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OBJECTIVES:

The objective of a hybrid solar inverter is to efficiently manage both solar power and grid power in a single system. These inverters are designed to work with solar panels to convert DC power generated by the sun into usable AC power for your home or business. Additionally, they have the capability to intelligently switch between solar power, battery power, and AC supply power to ensure a continuous and reliable power supply.

Key objectives of hybrid solar inverters include:

1. **Maximizing self-consumption:** By prioritizing the use of solar power generated system, hybrid inverters aim to minimize reliance on the system, thus reducing electricity bills.
2. **Energy storage integration:** Many hybrid inverters are compatible with battery storage systems, allowing excess solar energy to be stored for use during periods of low sunlight or during power outages.
3. **Backup power:** In the event of a power supply outage, hybrid inverters with battery backup can provide seamless transition to backup power, ensuring uninterrupted electricity supply.

Overall, the objective of hybrid solar inverters is to enhance the efficiency, reliability, and flexibility of solar power systems by integrating them with other energy sources and storage technologies.

III. COMPONENTS

- | | |
|--|---|
| 1. 12v,10w Solar Panel | 8. Resistor- 10k (2 quantity) |
| 2. 12v, Rechargeable Battery | 9. POT- 2k & 10k |
| 3. LM317 Voltage Regulator | 10. IC- CD4047 |
| 4. Capacitor – 0.1uf (2 quantity) & 1000uf | 11. Resistor- 220R 5W (2 quantity) |
| 5. IN4007 Diode | 12. Q1- P75N75, Q2- IRFP3205 |
| 6. Schottky Diode-3A,50V | 13. Step Up Transformer- 12v+12v 5A, 50W |
| 7. Resistors- 220 ohm & 680 ohms | 14. PCB Board (2 quantity) wires, 18W bulb. |

Components Details:

1. 12v,10w Solar Panel: A 12 v, 10w solar panel used for the charging of DC rechargeable battery. This solar panel is sufficient to charge the battery for external use, the battery is charged by this solar panel through the charging circuit which gives the appropriate supply to the battery. Solar panel charged the battery in only day time otherwise the battery is charged by the external supply i.e. our AC supply.

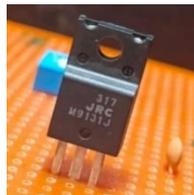


2. 12v, Rechargeable Battery: A rechargeable battery, Lead Acid battery, secondary cell, or accumulator is a type of electrical battery which can be charged, discharged into a load, and recharged many times. In our project we used Lithium ion 12V rechargeable battery, so we can charge the battery with the external supply also. The input from the Solar panel is charge the 12V battery by using charging circuit. Solar panel charged the battery in only day time otherwise the battery is charged by the external supply i.e., our AC supply.

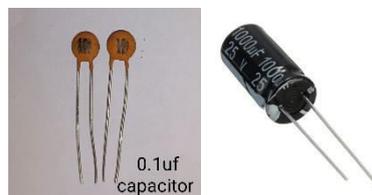


3. LM317 Voltage Regulator: The LM317 is a popular adjustable three-terminal positive voltage regulator integrated circuit (IC) commonly used in electronic circuits to provide a stable output voltage. The LM317 has three pins:

- **Input (Vin):** This is where the unregulated input voltage is connected.
- **Output (Vout):** This pin provides the regulated output voltage.
- **Adjust (ADJ):** This pin is used to adjust the output voltage. Connecting resistors between the ADJ pin and the output pin sets the output voltage.



4. Capacitors: Capacitors are fundamental electronic components that store electrical energy in an electric field. They consist of two conductive plates separated by an insulating material called a dielectric. When a voltage is applied across the plates, positive charge accumulates on one plate while negative charge accumulates on the other, creating an electric field between them. There are various types of capacitors. We use Ceramic and Electrolytic capacitor in this project, Two 0.1uf ceramic capacitor & one 1000uf Electrolytic capacitor.



5. IN4007 DIODE: The 1N4007 diode is a robust and cost-effective component widely used in various electronic circuits. The 1N4007 diode is commonly used in power supply circuits to convert AC voltage to DC voltage, IN4007 used because of it easily available, low cost, and have reliable performance. The forward voltage drop of the 1N4007 diode is typically around 0.7 volts when conducting current in the forward direction. The maximum forward current rating is 1 ampere, making it suitable for low to moderate current applications.



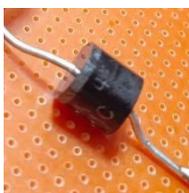


6. 18W bulb: An 18W bulb typically refers to the power consumption of the bulb, not the voltage. To power an 18W AC bulb with a 12v DC power source, we used a 12v to 220v step-up transformer capable of handling at least 18W of power. This ensures that the transformer can provide enough voltage and current to illuminate the bulb properly.

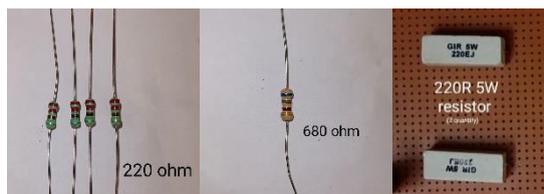


7. Schottky Diode-3A,50V:

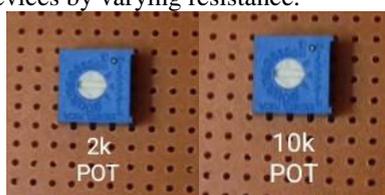
A Schottky diode, rated at 3A and 50V, is a type of diode that uses a metal-semiconductor junction to provide a low forward voltage drop and fast switching characteristics. Schottky diodes have a much lower forward voltage drop compared to standard silicon diodes, typically around 0.3 volts or less. Due to their unique construction, Schottky diodes have very fast switching characteristics. The diode you specified is rated for a maximum forward current (IF) of 3A, making it suitable for medium to high-current applications.



