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TAINTED-PANEL ABSORBING VEHICLE SERIES CHARGER USING PV ARRAY

B.Chandra Singh[1]

M. tech (Phd), J.B. Institute of Engineering & Technology, Hyderabad

S. Rohith Reddy[2], CH. Dileep[3], D. Narender[4], B. Shyam Kumar[5],

B. tech, Department of EEE, J.B. Institute of Engineering & Technology, Hyderabad

ABSTRACT

During the recent decade, the automobile industry is booming with the evolution of electric vehicle (EV). Battery charging system plays a major role in the development of EVs. Charging of EV battery from the grid increases its load demand. This leads to propose a photovoltaic (PV) array-based off-board EV battery charging system in this study. Irrespective of solar irradiations, the EV battery is to be charged constantly which is achieved by employing a backup battery bank in addition to the PV array. Using the sepic converter and three-phase bidirectional DC–DC converter, the proposed system is capable of charging the EV battery during both sunshine hours and non-sunshine hours. During peak sunshine hours, the backup battery gets charged along with the EV battery and during non-sunshine hours, the backup battery supports the charging of EV battery. The proposed charging system is simulated using Simulink in the MATLAB software and an experimental prototype fabricated.

Keywords-renewable energy integration, photovoltaic, battery electric vehicles, public grid, control charging system.

1. INTRODUCTION

Ever increasing effects of green house gases from the conventional IC engines lead to environmental concerns. This paved to the booming of pollution free electric vehicles (EVs) in the automobile. However, EV battery charging from the utility grid increases the load demand on the grid and eventually increases the electricity bills to the EV owners which necessitate the use of alternate energy source. Due to inexhaustible and pollution free nature of renewable energy sources (RESs), it can be used to charge the EV battery. Thus, RES driven EV can be termed as 'green transportation'. Solar is one of the promising RESs which can be easily tapped to utilise its energy to charge EV battery. Hence, PV array power is used to charge the EV battery in the proposed system with the help of power converter topologies. Lithium ion batteries are widely used in the EV due to its high power density, high efficiency, light weight and compact size. Also, these batteries have the capacity of fast charging and long life cycle with low self-discharge rate. They also have low risk of explosion if it is over charged or short circuited. During charging, these batteries require precise voltage control. Hence, various power electronic converters with voltage controller are used for charging EV battery. Due to the intermittent nature of the PV array, there is a need for power converters to charge the EV battery.

2. Literature Review:

Manuela Sechilariu, Christophe Forgez et.al: presents an experimental control strategy of electric vehicle charging system composed of photovoltaic (PV) array, converters, power grid emulator and programmable DC electronic load that represents Li-ion battery emulator. The designed system can supply the battery at the same time as PV energy production. The applied control strategy aims to extract maximum power from PV array and manages the energy flow through the battery with respect to its state of charge and taking into account the constraints of the public grid. The experimental results, obtained with a dSPACE 1103 controller board, show that the system responds within certain limits and confirm the relevance of such system for electric vehicle charging.

Sujitha Nachinarkiniyan1, Krithiga Subramanian et.al: During the recent decade, the automobile industry is booming with the evolution of electric vehicle (EV). Battery charging system plays a major role in the development of EVs. Charging of EV battery from the grid increases its load demand. This leads to propose a photovoltaic (PV) array-based off-board EV battery charging system in this study. Irrespective of solar irradiations, the EV battery is to be charged constantly which is achieved by employing a backup battery bank in addition to the PV array. Using the sepic converter and three-phase bidirectional DC–DC converter, the proposed system is capable of charging the EV battery during both sunshine hours and non-sunshine hours. During peak sunshine hours, the backup battery gets charged along with the EV battery and during non-sunshine hours, the backup battery supports the charging of EV battery. The proposed charging system is simulated using Simulink in the MATLAB software and an experimental prototype is fabricated and tested in the laboratory and the results are furnished in this study.

N. Sujitha, S. Krithiga et.al: renewable energy based Electric Vehicle battery charging system is booming in the automobile industry in the recent years. The intermittent nature of the renewable energy sources leads to the grid connected renewable energy systems for Electric vehicle battery charging applications. Hence, an Electric Vehicle battery charger using grid connected PV system is proposed in this paper. The proposed charger is capable of charging the EV battery continuously irrespective of solar irradiations using dc-dc converter and bidirectional ac-dc converter. Sepic converter is preferred for dc-dc converter and Line commutated converter is used as a bidirectional converter with the help of the proposed bidirectional configurator in the charging system. During sunshine hours, PV array power generated is used to charge the EV battery alone and during peak sunshine hours, apart from charging of EV battery, the excess PV array power is fed to the single phase utility grid. During low and non sunshine hours, the EV battery charging was supported by the utility grid through bidirectional ac-dc converter.Â The proposed electric vehicle battery charger is simulated in the MATLAB/Simulink software and the dynamic response of the system was studied and its results are furnished in this paper.

