Engin 365 Final Project Report

By

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Abstract

For my final project, I wanted to build a phone charger utilizing devices used in the course Engin 365 (diodes, op-amps, or transistors). Therefore, my circuit mainly required the use of diodes.

Introduction

For my final project, I built a Cell Phone Battery Charger Circuit. I found a project online [1] that I used as a guide to making my circuit capable of charging my phone (Android). In this project, I'll cover converting an AC signal (simulating a wall power) into a DC signal enough to charge my phone. A mobile phone normally charges at a regulated DC voltage of 5 V. Thus, I built a 5 V regulated DC supply from 10 AC supplied by a function generator. In contrast, on the website [1], the circuit used a transformer to reduce the power from the wall from 220 V AC to a smaller signal. However, I decided to make a change since working with wall power can be dangerous. Therefore, I used the function generator instead.

The components required for this project:

- Voltage regulator (IC 7805)
- Diodes (1N4005)
- 1000 μF capacitor
- Tektronix AFG 3022C Function Generator
- Tektronix DMM 4020 Digital Multimeter
- Tektronix DPO 2004B Oscilloscope
- Jumper wires
- Android Type-C port phone
- USB-C cable
- Breadboard
- USB-C Breakout

Background

Before building the physical circuit, we used the LTspice to run simulation. The Figure 1 is the LTspice simulation of my circuit where I used 4 diodes to build a full-wave rectifier, a capacitor to filter the signal, and thus a voltage regulator (not IC7805 but also regulates to 5V attached to the 1000 ohms resistors). In the end, the circuit convert the 10 V AC supply in to near 5 V DC supply (Figure 2).

