$$\alpha = \alpha_0 \quad ; \quad \beta = \beta_0$$

$$A = -\frac{A_{VOL\phi}}{1+\frac{S}{\omega_p}} \quad ; \quad \gamma = 0$$

$$A_f = \frac{\alpha A}{1-\beta A} \qquad A_f = -\frac{\alpha_0 \frac{A_{VOL\phi}}{1+\frac{S}{\omega_p}}}{1+\beta_0 \frac{A_{VOL\phi}}{1+\frac{S}{\omega_p}}}$$

$$A_f = \frac{-\alpha_0 A_{VOL\phi}}{\left(1+\frac{S}{\omega_p}\right)+\beta_0 A_{VOL\phi}} =$$

$$-\frac{\alpha_0 A_{VOL\phi}}{1+\beta_0 A_{VOL\phi}} \cdot \frac{1}{1+\frac{S}{\omega_p(1+\beta_0 A_{VOL\phi})}}$$

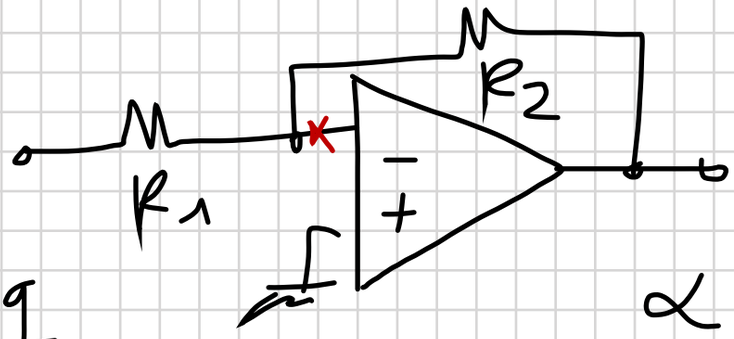
$$A_{f_0} = -\frac{\alpha_0 A_{VOL\phi}}{1+\beta_0 A_{VOL\phi}}$$

$$\omega_p' = \omega_p(1+\beta_0 A_{VOL\phi})$$

$$(PFB)\ A_f = \omega_p(1+\beta_0 A_{VOL\phi}) \; \frac{-\alpha_0 A_{VOL\phi}}{1+\beta_0 A_{VOL\phi}} =$$

$$(PGB)_{Af} = \alpha \underbrace{\omega_p A_{VOL\phi}}_{(PGB)_A}$$

$$(PGB)_{Af} = \alpha (PGB)_A$$



$$A_V = \frac{A_{VOL\phi}}{1 + \frac{s}{\omega_p}}$$

$$\alpha = \frac{R_2}{R_1 + R_2}$$

$$\beta = \frac{R_1}{R_1 + R_2}$$

$\gamma = 0$

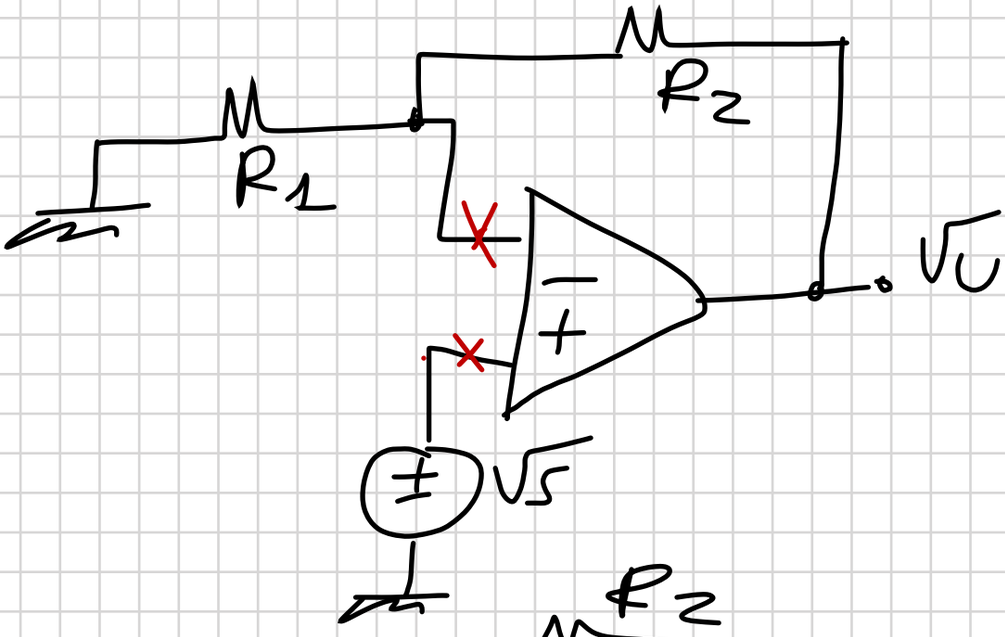
$$A = -\frac{A_{VOL\phi}}{1 + \frac{s}{\omega_p}}$$

