

      KHULNA UNIVERSITY OF ENGINEERING AND TECHNOLOGY

**ELECTRONICS AND COMMUNICATION ENGINEERING**

Report No : DC Power Supply

Course No.: ECE-2200

**Project Supervisor :**

Dr. Md. Faruque Hossain

Dr. Md. Faruque Hossain

Professore**(ECE)**

Md. Ebtidaul Karim

Assistant professor**(ECE)**

**Submitted By:**

Group No. : A6

Hasibul Hasan **(1909016)**

Mubtasim Fuad Chowdhury **(1909017)**

Fariha Alam Rafa **(1909018)**

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**Title:**

DC power supply with regulated voltage and short circuit detection and protection, under voltage and over voltage detection and protection.

**Motivation:**

DC power supplies are applied in portable electronic gadgets such as laptop computers and mobile phones, which are sourced with energy from batteries primarily. So we want to build up a supply that can give us good output at low cost.

**Objectives:**

Main objectives of this project is to design and fabricate a DC power supply which are :

* To make a regulated dc power supply.
* To provide fixed output voltage.
* To provide over voltage Protection.
* To provide under voltage protection.
* To provide short circuit protection.
* To provide uninterrupted supply.
* To ensure low cost & lightweight.

**Critical challenges:**

We were not getting the correct output for the offset voltage of the op-amp in the over voltage and under voltage protection circuit. We had to null the offset voltage.

**Conflicting Requirement:**

Sometime a little fluctuation may happen in measurement for accuracy level of regulated voltage and supply voltage to load. If we give a load resistance of 100 ohm to 1 Mohm then the load voltage and the output voltage of adjustable voltage regulator(LM317T) are always same. But if we give less than 100 ohm say 10 ohm or 50 ohm then there will be 2V or 2.5V difference like 15V at adjustable voltage regulator(LM317T) and 13V at load. And if we use more than 1 Mohm resistance, load current will decrease greatly.

**Introduction:**

Generally almost all types of electronic device or equipment require DC power supply to operate properly. In this project we tried to design and fabricate such a power supply that will be user friendly and will be commercially lower cost having a light weight. Almost all electronic equipment has its maximum ratings. If by any fault of the device, it exceeds its maximum rating then our power supply will automatically switch the output off without doing further hamper. This power supply provides the necessary protection and voltage, current ratings suitable for general operation of practical electronic component or for laboratory use as a variable DC power source with all necessary indication.

The operation of power supply circuit refers rectifiers, filters, regulators, adjustable part, protections etc. starting with an ac voltage, we obtain a steady dc voltage by rectifying the voltage. Then filtering to a desired dc level and finally regulating to obtain a desired fixed dc voltage. Generally our power supply in main line is 220V r.m.s which is very high in amplitude for electronics devices and circuits. For electronics >30 is better suited. So we removed this problem by using step down transformer. In this power supply we have used a step down transformer of rating 24V (rms ),1000mA.

**Mapping of P’s :**

We can explore how a few of P’s are addressed through this project--

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **P1**  **Depth of Knowledge** | **P2**  **Range of Conflicting Requirements** | **P3**  **Depth of Analysis** | **P4**  **Familiarity of Issues** | **P5**  **Extent of Applicable Codes** | **P6**  **Extent of Stake-holder Involvement** | **P7**  **Interdependence** |
| **Tick** |  |  |  |  |  |  |  |
| Justifications | This project required study of existing models of dc power supply with data collection from websites, knowledge of implementing circuit(K3),integration of different electronics components(K5,K6) and the guidance of our supervisors(K4). | Technical conflicting requirements -  The accuracy for short circuit protection and voltage protection was quite a handful to analyze in circuit. | No obvious circuit with those certain conditions  for this project is not available. The logic must be developed to interconnect certain portion of circuit. |  |  |  | This project involves interdependency between simulating in software and implementing on breadboard and veroboard. The components used in this project were chosen by analyzing their applications , output and level of interaction and dependency with other components. |

