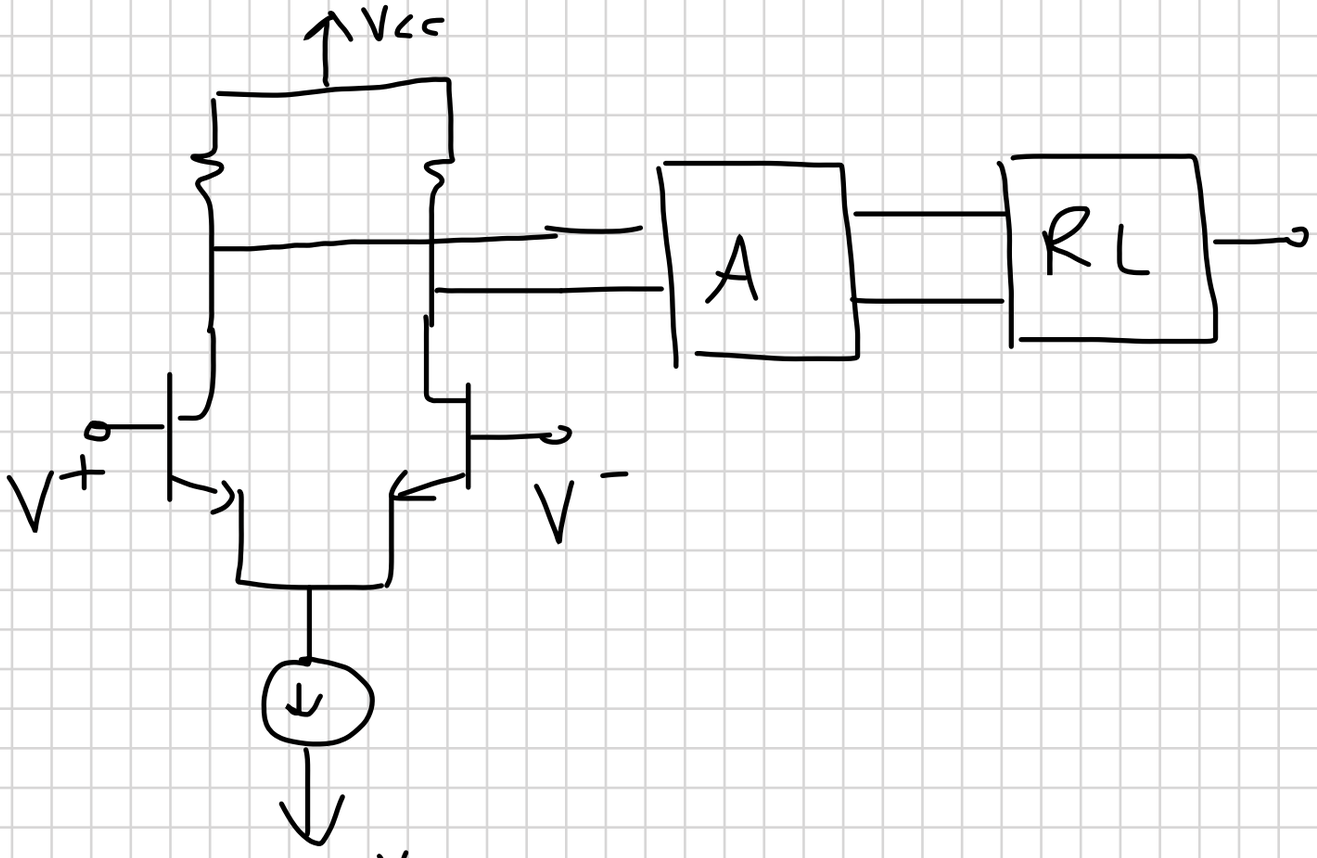
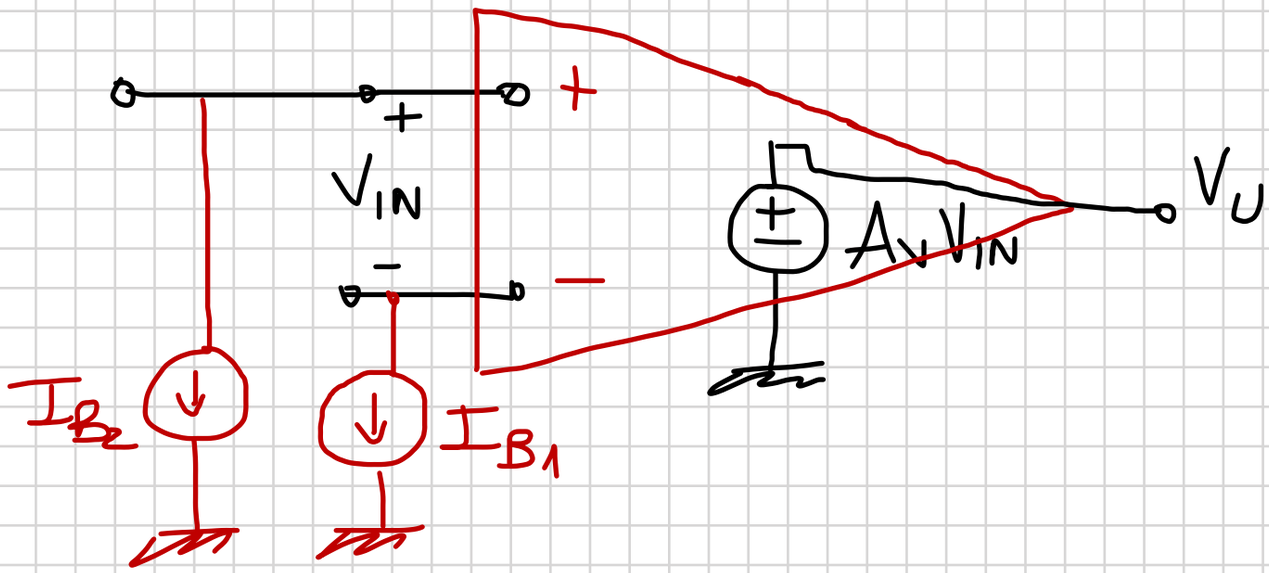
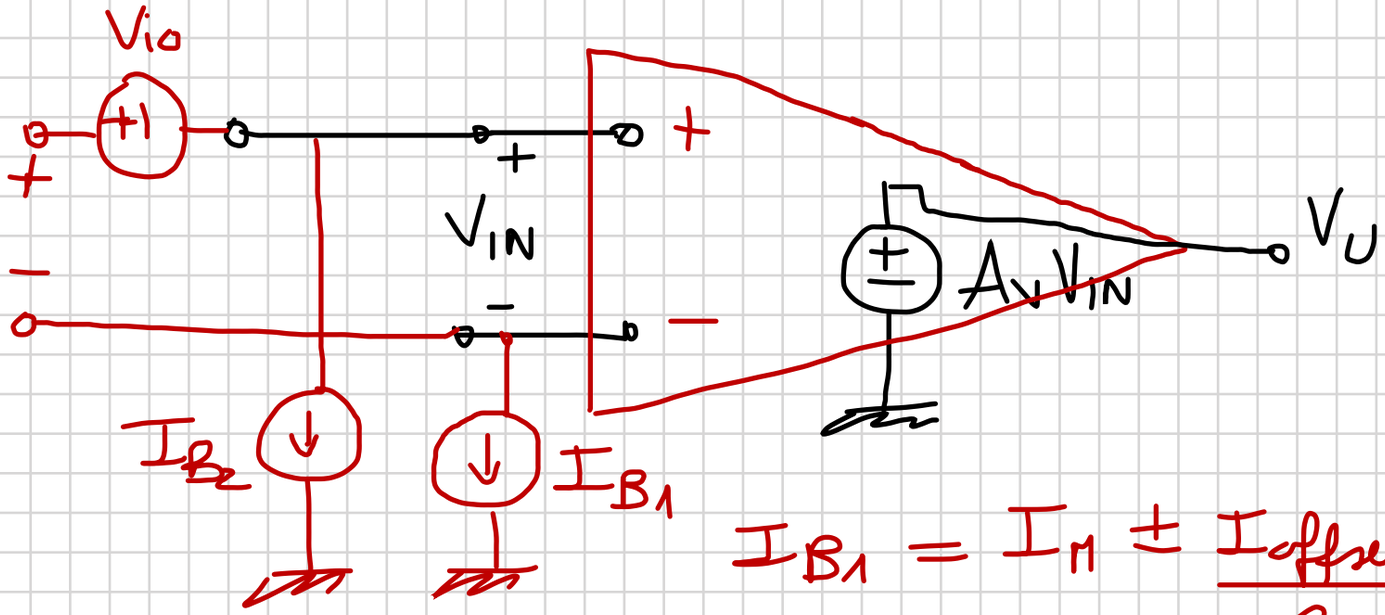




