

# “Power Supply Project”

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Submitted By:

**“RITVIK DAVE”**

**“YASHVI KHATRI”**

**“KRITIKA KUMAWAT”**

B-tech, 1<sup>st</sup> year

Branch:-Electronics & Communication Engineering

Submitted to:

**“Mr. Yashwant Soni”**

Asst. Professor

Under the Guidance of:

**“Mr. Pradeep Chhawcharia”**

HEAD OF DEPARTMENT

ECE

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR

**Department of ECE**

**TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY  
UDAIPUR**

# DECLARATION

I hereby certify that the work is being presented in this Report work entitled “Power Supply Project” is an authentic record of my own work carried under the supervision of **Mr. Yashwant Soni, Mr. ChandraShekhar Sir , and Mr. Ravindra sir ,Department of Electronics & Communication Engineering, TECHNO INDIA NJR INSTUTE OF TECHNOLOGY, UDAIPUR**

Date: **“RITVIK DAVE” (ECE)**  
**“YASHVI KHATRI” (EE)**  
**“KRITIKA KUMAWAT” (ECE)**

I certify that the above statement made by the student is correct to the best of my knowledge and belief.

Date: **“Mr. Pradeep Chhawcharia”**  
HEAD OF DEPARTMENT  
ECE  
TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY,UDAIPUR

## Countersigned By

**“Mr. RAJSHEKHAR VYAS”**  
**“DIRECTOR”**

“ TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY,UDAIPUR”

## ACKNOWLEDGEMENT

*"Achievement is finding out what you would be doing, what you have to do. The higher the summit, higher will be the climb."* It has been rightly said that we are build on the shoulders of others but the satisfaction that accompanies the successful completion of any task would be incomplete without the mention of the people who made it possible.

I am very thankful to **MRS. MEERA RANAWAT**, OWNER, TINJRIT, Udaipur for providing the facilities for the completion of Project work. I express my deep sense of gratitude towards **MR. RAJ SHEKHAR VYAS**, DIRECTOR, & **MR. PRADEEP CHHAWCHARIA**, HOD TINJRIT, Udaipur who has been a constant source of inspiration for me throughout this work.

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Date:

Place: TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR

**RITVIK DAVE**

BRANCH: ECE

**YASHVI KHATRI**

BRANCH: EE

**KRITIKA KUMAWAT**

BRANCH: ECE

## ABSTRACT

The aim of this lab assignment is to design a DC power supply. For this purpose we have to assemble a rectifier circuit on the output of a transformer. It also involve the calculation of different components used so the DC supply contains lesser ripples.

The DC power supply has wide applications in the modern world. Every day we use Mobile charger , Laptop Charger , Ring bell, TV etc. All these equipments require DC power supply to operate.



Fig.-:Image of DC power supply/ Mobile Charger

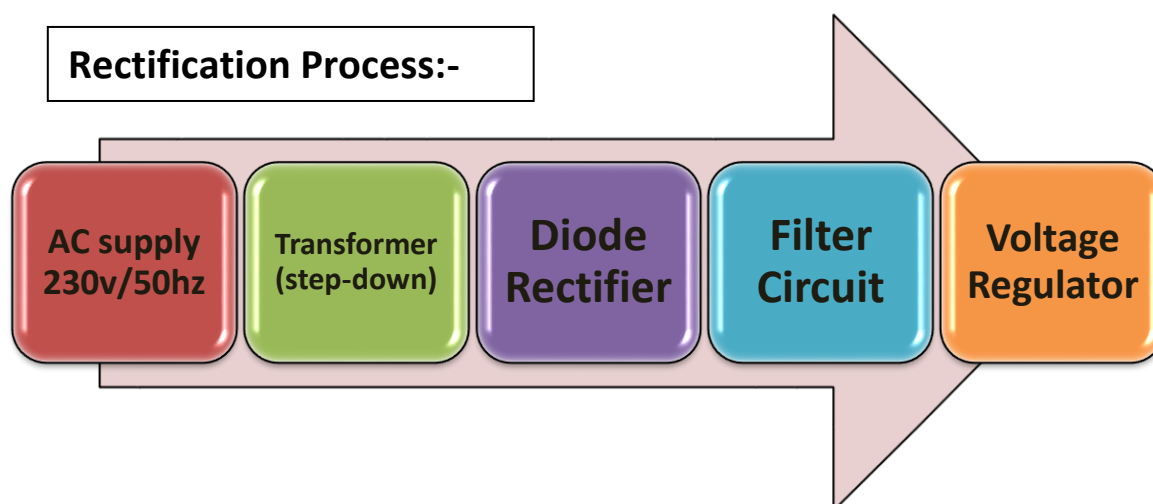
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**Object:-** To design a regulated DC power supply of (+5Volt/500mA).

## Rectification:-

The diode is an ideal and simple device to convert AC into DC. The process is called rectification. We shall focus our attention on some performance measure of a rectifier:



## Transformer

A Transformer is a static piece of equipments 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, wound on a common laminated magnetic core as shown in figure.

$N_1$ : no. of turns in primary coil

$N_2$ : no. of turns in secondary coil

If  $N_1 < N_2$  :- **Step-up transformer**

$N_1 > N_2$  :- **Step-down transformer**



*Fig.1.1: Transformer*

The following points may be noted carefully:-

- The transformer action is based on the law of electromagnetic induction.
- There is no electrical/physical connection between the primary & secondary windings. The ac power transferred from primary to secondary through magnetic flux.
- There is no change in frequency i.e. output power has the same frequency as the input power.

- iv. The losses that occur in transformer are:
- Core losses- eddy current & hysteresis losses.
  - Copper losses-in the resistance of a winding.

Relation b/w voltages and no. of turns is:

$$(V_1/V_2)=(N_1/N_2)$$

## Checking of Transformer:-

### 1. Cold check(without connecting power supply):-

- Insulation of Cu wire(short circuit)** :- if the circuit is short than its resistance will be “0”.
- Test for open circuit** :- if the winding is break (open) from anywhere than it will show very high “infinite” resistance.
- Insulation b/w winding and core & b/w primary and secondary windings:-** these are tested using “megger”.
  - If megger show some value when connect to two terminals means insulation is not proper b/w both terminals. Other wise it will show “out of limit”.



### 2. Hot Check(using power supply):-

**Rating error:-** It is to verify whether output of a transformer is according to its rating(voltage and current) or not.

It is identified by measuring  $V_{output}$  and  $I_{output}$  using multimeter.

