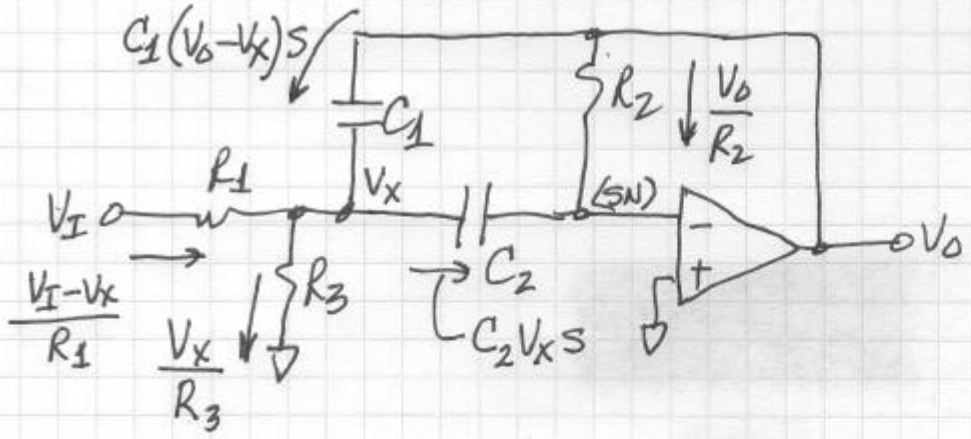
Ugly Xfer Function



AT NODE SN: $C_2 V_x s + \frac{V_o}{R_2} = 0$

THUS: $V_x = -\frac{V_o}{R_2 C_2 s}$

AT NODE V_x: $\frac{V_I - V_x}{R_1} - \frac{V_x}{R_3} + C_1(V_o - V_x)s - C_2 V_x s = 0$

COLLECTING TERMS:

$$\frac{V_I}{R_1} + C_1 V_o s = V_x\left[\frac{1}{R_1} + \frac{1}{R_3} + C_1 s + C_2 s\right]$$

THEN: $$V_x = \frac{\frac{V_I}{R_1} + C_1 V_o s}{\frac{1}{R_1} + \frac{1}{R_3} + (C_1 + C_2)s} = -\frac{V_o}{R_2 C_2 s}$$

$$\frac{V_I}{1 + \frac{R_1}{R_3} + R_1(C_1+C_2)s} = -V_o\left[\frac{1}{R_2 C_2 s} + \frac{C_1 s}{\frac{1}{R_1} + \frac{1}{R_3} + (C_1+C_2)s}\right]$$

$$\frac{V_I}{1 + \frac{R_1}{R_3} + R_1(C_1+C_2)s} = -V_o\left[\frac{1}{R_2 C_2 s} + \frac{R_1 C_1 s}{1 + \frac{R_1}{R_3} + R_1(C_1+C_2)s}\right]$$

(2)

$$\frac{V_1}{\cancel{1+\frac{R_1}{R_3}+R_1(C_1+C_2)s}} = -V_o\left[\frac{1+\frac{R_1}{R_3}+R_1(C_1+C_2)s+R_2C_2R_1C_1s^2}{\{R_2C_2s\}*\cancel{\{1+\frac{R_1}{R_3}+R_1(C_1+C_2)s\}}}\right]$$

