



Hybrid Solar inverter

Prof.R.S.Desai¹, Verma Shashikant Rajbhadur², Noman Parvez³, Mayank Upadhyay⁴

¹Assistant Professor, Department of Electrical Engineering, Bharti Vidyapeeth Deemed (to be) University, College of Engineering,

^{2,3,4}Pune, India UG Student, Department of Electrical Engineering, Bharti Vidyapeeth Deemed (to be) University, College of Engineering, Pune, India

Abstract

This paper is built in such a manner that it uses solar energy to circumvent this constraint. An inverter powered by a 12V battery makes up the Hybrid Inverter with Solar Battery Charging System. With the aid of driver circuitry and a heavy load transformer, this inverter can generate up to 230V AC. This battery is charged from two different sources: the mains power supply and solar power. If a mains power source is available, the relay will switch to the mains power supply to provide the load. This power supply also charges the battery, allowing it to be used as a backup in the event of a power loss in the future. The usage of a solar panel to charge the battery provides an additional benefit of extra power in the event that the mains power loss continues. As a result, this inverter can operate for extended periods of time and offer a continuous power supply to the user.

1 Introduction

Hybrid inverters are also called smart grid inverters. In view of the growing demand for energy and environmental issues, alternative methods of using non-renewable and environmentally harmful fossil fuels should be explored. One such alternative is solar energy. Hybrid inverter-a new generation. Dedicated UPS (uninterruptible power supply) with self-use renewable energy, especially suitable for photovoltaic solar systems. Due to the volatility of solar energy, it needs to be stored, and at certain times it only receives very small amounts of radiation. For example, if the weather is very cloudy, the energy generated by the collector will be very small. The storage system can store the excess energy generated during peak hours and release it again when the power drops. Direct current (DC) to alternating current (AC) equipment: With appropriate switching transformers and control circuits, the generated alternating current can have any desired voltage and frequency.

Uses of Solar Energy

People spend energy doing many things, but some common tasks use up the most energy. These tasks include transportation, heating, cooling, and power generation. Solar energy can be used for all four tasks with varying degrees of success.

I. HEATING

Heating is the business that solar power is best for. Solar heating requires almost no energy conversion and is therefore very efficient. Thermal energy can be stored in a liquid such as water or in a fixed bed. It is a container filled with small objects that can hold heat (like stones) with airspace between them. Thermal energy is also often stored in heat fusion or phase change units. These devices use a chemical that changes phase from solid to liquid at a temperature that can be generated by the solar panel itself, itself can later be used by allowing the chemical to return to its solid state. Solar energy is often used in residential buildings to heat water. This is an easy application, as the end result (hot water) you want is the memory. A hot water storage tank is filled with hot water during the day and emptied if necessary. This application is a very simple setting of normal fossil fuel water heaters.

II. COOLING

Solar energy can be used not only for heating, but also for other purposes. It may seem strange, but one of the most common uses of solar energy today is cooling, as solar cooling is much more expensive than solar heating, which is why it almost never occurs in private homes. Solar energy is used to cool things by using heat to convert the phase of a liquid to a gas and then forcing the gas into a lower pressure chamber, the temperature of a gas depends on the pressure it contains, and if all the other things the same, the same gas under a lower pressure has a lower temperature. This cold gas is used to absorb heat from the area of interest and is then forced into a higher pressure area where excess heat is lost to the outside world

III. TRANSPORTATION

Among the most important energy sources, solar energy is the least suitable for transportation. While large and relatively slow vehicles (such as boats) can be powered by large on-board solar panels, small, constantly rotating vehicles (such as cars) cannot. It can be fully powered by solar energy; it will use batteries, use solar energy to charge at a fixed point, and then charge in the car. Electric vehicles, some of which are powered by solar energy, are now available, but solar energy is unlikely to cover global transportation costs in the near future.

