Retraction

Retraction: Power factor correction based EV battery charger using a bridgeless isolated SEPIC converter (J. Phys.: Conf. Ser. 1916 012143)

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This article (and all articles in the proceedings volume relating to the same conference) has been retracted by IOP Publishing following an extensive investigation in line with the COPE guidelines. This investigation has uncovered evidence of systematic manipulation of the publication process and considerable citation manipulation.

IOP Publishing respectfully requests that readers consider all work within this volume potentially unreliable, as the volume has not been through a credible peer review process.

IOP Publishing regrets that our usual quality checks did not identify these issues before publication, and have since put additional measures in place to try to prevent these issues from reoccurring. IOP Publishing wishes to credit anonymous whistleblowers and the Problematic Paper Screener [1] for bringing some of the above issues to our attention, prompting us to investigate further.

[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:2107.06751v1

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Power factor correction based EV battery charger using a bridgeless isolated SEPIC converter

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Abstract. Electric Vehicle (EV) battery chargers which uses the conventional PFC (power factor correction) circuits have the limitation of efficiency because of its high conduction loss which occur at the input of DBR (diode bridge rectifier). To solve this issue, a bridgeless isolated single ended primary inductance converter (SEPIC) is used. Throughout the charging process, the input current operates with a power factor of one. Conduction losses are drastically reduced by the removal of the DBR and current conduction due to fewer devices. The overall performance of proposed system is shown by means of various modes of operation, simulation and experimental process. EV batteries are typically charged in constant current or voltage mode, which increases the charger’s overall efficiency.

Keywords: Electric Vehicle (EV), Diode bridge rectifier (DBR), SEPIC converter, constant current/ constant voltage

1. Introduction
To provide the necessary traction force Electric Vehicles are powered by using the rechargeable batteries. These batteries are generally recharged using an EV charger which is also known as AC-DC converter. The general design of EV battery charger, consists of a boost converter and an isolated converter [1]. Due to controlled output voltage and output current, the efficiency of DC-DC converter determines the performance of this conventional charger. Interspersing the PFC converter also produce higher current stress in switches available [2]. The full-bridge network is critical for these EV chargers because it offers benefits such as high efficiency and power density, but the four switches complicate the system [3]. At a large input range, an LLC resonant converter provides high performance, low Electromagnetic Interference noise and power density is high [4]. This form of topology is being replaced by AC-DC converters of bidirectional or unidirectional type in integrated configurations due to its design complexity [5]. Many DBR fed unidirectional isolated converters without isolation are recognized because AC-DC conversion is an important feature of EV battery chargers [6]. The performance of the conventional charger does not meet the IEC 61000-3-2 power quality standard. The existence of full wave diode bridge converter at the charger’s input causes a significant amount of harmonics distortion (55.3%) in current input during the charging process, resulting in a poor power factor. Furthermore, the input current is no longer sinusoidal, resulting in source voltage and current...
displacement rise. As a consequence, at front end of traditional DBR fed charger, an efficient PFC method is required, which also removes the negative effects of input DBR.

2. Proposed system

A new bridgeless isolated SEPIC converter is to be operated in discontinuous conduction mode (DCM) for Power factor correction (PFC) operation. Improved input wave shaping and isolated converter for EV battery charging under constant current and constant voltage conditions. The proposed converter has low power losses [7]. The proposed EV battery charger improves the EV battery’s charging profile based on power quality in figure 1.

3. Circuit design

The proposed EV charger integrates two isolated SEPIC converters that works independently in alternating supply voltage cycles, as shown in figure 2. With a common input inductor, input DBR is excluded, resulting in significant reductions in conduction losses related with switching devices [8].
3.1 Operating Principle during positive half cycle

3.1.1 Mode 1:
As switch $s_1$ is switched on, this mode begins. The current flowing through the inductance at the input as it begins to store the energy from supply, while $L_i$ increases in a linear fashion. As the magnetizing inductor, $L_{m1}$ stores the energy from the energy transfer capacitor, $C_1$ gets discharged in figure 3.

![Figure 3. Operating diagram for Mode 1](image)

3.1.2 Mode 2:
When the switch $S_1$ is switched off, the output diode $D_1$ is forced to conduct due to the flow of two inductor currents $i_L$ and $i_{Lm1}$. As a result, the sum of $i_L$ and $i_{Lm1}$ passes through both body diode and output diode ($D_2$ and $D_1$), as shown in figure 4. The voltage around the input and magnetizing inductor is $nV_{dc}$. The interval $(1-D)T_s$ provides the key switching waveforms.

![Figure 4. Operating diagram for Mode 2](image)

3.1.3 Mode 3:
Switch $S_1$ is still turned off in this mode, the energy in primary inductance $L_{m1}$ is fully exhausted. The current through $L_{m1}$ remains discontinuous for remaining cycles. Due to lack of energy transfer from HFT main to secondary, the output diode $D_1$ becomes reverse biased again. The DC link capacitor is supplying the required charging power at this time [9] in figure 5.

