iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** XI **Month of publication:** November 2017

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

Performance Analysis of Soft-Switching Isolated Buck-Boost Converters with Interleaved Functioning Of Boost Converter Using Mathlab/Simulink

Jaffer Hussiani Baig [1], Anguraja.R[2], Dr.R.Prakash[3]
[1] PG Scholar, Department of Electrical and Electronics Engineering, Don Boscov Institute of Technology, Bengaluru, Karnataka, India.)
[2]Associate Professor, Department of Electrical and Electronics Engineering, Don Bosco Institute of Technology, Bengaluru, Karnataka, India)
[3]Professor & Head of the Department of Electrical and Electronics Engineering, Don Bosco Institute of Technology, Bengaluru, Karnataka, India.)

Abstract: Due to the depletion of the fossil fuels day by day, this has enforced the mankind to rely abundantly on the renewable energy sources like solar energy, wind energy and fuel cells as well as the photo voltaic cells. But the open-circuit voltage of renewable sources, such as photovoltaic fuel-cell and thermoelectric generator is much higher than the maximum power point voltage; the highest conversion efficiency is usually achieved at the open-circuit voltage if an isolated boost converter is employed. In this case, high efficiency at the maximum power point, which is very important for the renewable power system, cannot be ensured. For the applications of battery charging and dis charging high conversion efficiency over the entire operating range is needed. Hence a new method has been described in this paper called isolated buck boost converter with single stage power conversion with interleaved functioning of the boost converter for improving the efficiency of the sources in terms of voltage and current. Hence, a transformer with reduced turns ratio and parasitic parameters, and low-voltage rated MOSFETs and diodes with better switching and conduction performances can be applied to improve the efficiency.
Keywords: Dc-Dc converter, interleaved boost converter, IBB converter, soft-switching.

I. INTR1ODUCTION

Separated dc– dc converters are generally required in different applications to meet the prerequisites of info/yield voltage go and galvanic segregation. As a rule, segregated converters can be characterized into three classes: buck converters [1]-[3], help converters [4]-[6] and buck-support converters [7]-[9] Voltage advance down can be executed with a disengaged buck converter, and the proficiency diminishes with the diminishing of the voltage change proportion. Oppositely, voltage advance up is accomplished with a detached lift converter, and the proficiency diminishes with the expanding of the voltage transformation proportion. Accordingly, the segregated buck or lift converters are not adaptable as far as change effectiveness and voltage run [8], [9].Take the greatest power point following converters for inexhaustible power age frameworks for instance. Since the open-circuit voltage of inexhaustible sources, for example, photovoltaic energy unit and thermoelectric generator is considerably higher than the most extreme power point voltage, the most noteworthy change productivity is typically accomplished at the open-circuit voltage if a separated lift converter is utilized [10]. For this situation, high proficiency at the greatest power point, which is essential for the sustainable power framework, can't be guaranteed. For the utilizations of battery charging and dis charging high change proficiency over the whole working reach is required. Accordingly, accomplishing high-effectiveness control change in a wide-voltage run is a vital research subject, particularly for the power frameworks that are sourced by batteries and sustainable power sources. From the perspective of change effectiveness, a separated buck support (IBB) converter would be a promising methodology. Tragically, in the previous decades, a ton of work has been improved the situation the secluded buck and lift converters, yet the exploration on the IBB converters is as yet lacking. The fly back converter is a run of the mill IBB converter , yet the proficiency is still lower due to the high voltage/current weights on segments and hard exchanging of the dynamic switch and correcting diode. Truth be told, an IBB converter is a separation variant of a comparing non detached buck-support converter.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

Therefore, an IBB converter can be derived easily by inserting a transformer into a non-isolated buck-boost converter, for example the Cuk, SEPIC, and ZETA converters. However, similar to the flyback converter, the isolated Cuk , ZETA, and SEPIC converters still suffer from the disadvantages of high component stress, hard-switching, and low efficiency.

Hence a new method has been described in this paper called isolated buck boost converter with single stage power conversion with interleaved functioning of the boost converter for improving the efficiency of the sources in terms of voltage and current. Hence, a transformer with reduced turns ratio and parasitic parameters, and low-voltage rated MOSFETs and diodes with better switching and conduction performances can be applied to improve the efficiency with the soft switching.

