

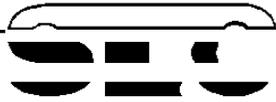
# Circuitos de Segundo Orden

$$H(s) = \frac{N(s)}{\left(\frac{s}{\omega_0}\right)^2 + 2z\left(\frac{s}{\omega_0}\right) + 1}$$

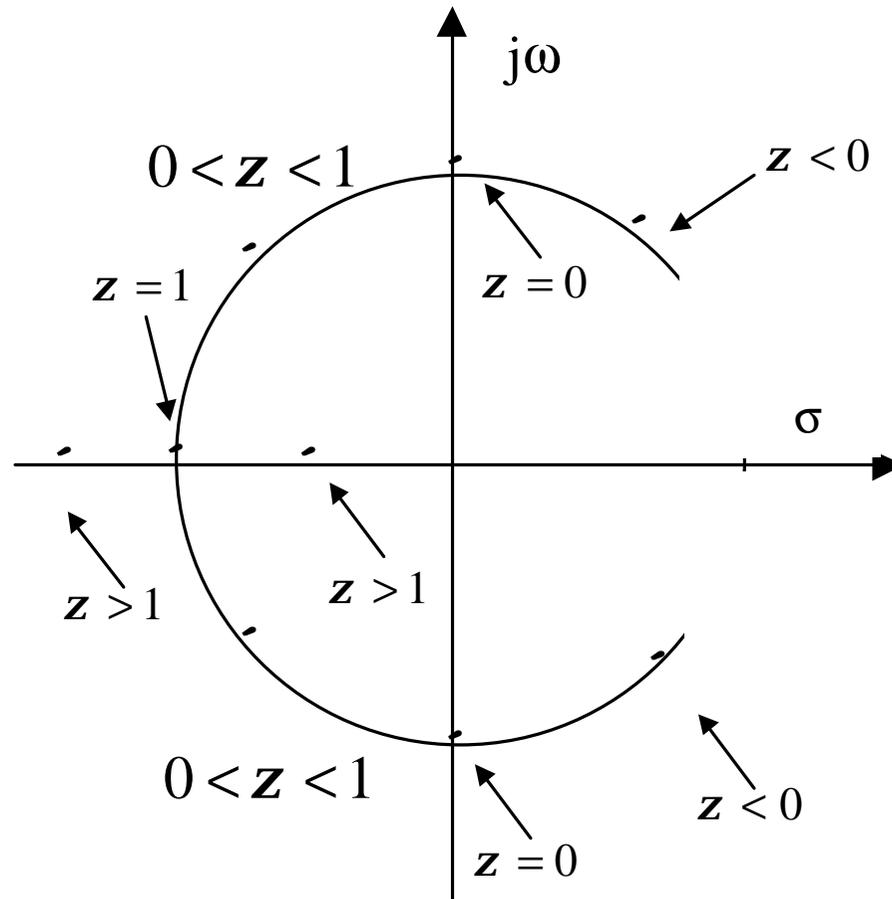
$$p_{1,2} = \left(-z \cdot \pm \sqrt{z^2 - 1}\right)\omega_0$$

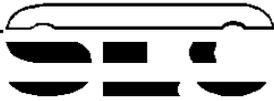
$$H(j\omega) = \frac{N(j\omega)}{1 - \left(\frac{\omega}{\omega_0}\right)^2 + \left(\frac{j\omega}{\omega_0 Q}\right)}$$