3. Operation Of the Proposed System

The proposed PV-EV battery charger consists of a PV array, a sepic converter, a half-bridge BIDC, an EV battery, a backup battery bank and a controller as shown in Fig.2.1. The controller is used to generate the gate pulses to the sepic converter for obtaining the constant output voltage at the dc link. The gate pulses to the switches of BIDC are also generated to operate BIDC in boost mode to charge the backup battery from PV array and in buck mode to charge EV battery from the backup battery. Also, the controller generates the gate pulses to the auxiliary switches Sa, Sb and S c.

During high solar irradiation, all the auxiliary switches are ON to interface dc link with PV array through the sepic converter, dc link with the backup battery through BIDC and dc link with EV battery. When solar irradiation is low, switch Sa is turned OFF isolating the PV array and sepic converter from the dc link. Whereas the switch S c is turned OFF to disconnect BIDC and backup battery from the dc link, when the solar power is insufficient to charge backup battery. The proposed system operates in three modes viz., mode 1, mode 2 and mode 3 as explained in this section.

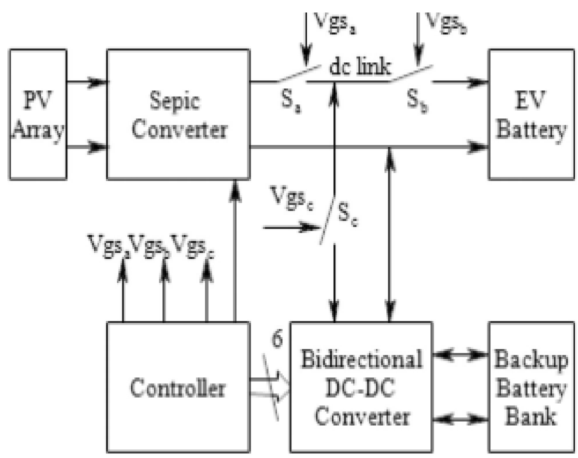
Mode 1: During peak sunshine hours, when the generated PV array power is higher, all the auxiliary switches are ON to charge both EV battery and backup battery simultaneously from PV array through sepic converter and BIDC, respectively. In this mode, BIDC operates in forward direction boosting the dc link voltage to charge backup battery.

Mode 2: Dlow solar irradiation conditions and non-sunshine hours, PV array power is insufficient to charge EV battery. Hence, the PV array is disconnected from the dc link by turning OFF the switch Sa and switches Sb & Sc are ON connecting EV battery to the backup battery through BIDC. In this mode, BIDC operates in reverse direction stepping down the backup battery voltage to charge EV battery.

Mode 3: When PV array power generated is sufficient to charge only EV battery, switches Sa and Sb are ON and switch Sc is OFF to disconnect the BIDC and backup battery bank from the dc link.

4. System Architecture:

Block diagram:



5. Description of components:

PV Array:

Photovoltaic cells are connected electrically in series and/or parallel circuits to produce higher voltages, currents and power levels. Photovoltaic modules consist of PV cell circuits sealed in an environmentally protective laminate, and are the fundamental building blocks of PV systems. Photovoltaic panels include one or more PV modules assembled as a pre-wired, field-installable unit. A photovoltaic array is the complete power-generating unit, consisting of any number of PV modules and panels.

Sepic converter:

In the proposed charging system, the sepic converter provides the constant output voltage irrespective of the PV array voltage by adjusting its duty ratio using the PI controller. The sepic converter consists of one IGBT switch, one diode, two inductors and two capacitors as shown in Fig.

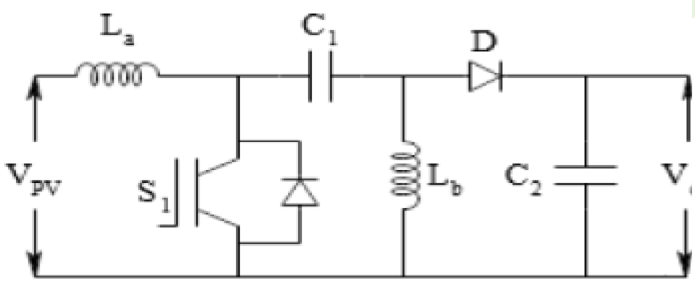
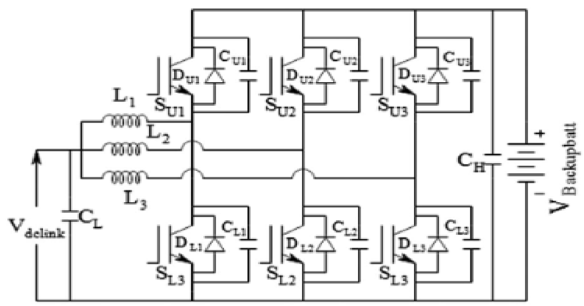


