Khulna University of Engineering & Technology

Department of Electronics and Communication Engineering

Course No: ECE 2200

Report On Adjustable, Regulated & Protected DC Power Supply

Group A-2

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Contents

1. Objectives:

- The main objectives of this project are –
- Making adjustable dc power supply.
- Providing regulated output.
- Providing over voltage protection.
- Providing under voltage protection.
- Providing short circuit protection.
- Providing uninterrupted supply.
- To Protect Transformer.
- To ensure low cost & lightweight.

2. Introduction:

The most essential part of an electronic circuit is a power supply. Every electric device, from smaller to the larger one needs an external power supply. A DC power supply is a must for every electronics devices because electronics devices work at DC voltages. We can get DC power supply in two ways- one is DC batteries which are available in the market and another is converting AC supply to DC supply. Though battery has advantages in some cases, but it has many disadvantages. The batteries are costly and they also get discharged after a period of time. So we have to buy a new one or if it is rechargeable, then we have to recharge it. Hence it is wise to make a device which will convert AC supply to DC supply as AC supply is available almost everywhere. In the electronics laboratories it is necessary to keep such kind of DC power supply to deliver supply in the electronic circuits and for other purposes. The first goal of this power supply is to provide regulated output. Again the output of dc power supply should not be short circuited i.e. the positive terminal should not be grounded. But if accidentally it occurs, a huge amount of current would flow in the circuit and the circuit may be damaged. For this reason, a short circuit protection is needed which will provide load isolation at such condition. Besides any-how a high voltage or low voltage appears in the input of the device then the device will also be damaged. Therefore, over voltage and under voltage protections are needed to make the power supply efficient.

