COLLEGE OF ELECTRICAL AND MECHANICAL ENGINEERING,RAWALPINDI

TWO CHANNEL DC POWER SUPPLY

COURSE :

SUBMITTED TO :

SUBMITTED BY: ME-44 (GROUP)

SUBMITTED ON :

DEPARTMENT OF ELECTRICAL ENGINEERING

Acknowledgment

First, we express our heartiest thanks and gratefulness to Allah almighty for his divine blessing makes us possible to complete this project successfully. We feel grateful to and wish our profound indebtedness to our Professor Dr, , whose knowledge & keen guide has worked as an influencer to carry out project. His endless patience, guidance, continual encouragement, constant and energetic supervision, constructive criticism, and valuable advice have made it possible to complete this project. We would like to express our heartiest gratitude to Prof. (Dr.) , for motivation and valuable suggestions time to time. I am also thankful to other faculty member and the staff of Physics department of our college. Lastly, I express my heartily regards to my parents whose blessings have always been a continuous source of inspiration to engage myself in higher pursuits.

ABSTRACT

We made a variable DC power supply, and the main working principle of this project is full wave rectification which is done by bridge configuration. Where we are using rectifier IC which rectifies the output of the step-down transformer, that step down the 220 AC volts to 24 AC volts. In this circuit we used capacitors, to get constant input to the regulator. Moreover, it also helps to reduce the sharp peaks in the output. 2200uF capacitors were also used to reduce the noise and ripples produce by the regulators, so that the regulated output has less ripples. Now the main task is to get variable output and for this we use the pair of voltage divider resistors Variable resistor of 10kΩ is used to to increase the output of the regulator and in which resistance is variable. So, when we increase or decrease the value of that resistor the output voltage of the regulator will also change accordingly, and we get a range of variable voltage. Voltage regulators that give constant voltage at the output is also designed for the fixed 5V dc .It comprises of op-amp which is used as feedback,a zener diode of 5.1 rating and voltage divider resistors to get desired output.

Objective

The Main Objective of the project was

1.To make a DC Power supply consisting of one channel.

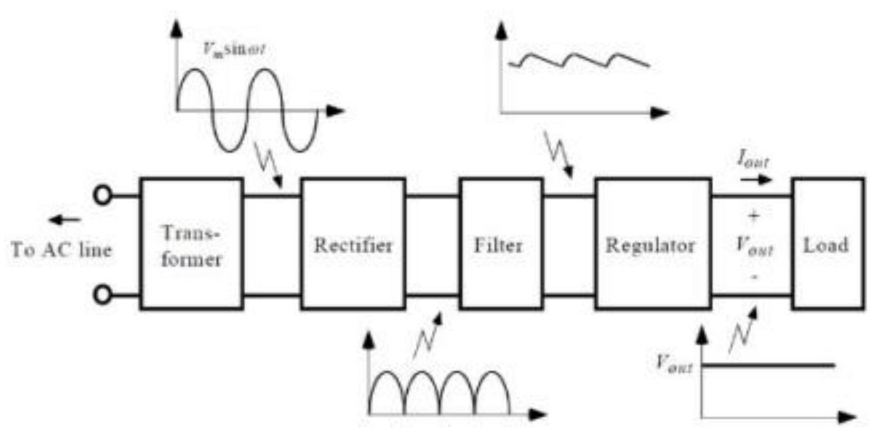
2.Channel one is a variable channel which gives constant 5V at output.

3.Design a proper voltage regulator circuit for 5V that should draw 1A current.

4.For learning purpose we made another variable channel of 0-24V that should draw 1A current.