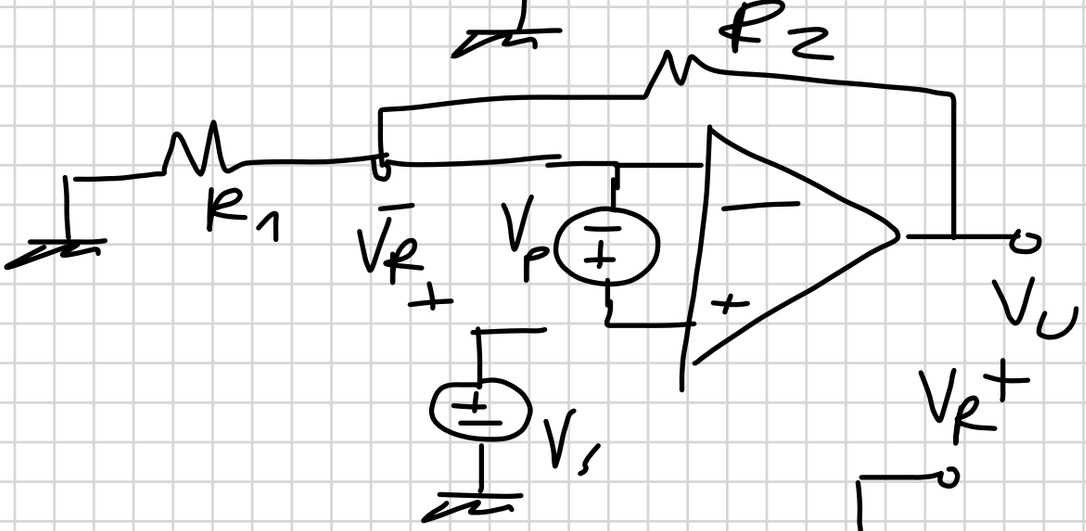
$$(PGB)_{Af} = \alpha (PGB)_A \qquad (PGB)_A = -\omega_p A_{VOL\phi}$$

$$(PGB)_{Af} = \omega_p' = -\frac{R_2}{R_1}$$

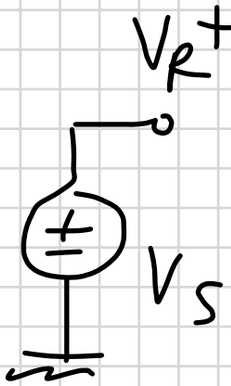
$$\omega_p' \left(+\frac{R_2}{R_1}\right) = \frac{R_2}{R_1 + R_2} \left(\omega_p \left(+A_{VOL\phi}\right)\right)$$

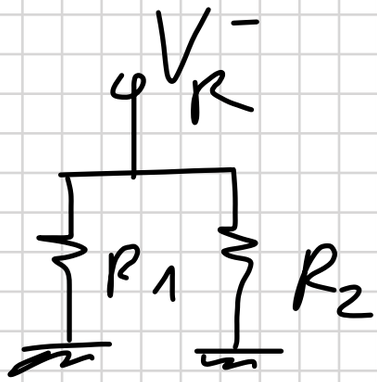
$$\omega_p' = \frac{R_2}{R_1 + R_2} \omega_p (A_{VOL\phi}) \; R_1/R_2$$