3. Circuit Diagram:

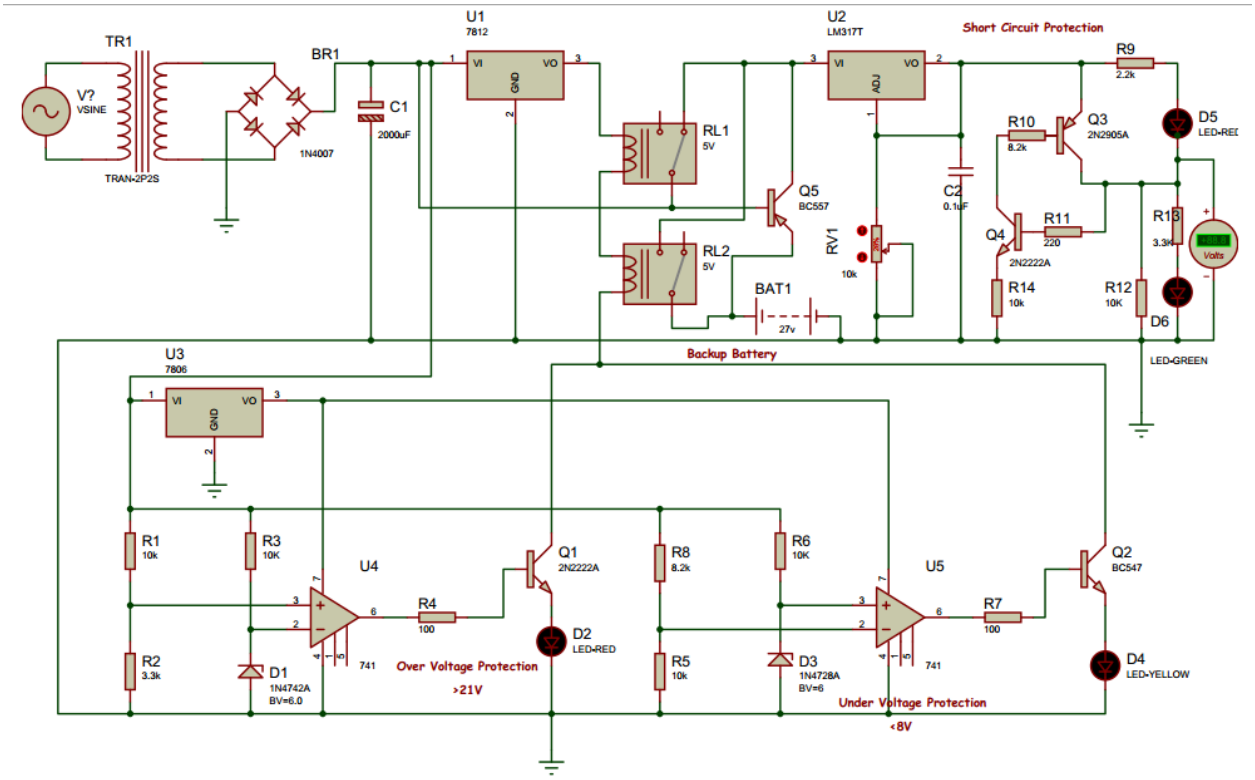

Figure 2.1: Circuit Diagram of DC Power Supply

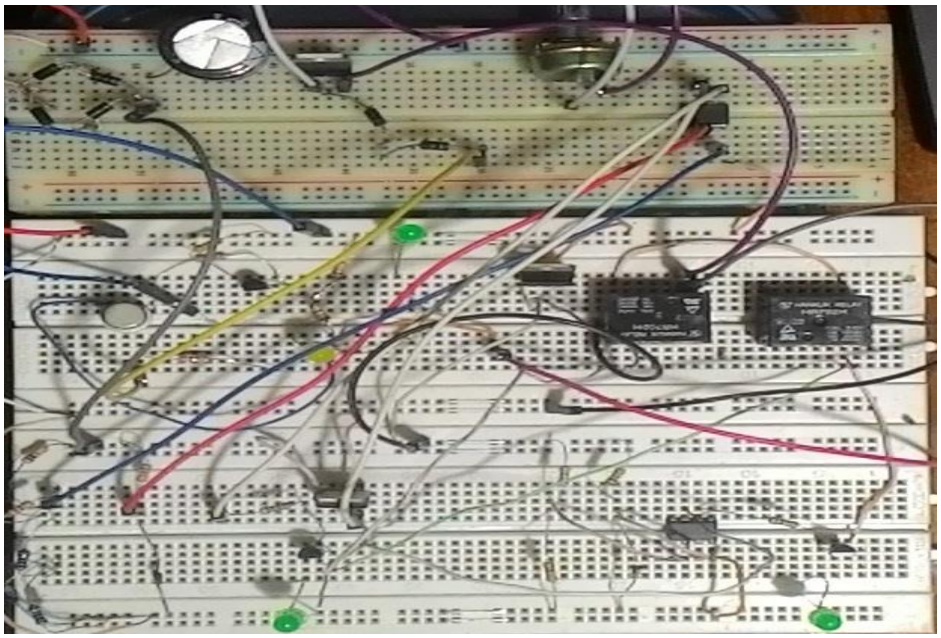

Figure 2.2: Breaboard Implementation

4. Components:

- Transformer- 1 piece (220V to 24V,1A)
- Diode-7 pieces(1N4007)
- Zener Diode-2 pieces(6V,3V)
- Capacitor-3 pieces(2200uF,10uF,1uF)
- Resistor-12 pieces
- Op-Amp-2 pieces(LM741)
- Adjustable regulator IC-1 piece(LM317)
- Regulator IC-2 pieces(LM7806, LM7812)
- Variable resistor-1 pieces
- Transistor-4 pieces(2N2905A, 2N2222A)
- Relay-2 pieces(6V)
- LED-4 pieces(Red, Green, Blue, Yellow)
-

5. Circuit Analysis:

5.1 Transformer Protection & Bridge Rectifier With Filter:

To protect the transformer from over current of supply ac voltage we use a FUSE at the input terminal of the transformer. The rating of the FUSE is 1 Amp. So if the current flow is over 1 amp then the Fuse will be cut and the transformer will be protected from being damaged.

Our main objective is to make a dc power supply. For that reason we use bridge rectifier circuit. It contains four diodes connected to form bridge. We use 1N4007 series diodes. As a result we get d.c output all the time which is pulsating d.c. Then we have used a capacitor C1 for filtering. After this we have got pure d.c power supply.

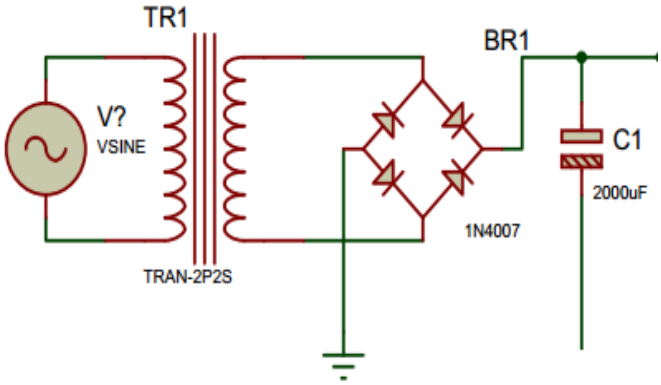

Figure 5.1 : Transformer Protection & Bridge Rectifier With Filter

5.2 Adjustable And Regulated Output:

Here we use a regulator and adjustable IC (LM317). We give 33v input to the IC. A 10k variable resistor use for vary the output .One diodes (1N4002) are used for protecting the IC .Capacitor are used for make the input and output perfect DC. When the variable resistor varies from 0 to 10k then the output also varies from 1.2V to 33V.

