International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 3 Issue 8, August - 2014

Push-Pull Quasi Resonant Converter Techniques used for Boost Power Factor Corrector

V. Siva Subramanyam
PG student, Department of EEE
Siddhartha institute of science and technology
Chittoor (D), Andhra Pradesh, India

K. Chandra Sekhar
Assistant Professor, Department of EEE
Siddhartha institute of science and technology
Chittoor (D), Andhra Pradesh, India

R. Ramesh
PG student, Department of EEE
Siddhartha institute of science and technology
Chittoor (D), Andhra Pradesh, India

T Kishore Babu
PG student, Department of EEE
Siddhartha institute of science and technology
Chittoor (D), Andhra Pradesh, India

***Abstract*—This project presents a power-factor corrector (PFC), which is principally composed of 2 section transition-mode (TM) boost-type power-factor correctors (PFCs) and a coupled inductor. By desegregation 2 boost inductors into one core, not solely the circuit volume is reduced, however additionally the operative frequency of the core is double of the switching frequency. Therefore, the power-factor price and also the power density are enhanced. A cut-in 0.5 duty cycle will cut back the physical phenomenon losses of the switches and each of the turns and diameters of the electrical device windings. The benefits of a metallic element boost greenhouse emission, like quasi-resonant (QR) depression change on the switch and zero-current switching (ZCS) of the output diode, are maintained to boost the conversion potency**

Keywords*— push pull topology, coupled inductor, quasi resonant converter

I. Introduction

Generally boost conveter topology is the most commonly used technique to improve the power factor. It is always neceesary to rech power factor as unity a cost effective solution can be obtained for greater than 0.95.In this proposed system we are using the push-pull technique to boost up the voltage level up to 380V dc for an input of 110 V ac supply.

A push–pull converter is a type of DC-to-DC converter that uses a transformer to change the voltage of a DC power supply. The proposed system having the capable of operating three modes of operation they are Continuous Conduction Mode, Discontinuous Conduction Mode and Transition Mode.

Even though Continuous Conduction Mode best suitable for high power applications the inductor value in this mode is high and in case of Discontinuous Conduction Mode the input harmonics level is high. But in case of transition mode the inductor value is moderate and useful for medium power applications so this mode is used for the proposed topology.

Derived from 2 TM boost converters with the interleaved operations, the power rating is increased and the input current and output current are shared equally with lower current ripples. Therefore, the total harmonic distortion (THD) of input current and the output capacitance can be reduced. However, the need of two inductors with two independent cores increases the circuit volume.

In this paper, a push–pull boost PFC composed of two interleaved TM boost PFCs and a coupled inductor is proposed and a single magnetic core is used. The two identical modules can share the output power and promote the power capability up to the medium-power-level applications.

In addition to this coupling of the two distributed boost inductors into a one magnetic core automatically reduces the circuit volume, which is the important goal of the development of switching power supply today. The interleaved operations of the switches act like a push–pull converter. The difference is that the operating frequency of the core is getting double of the switching frequency, which means that not only the circuit size is reduced and also the operating frequency of the core is getting double of the switching frequency.

The same distributions of the input current and output current, the proposed topology with a cut-in 0.5 duty cycle can reduce the conduction losses of the switches on both the turns and diameters of the inductor windings

It is also maintains the advantages of a TM boost PFC, such as QR valley switching on the switch and zero-current switching (ZCS) of the output diode, to reduce the switching losses and improve the conversion efficiency.

MATLAB/SIMULINK used for the proposed system to simulate for an universal line voltage of 110v ac, a 380-V output dc voltage and a 200-W output power in order to verify its feasibility.

II. Circuit Topology

Fig 1 shows block diagram for push-pull Qusi Resonant converter. Here the power conversion occurs in three segments. In the first segment single phase AC supply is fed to the rectifier, to convert AC to DC. The output from the rectifier is modulated sinwave. This modulated sinwave is given to the quasi resonant converter. Using quasi resonant converter the voltage has been boosted. Then it is given to the load.

