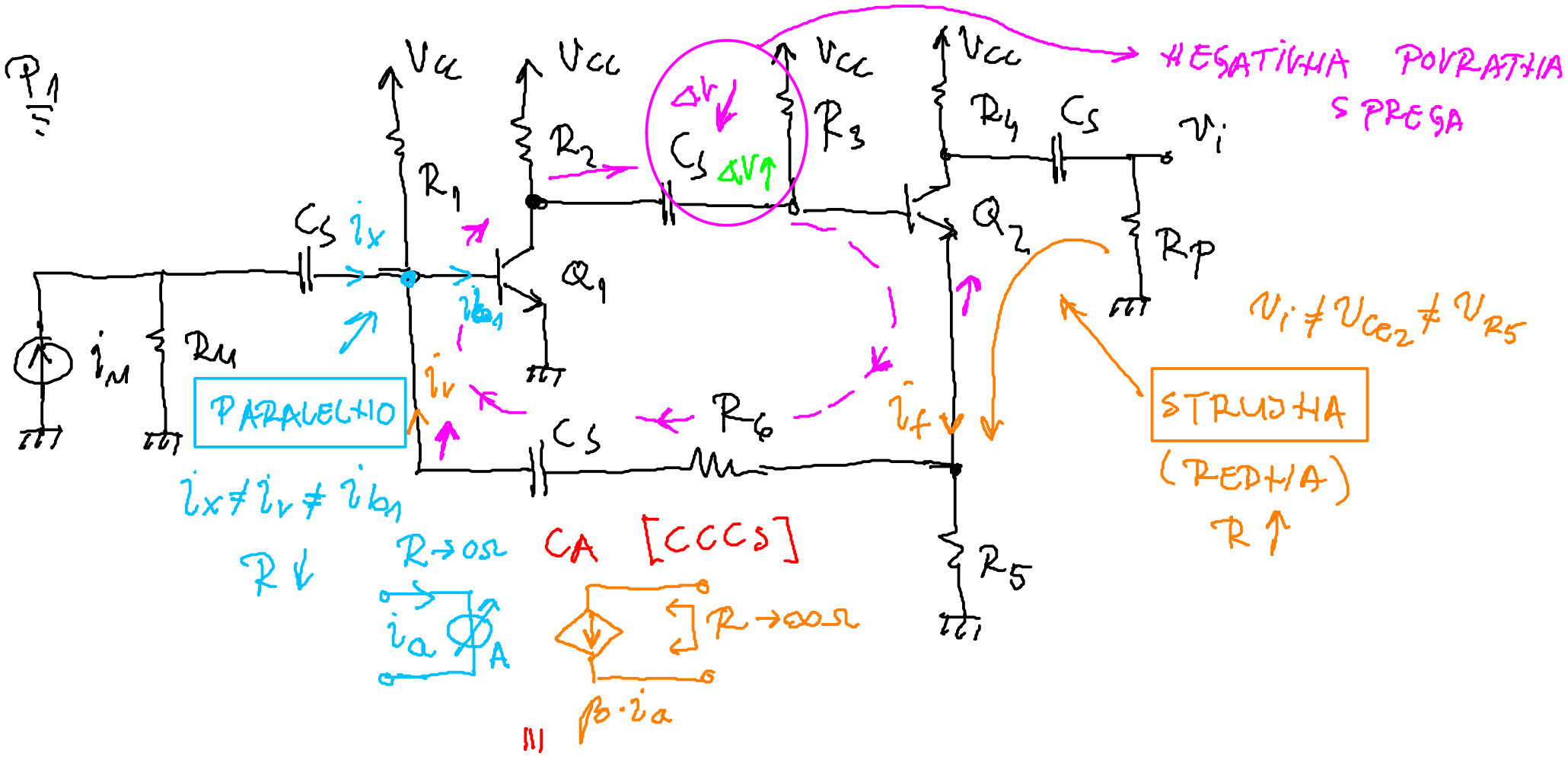
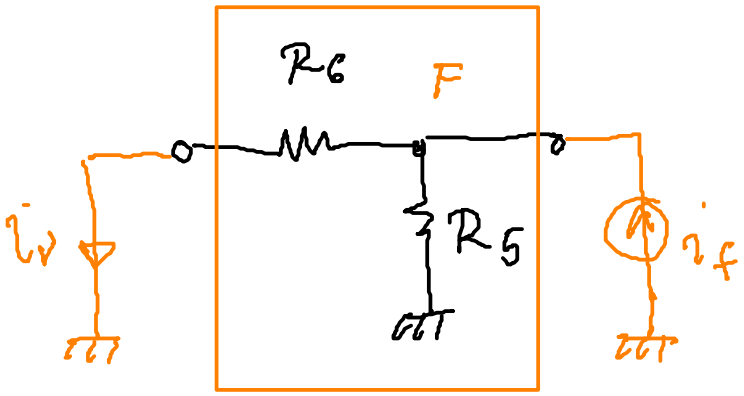


