UNIVERSITY of PENNSYLVANIA
DEPARTMENT of ELECTRICAL and SYSTEMS ENGINEERING

Electrical Circuits and Systems II Laboratory
ESE206

Power Supply Lab

Goals:

- Design and build a simple power supply consisting of a transformer, a bridge rectifier and a peak detector followed by a Zener regulator.
- Measure the line and load regulation.

Introduction:

This week's lab is similar to the mini-project you did earlier in class. The goal is to design, *build and characterize* a power supply regulator that is fed from a 120V, 60 Hz source and that supplies a constant voltage of about 4.7V. The power supply contains a transformer, a full-wave bridge rectifier with peak rectifier and a Zener regulator, as shown in Figure 1 below. Descriptions of each of these components can be found in the ESE216 class notes or the textbook (Microelectronics by Sedra and Smith, 3rd chapter).

You will design and build each part separately. At the end you will put both parts together and verify your overall design. It is recommended that you verify the design by PSpice before coming to the lab.

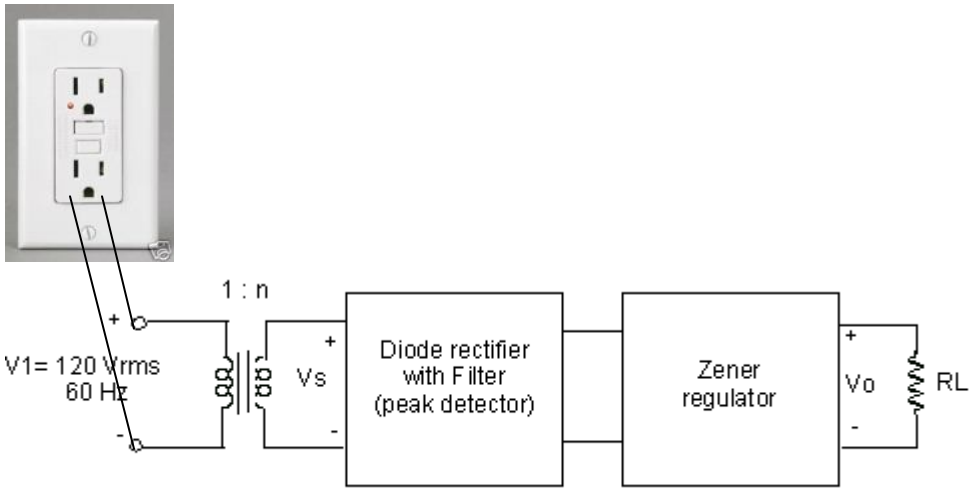

Figure 1: Schematic block diagram of a power supply

Pre-Lab:

The pre-lab is similar to the mini-project. The main difference is that the transformer ratio is given. You can assume that the amplitude v_s at the secondary terminals of the transformer is **15.6V** (unloaded). Your goal is to design the overall system. Here are some guidelines:

a. Draw the complete circuit schematic.
b. You will be using a 4.7V Zener diode (1N750: for the datasheet click here). The Zener can dissipate a maximum of 500mW and it knee current is about 5mA. The value of the Zener resistance r_Z can be found in the datasheet. Find the value of the **resistor R** that feeds the Zener diode. You should design it such that the load resistance can be as small as 200Ω.
c. Design the peak detector. A good choice is to design it for a ripple of about 1-2p (peak-to-peak). Find the value of the **capacitor C**. For the load resistor R use the value of the resistor R used in the Zener regulator.
d. What is the PIV of the diodes of the bridge rectifier and give the breakdown ratings of the diode assuming a 50% safety margin.
e. What is the maximum diode current flowing in the diodes of the peak detector?
f. Based on the choices of the components (R and C) calculate the value of the load regulation and the line regulation.
g. If you have time, it would be good to do a Spice simulation.

Lab Experiment

Equipment:

1. HP multimeter HP 34401A
2. HP function generator/waveform generator (HP 33120A)
3. Power supply
4. HP digital oscilloscope HP 54600
5. Diodes
6. Zener diode 1N750 (4.7V)
7. Capacitor and resistor
8. Transformer 120V-9Vac (AC/AC adaptor)

In-Lab Experiment:

Build the circuit starting with the rectifier and peak detector. When these parts work add the Zener regulator.

1. Frist, measure the output of the transformer (amplitude and RMS value). ***Be careful not to short the two terminals!***
2. Connect the bridge rectifier with a load resistor R (same value as the one used for the Zener regulator). Measure the output of the rectifier before and after connecting the capacitor C. What is the value of the ripple (peak-to-peak) of the peak detector? Measure also the current flowing through the diodes when the capacitor is connected over R (note the current flows only during a short period; to measure the current put a small resistor of 10 Ohms or smaller in series with one of the diodes and measure the voltage over this small resistor). Take screen shots of all measurements.
3. Connect the Zener regulator and measure the voltage over the Zener. Display its value on the scope. Measure both the average and ripple. To measure the peak-to-peak value of the ripple over Zener, use AC coupling for the scope's input. Find the line regulation.
4. Next connect a load resistor R_L of 1kΩ and measure the output including the ripple (over the Zener diode). Find the value of the load regulation.
5. Vary the load resistor R_L and check how small the resistor can be before the regulator ceases to operation properly.
6. Compare the measured values with those of the hand calculation, done during the pre-lab.

To hand-in

Well written report including schematics, measurement results and discussion. Follow the the guidelines of writing a lab report.

Created by Jan van der Spiegel, March 30, 2007