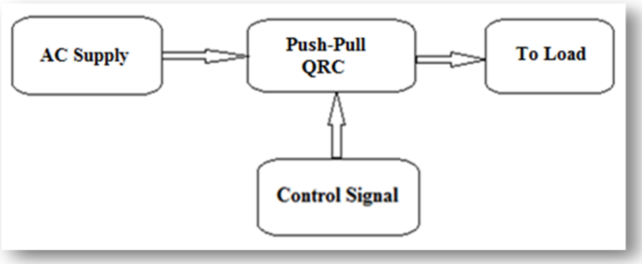

Fig.1. Block diagram of push-pull Quasi Resonant converter

A. *Circuit Diagram Of Push-Pull Quasi resonant Converter*

The circuit diagram for push- pull quasi resonant converter is shown in fig below. First we are converting ac voltage into dc voltage by using rectifier. The output from the rectifier is modulated sinwave then this supply is given to the push pull quasi resonant converter. This quasi resonant converter boost up the voltage to 380V. The proposed topology is operated by transition mode with constant on time and variable frequency.

The proposed topology consists of two modules. Module A consists of the switch S_a, the winding N_{Pa}, the inductor L_a, and the output diode D_a. Module B consists of the switch S_b, the winding N_{Pb}, the inductor L_b, and the output diode D_b. These two modules have a common output capacitor C_o. L_a and L_b are 2 coupled windings wound on the same magnetic core.Theoretically, the same turns of these two windings will lead to the same inductances

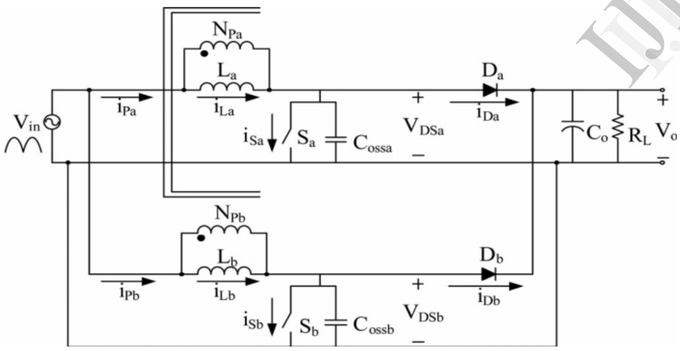

Fig.2.push pull quasi resonant converter

To analyze the operating principles, there are some assumptions listed as follows.

1) The conducting resistances of S_a and S_b are ideally zero. The conduction time interval is DT_s , where D is the duty Cycle and T_s will be the switching period.

2) The forward voltages of D_a and D_b are ideally zero.

3) The magnetic core for manufacturing L_a and L_b is perfectly Coupled without leakage inductance. In addition, The turns of the windings N_{Pa} and N_{Pb} will be same. Therefore, L_a and L_b are also matched