$$Q = \frac{1}{2z}$$



# Evolución de las raíces de un sistema de segundo orden





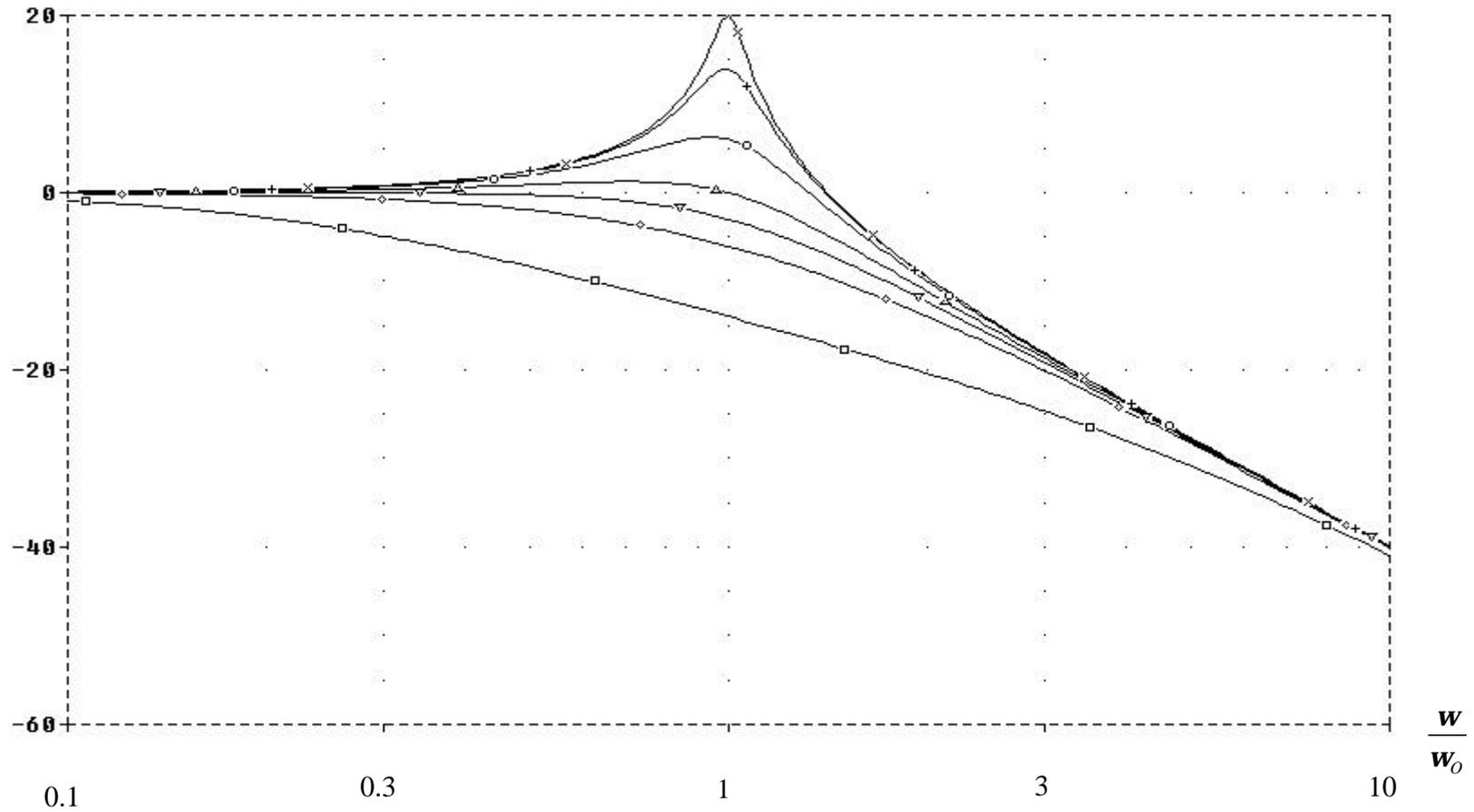
## Respuesta paso bajo

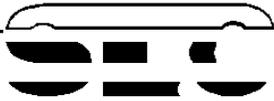
$$H(s) = H_{OLP} \frac{1}{\left(\frac{s}{\omega_0}\right)^2 + 2\zeta\left(\frac{s}{\omega_0}\right) + 1}$$

$$H(j\omega) = \frac{H_{OLP}}{1 - \left(\frac{\omega}{\omega_0}\right)^2 + j\left(\frac{\omega}{\omega_0 Q}\right)}$$



