

Efficient utilization of transformer by reducing leakage current using bidirectional converter

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Abstract-This paper deals with efficient use of transformer by reducing switch loss, large gaining force, bidirectional converter with fragile trading with high change proportion, and delicate start-up ability. Better utilization of transformer can be done by reducing leakage current. An isolated bidirectional full-bridge dc-dc converter has been proposed with high conversion ratio, high output power, and soft start-up capability. The current variation between leakage inductance of the isolation transformer and current fed inductor will produce voltage spike is managed by fly back converter. The user of a capacitor, fly back converter and through active switches a diode can reduce current streaming at the current fed side. Our proposed attains better performance compared to LCC-T Resonant Converter with ZCS.

1. Introduction

In practical dc-supply structures, batteries are commonly required to back-up power for electronic rigging. Their voltage levels are routinely much lower than the dc-transport voltage. Bidirectional converters for charging/discharging the batteries are along these lines required. For high-control applications, associate sort bidirectional converters have transform into a basic research point over the earlier decade. For raising power level, a twofold full-interface setup is regularly grasped, and its low side and high side are typically structured with lift type and buck-type topologies, separately. The noteworthy stresses of these examinations fuse decreasing trading adversity, reducing voltage and current nerves, and diminishing conduction setback due to course current.

A progressively extraordinary issue is a direct result of spillage inductance of the withdrawal transformer, which will result in high voltage spike in the midst of trading change. Likewise, the current freewheeling as a result of the spillage inductance will construct conduction hardship and lessen incredible commitment cycle. An elective procedure is to pre charge the spillage inductance to raise its present measurement up to that of the current-supported inductor, which can decrease their present

refinement and, along these lines, reduce voltage spike. Regardless, since the present dimension changes with load condition, it is difficult to tune the changing planning graph to coordinate these two flows. This paper acquaints a fly back snubber with reuse the consumed vitality in the cinching capacitor.

The fly back snubber can be worked freely to manage the voltage of the clipping capacitor; along these lines, it can support the voltage to a perfect measurement just to some degree higher than the voltage over the low-side transformer winding. Since the current does not course through the full-connect switches, their current anxieties can be lessened drastically under overwhelming burden condition, along these lines enhancing framework unwavering quality fundamentally.

Furthermore, in the midst of start-up, the fly back snubber can be controlled to pre-charge the high-side capacitor, improving reachable altogether. A bidirectional converter with low-side voltage of 48 V, high-side voltage of 360 V, and power rating of 1.5 kW has been organized and executed, from which exploratory results have affirmed the talked about execution.

The flyback snubber can reuse the held criticalness which is set away in the propping capacitor CC, while without current experiencing the standard switches. It can in like way secure the voltage to an enjoyed regard hardly higher than the voltage over the low side transformer. Since the snubber current does not course through the standard switches, current weight can be decreased inside and out under liberal weight condition. Regardless, the low-and high-side switches are worked with hard exchanging side road, accomplishing high-voltage spikes.

Then again, DC-DC booming converters with widely appealing AC association can ensure higher increments with sensitive trading limits. Distinctive periods of this kind of converters are 1. Front end inverter, 2.Fragile trading parts 3.Transformers 4.Rectifier 5.Yield channel. This sensitive trading feature is charming because it uses the spillage inductance of the transformer to forgo trading incidents along these lines converter can drive its changing repeat beyond what many would

consider possible. Higher repeat urges magnetics to acknowledge significantly humbler size.

2. Literature survey

Sheldon S. Williamson et.al (2015), presents the current and stream ask about examples and future issues for present day equipment related to transportation destroy. Unequivocal complement is put on electric and module crossbreed electric vehicles (EVs/PHEVs) and their essential drivetrain sections. The paper oversees industry related EV imperativeness amassing system issues, EV charging issues, and what's more control equipment and balance motor drives issues. The centrality of battery cell voltage leveling for course of action related lithium-molecule (Li-molecule) batteries for widened life time is displayed. Additionally, a broad survey of EV/PHEV battery charger request, checks, and requirements is presented. A couple of standard EV/PHEV front-end cooling/dc charger converter topologies and furthermore withdrawn DC/DC topologies are evaluated. Finally, this paper studies diverse EV stimulus system models and powerful bidirectional DC/DC converter topologies. Novel DC/AC inverter modification techniques for EVs are in like manner presented. The structures rely upon the battery voltage, limit, and driving span.

