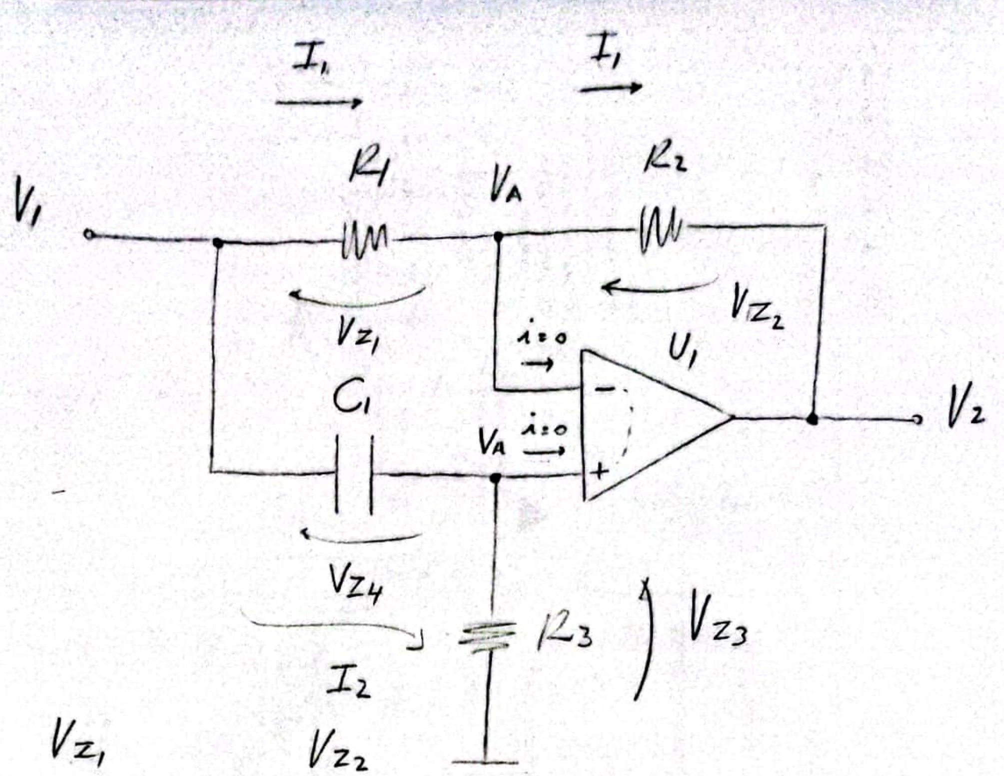


$Z_1 = R_1$

$Z_2 = R_2$

$Z_3 = R_3$

$Z_4 = \dfrac{1}{sC_1}$

$$I_1 = \frac{\overbrace{(V_1 - V_A)}^{V_{Z_1}}}{Z_1} = \frac{\overbrace{(V_A - V_2)}^{V_{Z_2}}}{Z_2} \; ; \quad (V_1 - V_A) Z_2 = (V_A - V_2) Z_1 \; ;$$

$$V_1 Z_2 - V_A Z_2 = V_A Z_1 - V_2 Z_1 \; ; \quad V_1 Z_2 + V_2 Z_1 = V_A (Z_1 + Z_2) \; ;$$

$$\boxed{V_A = \frac{V_1 Z_2 + V_2 Z_1}{Z_1 + Z_2}} \; ; \quad [V_A] = \frac{V.\Omega + V.\Omega}{\Omega} = \frac{V.\Omega}{\Omega} = [V] \checkmark$$

$$V_{Z_3} = V_1 \frac{Z_3}{Z_3 + Z_4} \; ; \quad V_{Z_3} = V_A \; ; \quad \frac{V_1 Z_2 + V_2 Z_1}{Z_1 + Z_2} = V_1 \frac{Z_3}{Z_3 + Z_4} \; ;$$