IV. GENERATION OF ELECTRICITY

Besides getting used for heating and cooling, sun electricity may be without delay transformed to strength. Most of our gear is designed to be pushed through strength, so if you may create strength thru sun power, you may run nearly something with sun power. The sun creditors that convert radiation into strength may be both flat-aircraft creditors and focusing creditors, and the silicon additives of those creditors are photovoltaic cells. Photovoltaic cells, through their very nature, convert radiation to strength. This phenomenon has been recognised for nicely over 1/2 of a century, however till these days the quantities of strength generated had been excellent for little extra than measuring radiation intensity. Most of the photovoltaic cells available in the marketplace these days' function at a performance of much less than 15%; that is, of all of the radiation that falls upon them, much less than 15% of its far transformed to strength.

2 Need of Solar Inverter

There are two types of sources for generating electrical energy, one is conventional the other is unconventional, today, most of the electrical energy is generated using conventional sources such as coal, gas, nuclear power generators, some of the conventional sources polluting the environment to generate electricity produce. And nuclear power is not very preferable to humanity because of its harmful radiation effects. After about ten years, conventional sources will not be enough to meet human needs. Therefore, some of the electrical energy has to be generated by unconventional ones. Energy sources such as sun, wind, with the continuous reduction in the cost of photovoltaics and the further worsening of the energy crisis, photovoltaic energy generation technology is increasingly used. Alternating current (AC) consists of a sinusoidal voltage source in which an ever changing voltage (and current) can be used to make use of magnetic components. Electrical transmission over long distances favours alternating current, as the voltage can be easily increased by using transformers. By increasing the voltage, less current is required to deliver a given amount of power to a load, thereby reducing the resistance loss across the conductors. AC power has created a trend in which most devices convert AC power from an electrical outlet to DC power for use by the device. AC power is not always available, however, and the need for mobility and simplicity has given batteries an advantage in portable power supplies for portable AC power, inverters are required. Inverters take a DC voltage from a battery or solar panel as an input and convert it to an AC voltage output.

3 Working

Inverters are widely used in the domestic as well as industrial environments to serve as second line of source in case of power cut from the electricity utility grids. However, due to low capacity of the battery the inverter dies out with the use of heavy load appliances. This project is designed in such a way that it overcomes this limitation by the use of solar energy. Hybrid Inverter with Solar Battery Charging System consists of an inverter powered by a 12V Battery. This inverter generates up to 110V AC with the help of driver circuitry and a heavy load transformer. This battery gets charged from two sources, first being the mains power supply itself. If the mains power supply is available, the relay switches to the connection using mains power supply to supply to the load. This power supply also charges the battery for using it as back up the next time there is power outage. The use of solar panel to charge the battery gives an additional advantage of surplus power in case the power outage of mains is prolonging. Thus this inverter can last for longer duration's and provide uninterrupted power supply to the user

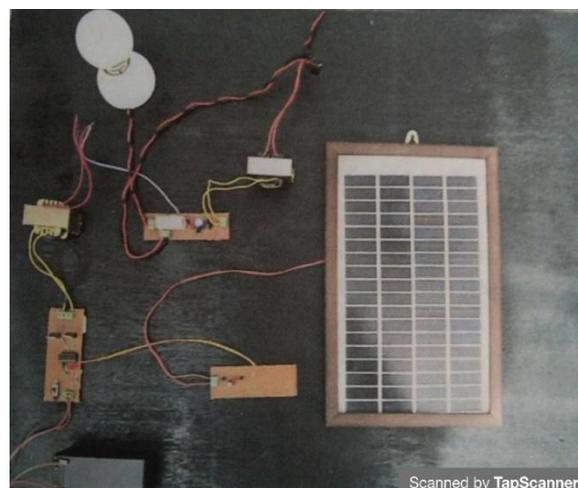


Fig1: Hybrid inverter with solar battery Charging

4 Solar inverter parts

There are few sections of the solar inverter they are:

i. Solar Battery Charger

A battery charger is a device used to put energy into a secondary cell or (rechargeable) battery by forcing an electric current through it. The charge current depends upon the technology and capacity of the battery being charged. For example, the current that should be applied to recharge a 12 V car battery will be very different from the current for a mobile phone battery. The solar battery recharger as the name suggest it is in fact a battery charger which charges a sealed rechargeable battery of 6V 4.5 AH in this case. The solar battery charger derives its power from the 12V 500mA solar panel. The solar panel which in turn converts the sunlight to electrical energy. The charger converts the raw 12V from the solar panel to a regulated voltage feed for the sealed rechargeable battery. The solar battery recharger features:

- a. Custom controllable voltage regulation.
- b. Auto cut-off when battery is fully charged.
- c. Filtered input from the solar panel.
- d. No current back flows from the battery.
- e. Very simple, compact and efficient.

ii. Solar Panel

Solar panel is a packaged connected assembly of solar cells also known as photovoltaic cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Because a single solar panel can produce only a limited amount of power, many installations contain several panels. A photovoltaic system typically includes an array of solar panels, an inverter and sometimes a battery and interconnection wiring.

Solar panels use light energy (photons) from the sun to generate electricity through the photovoltaic effect. The structural load carrying member of a module can either be the top layer or the back layer. The majority of modules use wafer-based crystalline silicon cells or thin-film cells based on cadmium telluride or silicon. The conducting wires that take the current off the panels may contain silver, copper or other non-magnetic conductive transition metals. The cells must be connected electrically to one another and to the rest of the system. Cells must also be protected from mechanical damage and moisture. Most solar panels are rigid, but semi-flexible ones are available, based on thin-film cells.



Fig 2: Solar Panel

iii. Rechargeable Battery

A rechargeable battery or storage battery is a group of one or more electrochemical cells. They are known as secondary cells because their electrochemical reactions are electrically reversible. Rechargeable batteries come in many different shapes and sizes, ranging anything from a button cell to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of chemicals are commonly used, including: lead acid, nickel cadmium (NiCd), nickel metal hydride (Nimitz), lithium ion (Li-ion), and lithium ion polymer (Li-ion polymer). Rechargeable batteries have lower total cost of use and environmental impact than disposable batteries. Some rechargeable battery types are available in the same sizes as disposable types. Rechargeable batteries have higher initial cost, but can be recharged very cheaply and used many times. Electrical connections are made in series to achieve a desired output voltage and/or in parallel to provide a desired current capability. Separate diodes may be needed to avoid reverse currents, in case of partial or total shading, and at night. The p-n junctions of mono-crystalline The battery used in this project is a rechargeable sealed lead sulphate battery rating 12V 4.5AH. This type of battery is excellent for rechargeable purpose



Fig 3: Rechargeable Battery

iv. Inverter

Since normal dc can't be used in most applications due to which there is a requirement that somehow the dc is changed to ac for this the inverter is used which converts the dc to ac of suitable range for use in household appliances. In this project the dc from the sealed rechargeable battery of 6V is fed to the inverter which then converts it to ac of 140V-220V. This makes it possible to recharge normal mobile chargers. An inverter is an electrical device that converts direct current (DC) to alternating current (AC), the converted AC can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits. Solid-state inverters have no moving parts and are used in a wide range of applications, from small switching power supplies in computers, to large electric utility high-voltage direct current applications that transport bulk power. Inverters are commonly used to supply AC power from DC sources such as solar panels or batteries. The inverter performs the opposite function of a rectifier.

Selection of Battery Size and Solar Panel

Suppose we need to design an inverter with a load of 40W and the backup time required by the battery is 1 hour. We need to consider the characteristics of the inverter and the number and quantity of solar panels required to calculate the solar inverter. They need batteries. In the following way.

