Project on

SQUARE WAVE INVERTER USING IC 555

Submitted in partial fulfillment of the requirement of the T.E. of Electrical Engineering

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Declaration

We declare that this written submission represents our ideas in our own words and where others" ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be a cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

In this paper, a method is proposed to improve the frequency stability and accuracy of the generated wave in DC/AC square wave inverters using a microcontroller-based stabilized oscillator circuit. The proposed technique relies on using the 555 microcontroller as a astable oscillator to generate two anti-phase 50 Hz square waves for the driving power stage of the inverter .These signals are then boosted to increase their voltage and current levels using BJT switching mode power transistors operating in the push/pull mode. The resulting signal is then raised into the required voltage level with the aid of a step-up transformer. A practical inverter circuit has been designed and constructed to convert a 12 V battery DC input into 220 V AC output based on the 555 microcontroller. This circuit consists of an 555 microcontroller, buffer, driver power transistor stage, final power transistor stage, and a step-up transformer. The inverter circuit has been simulated, implemented, and tested practically. The test measurements have indicated that the circuit gives a full load power of 10 W with full-load voltage regulation of 8%, and a maximum conversion efficiency of 70%.

Keywords: DC/AC Inverter, Power Electronics, 8051 Microcontroller, Square Wave Inverter

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Chapter 1

Introduction

An inverter is an electronic circuit that converts direct current (DC) to alternating current (AC) .

Inverters are used in a wide range of applications, from small switching power supplies in computers, to large electric utility applications that transport power, especially in renewable energy systems like solar systems, wind power systems, …etc. The inverter is so named because it performs the opposite function of a rectifier. Most inverters do their job by performing two main functions: first they convert the incoming DC into AC, and then they step up the resulting AC to the required voltage level using a transformer. The most important parameters of the inverter circuit are its conversion power efficiency, frequency stability, output voltage regulation, and output waveform distortion. Inverters can be classified into three types according to the shape of the generated waveform as depicted These are the square wave inverters, modified sine wave inverters, and pure sine wave inverters. Square wave inverters are simple in design and implementation. The output voltage alternates between positive and negative values. The output waveform, however, has a lot of amount of total harmonic distortion (THD) which results in a considerable power dissipation due to these harmonics. On the other hand, the square wave inverter cannot regulate its AC output voltage when the battery voltage changes significantly. This can cause some types of AC loads to fail suddenly

Chapter 2

Literature Review

Energy crisis are of special attention in today's world. The unending usage of non-renewable energy sources will bring an end to the limited resources in near future. In order to preserve the resources several alternative renewable sources have been in use these days. The power generated from Renewable sources, like solar energy, produces is a DC power which can be stored in batteries. This DC power needs to be converted to AC power as most of the appliances used in our daily life are dependent son AC power. To overcome this obstacle, DC-AC Inverter took birth.

In this thesis project, performance of topologies used in inverters has been analyzed and a DC-AC Square wave Inverter using the Analog control circuit has been implemented.

Chapter 3

Components Information

3.1 Component list

- IC1:- 555 Timer, Pulse generator
- Battery :- 12V DC
- Power Mosfet Q1,Q2:- N channel IRF 540
- Transistor T1 :- BC 549
- Resistance R1,:- 4.7K ohm
- Resistance R2:- 220 K ohm
- Resistance R3,R4:- 1k ohm
- Resistance R5:- 5.6 K ohm
- Capacitor C1,C2 :- 0.1uf
- Transformer X1 :- 230V AC primary to 12V-0-12V,2A secondary transformer

