IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified

Vol. 3, Issue 10, October 2016

# Comparison of Boost Converter over a SEPIC Converter with Using a Special Type of Load Drive

**Pramod Kumar**

Assistant Professor, Dept of Electrical Engineering, UIET, Baba Saheb Bhim Rao Ambedkar University, Lucknow

**Abstract:** After analyzing the whole circuit of proposed BOOST converter we find the double output voltage to input voltage. There are no ripples in output voltage. In this circuit the supply voltage is always in continuous conduction mode, when circuit is running in step up condition. A SEPI C converter is a purely DC-DC converter. Its features are similar to the Cuk converter. A boost converter is a step-up converter and a power converter with an output DC voltage greater than its input DC voltage.

**Keywords:** BOOST converter, SEPI C converter, DC-DC converter, Cuk converter

## I. STATEMENT

It is a class of switching-mode power supply containing at least two semiconductor switches and at least one energy storage element. Filters made of capacitors are normally added to the output of the converter to reduce output voltage ripple.

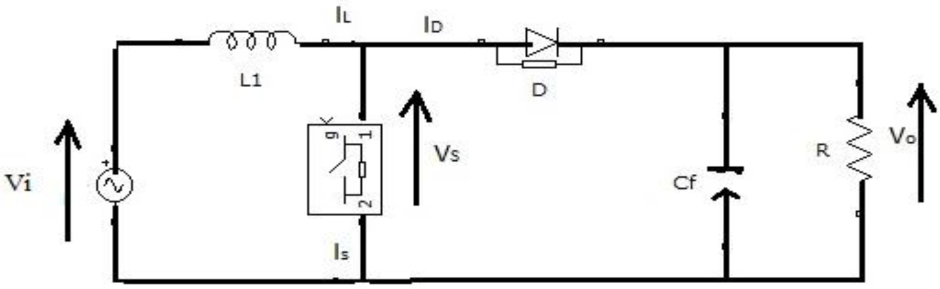



Figure 1.Circuit diagram of boost converter

## II. DESCRIPTION

In a boost converter the output voltage is always greater than input voltage. A boost converter has consisted a power MOSFET as a switch. The Circuit operation can be divided into two modes. Mode 1 begins when transistor Q1 is switched on at t = 0, the input current rises. Flows through inductor L and transistor Q1. Mode 2 begins when transistor $M_1$ is switched off at $t = t_1$. The current that was through the transistor would now flow through L,C and Load. The inductor current falls until transistor $M_1$ is turn on again in the Next cycle. The energy stored in inductor L3 is transferred to the load. A boost converter can step up the output voltage without any transformer. Due to a single transistor it has a high efficiency. The input current is continuous. However a high peak current has to flow through the power transistor. The output is very sensitive to change in duty cycle and it might be difficult to stabilize the regulator. The average output current is less than the average inductor current.

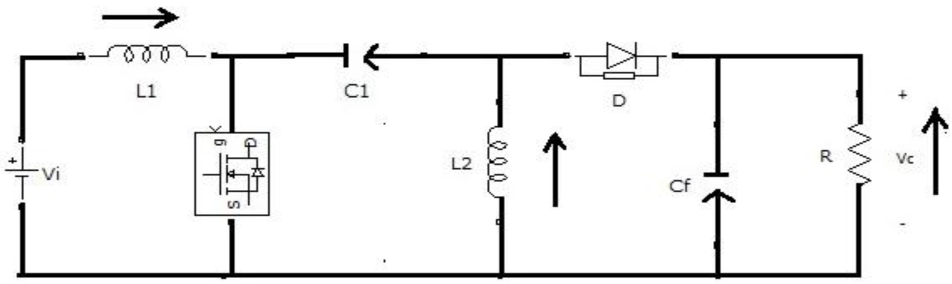



Fig.2.Circuit diagram of SECPIC Converter


DOI 10.17148/IARJSET.2016.31028

Power can also come from DC sources such as batteries, solar panels, rectifiers and DC generators. A process that changes one DC voltage to a different DC voltage is called DC- DC conversion. A boost converter is a DC- DC converter with an output voltage greater than the source voltage. A boost converter is sometimes called a step-up converter since it "steps up" the source voltage. Since power must be conserved, the output current is lower than the source current. For high efficiency, the simple mode of power switch must turn on and off quickly and have low losses.