$$(V_1 Z_2 + V_2 Z_1)(Z_3 + Z_4) = V_1 Z_3 (Z_1 + Z_2)$$

$$\cancel{V_1 Z_2 Z_3} + V_1 Z_2 Z_4 + V_2 Z_1 Z_3 + V_2 Z_1 Z_4 = V_1 Z_1 Z_3 + \cancel{V_1 Z_2 Z_3}$$

$$V_2 (Z_1 Z_3 + Z_1 Z_4) = V_1 (Z_1 Z_3 - Z_2 Z_4)$$

$$T(s) = \frac{V_2(s)}{V_1(s)} = \frac{Z_1 Z_3 - Z_2 Z_4}{Z_1 Z_3 + Z_1 Z_4}$$

Reemplazando Z_1, Z_2, Z_3 y Z_4:

$$T(s) = \frac{V_2(s)}{V_1(s)} = \frac{R_1 R_3 - \frac{R_2}{sC_1}}{R_1 R_3 + \frac{R_1}{sC_1}} = \frac{\frac{sR_1R_3C_1 - R_2}{\cancel{sC_1}}}{\frac{sR_1R_3C_1 + R_1}{\cancel{sC_1}}} = \frac{sR_1R_3C_1 - R_2}{sR_1R_3C_1 + R_1}$$

$$\boxed{T(s) = \frac{\cancel{R_1R_3C_1}}{\cancel{R_1R_3C_1}} \frac{s - \frac{R_2}{R_1R_3C_1}}{s + \frac{\cancel{R_1}}{\cancel{R_1}R_3C_1}} = \frac{s - \frac{R_2}{R_1R_3C_1}}{s + \frac{1}{R_3C_1}}}$$

$$[T(s)] = \frac{\frac{1}{s} + \frac{\cancel{\Omega}}{\Omega^{\cancel{2}}F}}{\frac{1}{s} + \frac{1}{\Omega F}} = \frac{\frac{1}{s} + \frac{1}{\Omega F}}{\frac{1}{s} + \frac{1}{\Omega F}} = \frac{\frac{1}{\cancel{s}}}{\frac{1}{\cancel{s}}}$$

$\to s$

$\to s$

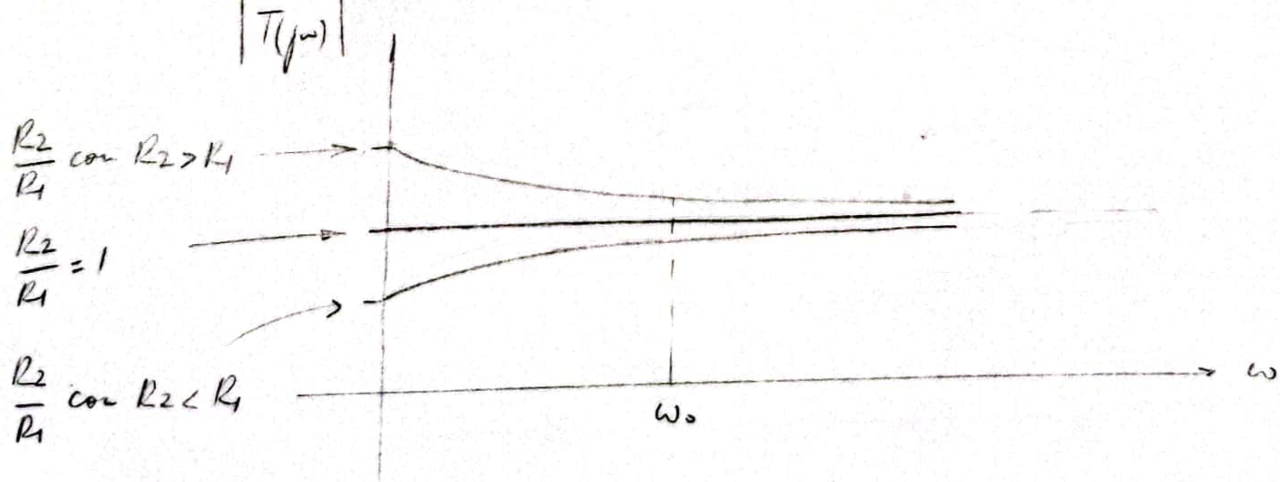
$$\left| T(s) \Big|_{s=j\omega} \right| = \left| \frac{j\omega - \frac{R_2}{R_1R_3C_1}}{j\omega + \frac{1}{R_3C_1}} \right| = \frac{\sqrt{\frac{R_2^2}{R_1^2R_3^2C_1^2} + (j\omega)^2}}{\sqrt{\frac{1}{R_3^2C_1^2} + (j\omega)^2}}$$

