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Design And Operation of Hybrid Inverter of Capacity 1kW

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ABSTRACT

This study describes the installation of a prototype instant power supply (IPS) system that uses both hybrid energy sources and the AC grid to provide continuous output current to load in residential applications. In remote places where national grids are scarce and power outages diminish the effectiveness of intermittent power supply (IPS), a utility connecting PWM inverter that can run on both solar energy and storage batteries is extremely necessary.

Building a 1000 watt (1 kW) 220 volt inverter at a frequency of 50 Hz is the aim of this project. This item is built using materials that meet specified requirements and components that are sourced locally. Its main method of functioning is a straightforward conversion of 12V DC from a battery to 220V AC across a transformer's windings at a frequency of 50 Hz using integrated circuits and semiconductors. Thus, a supplementary power source with the same power output as the public power supply is made available at a reasonable cost.

Keywords: Inverter, Integrated circuits, Semiconductors, Transformer, Solar Panel.

1. INTRODUCTION

One crucial part of a solar energy system is the solar inverter. The conversion of the variable DC output of the Photovoltaic (PV) module into a good sinusoidal 50 Hz AC current is then applied directly to the commercial grid or to a local, off-grid electrical network [1]. A solar cell is the smallest solid-state device that converts the energy of sunlight directly into electricity through the photovoltaic effect. A photovoltaic module is an assembly of cells in series or parallel to enlarge voltage or current. An arrangement of modules on a structure is called a panel. An assembly of panels at a location is called an array [2]. Essentially, the communications feature allows users to monitor and report on power and operating parameters, regulate the inverter grid connection and give firmware updates. A real-time microprocessor powers the inverter.

2. OBJECTIVE

The main objective of our projects is to design and construct a PV based system that produces electric energy and operates in dual mode, supplying stand-alone AC loads while minimising its cost and size. The system's main property is the production of quality electricity from a renewable source dependency on fossil fuels and the associated emissions of pollutants.

3. BASIC PRINCIPLE OF SOLAR INVERTER

A solar inverter, commonly referred to as an inverter, transforms the fluctuating direct current output of a photovoltaic solar panel into utility frequency alternating current, which can be fed into a commercial electrical grid or utilised by a nearby off-grid electrical network. It is an essential part of a solar system that permits regular commercial appliances to be used. Solar inverters are designed with specific features like maximum power point tracking and anti-islanding protection specially for use with solar arrays [3].

A. Inverter Specifications

A solar charge controller is part of an integrated system called a solar inverter. AC mains charger with inverter. Batteries can be charged by sharing current or by using solar, grid or DC power. The system prioritises solar power and only turns to the grid when solar power or battery charge is not enough to meet the load requirements. The load, solar power output and battery voltage are all constantly monitored. The solar UPS automatically disconnects [4] from the system when the batteries reach a present level of charges. The UPS then uses the batteries to run the load at maximum capacity while minimising the amount of energy drawn from the grid.

B. Salient features of proposed Inverter

- Most sophisticated integrated solar backup system.
- Clever and automatic use of the solar electricity that is available.
- Solar energy is preferred when it is accessible.
- When in backup mode, the output is a pure sine wave.
- Powerful battery charger that shares current.
- Possibility of turning off grid charger.(If the solar current is greater than three Amps)
- Selectable tubular battery charger to keep battery in top condition[5].
- Smart overload and short circuit protection.
- Intelligent thermal management system.
- LCD display to monitor the system.

C. AC mains mode specifications

AC input range 100V to 290V (wide range), 180V to 265V (narrow range)+10V change over 50 milliseconds(wide range), <10 milliseconds(narrow range) AC charging current 14 Amp+1 Amp maximum.

D. LCD Display

When Grid Present: AC Voltage, 7 Battery Charging Status, Battery Level, Solar Module Status, Solar Ampere.

IN Backup: Backup Mode ON/OFF, Hybrid Mode ON/OFF, Load Level In % , Solar PV Status.

