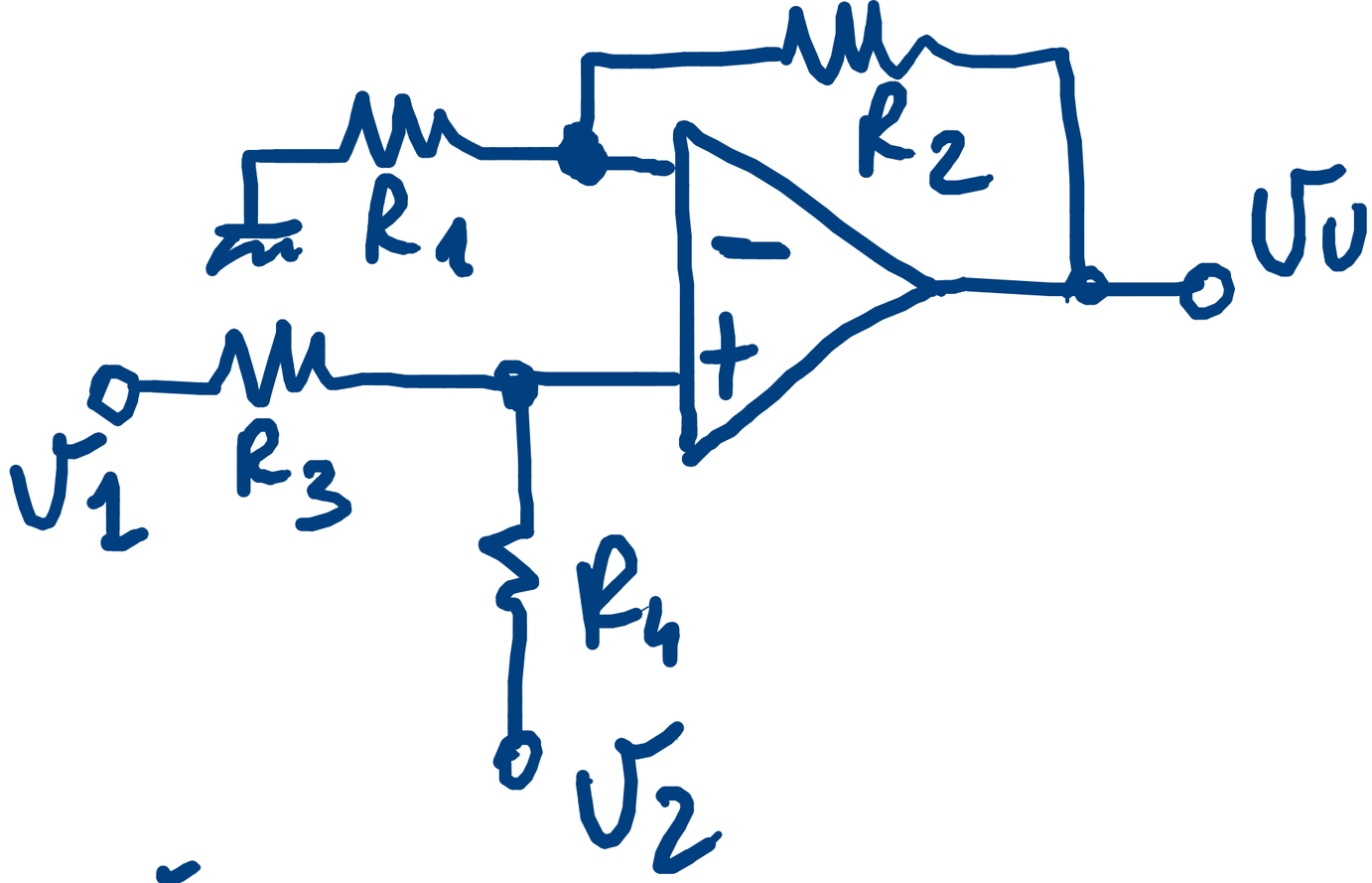


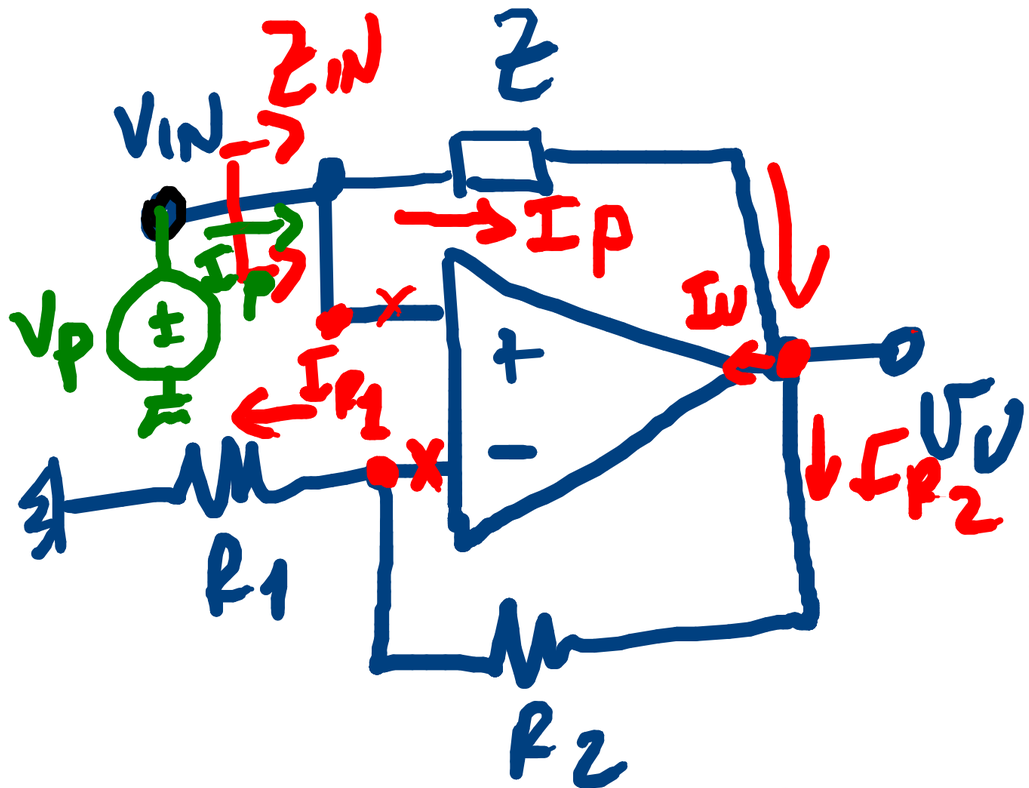
Agisce V_1

$$V_{U1} = \left(1 + \frac{R_2}{R_1}\right) \frac{R_4}{R_3 + R_4} V_1$$

Agisce V_2

$$V_{U2} = \left(1 + \frac{R_2}{R_1}\right) \frac{R_3}{R_3 + R_4} V_2$$

$$V_U = V_{U1} + V_{U2} = \left(1 + \frac{R_2}{R_1}\right) \left[\frac{R_4}{R_3 + R_4} V_1 + \frac{R_3 V_2}{R_3 + R_4}\right]$$



