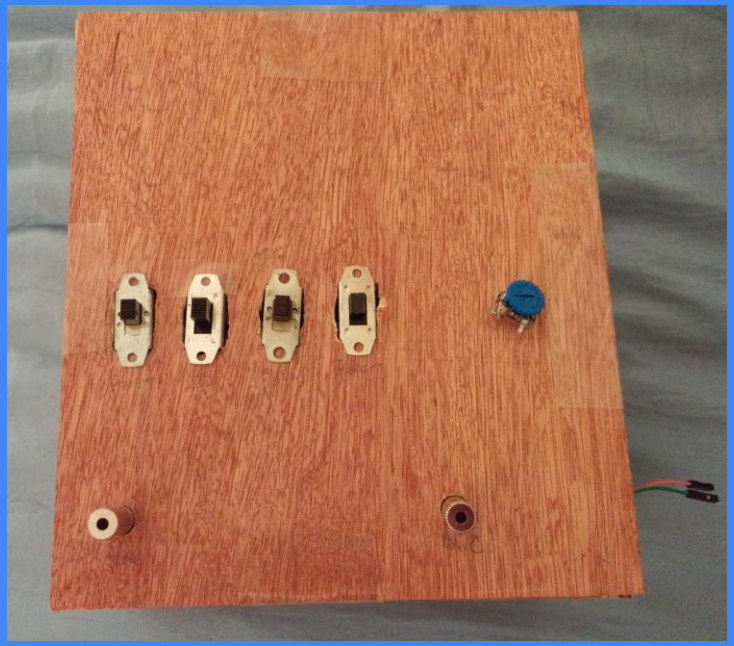
Audio Effects Box

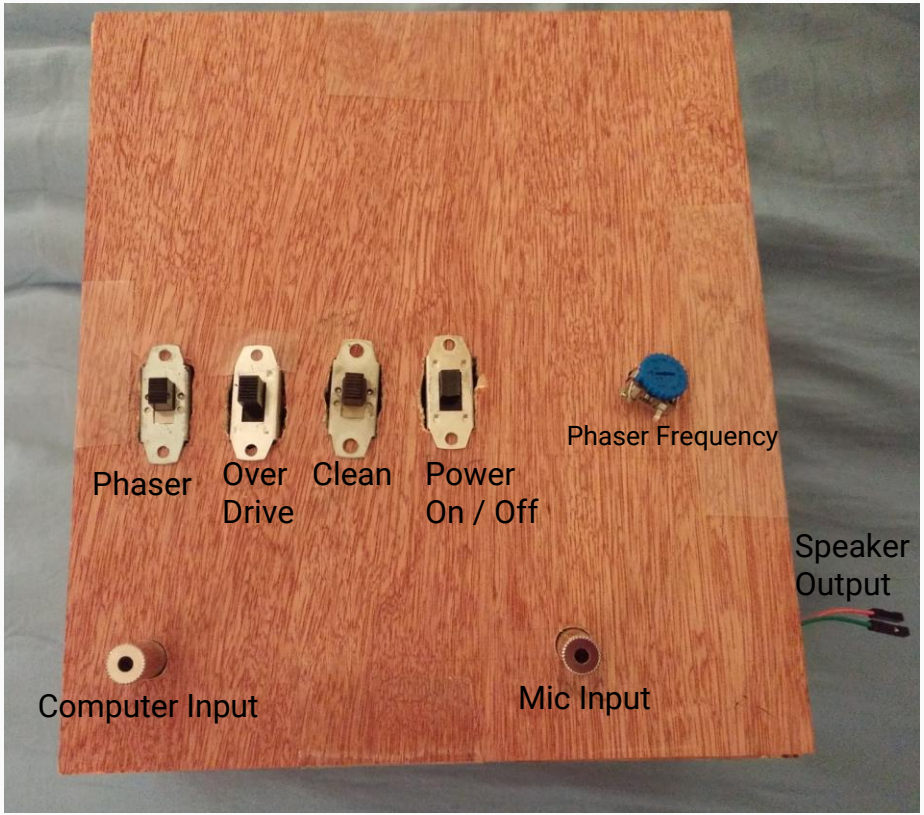


ELEG 312 Final Project, 12/6/16

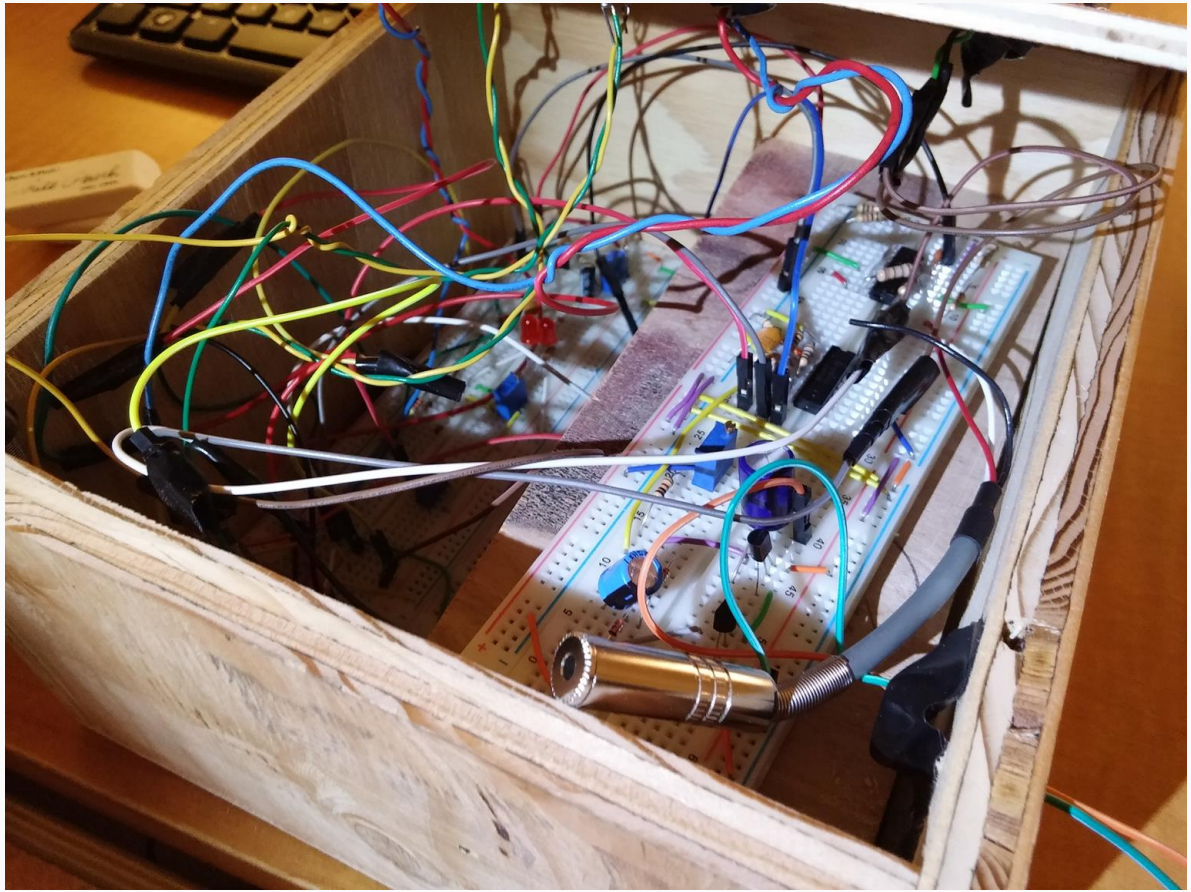
Group Members: Casey Campbell, Tianne Lassiter, Rohail Malik, Abraham McIlvaine, Benjamin Steenkamer

