Sallen-Key architecture bandpass filter

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ECE 262
PROJECT PROPOSAL
This project aims to simulate and layout a Sallen-key architecture bandpass filter with -3dB bandwidth from 1MHz to 2MHz. The Sallen-key architecture will implement a double pole Butterworth response using a unity gain op amp to achieve a sharp knee at the cutoff frequencies.
Block Diagram 1

- The gain block diagram of a Sallen-Key arch.

Figure 4. Gain-Block Diagram of the Generalized Sallen-Key Filter

- The ideal transfer function

\[
\frac{V_O}{V_i} = \left(\frac{c}{b}\right) \left\{ \frac{1}{1 + \frac{1}{a(f)b} - \frac{d}{b}} \right\}
\]
Block Diagram 2

Circuit Estimates

**High-pass Stage**
- $C1, C2 = 9 \text{ pF}$
- $R1 = 12.5 \text{ k}\Omega$
- $R2 = 25 \text{ k}\Omega$

**Low-pass Stage**
- $R3, R4 = 12.5 \text{ k}\Omega$
- $C3 = 9 \text{ pF}$
- $C4 = 6 \text{ pF}$
OTA Schematic
OTA Simulation

66 dB pass band magnitude response

135.21° phase angle at -3dB
- Sharp attenuation knee
- Actual -3dB cutoff $f = 2.19$ MHz
- $-84.512^\circ$ phase angle at -3dB
Highpass Simulation

-4.9 dB at 1MHz
Filter Layout

- W = 1124.57 um
- L = 1058.57 um
- Total Area = 1.19 cm²
Design Challenges

- OTA phase response
- Need large values of C
- Sallen-key architecture begins to fail at high freqs. (dependent on GB of the opamp)