Hybrid Solar Power With MPPT Technique For Rural Telephony

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Abstract

Rural telephony has historically been a recurring subject of concern for most large developing countries. This paper proposes the most feasible configuration of a Hybrid Solar Energy System with solar panel, battery, and diesel as a backup for cellular mobile telephony base station site in isolated areas of India. This paper describes a design of a charge controller to get the maximum power by using Pulse width Modulation (PWM) technique. In this paper PWM is controlled by the AT89S52 Microcontroller. The work of the paper is using a 24 watt solar panel with maximum power load is operated, and if there is absence of solar energy then battery is used. If both the solar and battery are not available then diesel is used as an alternative.

Keywords— Solar panel, Pulse width modulation technique, MPPT, Boost converter

1. Introduction

Photovoltaic cell efficiency is very important for solar application. The paper focuses on maximum power point PWM charge controller for photovoltaic application. When a solar panel is under an open circuit is able to supply a maximum voltage and there is no current, whereas under a short circuit is able to provide a maximum current with no voltage. In either case, the amount of power supplied by the solar panel is zero. The target is to develop a method whereby maximum power can be obtained from the voltage and current multiplied together. The technology for solar photovoltaic battery charge controllers increased dynamically. PWM charging is very famous for its useful application. In this paper a charge controller is designed to get the maximum power by using the PWM technique. This PWM technique is employed by the AT89S52 Microcontroller, which is of 8052 family. Here a load is operated as well as a 24 volt battery is charged by using a 24 watt solar panel with maximum power through the PWM charge controller circuit. Simulation of the PWM technique and after the hardware designs of DC-DC boost converter, software implementation, and flow chart of the program is discussed here. [1], [2]

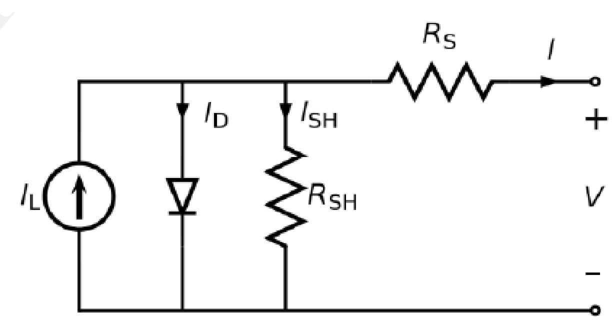

Fig.1: Equivalent electrical circuit of solar cell. [5]

2. DC-DC Boost Converter circuit and block diagram of Hybrid Solar Power

The solar panel to operate at its maximum power point, there are a few items needed. First, in order to know the output power of the solar panel, both the current and voltage of the solar panel have to be monitored. This will be accomplished by a high side current monitor and simple resistor divider on the solar panel's output voltage. There also needs to be a way to control the output power of the solar panel. This is done by manipulating the panel's output current. And lastly, a software algorithm is needed to know which way to manipulate the current (e.g., whether the current out of the solar panel should be increased or decreased). To make the Maximum Power Point Converter work, the functions of the boost converter need to be merged with the solar panel's output load. The boost converter is either storing current in the boost inductor (switch closed) or it is delivering current from the boost inductor to the load (switch opened). When the boost inductor is storing current, the current comes from the solar panel. In essence, the boost inductor is the solar panel's load. By making the current stored in the boost inductor programmable, the load of the solar panel becomes programmable. This is the principal on how the Maximum Power Point Converter works. The Maximum Power Point Converter combines a boost converter, a programmable current oscillator and a software algorithm to maximize the power out of a solar panel. [3]

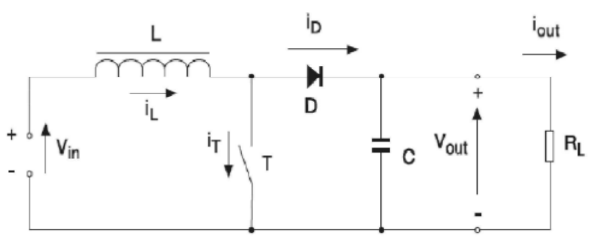

Fig.2: Equivalent circuit of Boost Converter.[5]