Overview

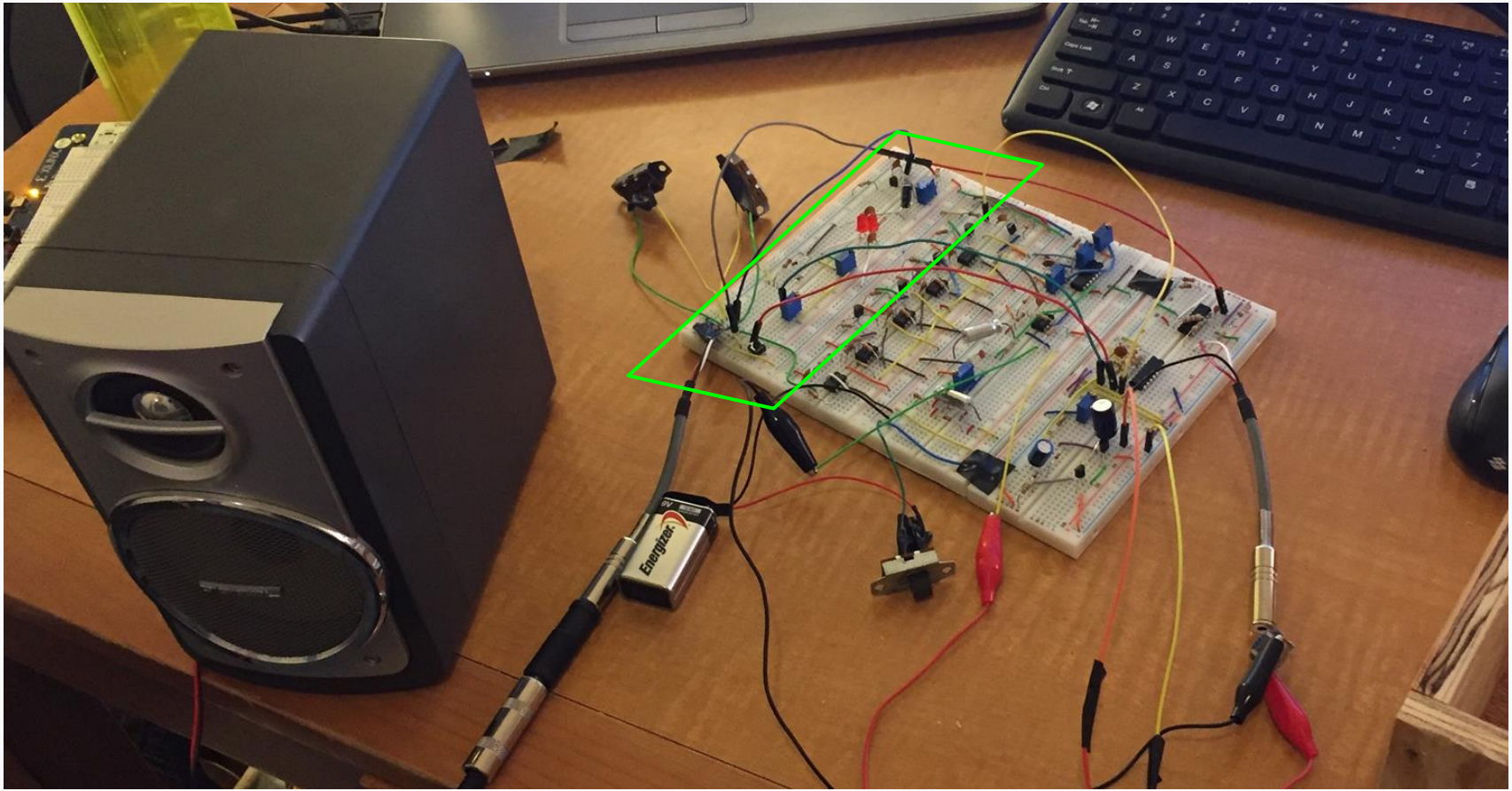
- Two 3.5 mm input jacks
  - Microphone and computer
- Two effects can be applied to the signal: overdrive or phaser.
  - Uses switches to turn on the effects.
  - Knob to change phaser.
- The resulting output is heard through the speaker.
- Powered by a single 9V battery.
  - On / Off switch
- Output stage for speaker and preamp for microphone.



Circuit Packaging



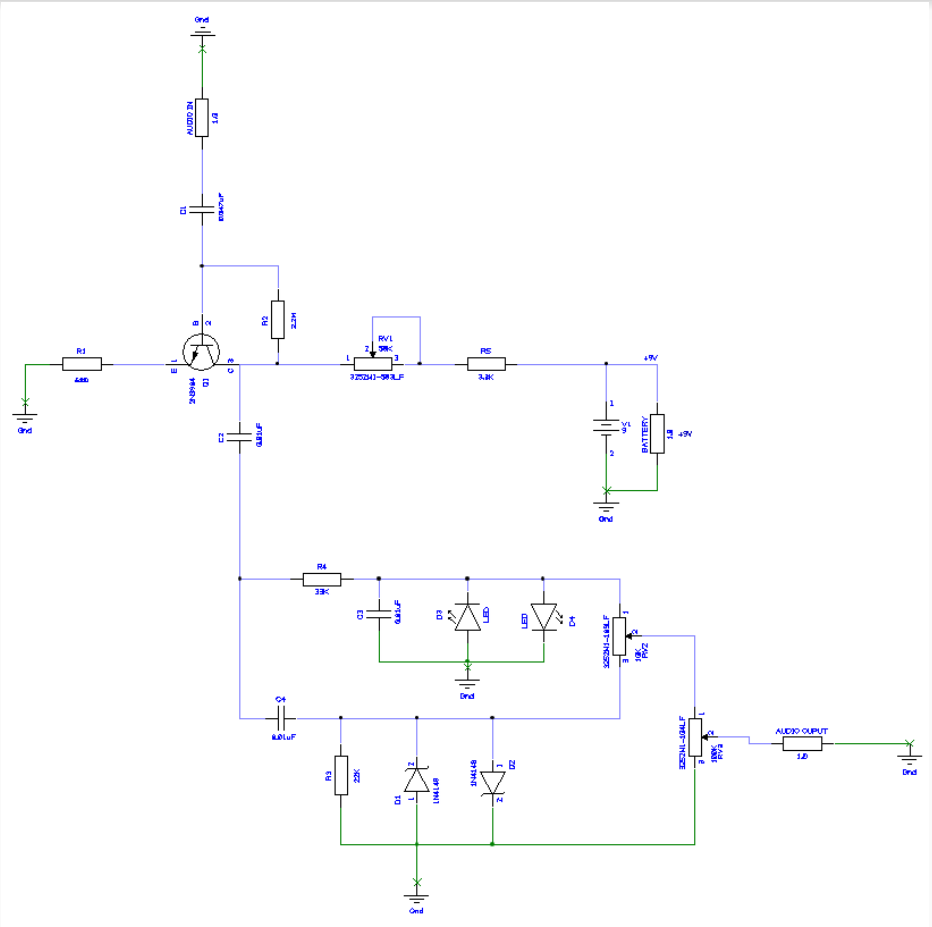
Overdrive Circuit



Overdrive Schematic

- Common emitter amplifier (2N3904) with emitter degeneracy.
  - Feedback resistor
- Power Source: 9V
- Low pass and high pass filters in parallel.
- In each filter, the signal is clipped by the diodes.
  - This is what creates the overdrive effect.