$$\left| T(s) \Big|_{s=j\omega} \right| = \frac{\sqrt{\frac{R_1^2}{R_1^2R_3^2C_1^2} - \omega^2}}{\sqrt{\frac{1}{R_3^2C_1^2} - \omega^2}}$$

$$\left| T(j\omega) \right|_{\omega_1 = 0} = \frac{\sqrt{\dfrac{R_2^2}{R_1^2 R_3^2 C_1^2}}}{\sqrt{\dfrac{1}{R_3^2 C_1^2}}} = \frac{R_2}{R_1}$$

$$\left| T(j\omega) \right|_{\omega_2 = \omega_0} = \frac{\sqrt{\dfrac{R_2^2}{R_1^2 R_3^2 C_1^2} - \omega_0^2}}{\sqrt{\dfrac{1}{R_3^2 C_1^2} - \omega_0^2}}$$

$$\left| T(j\omega) \right|_{\omega_3 \to \infty} = \frac{\sqrt{\dfrac{R_2^2}{R_1^2 R_3^2 C_1^2} - \overset{\to\infty}{\omega_3^2}}}{\sqrt{\dfrac{1}{R_3^2 C_1^2} - \overset{\to\infty}{\omega_3^2}}} \longrightarrow 1$$



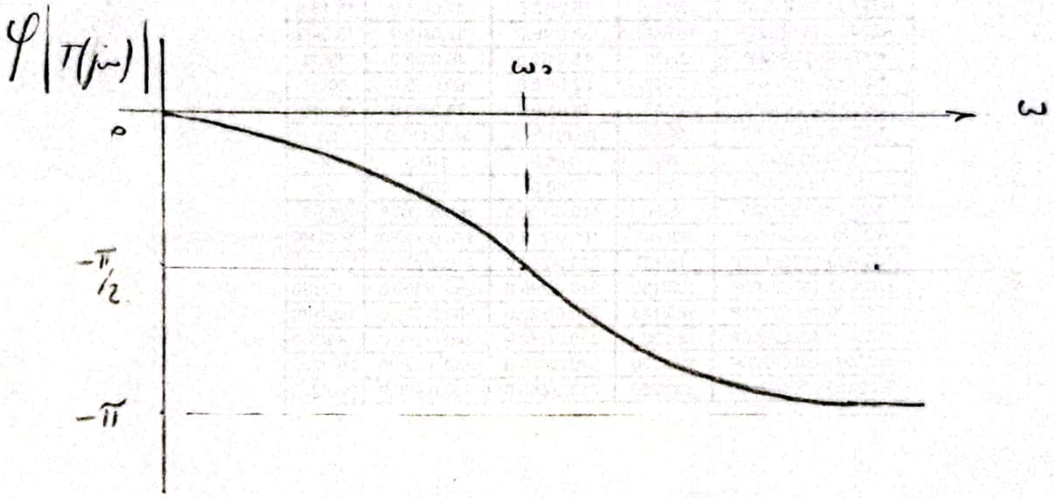
$$\varphi_T = \varphi_{Num}\left\{ T(s)\big|_{s=j\omega} \right\} - \varphi_{Den}\left\{ T(s)\big|_{s=j\omega} \right\} \quad ; \quad \varphi = \operatorname{arctg} \frac{Im}{Re}$$

