PERFORMANCE AND ANALYSIS OF SOFT SWITCHING FULL BRIDGE DC-DC CONVERTER USING PULSE WIDTH MODULATION METHODS

Dr.SAI

[1]Research Scholar, [2]Research supervisor,

Department of Electrical and Electronics Engineering,

Carrier Point University,

Kota, Rajasthan.

[1]ranadheer222@gmail.com,[2]drsmanikandan1978@gmail.com

Abstract: In this research paper proposed a new method of soft switching full bridge DC-DC converters are introduced. It is basically an uncontrolled half-bridge section of a hybrid combination and it realized of four switches in a phase-shift controlled full-bridge section. The zero-voltage-switching down to no-load is the main features of the proposed topology without conduction loss penalty series, frequency operation and near-ideal filter waveforms are mentioned. The input and output filter requirements the filter waveforms in significant savings are improved. The high power-density result is occurred. Two transformers and two dc-bypass capacitors are required by a new topology. The variable-input applications are combined VA rating of the two transformers. It compared to that is more than of the single transformer of conventional full-bridge converters. The input voltage is varies widely but the output voltage is fixed and regulated and the converter operation is analyzed for usual switch-mode power supply applications. The high-power application (e.g. more than 1 kW output) is essentially for an improved soft-switching full-bridge converter. Under all loading conditions two clamp diodes to the phase-shifted PWM (pulse width modulation) full-bridge DC-DC converter is reduced the switching losses of the transistors and the rectifier diodes. The effect of the added components on the operation of the converter is the conditions for lossless transitions. Due to circulation current it reduces switching loss, reducing voltage and current stresses, and reducing conduction loss. It proposed the bidirectional full-bridge dc–dc converter with high conversion ratio, high output power, and soft start-up capability. Through the active switches at the current-fed side the current difference between the current-fed inductor and leakage inductance of the isolation transformer is reducing the current flowing. It is implemented with low-side voltage of 48 V and high-side voltage of 360 V. The experimental results is verified its feasibility. It consists of a basic half-bridge dc-dc converter and an auxiliary circuit. Under ZCS conditions the power switches of auxiliary switches operate in the main power switches operate. By PWM control the output voltage of the proposed converter is different. The wide control range is proposed the converter is simple circuit, less component count and soft-switching operation. This proposed converter method is provided a new analysis and design techniques in pulse width modulation.

Keywords: DC-DC Converter, PWM, Full Bridge Converter.

1. INTRODUCTION

In the DC-DC converters the switching losses are reduced by the snubbers, quasi-resonant circuits or soft switching. It consists of the following Advantages.

- The simpler control circuits
- The simpler power circuit
- The simpler analysis
- The power transistors and rectifier diodes of exploitation
- The high efficiency
- The low EMI

The full-bridge soft –switching forward converter is use of four controlled switches at high power levels. The parent circuit, the full bridge forward converter with traditional PWM that converter is controlled by the phase-shifted PWM. In the full bridge soft-switching converters smaller than compare to the parent circuit and the dynamic losses of switches are controlled. The rectifier diodes of the switching losses are not decrease. The voltage overshoot and ringing of the rectifier with leakage inductance of the transformer is the interaction of reverse –recovery process .It is lead to be dynamic losses, EMI, or the rectifier failure. The diode reverse recovery time increases with the voltage rating and the severity of the problem increases the rectifier breakdown [1].

During the current –fall section of the rectifier reverse recovery using soft-recovery rectifier with low di/dt of the voltage overshoot is controlled. A clamp is also used. The rectifiers reduce the ringing and external registers to the switching losses of the RC snubbers connected. The problem is inefficient or complex solution [2]. A simplifier and more efficient solution are identified. The improved circuit is explaining in the following diagram. A small external inductor L_C in series with the primary winding of the power transformer and two low-current clamp diodes D_5 and D_6 are connected. In the rectifier diodes the switching loses and voltage stresses are reduced. The soft switching of the transistors is used by the inductor L_C. The L_C is the “commutating inductor”.