Based on: http://www.instructables.com/id/Overdrive-Pedal/?ALLSTEPS

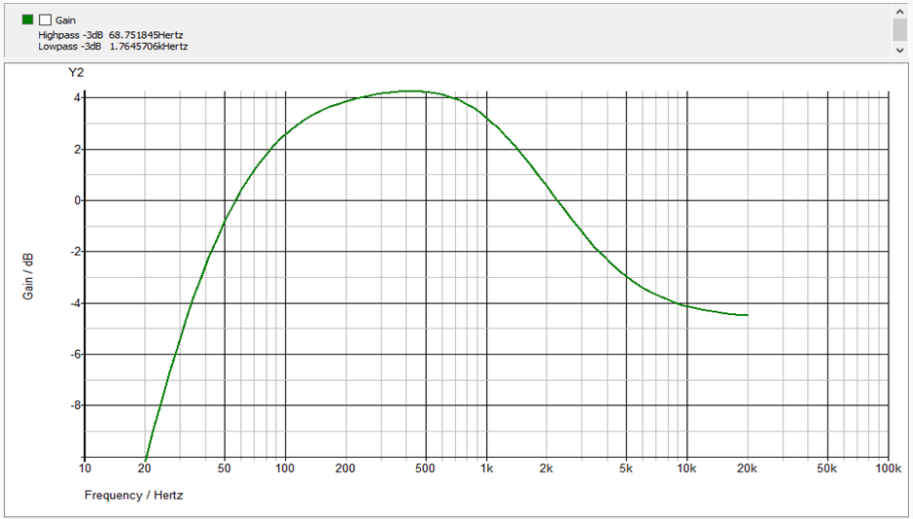


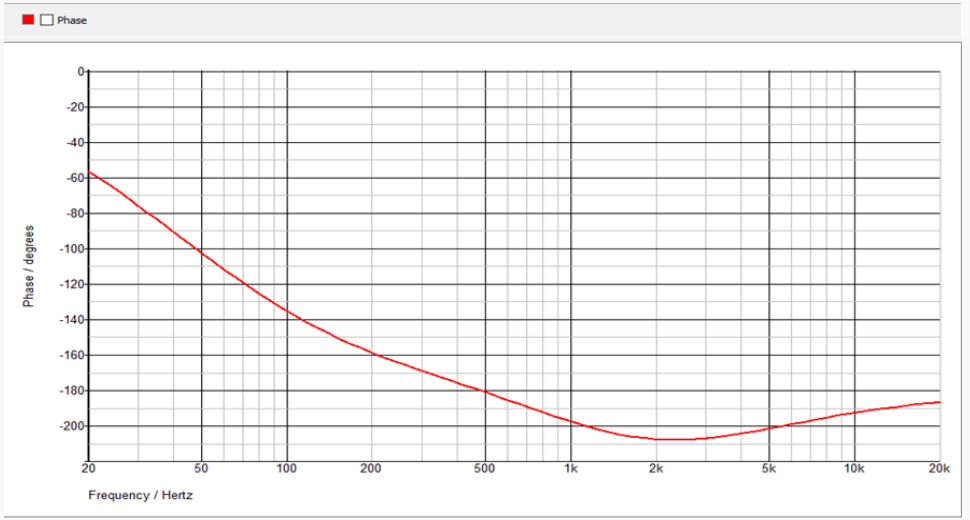
Overdrive Simulation

Spectrum analysis of the circuit for the frequencies from 20 Hz to 20 kHz.

- The low pass 3 dB frequency of the overdrive pedal is 68.75 Hz. Its high pass 3 dB frequency is about 1.7 kHz.
- The max gain of the circuit is about 4 dB. The gain remains constant at about -5 dB for frequencies higher than 20 kHz.

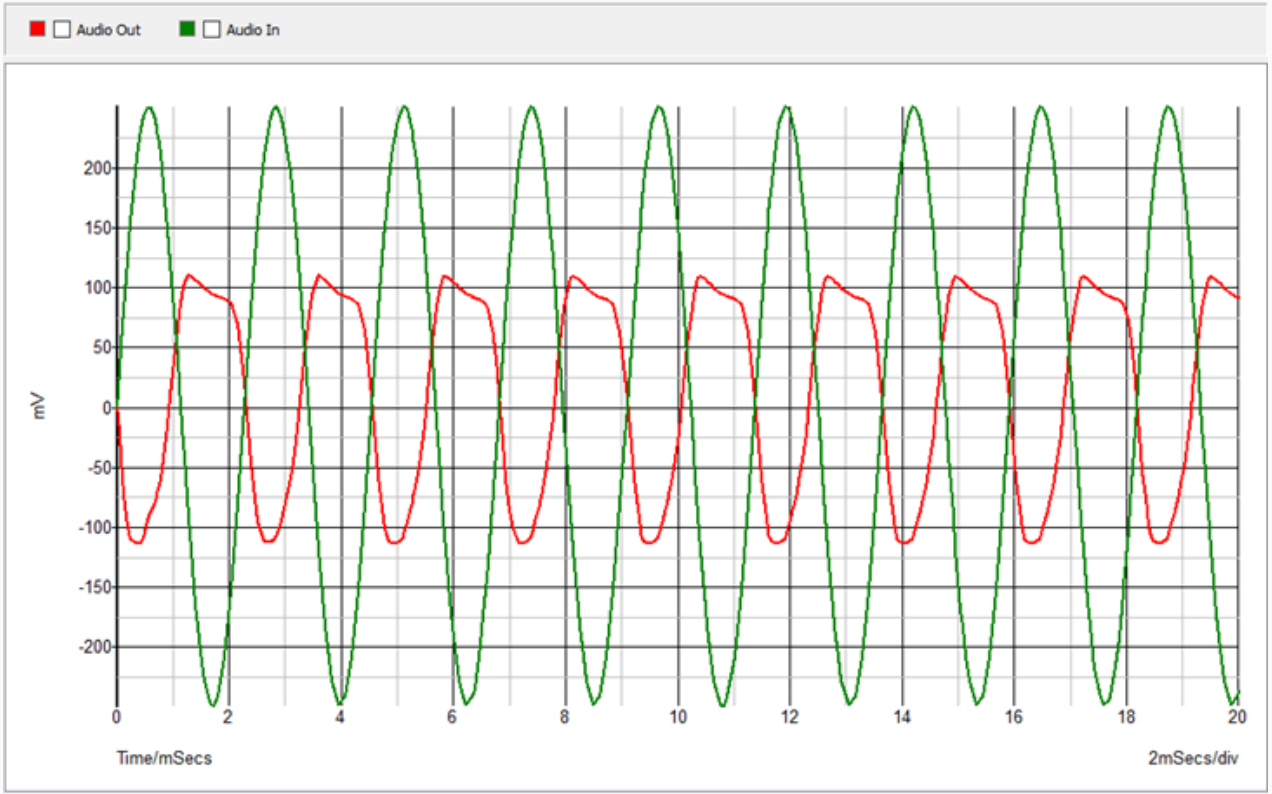
The Bode plots below illustrate the magnitude and phase response as frequency varies from 20 Hz to 20 kHz.



