ELC 3414: Electronic Design

Lab 8: Active Filters

Introduction

Filters are used to process signals by removing unwanted frequencies. These unwanted frequencies (and corresponding filter category) can be low (high-pass), high (low-pass), both high and low (band-pass), or in the middle (band-stop). For example, all FM radios use a filter to remove the high-frequency "carrier" signal on which the main audio signal ("baseband") is transmitted. As we've seen before, circuits with active components often have a better response than circuits with only passive components. Thus, we will investigate the design of an active filter.

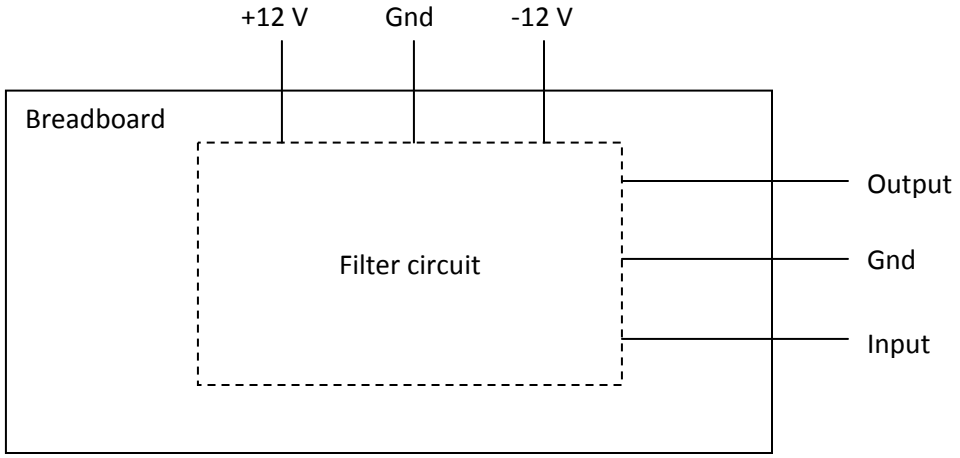
Objective

The goal of this lab is to design and measure the performance characteristics of low and high pass active filters constructed according to the Sallen-Key design methodology. This will be done both quantitatively, using a Bode plot, and qualitatively, by listening to the affect of the filters on an audio signal.

Procedure

Using the Sallen-Key method, design both a low and a high pass active filter. These filters can be cascaded to produce a band pass filter. Model all three circuits in PSpice (using a uA741 Op Amp) and produce Bode plots for each. Construct the circuits in hardware (using an LM741 Op Amp) and produce Bode plots of each for comparison to your simulated data.

Design both of your filters to have a 2nd order Butterworth (maximally flat) response. Choose the cutoff frequency of each according to the following constraint: 100 Hz ≤ f_{CHP} ≤ f_{CLP} ≤ 10 kHz. Construct your circuits according to the following diagram:



Deliverables

Once you have constructed your filters and developed your Bode plot, demonstrate one of your filters (low, high, or band-pass) to your instructor.

Submit a simple report, with the following items:

- Schematic of each circuit
- Bode plots of your simulated and actual circuits (6 plots)
- Comparison of the simulated to the measured response
- Discussion of the responses of the filters in general