The advent of a commercial semiconductor switch in the 1950s represented a major milestone that made Switched mode power supply such as the boost converter possible. Semiconductor switches turned on and off more quickly and lasted longer than other switches such as vacuum tubes and electromechanical relays.

The major DC- DC converters were developed in the early in 1960. When semiconductor switches had become available. The aerospace industry's need for small, lightweight and efficient power converters led to the converter's rapid development.

A switched system such as Switched Mode Power Supply is a challenge to design since its model depends on whether a switch is opened or closed. R.D. Middle brook from Caltech in 1977 published the models for DC to DC converters used today. Middle brook averaged the circuit configurations for each switch state in a technique called state-space averaging. This simplification reduced two systems into one. The new model led to insightful design equations which helped SMPS growth.

## III. OVERVIEW

After analyzing the whole circuit of proposed SEPIC converter we find the double output voltage to input voltage. There are no ripples in output voltage. In this circuit the supply voltage is always in continuous conduction mode, when circuit is running in step up condition.

A SEPIC converter is a purely DC-DC converter. Its features are similar to the Cuk converter. The analysis shows the high performance single switch+8 DC-DC Converter. The proposed converter is based on sepic configuration with output capacitor replaced by two identical capacitor connected through two diode. In the modified converter the modified sepic converter has lower voltage stress and higher step up and step down voltage conversion ratio.

The proposed converter is derived from the conventional sepic converter. It can operate in to capacitor-diode voltage multiplier, which offers single structure. SEPIC converter has been connected to dc servo drive which consist 120 volt input voltage and 240 volt output voltage.

## IV. MATHEMATICAL ANALYSIS OF PROPOSED BOOST CONVERTER

For Input Voltage

$$Vg = D' (V_{C1}+Vc) \qquad (1)$$

Where D' = 1 – D
And D = duty cycle of a switch
D' = Duty cycle of conventional Boost converter

$$D = \frac{\text{TurnonTime}}{\text{TolalTime}}$$

$$Vg = D' (V_{C1}+Vc) \qquad (2)$$

$$Vg = (1-D) (V_{C1}+Vc) \qquad (3)$$

Where

$$V_{C1} = \frac{1-D}{D}.Vc \qquad (4)$$

$$V_{C1} = \frac{D'}{D}.Vc \qquad (5)$$

Output Voltage

$$Vo = (2D + D') Vc + Dc_1 \qquad (6)$$

$$Vo = \{2D + (1-D')\}Vc + DVc_1 \qquad (7)$$

$$Vo = (D+1)Vc + DVc_1 \qquad (8)$$

$$\text{The Voltage Conversion ratio} = \frac{\text{Output}}{\text{Input}}$$

$$M = \frac{Vo}{Vg} = \frac{40}{20}$$

M = 2
M = Conversion Ratio
Vo = 2D

$$Vg = 1\text{-}D = D' \qquad (9)$$

$$M = \frac{2M}{1-D} = \frac{2D}{D'} \qquad (10)$$

## V. COMPARISON BETWEEN THE BOOST AND THE SEPIC CONVERTER

**Duty-Cycle D-**

In comparison with the conventional SEPIC converter, the proposed converter operates at lower duty ratio for the same overall conversion ratio. The relation between the respective duty ratios D and DC is obtained from

