Elec Eng 2EI5
Design Project #1

Problem Statement

Design and build a dc power supply that delivers 10 mA at 3V ± 0.1V from a source that is 120V (rms) at 1 kHz.

Test Requirements

1. In the lab, you will not work with a 120V source. You will use the function generator to produce a sinusoid of the amplitude that your design requires at the output of a transformer.
2. In your report, you must explain your choice of input level (transformer output), how you would obtain that from a transformer (i.e. what the transformer specifications need to be) and then demonstrate that your circuit delivers a final output of 10 mA at 3V ± 0.1V.

Warning

Power applications such as this project can be hazardous if care is not taken to avoid exceeding safe maximum currents and voltages. In this case we have eliminated one hazard since we will not work with high voltage. However, the use of reactive components (capacitors/inductors) can result in current/voltage spikes.

1. Carefully simulate your circuit before you attempt to build it.
2. Make sure that you are aware of the **current, voltage, and power ratings** for various components and do not exceed them.
3. Make sure that if you use a **polarized capacitor** that you connect it with the **correct polarity**.

Report Requirements

1. Cover page.
2. Pages 1-2:
    a. (5 pts) Summary: a concise statement of the problem and description of the basic design and its performance.
    b. (25 pts) Design: in general, a dc power supply includes a transformer, rectifier, filter, and regulator. Address each of these items as follows.
        i. Transformer: you will not use a transformer. Specify the input voltage(s) required for your design then determine the turns ratio of the transformer that would be needed if this input were to be generated from a 120V ac source. In your actual circuits and simulations, you will use the AD2 to provide the input(s) to your circuit.
        ii. Rectifier: identify and justify the rectifier topology used and identify the relevant diode parameters.
        iii. Filter: specify the filter used (including component values).
        iv. Regulator: a regulator is optional. State whether you used a regulator. If so, explain the design, including the values of components used.
        v. Provide a complete circuit schematic.

vi. Show the calculations that led to the choice of all component values.
vii. Specify the expected performance according to your design calculations.
viii. Discuss design tradeoffs, design margins, component ratings, safety, and other issues that you considered in your design? ***(This point is very important – you must show that you considered safety issues and component ratings in your design and you must show that you understand design margins and tradeoffs.)***

3. Page 3:
    a. (20 pts) Measurement and analysis:
        i. Include a photograph of your actual circuit. The photo must include a paper with your name, student number, and the date.
        ii. Explain the measurement procedure: how did you determine the performance?
        iii. Provide the key measurement results.
        iv. Include screenshots of your oscilloscope output, clearly marked to show the performance obtained.
4. Page 4:
    a. (15 pts) Simulation: include the information listed below.
        i. Circuit schematic from the simulator.
        ii. Netlist.
        iii. Simulation conditions. This includes type of simulation (operating point, transient, ac sweep, etc.) and the simulation parameters (e.g. simulation time).
        iv. Simulation output. Choose the output figures and numbers required to specify the performance of the circuit.
5. Page 5:
    a. (20 pts) Discussion:
        i. Compare the results from design, simulation, and measurement.
        ii. Discuss any discrepancies observed.
        iii. Discuss the limitations of the design and the limitations of the measurements you performed.
        iv. Describe any problems encountered in measurements and the troubleshooting steps you took.

In addition to the above, 15 points will be assessed on presentation. This includes the layout of the report according to the above sections, quality of figures, neatness, and clarity of presentation in a professional style.

Workload & Time Management

In order to successfully complete this project you will need to learn about:

1. Converting ac to dc;
2. The meaning of average voltage and voltage ripple;
3. Methods of reducing voltage ripple;
4. Using the Digilent Analog Discovery module;
5. Using a simulator;

6. Modeling diodes; and
7. Measuring ac signals.

Some of these items you will be able to learn during lectures. Others may be found in the textbook or in the supplementary labs published on Avenue. Doing what needs to be done for the project is your responsibility. You will need to plan. Figure out how much you want to do and the order in which you will need to do it.

Finally, re-read the Warning section above. DO NOT ATTEMPT TO BUILD THE FULL CIRCUIT BEFORE SIMULATING IT. You really need to have a good feel for how much current is going to run through your different components and ensure that it is within the safe limits for your components.