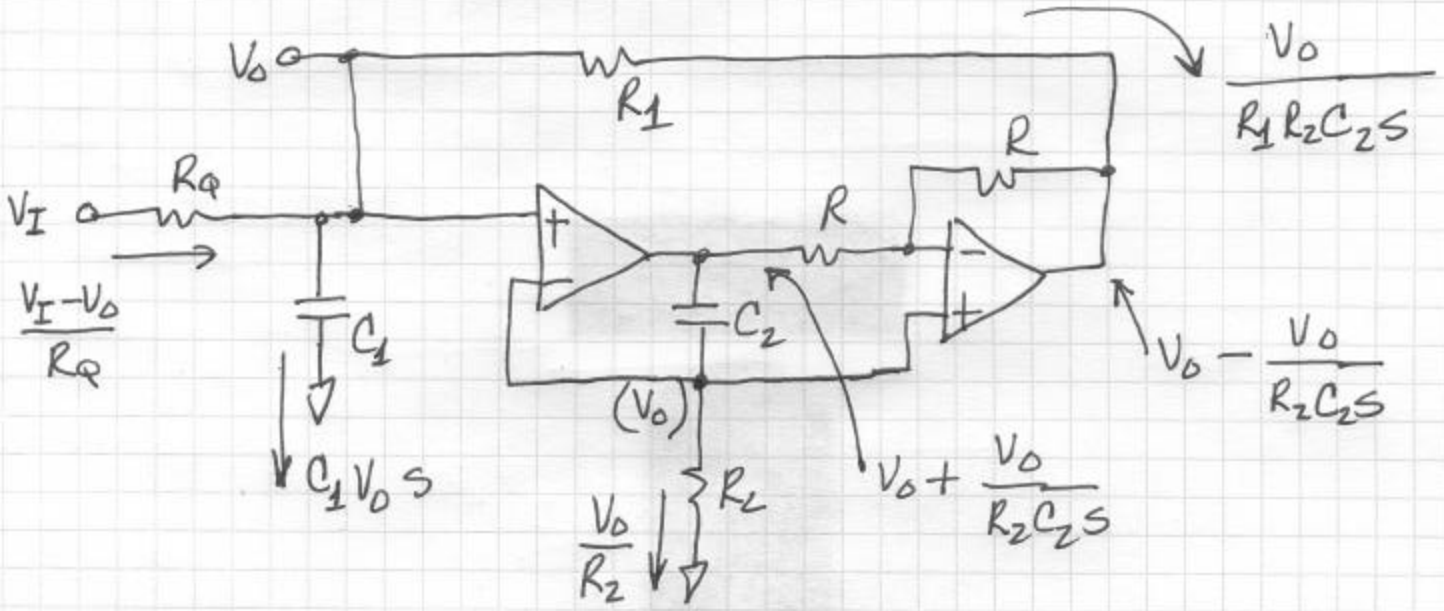
$$V_o = -V_1 \frac{R_2C_2s}{R_1R_2C_1C_2s^2+R_1(C_1+C_2)s+1+\frac{R_1}{R_3}}$$

$$\text{GAIN} = \frac{R_2C_2}{R_1(C_1+C_2)}$$

$$f_{\text{CENTER}} = \frac{1}{2\pi}\sqrt{\frac{(1+R_1/R_3)}{R_1R_2C_1C_2}}$$

$$\text{Bandwidth} = \frac{1}{2\pi}\cdot\frac{(C_1+C_2)}{R_2C_1C_2}$$

Gyrator BP Filter



SUM CURRENTS AT V_o NODE:

$$\frac{V_I - V_o}{R_Q} - C_1 V_o S - \frac{V_o}{R_1 R_2 C_2 S} = 0$$

$$\frac{V_I}{R_Q} = V_o \left[\frac{1}{R_Q} + C_1 S + \frac{1}{R_1 R_2 C_2 S} \right]$$

$$V_I = V_o \left[1 + R_Q C_1 S + \frac{R_Q}{R_1 R_2 C_2 S} \right]$$

$$V_o = V_I * \frac{R_1 R_2 C_2 S}{R_Q R_1 R_2 C_1 C_2 S^2 + R_1 R_2 C_2 S + R_Q}$$

$$V_o = V_I * \frac{\frac{R_1 R_2 C_2}{R_Q} S}{R_1 R_2 C_1 C_2 S^2 + \frac{R_1 R_2 C_2}{R_Q} S + 1}$$

GAIN = 1 $\quad f_{CENTER} = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$ $\quad$ BANDWIDTH $= \frac{1}{2\pi R_Q C_1}$

INDEPENDENT