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Photovoltaic Power Control using MPPT and Boost Converter

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Abstract: ***The world has shifted to cleaner sources of energy to meet the growing demands of energy and to adhere to the sustainable development goals with environment protection as the top priority. Solar power is one such cleaner sources of energy which meets the human needs of electricity and power. Photovoltaic cells or PV cells are used to convert sun's energy into electricity. PV cells work on the principle of photoelectric effect. The power output of PV cells is dependent on various conditions. In this paper we use boost converter for PV power control with the help of MPPT control mechanism. Maximum power output of PV cell is decided by MPPT, Maximum Power Point Tracking. The maximum power which can be produced in a PV cell due to voltage is the peak power voltage called as Maximum Power Point. The Matlab software is used to analyse the photovoltaic module. The maximum power output from Mppt is then fed to the load with boost converter with boosts the voltage to the required level. The maximum power is analysed with mppt algorithms written in Maltab software***.
Keywords: ***pv cells, mppt, solar energy, matlab***

I. INTRODUCTION

Solar energy is one of the most abundant forms of energy present on Earth whose efficient utilization can reduce the burden of the fossil fuels. Solar energy is pollution free thus it has no negative effect on the solar system.
Photovoltaic cells or solar cells are used to convert sun's heat and light into electricity. Solar cells work on the principle of photoelectric effect. The photovoltaic cells are made of semiconductor materials like Silicon. These semiconductor materials emit electrons when hit by the solar light consisting of protons. These free electrons when captured result into electricity.
MPPT or Maximum Power Point Tracking is the method which is used for obtaining the maximum power from PV cell at specific conditions. The peak voltage which produces the maximum power in a PV module is called maximum power point. Maximum power varies with solar radiation, ambient temperature and solar cell temperature.

A. Photovoltaic Cell

The conversion of sun's light into electricity is called as Photovoltaics. This photovoltaic is exhibited by some materials like Silicon . these materials absorb energy from the sun , photons of light and release electrons. These electrons are then captured and tuned to give electric current. This property of absorption of light energy and release of electron is called as photoelectric effect.

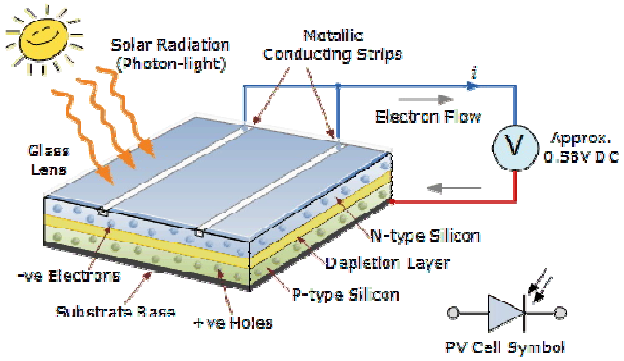

Fig. 1 Solar cell

A simple photovoltaic cell or a solar cell is shown in the figure above. Solar cells are built some special kind of materials called as semiconductor materials. Examples of semiconductor materials are silicon, germanium etc as per specific requirements. The solar cells have a thin semiconductor wafer which forms an electric field, with both positive and negative sides. When sun's energy hits the solar cell, free electrons are released from the atoms in the semiconductor material. The released electrons are captured with the

conductors completing the circuit of positive and negative and the electrons flow as electric current , constituting the flow of electricity . This generated electricity from sun's energy can be used to power the load, or light the house appliances, water heaters etc.

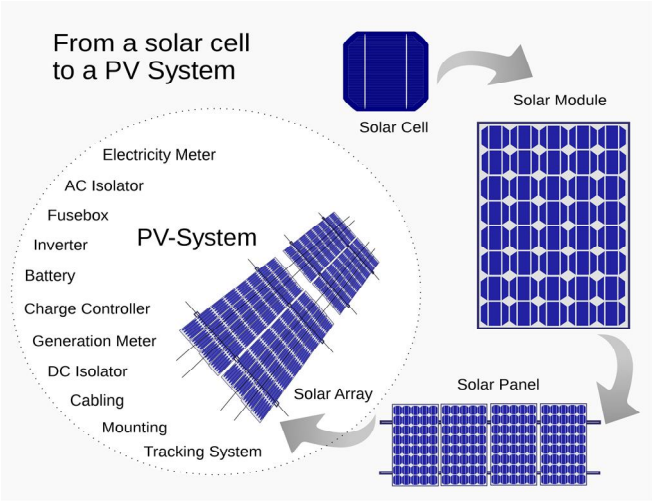

Fig. 2 PV Module

Multiple solar cells which are electrically connected to each other and mounted in a support structure or frame is called a photovoltaic module. Modules are designed to for specific requirements and voltages for generation of electricity, such as a common 12 volts system. The current produced is directly dependent on how much sun's light strikes the module.

