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Soft-Switching Bidirectional Isolated Full-Bridge Converter with Active and Passive Snubbers

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Abstract:
In this paper bidirectional isolated half-bridge dc–dc converter compared with full bridge dc-dc converter with a conversion ratio soft start-up, around nine times, and soft-switching features for battery charging/discharging is proposed. The Half Bridge DC-DC converter is equipped with an active flyback and two passive capacitor–diode snubbers. This can reduce voltage and current spikes, reduce voltage, switching losses and current stresses, while it can achieve near zero-voltage-switching and zero-current-switching soft-switching features. In this paper, the operational principle of the proposed converter is first described, and its analysis and design are then presented. The proposed bidirectional isolated dc-dc converter with active snubbers and passive snubbers can be carried out in MATLAB/Simulink.

Keywords: Bidirectional Half Bridge DC-DC Converter, Zero Current Switching, Zero-Voltage Switching.

1. INTRODUCTION

In renewable dc- supply systems, batteries are usually required to back-up power for electronic equipment. Their voltage levels are typically much lower than the dc -bus voltage. Bidirectional converters for charging/discharging the batteries are therefore required. For high-power applications, bridge-type bidirectional converters have become an important research topic over the past decade. For raising power level, a dual full-bridge configuration is usually adopted, and its low side and high side are typically configured with boost type and buck-type topologies, respectively.

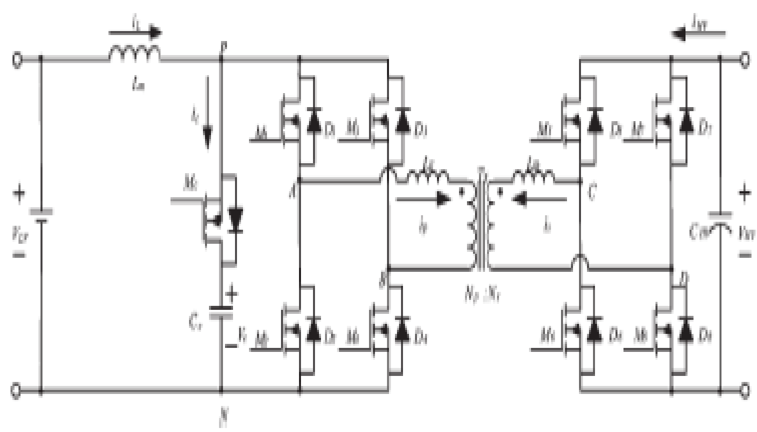


Fig.1. Bidirectional isolated full-bridge dc–dc converter with an active clamp snubber.

The major concerns of these studies include reducing switching loss, reducing voltage and current stresses, and reducing conduction loss due to circulation current. A more severe issue is due to leakage inductance of the isolation transformer, which will result in high voltage spike during switching transition. Additionally, the current freewheeling due to the leakage inductance will increase conduction loss and reduce effective duty cycle. An alternative approach is to precharge the leakage inductance to raise its current level up to that of the current-fed inductor, which can reduce their current difference in turn, reduce voltage spike. However, dissipated on the resistor, thus resulting in lower efficiency. A buck converter was employed to replace an RCD passive snubber, but it still needs complex clamping circuits. A simple active clamping circuit was proposed, which suits for bidirectional converters. However, its resonant current increases the current stress on switches significantly. Proposed a topology to achieve soft-starting capability, but it is not suitable for step-down operation. This paper introduces a flyback snubber to recycle the absorbed energy in the independently to regulate the voltage of the clamping capacitor; therefore, it can clamp the voltage to a desired level just slightly higher than the voltage across the low-side transformer winding. Since the current does not circulate through the full-bridge switches, their current stresses can be reduced dramatically under heavy-load condition, thus improving system reliability significantly. Additionally, during start-up, the flyback snubber can be controlled to precharge the high-side capacitor, improving feasibility significantly. Passive and active clamp circuits were proposed to suppress the voltage spike due to the current difference between the current-fed inductor and leakage inductance current. A conventional passive approach is employing a resistor–capacitor–diode snubber to clamp the voltage and the energy absorbed in the buffer capacitor is dissipated on the resistor, resulting in efficiency is low.

2. PROPOSED SYSTEM

The existing soft-switching bidirectional isolated fullbridge converter with an active flyback and two passive capacitor–diode snubbers . It can be operated with two types of conversions: step-up conversion and stepdown conversion. It consists of a current-fed switch bridge, an active flyback snubber at the low-voltage side, a voltage-fed switch bridge, and a passive snubber pair at the high-voltage side. Inductor Lm performs output filtering when power flows from the high-voltage side to the low-voltage side, which is denoted as a step-down conversion. On the other hand, it works in the step-up conversion.

