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Improving Voltage Gain in Full Bridge Converter Using Soft Switching Technique

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Abstract

This paper presents analysis on hybrid type full-bridge dc/dc converters to investigate the high efficiency, high power factor and less THD.Using a hybrid control scheme with a simple circuit structure, the proposed dc/dc converter has a hybrid operation mode. Under a normal input range, the proposed converter operates as a phase-shift full bridge series resonant converter that provides high efficiency by applying soft switching on all switches and rectifier diodes and reducing conduction losses. When the input is lower than the normal input range, the converter operates as an active-clamp step-up converter that enhances an operation range. Due to the hybrid operation, the proposed converter conventional converters under the normal input range. Full bridge voltage doublers and half bridge voltage doubles are presented to analyze the efficiency. Thus, the proposed converter is capable of being designed to give high power conversion efficiency and its operation range is extended. A1kW prototype is implemented to confirm the theoretical analysis and validity of the proposed converter.

Keywords: Full-Bridge Circuit, Phase-Shift Control, Active Clamp Circuit

1. Introduction

These days, requests on dc/dc converters with a powerful thickness, high effectiveness, and low electromagnetic impedance (EMI) have been expanded in different modern fields. As the changing recurrence increments to get high power thickness, changing misfortunes identified with the turn-on and turn-off of the exchanging gadgets expansion of the exchanging recurrence, delicate exchanging strategies are imperative. Among past dc/dc converters, a stage move

full-connect (PSFB) converter is alluring on the grounds that all essential switches are turned on with zero-voltage exchanging (ZVS) without extra assistant circuits [1]. Be that as it may, the PSFBconverter has some difficult issues, for example, thin ZVS scope of slacking leg switches, high power misfortunes by flowing current, and voltage ringing crosswise over rectifier diodes. Particularly, with a necessity of wide info extend, the PSFB converter is intended to work with little stage shift esteem under the typical data go; the configuration of the PSFB converter stretches the freewheeling interim and causes the over the top circling current which expands conduction misfortunes [2][3].As of late, the different PSFB converters utilizing helper circuits have been presented [4][12].The PSFB converters amplify ZVS go or diminish the circling current by using extra latent or dynamic helper circuits. In any case, the extra circuits resulting muddled circuit design, complex control procedure, and additional force misfortunes [13].Furthermore, some PSFB converters still require the additional snubber to avert genuine voltage ringing issue crosswise over rectifier diodes. The PSFB converters utilizing [14][15] an arrangement full converter have been presented, in particular, the PSFB arrangement thunderous converters; they have numerous points of interest, for example, delicate exchanging strategies of all essential switches and rectifier diodes, end of circling current, decrease of voltage weight on rectifier diodes, and a straightforward circuitstructure.Nonetheless, when all previously statedPSFB converters are required to ensure a wide operation range, regardless they work with the little stage shift esteem under the ordinary data range. The operation with the little stage shift esteem by and large gives high conduction misfortunes by high crest current; it results in low influence effectiveness. To accomplish high productivity under the typical information range and cover the wide data run, the distinctive systems are proposed The converters change the turn [16][17]proportion of the transformer by utilizing extra exchanging gadgets. In spite of the fact that the methodology accomplishes high productivity and guarantees the wide data extend, these strategies give circuit unpredictability and lessening of the transformer use. Dynamic clasp circuits have been usually used to retain surge vitality put away in spillage inductance of a transformer. Additionally, the circuits give a delicate exchanging procedure. A few studies have presented dc/converters joining the dynamic clasp circuit and voltage doublers or multiplier rectifier .The circuit arrangement permits to accomplish a stage up capacity like a help converter. The voltage anxieties of rectifier diodes are likewise clasped at the yield voltage and no additional snubber circuit is required. In this anticipate, a novel half breed sort FB dc/dc converter with high effectiveness is proposed; the converter is gotten from a blend of a PSFB arrangement thunderous converter and a dynamic clip venture up converter with a voltage doublers circuit. Utilizing a crossover control plan with a basic circuit structure, the proposed converter has two operation modes. Under the ordinary data run, the proposed converter works as a PSFB arrangement resounding converter. The proposed converter yields high proficiency by applying delicate exchanging procedures on all the essential switches and rectifier diodes and by diminishing conduction misfortunes. At the point when the data voltage is lower than the ordinary info extend, the converter works as a dynamic cinch venture up converter. In this mode, the proposed converter gives a stage up capacity by utilizing the dynamic cinch circuit on the essential side and the voltage double rectifier on the optionalside.Because of the half breed operation, the proposed converter works with bigger stage shift esteem than the routine PSFB converters under the typical info range. Along these lines, the proposed converter has the accompanying favourablecircumstances:

1) Under the typical information run, the proposed converter can be intended to streamline power

Change effectiveness.2) When the info is lower than the ordinary data go, the proposed converter performs a stage up capacity, which improves the operation range.