The transformer which we have used is given bellow

type:- **9-0-9** ;Current rating= **500mA**



Fig.1.1: Transformer

Readings :- at no load condition

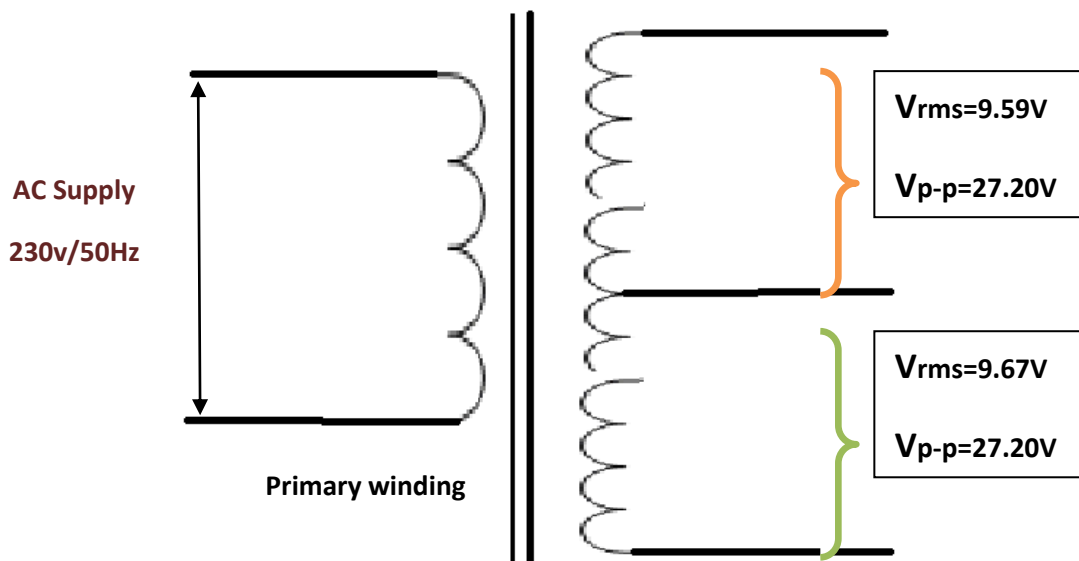


Fig.1.2: Transformer output observations

- I. To find voltages at full load condition.
- II. First we have to find appropriate load value.
- III. Load value is such that the current from the load is nearly 1Amp.
- IV. 1Amp current is flowing at  $18.2\Omega$  load.

$V_{rms}=17.5V$

$V_{p-p}=48.8V$

The following readings are taken through the transformer:

- a) Resistance of primary winding =  $127.8\Omega$
- b) Resistance of secondary winding =  $0.9\Omega/0.9\Omega$  (measured from different terminals 9-0-9)
- c) Secondary windings (at full load)

Readings:- at full load condition

If we vary the load resistance and set current at 1Amp. Then that value of resistance is the value of full load.

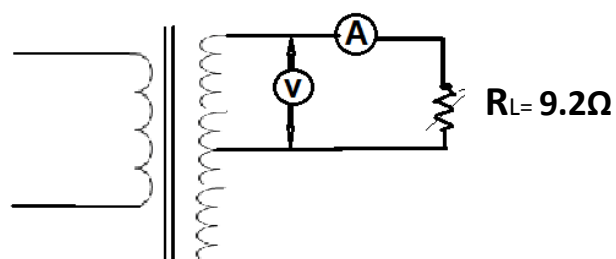


Fig.1.3: circuit to find value of  $R_L$



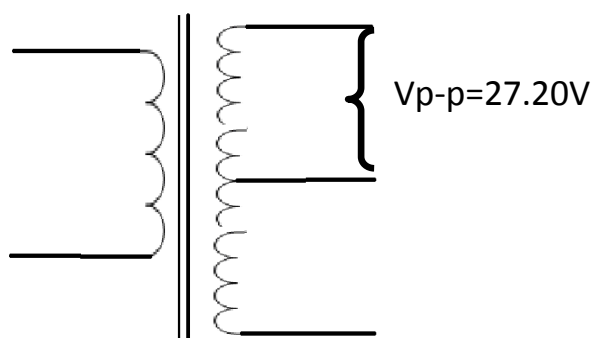
at  $I$ (current at output of transformer)=1 Amp

$$R_L = 9.2 \, \Omega ; \text{total } R_L = 18.4 \, \Omega ; V = 8.75V$$

Secondary windings (at no load):

$$V_{rms} = 27.2 / \sqrt{2} = 9.6453V$$

$$\text{Total } V_{rms} = 19.2906V$$



## Full Wave Rectifier

A Full Wave Rectifier Circuit produces an output voltage or current which is purely DC or has some specified DC component. Full wave rectifiers have some fundamental advantages over their half wave rectifier counterparts. The average (DC) output voltage is higher than for half wave, the output of the full wave rectifier has much less ripple than that of the half wave rectifier producing a smoother output waveform.

### The Full Wave Bridge Rectifier

Another type of circuit that produces the same output waveform as the full wave rectifier circuit above, is that of the **Full Wave Bridge Rectifier**. This type of single phase rectifier uses four individual rectifying diodes connected in a closed loop “bridge” configuration to produce the desired output. The main advantage of this bridge circuit is that it does not require a special centre tapped transformer, thereby reducing its size and cost. The single secondary winding is connected to one side of the diode bridge network and the load to the other side as shown below.

**The Diode Bridge Rectifier:-** The four diodes labelled  $D_1$  to  $D_4$  are arranged in “series pairs” with only two diodes conducting current during each half cycle

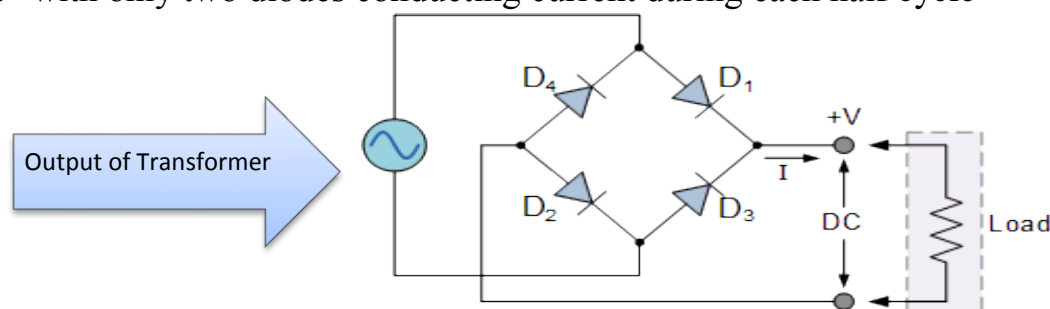
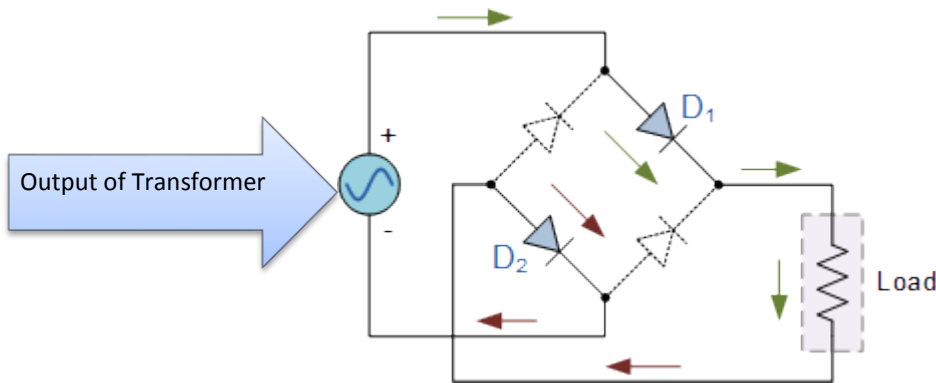