$$I_{R_2} \neq I_p$$

$$I_{R_2} = I_p - I_U$$

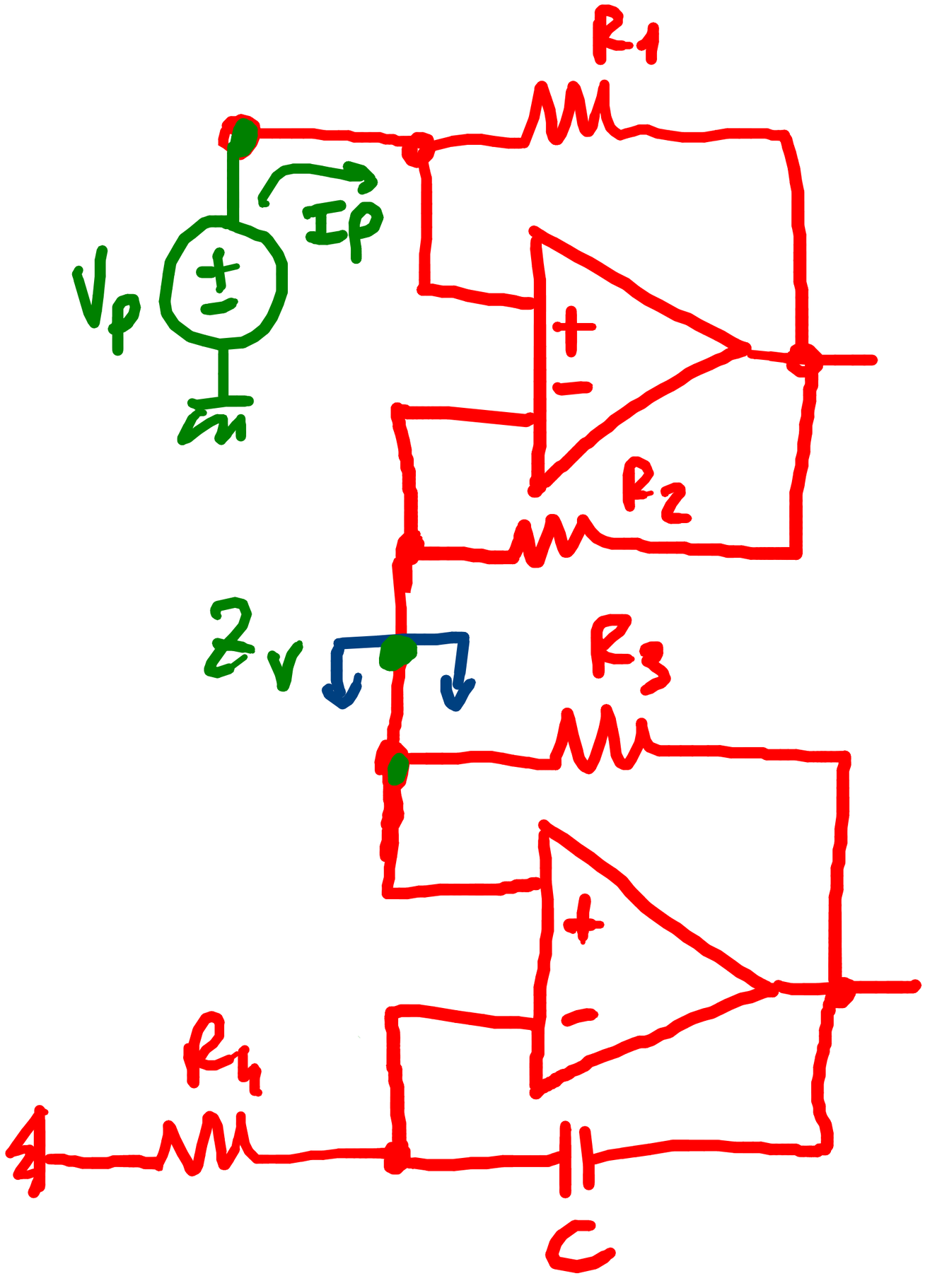
$$I_{R_2} = I_{R_1}$$

$$I_{R_1} = \frac{V_p}{R_1} \qquad V^+ = V_p \simeq V^-$$

$$\begin{cases} V_p = Z I_p + V_U \\ V_U = (R_2 + R_1) I_{R_1} = (R_2 + R_1)\frac{V_p}{R_1} = \left(1 + \frac{R_2}{R_1}\right) V_p \end{cases}$$

$$V_p = Z I_p + V_p + \frac{R_2}{R_1} V_p$$

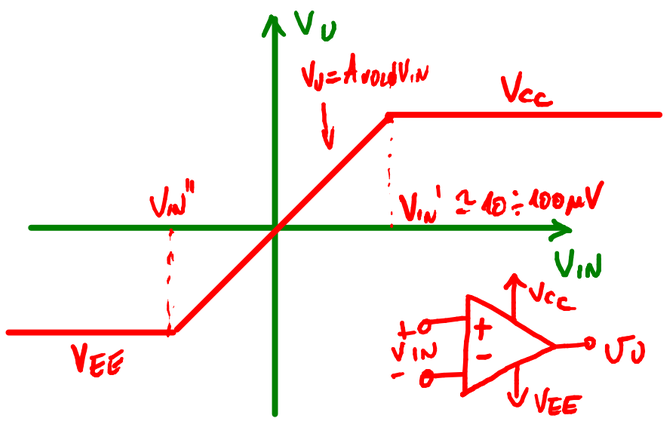
$$\boxed{\frac{V_p}{I_p} = -\frac{Z R_1}{R_2}}$$