III. OPERATION MODES IN QUASI RESONANT CONVERTER

The operating modes of the proposed topology are analyzed as follows

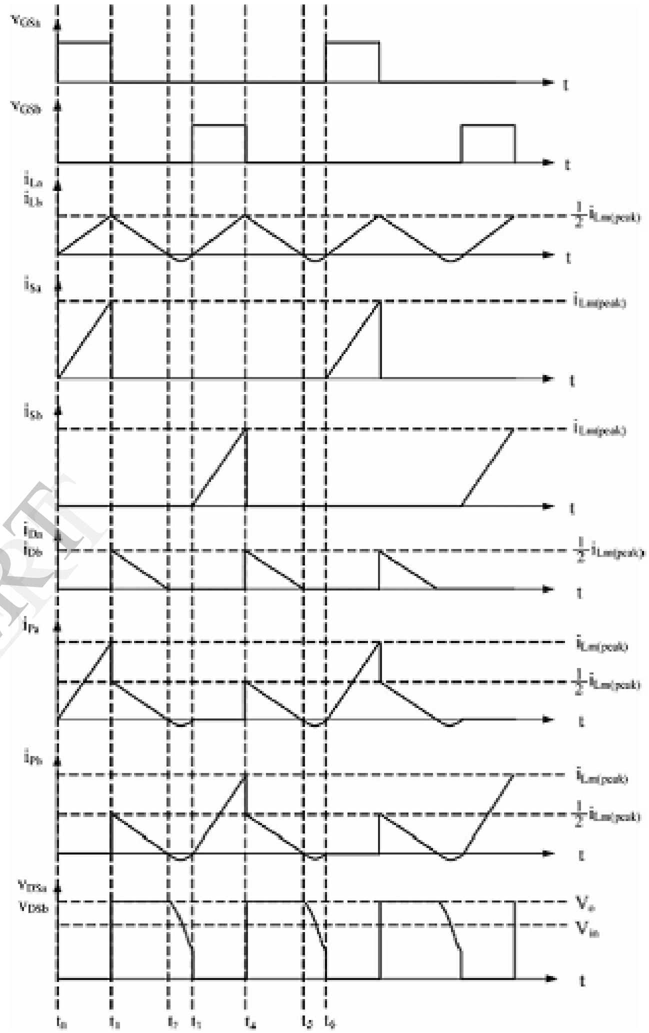

Fig.3 key wave forms for proposed topology

.

A. *Mode 1 operation:* $t_0 < t < t_1$

Referring to Fig. 4, in module A, S_a conducts. Thus, the voltage across N_{Pa} equals to the rectified line-in voltage V_{in}. The inductor current i_{La} increases linearly, and D_a is reverse-biased. In module B, S_b is turned OFF. The voltage across N_{Pa} is coupled to N_{Pb}. Hence, the voltage across N_{Pb} is also V_{in}, and the dotted terminal is positive. L_b stores energy as L_a does. The inductor current i_{Lb} increases linearly and flows into the non dotted terminal of N_{Pb}. By the coupling effect, this current flows into the dotted node of N_{Pa}. Since the voltage across S_b is zero, D_b is also reverse-biased. C_o supplies the energy to the load. The constant turn-on time of S_a is decided by the management of the controller depending on the rectified line-in voltage V_{in}. This is the initial mode of operation.

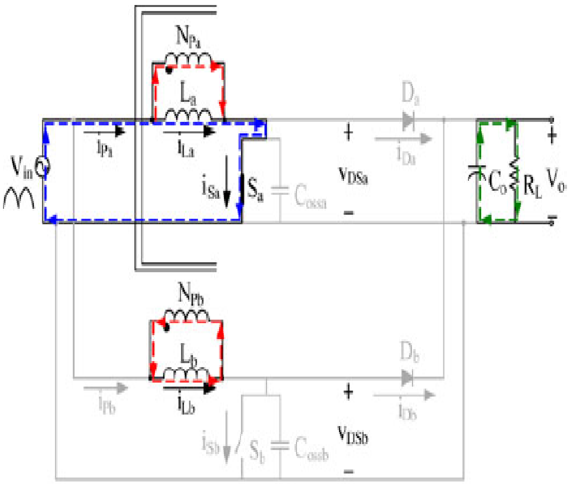

Fig.4. module A S_a ON, module B S_b OFF

B. Mode 2 operation: $t_1 < t < t_2$

As shown in Fig. 5, in module A, S_a is turned OFF. D_a conducts for i_{La} to flow continuously. L_a releases its energy to C_o and the load. The voltage across N_P is ($V_o - V_{in}$) and the dotted terminal is negative. In module B, S_b is still turned OFF the voltage across N_{Pa} is coupled to N_{Pb}.

