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HIGH EFFICIENCY FLYBACK CONVERTER WITH A NEW COUPLED INDUCTOR RECTIFIER(CIR)

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Abstract: The aim of this study is to develop a Flyback converter which is one of the most promising topologies in low power applications because of the zero-voltage switching of all switches and the small number of components. In addition, most of the output current is concentrated in high-voltage-rating diodes that have large forward voltage drop, large conduction loss occurs in the secondary rectifier. To solve these problems, a flyback converter with coupled inductor rectifier (CIR) is proposed in this paper. By adopting the CIR structure in the flyback converter, the proposed converter not only eliminates the DC-offset current in the transformer, but it also has equalize the current stress in the rectifier diodes. In general, various single-input single-output dc–dc converters with different voltage gains are combined to satisfy the requirement of various voltage levels, so that its system control is more complicated and the corresponding cost is more expensive. As a result, the proposed converter is to design a single-input multiple-output (SIMO) for increasing the conversion efficiency and voltage gain, reducing the control complexity, and saving the manufacturing cost.

Keywords : Coupled Inductor Rectifier, Single Input Multiple Output, Flyback Converter.

1. Introduction

Solar energy is a renewable free source of energy that is sustainable and totally inexhaustible, unlike fossil fuels that are finite. It is also a non-polluting source of energy and it does not emit any greenhouse gases when producing electricity. In order to protect the natural environment on the earth, the development of clean energy without pollution has the major representative role in the last decade. By dealing with the issue of global warning, clean energies, such as fuel cell (FC), photovoltaic, and wind energy, etc., have been rapidly promoted. Due to the electric characteristics of clean energy, the generated power is critically affected by the climate or has slow transient responses, and the output voltage is easily influenced by load variations. Besides, other auxiliary components, e.g., storage elements, control boards, etc., are usually required to ensure the proper operation of clean energy. For example, an FC-generation system is one of the most efficient and effective solutions to the environmental pollution problem. In addition to the FC stack itself, some other auxiliary components, such as the balance of plant (BOP) including an electronic control board, an air compressor, and a cooling fan, are required for the normal work of an FC generation system. In other words, the generated power of the FC stack also should satisfy the power demand for the BOP.

Thus, various voltage levels should be required in the power converter of an FC generation system. In general, various single-input single-output dc–dc converters with different voltage gains are combined to satisfy the requirement of various voltage levels, so that its system control is more complicated and the corresponding cost is more expensive. The motivation of this study is to design a single-input multiple-output (SIMO) converter for increasing the conversion efficiency and voltage gain, reducing the control complexity, and saving the manufacturing cost.

2. Flyback Converter

The flyback converter is used in both AC/D and DC/DC conversion with galvanic isolation between the input and any outputs. The flyback converter is a buck-boost converter with the inductor split to form a transformer, so that the voltage ratios are multiplied with an additional advantage of isolation. The schematic of a flyback converter can be seen in Fig. 1. It is equivalent to that of a buck-boost converter, with the inductor split to form a transformer.

Therefore, the operating principle of both converters is very similar, When the switch is closed (ON STATE)), the primary of the transformer is directly connected to the input voltage source. The primary current and magnetic flux in the transformer increases, that is storing energy in the transformer. The voltage induced in the secondary winding is negative, so the diode is reverse-biased (i.e., blocked). The output capacitor supplies energy to the output load. When the switch is opened (OFF STATE), the primary current and magnetic flux drops. The secondary voltage is positive, forward-biasing the diode, allowing current to flow from the transformer. The energy from the transformer core recharges the capacitor and supplies the load.

