PHYSICS 406

Shredder Distortion Pedal

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Introduction

For my lab project I decided to build and test a distortion pedal. The pedal I went with a pedal from BYOC that is based on the Marshall Shredmaster, a classic high gain step pedal known for its' 80's heavy metal distortion sound that was released in the 90's. The pedal has 5 controls. The first is gain, which controls the intensity. The second is Bass, which controls the lower frequencies. The third is contour, which controls the tone. The fourth is treble, controls the high-end response. The final control is volume, which controls the overall level. There is also a switch which triggers the effect and if off allows true bypass, which is where the wave form is passed straight through. This pedal was used by musicians including Jonny Greenwood and Thom Yorke of Radiohead, Gaz Coombes of Supergrass and Alex James of Blur. I went with the pedal because I wanted to build a device that would complement my guitar. I choose this pedal in particular besides from being a classic, it complemented the list of effects I already have for my guitar.

Now for a brief intro into distortion pedals. Distortion creates a unique sound by clipping or compressing the peaks of an electoral instruments sound wave. This originated in the 1950s from musicians wanting to attain a dirtier, grittier, and warmer sound and they accomplished this by pushing more electricity than average through the amplifier, which in turn is accomplished by maxing out the volume. Another important method, in regards to this pedal, is Solid-state distortion. Solid-state distortion uses transistors and op-amps to produce hard clipping overdrive, by adding additional high-amplitude odd harmonics. This is achieved by either clipping the signal across the diodes or by amplifying the signal till it is clipped.

Schematic

Parts Checklist

Resistors: (resistors may be 1% metal film which have a light blue body or 5%carbon film with a light brown body)

1 100ohm (1%-brown/black/black/black/brown or 5%-brown/black/brown/gold)
1 1k (1%-brown/black/black/brown/brown or 5%-brown/black/red/gold)
1 3.3k (1% orange/orange/black/brown/brown or 5% orange/orange/red/gold)
1 4.7k (1%-yellow/purple/black/brown/brown or 5%-yellow/purple/red/gold)
1 6.8k (1% blue/gray/black/brown/brown or 5% blue/gray/red/gold)
2 10k (1%-brown/black/black/red/brown or 5%-brown/black/orange/gold)
2 33k (1% orange/orange/black/red/brown or 5% orange/orange/orange/gold)
3 47k (1% yellow/purple/black/red/brown or 5% yellow purple/orange/gold)
2 100k (1% brown/black/black/orange/brown or brown/black/yellow/gold)
1 220k (1% red/red/black/orange/brown or 5% red/red/yellow/gold)
1 680k (1% blue/gray/black/orange/brown or 5% blue/gray/yellow/gold)
2 1M (1%brown/black/black/yellow/brown or 5%brown/black/green/gold)
1 2.2M (1%red/red/black/yellow/brown or 5% red/red/green/gold)

Pots:

3 100kA pot (gain, volume, bass)
1 25kB pot (treble)
1 100kB pot (contourl)

Capacitors:

1 47pf ceramic disc (code may read "470"small round orange)
1 100pf ceramic disc (code may read "101"small round orange)
2 .001uf film(102)
1 .0022uf film(222)
1 .01uf film(103)
2 .022uf film(223)
2 .047uf film(473)
2 .1uf film (100n)
5 .22uf film (220n)
1 47uf aluminum electrolytic
1 100uf aluminum electrolytic

Diodes:

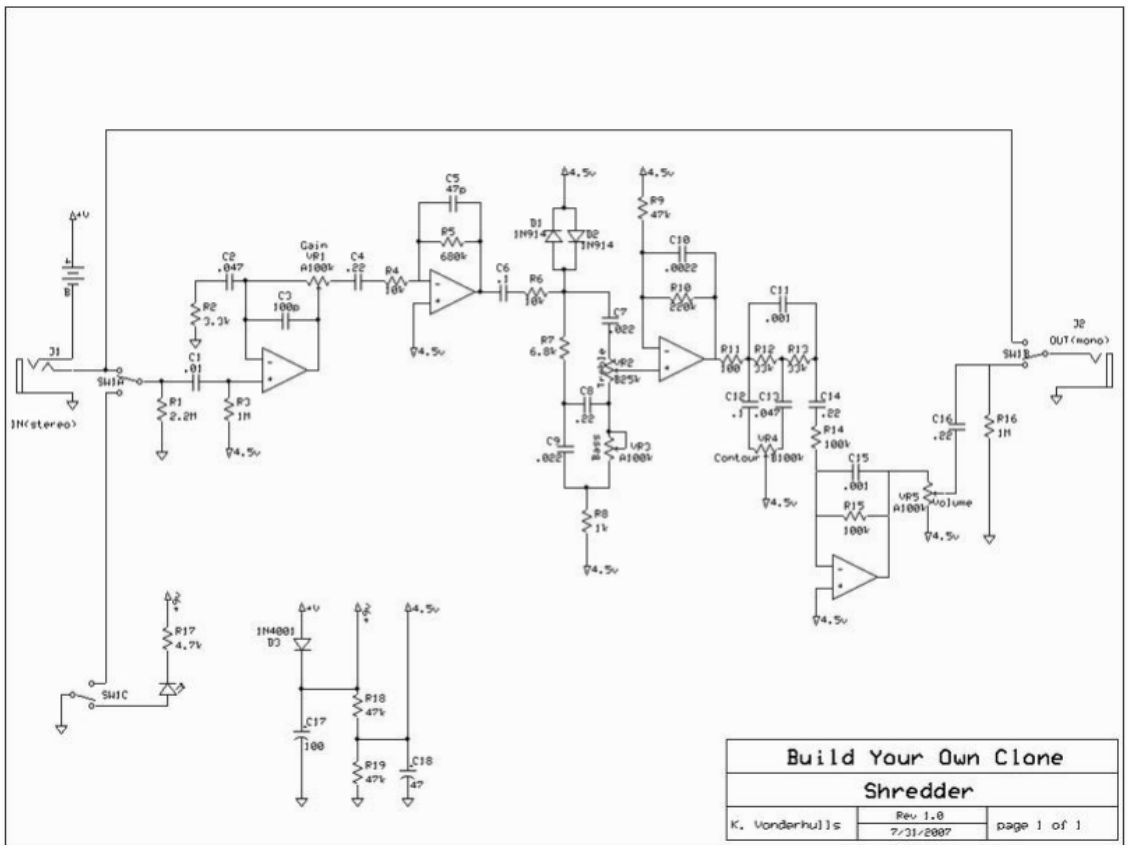
2 1N914 or 1N4148(small orange with black stripe)
1 1N4001 (large black with silver stripe)

IC's:

1 TL074
1 14 pin socket

Hardware:

3 self adheasive nylon standoffs
5 knobs
1 heavy duty battery snap
1 Red T 1 3/4 (5mm)LED
1 3PDT footswitch
1 1/4" mono jack
1 1/4" stereo jack
1 AC adaptor jack
1 125b size enclosure
1 Shredder PCB
Hook-up wire



This circuit is controlled through the 5 turn pots, which control the volume, gain, base, treble and contour. The top of the circuit, when turned on, allows for the true bypass. The input is the IN(stereo) and takes in the sinusoidal wave from the electric guitar. When not in true bypass mode it is passed through the center part of the circuit where it is modified based on the resistance of the turn pots to make the wave into the desired shape.

