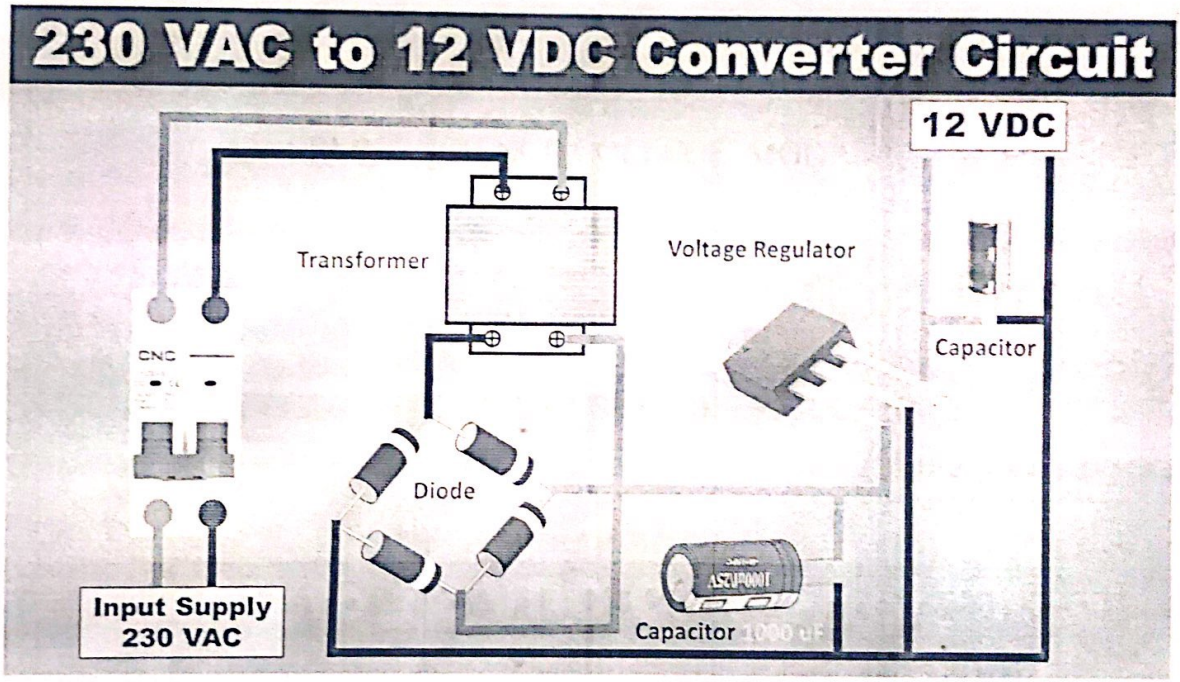
230V AC to 12V DC POWER SUPPLY CIRCUIT

SUBMISSION PRESENTED TO

SIR P.T. SCIENCE COLLEGE, MODASA

Project Report

PHYSICS Sem II



SIR P.T. SCIENCE COLLEGE, MODASA-383 315

APRIL – 2023

Project Report

Submitted to,

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SIR P. T. SCIENCE COLLEGE

MODASA – 383315

April – 2023

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CERTIFICATE

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24	Umeshkumar Kantibhai Pandor	1024
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This project work has been inspiring often exciting, sometimes challenging but always interesting And an enjoyable experience.

The success comes from experience and experience comes from bad experience and great failure. But bad experience is like carbon, in every polish it will give the shine and be a "diamond". Now we remembering with gratitude those hands behind the success of our project which really pushed us to cross the failure and inspiring to us.

First thank to our H.O.D .Dr. R.H.PARMAR for giving us such a genius guide and inspiration. We thank to our genius guide PROF. G. L. VEKARIA for supporting us in every difficulty. He gives us the deeply guidance according to present project work.

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All these thanks are, however, only a fraction of what is due to almighty for granting us an opportunity and strength to successfully accomplish this assignment.

OBJECTIVE

1. To design the circuit for variable dc power supply that varies 2v to 15 v & 2A current using IC LM317. 2. To observe the output to meet the requirement.

