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IMPROVED POWER QUALITY TRANSFORMERLESS SINGLE-STAGE BRIDGELESS CONVERTER BASED CHARGER FOR LIGHT ELECTRIC VEHICLES

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Abstract *:* Improved power quality transformer less single stage bridgeless converter-based charger for light electric vehicles, a bridgeless switched inductor Cuk (BSIC) converter-based charger is presented to provide the low-cost and reduced-size charging solution for the light electric vehicles, i.e., LEVs, with enhanced performances at the supply side. Generally, the chargers of LEVs such as E-Rickshaws, E-Bike, and E-Cycle, are equipped with an additional converter to charge the batteries at low voltages . The switched inductor con- figuration improves the step-down dc voltage gain of the charger with only one stage and also improves the reliability at such low voltages. It is noteworthy that the cost associated with the sensors along with the size of the magnetic components is considerably reduced by operating the charger in discontinuous current mode condition. Moreover, the high-gain transformer less configuration further improves the cost, size, and efficiency of the charger. The effectiveness of the charger is tested on a laboratory prototype, for an 850 W rating with 220 V, 50 Hz nominal supply voltage conditions. The steady state and dynamic behaviors of the charger are analyzed under different operating conditions. Moreover, the behaviors of the charger during the initialization of charging process are analyzed for ensuring the soft starting of the charger. .A basic comparison of the presented charger configuration with existing LEVs chargers is presented to highlight its advantages over the existing one.

Index Terms - **Bridgeless switched inductor, low-cost, reduce harmonics, reduced-size charging solution, existing LEVs chargers.**

INTRODUCTION

In the modern era, as the human population is increasing exponentially and thereby responsible for the rising need of vehicles. Increasing demand of vehicle, large transport dependence on oil that forces to exploit more and more fossil fuels like diesel, petrol etc. The limitation of fossil fuels and pollution caused by them are the big concerns nowadays. Demand is more and stocks are limited on the other hand pollution is playing a major role in damaging environment and its entities. So as a solution to these problems Electric Vehicle (EV) is the vital role player in modern cation and it is the need of the hour. The main advantages of introducing EV majorly involves cutting down the dependence of transport on oil and lowering down carbon emissions.In case of unavailability of any other alternative in transportation may lead to the scarcity of oil resulting in huge price hikes in oil industry. Although EV industry was rising but problems related to batteries were also to be bothered as batteries took quite longer time to recharge and they were costlier than the same size IC engines used and as a result in whole 20th century IC engines remained predominant. After it the concept of hybrid vehicle having IC engine combined with one or two electric units. Such a type of hybrid vehicle was introduced by Ferdinand Porsche in 1900which could run.

EXIASTING SYSTEM

The existing system is based on the reference frame theory the study of EV and its charging. Many new ways and research findings have been found regarding the better efficiency of EV and improved reliability of the vehicle. Onboard charger and Off board charger, former is used generally for the single phase while latter consist of three phase supply being higher in rating as compared to onboard chargers. As per onboard chargers can be used with three phase supply circuits in case of propulsion system integrated with them to make it an integrated onboard charger used for PHEV.

