ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 8, Issue 7, July 2019

INTERLEAVED BOOST CONVERTER WITH PI CONTROLLER

Sheeba S

Lecturer, Department of Instrumentation Engineering, Government Women's Polytechnic College,

Thiruvananthapuram, Kerala,India

ABSTRACT:This paper introduces an overview of a high voltage gain boost converter for the power conversion in renewable energy sources. It uses two phase interleaved converter using three winding coupled inductors in its input side and a capacitor - diode voltage multiplier cell on its output side for extending the voltage gain. The converter achieves high voltage gain without utilizing high duty ratio. The input current ripple is reduced by the interleaved structure. The voltage stress on the power switches are also reduced. As a result conduction losses are reduced and hence low rated power switches can be used. The diode reverse recovery problem is attenuated by the leakage inductance of the coupled inductor. The interleaved connection of the boost converter reduces the input current ripple as it is directed to two different paths.

KEYWORDS: Interleaved, multiplier cell, coupled inductor

I.INTRODUCTION

The objective of the paper is to give an overview of a small sized high gain boost converter and to simulate it in the MATLAB/SIMULINK for the performance verification and to obtain the sufficiency of the proposed converter. The existing open loop system is intended to make closed loop by including a PI controller which is subjected to tuning by trial and error method for fixing the optimum values for the controller parameters. With the proposed converter a desired constant dc output voltage with minimum ripple is to be achieved.

II.MAJOR COMPONENTS

Power MOSFET

High levels of powers are managed by power MOSFETs. Their switching speed is very high and their performance is better than the ordinary MOSFETs when they are operating in lower voltage levels. But its operating principle is same as that of ordinary MOSFET. There are three main types of Power MOSFETs modes viz. n-channel Enhancement-mode or p-channel Enhancement-mode or n-channel Depletion-mode.

The power relationship is $P = I^2R$, then a high channel resistance $R_{DS\text{-}on}$ would result in enormous amounts of power being dissipated and wasted within the MOSFET itself. This will cause excessive temperature rise. If this temperature rise cannot be controlled due to thermal overload condition

VOLTAGE MULTIPLIER CELL - The synchronous work of coupled inductors and switched capacitors is a superior idea to accomplish a high voltage increase, high efficiency, and low voltage stress , nevertheless, for high power applications.

When a number of voltage doublers are connected in cascade, it is called a voltage multiplier circuit. A single stage of a voltage level multiplier is considered as a voltage doubler. A high voltage multiplication factor is obtained when identical stages are joined in cascade. For achieving high voltage conversion ratio without extreme duty cycle, converters using coupled inductors are in practical use. The three winding coupled-inductor technology enables simultaneous parallel energy-transfer pathways: both electrical and magnetic. The Voltage Multiplier cell is an exceptional type of diode rectifier circuit whose output voltage is a multiple of the applied input voltage.

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PWM GENERATION - Pulse-width modulation is a modulation technique used in most communication systems for encoding the amplitude of a signal straight away into a pulse width or duration of a carrier signal, for transmission. Although PWM is used in communications, its main purpose is to control the power that is supplied to various types of electrical devices such as AC or DC motors.

In the PWM generator the carrier ramp voltage and a dc reference voltage is compared. When the reference voltage is greater than the ramp voltage PWM generator outputs 1 or 0 otherwise. The major advantage of PWM is that the power loss is minimum.

