DESIGN OF INVERTER FOR WIDE INPUT VOLTAGE RANGE

A Project report submitted in partial fulfillment
of the requirements for the degree of B. Tech in Electrical Engineering

by

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CERTIFICATE

To whom it may concern

This is to certify that the project work entitled "**DESIGN OF INVERTER FOR WIDE INPUT RANGE"** is the bona fide work carried out by **Swapnil Ghosh (11701614059),Tamal kotal (11701614062), Sujoy dey (11701615069), Ritesh Sah (11701614035)** students of B.Tech in the Dept of Electrical Engineering, RCC Institute of Information Technology (RCCIIT),canal south road,Beliaghata,Kolkata-700015,affiliated to Maulana Abul Kalam Azad University of Technology(MAKAUT),West Bengal, India, during the academic year 2017-2018,in patial fulfillment of the requirements for the degree of bachelor of Technology In Electrical Engineering and this project has not submitted previously for the award of any other degree, diploma and fellowship.

____

Signature of the guide

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Designation: Asst. Prof. of EE.

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Signature of the HOD,EE Dept. **Signature of External Examiner**

Name: Dr. Aloke Kole

Designation: HOD & Prof. of EE.

ACKNOWLEDGEMENT

It is our great fortune that we have got opportunity to carry out this project work under the supervision of **Mr. Nijam Ud-din Molla** in the Department of Electrical Engineering, RCC Institute of Information Technology (RCCIIT), Canal South Road, Beliaghata, Kolkata-700015, affiliated to Maulana Abul Kalam Azad University of Technology (**MAKAUT**), West Bengal, India. We express our sincere thanks and deepest sense of gratitude to our guide for his constant support, unparalleled guidance and limitless encouragement.

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Thanks to the fellow members of our group for working as a team.

SWAPNIL GHOSH (11701614059**)**

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To

The Head of the Department
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RCC Institute of Information Technology
Canal South Rd. Beliagahata, Kolkata-700015

Respected Sir,

In accordance with the requirements of the degree of Bachelor of Technology in the Department of Electrical Engineering, RCC Institute of Information Technology, We present the following thesis entitled "**DESIGN OF INVERTER FOR WIDE INPUT VOLTAGE RANGE**". This work was performed under the valuable guidance of Mr. Nijam ud-din Molla, Assistant Professor in the Dept. of Electrical Engineering.

We declare that the thesis submitted is our own, expected as acknowledge in the test and reference and has not been previously submitted for a degree in any other Institution.

Yours Sincerely,

SWAPNIL GHOSH (11701614059**)**

TAMAL KOTAL (11701614062**)**

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ABSTRACT

OBJECT:- Our object is to adapt solar cell and wind generator output with the domestic appliances. "**DESIGN OF INVERTER FOR WIDE INPUT VOLTAGE RANGE** is an electronic circuit that provides a stable DC voltage independent of the load current, temperature and AC line voltage variations. A voltage regulator may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

CHAPTER 1

(Introduction)

INTRODUCTION

“DESIGN OF INVERTER FOR WIDE INPUT VOLTAGE RANGE is an electronic circuit that provides a stable DC voltage independent of the load current, temperature and AC line voltage variations. The DC/AC converter consists of a 50% duty ratio rectangular voltage output inverter, a high-frequency transformer, a pulse-width modulation (PWM) cycloconverter, and an LC filter.This convertion is done with the help of the ic SG3525A.After convertion it is stepped up with the help of a step up transformer.

This project is basically divided into thee parts.In the first part variable DC voltage is converted to fixed DC voltage voltage.A variable voltage of 5 to 20v is supplied and we obtain a fixed voltage of 15v dc.This is done with the help of a buck and boost chopper.Then in the 2nd part this DC voltage is converted into ac with the help of the ic SG3525A.Then this ac voltage is stepped up with the help of a step up transformer.

1.1 BUCK AND BOOST CONVERTER

The buck boost converter is a dc to dc converter. The output voltage of the DC to DC converter is less than or greater than the input voltage. The output voltage of the magnitude depends on the duty cycle. These converters are also known as the step up and step down transformers and these names are coming from the analogous step up and step down transformer. The input voltages are step up/down to some level of more than or less than the input voltage. By using the low conversion energy, the input power is equal to the output power. The following expression shows the low of a conversion.

Input power (Pin) = Output power (Pout)

The 4-switch converter combines the buck and boost converters. It can operate in either the buck or the boost mode. In either mode, only one switch controls the duty cycle, another is for commutation and must be operated inversely to the former one, and the remaining two switches are in a fixed position. A 2-switch buck-boost converter can be built with two diodes, but upgrading the diodes to FET transistor switches doesn't cost much extra while due to lower voltage drop the efficiency improves. The output voltage is of the opposite polarity than the input. This is a switched-mode power supply with a similar circuit topology to the boost converter and the buck converter. The output voltage is adjustable based on the duty cycle of the switching transistor. One possible drawback of this converter is that the switch does not have a terminal at ground; this complicates the driving circuitry. However, this drawback is of no consequence if the power supply is isolated from the load circuit (if, for example, the supply is a battery) because the supply and diode polarity can simply be reversed. When they can be reversed, the switch can be on either the ground side or the supply side.

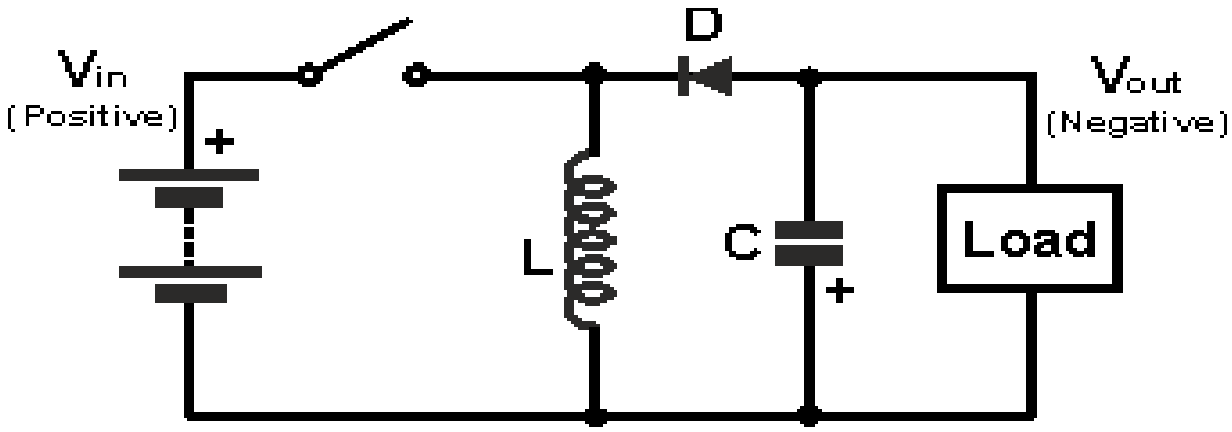


Fig.1.A BASIC CIRCUIT OF BUCK AND BOST CHOPPER

1.2 OVERVIEW AND BENEFITS

This specific device is created in the event that stabilization is needed to be brought to an unstable voltage fluctuation. The main reason as to why there is a fluctuation in the voltage is that the outer power web experiences a voltage load change which is an adjustable dual voltage regulator. The series is able to go through distortion which leads you to be able to make use of this series on a high quality basis. The voltage regulator stabilizer can be used in many different fields, ranging from precision machine tools, research, as well as medical facilities.

The difference between the two is the circuit power supplied as well as unit conversions. The automatic regulator has a few features that are different from the constant regulator; there is an alarm that sounds when an over-voltage is happening, and a time delay protection. It can also give you an extra low supply of power for when you are making use of the usual house hold appliances, which makes this device popular for domestic use. As for the constant inverting power supply, this is able to run with the use of a generator, therefore allowing you to have an unlimited power supply system in place.It helps in ultrafast voltage correction speed,no restrictions on the number of correction cycles,versatility of kVA rating, voltage and configuration,very low or no regular maintenance,good line isolation.

1.3 Organisation of thesis

The thesis is organised into five chapters including the chapter of introduction. Each chapter is different from the other and is described along with the necessary theory required to comprehend it.

Chapter 2 deals with the literature reviews. From this chapter we can see before our project who else works on this topic and how our project is different and advance from those projects.

Chapter 3 deals with the theory required to do the project. The voltage regulator, ic SG3525A,ic MC34063,MOSFET IRF540 , the step up transformer,overview of the project,basic circuit diagram are discussed in this section.

Chapter 4 deals with the hardware main features of prototypes. The main features, working principle step by step is mentioned, along with component listing and the hardware interfacing of the required components are described here.

