



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 4, April 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com



Non-Isolated Boost Converter Based on Voltage Lift Technique

Pranjal Haramkar¹, Aditya Kamble², Suyog Rupnar³, Sunny Pawar⁴, Prof Ritesh ulhe⁵

U.G. Student, Department of Electrical Engineering, MGM's College of Engineering and Technology, Navi Mumbai, Maharashtra, India^{1 2 3 4}

Assistant Professor, Department of Electrical Engineering, MGM's College of Engineering and Technology, Navi Mumbai, Maharashtra, India⁵

ABSTRACT: Now a day, use of non-isolated boost converter has increased with the development in renewable energy sources. An isolated dc-dc converter uses a transformer to eliminate the dc path between its input and output. In contrast, a non-isolated dc-dc converter has a dc path between its input and output. The free current ripple, direct connection of inductor to input voltage source, less stress of elements and providing infinite voltage gain for duty cycle near to one are the theoretical advantages of the conventional non isolated boost converter. While, the electromagnetic interface, overvoltage problem on switch, reverse recovery problem and stability are disadvantages of conventional non isolated boost dc-dc converter as its duty cycle is limited to 0.8. There are few techniques to overcome these drawbacks and to improve voltage gain. This includes Switched Capacitor Technique, Interleaving Technique, Combination Technique, Voltage Lift Technique. The voltage lift technique is popular technique so as to increase the output voltage by using storage elements features. Also the current and voltage stress on elements are reduced to acceptable value which ultimately improves stability and circuit characteristics. This technique can be used in more boosting applications such as electrical vehicles, medical equipment, portable devices, etc.

KEYWORDS; Nonisolated; boost converter; dc-dc converter; voltage lift technique; high voltage gains.

I. INTRODUCTION

In recent years, power generation based on renewable energy sources have rapidly developed. This type of generation system is composed of sources like fuel cells, Photovoltaic (PV) cells and wind power. But fuel cells and PV cells are low voltage source to provide enough DC voltage for generating ac voltage. So PV cells can be connected in series to obtain sufficient DC voltage. However, sufficient staking of cells is not possible in many high voltage applications and it is also difficult to avoid shadow effect. Hence, high step up DC-DC converters are usually used as the front end converters to step from low voltage to high voltage which are required to have a large conversion ratio, high efficiency and small volume.

In addition to above mentioned applications, a high step up DC-DC converter is also required by many applications such as, LED Lighting System, Portable Devices, Electrical Vehicles, Power factor correction, Uninterrupted Power Supply

Theoretically, high step up voltage gain with an extremely high duty cycle can be provided by the boost converter. In practice due to effect of power switch, rectifier diode and the equivalent series resistance of the inductor and capacitor can limit the voltage gain. Also, reverse recovery and electromagnetic interface problems are caused by the extreme duty cycle operation

There are various boosting techniques in which fundamental energy storing elements or transformers with switch and diode are utilized in the circuit. These techniques include Switched capacitor, Combination technique, Interleaving technique, Voltage lift technique etc. First three techniques have its own merits and demerits depending upon its applications, cost, complexity, power density, reliability and efficiency. Whereas, Voltage lift has advantage of less voltage and current stress on elements and higher voltage gain using fewer no of elements. When the proposed boost

converter is compared with conventional boost converter at 50% duty cycle the output voltage gain of proposed converter is two times of conventional converter.

II. RELATED WORK

In R.D. Middlebrooks from Caltech in 1977 published the model for DC to DC converters which are used today. In 1980's the use of field effect transistors (FET's) increased the efficiency of DC-DC converters. Later, literature has reported various voltage boosting techniques which incorporate fundamental energy storing elements (inductors and capacitors) or transformers in conjunction with switches and diodes. These techniques include switched capacitor (charge pump), voltage multiplier, magnetic coupling, voltage lift (switched inductor) etc. each has its own merits and demerits depending on application, cost, complexity, power density, reliability and efficiency.