8. Resistors: Resistors are passive two-terminal electronic components that resist the flow of electrical current. They are widely used in electronic circuits for various purposes such as voltage division, current limiting, and signal attenuation. Their specific resistance values determine their roles in circuits. We use 220 Ω , 680 Ω , resistors in DC Battery charging circuit. In Inverter circuit we used 10k Ω , 10k Ω , normal resistors and 220R 5W (2 quantity) through hole resistor. Resistors are essential components in electronic circuits, providing control over current flow and voltage levels.

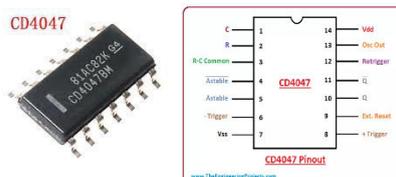


9. Potentiometer (POT): Potentiometers, also known as POTs, are variable resistors that allow you to adjust the resistance manually. They're commonly used in electronic circuits for tasks like volume control, brightness adjustments, and motor speed control. We used 2k & 10k POTs in inverter and DC battery charging circuit. A 2k potentiometer has a total resistance of 2,000 ohms, while a 10k potentiometer has a total resistance of 10,000 ohms. They're often used to control electrical devices by varying resistance.





10. IC-CD4047: The CD4047 is an integrated circuit (IC) commonly used in electronic circuits for generating stable multivibrator waveforms. It can function as either a monostable or astable multivibrator, making it versatile for various timing applications in electronics. Its ability to generate precise square wave signals at specific frequencies makes it useful in projects like timers, oscillators, and frequency dividers. To adjust the frequency of the output square wave signal & duty cycle of the output waveform we use potentiometer.



11. Q1- P75N75, Q2- IRFP3205: P75N75 and IRFP3205 are both the power MOSFET transistors commonly applications, particularly in power supply circuits, motor control, and audio amplifiers. They are known for their high power-handling capabilities and efficiency. The P75N75 is an N-channel MOSFET, while the IRFP3205 is also an N-channel MOSFET but with higher voltage and current ratings.



12. 12v-220v step up transformer: A 12v to 220v step-up transformer is commonly used to increase the voltage from a 12v DC power source (such as battery or a solar panel) to 220v AC, which is the standard voltage for household appliances in many countries. It's often used in applications where you need to power devices that require higher voltage than what's available from the power source.



WORKING:

1. Working of Charging circuit: The circuit uses a 12v solar panel and an adjustable voltage regulator LM317, solar panel consists of 1.2v rated solar cells. Pot RV1 is used to set the output voltage to the battery. Diode D2 prevents the discharge of battery. The circuits complete together and charge the DC battery which is connect to charge through the solar charging circuit. DC battery stores the power and transfer towards the inverter circuit.

2. working of Inverter Circuit: The inverter circuit is basically a multivibrator. The negative voltage passing through the capacitor C1 (0.1uf) turns off the transistor Q1 (P75N75) which causes the capacitor C1(0.1uf) to initiate charging through resistor R and Vcc, as well as through the base emitter of transistor Q2 (IRFP3205). This causes the transistor Q2 (IRFP3205) to acquire the momentary ON state. As soon as the voltage in capacitor C2 (1000uf) is sufficient to turn ON transistor Q1, Q1 switches ON and forces capacitor C1 to initiate discharging. The above process keeps recycling causing a sustained and alternate switching of the transistors as long as the circuit in the powered state and produces a near sinusoidal wave of frequency 60 Hz.



ADVANTAGES:

- The daily output will be more stable- since the inverter is run by two sources. Both energy sources may offset the demand in output mutually.
- Providing uninterruptable power supply- when solar power supply is not available load connects with main power supply and when both solar and mains power supply is not available load connects to the battery backup.
- It utilizes clean energy and doesn't involve any conventional fuel. So there is no chance of pollution by any means.
- The efficiency of the process is more as no moving parts are involved. Also this hybrid inverter has higher efficiency than conventional inverters as it mainly uses the solar energy and takes power from AC mains only when it is absolutely necessary.
- It doesn't require frequent maintenance and operating cost is also less.

DISADVANTAGES:

- One of the main problems in Solar Inverter system is inefficient charging of Battery during cloudy weather condition.
- Initial cost is high and area required for installation is high.
- If the battery is dead the whole circuit fails.
- The battery needs to be monitored and serviced on a regular basis and also we have to replace the battery after a interval of 2-3 years.

IV. CONCLUSION

- Sun, being source of clean, pollution-free energy and Photovoltaic power production is gaining more significance as a renewable energy source due to its various advantages. The advantages include everlasting production scheme, ease of maintenance, and direct sunbeam to electricity conversion. However the high cost of installations still forms an obstacle for this technology. Moreover the PV panel output power fluctuates as the weather conditions, such as the luminosity of the solar beam, cell temperature etc.
- The desired design of the system will produce the desired output of the project. The inverter will supply an AC source from a DC source.
- The project described is valuable for the promising potentials it holds within. Ranging from the long run economic benefits to the important environmental advantages. This work will mark an attempt and contribution in the field of renewable energy and can be implemented extensively.

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