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UTILIZING PHASE SHIFT CONTROL METHOD-BASED VOLTAGE DOUBLE: A ZERO-VOLTAGE SWITCHING METHOD FOR BIDIRECTIONAL DC/DC CONVERTERS

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ABSTRACT: Direct current is the most powerful type of energy. Power Electronics circuits may provide a significant quantity of power in an efficient manner even at a duty cycle of 50%. DC-to-DC devices can provide greater output voltages, but they cannot change the voltage in the normal way. To manage the output voltage, we recommend utilizing active power filters and rectifiers, commonly known as active boost rectifiers (ABR). Because both operations necessitate pulse-based switch control, the recommended rectifier combines parts of a bidirectional switch and a typical diode rectifier. After the switch is turned on, the output voltage can be adjusted by varying the phase difference between the primary and secondary sides. A family of soft-switching devices would be impossible without the a-b active boost rectifier. It is possible to switch between the primary and secondary sides of the converter without applying any voltage in the soft switching continuous conduction mode. Both the primary and secondary sides of the converter may transition to zero voltage and zero current while the converter is in its discontinuous conduction state. If the diode ever has trouble with reverse recovery, there is a means to boost its strength. In order to evaluate the success of the present ABR and converters idea, the study analyzes the complete bridge converter with a doubler diode filter and dissects its operation in terms of voltage conversion ratio and output characteristics. It provides the simulation findings for this study's viability and effectiveness.

KEYWORDS*:* Active boost rectifier (ABR), DC–DC converter, full bridge converter (FBC), soft switching, voltage doubler (VD).

1. INTRODUCTION

DC to DC converters are so common and effective that they are practically omnipresent. What are the benefits of voltage inversion in power electronics and computer applications in general? How likely is its use in such applications? The DC-to-DC Converter serves as the foundation for a wide range of switching converters. It is critical for avoiding issues like excessive switching and switching charges. A DC-to-DC converter is typically used as a safety measure in phase-shift full-bridge converters. ~

2. PROPOSED DC–DC CONVERTERS WITH ABR FILTER

Figure 1 depicts the concept of an Average Boost Rectifier (ABR) employing a Voltage Doubler (VD) and a Full Bridge Converter (FBC) rectifier. In preparation for the usage of DC converters, the duty cycles of each switch have been reduced to 50%. The voltage converter can be turned on or off using two switches (S1 and S4). There is an additional direct current (DC) source for the input voltage. This results in a square-wave voltage of uP being applied to the transformer's primary winding. This current oscillates between two values. As a result, Figure 2a depicts the converter depicted in Figure 1. The inclusion of a transformer T with a turn ratio of one results in an unregulated rectifier, as shown in Figure 2(b). The output voltage will remain constant even if all settings are set to half power. The circuit incorporates a bidirectional switch, designated by the symbol Sb in Figure 2(b). It makes output voltage control easier. Figure 3 shows an ABR-based Boost circuit that includes a capacitor C, a switch Sb, and an inductor Lk.

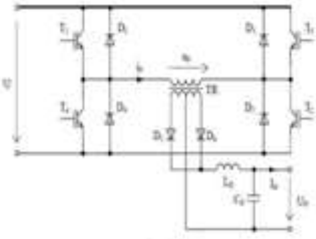


Figure 1
Full-bridge converter

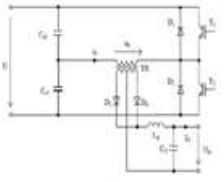
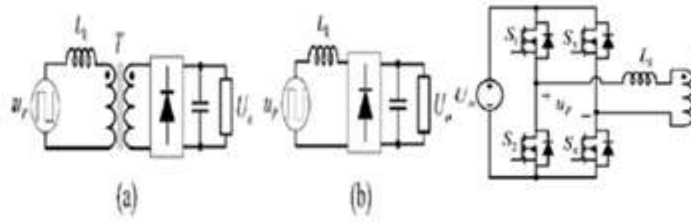


Figure 2
Half-bridge converter



(a) (b)

Fig 1. Voltage Doubler Rectifier Structure (Fig. 2.b) Bridge Conversion Made Simple

The system block configuration is depicted in Figure 1. Adding logic control for pulse width modulation (PWM) increased the performance of the proposed method. The circuit configuration and operation of the proposed system are explained in great depth in the next section. The primary and secondary controls used in the FBC-VD-ABR are depicted in Figure 2. The duty cycle will always be 0.5 as a result of these values. S2 and S3 could not be engaged or deactivated without S1 and S4. They are always performed concurrently. This is the phase difference between the signals leaving and arriving at the source.