2. Principle Operation of The proposed Converter

The circuit graph of the proposed converter. On the essential side of the force transformer T, the proposed converter has a FB circuit with one blocking diode DB and one cinch capacitor Cc. On the optional side, there is a voltage double rectifier. The operation of the proposed converter can be ordered into two cases. The one is a PSFB arrangement thunderous converter mode and the other is a dynamic brace venture up converter mode. To examine the unfaltering state operation of the proposed converter, a few presumptions are made

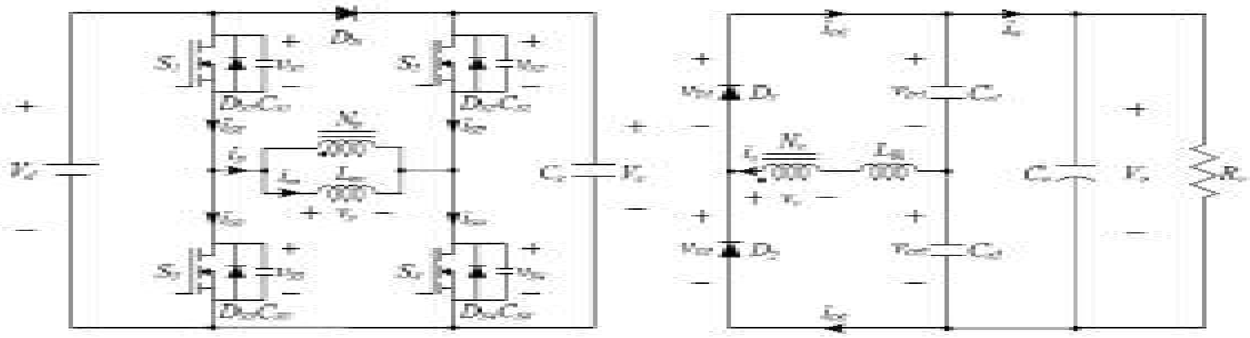

Figure 1 : Circuit diagram of the proposed hybrid-type fullbridgedc/dc converter

1) All switches S1, S2, S3, and S4 are considered as perfect switches with the exception of their body diodes and yield capacitors.2) The cinch capacitor Cc and yield capacitor Co are sufficiently expansive, so the brace capacitor voltage and yield voltage Vo have no swell voltage, separately.

3) The transformer T is made out of a perfect transformer with the essential winding turns Np, the optional winding turns Ns, the polarizing inductance, and the spillage inductance Llk.4) The capacitance of the thunderous capacitors Cr1and Cr2 is indistinguishable. Along these lines, Cr1=Cr2.

A. PSFB Series-resonant Converter Mode

Under the ordinary info voltage run, the proposed converter is worked by stage shift control. In this mode, Vc is the same as the info voltage Vdand DB is directed. All switches are driven with a steady obligation proportion 0.5 and short dead time. Fig demonstrates the operation waveforms and identical circuits, individually. A nitty gritty mode examination is given as four modes

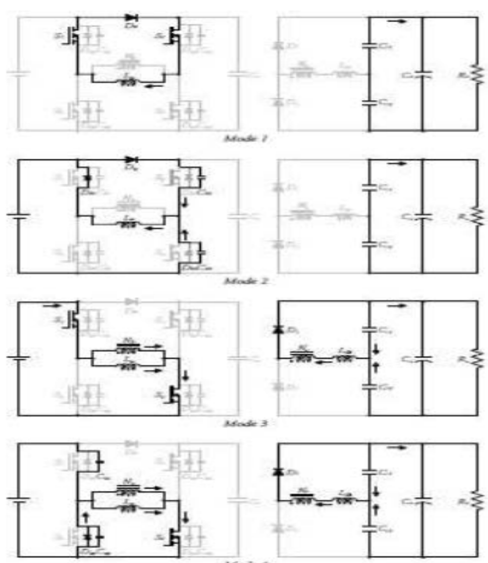

Figure 2: PSFB Series-resonant Converter Mode

Mode 1 [t0, t1]: Prior to t0, the switches S1 and S2are in on state and the optional current is zero. The essential current ip courses through DB, S1, S2, and. A mid this mode, the essential voltage vp and

Auxiliary voltage versus of the transformer T is zero. In this way, the polarizing current im is steady and fulfils as takes after:

$$i_m(t) = i_p(t) = i_m(t_0)$$

Mode 2 [t1, t2]: At t1, S2 is turned off. Since improving through S2 is low, S2 is turned off with close to zero-current. In this mode, ip charges CS2and releases CS4.