Chapter 5 describes the basic operation of the circuit. A flow chart is presented on the actions that. Advantages and disadvantages and cost estimation are listed in this chapter.Photographs of each part is given there.

Chapter 6 concludes the work performed so far. The possible limitations in proceeding research towards this work are discussed. The future work that can be done in improving the current scenario is mentioned. The future potential along the lines of this work is also discussed.

Chapter 7 References are listed in this chapter.

Appendix A,B Hardware description and datasheets are listed here.

CHAPTER 2

(Literature Review)

The system proposed in [1] describes and prototypes a variable voltage to a fixed voltage converter called voltage regulator.This is done with the help of buck and boost chopper and its hardware design. In this regards we have also converted the fixed dc voltage to ac and stepped up with the help of a step up transformer.

The system [2] & [3] gives a brief discussion about the different ic's and mosefet used i.e ic MC34063,ic SG3525A and IRF 540.It also covers the pin diagram,specification,block diagram of the ic's.It also heps us to know about the features,advantages,disadvantages and uses of the mosfet's and ic's.

The system [4] tells us about the various hardware parts used in the voltage regulator and DC/AC converter.

The system proposed in[5] we get a brief idea about the principle and overview of the thesis.Here the advantage and disadvantage of voltage regulator is discussed.Also a flow chart is used to give a detail overview of the project.The practical images of various sections of the project is given.The cost estimation of the thesis is also discussed in this section.

The system proposed in [6] has various modern day approach of voltage regulator and AC/DC converter.

The system proposed in [7] describes hardware required in the project i.e resistors, capacitors,inductors etc.In this section a brief description of various hardware required in this project is discussed.

The project we have made is a prototype of the reference discussed above.We form the basic model of voltage regulator and DC/AC converter.The prototype takes a input of +5v to +20v dc and gives a output of fixed +15v dc. This is mainly done with the help of a buck and boost converter.Then this 15v dc is converted to 15v ac with the help of the DC/AC converter.Then we have also stepped up the 15v ac to 230v with the help of a step up transformer.Then as a load a 5w bulb is lit at the output.

Basically there is a huge demand of voltage regulators and dc/ac converters in todays market,because of its nature of Low current consumption , Overvoltage/ Short-circuit protection ,Reverse polarity protection ,Overtemperature protection ,Load protection ,Pin-to-pin compatible to industry standard parts,High input voltage rating: Up to 45V,Very low dropout voltage,Temp. range: –40°C up to **+125°C.**It has got a great applications in todays market including industries.So that is why we have taken this as our project**.**

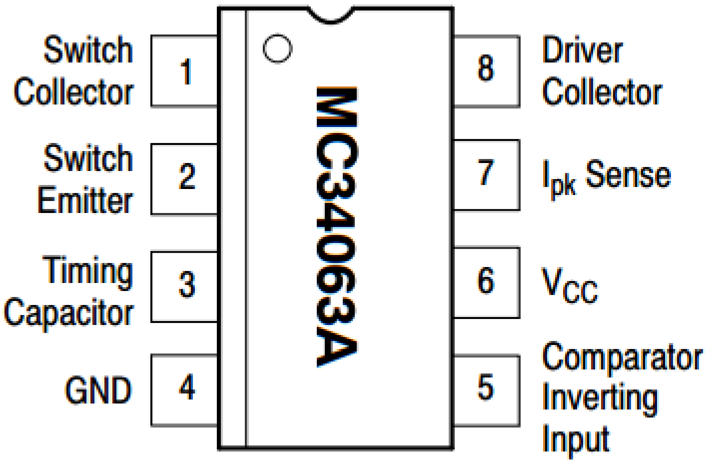
CHAPTER 3

(Theory)

IC's USED

3.1 MC34063

3.1.1 PIN DIAGRAM



The MC34063A Series is a monolithic control circuit containing the primary functions required for DC−to−DC converters. These devices consist of an internal temperature compensated reference, comparator, controlled duty cycle oscillator with an active current limit circuit, driver and high current output switch. This series was specifically designed to be incorporated in Step−Down and Step−Up and Voltage−Inverting applications with a minimum number of external components.

3.1.2 FEATURES

• Operation from 3.0 V to 40 V Input

• Low Standby Current

• Current Limiting

• Output Switch Current to 1.5 A

• Output Voltage Adjustable

• Frequency Operation to 100 kHz

• Precision 2% Reference

• NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable

• These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

3.1.3 OPERATION OF MC34063 AS BUCK CONVERTER

Time-On and Time-Off Calculation 3.3 Switch Peak Current Calculation Buck Regulator the basic buck switching regulator. Q1 interrupts the input voltage and provides a variable duty-cycle square wave to an LC filter. The filter averages the square wave and produces a dc output voltage that can be set to any level less than the input by controlling the percent conduction time of Q1 to that of the total switching cycle time. Vout = Vin(%t on) or Vout = Vin(t on/(t on + t off)) Figure 6. Buck Regulator As an example, suppose that the transistor Q1 is off, the inductor current (I L) is zero, and the output voltage is at its nominal value. The output voltage across capacitor Cout will ultimately decay below the nominal output level, because it is the only source of supply current to load RL. This voltage deficiency is sensed by the switching control circuit and causes Q1 to turn on. The inductor current starts to flow from Vin through Q1 and Cout in parallel with RL, and it rises at a rate of ΔI/Δt = V/L. The voltage across the inductor is equal to Vin – Vsat – Vout, and the inductor peak current at any instant is calculated as shown here: I L = ((Vin – Vsat – Vout)/L)t .At the end of the on period, Q1 is turned off. As the magnetic field in the inductor starts to collapse, it generates a reverse voltage that forward biases D1, and the peak current decays at a rate of ΔI/Δt = V/L as energy is supplied to Cout and RL. The voltage across the inductor during this period is equal to Vout + VF of D1. The current as a function of time is calculated as shown here: I L = I L(pk) – ((Vout + VF)/L)t Where VF is the forward voltage of D1.

3.1.4 TIME-ON AND TIME-OFF CALCULATION

As an example, suppose that during quiescent operation, the average output voltage is constant, and the system is operating in the discontinuous mode. Then I L(pk) attained during t on must decay to zero during t off, and a ratio of t on to t off can be determined.

((Vin – Vsat – Vout)/L)t on = ((Vout + VF)/L)t off

∴ t on/t off = (Vout + VF)/(Vin – Vsat – Vout)

3.1.5 SWITCH PEAK CURRENT CALCULATION

The volt-time product of t on must be equal to that of t off, and the inductance value is not a factor when determining their ratio. If the output voltage inside a switching period is to remain constant, the average current into the inductor must be equal to the output current for a complete cycle. The peak inductor current with respect to output current is:

(I L(pk)/2)t on + (I L(pk)/2)t off = I 18ut on + I 18ut off

∴ I L(pk) = 2I o

3.1.6 OPERATION OF MC34063 AS BOOST CONVERTER

As an example, suppose that transistor Q1 is off, the inductor current is zero, and output voltage is at its nominal value. At this time, load current is being supplied only by Cout, and it will eventually fall below nominal value. When the output voltage falls below the nominal value, it is sensed by the control circuit, which initiates an on cycle, driving transistor Q1 into saturation. Current starts to flow from input through the inductor and Q1, and it rises at a rate of $\Delta I/\Delta t = V/L$. The voltage across the inductor is equal to Vin – Vsat, and the peak current is roughly a linear function of t, as shown here: $I_L = ((V_{in} - V_{sat})/L)t$ When the on-time is completed, Q1 turns off, and the magnetic field in the inductor starts to collapse, generating a reverse voltage that forward biases D1, supplying energy to Cout and RL. The inductor current decays at rate of $\Delta I/\Delta t = V/L$, and the voltage across it is equal to Vout + VF – Vin. The current at any instant is calculated as shown here:

$$I_L = I_{L(pk)} - ((V_{out} + V_F - V_{in})/L)t$$

3.1.7 TIME –ON AND TIME-OFF CALULATION

Assuming that the system is operating in the discontinuous mode, the current through the inductor reaches zero after the t off period is completed. Then the $I_{L(pk)}$ attained during t on must decay to zero during t off, and a ratio of t on to t off can be written as shown here:

$$((V_{in} - V_{sat})/L)t_{on} = ((V_{out} + V_F - V_{in})/L)t_{of}$$

$$f \therefore t_{on}/t_{off} = (V_{out} + V_F - V_{in})/(V_{in} - V_{sat})$$

The volt-time product of t on must be equal to that of t off, and the inductance value does not affect this relationship. The inductor current charges the output filter capacitor through D1 during t off. If the output voltage is to remain constant, the net charge per cycle delivered to output filter capacitor must be zero ($Q+ = Q-$). $I_{chg} t_{off} = I_{dischg} t_{on}$.