Shiyu Zhang, Jianping Xu, Ping Yang, their work was based on the traditional voltage-lift-technique and they introduced a modified voltage-lift cell. A single-switch high gain quadratic boost converter is obtained by applying the modified voltage-lift cell to quadratic boost converter, the voltage gain of the converter is improved and the switch voltage stress of the converter is also reduced. The operation principle of the quadratic boost converter with modified voltage-lift cell is analyzed and compared with quadratic boost converter and the other single-switch high gain boost converter, the voltage gain of quadratic boost converter with modified voltage-lift cell is highest, and the switch voltage stress of quadratic boost converter with modified voltage-lift cell is lowest.

M. Shahir, M.A. Azar and B. Taher introduced a new structure for non-isolated boost DC-DC converter based on voltage-lift (VL) technique. The proposed structure provided satisfied output voltage only with one switch. The voltage gain along with voltage and current relation of each element in continuous current mode (CCM) is also mentioned. In addition, the current and voltage stress are analyzed individually. Also, the proposed converter is compared with some presented converter in terms of number of components and voltage gain in CCM.

III. METHODOLOGY

Project model consists of main equipment which includes a DC power supply or a solar panel, DC-DC converter, an astable multi vibrator circuit and a resistive load. From the figure 1.1 it is clear that sun ray is trapped by solar panel and gives output as DC. Converter is used to convert DC output of solar panel into boosted DC. IGBT is used as a switch for this converter. Switching pulses are given to the converter which are generated by an astable multivibrator. PWM technique is used to generate switching pulses. Hence it is sufficient to run the resistive load.

Modes of Operation

Mode 1 [$0 < t < T_{on}$]

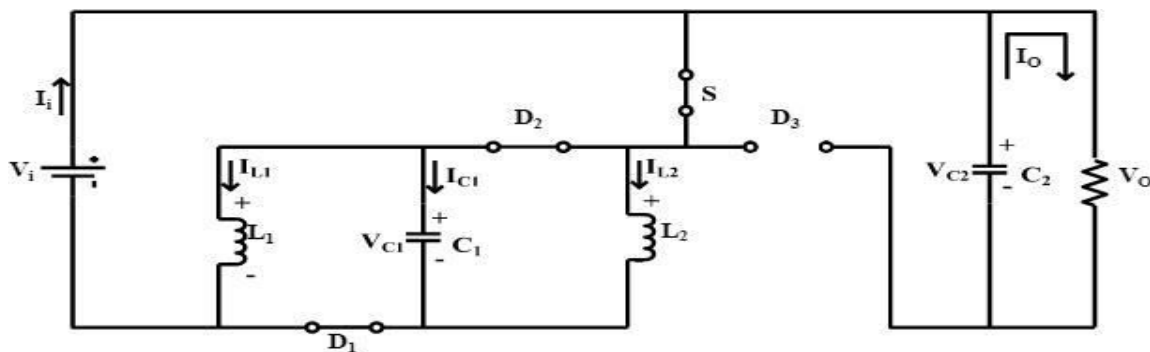


Figure 2.2 Proposed Boost Converter for T_{on}

The equivalent circuit of this time interval is shown in figure 2.3. When the switch S is turned on, diodes D1 and D2 are forward biased and the diode D3 is reverse biased. Thus the inductors L1 and L2 and capacitor C1 are connected in parallel. The input voltage source (V_i) is also connected to it in parallel. During this time interval, the stored energy of

inductors L1 and L2 are increased and the current through them are reached to their maximum values. Also the stored energy of capacitor C1 is increased to its maximum value. Meanwhile the load current is provided by capacitor C2. As a result, the voltage and stored energy of capacitor C2 is gradually decreased.

