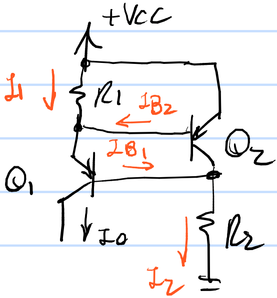
Nota de aula CEA

→ Análise da fonte de corrente realimentada



• Análise c.c.

$$-\ I_1 = \frac{0{,}7}{R_1}$$

$$-\ I_2 = \frac{Vcc - 1{,}4}{R_2}$$

$$I_{B_2} = \frac{I_{B_1} + I_2}{\beta}$$

$$I_{B_1} = \frac{I_1 + I_{B_2}}{\beta + 1}$$

$$\rightarrow I_{B_1} = \frac{1}{\beta+1} \cdot \left(I_1 + \frac{I_{B_1} + I_2}{\beta} \right)$$

$$I_{B_1} = \frac{I_1}{\beta+1} + \frac{I_2}{\beta^2+\beta} + \frac{I_{B_1}}{\beta^2+\beta}$$

$$I_{B_1}\left(1 - \frac{1}{\beta^2+\beta}\right) = \left(\frac{1}{\beta+1}\right)\left(I_1 + \frac{I_2}{\beta}\right)$$

$$I_{B_1}\left(\frac{\beta^2+\beta-1}{\cancel{\beta^2+\beta}}\right) = \left(\frac{1}{\cancel{\beta+1}}\right)\left(\frac{I_1 \cdot \beta + I_2}{\cancel{\beta}}\right)$$

$$I_{B_1} = \frac{I_1 \beta + I_2}{\beta^2 + \beta - 1} \Rightarrow \boxed{I_o = \frac{\beta^2 I_1 + \beta I_2}{\beta^2 + \beta - 1}}$$

Note que,

$$I_o = \frac{\beta^2 I_1}{\beta(\beta+1)-1} + \frac{\beta I_2}{\beta(\beta+1)-1}$$

se $\beta >> 1$

$$I_o \cong \frac{\cancel{\beta}^2 I_1}{\cancel{\beta}(\beta+1)} + \frac{\cancel{\beta} I_2}{\cancel{\beta}(\beta+1)}$$

$$\boxed{I_o \cong \alpha I_1 + \frac{I_2}{\beta+1}}$$

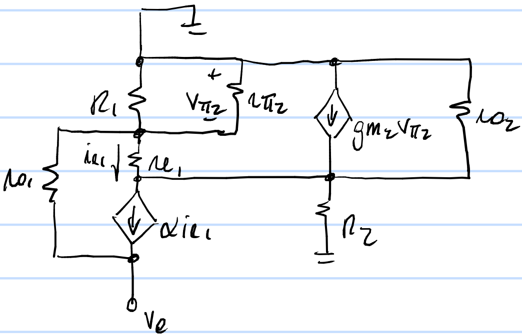
→ Podemos simplificar ainda mais ao assumirmos que $\alpha \cong 1$ e $\frac{1}{\beta+1} \cong 0$

assim: $\boxed{I_o \cong I_1}$ → $\boxed{I_o \cong \frac{0{,}7}{R_1}}$

De forma semelhante:

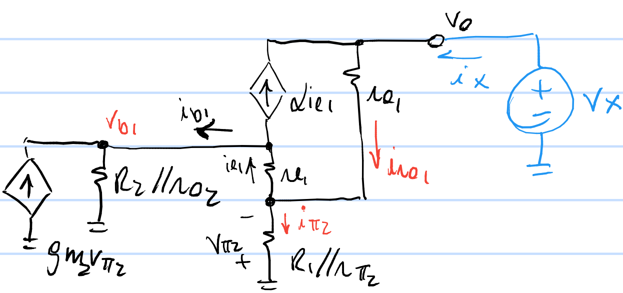
$$\boxed{I_{C2} \cong \frac{V_{CC}-1{,}4}{R_2}}$$

Análise c.a.



→ O objetivo da análise é encontrar Ro!

→ Redesenhando o circuito p/ simplificar:



→ Uma aproximação interessante é considerar que $\beta >> 1$ → $i_{b1} \simeq 0$!

$\alpha \simeq 1$

Com isso:

$$i_{\pi 2} \cong i_x \rightarrow V_{\pi 2} \cong -i_x\,(R_1 // r_{\pi 2})$$

$$\rightarrow V_{b1} \cong -g_{m2}\, i_x\,(R_1//r_{\pi 2})\cdot(R_2//r_{o2})$$

$$\cdot\ i_{e1} = \frac{-V_{\pi 2} - V_{b1}}{r_{e1}} \cong \frac{(R_1//r_{\pi 2})\, i_x}{r_{e1}}\left[1 + g_{m2} R_2//r_{o2}\right]$$

Como: $i_x \cong i_{ro1} - i_{e1}$

$$\text{e}\quad i_{ro1} = \frac{V_x + V_{\pi 2}}{r_{o1}} = \frac{V_x - (R_1//r_{\pi 2})\, i_x}{r_{o1}}$$

temos que:

$$i_x = \frac{V_x - R_1//r_{\pi 2}\, i_x}{r_{o1}} - \left[1 + g_{m2} R_2//r_{o2}\right]\frac{R_1//r_{\pi 2}\, i_x}{r_{e1}}$$

$$i_x\left[1 + \frac{R_1//r_{\pi 2}}{r_{o1}} + \frac{R_1//r_{\pi 2}}{r_{e1}}\left(1 + g_{m2} R_2//r_{o2}\right)\right] = \frac{V_x}{r_{o1}}$$

logo:

$$\boxed{R_o \cong r_{o1} + R_1//r_{\pi 2} + \frac{(R_1//r_{\pi 2})\, r_{o1}}{r_{e1}} + \frac{g_{m2}\, r_{o1}\,(R_2//r_{o2})(R_1//r_{\pi 2})}{r_{e1}}}$$

Aproximando:

$$\boxed{R_o \cong g_{m1}\, g_{m2}\, r_{o1}\,(R_2//r_{o2})(R_1//r_{\pi 2})}$$ //

Obs: $r_{e1} = \frac{V_T}{I_{E1}} = \frac{\alpha V_T}{I_{C1}}$

$$g_{m1} = \frac{I_{C1}}{V_T}$$

→ Consequentemente

$r_{e1} = \frac{\alpha}{g_{m1}}$ → Se $\alpha \cong 1$

$$\boxed{r_{e1} \cong \frac{1}{g_{m1}}}$$