SANTA CLARA UNIVERSITY	ELEN 115 Spring 2023	Shoba Krishnan

Project 2: Power Supply Design

I. OBJECTIVES

- To design of a DC power supply.
- To construct the circuit in the laboratory and record sufficient measurements to establish circuit operation in accordance with design objectives.

II. Analysis

The need exists for a small 5 VDC power source capable of delivering a load current to a 2.5K resistive load**.**

1. Rectifier Design:

It is decided to use a half-wave rectifier using 1N 4001 diode with a simple capacitor filter as shown in Fig.1.

The input voltage is obtained from a transformer that gives a 120Vrms 60 Hz sinusoid at the primary and a 31.8V peak to peak across the secondary (keeping the center tap floating).

(1) Find the value of the load current for the given specifications

(2) Identify the turns ratio of the transformer

(3) Find the value of the capacitor needed to obtain a peak to peak ripple of 2V.

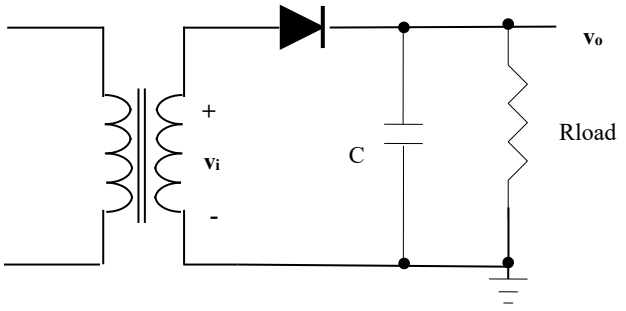

Fig.1: Half Wave Rectifier with Simple Capacitor Filter

2. Regulator:

In order to reduce the ripple voltage applied to the load without increasing the size of the filter capacitor, it is decided to use a 5.1 volt Zener diode (1N751A) with the original design as shown in Fig. 2.

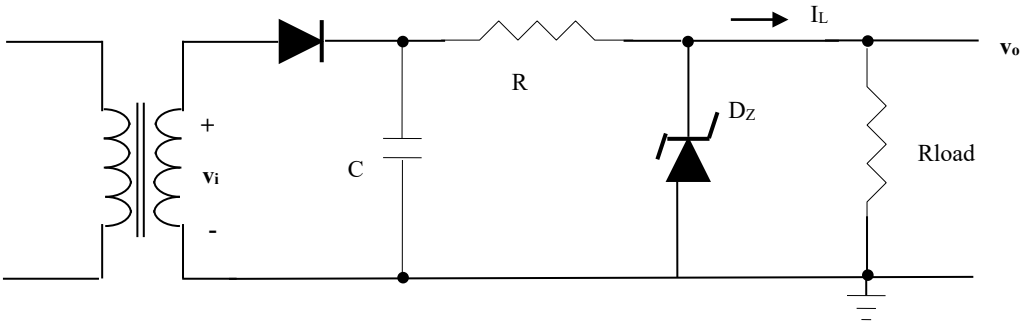

Fig.2: Power supply Design with Zener Regulator

(1) Look up the Zener diode data sheet to obtain the dynamic zener resistance and test data point.

(2) Determine a value for R that will supply the maximum required load current of calculated from part 1 to the resistive load and provide a minimum Zener current of 3.5mA.

Hint: Use minimum supply voltage, minimum Zener current and maximum load current when finding the R value.

Develop a test plan by answering the below questions

(1) How would you ensure that the rectifier action is happening?

(2) How would you know if the ripple specifications are being met?

(3) How would you know the load is getting the current it needs?

(4) How would you measure the output voltage ripple and ensure it has improved after the zener shunt regulator has been added?

(5) How would you measure load regulation?

(6) How would you find the maximum load current possible for this power supply?

III. PROCEDURE

1. Transformer

a) The input voltage is obtained from a transformer that gives a 120Vrms 60 Hz sinusoid at the primary and a 31.8V peak to peak across the secondary. Keep the center tap floating but tie the wire to unused section of your protoboard so as to keep it safely out of the way.

b) Remember to disconnect the transformer form the wall when you are making modifications to your circuit so as to be safe.

Note: Make the Probe Impedance of both the channels of the Oscilloscope equal to 1MOhm.

2. Half Wave Rectifier

a) Build the half wave rectifier circuit on the breadboard with only the Resistive load. Use a 1N4001 diode. Observe the output on the bench oscilloscope.
b) Add the capacitor across the load and observe the filtering action.
c) Make sufficient measurements with an oscilloscope to verify the expected results for rectified voltage and peak-to-peak ripple voltage.

3. Zener Regulator

a) Connect the Zener diode 1N751A and the designed current-limiting resistor R to your previous circuit to obtain a regulated output.

b) Make sufficient measurements to verify the expected results for regulated voltage and peak-to-peak ripple voltage.
c) Measure the DC voltage level with the digital voltmeter for the minimum value of RL along with several values above and below the minimum value. Be careful not to overload the Zener diode.