$$\alpha = \left.\frac{V_R}{V_S}\right|_{V_p=0} = 1$$



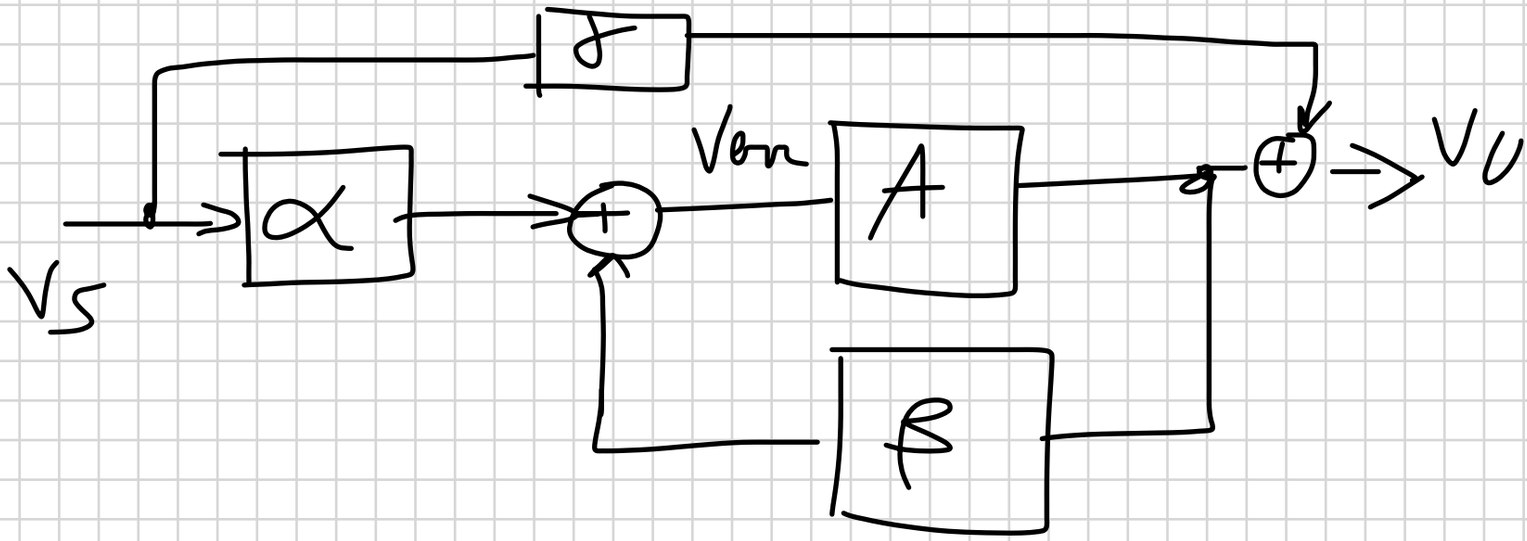


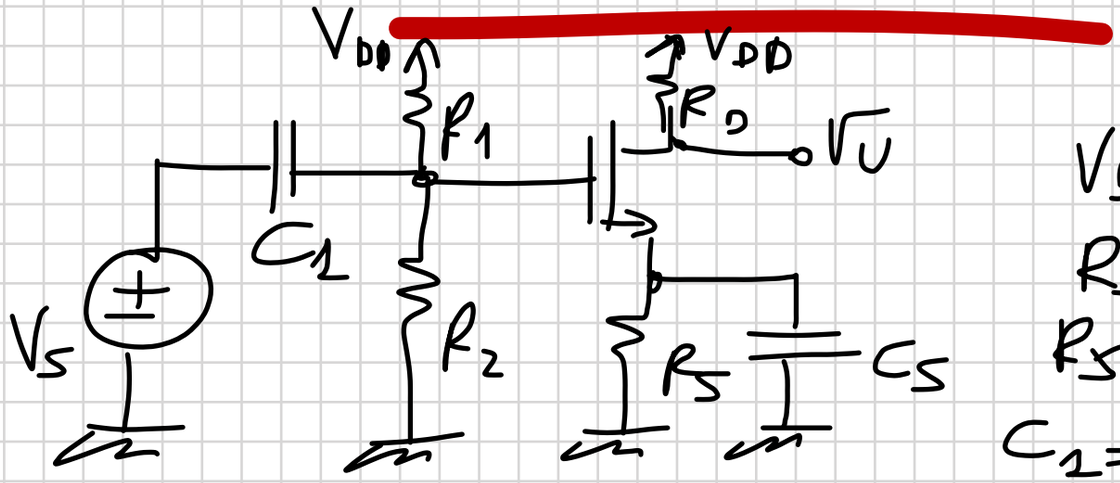
$$A_{f_0} = \left(1 + \frac{R_2}{R_1}\right)$$

$$(PGB)_{Af} = A_{f_0} \omega_p' = \alpha (PGB)_A =$$

$$A_{f_0} \omega_p' = \underbrace{\omega_p A_{VOL\phi}}_{\omega_G} \Rightarrow \omega_p' = \frac{\omega_G}{\left(1 + \frac{R_2}{R_1}\right)}$$