II. OPERATIONAL PRINCIPLES OF IBB CONVERTER

The IBB converter taken as an example to be analyzed is redrawn in Fig. 1. v_{DS1} ,v_{DS4} , and v_{DS6} are the drain to source voltages of $S1$, $S4$, and $S6$, respectively. $v_{NP}$and v_{S56} are the voltages of the primary side and secondary side of the transformer. And $i_{Lf}$is the current flowing through the inductor L_f .A proper dead-time is necessary for the primary-side switches to achieve ZVS and avoid shot-through of the switching bridges, but dead-time is not needed for the secondary-side switches $S5$and $S6$. To simplify the analysis, the parasitic capacitance of the MOSFET is ignored.

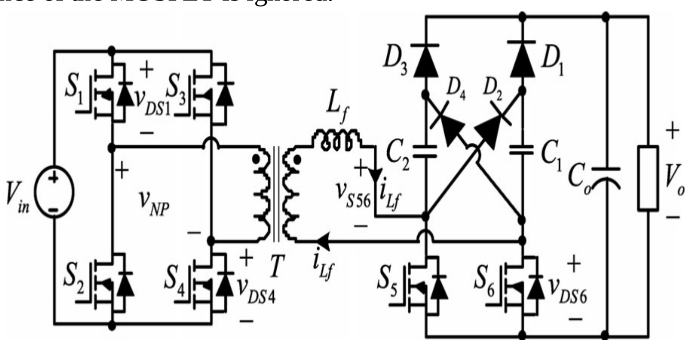


Fig 1 IBB Converter

The converter can work either in the buck mode (G <1) or the boost mode ($G \geq 1$). According to the waveform of the secondary-side current i_{Lf}, each operation mode can be further divided into continuous conduction mode (CCM) and discontinuous conduction mode (DCM). The soft switching waveforms of the boost and buck converter in the CCM mode as well as in the DCM mode are shown in the figures 2, figure 3 figure 4 and figure 5 respectively