3.1.8 PEAK CURRENT CALCULATION

By observing the capacitor current and making some substitution in the previous equation, a formula for peak inductor current can be obtained.

$$(I_{L(pk)}/2)t_{off} = I_{out}(t_{on} + t_{off})$$

$$\therefore I_{L(pk)} = 2I_{out}(t_{on}/t_{off} + 1)$$

3.1.9 FUNCTION BLOCK OF MC34063

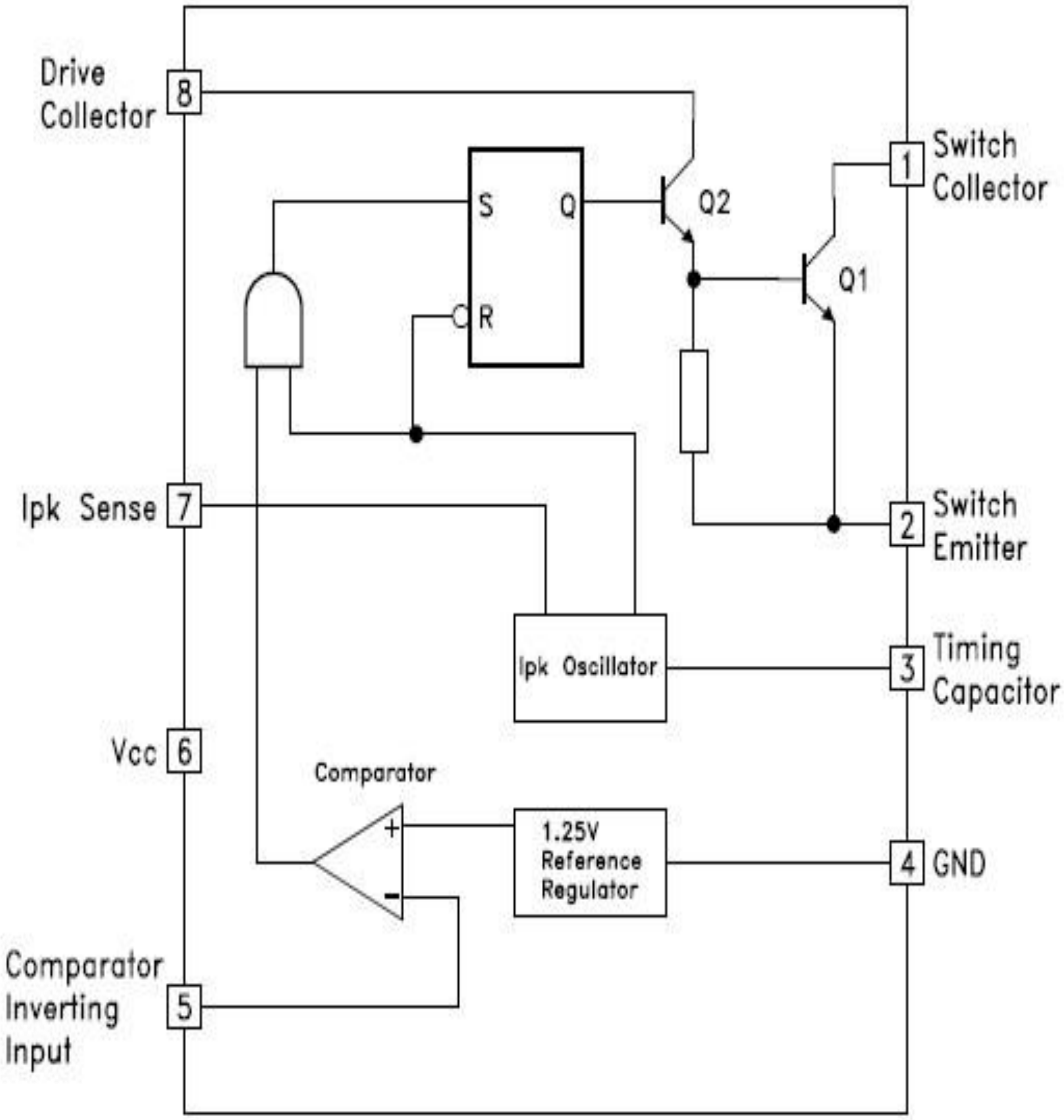
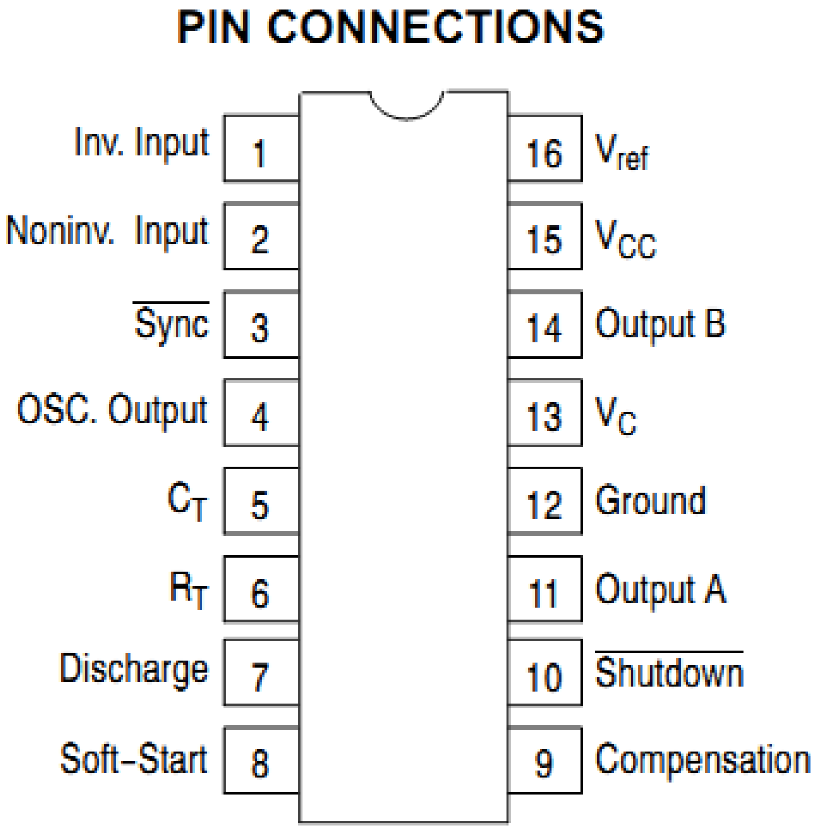


Fig.**2**

3.2 SG3525A

3.2.1 PIN DIAGRAM



The SG3525A pulse width modulator control circuit offers improved performance and lower external parts count when implemented for controlling all types of switching power supplies. The on−chip +5.1 V reference is trimmed to 1% and the error amplifier has an input common−mode voltage range that includes the reference voltage, thus eliminating the need for external divider resistors. A sync input to the oscillator enables multiple units to be slaved or a single unit to be synchronized to an external system clock. A wide range of deadtime can be programmed by a single resistor connected between the CT and Discharge pins. This device also features built−in soft−start circuitry, requiring only an external timing capacitor. A shutdown pin controls both the soft−start circuitry and the output stages, providing instantaneous turn off through the PWM latch with pulsed shutdown, as well as soft−start recycle with longer shutdown commands. The under voltage lockout inhibits the outputs and the changing of the soft−start capacitor when VCC is below nominal. The output stages are totem−pole design capable of sinking and sourcing in excess of 200 mA. The output stage of the SG3525A features NOR logic resulting in a low output for an off−state.

3.2.2 FEATURES

- 8.0 V to 35 V Operation
- 5.1 V 1.0% Trimmed Reference
- 100 Hz to 400 kHz Oscillator Range
- Separate Oscillator Sync Pin
- Adjustable Deadtime Control
- Input Undervoltage Lockout
- Latching PWM to Prevent Multiple Pulses
- Pulse−by−Pulse Shutdown
- Dual Source/Sink Outputs: 400 mA Peak

3.2.3 MAXIMUM RATINGS OF SG3525A

MAXIMUM RATINGS (Note 1)

Rating	Symbol	Value	Unit
Supply Voltage	V_{CC}	+40	Vdc
Collector Supply Voltage	V_C	+40	Vdc
Logic Inputs		–0.3 to +5.5	V
Analog Inputs		–0.3 to V_{CC}	V
Output Current, Source or Sink	I_O	±500	mA
Reference Output Current	I_{ref}	50	mA
Oscillator Charging Current		5.0	mA
Power Dissipation (Plastic & Ceramic Package) T_A = +25°C (Note 2) T_C = +25°C (Note 3)	P_D	 1000 2000	mW
Thermal Resistance Junction–to–Air	$R_{\theta JA}$	100	°C/W
Thermal Resistance Junction–to–Case	$R_{\theta JC}$	60	°C/W
Operating Junction Temperature	T_J	+150	°C
Storage Temperature Range	T_{stg}	–55 to +125	°C
Lead Temperature (Soldering, 10 seconds)	T_{Solder}	+300	°C

NOTES: 1. Values beyond which damage may occur.
2. Derate at 10 mW/°C for ambient temperatures above +50°C.
3. Derate at 16 mW/°C for case temperatures above +25°C.

