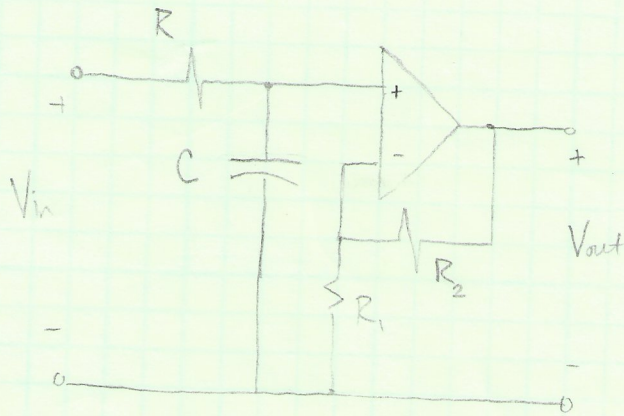


Active Low-pass filter

$$A_v = \frac{(1 + R_2/R_1)}{\sqrt{1 + \left(\frac{f}{f_c}\right)^2}}$$

$$DC_{gain} = \left(1 + \frac{R_2}{R_1}\right)$$

$$f_c = \frac{1}{2\pi RC}$$



Bass: 20-150 Hz

Upper Bass: 150-250 Hz

$$f_c = 200 \text{ Hz}$$

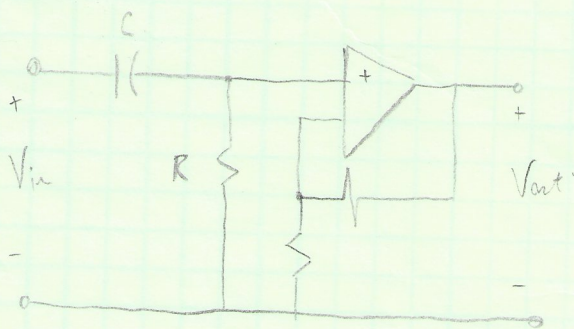
$$\Rightarrow 200 = \frac{1}{2\pi RC} = 200(2\pi) = \frac{1}{RC} \Rightarrow RC = \frac{1}{2\pi(200)}$$

$$\Rightarrow RC = 0.0007962 \Rightarrow C = 0.1 \mu\text{F} \\ R = 7.962 \text{ k}\Omega \approx 8 \text{ k}\Omega$$

Active High Pass Filter

Upper midrange: 2 kHz - 4 kHz

High frequency: 4 kHz - 20 kHz



$$f_c = 4 \text{ kHz}$$

$$\Rightarrow 4000 = \frac{1}{2\pi RC} = 4000(2\pi) = \frac{1}{RC} \Rightarrow RC = \frac{1}{2\pi(4000)}$$

$$\Rightarrow RC = 0.00004 \Rightarrow C = 0.01 \mu\text{F} \\ R = 4 \text{ k}\Omega$$

Active Band-Pass Filter

• Resonant frequency: $f_r = \sqrt{f_L \times f_H}$

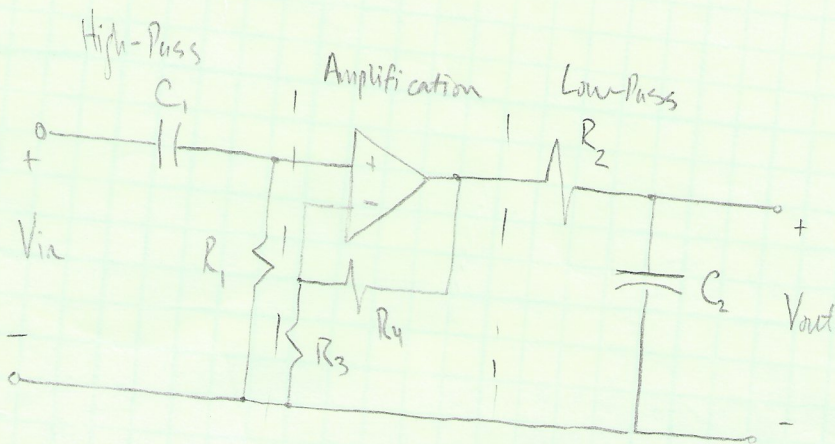
DC gain = $(1 + \frac{R_2}{R_1})$

• Q factor: $Q = \frac{1}{\alpha}$

$Q = \frac{f_r}{BW}$

• Damping: $\zeta = \frac{\alpha}{2}$

$BW = f_H - f_L$



$$f_{c_H} = \frac{1}{2\pi R_1 C_1}$$

$$f_{c_H} = 250 \text{ Hz}$$

$$\Rightarrow 250 = \frac{1}{2\pi R_1 C_1}$$

$$\Rightarrow R_1 C_1 = \frac{1}{2\pi(250)} = 0.000637$$

$$\Rightarrow C_1 = 0.1 \mu\text{F}$$

$$R_1 = 6.37 \text{ k}\Omega$$

$$f_{c_L} = \frac{1}{2\pi R_2 C_2}$$

$$f_{c_L} = 3 \text{ kHz}$$

$$\Rightarrow 3000 = \frac{1}{2\pi R_2 C_2}$$

$$R_2 C_2 = \frac{1}{2\pi(3000)}$$

$$\Rightarrow R_2 C_2 = 0.000053$$

$$C_2 = 0.01 \mu\text{F}$$

$$R_2 = 5.31 \text{ k}\Omega$$