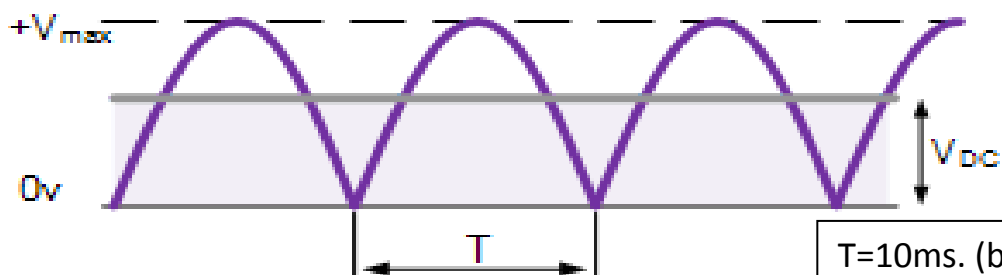
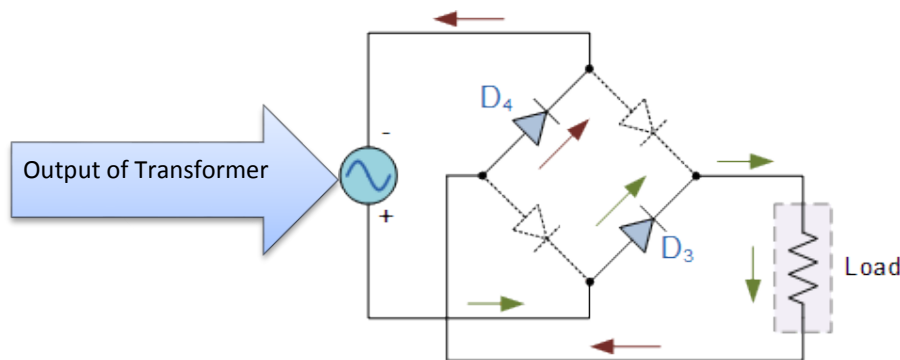
Fig.2.1: A full wave bridge Rectifier

## 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.



Resultant Output Waveform

$T=10\text{ms.}$  (because frequency is 50 Hz)

$$V_{d.c.} = \frac{2V_{\max}}{\pi} = 0.637V_{\max} = 0.9V_{RMS}$$

## CAPACITOR FILTER

We saw in the previous section that the single phase half-wave rectifier produces an output wave every half cycle and that it was not practical to use this type of circuit to produce a steady DC supply. The full-wave bridge rectifier however, gives us a greater mean DC value ( $0.637 V_{\max}$ ) with less superimposed ripple while the output waveform is twice that of the frequency of the input supply frequency. We can therefore increase its average DC output level even higher by connecting a suitable smoothing capacitor across the output of the bridge circuit as shown below.

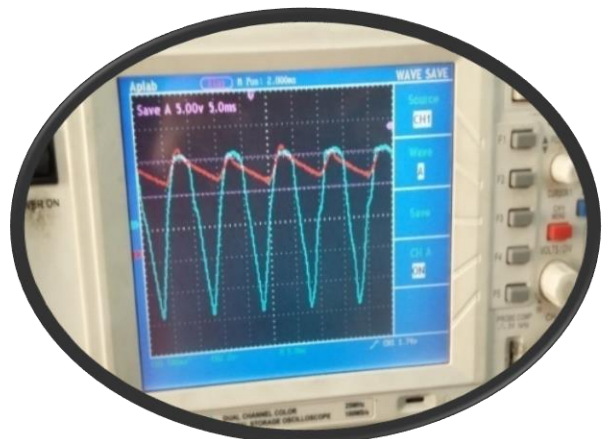
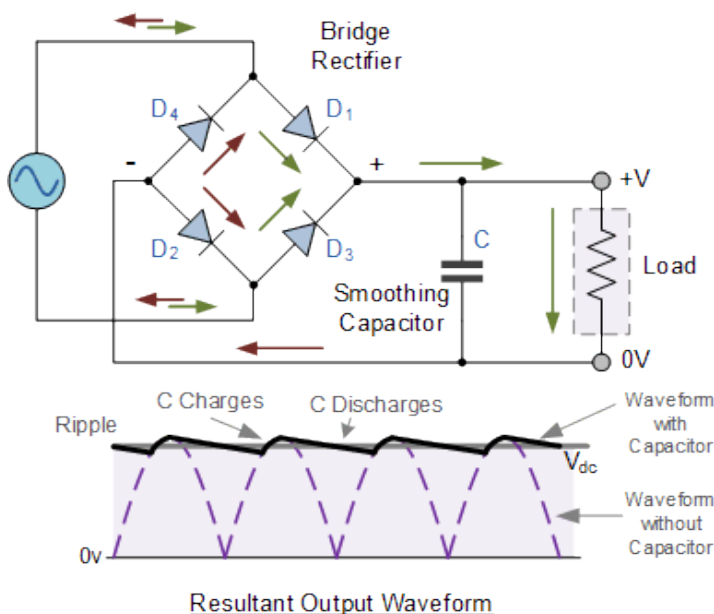


Fig.3.1: output waveform after connecting Capacitor in circuit

## Formulas to find capacitor value:-

There are so many ways to find capacitor values . the formulas mostly used are:-

1).

$$Q = CV$$

$$C = I_L / (2.f.\Delta V)$$

**OR**

2).  $Q = CV$

$$C = Q / \Delta V$$

$$C = I \cdot t_d / \Delta V \quad \{\text{because } Q = I \cdot t\}$$

Now we have to find values of  $I$  (current),  $t_d$  (discharging time period) and  $\Delta V$  (ripple voltage).

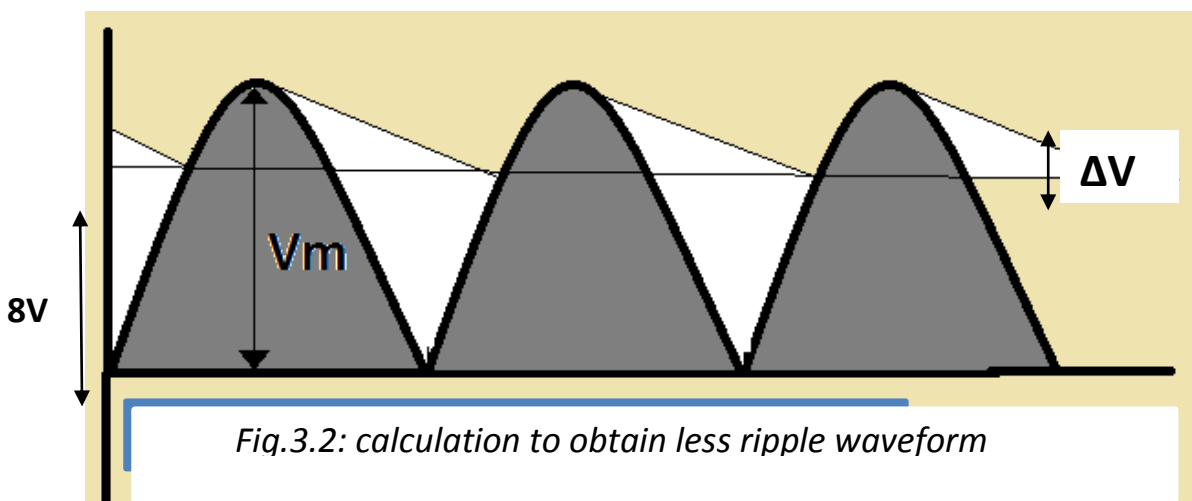
**For current:**

$I$  = current rating of transformer

**$\Delta V$  (ripple voltage):**

$\Delta V = V_m$  - value of voltage assumed in input of regulator which

Is sufficient to give required output



**$t_d$  (discharging time period):-**

the above waveform is sin wave so

$$v = V_m \cdot \sin \theta$$

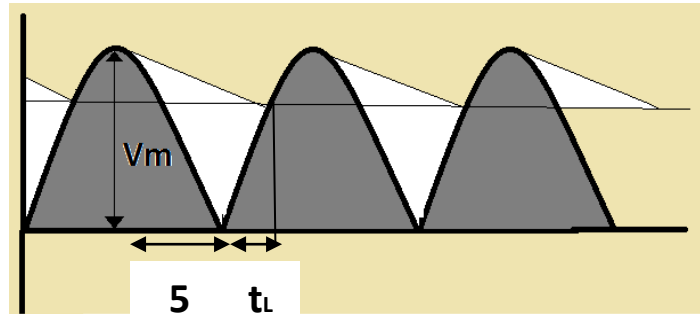
let instantaneous value of voltage  $v = 8V$

$$8 = V_m \sin \theta$$

$$\theta = \sin^{-1}(8/V_m)$$

As at  $180^\circ$  angle; time is 10ms (because the frequency of wave is 50Hz)