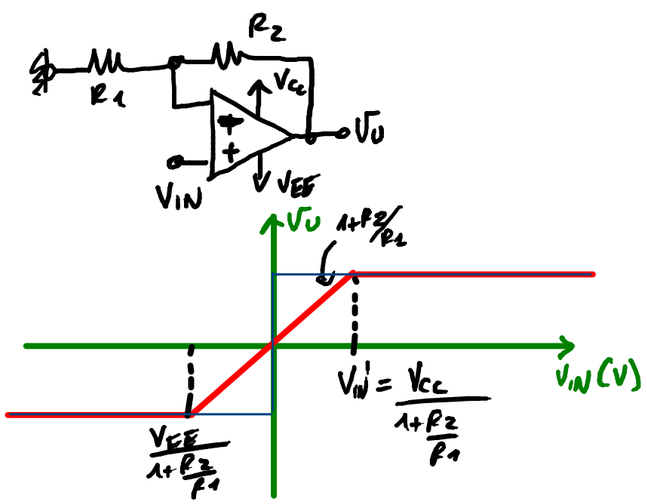


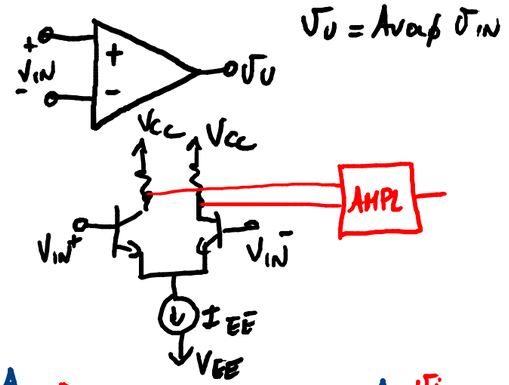
$$Z_V = -F_3 R_4 C_S$$

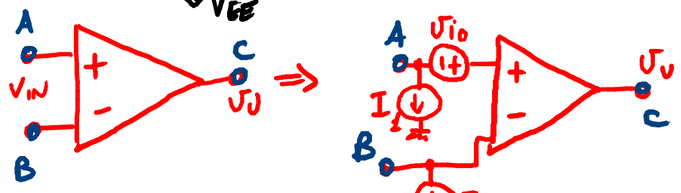
$$Z = \frac{V_P}{I_P} = -\frac{R_1 Z_V}{R_2} =$$

$$= \frac{R_1 R_3 R_4 C_S}{R_2}$$





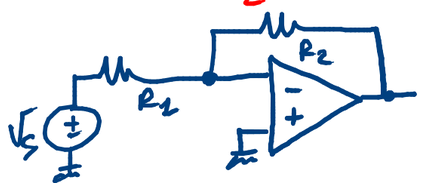


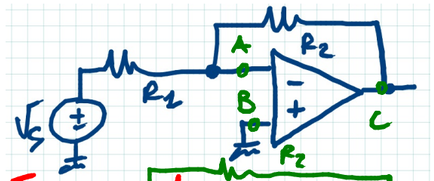


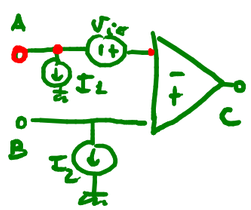
$|V_{io}| = 5mV$ (μA741)

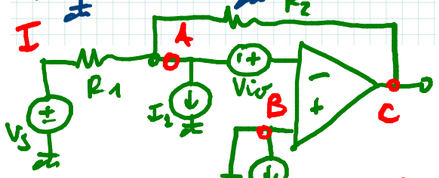
$I_B = \frac{I_1 + I_2}{2}$ $\wedge$ $I_{io} = |I_1 - I_2|$

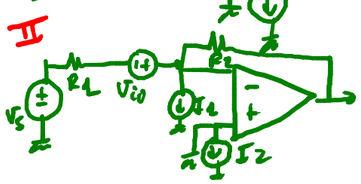
$I_1 = I_B \pm \frac{I_{io}}{2}$ $\wedge$ $I_2 = I_B \mp \frac{I_{io}}{2}$

