Collin Heist
ECE 311
Lab #6

Objective

The objective of this lab was to design and measure various attributes of both a zener rectifier circuit, and a 3.3V regulated DC power supply. With the Zener circuit, we were comparing our simulated values of the line regulation to the real-world line regulation, and the 3.3V circuit had us analyze how the load regulation changed as a function of the current through the load.

Procedure

To begin this lab, we created the zener regulator circuit provided in the lab worksheet. This was a sinusoidal AC voltage source with a DC amplitude shift, running through a resistor and then a parallel zener diode and a load resistor. Using the **1N5226** Zener diodes provided by the TA, we measured all the resistances of the circuit and then incrementally adjusted the AC voltage source's peak-to-peak variation.

By adjusting the variation for values between 1% and 20% of the DC shift, we effectively changed our **VHL** and **VLL** values. Looking at the load resistor on the oscilloscope allowed us to see those values across the load, and calculate the line regulation accordingly. As we expected, as our peak-to-peak variance grew, so too did our line regulation.

The next experiment was the 3.3V regulated DC power supply. This involved the standard FWR circuit we've built before, followed by a capacitor, a series resistor, and then a parallel Zener diode and load resistor. After we'd built this and verified the directionality of all of our components (and measured them accordingly), we measured our **V_NL**, the output voltage with no load attached.

Because our preliminary work shows we'd need a 872 microfarad capacitor, but that is not a readily available capacitor value, we created this by putting four 100 microfarad capacitors, and one 470 microfarad capacitors in parallel. Because the simulated resistor values were odd resistances (like 80.66, 531.05, etc.) we grabbed resistances as close to those as we could, and used those for our data collection. Each resistor measured value can be found in the worksheet table for **Part 2**.

We then started adding in each of our load resistors, measuring the corresponding DC voltage across it using our multimeter, and thus calculating the current (using **I = V / R**). Repeating this procedure for each of our resistors (between 80 and 5,600 Ohms), we could then calculate the load regulation for each of these resistors, using the pre-measured 3.47 V for our no-load voltage across the zener diode.

Plotting this load regulation versus the load current showed what our preliminary also showed. In the preliminary, we compared the LR versus the resistor itself, but given in this lab we plotted the LR versus the current the plots look inverted but show the same thing. As our load resistor increased, thus decreasing our current, the LR decreased accordingly. Though our measured data was not as clean as the simulated / calculated ones, it still revealed quite a lot about the relationship between LR and the load impedance.

Questions & Calculation

All relevant calculations are attached to the back of the lab write up.

Results

For the first experiment, our results coincide very well with our preliminary work. Just as simulated, the increase in the peak-to-peak variance of the input voltage increased our line regulation. This fits with our understanding of the circuitry as well, because a more varied input line will clearly have a less consistent line regulation.

Our second experiment's results were less clean, as the measurement system we were using was a lot less precise than in the first experiment, but the trend is still clearly evident, and it confirms our presuppositions. With a relatively small load resistor, our current is (comparatively) very large, which intuitively means that a small variation in the load current (caused by small changes in the impedance) has a large effect on the load voltage, thereby increasing the load regulation.

Conclusion

This lab was very useful in confirming a lot of my preconceived notions of line and load regulation. In particular, part one was very insightful with how direct the correlation is between a larger peak variance and a larger / worse load regulation. I think that the results of the second experiment are a bit more convoluted, as the inverse relationship between the load current and the load resistor complicate the intrinsic mathematics, but still, seeing the increasing load current directly cause an increase in the load regulation says a lot about these factors.