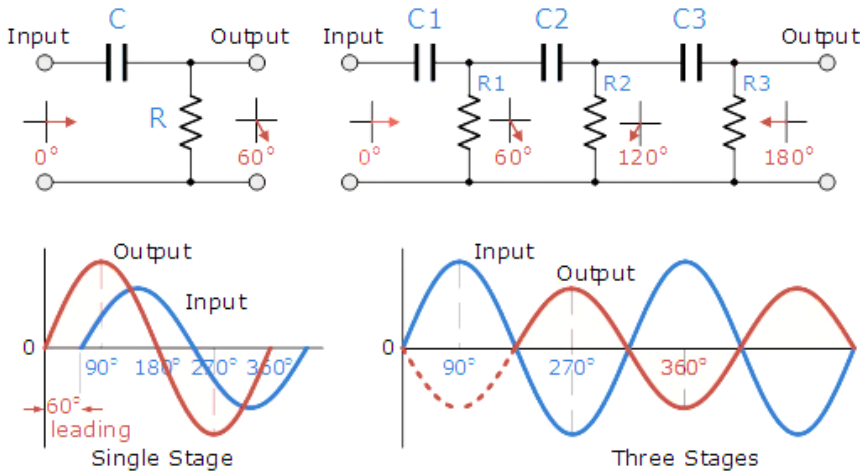
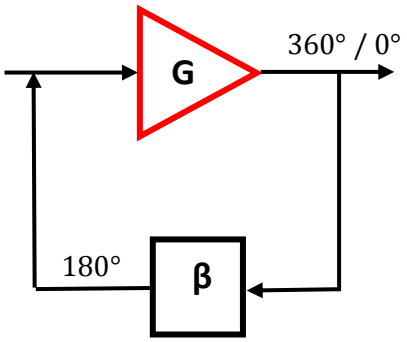
Oscilador

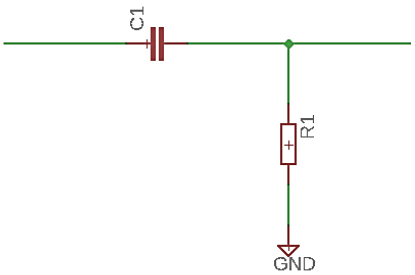


R-C

Criterio de Barkhausen:

- La ganancia total del sistema retroalimentado debe ser: $G\ \beta = 1$ (unitaria)
- El ángulo de fase de realimentación debe ser igual a 0 rad o a un número entero múltiplo de $2\ k\ \pi$ rad.





$$V_{out} = \frac{Z_2}{Z_1 + Z_2}\ V_{in} \Rightarrow$$

$$\frac{V_{out}}{V_{in}} = \frac{Z_2}{Z_1 + Z_2}$$

En donde:

$$Z_1 = Xc = \frac{1}{j\ \omega\ C}\ \ y\ \ Z_2 = R$$

$$\frac{V_{out}}{V_{in}} = \frac{R}{R + \frac{1}{j\ \omega\ C}}$$

$$\frac{V_{out}}{V_{in}} = \frac{j\ \omega\ R\ C}{1 + j\ \omega\ R\ C}$$

$$\frac{V_{out}}{V_{in}} = \frac{j\,\omega\,R\,C\,(1 - j\,\omega\,R\,C)}{(1 + j\,\omega\,R\,C)(1 - j\,\omega\,R\,C)}$$

$$\frac{V_{out}}{V_{in}} = \frac{j\,\omega\,R\,C - (j\,\omega\,R\,C)^2}{1^2 - (j\,\omega\,R\,C)^2}$$

$$\frac{V_{out}}{V_{in}} = \frac{(\omega\,R\,C)^2 + j\,\omega\,R\,C}{1 + (\omega\,R\,C)^2} \Rightarrow$$

$$\boxed{\frac{V_{out}}{V_{in}} = \frac{(\omega\,R\,C)^2}{1 + (\omega\,R\,C)^2} + j\,\frac{\omega\,R\,C}{1 + (\omega\,R\,C)^2}}$$

R = 1000 Ω

C = 0,1 µF

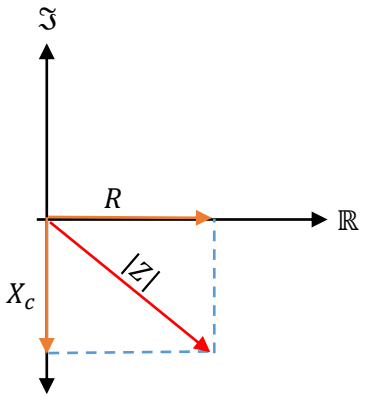
ω = 10000 rad/seg

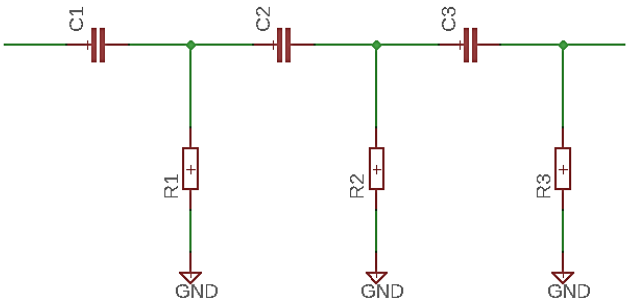
$$\omega = 2\,\pi\,f \Rightarrow f = \frac{\omega}{2\,\pi} = \frac{10000}{2\,\pi} \cong 1591{,}54\ Hz\ \cong 1{,}6\ KHz$$