So at angle  $\theta$ ; time  $= (10/180) \theta$



So from above figure it is clear that

$$t_d(\text{discharging time period}) = 5 + T \dots \dots \dots \text{eq.(1)}$$

now to find values of capacitor for  $V_m = 18.2\text{V}$

$$\& \quad R_L = 18.4\Omega$$

$$Q = CV$$

$$C = Q/\Delta V$$

$$C = I.t/\Delta V \quad \text{where} \quad \Delta V = V_m - 8 = 18.2 - 8 = 10.2\text{V}$$

$$\& \quad I_L = 1\text{Amp}$$

$$\text{So} \quad C = 1.t/10.2 \dots \dots \dots \text{eq.(2)}$$

To find “ $t_d$ ”

$$v = V_m \sin \theta$$

let instantaneous value of voltage  $v = 8\text{V}$

$$8 = V_m \sin \theta$$

$$\theta = \sin^{-1}(8/V_m)$$

$$\sin \theta = 8/18.2$$

$$\theta = 26.075$$

As at  $180^\circ$  angle; time is 10ms (because the frequency of wave is 50Hz)

So at angle  $\Theta$  ; time  $= (10/180) \Theta$

$$\text{time} = (10/180) 26.075 \quad t = 1.4486\text{ms}$$

from eq.(1)

$$\text{now } t_d = 5 + 1.4486 \quad t_d = 6.4486\text{ms}$$

from eq..(2)

$$C = 1 * 6.4486 / 10.2 \quad C = 632.17\mu f$$

But because of safety purpose we are using  $2000\mu f$  capacitor.

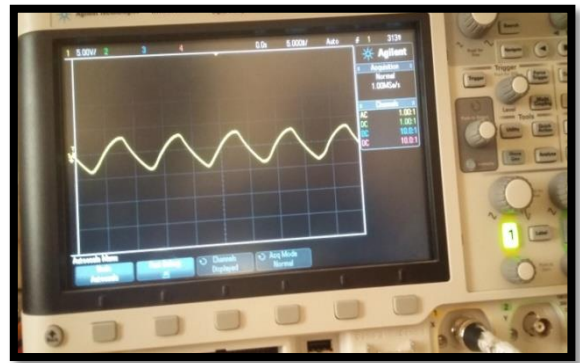
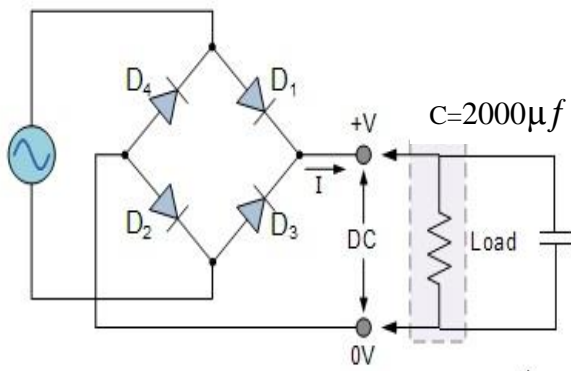


Fig. 3.3:- Image showing circuit of capacitive filter and output pulse from capacitor filter

## Voltage across capacitor:-

$$V_p = 24.88\text{V}$$

$$V_{rms} = 24.88 / (2\sqrt{3})$$

$$V_{rms} = 7.18223\text{V}$$

### NOTE

We are using...

$$V_{rms} = V_p / (2\sqrt{3})$$

[because the wave appears in saw-toothed form (triangular form) ]

Till there are some ripples in the output waveform. So we have to use some IC's like LM7805 or LM317 to obtain perfect DC wave. Now the next step is to put a voltage regulator IC in the circuit.

## Voltage Regulator

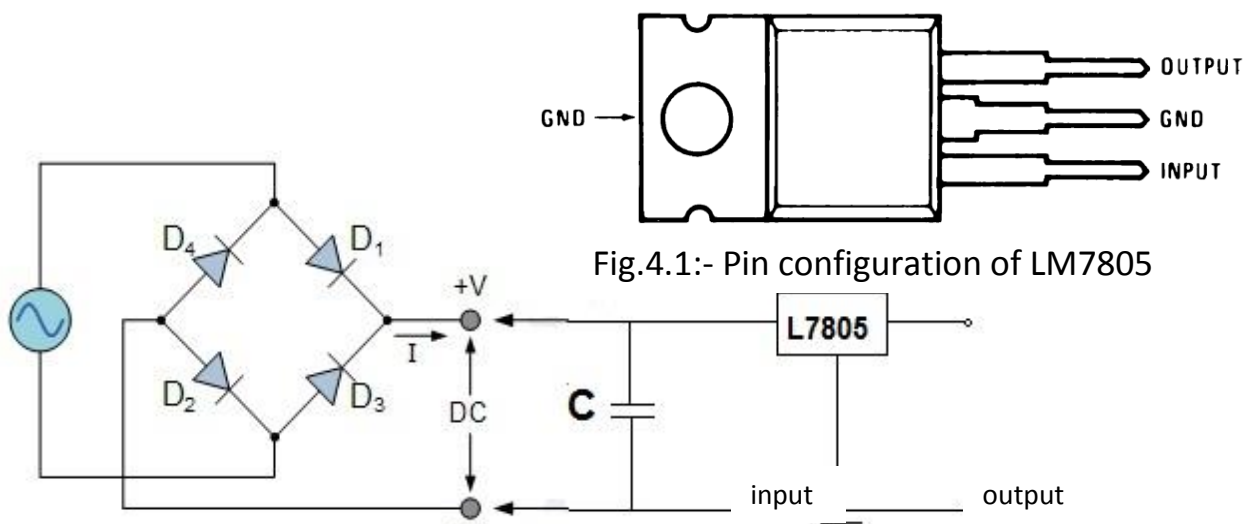
We are putting two IC's one by one to obtain perfect DC of 5Volt.

Using  
**IC-L7805**

Using  
**IC-LM317**

### (1). Designing of regulated DC Power Supply using adjustable Voltage Regulator LM7805:

It gives a constant direct voltage across its output terminals



Output of IC-LM7805

**$V_{DC}=5.050\text{Volt}$**

## Load regulation for LM7805

S. NO.	$R_L$ (Load Resistance)	$I_{bc}$	$V_{out}$
1.	9.8 $\Omega$	368.40 mA	5.02V
2.	31.2 $\Omega$	140.0 mA	5.04V
3.	49.6 $\Omega$	92.9 mA	5.08V
4.	72.4 $\Omega$	242.9 mA	4.98V
5.	100.9 $\Omega$	181.2 mA	4.84V
6.	123.2 $\Omega$	153.7 mA	4.82V
7.	123.6 $\Omega$	153.7 mA	4.8V
8.	220 $\Omega$	22.9 mA	4.995V
9.	560 $\Omega$	9.24 mA	5.024V
10.	2.2K $\Omega$	2.35 mA	5.021V
11.	4.6K $\Omega$	1.07 mA	5.018V

TABLE 4.1: Variation of output voltage with changing the load  $R_L$

## (2).Designing of regulated DC Power Supply using adjustable Voltage Regulator **IC-LM317**:-

It gives variable Output DC voltage with change in value of  $R_2$  .