A dynamic switch controls both the voltage and current at the output. The total inductance (Lf) of a transformer is the sum of its exterior (Lx) and leakage (Ll) inductances. By half the output voltage, large identical output capacitors Co1 and Co2 prevent secondary side switches and diodes from being overloaded. The drain-to-source values of diodes S1, S4, and S6 are represented by uDS1, uDS4, and uDS6. This circuit and the power factor adjustment boost converter have many similarities. This is how the Sb two-way switch may be used to change the output voltage. The ABR rectifier is made from of diodes and a two-position active switch known as Sb. The output voltage can be easily adjusted by replacing the DC transformer's uncontrolled diode rectifier with a programmable ABR (Automatic Bridge Rectifier). As a result, the output voltage will remain constant. When the ABR shown in Figure 1 is applied to the FBC, a completely new circuit is created.

3. DC–DC CONVERTERS BASED ON ABR FILTERS

In a previous experiment, an ABR circuit designed with a conventional VD diode rectifier was employed. This approach can also rectify full-wave diodes in addition to full-bridge rectifiers. This should serve as a great reminder of how crucial it is to keep it in mind at all times. To generate an ABR, we will need to use two one-way switches, Su1 and Su2, because the transformer has two unique secondary windings. A series connection of MOSFETs and diodes results in a switch that can work in either direction. However, connecting MOSFETs and diodes in parallel produces a switch that can only work in one direction. One-way and two-way switches are used on a regular basis in a number of situations. A number of ABR circuit designs are conceivable with these switches. Under diverse situations, numerous structures can be achieved. It is possible to replace the diodes in full-bridge diode rectifiers with two MOSFETs. As a result, the rectifier might become a two-way switch. The switch is linked in series to the generator's secondary winding in this setup. As a result, full-bridge ABR designs are simpler, as illustrated by the bidirectional red switches in Figure 8. The intervals between the diodes can be reduced by adjusting the distance between them.

This means that alternating current is required on the primary side circuit to generate a square wave voltage. One of the several primary-side circuit topologies is a voltage-sourced full-bridge layout. To establish the viability and benefits of this configuration, other topologies, including the enhance full-bridge, have been investigated. It is also critical to stress the significance of the ABR notion mentioned here. Despite the fact that several circuits have been built and tested, the topological technique used by this family of circuits has yet to be thoroughly documented. As a result, this study is significant. This essay bridges the gap.

4. FBC WITH VOLTAGE-DOUBLER ABR

A voltage booster may be available to someone who works with complete bridge converters. He is testing a potential biological procedure by activating the power and energy without doing any essential repairs. To do this, a thorough examination into the operation of an automatic boost rectifier is carried out. When the full wave rectifier was used again, neither the primary nor secondary controllers' duty cycles changed. This holds true even when the full wave rectifier is made again. If the primary current falls below a certain threshold before the primary side switch commutates, the converter enters Discontinuous Conduction Mode (DCM). The voltage differential across the key in this mode can form a whole bridge with eight phases in a single switching time. Because the circuit is balanced, the following equation only requires four phases to be valid. High-power applications, the usual phase-shift FBC, and the full-bridge LLC resonant converter were chosen for this inquiry due to structural and functional similarities. Some processors were barred from participating in the study because it was considered that comparing them to the others would be unfair. Table I compares the costs and profits of three different converters. When used, each translator has advantages and disadvantages. Solar or battery-powered systems, battery charging or discharging systems, and other applications requiring high efficiency, high frequency, and a broad range of input and output voltages may benefit tremendously from the recommended converter. It is likewise simple to produce a detectable voltage gain increase when using the ABR voltage doubler. This suggests that the proposed converter could be the first converter in a renewable energy system. It can also be used in circumstances where a large power spike is necessary.