3.2 Block Diagram

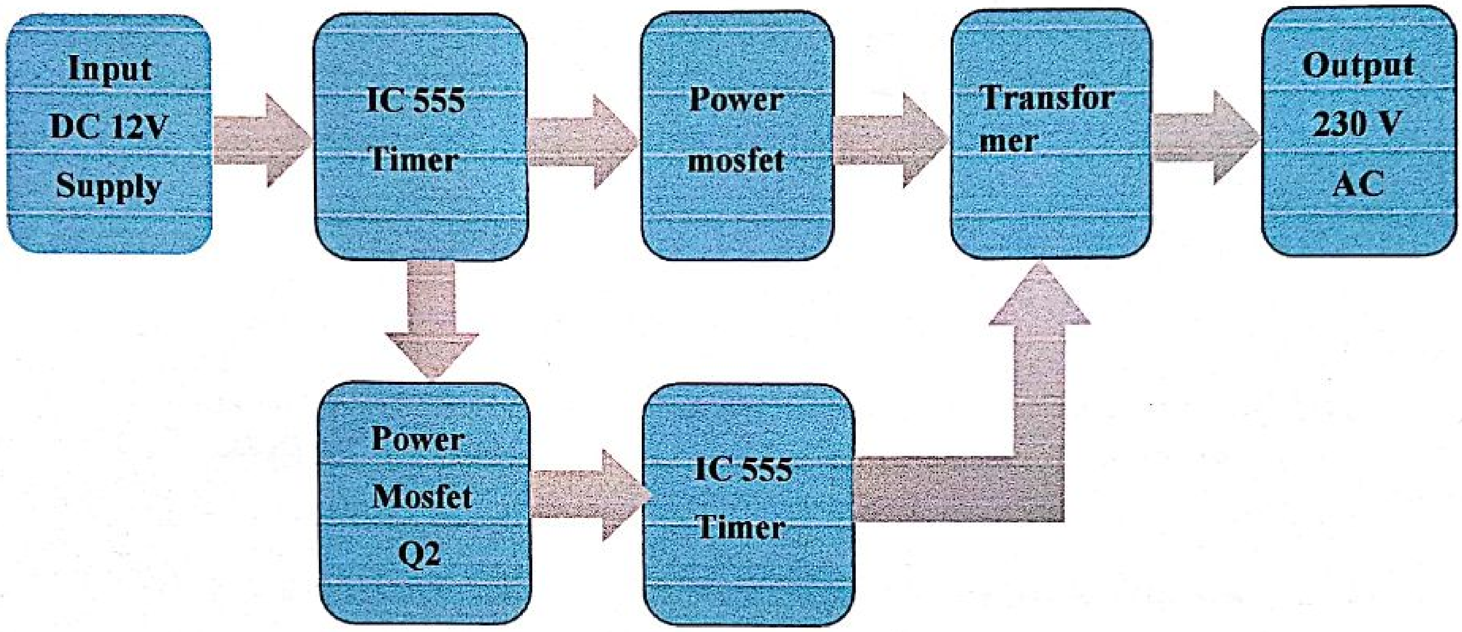
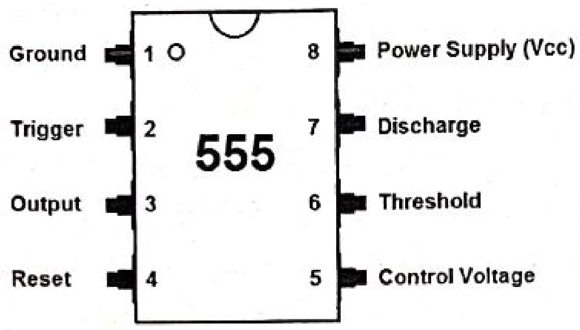


Fig 3.1 :- Block Diagram Of square wave inverter using IC 555 Timer

3.3 IC 555, Pulse Generator



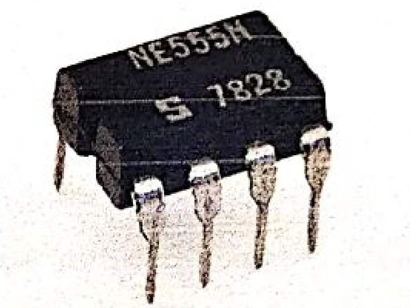


Fig 3.2 :- IC 555 Diagram

The **555 timer IC** is an integrated circuit (chip) used in a variety of timer, pulse generation, and oscillator applications. The 555 can be used to provide time delays, as an oscillator, and as a flip-flop element.

It is now made by many companies in the original bipolar and in low-power CMOS technologies. As of 2003, it was estimated that 1 billion units were manufactured every year. The 555 is the most popular integrated circuit ever manufactured

3.3.1 Pin Configuration

Pin No.1- Connect to ground.

Pin No.2- Connect between R1 and C1.

Pin No.3- Connect to output.

Pin No.4- Connect to Vcc.

Pin No. 5-Connect to C2.

Pin No.6- Connect between R1 and C1.