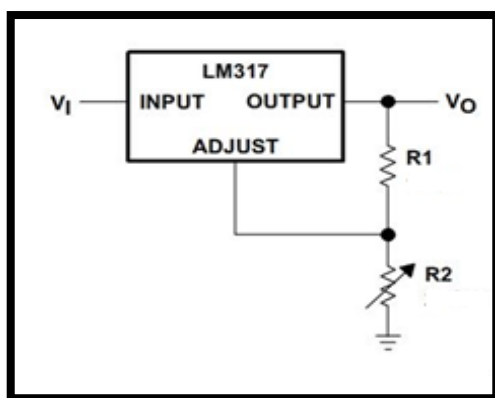
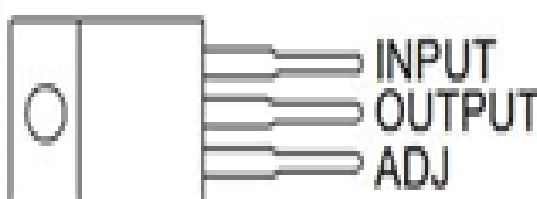


Fig 4.2.1:- connections for LM317



Fig 4.2.2:- pin configuration LM317





## Electrical properties of LM317:-

PARAMETER	TEST CONDITIONS†		MIN	TYP	MAX	UNIT
Line regulation‡	$V_I - V_O = 3\text{ V to } 40\text{ V}$			0.01	0.04	%/V
		$T_J = 25^\circ\text{C}$				
		$T_J = 0^\circ\text{C to } 125^\circ\text{C}$		0.02	0.07	
Load regulation	$I_O = 10\text{ mA to } 1500\text{ mA}$	$C_{ADJ} = 10\text{ }\mu\text{F}\$,$			25	mV
		$T_J = 25^\circ\text{C}$				
		$V_O \leq 5\text{ V}$		0.1	0.5	% $V_O$
		$V_O \geq 5\text{ V}$		20	70	mV
		$T_J = 0^\circ\text{C to } 125^\circ\text{C}$		0.3	1.5	% $V_O$
Thermal regulation	20-ms pulse, $T_J = 25^\circ\text{C}$			0.03	0.07	% $V_O$ /W
ADJUST terminal current				50	100	$\mu\text{A}$
Change in ADJUST terminal current	$V_I - V_O = 2.5\text{ V to } 40\text{ V}, P_D \leq 20\text{ W}, I_O = 10\text{ mA to } 1500\text{ mA}$			0.2	5	$\mu\text{A}$
Reference voltage	$V_I - V_O = 3\text{ V to } 40\text{ V}, P_D \leq 20\text{ W}, I_O = 10\text{ mA to } 1500\text{ mA}$		1.2	1.25	1.3	V
Output-voltage temperature stability	$T_J = 0^\circ\text{C to } 125^\circ\text{C}$			0.7		% $V_O$
Minimum load current to maintain regulation	$V_I - V_O = 40\text{ V}$			3.5	10	mA
Maximum output current	$V_I - V_O \leq 15\text{ V}, P_D < P_{MAX}$ (see Note 1)		1.5	2.2		A
	$V_I - V_O \leq 40\text{ V}, P_D < P_{MAX}$ (see Note 1), $T_J = 25^\circ\text{C}$		0.15	0.4		
RMS output noise voltage (% of $V_O$ )	$f = 10\text{ Hz to } 10\text{ kHz}, T_J = 25^\circ\text{C}$			0.003		% $V_O$
Ripple rejection	$V_O = 10\text{ V}, f = 120\text{ Hz}$	$C_{ADJ} = 0\text{ }\mu\text{F}\$$		57		dB
		$C_{ADJ} = 10\text{ }\mu\text{F}\$$	62	64		
Long-term stability	$T_J = 25^\circ\text{C}$			0.3	1	%/1k Hrs

to calculate the values of  $R_1$  &  $R_2$ :-

$$\left. \begin{array}{l} I_L = 10\text{ mA} \\ V_{\text{ref}} = 1.2\text{ V} \\ I_{\text{adj}} = 100\text{ }\mu\text{A} \end{array} \right\} \text{ (values from Datasheet)}$$

$$R_1 = V_{\text{ref}}/I_L = 1.2\text{ V}/10\text{ mA}$$

$$R_1 = 120\Omega$$

For  $R_2$

$$V_{\text{output}} = V_{\text{ref}}(1 + R_2/R_1) + (I_{\text{adj}} * R_2)$$

$$5\text{ V} = 1.25(1 + R_2/120) + (100\text{ }\mu\text{A} * R_2) \quad R_2 = 356.80\Omega$$

At No Load	At Full Load (10 $\Omega$ )
$V_{\text{out}} = 5.062\text{ V}$	$V_{\text{out}} = 4.828\text{ V}$
$I_{R1} = 10\text{ mA}$	$I_{R1} = 10\text{ mA}$
$I_{\text{adj}} = 50\text{ }\mu\text{A}$	$I_{\text{adj}} = 51.8\text{ }\mu\text{A}$
	$I_O = 517\text{ mA}$

**Formulas:-**

$$\text{Load Regulation} = [(V_{\text{no load}} - V_{\text{full load}}) / V_{\text{full load}}] * 100$$

$$\text{Line Regulation} = (\Delta V_{\text{output}} / \Delta V_{\text{input}}) * 100$$

$$\% / \text{Volt} = \{ \Delta V_{\text{output}} / V_{\text{output}} \} / \Delta V_{\text{input}} * 100$$

Load

Regulation=[(

5.062-4.828)/ 4.828]\*100

$$\% \text{ Load Regulation} = 4.846\%$$

To observe the load regulation(if the load on the output is changed but the output voltage remain constant) on load variation:-

S. No.	R <sub>L</sub> (Ω)	V <sub>output</sub> (Volt) (DC)	I <sub>output</sub> (mA)	V <sub>capcitor</sub> (Volt)
1.	10	5.074	517	24.88
2.	100	5.070	59.2	24.64
3.	200	5.370	26.1	24.11
4.	300	5.074	17.0	24.97
5.	400	5.664	15.0	24.34
6.	500	5.362	11.0	24.24
7.	600	5.184	9.0	24.68
8.	700	5.007	7.0	24.39
9.	1.191	5.027	4.0	24.48
10.	2.396	5.095	2.0	24.65