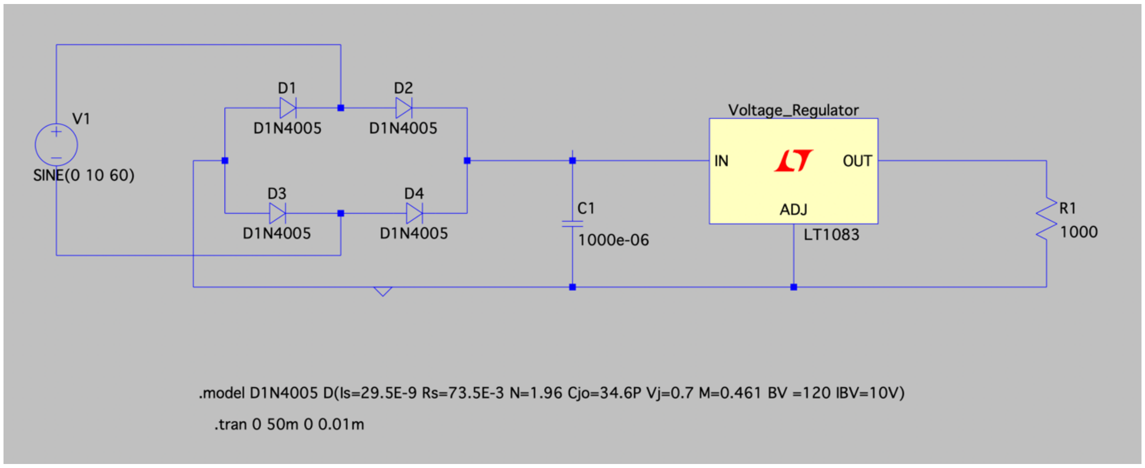

Figure 1: LTspice simulation of my phone charger circuit

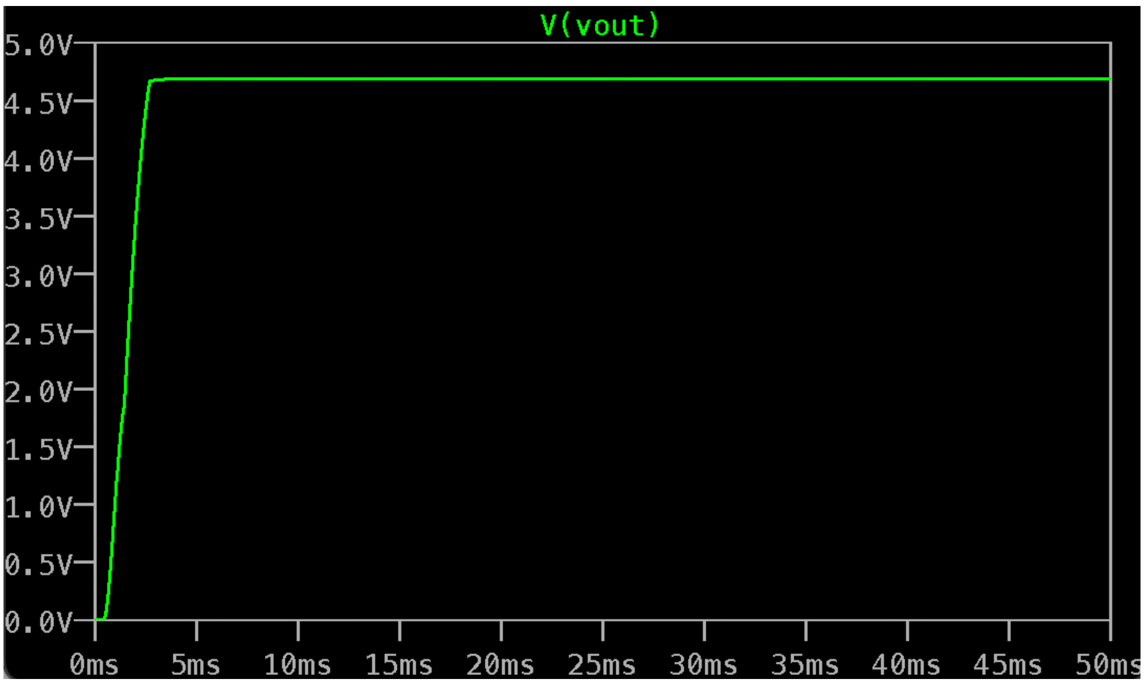

Figure 2: The 5 V DC signal from LTspice simulation

Experiment

The process of building the circuit is divided into three steps:

1) <u>Rectification</u>

   The rectification is the process of removing the negative part of the AC signal having the current flowing in one-way. Thus, having the function generator supplying the AC signal (Figure 3), the Full-wave bridge rectifier I built using the diodes would rectify the AC signal (Figure 4). Thus, the peak voltage is also reduced due to the diode's voltage drop of 0.7 V.

