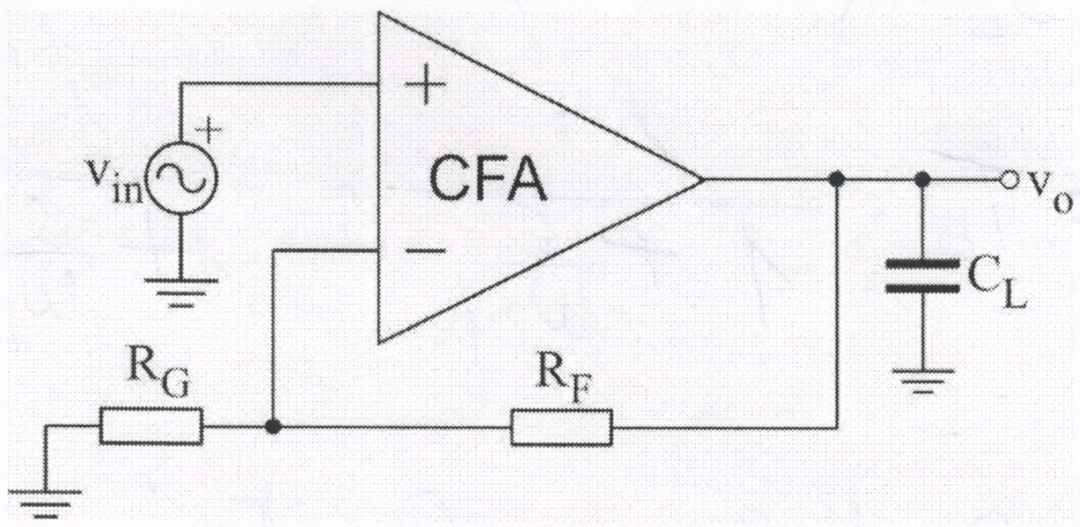
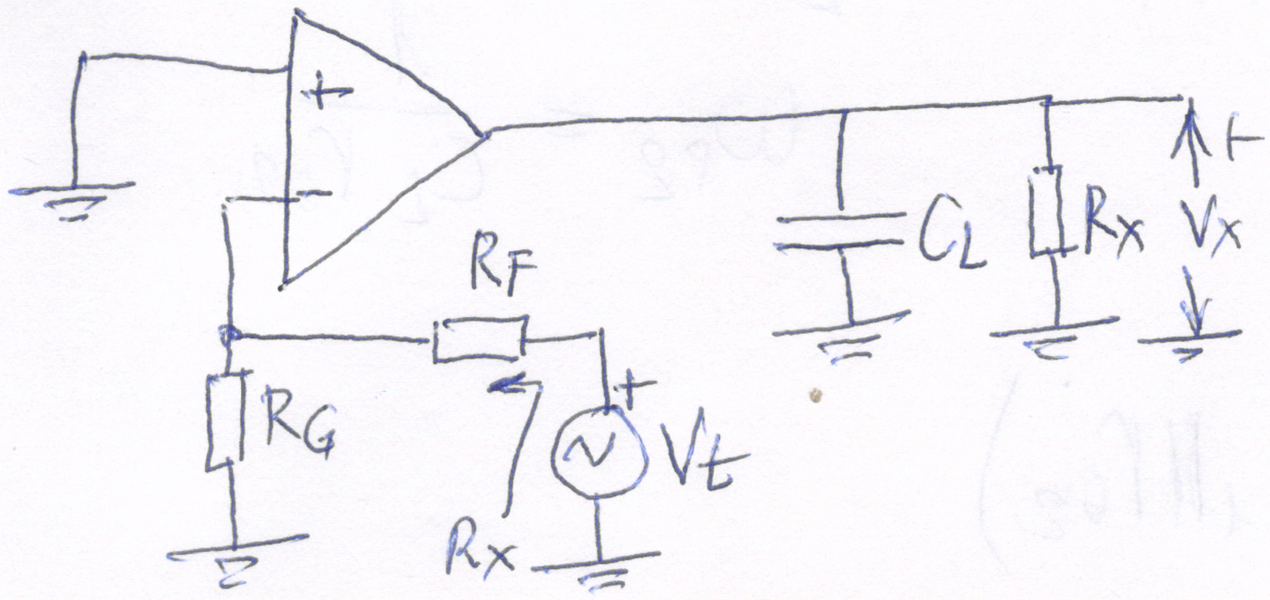
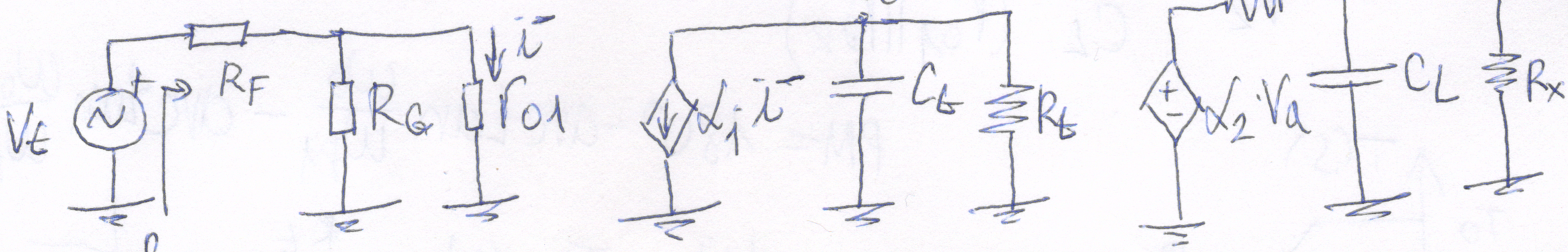
1. Na izlaz neinvertujućeg pojačavača realizovanog primenom transimpedansnog operacionog pojačavača priključen je kondenzator C_L. Poznate su vrednosti R_F i R_G . Ukoliko su poznati parametri CFA: izlazna otpornost ulaznog bafera r_{o1}, ulazna otpornost izlaznog bafera R_T, izlazna otpornost izlaznog bafera r_{o2}, kompenzaciona kapacitivnost C_c, odrediti:

   a) Odrediti polove kružnog pojačanja T(S), za zadatu vrednost otpornika R_F.

   b) Odrediti polove kružnog pojačanja T(S), kada su izlaz i invertujući ulaz kraktospojeni R_F=0.



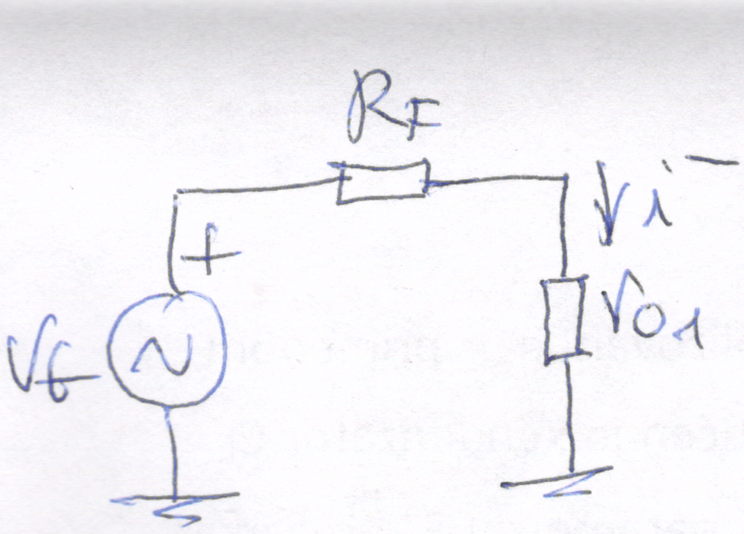


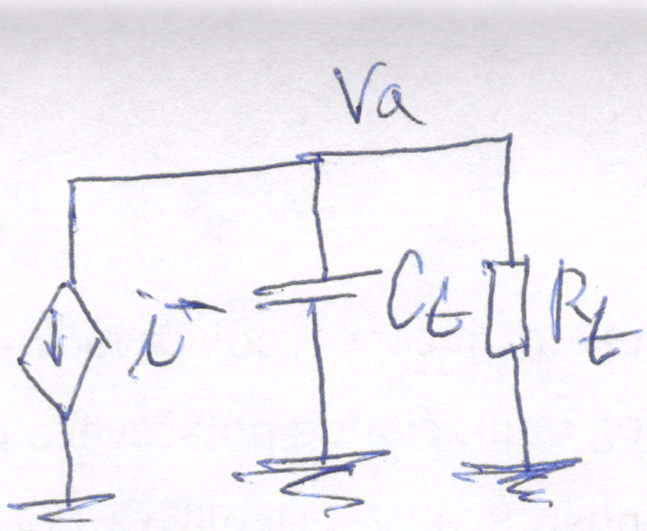


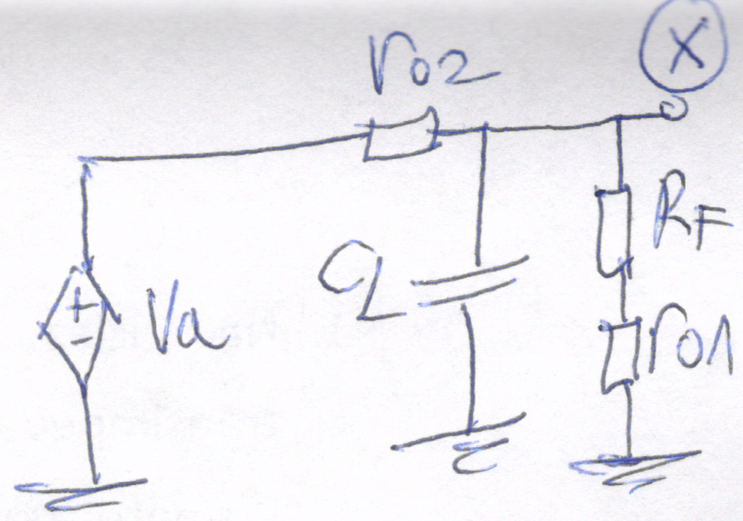
$$R_x = R_F + R_G \| r_{o1} \approx R_F + r_{o1} \qquad \alpha_1 = \alpha_2 = 1$$

$$T_0 = \frac{1}{R_x} \cdot \frac{R_G}{(R_G + r_{o1})} \cdot \alpha_1 \cdot R_L \frac{R_x \alpha_2}{R_x + r_{o2}} \approx \frac{R_L R_G}{R_G (R_x + r_{o2})}$$

$$T_0 = \frac{R_L}{R_F + r_{o1} + r_{o2}}$$ – Jednosmerna vrednost kružnog pojačanja







$$\tau_1 = C_t \cdot R_t$$

$$\omega_{p1} = \frac{1}{C_t \cdot R_t}$$ - доминантный полюс

$$\tau_2 = C_L \cdot r_{o2} \,||\, (R_F + r_{o1})$$

$$T(s) = T_0 \cdot \frac{1}{1 + \frac{s}{\omega_{p1}}} \cdot \frac{1}{1 + \frac{s}{\omega_{p2}}}$$