Hence, the voltage across N_{Pb} is also ($V_o - V_{in}$), and the dotted node is negative. D_b is thus forward-biased to carry the continuous i_{Lb}. L_b is also releases its energy to C_o and the load. Both i_{La} and i_{Lb} are decreasing linearly. This state ends until L_a and L_b release their energies completely, and i_{La} and i_{Lb} decrease to zero.in this mode we are boosting the voltage.

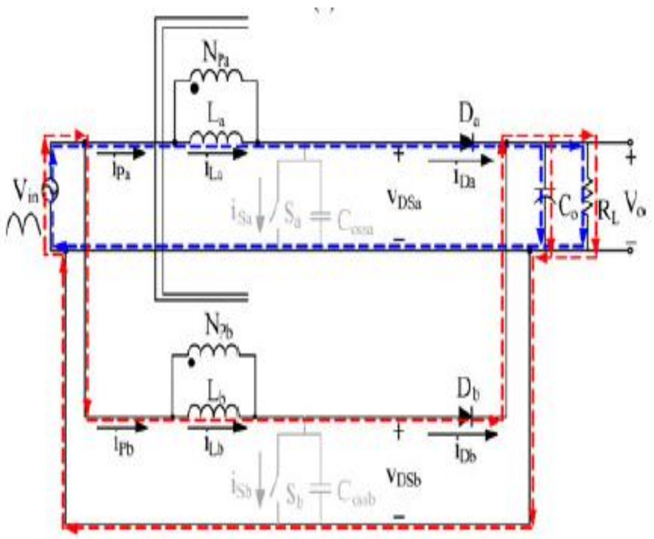

Fig 5 Module A S_a OFF Module B S_b OFF

C. Mode 3 operation: $t_2 < t < t_3$

As shown in Fig. 6, in module A, S_a keeps turned OFF. At t_2, D_a is turned OFF with ZCS since i_{La} decreases to zero natu- rally. Similarly, in module B, S_b is still turned OFF. D_b is turnedOFF with ZCS at t_2 since i_{Lb} decreases to zero naturally, too.In this interval, C_o supplies the energy to the load. At the sametime, in module A, the series resonant loop formed by V_{in}, theparallel connection of L_a and L_b, and the output capacitance ofthe switch S_a, C_{ossa}, starts to resonate. Similarly, in module B,the series resonant loop formed by V_{in}, the parallel connectionof L_a and L_b, and the output capacitance of the switch S_b, C_{ossb},begins to resonate. Therefore, v_{DSa} and v_{DSb} decrease simulta-neously. This mode is helpful to increasing the power factor.

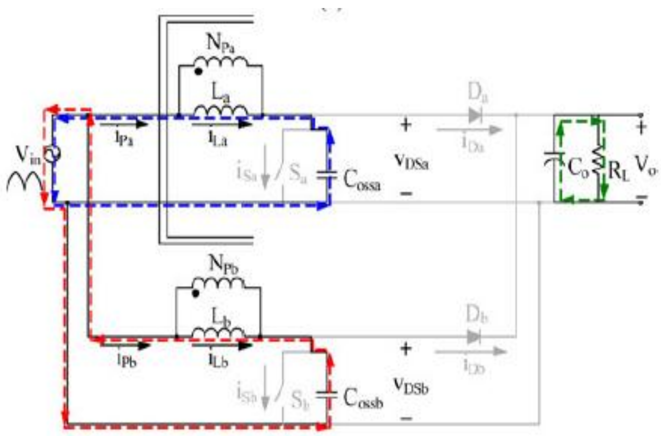

Fig.6. Module A S_a OFF Module B S_b OFF S_1

IV. SIMULATOIN RESULTS

MATLAB/SIMULINK is used for the simulation studies. Fig 7 shows the simulation circuit of push pull quasi-resonant converter for open loop system.

Simulation conducted for an open loop system fig.7 with input voltage of 110V AC the corresponding output voltage is 380V DC, P_o = 200 W and input current distortion is shown in fig 8 and fig 10.