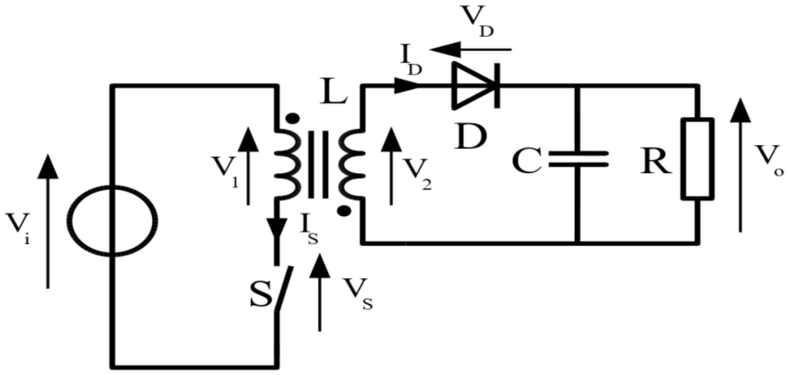

Fig 2.1 Flyback Converter

3. Concept and System Analysis

In the existing system phase shift full bridge converter employing a series resonant converter is used. In another method the converter changes the turn's ratio of the transformer by using the additional switching devices which gives high efficiency but the circuit structure is complex, maintenance required, high cost due to additional switching and circuit complexity.

The operation of the converter input dc voltage is applied to the half - bridge converter which convert the dc signal into ac signal then series filter is used which filters out the unwanted noise in the circuit. Then the isolating transformer is used to isolate the primary and secondary side of the transformer.Then bridge rectifier is rectified for the voltage and finally filter out the unwanted noise, and then given to the output dc voltage in the R load.