a) $\tau_2 = C_L \cdot r_{o2} \,||\, R_F \approx C_L \cdot r_{o2}$

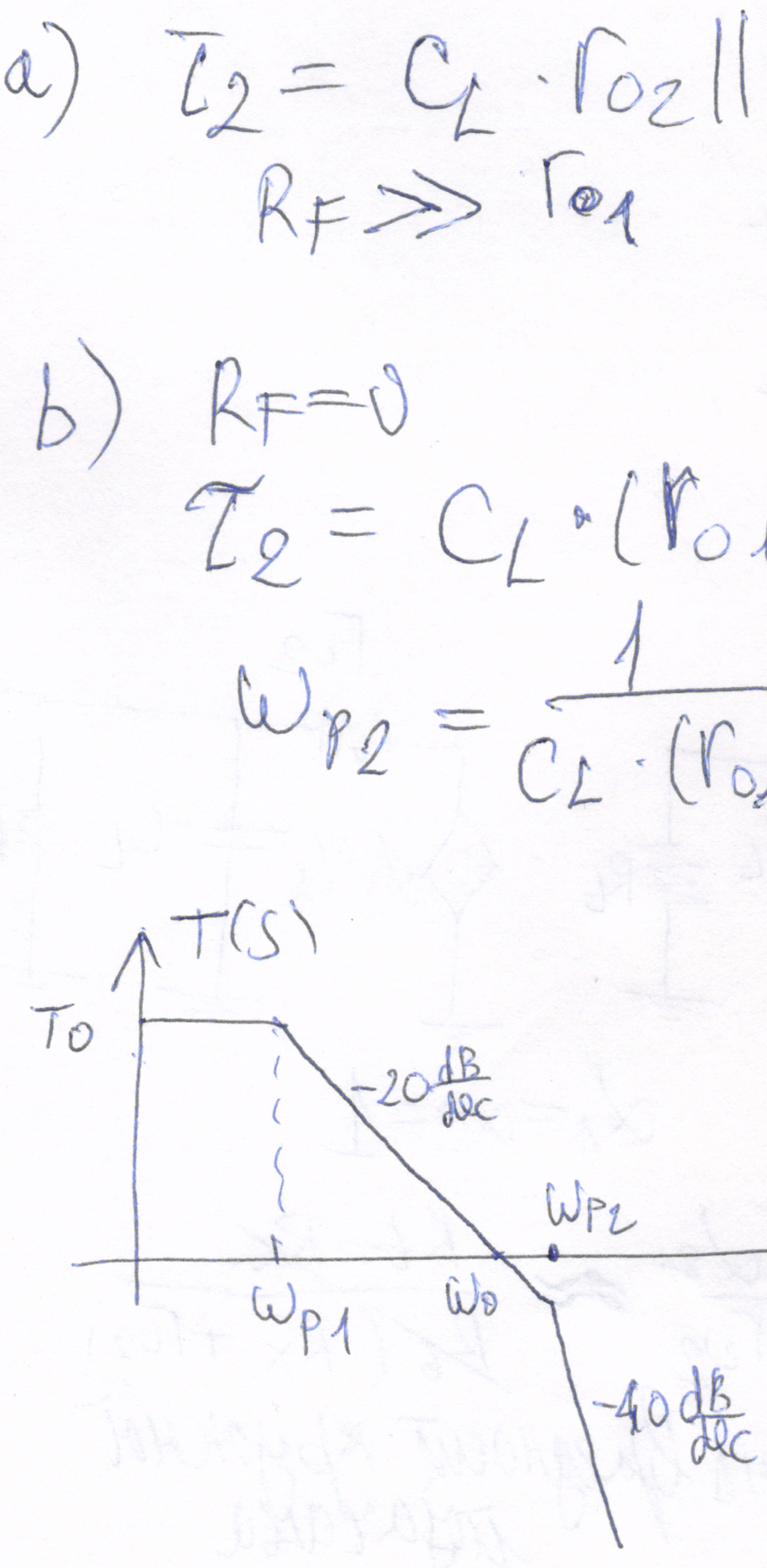
$R_F \gg r_{o1}$

$$\omega_{p2} = \frac{1}{C_L \cdot r_{o2}}$$

b) $R_F = 0$

$$\tau_2 = C_L \cdot (r_{o1} \,||\, r_{o2})$$

$$\omega_{p2} = \frac{1}{C_L \cdot (r_{o1} \,||\, r_{o2})}$$