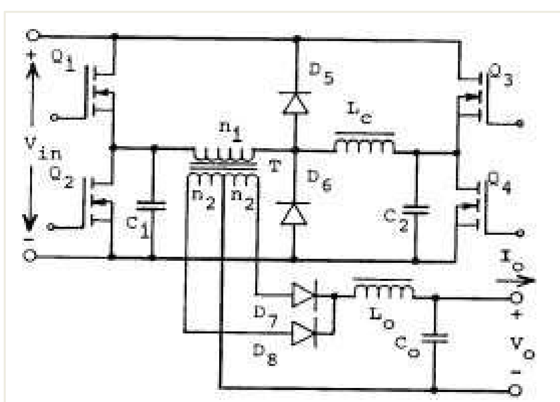

Figure 1: Full-bridge soft switching dc/dc converter with commutating inductor and clamp diodes

In this proposed system describes the following:

1. The operator states and switch transitions of the converters sed.

2. At nominal load, at overload, and at zero load lossless transitions ensure in the conditions.

3. The operation of the converter are effects the commutating inductor and the clamp diodes.

4. The practical considerations of the control method, current sensing, gate-drive circuit, and control and protection circuit are described.

5. The experimental results of 1.5kw current mode controlled the dc-dc converter and operate it.

2. OPERATING STATES AND SWITCHING TRANSITIONS

The following diagram figure 2 shows the equivalent circuit of the converter .The primary side of the power transformer T is the load network transformed. At the two poles of the bridge C_1 and C_2 is described the sum of the stray and snubbing capacitors. In the transformer L_l is the leakage inductance and L_m is the magnetizing inductance.

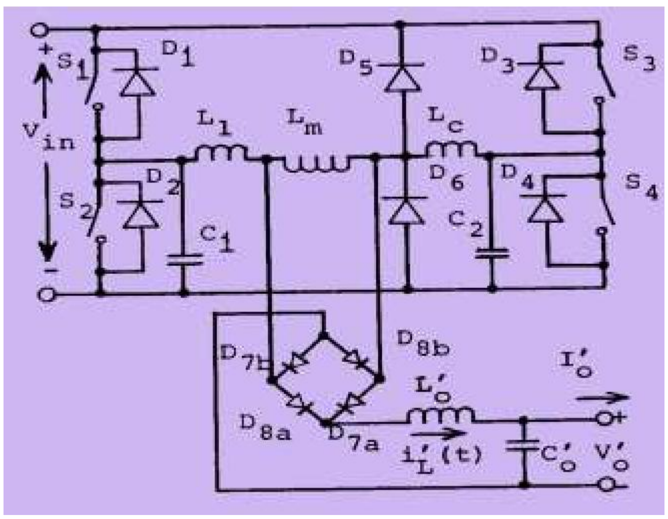

Figure 2: The equivalent circuit of the converter

The four allowed on/off combinations of the switches the converter have four states. The states of two diagonally opposite switches are conducting, for example s_1, s_2, s_3 and s_4 .These are called as the active. The power buses are conducting the state of the same side is called passive. During the active state substantial energy are flows in the converter [3]. Under significant different conditions the two legs of the bridge (s_1-s_2 and s_3-s_4) are operates. The active state to passive state the switching of the leg moves the converter. The other switching of two legs moves the leg from the passive to active. The leading leg is known as the switches only from the active to passive state. The active states lead in the switching process. The trailing leg is the other leg of switches from passive to active state. Figure 3 describes the operation of the converter is the fundamental waveforms [4].

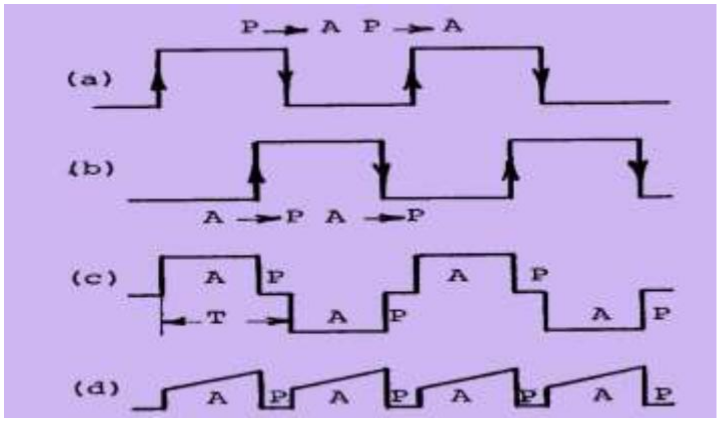

Figure 3: Waveforms illustrating the converter states and switch transitions (a) trailing-leg voltage (b) leading-leg voltage, (c) transformer voltage, (d) current drawn from the power source.