$$I_M = \frac{I_{B1} + I_{B2}}{2} \; ; \quad I_{offset} = |I_{B1} - I_{B2}|$$

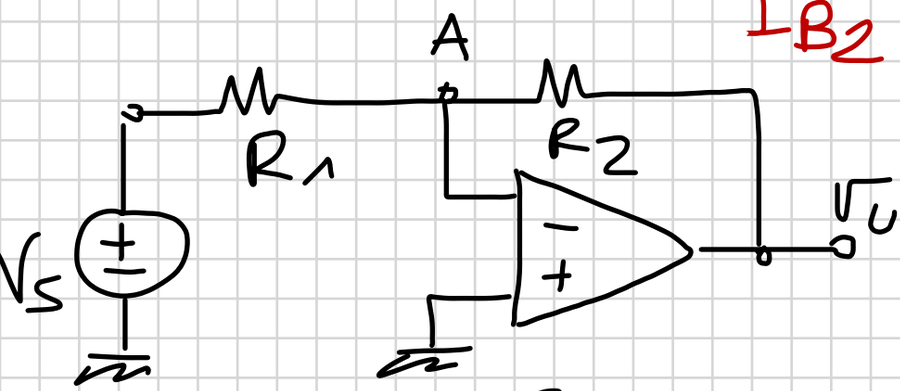
$\mu A741$ $\quad I_M = 80nA$

$I_{offset} = 20nA$



$$I_{B1} = I_M \pm \frac{I_{offset}}{2}$$

$$I_{B2} = I_M \mp \frac{I_{offset}}{2}$$

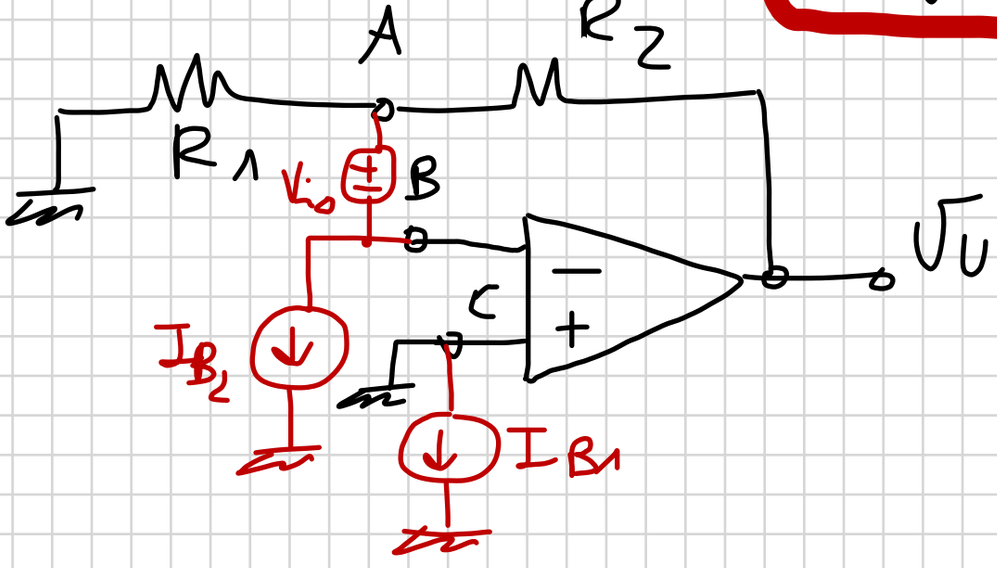


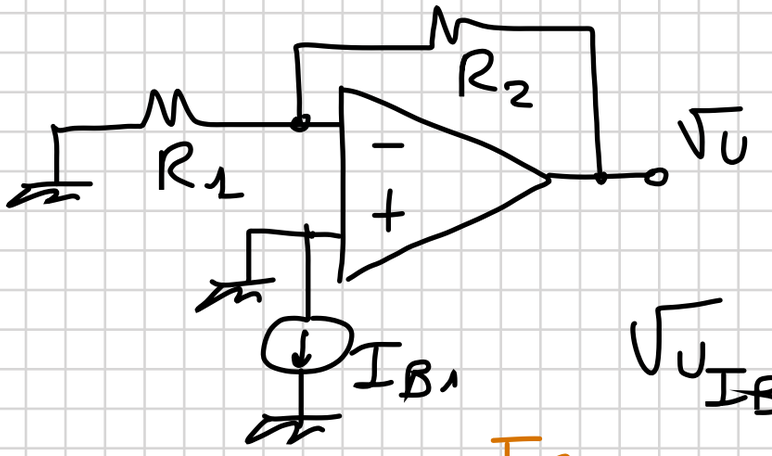
$$V_U = -\frac{R_2}{R_1} V_S$$

Se $V_s = 0$

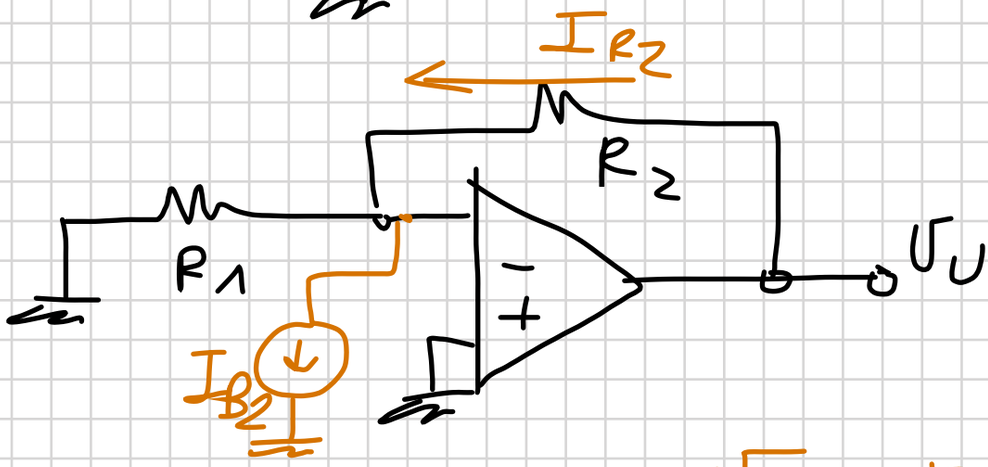
$\Downarrow$

$V_U = 0$

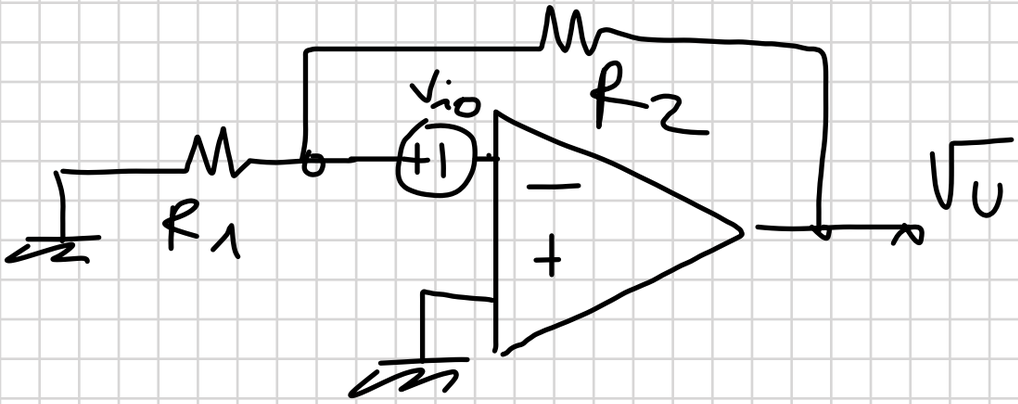


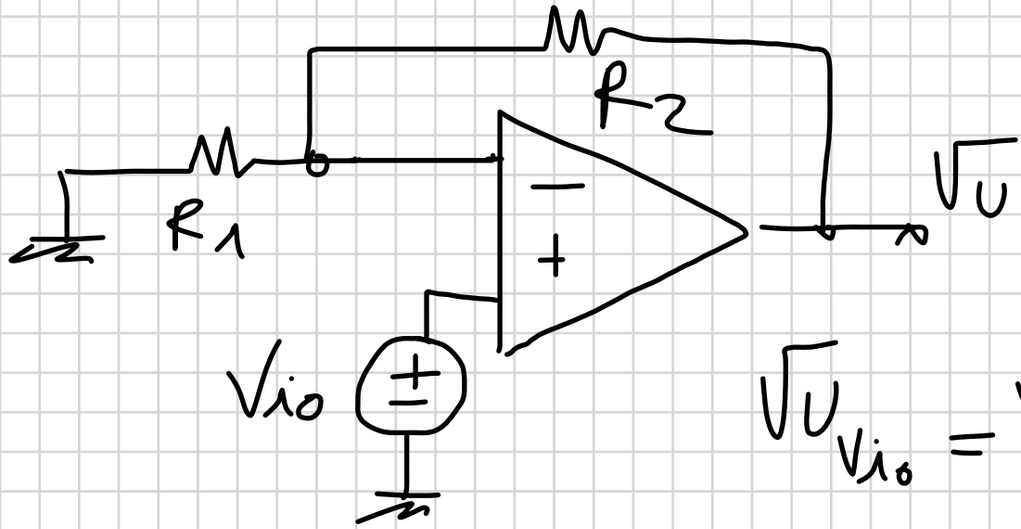


