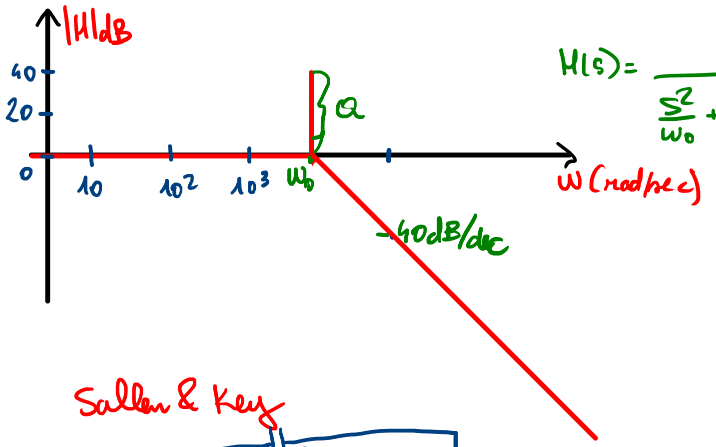
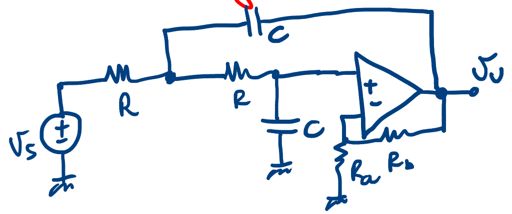
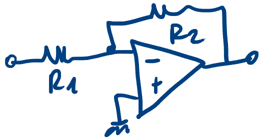


