



Comprehensive analysis of PV battery charging system with sepic boost converter

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ABSTRACT

This paper provides dual level dc output using Sepic converter with solar energy for charging batteries. Two different levels of DC voltage batteries can be charged. Single Ended Primary Inductor Converter (SEPIC) Boosts the solar output and gives dual level DC output for loads. The stand-alone Photovoltaic (PV) system is used as a source for the Sepic converter. Maximum power point tracking (MPPT) technique is used to track maximum power and to provide continuous pulses to the converter.

Keywords: Stand-alone, Sepic converter, dual level output, MPPT.

I. INTRODUCTION

In our everyday life we use many Electrical and Electronic devices, every device needs Electricity for its working. In the world of depleting fossil fuels and growing pollutions, we need an alternative to satisfy our needs. Solar energy the energy from the radiations of the sun, which can be a very good alternative energy source, after the main objective of the project is to charge the Batteries with the no harm freely available solar source. Batteries can be replaced for electricity in any application hence charging batteries with a renewable source is very reliable and more effective in today's world.

In this paper, The Main aim is to design and develop

a much efficient and effective power electronic convertor which utilizes the maximum of the input power from the solar Photo Voltaic (PV) panel.

The Dual Level SEPIC Boost convertor serves that cause, the convertor produces two level boosted output and that is used to charge the batteries.

To get maximum efficiency from the PV panel tracking of solar radiation is done. Energy stored in batteries are recommended to improve the Reliability of the standalone systems. The PV system With MPPT controller cannot produce the constant DC Voltage as the output voltage. so that various MPPT controllers are provided to get maximum power and to provide constant voltage. Sepic converter is chosen because of its efficiency, non-inverting polarity and there is a necessity of output voltage higher than the input voltage. The problem with the previously proposed paper is single output was taken and it can be given to only single battery charging or single application. But in our proposed paper, From the Sepic converter two different levels of voltages are taken. It may be given to charge two different level voltage batteries or any automotive applications where battery charging is required. The comparison of various converters with Sepic converter is given below:

COMPARISON OF VARIOUS BUCK -BOOST CONVERTERS

Converters	Buck-boost	Cúk	Positive Buck-boost [13]	SEPIC	Flyback
Output voltage Polarity	Invert	Invert	Non-invert	Non-invert	Non-invert
Input current	Pulsating	Nonpulsating	Depends on operation mode	Nonpulsating	Pulsating
Switch drive	Floated	Floated	One floated One grounded	Grounded	Grounded
Efficiency	Low	Medium	High with only one stage is active	Medium	Low
Cost	Medium due to float drive	Medium due to additional block capacitor	High due to an additional switch and diode, a more complex drive circuit	Medium due to additional block capacitor	Low due to grounded switch and no block capacitor

II. BLOCK DIAGRAM

The basic idea of developing this paper is to obtain maximum sunlight from the sun throughout the day, by tracking the movement of the sun. Here the Solar Cell Panel is moved according to the position of the sun. By tracking the movement of the sun, maximum sunlight is obtained; further this energy will be stored in a 12 V DC Battery. The solar cell panel will be mounting on a rotating structure. This structure will have DC motors that will help the structure to rotate. The LDR will be detecting the sunlight and send the data to the microcontroller. The energy generated through the solar panel will be sent to a DC battery through Sepic converter. The Sepic converter does the job that it will boost the input voltage to Two different voltage levels. The battery will store the energy for further applications.

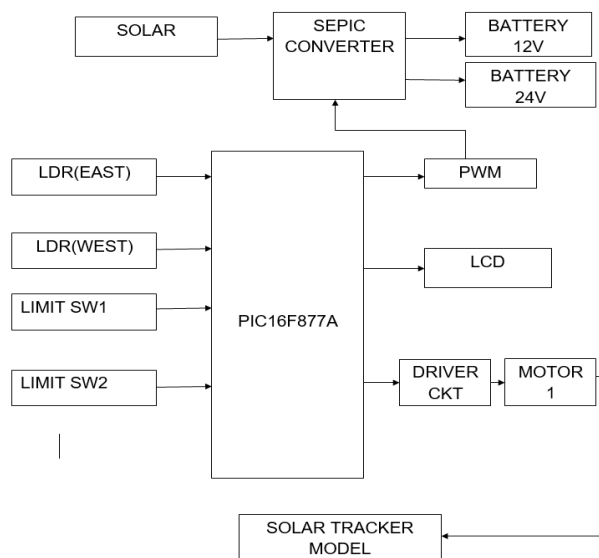


Fig1

The block diagram of proposes system is given below:

III. DESIGN AND IMPLEMENTATION

The single output Sepic converter includes a switch, capacitors and a coupled inductor. The circuit diagram of single input Sepic converter is given below:

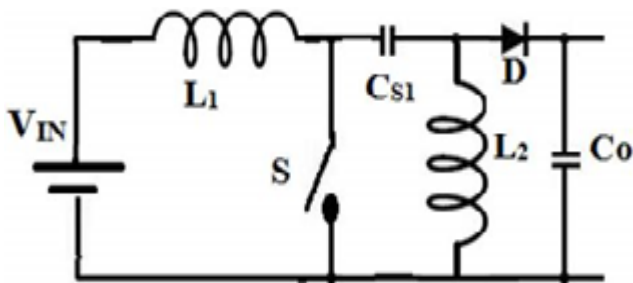


Fig 2

Design of inductors and capacitors are to be considered according to the output voltage, input voltage, Input and Output current ratings. The Sepic converter topology that provides a positive regulated output voltage from an input voltage that varies from above to below the output voltage.

The Sepic converter and PV based system have to be designed for getting dual level output for various applications. The design and implementation of Sepic converter and PV system is explained below

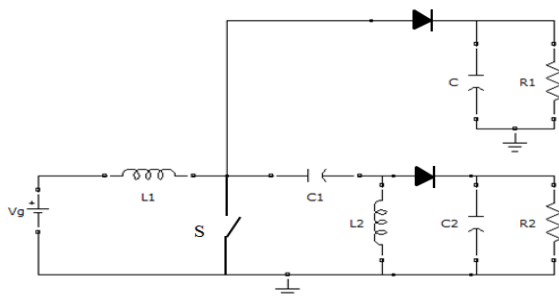


Fig 3

a) Design Of Sepic Converter:

According to Fig. 3, the voltage transfer ratio of the SEPIC in Continuous conduction mode is

$$V_{out}/V_{in} = D / (1-D)$$

Where D is the duty cycle of switch. For determining the inductance, peak-to-peak ripple current to be approximately 40% of the maximum input current at the minimum input voltage. The ripple current in equal value inductors $L1$ and $L2$ are given by

$$\Delta I_L = 40\% \text{ of input current}$$

The inductor values are calculated by

$$L1=L2= (V_{in}*D) / (\Delta I_L*f_{sw})$$

Where f_{sw} is the switching frequency and D is the duty cycle at the minimum V_{in} .

If $L1$ and $L2$ coils are wound on the same core, If coupled inductor is used, the value of inductance in the above equation is replaced by $2L$ due to mutual inductance. The inductor values are calculated by

$$L1=L2=0.5((V_{in}*D) / (\Delta I_L*f_{sw}))$$

When the power switch (MosFET) $Q1$ is turned on the inductor is charging the output current is supplied by the output capacitor. The RMS current in the output capacitor is

$$I_c = I_o ((V_o+V_D)/V_{min})$$

The capacitor connected before and after switch can be calculated by

$$C1=C2 = ((I_o*D) / (\Delta V_p*f_{sw}))$$

b) MPPT CONTROLLER DESIGN

The proposed MPPT controller tracks the Maximum power point tracking of a PV system under variable temperature and insolation conditions with fuzzy logic controller. MPPT in the sense it control the variation in the output of PV module and makes the suitable for use at the output according to the supply required to the load. Recently fuzzy logic have been introduced in the tracking of the MPPT in PV system. In conventional methods of tracking optimal point of operation have shown their limits to sudden changes of weather and the load connected to the panel. In other methods of controller design this method approaches the artificial intelligence in the case of fuzzy logic is implemented to improve control performance and pursuit of maximum power point by simulation model of controller design. Compared to other controllers (P&O, incremental conductance method) it exhibits a much better behavior. This method of fuzzy logic controller applied to the