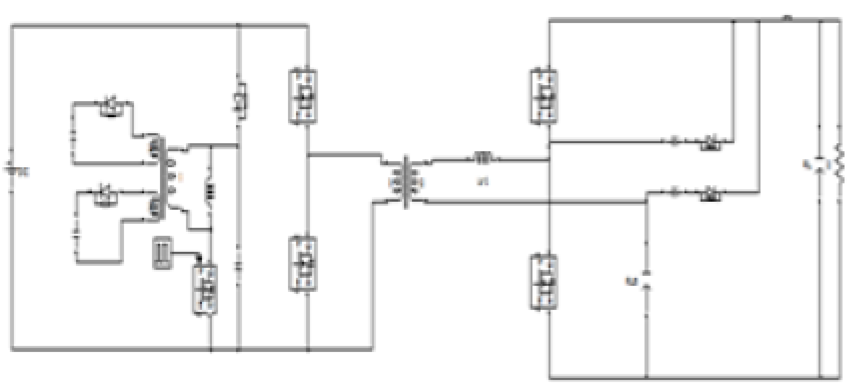
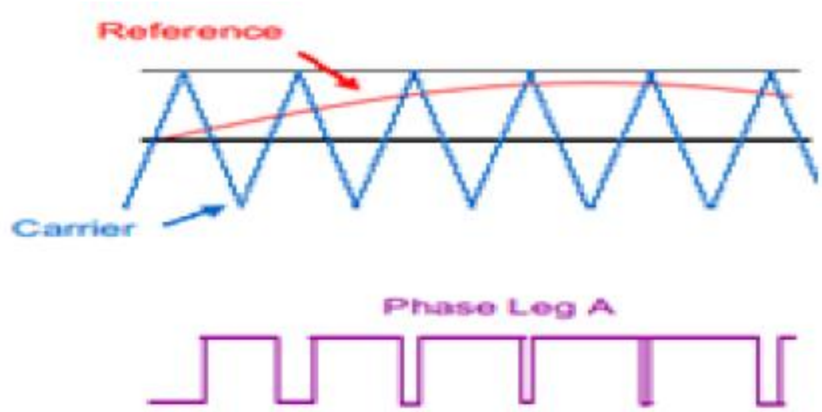


Fig.2. Proposed soft-switching bidirectional isolated half-bridge converter with an active flyback and two passive capacitor–diode snubbers.

Moreover, snubber capacitor CC and diode DC are used to absorb the current difference between current-fed inductor current iL and leakage inductance current iP of isolation transformer TP during switching commutation. The flyback snubber is operated to transfer the energy stored in snubber capacitor CC to buffer capacitors Cb1 and Cb2, and voltage VC can drop to zero. Thus, the voltage stresses of switches M1 and M4 can be limited to a lower level, achieving near ZCS turnoff. The main merits of the proposed snubber include no spike current circulating through the switches and achieving soft- switching features. Note that high spike current can result in charge migration, over current density, and extra magnetic force which will deteriorate in MOSFET carrier density, channel width, and wire bonding and, in turn, increase its conduction resistance.

3. PROPOSED PULSE WIDTH MODULATION TECHNIQUE

The pulse width modulation (PWM) concept is borrowed from communication systems, wherever an indication is modulated before its transmission, and so demodulated at the receiving terminal to recover the initial signal. Constant idea may be applied to an influence convertor. in an exceedingly power convertor, the switch network has associate on/off nonlinear nature. The desired continuous wave form is modulated and reborn to digitized signals to management the switch network. Then the modulated signals at the switch network AC terminals area unit demodulated by the AC filter to urge the specified continuous voltage or current wave form.



Fg.3. Waveforms of PWM technique

Normally a sinusoidal voltage or current is the control target for a power converter. The first PWM scheme was the sinusoidal PWM (SPWM) scheme and was proposed in 1964. Since the modulator has a great impact on voltage/current distortions, switching losses, and EMI, it is of great interest to the power electronics researcher. In the past there has been intensive research on this topic and there is much literature on it. The power losses are related to the total number of switching actions in one switching cycle, and the current level at switching. Therefore, different modulation schemes may result in different efficiencies. A PWM scheme with minimized switching losses is desirable especially for high power applications. Harmonic spectrum of the output voltage or current is related to the EMI issue and acoustic noise. It is desirable to minimize the EMI and acoustic noise. Dynamic range refers to the maximum

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possible control level in steady state or during transient. It can also be interpreted as the ratio between the maximum possible output and the input. It is desirable to have a higher ratio.

4. SIMULATION RESULTS

It is desirable to have a higher ratio. For a voltage source inverter, it means a better DC link voltage utilization, which is crucial for high voltage applications. It is preferable to have a PWM scheme that can be implemented easily. The below figs.4 to 6 shows the simulation circuit diagram of a proposed system and following shows the waveforms getting from the simulation diagram.