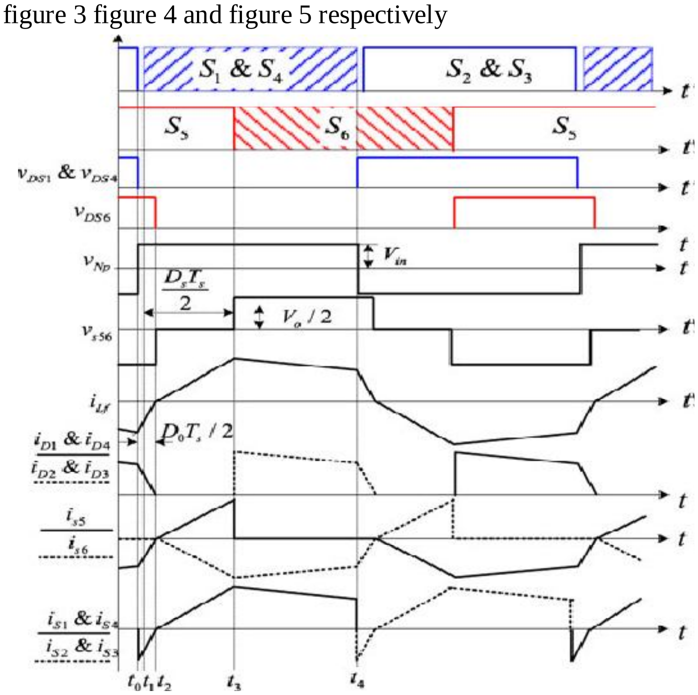


Fig 2 Key waveform of the boost CCM mode

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

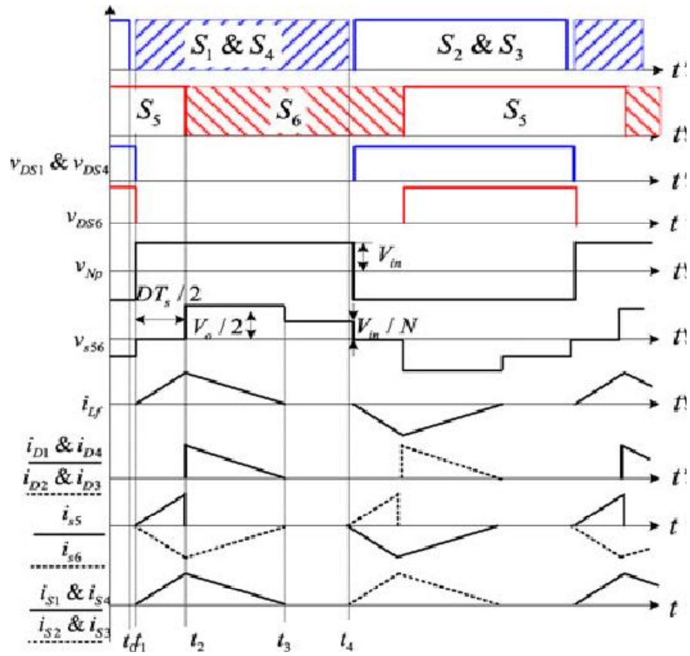


Fig 3 Key waveform of the boost DCM mode

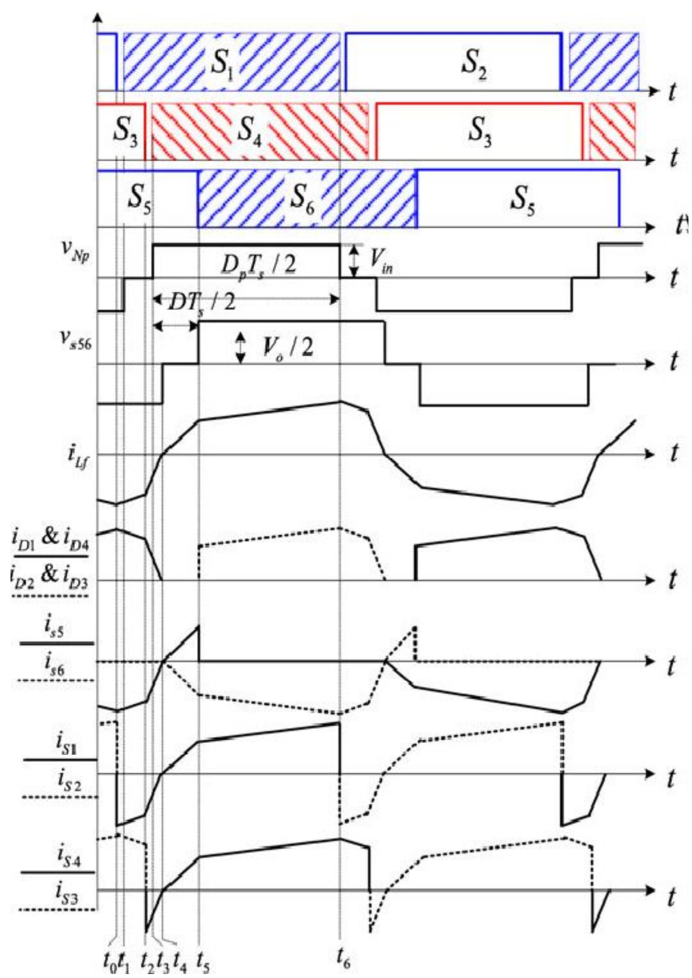


Fig 4 Key waveform of the buck CCM mode

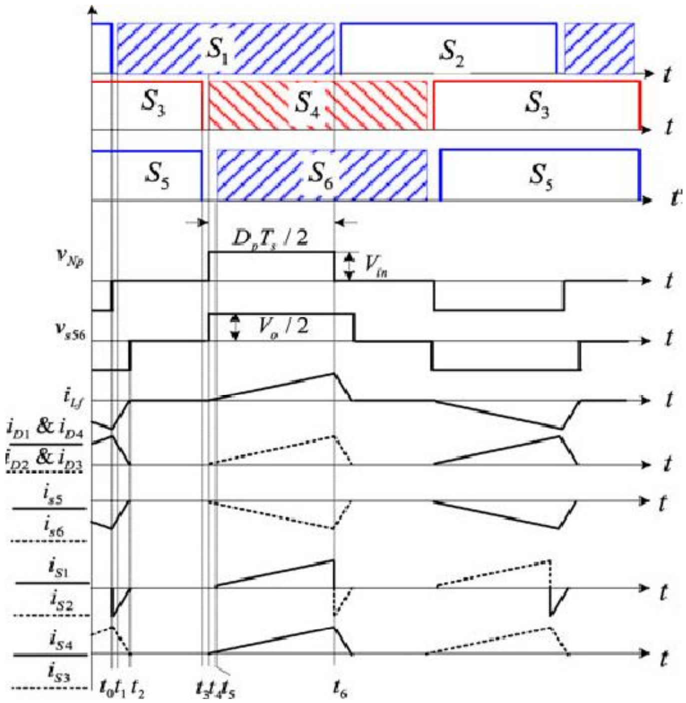


Fig 5 Key waveform of the buck DCM mode

III.DESIGN OF THE IBB SYSTEM

Based on the proposed bridgeless boost rectifiers, novel IBB converters can be derived by employing the input stage of an isolated buck converter as the primary-side circuit of the IBB converters. The primary-side circuit can be full-bridge, half bridge, or three-level half-bridge, Since the focus of this paper is the boost rectifiers, only the IBB converter topologies with full-bridge input stage are Obviously, the input stage of the IBB converter is a buck cell, the output stage is a bridgeless boost