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5193-6096

Report – Active Filter

Introduction

The purpose of this module is to explore the creation of an active filter that will meet several design specifications. There is a single main circuit to be designed for this module. The specifications include requirements for center frequency, passband width, stop band attenuation, and passive component tolerance. In order to complete the module, a two-stage active filter will be utilized. The details of the design are explained below.

Design

The filter was designed to meet the following requirements:

- The filter shall be a passband filter centered at 1096Hz +/- 5%.
- The filter shall have a passband width of 109Hz +/- 5%.
- The filter shall have a stop band attenuation of at least -30dB per decade.
- All passive components shall have a tolerance of 5% or greater.

With these requirements in mind, TI FilterPro was used to create an initial design for the filter. A two stage 4th order Bessel filter was utilized, centered around the LT1632 opamp from our parts kit.

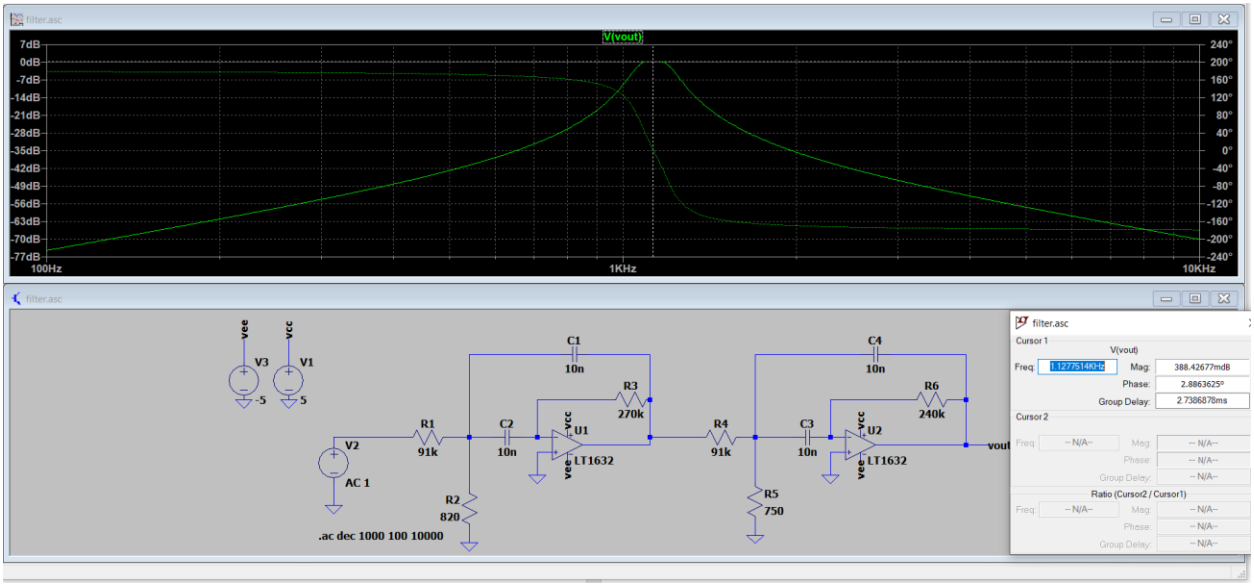

Figure 1. LTSpice schematic/simulation results

The filter designed in FilterPro was then built using LTSpice. The simulation results show a center frequency of 1127 Hz, and a pass bandwidth within tolerance. The circuit was then constructed physically on a breadboard.

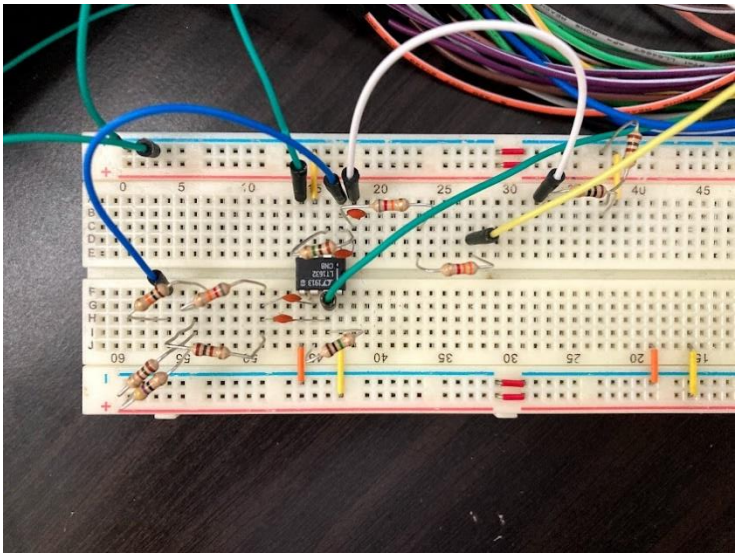

Figure 2. Filter circuit on breadboard

Because of the properties of the breadboard and tolerance of the components, some resistor values had to be changed in order to keep the design within specifications. However, the ultimate design of the filter remained the same.