Fig: Schematic diagram of sepic converter

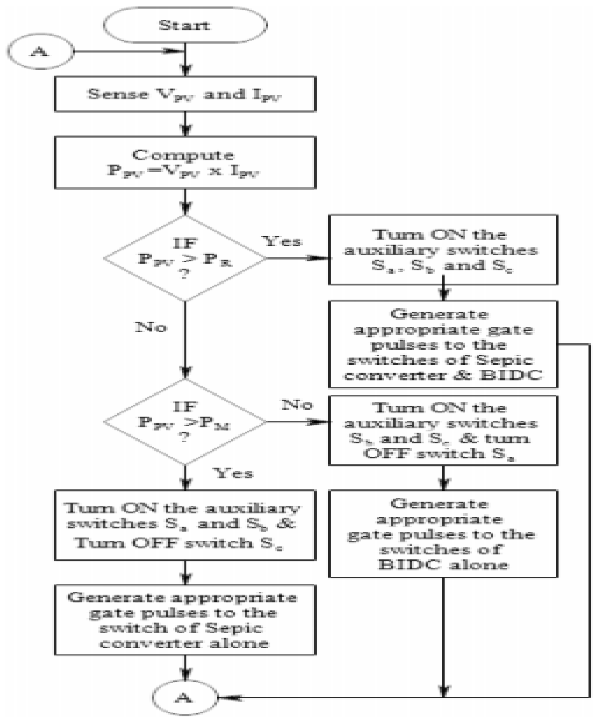
Bidirectional interleaved DC–DC converter

This type of converter nowadays is mainly used in electric vehicles. It is also called a Half-Bridge DC-DC converter. When the Buck and the boost converters are connected in antiparallel across each other with the resulting circuit is primarily having the same structure as the basic Boost and Buck structure but with the combined feature of bidirectional power flow is called Bi directional dc-dc converter. It works in both directions.

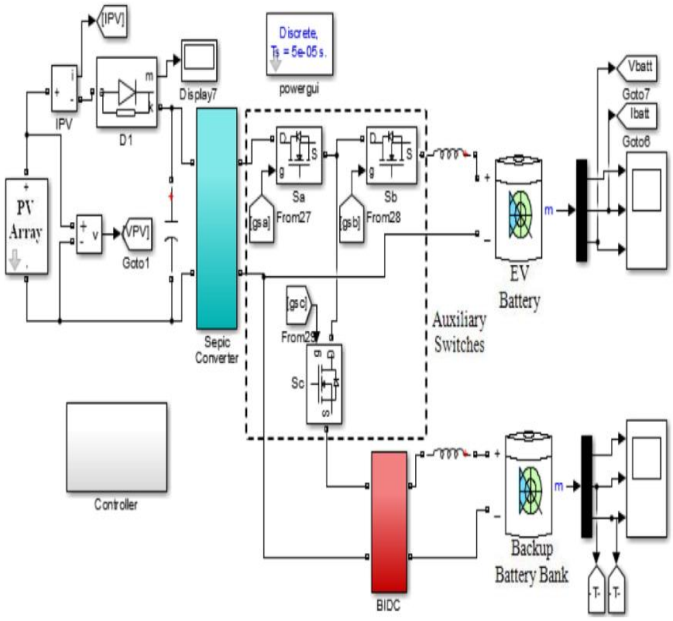


Controller:

Controller of the proposed charger generates gate pulses to the switches present in the sepic converter, BIDC and also to the three auxiliary switches. The algorithm to turn ON and turn OFF the auxiliary switches is shown in Fig. 4. Controller senses the PV array voltage and current, and computes the PV array power. If the PV array power is greater than EV battery rated power, PR, then the controller generates the gate pulses to turn ON all the auxiliary switches to charge both EV battery and backup battery bank simultaneously from the PV array. If the PV array power is lesser than EV battery rated power but higher than the minimum required power, PM, the switch, Sc is turned OFF disconnecting the backup battery from the charging system and switches, Sa and Sb are turned ON to charge the EV battery alone from the PV array. If the PV array power is lesser than the minimum required power, PM, then the switch, Sa is turned OFF to isolate the PV array and sepic converter from the charging system.