Working Principle and Procedure

A power supply converts the main AC voltage from the main outlet to a constant DC at the output. This is done using basic electronic devices and components. As shown below:



Step 1:

First the Power Supply Steps down the AC voltage to the required DC, this is down using a step-down transformer. A Transformer is an equipment used either for stepping up or stepping down the voltage of an ac supply with a corresponding decrease and increase in current. It essentially consists of two windings primary and secondary

N1: no. of turns in primary coil

N2: no. of turns in secondary coil

N1< N2: - Step-up transformer

N1> N2: - Step-down transformer

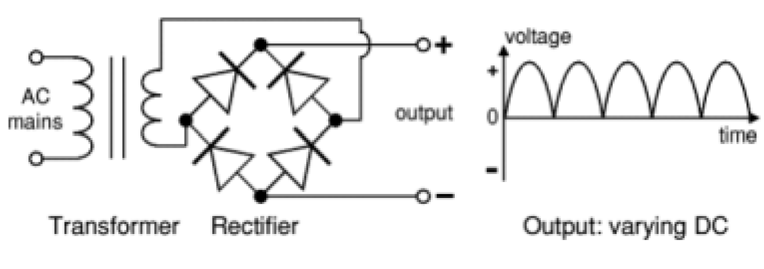
Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC, and this is one of the reasons why mains electricity is AC. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230v) to safer low voltage. Transformers waste very little power so the power out is (almost) equal to the power in. Note that as voltage is stepped down **current is stepped up**.

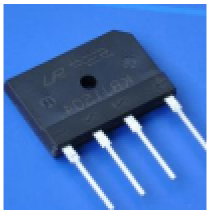
$$\text{Turns ratio} = \frac{V_p}{V_s} = \frac{N_p}{N_s} \quad \text{and} \quad \text{power out} = \text{power in}$$

$$V_s \times I_s = V_p \times I_p$$

Step 2:

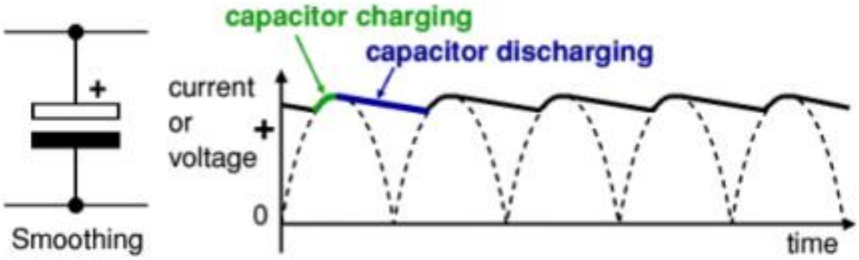
The output from the transformer is stepped down, but it is still AC. This AC voltage is converted to DC signal using various combinations of diodes, known as **rectifier**. There are several ways of connecting diodes to make a rectifier to convert AC to DC. The bridge rectifier is the most important and it produces full wave varying DC. **A full-wave rectifier** can also be made from just two diodes if a centre-tap transformer is used, but this method is rarely used now that diodes are cheaper. A single diode can be used as a rectifier, but it only uses the positive **(+)** parts of the AC wave to produce half-wave varying DC.





Step 3:

Is our signal now a constant DC? No. It is DC, but it is varying repeatedly, and we cannot use it for our devices that are sensitive to variations. This varying DC signal is passed through a Filter to clear off all the DC variations. **Filter circuit** consists of a capacitor, whose value is chosen according to the received input and required output. Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage from the rectifier is falling. The diagram shows the unsmoothed varying DC (dotted line) and the smoothed DC (solid line). The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output.