Tooth Lin Luo (2002) portrays, the voltage lift framework is a popular procedure for the most part associated in electronic circuit plan. Since the effect of parasitic segments obliges the yield voltage and power trade viability of DC-DC converters, the voltage lift system opens a not too bad technique to upgrade circuit characteristics. After long haul examine, this system has been successfully associated for DC-DC converters. Luo-converters are a movement of new DC-DC adventure up (bolster) converters, which were delivered from models using voltage lift framework. These converters perform positive to positive DC-DC voltage growing change with high power thickness, high adequacy and decrepit topology in fundamental structure. They have high yield voltage with little swells. Accordingly, these converters will be generally utilized in PC fringe hardware and mechanical applications, particularly for high yield voltage ventures.

Mojtaba Forouzesh (2017), discusses DC-DC converters with voltage bolster limit are extensively used in a far reaching number of force change applications, from division of-volt to an enormous number of volts at power levels from milliwatts to megawatts. The composing has given

insights about various voltage-boosting strategies, in which key imperativeness securing parts (inductors and capacitors) and moreover transformers identified with switch (es) and diode(s) are utilized in the circuit. These techniques fuse traded capacitor (charge siphon), voltage multiplier, traded inductor/voltage lift, alluring coupling, and multistage/ - level, and each has its very own advantages and negative marks relying upon application, as far as cost, intricacy, control thickness, unwavering quality, and effectiveness. To take care of the creating interest for such applications, new power converter topologies that use the above voltage-boosting systems, and additionally some dynamic and latent segments, are ceaselessly being proposed. The stages and mixes of the diverse voltage-boosting procedures with additional parts in a circuit think about different new topologies and courses of action, which are consistently bewildering and difficult to seek after. Thusly, to demonstrate an indisputable picture on the general law and structure of the progression of forefront adventure up dc-dc converters, this paper expects to totally overview and gathering distinctive development up dc-dc converters reliant on their properties and voltage-boosting methodology. What's more, the points of interest and impediments of these voltage-boosting procedures and related converters are talked about in detail. At long last, wide utilizations of dc-dc converters are given and condensed near investigation of various voltage-boosting systems.

Sang-Kyoo Han (2005), presents another dynamic bracing zero-voltage trading (ZVS) beat width alteration (PWM) current-supported half-associate converter (CFHB) is proposed in this paper. Its dynamic cut-out snubber (ACS) can not simply ingest the voltage surge over the slaughtered switch, yet moreover achieve the ZVS of all power switches. Furthermore, it will in general be associated with all current-empowered power change topologies and its movement and what's more structure is astoundingly fundamental. Since associate switches in the snubber circuit are traded correlatively to central switches, an additional PWM IC isn't critical. Likewise, it needn't mess with any support winding and aide circuit other than additional two power switches and one capacitor while the normal current-reinforced half framework converter must be outfitted with two clasp windings, two ZVS circuits, and two snubbers. Thusly, it can ensure the higher working repeat, more diminutive evaluated open portions, cut down cost of age, less difficult utilization, and higher adequacy. The operational rule, speculative examination, and plan considerations are shown. To attest the action, authenticity, and features of the proposed circuit, test

results from a 200-W, 24-200Vdc model are presented.

Sina Salehi Dobakhshari et.al (2017) describes a semi thunders dc-dc converter with high voltage gain and low current loads on switches are proposed in this paper. This converter spared unavoidable ideal conditions of current-reinforced structures, for instance, zero polarizing dc balance, uninformed swell, and low transformer turn extent. What's more, by using the dynamic secure circuit, the voltage spikes over the essential change, in view of the nearness of spillage inductance of the restricting transformer, is ingested, and switches work in zero voltage trading. Since semi resounding exchanging procedure is utilized, kill current (TOC) and misfortunes of switches are impressively lessened. As a result of zero current exchanging (ZCS), turn around recuperation issue of diodes is mitigated. Exploratory outcomes on a 150-W model are given to approve the proposed idea.

3. Proposed system

The main objective of this paper is to reduce leakage current and to increase utilization of transformer. Apart from this the other objective focused in here are Lossless switching transition, Reduced EMI/RFI during switching due to transition, Short circuit toleration and Reduction in switching stresses.

Being a zero emission energy sources, PV/Fuel cells can offer significant contribution in controlling the unbridled pollution raise in environment. DC-DC converters play important role in harnessing power from these sources. Such converters need exceptionally high gain, high power densities, very small input current ripple, and higher efficiencies, higher reliability.