$$V_{U_{I_{B1}}} = 0$$



$$I_{B_2} = I_{R_2} \Longrightarrow V_{U_{I_{B_2}}} = R_2 I_{B_2}$$





$$V_{U_{V_{io}}} = V_{io}\left(1 + \frac{R_2}{R_1}\right)$$

$$V_U = V_{U_{I_{B1}}} + V_{U_{I_{B_2}}} + V_{U V_{io}} =$$

$$V_U = R_2 I_{B2} + \left(1 + \frac{R_2}{R_1}\right) V_{io}$$

$R_2 = 1K\Omega$

$R_1 = 1K\Omega$

$I_M = 80mA$

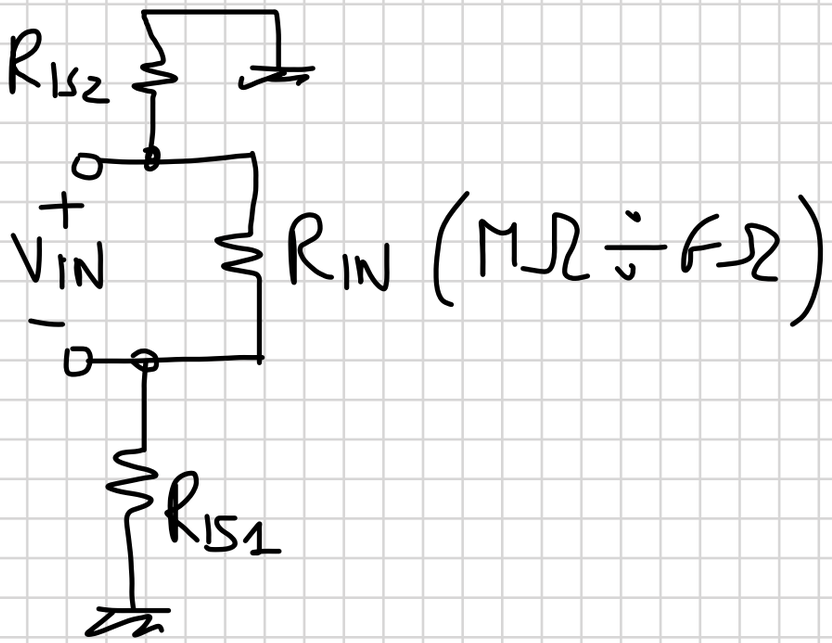
$I_{offset} = 20mA$

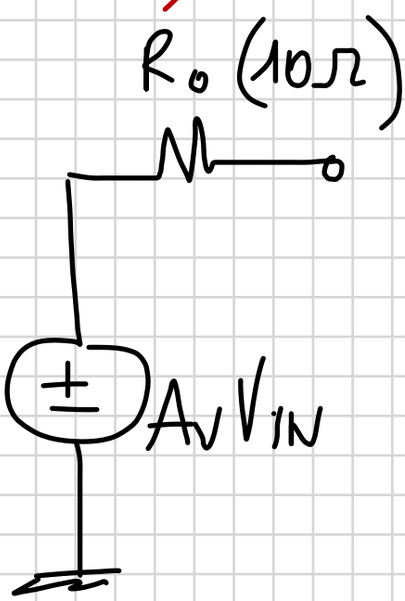
$V_{io} = 5mV$

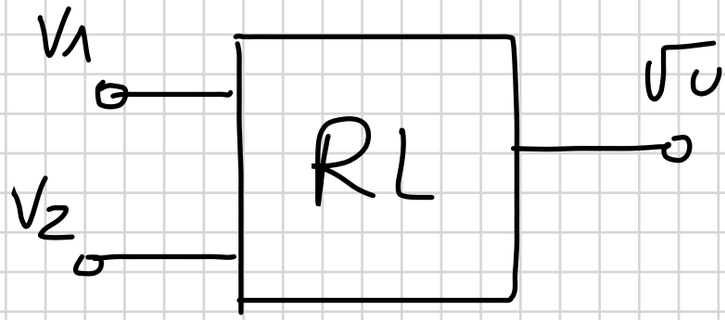
I_{B1} → $90mA$, $70mA$

I_{B2} → $70mA$, $90mA$

