Regulated Power Supply Using Proteus

Project synopsis submitted in partial fulfilment

for the Award of

CERTIFICATION

in

Electric Vehicle Course

by

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PROJECT DESCRIPTION

<u>Objective</u>

The main objective of this project is to develop a regulated power supply using Proteus, which takes input 230V AC and generated output 5V DC by understanding the hardware design and virtual prototyping.

Block Diagram

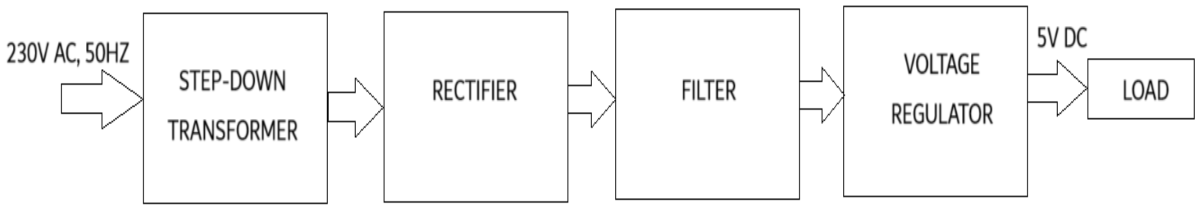

Fig-1

A Supply of 230 V AC is given to the Step-Down transformer as input and it steps down the voltage to some desired voltage let say 14 V AC as output. Then, it will send as input to Rectifier which converts the AC to pulsating DC i.e., DC with ripples. Here, we use Full Wave Bridge Rectifier for Rectification. This pulsating DC is sent to the filter which smoothens the wave form by decreasing the ripples using Capacitor Filter or C-filter. However, the filtered DC output has also some ripples and this will be sent to the Voltage Regulator which regulates the voltage in desired range i.e., 5 V and reduces the ripples and provides constant DC Supply to the Load. Here, we use Zener Diode as Voltage Regulator.

<u>Expected Result</u>

Through this project we will understand the following points:

- Design a power supply circuit by using proteus that converts 230V AC to stable 5V DC.
- Understanding the function of the filter capacitor in reducing the output voltage ripples and providing a Steady DC output.
- Understanding the load of Zener diode in regulating the output voltage.

<u>Pre-requisites</u>

To complete this project, we must have some knowledge on

- Basic Working process of electronic components like Transformer, diodes, rectifiers, capacitors and filters.
- Proteus software Basics and Basic Mathematics.

CHAPTER 3

REQUIRED INPUT PARAMETERS AND CALCULATIONS

Input Parameters

Given Input Parameters are,

Input Voltage V_{in} = 230 V

Frequency f = 50Hz

Output Voltage V_{out} = 5V

Zener Voltage V_Z = 5.1 V

Minimum Zener Current $(I_z)_{Min}$ = 5mA

Range of Output Current I_{out} = 10mA to 50mA

Assumptions

We have to made some assumptions to analyse the Circuit in addition to the input parameters,

Let,

- The Load Resistance R_L be 10kΩ, 20kΩ, 30kΩ, 40kΩ respectively.
- The Ripple factor of a Full Wave Rectifier be 30%.