cell, and the two cells are linked by a high-frequency inductor and transformer. This structure is similar to the non-isolated two-switch buck-boost converter High conversion efficiency.

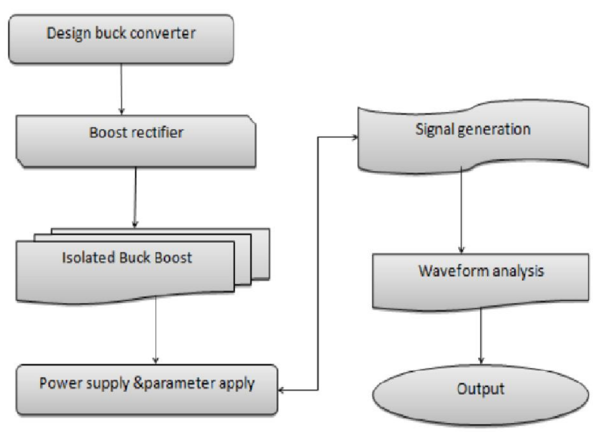


Fig 6 General architecture of IBB converter

The conventional IBB system which is being used in the present scenario is simulated in the Matlhlab and is shown in the below figure 7. This conventional system has very poor efficiency and switching losses are more in comparison with proposed IBB system

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

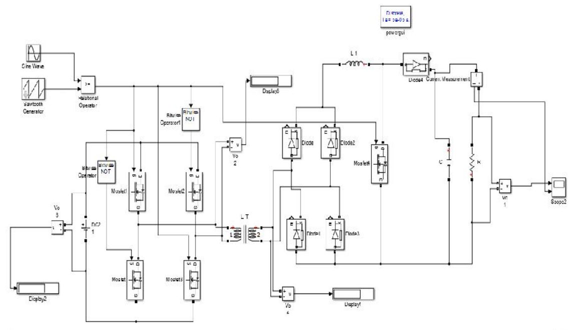


Fig 7 Conventional IBB circuit diagram

The proposed IBB system with two diodes, with bridge rectifier circuit arrangement and with the increasing passive elements is shown in the figures 8, figure 9 and figure 10 respectively. This IBB system has better performance than the conventional type

