Pspice Assignment #1

Electronics

January 31, 2013

1 Voltage rectifier

Our electronics typically get their power from a wall socket (even if the power is just used to charge their batteries). However, most electronics (including chargers) require one or more DC voltages. This assignment will look at one method for generating these voltages. We have utilized a transformer to "step–down" the AC voltage. It now has a 15 V and is oscillating at 60 Hz. The rectifier circuit is show in Figure 1. Solve the following problems.

1.1 Current

- Trace the current path through the diode rectifier when V_{ac} is positive. Do this by hand.
- Trace the path when V_{ac} is negative.
- Plot the current through each diode using the transient analysis.

1.2 Capacitor

- What is the purpose of the capacitor, C_1?

  **As a side note*: You typically need an electrolytic capacitor to get this high of capacitance and they have a preferred direction of polarization.
- Explain what happens if $C_1 = 10000$ μF?
- $C_1 = 1$ μF?

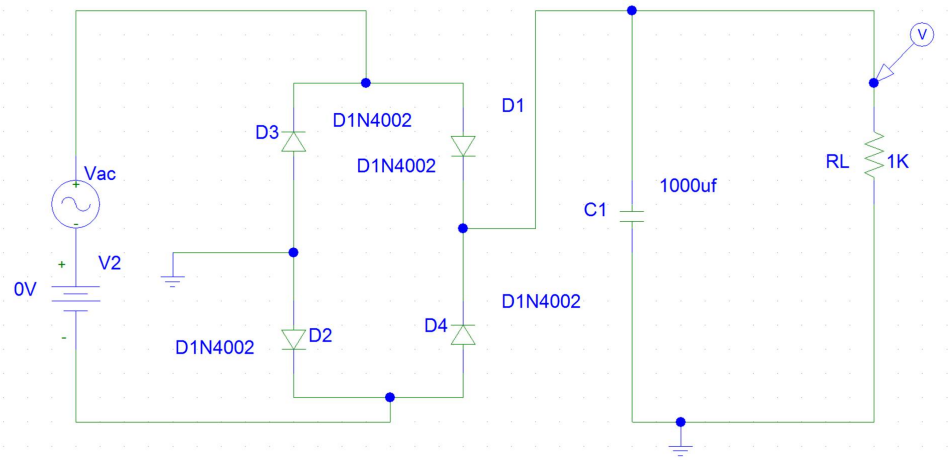

Figure 1: Circuit for problem 1

1.3 Output voltage

- Plot V_{out} (voltage across R_L) using the transient analysis. We leave it up to the student to choose an acceptable time–scale that will illustrate the initial start–up conditions as well as provide a reasonable approximation of steady–state. Do this on one graph.
- Plot V_{out} for $R_L = 100K$
- Measure the AC "ripple for $R_L = 1K$ and $100K$.
- Is there a problem with this power supply?

  Think along the lines of connecting different types of electronics to it.

1.4 DC sweep

Sweep the DC source (V_2) from ± 15 V.

- Generate a plot of the current through each diode.
- Generate a plot of the output voltage.

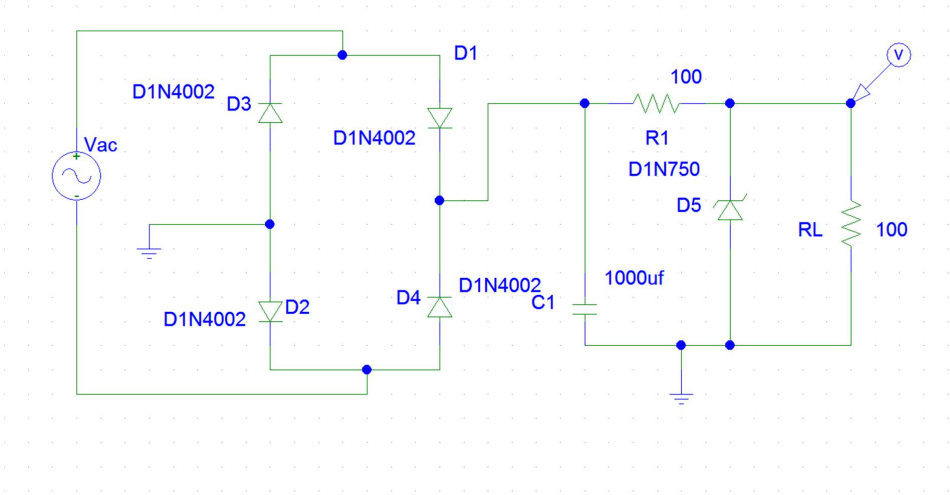

Figure 2: Circuit for problem 2

2 Voltage rectifier – Part 2

Hopefully, you have established why the previous voltage rectifier is not ideal. We will now examine a modification that will remedy this problem. The new circuit is shown in Figure 2. Notice the addition of a zener diode (D_5) and a resistor (R_1). Note:D_5 has a break down voltage of ≈ 4.8 V. (Make sure you use D1N750)

2.1 Output Voltage

- Plot V_{out}
- Plot the current through D_5.

2.2 DC sweep

- As before, sweep the DC voltage source from ± 15 V.
- Plot V_{out} versus time (transient analysis).
- Plot the current through D_5 versus time.

2.3 Zener diode

- What does D_5 accomplish?
- In terms of power consumption, what is wrong with this circuit?

3 Write–up

Your report should be typed and in a report format. The student is expected to provide a detailed explanation and analysis of their results. Embed the plots and figures in your document. Please, ensure your graphs and plots are clearly labeled with the appropriate captions and figure numbers. If they are not labeled, we will not try to guess where they belong and the problem will be marked wrong. Include a copy of you schematic in the report. Try to use the same component labels that are in the assignment otherwise the grader cannot figure out where your mistake was made. Feel free to leave white space in your report for any equation you want to write and then fill it in by hand.

One last note: The circuits we simulated are rarely used in low–power electronics. This assignment should make it clear as to why.