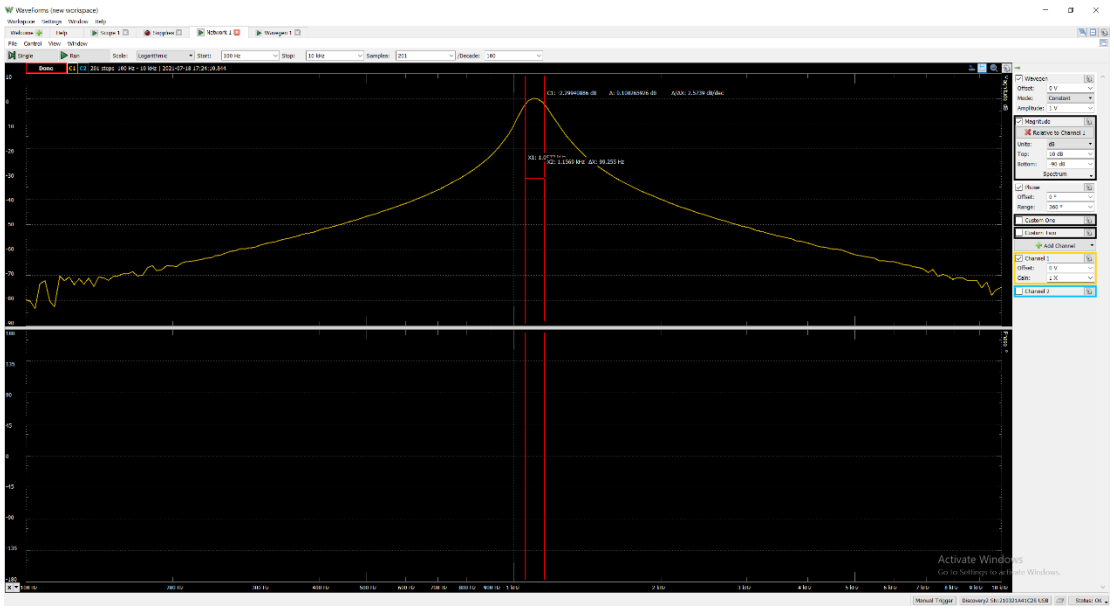

Figure 3. Filter response of physical circuit

The magnitude response shown above was plotted in WaveForms using the DAD board. It confirms that after slight modifications, the physical implementation of the circuit meets the design requirements outlined at the beginning of this report.

Design 1 - Active Filter - Bill of Materials				
Description	Quantity	Price/Part	Part Number	Source
Resistor - 240k Ohms - Through-Hole	1	$ 0.10	CF14JT240K	https://www.digikey.com/en/products/detail/stackpole-electronics-inc/CF14JT240K/1741357
Resistor - 270k Ohms - Through-Hole	1	$ 0.10	CFM14JT270K	https://www.digikey.com/en/products/detail/stackpole-electronics-inc/CFM14JT270K/1742156
Resistor - 91k Ohms - Through-Hole	2	$ 0.10	CF14JT91K0	https://www.digikey.com/en/products/detail/stackpole-electronics-inc/CF14JT91K0/1741530
Resistor - 820 Ohms - Through-Hole	1	$ 0.10	CF14JT820R	https://www.digikey.com/en/products/detail/stackpole-electronics-inc/CF14JT820R/1741515
Resistor - 750 Ohms - Through-Hole	1	$ 0.10	CF14JT750R	https://www.digikey.com/en/products/detail/stackpole-electronics-inc/cf14jt750r/1741501
Capacitor - 10uF - Through-hole	4	$ 0.48	FA18C0G2A103JRU06	https://www.digikey.com/en/products/detail/tdk-corporation/FA18C0G2A103JRU06/8343836
Opamp	1	$ 8.40	LT1632CN8#PBF	https://www.digikey.com/en/products/detail/analog-devices-inc/LT1632CN8-PBF/891007
	Total:	$ 10.92		

Conclusion

The design and implementation of this module was overall a success. FilterPro proved a useful tool to outline a basic design that provided a near ideal response in simulations. However, the physical implementation did offer some challenge. A decent amount of trial and error was required to pinpoint the center frequency and adjust the bandwidth. Ultimately, however, the physical implementation performed even better than the initial simulations. The circuit designs demonstrated met all requirements for this module.