(DC-DC) Sepic converter device and gives boosted voltage to load. In order increasing efficiency MPPT controllers are used. The proposed fuzzy logic algorithm is applied to obtain high performance through the Fuzzy control of the MPPT of the PV in order to track the MPP of the non-linear characteristic of PV array by controlling the duty-cycle of the Sepic boost convertor based on the following rule: “ If the last change in the duty cycle (DC) has caused the power to raise, keep moving the duty-cycle (DC) in the same direction; otherwise ,if it has caused the power to drop, move it in the opposite direction. The input and output variables of the process to be controlled need to be identified, the subsets that cover the universe of discourse of each variable are to be defined and a linguistic label to each one is to be assigned to model the considered system linguistically and the defuzzification is considered to generate a crisp output from the fuzzy outputs generated from the rule base. The two FLC input variables error E and change of error CE at sampled ties K defined by

$$\text{Error (k)} = P(k) - P(k-1) / V(k) - V(k-1)$$

$$\text{CE (k)} = E(k) - E(k-1)$$

Where P (k) is the instantaneous power of the photovoltaic generator.

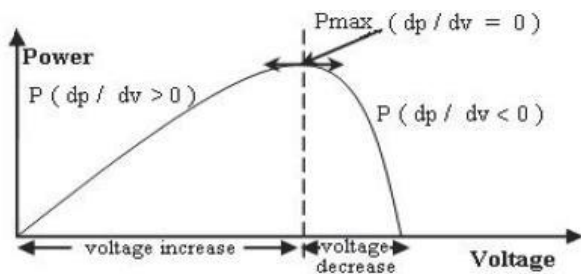


Fig 4

IV. RESULTS AND DISCUSSION

The results for dual level output of Sepic converter with PV system is explained clearly below:

A SEPIC-boost combination converter (Se-BoCC) topology gives two different level output voltages

with different magnitudes but with same polarities. The SEPIC is a positive-output step-down/step-up converter, and the boost is a positive output step-up converter. This combination presents discontinuous (high-ripple) positive and negative output currents and a continuous (low-ripple) input current. The solar input of 12V with the help of MPPT is given as a source.

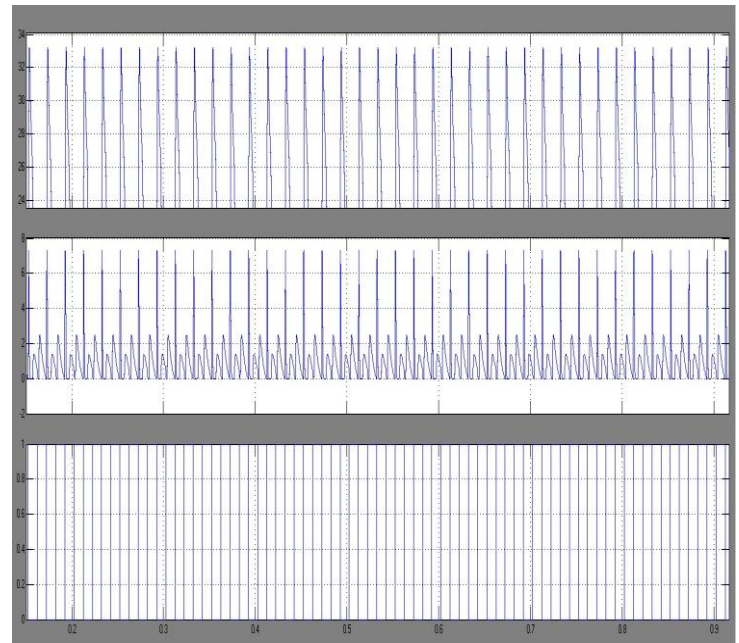


Fig5

The figure 5 shows the two output voltage waveform and one pulse signal waveform; from the figure we had inferred that we are obtaining two output voltages with different in magnitude from the first graph voltage is up to 32V and from the second graph voltage is up to 8V, here input voltage of 12V is given to the circuit at the source side.

V. CONCLUSION

Sepic-Boost converter with dual level output voltage for two different levels of load had been designed and simulated. The future Scope of this proposed paper is that it can designed and implemented for multiple loads and solar supply may be upgraded.

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