**Mapping for A’s:**

We explore how a few of A’s are addressed through this project—

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **A1**  **Range of resources** | **A2**  **Level of Interaction** | **A3**  **Innovation** | **A4**  **Consequences for society and the environment.** | **P5**  **Familiarity** |
| **Tick** |  |  |  |  |  |
| **Justifications** | This project needs to engage diverse resource including individual, money, equipment, materials, information and technologies. | A level of interaction is needed between | This project involves the use of an op-amp as comparator, use of relay switch to operate circuit in one condition  rather than another and a level of  knowledge is needed in implementation of circuit. |  | This project deals with the knowledge of electronics and logic analysis engineering graduates. |

**Theory:**

In this experiment we are working on DC power supply. For that we need to know what A DC Power Supply is. A DC power supply is one that supplies a voltage of fixed polarity (either positive or negative) to its load. Depending on its design, a DC power supply may be powered from a DC source or from an AC source such as the power mains.

AC-to-DC supply

Some DC power supplies use AC mains electricity as an energy source. Such power supplies will sometimes employ a transformer to convert the input voltage to a higher or lower AC voltage. A rectifier is used to convert the transformer output voltage to a varying DC voltage, which in turn is passed through an electronic filter to convert it to an unregulated DC voltage. The filter removes most, but not all of the AC voltage variations; the remaining voltage variations are known as ripple. The electric load's tolerance of ripple dictates the minimum amount of filtering that must be provided by a power supply. In some applications, high ripple is tolerated and therefore no filtering is required. For example, in some battery charging applications it is possible to implement a mains-powered DC power supply with nothing more than a transformer and a single rectifier diode, with a resistor in series with the output to limit charging current.

Linear regulation

The function of a linear voltage regulator is to convert a varying DC voltage to a constant, often specific, lower DC voltage. In addition, they often provide a current limiting function to protect the power supply and load from overcurrent (excessive, potentially destructive current).A constant output voltage is required in many power supply applications, but the voltage provided by many energy sources will vary with changes in load impedance. Furthermore, when an unregulated DC power supply is the energy source, its output voltage will also vary with changing input voltage. To circumvent this, some power supplies use a linear voltage regulator to maintain the output voltage at a steady value, independent of fluctuations in input voltage and load impedance. Linear regulators can also reduce the magnitude of ripple and noise present appearing on the output voltage.

**Apparatus required:**

|  |  |  |  |
| --- | --- | --- | --- |
| **SI No.** | **Apparatus** | **Rating** | **Quantity** |
| **01** | Transformer |  |  |
| **02** | Diode |  |  |
| **03** | Zener diode |  |  |
| **04** | Capacitor |  |  |
| **05** | Resistor |  |  |
| **06** | Op-amp |  |  |
| **07** | Adjustable regulator |  |  |
| **08** | Variable resistor |  |  |
| **09** | Transistor |  |  |
| **10** | Relay Switch |  |  |
| **11** | LED |  |  |
| **12** | Push Button |  |  |

**Cost Analysis:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name** | **Price(tk)** | **Quantity** | **Total Price(tk)** |
| Transformer |  |  |  |
| Diode |  |  |  |
| Zener diode |  |  |  |
| Capacitor |  |  |  |
| Resistor |  |  |  |
| Op-amp |  |  |  |
| Adjustable regulator |  |  |  |
| Variable resistor |  |  |  |
| Transistor |  |  |  |
| LED |  |  |  |
| Push Button |  |  |  |

**Block Diagram :**

Under voltage and over voltage protection circuit

Bridge rectifier &

Filter circuit

Input AC supply

Regulator circuit

Load voltage Supply

Short circuit protection circuit

Figure 1: Block diagram of DC power supply

**Circuit Diagram:**

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Figure 2: Circuit diagram of DC power Supply

**Circuit Analysis:**

Rectifier:

A portion of the circuit 2.1 is given bellow, which shows the rectification. The fuse of the circuit protects the transformer from the unwanted huge power. After that the step down transformer T1 brings down the AC supply to required level. Then the Bridge rectifier circuit BR1 rectifies the AC signal and we get d.c output all the time which is pulsating d.c. The capacitor C1 filters the pulsating DC to straight DC. Hence pure DC supply is generated.

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Figure 2.1: Bridge rectifier circuit

Regulated DC Supply:

In this circuit the IC U1 acts as a regulator. Capacitors C2 acts as a ripple remover & reduces transient effect. The output of the circuit depends on the ratio of VR1 & r1 as follows

𝑣 = 1.25(1 +( 𝑉𝑅1 /𝑅1 ))

By varying the resistance of the variable resistor regulated output is found.