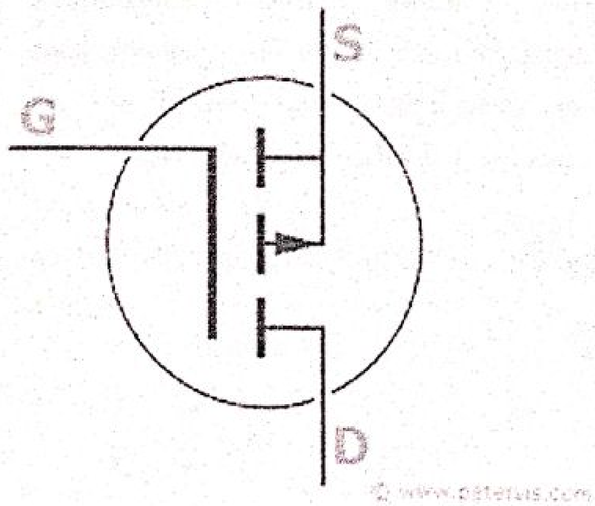
Pin NO.7- Connect R1 and R2

Pin No. 8 - Connect to Vcc.

3.3.2 Features :-

- It operates from a wide range of power supply ranging from 5V to 18V supply voltage .
- Sinking 200 mA of load current.
- It has high current of the output can drive TTL.
- It has a tempature stability of 50 partsper million per degree Celsiuschange in temperature 0.005 %c.

3.4 Mosfet IRF540N



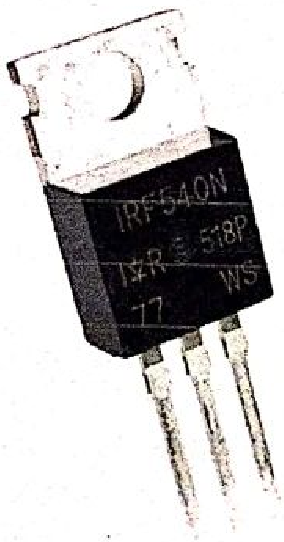


Fig 3.3 :- Mosfet Digram

Third generation power MOSFET from provide the design with the best combination of fast switching, ruggedized device design, low on resistance and cost resistance.

The TO-220AB package is universally preferred for all commercial and industrial applications at power dissipation level to approximately 50W. The low thermal resistance and low packages cost of the TO-220AB contribute to its wide acceptance throughout the industry.

3.4.1 Features

- no cathode heater (which produces the characteristic orange glow of tubes), reducing power consumption, eliminating delay as tube heaters warm up, and immune from cathode poisoning and depletion;
- very small size and weight, reducing equipment size;
- large numbers of extremely small transistors can be manufactured as a single integrated circuit;
- low operating voltages compatible with batteries of only a few cells;
- circuits with greater energy efficiency are usually possible. For low-power applications (e.g., voltage amplification) in particular, energy consumption can be very much less than for tubes;
- complementary devices available, providing design flexibility including complementary-symmetry circuits, not possible with vacuum tubes;
- very low sensitivity to mechanical shock and vibration, providing physical ruggedness and virtually eliminating shock-induced spurious signals (e.g., microphonics in audio applications);
- not susceptible to breakage of a glass envelope, leakage, outgassing, and other physical damage.

3.5 IC LM393

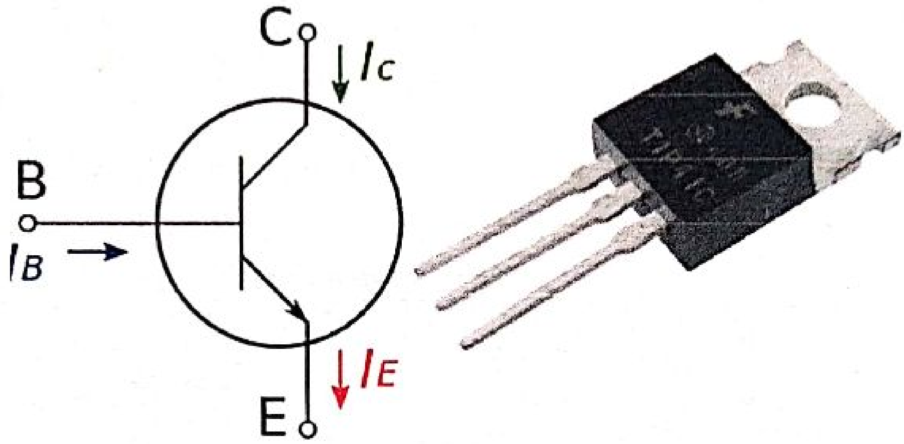


Fig 3.4 :- Transistor BC549

A **transistor** is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals controls the current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal. Today, some transistors are packaged individually, but many more are found embedded in integrated circuits.