Mode 3 [t2, t3]: At t2, the voltage crosswise over S4achieves zero. In the meantime, ip courses through the body diode DS4. Along these lines, S4 is turned on with zero-voltage while DS4 is led. In this mode, versus is n Vd where the turn proportion n of the transformer is given by Ns/Np and the optional current is starts to course through D1.

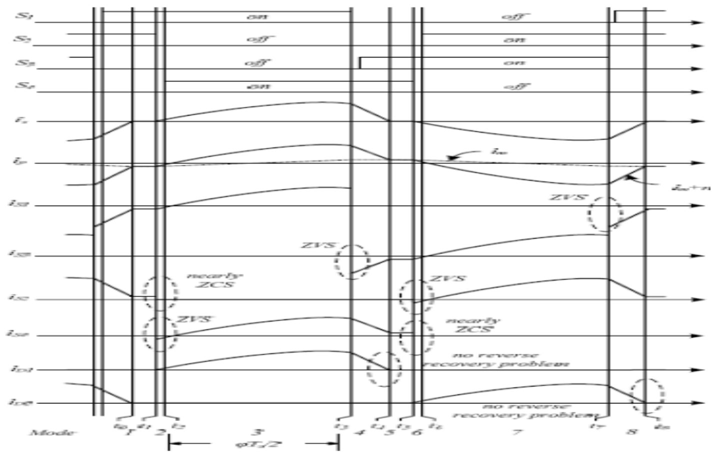

Figure 3: Operation waveforms in the PSFB series resonant converter mode.

The state mathematical statement of this mode is composed as takes after:

$$K_{lk}\frac{di_s(t)}{dt} = nV_d - V_{cr1}(t)$$

$$i_s(t) = C_{r1}\frac{dV_{cr1}(t)}{dt} - Cr2\frac{dv_{cr2}(t)}{dt}$$

Where *vcr1* and *vcr2* are the voltages across *Cr1* and *Cr2*, respectively Since *V*o is constant, the secondary current *is* can be obtained as

$$i_s(t) = C_{r1}\frac{dv_{cr1(t)}}{dt} - C_{r2}\frac{d(v_0 - v_{cr1}(t))}{dt} = C_r\frac{dv_{cr1(t)}}{dt}$$

Where the equivalent resonant capacitance

$$i_s(t) = \frac{nV_d - V_{cr1}(t_2)}{Z_r} sin\omega_r(t - t_2)$$

The angular frequency *ωr* and characteristic impedance *Zr* are given by

$$\omega_r = \frac{1}{\sqrt{L_{lk\,C_r}}}, Z_r = \sqrt{\frac{L_{lk}}{C_r}}$$

Meanwhile, the magnetizing current *i*mincreases linearly as follows

$$i_m(t) = i_m(t_2) + \frac{V_d}{L_m}(t - t_2).$$

In this mode, power is transferred from the input to the output.

Mode 4 [t3, t4]: This mode starts when S1 is turned off. The essential current ip charges CS1 anode diode DS3.Therefore, S3 is turned on with zero voltage while DS3 is led. At the point when vp is zero, D1 is still directed and - vcr1 is connected to Llk. Along these lines, the auxiliary current is goes to zero quickly. End of this mode, since the optional current is near zero proceeding D1 is opposite predisposition, the misfortunes by the converse recuperation issue are little as immaterial. Since operations amid the following half exchanging period are comparative with Mode 1-4, actions of Mode 5-8 are not introduced

B. Active-clamp Step-up Converter Mode

As the information voltage diminishes up toa specific least estimation of the typical data extend, the stage shift esteem φ increments up to its most extreme quality, 1. In the event that the data voltages lower than the base estimation of the ordinary information extend, the proposed converter is worked by double lopsided heartbeat width
Adjustment (PWM) control. The switches (S1, S4) and (S2, S3) are dealt with as switch matches and worked integrally with short dead time. The obligation D more than 0.5depends on (S1, S4) pairIn this circumstance, the cinch capacitor voltage Vc is higher than Vd. At that point, the blocking diode DB is opposite one-sided and the proposed converter works as the Dynamic cinch venture up converter. Fig demonstrates the operation waveforms and comparable circuits in the dynamic brace venture up converter mode, individually.