$$H(s) = \frac{1}{\frac{s^2}{\omega_0} + \frac{s}{\omega_0 Q} + 1}$$

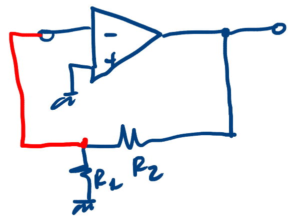
Sallen & Key



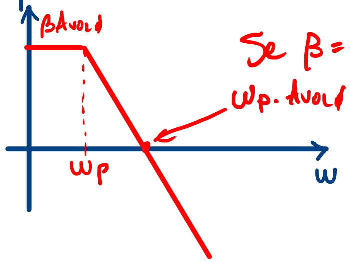
$\beta A \gg 1$



$$A = \frac{A_{vol}}{1 + \frac{s}{\omega_p}}$$

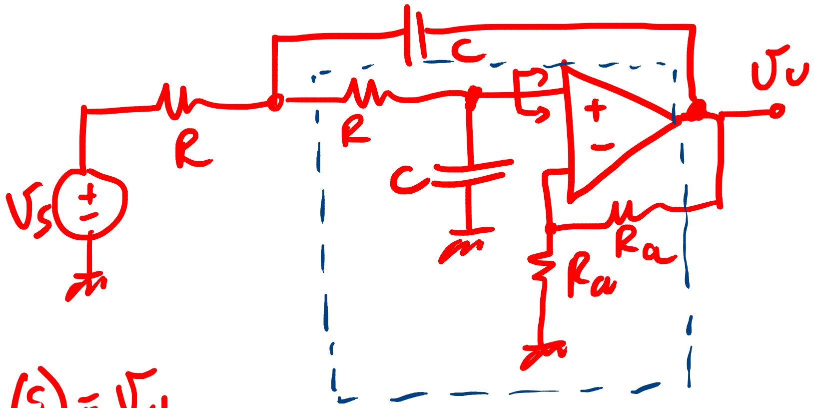


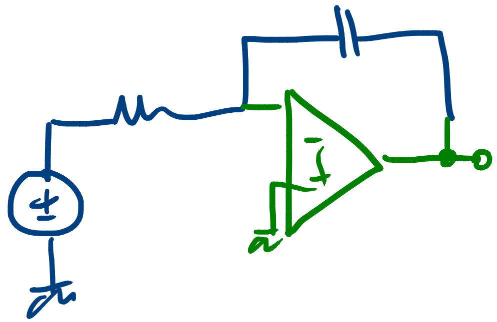
$\beta A \gg 1$



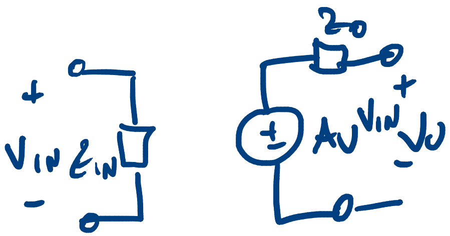
Se $\beta = 1$

$\omega_p \cdot A_{vol}$





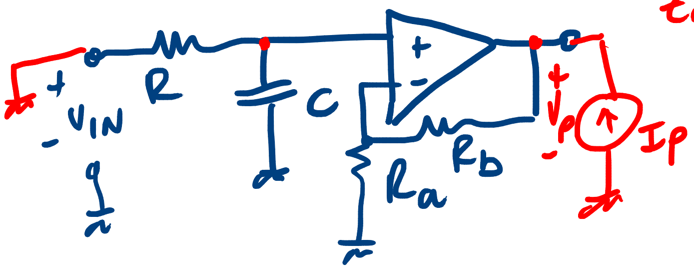
$$A_v(s) = \frac{V_u}{V_s} =$$



$$Z_{IN} = R + \frac{1}{Cs} \,//\, R_{iop} =$$

$$= R + \frac{1}{Cs}$$

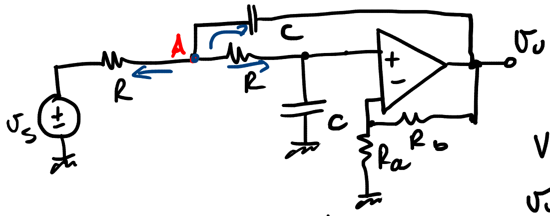
$$Z_o = \phi$$



$$Z_o = \frac{V_p}{I_p} = \frac{0}{I_p} = 0$$

$$A_v = \frac{A_{v0}}{\left(1 + \frac{s}{\omega_p}\right)} \qquad A_{v0} = \left(1 + \frac{R_b}{R_a}\right)$$

$$\omega_p = \frac{1}{RC}$$



$$A_V = 1 + \frac{R_b}{R_a}$$

$$V^+ \simeq V^-$$

$$V_U = \left(1 + \frac{R_b}{R_a}\right) V^+$$

$$\frac{V_A - V_S}{R} + \frac{V_A - V^+}{R} + (V_A - V_U)Cs = 0$$

$$V^+ = \frac{\frac{1}{Cs}}{\frac{1}{Cs} + R} V_A = \frac{V_A}{1 + RCs}$$

$$V_A = (1 + RCs)V^+$$

$$V^+ = \frac{V_U}{A_V}$$

$$V_A = (1 + RCs)\frac{V_U}{A_V}$$

$$(V_A - V_S) + V_A - V^+ + RCs(V_A - V_U) = 0$$

$$2V_A - V_S - V^+ + RCs(V_A - V_U)$$

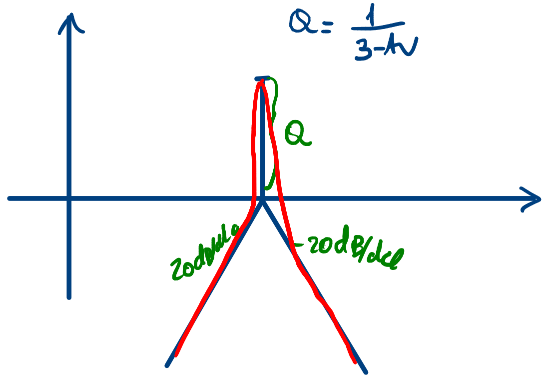
$$2(1 + RCs)\frac{V_U}{A_V} - V_S - \frac{V_U}{A_V} + RCs\left[(1 + RCs)\frac{V_U}{A_V} - V_U\right] = 0$$

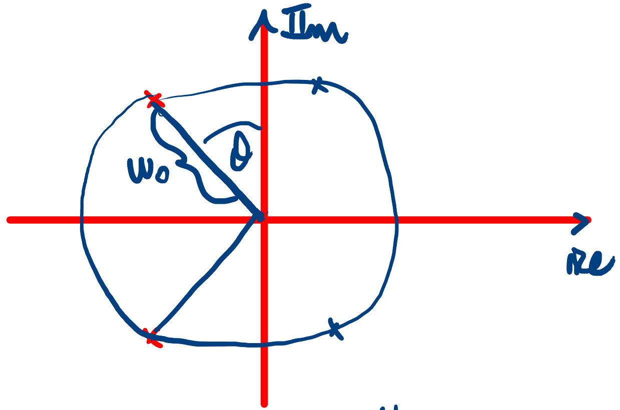
$$A(s) = \frac{V_U(s)}{V_S(s)} = \frac{A_V}{R^2C^2s^2 + (3 - A_V)RCs + 1}$$