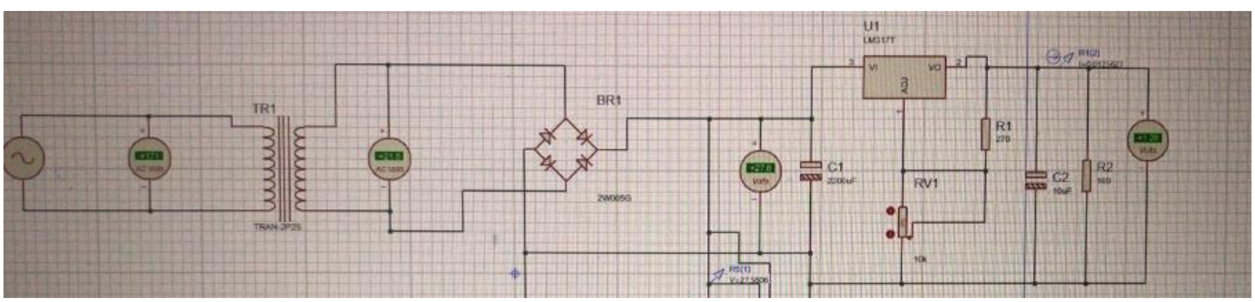


Smoothing is not perfect due to the capacitor voltage falling a little as it discharges, giving a small ripple voltage. For many circuits a ripple which is **10%** of the supply voltage is satisfactory and the equation below gives the required value for the smoothing capacitor. A larger capacitor will give less ripple. The capacitor value must be doubled when smoothing half-wave DC So, in this we concluded that the pulsating DC voltage is applied to the smoothing capacitor. This smoothing capacitor reduces the pulsations in the rectifier DC output voltage. The smooth DC output has a small ripple. It is suitable for most electronics circuits.

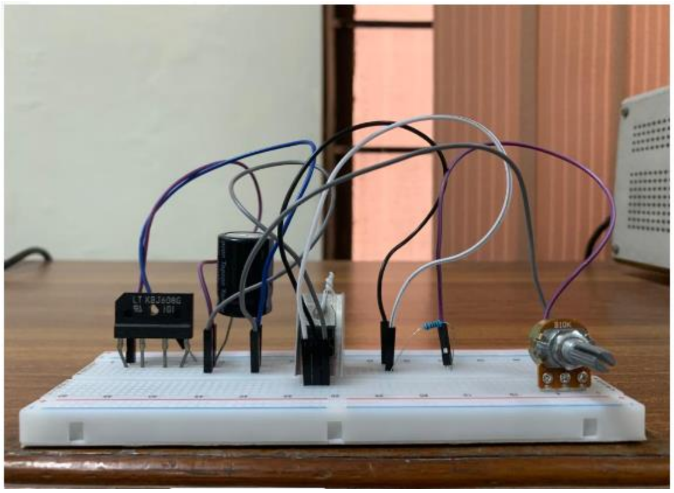
Step 4:

Since there are still variations in the output from the capacitor, we make use of a voltage regulator to give us a required dc at output irrespective of the changes in input voltage levels. There are various types of voltage regulators available in the market. Ranging from constant to variable output supplier at the output. We have used **LM317** for this purpose.

PROTEUS SIMULATION OF VARIABLE CHANNEL:



HARDWARE OF 1~24V CHANNEL:



CALCULATIONS:

The value of capacitor was calculated by using the formula:

C=I*t/V

The input current is **1AMP** in this case.

Value of frequency is:

F=50Hz

T=1/F=**20ms**

V=**20%** of input voltage across secondary

V=24*(20/100)

V=4.8V

Value of capacitor is:

C=(1*10,000)/4.8

C=2220uf

2200 valued capacitor was not available so we used 3300u which works same as 2200 so

C=3300uF

FIXED CHANNEL:

Channel no 2 of the power supply will provide constant 5v from the input AC source.For this purpose a complete schematic circuit is designed using