$$\frac{V_{out}}{V_{in}} = \frac{(10000\ 1000\ 0{,}1\ 10^{-6})^2}{1 + (10000\ 1000\ 0{,}1\ 10^{-6})^2} + j\,\frac{(10000\ 1000\ 0{,}1\ 10^{-6})}{1^2 + (10000\ 1000\ 0{,}1\ 10^{-6})^2}$$

$$\frac{V_{out}}{V_{in}} = 0{,}5 + j\,0{,}5$$

$$\phi = ArcTan\left(\frac{0{,}5}{0{,}5}\right) = 45$$

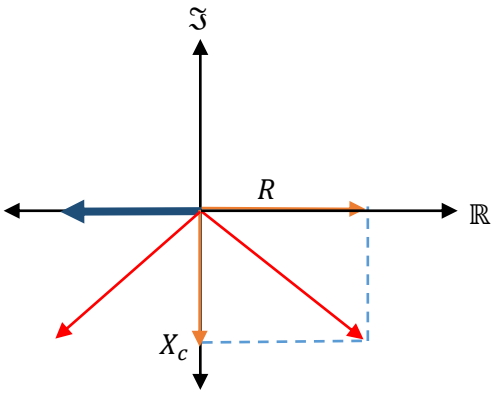




Si:

$$C_1 = C_2 = C_3 \;\; y \;\; R_1 = R_2 = R_3$$

$$\frac{V_{out}}{V_{in}} = \frac{1}{1 - \frac{5}{(\omega\, R\, C)^2} - j\left(\frac{6}{\omega\, R\, C} - \frac{1}{(\omega\, R\, C)^3}\right)}$$



$$\frac{6}{\omega\, R\, C} = \frac{1}{(\omega\, R\, C)^3}$$

$$6 = \frac{1}{(\omega\, R\, C)^2}$$

$$\omega = \frac{1}{R\, C\, \sqrt{6}}$$

Reemplazando:

$$\frac{V_{out}}{V_{in}} = \frac{1}{1 - \frac{5}{\left(\left(\frac{1}{R\ C\ \sqrt{6}}\right) R\ C\right)^2} - j(0)}$$

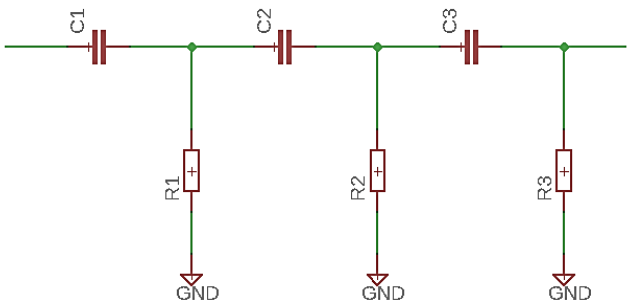
$$\frac{V_{out}}{V_{in}} = \frac{1}{1 - \frac{5}{\left(\frac{1}{\sqrt{6}}\right)^2}}$$

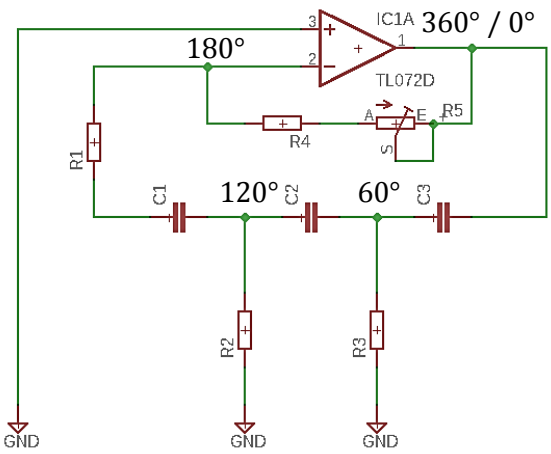
$$\frac{V_{out}}{V_{in}} = \frac{1}{1 - \frac{5}{\frac{1}{6}}} = \frac{1}{1 - 30}$$

$$\boxed{\frac{V_{out}}{V_{in}} = -\frac{1}{29}}$$

Por otro lado:

$$\boxed{f = \frac{1}{2\ \pi\ R\ C\ \sqrt{6}}}$$





$$\boxed{G = -\frac{R_f}{R_g} = -\frac{(R_4 + R_5)}{R_1}}$$

Ejemplo de aplicación:

$C_1 = C_2 = C_3 = 0{,}1\ \mu F$

$R_1 = R_2 = R_3 = 1000\ \Omega$

$$f = \frac{1}{2\,\pi\,R\,C\,\sqrt{6}} = \frac{1}{2\,\pi\,(1000)\,(0{,}1\ 10^{-6})\,\sqrt{6}} = 649{,}74\ Hz$$

$$G = -\frac{(R_4 + R_5)}{R_1} = -\frac{(R_4 + R_5)}{1000} = 29 \Rightarrow$$

$$R_4 + R_5 = 29000\ \ \Omega$$

Elijo:

$R_4 = 20\ K\Omega$

$R_5 = 20\ K\Omega\ (Potenciómetro)$