Mode 2 [TON < t < TOFF]

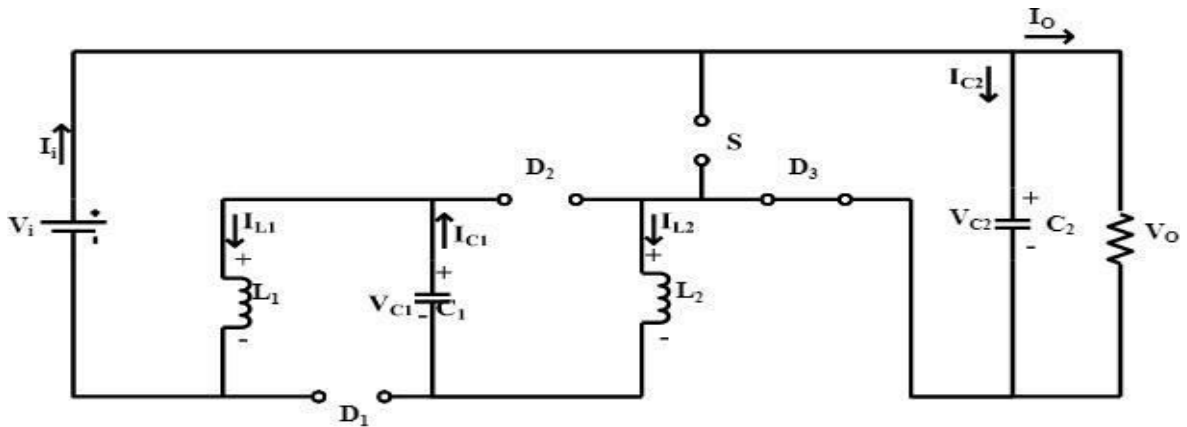
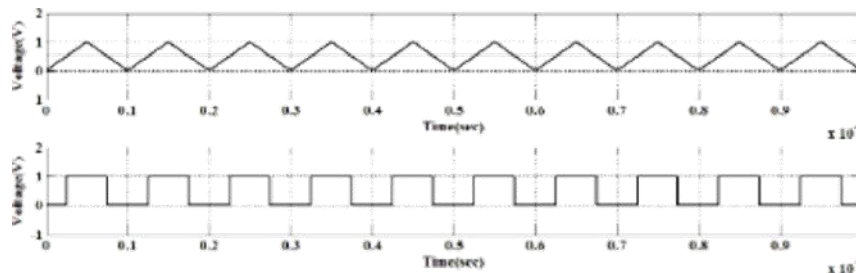


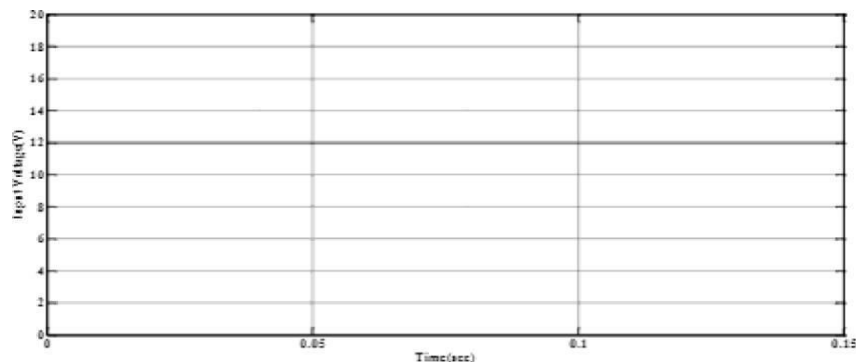
Figure 2.3 Proposed Boost Converter for TOFF

The equivalent circuit of this time interval is shown in figure 2.2. When the switch S is turned off, diode D3 is forward biased and the diodes D1 and D2 are reverse biased. Thus the inductors L1 and L2, capacitor C1 and the input voltage source (Vi) are connected in series. During this time interval, the stored energy of inductors L1 and L2, capacitor C1 are decreased. Meanwhile, the stored energy and voltage of capacitor C2 is increased to its maximum value and the load current is provided by series combination of elements and source.