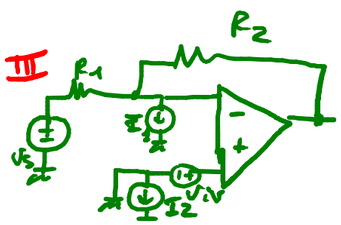


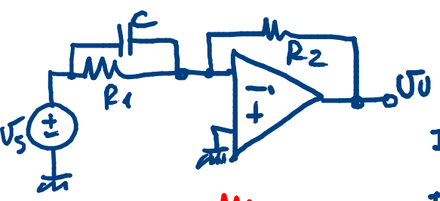








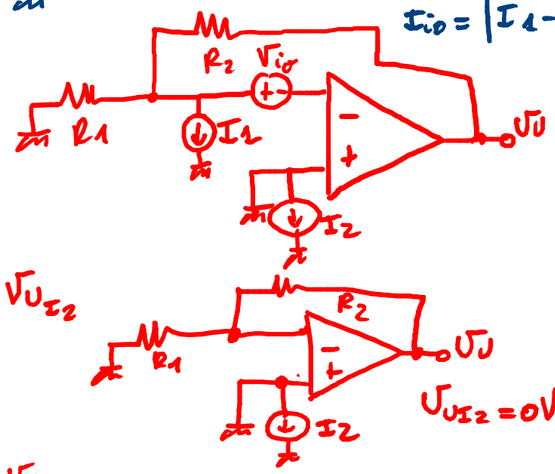




$|V_{io}|$

$I_B = \frac{I_1+I_2}{2}$

$I_{io} = |I_1 - I_2|$



$V_{UI_1} = R_2 I_1$

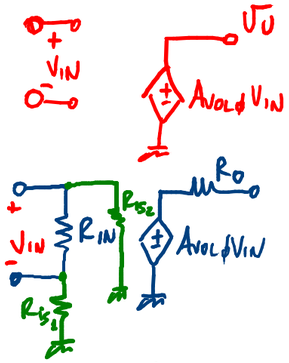
$V_U = V_{UI_2} + V_{UI_1} + V_{UV_{io}} = \left(1 + \frac{R_2}{R_1}\right) V_{io} + R_2 I_1$

$|V_{io}| = 5\,mV$

$I_B = 80\,mA \quad I_{io} = 20\,mA$

$I_1 = \begin{cases} 90\,mA \\ 70\,mA \end{cases} \wedge I_2 = \begin{cases} 70\,mA \\ 90\,mA \end{cases}$