MATERIAL REQUIRED

[A] Components

1. Transformer 240v 50 HZ (6v-0.5mA)

2. 4 diode 1N4007

3. 10μF/50v capacitor

4. 0.01μF(103)capacitor

5. LM317T IC

6. Variable resistor 1kΩ & 10kΩ

7. 1KΩ/1W resistor

[B] Apparatus

1. Power supply

2. Multimeter

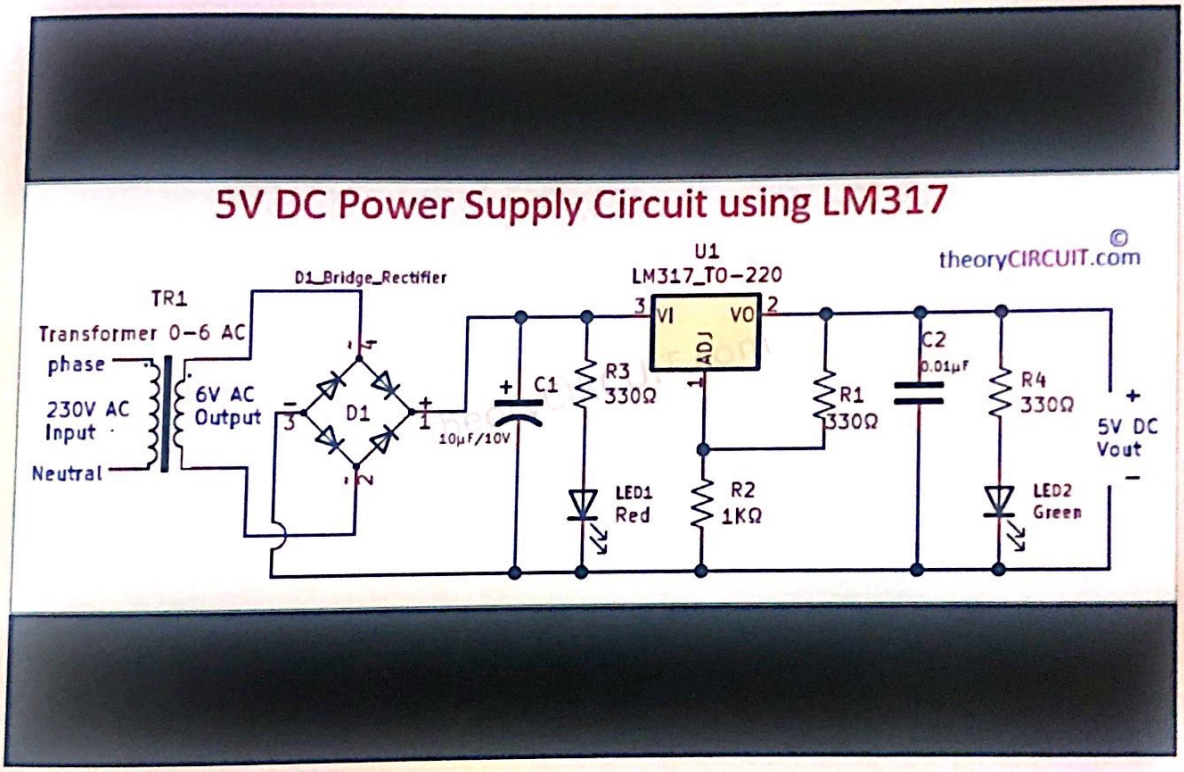
3. PCB

4. Connection wires

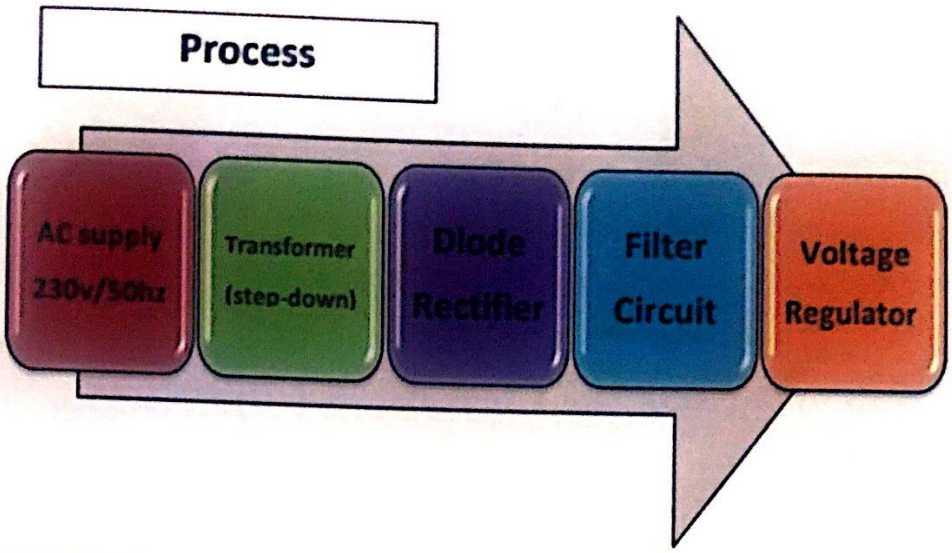
5. Wire cuter

6. Soldering Iron

