CMPE314: Principles of Electronic Circuits

Dr. Yan

Lab 02 Report:

Diode-Based Filtered Rectifier and Regulator Circuits

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1. Objective

Examine a filtered rectifier circuit. Theoretically and experimentally determine the proper resistance for the filter

2. Equipment

a. One potentiometer
b. One 22 µF capacitor
c. One 1N4740 diode
d. One 741 operational amplifier
e. Oscilloscope, DC power supply, digital multi-meter, function generator, breadboard

3. Background

Filtered rectifiers convert AC waveforms into useful near-DC waveforms. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. They may be made of solid state diodes, vacuum tube diodes, and other components. A voltage buffer amplifier is used to transfer a voltage from a first circuit, having a high output impedance level, to a second circuit with a low input impedance level. A unity gain buffer, also known as a voltage follower, has a voltage gain of approximately unity, while it provides considerable current gain and thus power gain.

4. Procedures

4.1 Part A. Diode-Based Filtered Rectifier Circuit

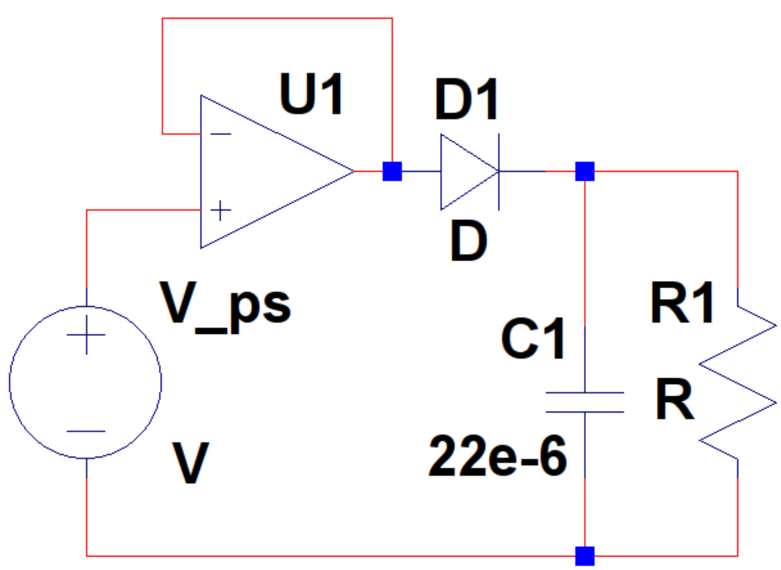

Figure 1: Filtered Rectifier Circuit

a. Use a 1N4740 diode to construct the circuit from Figure 1.

b. Set the input signal amplitude to be 5 V and frequency to be 60 Hz.
c. Vary the potentiometer until the output ripple voltage is less than 10%.
d. Measure the potentiometer resistance as $R_{L\_measured}$. Compare the expected value for R_L with the measured value.

4.2 Part B. Diode-Based Filtered Regulator Circuit (Simulation)

a. Simulate the same circuit from Figure 1 on Cadence Orcad PSPICE.

5. Results

Since there were no potentiometers available in the lab kit, several resistors of different resistance were used in an iterative/brute-forced manner. The value of R_L computed in the pre-lab was around 4 kΩ. $R_{L\_measured}$ turned out to be 7.25 kΩ.

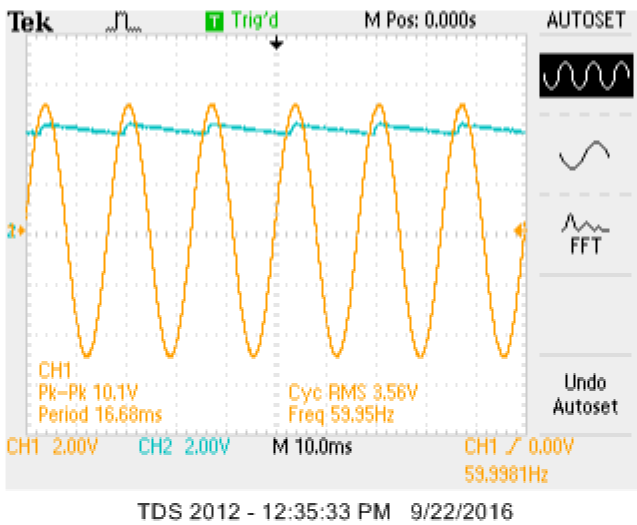

Figure 2: Waveform of Figure 1 after adjusting the value of R_L until the ripple voltage was less than 10%

The circuit from Figure 1 was simulated on Cadence Orcad PSPICE, assigning the value of R_L to $R_{L\_measured}$ = 7.25 kΩ.