$$M = 2D / (1-D) \qquad (11)$$

M= conversion ratio

$$D = D_c/(2 - D_c) \qquad (12)$$

IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified

Vol. 3, Issue 10, October 2016

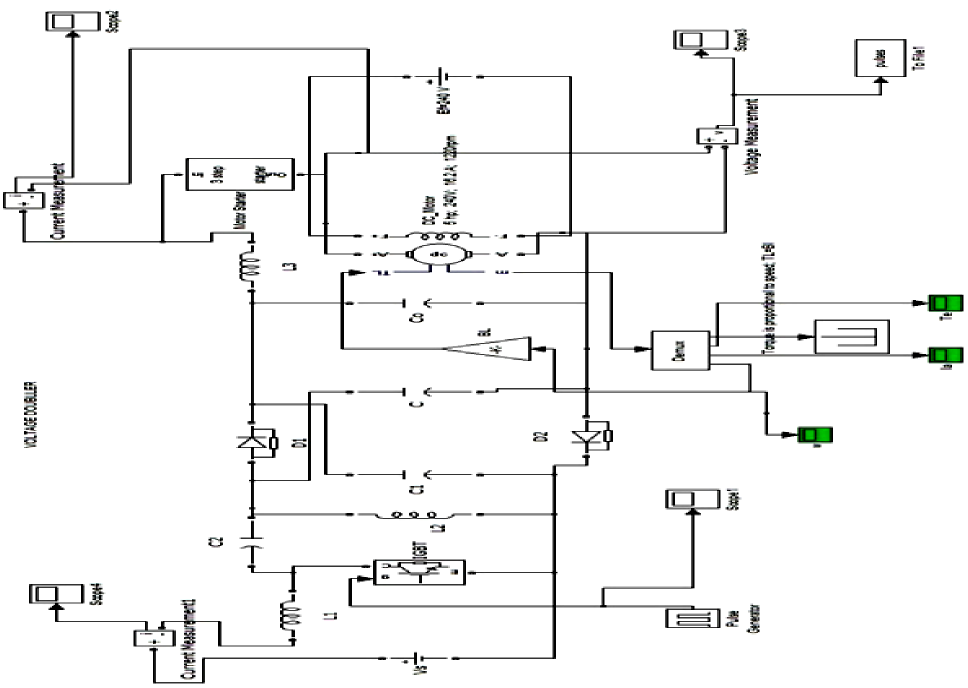
D is always less than Dc. This is an attractive feature for high DC voltage gains, since the conventional SEPIC converter must operate at extremely high duty-cycle ratios. This means that the output of diode in the SEPIC must sustain a short pulse width current with high amplitude. Thus, result the severe reverse-recovery as well as high EMI problems.

Semiconductors Stresses the comparison between the semiconductors normalized stresses for the proposed SEPIC topology and conventional SEPIC converter. Voltages and currents are normalized with respect to VO and Io, respectively. Referring to Table I, it can be seen that the proposed SEPIC topology has lower switch and diode blocking voltages than the conventional SEPIC converter. Moreover, the switch voltage stress in the proposed SEPIC topology decreases as M increases, approaching half of the output voltage in the limit. This is unlike the conventional SEPIC converter where the switch voltage stress approaches the output voltage for high values of M. Thus, the proposed converters enable the use of a lower voltage rated with low RDS-ON MOSFET switch that are smaller and less costly; hence, it reduces switch conduction and turn-on losses. Circuit also shows that the average diode current in both the proposed topology and the conventional SEPIC are equal to the output load current Io. However, the peak diode current in the proposed topology is lower than its matching part in the conventional SEPIC converter. Consequently, the diode root-mean-square current is lower for the proposed topology. On the other hand, the switch current in the proposed convert is equal to the sum of the three inductor currents, whereas in the conventional SEPIC the switch current equals to the sum of two inductor currents. As a result, the switch rms current in the proposed converter is slightly higher than its counterpart in the conventional SEPIC. This is the main disadvantage of the proposed converter. However, this does not mean that the switch conduction loss in the proposed con

1. The converter works as a voltage follower.
2. Theoretical power factor is unity.
3. The input current ripple is defined at the design stage.

Besides, input-output galvanic isolation is easily obtained. This dissertation analyzes the operation of both converters as Discontinous Conduction Mode–PFP. Design equations are derived, as well as a small-signal model to aid thecontrol loop design. Both MATLAB SIMULATION results arepresented that are in agreement with the theoretical analysis andbalance the work.
In purpose of DC-DC Sepic converter Laszlo Huber and Milian M. Jovanovic describe the Present specifications for computer power supplies for networking applications call for designs with dual inputs: the universal ac-line input and the 48-V nominal dc input. In this paper, a design and evaluation of the dc-input version of a 900-W server power supply is presented. The dc-input version of this power supply is leveraged from the ac-input version by using the same output stage, and by replacing the ac front-end in the ac-input version with a dc front end which provides the same input voltage to the output stage. By adopting this design approach, it is possible to achieve design modularity, design standardization, minimize the design time, optimize utilization of resources, and minimize the cost. The dc-input version uses a cascade connection of two dc boost converters because of its superior performance compared with other topologies.