"A" denotes the active states and "B" denotes the passive state.

3. PROPOSED SYSTEM

The bidirectional full-bridge dc–dc converter with a fly back snubber is shown in the following diagram. The two modes are used to converter operation. They are the buck mode and boost mode. At the low-voltage side the figure includes a current-fed switch bridge, a fly back snubber. At the high-voltage side a voltage-fed bridge are used. When power flows from the high-voltage side to the batteries Inductor Lm performs output filtering it describes the buck mode. The high-voltage side when power is transferred from the batteries it works in boost mode. During switching commutation to absorb the current difference between current-fed inductor Lm and leakage inductance L_{ll} and L_{lh} of isolation transformer is T_x, the clamp branch capacitor CC and diode DC are used. To regulate V_C to the desired value, the fly back snubber independently controlled [5] [6]. It is higher than V_{AB}. At a low level the voltage stress of switches M_1–M_4 are limited.

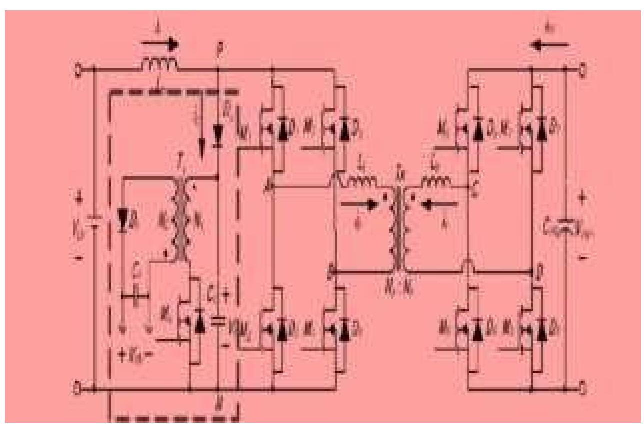

Figure 4: Isolated bidirectional full-bridge dc–dc converter with a fly back snubber

The proposed converter configuration includes no spike current circulating. Across switches of M_1– M_4, improving system reliability significantly the power switches and clamping the voltage [7]. A bidirectional dc–dc converter is consisting of two types of conversions. They are step-up conversion (boost mode) and step-down conversion (buck mode). In boost mode, switches M_1–M_4 are controlled. As a rectifier the body diodes of switches M_5–M_8 are used. In buck mode, switches M_5–M_8 are controlled. Then as a rectifier the body diodes of switches M_1–M_4 operate. The steady-state analysis, simplify the following:

1. It describes all components are ideal. An ideal transformer is associated with leakage inductance. Here transformer is treated as an ideal transformer.
2. A switching period Inductor Lm is large to keep the current i_L constant.
3. Comparison of parasitic capacitance of switches M_1–M_8 is lesser then clamping capacitor CC [9].

4. SIMULATION AND RESULTS:

The simulation model for boost and buck modes of isolated bidirectional full bridge dc-dc converter results are obtained. It used the fly back converter and their voltage and current waveform [8] [9]. At the low-voltage side is employed as an energy-storage element of working a battery module and the voltage rating is mentioning 48 V. In the boost operation high-voltage side is 360 V. Using the simulation link in MATLAB and their voltage and current waveform these simulation results for boost and buck modes of isolated bidirectional full-bridge dc-dc converter with a fly back snubber. It using the VLV=48V, VHV=360V, fs=25 kHz, Lll=0.5 µH, Llh=9 µH, Lm=500 µH, CLV=100 µf, CHV=470 µf×2. The four MOSFET switches are used in the primary side. In the secondary diodes are used in the transformer [10] [11]. The figure 7is shows the circuit model of isolated boost D.C to D.C. converter. The square Pulse width is applied with constant frequency the figure 7.1shows it. The figure 7.2 shows the inverter output voltage. The figure 7.3 is shows the driving pulses for MOSFETS M1 – M4 and Ms. Then Figure 7.4 is describe the Current waveform ids of switch M_4.The figure 7.5 describe the Voltage waveform ids of switch M4 . The transformer is stepped up the voltage. Then capacitor is connected across the R-load with converted A.C into D.C. The figure 7.6 shows the driving pulses for MOSFETS M1 – M4 .The figure 7.7 is shows the waveform for speed measured [8].