$$A_f = \frac{A_{f_0}}{\left(1 + \frac{S}{\omega_p'}\right)}$$





$V_{DD} = 12V$

$R_D = 1{,}8\,k\Omega$

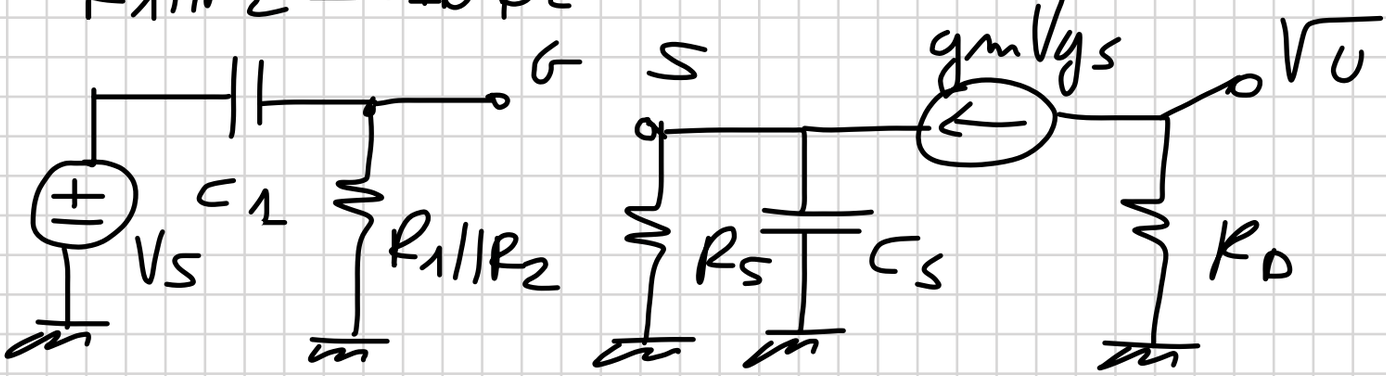
$R_S = 0{,}2\,k\Omega$

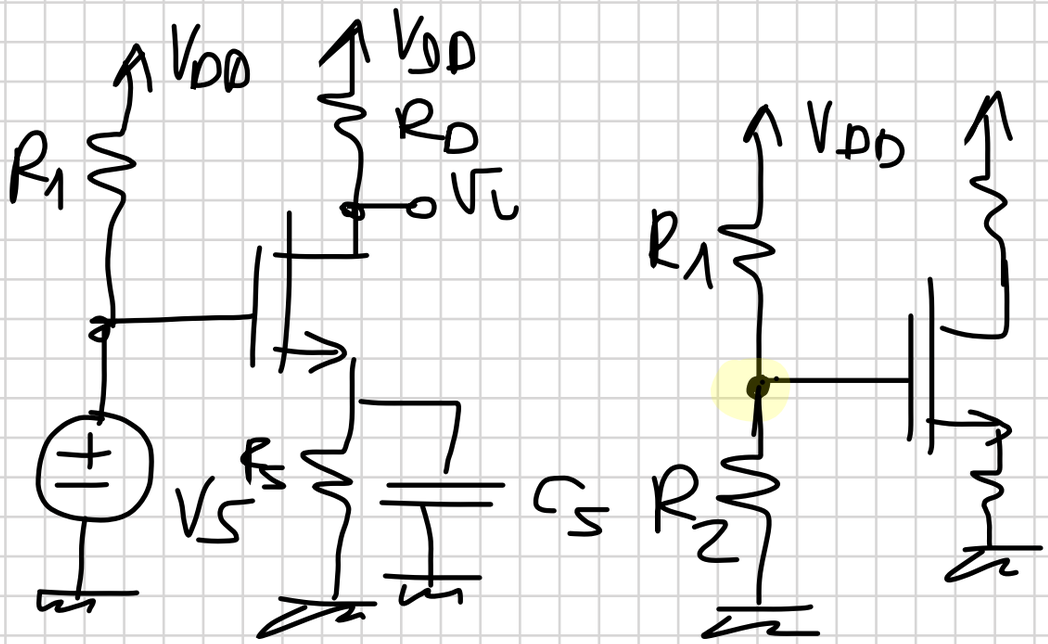
$C_1 = 1\mu F$

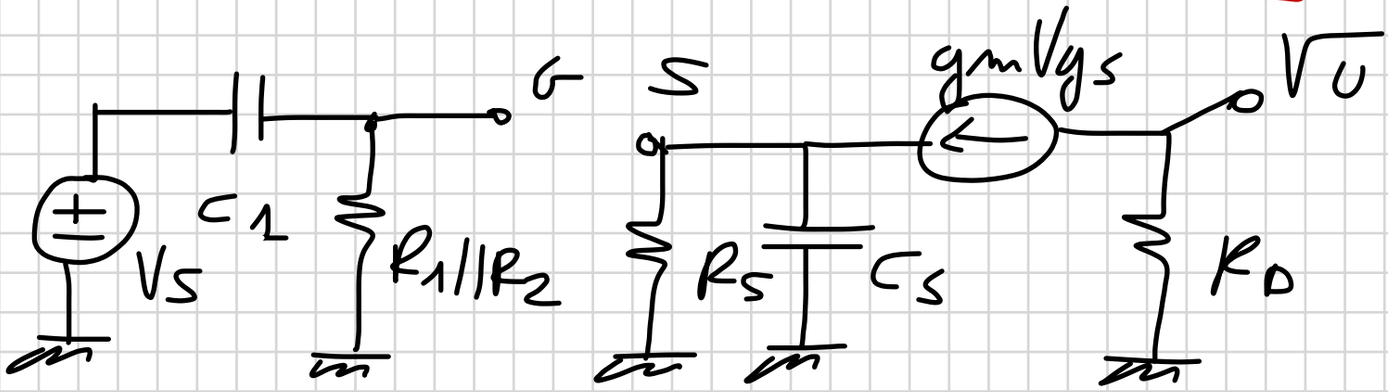
$C_2 = 100\mu F$

$g_m = 5\,mS$

$R_1 \| R_2 = 10\,k\Omega$







$$A_f = \frac{V_U}{V_S} = \frac{K s \left(1 + \frac{s}{\omega_0}\right)}{\left(\frac{s}{\omega_{p1}} + 1\right)\left(\frac{s}{\omega_{p2}} + 1\right)}$$

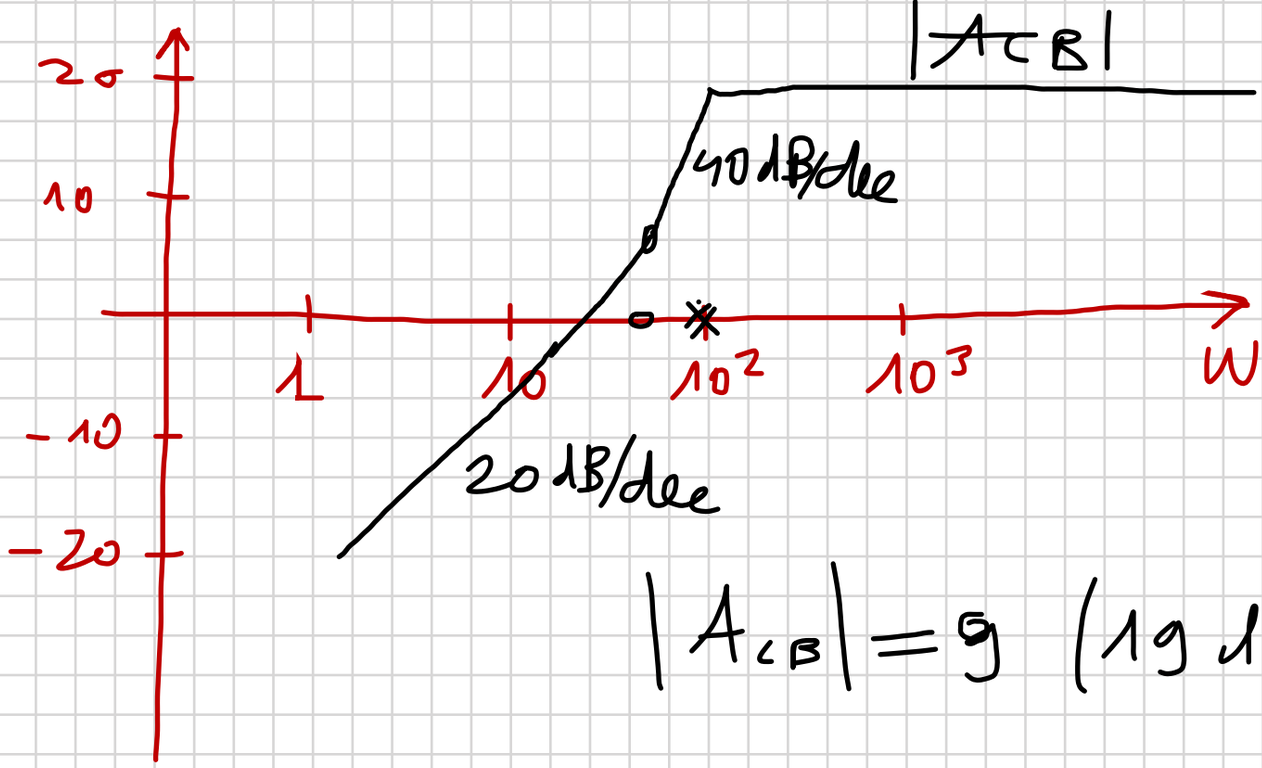
$$A_{f\infty} = -g_m R_D \qquad \omega_0 = \frac{1}{R_S C_S}$$