B. MPPT Algorithms

Maximum power point tracking (MPPT) is the algorithm which is performed by some battery charge controllers and by most grid connected PV inverters. The governing condition is the adjustment of the operating voltage of the pv cell to produce maximum and optimum power output closely related to theoretical value of pmax.

C. MPPT Principle

The mppt works on the principle of derivation of maximum power from pv cell or pv module by allowing the operation of pv module at the optimum voltage. The ouput of pv module is checked by the mppt and then compared to the battery voltage and then analysed the maximum power pv module can produce at the voltage which supplies battery maximum current. The mppt can be used to power a dc load which is connected to the battery.

To ensure that maximum current reaches the battery from pv module, mppt has an addition charge controller embedded in it.. MPPT takes dc input from the pv cell , converts it to ac and the reconverts the ac to different dc voltage and current to ensure maximum supply of pv cell power to the battery. These mppt solar charge controllers are useful in various applications in home or offices etc be it water system, light system etc.

D. Characteristics of Mppt

The features of MPPT solar charge controller are-

1) Accuracy in variations of I-V characteristics of solar cell.
2) To obtain maximum power from PV module.
3) Use of higher voltage output than battery voltage.
4) Complexity of system reduced.
5) High efficiency output.
6) Extended to other renewable energy sources.

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E. Boost Converter

Boost converter steps up the input voltage to the required dc voltage without the use of transformer. Boost converter overcomes the need of switched mode supplies for dc-dc conversion and also extends the life of battery used. Batteries, ac mains supply, dc from solar cells etc form the input to boost converter. Boost converter output voltage is greater than equal to the input voltage while the output current is equal or less than the input current , to balance power equation of P=VI.

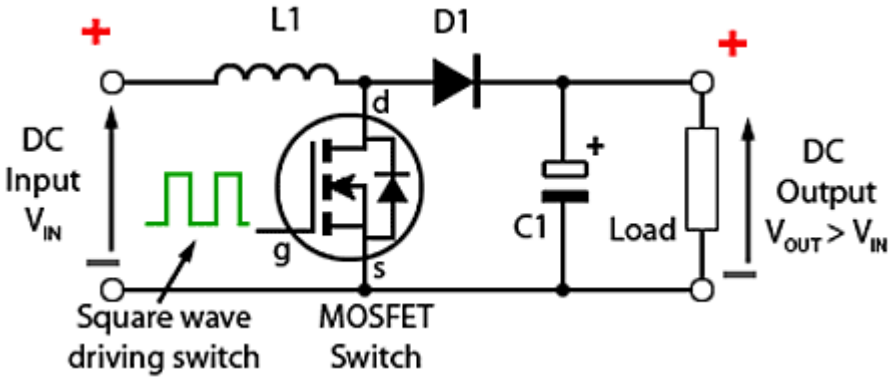

Fig. 3 Basic Boost Converter Circuit

In the boost converter shown above, the switching transistor is a power mosfet. Current, voltage, switching speed , cost etc are the factors that decide the choice of switching device. Boost converter works in 2 modes- charging mode and discharging mode.In charging mode of operation; the switch is closed and the inductor is charged by the source through the switch. The charging current is exponential in nature but for simplicity is assumed to be linearly varying.The diode restricts the flow of current from the source to the load and the demand of the load is met by the discharging of the capacitor. In discharging mode of operation; the switch is open and the diode is forward biased. The inductor now discharges and together with the source charges the capacitor and meets the load demands.

