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Maximum Power Point Tracking Controller of a PV System Using SEPIC Converter

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ABSTRACT

This paper deals with solar (PV) system fed SEPIC converter with MPPT controller. In this analysis maximum power is tracked by the MPPT technique at a certain temperature. Here a new converter called SEPIC converter is used. Compared to the all type of converters, the SEPIC converter has more advantages. The outputs of PV system with MPPT controller are connected to the SEPIC converter. The whole analysis and the results are carried out in MATLAB/ SIMULINK model.

Keywords: *PV system, MPPT controller, constant voltage method and SEPIC converter.*

INTRODUCTION

Recently the solar energy becomes an important source of renewable energy because the radiant light and heat from the sun are using in a range of ever evolving technologies like solar heating, photovoltaics and solar thermal energy. The formation of PV system is clearly shown in the fig1.

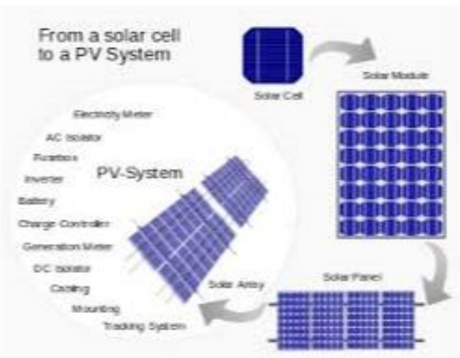


Figure1. *Formation of a PV system*

In this paper PV system is connected to the SEPIC converter with a maximum power point tracking control system. The MPPT control technique is mostly used for the solar (PV) systems to maximize the power extraction under all conditions.

As the sunlight varies from time to time in a day, the characteristics of a load which gives the maximum power transfer efficiency will be changed, so that the efficiency of the system is optimized. By these load characteristics the point at which the maximum power can be transferred will be known. A stand alone PV system is shown in the following figure2.

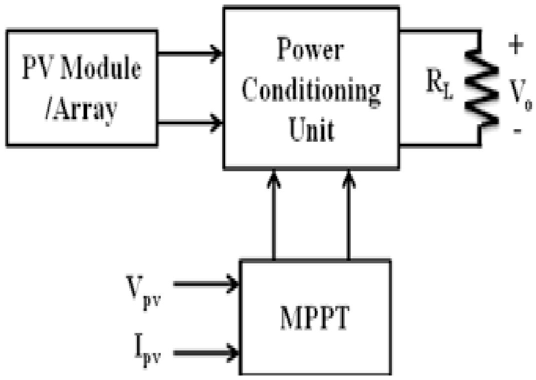


Figure2. *Stand alone PV system*

SEPIC converter is similar to the buck-boost converter having an advantage of non-inverting output. The output of SEPIC converter is directly connected to the load.

DC-DC CONVERTERS

A dc to dc converter is a electromechanical device which converts one level of dc voltage into another level of dc voltage. The dc-dc converter is also called as a power converter in which power levels ranges from very low to very high. The SEPIC converter doesn't require a input filter and it provides a positive output voltage. The output voltage of a SEPIC converter is either higher or lower than its input voltage. The diagram of a SEPIC converter is in figure3.

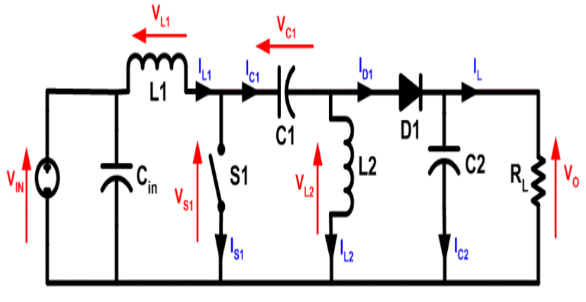


Figure3. *SEPIC converter*

The output of the SEPIC converter is controlled by the duty cycle of controlled transistor. To reduce the high voltage spikes across the inductors, the switching time of a diode should be fast.

Modeling of PV System

Solar power system or PV system is a renewable energy system which uses PV modules to produce electricity from the sunlight. Solar PV system is more reliable and a clean source for production of electricity that can has a wide range of applications like industries, residence, agriculture, livestock, etc.

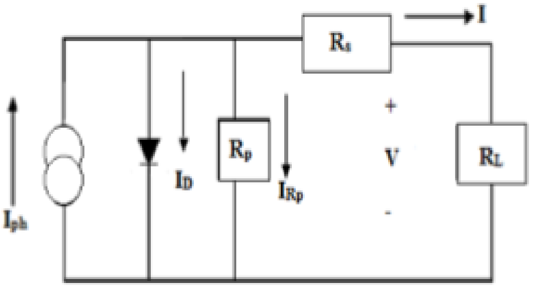


Figure4. *PV cell equivalent circuit*

From the above circuit diagram, the voltage and current equations are as follows

$$I = n_p I_{ph} - n_p I_{rs}\left[exp\left(\frac{qV}{KTAn_s}\right) - 1\right] \quad (1)$$

$$I_{rs} = I_{rr}\left(\frac{\tau}{\tau_r}\right)^3 \left\{exp\left[\frac{qE_G}{KA}\left(\frac{1}{\tau_r} - \frac{1}{\tau}\right)\right]\right\} \quad (2)$$

$$E_G = E_G(0) - \frac{\alpha\tau^2}{\tau+\beta} \quad (3)$$

$$I_{ph} = [I_{scr} + K_i(T - T_r)]\frac{s}{100} \quad (4)$$

From the equation 1 the output voltage can be written as

$$V = \frac{N_S KTA}{q} ln\left[\frac{n_P I_{ph} - I}{n_p I_{rs}} + 1\right] \quad (5)$$

