ISSN: 2455 - 9938

EIJO: Journal of Science, Technology and Innovative Research (EIJO–JSTIR)

Einstein International Journal Organization (EIJO)

Available Online at: www.eijo.in

Volume – 2, Issue – 2, March – April - 2017, Page No. : 01 - 05

Solar Energy by Using Voltage Multiplier with a Fly Back Boost Converter

G.Tejaswini, I.Geethanjali, T.Sumadhar, K.Abhishek Raj

[1]B.Tech scholars, Dept of EEE, SVS Institute of Technology, Hanamkonda, Warangal, T.S, India

B. Rajender

[2]Associate Professor, Dept of EEE, SVS Institute of Technology, Hanamkonda, Warangal, T.S, India

Abstract

A High step-up converter suitable for renewable energy system is designed in this paper. Using a conventional interleaved boost converter, accompanied by a voltage multiplier module composed of switched capacitors and coupled inductors, high step-up gain is obtained without operating at extreme duty ratio. The topology of the proposed converter reduces the current stress. The topology constrains the input current ripple, and hence the conduction loss reduces. The circuit also increases the lifetime of the source. Because of the lossless passive clamp performance, the leakage energy can be recycled to the output terminal. This leads to the reduction in large voltage spikes across the switches and improvement in the overall efficiency. The low voltage stress enables the use of low-voltage-rated MOSFETs for reductions of conduction losses and cost. The circuit with 12-V input voltage and 100-W output power was simulated using Matlab simulink and an output voltage of 110-V was obtained.

Keywords: Boost–Fly Back Converter, High Step-Up, Photovoltaic System, Voltage Multiplier Module.

1. Introduction

Renewable energy attracts interest for power generation because the non renewable energy like petrol, diesels etc are diminishing and energy crisis is an important concern in most of the nations. In renewable energy, solar energy attracts more because it has more advantage compare to other renewable energy s like the selection of area is not complicated, the systems can either be operated as isolated systems or connected to the grid as a part of an integrated system, it has no moving parts; it has a long lifetime and low maintenance requirements and most importantly it is one solution that offers eco friendly power. Photovoltaic system requires a power electronics interface to be connected to the grid. The most commonly used dc/dc converter is a boost converter which provides an acceptable voltage conversion ratio and also requests a continuous current from the power source. The characteristics required in photovoltaic applications are low current ripple injected to the power source and high conversion efficiency. In the photovoltaic case, the current ripple impacts the power generation since it produces an oscillation around the Maximum Power Point (MPP) reducing the energy extracted from the photovoltaic generator.

Those characteristics make the boost converter a good candidate to interface the photovoltaic systems. Additionally it requires filter between the power generator and the power converter, increasing also the power losses, size, weight, cost and order of the system. Another possibility to reduce the converter’s input current ripple is given by the interleaving structures. The interleaving technique connects dc/dc converters in parallel to share the power flow between two or more conversion chains. However, the conventional interleaved converter has some disadvantages like the duty ratio is extremely large in order to get a high gain, this increases the current ripple, conduction losses and the turnoff losses.

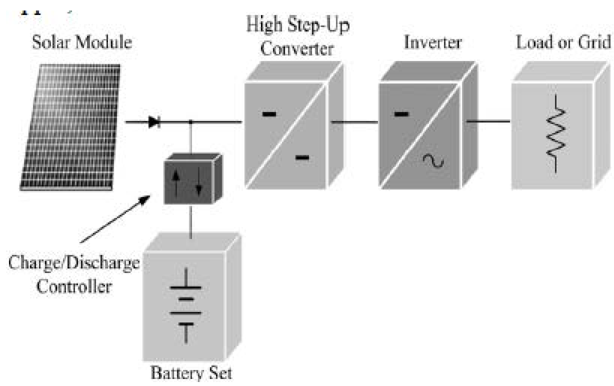

Figure 1 : Block diagram of high step up converter

Then, the switches voltage stress is the high and the output diode reverse-recovery problem is very severe, which induces additional voltage and current stresses and losses and also the electromagnetic interference (EMI) noise is very serious. To improve voltage gain interleaved structures can be used with transformers or the inductors. Interleaved converters is able to reduce output current ripple without any modification on the PWM technique (need phase shift only) and circuit theory of boost converter. When the duty cycle is high the voltage gain is theoretically infinite. So the switch turn on period becomes long as the duty cycle (D) increases causing conduction losses to increase. The single switch boost converter power rating is limited to switch rating. Interleaved parallel topology is the solution to increase the power and reduce input current ripple allowing lower power rated switches to be used.

