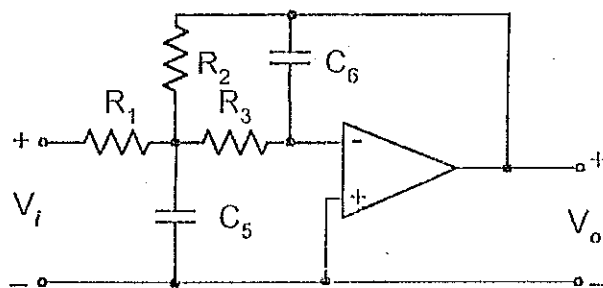


PASA BAJOS GANANCIA INFINITA

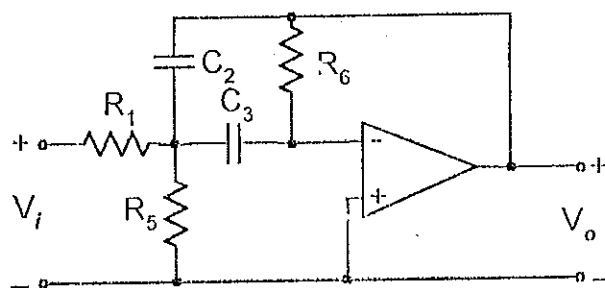


$$\frac{V_o(s)}{V_i(s)} = \frac{-1/R_1 R_3 C_5 C_6}{s^2 + s(1/C_5)(1/R_1 + 1/R_2 + 1/R_3) + 1/R_2 R_3 C_5 C_6}$$

$$\omega_o = \frac{1}{\sqrt{R_2 R_3 C_5 C_6}}$$

$$\frac{1}{Q} = \sqrt{\frac{C_6}{C_5}} \left(\sqrt{\frac{R_2 R_3}{R_1}} + \sqrt{\frac{R_3}{R_2}} + \sqrt{\frac{R_2}{R_3}} \right)$$

PASA BANDA GANANCIA INFINITA

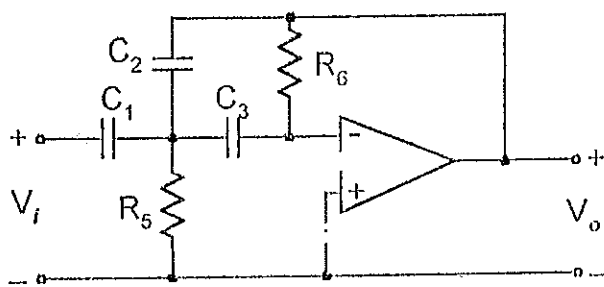


$$\frac{V_o(s)}{V_i(s)} = \frac{-\frac{s}{R_1 C_2}}{s^2 + s \left(\frac{1}{R_6 C_3} + \frac{1}{R_6 C_2} \right) + \left(\frac{1}{R_6 C_2 C_3} \right) \left(\frac{1}{R_1} + \frac{1}{R_5} \right)}$$

$$\omega_o = \sqrt{\frac{1 + R_5 / R_1}{R_5 R_6 C_2 C_3}}$$

$$\frac{1}{Q} = \frac{\sqrt{R_5 C_2 / R_6 C_3} + \sqrt{R_5 C_3 / R_6 C_2}}{\sqrt{1 + R_5 / R_1}}$$

PASA ALTOS GANANCIA INFINITA

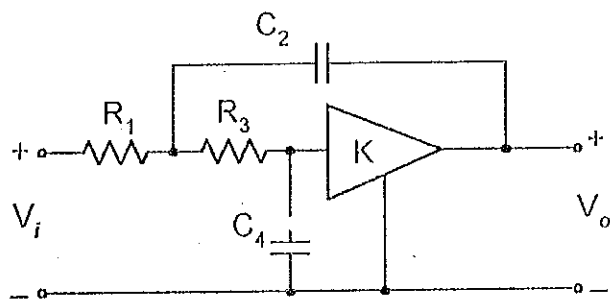


$$\frac{V_o(s)}{V_i(s)} = \frac{-s^2 \frac{C_1}{C_2}}{s^2 + s \left(\frac{1}{R_6} \right) \left(\frac{C_1}{C_2 C_3} + \frac{1}{C_2} + \frac{1}{C_3} \right) + \frac{1}{R_5 R_6 C_2 C_3}}$$

$$\omega_o = \frac{1}{\sqrt{R_5 R_6 C_2 C_3}}$$

$$\frac{1}{Q} = \sqrt{\frac{R_5}{R_6}} \left(\frac{C_1}{\sqrt{C_2 C_3}} + \sqrt{\frac{C_3}{C_2}} + \sqrt{\frac{C_2}{C_3}} \right)$$

PASA BAJOS SALLEN Y KEY



$$\frac{V_o(s)}{V_i(s)} = \frac{K / R_1 R_3 C_2 C_4}{s^2 + s(1/R_3 C_4 + 1/R_1 C_2 + 1/R_3 C_2 - K/R_3 C_4) + 1/R_1 R_3 C_2 C_4}$$