Figure 3: The AC signal from funtion generator

$V_p = V_{in} - 2 * V_D = 10 - 1.4 = 8.6\ V$

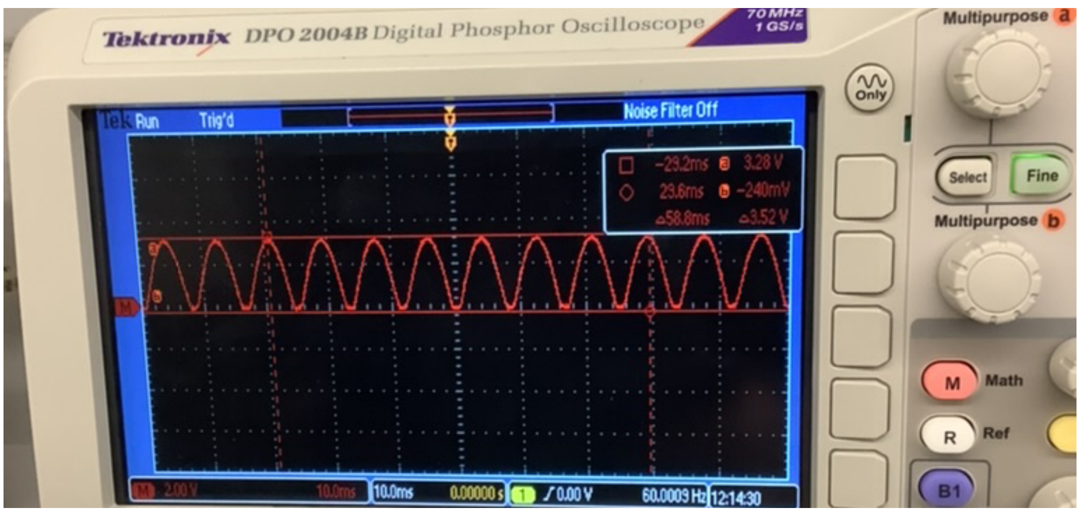

Figure 4: Rectified signal

2) <u>Filtration</u>

Thus, after getting the rectified circuit we need to use Capacitor to filter it out. The capacitor will charge till the wave form goes to V_p and it discharges when the waveform goes low. Thus, when output is going low, capacitor maintains the proper voltage supply into the Load circuit, hence creating the DC [1]. I used 1000 μF capacitor to filter the rectified signal. Thus, I used the digital multimeter to measure the DC voltage and got the following:

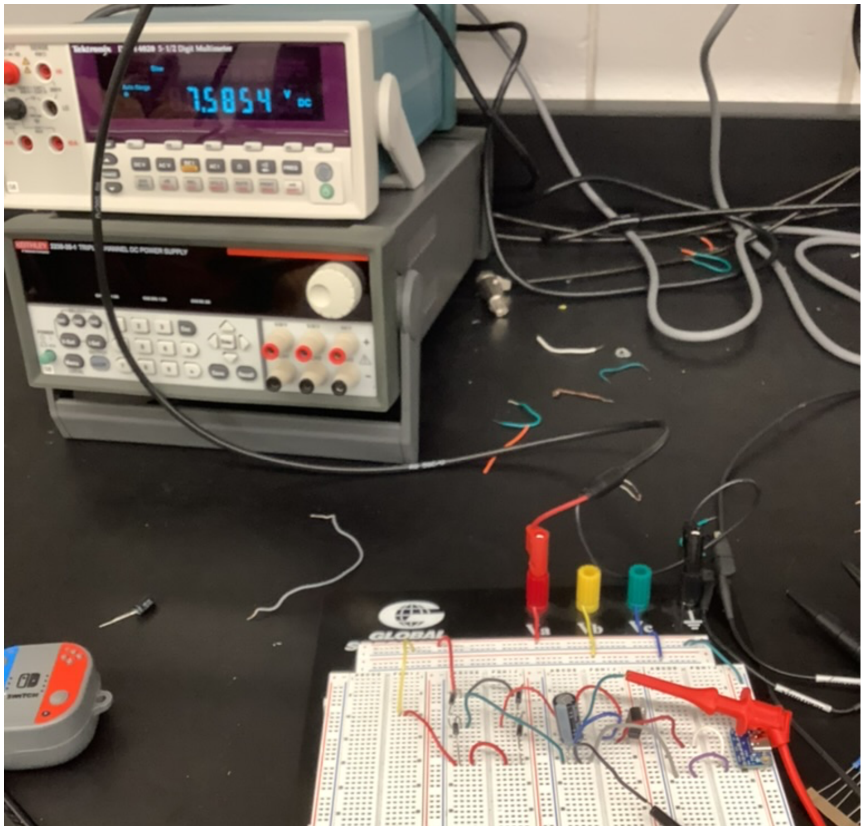

Figure 5: The measurement of the DC voltage after filtration

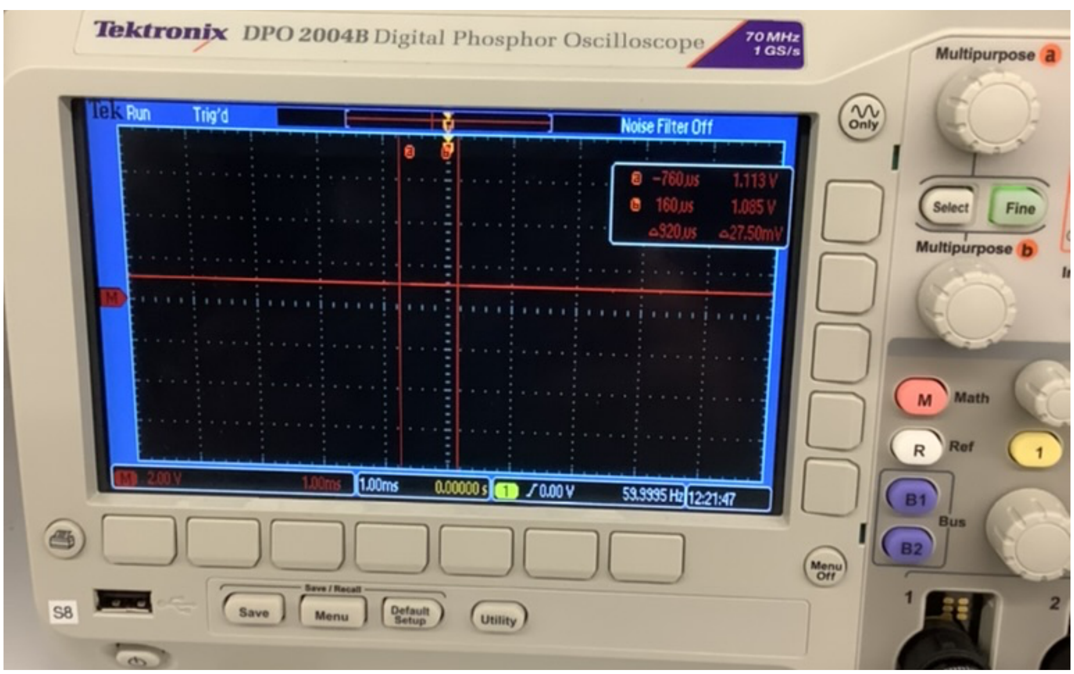

Figure 6: The ripple voltage after filtration

3) <u>Voltage Regulation</u>

The IC7805 voltage regulator is used to provide a regulated 5 V DC as long as the input voltage is at least 7 V DC. It operates in input voltage range of 7-20 V [1]. Therefore, after filtration 7.58 V is the input voltage (Figure 5) into the regulator, and thus an approximately 5 V is being provided (Figure 7).