Table.1.Rating of SG3525A

3.2.4 BLOCK DIAGRAM OF SG3525A

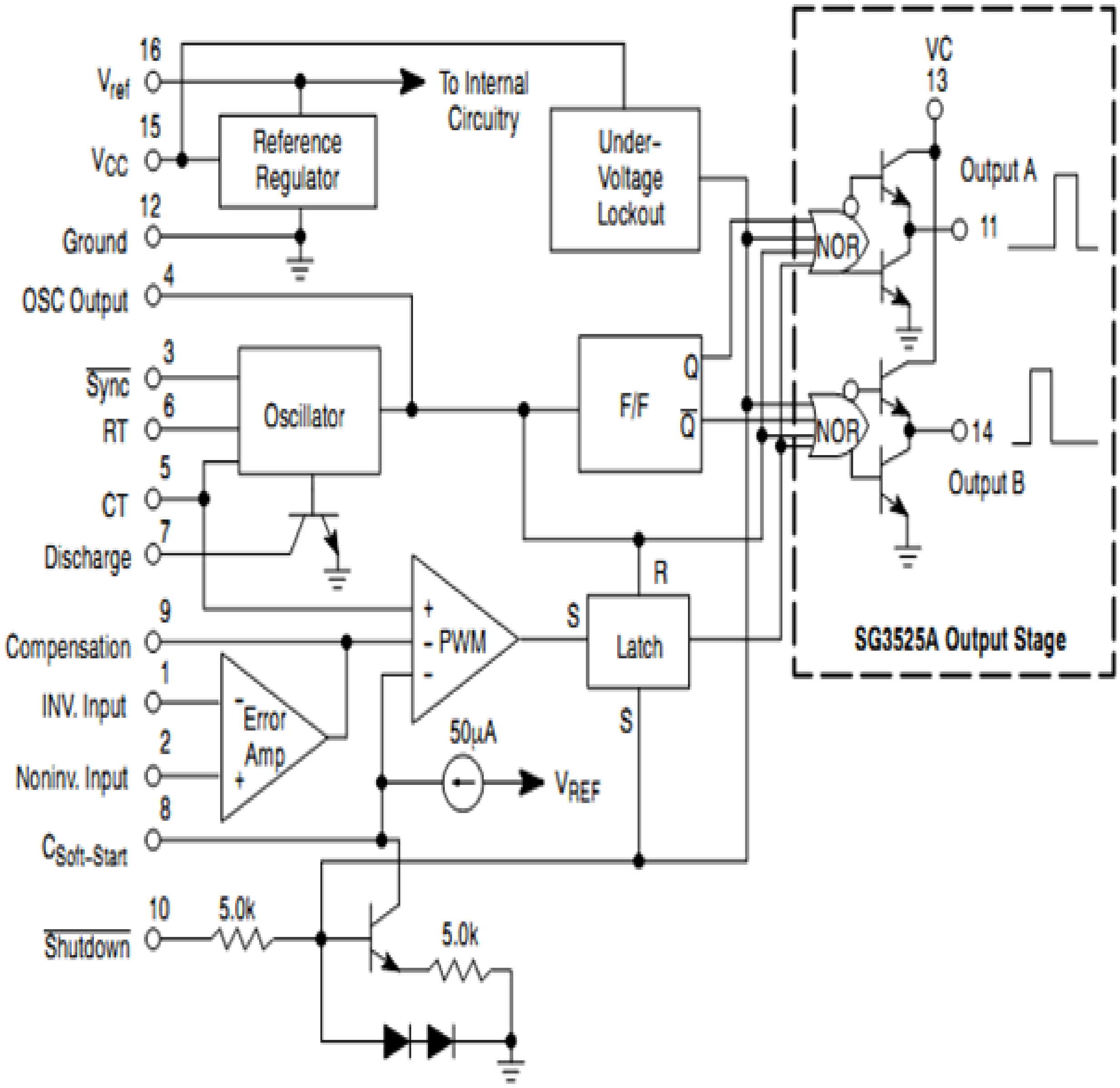


Fig.3

3.3 MOSEFET IRF540

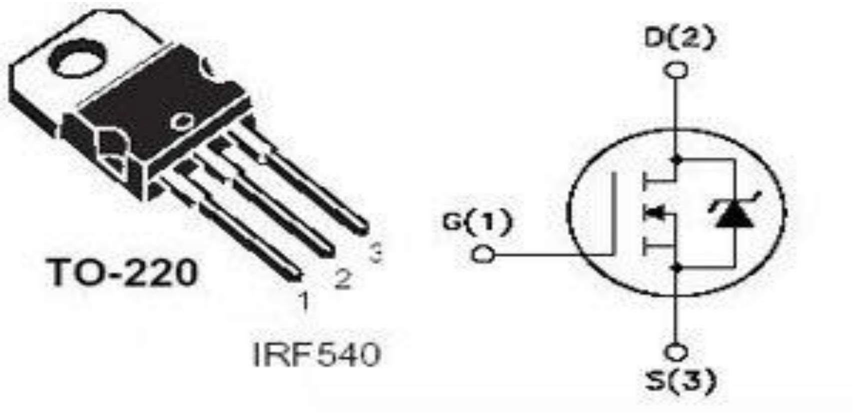


Fig.4

3.3.1 GENERAL SPECIFICATION

The general specifications e.g. configuration, channel type, channel mode, pin numbers, package and category are provided in the table shown below.

General Specifications of IRF540	
Parameters	**Specifications**
Configuration	Single
Elements/Clip	1
Channel type	N-Channel
Channel mode	Enhanced
Package	TO-220
No of pins	3
Category	Power MOSFET
Technology	HEXFET

Table.2.Specification of IRF540

3.3.2 RATINGS OF IRF 540

IRF540 Ratings			
Parameters	**Symbol**	**Values**	**Units**
Drain voltage	V_D	100	V
Gate voltage	V_G	±20	V
Power dissipation	P_D	150000	mW
Gate charge	Q_G	72	@10V
Fall time	T_F	43	ns
Input capacitance	C_i	1700	pF
Drain current	I_D	28	A
Rise time	I_R	44	ns
Turn ON delay time	T_{D_ON}	11	ns
Turn OFF delay time	T_{D_OFF}	53	ns

Table.3.Rating of IRF540

3.3.3 WORKING PRINCIPLE

IRF540 works on a pretty simple principle. Its has three kinds of terminals e.g. **Drain, Gate** and **Source.** When we apply any of the pulse at its **Gate** terminal, its Gate and Drain gets short i.e. they make a common connection with each other. When the Gate and the Drain gets short, only then we will be able to obtain the desired results otherwise it will produce unnecessary or unwanted results.

3.3.4 APPLICATIONS

- The applications associated with IRF540 are given below.
- It can be used as switching converters.
- We can use it as relay drivers.
- It can also be used as high speed switching drivers.
- We can use it as motor drivers.
- It can be used for fast switching and for amplification processes.

3.4 VOLTAGE REGULATOR

A **voltage regulator** is an electronic circuit that provides a stable DC voltage independent of the load current, temperature and AC line voltage variations. A voltage regulator may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages

3.5 STEP UP TRANSFORMER

A **transformer** is a static electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. A varying current in one coil of the transformer produces a varying magnetic field, which in turn induces a varying electromotive force (emf) or "voltage" in a second coil. Power can be transferred between the two coils, without a metallic connection between the two circuits. Faraday's law of induction discovered in 1831 described this effect. Transformers are used to increase or decrease the alternating voltages in electric power applications.