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III.STRUCTURE SCHEMATIC

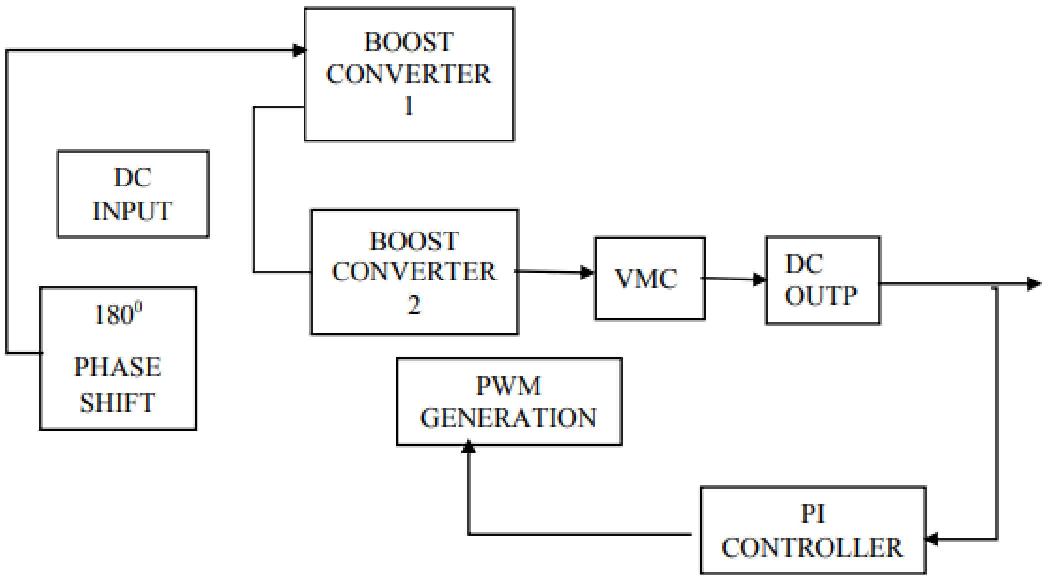

Fig.1: Block diagram of the converter

Fig.1 shows the block diagram of the boost converter. It includes two interleaved boost converters together with a voltage multiplier cell. An interleaved boost converter with two phases are used here. By using the voltage multiplier cell additional boost of the input voltage is achieved. The frequency of the output voltage ripples obtained across the output capacitor is twice that of a single phase boost converter. The input current ripple amplitude is at a low level.This advantage makes this topology very attractive for the renewable energy sources. The phase delay between the two gating pulses are 360/n, where n is the number of boost converters connected in parallel. The phase delay between the gating pulses for a two phase interleaved boost converter is 180 degrees as n=2

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IV. **SIMULINK MODEL OF THE CONVERTER**

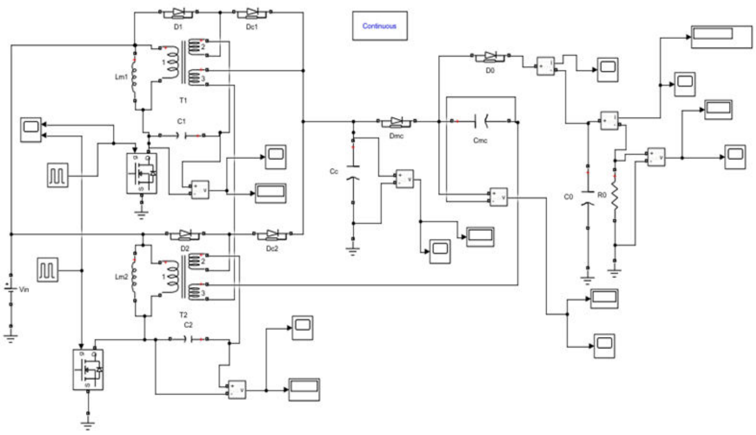

Fig.2: Converter without controller Simulation Model.

From the model it is clear that the gating pulses for the power MOSFET switches are given separately which are 180^0 out of phase.