Fault Conditions: Battery Load, Overload, Short Circuit, Fuse Blown, Temperature High, No Load, Mains Failure.

E. Technical Specification

I/P Range Normal Mode

100V-290V

I/P Range UPS Mode

180V-265V

O/P Voltage

230V

O/P Frequency

50Hz

O/P Waveform

Sine Wave

solar Charging Current

40A/60A

Maximum PV Rating

500W/750W

Maximum PV Open Circuit Voltage

22V

Charging Cut Off (Mains)

14.0V

Charging Cut Off (Solar)

14.5V

Solar Charging Type

PWM

Technology

MOSFET

Reverse Panel Protection

YES

Priority Selection Mode SMB/SBM

Available

Charging Selection

Grid+Solar/Only Solar

4. SYSTEM OPERATION WITH BLOCK DIAGRAM

The solar panel transforms solar 14 energy into electrical energy by absorbing it. It accomplishes this by allowing the sun's rays to enter the solar panel's modules, which release free electrical charge carriers in the valence and conduction bands [6]. The charge controller received the electricity generated by the solar panel. The pace at which electricity is pulled from and to the battery is controlled by the charge controller. When the battery reaches the ideal charging point, it cuts off charge; when it falls below a certain threshold, it turns on charge again. 12 The battery is fully charged without being allowed to overcharge. Next, the solar battery received the controlled voltage from the charge controller. The main part of the solar setup were the batteries. It gave the system energy storage. Because the loads were AC, the energy stored in the batteries had to be transformed to AC voltage using an inverter before it could 14 be used to power them. The power transformer was connected to a regulated oscillatory system [7] that regularly commuted the direct current produced by solar cells. This current was then used to power electronic semiconductor switches, such as transistors. 2 In this case, the voltage was increased to the target AC voltage. When there is a public power source, the inverter may also be used to charge the battery.

A. Solar charge controller

When the inverter section receives an AC main supply, it stops operation but the charger section in the inverter starts its operation [8]. In this mode, the inverter transformer works as a step down transformer and outputs 12V at its secondary winding. During the charging, MOSFET transistors at the output section work as a rectifier with the drain working as the cathode while the source works as the[9] anode. The centre-tapping of the transformer receives positive supply and the MOSFET source ‘S’ receives negative supply from the battery. The centre- tapping is connected to the positive terminal of the battery and the MOSFET source ‘s’ is connected to the negative terminal with a shunt resistance. Thus, when the inverter receives an AC main supply, the inverter transformer and MOSFET together work as a charger and charge the battery.

B. Solar charging type

The best way to switch the power devices of the solar system controller and achieve consistent voltage battery charging is to use pulse width modulation (PWM). The solar arrays current tapes in accordance with the battery state and recharging requirements when it is in PWM regulation.

PWM solar chargers use technology similar to other modern high quality battery chargers [10]. When a battery voltage reaches the regulation set point, the PWM algorithm slowly reduces the charging current to avoid heating and gassing of the battery, yet the charging continues to return the maximum amount of energy to the battery in the shortest time [11,12]. Higher charging efficiency, quicker recharging and a fully charged, healthy battery are the end results. Furthermore, the PWM pulsing in this novel solar battery charging technique promises some highly intriguing and special advantages.

5. CALCULATIONS

We are going to install a power system in our home for a total load of 800W where the required backup time of the battery is 3 hours.

Load = 800W

Required backup time for batteries = 3hrs

What we need to know?

2 Inverter/UPS rating = ?

No. of batteries for backup power = ?

Backup hours of batteries = ?

Series or Parallel connection of batteries = ?

Charging current for batteries = ?

Charging time for batteries = ?

Required No. of solar panel = ?

Series or Parallel connection of solar panels = ?

