BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

EEE 316

Power Electronics Laboratory

Final Project Report

Section: B2 Group: 08

Multifunctional Solar Inverter for home appliances

Course Instructors:
1. Wasifa Mashiyath, PT, Dept. of EEE, BUET
2. Md. Ayenul Azim, PT, Dept. of EEE, BUET

Academic Honesty Statement:

"In signing this statement, We hereby certify that the work on this project is our own and that we have not copied the work of any other students (past or present), and cited all relevant sources while completing this project. We understand that if we fail to honor this agreement, We will each receive a score of ZERO for this project and be subject to failure of this course."

Signature: ____________ **Full Name: Nilanjona Majumder Medha** **Student ID: 2006100**	**Signature:** ____________ **Full Name: Shanta Sarker** **Student ID:2006103**
Signature: ____________ **Full Name: Sheikh Munkasir Ahmed Rafeed** **Student ID: 2006109**	**Signature:** ____________ **Full Name: Arpon Kumar Chanda** **Student ID: 2006110**

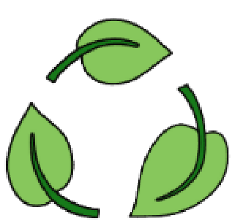
Table of Contents

1.Abstract

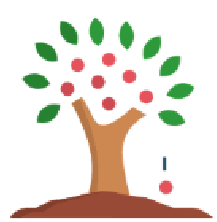
The goal of this project is to use solar energy to create a dependable and effective inverter system that produces electricity during the day to power small appliances in the home and store it in a battery for use at night or in transportation vehicles. The system includes a boost converter to provide a higher DC voltage from the solar inverter system, making it suitable for DC power applications. Since solar energy is influenced by environmental factors, incorporating a boost converter into the design helps stabilize the input voltage to the inverter. This guarantees steady functioning even in varying sunshine conditions. The technology provides a useful way to run small items like cellphone chargers, lamps, and tube lights in rural locations that frequently experience load shedding. The design is scalable for future usage with larger appliances, even though it was primarily intended for low-power applications. This opens the door for a wider use of renewable energy technology.

2.Introduction

Our natural resources are finite, and a significant portion of them is being consumed for electricity generation. This has led to a growing emphasis on the development and utilization of clean, renewable energy sources. In this project, we will explore how electricity can be harnessed from sunlight, stored as direct current (DC), and then converted into alternating current (AC) to power household appliances. Solar energy is the most abundant form of renewable energy but at the same time the extraction of energy is very much dependent on the environment. Solar inverter is a critical component in a solar energy system. It converts DC power output into AC current that can be fed into grid and directly influences the efficiency and reliability of a solar energy system. In most occasions, 220VAC and 110VAC are needed for power supply. Because direct output from solar energy is usually 12VDC, 24VDC, or 48VDC, it is necessary to use DC-AC inverter in order to be able to supply power to 220VAC electronic devices.



Sustainability



Abundance

Energy Cost Saving

3.Design

3.1 Problem Formulation (PO(b))

3.1.1 Identification of Scope

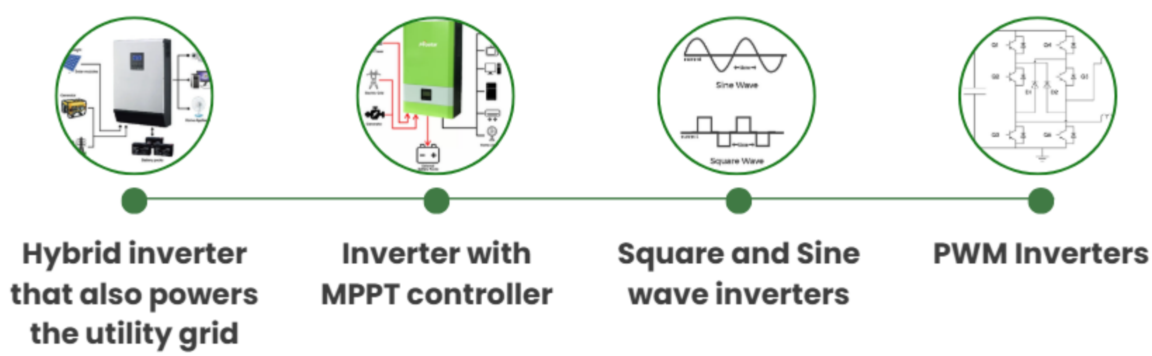
Today, many strive to have an independent source of energy, with the use of renewable energy sources being the most common approach to achieving this goal. Solar energy, harnessed through solar panels, is one such source. As a relatively new form of energy, solar power has not yet reached its full potential. Therefore, it can be utilized by converting it into alternating current (AC), as most household and industrial appliances require AC for operation.

3.1.2 Literature Review

A lot of research has been conducted on the quality of work in the inverter industry. Different strategies are employed in different locations, such as square and sine wave inverters, hybrid inverters that also supply electricity to the utility grid, and inverters with MPPT controllers.

We have studied some papers related to this project. From the paper “Cost Effective Solar based PWM Push-Pull Inverter for low Power Application”, we have come to know that push-pull topology is notable for its ability to lower conduction losses, minimize switching losses, increase efficiency, and provide an extremely cost-effective inverter design architecture.

From the book, “Power Electronics, Circuits, Devices, and Applications”, Third Edition by Muhammad H. Rashid, we learnt the detailed working mechanism of a DC-to-DC boost converter.



3.1.3 Formulation of Problem

With the increasing demand for energy and the limited availability of fossil fuels, there has been a growing focus on renewable energy sources. These sources are not only sustainable for the future but also environmentally friendly and practical.

Solar power systems play a vital role in providing electricity to off-grid and remote areas where traditional grid connections are not feasible. Additionally, solar energy can help mitigate issues such as load shedding. The design of solar inverters is essential for powering AC loads, which are commonly used for almost all appliances in our daily lives.

3.1.4 Analysis

The solar power system is designed to provide electricity for remote homes, cabins, telecommunications equipment, and even entire communities. In this system solar panels generate DC power, which is used to charge a battery. The battery serves as a DC power source for further processing. The DC voltage is fed to a DC-AC inverter. The inverter produces a 12V, 50Hz square wave AC output. The voltage is stepped up to 220V, 50Hz AC using a transformer to meet standard AC power requirements. A filter circuit is applied to convert the square wave into a sinusoidal AC waveform. The system delivers 220V, 50Hz AC power suitable for household appliances and other equipment. The battery's DC voltage is stepped up to a constant, regulated value using a boost converter circuit which can drive a DC load. This design efficiently combines solar power generation, DC-DC boost conversion, and DC-AC inversion to provide reliable AC output for remote and standalone applications.

3.2 Design Method (PO(a))

For our project, we have used a 20W solar panel as the main power supply source.

The output load is 5W, 85V rated light bulb.