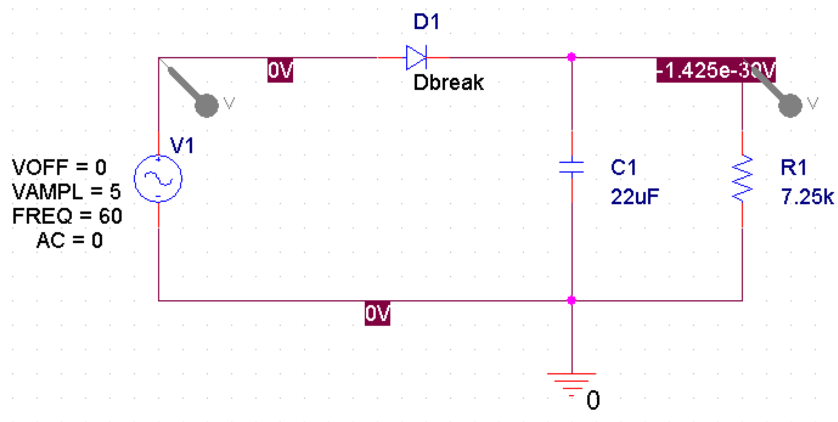

Figure 3: Simulation of Figure 1 on PSPICE

The circuit was simulated with the same input waves and the voltage across the diode was plotted. The input/output voltage waveforms simulated on PSPICE appeared almost identical to the waveforms captured on the oscilloscope.

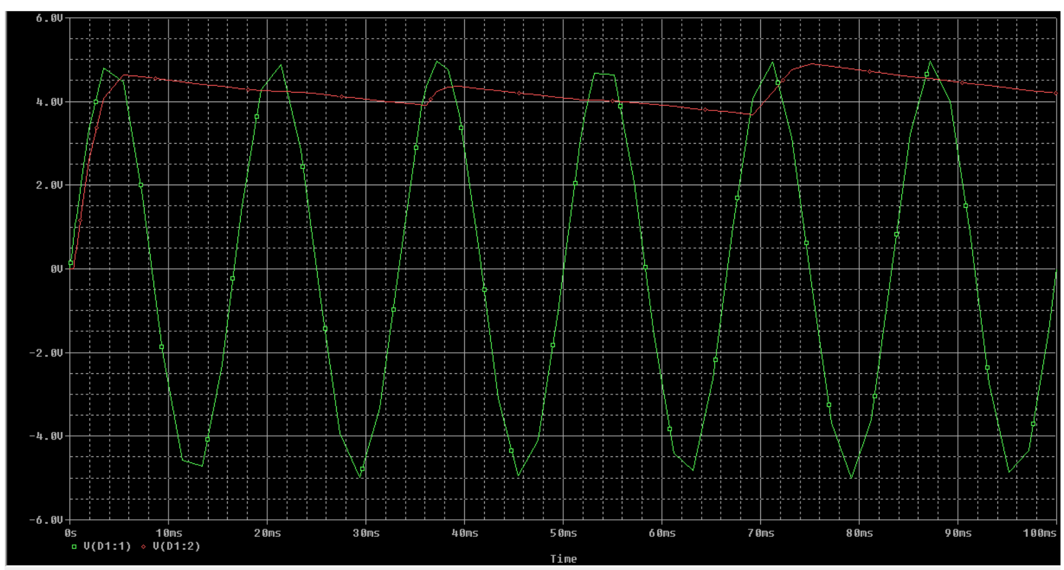

Figure 4: Voltage Across the Diode of the Circuit Simulated on PSPICE

6. Conclusion

The value of the load resistance, R_L, computed theoretically had a very high percentage error to the actual measured value. $\frac{|7250-4000|}{|7250|} = 44.8\%$. The result is due to the fact my approach to computing the value on the pre-lab assignment was incorrect, otherwise the value computed theoretically should have been closer to the value measured.