Engr 203 Graphic Equalizer

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Abstract

This lab uses analog filters to create a 3-band audio visualizer. Unlike PCM, the parallel topology splits the current, so gain is added first. The tuning of each cutoff may present a challenge with PWM dimming. Additionally, channel gain may vary since signals with longer duty cycles carry more power.

Design

Stage 1 amplifies the input from 4-volts to 6.

Stage 2 filters each frequency channel in parallel.

Stage 3 amplifies current to control LED brightness.

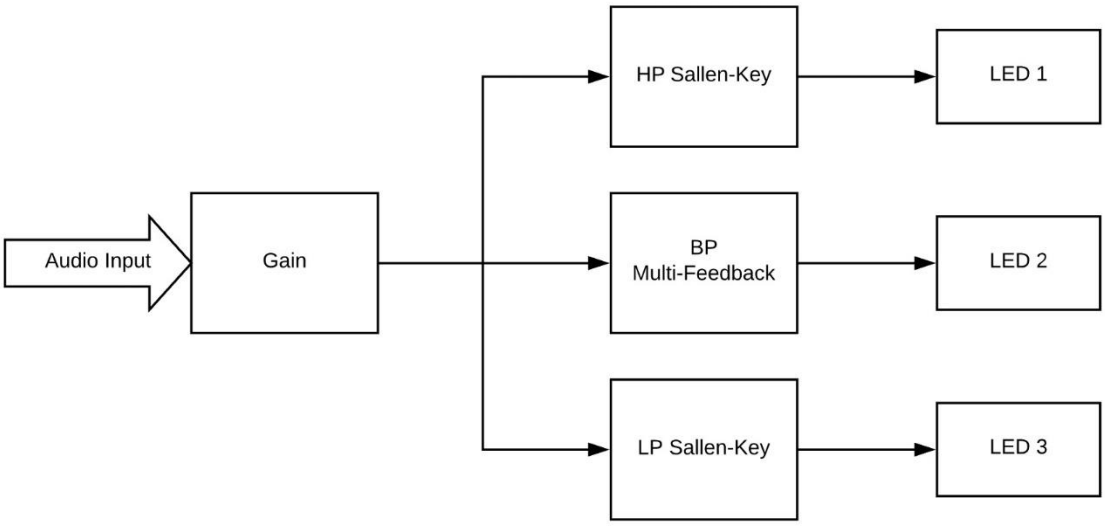

Figure 1 – Stage 1-3 Block Diagram

Schematic

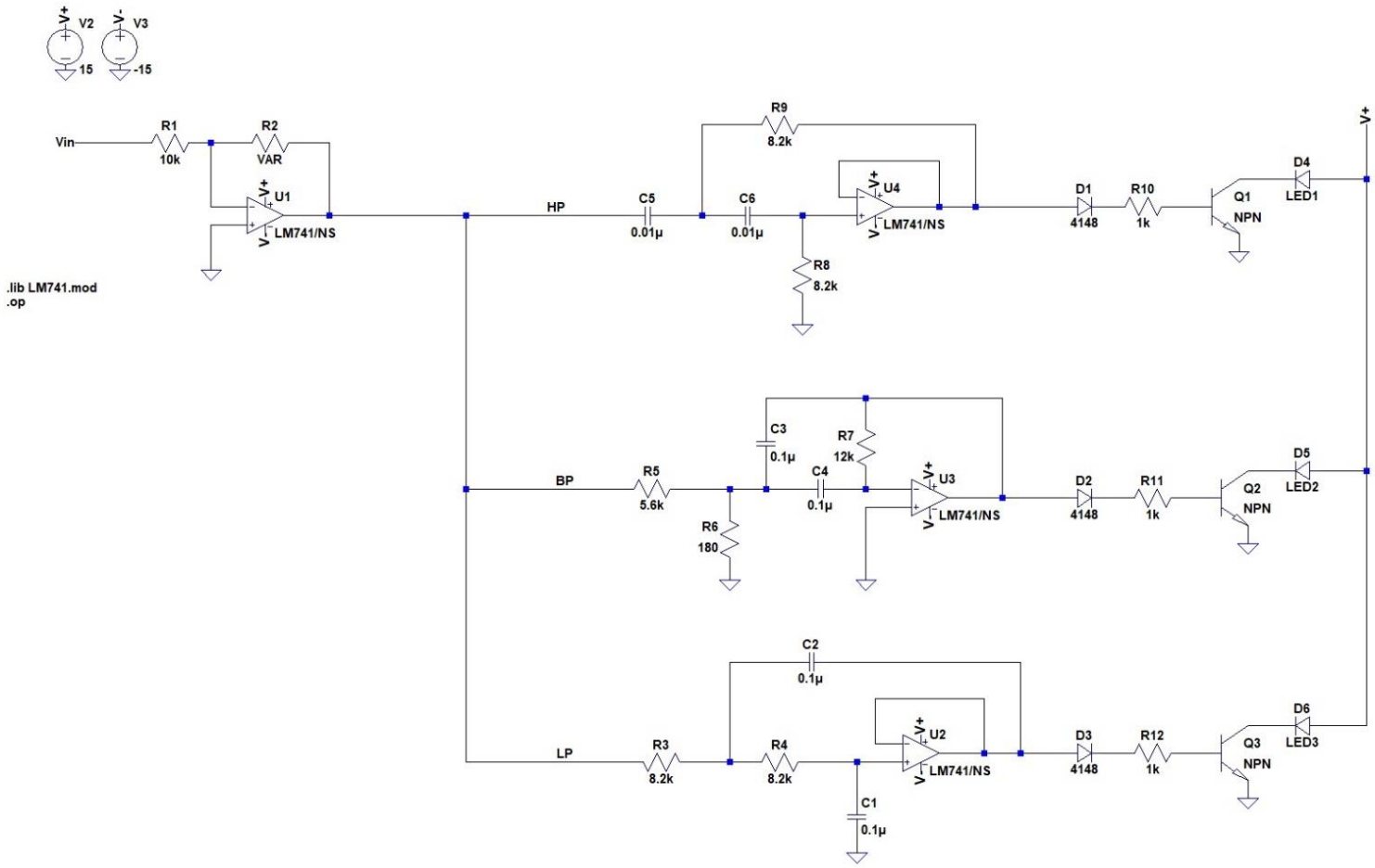

Figure 2 - Graphic Equalizer Schematic

Tests

Device performance will be tested using FL studio 12. The band filter plugin will allow for easy and measurable frequency modulation to characterize the cutoff of each filter as well as the voltage transfer function from input to LED. Because FLS12 has C++ and python integration, it would be possible to conduct high precision testing with better graphical features than MATLAB via Virtual Studio Technology (VST) modules created for the purpose. For this project however, the filters are only second order and distinctions will be made roughly for visual effect.

Summary

A 3-band analog filter was created for an audio visualizer and tested with various waveforms. Due to the low power of the circuit, it was difficult to avoid overloading or underloading the filter stage. The prototype worked only briefly with flickering, possibly attributed to previous shorting issues effecting the MOSFET. It appeared that using jumper cables created enough resistance to degrade the signal, which manifested as noise on the oscilloscope. Another possible source of error comes from the fact that adjacent frequency bands often have the same note ringing in different octaves due to music production optimizations, showing the limitations of analog for this purpose. A possible future experiment would be to use a photodetector to recover audio information from each channel via light; comparing this to the simulated output would help quantify the visual aspect and allow for PID feedback control of the gain stage which is fixed in this example.

Sources

http://www.midiox.com/index.htm?http://www.midiox.com/myoke.htm

https://www.electronics-tutorials.ws/filter/filter_8.html

Microelectronic Circuits (The Oxford Series in Electrical and Computer Engineering) 7th edition