3.1. Existing system

Thunderous converters with capacitive yield channels are exceptionally outstanding for their higher voltage gain and littler structures. Regardless, bigger piece of the converters underutilizes the transformer as they are presented to broken current. This unpredictable current has gigantic current swells which convey tremendous focus adversities and bothers the temperature climb of the transformer. This frequently prompts saturation of transformer.. This paper display a LCC-T thunderous DC/DC converter with capacitive yield divert working all switches in ZCS trading mode and whose transformer current is a predictable sinusoidal with minimum load

on full tank sections. This is accomplished by getting transformer arrangement to resounding inductor.

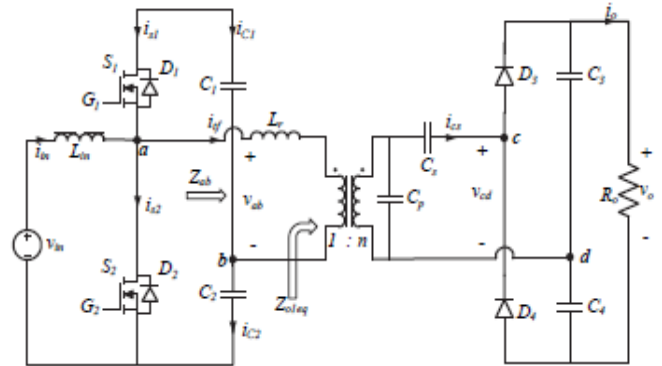


Figure 1. Conventional Block Diagram

Disadvantages:

- High Switching Stress
- High EMI (electromagnetic interference)

3.2. Proposed system

This paper exhibits a novel bidirectional current fed push-pull DC-DC converter topology with galvanic confinement. The control calculation proposed empowers full-soft-switching of all transistors in an extensive variety of info voltage and power with no necessity for snubbers or resonant switching.

The converter includes a functioning voltage doubler rectifier controlled by the changing arrangement synchronous to that of the info side switches. Subsequently, full-soft-switching task at a settled exchanging recurrence is accomplished.

Task rule for the vitality move in the two headings is portrayed, trailed by confirmation with a 300 W trial model. The converter has impressively higher voltage step up execution than customary current-fed converters. Experimental outcomes acquired are in great concurrence with the theoretical enduring state investigation.

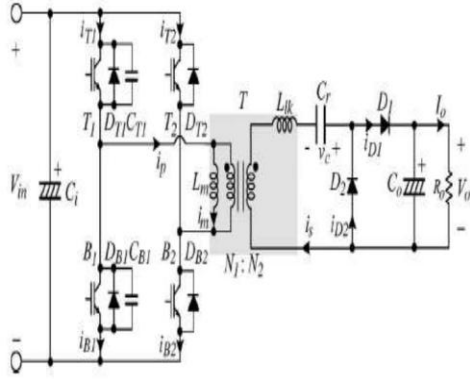


Figure 2. Proposed Block Diagram

ADVANTAGES:

- Ideal Switches.
- Ripple free Input Voltage.
- Ideal transformer with magnetizing and leakage inductances alone.

4. Result and discussion

4.1. Simulation parameters

Simulation is performed utilizing MATLAB/SIMULINK programming. Simulink library documents incorporate inbuilt models of numerous electrical and gadgets parts and gadgets, for example, diodes, MOSFETS, capacitors, control supplies, etc. The circuit segments are associated according to structure without blunder, parameters of all segments are arranged according to necessity and reproduction is performed.

DC input voltage=48V

Source side inductance $L_m=500\mu\text{H}$

Capacitance $C_c=100\text{nf}$

Table 1. System Specifications

Diode ratings:	Flyback transformer ratings:	Active snubber parameters:
$R_{ON}=0.001 \Omega$ $V_{fd}=0.8\text{V}$ Snubber: $R_s=500 \Omega$; $C_s=250\text{nF}$	100VA 50Hz $n=1/ 4.25$ Winding-1: $R=4.3 \Omega$, $L_1=0.4\text{H}$ Winding-2: $R=0.793\Omega$, $L_2=0.08\text{H}$ $R_m=1\text{M}\Omega$;	$L_i=500\mu\text{H}$ $C_c=100\text{nF}$ Three Winding Transformer 100VA, 50Hz Winding-1 : 50V, $R_l=4.3\Omega$, $L_l=0.45\text{H}$ Winding-2:

	$L_m=2866\text{H}$	150V, $R_2=0.793\Omega$, $L_2=0.084\text{H}$ Winding-3: 150V, $R_3=0.793 \Omega$, $L_3=0.084\text{H}$ Turns ratio , $n=1:3$
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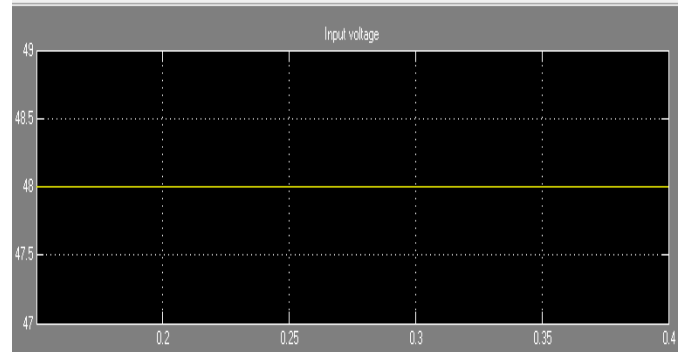


Figure 3. Input voltage

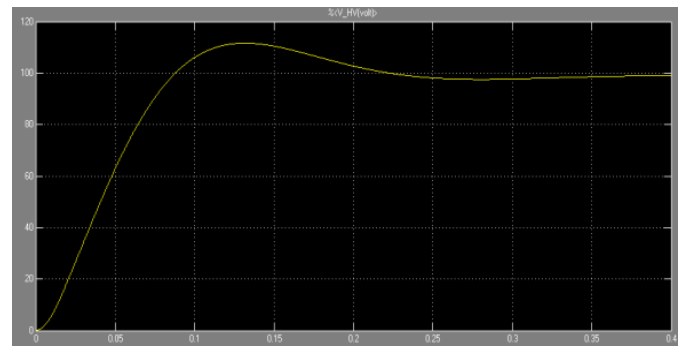


Figure 4. Output voltage

This high voltage at output side is due to step up operation of the converter circuit.

The step up conversion ratio in case of proposed converter system is the ratio of output voltage to input voltage.

Voltage step up gain, $G= V_o/V_i$

Here,

$V_o=100\text{V}$; $V_{in}=48\text{V}$

Therefore, $G=100/48=2.08$

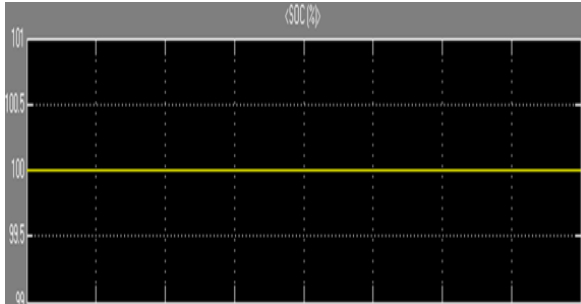


Figure 5. State of Charge (SOC)

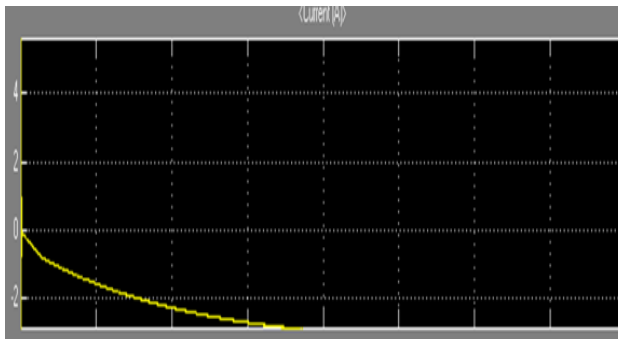


Figure 6. Charging current

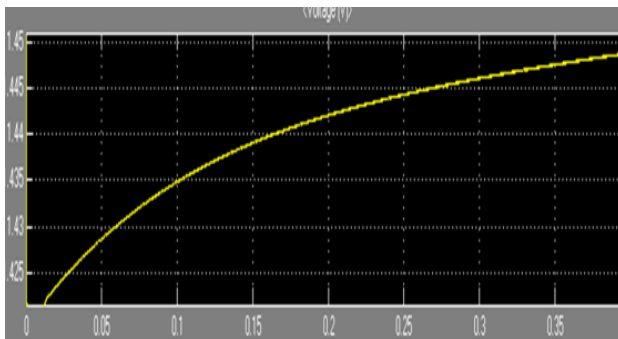


Figure 7. Charging voltage

5. Conclusion

Leakage current is reduced and transformer utilization has been enhanced by bidirectional converter. In bidirectional both input processing and charging takes place. The switching process consumes energy leads to ripples also reduced by implementing soft switching approach. This operated switching process even in 0 current and 0 voltage. Here voltage with high advance up gain is gotten with this circuit is utilized to energize the super limit batteries. These batteries after charged, can be utilized as reinforcement in the substations for legitimate hand-off tasks or can be utilized in car driving applications.

