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Soft-Switching DC-DC Converters Based on a Phase Shift Controlled Active Boost Rectifier

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ABSTRACT

High productivity and high power thickness can be achieved with a dc–dc transformer by working all switches at a settled half obligation cycle. Be that as it may, the yield voltage of the dc–dc transformer can't be directed. Novel rectifiers named dynamic help rectifiers (ABRs) are proposed in this paper. Essentially, an ABR is made out of a conventional diode rectifier and a bidirectional switch. By receiving stage shift control between the essential and optional side switches, the yield voltage direction can be accomplished while acquainting the ABR with a dc–dc transformer. Subsequently, a group of novel delicate exchanging dc–dc converters is gathered. At the point when the proposed converter works in the delicate exchanging ceaseless conduction mode, zero-voltage exchanging (ZVS) execution for all the essential and optional side switches is accomplished. At the point when the converter works in the inconsistent conduction mode, zero current exchanging (ZCS) for the essential side switches and ZVS for the optional side switches are accomplished.

Index Terms: ***Active boost rectifier (ABR), DC–DC converter, fullbridge converter (FBC), soft switching, voltage doubler (VD).***

INTRODUCTION

DC-DC converters are important in most of the portable electronic devices and are employed in variety of applications including supply for personal computers, office equipment, spacecraft power systems, laptops, telecommunication equipment's as well as DC motor drives which are very much useful to people . With rapid developments of renewable energy, smart grid, and electric vehicles, isolated dc–dc converters have been widely used in a number of applications to meet the requirements of galvanic isolation and/or voltage conversion ratio. For further improvements on performance of efficiency, power density, and electromagnetic noise, many soft-switching dc–dc converters have been proposed for various applications to overcome the disadvantages in hard-switching dc–dc converters. Among them, the phase-shift full bridge converter (FBC) is more attractive because it can achieve zero voltage switching (ZVS) for all the active switches by adopting phase-shift modulation. However, untilnow, it still suffers from high voltage ringing and reverse recovery on the secondary-side rectifier diodes, limited ZVS range, circulating current-related power loss, and duty cycle loss.

Consequently, high productivity and high power lair sity can be effectively accomplished. In any case, the yield voltage/force of a dc–dc transformer can't be managed.

In the event that the yield voltage of a dc–dc transformer can be managed, high proficiency might be effortlessly accomplished. To accomplish the objective specified already, this paper proposes the dynamic support rectifier (ABR) idea. The ABR circuit is acquainted with the dc–dc transformer topology to actualize yield voltage/power direction. Accordingly, a group of wide-range delicate exchanging detached dc–converters is gathered. The significant preferred standpoint of the proposed converters is that the ZVS for all the dynamic switches can be accomplished in a wide load range.

Above all, these converters can take out the opposite recuperation issue of rectifier diodes, which is extremely basic for high-productivity applications. This paper is composed as takes after.

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This frequency elevation is responsible for the growing importance of pulse-width modulation on the one hand and for the use of resonance on the other hand. Another important trend resides in reduction of voltage and current stresses on the semiconductors and limitation of the conducted and radiated noise generated by the converters due large di/dt and du/dt. Both these requirements, size and noise, are minimized if each switch in a converter utilizes soft switching technique to change its status. The converter topologies and the switching strategies, which result in soft switching, are discussed in this paper.

PROPOSED DC-DC CONVERTER

1. Working of an ABR

The obligation cycles of all the switches are altered at 0.5. The voltage-source full-connect inverter, which is made out of a dc info voltage source Uin and four switches S1 − S4, creates an air conditioner square-wave voltageuP, applying tothe essential twisting of the transformer. Hence, the converter appeared in Fig. 1 can be spoken to by the one appeared in Fig. 2(a). For straightforwardness, considering a perfect transformer T with turns a proportion of 1, this circuit can be further rearranged to an uncontrolled rectifier, as appeared in Fig. 2(b). Clearly the yield voltage can't be directed if the obligation cycles of all the switches are settled at 0.5.

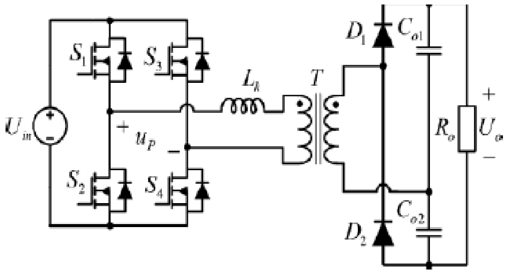

Fig. 1.Topology of a full-bridge converter with voltage-doubler rectifier.

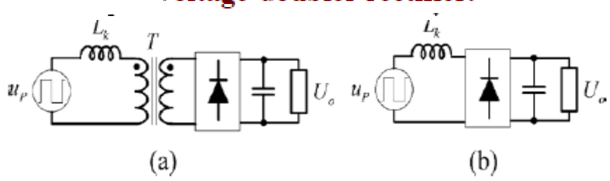

Fig. 2. Simplified circuits of the full-bridge converter shown in Fig. 1: (a) including the transformer and (b) excluding the transformer.