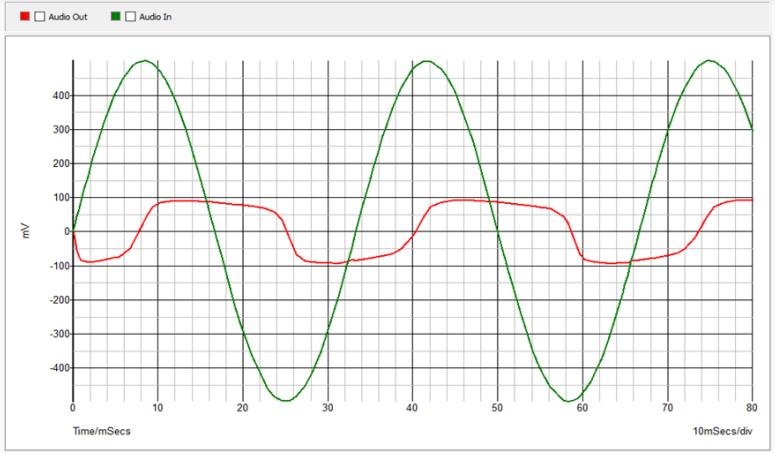


Overdrive Simulation

Transient Analysis

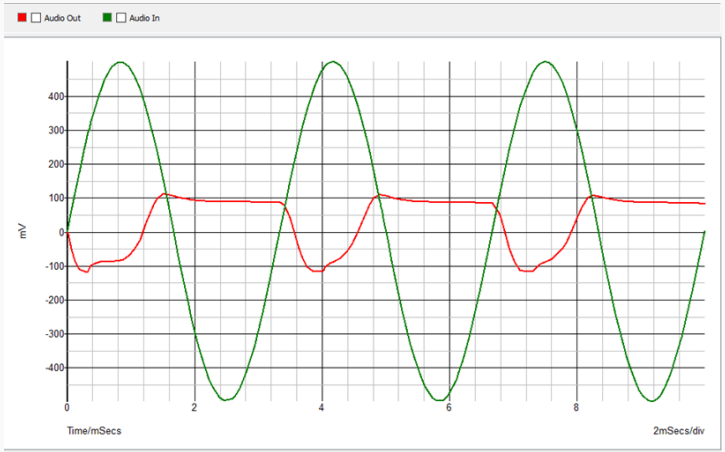


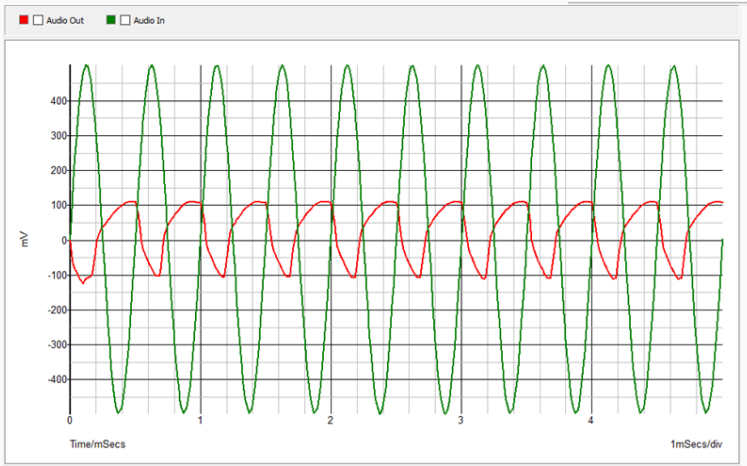
Overdrive Simulation



Above: Transient analysis response of the circuit at a frequency of 30 Hz which is lower than the low pass 3 dB frequency of the circuit. At this frequency, circuit acts as a high pass filter. The amplitude of the output goes down to zero as we decrease the frequency.

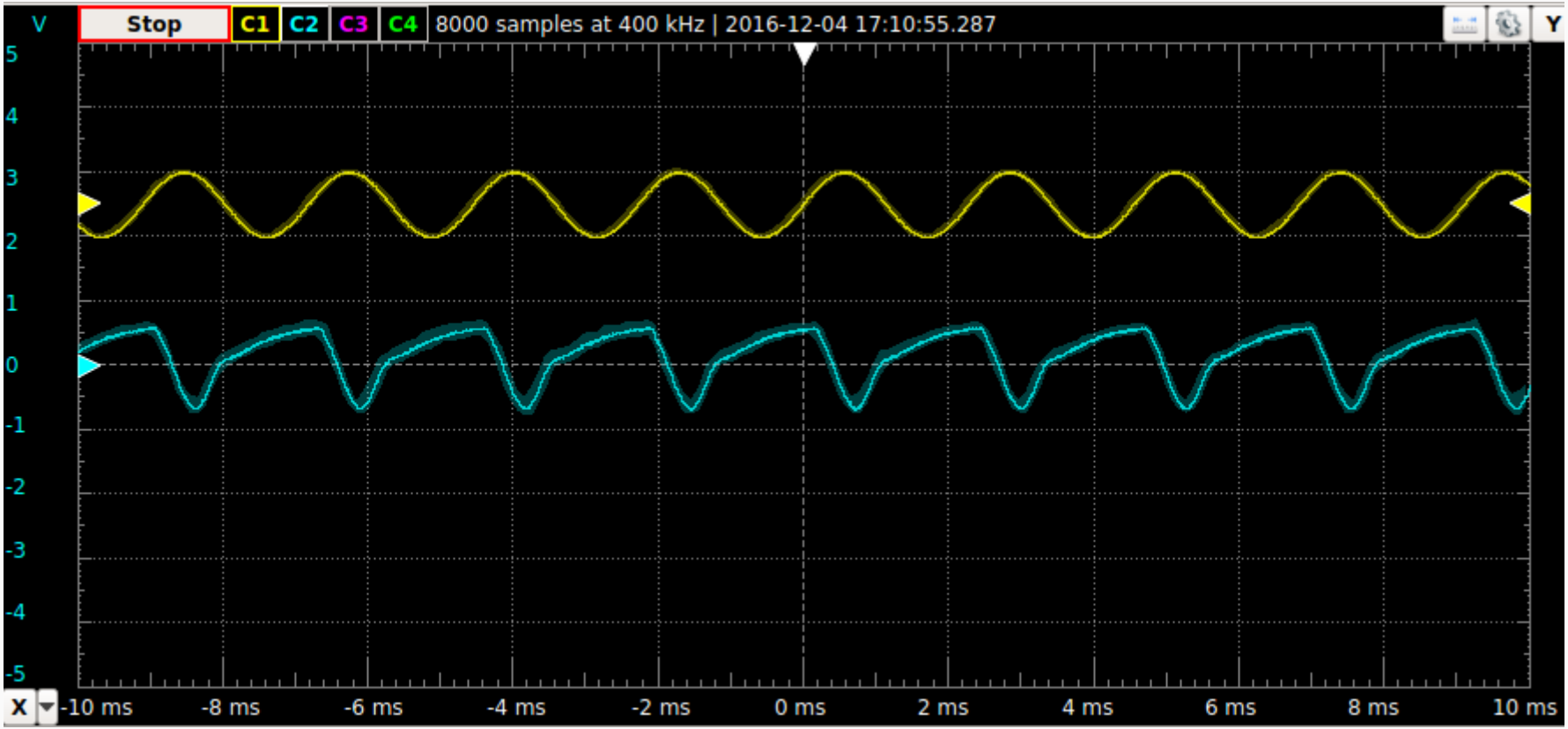
Below: Transient analysis response of the circuit at a frequency of 2 kHz which is high than the high pass 3 dB frequency of the circuit. At this frequency, the circuit acts as a low pass filter. The amplitude of the output goes to zero as we keep increasing the frequency to infinite.





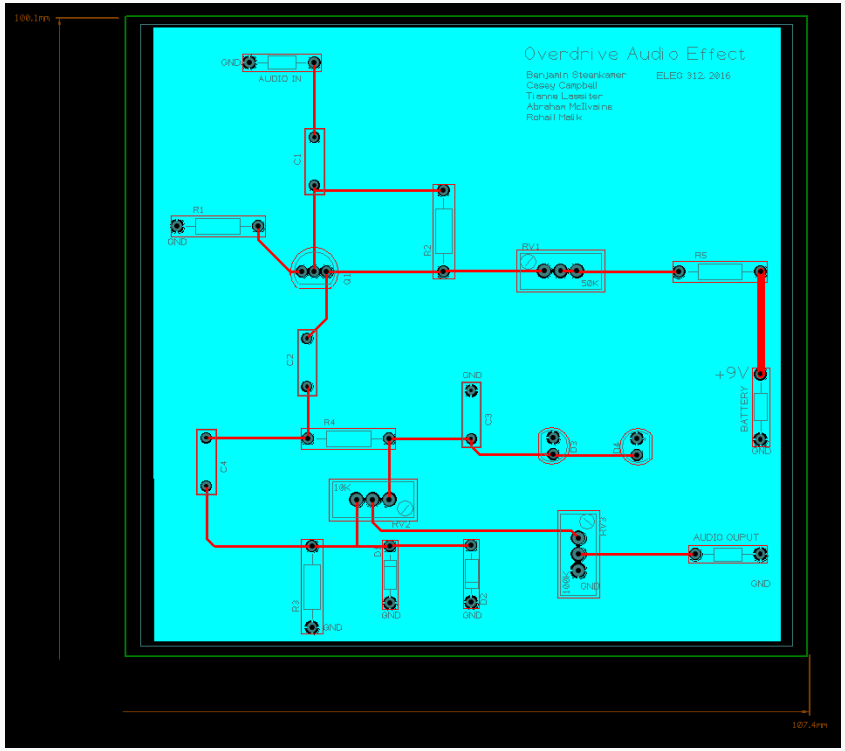
Above: Transient analysis response of the circuit at a frequency of 300 Hz. At this frequency the circuit has the maximum gain of 4 dB. (Determined by looking at the Bode plot).

