INVERTER 12 V TO 220 V

PROJECT REPORT

Submitted by
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Submitted to
Mahatma Gandhi University, Kottayam

In the partial fulfillment of the requirements of award of Bachelor degree of Science in Physics.

ST. TERESA'S COLLEGE (AUTONOMOUS)
ERNAKULAM
2023-24

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ERNAKULAM

CERTIFICATE

This is to certify that the project report entitled "**INVERTER 12 V TO 220 V"** is an authentic work done by **PERSIS ABEY**, St Teresa's College, Ernakulam, under my supervision at Department of Physics, St Teresa's college, Ernakulam, for the partial requirements for the award of Degree of Bachelor of Science in Physics during the academic year 2023-24. The work presented in this dissertation has not been submitted for any other degree in this or any other university.

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PROJECT REPORT

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Register Number : AB21PHY006

Year of Work : 2023-2024

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Submitted for the University examination held at St. Teresa's College, Ernakulam.

DATE: 29/04/2024

EXAMINER: 29/4/2024

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DECLARATION

I, **PERSIS ABEY,** final year B.Sc Physics student, Department of Physics, St. Teresa's College (Autonomous), Ernakulam, do hereby declare that the project work entitled **"INVERTER 12 V TO 220 V"**, has been originally carried out under the guidance and supervision of **Smt. Dr. MARY VINAYA**, Assistant Professor, Department Of Physics St. Teresa's College (Autonomous), Ernakulam, in partial fulfillment for the award of the degree of Bachelor of Physics. I further declare that this project is not partially or wholly submitted for any other purpose and the data included in the project is collected from various sources and are true to be the best of my knowledge.

PLACE: ERNAKULAM

DATE : 29/04/2024

CONTENTS

ABSTRACT

This project focuses on constructing a 12V DC to 240V AC inverter capable of producing of power using minimal electrical components. The inverter utilizes a transformer to step up the power and is designed to power electronics and electrical equipment rated at the AC mains voltage. It serves various applications, including standalone use for solar power systems or as a backup power supply from batteries. Additionally, it finds wide usage in the inverting stages of switched-mode power supplies.

CHAPTER-1

INTRODUCTION

There are mainly two types of electric currents;

1.Alternating Current (AC):

Characteristics:

- AC periodically reverses direction, typically following a sinusoidal waveform.
- Its voltage and current alternate between positive and negative values over time.
- The frequency of AC, measured in Hertz (Hz), represents the number of complete cycles per second.

Generation:

- AC is commonly generated by rotating machinery such as generators in power plants.
- Generators produce AC by rotating coils of wire within a magnetic field, inducing an alternating voltage.

Transmission:

- AC is well-suited for long-distance transmission over power grids.
- High-voltage AC reduces energy losses during transmission, as it can be efficiently stepped up using transformers and stepped down for distribution to consumers.

Applications:

- Household Electricity: Most residential and commercial electrical systems utilize AC power.
- Industrial Machinery: AC motors are widely used in various industrial applications due to their reliability and efficiency.
- Electronics: Many electronic devices incorporate AC-to-DC converters to adapt AC power for use in circuits.

2. Direct Current (DC):

Characteristics:

- DC flows continuously in one direction, maintaining a constant polarity.
- Its voltage remains constant over time.

Generation:

- DC can be produced by sources such as batteries, solar cells, and rectifiers.
- Chemical reactions in batteries and photovoltaic cells generate DC electricity directly.

Transmission:

- DC transmission is typically used for shorter distances or specialized applications.
- High-voltage DC (HVDC) transmission is employed for long-distance transmission, offering lower losses than AC over very long distances.

Applications:

- Electronics: Many electronic devices and circuits operate on DC power.
- Automotive Systems: Vehicle batteries supply DC power for starting engines, lighting, and operating various electrical components.
- Renewable Energy Systems: Solar panels and wind turbines generate DC electricity, which is often converted to AC for grid integration or storage.

WHY TO CONVERT DC TO AC?