$\beta \cdot i_a$

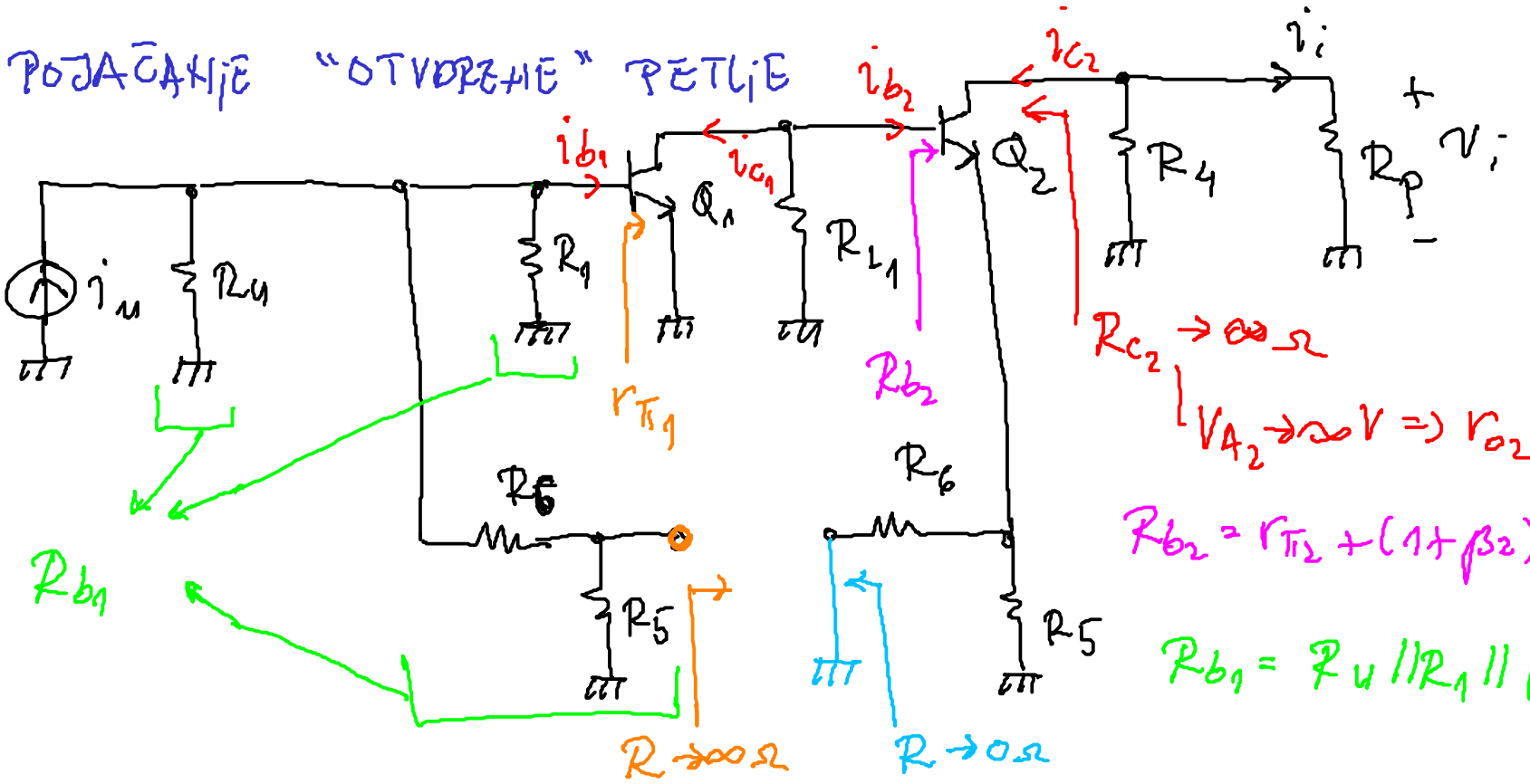
III

A → STRUJNO POJAČANJE



$$F = \frac{i_v}{i_f} = \frac{R_5}{R_5 + R_6}$$

POJAČANJE "OTVORENE" PETLJE



$R_{L_1} = R_2 \| R_3$

$R_{c_2} \to \infty\,\Omega$

$V_{A_2} \to \infty\,V \Rightarrow r_{o_2} \to \infty\,\Omega$

$R_{b_2} = r_{\pi_2} + (1+\beta_2)\cdot(R_6 \| R_5)$

$R_{b_1} = R_u \| R_1 \| (R_5 + R_6)$

$$A = \frac{i_i}{i_u} = \frac{v_i}{i_{c_2}} \cdot \frac{i_{c_2}}{i_{b_2}} \cdot \frac{i_{b_2}}{i_{c_1}} \cdot \frac{i_{c_1}}{i_{b_1}} \cdot \frac{i_{b_1}}{i_u} = -\frac{R_4}{R_4 + R_p} \cdot \beta_2 \cdot \left(-\frac{R_{L_1}}{R_{L_1} + R_{b_2}}\right) \cdot \beta_1 \cdot \frac{R_{b_1}}{R_{b_1} + r_{\pi_1}} \quad [A/A]$$

$$A_r = \frac{A}{1 + A \cdot F}$$

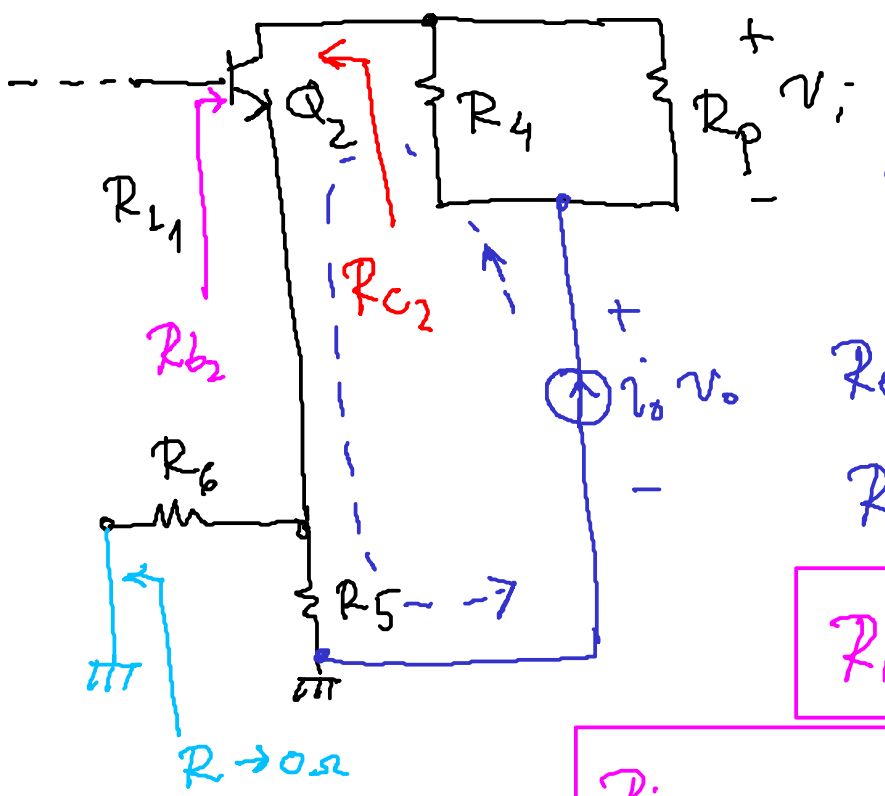
$R_{ul} = R_{b_1} \| r_{\pi_1}$

$$R_{ul_r} = R_{ul} / (1 + A \cdot F) \Rightarrow R_{ul_{r,amp}} = \frac{1}{G_{ul_{r,amp}}}$$

$$G_{ul_{r,amp}} = G_{ul_r} - G_u$$

$\frac{1}{R_{ul_r}} \Uparrow \quad \frac{1}{R_u} \Uparrow$

• KOD REDNE (STRUJNE) SPREGE R_{ek} JE OTPORNOST KONTURE!