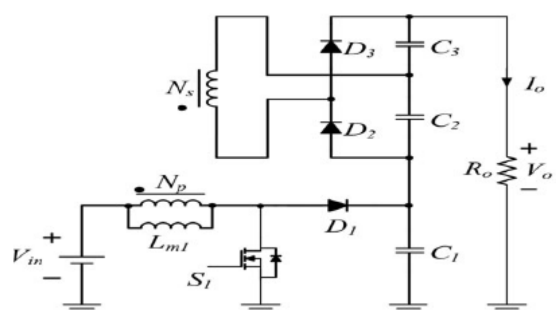

Figure 2: Integrated Fly back–Boost Converter Structure

2. Proposed System

In this paper, an asymmetrical interleaved high step-up converter that combine the advantages of the aforementioned converters is proposed, which combined the advantages of both. In the voltage multiplier module of the proposed converter, the turn's ratio of coupled inductors can be designed to extend voltage gain, and a voltage-lift capacitor offers an extra voltage conversion ratio. In this paper a high step-up converter is proposed for a frontend photovoltaic system. Through a voltage multiplier module, an asymmetrical interleaved high step-up converter obtains high step up gain without operating at an extreme duty ratio. The voltage multiplier module is composed of a conventional boost converter and coupled inductors. An extra conventional boost converter is integrated into the first phase to achieve a considerably higher voltage conversion ratio. The two-phase configuration not only reduces the current stress through each power switch, but also constrains the input current ripple, which decreases the conduction losses of metal–oxide– semiconductor field effect transistor

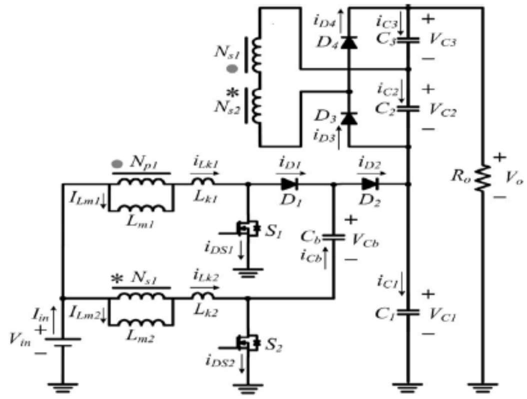

Figure 3: Equivalent Circuit for Proposed System.

The proposed method adopts continuous mode of operation. So the stress on the switching device will be less and hence efficiency will be more. MOSFET in the fly back converter is controlled by the sinusoidal pulse width modulation. In sinusoidal pulse width modulation, carrier signal is a triangular wave and reference signal is a sine wave. By comparing the reference signal with the carrier wave gating pulses are generated. The main advantage of PWM (Pulse Width Modulation) is that the power loss in the switching device is very less. The switching period can be subdivided in to six modes of operation. The modes 1-3 are same as modes 4-6. So the first three modes are explained here. To make the circuit operation simpler, some assumptions are made the transformer leakage inductances are negligible. The magnetizing inductances Lm1 and Lm2 are identical the phase shift between two switches are 1800. Mode 1: In mode 1, S1 is ON and S2 is ON. All of the diodes are reverse biased. Magnetizing inductors Lm1 and Lm2 as well as leakage inductors Lk1 and L K2 are linearly charged by the input voltage source Vin1. Mode 2: The switch S2 is switched OFF, there by turning ON diodes D2 and D4.The energy that magnetizing inductor Lm2 has stored is transferred to the secondary side charging the output filter capacitor C3 Mode 3: Diode D2 automatically switches OFF because the total energy of leakage inductor Lk2 has been completely released to the output filter capacitorC1.

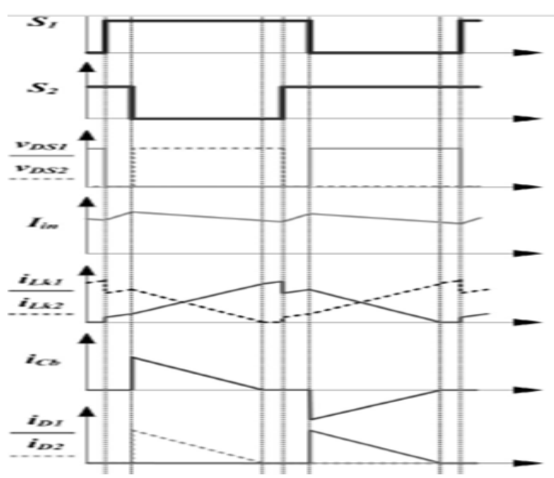

Figure 4: Steady waveforms of the proposed converter at CCM.