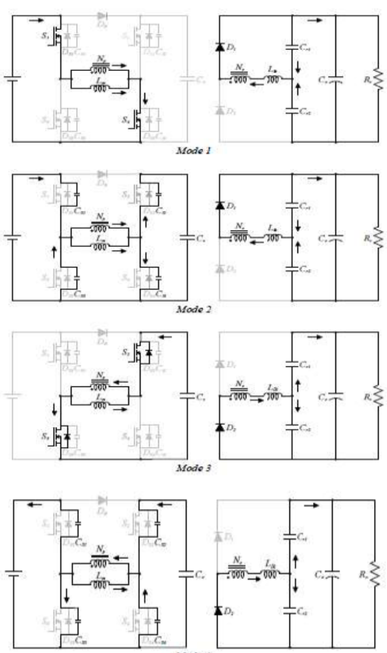

Figure 4 : Equivalent circuits during a switching period in the active-clamp step-up converter mode.

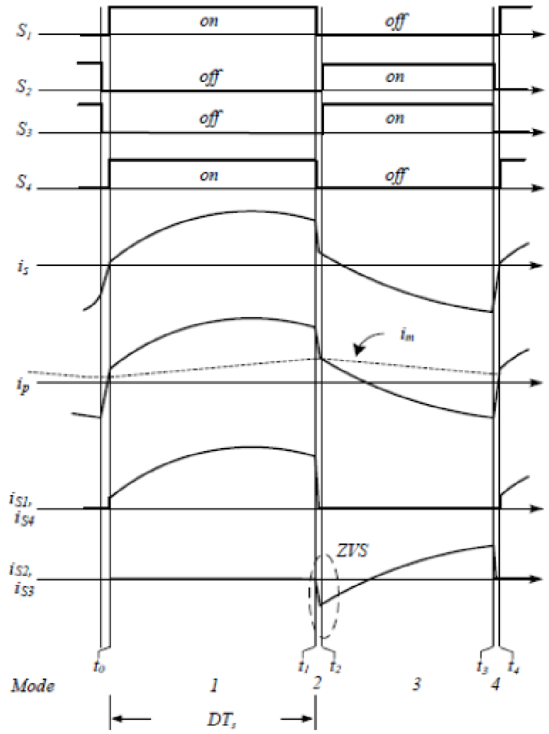

Figure 5: Operation waveforms in the active-clamp step-up converter mode

Mode 3 [t2, t3]: This mode begins when the voltages across *S2* and *S3* are zero. At the same time, *i*p flows through *DS2* and *DS3*. Thus, *S2* and *S3* are turned on with zero-voltage. Since the negative voltage -*Vc* is applied to *Lm*, the magnetizing current *i*m decreases linearly as

$$i_m(t) = i_m(t_3) + \frac{V_C}{L_m}(t - t_3)$$

In this mode, the secondary current *is* begins to second resonance and the state equation is written as follows

$$L_{lk}\frac{di_s}{dt} = v_{cr2}(t) - nV_C$$

$$i_s(t) = C_{r1}\frac{dV_{cr1}(t)}{dt} - C_{r_2}\frac{dV_{Cr2}(t)}{dt} = -C_r\frac{dv_{Cr2}(t)}{dt}$$

$$i_s(t) = i_s(t3)\cos\omega_r(t - t_2) - \frac{nV_c - V_{cr2}(t_2)}{Z_r}\sin\omega_r(t - t_2)$$

Proposed Simulation Models Hybrid Full Bridge with full bridge voltage double model:

This hybrid-type full-bridge dc/dc converter with full bridge voltage doubler circuit shown below using a hybrid control scheme with a simple circuit structure, the existed dc/dc converter has a hybrid operation mode. Under a normal input range, the converter operates as a phase-shift full-bridge series resonant converter that provides high efficiency by applying soft switching on all switches and rectifier diodes and more conduction losses. Due to the normal operation, the existed converter operates with larger phase shift value than the conventional converters under the normal input range. In existed system less efficiency and less voltage profile.