$$V_U \left(I_{B2} = 90mA \wedge V_{io} = 5mV \right)$$







$$V_U = A_1 V_1 + A_2 V_2$$

$$V_d = V_1 - V_2 \quad ; \quad V_C = \frac{V_1 + V_2}{2}$$

$$V_U = A_d V_d + A_c V_C$$

$$CMRR = \frac{A_d}{A_C}$$

$$V_1 = V_C + \frac{V_d}{2}$$

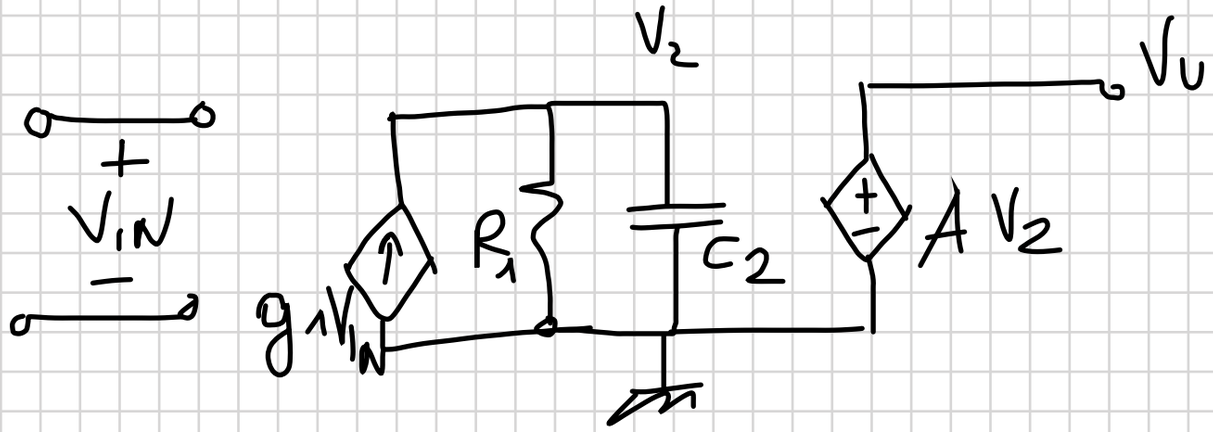
$$V_2 = V_C - \frac{V_d}{2}$$

$$V_U = \left(\frac{A_1 - A_2}{2}\right) V_d + \left(A_1 + A_2\right) V_C$$

A_d $\qquad$ A_C

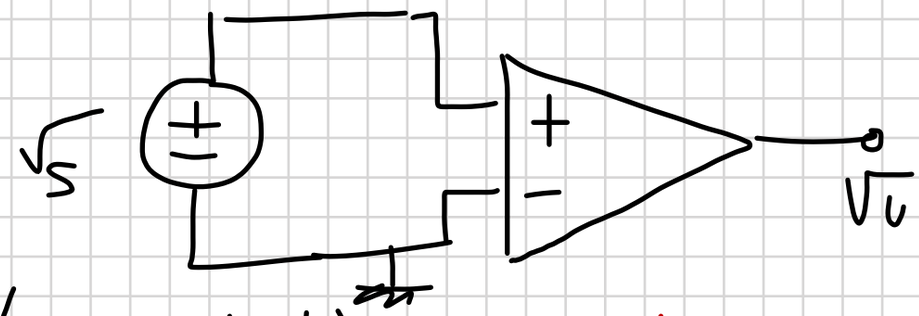
$$V_U = A_d \left(V_d + \frac{V_C}{CMRR}\right) \xrightarrow[CMRR \to +\infty]{} V_U \simeq A_d V_d$$