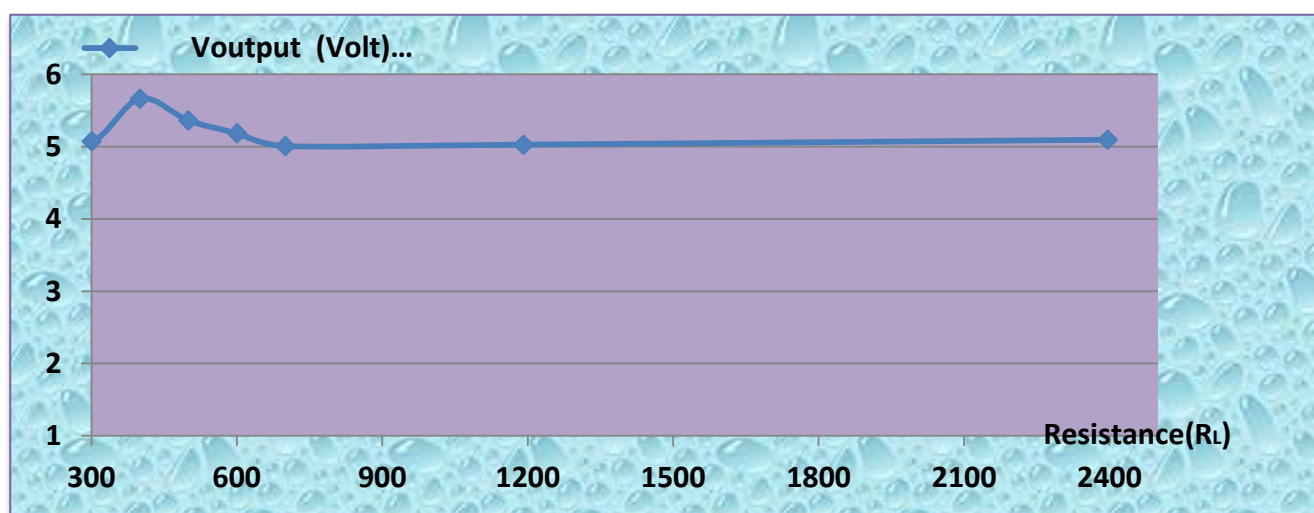


Fig.4.2.1: Graph showing variation of o/p Voltage with Load resistance R<sub>L</sub>

**Line Regulation:-** If the line voltage or supply voltage is varied but the output voltage remain constant.

The supply voltage is varied through an Auto Transformer

- It can vary the supply voltage from 0 to 260 Volt.
- Carbon Brush with spring contact makes the voltage step-up or step-down.



**“Line regulation at no load”**

Line Voltage( $V_{input}$ ) [ AC in Volt ]	$V_{output}$ {Volt}
121.5	4.966
195.7	4.966
205.6	4.967
215.5	4.966
230.2	4.966
250.3	4.966
260.0	4.967
265.0	4.967

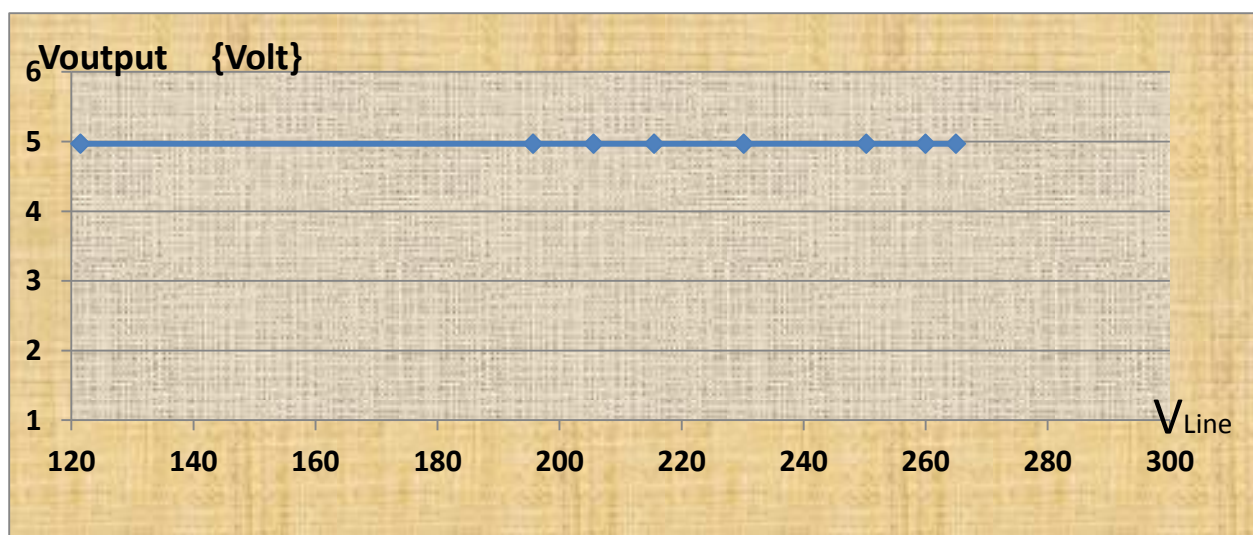


Fig.4.2.2:Graph showing variation of o/p voltage with line voltage

Now

$$\Delta V_{\text{input}} = 265.0 - 121.5 \quad \Delta V_{\text{input}} = 143.5\text{V} \quad (\text{Input voltage difference})$$

$$\Delta V_{\text{output}} = 4.967 - 4.966 \quad \Delta V_{\text{output}} = 0.001\text{V} \quad (\text{output voltage difference})$$

By formula.....

$$\% \text{ Line Regulation} = (0.001 / 143.5) * 100$$

$$\% \text{ Line Regulation} = 0.006\%$$

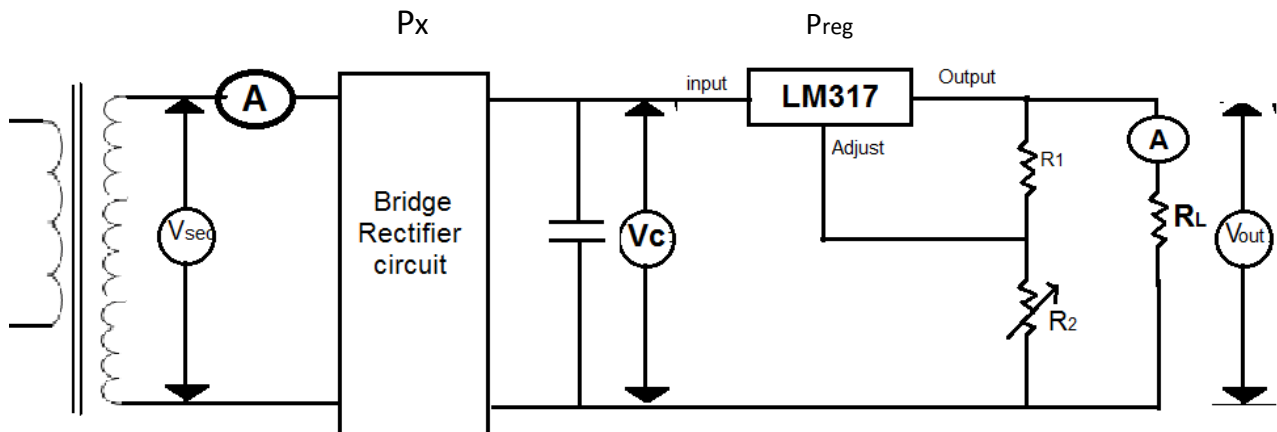
$$\text{Line Regulation in } \%/V = \{[\Delta V_{\text{output}} / V_{\text{output}}] / \Delta V_{\text{capacitor}}\} * 100$$

$$\%/V = \{[0.001 / 5.062] / 5.4\} * 100$$

$$\text{Line Regulation} = 0.0025 \%/V$$

Because we are not able to set the same temperature and other testing condition for the measurement so the outputs are not following exact the datasheet of LM317.