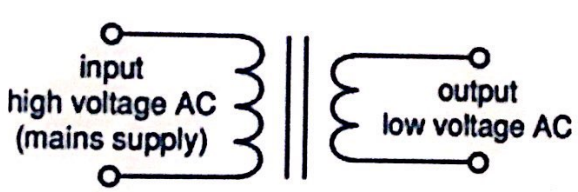
CIRCUIT DIAGRAM



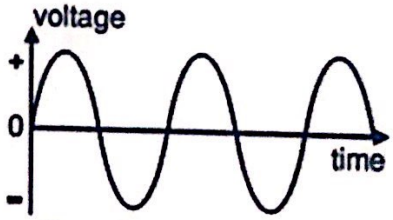
THEORY & WORKING



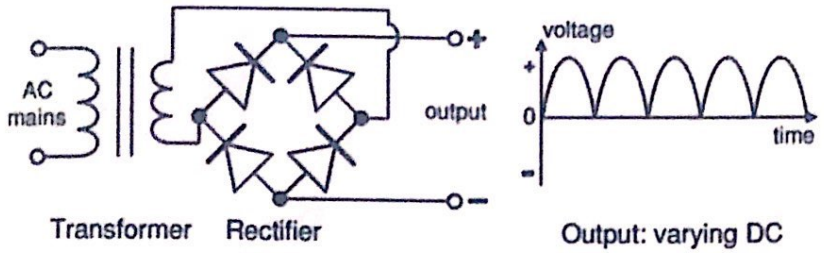
Transformer: -



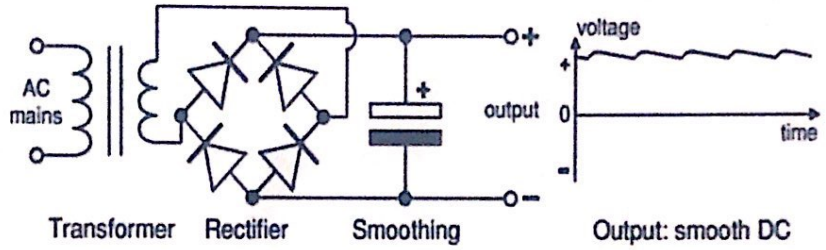
Transformer



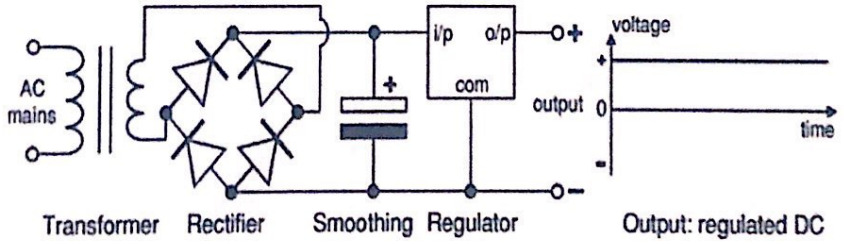
Output: low voltage AC



Transformer + Rectifier + Smoothing: - The smooth DC output has a small ripple.