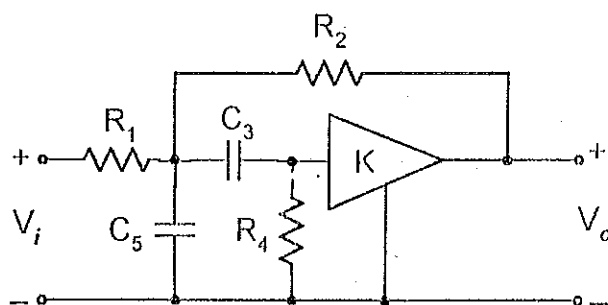
$$\omega_o = \frac{1}{\sqrt{R_1 R_3 C_2 C_4}}$$

$$\frac{1}{Q} = \sqrt{\frac{R_3 C_4}{R_1 C_2}} + \sqrt{\frac{R_1 C_4}{R_3 C_2}} + (1 - K) \sqrt{\frac{R_1 C_2}{R_3 C_4}}$$

Si se adopta $R_1 = R_3 = R$ y $C_2 = C_4 = C$ resulta

$$\omega = \frac{1}{RC} \quad \frac{1}{Q} = 3 - K$$

PASA BANDA SALLEN Y KEY



$$\frac{V_o(s)}{V_i(s)} = \frac{s K / R_1 C_5}{s^2 + s \left(1 / R_1 C_5 + 1 / R_2 C_5 + 1 / R_4 C_5 + 1 / R_4 C_3 - K / R_2 C_5 \right) + (1 / R_4 C_3 C_5) (1 / R_1 + 1 / R_2)}$$

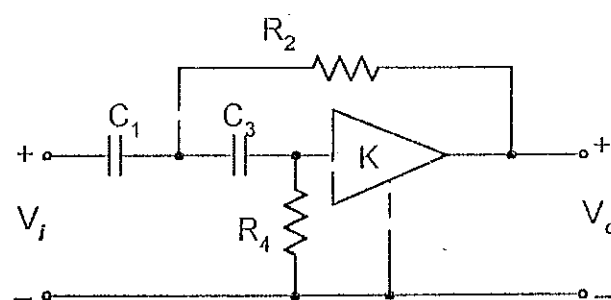
$$\omega_o = \sqrt{\frac{1 + R_1 / R_2}{R_1 R_4 C_3 C_5}}$$

$$\frac{1}{Q} = \frac{[1 + (R_1 / R_2)(1 - K)] \sqrt{R_4 C_3 / R_1 C_5} + \sqrt{R_1 C_3 / R_4 C_5} + \sqrt{R_1 C_5 / R_4 C_3}}{\sqrt{1 + R_1 / R_2}}$$

Si se adopta $R_1 = R_2 = R_4 = R$ y $C_3 = C_5 = C$ resulta

$$\omega_o = \frac{\sqrt{2}}{RC} \quad \frac{1}{Q} = \frac{4 - K}{\sqrt{2}}$$

PASA ALTOS SALLEN Y KEY



$$\frac{V_o(s)}{V_i(s)} = \frac{s^2 K}{s^2 + s \left(\frac{1}{R_2 C_1} + \frac{1}{R_4 C_3} + \frac{1}{R_4 C_1} - \frac{K}{R_2 C_1} \right) + \frac{1}{R_2 R_4 C_1 C_3}}$$

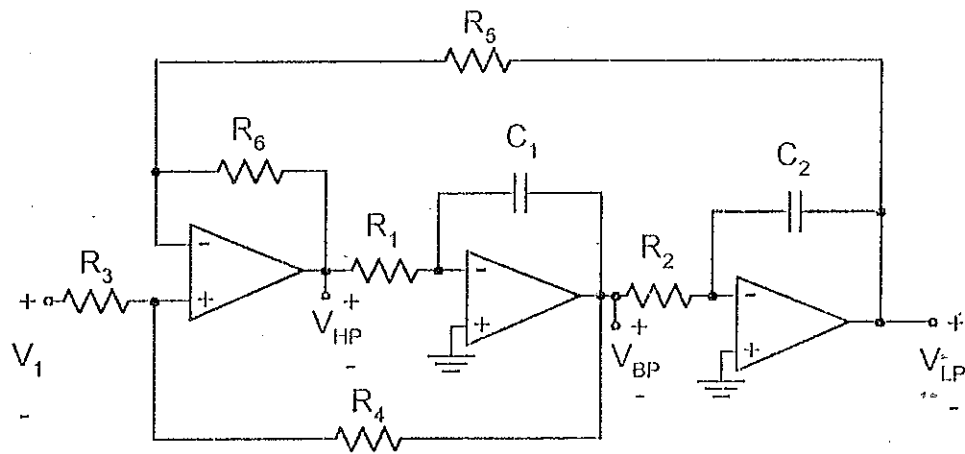
$$\omega_o = \frac{1}{\sqrt{R_2 R_4 C_1 C_3}}$$

$$\frac{1}{Q} = \sqrt{\frac{R_4 C_3}{R_2 C_1}} + \sqrt{\frac{R_2 C_1}{R_4 C_3}} + \sqrt{\frac{R_2 C_3}{R_4 C_1}} - K \sqrt{\frac{R_4 C_3}{R_2 C_1}}$$