## Power Calculation:-



Observations:  $V_{\text{sec.}} = 17.76 \text{ Volt}$  ;  $I_{\text{sec}} = 0.834 \text{ Amp}$

$V_{\text{capacitor}} = 20.12 \text{ Volt}$  ;  $R_L = 10\Omega$

$V_{\text{out}} = 5.04 \text{ Volt}$  ;  $I_{\text{out}} = 490 \text{ mA}$

<b>INPUT POWER</b> $P_i = I_{sec} * V_{sec} =$ $0.831 * 17.76$ <b><math>P_i = 14.7585 \text{ Watt}</math></b>	<b>Output POWER</b> $P_i = I_o * V_o =$ $5.04 * 490 \text{mA}$ <b><math>P_i = 2.4696 \text{ Watt}</math></b>
--	---

Power consumed by regulator:

$$P_{reg} = I_o * (V_c - V_o) = 15.08 * (20.12 - 5.04)$$

$$P_{reg} = 7.389 \text{ Watt}$$

Power consumed by rectifier:

$$P_x = P_i - (P_o + P_{reg}) = 14.7585 - (2.4696 + 7.389)$$

$$P_x = 4.899 \text{ Watt}$$

To design different output DC supply we have to vary  $R_2$  value . Some of the output with specification is listed below:

Design of DC supply	$R_1$	$R_2$	$I_L$	Output Voltage at NO Load
5V	$120\Omega$	$353.3\Omega$	517mA	5.062V
6V	$120\Omega$	$451.8\Omega$	558mA	6.01V
9V	$120\Omega$	$737\Omega$	1158mA	9.02V
10.5V	$120\Omega$	$884\Omega$	0.958A	10.50V

## PCB Manufacturing Process

A **PCB** is used to connect electronic components electrically. This is done by making conductive path ways for circuit connections by etching tracks from copper sheet laminated onto a non-conductive substrate.

### Advantages of PCB over Bread-board

1. You can get a much higher density board with PCB.
2. You will find the PCB design to be more reliable than the one made on a bread board. The circuit will look neat without any wires popped up and will not fall apart.
3. You can have very precise control over the circuit component you are using, and you can comfortably fit in odd shaped components that are difficult to fix on a bread board.
4. For production of large volume of circuit boards, the costs become less and the soldering can be done by fully automated machines.

For PCB fabrication, some basic steps have to be followed. The detailed description on how to make PCB is explained below.

Once you have decided which electronic circuit is to be made on a PCB, you will have to make the design for the board on your PC. You can use different PCB designing CAD softwares like EAGLE. The most important point to note is that everything has to be designed in reverse because you are watching the board from above. If you need the circuit to be designed on a PCB, the layout must have a 360 degree flip. The next step is to print out the layout using a laser printer.



Fig.5.1:- image of DC supply Printed circuit Board

## PCB Etching Process

All PCB's are made by bonding a layer of copper over the entire substrate, sometimes on both sides. Etching process has to be done to remove unnecessary copper after applying a temporary mask, leaving only the desired copper traces.

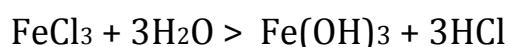
Though there are many methods available for etching, the most common method used by electronics hobbyists is etching using ferric chloride or hydrochloric acid. Both are abundant and cheap. Dip the PCB inside the solution and keep it moving inside. Take it out at times and stop the process as soon as the copper layer has gone. After etching, rub the PCB with a little acetone to remove the black colour, thus giving the PCB a shining attractive look. The PCB layout is now complete.



Fig.6.1:- Etching of PCB in  $\text{FeCl}_3$  solution

### REACTIONS:-

When Ferric crystals are mixed with water some free HCL produced through hydrolysis.



The basic etching reaction takes place in 3 stages. First the ferric ion oxidizes copper to cuprous chloride, which is then further oxidized to cupric chloride.



As the cupric chloride builds up at further reaction takes place,



The etch rate quickly falls off after about 100g/l of copper has been etched. For a typical solution containing 5.3lb/gallon (530g/l) of ferric chloride.



## PCB Drilling

The components that have to be attached to the multi-layered PCB can be done only by VIAS drilling. That is, a pated-through hole is drilled in the shape of annular rings. Small drill bits that are made out of tungsten carbide is used for the drilling. A dremel drill press is normally used to punch the holes. Usually, a 0.035 inch drill bit is used. For high volume production automated drilling machines are used



Fig.7.1:- drilling on PCB

## PCB Assembling & Soldering

PCB assembling includes the assembling of the electronic components on to the respective holes in the PCB. This can be done by through-hole construction or surface-mount construction. In the former method, the component leads are inserted into the holes drilled in the PCB. In the latter method, a pad having the legs similar to the PCB design is inserted and the IC's are placed or fixed on top of them. The common aspect in both the methods is that the component leads are electrically and mechanically fixed to the board with a molten metal solder.



## PCB circuit Testing

### Use of Heat sink:

A **heat sink** is a passive heat exchanger that transfers the heat generated by an electronic or a mechanical device into a coolant fluid in motion. Then-transferred heat leaves the device with the fluid in motion, therefore allowing the regulation of the device temperature at physically feasible levels.

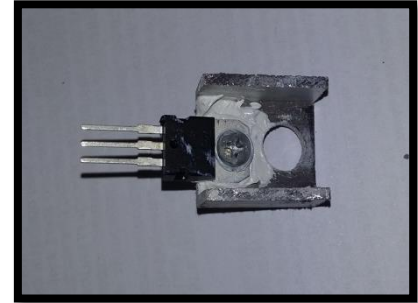


Fig.8:- a heat sink bolted on IC

### Heat transfer principle

A heat sink transfers thermal energy from a higher temperature device to a lower temperature fluid medium. The fluid medium is frequently air, but can also be water, refrigerants or oil. If the fluid medium is water, the heat sink is frequently called a cold plate. In thermodynamics a heat sink is a heat reservoir that can absorb an arbitrary amount of heat without significantly changing temperature.

Practical heat sinks for electronic devices must have a

- a) temperature higher than the surroundings to transfer heat by convection, radiation, and conduction.
- b) A heat sink should be of light weight eg. Al is used .
- c) It should have high Thermal conductivity.
- d) Its cost should be low.

## Load Regulation:-

S. No.	$R_L (\Omega)$	$V_{\text{output}} (\text{Volt})$ (DC)	$I_{\text{output}}$ (mA)	$V_{\text{capcitor}}$ (Volt)
1.	10	4.98	490	20.58
2.	100	4.98	45	22.58
3.	200	4.98	25	22.78
4.	300	4.98	16	22.80
5.	400	4.98	12	23.07
6.	500	4.98	10	22.96
7.	600	4.98	8	23.19
8.	700	4.99	7	23.18
9.	1224	4.98	4	23.28
10.	2448	4.98	2	23.32