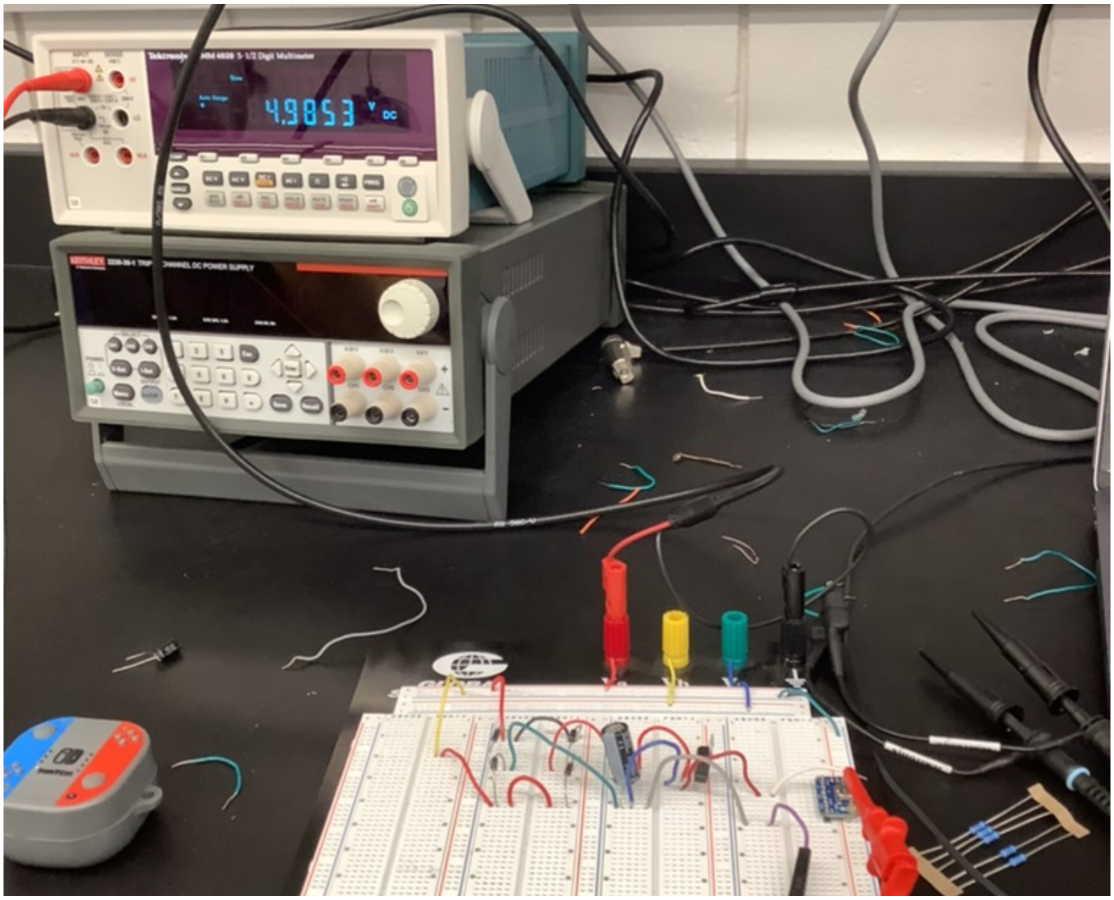

Figure 7: The measured DC voltage regulated by the IC7805 voltage regulator

Thus, having the regulated 5 V DC I connected the USB-C cable into the USB-C breakout and connected into my phone.

Result

The circuit was built as shown in Figure 8. Finally, when the charger was connected to the phone, it was soon detected, and the phone began to charger (Figure 9).