Converting DC to AC involves transforming the flow of electricity to make it compatible with our standard power systems. AC electricity is preferred for long-distance travel because it loses less energy along the way. AC systems offer more control over voltage and frequency, which is crucial for maintaining stability in our power grids. Advanced inverters play a key role in efficiently converting DC power, such as that from batteries or solar panels, into AC power. This conversion process ensures seamless integration of different power sources into our electrical networks, ensuring reliability and efficiency.

INVERTER

An inverter is a device that converts direct current (DC) electricity into alternating current (AC) electricity. It's commonly used to change the type of power produced by sources like batteries or solar panels so that it can be used in regular electrical systems, like those in homes and businesses.

Inverters are essential for various applications, including renewable energy systems, backup power supplies, and powering AC appliances from DC sources. They come in different sizes and types depending on their intended use.

DIFFERENT TYPES OF INVERTERS

1. Stand-alone Inverters:

- Used in off-grid systems where there is no connection to the utility grid.
- Convert DC power from batteries or renewable sources into AC power for household use.

2. Grid-tie Inverters:

- Connect to the utility grid and convert DC power from solar panels or wind turbines into AC power.
- Can feed excess power back into the grid or draw power from the grid as needed.

3. Battery-based Inverters:

- Designed to work with battery storage systems.
- Convert DC power from batteries into AC power for use during power outages or when off-grid.

4. Microinverters:

- Installed at each solar panel to convert DC power directly into AC power.
- Offer flexibility and optimization at the panel level, improving system performance.

5. String Inverters:

- Connected to multiple solar panels (or strings) and convert DC power from these panels into AC power.
- Cost-effective solution for residential and small commercial solar installations.

6. Central Inverters:

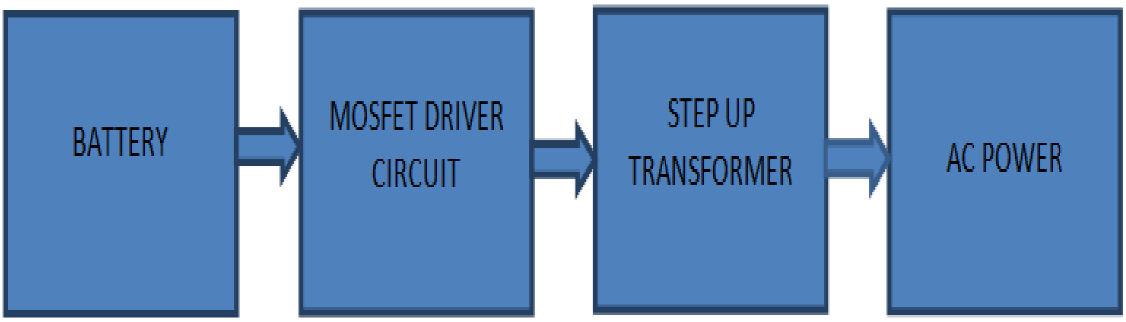
- Used in large-scale solar installations.
- Convert DC power from multiple strings of solar panels into AC power at a central location.

These are some common types of inverters used in various applications, each with its own advantages and suitability depending on the specific requirements of the system.

CHAPTER-2

INVERTER

2.1 BLOCK DIAGRAM



BLOCK DIAGRAM OF INVERTER

Fig 1

The block diagram of an inverter using a battery, MOSFET circuit, step-up transformer, and AC power typically involves the following components:

1. Battery: This serves as the DC power source, providing the input power to the inverter. The battery supplies direct current (DC) voltage to the circuit.

2. MOSFET Circuit: The MOSFET circuit includes one or more MOSFETs (Metal-Oxide-Semiconductor Field-Effect Transistors). These MOSFETs switch the DC voltage from the battery on and off rapidly, generating a pulsed DC waveform.

3. Step-up Transformer: The pulsed DC voltage from the MOSFET circuit is fed into a step-up transformer. The transformer steps up the voltage to a higher level, transforming the low-voltage DC input into a higher-voltage AC output.

4. AC Power: The AC output suitable for powering electrical loads, such as household appliances or other devices requiring AC power.