Transformer + Rectifier + Smoothing + Regulator: - The regulated DC output is very smooth with no ripple. It is suitable for all electronic circuits.



Transformer

A Transformer is an equipment used either for raising or lowering the voltage of an ac supply with a corresponding decrease and increase in current. It essentially consist 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.

The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils, instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core. 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. The ratio of the number of turns on each coil, called the turn's ratio, determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage.

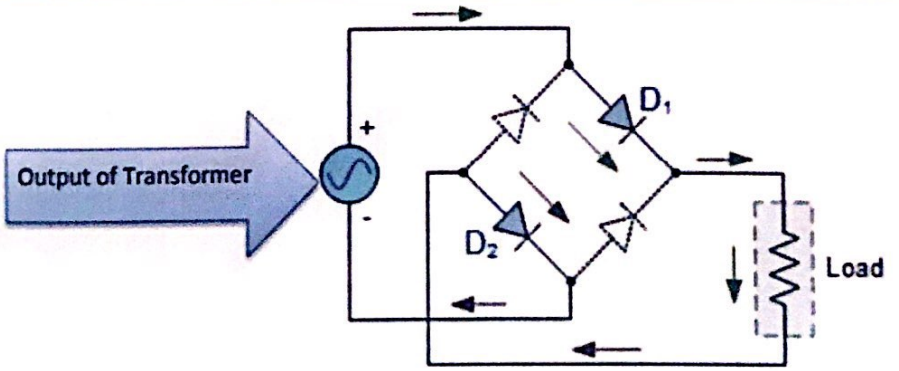
Rectifier

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.

Bridge Rectifier

A bridge rectifier can be made using four individual diodes, but it is also available in special packages containing the four diodes required. It is called a full-wave rectifier because it uses all the AC wave (both positive and negative sections).

Working of Full Wave Bridge Rectifier:- The Positive Half-cycle. During the positive half cycle of the supply, diodes D1 and D2 conduct in series while diodes D3 and D4 are reverse biased and the current flows through the load as shown below



The Negative Half-cycle During the negative half cycle of the supply, diodes D3 and D4 conduct in series, but diodes D1 and D2 switch "OFF" as they are now reverse biased. The current flowing through the load is the same direction as before.

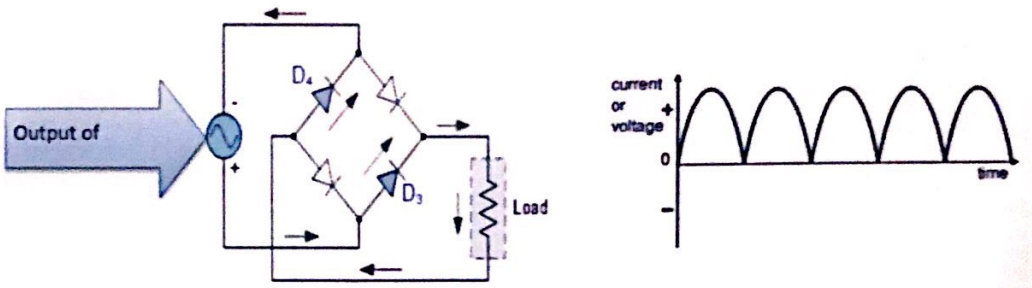
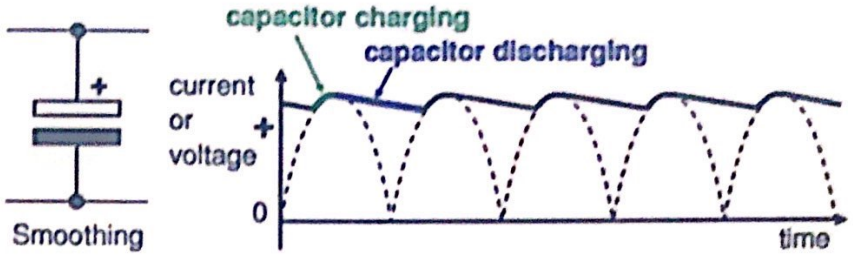


Fig: Resultant wave form

Hence, we can say that the bridge wave rectifier give the pulsating DC voltage which are not suitable for electronics circuit.

