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Boost Converter with High Voltage Gain Using Coupled Inductor Technique

KEYWORDS: DC-DC Converter, Boost converter, coupled inductor, Voltage gain.

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ABSTRACT *This paper propose to basic boost converter, the modify boost topologies are study in order to reduce the ripple free input current. The comparisons of boost topologies are making with the basic boost converter. The improve dc-dc boost converter and its operation is analyze. The improve boost converter is a transformer less dc-dc converter and a step-up DC–DC converter that uses voltage-lift technique, to adjusts the turns ratio of the coupled inductor and achieve high step-up voltage gain*

INTRODUCTION

A boost converter (step-up converter) is a power converter with an output DC voltage greater than its input DC voltage. It is a class of switching mode power supplies (SMPS) containing at least two semiconductor switches (a diode and a transistor) and at least one energy storage element. Filters made of capacitors (sometimes in combination with inductors) are normally added to the output of the converter to reduce output voltage ripple. For high efficiency, the SMPS 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 SMPSs

High step-up DC–DC converters are widely used in many applications, such as in high-intensity discharge (HID) lamp ballasts for automobile headlamps, DC back-up energy systems for uninterruptible power supplies, front-stages of clean-energy sources and the drive systems of electric vehicles.

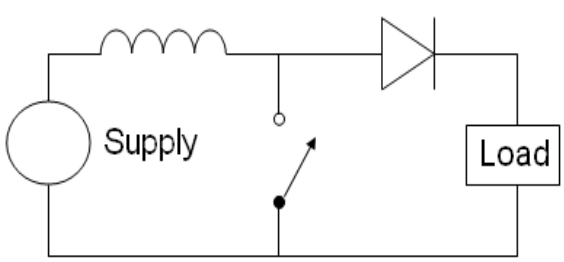

Fig.1: The basic schematic of a Boost Converter

Theoretically, the conventional boost converter can be used for high step-up voltage conversion with a large[3] duty ratio. However, the conversion efficiency and step-up voltage gain of the boost converter are limited under a large duty ratio condition owing to the loss of power switches and rectifier diodes, as well as the equivalent series resistance of inductors and capacitors . Therefore a step-up converter with a reasonable duty ratio to achieve high efficiency and high voltage gain performance is very important for high voltage gain applications[7].

However, this converter has two issues:

Three power devices exist in the current-flow path during the switch-on period, and two power devices exist in the current flow path during the switch-off period, and

The voltage stress on the active switch is equal to the output voltage.

To reduce the voltage spike, the resistor–capacitor–diode (RCD) snubber is adopted to limit the voltage stress on the active switch. However, this approach reduces the efficiency. Hence, non-dissipative snubbers have been applied to recycle the leakage inductance energy and to suppress the voltage spike on the active switch. Since the energy regeneration snubber circuit requires additional components, it has an increased cost. A novel high-efficiency DC–DC converter, which uses the coupling inductor and voltage-lift technique to achieve a high voltage gain. The proposed converter has the following features:

- High step-up voltage gain.
- The duty ratio can be designed to less than 0.5 by adjusting the turns ratio of the coupled inductor.
- The energy stored in the leakage inductance of the transformer is recycled, thus, increasing the efficiency.
- The converter uses low-rating switch and diodes to minimize the cost

COUPLED INDUCTOR

Coupled-inductor and other integrated-magnetic techniques have existed for many years, but most power electronics engineers are uncomfortable with them. This may be because of limited experience with coupled magnetics.

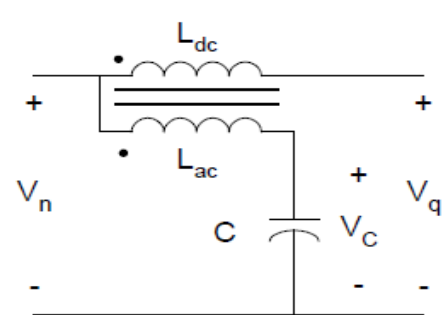

Fig.2: Coupled Inductor

Because these components form a linear two-port filter, the building block can be implemented in any dc circuit to reduce the ripple current wherever a choke is currently used. Thus it may be applied to the dc input of a converter, its dc output, or an internal dc link (in applications such

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as motor drives or HVDC transmission)[4]. The coupled inductor is schematically represented in Figure 7.

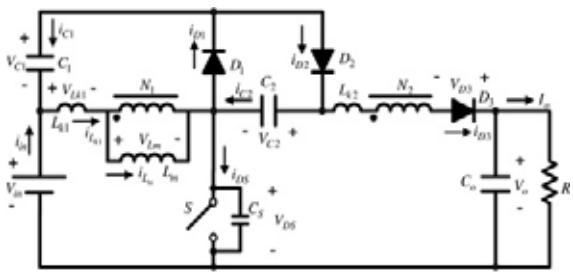
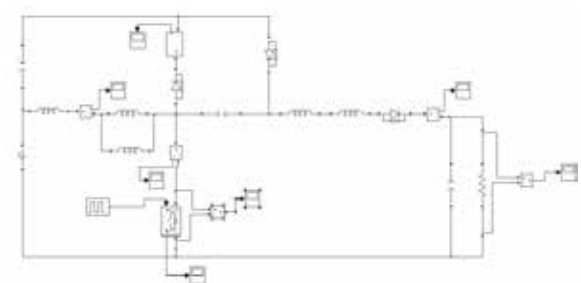


Fig.6: Circuit configuration of the proposed Converter

SIMULATION RESULTS

The simulink model of the proposed DC-DC boost converter is shown in Fig.7. In this model coupled inductor and voltage lift technique is used to step-up the voltage. The energy stored in the inductor is recycled and thus the efficiency of the converter is improved. Due to high voltage gain and efficiency the cost of the converter is reduced. The output voltage of this proposed boost converter is obtained as 82 V as shown in Fig.8.



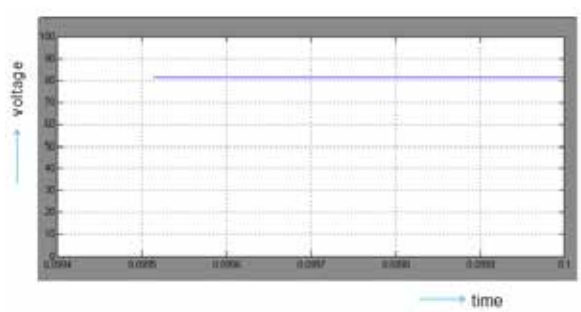


Fig.7:Simulink model of proposed

Fig.8: Output voltage of proposed DC-DC converter

Table 5.1: Comparisons of various Basic boost converters

Converter Type	Input Voltage	Voltage Gain	Output Voltage
Basic Boost Converter	12V	$\frac{1}{(1-D)}$	40
Proposed Boost Converter	12V	$\frac{(2+D)}{(1-D)}$	82

From the above Table1 the input voltage is same for all boost converters. It is clear that the voltage gain has increased from basic boost converter to improved boost converter and from improved boost converter to proposed boost converter and thus the proposed boost converter has high voltage gain[10]. It is clearly shown that the output voltage of the proposed boost converter is almost two times the output voltage of the basic boost converter.

CONCLUSION AND FUTURE SCOPE

With the knowledge of basic boost converter, the modified boost topologies are studied in order to reduce the ripple free input current. The comparisons of boost topologies are made with the basic boost converter. The improved dc-dc boost converter and its operation is analyzed..

The proposed converter is highly efficient because it recycles the energy stored in the leakage inductor of the coupled inductor. This project also describes the operating principle and the steady state analysis in detail.

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