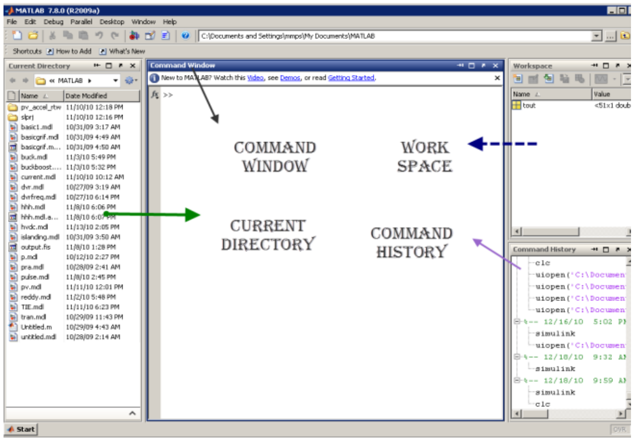


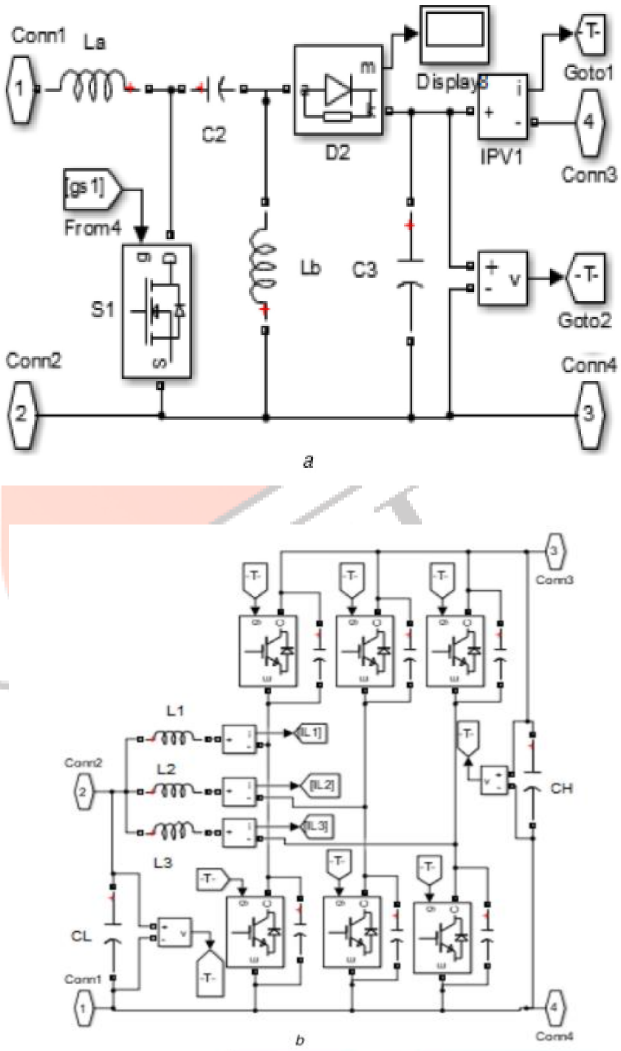
Model of the proposed charge



6. Introduction to Mat lab:

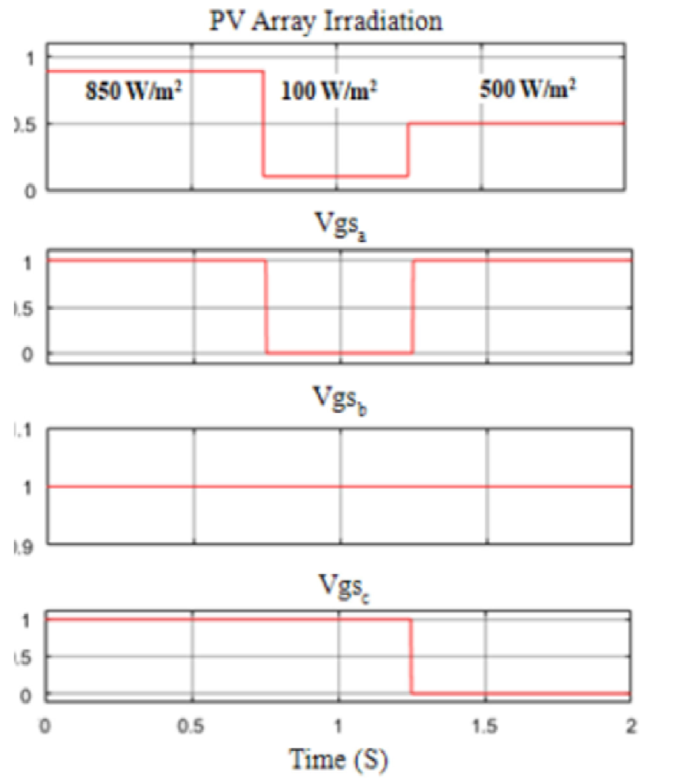
Matlab is a high-performance language for technical computing. The name mat lab stands for matrix laboratory. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include Math and computation Algorithm development Data acquisition Modeling, simulation, and prototyping Data analysis, exploration, and visualization Scientific and engineering graphics Application development, including graphical user interface building.