The inverter must be 25% larger than the total load.

$$40 \times (25/100) = 10$$

$$40 + 10 = 50 \text{ W}$$

This is the output of the UPS (inverter)

Now the required backup time (hours) = 2.5 hours

Suppose we are installing 4.5 Ah, 6 batteries, $6 \text{ V} \times 4.5 \text{ Ah} = 27 \text{ Wh}$

Now to the battery (d)

So $1 / 0.675 = 2$, i.e., we now connect two 4.5Ah batteries, each 6V

So this is a 12V inverter system. Now we have to install two batteries in parallel (each 6V, 4.5 Ah). Because this is a 6V inverter system, the voltage of the 6V battery remains the same. Connected in parallel, and their Ah (Ampere hour) value has increased by twofold. When connected in parallel, the voltage of each cable or part is the same, but the current is different, that is, the current is added, for example, $11 + 12 + 13 \dots + I_n = 4.5 \text{ Ah} + 4.5 \text{ Ah} = 9 \text{ Ah}$

In a series connection, the current is equal in each wire or part, but the voltage is different, that is, the voltage is added, for example $V_1 + V_2 + V_3 \dots + V_n$ for the above system, if we combine these. If the batteries are connected in series instead of parallel, the battery capacity is $V_1 + V_2 = 12 \text{ V}$, and the rated current is the same, i.e., 4.5 Ah.

Now we connect 2 batteries in parallel (each 4.5Ah, 6V), so the two batteries are 9Ah 6V, now these two batteries need charging current (charging current should be 1/10Ah of the battery) $9 \text{ Ah} \times (1/10) = 0.9 \text{ A}$

The number of solar panels needed now

$$P = VI$$

$$P = 6 \text{ V} \times 0.9 \text{ A}$$

$$P = 5.4 \text{ W}$$

These are the wattages of solar panels we need (only for charging the battery, and then the battery powers the load), now

$$5.4 \text{ W} / 3 \text{ W} = 2 \text{ solar panels}$$

Or

$$5.4 \text{ W} / 6 = 1 \text{ solar panel}$$

5 Applications of Solar Inverter

1. Use DC power source

Inverter converts DC power source from battery, solar panel or fuel cell 10 power source into AC power source. Electricity can be any desired voltage; specifically, you can use AC equipment powered or rectified by mains to generate DC power at any voltage you want.

2. Uninterruptible Power Supply

Uninterruptible Power Supply (UPS) uses batteries and inverters to provide AC power when the utility power is unavailable. When the main power is restored, the rectifier provides DC power to charge the battery.

3. HVDC transmission

In HVDC transmission, alternating current is rectified, and high-voltage direct current converts the current back to alternating current. In the receiving position, the inverter in the static inverter system

4. General transformer

A can convert AC power to any desired voltage, but with the same frequency. It can be designed to convert any AC or DC voltage into any other voltage, including AC or DC voltage, with any frequency. The output power will never exceed the input power, but the efficiency is high, and the proportion of power dissipation as waste heat is small.

6 Conclusion

Due to its many advantages, photovoltaic energy generation is becoming more and more important as a renewable energy source. These benefits include a pollution-free perpetual power generation scheme, easy maintenance, and direct conversion of sunlight into electricity. This technology in addition, the output power of the photovoltaic module fluctuates depending on weather conditions such as solar radiation and cell temperature The system design described will provide the desired output of the project The inverter supplies an AC source from a DC source.

Reference

- [1] Khan, B.H, "Non-Conventional Sources of Energy", 5e, Mc Graw Hill Education(India).
- [2] Van Valkenburg, M.E, "Network Analysis", 3/e, Mc Graw Hill Education (India).
- [3] Milliman, Jacob, Christos Halkias, "Integrated Electronics", 2e, Mc Graw Hill Education(India).
- [4] Gupta, J.B. "Electronics Devices & Circuit", 3/e, S.K. Kataria & Sons, 2009.
- [5] Salivahanan, S. & S. Arivazhagan, "Digital Electronics", 3/e, Vikas Publication, 2007.
- [6] Fitzgerald, A.E., Charles Kingsley, Stephen D. Umans, "Electric Machinery", 3/e, Mc Graw Hill Publication (India).
- [7] Hussain, Ashfaq, "Electrical Machines, Second Edition", Dhanpat Rao Publications.