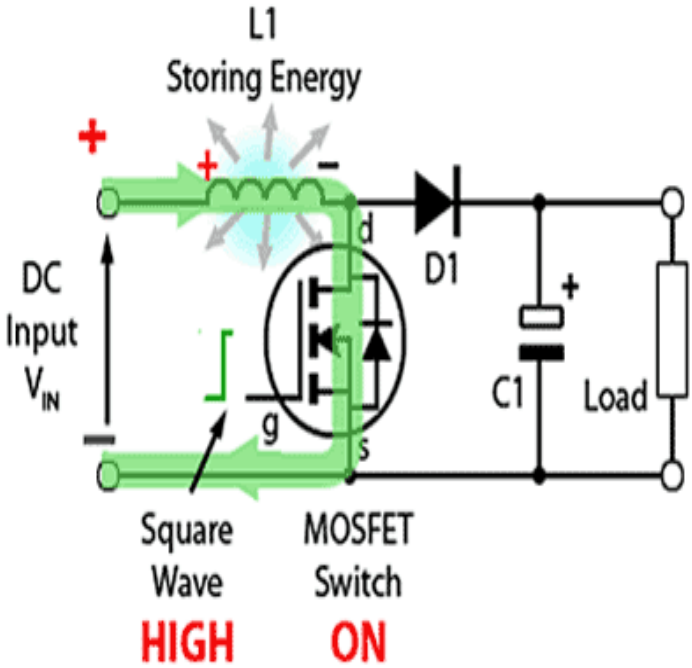

Fig. 4 Boost Converter Operation at Switch On

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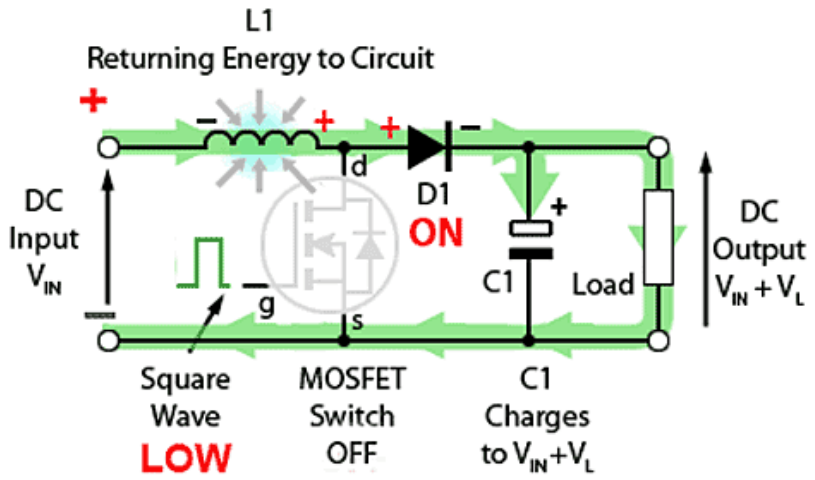