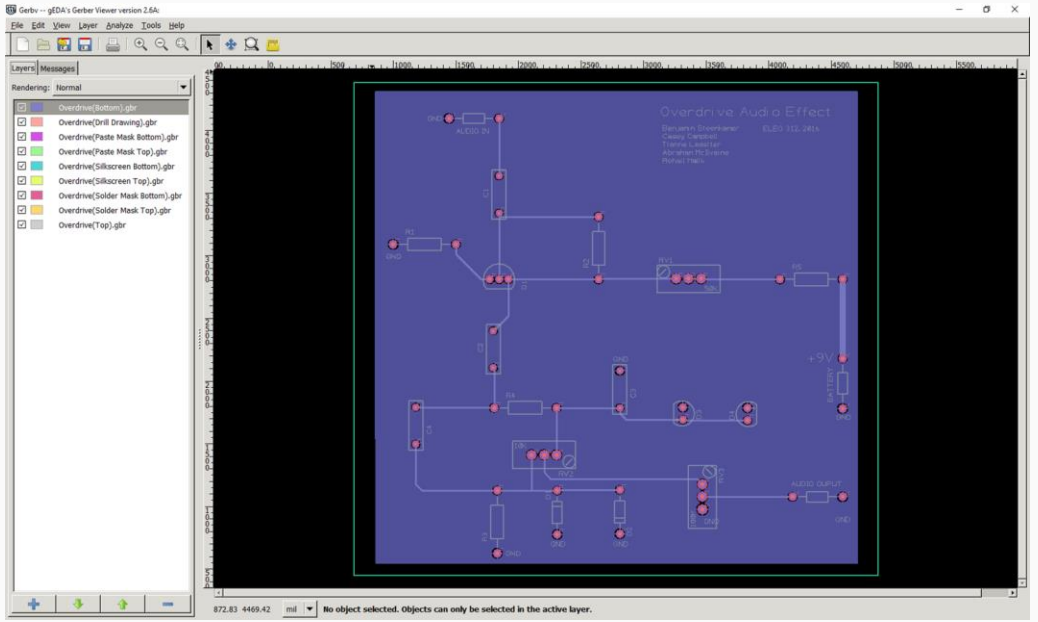
Overdrive Circuit Performance



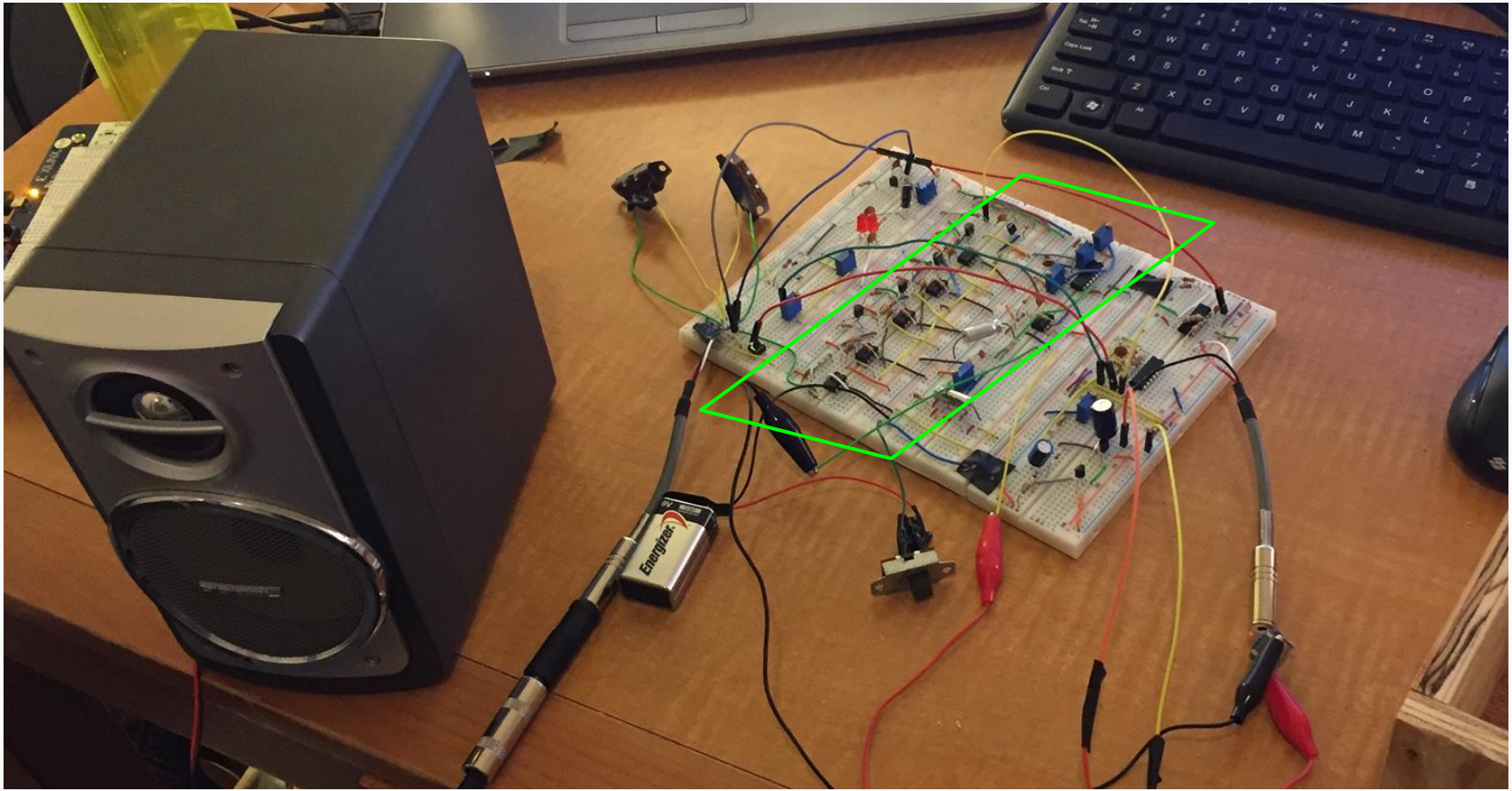
Input signal is a 440 Hz sine wave.

