HYBRID INVERTER WITH SOLAR BATTERY CHARGING

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Abstract: - Conventional energy sources are on the verge of extinction forcing the world to switch onto non-conventional energy sources which have their abundance in nature and are environment friendly More and more countries are establishing high renewable energy targets in their energy systems. The earliest kind of renewable energy is solar energy. Solar energy varies in a day and it is difficult to rely on Solar completely. This work focuses on increasing the reliability on the Solar energy by designing a hybrid inverter with over voltage protection that is required to power AC loads that are typically used as consumables. The suggested microprocessor controllers allow for a customizable inverter setup. The proposed battery charge controller can extend the battery service life along with an overvoltage protection circuit for the load.
Keywords: Solar energy, inverter etc.

I. INTRODUCTION

Solar energy is the ideal solution for power generation, as it can replace fossil fuels such as coal and gas, which pollute the air, water, and land. Solar energy (in the form of DC) can be stored in a battery for later use. A converter that transforms DC to AC power is known as an inverter. In the context of power electronics, the term "inverter" refers to a type of power conversion circuit that takes a DC voltage or current and transforms it into ac voltage or current. Even though a DC source is required as input to an inverter circuit, this dc is rarely derived from an ac source such as a utility ac supply. The importance of a solar inverter is growing by the day. It's a typical inverter, but it uses "solar energy," which is energy derived from the sun. This type of inverter aids in the conversion of DC to AC using solar electricity. DC power runs in one way in this circuit, and it also helps to supply current when there is no electricity.

Inverters are widely utilized in a variety of industrial applications, including induction motor drives, uninterruptible power supply, electric vehicle power systems, renewable energy sources, and other fields of power electronics. Different topologies, such as single-phase and multiphase systems, are available. The major goal of all investigations is to reduce the number of switches while improving the output voltage and load current quality.

A hybrid inverter, also known as a smart grid inverter, is a popular type of inverter for solar applications that use renewable energy for household use, particularly solar photovoltaic installations. A hybrid inverter (also known as a multi-mode inverter) is an inverter that can manage inputs from both solar panels and a battery bank at the same time, charging batteries with either solar panels or power from the grid (depending on which is more economical or preferred). However, certain devices can handle inputs from wind turbines, generators, and other power sources, thus their capabilities may extend beyond this.

The goal of this study is to design a 20W Lithium-Ion battery-powered hybrid inverter. The suggested system can operate in both standalone and grid-linked modes, as well as fluidly transition between grid connected and grid disconnected modes. The solution is based on a conventional microgrid power electronics cell concept.

II. OBJECTIVES

- The main objective of this project is to design and construct a PV based system that produces electric energy and to maximize the consumption of solar energy.
- The possibility of frequent power failures is reduced.
- The single-phase hybrid inverter with battery energy storage which is suitable for required output load is to be designed.
- To provide over voltage protection for output load.

III. LITERATURE REVIEW

Photovoltaics is a proven technology capable of making a substantial contribution to a sustainable global energy system. Its widespread use in all geographic regions, versatility in application, modularity in scale enables a socially acceptable energy transition by offering distributed electricity generation, employment and new business opportunities.

Several national and international studies have looked into the possibilities of reducing electricity usage and improving energy efficiency in institutional and governmental buildings during peak hours. These studies illustrate that increasing energy use can be limited without having detrimental consequences.

As a result, the Indian government has devised a strategy to adopt several policies by 2030 to diversify energy resources and streamline the energy requirements of various activities without impeding development goals. Taking executive initiatives to improve energy efficiency to reduce overall energy consumption by 8.3 percent by 2030 and attaining a 20 percent renewable energy generation mix by 20 are two of these policies.

More recently, both battery and photovoltaic technology developments are being accelerated by intensive marketing and strong policy support. The cost of battery production has been decreased significantly in the last three years. Solar panel production has been increased rapidly and that too for the one third of the cost.