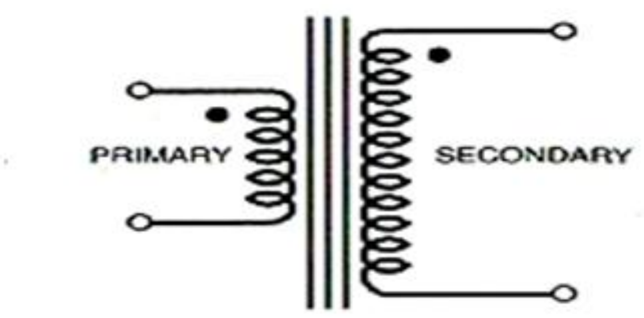
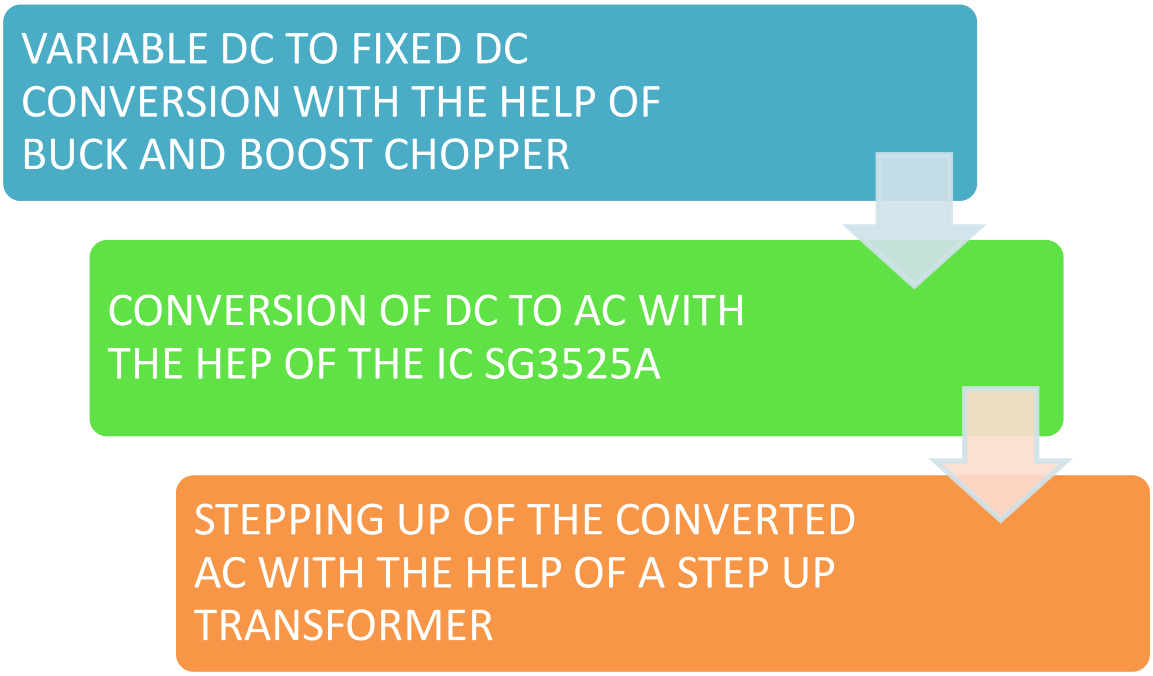


Fig.5

A step-up transformer is the direct opposite of a step-down transformer. There are many turns on the secondary winding than in the primary winding in the step-up transformers. Thus, the voltage supplied in the secondary transformer is greater than the one supplied across the primary winding. Because of the principle of conservation of energy, the transformer converts low voltage, high-current to high voltage-low current. In other words, the voltage has been stepped up

3.6 OVERVIEW OF THE PROJECT



3.7 CIRCUIT DIAGRAM

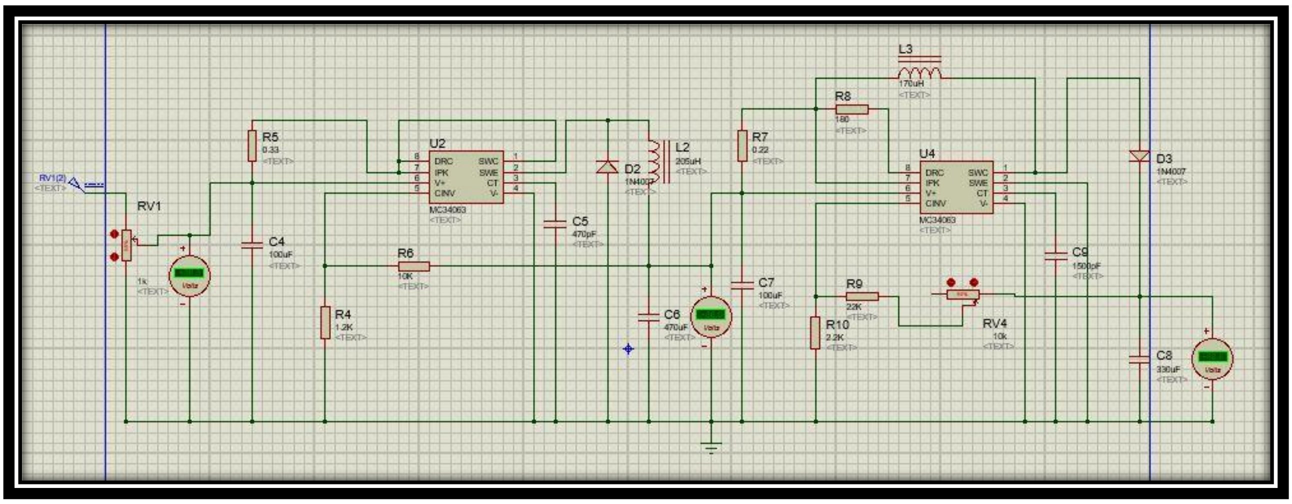


Fig.6..Screenshot of the buck and boost converter from proteaus

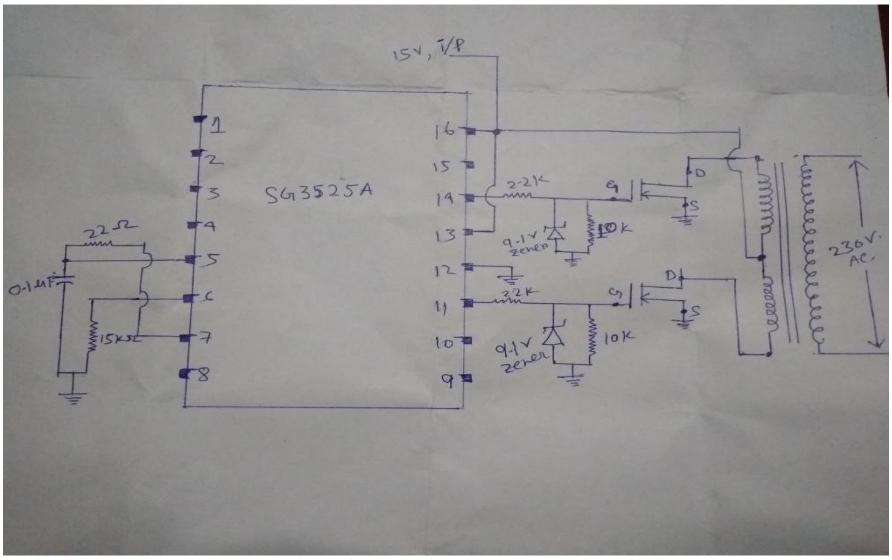


Fig.7.Circuit of DC/AC converter and step up transformer

The complete circuit is first simulated in the PROTEUS software, the screenshot of the circuit is shown in figure. The circuit is running well in this software.The circuit comprises of IC 3C34063,ICSG3525A,MOSEFET IRF 540.Variable voltage of 5 to 20v dc is applied and a fixed output voltage 15v dc is obtained.5 bulbs in series is connected acoss the output.Then this 15v dc is converted to 15v ac with the help of the ic SG3525A. Then this 15v ac is stepped up to 230v with the help of a step up transformer. And a bulb of 5watt is lit across the output.