$$A_d = \frac{A_{VOL\phi}}{\left(1 + \frac{S}{W_P}\right)}$$

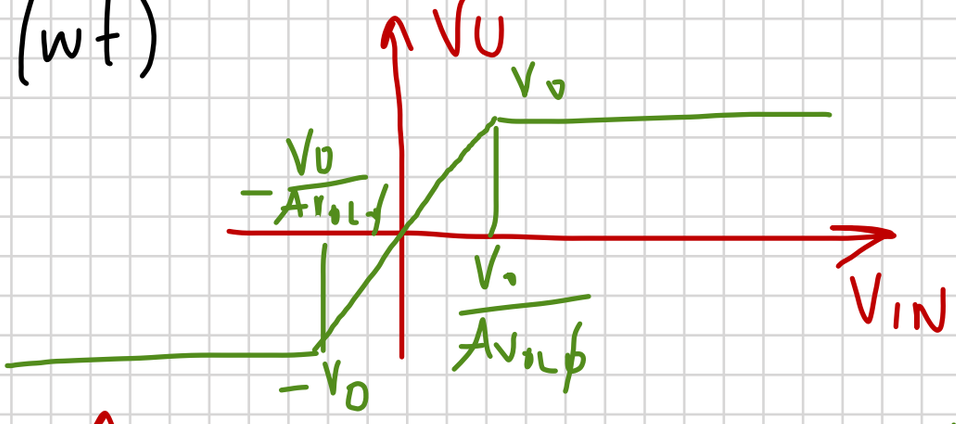


$$A = A_{VOLφ} \qquad g_1 R_1 = 1$$

$$W_p = \frac{1}{R_1 C_2}$$

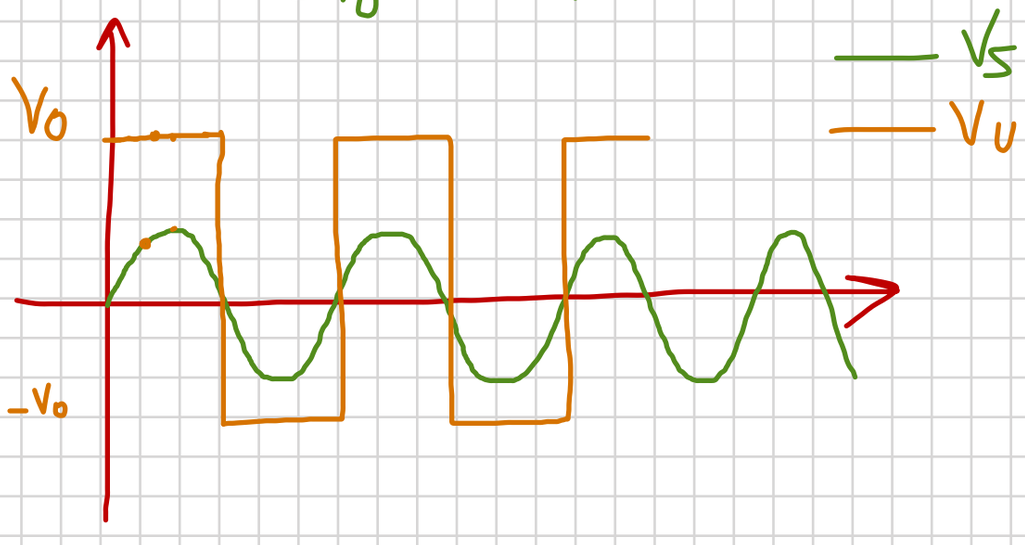


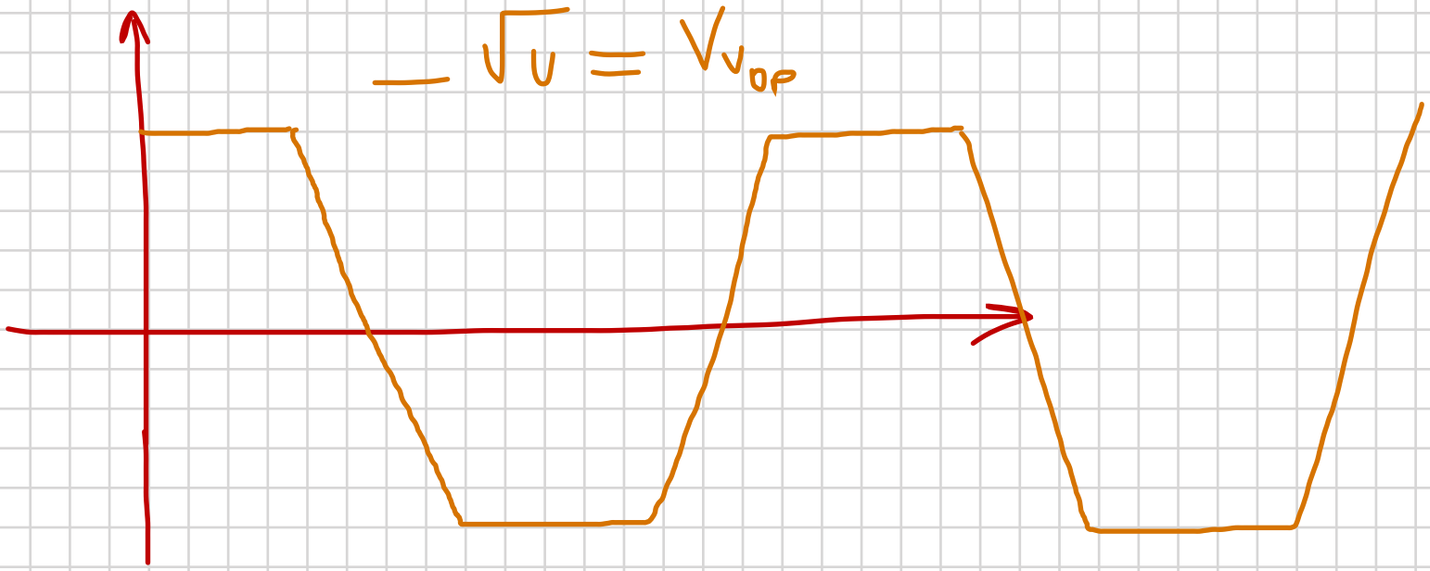