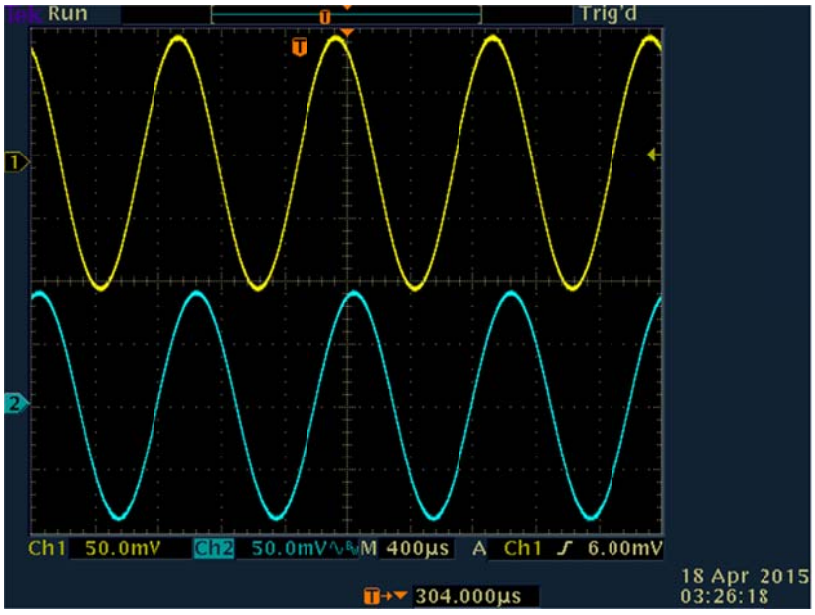
Building Process

Due to the complicated nature of this project I decided it would be best to order a device kit online that came with a schematic, with which I went with a pedal from Build Your Own Clone. The building of this device was the most complicated part of this assignment. While it took time for all the parts to come in, the difficult and time part was soldering. It was difficult for three reasons. The first was the size of the box and board. The size of the board made it very difficult to correctly solder the parts and resulted in a lot of dry sockets. Meanwhile the size of the box made it very difficult to solder everything together and to debug. The third reason was the poorly labeled schematics which led to difficulty in debugging. It was very difficult to keep

track of which parts corresponded to what parts on the schematic. As such it took a considerable amount of time to step through the circuit with an oscilloscope to identify the dry sockets that occurred.

Waveform Analysis

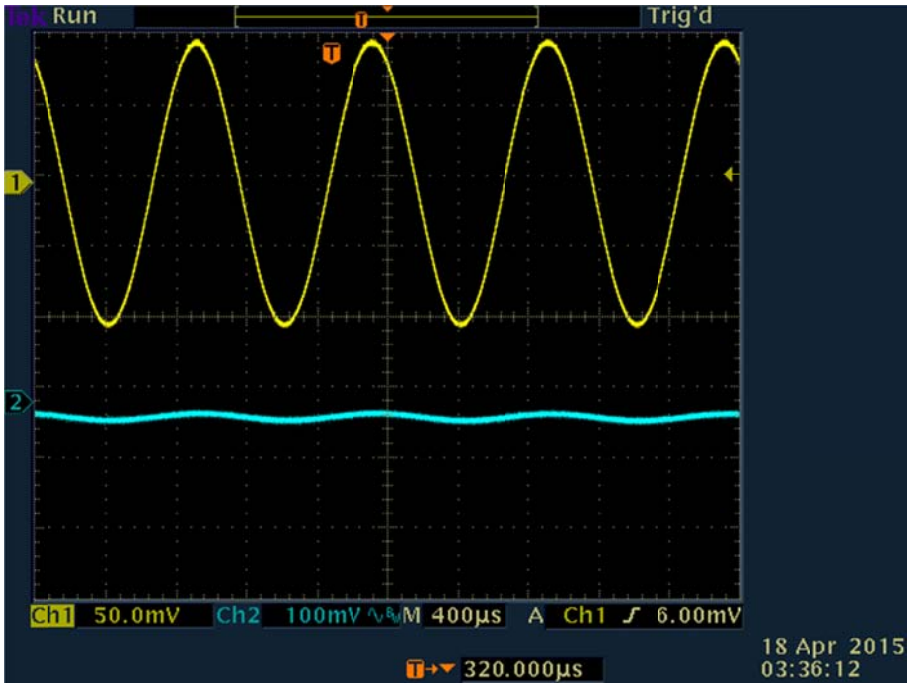
1. Regular Wave Form

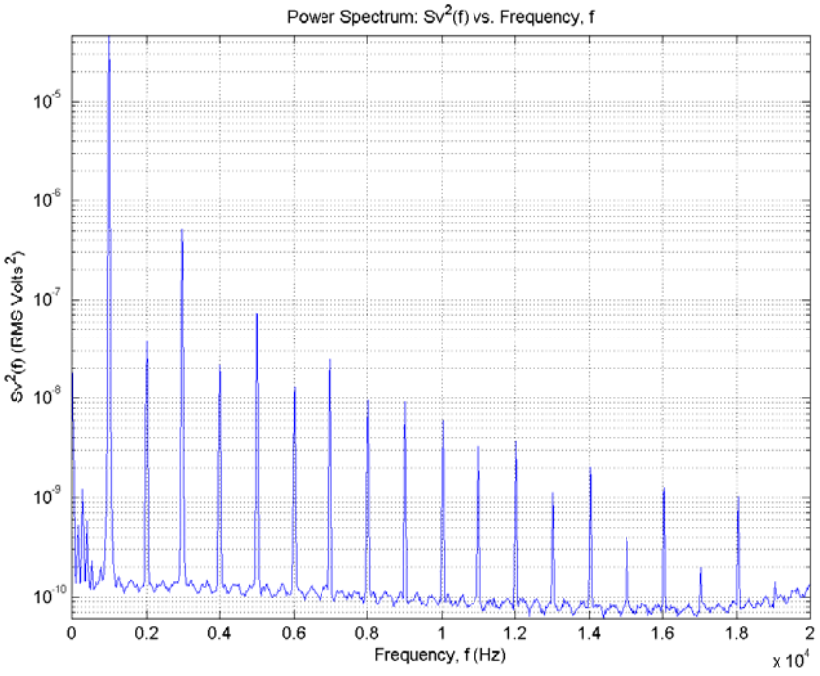


Standard wave form on true bypass, the wave is passed straight through

In the proceeding analysis the blue waves represent the output and the yellow wave represents the standard input wave and it is operating at 1 kHz.