Calculations

For Step-Down Transformer,

Let Inductance of Primary Transformer L_1 = 1H

Primary Voltage V_1 = 230 V

Peak Voltage $V_{peak} = V_1 \times \sqrt{2} = 230 \times \sqrt{2} = 325.27$ V

Secondary Voltage V_2 = 14 V

We know that

$L_1 / L_2 = (V_1 / V_2)^2$

$L_2 = 1 / (230/14)^2$

Secondary Inductance L_2 = 0.0037 H = 3.7 mH

For Capacitor Filter,

Ripple Factor = $1 / 4\sqrt{3} \times f \times C \times R_L$

When $R_L = 10k\Omega$,

$0.03 = 1 / 4\sqrt{3} \times 50 \times C \times 10000$

Capacitance C = 9.6 μF

When $R_L = 20k\Omega$,

$0.03 = 1/4\sqrt{3} \times 50 \times C \times 20000$

Capacitance C = 4.8 μF

When $R_L = 30k\Omega$,

$0.03 = 1/4\sqrt{3} \times 50 \times C \times 30000$

Capacitance C = 3.2 μF

When $R_L = 40k\Omega$,

$0.03 = 1/4\sqrt{3} \times 50 \times C \times 40000$

Capacitance C = 2.4 μF

For Zener Diode,

Minimum Zener Voltage $(V_z)_{min} = V_z + IR_L$

Where,

Source Current, $I = I_L + (I_Z)_{min}$

Load Current, $I_L = V_z / R_L$

R_L = Load Resistance

When $R_L = 10\ k\Omega$,

$I_L = 5.1 / 10000 = 0.51$ mA

$I = 0.51 + 5 = 5.51$ mA

$(V_z)_{min} = 5.1 + (5.51)\ (10)$

$(V_z)_{min} = 60.2$ V

When $R_L = 20\ k\Omega$,

$I_L = 5.1 / 20000 = 0.26$mA

$I = 0.26 + 5 = 5.26$ mA

$(V_z)_{min} = 5.1 + (5.26 \times 20)$

$(V_z)_{min} = 110.3$ V

When $R_L = 30\ k\Omega$,

$I_L = 5.1 / 30000 = 0.17$ mA

$I = 0.17 + 5 = 5.17$ mA

$(V_z)_{min} = 5.1 + (5.17 \times 30)$

$(V_z)_{min} = 160.2$ V

When $R_L = 40\ k\Omega$,

$I_L = 5.1 / 40000 = 0.13$ mA

$I = 0.13 + 5 = 5.13$ mA

$(V_z)_{min} = 5.1 + (5.13 \times 40)$

$(V_z)_{min} = 210.3$ V

CHAPTER 4

OUTPUT PARAMETERS

The outcomes that are expected from this project are discussed as follows:

- Understanding the Hardware design and Virtual prototyping while designing the Volage regulator power supply circuit.
- Understanding the importance if the electrical components which are used in the circuit.
- Understanding the role of the rectifier in converting the current from AC to DC.
- Analysing the function of the filter capacitor in reducing the output voltage ripples under load variations.
- Understanding the role of Zener diode in regulating the output voltage and current and also in providing the smooth and steady output under load variations.

CHAPTER 5

RESULT

Since, we have designed the circuit of Voltage regulated power supply using proteus and the results at different loads are

1. At R_L = 10 kΩ, C = 9.6 μF

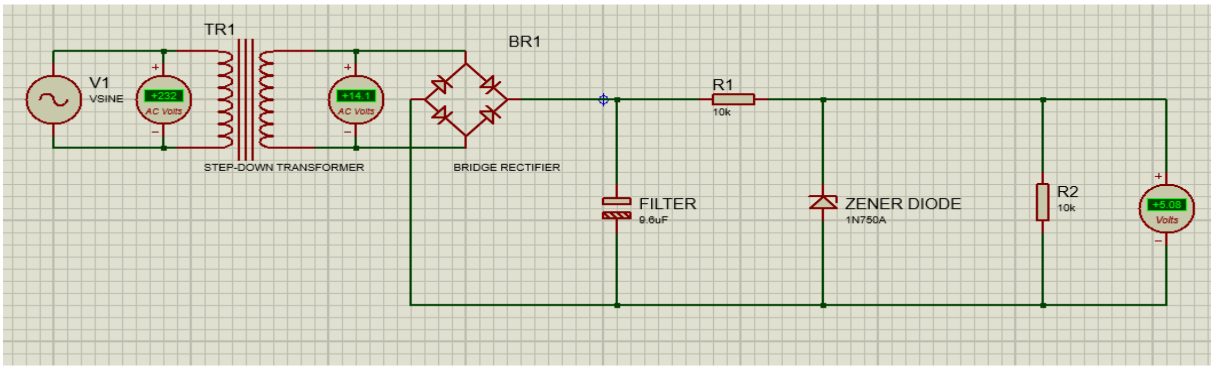

Fig-2

In the above Figure, we can observe that we give a supply of 230 V AC (Approx.) in the primary transformer which is stepped down into 14 V AC in the secondary transformer. Then, this current will be passed through bridge rectifier and filter which has capacitance of 9.6 μF for the load of 10 kΩ and then passes through Zener Diode which regulates the Voltage with respect to the desired output. We can observe that the voltage generated as output is 5.08 V DC.

2. At R_L = 20 kΩ, C = 4.8 μF

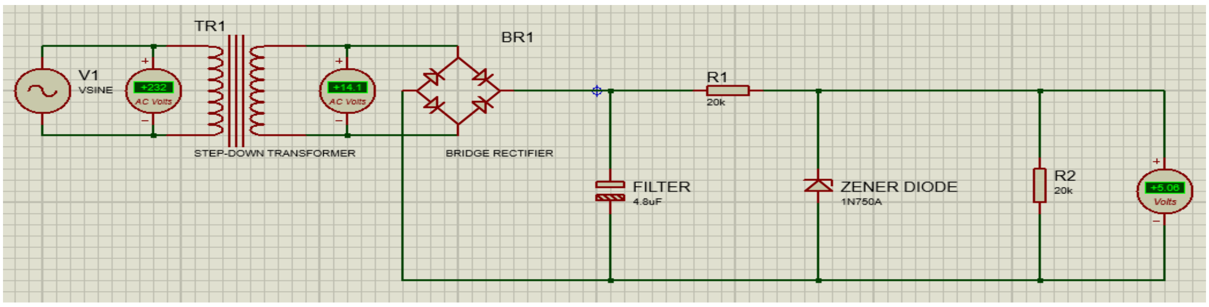

Fig-3

The Similar process is done in this case also as we seen in the above figure but here, we can observe that the capacitance is 4.8 μF for the Load of 20 kΩ and the output can be observed as 5.06 V DC for the same input as we discussed in the above case.