Battery used = 3*3.7 = 11.1V

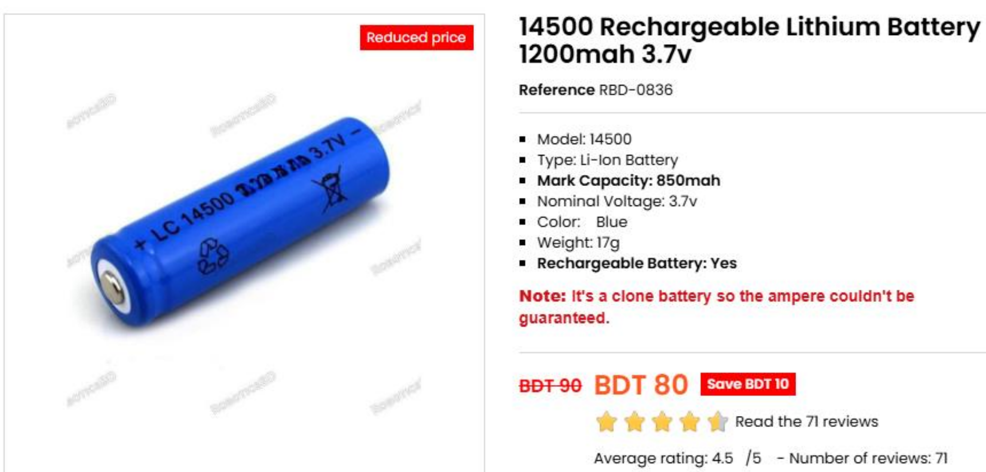
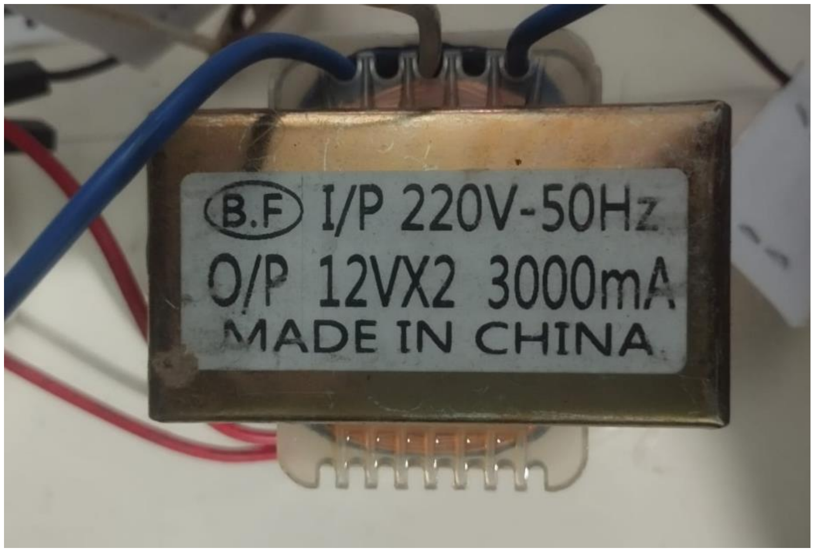
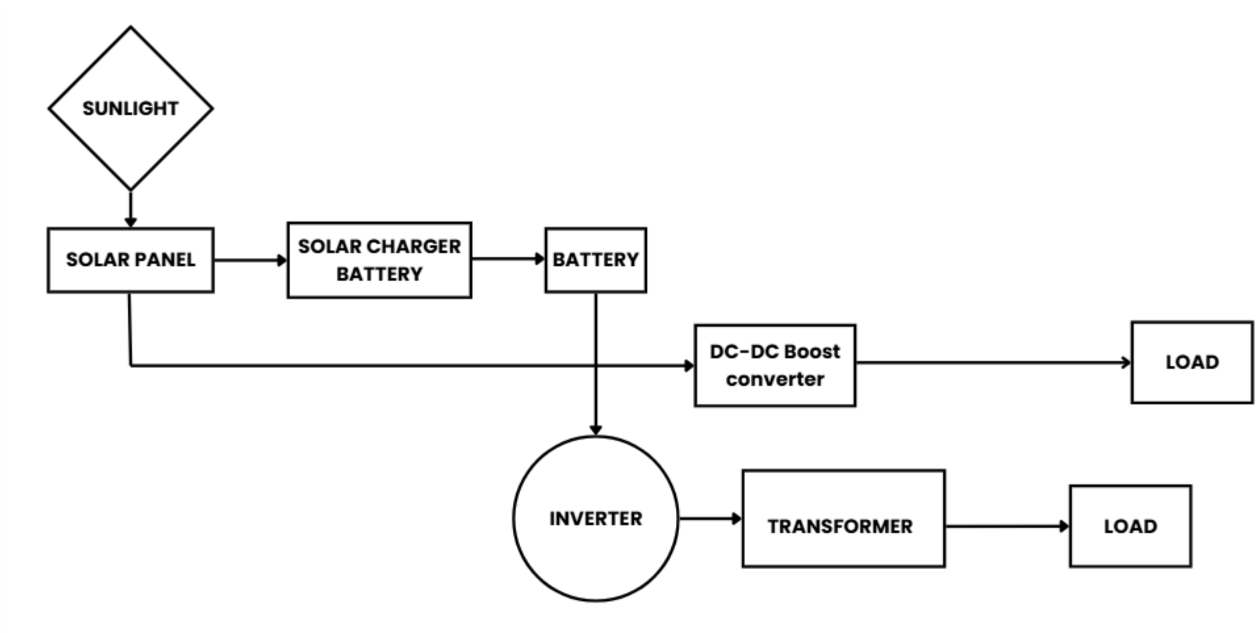


Figure: Battery Used

Transformer rating = 12/220V, 50Hz

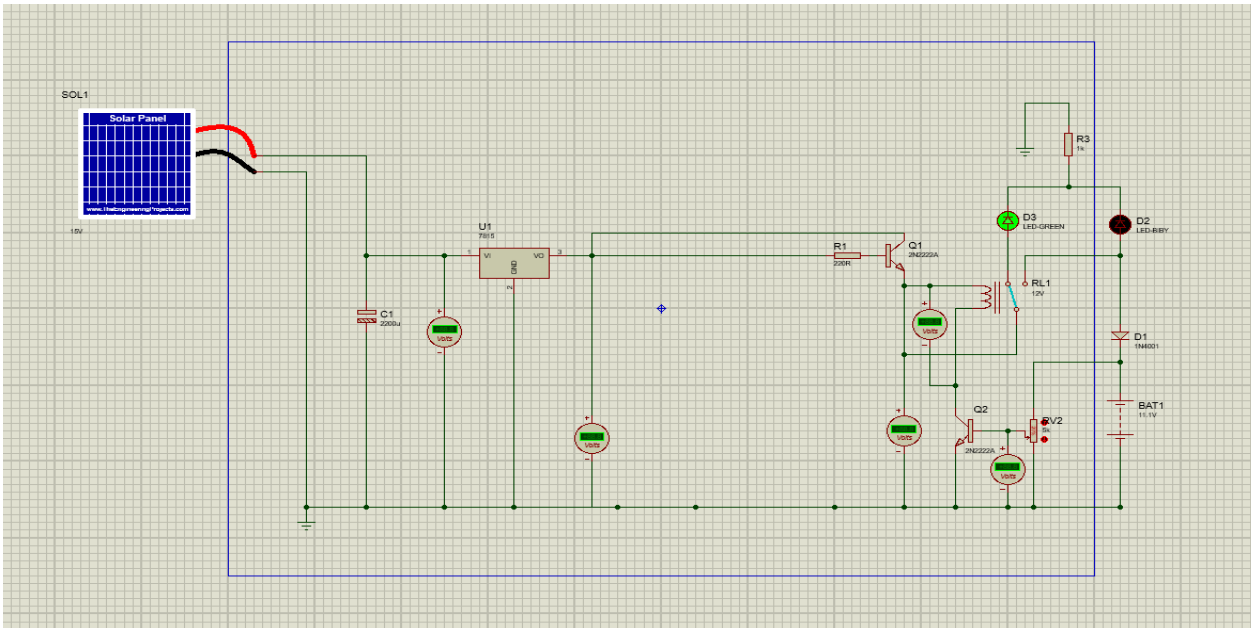


3.3 Circuit Diagram

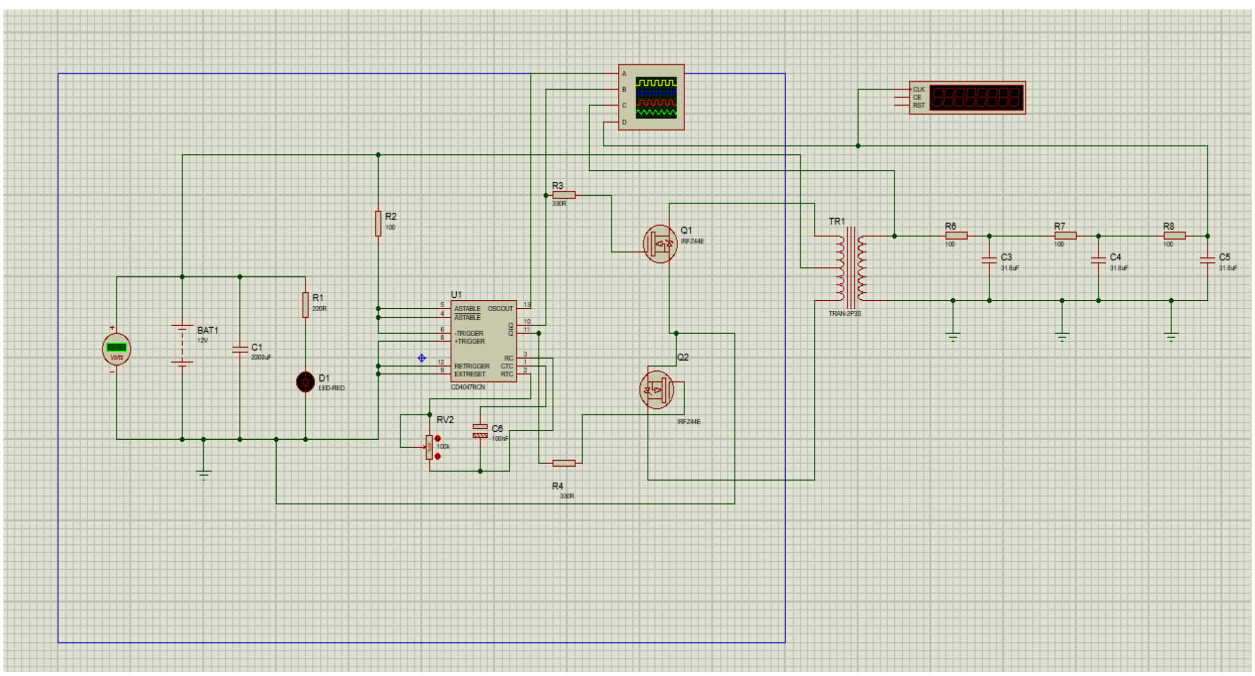


3.4 Simulation Model

<u>Simulation of Solar battery charger:</u>



<u>Simulation of Push-Pull inverter:</u>



Simulation of DC-DC Boost converter:

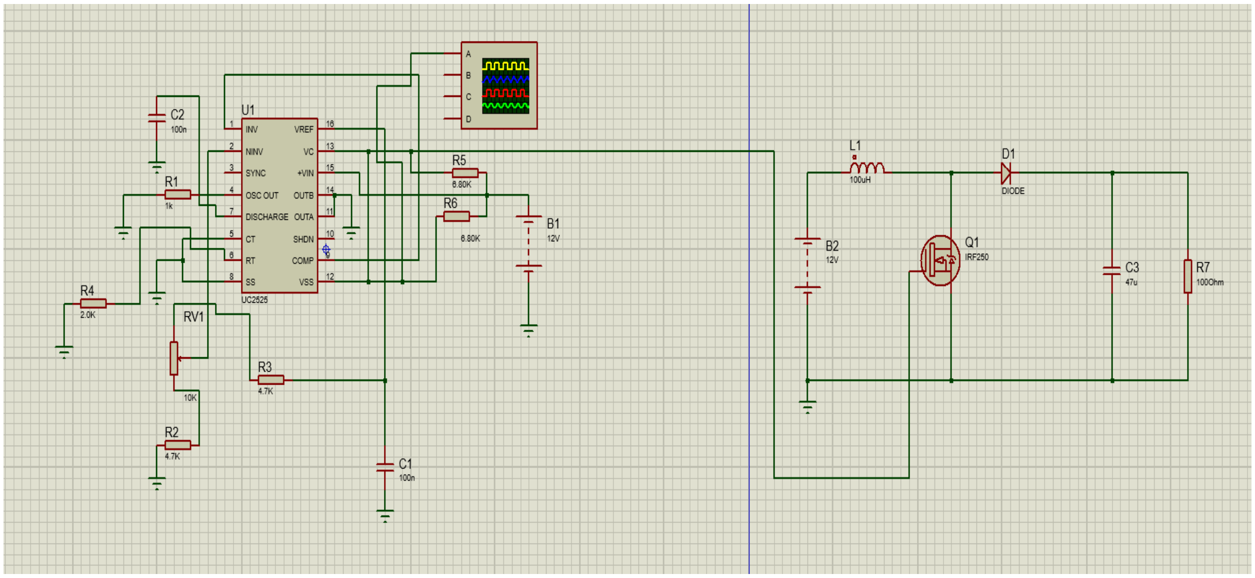


Figure: Simulation of DC-DC Boost converter

4. Implementation

4.1 Description

Charger circuit:

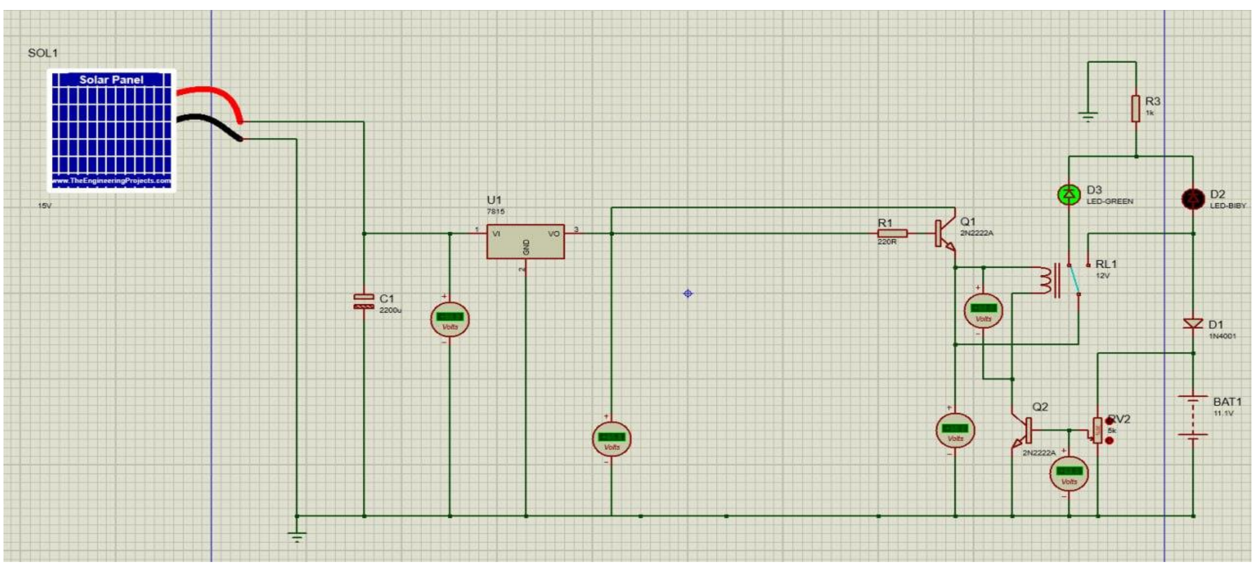


Fig: Simulation model of charger circuit

This solar charger circuit utilizes a solar panel to generate a DC voltage which is then managed and regulated for use in charging a battery.
The proposed circuit is a solar-powered battery charging system. A 20W solar panel serves as the primary power source, providing DC voltage regulated to a stable 15V using an LM317 voltage regulator. This ensures a consistent voltage supply; for example, if the solar panel output is 20V, the voltage regulator stabilizes it to a fixed 15V DC. Additionally, it protects the components from high voltage surges. A bypass capacitor minimizes harmonic distortions and stabilizes the input voltage. Power BJTs (Q1 and Q2) control the current flow, with Q1 always on and Q2 regulated by the battery's voltage state. A relay, LEDs, and a potentiometer work together to monitor and indicate the charging status, with yellow and green LEDs illuminating during charging and fully charged states, respectively. The potentiometer is used to adjust the voltage across Q2 to display the charging and fully charged states, as a fixed DC battery (11.1V) is used for demonstration purposes.
The circuit operation begins with the solar panel supplying variable DC voltage, which is stabilized by the LM317. During the charging process, Q2 remains off, the relay stays in the "charging" position (opposite to that shown in the figure above), and the yellow LED indicates the "charging" state. As the battery nears full charge, its voltage rises, activating Q2. This switches the relay to the "fully charged" position (as shown in the figure above) as the coils become magnetized, lighting the green LED. A diode prevents current backflow, ensuring correct directionality, while the potentiometer allows for the demonstration of charging and discharging states by manually varying the voltage across a fixed DC source.

Inverter circuit:

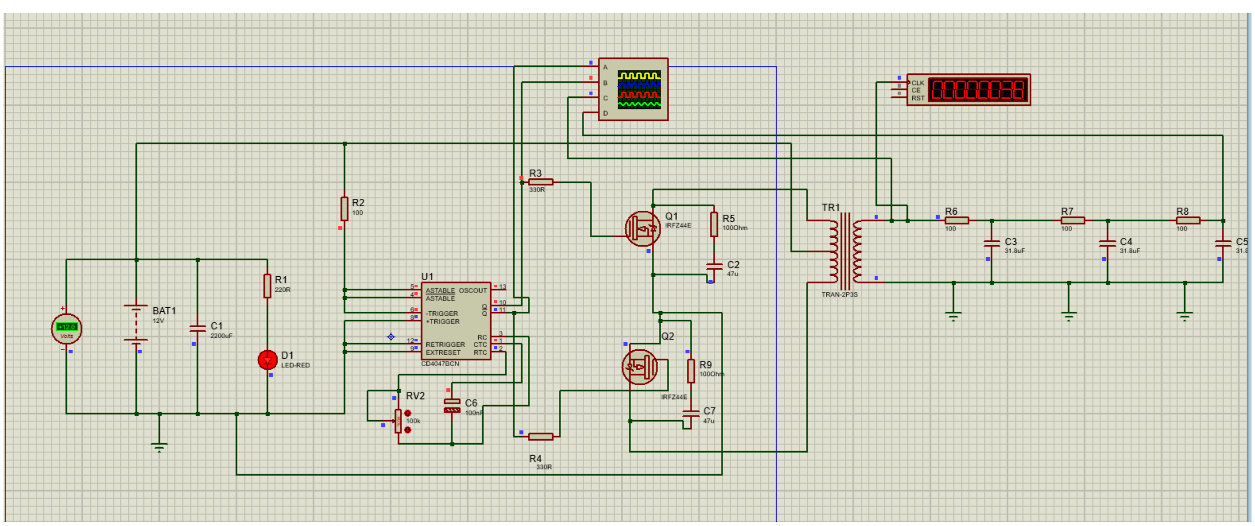
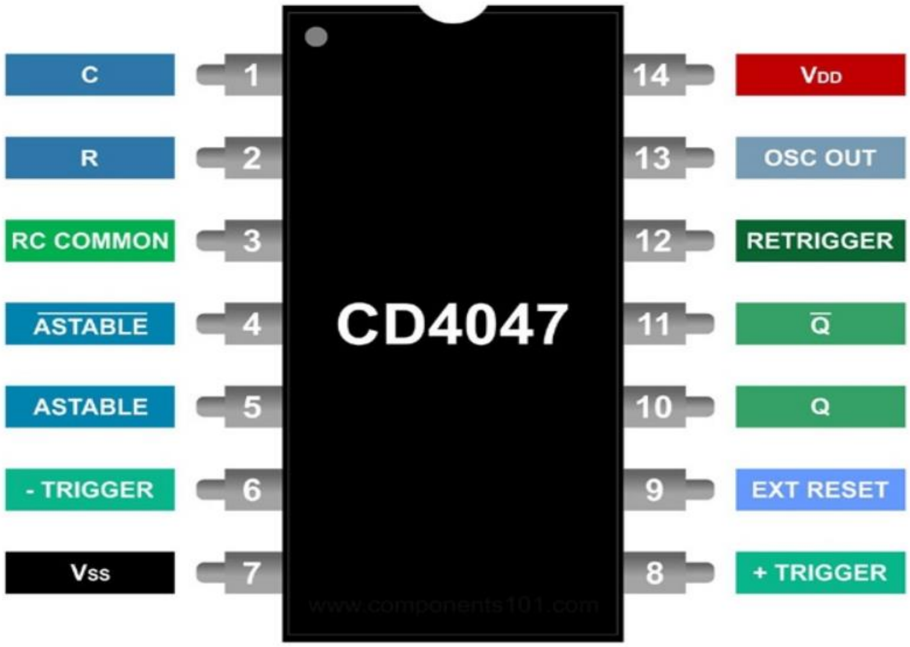
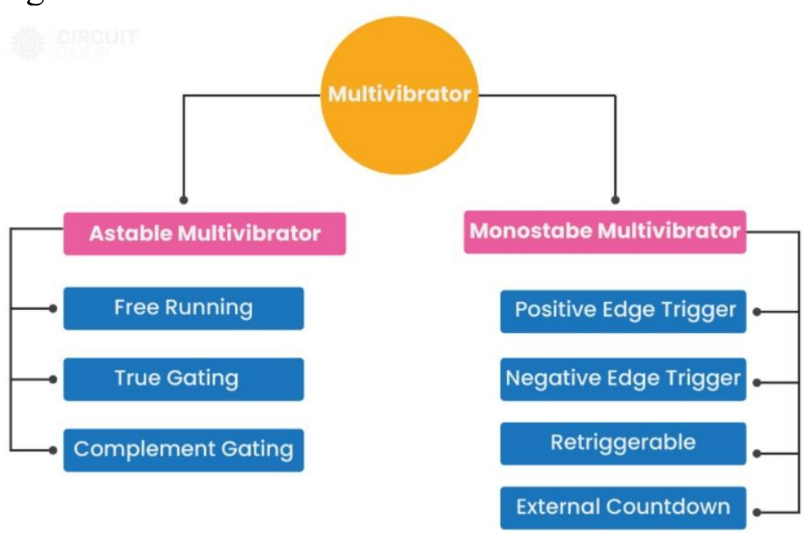


Fig: Simulation model of solar inverter circuit



Charged battery feeds the whole circuit where we used a bypass capacitor to remove any alternating current component of the signal by creating an alternating current short circuit to the ground. Also, a red LED is implemented through the path to ensure the circuit is powered.
However, the pulse generator used in the circuit is IC 4047, a CMOS multivibrator that is operating in astable mode.



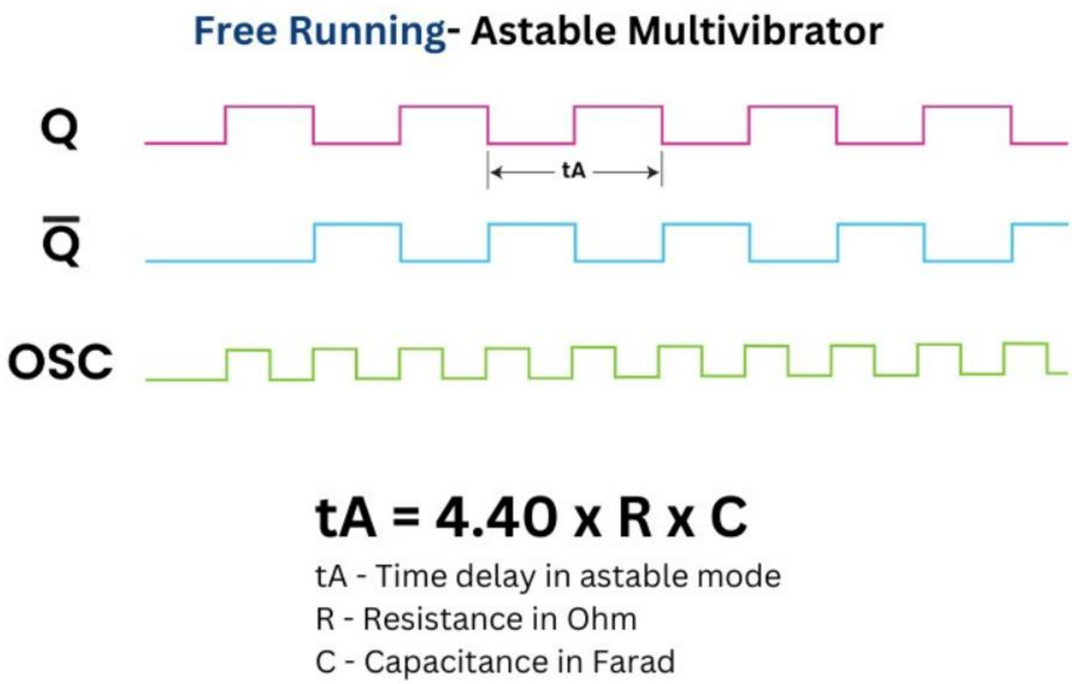
It is a 14-pin IC where 4,5,6 is shorted at adjusted to the Vcc, 8,12,9 is shorted at ground. The 14 no pin is connected to Vcc to empower the IC and pin 7 is connected to the ground. Pin 1 and 2 is used to connect the external capacitor and resistor and 3 is their common point. We can observe their oscillator output from pin 13. Pin 10 and 11 showed inverted output (Coming from the frequency divider block which divides the frequency by two) to each other which is going to drive our mosfets.

Pin diagram of multivibrator IC:

Pin No	Pin Name	Description
1	C	Used to connect External Capacitor
2	R	Used to connect External Resistor
3	R-C COMMON	Common Pin for the externally connected Resistor and Capacitor
4	$\overline{\text{ASTABLE}}$	Used as a Trigger Input, only for the Complement Gating Function, OtherWise kept HIGH
5	ASTABLE	Used as a Trigger Input for Astable Modes, otherwise kept LOW
6	-TRIGGER	Used as a Trigger Input, Only for Negative Edge Trigger Mode, Otherwise kept LOW in the case of Monostable Functions or HIGH in the case of Astable Functions
7	VSS	Negative Supply Voltage
8	TRIGGER	Used as a Trigger Input for Monostable Modes, Otherwise Kept LOW
9	EXTERNAL RESET	A Positive Pulse Resets the Q and $\bar{Q}$ State to LOW and HIGH Respectively
10	Q	Output
11	$\bar{Q}$	Inverted Output
12	RETRIGGER	Used as a Trigger Input For Retriggerable Function, else kept LOW.
13	OSC OUT	Oscillator Output

14	VDD	Positive Supply Voltage

As it is in ‘astable multivibrator free running mode’, the relationship tA=4.4RC By choosing the resistor and capacitors carefully we can control the frequency of the pulses.



t=4.4RC
f= 1/(4.4RC)
C=100nF
Expected frequency, f=50Hz
R is calculated to be 45.454k ohm which is adjusted by 100k pot
The mutually inverted outputs from pins 10 and 11 are driving the MOSFETS. Thus, when the MOSFET1 is operating, MOSFET2 is off, when the MOSFET2 is operating, MOSFET1 is off.