$$A_{f\infty} = \frac{K \omega_{p1} \omega_{p2}}{\omega_0} \Rightarrow K = \frac{A_{f\infty} \omega_0}{\omega_{p1} \omega_{p2}}$$

$\omega_0 = 50$ rad/sec

$\omega_{p1} = 100$ rad/sec

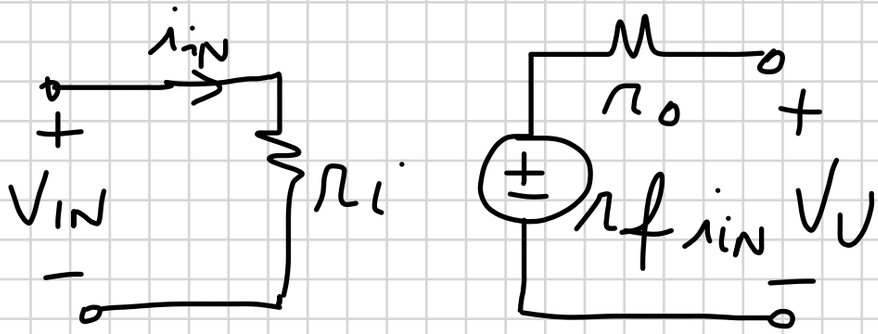
$\omega_{p2} = 100$ rad/sec



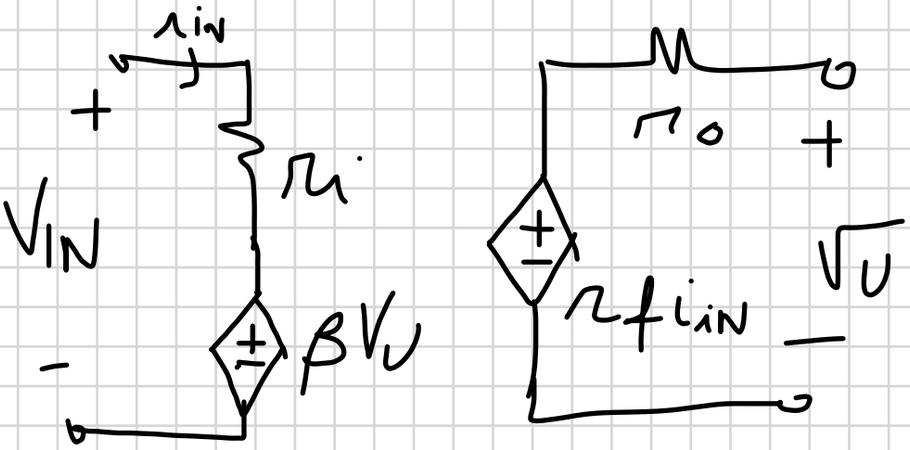
$$|A_{cB}| = 9 \quad (19\ dB)$$

$r_i = 1\ m\Omega \qquad r_o = 1\ \Omega$

$r_f = 100\ k\Omega$



$f_f = 10$



$$V_U = r_f \frac{V_{IN} - \beta V_U}{r_i} \Rightarrow V_U \left(1 + \beta \frac{r_f}{r_i}\right) = \frac{r_f}{r_i} V_{IN}$$

$$f_f = 1 \Big/ \left(\frac{r_i}{r_f} + \beta\right) = 10 \Rightarrow \beta \leq 0{,}1$$