# Respuesta paso bajo para distintos valores de Q

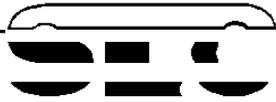




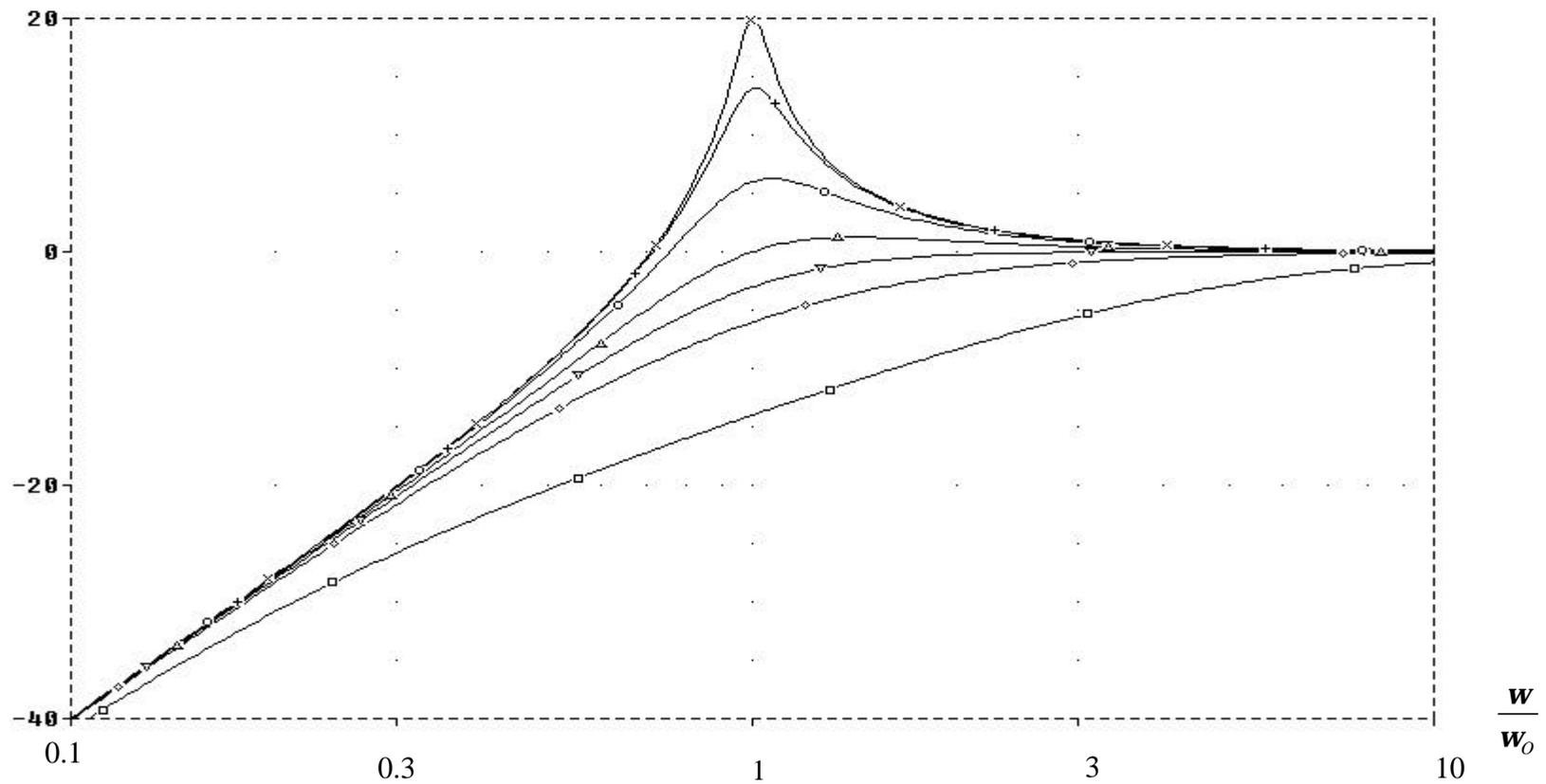
# Respuesta paso alto

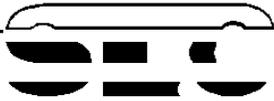
$$H(s) = H_{OHP} \frac{s^2}{\left(\frac{s}{\omega_0}\right)^2 + 2\zeta\left(\frac{s}{\omega_0}\right) + 1}$$

$$H(j\omega) = H_{OHP} \frac{-\left(\frac{\omega}{\omega_0}\right)^2}{1 - \left(\frac{\omega}{\omega_0}\right)^2 + \left(\frac{j\omega}{\omega_0 Q}\right)}$$



