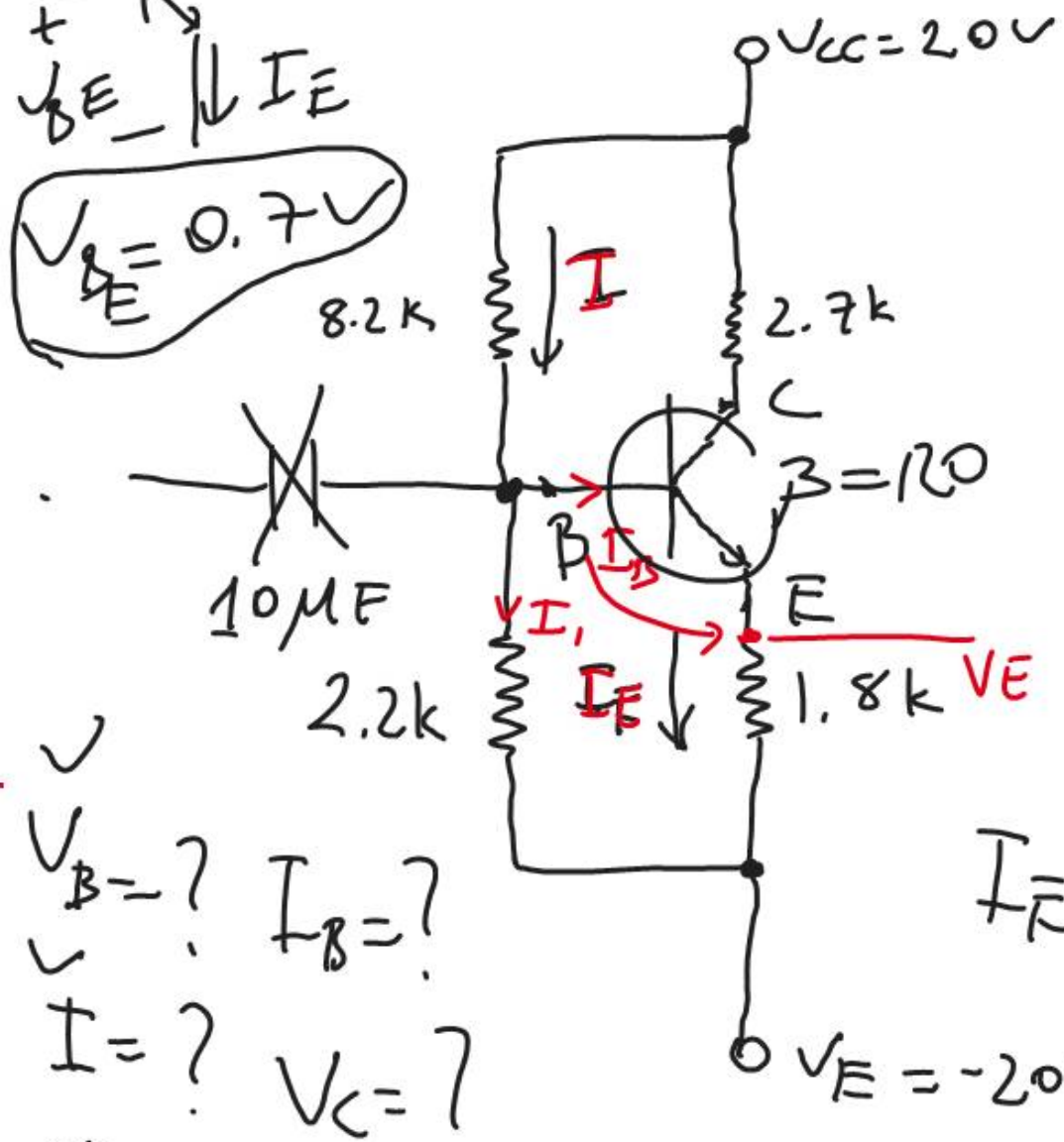
VOLTAGE DNIDER BIAS

$I_C = \beta I_B$ ①

I_B → I_C

+ V_{BE} − ↓ I_E

$V_{BE} = 0.7V$



$I_B = \frac{I_C}{\beta} = \frac{4.25mA}{120}$

$I = \frac{20 - (-20V)}{8.2k + 2.2k}$

$I = 3.85mA$

$V_B = 20 - I\,8.2k = -11.5$

$V_E = V_B - 0.7V = -12.23$

$I_E = \frac{V_E - (-20V)}{1.8k} = 4.25mA$

$I_E \simeq I_C$

$V_C = V_{CC} - I_C \cdot 2.7k$

V