2.2 WORKING

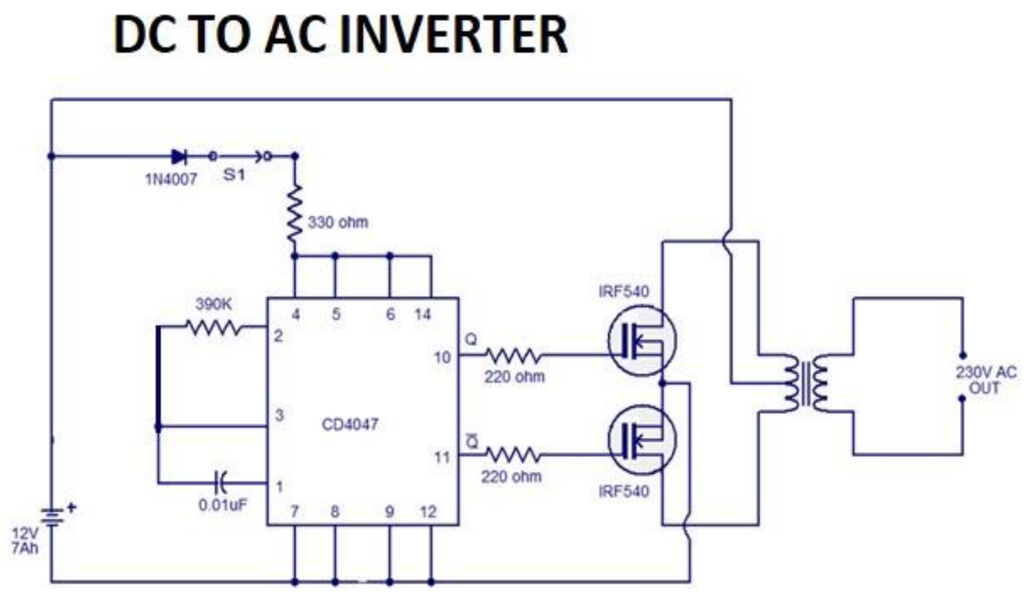


Fig 2

In this inverter circuit diagram we observe that 12V battery is connected to the diode and also connected to the pin8,pin7,pin9 and pin12 of the IC. The positive power supply is also connected to pin 4,5,6 and 14 of the IC CD 4047. The Basic function of Diode in the circuit is to prevent reverse current.

CD4047 IC works in the astable multi-vibrator mode. To work the IC in an astable multi vibrator mode we need a capacitor which is connected between the pin1 and pin3 of IC. Pin2 is connected through resistor to determine the output frequency of the inverter. The pins 10 and 11 of the IC are connected to the gate of the IRF540. The output frequencies of pin 10 and 11 generate frequency with 50% duty cycle.

The output frequency is connected to the MOSFET through 220ohm resistors which will help to prevent the loading of the MOSFET. Here we use the N-channel MOSFET because it has high-switching speed, low gate drive and high input impedance. The MOSFET act as electronic switches in this circuit. The main AC current is generated by both the MOSFET (IRF540). A heat sink is mounted to the MOSFET. Heat sinks are crucial for MOSFETs to dissipate heat generated during operation. They increase surface area for efficient heat transfer, preventing overheating and ensuring reliable performance. By enhancing thermal management, heat sinks help maintain safe operating temperatures and prolong the lifespan of MOSFETs in electronic circuits.

The output AC is given to the primary coil of the step-up transformer and hence it results in the increase in the AC voltage. These voltages depend on the power of transformer.

In this way DC is converted into AC Current.

2.3 COMPONENTS

LIST OF COMPONENTS USED

- IC CD4047
- BATTERY 12 V
- STEP-UP TRANSFORMER
- CAPACITOR (i) 0.1µF
- MOSFET IRF540
- RESISTOR (i) 330Ω
  (ii) 220Ω
  (iii) 390KΩ
- DIODE 1N400
- SWITCH
- HEAT SINKS
- BATTERY ELIMINATOR