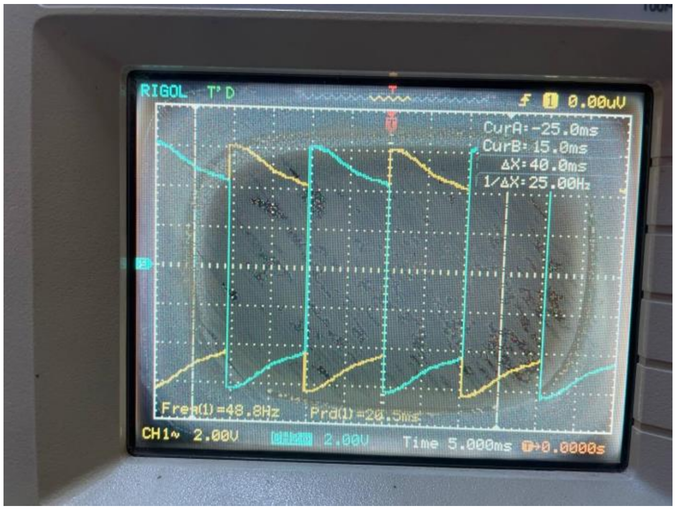


Fig: IC's mutually inverted pulses

When MOSFET1 is on, the current will flow from the CT transformer's center => MOSFET1's drain to source=> ground. Due to the transformer's polarity, the load will supply power to the source. Again, When MOSFET2 is on, the current will flow from the CT transformer's center => MOSFET2's drain to source=> ground. Due to the transformer's polarity, the source will supply power to the load. As the mutually inverted position creates a push and pull of power between the source and load, we call it a push-pull inverter circuit.

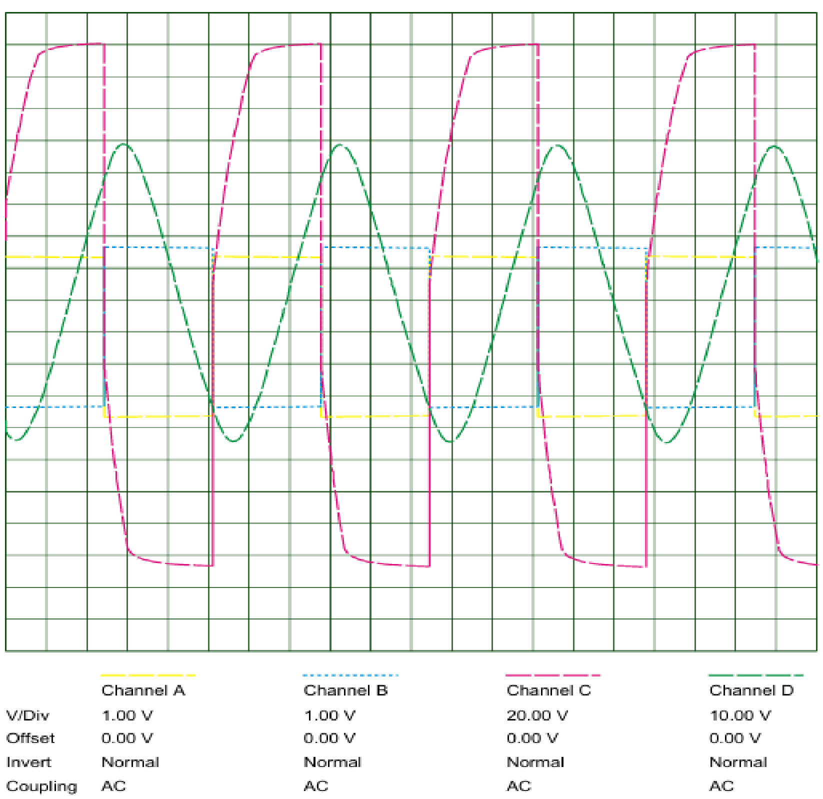


Fig: Simulation result

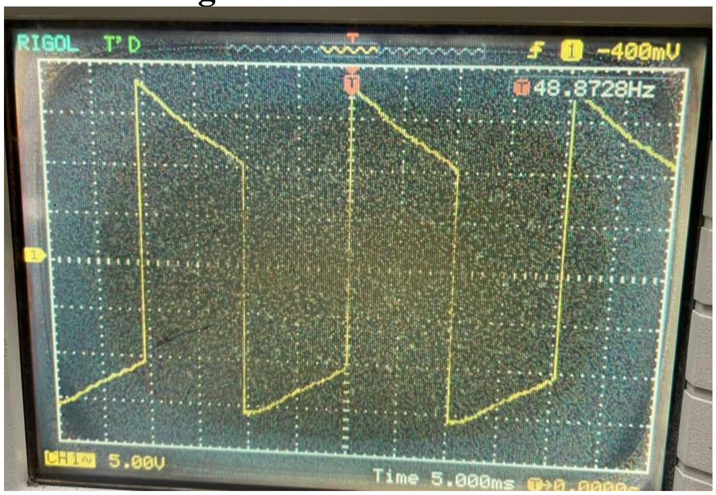
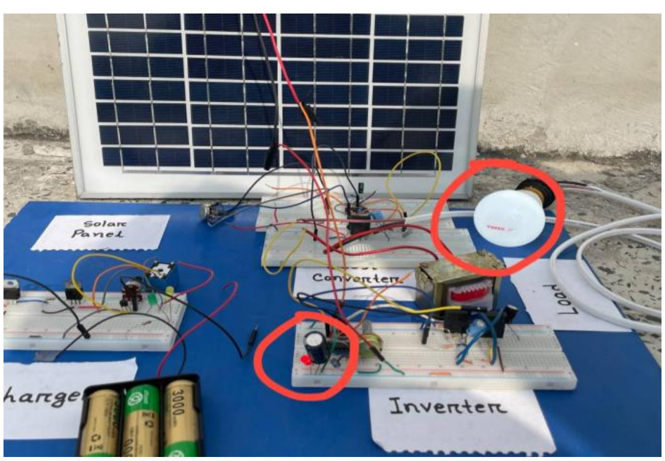


Fig: AC square wave at Transformer's primary

However, we added an RC snubber circuit along the MOSFETS' drain and source to make sure when the transition state of a MOSFET is observed, a high voltage spike can't occur across the load. Besides, if a high-frequency component is present anyhow, the capacitor's impedance will make it almost zero, Xc=1/(2*pi*f*C), and the current will find a path to reach the ground.
The output we observe at the transformer's secondary is quite like a square wave but our objective was to find a perfect sinusoidal wave shape. We needed to use a low-pass RC filter to remove the high-frequency components from the square wave and show a sinusoidal wave shape like the simulation. But when we tried to implement it in the lab, the capacitor's rating wasn't supporting this much high voltage and it bursted out. Then we skipped this step and ran the AC load by the square AC wave we achieved at the transformer's secondary.



DC-DC Boost converter:

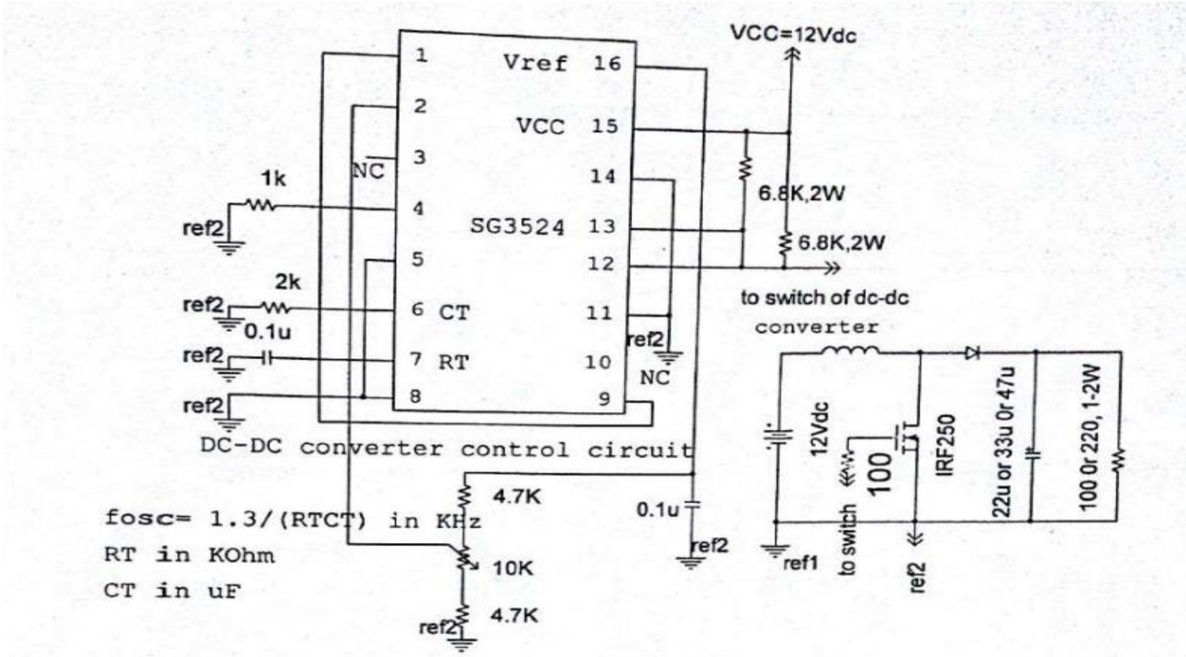
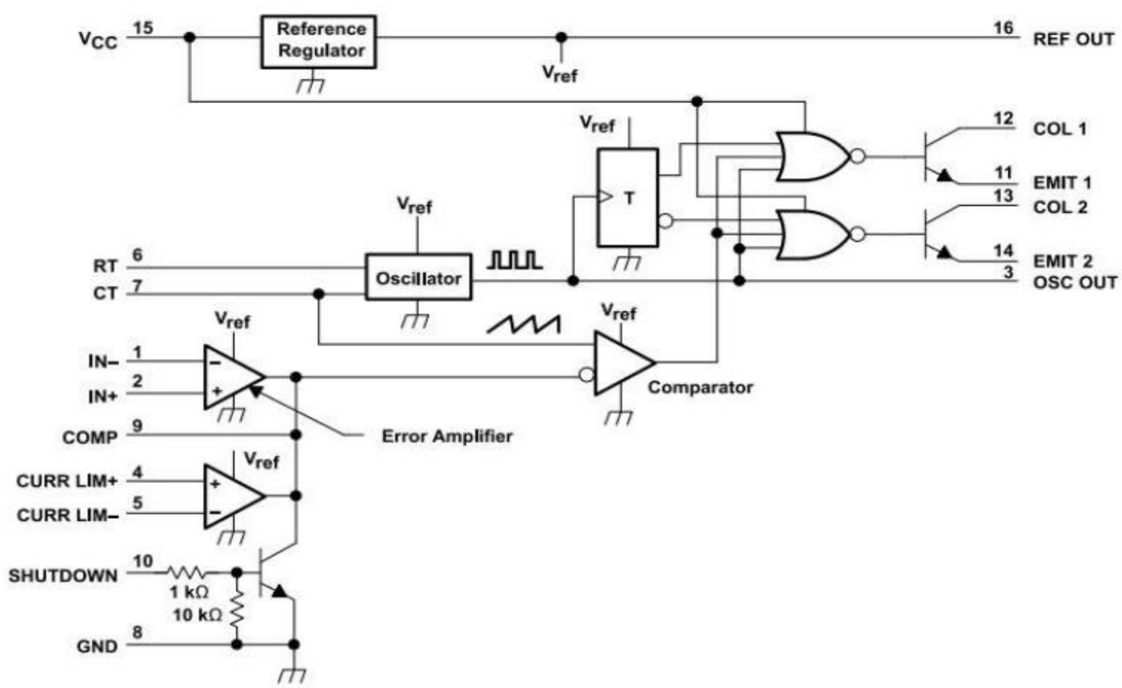


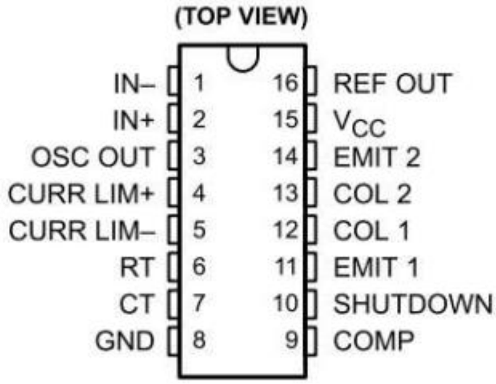
Figure: DC-DC Boost Converter and control circuit

In this part, we have designed and implemented a PWM generator circuit using SG3524 IC and a DC-DC Boost converter circuit.

The PWM switching pulse generator is the heart of this circuit, which is responsible for producing a PWM pulse. The functional block diagram of IC SG3524:



The pin layout of IC SG3524:



Here the IC SG3524 gives fixed frequency PWM that can be varied by RT (pin 6) and CT (pin 7) element values.

$f = \frac{1.3}{RT*CT}$

In our circuit we have used RT=2.2kΩ, and CT= 0.1 uF, so

$f = \frac{1.3}{RT*CT} = 6$ kHz

Pins 1 (Inverting Input) and 2 (Non-Inverting Input) are the inputs to the on-board error amplifier. We can think of it as a comparator that controls the increase or decrease of the duty cycle for the “feedback” that we associate with Pulse Width Modulation (PWM). This functions either to increase or decrease the duty cycle depending on the voltage levels on the Inverting and Non-Inverting Inputs – pins 1 and 2 respectively. We can control the duty cycle of the pulse signal by varying the pot resistance connected to pin 2. Pin 15 is VCC – the supply voltage to the SG3525 that makes it run. Pins 12 and 13 are the outputs from which the driver signals are to be taken. They are the outputs of the SG3524 internal driver stage and can be used to directly drive MOSFETs and IGBTs.

The generated gate pulse drive the MOSFET of the DC-DC Boost converter circuit. In DC-DC Boost converter circuit, the solid-state device such as power MOSFET which operates as a switch is connected across the source. A diode is used as a second switch. The diode is connected to the capacitor and the load. The capacitor and load are connected in parallel as shown in the above circuit diagram. The inductor is connected in series with the supply voltage source which leads to a constant input current. So the boost converter acts as a constant current input source and loads act as a constant voltage source.

There are two modes of operation of the Boost converter. They are:

Mode I: MOSFET is ON and Diode is OFF

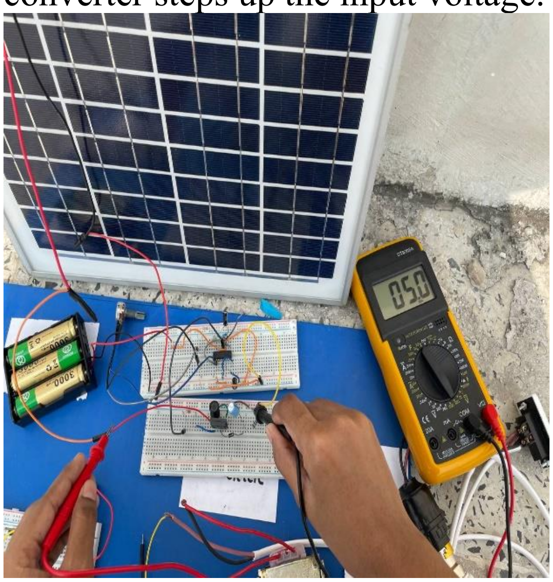
Mode II: MOSFET is OFF and Diode is ON

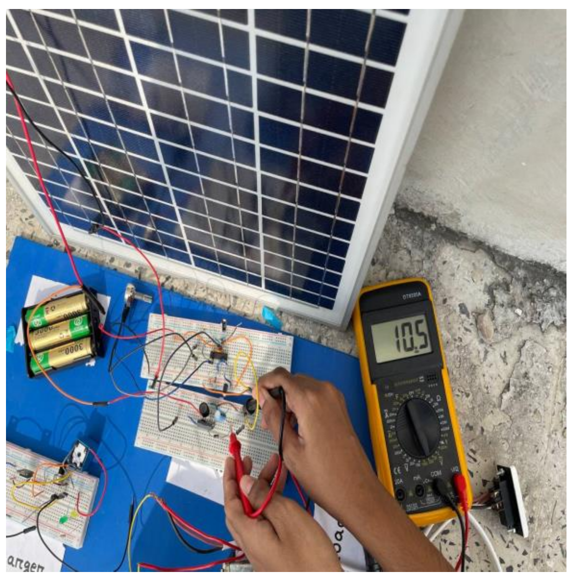
Mode I: MOSFET is ON and Diode is OFF

In this mode of operation, MOSFET is in closed condition i.e. ON state, and diode is in open condition i.e. OFF state. Thus, MOSFET allows the flow of current through it. All the current will flow through the closed path including inductor L, MOSFET, and back to the dc input source. Here, the polarity of the inductor will be according to the direction of the flow of current. In this mode of operation, the diode is in reverse biased condition so that diode does not allow the flow of current through it to the circuit. In this condition, the voltage across the MOSFET will appear across the load resistance and hence output voltage.