IV. METHODOLOGY

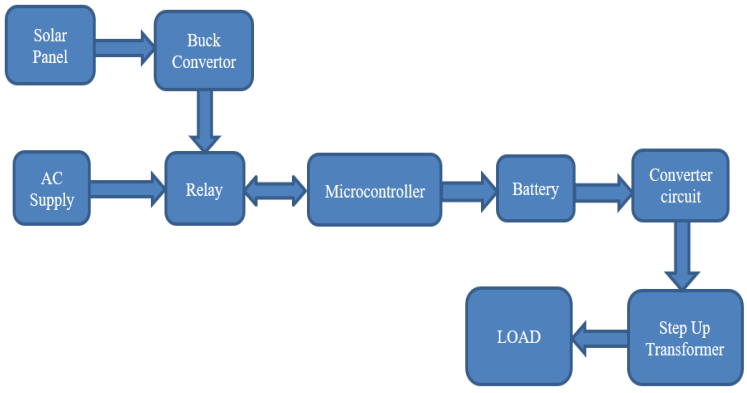


Fig.1 Block Diagram of Hybrid Inverter

The system is composed of supply unit, switching unit, storage unit and convertor unit. Supply unit consists of the types of conventional and unconventional sources that is one from the Ac mains supply and the other from the Solar panel. Switching unit consists of number of relays which sense the abundance of voltage supply and switch onto the available source of energy which is commanded by a microcontroller.

Furthermore, the excessive current is stored in a battery for future or emergency uses. After this stage, the current is converted from DC to AC for the load via a convertor circuit and is stepped up to the required value for the load by a step-up transformer.

V. CIRCUIT IMPLEMENTATION

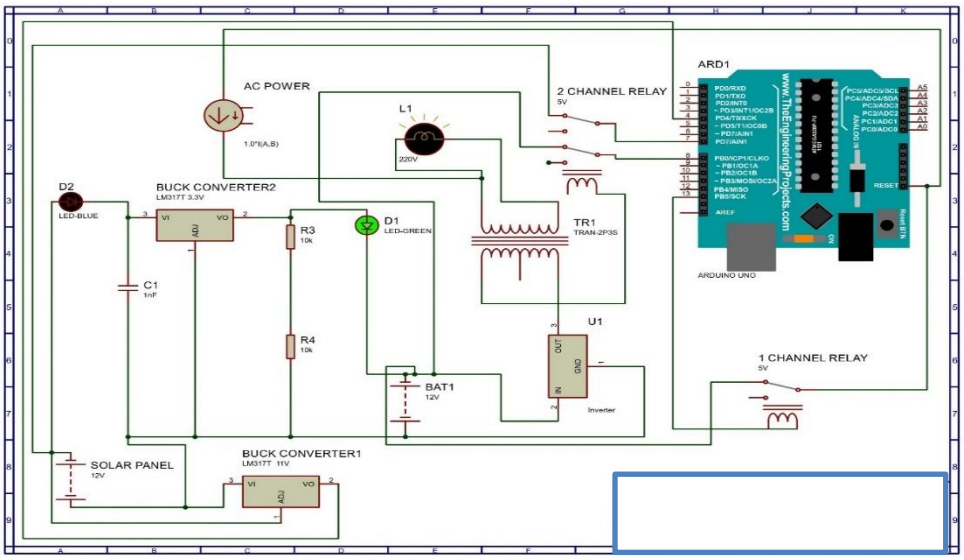


Fig.2 Circuit Diagram of Hybrid Inverter

The hybrid inverter circuit (Fig.2) comprises of Solar panel, Buck converters 1&2, Diode D1 &D2, Inverter unit U1, step-up transformer T1,1 channel relay, double channel relay, Arduino ARD1, battery BAT1, Resistors R3&R4, Capacitor C1 and Load L1.

In this circuit, Buck converter is used to step down the voltage level available from the Solar panel to a minimum level which can be detected by the microcontroller without harming it. It steps down from 11v to 3v which the optimum working voltage for an Arduino Board. Capacitor C1 acts as a high frequency filter and avoids oscillation problems.

Inverter unit consist of a converting unit and an overvoltage protection circuit as well.
Converting unit consists of SG3525a which is extensively used in DC-DC converters, DC-AC inverters, home UPS system, solar inverter, power supplies, battery chargers and numerous applications. A sync input to the oscillator allows multiple units to be slaved or a single unit to be synchronized to an external system clock. A single resistor between the CT and the discharge terminals provides a wide range of dead time adjustment. These devices also feature built-in soft-start circuitry with only an external timing capacitor required.

Overvoltage protection circuit (Fig.3) consists of BC547, resistors and diodes. BC547 can transfer current and regulate voltage up to 5.1 V and blocks anything less than 5 V. Diodes and Resistor are two components that protect the output from protection from over-voltage.