2.4 COMPONENT DISCRIPTION

➢ IC CD4047

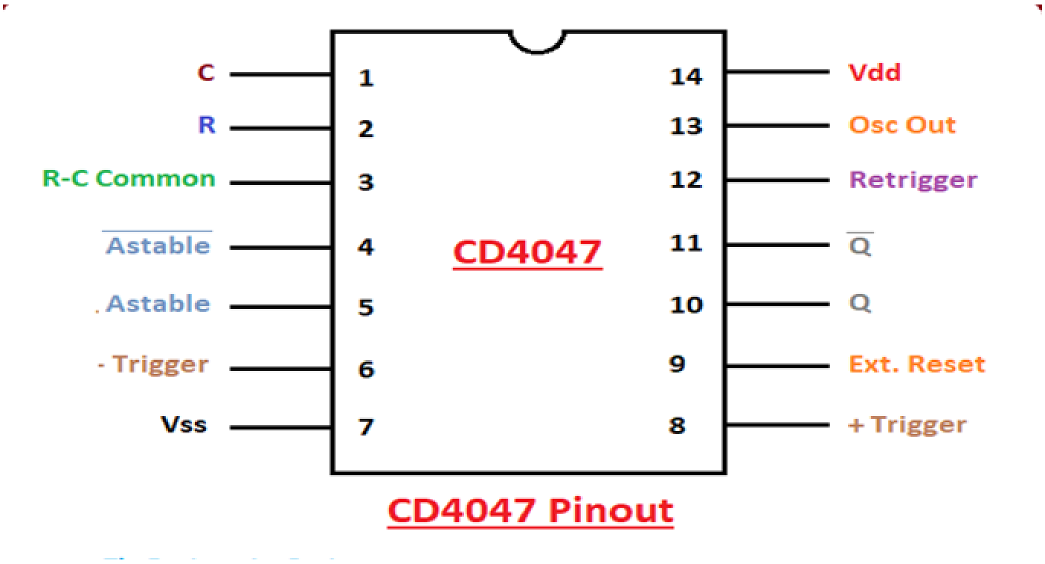


Fig 2.4(a)

The CD 4047 IC (also known as the 4047 CMOS multivibrator) is a versatile integrated circuit that operates in two modes: monostable and astable modes.

Monostable Mode:

- In this mode, the CD 4047 acts as a one-shot pulse generator.
- It requires an external resistor and capacitor to determine the output pulse width.

Key pins for monostable operation:

- Pin 6 (Trigger): When used in monostable mode, a high-to-low transition at this pin triggers the circuit.

- Pin 8 (+Trigger): Activating this input with a low-to-high signal enables monostable operation.
- Pin 9 (External Reset): Connecting this pin to a high level resets the output from Q to 0 and the non-inverting output (Q) to 1.
- Pin 12 (Retrigger): Used to simultaneously activate pins 7 and 8 within monostable mode.
- Pin 10 (Q): Non-inverting output.

Astable Mode:

- In astable mode, the CD 4047 functions as an oscillator.
- It generates a continuous square wave output.

Key pins for astable operation:

- Pin 4 (Astable): Low when used in astable mode.
- Pin 5 (Astable): High when used in astable mode.
- Pin 13 (OSC Output): Provides the oscillated output.
- Pin 14 (Vdd): Positive power supply pin.

APPLICATIONS

- Frequency Discriminators
- Timing Circuits
- Time-delay Applications
- Envelope Detection
- Frequency Multiplication

➢ BATTERY 12V

Fig 2.4(b)

The power input for the inverter circuit is from the 12V rechargeable battery. When12V rechargeable battery supply is fed to the control circuit through the relay, then the input power to the circuit will be ON.

➢ DIODE

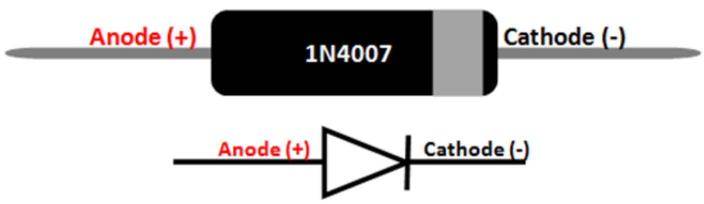


Fig 2.4(c)

A diode is a device which allows current flow through only one direction. That is the current should always flow from the

Anode to cathode. The cathode terminal can be identified by using a grey bar as shown in the picture above.