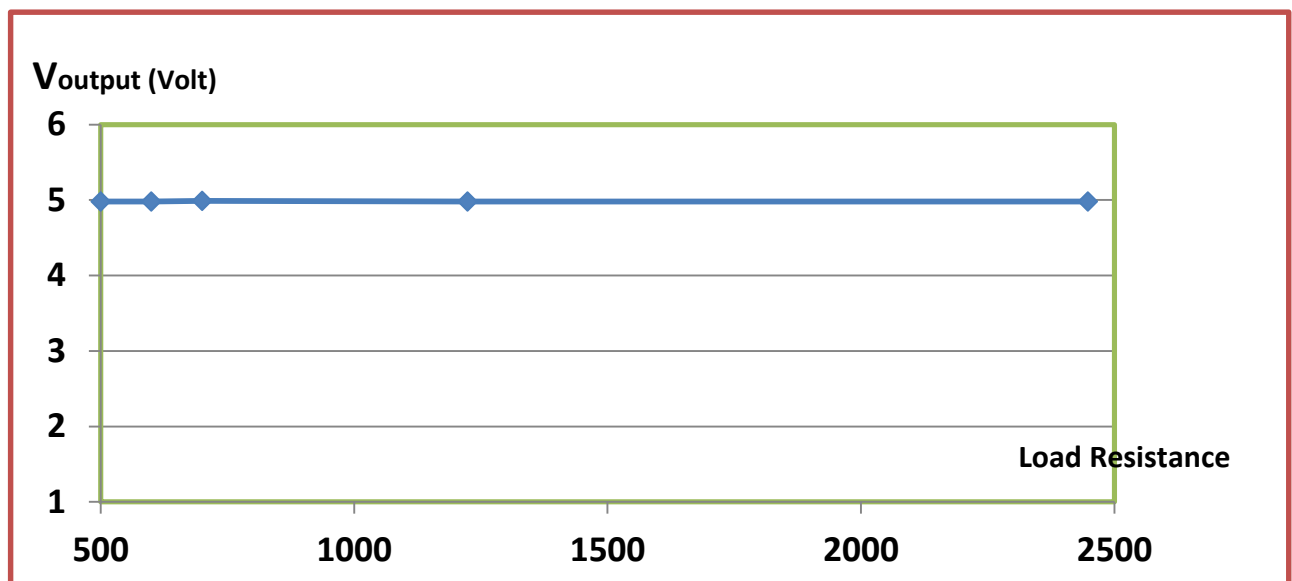


Fig.9.1: Graph showing variation of o/p Voltage with Load resistance  $R_L$

## Conclusion:

1. There is no change in output voltage when change in load resistance.
2. More accurate results on PCB than that of Breadboard.

## Line Regulation:-

“Line regulation at no load”

Line Voltage( $V_{input}$ ) [ AC in Volt ]	$V_{output}$ {Volt}
150.7	5.008
160.6	5.009
170.8	5.010
180.4	5.011
190.3	5.011
200.8	5.012
210.3	5.012
220.0	5.012
230.1	5.013
240.5	5.013
250.6	5.014
260.3	5.014

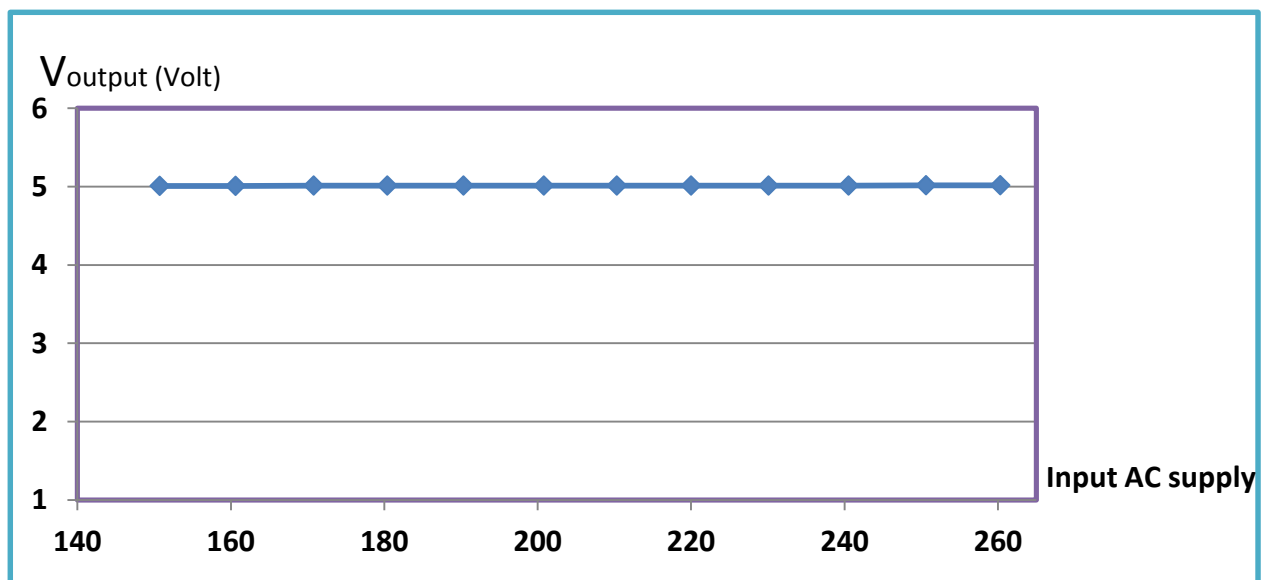
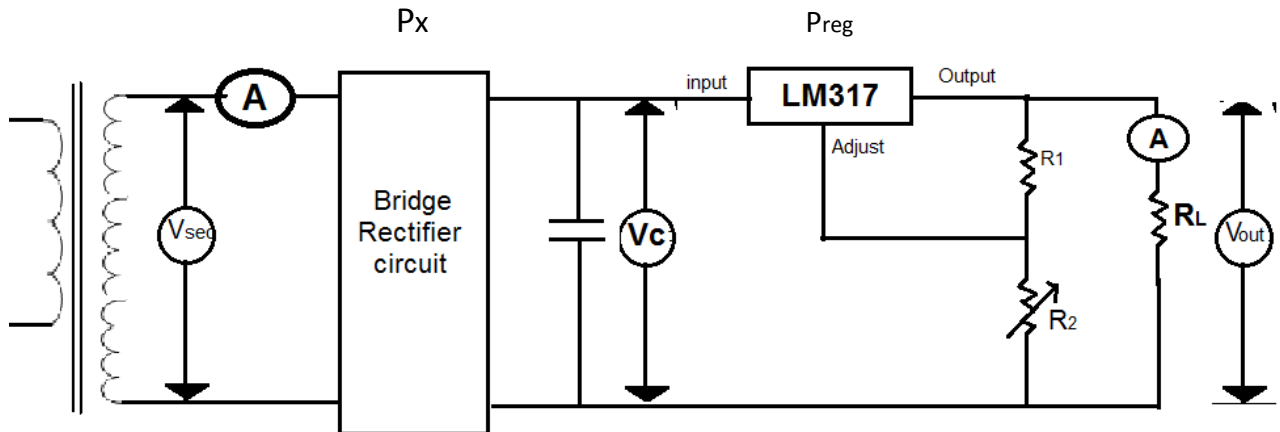


Fig.9.2: Graph showing variation of o/p Voltage with Input AC supply

## Conclusion:

There is no change in output voltage when change in Input AC voltage .

## Power Calculation:-



S. No.	Parameter	Observations/Calculation
1.	$I_{out}$	490mA
2.	$V_{out}$	4.98V
3.	$V_{capacitor}$ (DC)	20.58V
4.	$I_{sec.}$	1.016A
5.	$V_{sec.}$	19.20V
6.	(Power) $P_{input} = I_{sec} * V_{sec}$	19.507Watt
7.	$P_{output} = I_{out} * V_{out}$	2.440Watt
8.	$P_{regulator} = I_{out} * (V_{capacitor} - V_{out})$	7.644Watt
9.	$P_x$ (power consumed by rectifier) $= P_{input} - (P_{output} + P_{reg.})$	9.4228Watt

We are putting a  $1\Omega$  resistance in series with capacitor to find the current in capacitor. so by formula  $V=IR$  where  $R=1\Omega$  so the current waveform in resistance is same as voltage waveform as shown bellow.



Across Capacitor

Across  $R=1\Omega$

Fig.:- Voltage Wave form across Capacitor and resistance

## CONCLUSION:-

- When our DC supply remain switch on for half an hour it is giving constant output voltage .
- The results are better and accurate on the PCB than that on bread-board.
- There are very less ripple in the output waveform.

**THANK YOU**