![Retracted](image)
4. Simulation results

The performance of designed controller are tested in MATLAB and the feasible results are discussed below. The system consists of EV based Battery source for the stability improvement in proposed network [10]. The results are made analyzed under controller for the enhancement of dynamic behavior of the entire system. The results are exhibit the battery performance under controller and the attained results shows the enhancement of dynamic behavior system.
Figure 6 shows the variation of voltage and current waveform without controller. It is observed that the voltage got oscillated and produce more noise in the waveform, it needs to be eliminated \[11\]. And also, the current waveform is got distortion due to change of load conditions it is seen during 5 sec. The figure 7 shows the corresponding variation of battery and their support to improve the entire system. The state of charge and its corresponding voltage and current waveform are attained with ripples, hence it need to be controlled with proper controller \[12\].

Figure 7. Performance of Battery under without controller

Figure 8. System Voltage and Current under Resistive load with controller
Figure 9. Performance of Battery under without controller

Figure 8 shows the controlled output of system under resistive load. It can be observed that, the enhancement of voltage is attained to 120 V and its corresponding current value is increased about 10 A. The oscillation in the system are minimized using the BL isolated SEPIC converter. Figure 9 shows the enhanced performance of battery under controller.

5. Conclusion

The required design and control strategy for improving unity power factor so that they met the required IEC 61000-3-2 standards have been presented for an isolated bridgeless SEPIC converter based Electric Vehicle battery charger. With a smaller number of components and a single switching interval, BL converter has a lower conduction loss with conduction of current. The input inductor of two switches of PFC is shared, reducing the charger’s size and cost. The results provide the charging in steady state and all line, load conditions. The source current is altered in phase with source voltage and current and the total harmonic distortion is reduced to 11%.

References

[1] Y. Jang and M. M. Jovanovic, Bridgeless high-power-factor buck converter, IEEE Trans. Power Electron., vol. 26, no. 2, pp. 602–611, Feb. 2011.
[2] Y. Jang and M. M. Jovanovic, A bridgeless PFC boost rectifier with optimized magnetic utilization, IEEE Trans. Power Electron., vol. 24, no. 1, pp. 85–93, Jan. 2009.
[3] B. Zhao, A. Abramovitz and K. Smedley, Family of bridgeless buck-boost PFC rectifiers, IEEE Transactions Power Electronics, vol. 30, no. 12, pp. 6524-6527, Dec. 2015.
[4] B. Singh, S. Singh, A. Chandra and K. Al-Haddad, Comprehensive study of single-phase AC-DC power factor corrected converters with high-frequency isolation, IEEE Trans. Ind. Informatics, vol. 7, no. 4, pp. 540-556, Nov. 2011.
[5] G. Tian, W. Qi, Y. Yan and Y. Z. Jiang, High power factor LED power supply based on SEPIC converter, Electronics Letters, vol. 50, no. 24, pp. 1866-1868, 2011.
[6] Y. Wang, N. Qi, Y. Guan, C. Cecati and D. Xu, A single-stage LED driver based on SEPIC and LLC circuits, IEEE Trans. Ind. Elect., vol. 64, no. 7, pp. 5766-5776, July 2017.
[7] A. M. Al Gabri, A. A. Fardoun and E. H. Ismail, Bridgeless PFC-modified SEPIC rectifier with extended gain for universal input voltage applications, IEEE Transactions Power Electronics, vol. 30, no. 8, pp. 4272-4282, Aug. 2015.

[8] J. Kwon, W. Choi, J. Lee, E. Kim and B. Kwon, Continuous conduction-mode SEPIC converter with low reverse-recovery loss for power factor correction, IEE Proceedings-Electric Power Applications, vol. 153, no. 5, pp. 673-681, Sept. 2006.

[9] S. D., & H, A. (2019). AODV Route Discovery and Route Maintenance in MANETs. 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS). doi:10.1109/icaccs.2019.8728456

[10] H. Anandakumar and K. Umamaheswari, An Efficient Optimized Handover in Cognitive Radio Networks using Cooperative Spectrum Sensing, Intelligent Automation & Soft Computing, pp. 1–8, Sep. 2017. doi:10.1080/10798587.2017.1364931

[11] H. Vu and W. Choi, A Novel Dual Full-Bridge LLC Resonant Converter for CC and CV Charges of Batteries for Electric Vehicles, IEEE Transactions Industrial Electronics, vol. 65, no. 3, pp. 2212-2225, March 2018.

[12] B. Lee, J. Kim, S. Kim and J. Lee, An Isolated/Bidirectional PWM Resonant Converter for V2G(H) EV On-Board Charger, IEEE Transactions Vehicular Technology, vol. 66, no. 9, pp. 7741-7750, Sept. 2017.