For 1n4007 diode, the maximum current carrying capacity is 1A it can withstand peaks up to 30A. We use this in the circuits that are designed for less than 1A. The reverse current is 5µa which is negligible. The power dissipation of this diode is 3W.

➢ STEP-UP TRANSFORMER

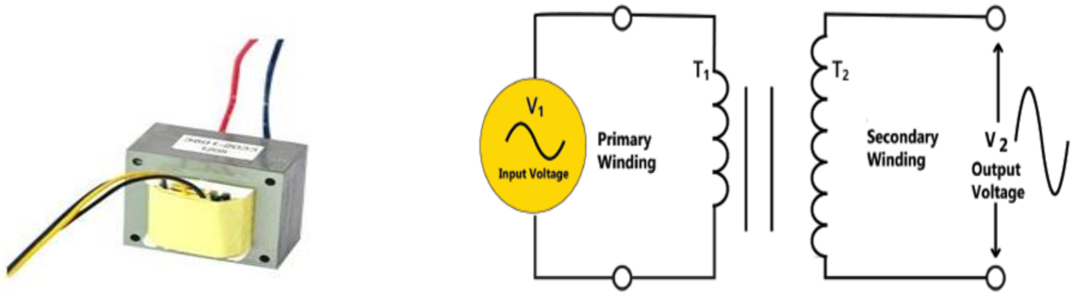


Fig 2.4(d)

Step-up transformers are a crucial component in certain types of inverters, particularly those designed to convert low-voltage DC power (typically from batteries or solar panels) into higher-voltage AC power.

A step-up transformer, as the name suggests, increases the voltage level of the electrical signal passing through it. In the context of inverters, this means it takes the relatively low-voltage DC power input and boosts it to the higher voltage needed for AC output.

In an inverter, the DC power from the input source (such as batteries or solar panels) first passes through a converter stage to convert it to AC. However, this AC power might still be at a lower voltage level than required for grid-tie applications or powering appliances. The step-up transformer then increases this voltage to the desired level.

While step-up transformers are essential for certain applications, they can also introduce losses due to resistance and magnetic core losses. Designing efficient transformers is crucial to minimize these losses and maximize the overall efficiency of the inverter system.

➢ MOSFET IRF540

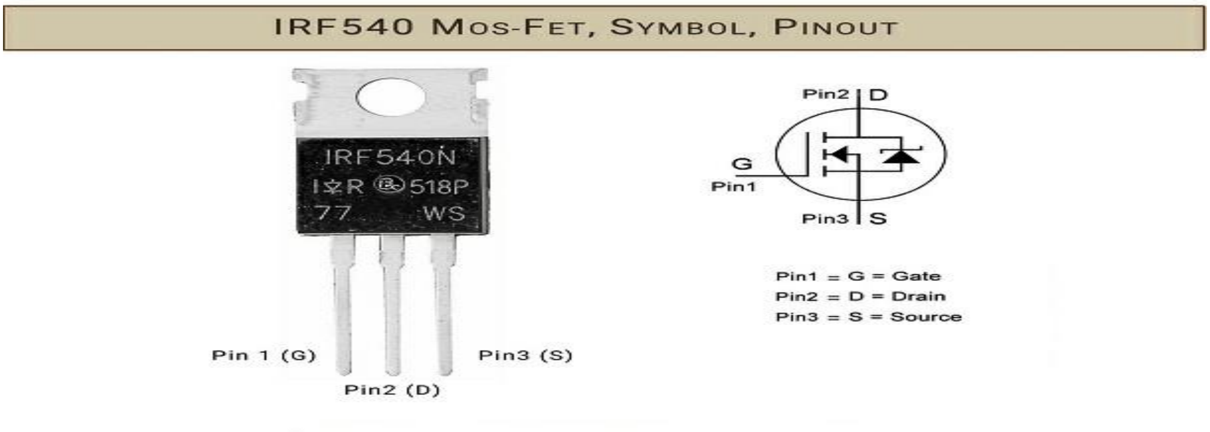


Fig 2.5(e)

The IRF540 is a popular power MOSFET (Metal-Oxide-Semiconductor Field-Effect Transistor) used in a variety of electronic applications, particularly in power switching circuits. Here we use an N-channel enhancement mode MOSFET. This means that it operates with a positive voltage applied to the gate relative to the source to allow current to flow from the drain to the source.