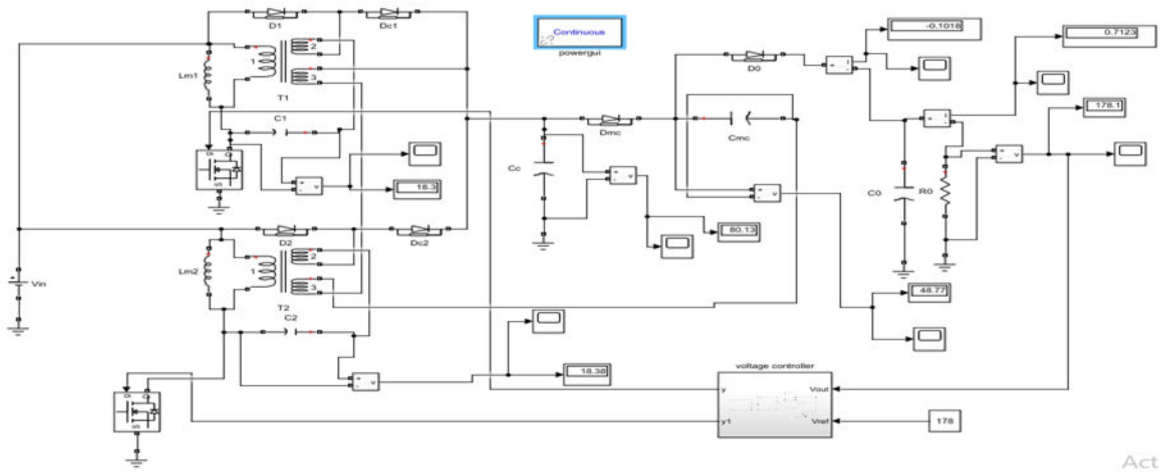

Fig.3: Converter with PI controller

Fig. 4.9 shows the Simulink model of the proposed converter with PI controller and Fig. 4.10 shows the subsystem model for the PI controller. The actual output voltage and the reference voltage of 178V is compared and the error signal is given to the PI controller as input. The output of the PI controller for a reference voltage of 178V is 0.25V as shown in Fig. 4.12. From the Fig. 4.11 it is clear that with the use of PI controller, the output voltage is maintained constant at 178V for a reference voltage of 178V

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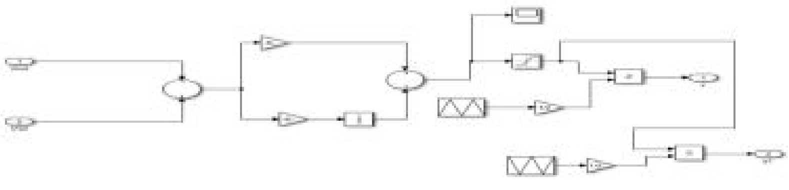