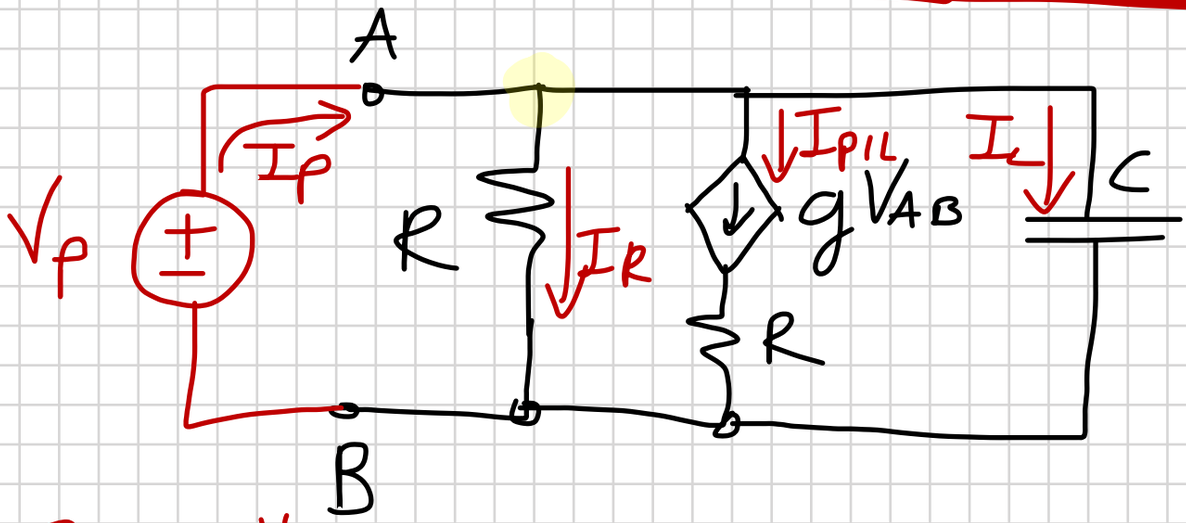
$$V_{in} = \frac{1}{f_i} i_{in}$$

$$i_{in} = \frac{V_{in} - \beta V_U}{r_i} = \frac{V_{in}(1 - \beta f_4)}{r_i}$$

$$\frac{V_{in}}{i_{in}} = \frac{r_{in}}{1 - \beta f_4} \simeq 10\,k\Omega$$

$$W_{p1} = \frac{1}{C_1 R_{VC1}} \qquad R_{VC1} = R_1 // R_2$$

$$W_{p2} = \frac{1}{C_2 R_{VC2}} \Rightarrow R_{VC2} = R_5 // \frac{1}{g_m}$$



$R = 1\,k\Omega$

$C = 1\,\mu F$

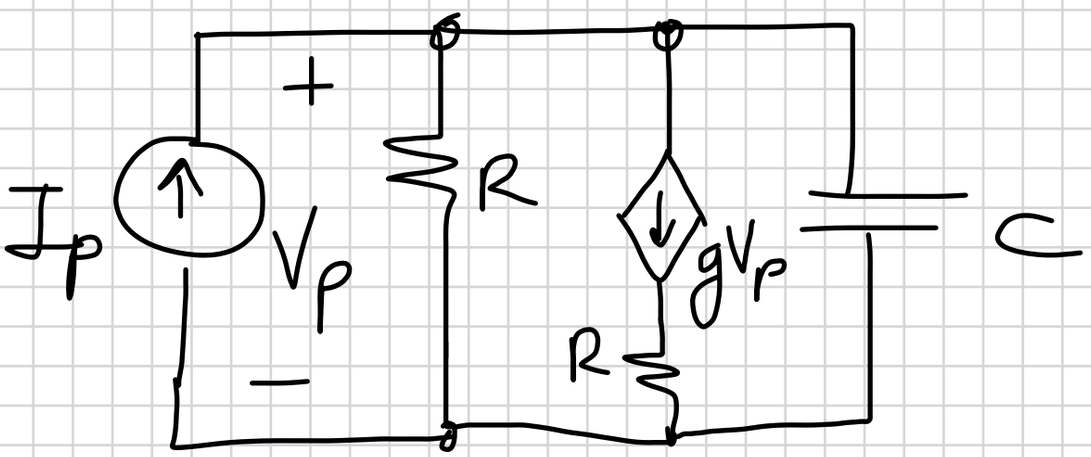
$g = 1\,mS$

$$Z_{AB} = \frac{V_P}{I_P} \qquad I_P = I_R + I_{PIL} + I_C$$

$$I_R = \frac{V_P}{R}; \quad I_{PIL} = gV_P; \quad I_C = C_S V_P$$

$$\frac{V_p}{I_p} = \frac{1}{\frac{1}{R} + g + Cs} = \frac{R_0}{\frac{s}{w_p} + 1}$$

$$R_0 = \frac{R}{1 + Rg} \qquad w_p = \frac{1}{R_0 C}$$



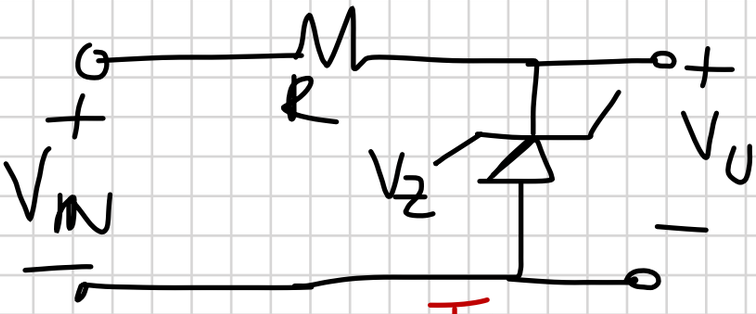
$$Z = \frac{R_0}{1 + \frac{s}{w_p}} \qquad R_0 = R \,//\, 1/g$$

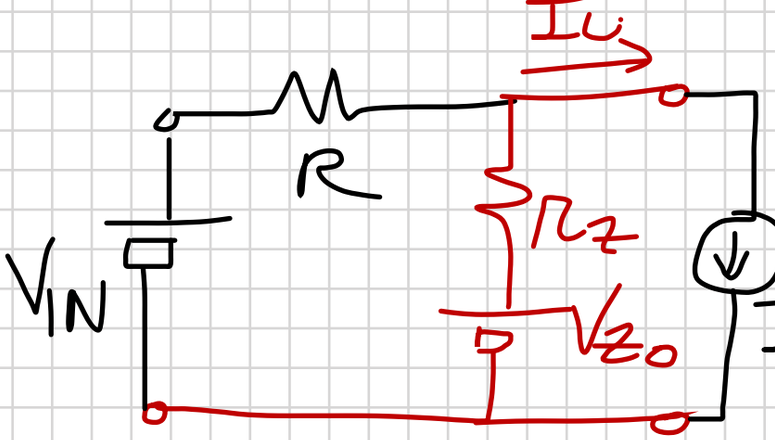
$$w_p = \frac{1}{R_{Vc} C} \qquad R_{Vc} = R_0$$