## VI. SIMULATION AND RESULT



IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 3, Issue 10, October 2016

WAVEFORM

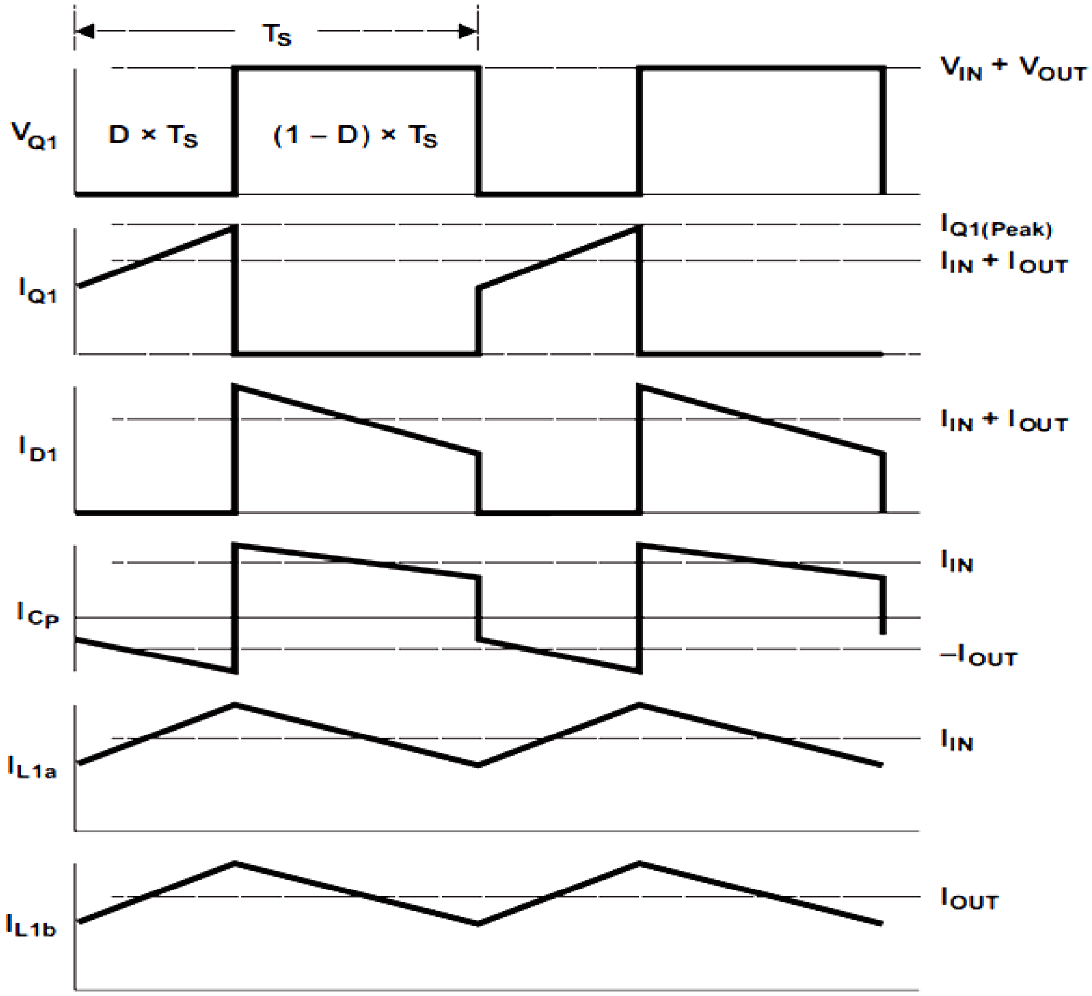
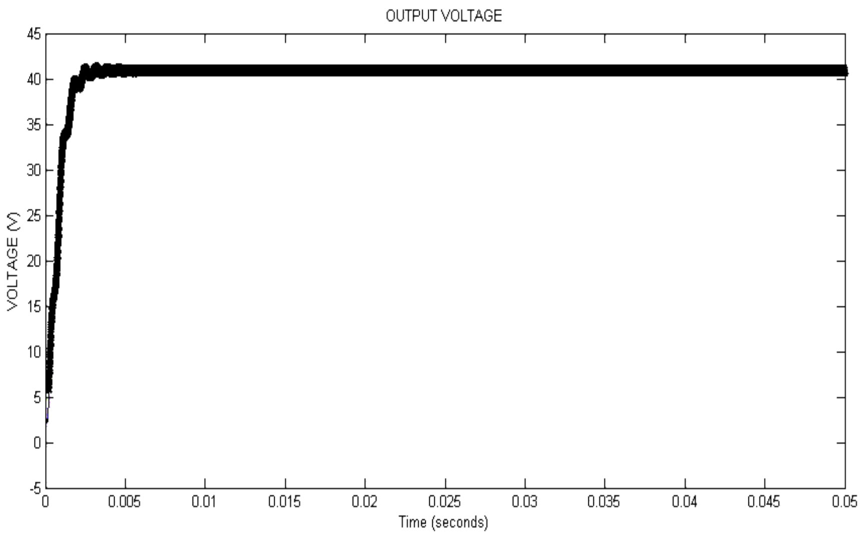