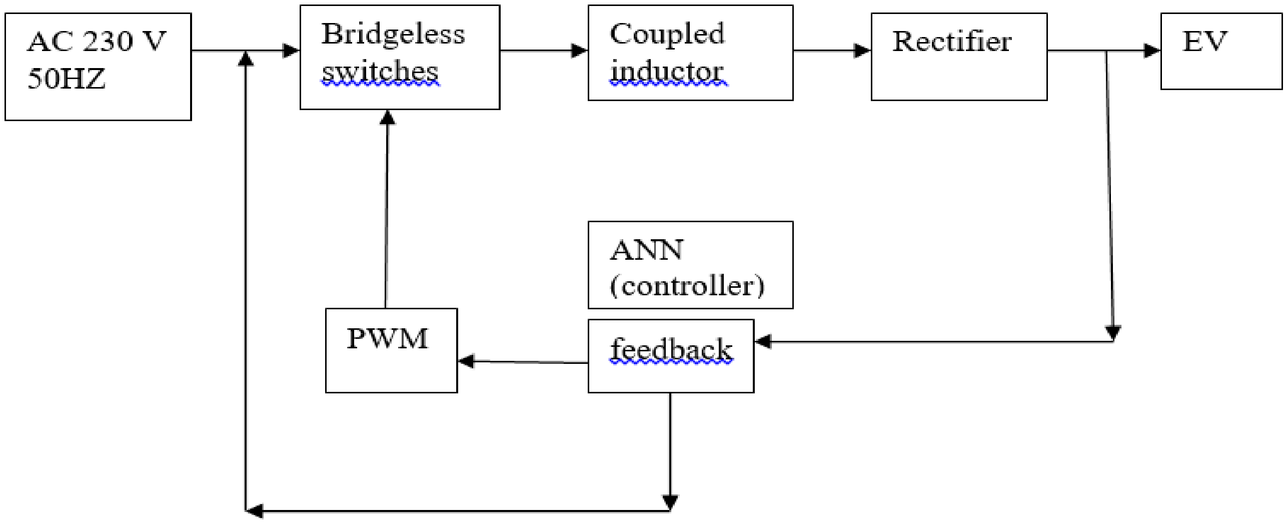
In charger configuration any DC-DC converter is taken to be as PFC unit but as time has passedit is observed that Buck and boost converters are not recommended for PFC as compared to buck-boost converter as given rather other modified circuits can be used for boost, one of them is mentioned in. Buck-Boost converter with very simple configuration and less components, A comparison for different configurations which can be used in buck-boost is given in. So, these two converters are not suitably used due to the disadvantages as given in , of poor current shaping feature as well as low variation availability of duty cycle.

CHARGING SYSTEM FOR ELECTRIC VEHICLE

This section explains the current and planned topology. The illustrates the blocks. A uniform AC input voltage is provided to diode-bridge rectifier. It transforms AC into DC voltage and the output may be unregulated uncontrolled in nature. A capacitor is required to make this voltage manageable. And the filter's size is large enough to filter the rectified voltage. The converter's output is adjusted in line with the selective gate pulse intruded in the controller.Harmonics are also eliminated as a result of this. The construction of a low rippling output voltage supply to the battery is a required condition for electric car charging. Any distortion in the voltage injection to the battery might resultin the battery's life being cut short.

As a result, extra attention to AC-DC conversion is required. In order to solve the problems previously identified and save consumers time, money and help the retailers to win loyal clients, in this proposed system, each product will have a passive Radio Frequency ID tag which is bearing a unique Electronic Product Code. This Electronic Product Code provides the information about the product i.e., its name and price. When the customer puts the product in the Smart Trolley, the Radio Frequency ID reader scans the tag, and the Electronic Product Code number is generated.

Fig 1. Block diagram for Electric Vehicle Charger.



Radio Frequency ID reader passes the Electronic Product Code to the microcontroller. In the current system, bar codes are used for scanning the product details where the customers tend to wait in long queue for generating the bill followed by payment.The existing chargers for the LEVs generally consist of an isolate and non-isolated dc–dc converter, followed by a combinationof diode bridge rectifier (DBR) and dc link capacitor. The combination of DBR with a heavy dc-linkcapacitor draws harmonics-rich distorted current from the supply, and therefore, it deteriorates the input power factor (PF), distortion factor (DF), displacement factor (DIF), and efficiency of the charger .The single-phase active power factor correction(APFC) methods are extensively utilized to eliminate the above- mentioned drawbacks of the conventional low power rating chargers. In an APFC method, a dc–dc converter is employed be-tween DBR and C_{DC}, to improve the supply-side performancesof the charger from a power quality point of view.

In addition, filters and other electronics can be used to produce a voltage that varies as a clean, it is an APFC converter can perform multiple tasks in a chargerbased on the configuration of a charger, i.e., single-stage charger or double-stage chargers. In a double-stage configuration, an APFC is employed to fulfill supply-side requirements and another dc–dc converter is required for satisfying the load-sidedemands, whereas only an APFC dc–dc converter performs both the tasks in the single-stage chargers. Several two-stage charger configurations based on different APFC solutions have been explored for the EVs/LEVs charging applications.