Most transistors are made from very pure silicon or germanium, but certain other semiconductor materials can also be used. A transistor may have only one kind of charge carrier, in a field effect transistor, or may have two kinds of charge carriers in bipolar junction transistor devices. Compared with the vacuum tube, transistors are generally smaller, and require less power to operate. Certain vacuum tubes have advantages over transistors at very high operating frequencies or high operating voltages. Many types of transistors are made to standardized specifications by multiple manufacturers.

3.5.1 Features

- Dynamic dV/dt rating.
- Repetitive avalanche rated.
- 175 Degree Celsius operating temperature.
- Fast switching.
- Simple drive requirement.
- Ease of paralleling.

Chapter 4

Working

4.1 Working process

The basic idea behind the inverter circuit due to produce oscillations using the given dc supply. Applying these oscillations across the primary of transformer by amplifying the current this primary voltage is then setup to higher voltage depending upon number of turns in the primary and secondary coil.

The circuit is divided into two three parts- oscillator, amplifier and transformer.A50Hz oscillator is required as the frequency of ac supply is 50 Hz this can be achive by constructing an astable multivibrator which produce a square wave at 50 Hz in circuit

When 12v dc supply is given to IC 555 it produce square pules which is logic high(1)and low(0)when the output is at logic high level the MOSFET Q1 will conduct through R3 for positive half cycle and transistor remains off. The transistor is switch on when output is logic low level the transistor will conduct and current will flow via MOSFET Q2 this will produce negative half cycle for ac this allows the dc voltage to be produced across the primary of transformer at alternate intervals the capacitor insure that the frequency of signal is at required fundamental frequency the 12volt Ac signal across the primary of transformer is then stepped up to 220volt ac signal across the transformer secondary.

4.2 Circuit Diagram

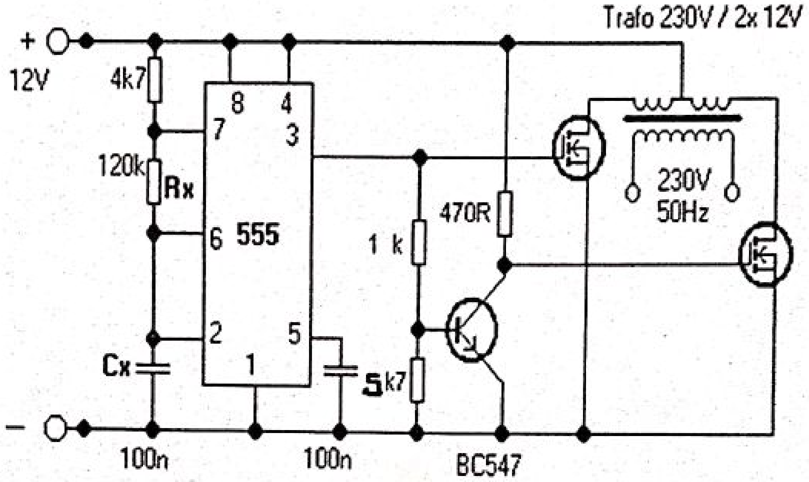
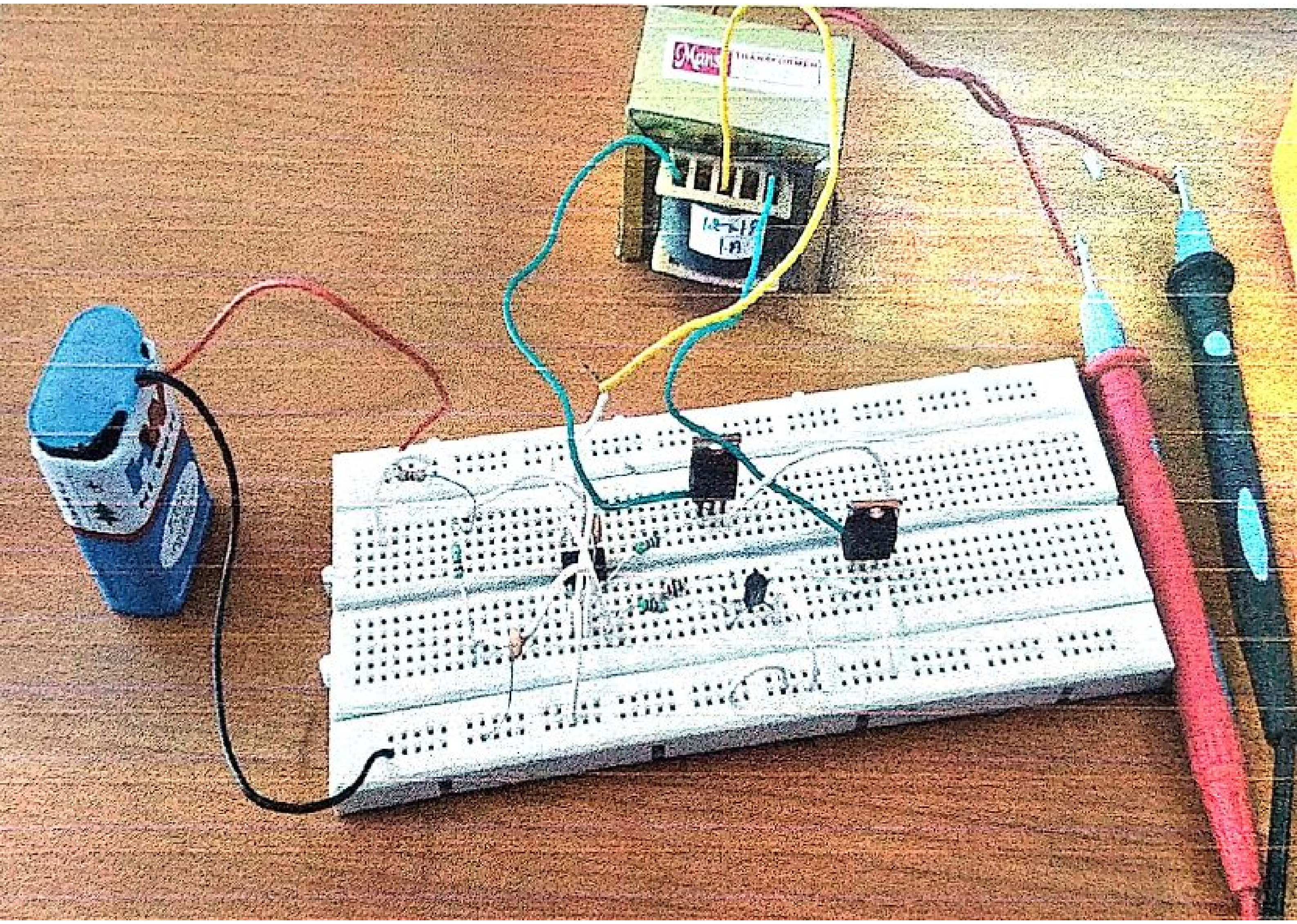


