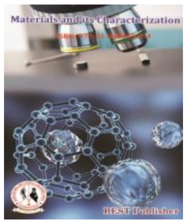
Materials and its Characterization
Vol: 2(3), 2023
REST Publisher; ISBN: 978-81-948459-0-4
Website: https://restpublisher.com/book-series/mc/



Improvement of Voltage Gain in DC–DC Converter Using Switched Coupled Inductor

T.Dharmaraj, B.Kanagasavitha
VV College of Engineering, Tisaiyanvilai, Tirunelveli, Tamil Nadu, India

Abstract. *This paper presents a novel DC–DC converter configuration, which successfully integrates two technologies, including a switched capacitor and a switched coupled inductor, into one converter. By adopting a coupled inductor to charge a switched capacitor, the voltage gain can be effectively increased, and the turns ratio of the coupled inductor can be also reduced. Not only lower conduction losses but also higher power conversion efficiency is benefited from a lower part count and lower turns ratios. The proposed converter is simply composed of six components, which can be further derived to varied converters for different purposes, such as a bidirectional converter. The operating principle and steady-state analysis are discussed in this Work.*

Keywords: *Coupled inductor, Non-isolated, High gain, DC-DC converter*

1. INTRODUCTION

As renewable energy becomes increasingly important and prevalent in worldwide power generation systems nowadays, DC–DC step-up converters have been frequently adopted for low-power conversion applications. Previous research on various converters for high step-up applications has included the analysis of the switched-inductor and switched capacitor type, the transformer less switched capacitor type, and the voltage-lift type. Some converters, which are the combination of boost and fly back converters or the combinations of other types of converters, are developed to carry out a high step-up voltage gain by using a coupled-inductor technique. However, the leakage inductance of the coupled-inductor will cause a high voltage spike on active switches when the switches were turned off. A small resistor or a resistor– capacitor–diode snubber can be used to dissipate this leakage energy and suppress the voltage spike, but these simple solutions are unable to benefit the converter efficiency. Alternatively, employing an active clamp technique to recycle the leakage energy can achieve soft switching for active switches.

2. PROPOSED TOPOLOGY

Proposed Circuit Diagram:

The proposed converter is shown in Fig. 2.1. Two diodes D 1 and D 2 and capacitor C 1comprise a conventional voltage-lift network .A coupled inductor T 1, along with a single active switch S1, is inserted between capacitor C 1 and diodes D1 and D 2. Coupled inductor T 1 plays the role of energy storage and a transfer device. The magnetizing inductor $L\ m$ of coupled inductor T 1 is equivalent to the input inductor of a conventional boost converter. IMPROVEMENT OF VOLTAGE GAIN IN DC–DC CONVERTER USING SWITCHED COUPLED INDUCTOR Mr. T.DHARMARAJ, Assistant Professor, B.KANAGASAVITHA, PG scholar, Dept of EEE, VV College of Engineering, Thoothukudi District, India. Switching capacitor C1 obtains energy from input source Vin and secondary winding N 2 and then releases it to output capacitor c2 and load R through output rectifier diode D 2

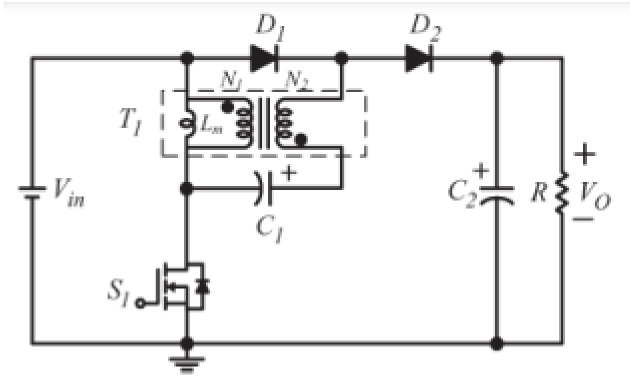


FIGURE 1. Circuit configuration of the proposed converter

The proposed converter has several features:

1) The coupled inductor transfers energy when the active switch is either turned on or turned off, which increases the usage of the coupled inductor.
2) Switched capacitor v 1 obtains energy from the input source vin and secondary winding N 2 of the coupled inductor; hence, the voltage conversion ratio can be efficiently enlarged.
3) The charging current of switched capacitor C 1 has been constrained by leakage inductance, which can effectively reduce the inrush current of the switching capacitor.
4) The leakage inductor energy of the coupled inductor can be recycled and directly output to the load, which successfully increases the power conversion efficiency.
5) The proposed converter consists of few components; hence, the demand for a compact size and a high power density can be achieved. Compared with a conventional flyback converter, the proposed converter has lower voltage stress on the switch, and it requires a lower duty ratio to reach a high voltage ratio.

