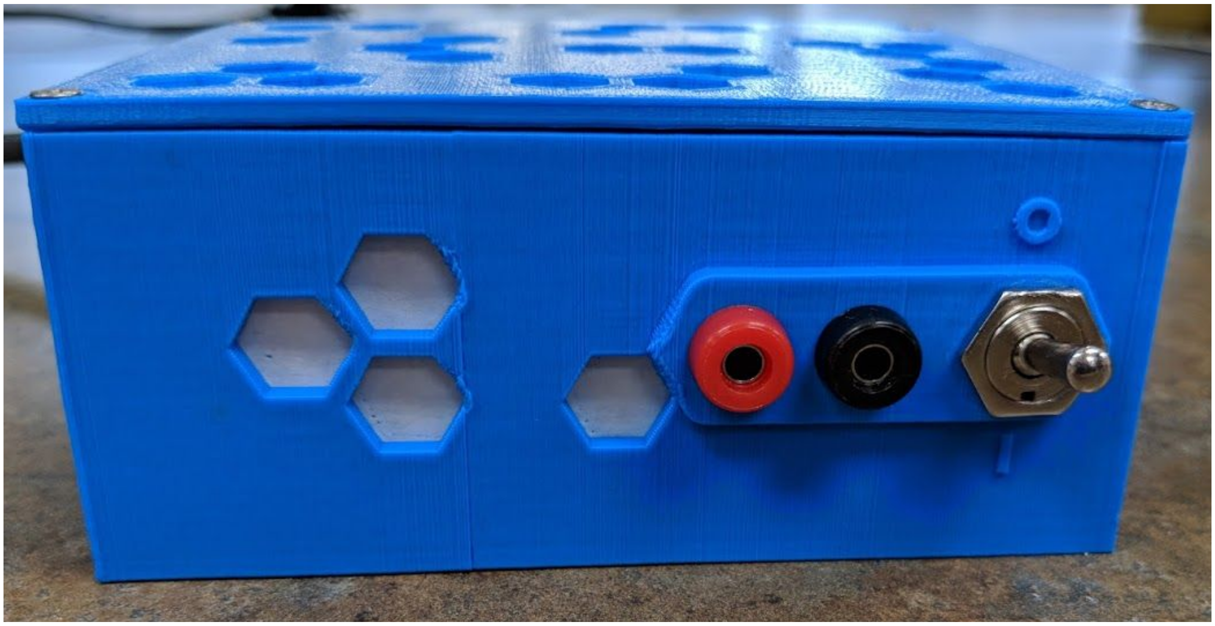
Power Supply



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Objective:

The objective of this project is to build a power supply with a 10 mV ripple with a 100 **Ω** load.

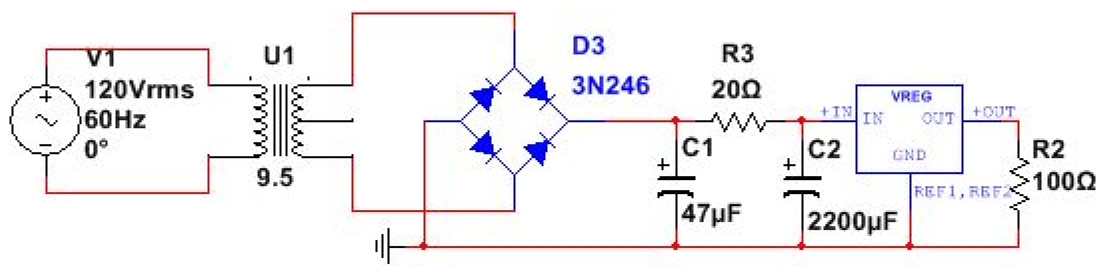
Materials:

- 20**Ω** 10w resistor
- 47µF capacitor
- 2200µF capacitor
- 12.6vct transformer
- W01M bridge rectifier
- MA712 voltage regulator
- 0.25w fuse
- Fuse Holder
- Red Female Banana plug
- Black Female Banana plug
- 3 Prong Power Cable
- Switch
- Heatsink

Procedure:

After receiving our parameters for the project we designed a circuit and tested it on multisim as shown in figure 1. When creating the filter for the power supply, in order to produce a ripple of less than 10 mV with a load of 100 **Ω** we had used a Pi filter in order to minimize ripple.

Figure 1



The Pi filter is made up of a reservoir capacitor and a low pass filter, the reservoir cap holds back some of the initial AC voltage, creating a sawtooth-wave. The low pass part of the Pi filter then shorts most of the AC voltage to ground, producing an almost completely DC voltage. The low pass will start to block any AC voltage at a starting value of 120 Hz. We know this due to the fact that the output of the bridge rectifier is 120 Hz, this happens because the rectifier takes the incoming 60 Hz wave and flips the negative part of the wave to positive. Producing twice the amount of positive peaks in the wave, which would in turn produce twice the frequency of the initial frequency. We can calculate the cutoff frequency with the use of formula 1.