$$V_S = V_M \sin(wt)$$



$V_H = 5V$

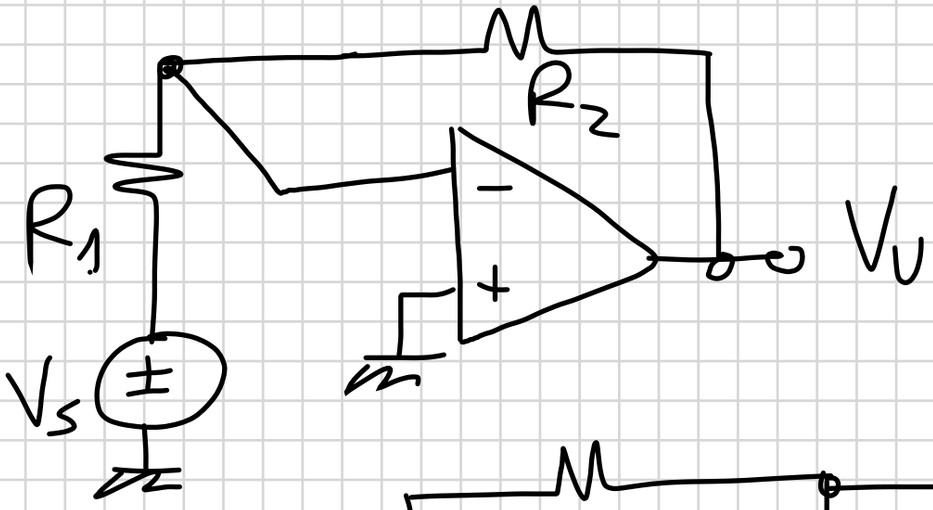
$V_O = 10V$



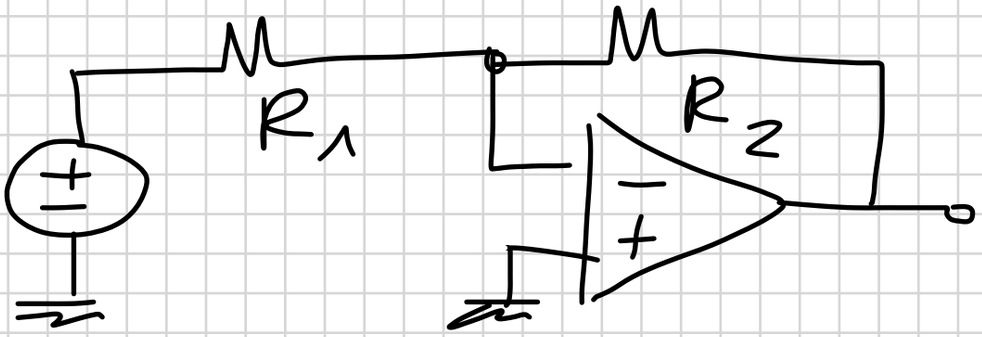


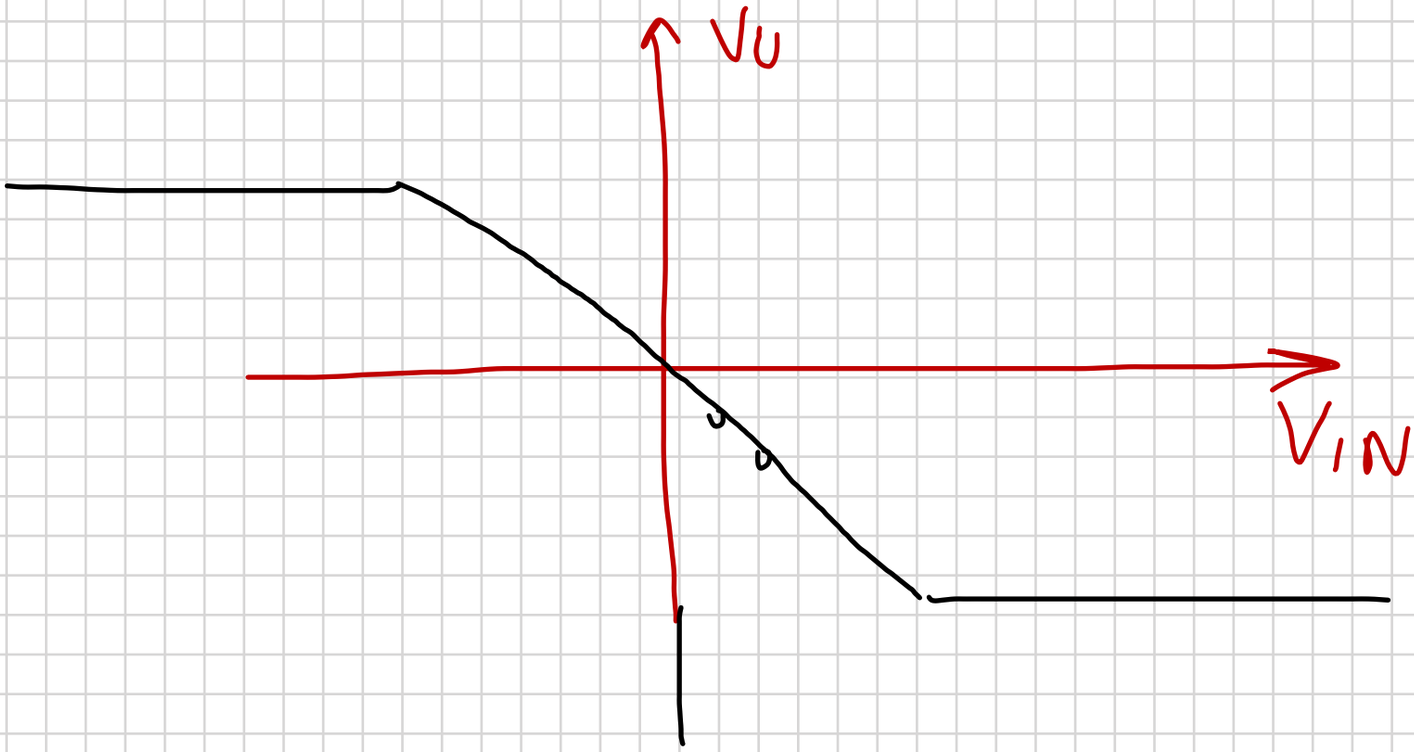
$$\left|\frac{dV_{U_{OPAMP}}}{dt}\right|_{MAX} = \sigma$$