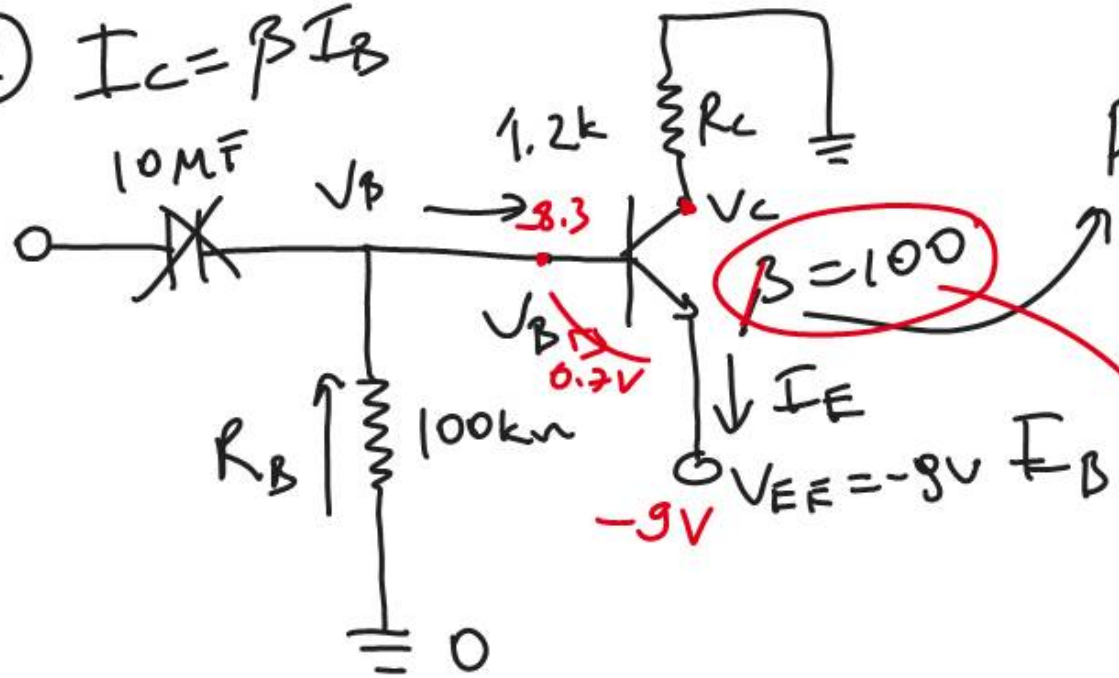
$V_B = ?$ $I_B = ?$

$I = ?$ $V_C = ?$

$VI_C = ?$ V

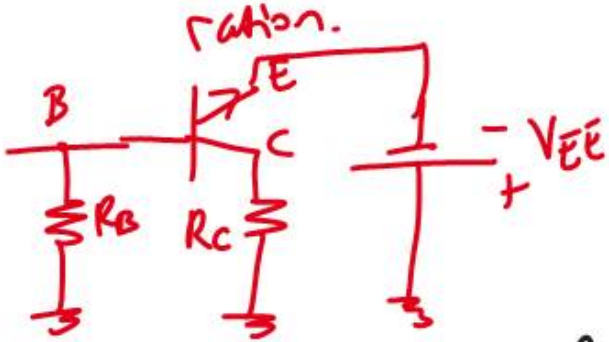
① $V_B - V_E = 0.7V$ ③ $I_C \cong I_E$

② $I_C = \beta I_B$



A common collector configuration.

$\beta \gg 1$



$$I_B = \frac{0 - V_B}{100k} = \frac{8.3}{\frac{100k}{10^5}} = 83\mu A$$

$$I_C = 83 \times 10^{-6} \times 10^{2} = 8.3\,mA$$

V V_B = ?

V I_B = ?

V I_C = ?

