Hybrid Inverter Using Solar Battery Charger

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Abstract - *This report presents a study on the hybrid inverter using solar charger, which combines two renewable energy sources, solar energy and electricity from the grid, to generate power for domestic and commercial use. The hybrid inverter technology has gained popularity in recent years due to its high efficiency, reliability and cost effectiveness. The report describes the design and working principle of the hybrid inverter, including its components such as solar panels, batteries, and charge controllers. The results of testing and analysis indicate that the hybrid inverter is a promising technology that can contribute to the reduction of energy consumption and carbon emissions.*

Key Words: **Hybrid, Inverter , Solar , Battery, charger, Renewable, Energy**

1.INTRODUCTION

The increase in global energy demand and the depletion of fossil fuels have led to the exploration of alternative sources of energy, including solar energy. Solar energy is a renewable source of energy that is abundant, environmentally friendly and cost-effective. The use of solar energy can be combined with the electricity from the grid to generate power using a hybrid inverter. The hybrid inverter technology has gained popularity in recent years due to its high efficiency, reliability and cost effectiveness.

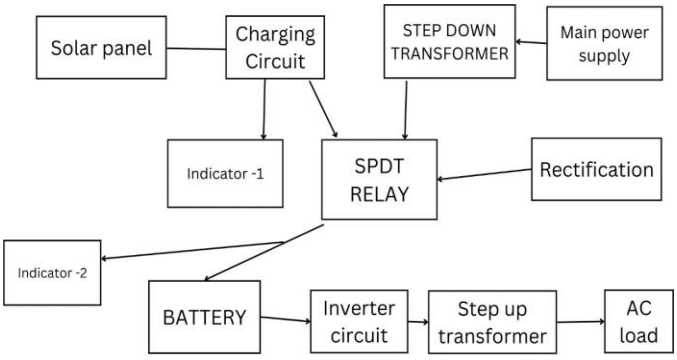

Fig-1: Block Diagram

1.1 Design And Working Principle

The hybrid inverter using solar charger is a device that combines two renewable energy sources, solar energy and electricity from the grid, to generate power for domestic and commercial use. The device consists of solar panels, batteries, charge controllers, and an inverter. The solar panels convert sunlight into electricity, which is then stored in batteries through the charge controller. The inverter converts the direct current (DC) stored in the batteries to alternating current (AC), which can be used to power domestic and commercial appliances.

The hybrid inverter is designed to operate in two modes, namely, the grid-tied mode and the standalone mode. In the grid-tied mode, the inverter is connected to the grid and uses electricity from the grid to supplement the power generated by the solar panels. In standalone mode, the inverter uses only the power generated by the solar panels and the batteries.

2. TITLE INFORMATION

An intelligent hybrid inverter, also known as a smart grid inverter, is a new type of dedicated U.P.S. (Uninterruptible Power Supply) system that can charge the system storage battery using both electrical and solar energy. The system storage battery can then be used to generate electricity if one or both energy sources are unavailable. Solar energy is typically only produced during the day, with midday being the peak time. This electricity fluctuates and is not coordinated with the household's use of electricity. Energy must be stored for later use and managed intelligently in order to close the gap between what is produced and what is needed during the evening hours when solar electricity production is not taking place.

A DC-AC power converter is essentially what an inverter is. In the context of power electronics, the term "inverter" refers to a type of power conversion circuits that operate from a source of dc voltage or dc current and convert it to ac voltage or current. Although a dc source is the input to an inverter circuit, it is not unusual for this dc to come from an ac source, such as a utility ac supply. Hence, for instance, a

utility ac voltage supply that is transformed to dc by an ac to dc converter and then inverted back to ac using an inverter could serve as the main source of input power. Hence, the output could have a frequency and magnitude that differs from the input ac.

3. LITERATURE REVIEW

Several research at the national and international levels have looked into ways to cut back on electricity use and boost energy efficiency in institutional and governmental buildings during peak times. These studies demonstrate that it is relatively feasible to restrict the growth in energy use without suffering harmful consequences. In order to diversify energy sources and streamline the energy requirements of various activities without impeding development goals, the Egyptian government has devised a strategy to implement a number of policies through the year 2022.