After completing the previous position, has moved on to a new one. The trigger, as seen in the preceding photographs, displays the input and output voltages as well as the appropriate pulse waveforms. Three-phase electricity is being delivered, and the voltage leaving the system is far higher than expected. If the result is continuous and free of dips and spikes, as shown in the image, the execution was successful.

Soft-Switching Characteristics

The converter's working principles allow for the ZVS turn-on of power MOSFETs on the primary side in both SS-CCM and HSCCM modes of operation. When capacitors are connected between the drain and source wires of a primary side MOSFET, it will turn off during zero voltage switching (ZVS). As a result, MOSFETs can be turned off without the application of additional voltage. When the converter is in SS-CCM mode, the ZVS turn-on of the secondary-side MOSFETs and the ZCS turn-off of the rectifier diodes can both happen at the same time. It is more difficult to move devices on the secondary side without halting when operating in HS-CCM mode. When the output power level remains constant, the HS-CCM has the lowest turn-off current when compared to the other two operation modes. This means that there is less loss when the MOSFET on the secondary side is turned off. The primary switches and secondary rectifier diodes achieve zero current switching (ZCS), whereas the MOSFETs on the secondary side of the circuit achieve zero voltage switching (ZVS).

All of this happens while the converter is in DCM (Discontinuous Conduction Mode). When investigating the working principle, the magnetizing inductance is neglected to simplify the analysis. Because of the transformer's low magnetizing current, the electrical current passes through it with few gaps. The LLC resonant converter can benefit low-power settings, and primary-side MOSFETs can achieve Zero Voltage Switching (ZVS) with the help of the magnetizing current. This has the potential to improve circuit switching even further.

Control Loop

The characteristic charts show how the duty cycle of the rectifier affects the FBC-VD-ABR's output voltage and power. The phase shift angle, which effects voltage and power, is the sole constant variable that may be changed. The output voltage can be adjusted using a well-known voltage feedback loop if the PI regulator's input is connected to both the voltage reference and the recorded output voltage. The standard voltage feedback loop is used for this purpose. This is the location of the phase-shift modulator's command setting. The control loop can be built using a digital, analog, or digital signal processing (DSP) circuit due to its simplicity.

Performance Comparison

The performance of the FBCVD-ABR must be compared to that of other converters to aid in the design of tradeoffs and the selection of topologies for engineering applications.

5. SIMULINK RESULTS AND OUTPUTS

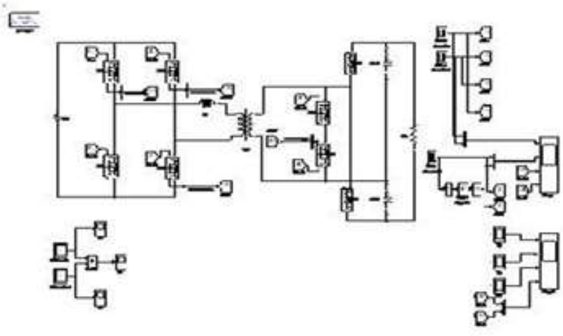


Fig 3 Schematic of a Potential ABF Circuit

The preceding image shows the importance of power by utilizing simulation software with realtime power filters. An AC-to-boost rectifier for power purification and an AC-to-full-bridge converter with voltage boosting and gentle switching circuits are among the apparatus components. Within the rectifier is a diode rectifier and a phase-controlled bidirectional speech converter. Both real-world and computer models show that the rectifier's pulse control is not completely accurate. Because of these considerations, the sword's switching approach comprises of a main side switch with no voltage and a secondary side switch with no current. On both the primary and secondary sections of a converter operating in Synchronous Soft-Switching Current Mode (SS-CCM), zero voltage switching (ZVS) is available. As the waveforms below show, the converter can only function in high-side continuous conduction mode (HS-CCM) as zero-voltage switching (ZVS) on the primary side when the secondary switches are completely open. This is the only configuration in which the adapter can function. Only a little amount of electricity travels through the secondary side of HS-CCM switches when they are turned on or off.