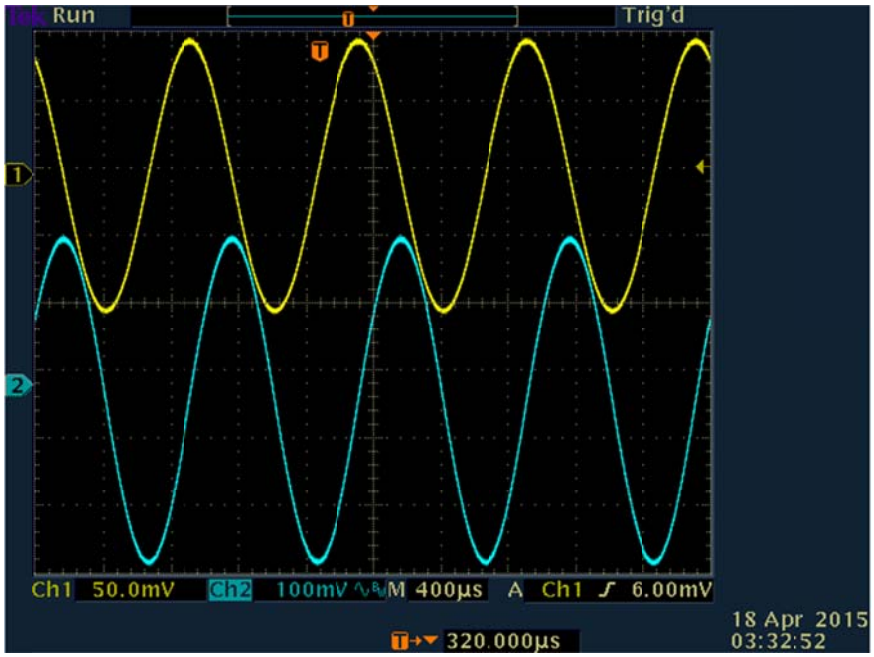
2. Low Gain Low Treble Low Contour Low Bass

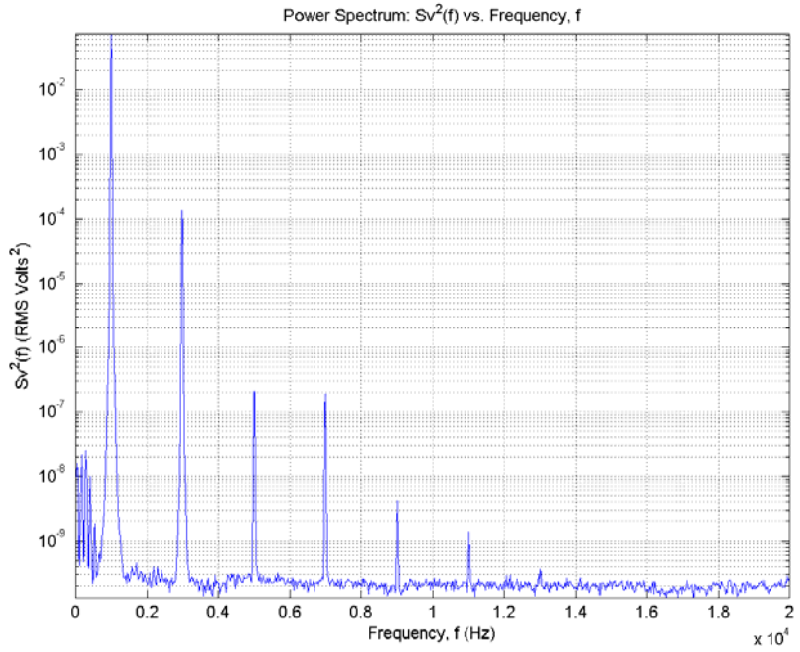




When everything is low there is little effect to the harmonics; however, the wave forms amplitude is significantly reduced

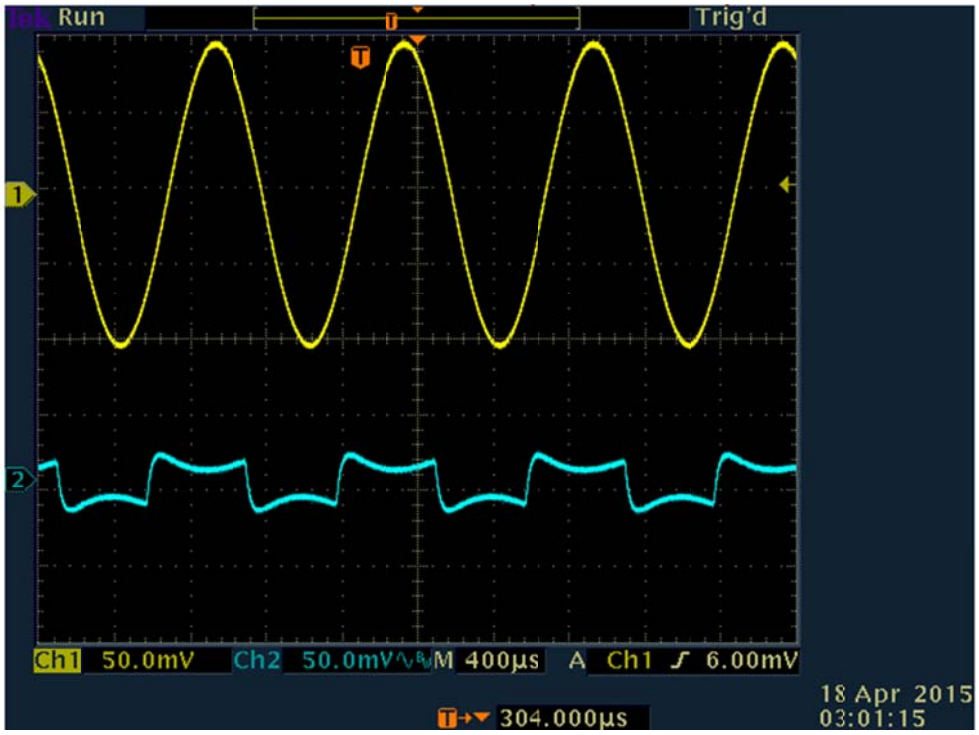
3. Low Gain High Treble High Contour High Bass