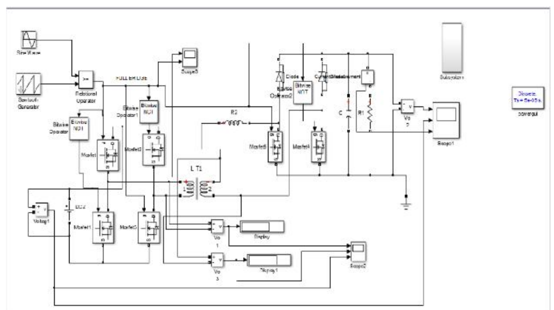


Fig 8IBB system with only 2 diodes

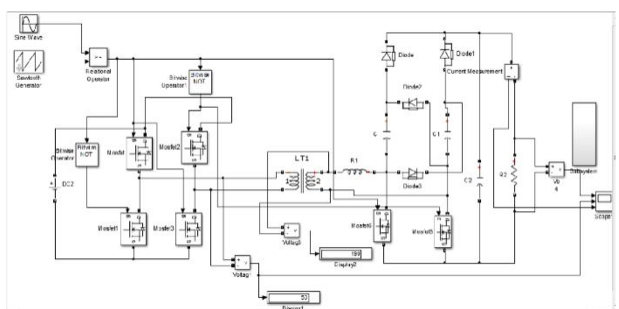


Fig 9 IBB system with diodes in full bridge arrangements

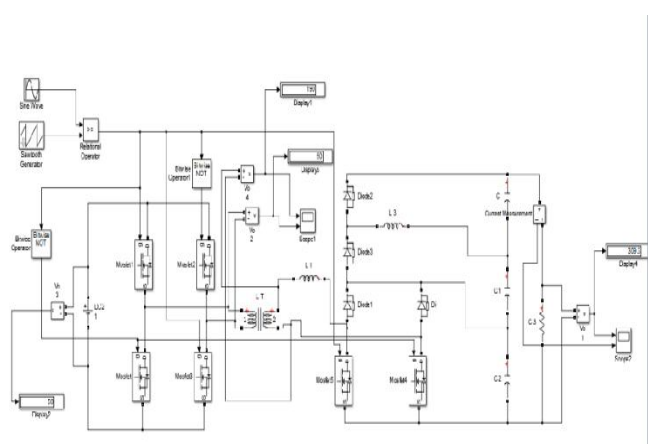


Fig 10 IBB system with increased passive elements

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

IV. RESULTS AND DISCUSSION

In this section we will discuss simulation results of the components designed and the simulation results of a interleaved functioning of a boost converter using Math lab and Simulink software. The simulation results of phase angle waveform, frequency waveform, output voltage and current waveforms of the IBB system of the Figures 8, 9 and 10are presented. The codingresults of 60V IBB converter system output is also shown below.