$V_Z = 12V$; $r_Z = 0.2\Omega$ @ $I_Z = 2A$

$r_{ZK} = 100\Omega$ @ $I_{ZK} = 0,1A$

$V_{IN} = 16 \div 20V$





$V_{Z0} = V_{Znom} - r_Z I_{Znom} =$

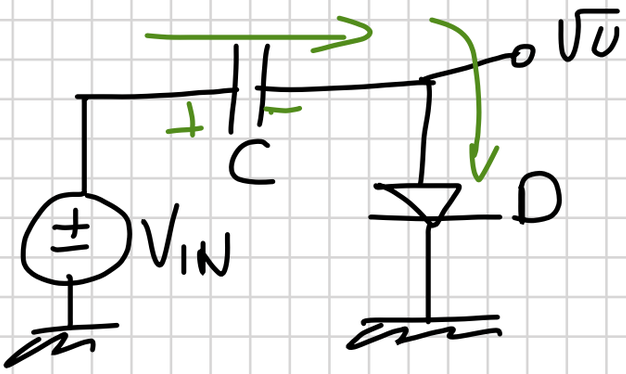
$= 11,6V$

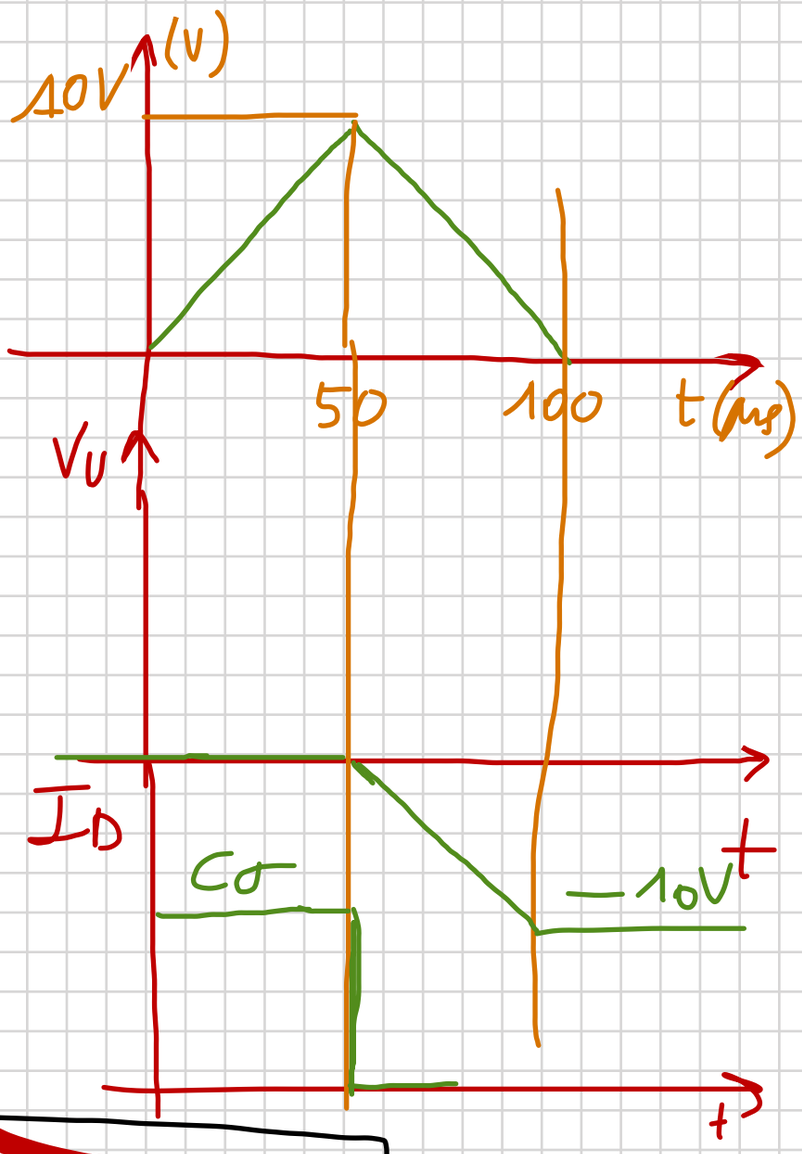
$P_{ZMAX} = V_{Z0} I_{ZMAX} + r_Z I_{ZMAX}^2$