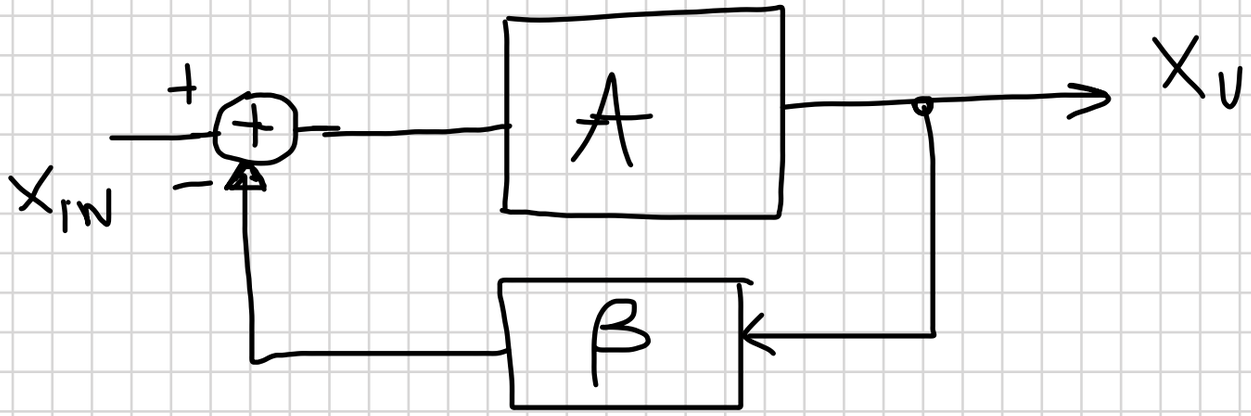
SLEW RATE

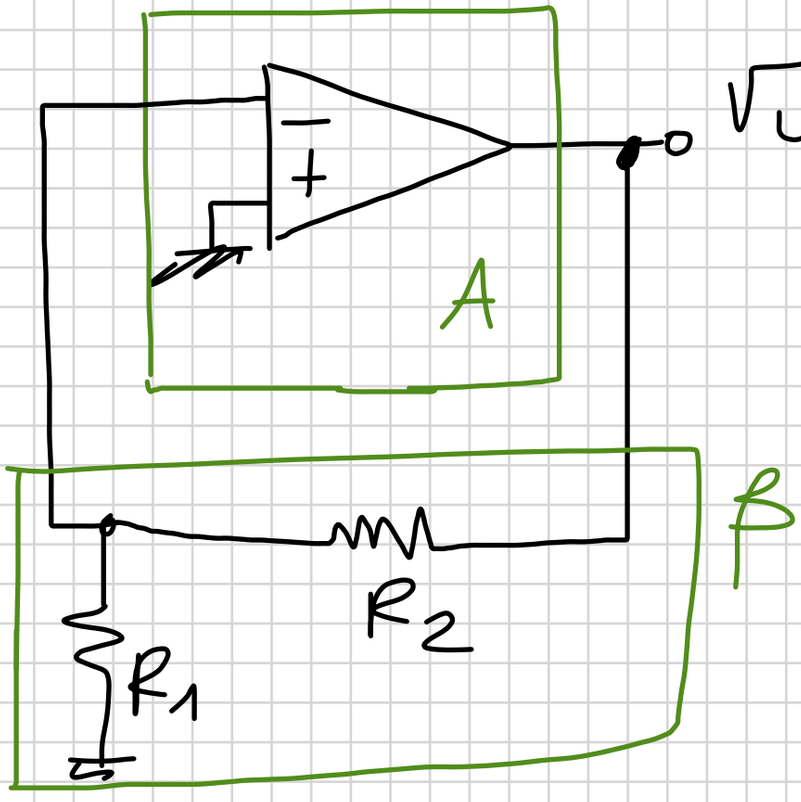


$R_1 = R_2$







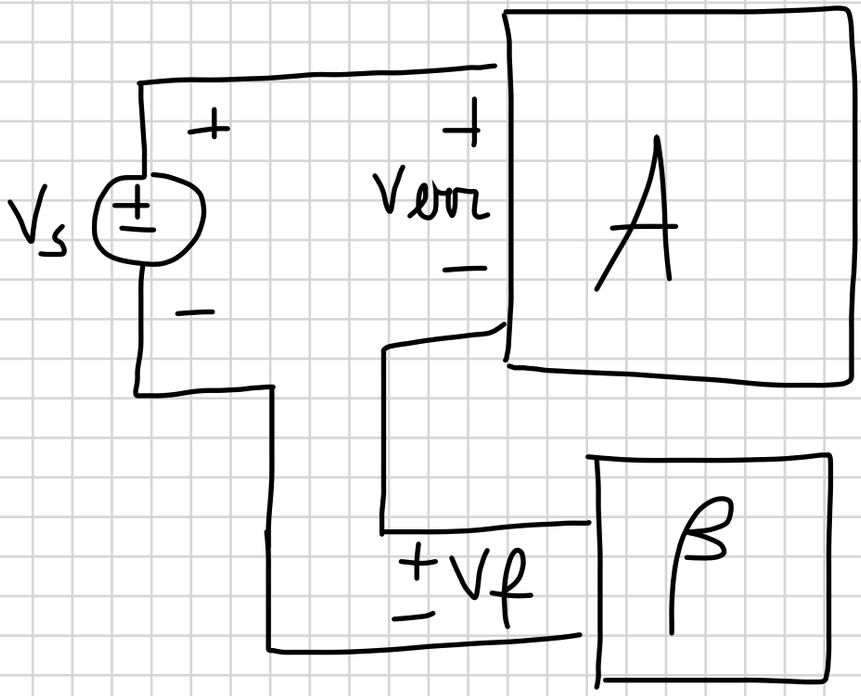


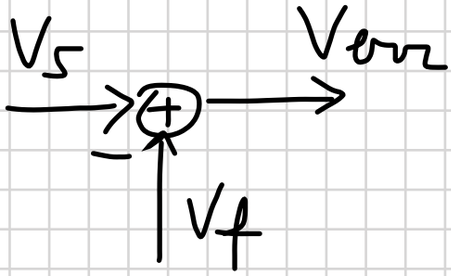
$$X_U = A X_{err} =$$

$$= (X_{IN} - \beta X_U) A =$$

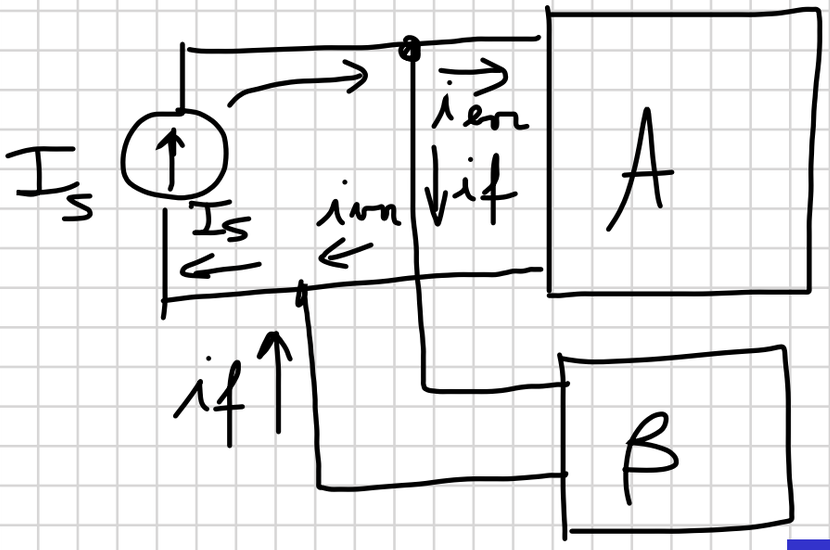
$$X_U = X_{IN} \frac{A}{1+\beta A} =$$

$$= X_{IN} \frac{1}{\beta} \underbrace{\left(\frac{\beta A}{1-\beta A} \right)}$$