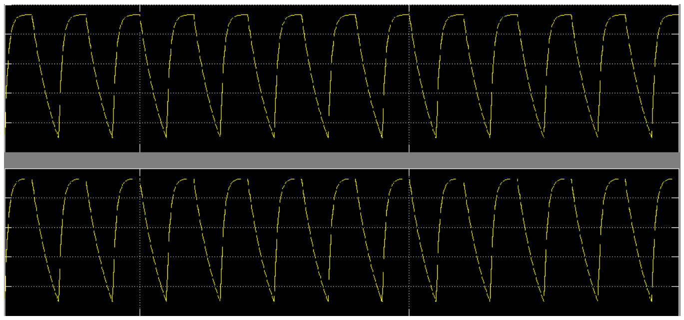


Fig 11 voltage and current waveform of conventional IBB system

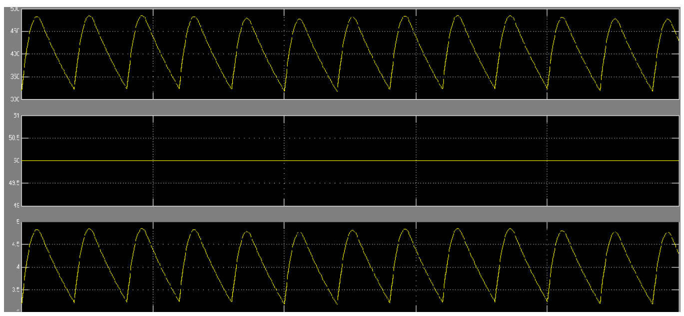


Fig 12 voltage and current waveform of 2 diode IBB system

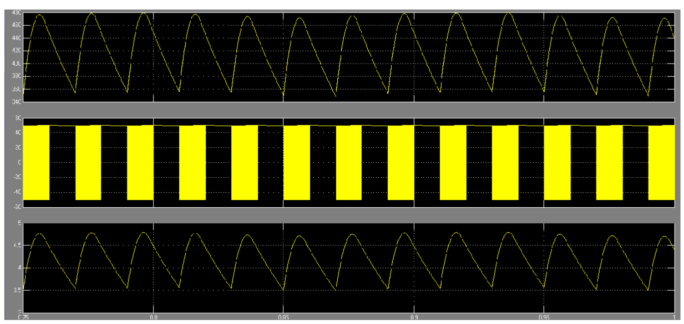


Fig 13 voltage and current waveform of full bridge IBB system

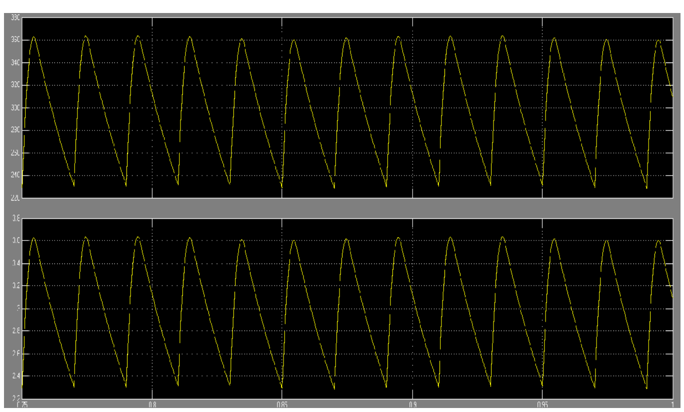


Fig 14 voltage and current waveform of full bridge IBB system with increasing passive elements

From the simulation results of the figure 12, 13 and 14 we can see that voltage is boosted in the secondary side and the switching losses are comparatively low in comparison with convention type IBB system and voltage boosting takes with 2 diodes, and diodes with full bridge arrangement and by increasing the passive element components. The frequency response and the phase angle response by writing the coding program in the Math lab with the values obtained from the proposed IBB system is shown below

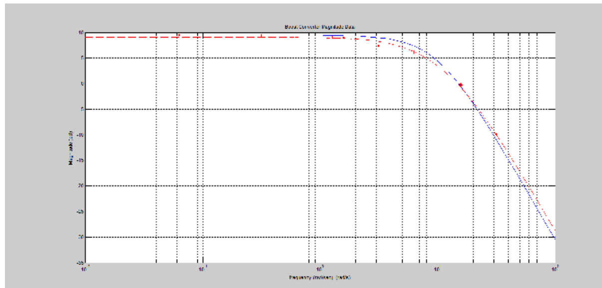


Fig 15 Frequency response curve of proposed IBB system

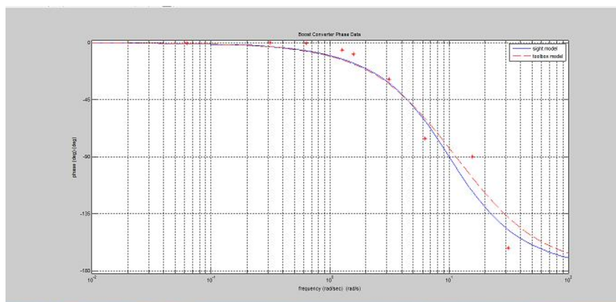


Fig 16 Phase angle response curve of proposed IBB system

V.CONCLUSION

IBB converters with single-stage power conversion with interleaved functioning of boost rectifiers have been proposed and investigated in this paper. A full-bridge IBB converter with a voltage multiplier on the secondary-side bridgeless boost rectifier has been investigated. The voltage stresses of the semiconductors in the boost-rectifier are reduced significantly due to the voltage multiplier; hence, low-voltage-rated devices with better conduction and switching performance can be used to improve efficiency especially in the field of renewable energy source outputs. In other words, this converter is more attractive for high-output-voltage applications. Frequency and phase angle responses are drawn by coding with output values obtained from the voltage and current waveformswhich are designed in the Mathlab/Simulink.