$R_{L_1} = R_2 \| R_3$

$R_{ek} = \frac{v_o}{i_o} \equiv R_{iz}$

$R_{ek} = (R_4 \| R_p) + R_{C_2}$

$R_{ek} \to \infty\Omega \Rightarrow R_{iz} \to \infty\Omega$

$R_{C_2} \to \infty\Omega$

$V_{A_2} \to \infty V \Rightarrow r_{o_2} \to \infty\Omega$

$R_{b_2} = r_{\pi_2} + (1+\beta_2)\cdot(R_6 \| R_5)$

$R_{b_1} = R_u \| R_1 \| (R_5 + R_6)$

$$R_{iz_r} = R_{iz}(1 + AF) \to \infty\Omega$$

$$R_{iz_{r,amp}} = R_{iz_r} - R_p \to \infty\Omega$$

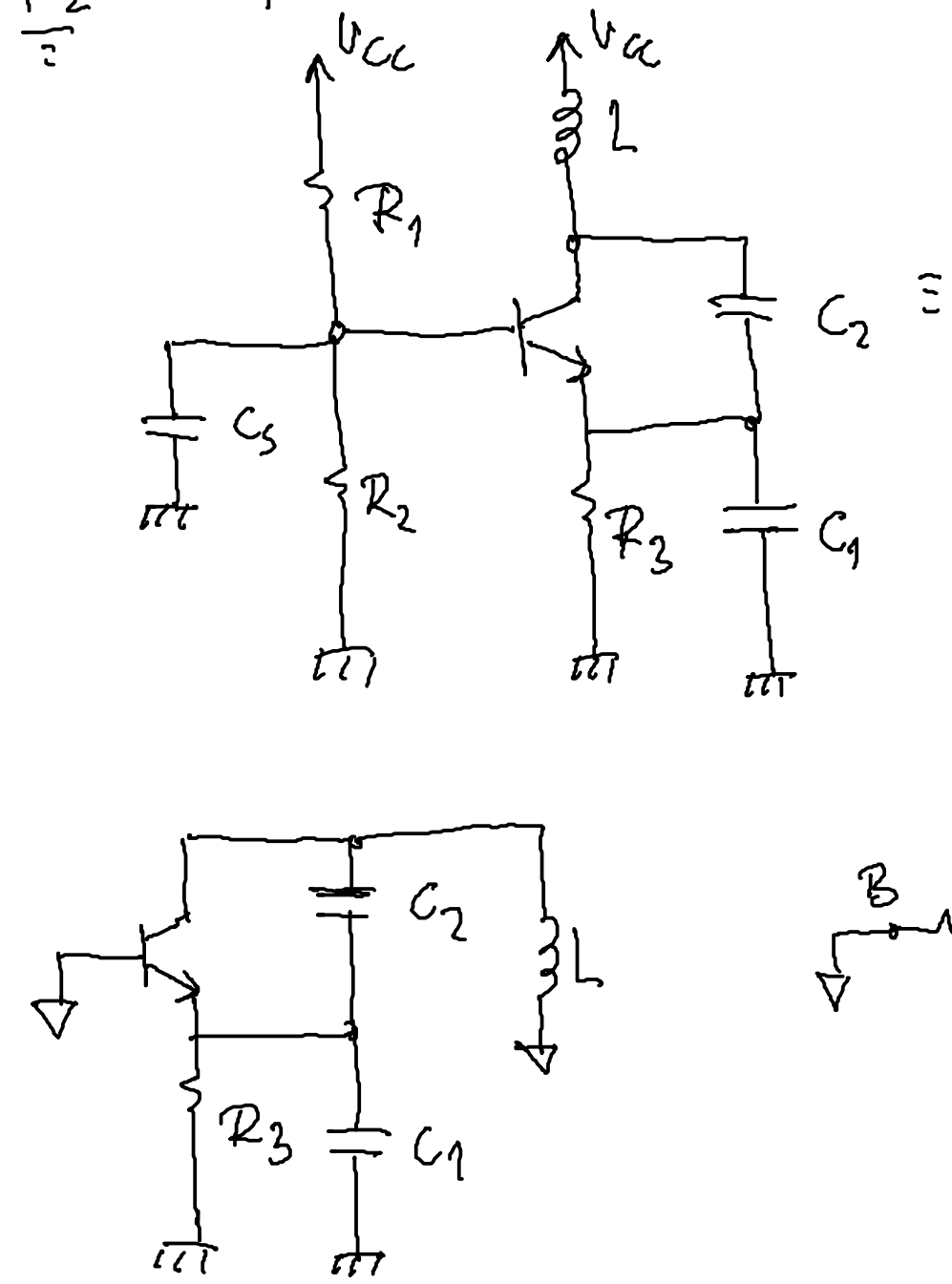
* AKO BI SE TRAŽILO NAPONSKO POJAČANJE SA REAKCIJOM:

$$A_{r,n} = \frac{v_i}{v_u} = \frac{v_i}{i_i}\cdot\frac{i_i}{i_u}\cdot\frac{i_u}{v_M} = \left(\frac{v_i}{i_i}\right)\cdot A_r\cdot\left(\frac{i_u}{v_M}\right)$$