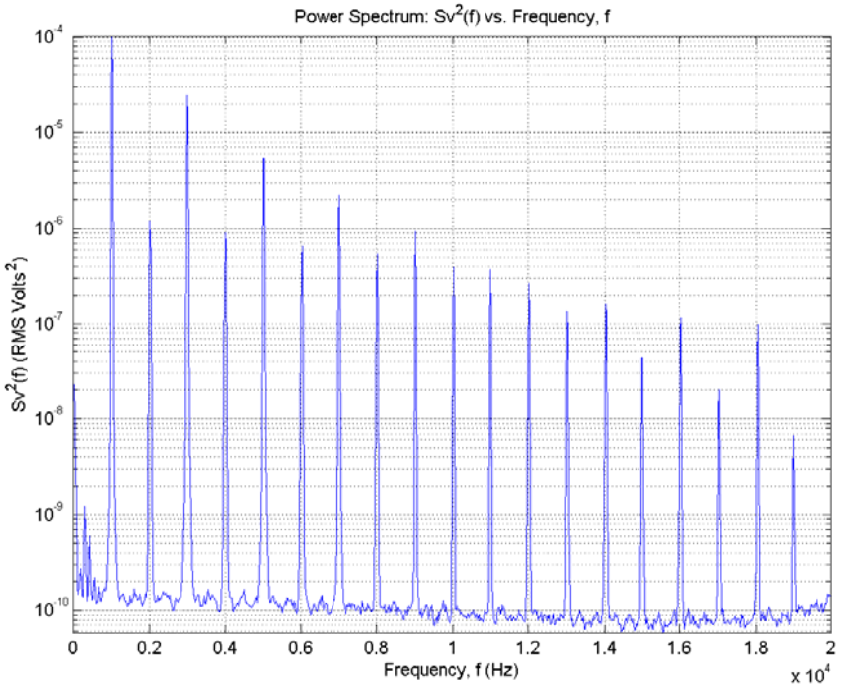




With low gain and high base, contour and treble the wave's amplitude is raised and the odd harmonics are enhanced and even harmonics are clipped

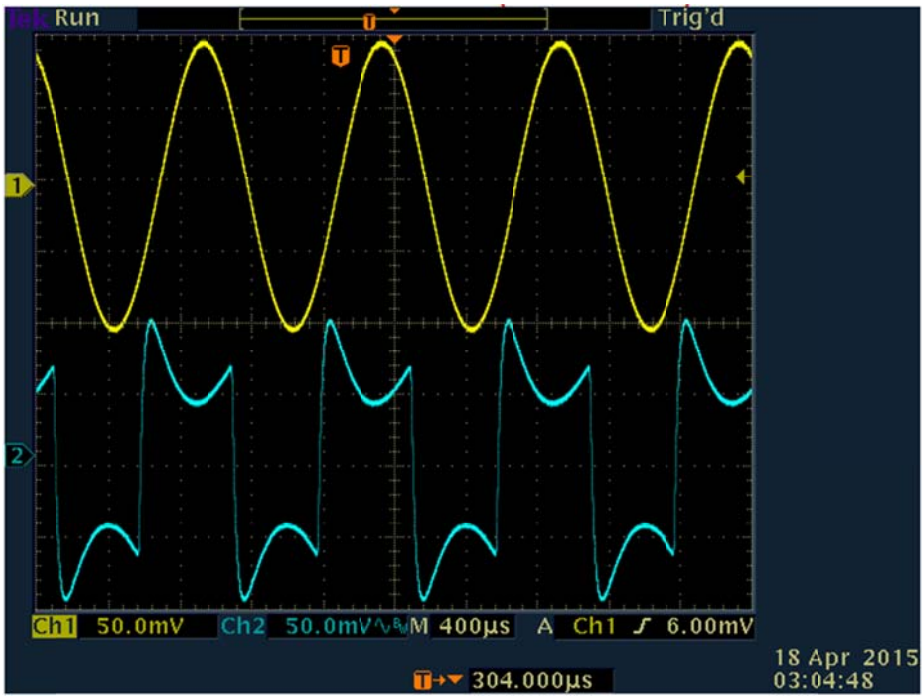
4. High Gain Low Treble Low Contour Low Bass

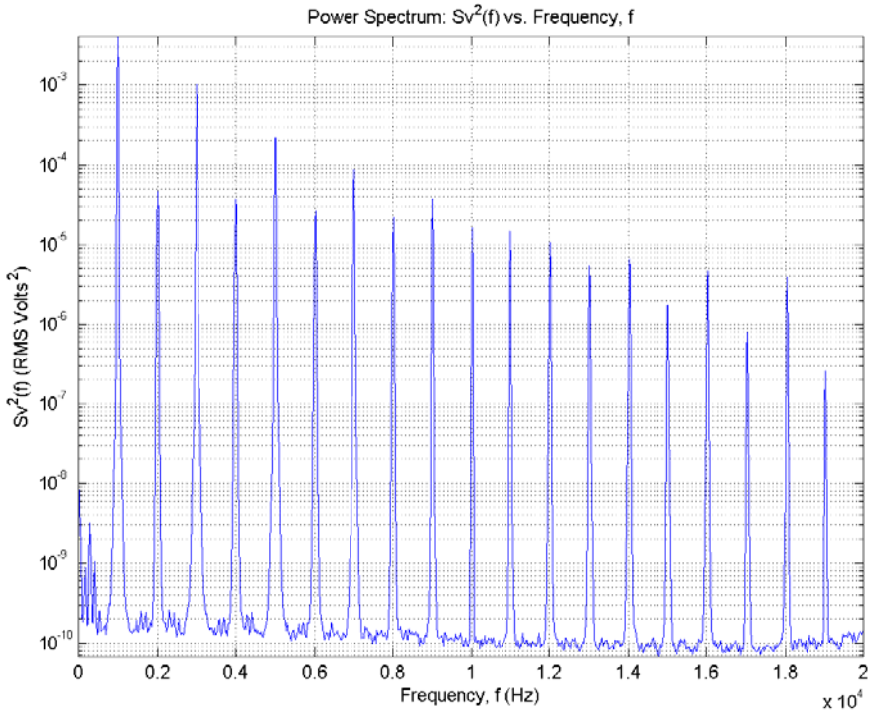




High gain with low treble, contour and base results in a square wave form with a lessoned amplitude and slightly increased odd harmonics and greatly increased odd harmonics.