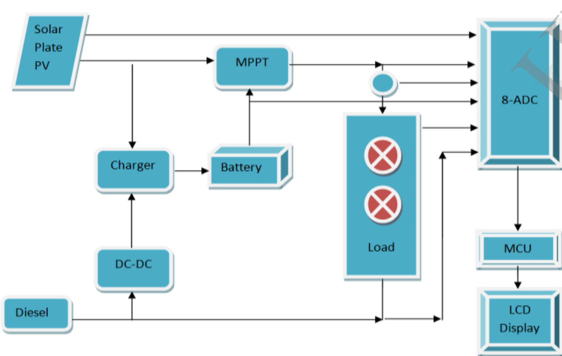

Fig.3: Block diagram of Hybrid Solar Power

3. Simulation of Solar Charge Controller Circuit

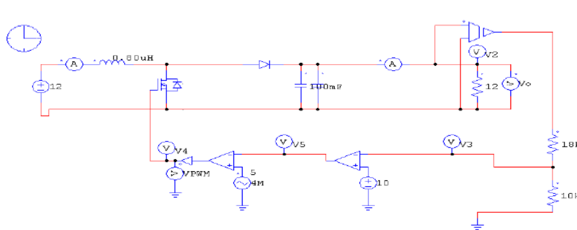

Fig.4: Simulation of charge controller circuit

Result of dc-dc boost converter

Input voltage= 12v
Output voltage =28 v
Output current=2.08 A

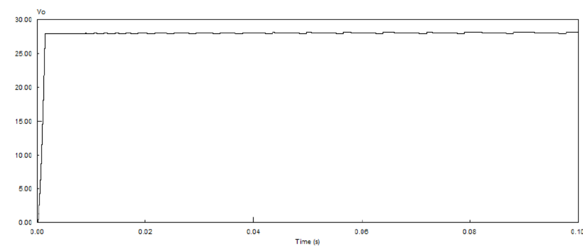

Fig.5: Result of Dc-Dc Boost Converter for Input voltage 12V and Output voltage 28V

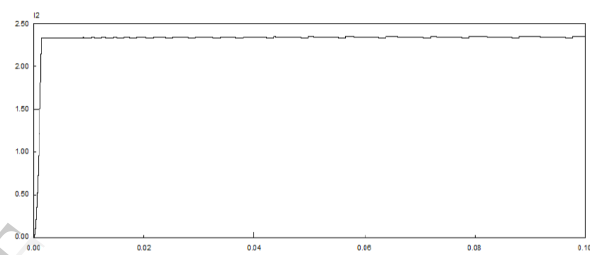

Fig.6: Result of Dc-Dc Boost Converter for Input current 2.08A

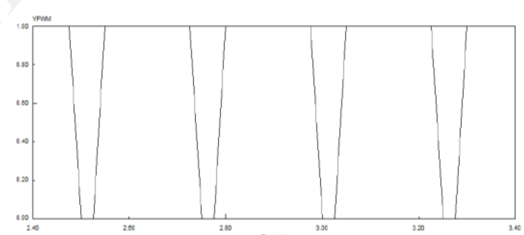

Fig.7: Result of Pulse width modulation

4. Hardware design and implementation

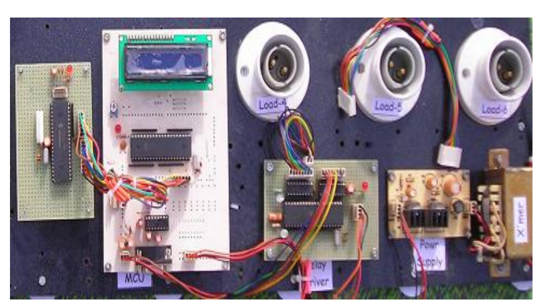

Fig.8: Hardware design of the work

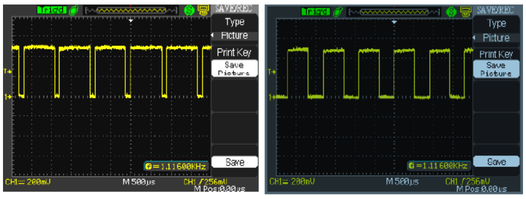

Fig.9: Result of Solar charge controller PWM

According to the flow chart a program is written in assembly language and loaded the program in to the microcontroller. Here, the microcontroller initially set a pulse which is appropriate for 12 volt at where the maximum power point was achieved from the experiments before. Microcontroller gets the solar panels voltage through its one pin and digitizes it. It compares the digitized value with the stored value of 12 volt. If it matches, microcontroller maintains the pulse. But if the getting voltage is greater than 12 volt, decreases the pulse width, hence voltage will be increased and vice versa. [1]

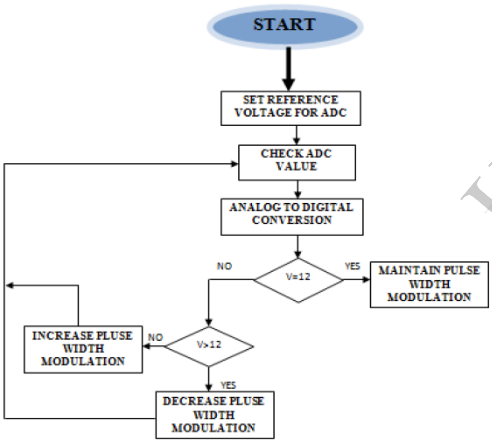

Fig.10 Flow Chart of the PWM Charge Control program

5. Conclusion

The output of dc-dc boost converter is constant for variable Input voltage so this type of converter is used for getting constant voltage and maximum power from source. Solar radiation is varying during the day hence this converter is used to get maximum power under variable input condition using MPPT logic. PSIM Software simulation result and hardware result is equally match.
PWM technique and Microcontroller (AT89S52) can be used to implement Maximum power tracking logic and as a result we can get maximum power at output (load) from solar panel.

6. References

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