Overdrive PCB Layout and Gerber Files

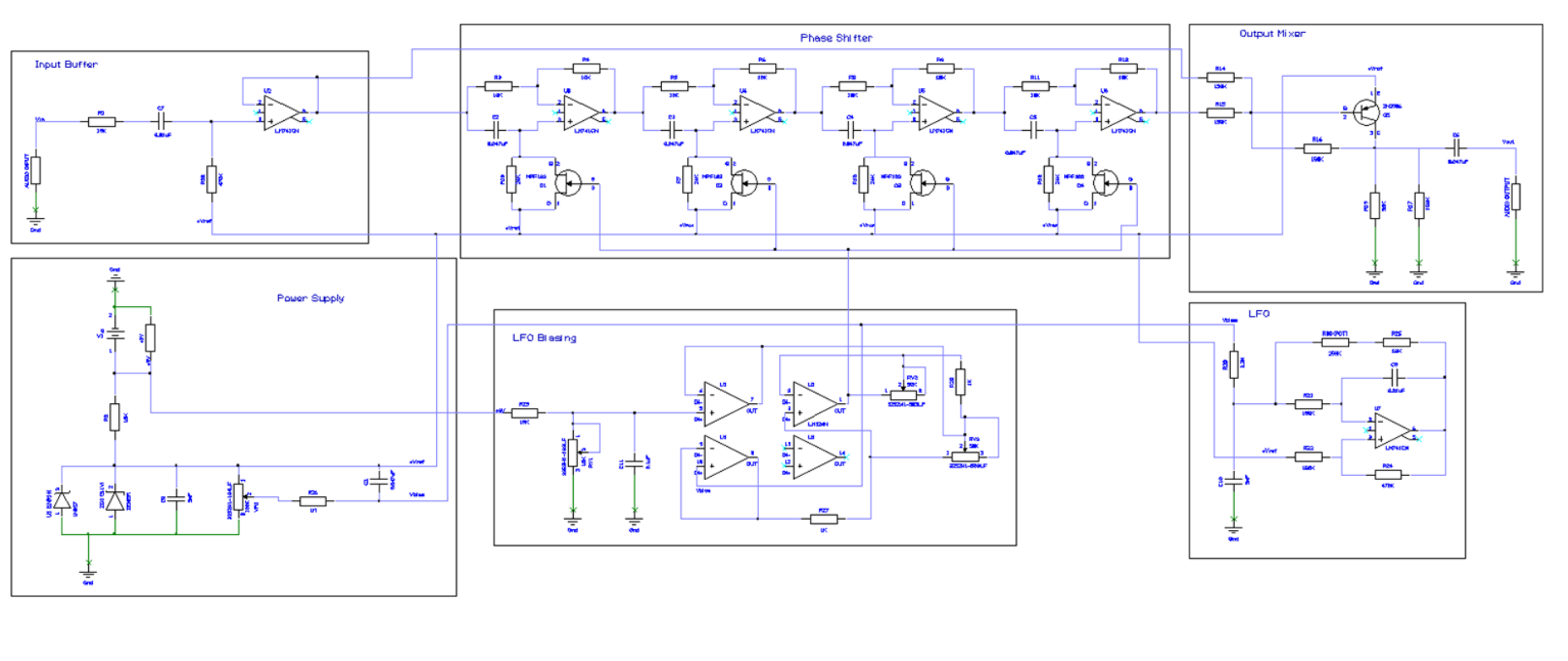




Phaser Circuit

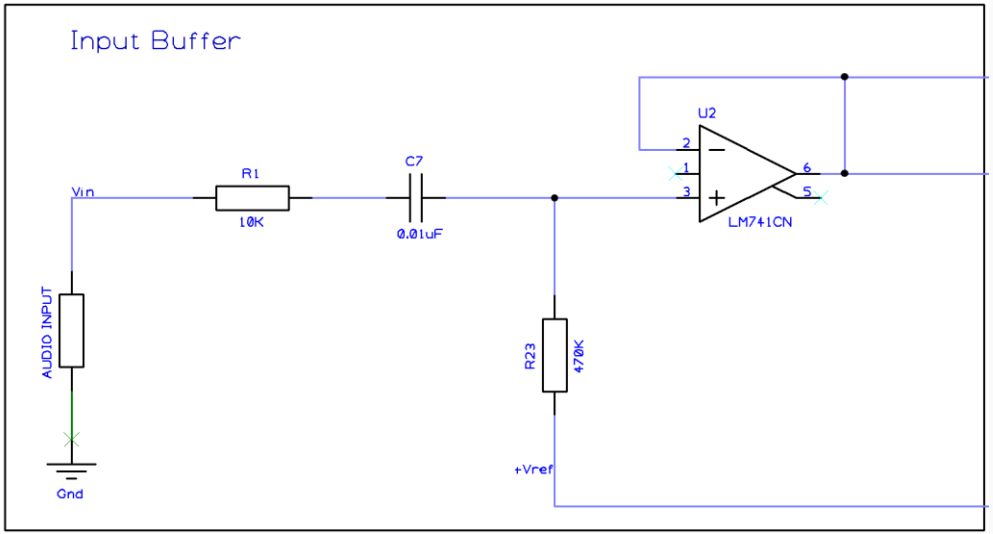


Phaser Schematic

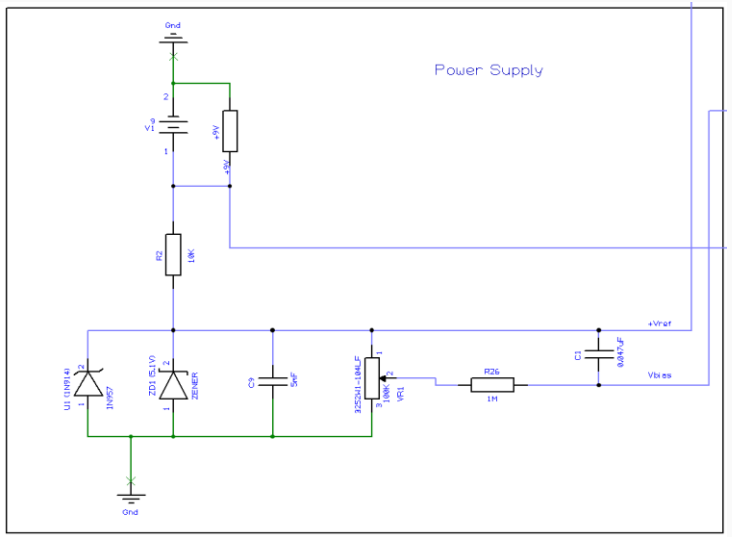


Based on the MRX Phase 90 guitar pedal.

Phaser Stages

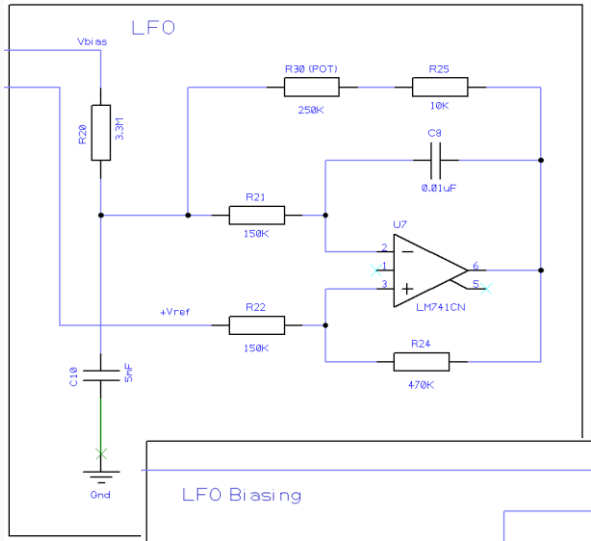


- Has a high pass filter threshold of 33 Hz.
- Input becomes biased around Vref (~5.1 V).
- LM741