Figure 2.2: Regulated DC output circuit

Short circuit protection circuit :

Just after the output of the regulator, a relay switch with logic combination has seen. This is the basic short circuit protection unit. We also At first, at normal condition, the load will be short circuited and When the load is short circuited there will be no potential difference between two pin of relay where we should get the supply. So the relay switched its place and the total current will flow through the transistor Q1 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.

Voltage protection DC supply:

A portion of the circuit fig 2 is given bellow, which shows the over & under voltage protection & the backup battery to give uninterrupted DC output voltage. The ICs U2 & U3 gives over voltage & under voltage protection respectively. For both cases if the output from the rectified DC goes in a level (in this circuit for over 46V & for under 36V) defined as over or under voltage then each IC produce positive voltage to the transistor Q3 & Q4 respectively. As a result the RELAY1 is switched & the unwanted voltage is grounded by resistor R15. At the same time the RELAY2 is also switched which connects the BATTERY to the input of LM317T. The diode D1 & D2 resist the flow of current from battery to rectified DC or vice versa. The condition for LM741s to give positive output is defined as follows

6 = 𝑅7 /(𝑅7+𝑅9) ∗ 𝑉 (For over voltage)

3.3 = 𝑅6 /(𝑅6+𝑅8)∗ 𝑉 (For under voltage)



Figure 2. : Circuit diagram for voltage protection

**Practical view:**

**Performance:**

Figure 2. :Voltage Vs Current characteristics curve

**Result Analysis:**

* Transformer input = 220V (AC)
* Transformer output = 28V(AC),1000mA
* Output after filtering = +39.1V t0 -39.1V (DC)
* Maximum output current = 367 mA
* Input Supply voltage range for operation=200~240 V(AC)
* Output voltage range= 3.04V to 36V(DC)
* Minimum Load=100 ohm
* Maximum Load=1 Mohm
* Maximum short circuit current= 77 mA
* Power loss=

**Limitation:**

* Current rating is very low.
* Circuit efficiency is only 28 %.
* Its output voltage range is only 1.26~36.2.
* The load is limited as output voltage.
* Bellow 2.7 V the circuit gives low output rather than low voltage protection.

**Possible improvement:**

In this power supply, maximum output current is 367mA.The minimum load in the output is also limited. Again there is a great power loss in the internal circuit. In the circuit the logic combination between short circuit protection and voltage protection circuit is also vulnerable and after long time supply to load it does not work precisely . So all these things can be solved by designing mose efficient circuit.

**Advantages:**

**ϖ Simplicity:**

The circuit operation is quite simple. And can be easily used for various purposes.

**ϖ Low cost:**

The price of the components & manufacturing cost is very low.

**Disadvantages:**

**ϖ 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.

**ϖ 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.

**Application:**

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

**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. Our designed model is stable up to 50 volt rectified DC output. The output of this circuit can be varied from 3.04 to 36 volt. In this region circuit is well protected from voltage & short circuit. The output ripple is very small (max=5 mV). Though there is a limitation of minimum load the value is also negligible. Hence our designed model can be used as a good source in different purpose and in the output the maximum current is only 367 mA.

**Conclusion:**

The dc power supply that we have that we have created provides us regulated and adjustable power supply. Moreover our circuit is short circuit, over and under voltage protected. As rating of the equipment is suitable for this circuit and the total cost is quite low from the market cost. At a whole this project will help us for our several future projects.

**Reference:**

* Electronic Devices And Circuit Theory-

-by Robert L. Boylestad, Louis Nashelsky,

- Ninth Edition, 2007-08.

* Electronic Devices & Circuits-

-by Jacob Millman, Satyabrata Jit

2nd edition.

* Principles of Electronics-

-by V.K Mehta, Rohit Mehta,S. Chand

& Company,2005.

* Internet-

[*http://techlib.com*](http://techlib.com)

[*http://www.electroschematics.com*](http://www.electroschematics.com)

[*http://en.wikipedia.org*](http://en.wikipedia.org)

*https://www.wikipedia.org/wiki/ https://www.youtube.com/watch?v=ajgMUlO4o\_c/ http://en.wikipedia.org/wiki/Power\_supply*