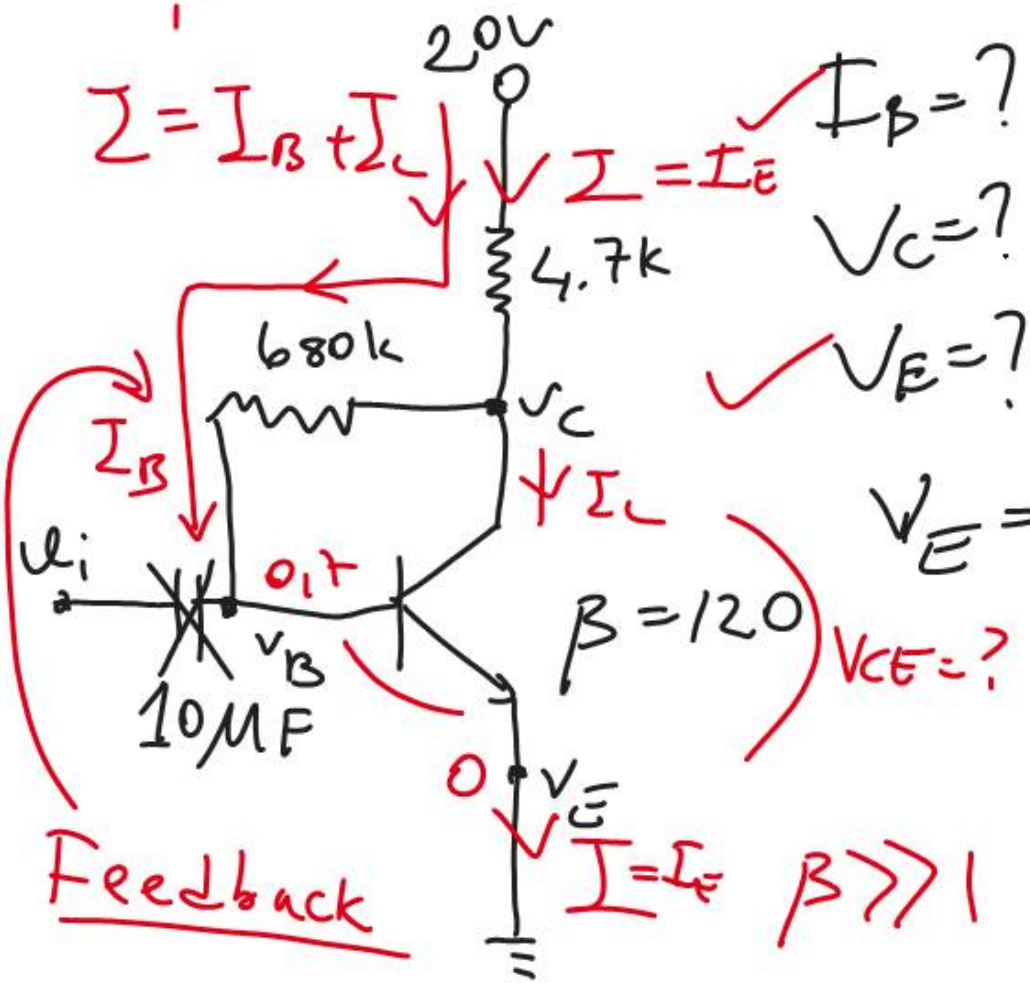
V_C = ?

$V_B - V_E = 0.7V$

$V_B - (-9V) = 0.7V$

$\boxed{V_B = -8.3V}$

$$\frac{0 - V_C}{1.2k} = 8.3\,mA$$



INPUT KVL:

$20V - I_E \times 4.2\times10^3 - I_B \times 680\times10^3 - V_{BE} = 0$

$I_E = (\beta+1) I_B$

$I = I_B + I_C$

$I = I_E$

$I_B = ?$

$V_C = ?$

$V_E = ?$

$I \cong I_C$

$V_E = 0V$

$V_{CE} = ?$

$\frac{20 - V_C}{4.7k} = I_B(\beta)$

$= \frac{V_C - 0.7}{680k} 120$

$I = I_E$ $\beta \gg 1$

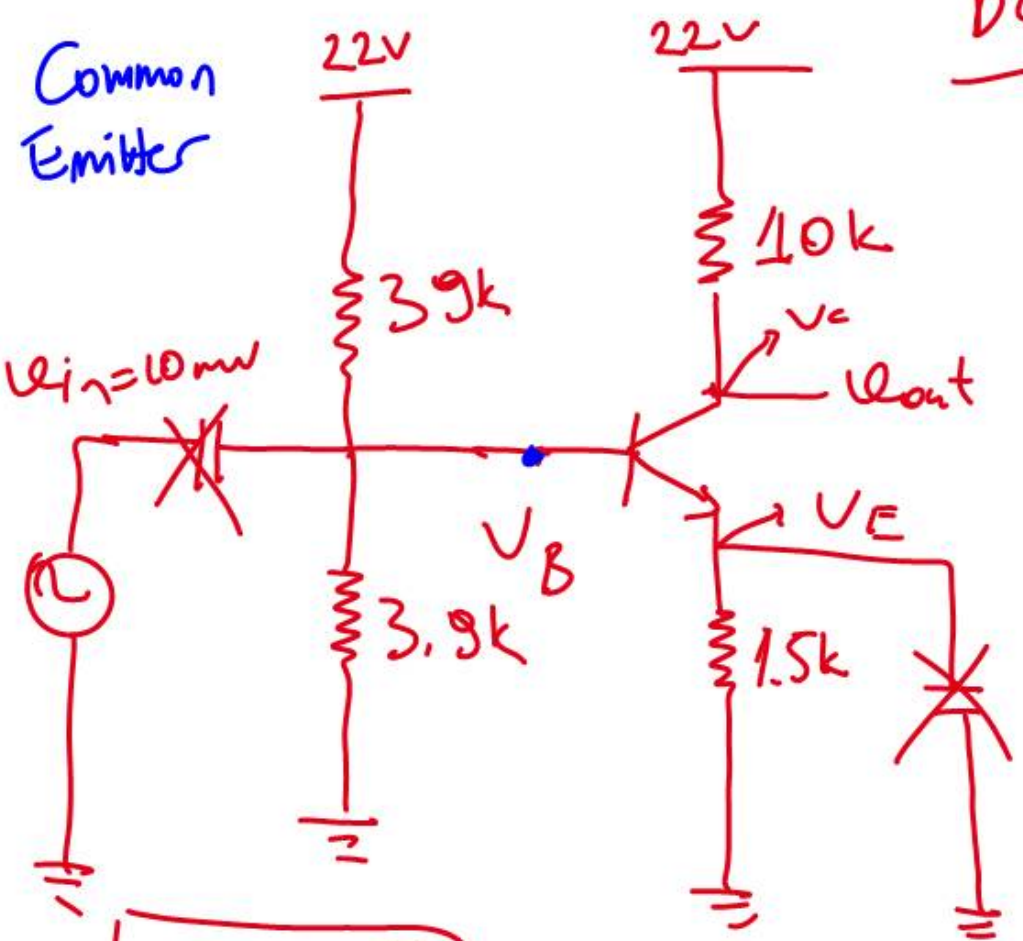
$I_C = \frac{20 - V_C}{4.7k}$

$I_C = (\beta+1) I_B$

$* \; 20 - I_E \cdot 4.2\times10^3 - V_{CE} = 0$ OUTPUT KVL

DC Analysis

Common Emitter



$$V_B = \frac{3.9k}{3.9k+39k} \times 22V$$

$V_E = V_B - 0.7V$

$$I_E = \frac{V_E}{1.5k}$$

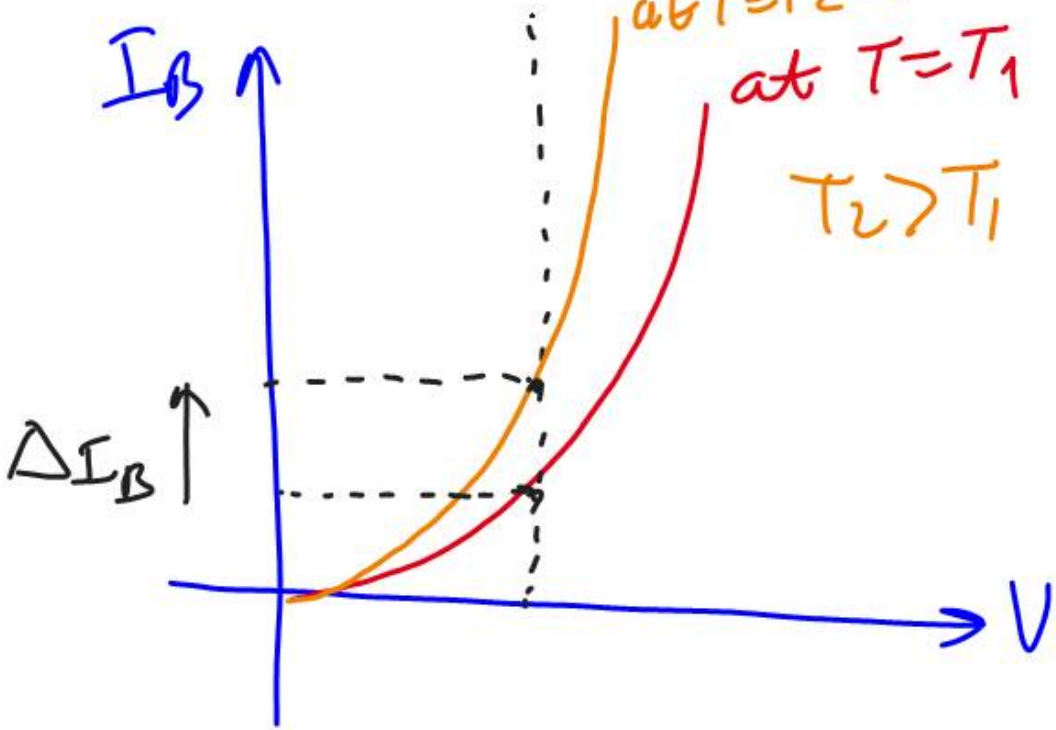
$I_E \cong I_c$

$V_c = 22 - I_c\,10k$

$V_{CE} = ? = V_C - V_E$

EMITTER RESISTOR FEEDBACK