However, the increased control complexities and high device stresses make them less attractive for LEVs applications. The ripple-free charging current is considered as a major advantageof a single-phase two-stage charger. However, several authors have claimed that low-frequency ripples in the charging current, if controlled properly, do not affect performance of the battery

Technologies used:

- Zero Voltage Switching (ZVS)
- Artificial neural network (ANN)

- Pulse-Width Modulation (PWM)

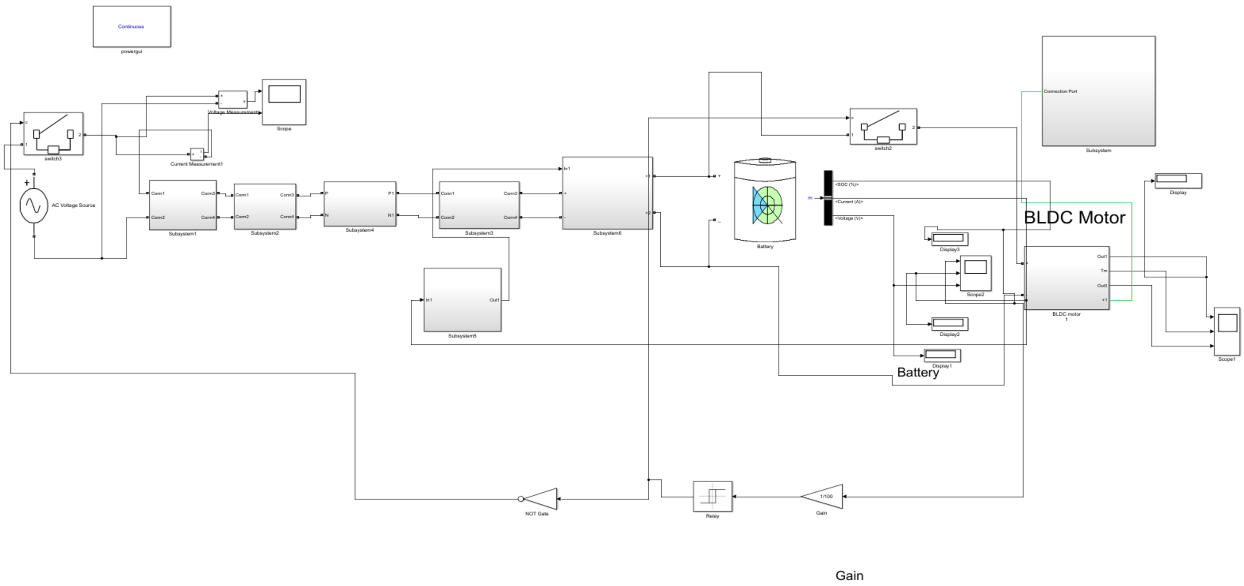


Fig 2. Simulation Block Diagram

Artificial Neural Network algorithm (ANN) is a procedure which is executed iteratively by comparing various solutions till an optimum or a satisfactory solution is found. An MPPT is electronic tracking – usually digital. The charge controller looks at the output of the panels and compares it to the battery voltage. It then figures out what is the best power that the panel can put out to charge the battery. Pulse-Width Modulation (PWM) is a powerful technique for controlling analog circuits with a microcontroller's digital outputs. PWM is used in many applications ranging from communications to power control and conversion.