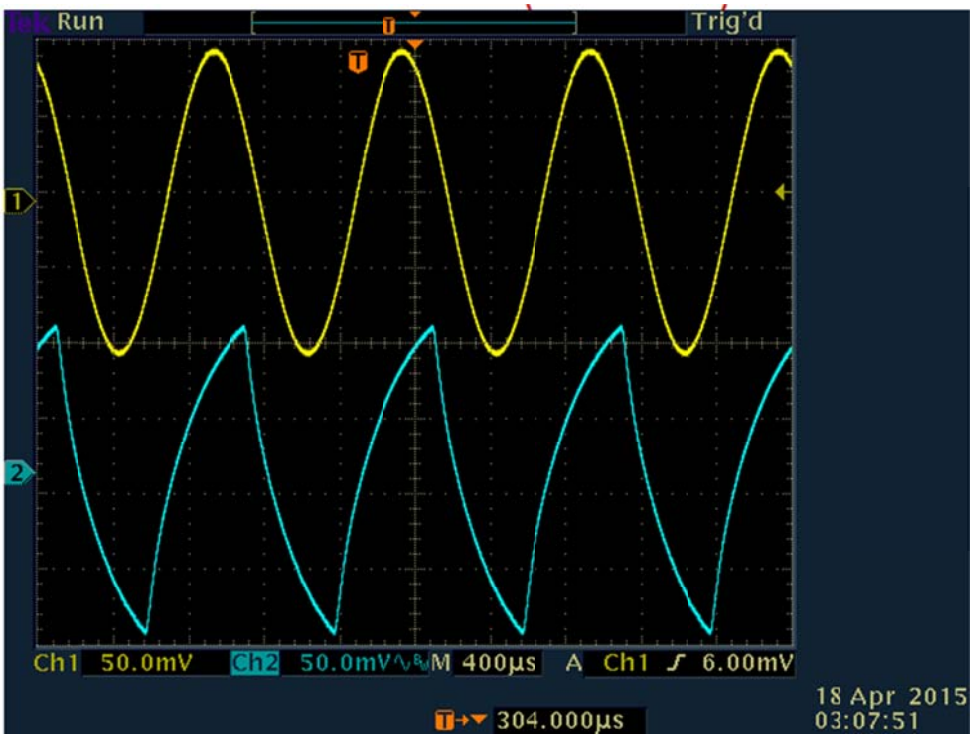
5. High Gain High Treble Low Contour Low Bass

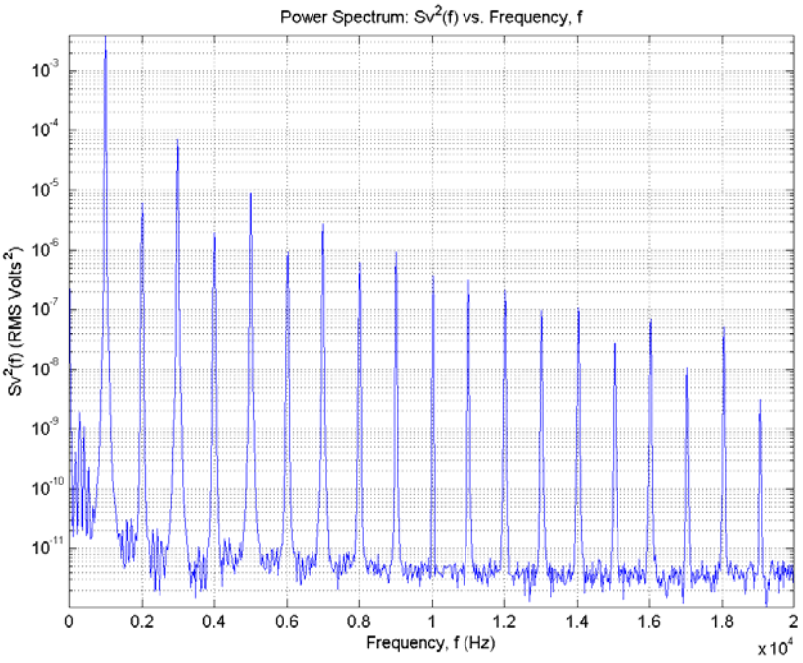




High gain and treble with low contour and base results in a square wave form with a lessoned amplitude and increased odd and even harmonics with a high end response.

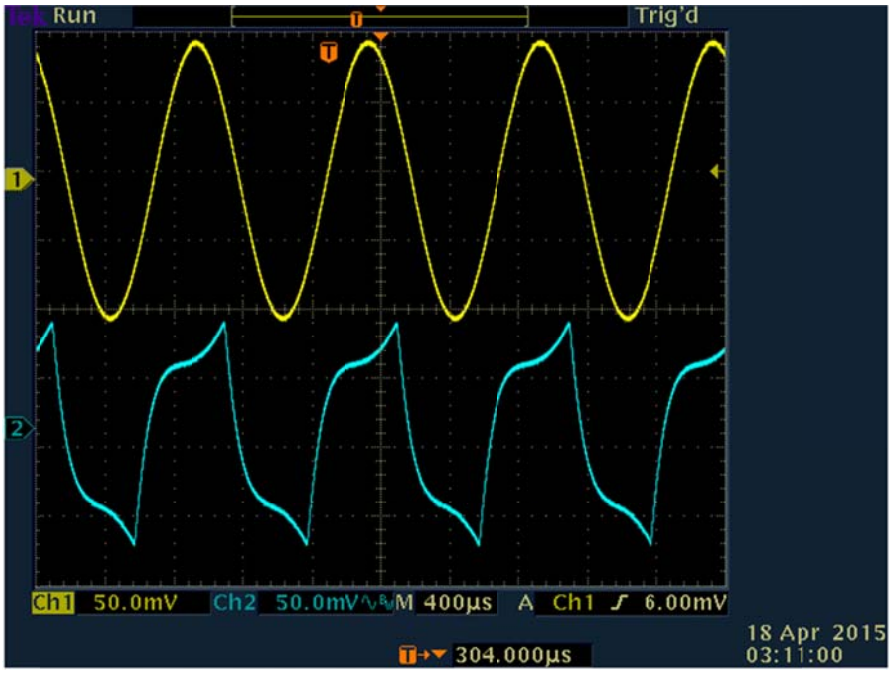
6. High Gain Low Treble High Contour Low Bass