Formula 1:

$$fc = \frac{1}{2(3.14)RC}$$

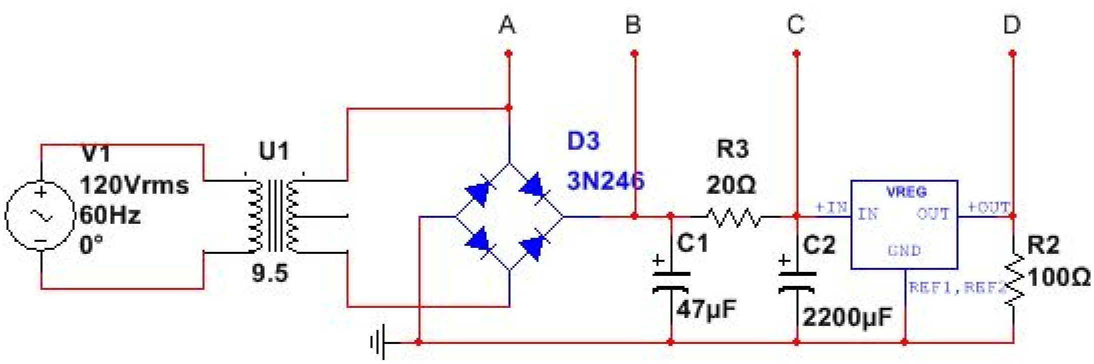
$$fc = \frac{1}{2(3.14)(20)(2200\mu)}$$

$$fc = \frac{1}{.276}$$

$$fc = 3.62 \text{ Hz}$$

With formula 1 we can tell that the cutoff frequency is very low at 3.62 Hz, therefore a low ripple will be created due to the fact that most of the AC voltage will be blocked. The low pass filter produces a near DC voltage source with a very little amount of an AC wave component to the source. With the circuit built, and the Pi filter proven to work. We can now use Figure 2 and use the reference points shown in the schematic to fill out table 1 and table 2. We do this in order to compare the physical and multisim values and to measure the ripple value of the circuit both with and without a load.

Figure 2

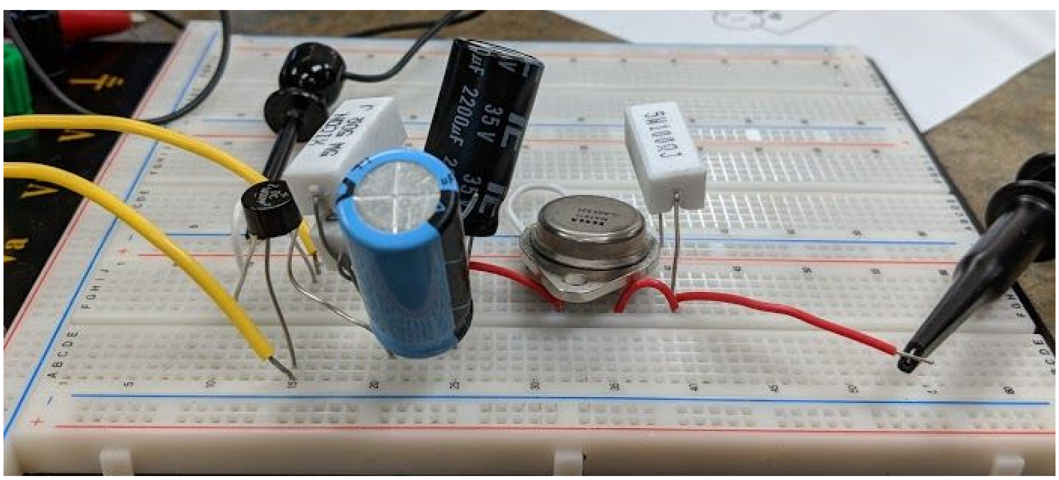


	Physical Measurements of the 12v Power Supply				
Table 1	**Point A**	**Point B**	**Point C**	**Point D**	**Ripple**
Without Load	24 V ptp	23.32 V rms	23.17 V rms	12.23 V rms	1 mV ptp
With Load	24 V ptp	18.14 V rms	15.61 V rms	12.04 V rms	2 mV ptp

	Multisim Measurements of the 12v Power Supply				
Table 2	**Point A**	**Point B**	**Point C**	**Point D**	**Ripple**
Without Load	35.54 V ptp	33.17 V rms	33.12 V rms	12.02 V rms	7.523 µV ptp
With Load	34.88 V Ptp	27.72 V rms	25.26 V rms	12.01 V rms	2.2 mV ptp

Once the multisim was completed a breadboard version was made as shown in figure 3.

Figure 3



Then the PCB was designed on ultiboard and created as seen in figure 4.0 and figure 4.1.