APPLICATIONS:

- Switching Circuits: Due to its high current and voltage ratings, the IRF540 is commonly used in power switching applications such as motor control, power supplies, and inverters.
- Amplification: While not as common, MOSFETs can also be used in amplification circuits, particularly in high-frequency applications.

➢ HEAT SINKS

Fig 2.6(f)

A heat sink is a common component used with MOSFETs (Metal-Oxide-Semiconductor Field-Effect Transistors) and other electronic devices to dissipate heat generated during operation. MOSFETs dissipate heat during operation due to the flow of current through them. This heat must be dissipated effectively to prevent the MOSFET from overheating, which can lead to performance degradation or even failure. A heat sink is typically made of a thermally conductive material such as aluminium or copper. It is attached to the MOSFET package using a thermally conductive adhesive or a mechanical mounting mechanism to ensure good thermal contact between the MOSFET and the heat sink.

CHAPTER-3

OBSERVATIONS

By supplying 12V DC, the circuit successfully powers a bulb, producing approximately 220V AC.

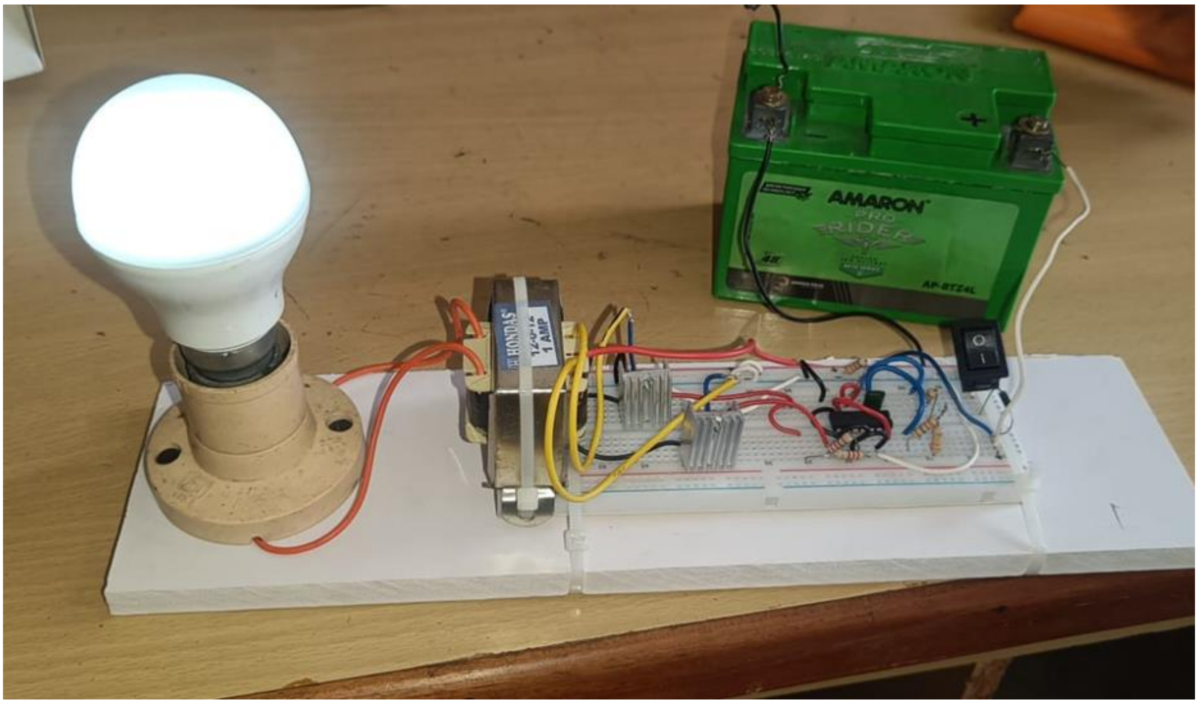


Fig 3.1(a)

CONNECTED TO 12 V BATTERY

To assess the performance, we substitute the battery with a battery eliminator, allowing us to vary the DC input and observe corresponding changes in the AC input.