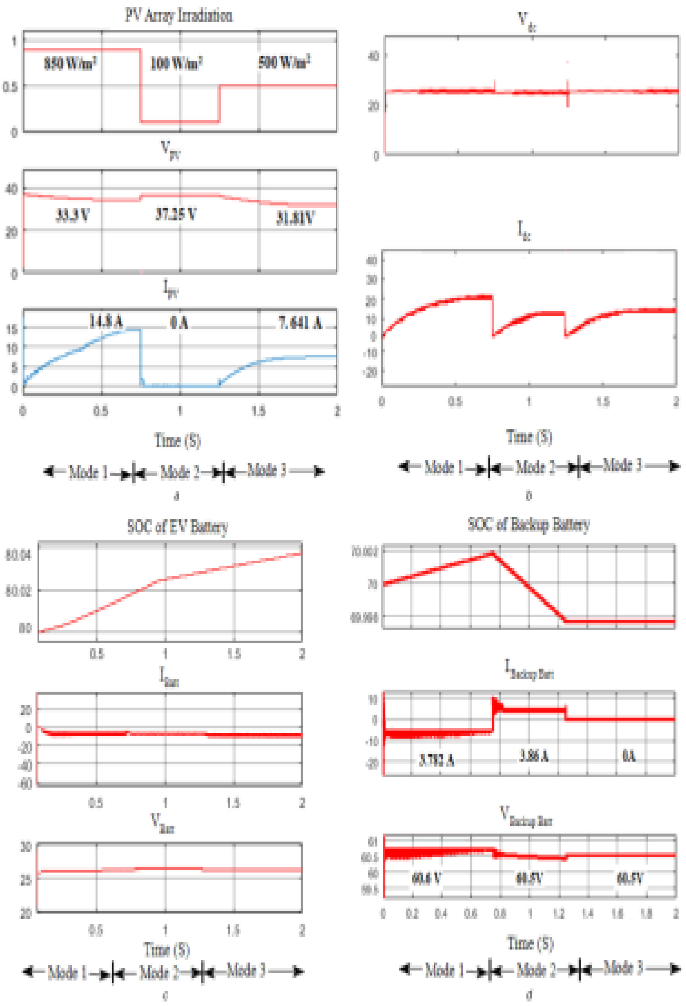




Simulation model of(a) Sepic converter, (b) BIDC

Results





CONCLUSION

In this project, an off-board EV battery charging system fed from PV array is simulated. This project illustrates the flexibility of the system to charge the EV battery constantly irrespective of the irradiation conditions. The system is designed and simulated in Simulink environment of the MATLAB software.

REFERENCES

1. X. Yu, C. Cecati, T. Dillon, M. G. Simoes, "New frontier of Smart Grids", IEEE Industrial Electronics Magazine, vol 5, no. 3, pp 49-63, 2011

2. M. Kezunovic , "Data analytics: creating information and knowledge," IEEE Power & Energy Magazine, vol. 10, no. 5, pp. 14-23, 2012.

3. D. Alaha koon and X. Yu, "Advanced analytics for harnessing the power of smart meter big data," Proceedings of 2013 IEEE International Workshop on Intelligent Energy Systems (IWIES), pp. 40-45, November 2013.

4. Available :http://www.prnewswire.com/news releases/emerging-marketsto-morethan-double-smart-meter-growth-in-2013-56bn-market.

5. 2022-182794261.html [Accessed 25th April 2014].

6. Available :http://www.pikeresearch.com/newsroom/smart-gas meterpenetration-toreach-11-by-2016. [Accessed 25th April 2014]

7. P. Mallet, P.-O. Grahstrom, P. Hallberg, G. Lorez and P. Mandatova, "Power to the people," IEEE Power & Energy Magazine, vol. 12, no. 2, pp. 51-64, 2014.

8) Rajashekar Gorthi,K.Giribabu,Dr.S.Shiva prasad:Simulink model for cost effective analysis of Hybrid system:International Journal of modern Engineering Research(volume:4,Issue:2,Feb 2014)