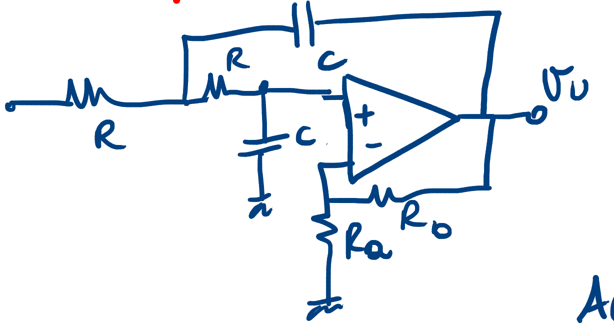
$$\frac{s^2}{\omega_0^2} + \frac{s}{\omega_0 Q} + 1$$

$$\omega_0 = \frac{1}{RC}$$

$$Q = \frac{1}{3 - A_V}$$





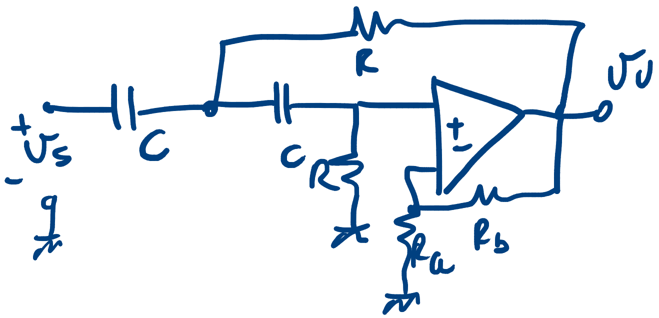


$$A(s) = \frac{A_v}{R^2C^2s^2 + (3-A_v)RCs + 1}$$

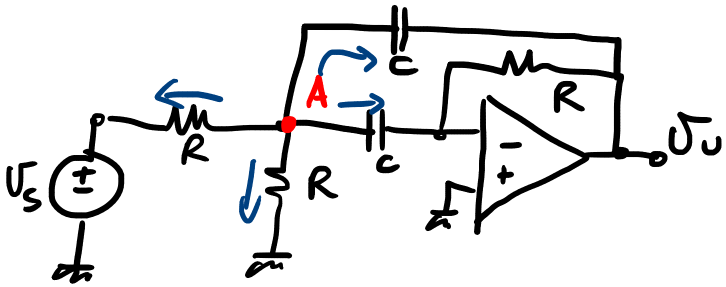
$$R \to \frac{1}{C's} \qquad Cs \to \frac{1}{R'}$$

$$A(s) = \frac{A_v}{\frac{s^2}{C'^2R'^2s^2} + \frac{(3-A)}{R'C's} + 1} =$$

$$A(s) = \frac{A_v\, R'^2C'^2s^2}{R'^2C'^2s^2 + (3-A_v)R'C's + 1}$$



Filtro passa banda



$$\underbrace{V_U = -RCs\,V_A}_{V_A = -\frac{1}{RCs} V_U}$$

$$\frac{V_A - V_S}{R} + \frac{V_A}{R} + V_A Cs + (V_A - V_U)Cs = 0$$

$$V_A - V_S + V_A + RCs\,V_A + RCs(V_A - V_U) = 0$$

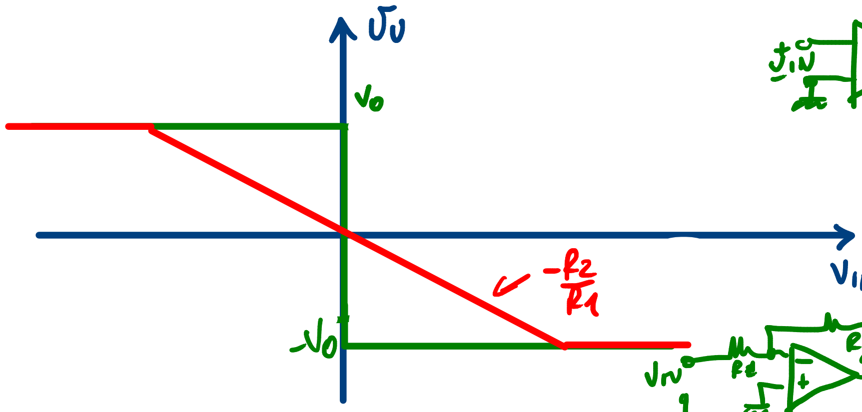
$$V_A(2 + 2RCs) - RCs\,V_U = V_S$$

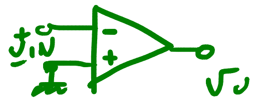
$$-\frac{2}{RCs}(1 + RCs)V_U - (RCs)V_U = V_S$$