Figure 4.0

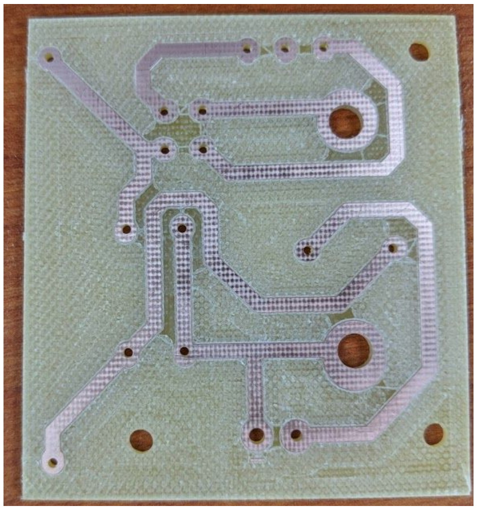
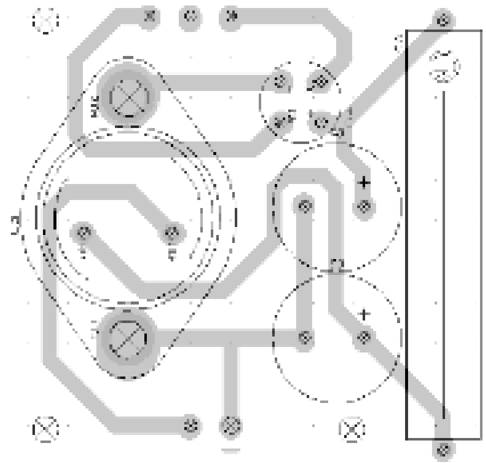
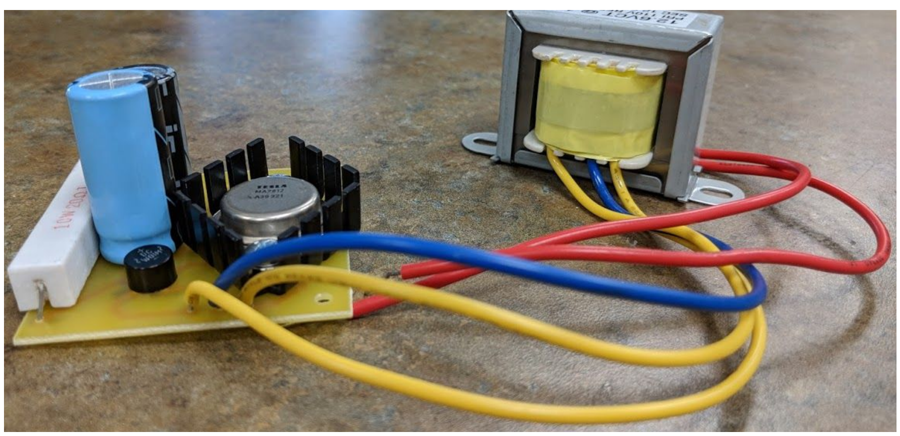


Figure 4.1



Once the PCB was printed the circuit was assembled as shown in figure 5.

Figure 5



With the cricut soldered, an enclosure was designed and 3d-printed as shown in figure 6.0 and figure 6.1 with the circuit placed within this box.

Figure 6.0

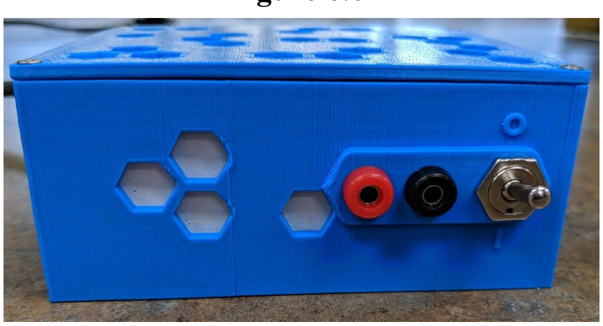


Figure 6.1

Discussion:

While creating the protoboard we had placed the transformer on the board. When preparing to print out the pcb, we were told that we should place the transformer elsewhere inside the enclosure. When choosing the voltage regulator values, we decided to use a 12 volt regulator due to the fact that many automotive and computer components use 12 volt.

Conclusion:

A power supply converts an AC source voltage into a constant DC voltage. First the AC is sent through the transformer, which in this case is a step down transformer. So the AC voltage decreases and the current increases, the AC voltage is then sent through a bridge rectifier. This component uses 4 diodes to block and pass parts of an AC sine wave to produce a wave that does not become negative, but rather is constantly positive and doubles the frequency. Once the wave passes through the bridge rectifier, it then passes through a Pi filter which slows the wave, producing a sawtooth-like wave. The voltage regulator can then take the irregular voltage and convert it to a more usable DC voltage by passing all of the excess voltage straight to ground.