$$PM = 180° - \arctan\frac{\omega_0}{\omega_{p1}} - \arctan\frac{\omega_0}{\omega_{p2}}$$

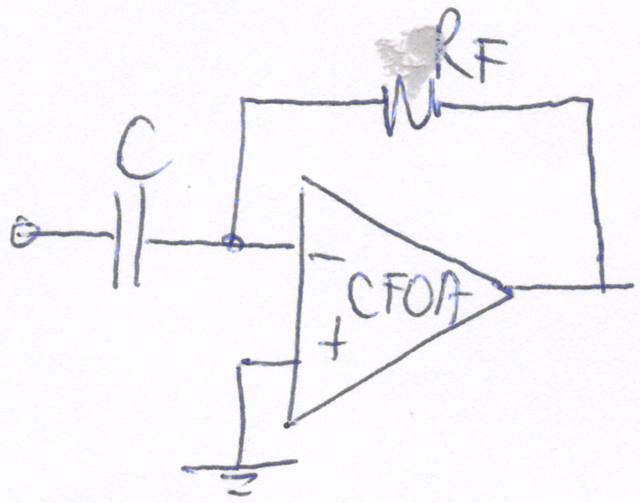
$$\omega_0 = T_0 \cdot \omega_{p1} = \frac{R_t}{r_{o1} + r_{o2}} \cdot \frac{1}{R_t C_L}$$

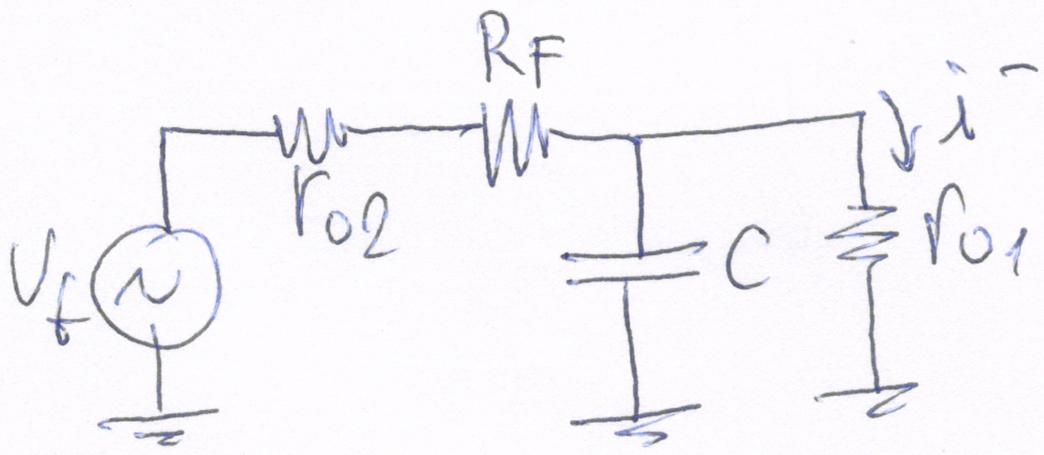
$\omega_0 \gg \omega_{p1} \Rightarrow \arctan\frac{\omega_0}{\omega_{p1}} = 90°$