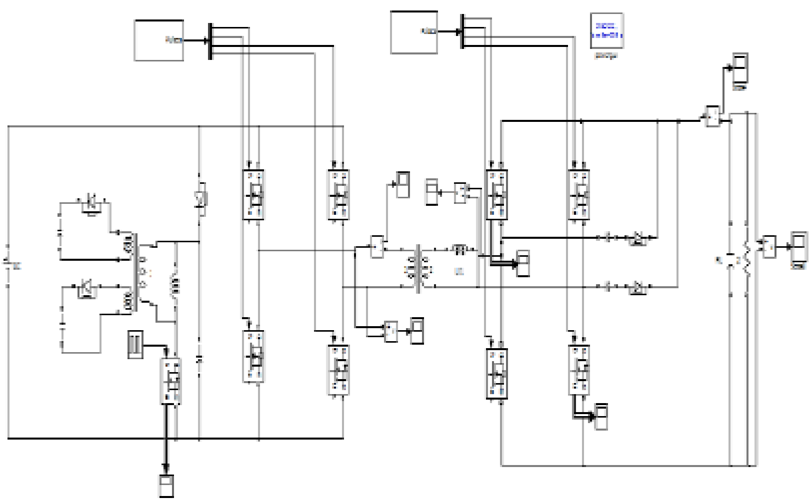

Fig.4. Conventional DC-DC isolated full bridge converter simulation diagram.

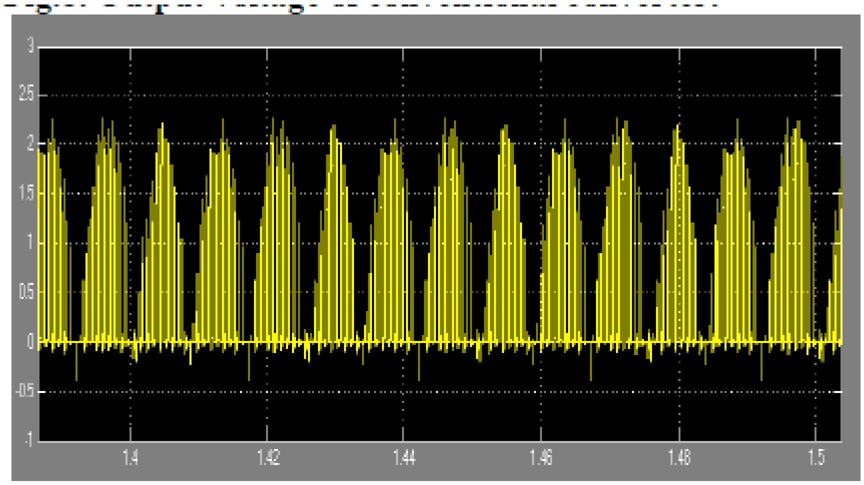

Fig.5. Output current of conventional converter

CONCLUSION

Paper has presented a soft-switching bidirectional isolated half-bridge converter compared with the full bridge converter, which allows input voltage, for battery charging/discharging application. Proposed converter can reduce the voltage spike caused by the current difference between leakage inductance and current fed inductor currents and the current spike due to diode reverse recovery, switching losses, the current and voltage stresses, while it can achieve near ZVS and ZCS soft-switching feature. The passive snubber can hold voltage Vb1 or Vb2 and improve the slew rate of diP /dt, which can reduce duty losses. However, near ZVS turn-on transition cannot be achieved under light- load condition in step-down conversion. Simulation results measured from the isolated bidirectional full-bridge dc–dc converters compared with the half bridge DC-DC converter.

REFERENCES

[1] Z. Zhang, O. C. Thomsen, and M. A. E. Andersen, “Optimal design of a push–pull–forward half-bridge (PPFHB) bidirectional DC–DC converter with variable input voltage,” IEEE Trans. Ind. Electron., vol. 59, no. 7, pp. 2761–2771, Feb. 2012.

[2] D. V. Ghodke, K. Chatterjee, and B. G. Fernandes, “Modified softswitched three-phase three-level DC–DC converter for high-power applications having extended duty cycle range,” IEEE Trans. Ind. Electron., vol. 59, no. 9, pp. 3362–3372, Sep. 2012.

[3] F. Zhang, L. Xiao, and Y. Yan, “Bi-directional forward- flyback DC–DC converter,” in Proc. IEEE Power Electron. Spec. Conf., 2004, vol. 5, pp. 4058–4061.

[4] H. Li, D. Liu, F. Z. Peng, and G.-J. Su, “Small signal analysis of a dual half bridge isolated ZVS bi-directional DC–DC converter for electrical vehicle applications,” in Proc. IEEE Power Electron. Spec. Conf., 2005, pp. 2777– 2782.

[5] L.-S. Yang and T.-J. Liang, “Analysis and implementation of a novel bidirectional DC–DC converter,” IEEE Trans. Ind. Electron., vol. 59, no. 1, pp. 422–434, Jan. 2012.

[6] D. Liu and H. Li, “Design and implementation of a DSP based digital controller for a dual half bridge isolated bi- directional DC–DC converter,” in Proc. IEEE Appl. Power Electron. Conf., 2006, pp. 695–699.

[7] B. Zhao, Q. Yu, Z. Leng, and X. Chen, “Switched Z- source isolated bidirectional DC–DC converter and its phase- shifting shoot-through bivariate coordinated control strategy,” IEEE Trans. Ind. Electron., vol. 59, no. 12, pp. 4657–4670, Dec. 2012.

[8] U. K. Madawala, M. Neath, and D. J. Thrimawithana, “A power-frequency controller for bidirectional inductive power transfer systems,” IEEE Trans. Ind. Electron., vol. 60, no. 1, pp. 310–317, Jan. 2013.