3. At R_L = 30 kΩ, C = 3.2 μF

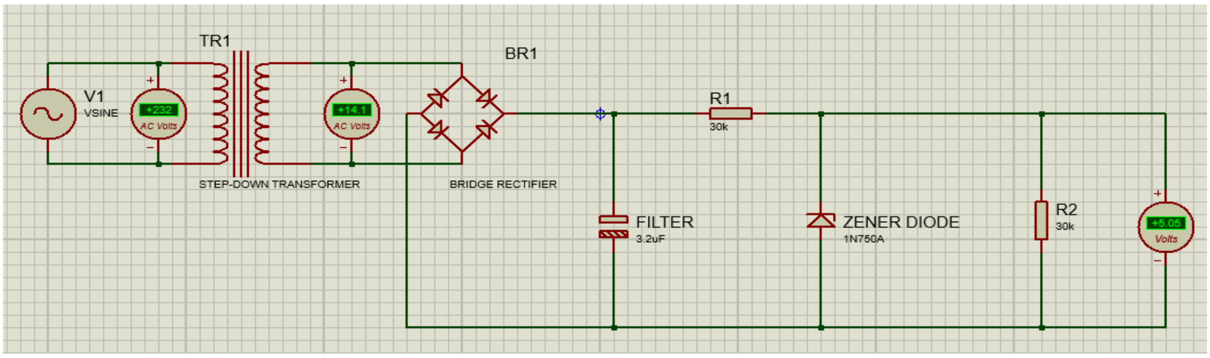

Fig-4

Similarly, here also same process happens for the load of 30 kΩ and capacitance of 3.2 μF. In this case, we can observe a output of 5.05 V DC as we seen in the above figure with the same input as above cases.

4. At R_L = 40 kΩ, C = 2.4 μF

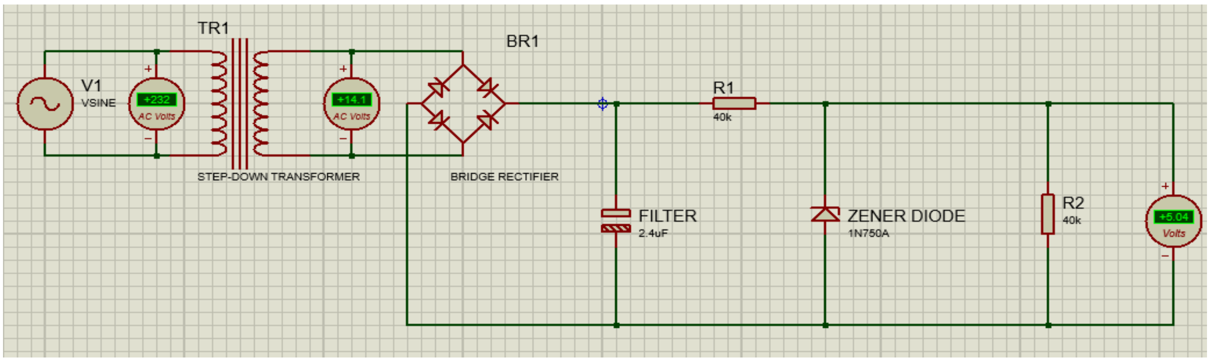

Fig-5

In the above Figure, the capacitance of the filter becomes 2.4 μF for the load of 40 kΩ. In this case the output generated as 5.04 V DC for the same input of 230 V AC (Approx.) at a frequency of 50 Hz.

CHAPTER 6
OBSERVATIONS AND CONCLUSION

The Outputs observed for the different loads are tabulated as follows:

Sl. No	Input Voltage (AC) Frequency (Hz) (Approx.)	Load Resistance (R_L)	Capacitance of Filter (C)	Output Voltage (DC)
1	230V, 50Hz	10 kΩ	9.6 μF	5.08 V
2	230V, 50HZ	20 kΩ	4.8 μF	5.06 V
3	230V, 50HZ	30 kΩ	3.2 μF	5.05 V
4	230V, 50HZ	40 kΩ	2.4 μF	5.04 V

Fig-6

Since, we can conclude that the project successfully achieved its objectives of designing a regulated power supply using proteus. The power supply was able to deliver a 5 V DC voltage under different loads as we can observe through the above table. From this, we can say that it is working efficiently. The filter capacitor effectively reduces the voltage ripples, resulting in a smooth and steady DC output. The role of Zener Diode in regulating the output voltage was also studied under different load conditions. In Overall, the project outcomes are achieved with better understanding of design of the regulated power supply and their components, enabling the design of reliable and efficient power sources for various electronic applications.

References

1. https://www.youtube.com/watch?v=NJIbSI6qG6Q
2. https://www.theengineeringprojects.com/2020/01/introduction-to-proteus.html

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