2. Power Stages of the PWM DC-DC Converters

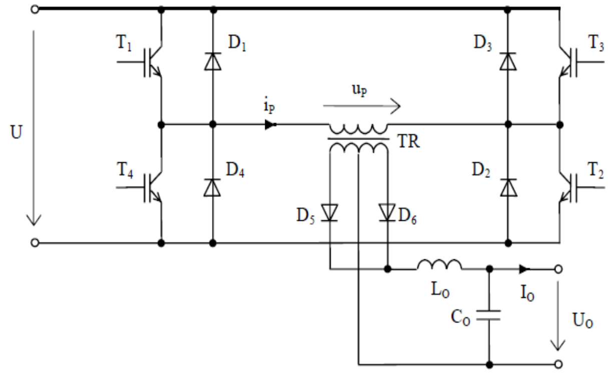

Figure 1

Full–bridge converter

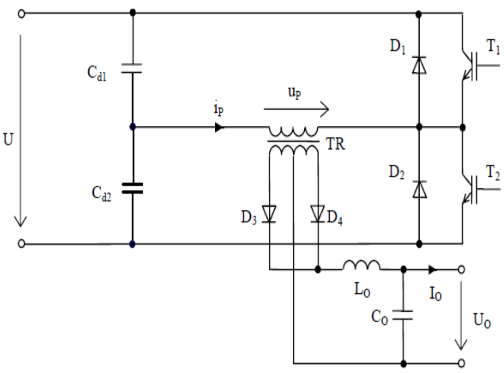

Figure 2

Half–bridge converter

The proposed system block diagram is shown in figure1. In the proposed system we have used the pwm logic controlling technique to improve the efficiency of the system. The system circuit diagram and operation of the proposed system is discussed below. The FBC-VD-ABR is redrawn in Fig.2, where all the switches on the primary and secondary sides have a constant duty cycle of 0.5. S1 and S4 are always turned- ON/OFF simultaneously, and the same with S2 and S3. A phase-shift angle between the primary- and secondary-side active switches is employed to regulate the output power and voltage. Lf stands for the total of the transformer leakage inductance and external inductor. The output series capacitors Co1 and Co2 have the same capacitance and are large enough to clamp the voltage stresses of the secondary-side switches and diodes to half of the output voltage. uDS1, uDS4, and uDS6 are the drain to source voltages of S1, S4, and S6,

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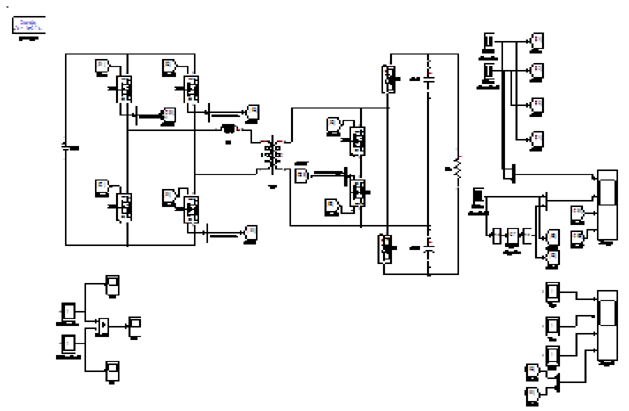
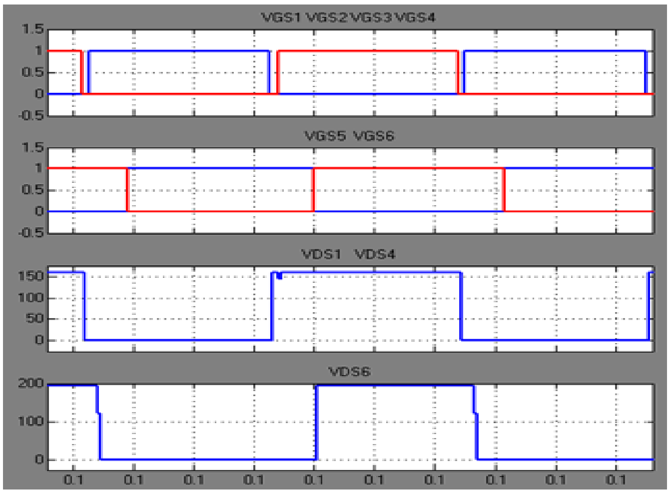
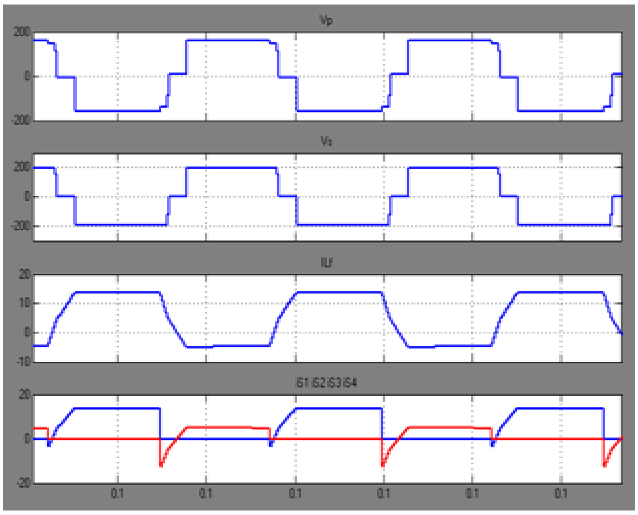
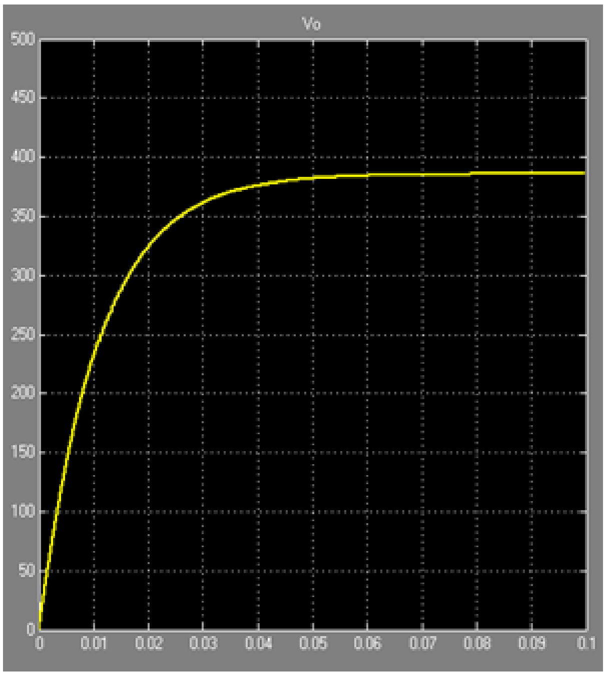
respectively. uP and uS are the voltages on the primary side and secondary side of the transformer. And iLfis the primary current flowing through the transformer with the positive direction shown in Fig.2.