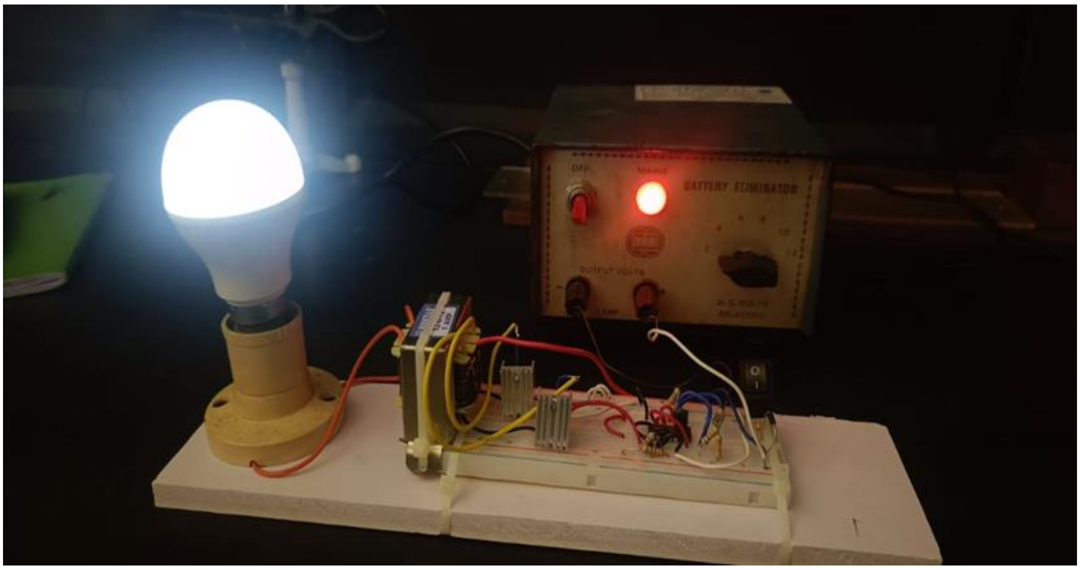


Fig 3.2(b)

INPUT DC VOLTAGE 2V

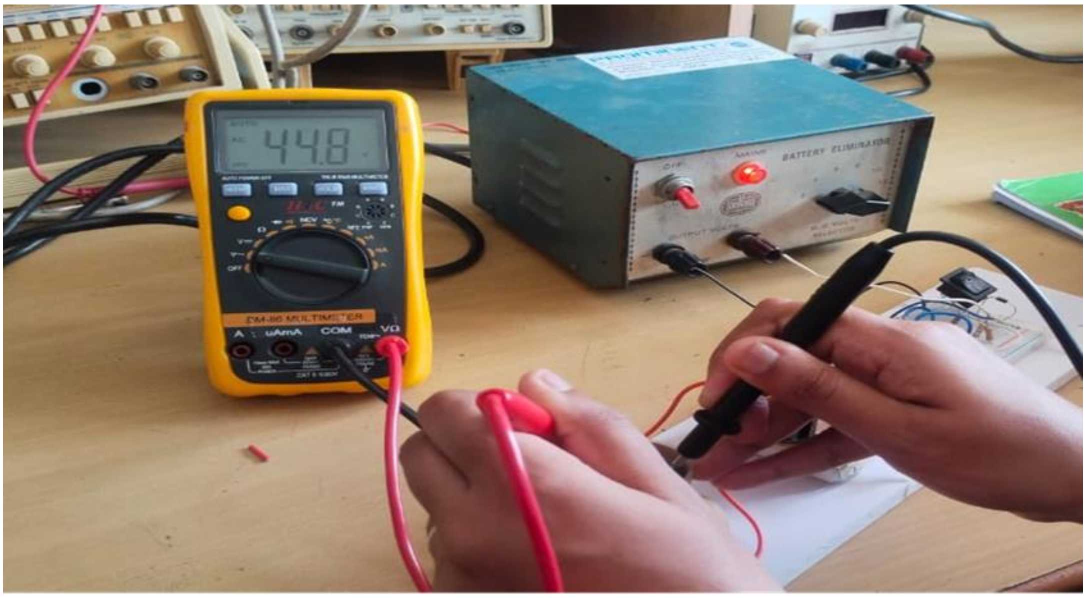


Fig 3.3(c)