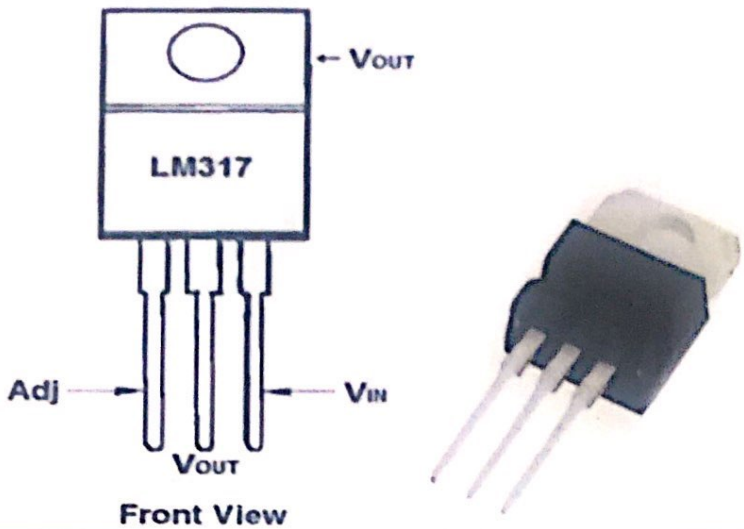
Smoothing (Filter):-

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.



Note:- Note that smoothing significantly increases the average DC voltage to almost the peak value (1.4 × RMS value). 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.

Voltage Regulation:(using IC LM317) Output from the full wave bridge rectifier is fed to a LM317 regulator IC LM317 provides varied voltage from 1.2V to 35V. Reference voltage of 1.25 V is maintained at 220 ohm Resistor. The LM317 Voltage Regulator is a 3-terminal adjustable voltage regulator which can supply an output voltage adjustable from 1.2V to 35V. It can supply more than 1.5A of load current to a load. LM317 Pinout The LM317 Voltage Regulator has 3 pins. Below is the pinout:



Looking from the front of the voltage regulator, the first pin (on the left) is the Adjustable Pin, the middle is Vout, and the last pin(on the right) is VIN. VIN - VIN is the pin which receives the incoming voltage which is to be regulated down to a specified voltage. For example, the input voltage pin can be fed 12V, which the regulator will regulate down to 10V. The input pin receives the incoming, unregulated voltage. Adjustable - The Adjustable pin (Adj) is the pin which allows for adjustable voltage output. To adjust output, we swap out resistor R2 value for a different resistance. This creates adjustable voltages. VOUT - VOUT is the pin which outputs the regulated voltage. For example, the LM317 may receive 12V as the input and output a constant 10V as output.

CAPACITORS C2 & C3 :-

The capacitors C2 (0.1 uF) and C3(10 uF) are used to clean up the power line. C2 is optional and it's used to clean up transient response. C3 is needed if the device is far from any filter capacitors. This capacitors helpssmooth out the power supply line in case of abrupt current spikes. C2-0.1uF (Ceramic Capacitor or Mylar Capacitor) reduces noise.