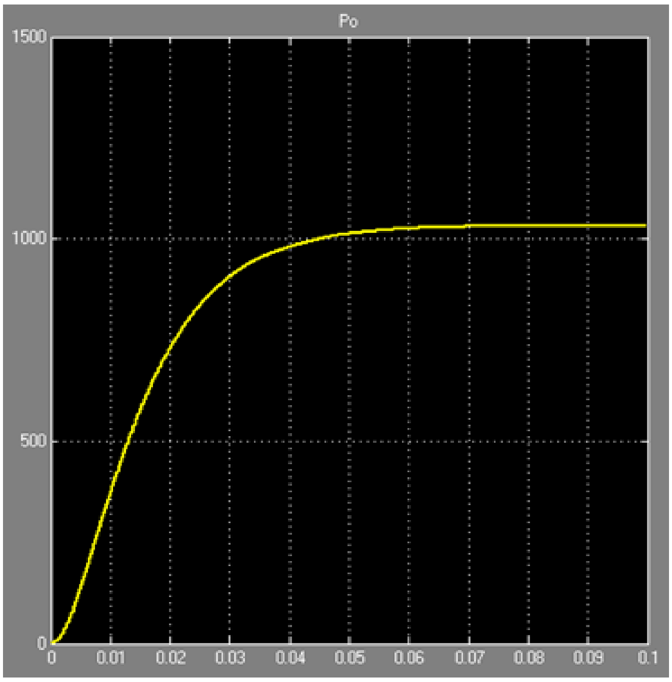
SIMULINK RESULTS AND OUTPUTS











CONCLUSION

In this paper, a family of soft-switching dc–dc converters has been presented for high-efficiency applications based on the novel proposed ABRs. In the proposed converters, all the power switches are operated at fixed 50% duty cycle, and the output voltage regulation is achieved by adopting phase-shift control between the primary and secondary-side switches. ZVS performance has been achieved for both the primary- and secondary-side switches in a wide voltage and load range. Furthermore, the reverse-recovery problems associated with the rectifier diodes are alleviated. Therefore, the switching losses of the proposed converters can be reduced, which is important for high-frequency, high-efficiency, and high-power density applications. Moreover, the leakage inductance of the transformer has been utilized as the energy transfer inductor, and all the devices voltages are clamped to the input or output voltage. Thus, the voltage overshoots on the devices are effectively suppressed.

In addition, the proposed converters are suitable for wide-range applications because they can operate either in Buck or Boost mode.As an example, the FBC with VD ABR is analyzed with operation principles and output characteristics presented. Experimental results of a 1 kW prototype have verified the feasibility and effectiveness of the proposed topological methodology and converters.

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