CHAPTER 4

(Hardware Modeling)

PHOTOGRAPHS OF THE PROTOTYPE

MAIN PCB BOARD MC34063A

1 ST PART:-

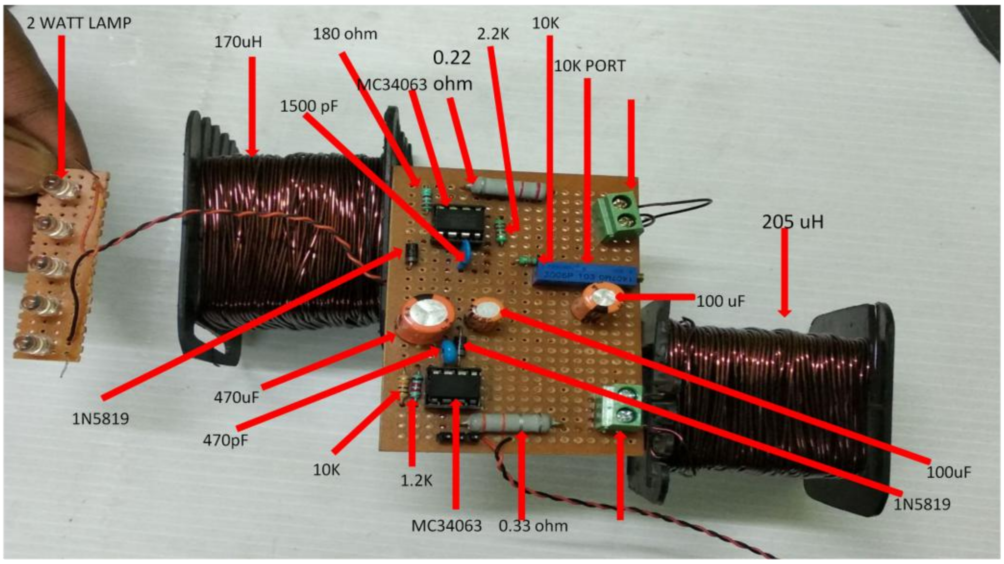


Fig..Voltage Regulator

MAIN PCB BOARD SG3525A

2ND PART:-

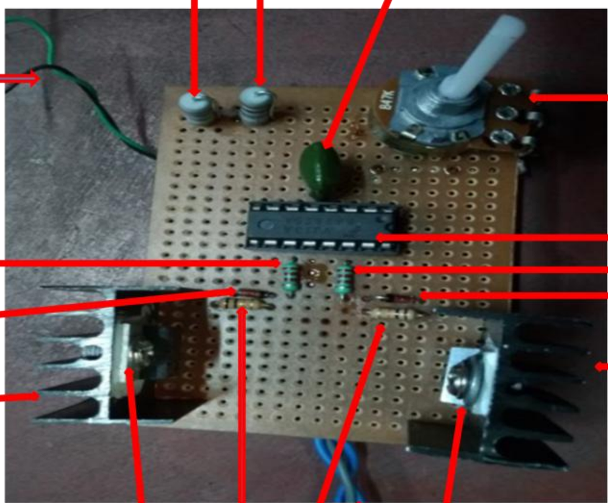


Fig..dc/ac converter

Main features of the prototype

The features of the developed prototype are:

1.Voltage Regulator

2.DC/AC Converter

3.Step-up transformer

Step by step operation of the prototype

1.A variable voltage of 5 to 20v is supplied as input to the circuit.

2.Then 15v fixed DC is obtained at the output.5 led's is connected in series with it as a display load.

3.Then this 15v dc is directly given as input to the ic SG3525A.And it is converted to 15v ac.

4.Then this 15v ac is directly fed to the step up transformer and 230v is produced.

5.A 5w bulb is lit at the output as a load.

CHAPTER 5

(Logic & Operation)

5.1 INTRODUCTION

After assembling the system, what remains is to observe its operation and efficiency of the system. The total system is divided in several sub systems, like

- Buck and Boost converter section
- Ic SG3525A section
- Voltage step up section

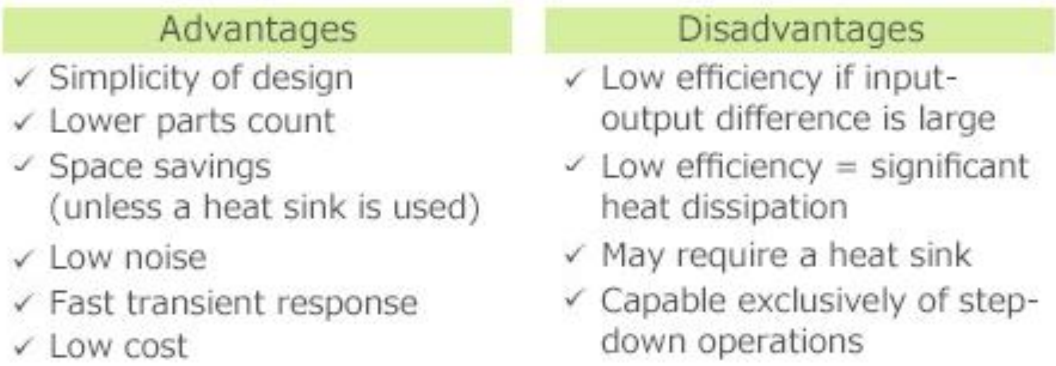
The operation of the whole circuit is depending on every sections performance

5.2 PRINCIPLES AND OPERATIONS

A **voltage regulator** is an electronic circuit that provides a stable DC voltage independent of the load current, temperature and AC line voltage variations.Here variable 5-20v dc is converted to fixed 15v dc.

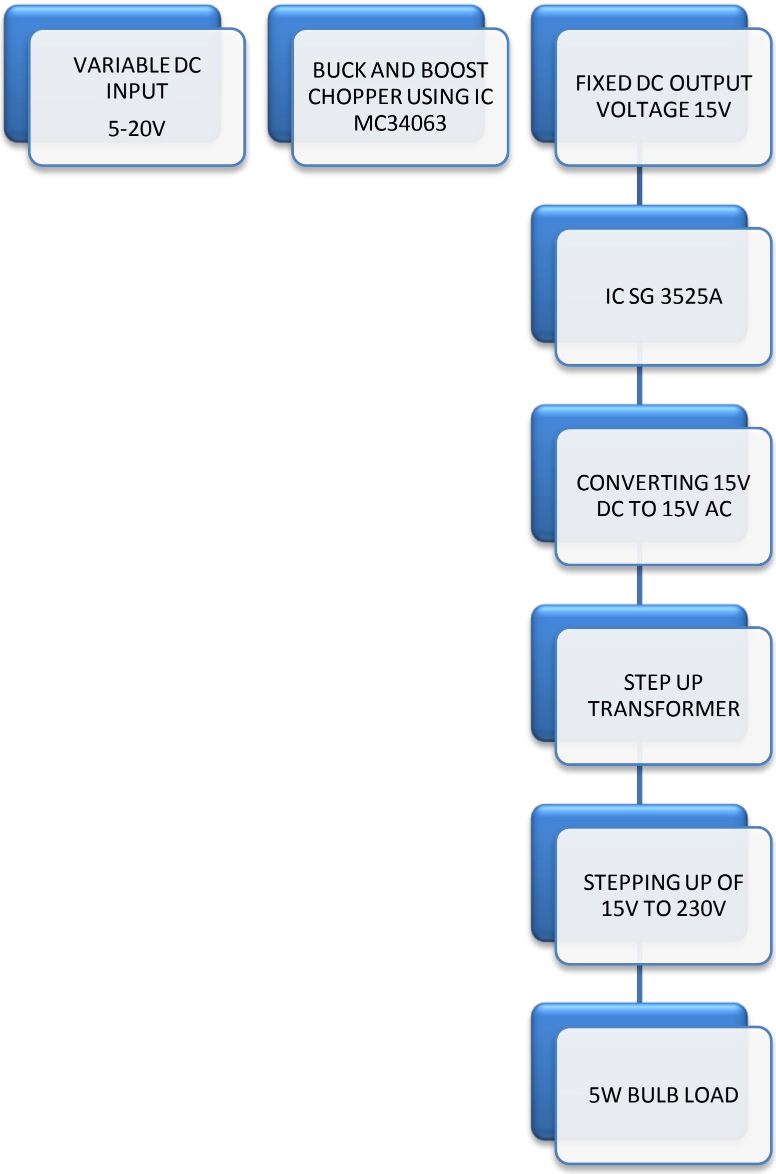
The DC/AC converter consists of a 50% duty ratio rectangular voltage output inverter, a high-frequency transformer, a pulse-width modulation (PWM) cycloconverter, and an LC filter.This convertion is done with the help of the ic SG3525A.After convertion 15v dc is stepped up to 230v with the help of a step up transformer.