$I_{ZMAX} = \dfrac{(V_{IN})_{MAX} - V_{Z0}}{R + r_Z}$

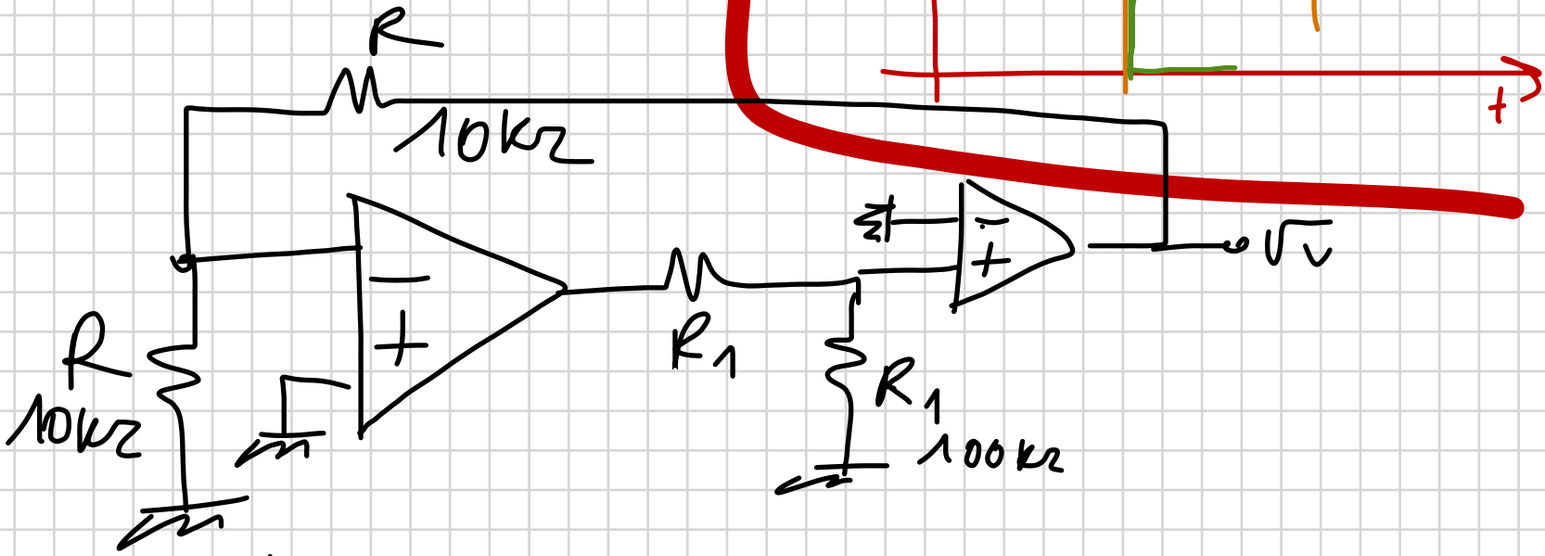
$4I_{ZK} = \dfrac{(V_{IN})_{MIN} - V_{Z0}}{R + r_Z} - I_{UMAX} \dfrac{R}{R + r_Z}$

$R = \dfrac{(V_{IN})_{MIN} - V_{Z0} - 4r_Z I_{ZK}}{4I_{ZK} + I_{UMAX}} = 3,09\Omega$



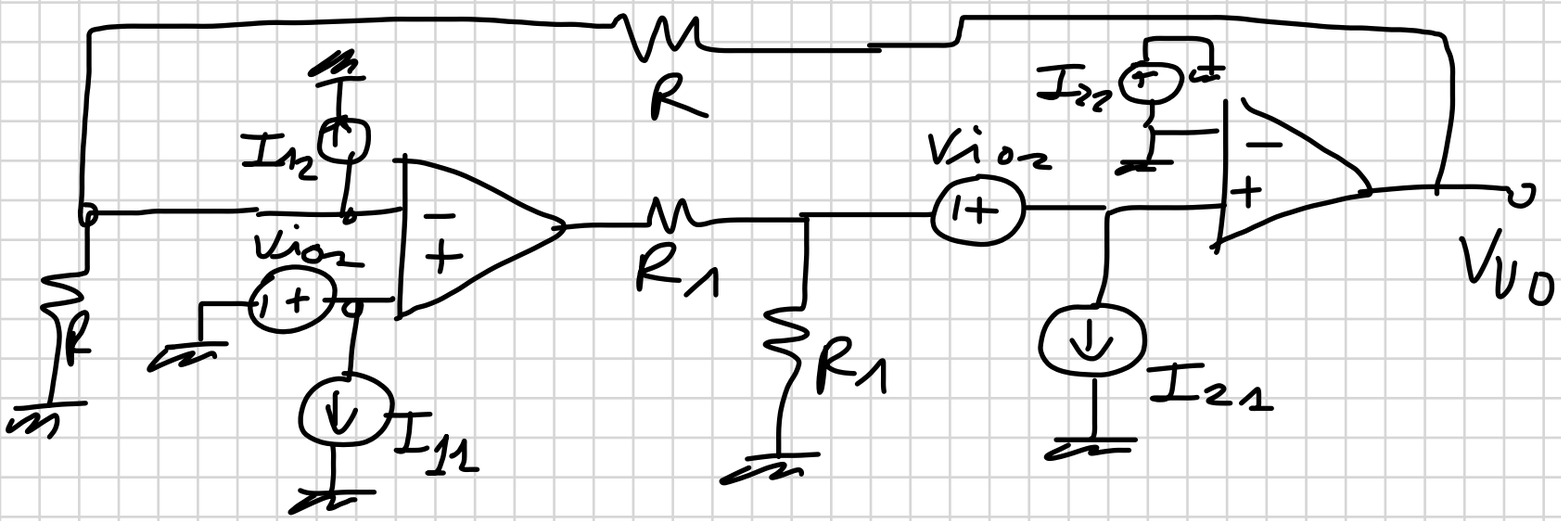


$$i_D = C\frac{dV_{IN}}{dt} = C\sigma$$



$$|V_{io}| < 1\,mV \qquad I_B = 10\,nA = \frac{I_1 + I_2}{2}$$

$$|I_o| = |I_1 - I_2| < 2\,nA$$



$$V_{U_{I11}} = 0$$

$$V_{U_{Vio}} = \left(1 + \frac{R}{R}\right) V_{io}$$

$$V_{U_{I12}} = R\, I_{12}$$

I_{11} → 11mA

I_{12} → 9mA ; 11mA

$$V_U = \left(1 + \frac{R}{R}\right) V_{io} + R\, I_{12}$$

$I_{12} = 11\,mA \qquad V_{io} = 1\,mV$

$$V_{U_{MAX}} = 2,11\,mV$$