Fig 4.1 :- Square inverter using IC



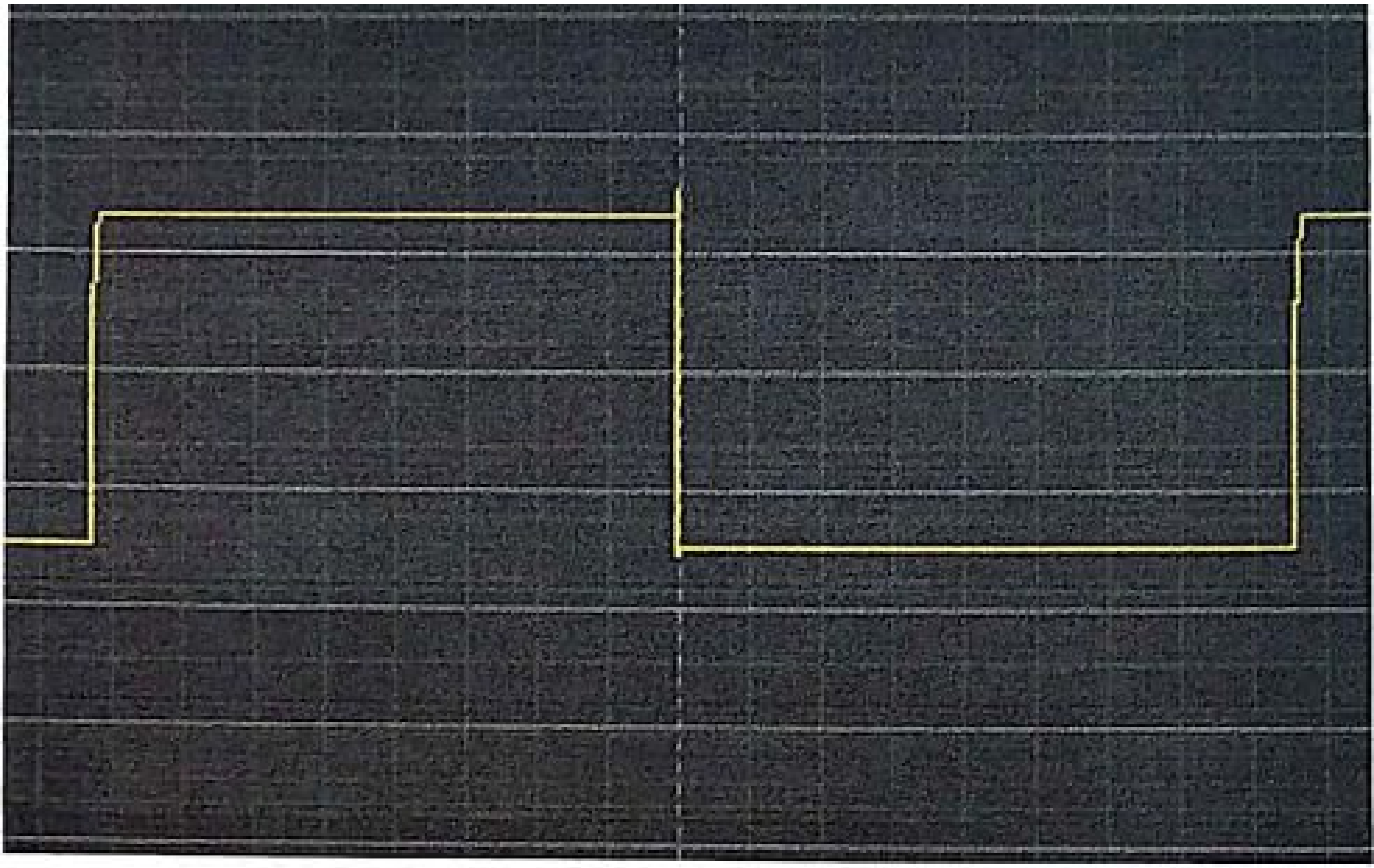


Fig :- Proteus output

Chapter 7

Advantages & Application

7.1 Advantages

- The system is highly reliable.
- Easily available in market.
- Low cost .
- Maintenance is very less.

7.2 Application

- This circuit can be used in cars and other vehicles to charge small batteries .
- The cir cuit can be used to drive low power ac motors.
- It can be used in solar power system .

Chapter 8

Result and Conclusion

8.1 Result

220 V AC output voltage has been designed and constructed based on the 555 microcontroller. After reporting the test results, it has been shown that the stability and accuracy of the frequency for the generated waveform are greatly enhanced through the use of the microcontroller as a stabilized oscillator. It was also noticed that the output voltage falls from 216 V at no-load to approximately 200 V at full-load with an overall voltage regulation of 8%. The main cause in load voltage reduction is the limited power capability of the transformer, and the harmonics presented in the output waveform. The inverter efficiency increases with the In this work, a practical inverter circuit to convert a 12 V input DC voltage into load power reaching to 70% at 10 W. Factors affecting the overall conversion efficiency include power dissipation in the power transistors, transformer leakage and core loss, and power consumption in the voltage regulator module and the microcontroller chip. The relatively high saturation voltage of the 2N3055 power transistor reduces the effective amplitude of the generated signal. The current rating of the transformer is 1 A, and a larger transformer can be used to obtain much more load power. The amplitude regulation of th1e inverter can be improved by using a 12V IC voltage regulator for the power transistors with high current capability. This will, however, increase the power losses and hence degrade the conversion efficiency. Power MOSFETs can be used as the switching devices instead of the BJTs to minimize the switching losses.

Chapter 9

Conclusion & References

9.1 Conclusion

To demonstrate the inverter a resistive load such as light bulb is connected to it and tested it by giving the supply. Input 12V DC supply produce the output voltage of about 220V AC essential to make the bulb glow brightly. The 9V volt DC supply is first fed into the boost converter. The square wave obtained from the MOSFET then fed into the filter circuit to convert to SQUARE wave with less harmonics using low frequency transformer. Similar to resistive, inductive and capacitive load could also be connected to circuit and the power factor and its harmonics could be determine the that is very efficient when comparing with other inverter.

9.2References

- ABS Alaskan. DC to AC power inverter .Retrived December 14,2006, from http//www.absak.com/ac/inverter. s
- http://www.electronicsforu.com>Squre wave inverter.