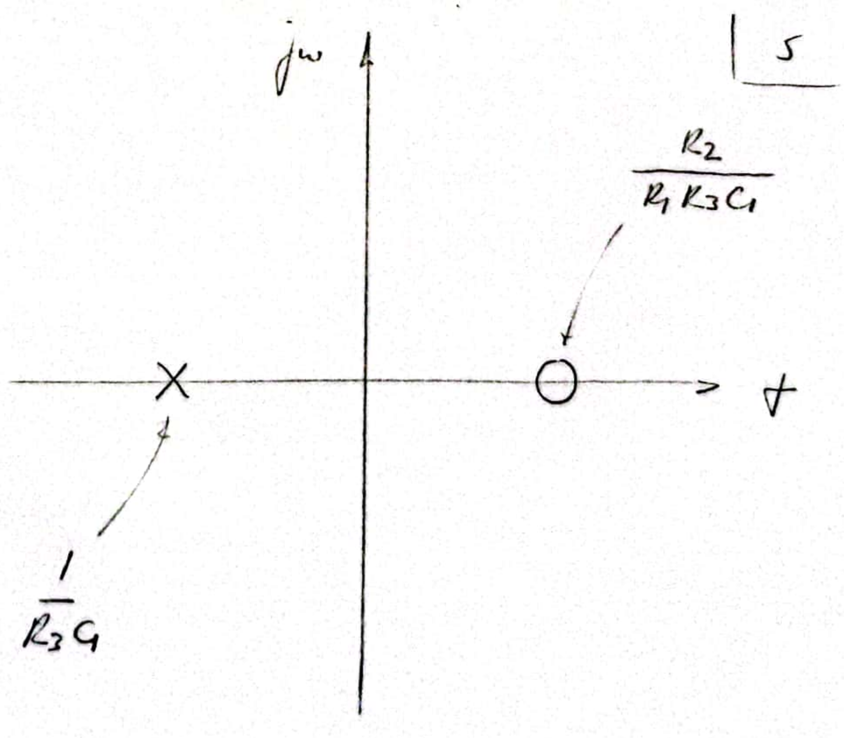
$$\varphi_T = \operatorname{arctg} \frac{\omega}{\left(-\dfrac{R_2}{R_1 R_3 C_1} \right)} - \operatorname{arctg} \frac{\omega}{\dfrac{1}{R_3 C_1}}$$

$$\varphi_T = \operatorname{arc\,tg}\left(-\frac{R_1 R_3 C_1}{R_2}\,\omega\right) - \operatorname{arc\,tg}\left(R_3 C_1\,\omega\right)$$

$$\varphi_T\Big|_{\omega_1=0} = 0 - 0 = 0$$

$$\varphi_T\Big|_{\omega_2\to\infty} = -\frac{\pi}{2} - \frac{\pi}{2} = -\pi$$





Se trata de un filtro pasa todo.

Escaneado con CamScanner

$$T(s) = \frac{s - \frac{R_2}{R_1 R_3 C_1}}{s + \frac{1}{R_3 C_1}} = \frac{s - \left(\frac{R_2}{R_1}\right)\frac{1}{R_3 C_1}}{s + \frac{1}{R_3 C_1}} \; ; \; \Omega_\omega = \omega_0 = \frac{1}{R_3 C_1}$$

$$D = \frac{R_2}{R_1}$$

$$T(s) = \frac{s - D\omega_0}{s + \omega_0} \; ; \; \not{s} = \frac{s}{\Omega_\omega} \; ; \; T(\not{s}) = \frac{\not{s}\,\omega_0 - D\omega_0}{\not{s}\,\omega_0 + \omega_0} =$$

$$\boxed{T(\not{s}) = \frac{\cancel{\omega_0}}{\cancel{\omega_0}} \, \frac{\not{s} - D}{\not{s} + 1}}$$