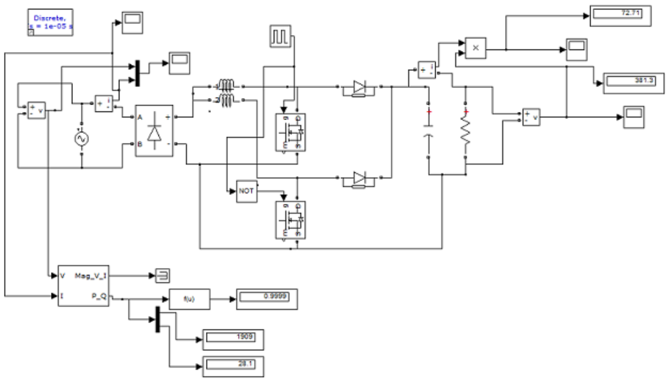

Fig.7.Simulation circuit of push pull quasi resonant converter for open loop system

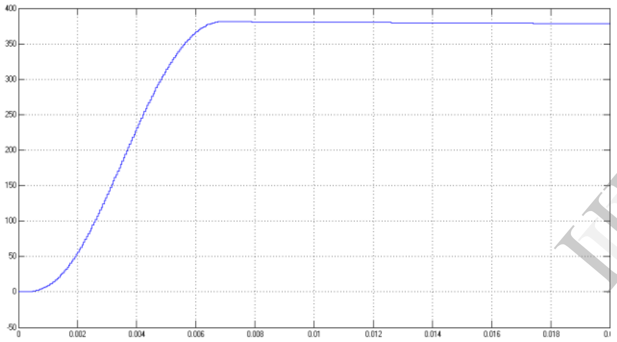

Fig.8. output voltage 380V (DC) for open loop system

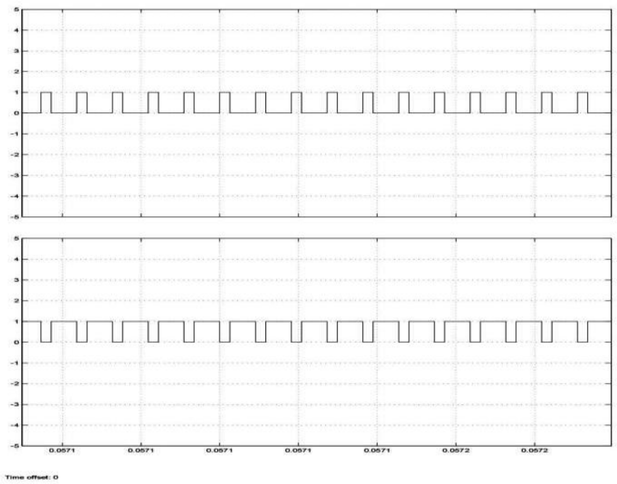

Fig.9.Gate pulses of the switch S_a and S_b with 50% Duty cycle push pull quasi resonant converter.

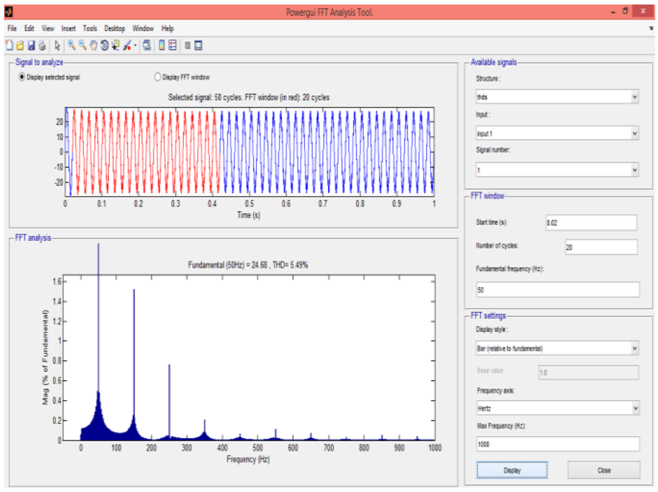

Fig 10. I/P Current Distortion for open loop system

Simulation circuit for closed loop system is shown in fig 11. Simulation conducted with input voltage of 110V AC the corresponding output voltage 380V DC, P_o = 200 W and input current distortion is shown in fig 12 and fig 13.