Mode II: MOSFET is OFF and Diode is ON

In this mode of operation, MOSFET is in open condition i.e. OFF state and diode is in closed condition i.e. ON state. Thus, diode allows the flow of current through it. As we know, the inductor in the circuit store energy in the form of the magnetic field, the inductor acting as the source when the MOSFET is open. Hence diode becomes closed. In this mode of operation, the inductor releases the energy stored in the previous mode when MOSFET was closed. During releasing of energy stored in the inductor, the polarity of the inductor gets reversed which causes the diode to come in forward biased condition. So it allows the flow of current in the circuit through diode. The released energy is ultimately dissipated in the load resistance which helps to maintain the flow of current in the same direction through the load and also steps up the output voltage. Hence in this way boost converter steps up the input voltage.





5. Design Analysis and Evaluation

5.1 Novelty

1. Solar panel battery charging features increase the reliability and availability of solar power.
2. Acts as a power backup solution and eco-friendly means of power generation.
3. Reduction in consumption of conventional energy sources.
4. Scalable and adaptable to meet the specific energy demands of various household applications.

5.2 Design Considerations (PO(c))

5.2.1 Considerations to public health and safety

User-Centric Design:
The project is developed with a focus on user safety and ease of operation. Every aspect of its design prioritizes the well-being of individuals, ensuring that it can be used safely and effectively in various environments.

Environmental Safety:
The project is carefully engineered to have no adverse effects on the environment. Its operational framework aligns with eco-friendly principles, ensuring that it is both safe for humans and environmentally sustainable.

Management of High-Voltage Components:
Although the system includes high-voltage elements, robust safety measures are in place to mitigate associated risks. These include comprehensive insulation techniques to safeguard against electrical hazards.

Use of High-Rated Equipment:
The integration of high-quality, certified equipment enhances the system's reliability and safety. These components are rated to handle the required voltage and current levels, ensuring stable and secure operations.

Fire Hazard Reduction:
Proactive measures, such as the selection of fire-resistant materials and adherence to strict safety standards, significantly reduce the risk of fire. This ensures that the system remains secure even during prolonged usage.

Comprehensive Risk Mitigation:
A detailed risk assessment and the incorporation of advanced safety features ensure minimal potential for damage, making the project both safe and reliable.

5.2.2 Considerations to Environment

- **Harnessing Solar Energy:**
  The project is designed to utilize solar energy, a renewable and abundant resource. This approach significantly reduces dependence on non-renewable fossil fuels, contributing to sustainable energy practices.
- **Environmental Friendliness:**
  By relying solely on solar power, the project eliminates the generation of harmful emissions or byproducts. This ensures that the process is environmentally safe and does not contribute to air or water pollution.
- **Zero Carbon Footprint:**
  Since solar energy does not produce greenhouse gases during operation, the project supports global efforts to mitigate climate change and reduce the carbon footprint of energy production.
- **Minimal Maintenance:**
  Solar energy systems typically require very little upkeep compared to conventional energy systems. This lowers operational costs and reduces the environmental impact associated with maintenance activities.
- **Eco-friendly in Any Situation:**
  The project's design ensures that its environmental impact remains negligible, regardless of location or operating conditions. This makes it a versatile solution for sustainable energy needs worldwide.
- **Sustainability Focus:**
  By aligning with green energy goals, the project emphasizes long-term environmental preservation and energy security, supporting a cleaner and healthier future.

5.2.3 Considerations of cultural and societal needs

Power is expensive, and many individuals living in poverty resort to stealing electricity from the grid. By utilizing this project, we aim to provide access to affordable power for those who cannot afford it. We have designed the project to be as cost-effective as possible, ensuring it meets social and cultural needs efficiently.

5.3 Investigations (PO(d))

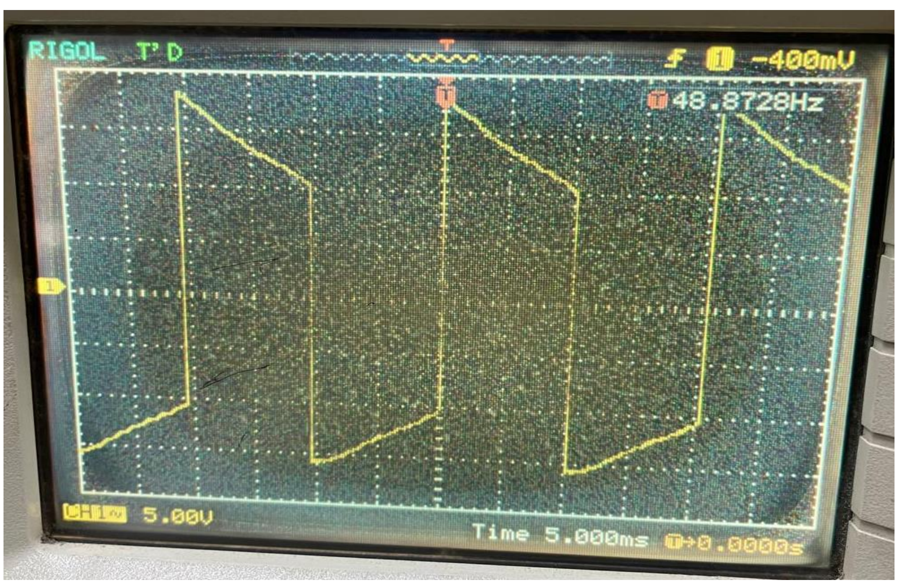
5.3.1 Data Collection

We can obtain about 20 V from the solar panel and use it to charge the battery. We used an 11.1-volt battery that was charged by a solar panel. A circuit for a battery charger was utilized for charging, and a potentiometer was used to adjust the voltage. For the 11.1V battery to successfully charge, we set the voltage to 12V. The inverter circuit receives 11.1V from the battery.

Performance evaluation with a 11.1-volt battery:
Voltage without load = 140V
Voltage at full load = 120V
Regulation of Voltage = (No Load – Full Load)/Full Load = 16.67%
Performance evaluation of DC-DC Boost converter:
Duty cycle = 53%
Input voltage = 5 V
Output voltage =10.5 V (Observed)
Output voltage=10.64 V (Theoretical)

5.3.2 Results and Analysis

To convert DC to AC, we used a push-pull inverter. The inverter circuit's outputs in the primary side of the transformer:



We got from the secondary side of the winding,

Voltage without load = 140V
Voltage at full load = 120V
Finally, it can be said that our project was successfully finished. The light bulb illuminates brightly. The transformer end's output matches what was intended. Additionally, voltage regulation is satisfactory after a load is added.

5.4 Limitations of Tools (PO(e))

Charger circuit:

We designed the mechanism of the charger circuit so that it can control the charging of the battery that would be fed into the inverter and boost converter circuit. Here, we had to use a rechargeable battery to understand the change of remaining voltage in the battery, but we couldn't use a rechargeable battery due to high price and low availability.

Inverter circuit:

The most significant limitation we have in the inverter circuit is, that we found a square pulse (enough distorted, however) from the transformer secondary. To achieve perfect sinusoidal waveshape, we had to use a staged low-pass RC filter before feeding the pulse into the AC load. However, once we used the RC filter, the capacitors busted due to high voltage(above 200V, out of the rating range of the capacitors) and the circuit stopped working. That's why we had to avoid the use of RC filters. Besides, the transformer used in our circuit is heavy which makes the circuit difficult to handle.

Boost converter:

While testing in the Laboratory, as we increased the DC input supply voltage, the voltage source was limiting the current from the source, as a result, we were not able to increase the input voltage to more than 3.5 V.