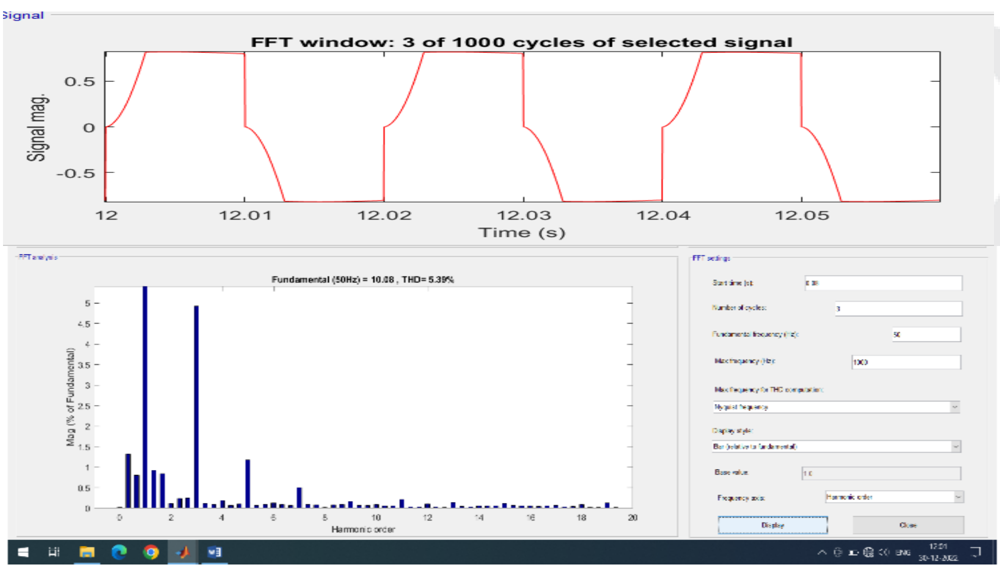


Fig 3.Simulation Without Filter.

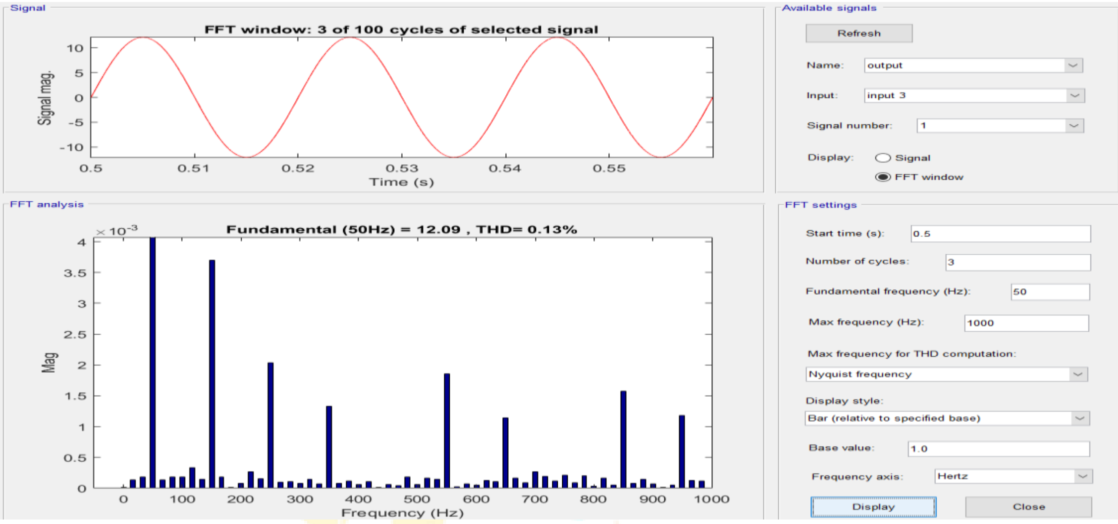


Fig 4. Simulation after compensation.

Benefits of Electric Vehicle Charger

- It requires a low cost of equipment and installation
- Maintains power factor
- Reduces harmonics
- Increase in Efficiency
- Maximum power can be transferred

CONCLUSION

Thus, a short comparison of the presented bridgeless Converter based charger with the other charge topologies has been carried out and presented in a tabular form. Finally, it has been shown that the presented charger configuration is advantageous in many ways such as low cost, less size, enhanced supply-side performances, minimum components counts, and fewer control complexities.

References

[1] M. Ehsani, Y. Gao, S. E. Gay, and A. Emadi, *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles*. Boca Raton, FL: CRC Press, 2005.A. Y. Saber and G. K. Venayagamoorthy, "One million plug-in electric vehicles on the road by 2015," in *Proc. 12th International IEEE Conference on Intelligent Transportation Systems*, St. Louis, MO, 2009, pp. 1-7.

[2] Emadi,M. Ehsani, and J.M.Miller, *Vehicular Electric Power Systems: Land, Sea, Air, and Space Vehicles*. New York: Marcel Dekker, 2003.M. Rawson and S. Kateley, "Electric vehicle charging equipment design and health and safety codes," *California Energy Commission*, Aug. 31, 1998.