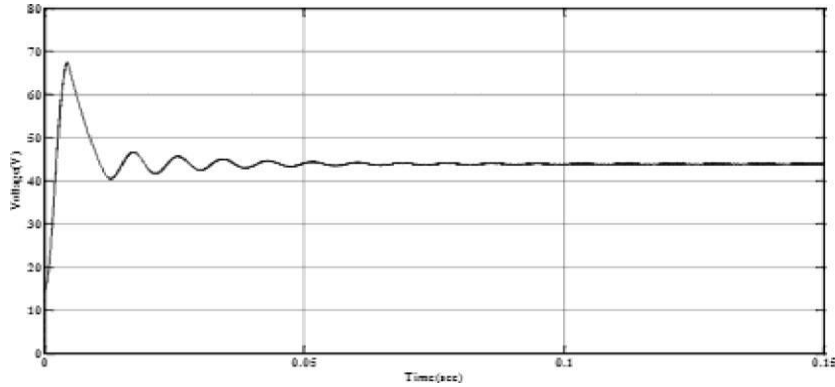
IV. SIMULATION RESULTS



(a)



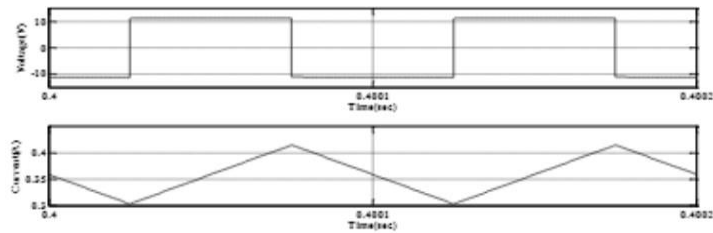
(b)



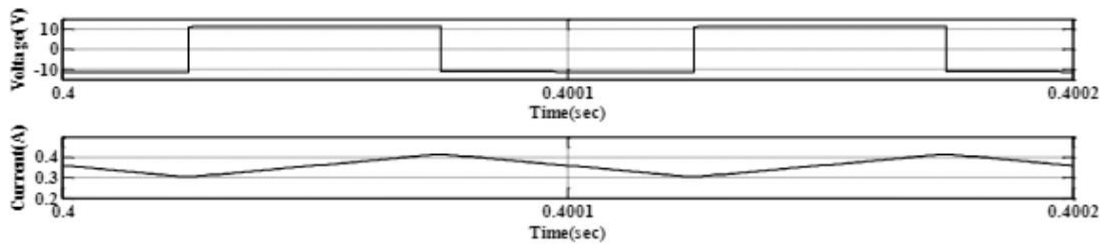
(c)

Figure 3.2 (a) Generation of Gate Pulses by PWM Technique (b)Input Waveform (c)Output Waveform

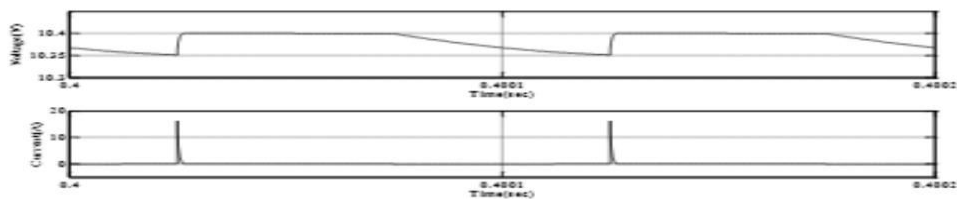
The generation of gate pulses by PWM is shown in figure 3.2(a). The rectangular pulses are generated by comparing triangular carrier signal with constant magnitude signal of 0.5 amplitude. Input waveform is shown in figure 3.2(b). Constant 12volts is given as input to the converter. Output waveform is shown in figure 3.2(c). As shown in figure magnitude of output voltage is nearly four times as that of input voltage



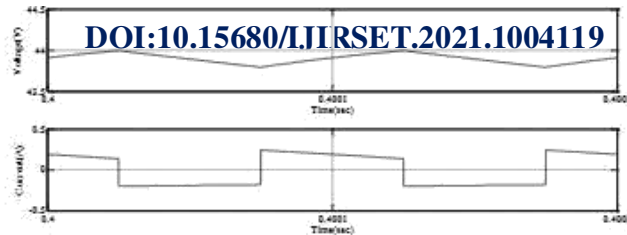
(a)



(b)



(c)



(d)

Figure 3.3 Voltage and Current Waveforms of: (a)Inductor L_1 (b)Inductor L_2
(c)Capacitor C_1 (d)Capacitor C_2