5.3 ADVANTAGES AND DISADVANTAGES OF VOLTAGE REGULATOR



Advantages	Disadvantages
✓ Simplicity of design	✓ Low efficiency if input-output difference is large
✓ Lower parts count	✓ Low efficiency = significant heat dissipation
✓ Space savings (unless a heat sink is used)	✓ May require a heat sink
✓ Low noise	✓ Capable exclusively of step-down operations
✓ Fast transient response	
✓ Low cost	

5.4 FLOW CHART



5.5 COST ESTIMATION OF THE PROJECT

SL.NO.	COMPONENTS	OTY	COST(RS)
1	MC34063	5	100
2	SG3525A	3	50
3	IRF540	2	30
4	IN5819	4	4
5	RESISTORS	LOT	15
6	CAPACITORS	LOT	10
7	8Pin IC BASE	2	4
8	16PIN IC BASE	2	6
9	HEAT SINK AND SCREW	2	27
10	POT 10K	3	120
11	LED	5	20
12	SOULDER BIT 25W	1	45
13	ZENER DIODE	4	8
14	DIODE	2	4
15	VELLOBOARD	3	60
16	CONNECTING WIRE	LOT	50
17	STEP UP TRANSFORMER	1	145
	TOTAL		698

Table.4.Cost estimation

5.6 PRACTICAL PHOTOGRAPS OF VARIOUS SECTION OF THE PROJECT

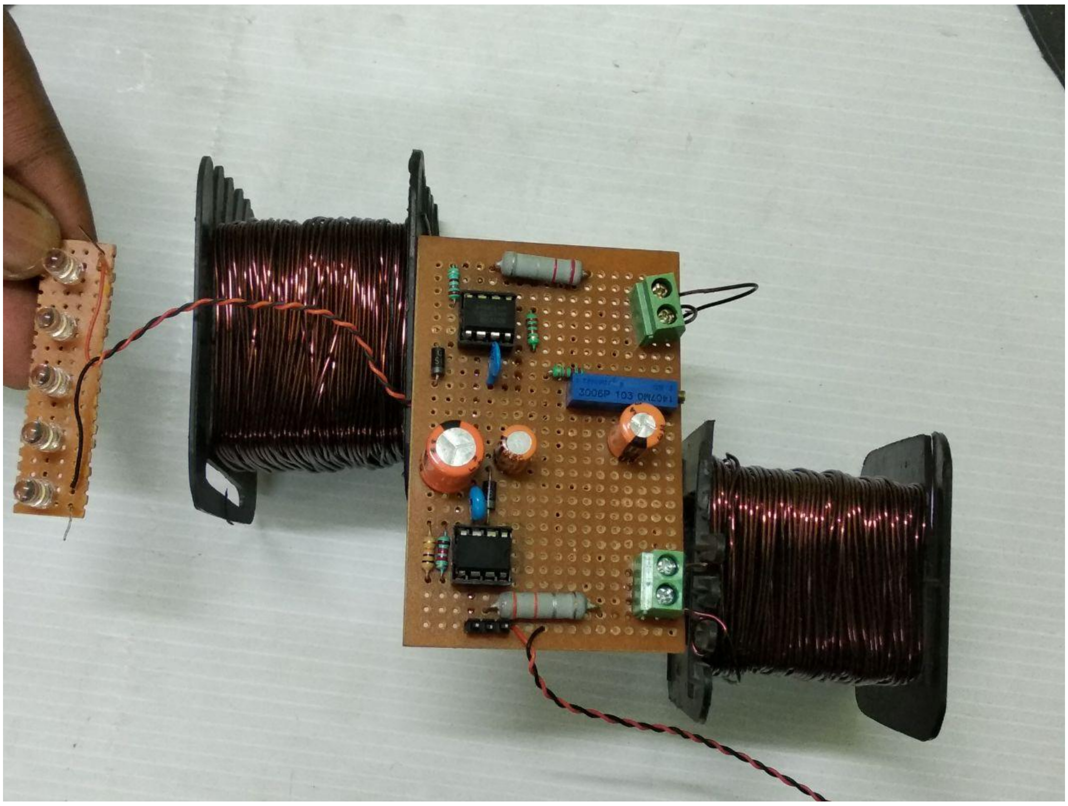


Fig.8.VOLTAGE REGULATOR

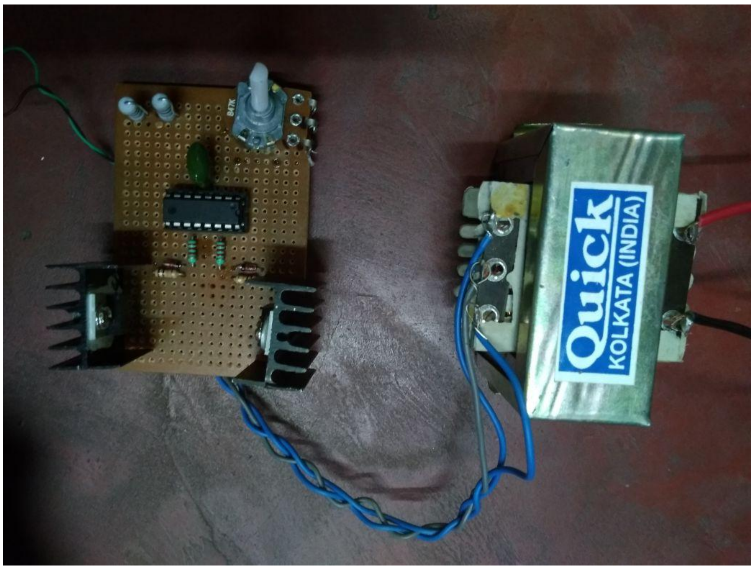


Fig.9.DC/AC CONVERTER AND STEP UP TRANSFORMER

Chapter 6

(Conclusion & Future Scope)

6.1 CONCLUSION

Therefore in this project we have successfully developed a voltage regulator.We have also developed a dc/ac converter and also stepped up an ac voltage successfully. Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.Thus in this project we have converted a variable dc to a fixed dc output. Then this dc voltage is converted to ac with the help of the IC SG3525A.And then the ac voltage is stepped up with the help of a step up transformer.A 5watt bulb is lit at the output as a load.

6.2 RESULTS

The experimental model was made according to the circuit diagram and the results were as expected.A fixed DC voltage of 15v was obtained.This 15vdc was converted to ac and stepped up to 230v.And as per requirement a 5watt bulb was lit as a load at the output.

6.3 FUTURE SCOPE

1.This is routed many ways for the future researchers to work further on the grid connections based WECS.

2. The steady state and dynamical behaviour analysis of shunt active filter with grid connection.

3. The THD for experimental analysis is slightly higher than the imulation result, which will lead to further research in future.

4. The hardware result of reactive power is not exactly zero when using matrix converter. This will lead to develop a new design in future.

5. Experimental setup for the proposed system is carried out only by using laboratory wind emulator and future researchers may use real wind turbine.

Chapter 7

(References)

1.Donald G. Fink, H. Wayne Beatty, *Standard Handbook for Electrical Engineers Eleventh Edition*, Mc Graw Hill, 1978

2.Texas Instruments LM2825 Integrated Power Supply 1A DC-DC Converter

3.*Linear Technology µModule Regulators*

4.www.onsemi.com

5.Application Report,Texus Instruments

6.LINK:- http://microcontrollerslab.com/wp-content/uploads/2014/08/SG3525_pin.png.

7.The Flyback Converter - Lecture notes - ECEN4517 - Department of Electrical and Computer Engineering - University of Colorado, Boulder.

8.Motorola Semiconductor. "Application note AN954: A Unique Converter Configuration provides step-up/down functions". 1985. "... a unique step-up/down configuration can be created ... which still employs a single inductor for the voltage transformation."

9.Mack, James E.; Shoemaker, Thomas (2006). *Chapter 15 - Distribution Transformers*(PDF) (11th ed.). New York: McGraw-Hill.

10.L. Dalessandro, F. d. S. Cavalcante, and J. W. Kolar, "Self-Capacitance of High-Voltage Transformers," IEEE Transactions on Power Electronics, vol. 22, no. 5.

11.LINK:-https://www.theengineeringprojects.com/2017/06/introduction-to-irf540.html.

12.Haifeng Fan. "Wide VIN and High-Power Challenges with Buck-Boost Converter"

Appendix A

(Hardware description)

Resistor

Figure 10: Resistor

Resistance is the opposition of a material to the current. It is measured in Ohms Ω. All conductors represent a certain amount of resistance, since no conductor is 100% efficient. To control the electron flow (current) in a predictable manner, we use resistors. Electronic circuits use calibrated lumped resistance to control the flow of current. Broadly speaking, resistor can be divided into two groups viz. fixed & adjustable (variable) resistors. In fixed resistors, the value is fixed & cannot be varied. In variable resistors, the resistance value can be varied by an adjuster knob. It can be divided into (a) Carbon composition (b) Wire wound (c) Special type. The most common type of resistors used in our projects is carbon type. The resistance value is normally indicated by color bands. Each resistance has four colors, one of the band on either side will be gold or silver, this is called fourth band and indicates the tolerance, others three band will give the value of resistance (see table). For example if a resistor has the following marking on it say red, violet, gold. Comparing these colored rings with the color code, its value is 27000 ohms or 27 kilo ohms and its tolerance is ±5%. Resistor comes in various sizes (Power rating).The bigger the size, the more power rating of 1/4 watts. The four color rings on its body tells us the value of resistor value.