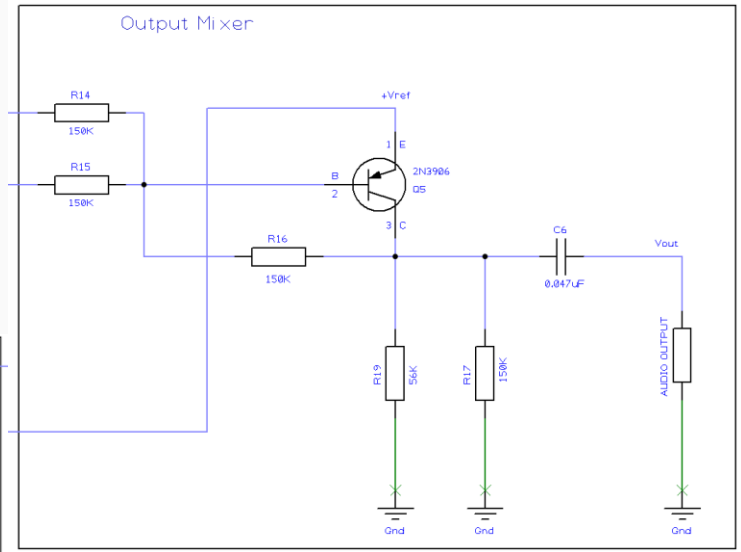


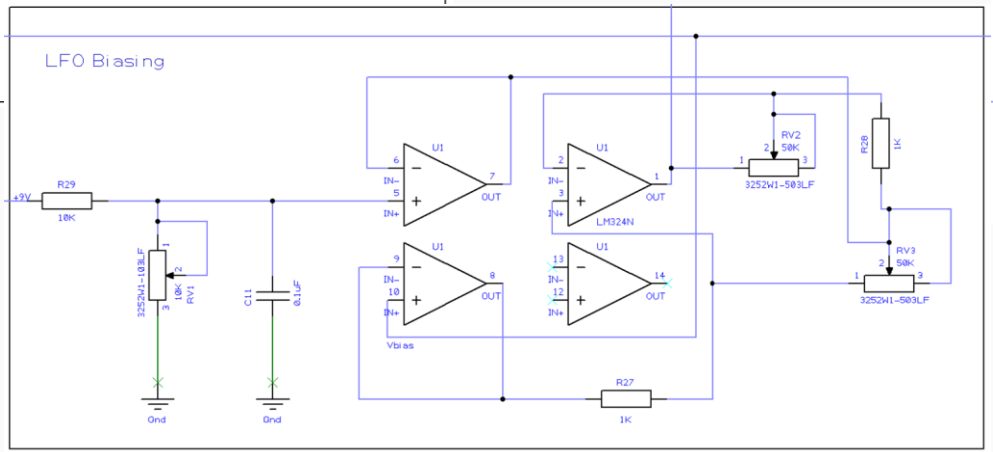
- Power supply for the entire circuit.
- 5.1 V Zener diode sets Vref voltage.
- Capacitor reduces power supply noise.
- Potentiometer sets bias voltages for LFO.