A. Inverter/UPS Ratings

Inverter/UPS 5 should be greater than 25% of the total load (for future load as well as taking losses consideration)

800 x (25/100) = 200W

Our Load + 25% Extra Power = 800+200 = 1000W

This is the rating of inverter/UPS [13] 3 i.e. we need 1000W Inverter/UPS for solar panel installation according to our need (based on calculation)

B. Required number of batteries

Now required the number Backup time of batteries in hours = 3hrs

Suppose we are going to install 100Ah, 12V batteries = 12 x 100Ah = 1200Wh

Now for one battery (i.e. the backup time of one battery) = 1200Wh/800W = 1.5 hrs

But our required Backup time is 3 hrs.

Therefore, 3/1.5 = 2 i.e. we will have to connect two batteries each of 100Ah, 12V.

C. Backup hours of batteries

If [1] the number of batteries are given and you want to know the backup time for these given batteries, then use this formula to calculate the backup hours of batteries.

1200Wh x 2 batteries = 2400Wh

2400Wh/800 = 3hrs

In the first scenario, we will use a 12V inverter system, therefore we will have to connect two batteries (each of 12V, 100Ah) in parallel. But a question raised below:

D. [2] Series or Parallel connection for batteries

Why batteries in parallel, not in series?

Because [3] this is a 12V inverter system, so if we connect these batteries in series instead of parallel, then the rating of batteries becomes V1+V2 = 12V+12V = 24V while the current rating would be the same i.e. 100Ah.

In series circuits, [9] current is same in each wire or section while voltage is different i.e. voltage are additive e.g. V1+V2+V3+........+ Vn. [2] That's why we will connect the batteries in parallel, because the voltage of the battery (12V) remains the same, while its Ah (Ampere Hours) rating will be increased. i.e. the system would become = 12V and 100Ah+100Ah = 200Ah

[13] In parallel connection, voltage will be same in each wire or section, while current will different i.e. current is additive e.g. I1+I2+I3+......+In

Now we will connect [15] two batteries in parallel (each of 12V, 100Ah) = 12V, 100Ah+100Ah = 12V, 200Ah (Parallel)

Good to know: Power in watts is additive in any configuration of resistive circuit the total power (P) = P1+P2+P3+.......+ Pn (neglecting the 40% installation loss)

E. [3] Charging current for batteries

Now required charging current for these two batteries.

(Charging current should be 1/10 of batteries Ah)

200Ah/(1/10) = 20A

F. 2 Charging time required for battery

Here is the formula of charging time of lead acid battery.

13 Charging time of battery = Battery Ah/Charging current

T = Ah/A

For example, for a single 12V, 100Ah battery, The charging time would be:

T = Ah/A = 100Ah/10A = 10hrs (Ideal case)

Due to some losses,(It has been noted that 40% of loose occurred during the battery charging)

this 10 way, we take 10A-12A charging current instead of a 10A,this way the charging time required for a 12V,100Ah battery would be:

100Ah x (40/100) = 40 (100Ah x 40% of losses)

Now required the charging current for the battery would be: 140Ah/12A = 11.66hrs

G. 1 Required number of solar panels (Series or Parallel)

Now the required number of solar panels we need for the above system as below:

Scenario1: DC Load is not connected = Only battery charging

We know the power formula (DC)

P = VI(Power = voltage 3 x current)

Putting these values of batteries and charging current.

P = 12V x 20A =240W

These are the required wattage of solar panel (only for battery charging and then battery will supply power to thee load i.e. direct load is not connected to the solar panels)[14]

Now

240W/60W = 4W

Number of solar panels, Therefore we will connect four solar panels (each of 60W, 12V, 5A) in parallel.

6. FUTURE SCOPE

Our project will use 11 solar energy to generate power, which will assist to mitigate the global warming and energy crisis issues that the entire globe is currently facing. Sunlight is a limitless supply of energy. Promoting the usage of renewable energy sources is the main goal of our project. The reason this project is the most beneficial in our lives is because it just requires a single lifetime investment. When nonrenewable energy runs out, we will switch to renewable energy in the future. The solar inverter we manufactured is merely a prototype for similar projects in the future that will use cutting-edge technologies like charge control and micro-controlled sun tracking. This demonstrates how solar inverters are incredibly affordable and simple to install, shifting the energy demands to renewable energy sources. More development in this area is expected to completely transform the energy source, with solar energy bearing the greatest significance of all.