5.5 Impact Assessment (PO(f))

5.5.1 Assessment of Societal and Cultural Issues

- **Energy Access and Equity**:
    - Facilitates access to clean energy in underserved and remote communities.
    - Reduces reliance on conventional grid electricity, promoting energy independence.
    - Bridges the energy gap, particularly in regions with inconsistent power supply.
- **Affordability and Economic Impact**:

    - High initial investment may exclude low-income households.
    - Potential long-term cost savings through reduced electricity bills and maintenance.
    - Stimulates local economies through job creation in manufacturing, installation, and maintenance.
- **Cultural Adaptability**:
    - The design must align with regional preferences, norms, and appliance compatibility.
    - Acceptance may be influenced by perceived complexity or unfamiliarity with the technology.
- **Environmental Awareness and Adoption**:
    - Encourages a shift toward sustainable energy use, reducing carbon footprints.
    - Acts as a catalyst for broader adoption of renewable technologies in communities.
- **Gender and Social Dynamics**:
    - Empowers women in energy-limited households by enabling the use of electrical appliances.
    - Enhances educational opportunities by providing reliable lighting and device charging.
- **Integration with Existing Systems**:
    - Compatibility with traditional power systems and local infrastructure is crucial.
    - Requires targeted awareness campaigns for smooth adoption.
- **Cultural Resistance and Misconceptions**:
    - Resistance may stem from mistrust of new technologies or misinformation.
    - Effective communication and community engagement can mitigate these concerns.

5.5.2 Assessment of Health and Safety Issues

- **Electrical Safety**:
    - Risk of electric shock or fire due to improper installation or poor maintenance.
    - Requires adherence to electrical codes and standards for safe operation.
- **Battery-Related Hazards**:

    - Potential for overheating, leakage, or explosion in integrated battery systems.
    - Proper handling, storage, and disposal of batteries are essential to prevent accidents.
- **Thermal Risks**:
    - High operational temperatures may cause burns or equipment damage.
    - Adequate ventilation and thermal management systems are necessary to mitigate risks.
- **EMF (Electromagnetic Field) Exposure**:
    - Low-level electromagnetic radiation may raise concerns, though within regulatory limits.
    - Proper shielding can reduce any perceived risks of long-term exposure.
- **Installation and Maintenance Hazards**:
    - Physical risks to technicians during installation, such as falls or tool-related injuries.
    - Routine maintenance must be performed by trained professionals to ensure safety.
- **Reliability and System Failures**:
    - Faulty inverters can lead to appliance damage, power outages, or potential hazards.
    - Incorporating protective features such as surge protectors and fault detection mechanisms is crucial.
- **Fire Safety**:
    - Poor wiring or component failures can increase fire risks.
    - Fire-resistant materials and built-in safety shutoff mechanisms can minimize this threat.
- **Environmental and Chemical Exposure**:
    - Risk of exposure to harmful chemicals in case of component damage or disposal issues.
    - Compliance with eco-friendly manufacturing and recycling practices is essential.

5.6 Sustainability Evaluation (PO(g))

DC to AC inverters' sustainability is contingent upon a number of criteria, including their contribution to the overall sustainability of the solar power system, lifetime analysis, durability, and energy efficiency. Adopting sensible production

and disposal procedures, along with selecting high-quality, efficient inverters, can support sustainability in the solar energy sector.
The adoption of solar energy, which has many positive social effects such as cleaner energy production, job development, energy access, and less environmental impact, is greatly aided by solar DC to AC inverters. Their influence goes beyond producing energy; they also help create a society that is more robust and sustainable.

5.7 Ethical Issues (PO(h))

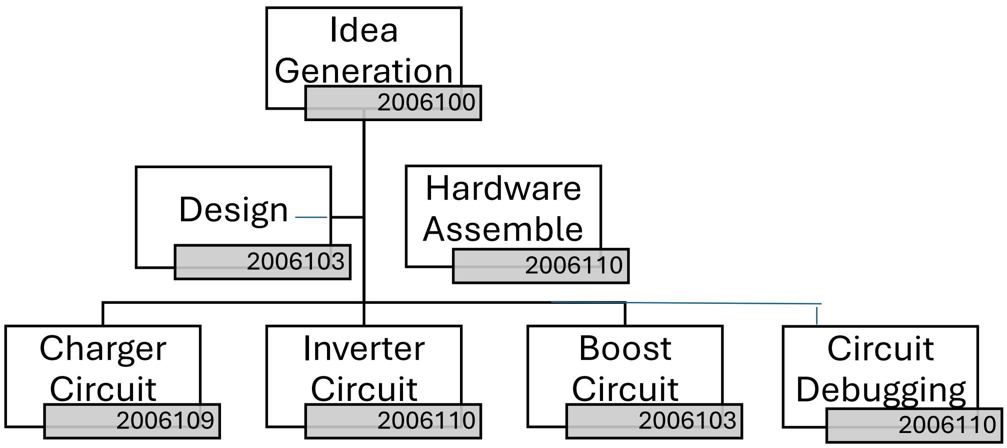
The manufacturing process, supply chain, land use, and the disposal of outdated equipment are some of the variables that can affect the ethical impact of solar inverters. In order to reduce environmental effects, inverters should be recycled or disposed of responsibly at the end of their lives. We are aware that the sun's energy is cost-free and equally accessible to all those who can utilize it. Therefore, there are no legal or energy access violations associated with the use of such a project. All things considered, the moral application of solar DC to AC inverters is strongly related to the more general ethical concepts of sustainability, environmental responsibility, social justice, and long-term well-being, which makes them an important instrument in the shift to a more moral and sustainable energy future.

6. Reflection on Individual and Team Work (PO(i))

6.1 Individual Contribution of Each Member

ID	Statement
2006100	Idea generation and Solar inverter circuit
2006103	Design and Boost converter circuit
2006109	Charger circuit and circuit debugging
2006110	Hardware management and circuit debugging

6.2 Mode of Teamwork



6.3 Diversity Statement of Team

Collaborative Approach

The key to our team's success is cooperation. Every member was invited to share their thoughts and offer helpful criticism since we placed a high value on open communication. Team meetings were held regularly to review progress, resolve issues, and coordinate our objectives.

Division of Labor

To maximize efficiency and capitalize on individual strengths, our team has adopted a well-structured division of labor. Each member is assigned specific roles and responsibilities.

7. Communication to External Stakeholders (PO(j))

7.1 Executive Summary

To ensure the preservation of our planet, safeguard our future, and provide for the next generation, it is essential to prioritize green energy. Solar electricity, a renewable and infinite resource, offers a sustainable alternative to non-renewable sources, allowing us to conserve energy for urgent needs. The implementation of solar inverters enhances the efficient use of solar power by converting it into electricity for domestic consumption. This transition brings numerous advantages, including a reduction in environmental pollution, lower costs, greater energy independence, and the elimination of load shedding. By embracing solar technology, we move towards a more sustainable and resilient energy future, making solar inverters a superior and necessary system for modern energy needs.

7.2 User Manual

The project is very easy to set up and use, and no technical expertise is needed for setup. The following sets are required for the project to be installed correctly.

1) Set the solar panel in the area with the most sunshine.
2) Connect two wires from the terminals of the solar panel to the solar battery charger circuit which will charge a battery.
3) Connect the battery to the inverter circuit
4) In the secondary side of the transformer a load must be connected
5) Now connect the battery to the boost converter circuit. The boost converter must be set to a specified value that the user wants to drive a dc load

7.3 GitHub Link

7.4 YouTube Link

https://www.youtube.com/playlist?list=PLxidbClDBosfA7evNjWlTWIH-K2T3a2TN&jct=WNr96pPS-XSZgAJBIX9WbQ

8. Project Management and Cost Analysis (PO(k))

8.1 Bill of Materials

8.2 Timeline of Project Implementation

Date	Performance
27/09/2024	Proposal submission
09/10/2024	Project assigned by the instructor
11/10/2024	Development of design ideas
01/11/2024	Implementation of solar inverter circuit in hardware
04/11/2024	**First Update**
01/12/2024	All setup completion
04/12/2024	Full project setup tested in lab
15/12/2024	**Final Presentation**

9. Future Work (PO(l))

The project is just a prototype for demonstrating the use of inverters to harvest solar energy for use in day-to-day life. Although the project can be used for practical use it is important to mention the project is far from being installed at homes and offices. Thus, the project has a lot of scope for further improvements such as using high-rating wire for durability and current tolerance, using higher-rating solar panels for more power harvesting, increasing the number of MOSFET for even better generation of the square waves, investigating hybrid storage options to boost energy reliability in the face of changing environmental circumstances, and integrating sophisticated control systems, such as microcontroller-based monitoring, to maximize performance and facilitate fault diagnosis.

10. References

1. https://www.researchgate.net/publication/337689469_Solar_Based_Inverter_Design_A_Brief_Review
2. https://ieeexplore.ieee.org/abstract/document/8862620
3. Muhammad H. Rashid, “Power Electronics, Circuits, Devices, and Applications”, Third Edition, Pearson Education,Inc.,2004
4. https://how2electronics.com/boost-converter-basics-working-design-application/