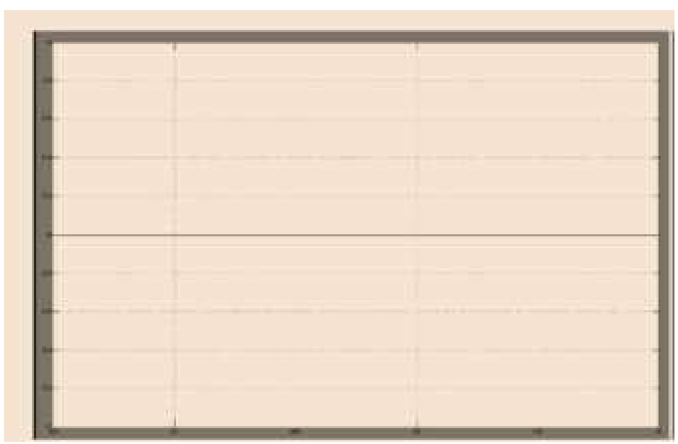

Figure5: Input voltage waveform of boost converter

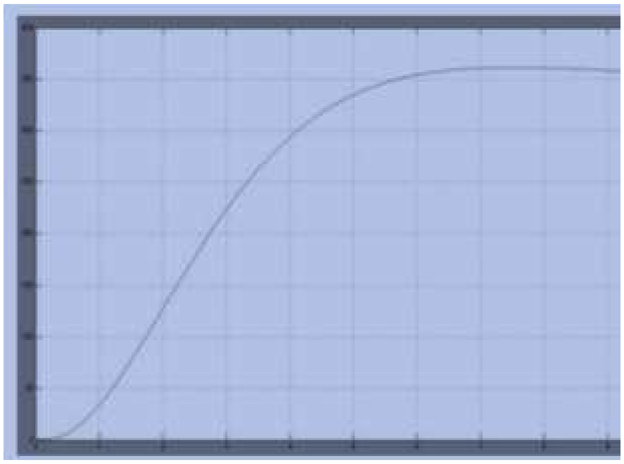

Figure 6. Output voltage waveform of boost converter

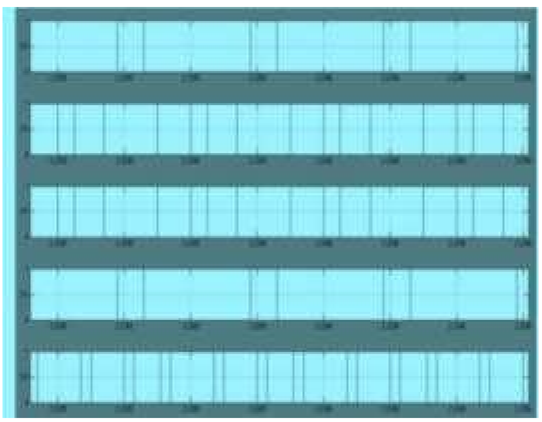

Figure7 Driving pulses for MOSFETS M1-M4 and Ms

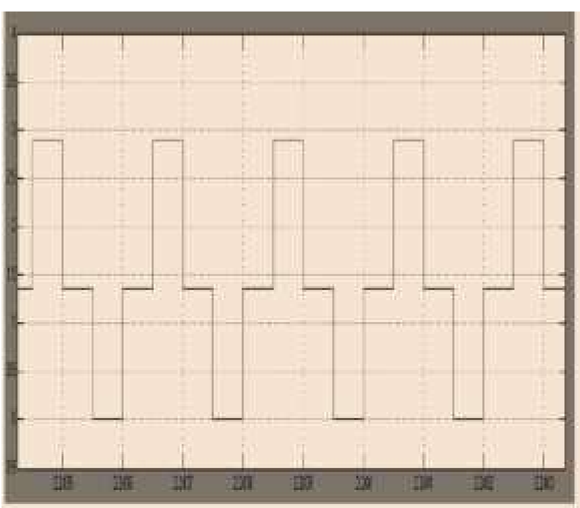

Figure: 8 Current ids of switch M_4

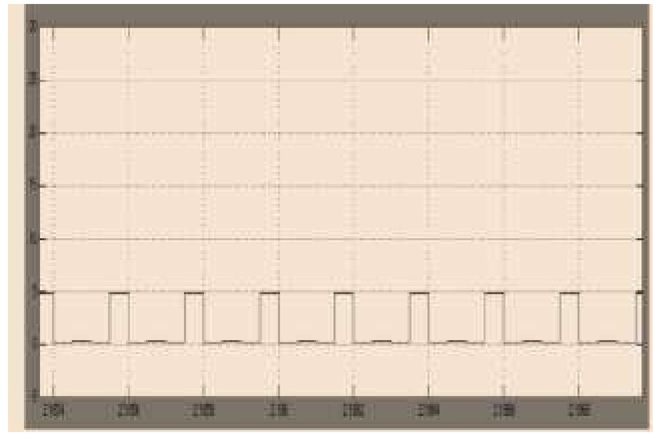

Figure: 9 voltage V_{ds} of switch M_4

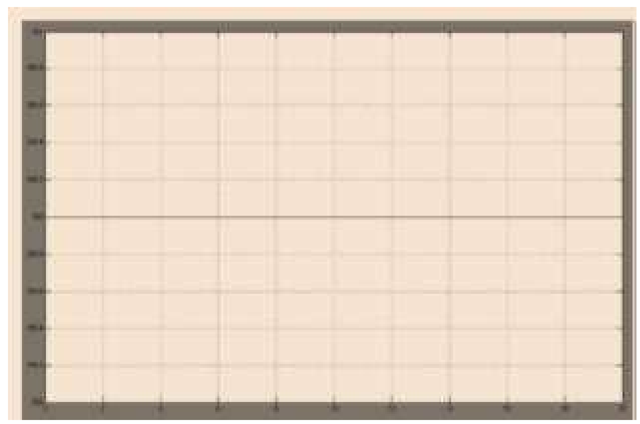

Figure: 10. Input voltage waveform of buck converter

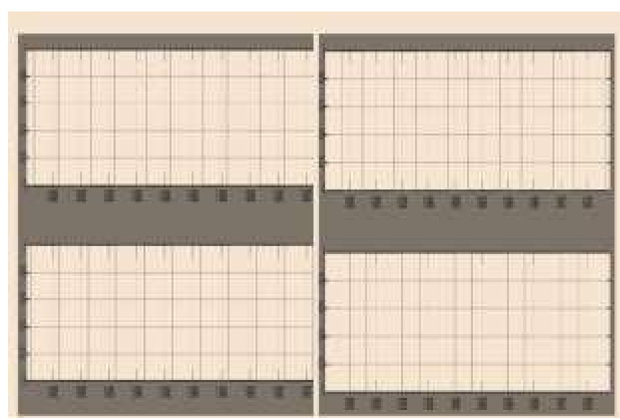

Figure: 11 Driving pulses for MOSFETS M_1-M_4

5. CONCLUSION

This proposed method explains the high power applications by used a bidirectional full-bridge dc–dc converter with a fly back snubber circuit. The current difference is flowing between the current-fed inductor and leakage inductance of the isolation transformer to the fly back snubber is alleviating the voltage spike. At the current fed side is 50%, it reduces the current flowing through the active switches. Under the heavy-load condition the current does not circulate to the entire system. Then the full-bridge converter switches and their current stresses reduced dramatically and significantly improved the system. At the low-voltage side a battery module is working, the voltage rating is 48 V in energy-storage element and the high-voltage side is 360 V. The expense of four controlled switches is justifiable in the power supply. The dynamic losses and the overshoot and ringing of the rectifier diodes of the small commutating inductor and two low current clamp diodes are eliminated. The losses transition of the trailing leg of the converter helps the commutating inductance. It does not require the excessive magnetizing current in the transformer. All switch and rectifier voltage and currents voltage overshoots and exhibits the controlled transitions. The conclusion of an experimental results are explained clearly about the Input voltage waveform of boost converter, Output voltage waveform of boost converter, Driving pulses for MOSFETS M1-M4 and Ms, Current ids of switch $M_{4,}$ voltage V_{ds} of switch $M_{4,}$ Input voltage waveform of buck converter, Output voltage waveform of buck converter, Driving pulses for MOSFETS M_1-$M_{4,}$ Transformer secondary voltages, and the waveform of Speed in rpm.

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