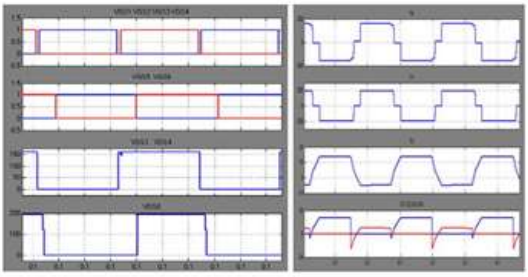
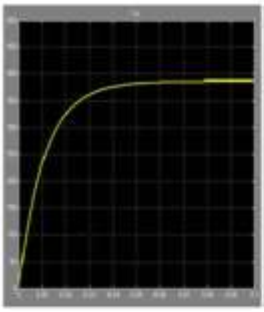


Fig. 4 Input phase gate pulses



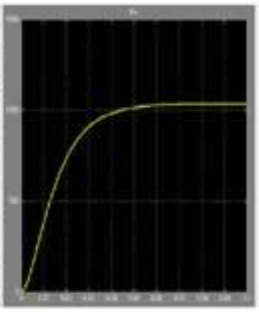


Fig 5 the arrival of voltage Fig 6 Voltage Result

6. CONCLUSION

A 50% duty cycle is usually thought to be best for DC-to-DC converters. Applications needing high frequency, low frequency, and great power efficiency benefit from lower switching loss. A loss of switching power is not caused by excessive inductance loss. In order to prevent voltage surges, regulators are linked to both the input and output voltages. Finally, an ABS voltage switching family is accessible.

REFERENCES

1. M. Yilmaz and P. T. Krein, Review of the impact of vehicle-to-grid technologies on distribution systems and utility interfaces, IEEE Trans.Power Electron., vol. 28, no. 12, pp. 5673–5689, Dec. 2013.
2. M. Yilmaz and P. T. Krein, Review of battery charge topologies, charging power levels, and infrastructure for plug-in electric and hybrid vehicles, IEEE Trans. Power Electron., vol. 28, no. 5, pp. 2151–2169, May 2013.
3. Y. H. Kim, S. C. Shin, J. H. Lee, Y. C. Jung, and C. Y. Won, Soft switching current-fed push-pull converter for 250-W AC module applications, IEEE Trans. Power Electron., vol. 29, no. 2, pp. 863–872, Feb. 2014.
4. X. Pan and A. K. Rathore, Novel interleaved bidirectional snobberies soft-switching current-fed full-bridge voltage doubler for fuel-cell vehicles, IEEE Trans. Power Electron., vol. 28, no. 12, pp. 5535–5546, Dec. 2013.
5. W. J. Lee, G. E. Kim, G. W. Moon, and S. K. Han, A new phase-shifted full-bridge converter with voltage-doubler-type rectifier for high efficiency PDP sustaining power modules, IEEE Trans. Ind. Electron., vol. 55, no. 6,pp. 2450–2458, Jun. 2008.
6. W. Yu, J. S. Lai, W. H. Lai, and H. Wan, Hybrid resonant and PWM converter with high efficiency and full soft-switching range, IEEE Trans.Power Electron., vol. 27, no. 12, pp. 4925–4833, Dec. 2012.
7. H. Y. Cha, L. H. Chen, R. J. Ding, Q. S. Tang, and F. Z. Peng, An alternative energy recovery clamp, IEEE Trans. Power Electron., vol. 23, no. 6, pp. 2828–2837, Nov. 2008.
8. D. S. Gautam and A. K. S. Bhat, A comparison of soft-switched dc-todc converters for electrolyzer application, IEEE Trans. Power Electron., vol. 28, no. 1, pp. 54–62, Jan. 2013.
9. Z. Chen, S. Liu, and L. Shi, A soft switching full bridge converter with reduced parasitic oscillation in a wide load range, IEEE Trans. PowerElectron., vol. 29, no. 2, pp. 801–811, Feb. 2014.
10. W. Chen, X. Ruan, and R. Zhang, A novel zero-voltage-switching PWM full bridge converter, IEEE Trans. Power Electron., vol. 23, no. 2, pp. 793–801, Feb. 2008.