# Respuesta paso alto para diferentes valores de Q





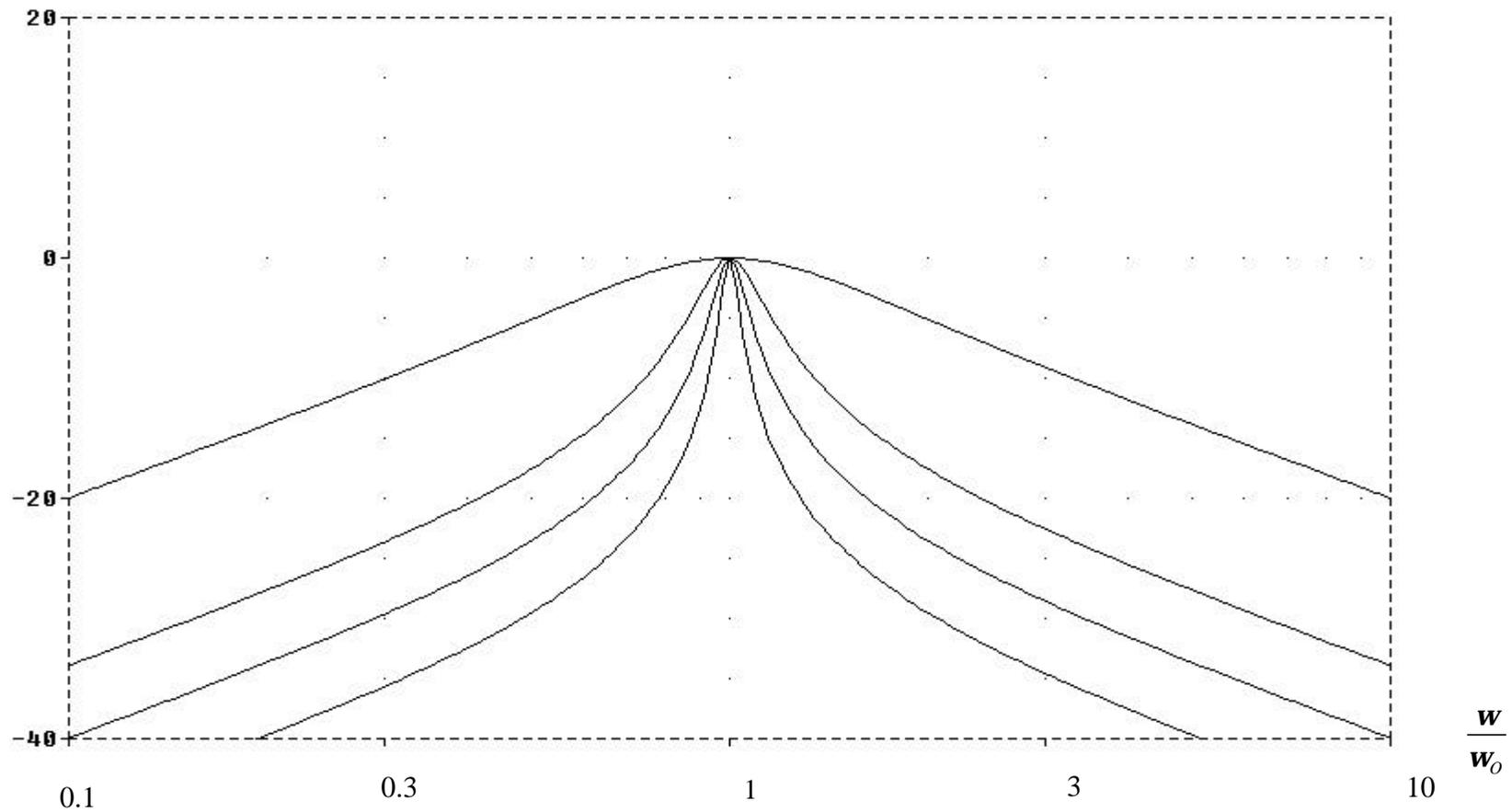
# Respuesta paso banda

$$H(s) = H_{OBP} \frac{2Z \frac{s}{\omega_0}}{\left(\frac{s}{\omega_0}\right)^2 + 2Z \left(\frac{s}{\omega_0}\right) + 1}$$

$$H(j\omega) = H_{OBP} \frac{\left(\frac{j\omega}{\omega_0 Q}\right)}{1 - \left(\frac{\omega}{\omega_0}\right)^2 + \left(\frac{j\omega}{\omega_0 Q}\right)}$$