Principle of Operation: The proposed converter is simply operated by a single switch without zero switching network and complex control.Fig.2.1 briefly illustrates two steady operating states of the proposed converter. Only the operating principles in the continuous conduction mode (CCM) are discussed in this section. Because parasitic resistance and the capacitance of the active switch and leakage inductance are neglected, the transient states in the operating principle will not be discussed here.

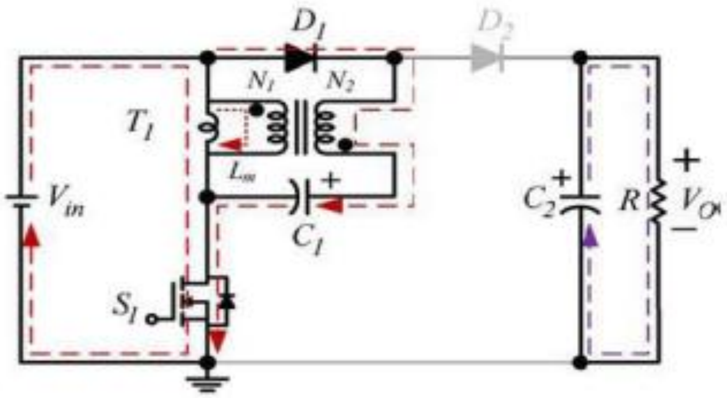


FIGURE 2. Current flowing path in mode 1 during one switching period in the CCM operation

The energy is being stored in this mode. Active switch S1 and diode D1 are conducted, and diode D2 is turned off. During this mode, switched capacitor C1 receives energy from the input source and coupled inductor T1. Because the charging current from input source Vin flows to switched capacitor C1 through diode D1 in series with the secondary winding N2 of coupled inductor T1, the voltage on switched capacitor.

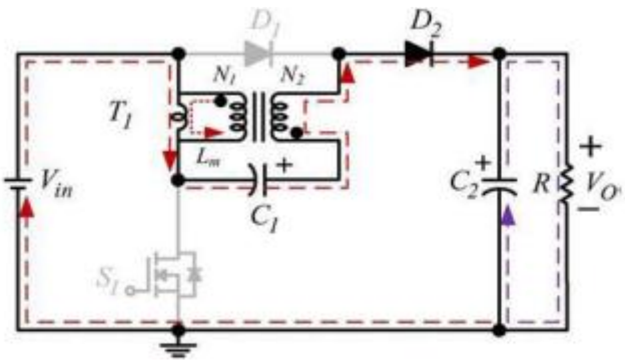


FIGURE 3. Current flowing path in two operating modes during period in the CCM operation

3. Principle of Operation

The energy is being released in this mode. Active switch S1 and diodeD1 are turned off, but diode D2 is conducting. During this mode, energy is being released through the series-connected path that consists of input source Vin, magnetizing inductor Lm, switched capacitor C1, secondary winding N2, and diode D2 to charge capacitor C2 and load R. The energy of secondary winding N2 is coupled from magnetizing inductor Lm at the primary side of the coupled inductor. The energy is released through the current path shown in Fig.2.3. This mode ends when switch S1 is turned on at the beginning of the next switching period. The typical waveforms of several key components in the CCM operation are shown Fig. 2.4. Vg is the gate signal of active switch S1.

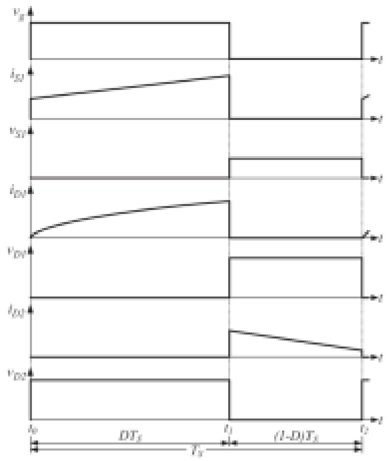


FIGURE 4. Current flowing path in two operating modes during period in the CCM operation

5. CONCLUSION

The proposed switched-coupledinductor converter is a simple DC–DC stepup converter with a high voltage conversion ratio inherent in this converter. By adopting coupled-inductor and switched-capacitor techniques, the proposed converter successfully enlarges the voltage conversion ratio without a high turns ratio of the coupled inductor. The proposed converter can be also expanded to varied converters for different applications by simply adding series-connected or parallelconnected modules to it. Finally, the laboratory hardware prototype is implemented, and its performance is verified. The total parts count is only six. The voltage gain is 11 when the turns ratio of the coupled inductor is three. The highest efficiency is up to 97.2%, and the full-load efficiency is kept at 93.6%. The proposed converter can be seen as a module, where multiple modules can be connected to form a new converter for different applications, such as a multiple cascaded switched coupled- inductor converter. An interleaved switched-coupled inductor converter can be obtained by integrating two modules using an interleaving operation. Moreover, the diodes can be replaced with switches to form a bidirectional switched-coupled inductor converter.

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