1.OPERATIONAL AMPLIFIER

2.TRANSISTORS

3.ZENER DIODES

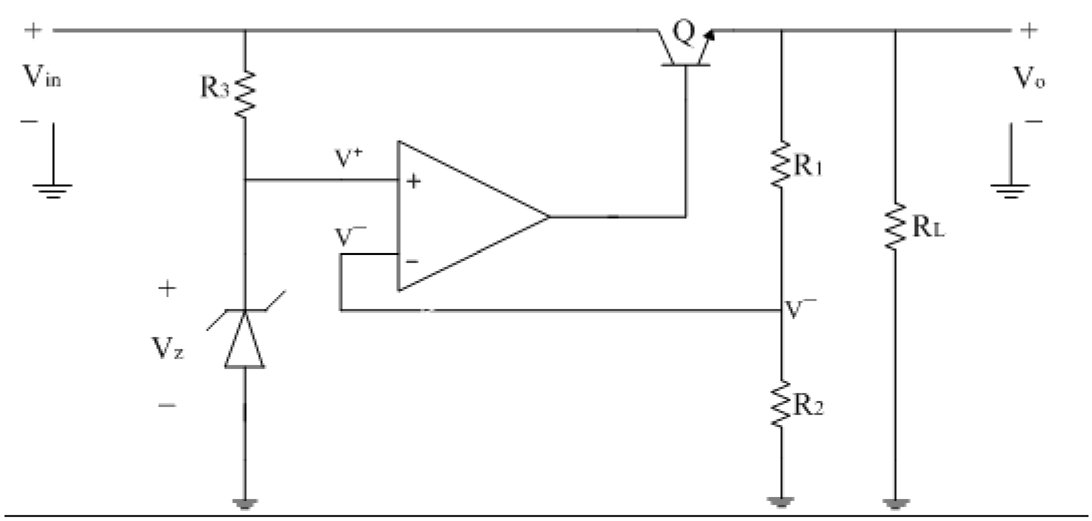
4.RESISTORS

5.CAPACITOR

VOLTAGE REGULATOR:

A voltage regulator regulates voltage during power fluctuations and variations in loads. It can regulate AC as well as DC voltages. A voltage regulator usually takes in higher input voltage and emits a lower, most stable output voltage.

SCHEMATIC CIRCUIT:



Zener diode:

When we are using Zener diode as a voltage regulator, ideally, it has a constant voltage drop equal to its nominal Zener voltage. A zener diode is always operated in its reverse biased condition. As such a simple voltage regulator circuit can be designed using a zener diode to maintain a constant DC output voltage across the load in spite of variations in the input voltage or changes in the load current.Zener is placed in series with a resistor with specific value.

OPERATIONAL AMPLIFIER:

The op amp is used as a voltage comparator: On the non-inverting input is the reference voltage V_{REF} (so called because it remains steady when the input voltage changes), while on the inverting input is the voltage that will be generated at the output.

VOLTAGAE DIVIDER :

The ratio of the two resistance values must be suitable to enable the desired output voltage to be set.

TRANSISTOR:

The transistor has the task of supplying the load with a current greater than the maximum obtainable with the op amp only.

DESIGN AND CALCULATIONS:

At non inverting terminal of op amp : Vz

Vz = Vout * R2/(R1+R2)

At inverting terminal : V2=Vz

Vz = Vout *R2/(R1+R2)

By substitution we derive the formula for Vz:

Vz*(R1+R2) = Vout*R2

Here we rearrange for Vout:

Vout = Vz *(R1+R2)/R2

For Vz = 5.2*10*10^3/100+10*10^3

/Vz = 5.14V

So R1 = 100 ohm

R2 = 10*10^3 ohm

Vout = 5.14*100+10*10^3/10*10^3

Vout =5.19V

Here is the final expression for Vout in terms of Vz and resistors R1 and R2.

LOAD REGULATION:

=Vout/Vin

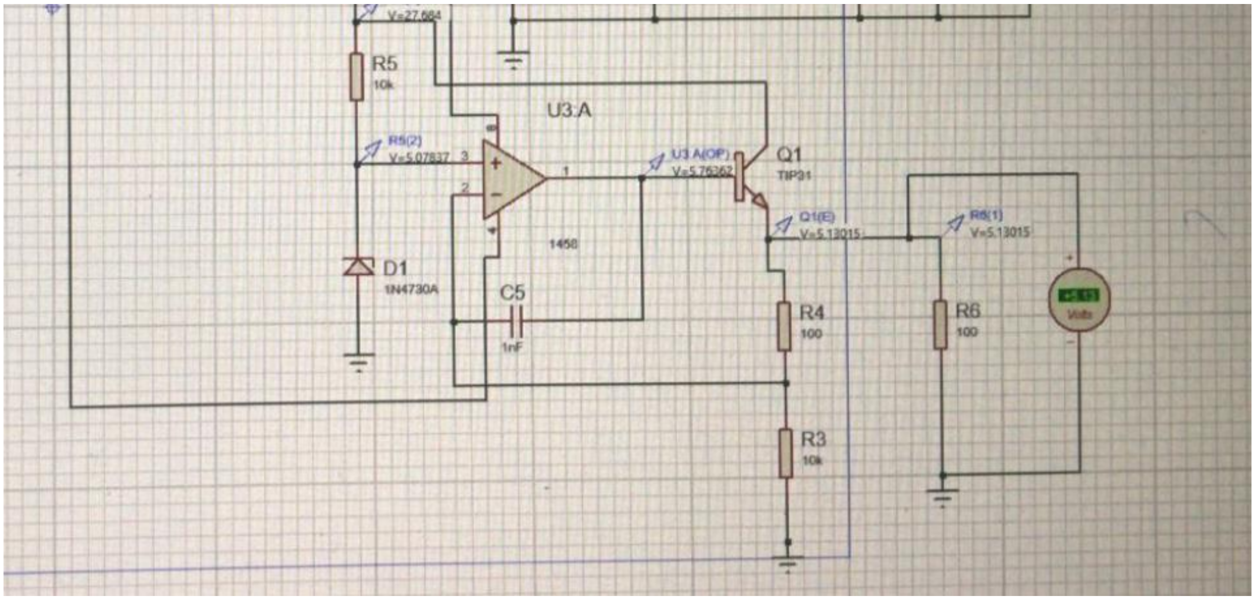
=5/24=0.2083

LINE REGULATION:

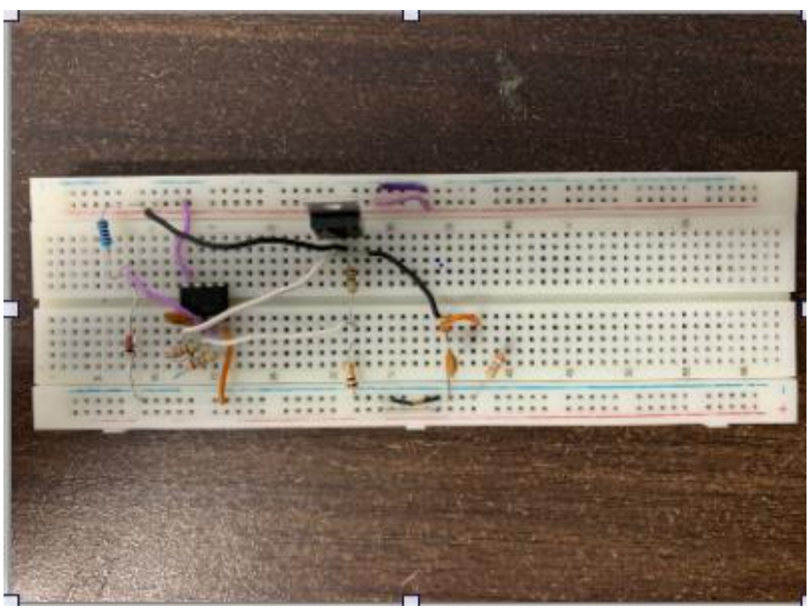
=Vout/IL

=5/1=5V

PROTEUS SIMULATIONS:


V=27.664
R5
10k
U3:A
R5(2)
V=5.07837
U3:A(OP)
V=5.76362
Q1
TIP31
Q1(E)
V=5.13015
R6(1)
V=5.13015
D1
1N4730A
1458
C5
1nF
R4
100
R6
100
R3
10k

HARDWARE:



Components and Required Materials

SR.NO	COMPONENTS
1	Transformer
2	Bridge Rectifier
3	Capacitor(3300u)
4	Capacitor(10u)
5	Capacitor(1n)
6	Potentiometer
7	Jumper Wires
8	Breadboard
9	Wire cutter
10	Resistors
11	Zener Diode
12	Tip31c
13	Op-Amp 1458
14	LM317
15	PCB BOARD
16	ACID
17	FLUX
18	STEEL BOX
19	KNOBS

CONCLUSION:

In conclusion, the dual-channel power supply with a fixed 5V channel and a variable channel ranging from 24V to 2V, along with the incorporation of heat sinking, provides a reliable and adaptable solution for powering electronic devices. The fixed 5V channel ensures stability and consistency in voltage supply, while the variable channel offers flexibility to accommodate different voltage requirements. By effectively dissipating excess heat through heat sinking, the power supply safeguards the transistors from overheating, ensuring their optimal performance and longevity. This design not only enhances the efficiency and reliability of electronic systems but also contributes to their safe operation in a wide range of applications.