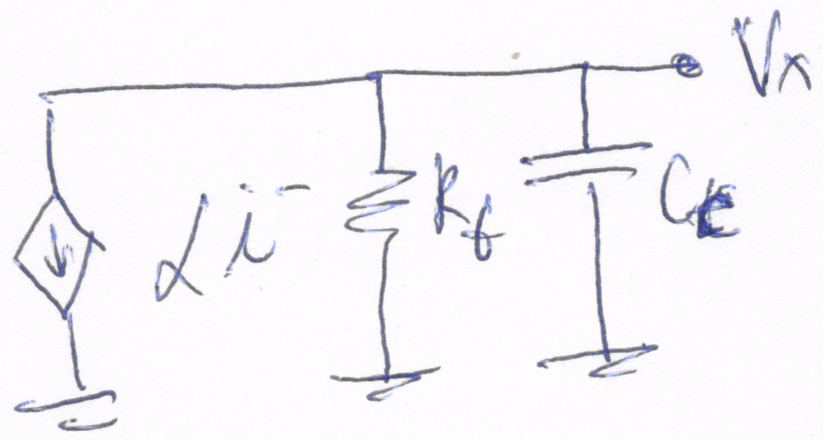
$$PM = 90 - \arctan\frac{\omega_0}{\omega_{p2}}$$

$$\frac{\omega_0}{\omega_{p2}} = \tan(90° - PM) \Rightarrow C_L \geq \frac{C_t (r_{o1} + r_{o2})^2}{r_{o1} \cdot r_{o2} \cdot \tan(PM)}$$

2) Odrediti za koje će vrednosti kapacitivnosti i otpornosti u diferencijatoru realizovanom transimpedansnim pojačavačem margina faze biti manja od zadate vrednosti PM. Poznati su parametri CFA: izlazna otpornost ulaznog bafera r_{o1}, ulazna otpornost izlaznog bafera R_T, izlazna otpornost izlaznog bafera r_{o2}, kompenzaciona kapacitivnost C_c.







$T(s) = \frac{V_x(s)}{V_f(s)}$ — кружно појачање

кош повратне спреге је струја на излазу излазног бафера

$$T_0 = \frac{i^-}{V_f} \alpha \cdot R_t = \frac{R_t}{r_{o1} + r_{o2} + R_F} \approx \frac{R_t}{R_F}$$

$$\tau_1 = R_t C_t \qquad \omega_{p1} = \frac{1}{R_t C_t}$$ — доминантни пол

$$\tau_2 = C \cdot [r_{o1} \,||\, (r_{o2} + R_F)] = C \; r_{o1} || R_F \approx C \cdot r_{o1}$$

$$\omega_{GBW} = \omega_{p1} \cdot T_0 = \frac{1}{R_t C_t} \cdot \frac{R_t}{R_F} = \frac{1}{C_t R_F}$$

фреквенција јединичног кружног појачања

$$PM = 180 - \arctan\frac{\omega_{GBW}}{\omega_{p1}} - \arctan\frac{\omega_{GBW}}{\omega_{p2}}$$

$$PM = 180 - 90 - \arctan\frac{\omega_{GBW}}{\omega_{p2}}$$

$$\frac{\omega_{GBW}}{\omega_{p2}} = \tan(90 - PM)$$

$$\frac{\omega_{GBW}}{\omega_{p2}} = \frac{1}{\tan PM}$$

$$\frac{1}{C_f \cdot R_F} \cdot C \cdot r_{o1} = \frac{1}{\tan PM}$$

$$\frac{C}{R_F} = \frac{C_f}{r_{o1}} \cdot \frac{1}{\tan PM}$$

$$\frac{R_F}{C} \geq \frac{r_{o1}}{C_f} \cdot \tan PM$$