REFERENCES

[1] G. Di Capua, S. A. Shirasavar, M. A. Hallworth, and N. Femia, “An enhanced model for small-signal analysis of the phase-shifted full-bridgeconverter,” IEEE Trans. Power Electron., vol. 30, no. 3, pp. 1567–1576, Mar. 2015.

[2] Z. Guo, D. Sha, and X. Liao, “Input-seriesoutput-parallel phase-shift full-bridge derived DCDC converters with auxiliary LC networks to achieve wide zero-voltage switching range,” IEEE Trans. Power Electron., vol. 29, no. 10, pp. 508– 513, Oct. 2014.

[3] H. Wu and Y. Xing, “Families of forward converters suitable for wideinput voltage range applications,” IEEE Trans.Power Electron., vol. 29, no. 11, pp. 6006–6017, Nov. 2014.

[4] Y. Wang, W. Liu, H. Ma, and L. Chen, “Resonance analysis and softswitching design of isolated boost converter with coupled inductors for vehicle inverter application,” IEEE Trans. Power Electron., vol. 30, no. 3, pp. 1383–1392, Mar. 2015.

[5] F. Evran and M. T. Aydemir, “Isolated high step-up DC-DC converterwith low voltage stress,” IEEE Trans. Power Electron., vol. 29, no. 7,pp.3591–3603, Jul. 2014.

[6] Y. Zhao, W. Li, Y. Deng, and X.He, “Analysis, design, and experimentation of an isolated ZVT boost converter with coupled inductors,” IEEETrans. Power Electron., vol. 26, no. 2, pp.541–550, Feb. 2011.

[7] H. Keyhani and H. A. Toliyat, “Partial-resonant buck-boost and flyback DC-DC converters,” IEEE Trans. Power Electron., vol. 29, no. 8, pp. 4357– 4365, Aug. 2014.

[8] C. Yao, X. Ruan, X. Wang, and C. K. Tse, “Isolated buck-boost DC/DC converters suitable for wide input-voltage range,” IEEE Trans. PowerElectron., v ol. , no. 9, pp. 2599–2613, Sep. 2011.

[9] C. Yao, X. Ruan, and X.Wang, “Automatic mode-shifting control strategy with input voltage feed-forward for full-B bridge-boost DC-DC converter suitable for wide input voltage range,” IEEE Trans. Power Electron., vol. 30, no. 3, pp. 1668 1682, Mar. 2015

[10] C. Konstantopoulos and E. Koutroulis, "Global maximum power point tracking of flexible photovoltaic modules," IEEE Trans. Power Electron., vol. 29, no. 4, pp. 2817–2828, Jun. 2014

[11] M. Jang and V. G. Agelidis, "A boost-inverter-based, battery-supported fuel-cell sourced three-phase stand-alone power supply," IEEE Trans.Power Electron., vol. 29, no. 12, pp. 6472–6480, Dec. 2014