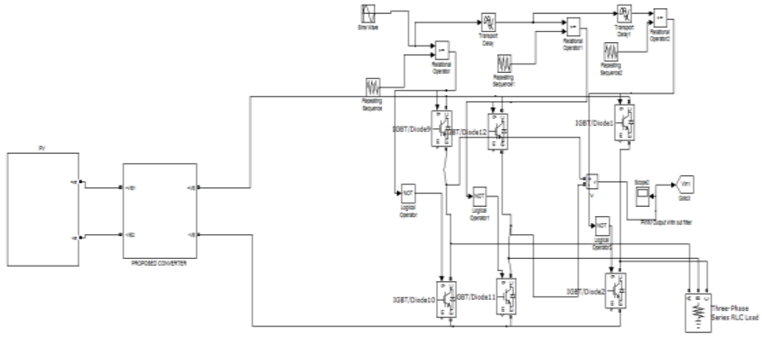

Figure 5: Simulation circuit.

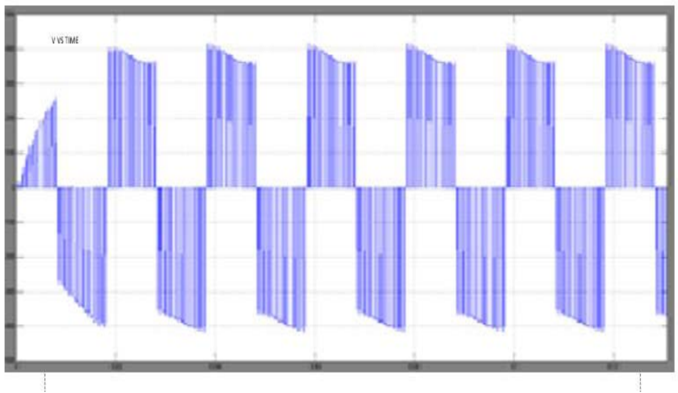

Figure 6: Simulated output waveform of inverter output voltage.

3. Conclusion

The control system of power converters is one of the most important parts of the photovoltaic power generation system. In the paper, proposed step up converter interleaved with voltage multiplier module with single phase full bridge inverter and single phase half bridge inverter using solar power source is simulated using Matlab/Simulink and compared with conventional step up converter with inverter for solar system. The proposed step up converter interleaved with voltage multiplier module which converts the DC 40V input supply to 380V DC output. The output voltage of proposed converter with full bridge inverter is obtained as 380V AC supply with a THD of 1.48%. The output voltage of proposed converter with half bridge inverter is obtained as 190V AC supply with a THD of 3.76%. The conventional step up converter which converts the 40V DC input supply to the 140V DC supply and then inverter converts 140V AC output supply. Thus the proposed step up converter is more suitable than the conventional step up converter for the photovoltaic power generation system.

4. References

[1] J. T. Bialasiewicz, “Renewable energy systems with photovoltaic power generators: Operation and modeling,” IEEE Trans. Ind. Electron., vol. 55, no. 7, pp. 2752–2758, Jul. 2008.

[2] T. Kefalas and A. Kladas, “Analysis of transformers working under heavily saturated conditions in grid- connected renewable energy systems,” IEEE Trans. Ind. Electron., vol. 59, no. 5, pp. 2342–2350, May 2012.

[3] Y. Xiong, X. Cheng, Z. J. Shen, C. Mi, H. Wu, and V. K. Garg, “Prognostic and warning system for power-electronic modules in electric, hybrid electric, and fuel-cell vehicles,” IEEE Trans. Ind. Electron., vol. 55, no. 6, pp. 2268–2276, Jun. 2008.

[4] A. K. Rathore, A. K. S. Bhat, and R. Oruganti, “Analysis, design and experimental results of wide range ZVS active-clamped L–L type currentfed DC/DC converter for fuel cells to utility interface,” IEEE Trans. Ind. Electron., vol. 59, no. 1, pp. 473–485, Jan. 2012.

[5] C. Hua, J. Lin, and C. Shen, “Implementation of a DSP-controlled photovoltaic system with peak power tracking,” IEEE Trans. Ind. Electron., vol. 45, no. 1, pp. 99–107, Feb. 1998.

[6] J. M. Carrasco, L. G. Franquelo, J. T. Bialasiewicz, E. Galvan, R. C. P. Guisado, M. A. M Prats, J. I. Leon, and N. Moreno-Alfonso, “Power-electronic systems for the grid integration of renewable energy sources: A survey,” IEEE Trans. Ind. Electron., vol. 53, no. 4, pp. 1002– 1016, Jun. 2006.