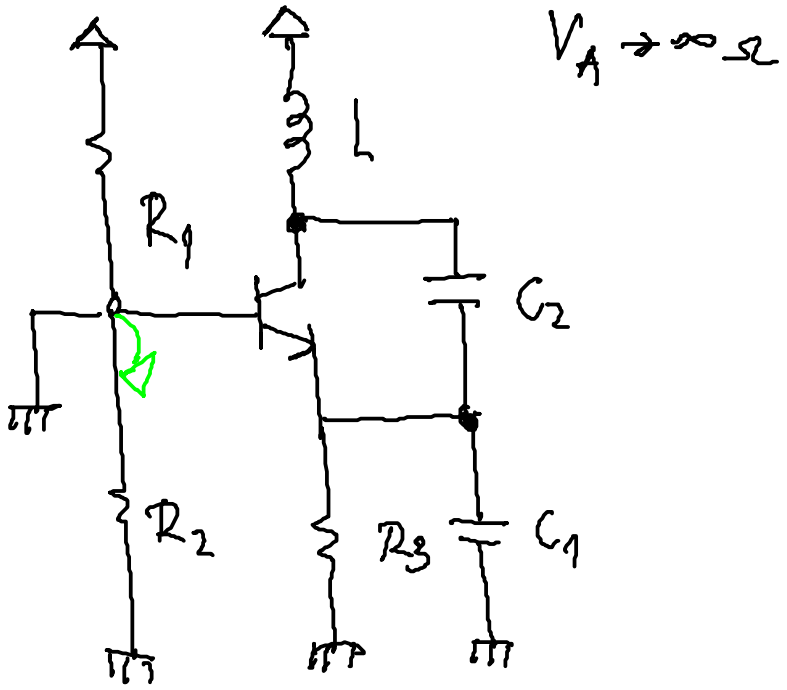
→ ODREDITI IZ KOLA.

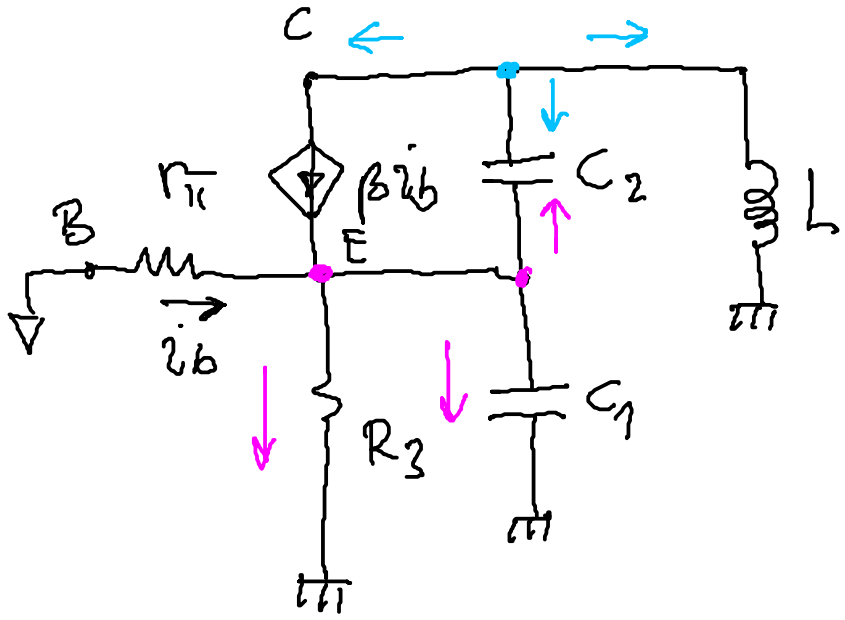
P2

"Colpitts" LC OSCILATOR



≡





(C) $\beta i_b + (V_c - V_e)\cdot sC_2 + V_c/sL = 0$

(E) $-(1+\beta) i_b + (V_e - V_c)\cdot sC_2 + V_e/R_3 + V_e \cdot sC_1 = 0$

(HJ) $i_b = -V_e/r_\pi$ ↑

(C) $V_e\left[-sC_2 - \frac{\beta}{r_\pi}\right] + V_c\left[sC_2 + \frac{1}{sL}\right] = 0$ $\quad * \beta = r_\pi \cdot g_m$