Si se adopta $R_2 = R_4 = R$ y $C_1 = C_3 = C$ resulta

$$\omega = \frac{1}{RC} \quad \frac{1}{Q} = 3 - K$$

FILTRO KHN



$$\frac{V_{BP}(s)}{V_s(s)} = \frac{- \left[\frac{1 + R_6 / R_5}{1 + R_3 / R_4} \frac{s}{R_1 C_1} \right]}{D(s)}$$

$$\frac{V_{LP}(s)}{V_s(s)} = \frac{\frac{1 + R_6 / R_5}{1 + R_3 / R_4} \frac{1}{R_1 R_2 C_1 C_2}}{D(s)}$$

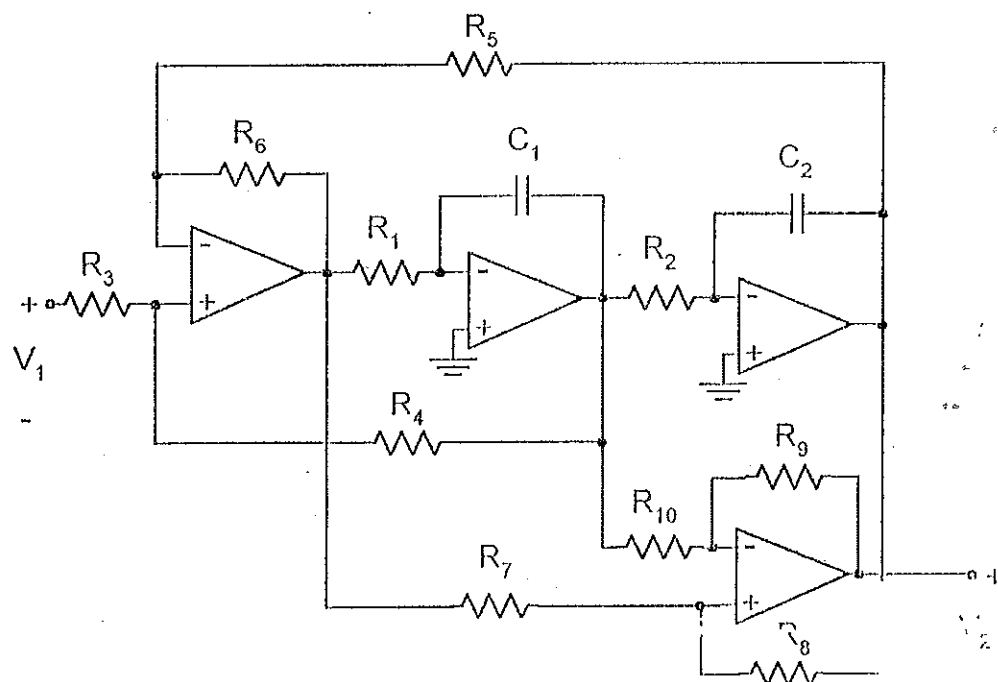
$$\frac{V_{HP}(s)}{V_s(s)} = \frac{\frac{1 + R_6 / R_5}{1 + R_3 / R_4} s^2}{D(s)}$$

$$D(s) = s^2 + \frac{s}{R_1 C_1} \frac{1 + R_6 / R_5}{1 + R_4 / R_3} + \frac{R_6 / R_5}{R_1 R_2 C_1 C_2}$$

$$\omega_o = \sqrt{\frac{R_6 / R_5}{R_1 R_2 C_1 C_2}}$$

$$\frac{1}{Q} = \frac{1 + R_6 / R_5}{1 + R_4 / R_3} \sqrt{\frac{R_5 R_2 C_2}{R_6 R_1 C_1}}$$

FILTRO BICUADRATICO



$$\frac{V_2(s)}{V_1(s)} = \frac{1 + R_9/R_{10}}{1 + R_7/R_8} \frac{1 + R_6/R_5}{1 + R_3/R_4} \frac{s^2 + \frac{s}{R_1 C_1} \frac{1 + R_7/R_8}{1 + R_{10}/R_9} + \frac{R_7/R_8}{R_1 R_2 C_1 C_2}}{s^2 + \frac{s}{R_1 C_1} \frac{1 + R_6/R_5}{1 + R_4/R_3} + \frac{R_6/R_5}{R_1 R_2 C_1 C_2}}$$

$$\omega_z = \sqrt{\frac{R_7/R_8}{R_1 R_2 C_1 C_2}}$$

$$\omega_p = \sqrt{\frac{R_6/R_5}{R_1 R_2 C_1 C_2}}$$

$$\frac{1}{Q_z} = \frac{1 + R_7/R_8}{1 + R_{10}/R_9} \sqrt{\frac{R_8 R_2 C_2}{R_7 R_1 C_1}}$$

$$\frac{1}{Q_p} = \frac{1 + R_6/R_5}{1 + R_4/R_3} \sqrt{\frac{R_5 R_2 C_2}{R_6 R_1 C_1}}$$