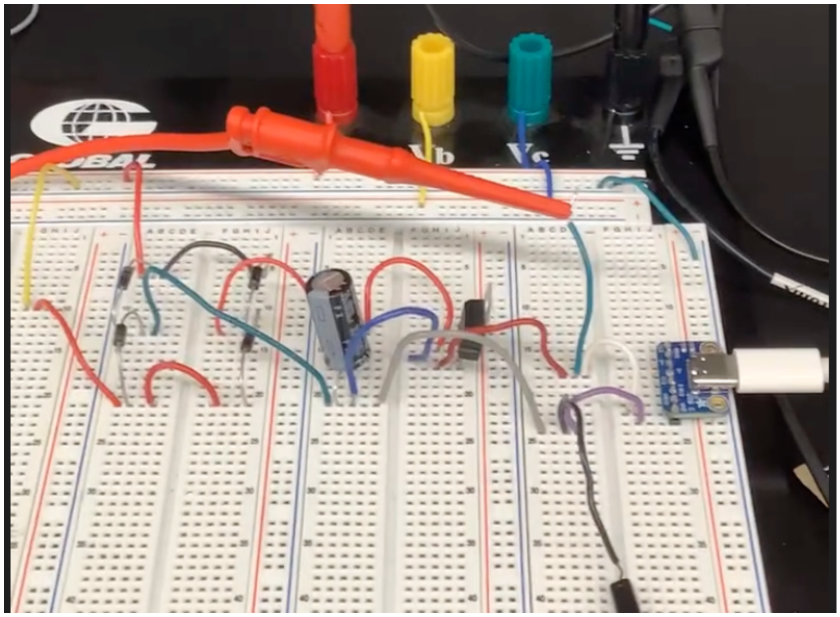

Figure 8: My phone charger physical circuit

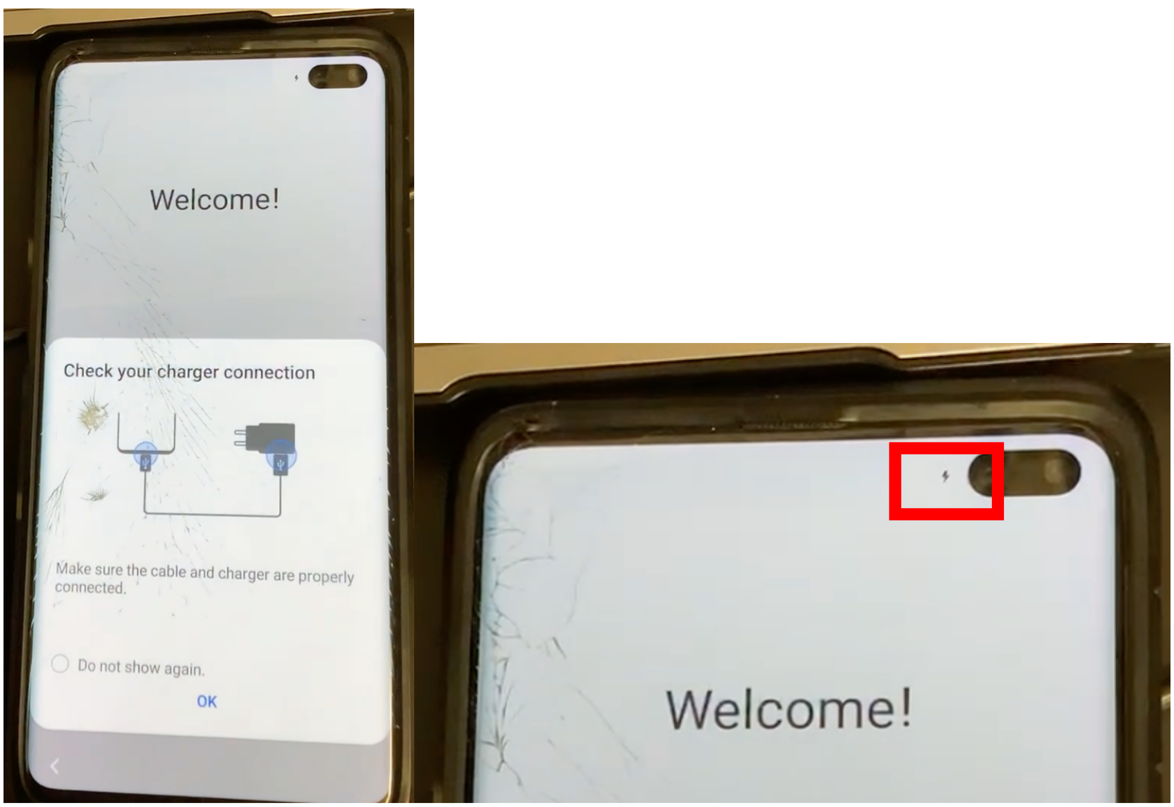

Figure 9: The result, having the phone charging.

Conclusion

I am pleased with the outcome of my final project. As a result, the circuit was able to connect to the phone and begin the charging process. Two factors, however, caused my phone to charge slowly: first, the charging port on my phone is loose and does not fit securely when connected. Secondly, the resistance of the function generator would influence the voltage and current flowing through the circuit. Nevertheless, I enjoyed working on this project and learned how to use diodes better.

Reference

[1] https://circuitdigest.com/electronic-circuits/cell-phone-charger-circuit-diagram