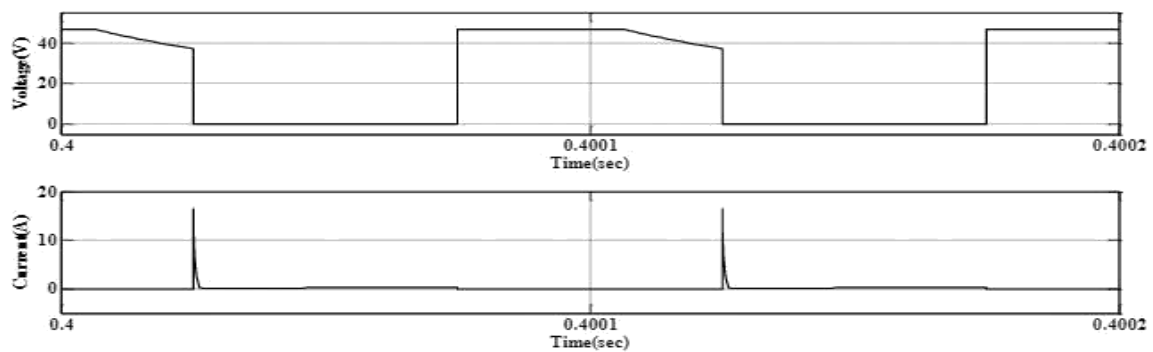


Figure 3.5 Voltage and Current Waveform of IGBT switch

The voltage and current waveforms of IGBT is shown in figure 3.5. Voltage of switch S is changing from 0 to -43V. The current of switch has a ripple of 16amps magnitude for a very short duration

V. CONCLUSION

A compactly designed single switch non-isolated boost converter based on voltage lift technique is proposed in this project. In our project less number of elements are used and using storage element feature output voltage is raised. Hence, the proposed converter is applicable for more boosting applications and can be used with less no. of solar panels to boost the voltage easily up to the system voltage. Thus, it plays a greater role in development of renewable energy sources.

REFERENCES

- [1] P. Muthukrishnan, R. Dhanasekaran, "DC-DC Boost Converter for Solar Power Application", Journal of Theoretical and Applied Information Technology, 2014, Vol. 68 No.3.
- [2] G. Rohini, S. Vaishnavi, B. Yogeshwaran and K. Surendra Kumar, "High Efficient DC-DC Converter for Portable Device", Arpn Journal of Engineering and Applied Sciences, 2018, Vol. 13, No.11.
- [3] Carlos E. A. Silva, René P. T. Bascopé, Demercil S. Oliveira Jr., "Proposal of A New High Step- Up Converter for UPS Applications", IEEE ISIE, 2006.
- [4] Shiyu Zhang, Jianping Xu, Ping Yang, "A Single-Switch High Gain Quadratic Boost Converter Based On Voltage-Lift-Technique", IEEE IPEC, 2012.
- [5] Yiyang Li, Swamidoss Sathiakumar, "Improved Quadratic Boost Converter Based On The Voltage Lift Technique", Asia Modelling Symposium (AMS), 2017.
- [6] Farzad Mohammadzadeh Shahir, Mehrdad Aberoumand Azar, "Analysis And Design A New Topology For Non-isolated Boost DC-DC Converter", IEEE, 2018
- [7] F.M. Shahir, E. Babaei, M. Sabahi, and S. Laali, "A New DC-DC Converter Based On Voltage Lift Technique", International Transactions On Electrical Energy Systems (ETEP), 2016, Vol. 26, Pp.1260-1286.
- [8] F. M. Shahir and E. Babaei, "A New Structure for Non-Isolated Boost DC-DC Converter Based On Voltage-Lift Technique", In Proc. PEDSTC, 2017.
- [9] F.M. Shahir, M.A. Azar and B. Taher, "New Single Switch Topology for Non-Isolated Boost DC-DC Converter Based On Voltage Lift Technique", IEEE 12th International Conference On Compatibility, Power Electronics, And Power Engineering, 2018



INNO  **SPACE**
SJIF Scientific Journal Impact Factor

Impact Factor:
7.512

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details