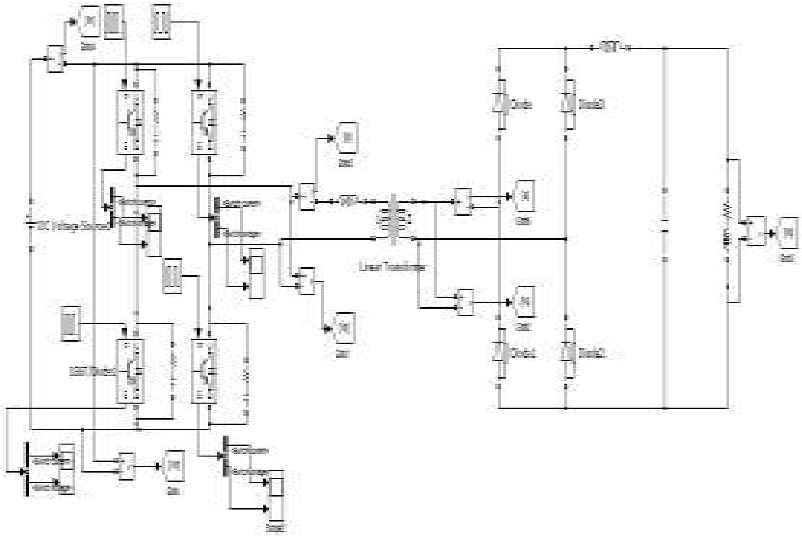

Figure 6 : Simulink model for the Hybrid full bridge with full bridge voltage doubler dc to dc converter

3. Simulation Results

The current stress in the proposed converters much lower. In addition, the proposed converter eliminates the circulating current. The waveforms for the input and output voltages in the transient-state When the input voltage *Vd* is reduced from 350V to 250V, the proposed converter regulates the output voltage without any hysteresis. Shows measured efficiencies for the conventional series-resonant converter and the proposed converter when *Vd* =350V. It shows that the proposed converter has higher efficiency over all load conditions. Shows the variation of the output voltage *V*o at full-load condition when the input voltage *Vd* decreases from 250V to 200V. Range of the conventional converter, *V*O decreases. In the proposed converter, *V*O is maintained as 200V although the input voltage decreases below the designated operation range. Shows the comparative plot of analytical andsimulink voltage gain of the proposed converter

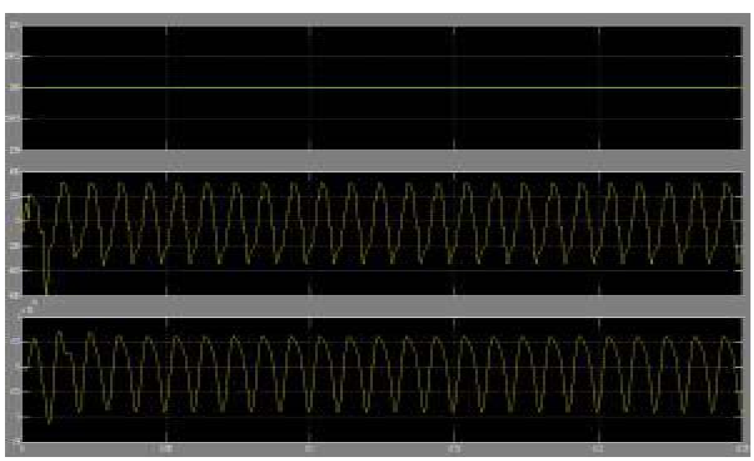

Figure 7: Results of input voltage and primary voltage of T/F and secondary voltage of T/F

The simulation results for the hybrid full bridge dc-dc converter input voltage and primary voltage at transformer and secondary voltage at transformer. Gives load voltage and gives the information about the efficiency of the proposed full bridge with half bridge voltage doubler circuit