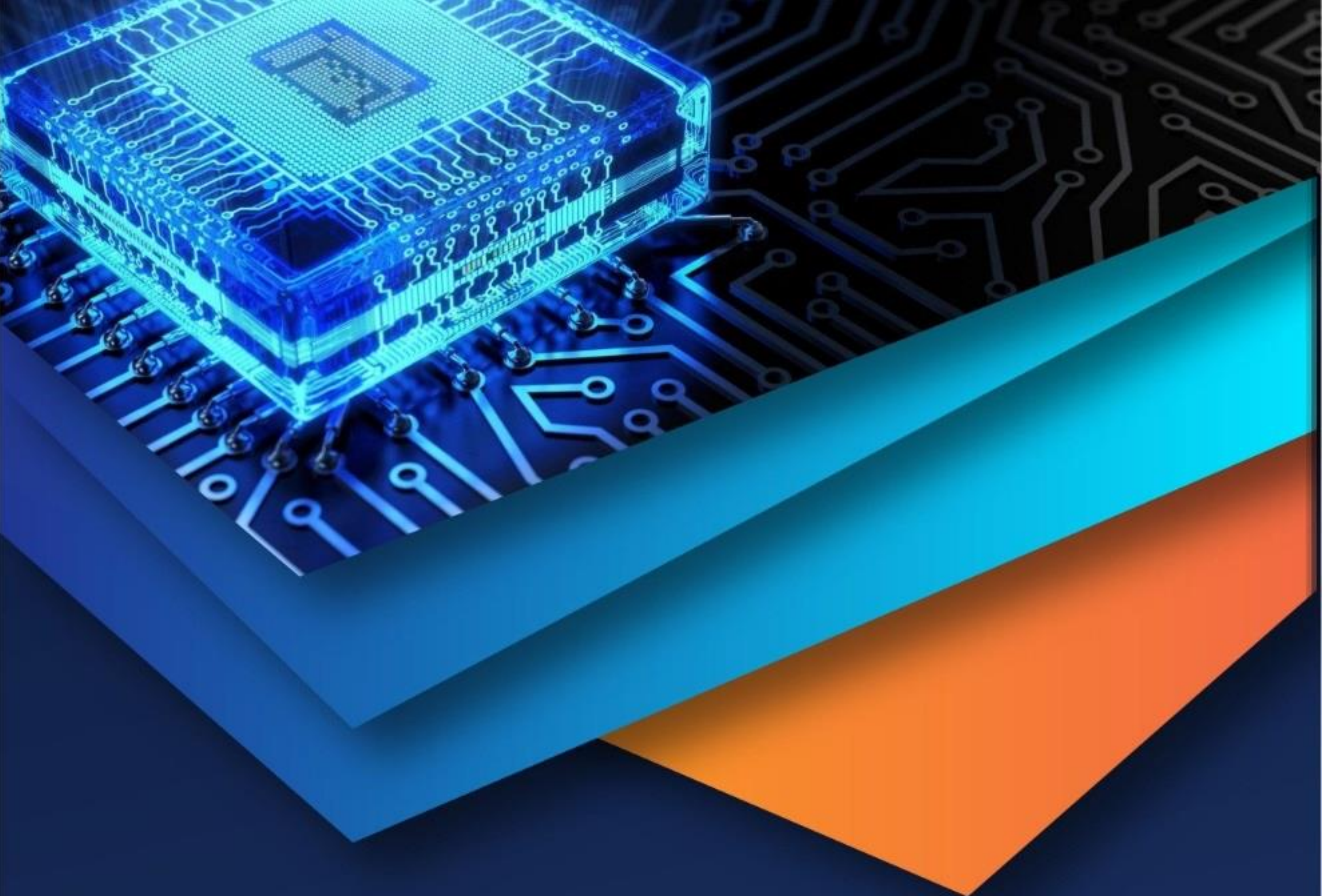
[12] I. Laird and D. D.-C. Lu, "High step-up DC/DC topology and MPPT algorithm for use with a thermoelectric generator," IEEE Trans. PowerElectron., vol. 28, no. 7, pp. 3147–3157, Jul. 2013

AUTHORS

A. Jafferhussianibaig- Received B.E in Electrical and Electronics Engineering from AIT, Chikmagaluru in the year 2014 and now currently pursuing M.Tech in Power System Engineering from DBIT, Bengaluru, His academic interest area include power generation, Renewable Energy Sources , power electronics and power systems. E-mail address: Jaffer.hussiani23@gmail.com

B. Anguraja R – Received B.E in Electrical and Electronics Engineering from Bharathidasan University in the year 1996 and M.Tech in High Voltage Engineering from SASTRA University in the year 2004.He is pursuing Ph.D. in High Voltage Engineering. He is currently working as Associate Professor in Departmentof electrical and electronics engineering in Don Bosco Institute of Technology. His research interests includes are Power System, power electronics, Renewable Energy and High Voltage Engineering.E-mail address:angurajaramasamy@gmail.com.

C. Dr R Prakash–Received B.E in electrical and Electronics Engineering from Basaveshwara College of Engineering, Bagalkot, M.E in Power System Engineering from Walchand college of Engineering, Sangli and Ph.D from VTU, Belgaum. He is currently working as a Professor & head of the department of electrical and electronics engineering, Don Bosco Institute of Technology, Bengaluru. His research interest includes Power Systems, Power electronics , Renewable energy, Micro Grids & Smart Grids.E-mail address: prakashrp1960@gmail.com



10.22214/IJRASET

INDEX COPERNICUS

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)