[3] Botsford and A. Szczepanek, "Fast charging vs. slow charging: Pros and cons for the new age of electric vehicles," presented at the *24th Electric Vehicle Symposium*, Stavanger, Norway, May 2009.

[4] Aggeler, F. Canales, H. Zelaya-De La Parra, A. Coccia, N. Butcher and O. Apeldoorn, "Ultra-fast DC-charge infrastructures for EV- mobility and future smart grids," in *Proc. IEEE PES Innovative Smart Grid Technologies Conference Europe (ISGT Europe)*, Gothenberg, 2010, pp. 1-8.

[5] S. Habib, M. M. Khan, K. Hashmi, M. Ali and H. Tang, "A comparative study of electric vehicles concerning charging infrastructure and power levels," in *Proc. International Conference on Frontiers of Information Technology (FIT)*, Islamabad, 2017, pp. 327-332.

[6] L. Solero, "Nonconventional on-board charger for electric vehicle propulsion batteries," in *IEEE Transactions on Vehicular Technology*, vol. 50, no. 1, pp. 144-149, Jan. 2001.

[7] L. De-Sousa, B. Bouchez, "Combined Electric Device for Powering and Charging", *International Patent WO 2010/057892 A1*, 2010.

[8] M. Grenier, M. G. Hosseini Aghdam and T. Thiringer, "Design of on- board charger for plug-in hybrid electric vehicle," in *Proc. 5th IET International Conference on Power Electronics, Machines and Drives (PEMD)*, Brighton, UK, 2010, pp. 1-6.

[9] M. Yilmaz and P. T. Krein, "Review of battery charger topologies, charging power levels, and infrastructure for plug-in electric and hybrid vehicles," in *IEEE Transactions on Power Electronics*, vol. 28, no. 5, pp. 2151-2169, May 2013.

[10] F. Musavi, M. Edington, W. Eberle and W. G. Dunford, "Evaluation and efficiency comparison of front end AC-DC plug-in hybrid charger topologies," in *IEEE Transactions on Smart Grid*, vol. 3, no. 1, pp. 413- 421, March 2012.

[11] M. A. Fasugba and P. T. Krein, "Gaining vehicle-to-grid benefits with unidirectional electric and plug-in hybrid vehicle chargers," in *Proc. IEEE Vehicle Power and Propulsion Conference*, Chicago, IL, 2011, pp.1-6.

[12] Y. Lee, A. Khaligh, and A. Emadi, "Advanced integrated bi-directional AC/DC and DC/DC converter for plug-in hybrid

electric vehicles," in *IEEE Transactions on Vehicular Technology*, vol. 58, no. 3, pp. 3970– 3980, Oct. 2009.

[13] O. Garcia, P. Zurnel, A. de Castro, and A. Cobos, "Automotive dc–dc bidirectional converter made with many interleaved buck stages," in *IEEE Transactions on Power Electronics*, vol. 21, no. 3, pp. 578–586, May 2006.

[14] C. Erb, O. C. Onar and A. Khaligh, "Bi-directional charging topologies for plug-in hybrid electric vehicles," in *Proc. Twenty-Fifth Annual IEEE Applied Power Electronics Conference and Exposition (APEC)*, Palm Springs, CA, 2010, pp. 2066-2072.

[15] S. Haghbin, K. Khan, S. Lundmark, M. Alak¨ula, O. Carlson, M. Leksell and O. Wallmark, "Integrated chargers for EV"s and PHEV"s: Examples and new solutions," in *Proc. XIX International Conference on Electrical Machines - ICEM,* Rome, 2010, pp. 1–6.

[16] S. Lacroix, E. Laboure and M. Hilairet, "An integrated fast battery charger for electric vehicle," in *Proc. IEEE Vehicle Power and Propulsion Conference*, Lille, 2010, pp. 1-6.

[17] Thimmesch, "An SCR inverter with an integral battery charger for electric vehicles," in *IEEE Transactions on Industry Applications*, vol. IA-21, no. 4, pp. 1023-1029, July 1985.W. E. Rippel, "Integrated traction inverter and battery charger apparatus," *US Patent 4920475,* April 1990.