References

- [1] S. S. Williamson, A. K. Rathore, and F. Musavi, "Industrial Electronics for Electric Transportation: Current State-of-the-Art and Future Challenges," *IEEE Trans. Ind. Electron.*, vol. 62, no. 5, pp. 3021–3032, May 2015.
- [2] Fang Lin Luo, "Luo-converters, voltage lift technique," in *PESC 98 Record. 29th Annual IEEE Power Electronics Specialists Conference (Cat. No. 98CH36196)*, vol. 2, pp. 1783–1789.
- [3] J. A. Morales-Saldana, E. E. C. Guti, and J. Leyva-Ramos, "Modeling of switch-mode dc-dc cascade converters," *IEEE Trans. Aerosp. Electron. Syst.*, vol. 38, no. 1, pp. 295–299, Jan. 2002.
- [4] M. S. Makowski and D. Maksimovic, "Performance limits of switched capacitor DC-DC converters," in *Proceedings of PESC '95 – Power Electronics Specialist Conference*, vol. 2, pp. 1215–1221.
- [5] M. Forouzes, Y. P. Siwakoti, S. A. Gorji, F. Blaabjerg and B. Lehman, "Step-Up DC-DC Converters: A Comprehensive Review of Voltage-Boosting Techniques, Topologies, and Applications," in *IEEE Transactions on Power Electronics*, vol. 32, no. 12, pp. 9143-9178.
- [6] M. K. Kazimierczuk and R. Cravens, II, "Current source parallel resonant DC/AC inverter with transformer," in *Telecommunications Energy Conference, 1994. INTELEC '94., 16th International, 1994*, pp. 135-141, 1994.
- [7] M. Kazimierczuk and D. Czarkowski, *Resonant power converters: Wiley-Interscience, 1995.*
- [8] Sang-Kyoo Han, Hyun-Ki Yoon, Gun-Woo Moon, Myung-Joong Youn, Yoon-Ho Kim and Kang-Hee Lee, "A new active clamping zero-voltage switching PWM current-fed half-bridge converter," in *IEEE Transactions on Power Electronics*, vol. 20, no. 6, pp. 1271-1279, Nov. 2005.
- [9] S. J. Jang, C. Y. Won, B. K. Lee and J. Hur, "Fuel Cell Generation System With a New Active Clamping Current-Fed Half-Bridge Converter," in *IEEE Transactions on Energy Conversion*, vol. 22, no. 2, pp. 332-340, June 2007.
- [10] S. Salehi Dobakhshari, J. Milimonfared, M. Taheri and H. Moradisizkoohi, "A Quasi-Resonant Current-Fed Converter With Minimum Switching

Losses," in IEEE Transactions on PowerElectronics, vol. 32, no. 1, pp. 353-362, Jan. 2017.

[11] Y. G. Kang, A. K. Upadhyay and D. Stephens, "Analysis and design of a half-bridge parallel resonant converter operating above resonance," Conference Record of the 1988 IEEE Industry Applications Society Annual Meeting, Pittsburgh, PA, USA, 1988, pp. 827-836 vol.1.

[12] F. Shang, G. Niu and M. Krishnamurthy, "Design and Analysis of a High-Voltage-Gain Step-Up Resonant DC-DC Converter for Transportation Applications," in IEEE Transactions on Transportation Electrification, vol. 3, no. 1, pp. 157-167, March 2017.

[13] M. K. Kazimierczuk, "Analysis of class E zero-voltage-switching rectifier," in IEEE Transactions on Circuits and Systems, vol. 37, no. 6, pp. 747-755, Jun 1990.

[14] C. S. Leu, P. Y. Huang and W. K. Wang, "LLC converter with Taiwan Tech center-tapped rectifier (LLC-TCT) for solar power conversion applications," 2013 1st International Future Energy Electronics Conference (IFEEEC), Tainan, 2013, pp. 515-519.

[15] D. Li, B. Liu, B. Yuan, X. Yang, J. Duan and J. Zhai, "A high step-up current fed multi-resonant converter with output voltage doubler," 2011 Twenty-Sixth Annual IEEE Applied Power Electronics Conference and Exposition (APEC), Fort Worth, TX, pp. 2020-2026, 2011.