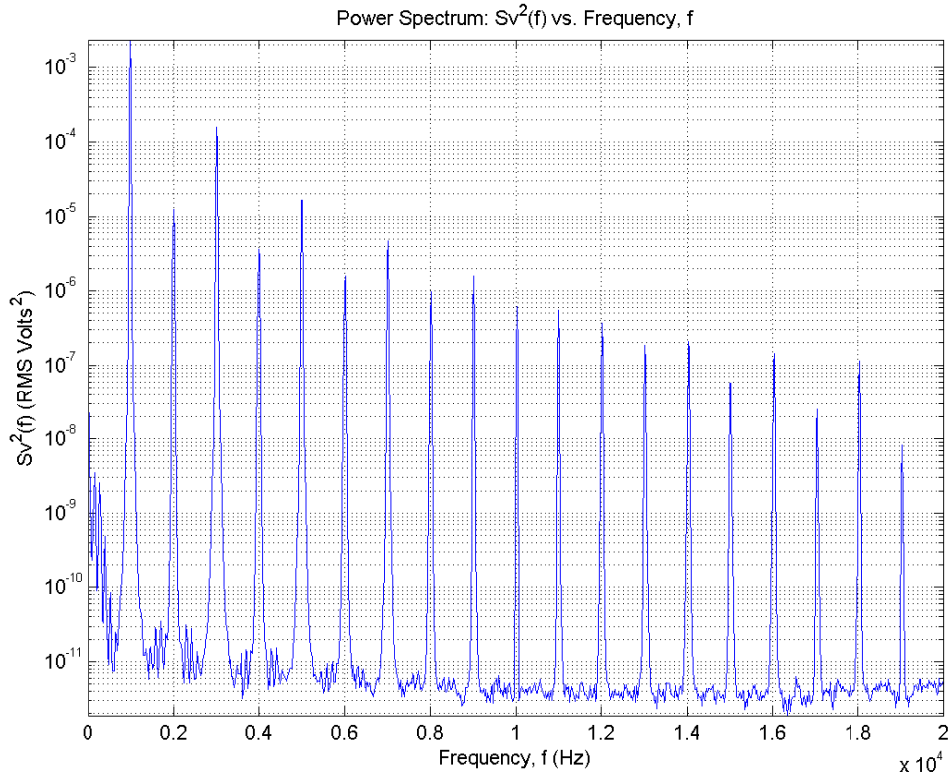




High gain and contour with low treble and base results in a shark fin wave. Harmonics are increased with a slightly higher increase for odd harmonics

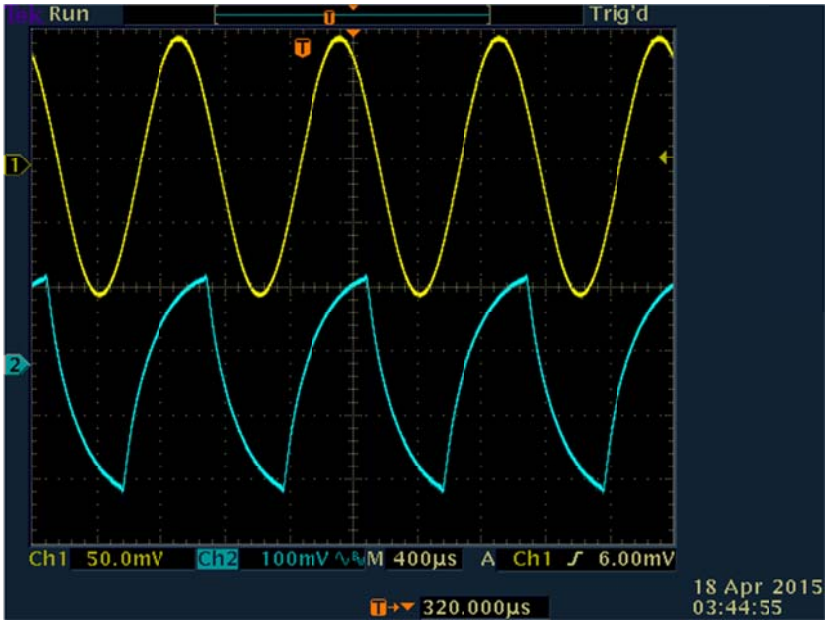
7. High Gain Low Treble Low Contour High Bass

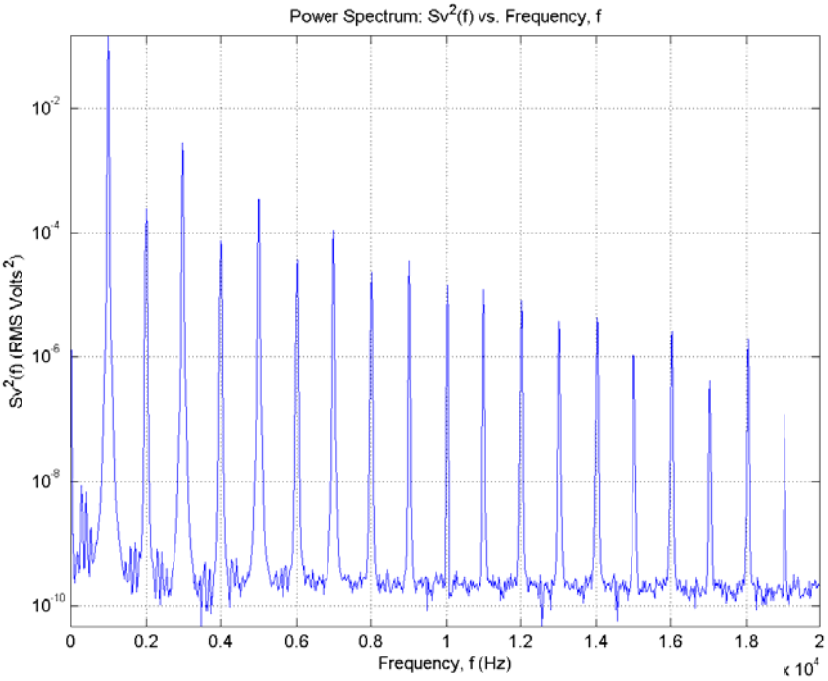




High gain and base with low treble and contour result in a distorted wave and harmonics are increased with a slightly higher increase for odd harmonics

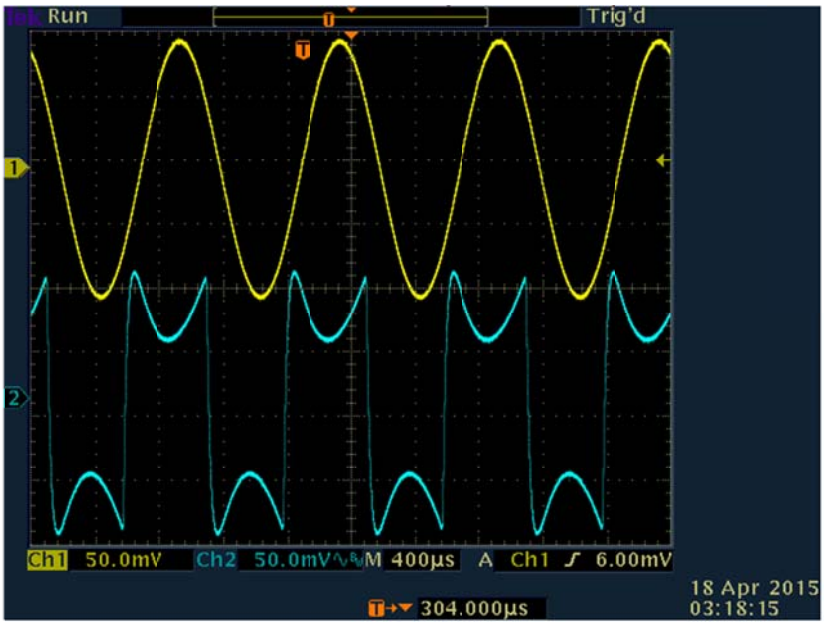
8. High Gain High Treble High Contour Low Bass