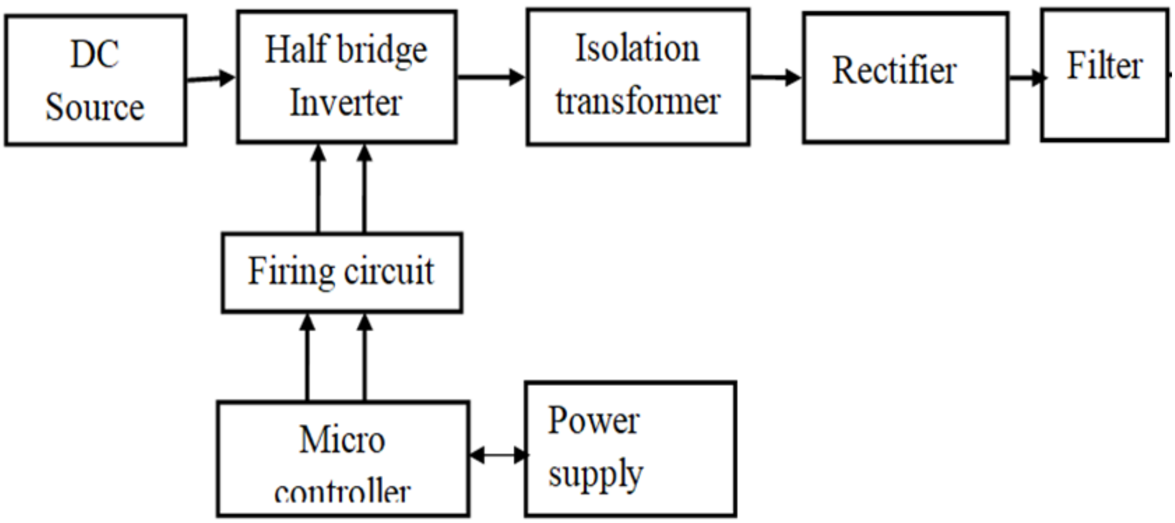

Fig 3.1 Block Diagram of Existing System

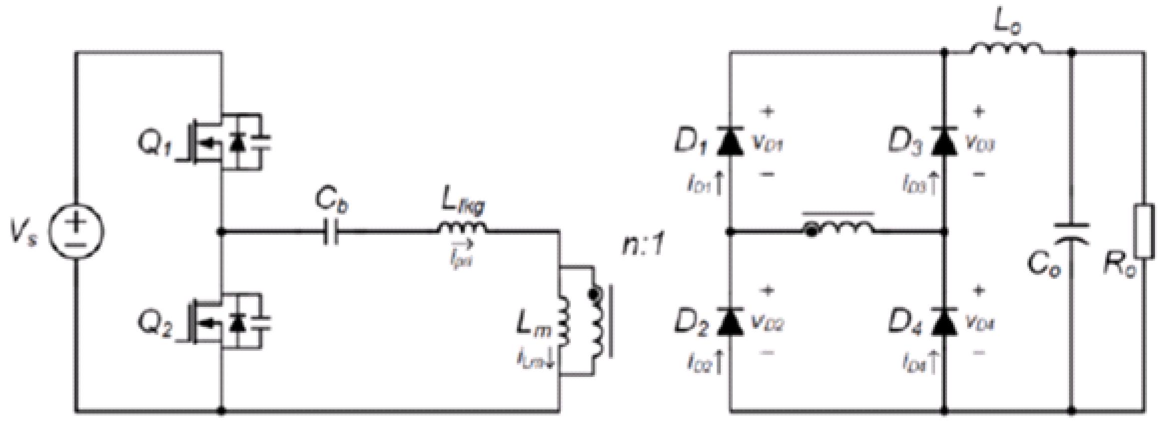

Fig 3.2 Circuit Diagram of Existing System

The proposed circuit is reducing the switch and output voltage will be improved. Then converter ripples are reduced through filter and it also maintains constant output voltage.The operation of the converter input dc voltage is applied to the flyback converter which convert the dc signal into ac signal then series filter is used, which filters out the unwanted noise in the circuit. Then the isolating transformer is used to isolate the primary and secondary side of the transformer; applies the signal is bridge rectifier, rectification of the voltage and rectified supplies is sent to the filter. Then output filter is filtered for the noises in the converter, finally the dc signal is sent for the output. They have given to the dc voltage in R load.