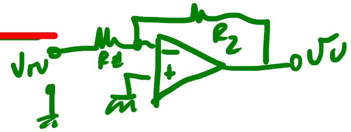
$$+2(1 + RCs)V_U + (RCs)^2 V_U = -RCs\,V_S$$

$$V_U\left[R^2C^2s^2 + 2RCs + 2\right] = -RCs\,V_S$$

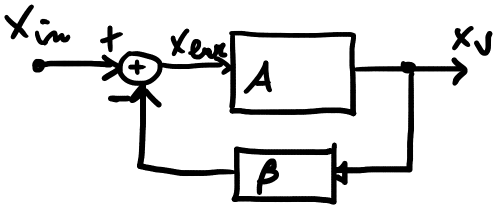
$$\frac{V_U}{V_S} = -\frac{RCs}{R^2C^2s^2 + 2RCs + 2}$$







$$v_U = -\frac{R_2}{R_1} v_{IN}$$



$$x_{err} = x_{in} - \beta x_U$$

$$x_U = A x_{err}$$

$$x_U = A(x_{in} - \beta x_U)$$

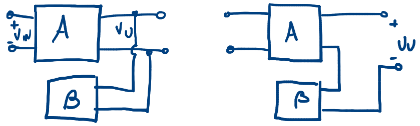
$$\boxed{x_U = \frac{A\, x_{in}}{1+\beta A}}$$

$$x_{err} = \frac{x_U}{A} = \frac{x_{in}}{1+\beta A}$$

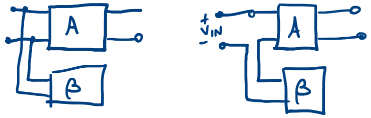
$$x_U = \underbrace{\frac{1}{\beta}\,\frac{\beta A}{1+\beta A}}_{A_f = \frac{x_U}{x_{in}}} x_{in}$$

Se $\beta A \gg 1$ $\quad A_f \to \frac{1}{\beta}$

PRELIEVO

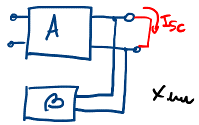


INS.

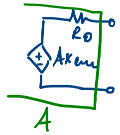


$$V_{in} = Z_V I_N$$

$$Z_V = \frac{V_{in}}{I_N}$$



$$I_{sc} = \frac{A x_{err}}{R_o}$$

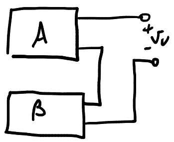


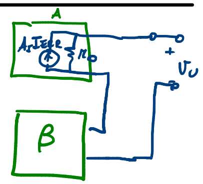
$$x_{err} = x_{in}$$

$$I_{sc} = \frac{A x_{in}}{R_o}$$

$$V_o = X_u = \frac{A x_{in}}{1+\beta A}$$

$$R_o' = \frac{V_o}{I_{sc}} = \frac{\cancel{A x_{in}}}{(1+\beta A)} \frac{R_o}{\cancel{A x_{in}}} = \frac{R_o}{1+\beta A}$$





$$V_o = r_o \cdot A_I I_{ERR} = r_o A_I I_S$$

$$I_{sc} = \frac{A_I}{1+\beta A_I} I_S$$

$$R_u = \frac{V_o}{I_{sc}} = \frac{r_o \cancel{A_I} \cancel{I_S}}{\frac{\cancel{A_I}}{1+\beta A_I} \cancel{I_S}} = r_o (1+\beta A_I)$$

$$\omega_p' = \omega_p (1+\beta A_{vol0})$$

$$A_f = \frac{A}{1+\beta A} \qquad A = \frac{A_{vol0}}{1+\frac{s}{\omega_p}}$$

$$A_f = \frac{A_{vol0}}{1+\beta A_{vol0}} \frac{1}{\left(\frac{s}{\omega_p'}+1\right)}$$