Fig. 5 Current Path with MOSFET Off

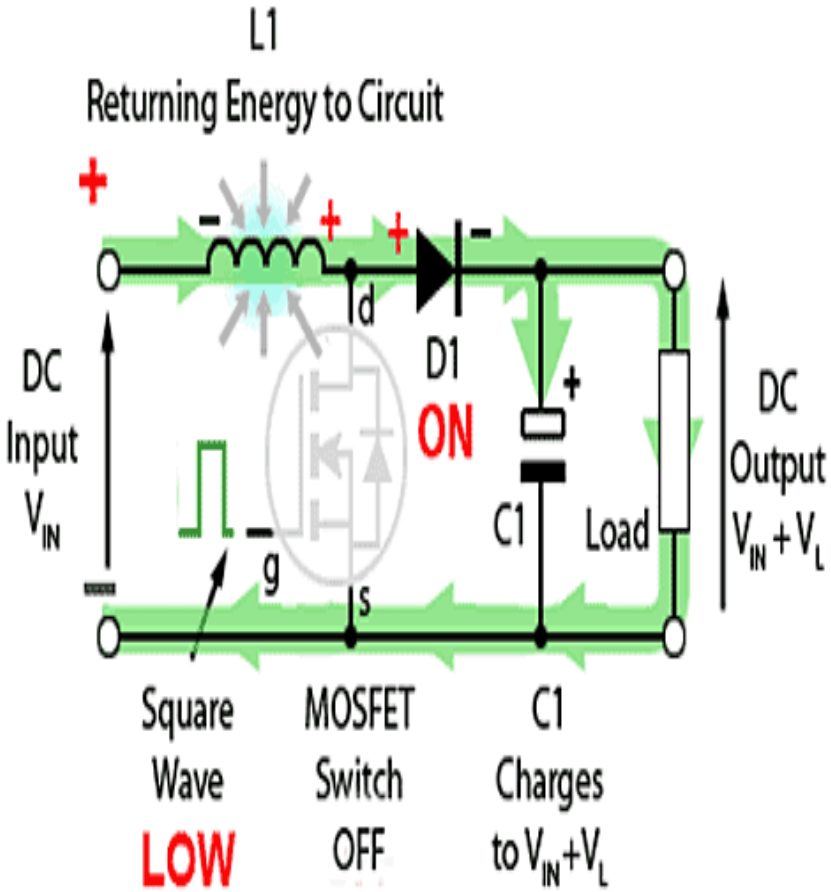

Fig. 6 Current Path with MOSFET Off

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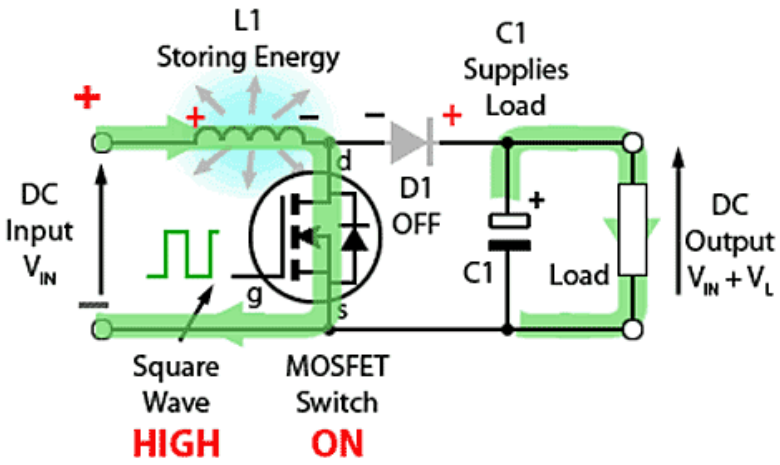


Fig. 7 Current Path with MOSFET On

II. RESULT

The output waveforms of boost converter is shown below. The waveforms are plotted between voltage and time, current and time.

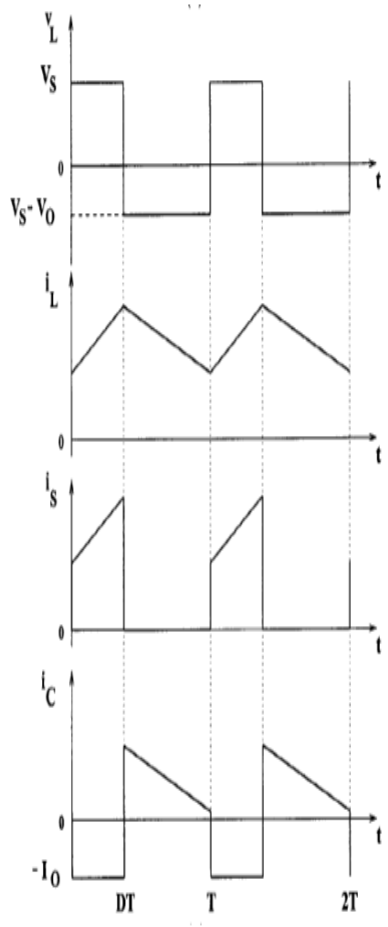


Fig. 8 Boost Converter Circuit waveform

The matlab stimulation of the pv panel and mppt and boost converter is shown below.

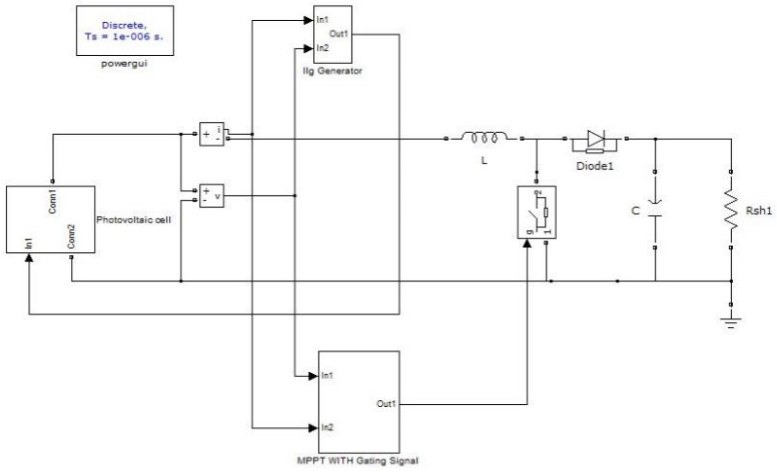


Fig.9 MATLAB model of solar cell with Boost Converter and MPPT

III. CONCLUSION

The maximum power point tracking of solar cells or pv modules differ with the varied algorithms followed and different methods used for the calculation of output power. The output power efficiency also varies with different conditions of temperature and humidity and other atmospheric conditions. The mppt solar controller is a tool for simplifying the solar system and increases the output power efficiency. This calculations can be analysed in various software tools like matlab, labview etc.