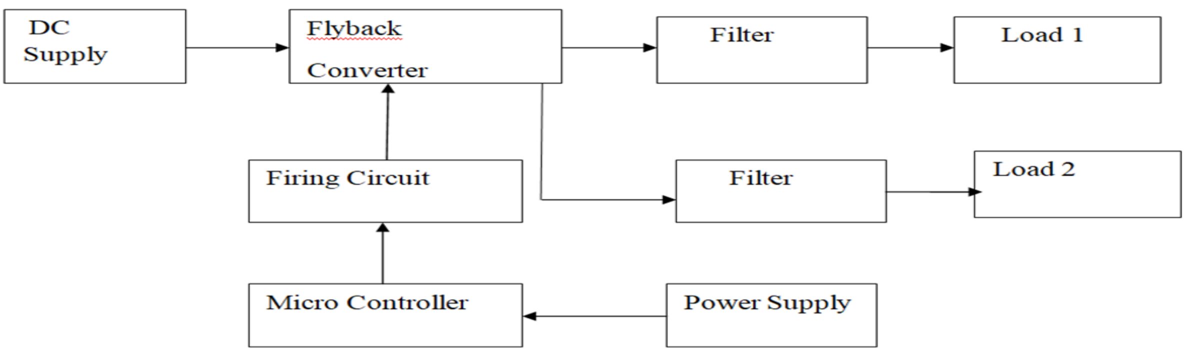

Fig 3.3 Block Diagram of Proposed System

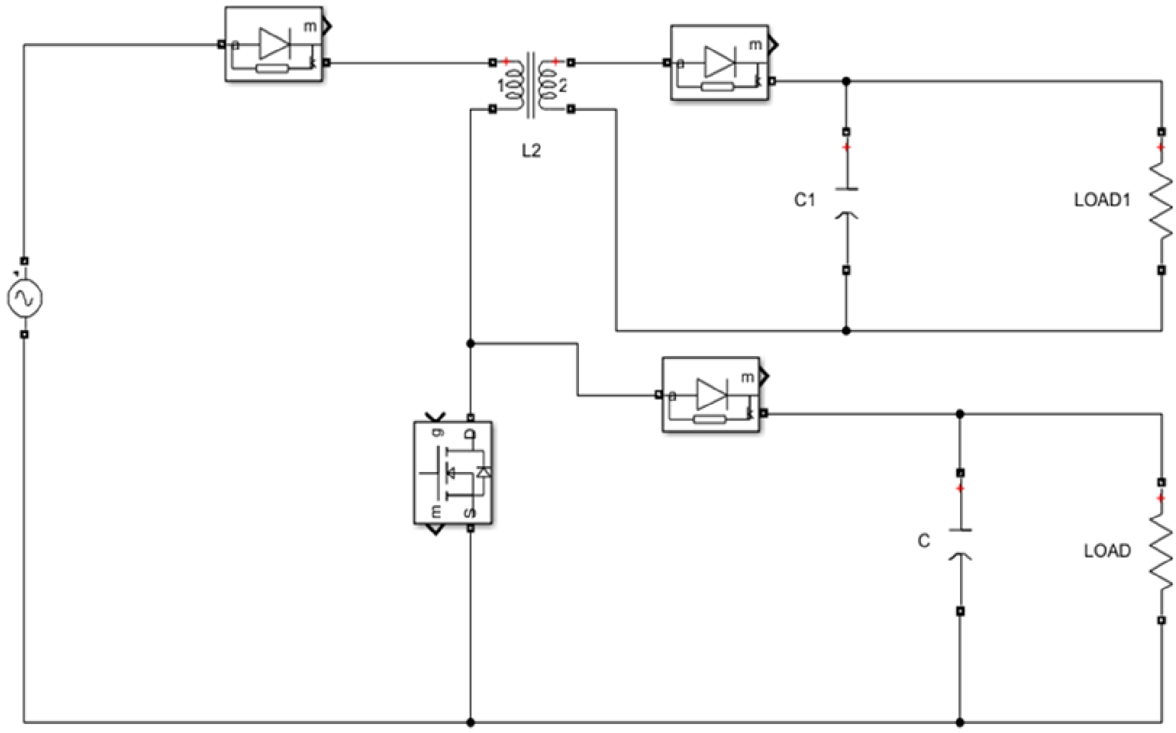

Fig 3.4 Circuit Diagram of Proposed System

4. Simulation Results

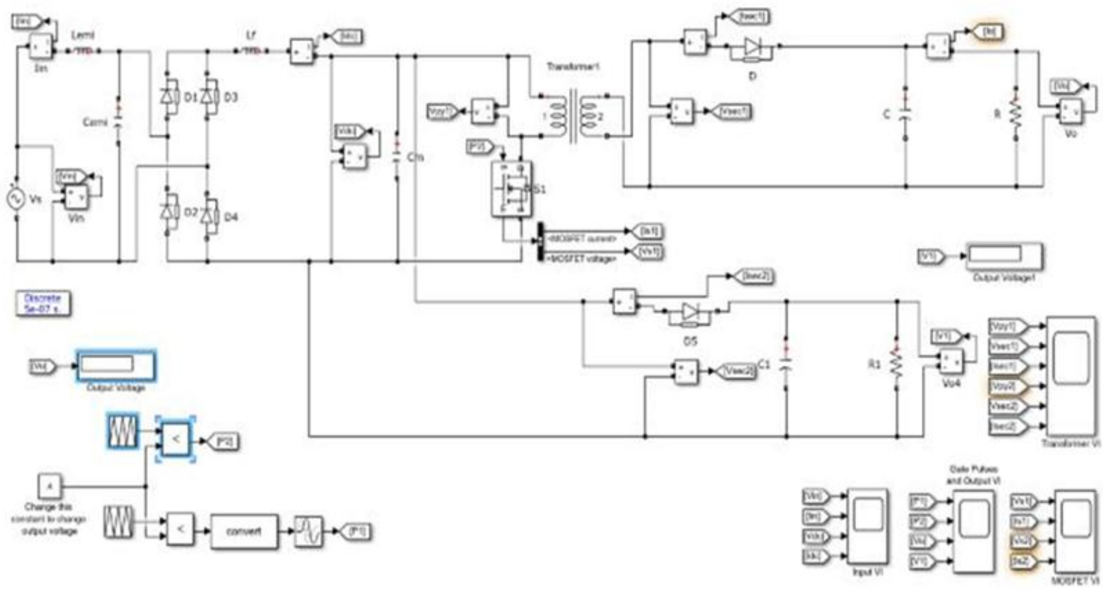

Fig 4.1 Simulink Diagram of the Module

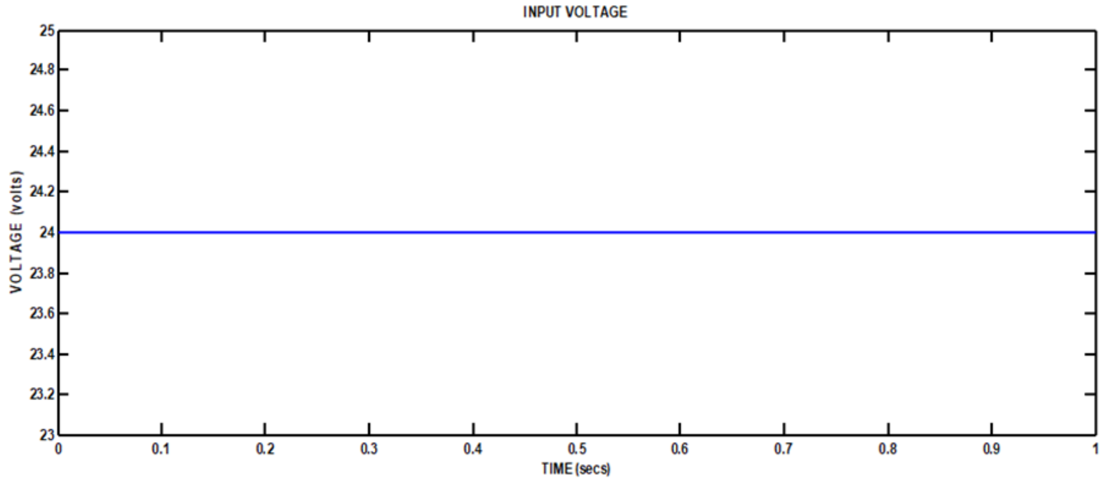

Fig 4.2 Waveform of Input Voltage

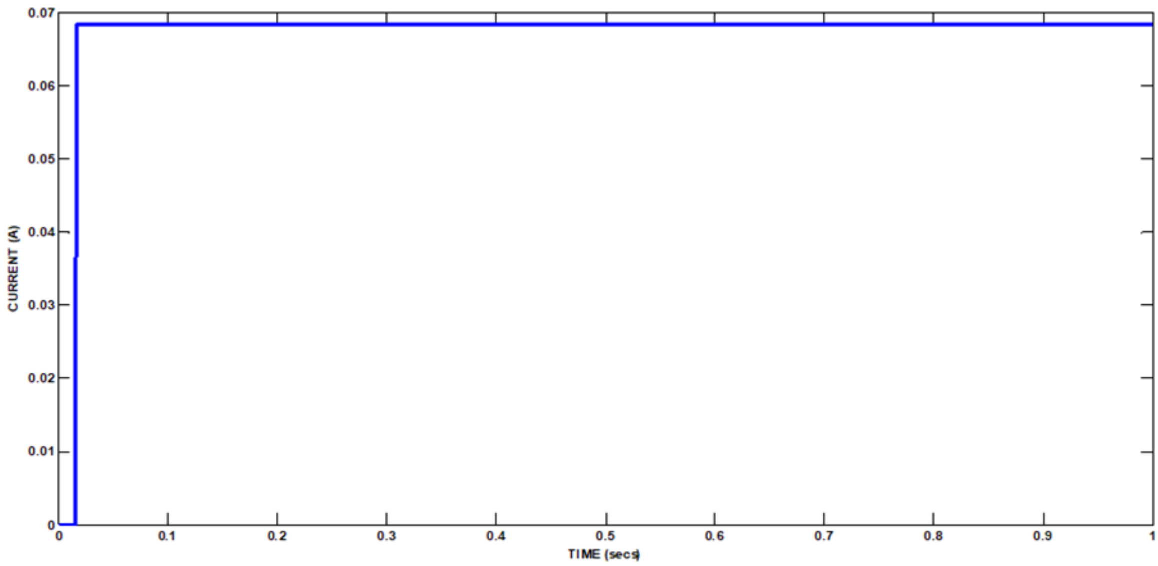

Fig 4.3 Output waveform of Current

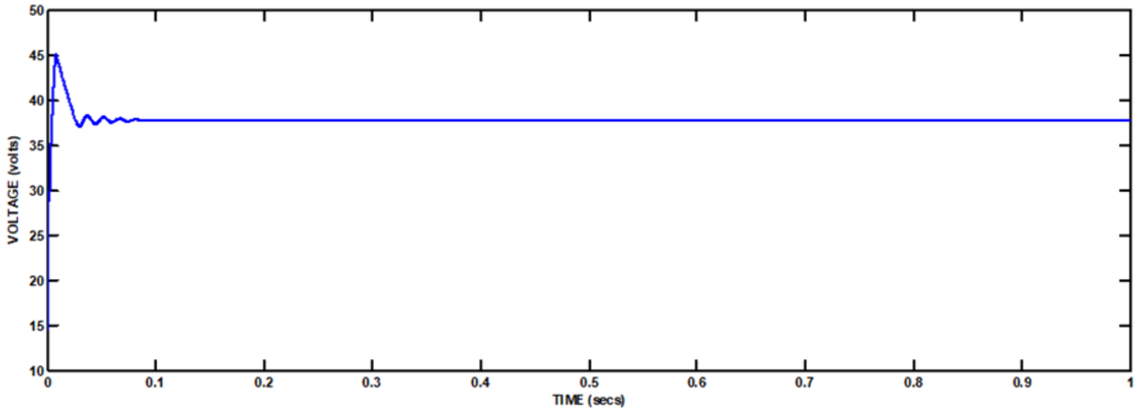

Fig 4.4 Output Voltage Waveform of Load 1

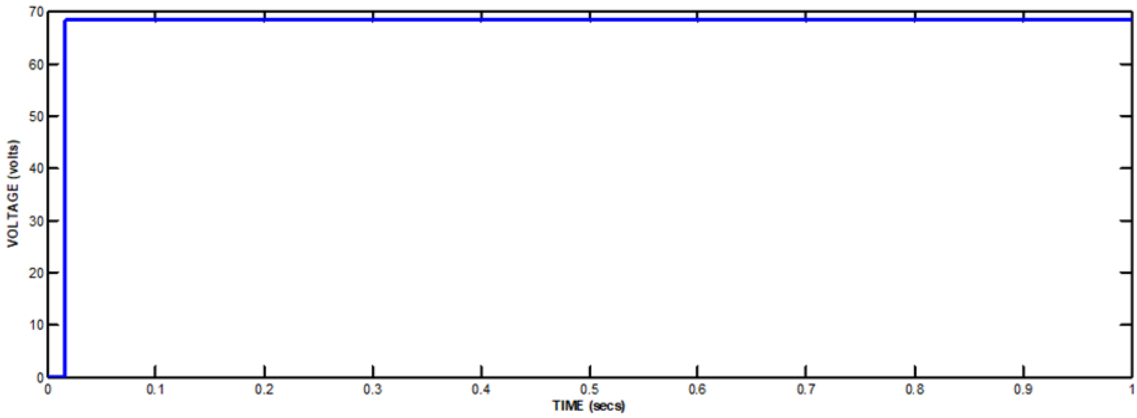

Fig 4.5 Output Voltage waveform of Load 2

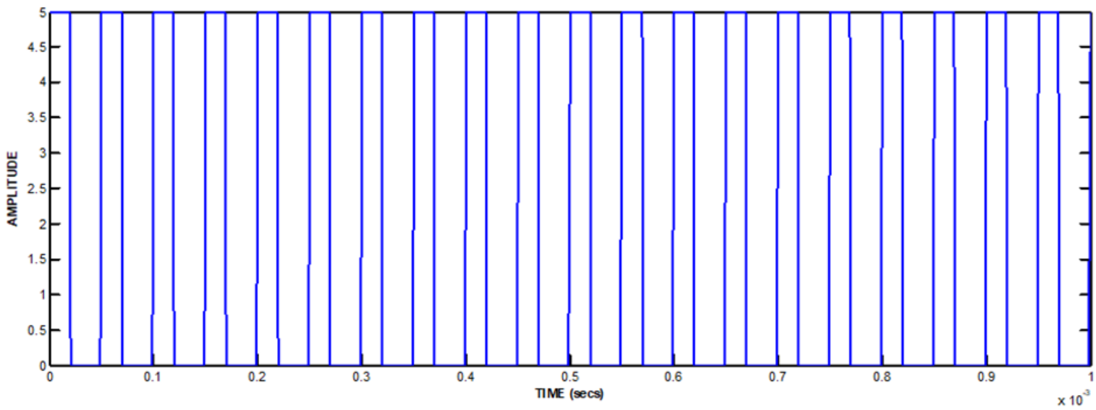

Fig 4.6 Gate Pulse of MOSFET

5. Conclusion

This project presents a new flyback converter with a CIR structure is proposed. By adopting the CIR structure to the flyback converter, the proposed converter eliminates the DC-offset current in the transformer which reduces the size