OUTPUT AC VOLTAGE 44.8V

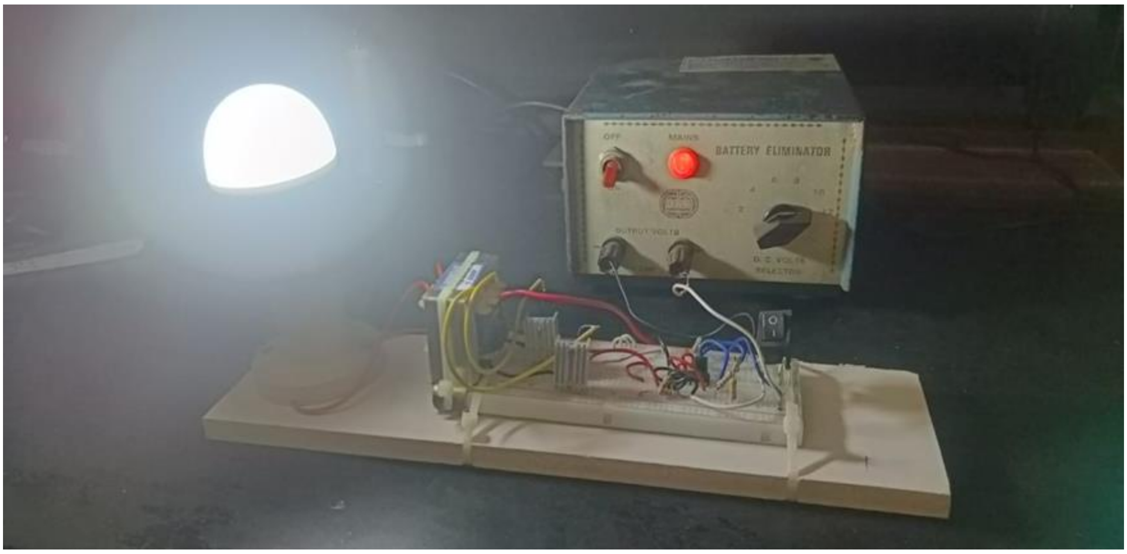


Fig 3.4(d)

INPUT DC VOLTAGE 12 V

Fig 3.5(e)

OUTPUT AC VOLTAGE 246 V

CHAPTER-4

READINGS

DC VOLTAGE (V)	AC VOLTAGE ACROSS PRIMARY OF TRANSFORMER (V)	AC VOLTAGE ACROSS SECONDARY OF TRANSFORMER (V)
2	6.38	44.8
4	10.49	72.7
6	16.23	117
8	22.1	172
10	27.2	204
12	32.2	246

CHAPTER-5

APPLICATIONS

➢ **Renewable Energy Systems**:

Inverters play a crucial role in renewable energy systems such as solar photovoltaic (PV) and wind power systems. They convert the DC power generated by solar panels or wind turbines into AC power suitable for grid connection or household use.

➢ **Uninterruptible Power Supplies (UPS)**:

Inverters are used in UPS systems to provide backup power during mains power failure. They convert DC power from batteries into AC power to keep critical equipment running smoothly.

➢ **Home Appliances**:

Inverters are increasingly being integrated into household appliances such as refrigerators, washing machines, and air conditioners to provide variable speed operation and energy efficiency improvements

CHAPTER-6

REFERENCES

https://envirementalb.com/100-watts-inverter-circuit/

https://www.academia.edu/42640710/A_project_report_on_MINI_INVERTER_12V_TO_220V