STABILITY



increasing temperature increases I_B at the same V_{BE}.

$I_C = \beta \cdot I_B$

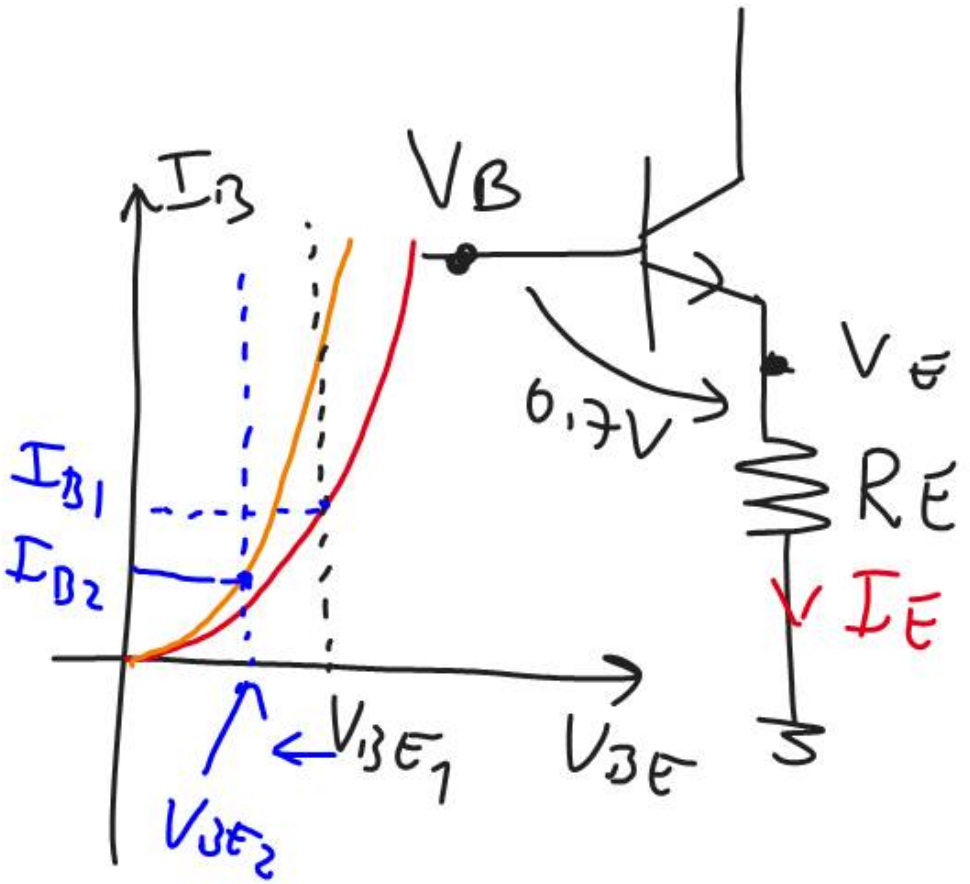
So I_C increases

↳ Increasing I_C heats up the transistor,
in Heated transistor ($T\uparrow$) I_B increases more, so does I_C
Increasing I_C heats up transistor more

THERMAL RUNAWAY occurs and transistor is damaged.

However, an emitter resistor R_E prevents the THERMAL RUNAWAY.

↳ Stability problem



$$V_E = I_E \cdot R_E$$

$$V_E = V_B - 0,7V$$

↑ constant.

as $I_B \uparrow$, and $I_C \uparrow$, $I_E \uparrow$

then $V_E = I_E \cdot R_E \uparrow$

$V_B - V_E = V_{BE}$ decreases

V_B ↓ const. V_E ↑ and I_B decreases.

NO THERMAL RUNAWAY!