3.1 Components

3.1.1Solar panel

Solar panels with photovoltaic technology use sunlight as a source of energy to produce electricity. A bundled, connected assembly of typically 6x10 photovoltaic solar cells is known as a photovoltaic (PV) module. A photovoltaic system's photovoltaic array, which generates and supplies solar electricity for use in both commercial and residential applications, is made up of photovoltaic modules. According to its DC output power under standard test circumstances (STC), each module is given a rating, which normally varies from 100 to 365 Watts (W). An 8% efficient 230 W module will have twice the area of a 16% efficient 230 W module for the same rated output. This is because module efficiency impacts module size. Solar panel 3.1.1

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3.1.2RECHARGABLE 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, as opposed to a disposable or primary battery which is supplied fully charged and discarded after use.

3.1.3 Op Amp

The IC 741 operational amplifier looks like a small chip. The most significant pins are 2, 3 and 6, where pin 2 and 3 denotes inverting & non-inverting terminals and pin6 denotes output voltage. The triangular form in the IC signifies an op-amp integrated circuit. The current version of the chip is denoted by the famous IC 741 op amp.

3.1.4 12V Single Changeover Relay

An electrically controlled switch is a relay. Solid-state relays are one type of working principle, although many relays employ an electromagnet to mechanically operate a switch. Relays are employed when multiple circuits need to be controlled by a single signal or when a separate low-power signal is required to control a circuit.

3.1.5 Diode

The diodes are of the axial kind. They are simple to mount on the multipurpose PCB. This diode's key characteristics are:

- Good reliability
- low forward voltage drop
- high current capacity,
- high surge current capacity

3.1.6 Transistor

A transistor is an NPN (negative-positive-negative) transistor that is employed in a variety of applications. It can be used as the active component for switches and amplifiers along with other electrical parts including resistors, coils, and capacitors. This kind of NPN transistor has an emitter terminal, a base or control terminal, and a collector terminal, much like all other NPN transistors.

3.1.7 Transformer

A transformer is a static device with no moving elements that transfers electrical power between circuits while varying the voltage and current but not the frequency.

A step-down transformer is one that reduces voltage from primary to secondary by having fewer secondary winding turns than primary winding turns. A step-up transformer is one with more secondary winding turns than primary winding turns and boosts voltage from primary to secondary. The mutual induction theory underlies the operation of an electrical transformer.

4. WORKING PRINCIPLE OF HYBRID INVERTER – USING SOLAR BATTERY CHARGER

Hybrid inverter using solar charger is combination of two circuits

1.Charging circuit.

2.Inverter circuit

4.1 Charging Circuit

When the solar panel's output reaches 12 volts in the charging circuit, the battery is charged using solar energy. The battery is charged using the AC mains power source when the solar panel's output falls below 12 volts. The 12 volt SPDT (single pole double throw) relay is used for this switchover.

In direct sunlight, a solar panel consistently produces 12 volts. When this happens, the Zener diode enters the breakdown zone and delivers 11 volts to the comparator's inverting terminal. The comparator's output turns high and is shown by a glowing green light at this point since its non-inverting input has received a greater voltage. The transistor then conducts and the relay energizes.

4.2 Inverter Circuit

Operation-1: Charging From AC Mains

The battery receives the charging current from the transformer-based power source through the Normal Close(N/C) and common contacts of the relay when solar power is not available but AC mains is. This power supply has a step down transformer that converts 230 volts of alternating current to 15 volts of direct current, two rectifying diodes, and a smoothing capacitor that eliminate voltage ripple.

The relay changes to AC power when the solar panel's output is less than 12 volts, charging the battery from the AC mains while the indicator red LED illuminates. When the solar panel's output is greater than 12 volts, the relay switches to solar power.

Operation-2: Charging from Solar Panel

The 12V, 10W solar panel produces 12 volts DC and up to 0.5 amps of current under direct sunlight. A capacitor buffers the power from the solar panel, while a diode protects against reverse polarity. OP-AMP is employed as a straightforward voltage comparator.

The non-inverting input of the IC receives power from the solar panel, while the inverting input of the comparator receives a reference voltage of 11 volts from the Zener diode. Indicated by a flashing green LED, the comparator's output turns high when the solar panel delivers 12 volts at its output port. The relay then energizes to the normally-open (N/O) state and the transistor conducts, allowing the battery to receive the solar panel's charging current through its N/O and common contacts. So we are able to continuously charge the battery using both the AC mains and the solar panel.