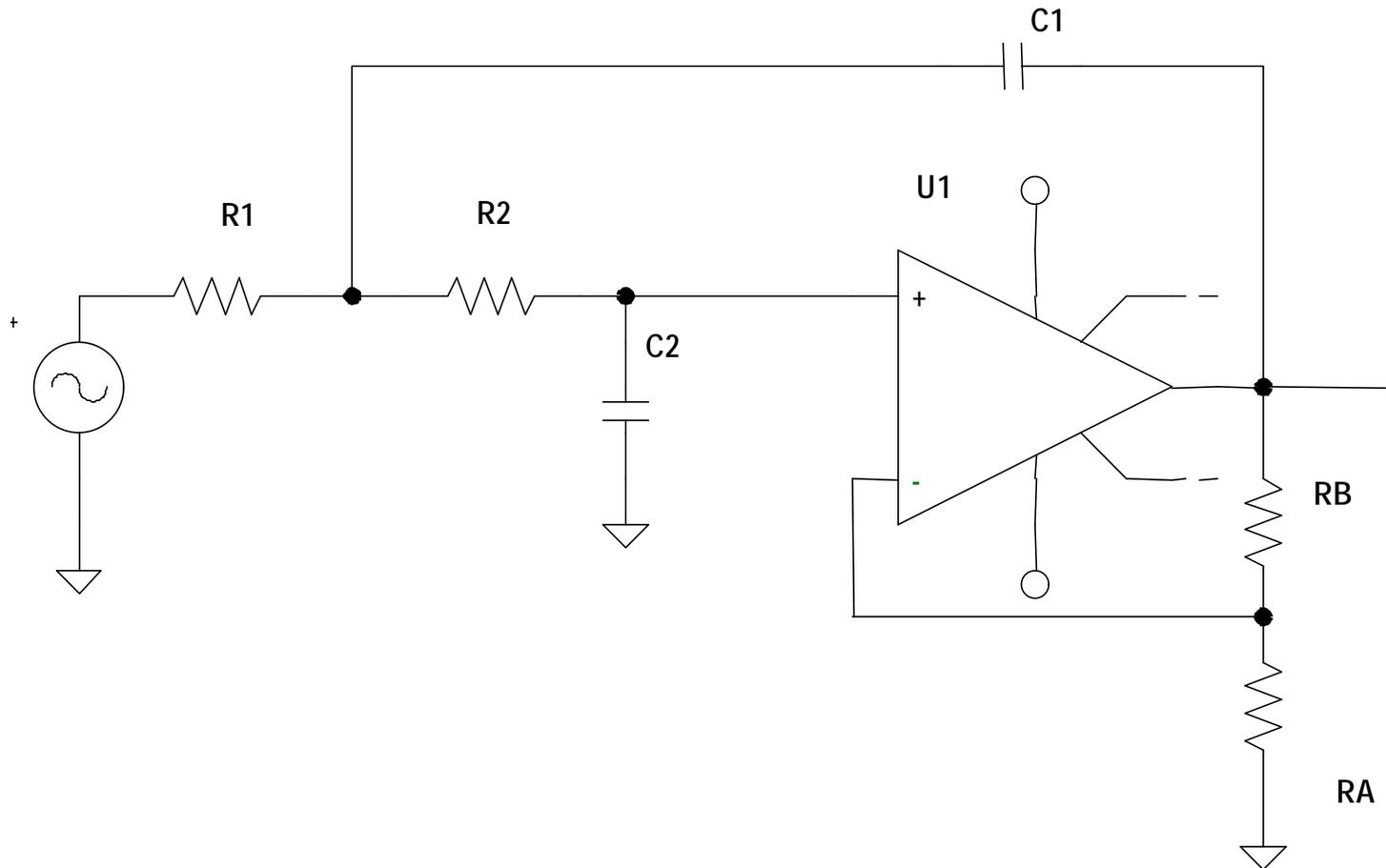


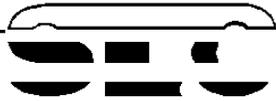
# Respuesta paso banda para distintos valores de $Q$





# Ejemplo de filtro paso bajo de segundo orden

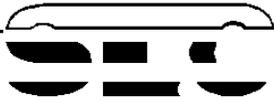




# Función de transferencia

$$H(s) = \frac{K}{R_1 C_1 R_2 C_2 s^2 + [(1-K)R_1 C_1 + R_1 C_2 + R_2 C_2]s + 1}$$

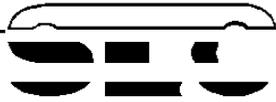
$$K = 1 + \frac{R_B}{R_A}$$



$$\text{Con: } R_1 = R_2 = R \quad C_1 = C_2 = C$$

$$H(s) = \frac{K}{(RCs)^2 + (3-K)RCs + 1}$$

$$w_o = \frac{1}{RC} \quad Q = \frac{1}{3-K} \quad H_{OLP} = K$$



# Ejemplo de filtro paso banda