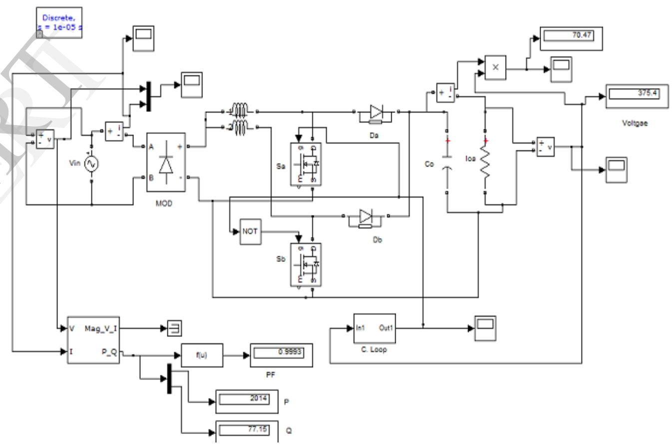

Fig.11. Simulation circuit of push pull quasi resonant converter for closed loop system

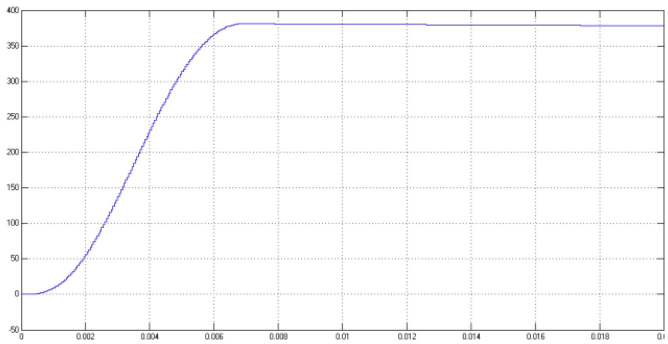

Fig.12.output voltage 380V (DC) for open loop system

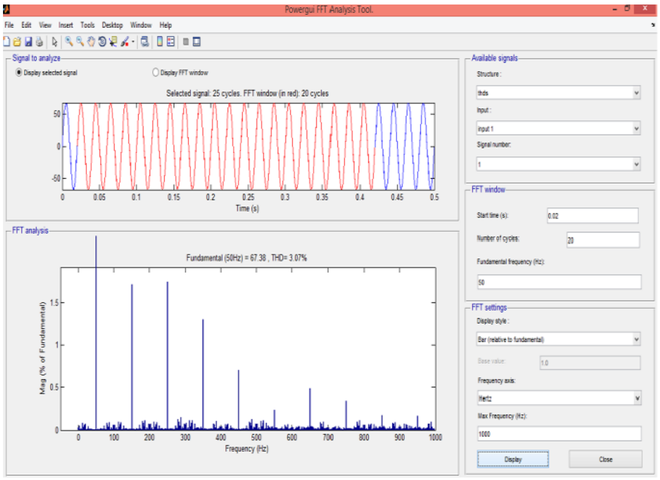

Fig.13. I/P Current Distortion for open loop system

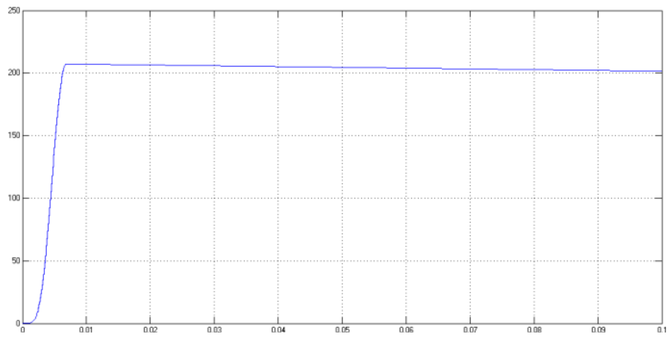

Fig.14 Output waveform of the Power of the proposed circuit

V. CONCLUSION

In this paper, a novel of push pull quasi resonant converter techniques for Boost PFC is implemented in order to boost up the voltage level and improve the power factor. Simulation has been done using MATLAB/SIMULINK for an input voltage of 110V AC for both open loop and closed loop system. In both the systems we are gaining the power factor near by unity.

REFERENCES

[1] K. Yao, X. Ruan, X. Mao, and Z. Ye, "Reducing storage capacitor of a DCM boost PFC converter," *IEEE Trans. Power Electron.*, vol. 27, no. 1, pp. 151–160, Jan. 2012.

[2] X. Zhang and J.W. Spencer, "Analysis of boost PFC converters operating in the discontinuous conduction mode," *IEEE Trans. Power Electron.*, vol. 26, no. 12, pp. 3621–3628, Dec. 2011.

[3] B. Su, J. Zhang, and Z. Lu, "Totem-pole boost bridgeless PFC rectifier with simple zero-current detection and full-range ZVS operating at the boundary of DCM/CCM," *IEEE Trans. Power Electron.*, vol. 26, no. 2, pp. 427–435, Feb. 2011.

[4] B. Akın and H. Bodur, "A new single-phase soft-switching power factor correction converter," *IEEE Trans. Power Electron.*, vol. 26, no. 2, pp. 436–443, Feb. 2011.