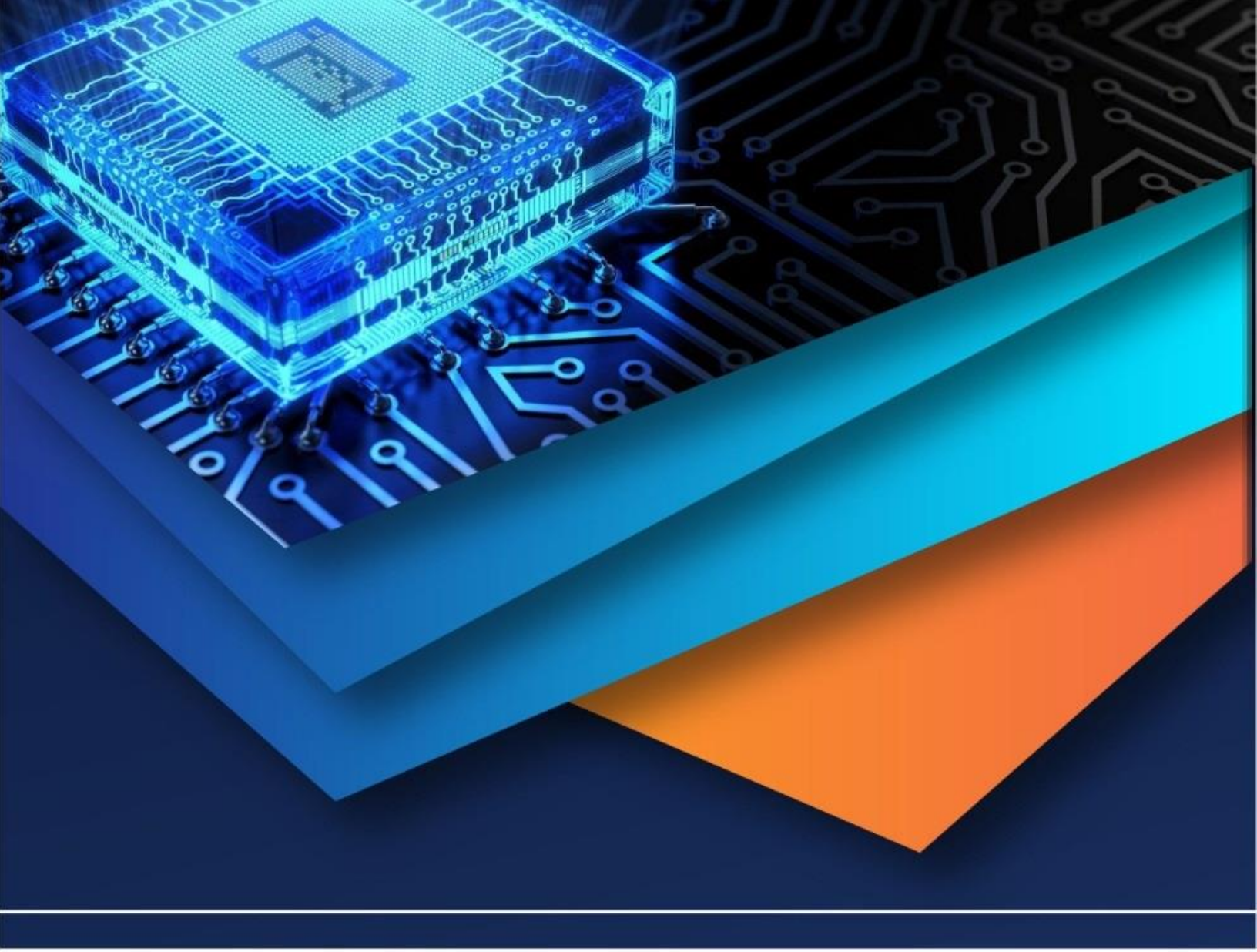
REFERNCES

[1] M. G. Villalva, J. R. Gazoli, E. Ruppert F, "Comprehensive approach to modeling and simulation of photovoltaic arrays", IEEE Transactions on Power Electronics, 2009 vol. 25, no. 5, pp. 1198--1208, ISSN 0885-8993.

[2] M. G. Villalva, J. R. Gazoli, E. Ruppert F, "Modeling and circuit-based simulation of photovoltaic arrays", Brazilian Journal of Power Electronics, 2009 vol. 14, no. 1, pp. 35--45, ISSN 1414-8862.

[3] Mummadi Veerachary, "Control of TI-SEPIC Converter for Optimal Utilization of PV Power", IICPE, 2010 New Delhi.

[4] R. Sridhar, Dr. Jeevananathan, N. Thamizh Selvan, Saikat Banerjee, "Modeling of PV Array and Performance Enhancement by MPPT Algorithm", International Journal of Computer Applications (0975 – 8887) Volume 7– No.5, September 2010.



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