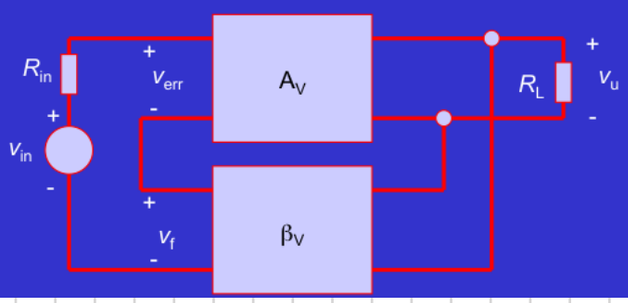


$$V_{err} = V_S - V_f$$

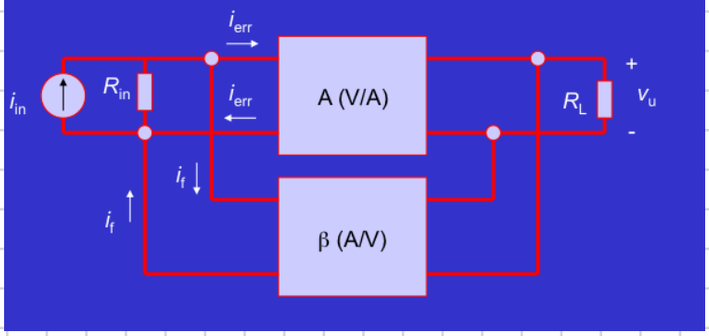


$$i_{err} = I_S - i_f$$

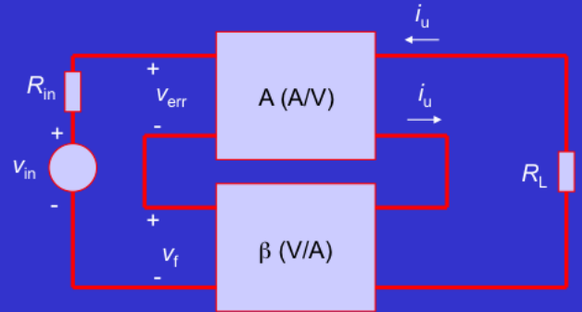
Reazione di tensione serie



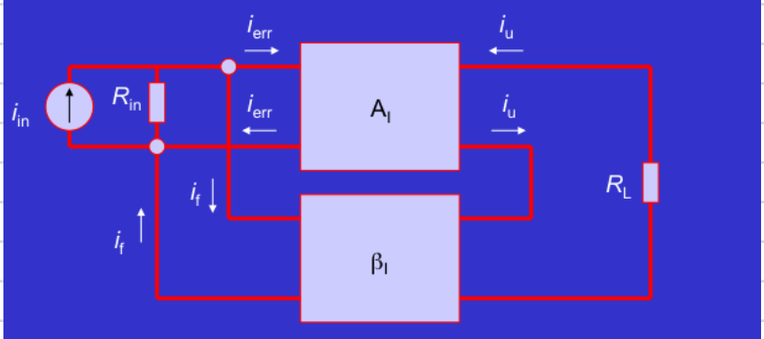
Reazione di tensione parallela

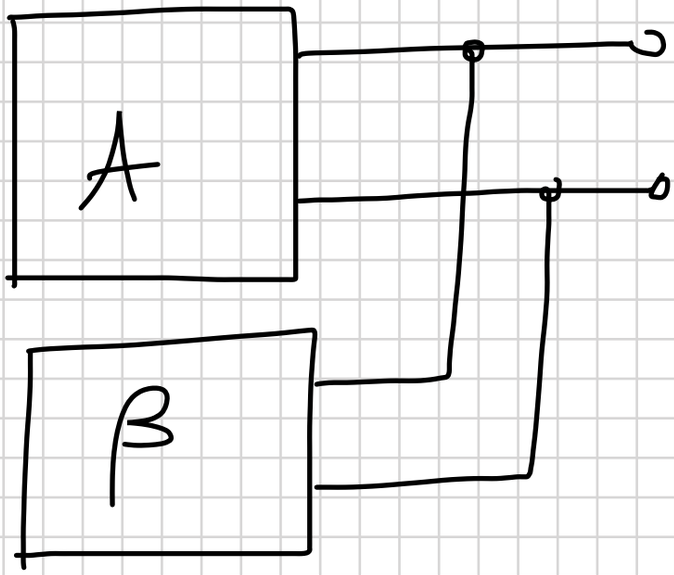


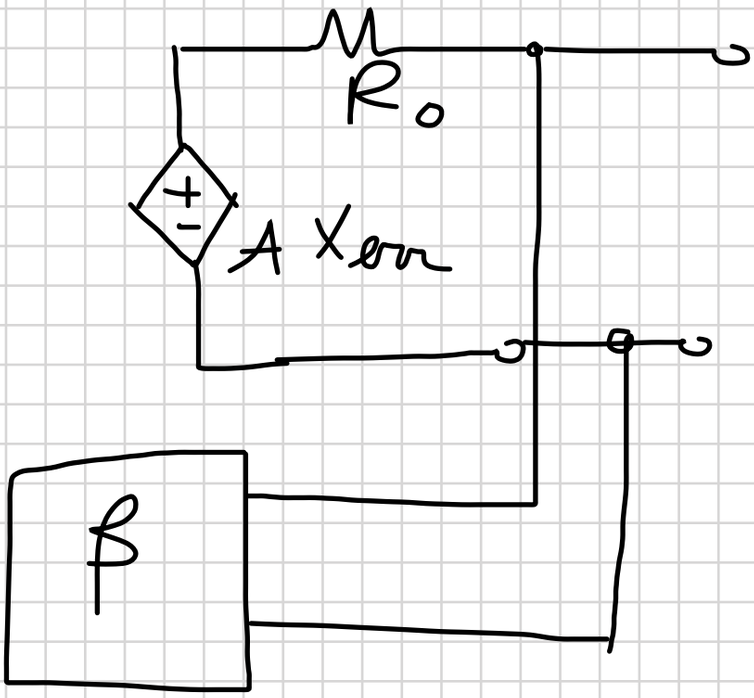
Reazione di corrente serie

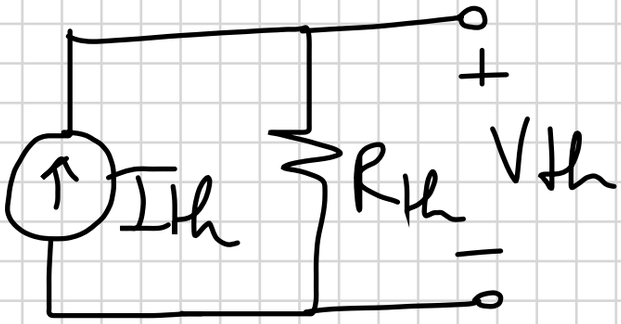


Reazione di corrente parallela









$$V_{th} = R_{th}\, I_{th}$$

$$R_{th} = \frac{V_{th}}{I_{th}}$$

$$R_V = \frac{V_0}{I_{sc}}$$

$$I_{sc} = \frac{A\, X_{err}}{R_0}$$

$$X_{err} = X_{IN}$$

$$I_{sc} = \frac{A\, X_{IN}}{R_0}$$

$$V_0 = V_U = \frac{A}{1+\beta A}\, X_{IN}$$

$$R_V = \frac{V_0}{I_{sc}} = \frac{\frac{A}{1+\beta A}\, X_{IN}}{\frac{A\, X_{IN}}{R_0}} = \frac{A}{1+\beta A}\,\frac{X_{IN}}{A\, X_{IN}}\, R_0$$

$$R_V = \frac{R_0}{1+\beta A}$$