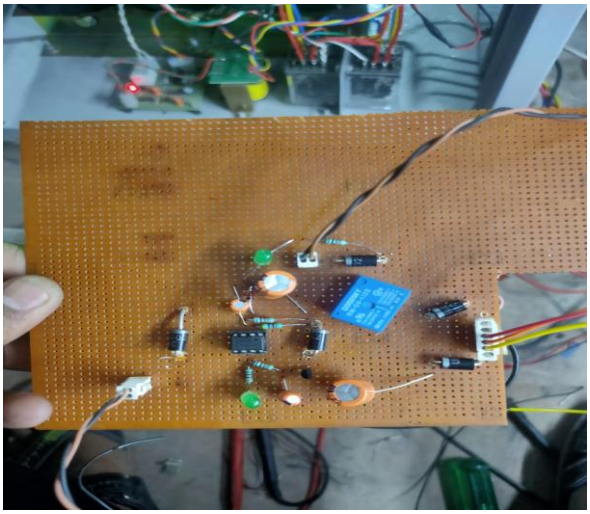
Operation 3: To Operate The Load

Now, we operate an ac load while charging the 12 volt battery with dc electricity inside the charging circuit. Thus, to increase the voltage to 230 volts, we first utilize an inverter circuit and then a transformer.

The multivibrator circuit that controls the output frequency is made up of two MJE13003 NPN transistors, two 1F electrolytic capacitors, two 680 resistors, and two 16.5K resistors. It's mainly the 1μF capacitors and the 16.5KΩ resistors that chiefly set the frequency. The time constant that the output switches on and off at is given by the formula =RC= (16.5K)(1F)=0.0165s because the resistor and capacitor pair forms an RC network. The frequency, or f, is equal to or less than the time constant, or 1/0.0165s, or 60Hz.

A multivibrator makes up this portion of the circuit. It produces a waveform that resembles a sinusoidal wave. Both transistors are off when one is turned on. Because of the capacitor's nearly sinusoidal charging cycle.

5. RESULTS



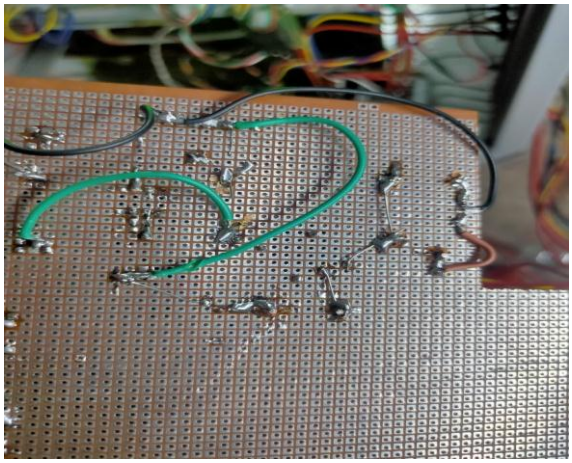


Fig 2,3- PCB design of Inverter Circuit

A hardware prototype is a standard model that complies with the project's requirements. The prototype shown below can successfully use solar energy as well as ac mains and can provide the load continuously.

Charging circuit:

The charging circuit which offers two modes of battery charging i.e one from AC mains and other from solar power.

Inverter circuit:

This circuit helps to invert the 12v dc to 230v ac to operate the loads.

6. Advantages and Disadvantages

Advantage

The daily output will be more stable- since the inverter is run by two sources. Both energy source may offset the variation in output mutually. The overall system will be more stable during the day and during the night, since main power supply is not limited by sunlight. Of course, the supply will be higher during the day but is does not drop to zero at night.

Providing uninterruptable power supply- when solar power supply not available load connect with main power supply and main power supply not available load connected with inverter power supply.

Disadvantage

One of the main problems in Solar Inverter system is inefficient charging of Battery during cloudy weather condition. The high battery requires more than 1 Ampere current for proper charging. To solve this problem, we made a" Hybrid Solar charger" circuit. So the charger has two sides. One side gets power from Solar panel and the other side from a Step-down transformer. If the voltage from Solar panel reduces below 9 volts, the charger shifts to AC mode and battery charges via the current from transformer.

7. Conclusion

The hybrid inverter using solar charger is a promising technology that combines two renewable energy sources, solar energy and electricity from the grid, to generate power for domestic and commercial use. The technology is cost effective, environmentally friendly, reliable, and has high efficiency. The use of Hybrid inverter can contribute to the reduction of energy consumption and carbon emissions. Therefore, the hybrid inverter is recommended for use in domestic and commercial applications.

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