fig.4 output of simulated circuit




## VII. USE OF DC SERVO DRIVE LOAD

The steady state equivalent circuit of armature of a DC machine is shown in figure. Resistance $R_a$is the resistance of the Armature circuit .For separately excited and shunts motors, it is equal to the resistance of the armature binding and for series and compound motors. It is the sum armature and field binding resistance.


DOI 10.17148/IARJSET.2016.31028

## VIII. CONCUSION

This paper presented a high performance SEPIC derived converter with wide range of voltage conversion ratio, continuous output current and reduced voltage stress on all the semiconductors. The input and output current ripple can be reduced to near zero level due to the utilization of a coupled inductor techniques. The proposed converter has few extra components in comparison to a standard SEPIC and it is regulated by the conventional PWM technique at constant frequency. However, the additional components are far outweighed by the remarkable advantages gained and expecting the popularity of this technique with respect to other exiting topologies. The performance of the converter is verified by means of simulation results. This dissertation has presented a modified SEPIC converter with a Continuous output current. The principle of operation and the design-oriented analysis of the proposed converter have been presented. Normalized expressions for peak component stresses are also given, which allow the design optimization of the power stage.

## REFERENCES

[1] S. Cuk and R. D. Middlebrook, "A new optimum topology switching+33 DC-to-DC converter," in Conference Rec. 1977 IEEE Power electronics Specialist Confe.,pp. 160-179.
[2] S. Cuk and R. D. Middlebrook, "Coupled-inductor and other extensions of a new optimum topology switching DC-to-DC converter", in Conf.Rec.1977 IEEE Industry Application Society Annual Meeting pp.1110-1126.
[3] R. Massey and E. Snyder, "High voltage single ended DC-DC converter," in conf.Rec.1977 IEEE Power electronics Specialist conf.pp.156-159.
[4] S. Cuk, "A new zero-ripple switching DC-to-DC converter and integrated magnetics," IEEE Transformer on magnetics,vol.19,no.2,pp.57-75,March1983.
[5] F. S. Dos Reis, J. Sebastian, and J. Uceda, "Characterization of conducted noise generation for Sepic, Cuk and Boost converters working as power factor preregulators,"in conf. Rec. 1993 IEEE ,pp.965-970.
[6] L. Huber and M. M. Jovanovic, "A design approach for server power supplies for networking,"inconf.Rec.2000 IEEE Applied Power electronics conf.pp.1163-1169.
[7] B. Axelrod, Y. Berkovich, and A. Ioinovici, "Transformerless DCDC converters with a very high DC line-to-load voltage ratio," in 2003 IEEE International Symposium on circuit and system, vol.3,pp.435-438.
[8] H. Nomura, K. Fujiwara, and M. Yoshida, "A new DC-DC converter circuit with larger step-up/down ratio" in conf. Rec.2006 IEEE Power electronics specialist conf.pp.1-7.
[9] R. W. Erickson and D. Makismovic, "Fundamentals of power electronics".2$^{nd}$ed,Spinger Science.USA,2001.ch.6.
[10] D. S. L. Simonetti, J. Sebastian, "The discontinuous conduction mode Sepic and Cuk

 DOI 10.17148/IARJSET.2016.31028 