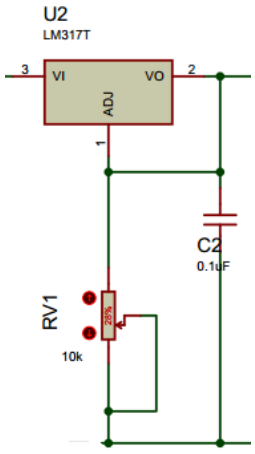

Figure 5.2: Adjustable And Regulated Output

5.3 Short Circuit Protection:

Just after the output of the regulator, a combination of two transistors and some resistors are seen. This is the basic short circuit protection unit. When the load is short circuited there will be no potential difference between the emitter

and base of transistor Q4. So the total current will flow through the transistor Q3 and to the ground. When the short circuit is separated the current will again start flowing through the normal path. This way the load will be protected if short circuit occurs.

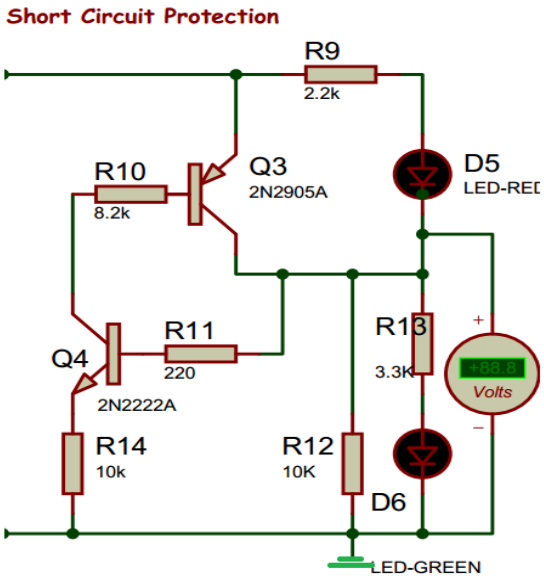

Figure 5.3 : Short Circuit Protection

5.4 Over Voltage Protection

This circuit provides over voltage protection. Rectified output is applied across voltage divider portion. Using zener diode a reference voltage is set which is applied to the inverting terminal of an Op-Amp. Again using a voltage divider combination a portion of rectified voltage is applied in the non-inverting terminal. When rectified output changes, input voltage of non-inverting terminal also changes and when it goes above reference voltage then comparator gives output voltage and Q1 becomes on and hence relay isolate the DC power supply.

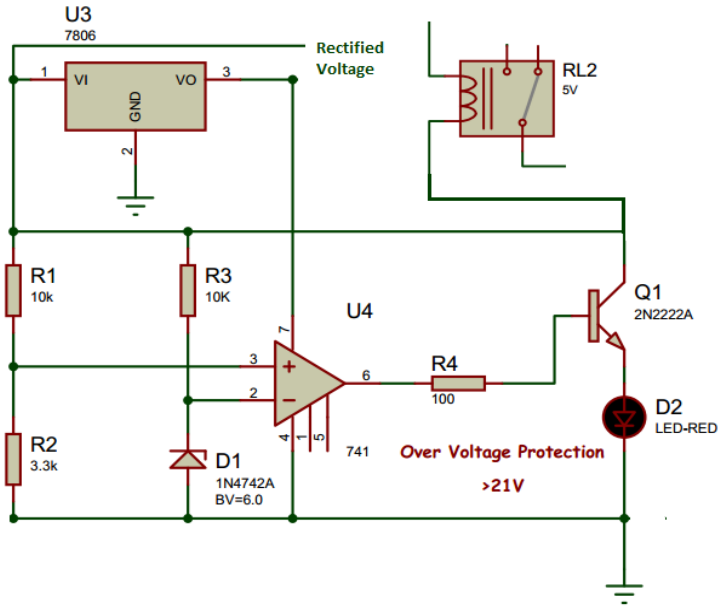

Figure 5.4: Over Voltage Protection

5.5 Under Voltage Protection:

The following portion performs under voltage protection. Rectified output is applied across voltage divider portion. Using zener diode a reference voltage is set which is applied to the non-inverting terminal of an Op-Amp. Again using a voltage divider combination a portion of rectified voltage is applied in the inverting terminal. When rectified output changes, input voltage of inverting terminal also changes and when it goes reference voltage then comparator gives output voltage and Q2 becomes on and hence relay isolate the DC power supply.