From the equation 5 the PV system can be modelled as shown in the figure 5

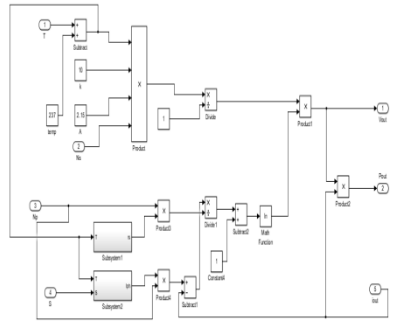


Figure5 *Simulink diagram of PV system*

Modelling of MPPT Controller

Here, the MPPT acts as a controller of a solar (PV) system and is used to track maximum possible amount of solar energy which is efficient and reliable.

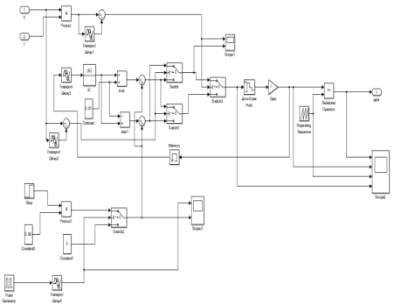


Figure6. *Simulink diagram of MPPT controller*

In this system, we used perturb and observe method because it is very simple and easy. In this method the operating voltage is sampled and it changes the operating voltage in the required direction. The iteration is continued until it reaches the maximum power point. This technique is very simple to implement. The simulation diagram of perturb and observe controller is shown in the figure6.

Proposed System

In this proposed system the PV system acts as a input to the SEPIC converter with MPPT controller as shown in following diagram.

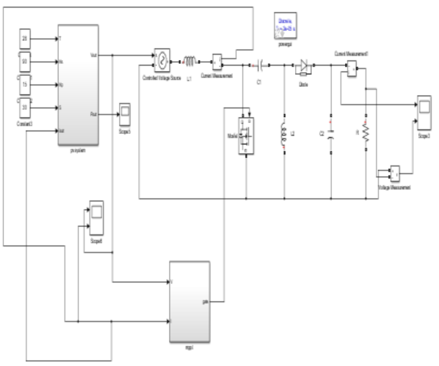


Figure7. *Simulink diagram of proposed system*

Simulation Results

A. input voltage and current of SEPIC converter

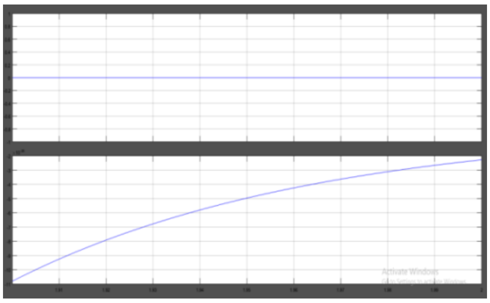


Figure8. Input voltage and current of SEPIC converter

B. simulation output of MPPT controller

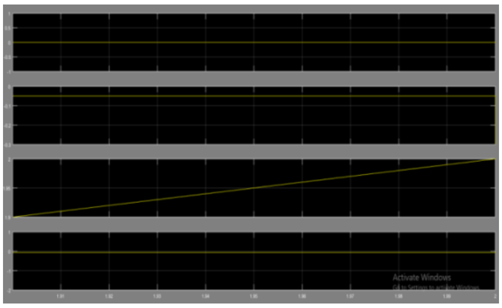
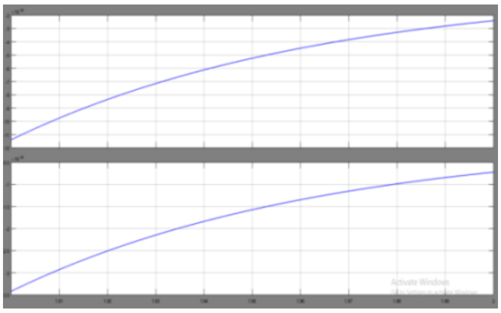


Figure9. *Simulation output of MPPT controller*

C. output voltage and current of the SEPIC converter



Figue10. *Output voltage and current of the SEPIC converter*

Conclusion

This paper presents the simple and easy control technique for tracking the maximum power in the proposed system. The control technique used is most efficient and reliable and this topology requires less operating cost as compared to remaining controlling methods.

It can be applied in power generated remote areas and for constant speed and variable speed energy conversion system. For modelling the PV system, MPPT controller and the proposed system, the MATLAB/SIMULINK software is used.

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