7. CONCLUSIONS

Gathering materials and testing individual components led to the gradual building of this 1000W (1kW), 220V inverter operating at a 50Hz frequency. As an additional alternative energy source to the diesel engine, the project was designed to operate 1000W of electricity. Everything went smoothly and effectively during the building. Effective and free of additional operating costs, the solar system performed as intended. Apart from the initial costs, it was more expensive than a 1.5 kVA petrol generator. This system only required sunshine, a free gift from nature, to function, so it was eventually determined to be expensive. The solar cell functioned as a source of battery charging and converted stored energy using an inverter into power that could be used for any kind of load. For many household equipment that require sinusoidal inputs, the power output was suitable.

8. REFERENCES

1. Electronic Products (Nov 6, 2013)
   https://www.electronicproducts.com/solar-power-inverters-block-diagram/
2. Energy efficiency and Renewable energy “Department of Energy”
   https://www.energy.gov/eere/solar/solar-photovoltaic-technology-basics
3. Solar inverter, From Wikipedia
   https://en.wikipedia.org/wiki/solar_inverter
4. Solar Guide

https://www.solarguide.co.uk/solar-back-batteries-power-cuts#:~:text=solar%20batteries%20with%20back%2Dup%20power%20have%20a%20relay%20

5. GKE Green Energy, High Capacity Inverter
https://5.iming.com/data5/FY/RE/BF/SELLER-88996/sine-wave-hups-inverter.pdf

6. P.W.J. Glover, Treatise on Geophysics (Second Edition), 2015
https://www.sciencedirect.com/topics/earth-and-planetary-sciences/charge-carrier

7. Hitachi Energy "Controlled switching of high-voltage circuit breakers" https://library.e.abb.com/public/64e646519af3457da2caaf2d51549a08/2GHV092716_en_B_Controlled_switching_of_high-voltage_circuit-breakers_GTI.pdf?x-sign=ct+8ILM8Zh+jSzzQ1wMBk7EHAI/jTN8/pOZO6sI5yIjsnxbR66GMCRLbERIXiNIx

8. 1 Olusegun O. Omitola "Design and Construction of 1kW(1000VA) Power Inverter"
https://issunn.com/alexanderdecker/docs/design_and_construction_of_1kw_100

9. Segun O. Olatinwo "Innovative Systems Design and Engineering"
https://core.ac.uk/reader/143491210

10. Dan Arnold(Oct 12) "PWM Solar Charge Controllers"
https://www.vorpenergy.com/batteries/pwm-solar-charge-controllers/#:~:text=When%20in%20PWM%20regulation%2C%20the,modern%20high%20quality%20battery%20 chargers

11. Morningstar Corporation
https://www.stellavolta.com/content/MSCWhyPWM.pdf/

12. Arduino Solar Charge Controller https://www.instructables.com/ARDUINO-SOLAR-CHARGE-CONTROLLER-PWM/

13. GKE Green Energy,High Capacity Inverter https://5.iming.com/data5/FY/RE/BF/SELLER-889964/sine-wave-humps-inverter.pdf

14. 16 A Complete Guide About Solar Panel Installation https://www.scribd.com/document/585009832/A-Complete-Guide-About-Solar-Panel-Installatio

Sources

1	https://www.researchgate.net/publication/359068477_Development_a... INTERNET	6%
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7	https://www.gurukirpaelectronics.net/solar-hybrid-pcu-sine-wave... INTERNET	1%
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11	https://www.geeksforgeeks.org/solar-energy INTERNET	1%
12	energypedia.info/wiki/Charge_Controllers INTERNET	<1%
13	sunlypower.com/wiring-batteries-in-series-vs-parallel/ INTERNET	<1%
14	https://www.electrical4u.com/solar-cell INTERNET	<1%

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