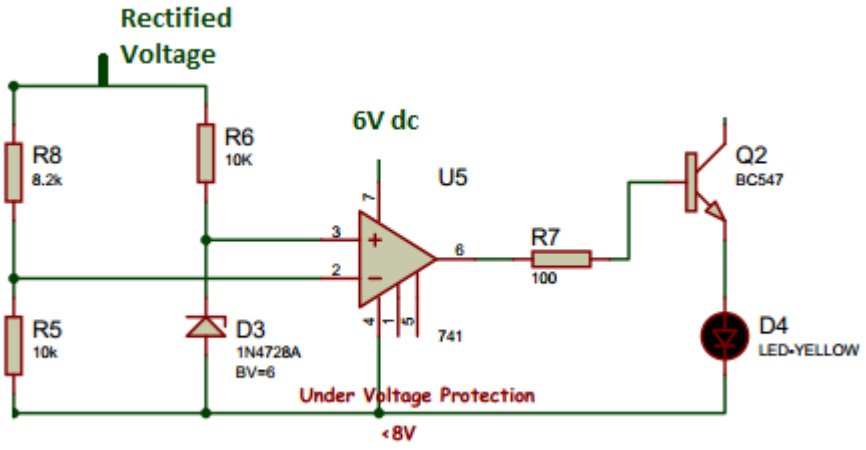

Figure 5.5 : Under Voltage Protection

6. Result Analysis:

- Transformer input=220 V ac.
- Transformer output=24 V ac, 1000mA
- Output after filtering=33V DC.
- Maximum output current=92 mA.
- Input supply voltage range for operation =180~240 V ac.
- Output voltage range=1.20V~33V DC.
- Current consumption by short circuit portion is 6mA.
- Minimum Load = 120 Ohm
- Maximum Load = 1 M ohm

7. Cost Analysis :

S.L No.	Name	Price per piece (Tk.)	Quantity	Price (Tk.)
1	Transformer	90	1	90
2	Diode	2	6	12
3	Zener Diode	2	2	4
4	Capacitor	25	1	25
5	Resistor	.5	14	7
6	Op-Amp	20	2	40
7	IC	20	3	60
8	Transistor	20	4	80
9	Relay	25	2	50
10	LED	1	4	4
11	Variable resistor	25	1	25
	TOTAL =			337

8. Problem Faced :

In the implementation of this project we have faced some problems. For the voltage protection the reference voltage is a great thing. But likewise the calculation the components are not available, hence the output is not same as calculated first. In the short circuit region the pnp transistor shows great vulnerability.

9. Application :

It can be used as

✓ Constant DC source
✓ Continuous DC voltage source
✓ Laboratory power supply, or various household work

10. Advantages :

❖ **Simplicity:** The circuit operation is quite simple. And can be easily used for various purposes.
❖ **Low cost:** The price of the components & manufacturing cost is very low.

11. Disadvantages :

❖ **Range of application:** It can be used only as a step down regulator. In case of AC-DC power supplies, a transformer with rectification and filtering must be placed before the linear power supply. This pre power conditioning increases the cost.
❖ **Number of output:** It has only one output voltage. To get additional output voltage, an entire separate linear regulator must be added. It increases system cost.

12. Limitations :

✓ Current rating is very low.
✓ Circuit efficiency is only 28 %.
✓ Its output voltage range is only 1.26~31.2.
✓ The load is limited as output voltage.
✓ Bellow 2.7 V the circuit gives low output rather than low voltage protection.

13. Discussion :

In this design we have constructed a DC power supply which gives us regulated output, over voltage protection, under voltage protection, short circuit protection & uninterrupted power supply when the circuit is protecting from unwanted voltage. At the short circuit protection the output current is limited by resistor R2. So if one unwillingly grounded the supply it will not harm the internal circuit. Again fuse gives the protection of the transformer from being damaged. The circuit isolates the output from over & under voltage & at that time backup battery gives this energy. Hence we get a complete design for our desired project. But it has some disadvantages. The power loss of the circuit is quite high. Again in the output the maximum current is only 300 mA.

14. Conclusion :

This project has enriched our knowledge about analog electronics. It has also increased our practical skills on electronics. Therefore this kind of projects will make us a perfect electronics engineer.

15. Future Work :

In this power supply, maximum output current is 92mA. Again, if short circuit or over voltage or under voltage occurs the relay works continuously even if those conditions are eliminated. Manually if reset button is pressed, the relay stops working and the circuit goes to normal condition. So the criteria may be changed and it will better if relay works automatically. Therefore to increase output current, LM317 should be replaced by LM150/LM350/LM338.

16. References :

- Electronic Devices And Circuit Theory-
  -by Robert L. Boylestad, Louis Nashelsky,
- Electronic Devices & Circuits-
  -by Jacob Millman, Satyabrata Jit
- Principles of Electronics-
  -by V.K Mehta, Rohit Mehta.
- Internet-
  - http://techlib.com
  - http://www.electroschematics.com