The C4 - 470uF 25V (electrolytic capacitors) acts like a miniature battery that supplies power during the spike

$$V_{out} = V_{ref} + \left(1 + \frac{R_L}{R_n}\right)$$

$$V_{ref} = 1.25V$$
$$R_L = 1K\Omega$$
$$R_n = 330\Omega$$

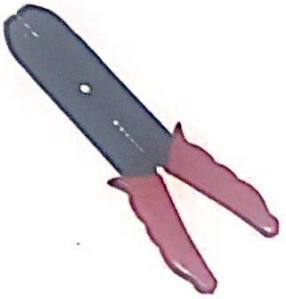
$$V_{out} \approx 5V$$

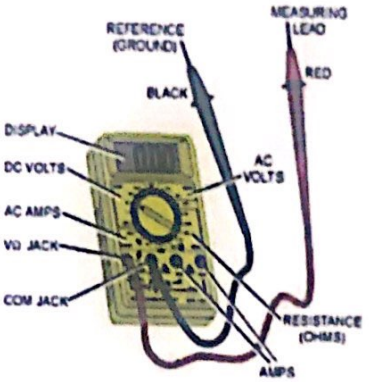
FABRICATION PROCESS

Electrical Fabricating, consisting of electrical design i.e. making PCB, soldering, is making connection correctly etc. Various Tools & Equipment Needed For Fabrication

Soldring wire

flux





Soldering

Soldering is a process in which two or more metal items are joined together by melting and flowing a filler metal into the joint, the filler metal into the joint, the filler metal having a relative low melting point. Soft soldering is characterized by the melting point of the filler metal, which is below 4000 C (7520F). The filler metal used in the process is called solder. In a soldering process, heat is applied to the parts to be joint by capillary action and to bond to the materials to be joined by wetting action. After the metal cools, the resulting joints are not as strong as the base metal, but have adequate strength.

Tips & Tricks Soldiering is something that needs to be practiced. These tips should help you began successful so you can stop practicing and get down to some serious building. 1. Keep the iron tip clean. A clean iron tip means better heat conduction and a better joint. Use a wet sponge to clean the tip between joints. 2. Double check points. It is good idea to check all the soldiers joints with an Ohm meter after they are cooled. If the joint measures any more than a few tenths of an ohm, then it may be a good idea to resolder it. 3. Use the proper iron. Remember that bigger joints will take longer to heat up with an 30W iron than with a 150w Iron. 4. Solder small parts first. Solder resistors , jumper leads, diodes andany other small parts before you solder larger parts like capacitors and transistors. This makes assembly much easier.

A constant current source in electronics is a device/circuit that produces a constant value of current regardless of source voltage or load resistance. Here we design a simple and easy constant current DC power supply circuit using Three terminal adjustable regulator IC LM317. This circuit will provide different voltage output according to the input voltage and constant current output depends on the value of reference resistor R1.

Hardware Components

The following components are required to make DC Power Supply Circuit

S. No	Components	Value	Qty
1	Transformer	0-9V DC Output	1
2	Regulator IC	LM317	1
3	Diode	1N4007	4
4	Electrolytic Capacitor	100µF/16V	1
5	Ceramic Capacitor	0.1µF	1
6	Resistor (Depend on Load)		1

Working Explanation

As we can see in the circuit, first we need to build a rectifier circuit by implementing a step-down transformer and bridge rectifier to make a constant current DC power supply. Here we used 230V input primary, 0-9V AC secondary step-down transformer, and 1N4007 diode to form a bridge rectifier. Capacitors C1 and C2 are placed as a filter to remove AC ripples from the DC supply, then to regulate the current output we used an IC LM317.

IC LM317 from Texas Instruments is a three-terminal adjustable regulator and it can handle output current up to 1.5A it has internal short circuit current limiting options and a thermal overload protection circuit. Now the adjusted terminal of LM317 is connected with the output load after the R1 reference resistor and it functions as current feedback. In the prototype circuit, we used a 10Ω / 5W resistor and obtained a 125mA constant current output DC power supply.

Iout = Vref/R1

Vref = 1.25V for LM317 we can calculate the R1 resistor value with this formula, the R1 resistor value depends on your current output requirements.

Applications

These are useful for laser and electroplating applications.

A regulated Power supply (RPS) is an ambedded circuit, used to convert unregulated alternating current into a stable direct current by using a rectifier. The main function of this is to supply a contant voltage to a circuit that should be functioned in a particular power supply limit.

Mobile phone chargers.

Regulated power supplies in different application.

Various oscillators and amplifiers