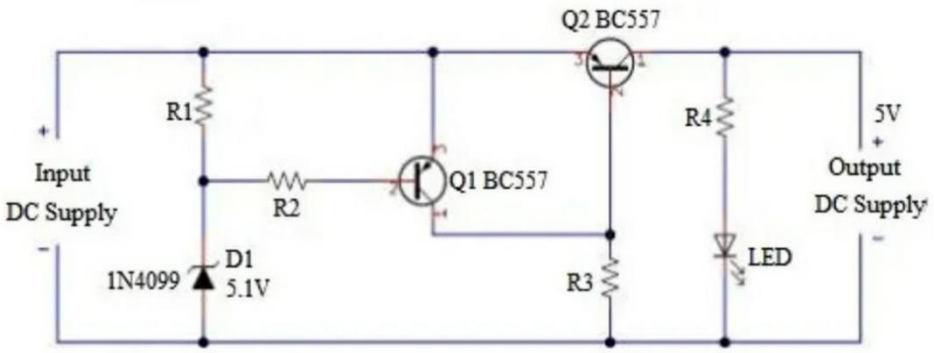
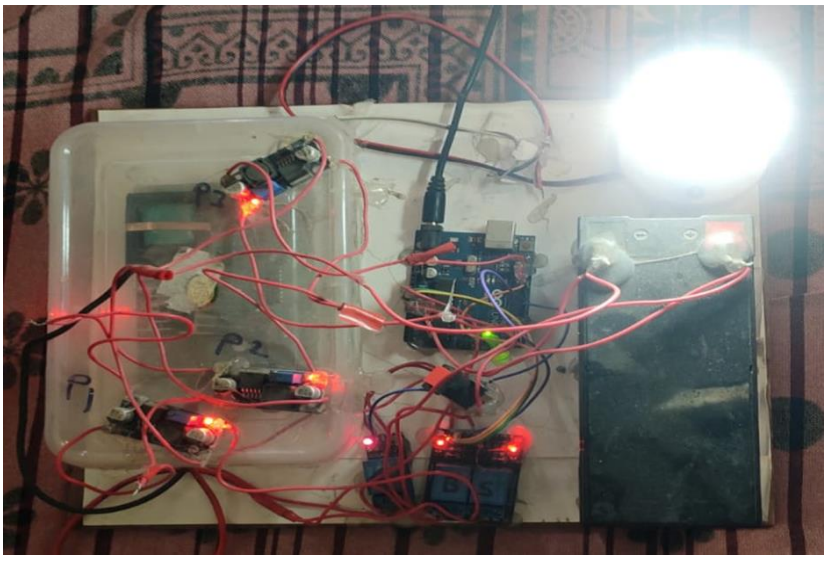


Fig. 3 Overvoltage protection circuit

VI. RESULT

The hybrid inverter is successfully made and tests were made to ensure the smooth functioning of the system. Project Specifications are as follows :

1. Solar Panel (Polycrystalline Type):
   Rated Power (Pmax) : 37 W ±3%
   Voltage at Max Power (Vmp) : 17.7 V
   Current at Max Power (Imp) : 2.15 A
2. Battery :
   Output Terminal Voltage : 12 V
   Battery Capacity : 8 AH
3. Load :
   9 W LED Bulb
   Output AC Voltage : 230-240 V/AC (±10%)
   Output AC Frequency : 50 Hz ((±5%)



VII.CONCLUSION

Photovoltaic power production is gaining more significance as a renewable energy source due to its many advantages. These advantages include everlasting pollution free energy production scheme, ease of maintenance, and

direct Sunbeam to electricity conversion. However, the high cost of PV installations still forms an obstacle for this technology. Moreover, the PV panel output power fluctuates as the weather conditions, such as the insolation level and cell temperature. The described 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 one of the few attempts and contributions in the world in the field of renewable energy; where such projects could be implemented extensively.

With the increasing improvements in solar cell technologies and power electronics, the role of inverters cannot be neglected and justified without the extensive use of power electronics especially IC SG3525A and relays which ricochet the inverter to hybrid inverter. Relays are the most important part of the project which enable the smart and efficient switching from either of the sources be it conventional or non-conventional which overcomes the limitations provided by Solar panel due to irregular radiations.

Also, the hybrid inverter with solar battery charging provides a continuous power source during power outages, It's also cost-effective, pollution-free and environmentally friendly. A solar hybrid system can store extra solar energy and provide backup power in the event of a blackout. Because the inverter offers continuous electricity, this project can be used in places like hospitals and educational institutions. All of the proposed circuit topologies in this paper are for a single-phase inverter system. Combining solar with wind energy and other renewable sources, as well as over-voltage protection for the load, might increase its reliability.

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