of the transformer and improves the ZVS condition of Mosfet. In addition, the two rectifier diodes have the same current stress even in the asymmetrical duty-ratio which reduces conduction loss in high-voltage-rating diode. As a result, the proposed converter achieves higher efficiency than the conventional AHB converter. Furthermore, the proposed converter does not need additional components and a control method, its cost and complexity are not increased. Consequently, the proposed converter will be a good for low power and a wide input voltage range applications.

References

- H.-S. Lee, H.-J. Choe, S.-H. Ham, and B. Kang, “High-Efficiency Asymmetric Forward-Flyback Converter for Wide Output Power Range,” IEEE Trans. Power Electron., vol. 32, Jan. 2017
- M. Arias, M. F. Diaz, D. G. Lamar, F. M. F. Linera, J. Sebastian, “Small-Signal and Large-Signal Analysis of the Two-Transformer Asymmetrical Half-Bridge Converter Operating in Continuous Conduction Mode,” IEEE Trans. Power Electron., vol. 29, Jul. 2014.
- W. Li, Y. He, X. He, Y. Sun, F. Wang, “Series Asymmetrical Half-Bridge Converters With Voltage Autobalance for High Input-Voltage Applications,” IEEE Trans. Power Electron., vol. 28, Aug. 2013.
- M. Arias, M. F. Diaz, D. G. La mar, D. Balocco, A. A. Diallo, and J. Sebastian, “High-Efficiency Asymmetrical Half-Bridge Converter Without Electrolytic Capacitor for Low-Output-Voltage AC-DC LED Drivers,” IEEE Trans. Power Electron., vol. 28, May. 2013.
- Y.-S. Lai, Z.-J. Su, and W.-S. Chen, “New Hybrid Control Technique to Improve Light Load Efficiency While Meeting the Hold-up Time Requirement for Two-Stage Server Power,” IEEE Trans. Power Electron., vol. 29, Sep. 2014.
- H. Wang, H. S.-H. Chung, and W. Liu, “Use of a Series Voltage Compensator for Reduction of the DC-Link Capacitance in a Capacitor-Supported System,” IEEE Trans. Power Electron., vol. 29, Mar. 2014
- J.-W. Kim, and G.-W. Moon, “A New LLC Series Resonant Converter With a Narrow Switching Frequency Variation and Reduced Conduction Losses,” IEEE Trans. Power Electron., vol. 29, Aug. 2014.
- R. Kathiresan, P. Das, T. Reindl, and S. K. Panda, “A Novel ZVS DC-DC Full-Bridge Converter With Hold-Up Time Operation,” IEEE Trans. Industrial Electron., vol. 64, no. 6, pp. 4491-4500, Jun. 2017
- J.-B. Lee, J.-K. Kim, J.-H. Kim, J.-I. Baek, and G.-W. Moon, “A High-Efficiency PFM Half-Bridge Converter Utilizing a Half-Bridge LLC Converter Under Light Load Conditions,” IEEE Trans. Power Electron., vol. 30, Sep. 2015.
- M.-H. Park, C.-O. Yeon, J.-S. Park, C.-Y. Lim, J.-K. Han, and G.-W. Moon, “Wide-Range ZVS Asymmetric Half-Bridge Converter With Clamping Switches for Small DC-Offset Current,” IEEE International Power Electronics and Motion Control Conf., May. 2016.