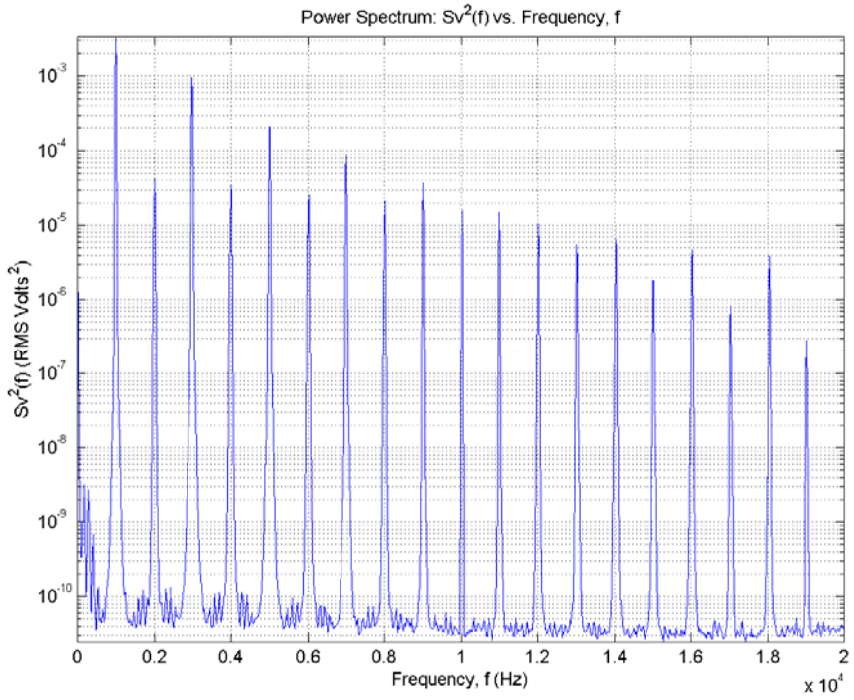




High gain, treble, and contour with low base results in a shark fin wave. Odd harmonics are greatly increased while even harmonics receive a lesser boost

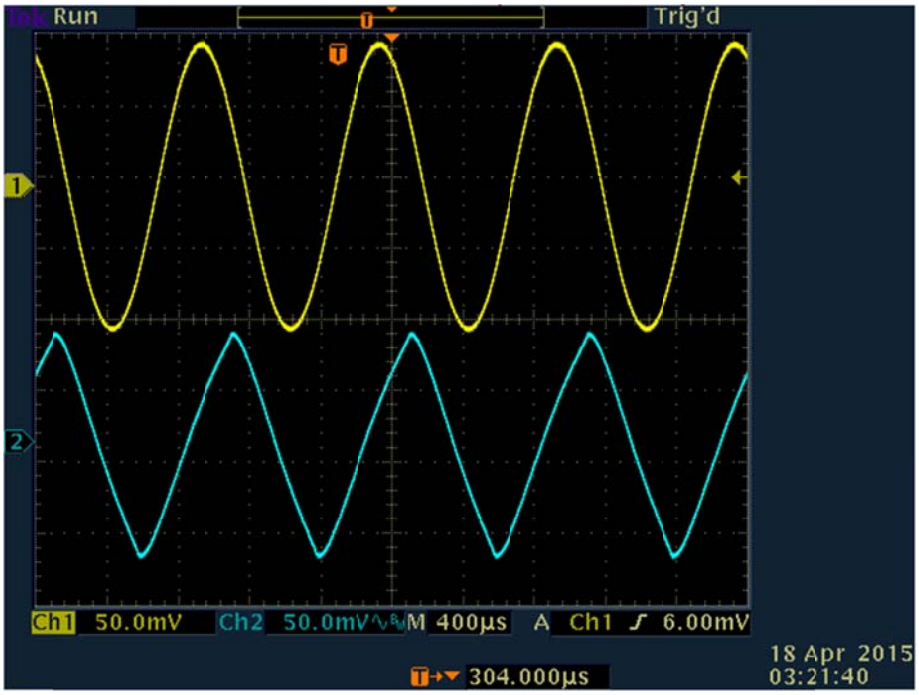
9. High Gain High Treble Low Contour High Bass

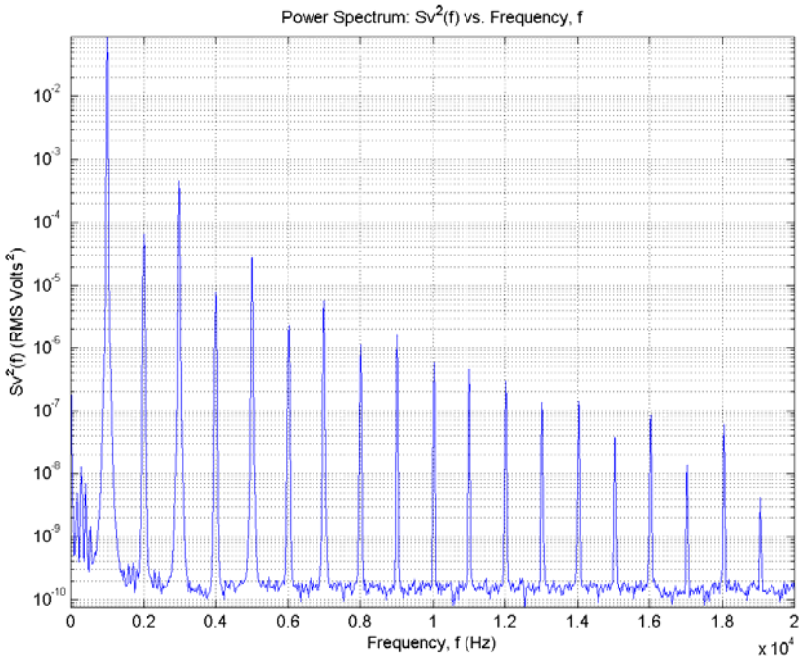




High gain, treble, and base with low contour results in a distorted/clipped wave. Harmonics are increased with a slightly higher increase for odd harmonics