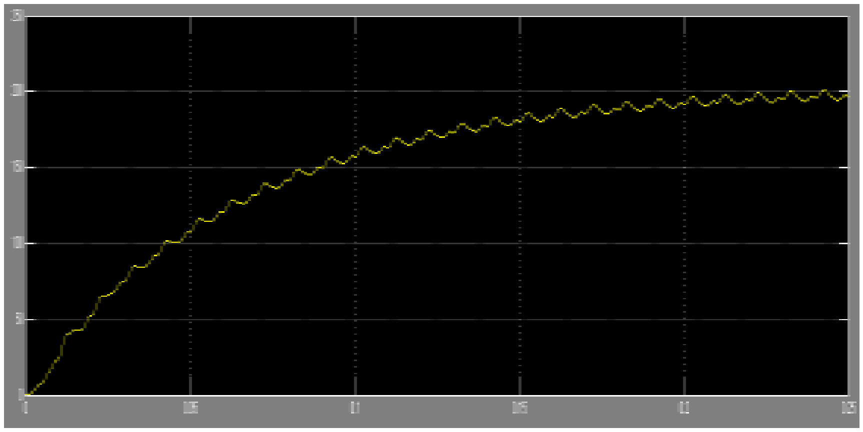

Figure 8: Output voltage levels at load voltage

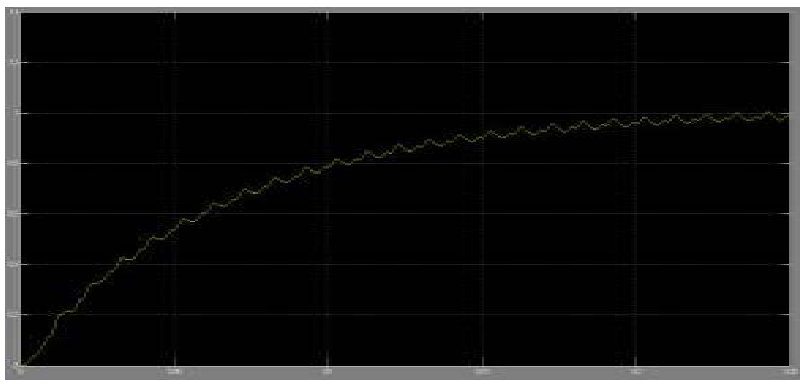

Figure 9 : Efficiency of the proposed hybrid full bridge and half bridge voltage doubler circuit

4. Conclusion

The novel hybrid full-bridge dc/converter has been introduced to verify the analysis on dc – dc converters. By using the hybrid control scheme with the simple circuit structure, the proposed converter has both the step-down and step up functions, which ensure to cover the wide inputrange.Under the normal input range, the proposed converter achieves high efficiency by providing soft switching technique to all the switches and rectifier diodes, and reducing the current stress. When the input is lower than the normal input range, the proposed converter provides the step-up function by using the active-clamp circuit and full bridge voltagedoubler and half bridge doubler are presented, which extends the operation range The proposed converter can simulated under two different conditions and I verified the Total harmonic distortion (THD), Efficiency &Power factor. To confirm the validity of the proposed converters the hybrid full bridge converters with half bridge doubler can achieve more efficiency and power factor and less THD contents, 1kWprototype was built and tested. Under the normal input range, the conversion efficiency is over 96% at full-load condition, and the input range from 250V to 350V is guaranteed. Thus, the proposed converter has many advantages such as high efficiency and wide input range.

5. References

[1] J. A. sabaté, V.Vlatkovic, R. B. Ridley, F. C. Lee, and B. H.Cho,"Design considerations for high–voltage high-power fullbridgezerovoltage- switching PWM converter," in *Proc. Appl.Power Electron. Conf.*, 1990, pp. 275-284.

[2] I. O. Lee and G. W. Moon, "Phase-shifted PWM converter with a wide ZVS range and reduced circulating current," *IEEETrans. Power Electron.*, vol. 28, no .2, pp. 908-919.Feb. 2013

[3] Y. S. Shin, S. S. Hong, D. J. Kim, D. S. Oh, and S. K. Han, "Anew changeable full bridge dc/dc converter for wide input voltage range," in Proc. *8th Int. Conf. Power Electron.-ECCE Asia*, May2011, pp. 2328- 2335.

[4] P. K. Jain, W., Kang, H. Soin, Y., Xi, "Analysis and design considerations of a load and line independent zero voltage switching full bridge dc/dc converter topology," *IEEE Trans.Power Electron.*, vol. 17, no .5, pp. 649-657.Sep. 2002.

[5] I. O. Lee and G. W. Moon, "Soft-switching DC/DC converter with a full ZVS range and reduced output filter for high-voltage application," *IEEE Trans. Power Electron*, vol. 28, no .1, pp.112-122.Jan. 2013.

[6] G. N. B. Yadav and N. L. Narasamma, "An active soft switched phase shifted full-bridge dc-dc converter: analysis, modeling, design, and implementation," *IEEE Trans. Power Electron.*, vol. 29 no. 9, pp. 4538- 4550, Sep. 2014.

[7] Y. Jang, M. M. Jovanović, and Y. –M. Chang, "A new ZVSPWMfullbridge converter," *IEEE Trans. Power Electron.*, vol.18 no. 5, pp. 1122- 1129, Sep2003.