Phaser Stages

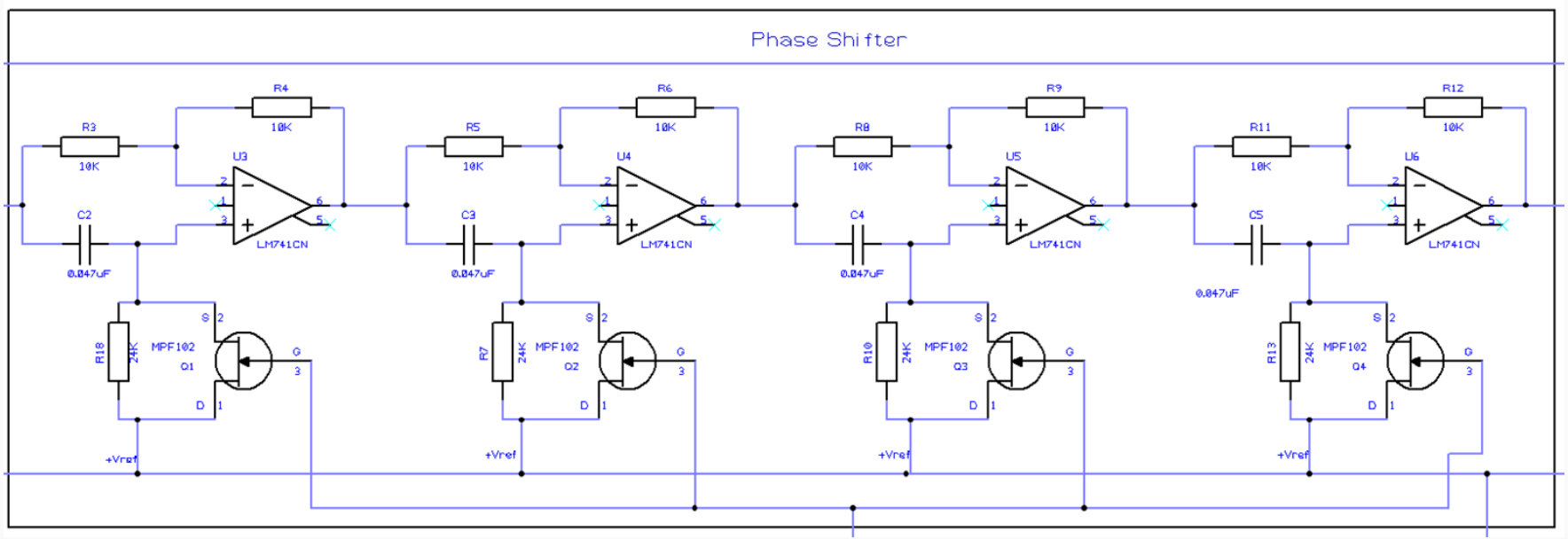


- LFO: Low Frequency Oscillator
- 2N3906
- LM741
- LM324



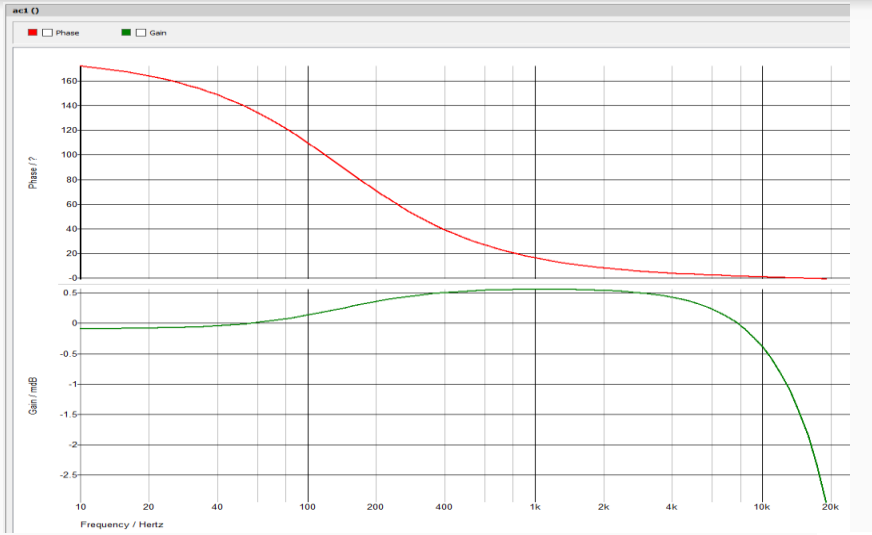


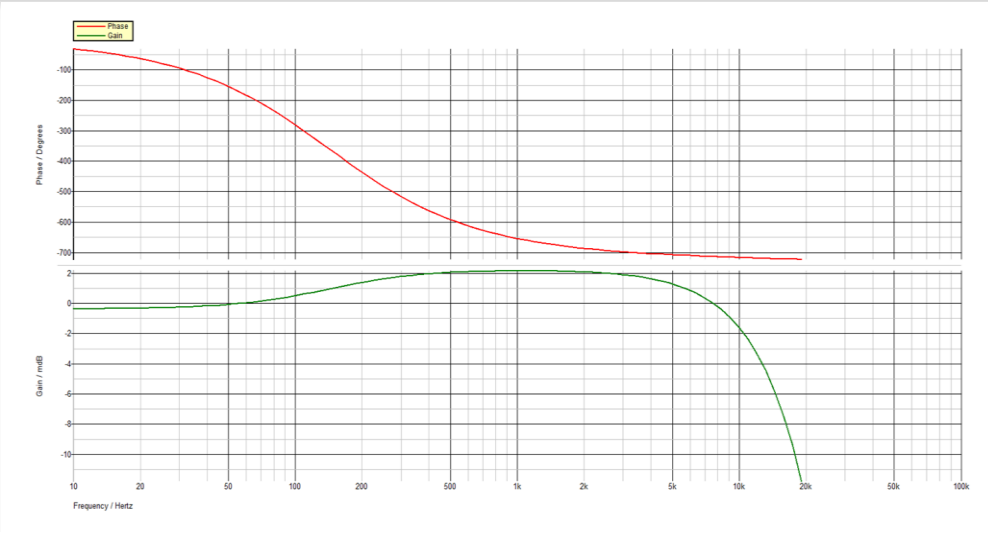
Phaser Stages



- LM741
- MPF102

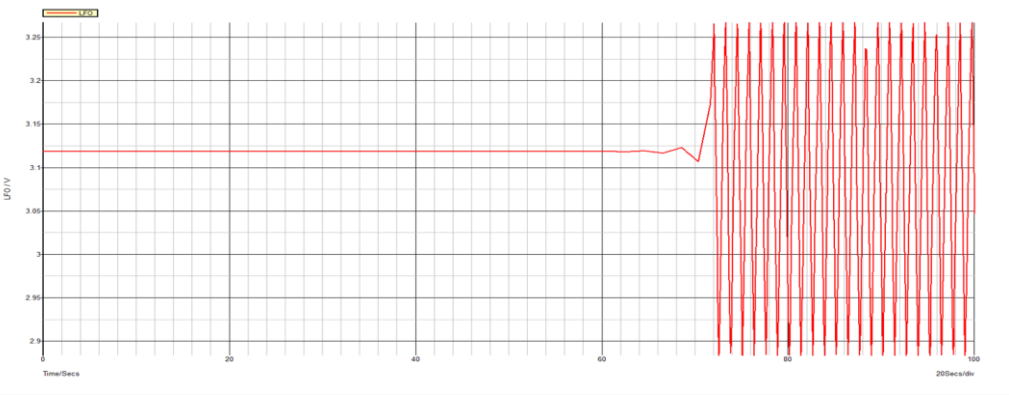
Phaser Simulation



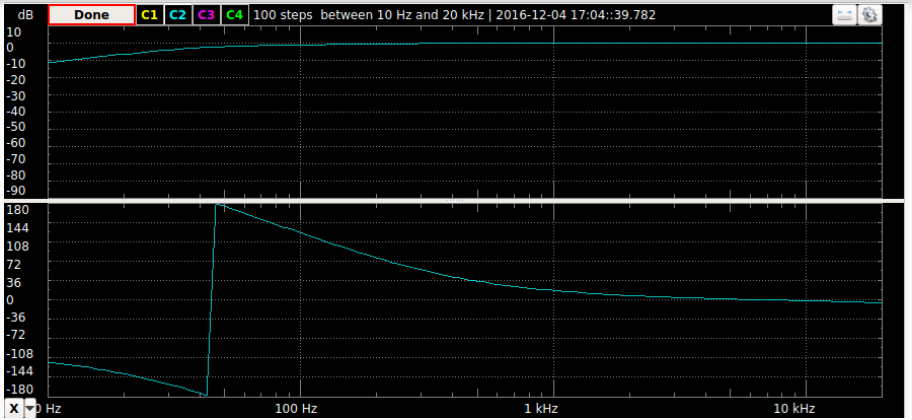


Frequency responses and AC analysis

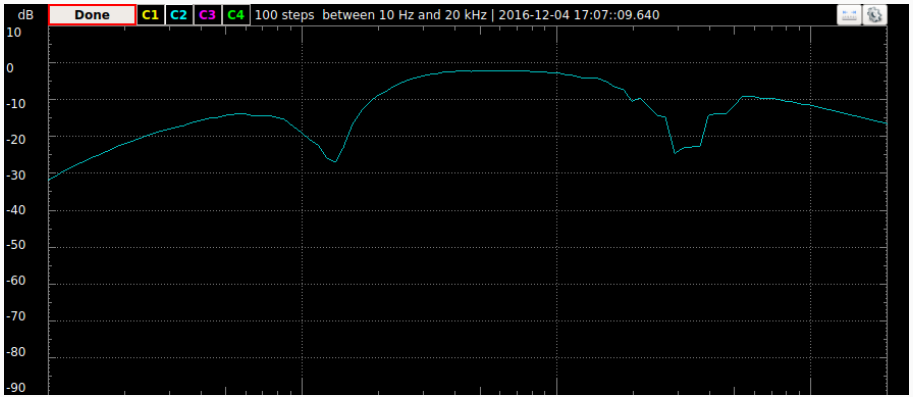
Top left: Single phase shifter stage
Top right: Four phase shifter stages
Bottom: LFO output

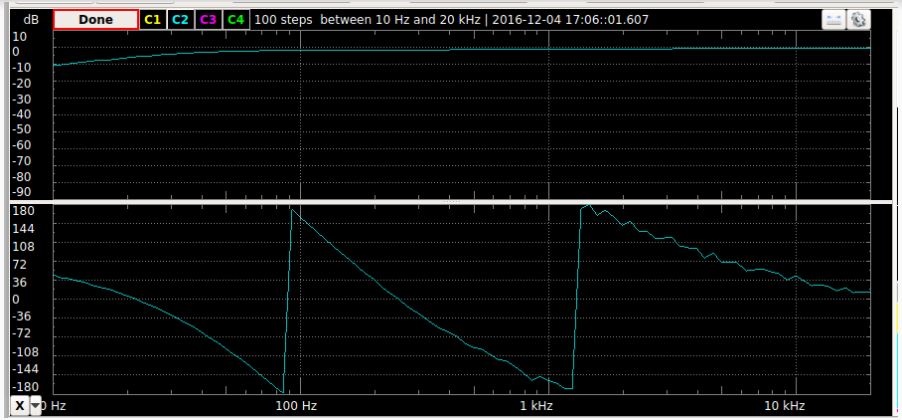


Phaser Circuit Performance

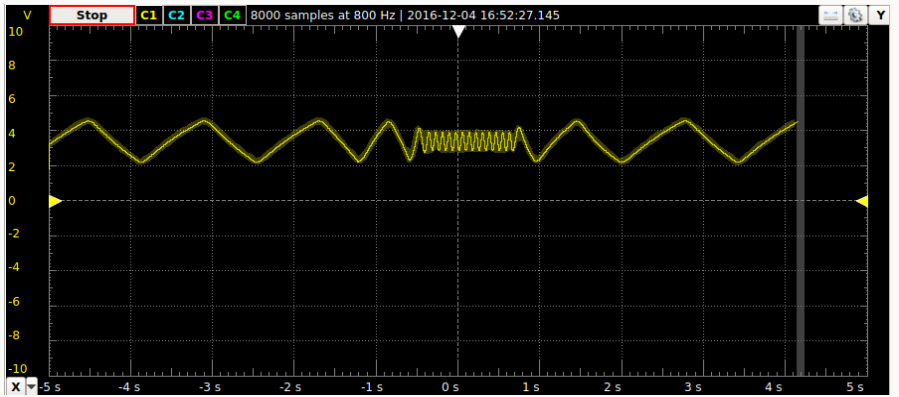


Above: 1 stage of phaser Bode plot.
Below: Phaser mixed output Bode gain plot.





Above: 4 stage phaser Bode plot. Below: LFO output.



Phaser PCB Layout and Gerber Files