(E) $V_e\left[sC_2 + \frac{1}{R_3} + sC_1 + \frac{(1+\beta)}{r_\pi}\right] + V_c\left[-sC_2\right] = 0$

$$\Delta = \begin{vmatrix} -(sC_2 + g_m) & sC_2 + \frac{1}{sL} \\ s(C_1+C_2) + \frac{1}{R_3} + \frac{1}{r_\pi} + g_m & -sC_2 \end{vmatrix} \overset{!!!}{=} 0 \Rightarrow \begin{matrix} \mathrm{Re}\{\Delta\} = 0 \\ \mathrm{Im}\{\Delta\} = 0 \end{matrix}$$

$B = 1$

$$sC_2\left(sC_2+g_m\right)-\left(sC_2+\frac{1}{sL}\right)\cdot\left(\frac{1}{R_3}+\frac{1}{r_\pi}+g_m+s\left(C_1+C_2\right)\right)=0$$

$$s^2\left[C_2^2-C_2\left(C_1+C_2\right)\right]-s\left[-g_m C_2+C_2\left(\frac{1}{R_3}+\frac{1}{r_\pi}+g_m\right)\right]$$

$$-\frac{1}{s}\cdot\frac{1}{L}\left(\frac{1}{R_3}+\frac{1}{r_\pi}+g_m\right)-\frac{C_1+C_2}{L}=0\ /\cdot s$$

$$s^3\left[-C_2C_1\right]-s^2\left[C_2\left(\frac{1}{R_3}+\frac{1}{r_\pi}\right)\right]-s\,\frac{C_1+C_2}{L}-\frac{1}{L}\left(\frac{1}{R_3}+\frac{1}{r_\pi}+g_m\right)=0$$

$$\mathrm{Re}\{\Delta\}=\omega_0^2 C_2\left(\frac{1}{R_3}+\frac{1}{r_\pi}\right)-\frac{1}{L}\left(\frac{1}{R_3}+\frac{1}{r_\pi}+g_m\right)=0$$

$$\mathrm{Im}\{\Delta\}=-\omega_0\frac{C_1+C_2}{L}+\omega_0 C_2C_1=0\Rightarrow\omega_0=\frac{1}{\sqrt{L\,C_{ek}}};\ C_{ek}=\frac{C_1C_2}{C_1+C_2}$$

$$\boxed{f_0=\frac{\omega_0}{2\pi}=\frac{1}{2\pi}\cdot\frac{1}{\sqrt{L\,C_{ek}}}}$$

FREKVENCIJA OSCILOVANJA.

$$\omega_0^2 C_2 \left(\frac{1}{R_3}+\frac{1}{r_\pi}\right) - \frac{1}{L}\left(\frac{1}{R_3}+\frac{1}{r_\pi}+g_m\right) = 0$$

$$\frac{1}{L \cdot \frac{C_1 C_2}{C_1+C_2}} \cdot C_2 \left(\frac{1}{R_3}+\frac{1}{r_\pi}\right) = \frac{1}{L}\left(\frac{1}{R_3}+\frac{1}{r_\pi}+g_m\right)$$

$$\left(1+\frac{C_2}{C_1}\right)\left(\frac{1}{R_3}+\frac{1}{r_\pi}\right) = g_m + \left(\frac{1}{R_3}+\frac{1}{r_\pi}\right) \quad \Rightarrow \text{USLOV OSCILOVANJA}$$

$$\boxed{g_m = \frac{C_2}{C_1}\cdot\left(\frac{1}{R_3}+\frac{1}{r_\pi}\right) \Rightarrow \frac{C_2}{C_1}\cdot\frac{1}{R_3 \| r_\pi}}$$

$$g_m = \frac{V_T \to \frac{kT}{2} \approx 25\,mV \;@\; T = 300\,k}{I_C \to \text{POLARIZACIJA (VREDNOSTI OTPORNIKA)}}$$