[5] Y.-S. Roh, Y.-J. Moon, J.-C. Gong, and C. Yoo, "Active power factor correction (PFC) circuit with resistor free zero-current detection," *IEEE Trans. Power Electron.*, vol. 26, no. 2, pp. 630–637, Feb. 2011.

[6] Y.-T. Chen, S. Shiu, and R. Liang, "Analysis and design of a zero-voltage switching and zero-current-switching interleaved boost converter," *IEEE Trans. Power Electron.*, vol. 27, no. 1, pp. 161–173, Jan. 2012.

[7] T.-H. Hsia, H.-Y. Tsai, D. Chen, M. Lee, and C.-S. Huang, "Interleaved active-clamping converter with ZVS/ZCS features," *IEEE Trans. Power Electron.*, vol. 26, no. 1, pp. 29–37, Jan. 2011.

[8] S. Dwari and L. Parsa, "An efficient high-step-up inter leaved DC–DC converter with a common active clamp," *IEEE Trans. Power Electron.*, vol. 26, no. 1, pp. 66–78, Jan. 2011.

[9] Y.-C. Hsieh, M.-R. Chen, and H.-L. Cheng, "An interleaved flyback converter featured with zero-voltage transition," *IEEE Trans. Power Electron.*, vol. 26, no. 1, pp. 79–84, Jan. 2011.

[10] R.-L. Lin,C.-C. Hsu, and S.-K. Changchien, "Interleaved four-phase buckbased current source with center-tapped energy-recovery scheme for electrical discharge machining," *IEEE Trans. Power Electron.*, vol. 26, no. 1, pp. 110–118, Jan. 2011.

[11] W. Li and X. He, "A family of isolated inter leaved boost and buck converters with winding-cross-coupled inductors," *IEEE Trans. Power Electron.*, vol. 23, no. 6, pp. 3164–3173, Nov. 2008.

[12] L. Huber, B. T. Irving, andM.M. Jovanovic, "Open-loop control methods for interleaved DCM/CCM boundary boost PFC converters," *IEEE Trans. Power Electron.*, vol. 23, no. 4, pp. 1649–1657, Jul. 2008.