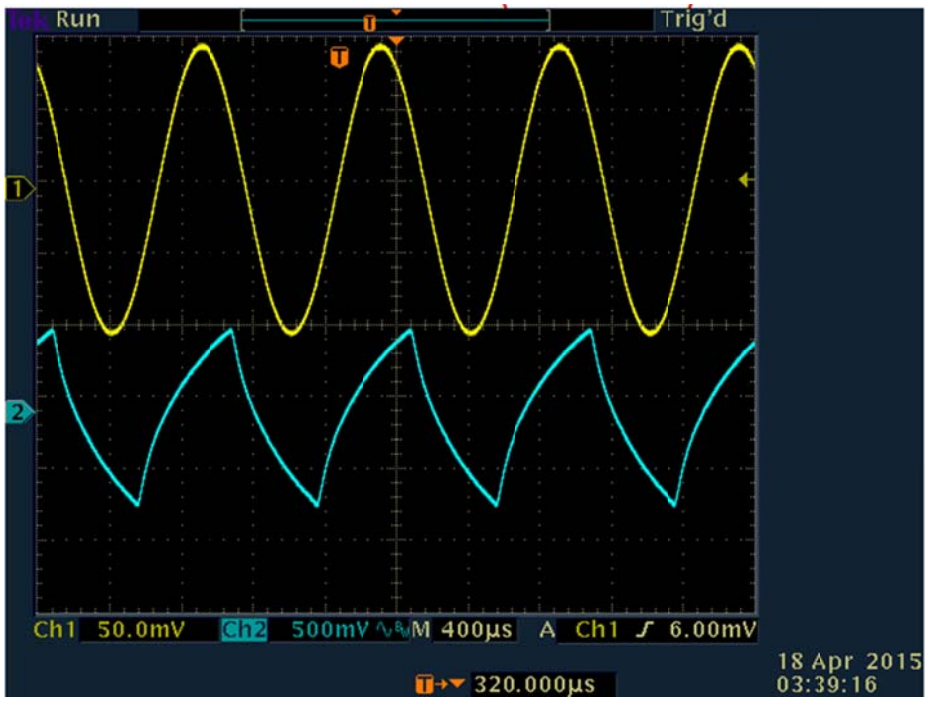
10.High Gain Low Treble High Contour High Bass

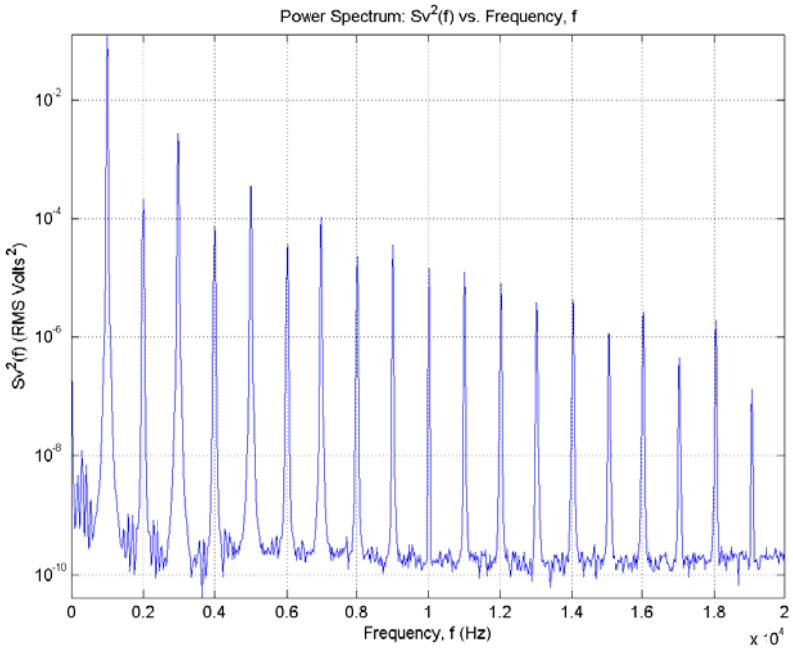




High gain, contour and base with low treble results in a triangle wave and a boost for the odd harmonics and high end response

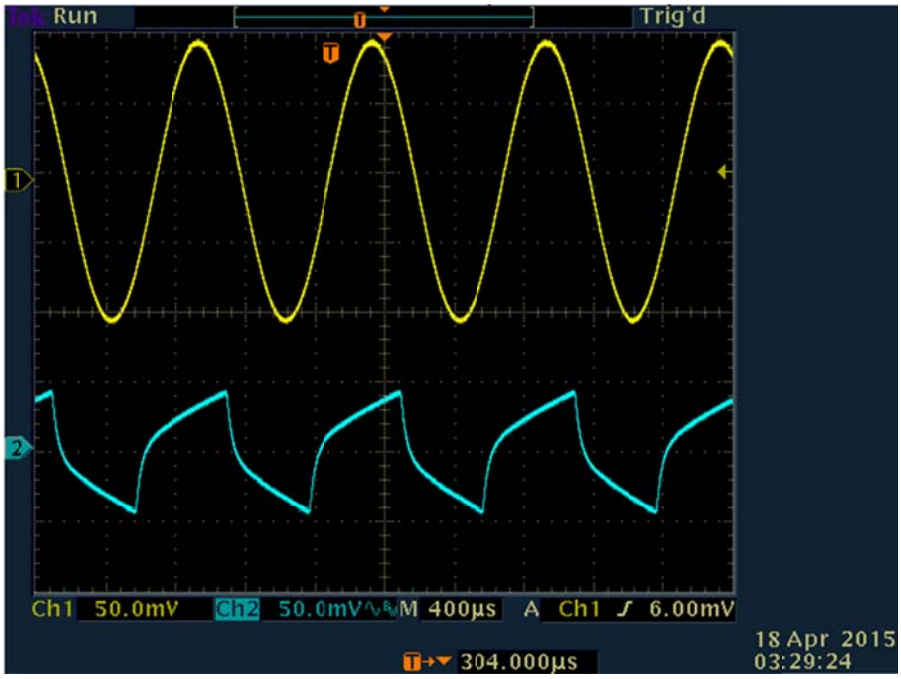
11.High Gain High Treble High Contour High Bass





High gain, contour, treble, and base results in a shark fin wave. Harmonics are increased with a slightly higher increase for odd harmonics

12.High Gain Low Treble Medium Contour High Bass



High gain and base with low treble and medium contour results in a distorted shark fin wave.

Conclusion

In conclusion the pedal worked fairly well. It gave me a new effect for my guitar that I lacked. And I also accomplished my goal of building a step pedal. I do not know if I would recommend this pedal again, or at least for people with little experience. The schematics were not well labeled and the board was very small, leading very little room in error for soldering the project. Overall though I believed the project went well.