$V_{U\,MAX} \iff V_{io} = 5\,mV \text{ e } I_1 = 90\,mA$



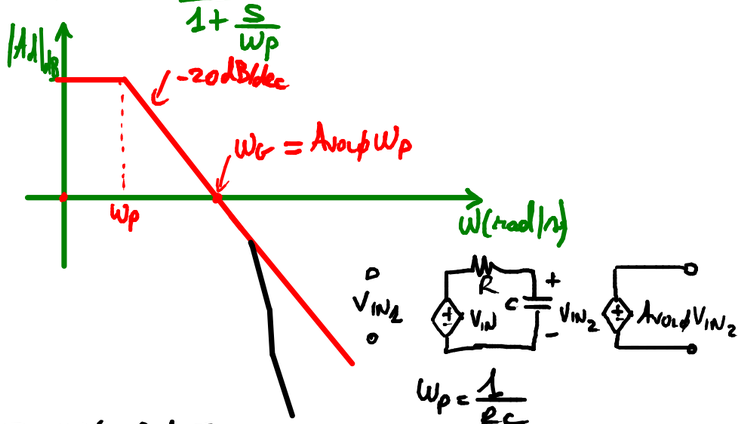
$$P = CMRR = \frac{A_d}{A_c}$$

$$V_U = A_d V_d + A_c V_c = A_d \left[V_d + \frac{A_c V_c}{A_d} \right] =$$

$$= A_d \left[V_d + \frac{V_c}{P} \right]$$

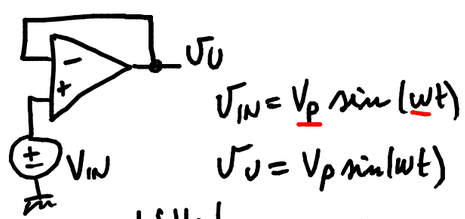
PSRR

$$A_d(s) = \frac{A_{VOL\phi}}{1 + \frac{s}{\omega_p}}$$



SLEW RATE

$$\sigma = \left| \frac{\delta V_U}{\delta t} \right|_{max}$$

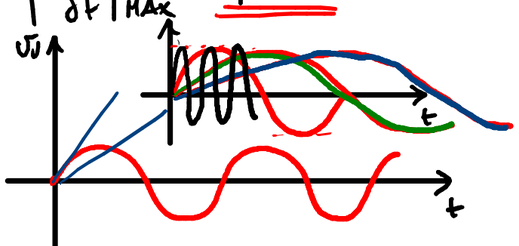


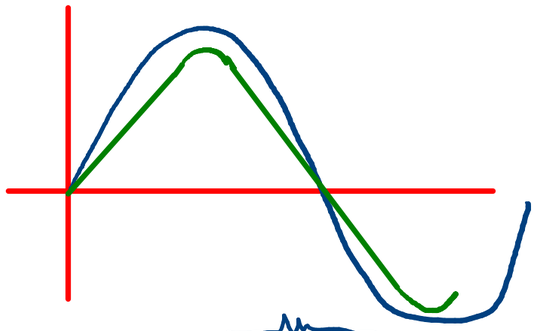
$$V_{IN} = V_p \sin(\omega t)$$

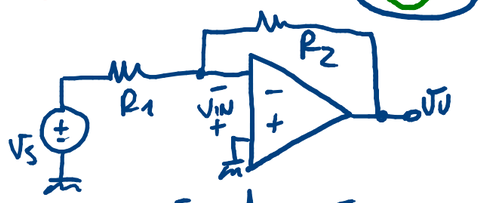
$$V_U = V_p \sin(\omega t)$$

$$\left| \frac{\delta V_U}{\delta t} \right|_{max} \Rightarrow \frac{\delta V_U}{\delta t} = V_p \omega \cos(\omega t)$$

$$\left| \frac{\delta V_U}{\delta t} \right|_{MAX} = V_p \omega \leq \sigma$$







$$V_U = \frac{A_{VOL\phi}}{1+\frac{s}{\omega_p}} V_{IN}$$

$$-V_{IN} = \frac{R_2}{R_1+R_2} V_S + \frac{R_1}{R_1+R_2} V_U$$

$$-V_U = \frac{A_{VOL\phi}}{1+\frac{s}{\omega_p}} \cdot \frac{R_2}{R_1+R_2} V_S + \frac{A_{VOL\phi}}{1+\frac{s}{\omega_p}} \frac{R_1}{R_1+R_2} V_U$$

$$-\left(1+\frac{R_1}{R_1+R_2}\frac{A_{VOL\phi}}{1+\frac{s}{\omega_p}}\right) V_U = \frac{A_{VOL\phi}}{1+\frac{s}{\omega_p}} \frac{R_2}{R_1+R_2} V_S$$

$$-\left[\frac{\left(1+\frac{s}{\omega_p}\right)+\frac{R_1}{R_1+R_2}A_{VOL\phi}}{\left(1+\frac{s}{\omega_p}\right)}\right] V_U = \frac{A_{VOL\phi}}{1+\frac{s}{\omega_p}} \frac{R_2}{R_1+R_2} V_S$$

$1-\beta_0$

$$V_U = \frac{-A_{VOL\phi}\frac{R_2}{R_1+R_2} V_S}{1+\frac{s}{\omega_p}+\underbrace{\frac{R_1}{R_1+R_2}}_{\beta_0} A_{VOL\phi}}$$

$$V_U = \frac{-A_{VOL\phi}(1-\beta_0) V_S}{1+\beta_0 A_{VOL\phi}+\frac{s}{\omega_p}} =$$

$$= \frac{-A_{VOL\phi}(1-\beta_0)}{1+\beta_0 A_{VOL\phi}} \cdot \frac{V_S}{1+\frac{s}{\omega_p(1+\beta_0 A_{VOL\phi})}} =$$

$$\Rightarrow A_d = \underbrace{\frac{-A_{VOL\phi}(1-\beta_0)}{1+\beta_0 A_{VOL\phi}}}_{\frac{R_2}{R_1}\left(\text{se } A_{VOL\phi} \gg 1\right)} \cdot \frac{1}{1+\frac{s}{\omega_p(1+\beta_0 A_{VOL\phi})}}$$

$$A_d = -\frac{R_2}{R_1}\frac{1}{1+\frac{s}{\omega_p'}}$$

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