Color Code of the resistor

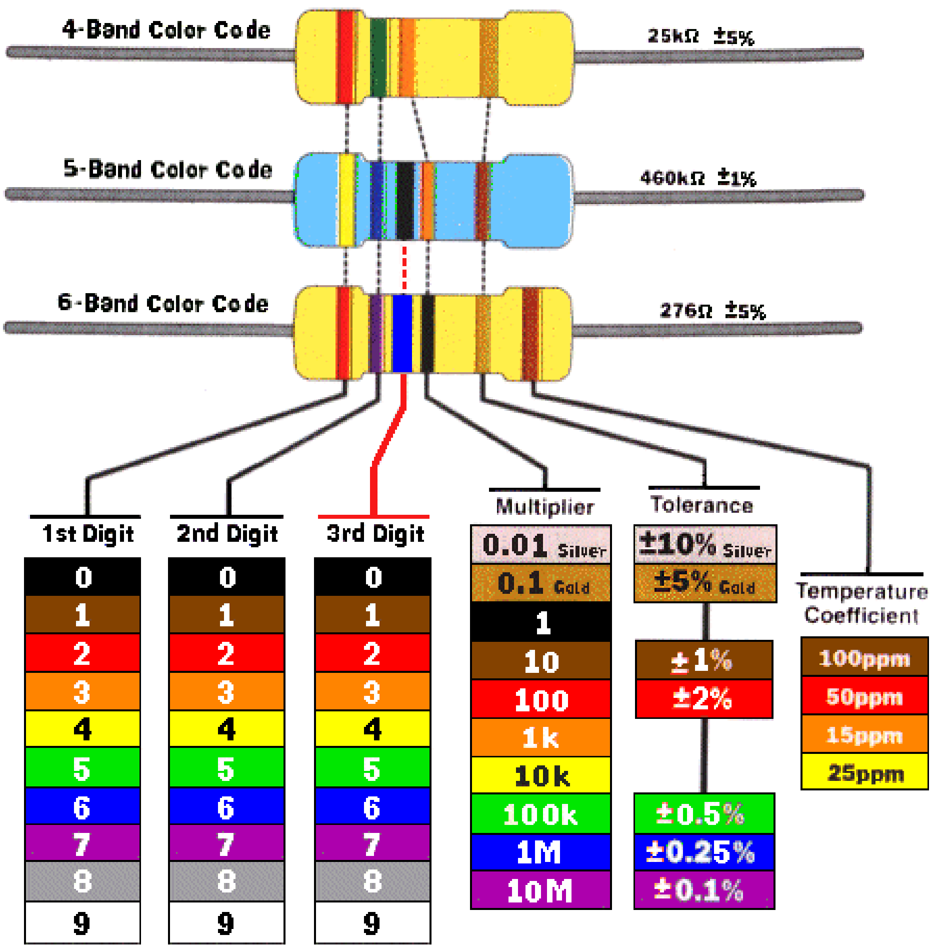


Figure 11: Color Code for resistance

Capacitors

It is an electronic component whose function is to accumulate charges and then release it.

To understand the concept of capacitance, consider a pair of metal plates which all are placed near to each other without touching. If a battery is connected to these plates the positive pole to one and the negative pole to the other, electrons from the

Figure 12: Types of capacitors

battery will be attracted from the plate connected to the positive terminal of the battery. If the battery is then disconnected, one plate will be left with an excess of electrons, the other with a shortage, and a potential or voltage difference will exists between them. These plates will be acting as capacitors. Capacitors are of two types: - (1) **fixed type** like ceramic, polyester, electrolytic capacitors - these names refer to the material they are made of aluminum foil. (2) **Variable type** like gang condenser in radio or trimmer. In fixed type capacitors, it has two leads and its value is written over its body and variable type has three leads. Unit of measurement of a capacitor is farad denoted by the symbol F. It is a very big unit of capacitance. Small unit capacitor are pico-farad denoted by pf (1pf=1/1000,000,000,000 f) Above all, in case of electrolytic capacitors, it's two terminal are marked as (-) and (+).

INDUCTOR

An **inductor**, also called a **coil**, **choke** or **reactor**, is a passive two-terminal electrical component that stores energy in a magnetic fieldwhen electric current flows through it.[1] An inductor typically consists of an insulated wire wound into a coi around a core.

Fig.13.Inductor

When the current flowing through an inductor changes, the time-varying magnetic field induces an electromotive force(*e.m.f.*) (voltage) in the conductor, described by Faraday's law of induction. According to Lenz's law, the induced voltage has a polarity (direction) which opposes the change in current that created it. As a result, inductors oppose any changes in current through them.

An inductor is characterized by its inductance, which is the ratio of the voltage to the rate of change of current. In the International System of Units (SI), the unit of inductance is the henry (H) named for 19th century American scientist Joseph Henry. In the measurement of magnetic circuits, it is equivalent to weber/ampere. Inductors have values that typically range from 1 µH (10^{-6} H) to 20 H. Many inductors have a magnetic core made of iron or ferrite inside the coil, which serves to increase the magnetic field and thus the inductance. Along with capacitors and resistors, inductors are one of the three passive linear circuit elements that make up electronic circuits. Inductors are widely used in alternating curret (AC) electronic equipment, particularly in radio equipment. They are used to block AC while allowing DC to pass; inductors designed for this purpose are called chokes. They are also used in electronic filters to separate signals of different frequencies, and in combination with capacitors to make tuned circuits, used to tune radio and TV receivers.

TRANSFORMAR

Fig.14

Pole-mounted distribution transformer with center-tapped secondary winding used to provide "split-phase" power for residential and light commercial service, which in North America is typically rated 120/240 V.[1][2]

Transformer is a static electrical device that transfers electrical energy between two or more circuits through electromagnetic induction. A varying current in one coil of the transformer produces a varying magnetic field, which in turn induces a varying electromotive force (emf) or "voltage" in a second coil. Power can be transferred between the two coils, without a metallic connection between the two circuits. Faraday's law of induction discovered in 1831 described this effect. Transformers are used to increase or decrease the alternating voltages in electric power applications.

Since the invention of the first constant-potential transformer in 1885, transformers have become essential for the transmission, distribution, and utilization of alternating current electrical energy.[3] A wide range of transformer designs is encountered in electronic and electric power applications. Transformers range in size from RF transformers less than a cubic centimeter in volume to units interconnecting the power gridweighing hundreds of tons.

POTENTIOMETER

Fig.15.

A **potentiometer** is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage dividEr.[1] If only two terminals are used, one end and the wiper, it acts as a ***variable resistor*** or ***rheostat***.

The measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name.

Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick. Potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load.

Blank PCB

A **printed circuit board** (**PCB**) mechanically supports and electrically connects electronic components using conductive tracks, pads and other features etched from copper sheets laminated onto a non-conductive substrate. PCBs can be *single sided* (one copper layer), *double sided* (two copper layers) or *multi-layer* (outer and inner layers). Multi-layer PCBs allow for much higher component density. Conductors on different layers are connected with plated-through holes called vias. Advanced PCBs may contain components - capacitors, resistors or active devices - embedded in the substrate.

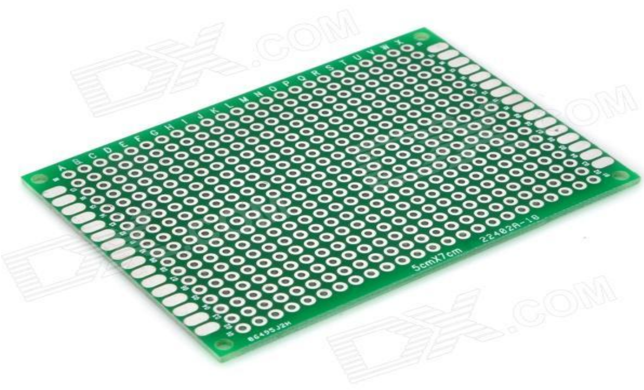


Figure 16: Blank glass epoxy PCB Board

FR-4 glass epoxy is the primary insulating substrate upon which the vast majority of rigid PCBs are produced. A thin layer of copper foil is laminated to one or both sides of an FR-4 panel. Circuitry interconnections are etched into copper layers to produce printed circuit boards. Complex circuits are produced in multiple layers.

Printed circuit boards are used in all but the simplest electronic products. Alternatives to PCBs include wire wrap and point-to-point construction. PCBs require the additional design effort to lay out the circuit, but manufacturing and assembly can be automated. Manufacturing circuits with PCBs is cheaper and faster than with other wiring methods as components are mounted and wired with one single part. Furthermore, operator wiring errors are eliminated.

Appendix B

(Data sheets)