Fig.4: Subsystem for PI controller

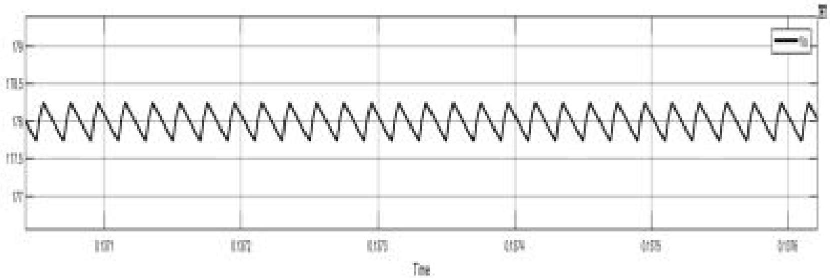

Fig.5: Output voltage when the reference voltage is 178V

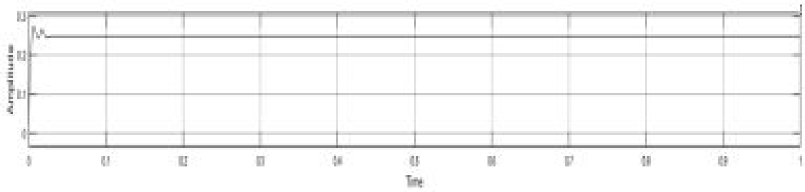

Fig.6: PI Controller output for a reference signal of 178V

V. CONCLUSION

This paper gives an overview of interleaved input high voltage gain dc-dc converter based on three winding coupled inductor and voltage multiplier cell. In the existing system several diode–capacitor cells are required to meet a very high step-up gain. A combination of voltage multiplier cell and coupled inductors are used to get a high value of voltage gain. Besides the operation of voltage multiplication, the multiplier cell capacitor functions as clamp capacitor too to reduce the switch voltage stress. The voltage gain is increased without using an extreme duty cycle. MATLAB/SIMULINK tool is used for circuit simulation. The existing system consists of a number of power capacitors and diodes. Hence the system is bulky. In the proposed system by reducing the number capacitors and diodes high voltage gain is achieved. In order to obtain a better performance of the proposed converter, a PI control strategy is implemented. With this type of loop control, a constant output voltage despite the changes in source voltage or load current or for the same input voltage, we can get the desired output voltage.

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REFERENCES

[1] Seyed Mohsen Salehi, Seyed Mohammad Dehghan, Saeed Hasanzadeh 'Interleaved-Input Series-Output Ultra High Voltage Gain DC-DC Converter' IEEE Transactions on power electronics, DOI: 10.1109/TPEL.2018.2853577

[2] The Text book 'Pulse width modulated Dc-DC converters' by Keng Chih Wu,Staff Engineer, Power Electronics, Lockheed Martin Missile & Space.

[3] M.Forouzesh, Y. Shen.K. Yari.Y.P. Siwakoti and F. Blaabjerg. 'High Efficiency High Step-Up DC-DC Converter with Dual Coupled Inductors for grid connected photovoltaic system' IEEE Transactions On Power Electronics, DOI 10.1109/TPEL.2017.2746750

[4] Y. Ye, K. Cheng, and S. Chen, "A High Step-up PWM DC-DC Converter With Coupled-Inductor and Resonant Switched-Capacitor," IEEE Transactions on Power Electronics, vol. 32, pp. 7739-7749, 2017

[5] G. Spiazzi,P. Mattavelli, and A. Costabeber. 'High step-Up ratio flyback converter with active clamp and voltage multiplier'. IEEE Transactions on Power Electronics, Volume: 26 ,Issue: 11 , Nov. 2011

[6] X. Hu and C. Gong, "A high gain input-parallel output-series DC/DC converter with dual coupled inductors," IEEE transactions on power electronics, vol. 30, pp. 1306-1317, 2015.

[7] Yuanmao Ye, K.W.E. Cheng, Senior Member, IEEE, Sizhe Chen 'A high step-up PWM DC-DC Converter with coupled inductor and resonant switched capacitor'. IEEE Transactions on Power Electronics , Volume: 32, Issue: 10 , pp. 7739 – 7749, Oct. 2017

[8] T. Nouri, S. H. Hosseini, E. Babaei, and J. Ebrahimi, "Interleaved high step-up dc–dc converter based on three-winding high-frequency coupled inductor and voltage multiplier cell," IET Power Electronics, vol. 8, pp. 175-189, 2014.

[9] S. Salehi, S. Dehghan, and S. Hasanzadeh "Ultra step-up DC-DC converter based on three windings coupled inductor, " in Power Electronics and Drive Systems Technologies Conference (PEDSTC), 2016 7th, 2016, pp. 171-176.

[10] Y.Gu and D. Zhang, "Interleaved boost converter with ripple cancellation network," IEEE transactions on power electronics, vol. 28, pp. 3860-3869, 2013.

[11] B. Zhu, L. Ren, and X. Wu, "Kind of high step-up dc/dc converter using a novel voltage multiplier cell," IET Power Electronics, vol. 10, pp. 129-133, 2017.

[12] Wuhua Li, Member, IEEE,Yi Z.hao, Yan Deng, and Xiangning He, Fellow IEEE. "Interleaved Converter With Voltage Multiplier Cell for High Step-Up and High-Efficiency Conversion", IEEE Transactions on power electronics,Vol .25,No.9,SEPTEMBER 2010.