International Journal of Electronics, Electrical and Computational System
IJEECS
ISSN 2348-117X
Volume 6, Issue 12
December 2017

Fuel Cell based Multi-input Boost Converter with increased output Voltage Gain and Efficiency

[1]Devarampally Nirosha, [2]Dr.M.Kondalu, [3] A.Srilatha
[1]PG scholar, Department Of EEE, Joginpally B.R. Eng. College, Yenkapally, Moinabad, Hyderabad,
[2]Professor&HOD, Department Of EEE, Joginpally B.R. Eng. College, Yenkapally, Moinabad, Hyderabad,
[3] Associate Professor, Department Of EEE, Joginpally B.R. Eng. College, Yenkapally, Moinabad, Hyderabad,

Abstract

A multi input boost DC-DC converter (MIBC) is proposed to integrate various DC sources with different voltage levels with bidirectional power flow capability. The structure of multi input bidirectional DC-DC converter simpler to design compare with single input converters. Battery and ultra capacitor are energy storage elements. In addition, the slower response of renewable energy source problem solves by the integration of energy storage elements. Here input source is Fuel Cell source. The voltage from the Fuel cells is fed to the converter to step up the voltage before feeding to inverter providing the power to propulsion of three phase induction motor. The multi input boost converter can deal with ultra capacitor and battery individually or simultaneously with proper control mechanism. The proposed circuit is validated through the simulation results presented in the paper.

Keywords: Multi Input Boost Converter (MIBC), DC-DC converter, Hybrid Electric Vehicles (HEV).

I. INTRODUCTION

Due to increasing diligence on energy crisis and environmental protection, the Hybrid Electric Vehicles (HEVS) are received lot of attention in recent years. Petroleum is used world-wide at a higher rate due to the wider requirement of transport. It plays a major role in modeling the vehicles with minimum and without consumption of petroleum. And therefore the alternate propulsion technologies have been increasingly engaged by the automobile industries and this has led to the increased exploitation rate of HEV. One of the main advantages for the HEV drive is to improve the efficiency of the motor drive. The key components of the traction systems in hybrid electric vehicles are the multi input bidirectional DC-DC converters. Multi input bidirectional converters have combine the dissimilar sources, for instance batteries, ultra capacitor, photovoltaic cells, fuel cells, and other renewable energy sources, by diverse voltage features. The designs characteristic of the induction motor are used in HEV [1-6], the overview of HEV are discussed. By applying suitable starting frequency and voltage for the inverter fed induction motor low starting current and high starting torque can be obtained [7]. Using high frequency transformer to connect different sources, where each source is connected by full-bridge cells using 12 switches for three sources [8]. A current fed half-bridge topology has been proposed in [9] to reduce the ripple current in the battery using phase shift modulation. The stability analyses of multiple input isolated buck–boost and forward converters along have been presented in [10]. In these types of converters, power sharing between various sources is difficult to control. In [11], energy flow between number of different sources and the dc link are discussed. In this topology, it is not possible to transfer energy directly between dc sources, and also, a higher number of devices are being used. In this paper a new type of multi input bidirectional DCDC converter will be proposed in order to integrate various energy sources. The proposed circuit will be analyzed, modeled, designed, controlled, and simulated. Because of the benefits like small price and solid arrangement multi input bidirectional DC-DC converter are stated to be considered for HEV application. DC-DC converter is an electrical circuit which provides varying

International Journal of Electronics, Electrical and Computational System
IJEECS
ISSN 2348-117X
Volume 6, Issue 12
December 2017

voltage levels that differs from the supplied voltage. DC-DC converter is employed in variety of application. The unregulated DC voltage is given as the input to the DCDC converter, That converter produces the regulated output voltage even though the input voltage is changing. The output voltage control is depends the duty cycle D. Duty cycle is given in the equation (1)

$$D = \frac{T_{on}}{T_s} \quad \text{.....} \quad (1)$$

Where, D is the duty cycle TON is the ON period of the switch TS is the total time period (TON + TOFF).

II-MULTI INPUT BIDIRECTIONALCONVERTER SYSTEM

Multi input bidirectional DC-DC converter is used to interconnect the multiple sources with different voltage levels. It reduces the system size, cost and power losses due to the less number of components used in the system. The purpose of multi input bidirectional converter is increase or decrease the voltage level of the system with bidirectional power flow capability. Multi input bidirectional DC-DC converter applications area is energy storage systems for hybrid vehicles, renewable energy storage systems, uninterruptable power supplies and fuel cell storage systems. The multi input bidirectional converter topology is shown in Figure 2.

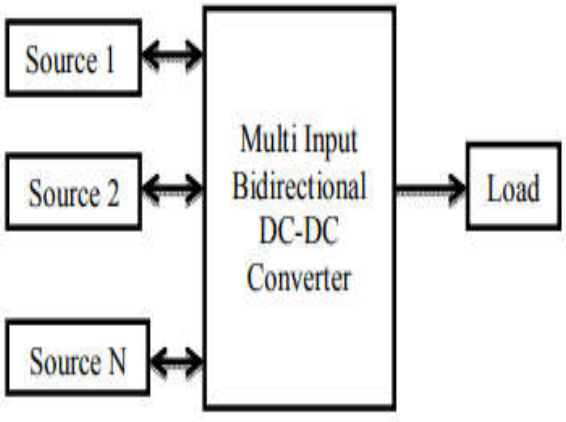

Figure 1: Multi input bidirectional converter system

III-THE PROPOSED SYSTEM

Fuel Cell becomes the most important renewable energy source. The structure of proposed three-input DC-DC boost converter is formed of two conventional boost converters, substituting extra capacitor in one of the converters, and a battery to store the energy. Characteristic of the converter is suitable for hybrid systems. In this paper, behavior of the converter in terms of managing the sources is analyzed in power management and control part. Then VPV and VFC are two independent power sources, that output is based on characteristic of them. L1 and L2 are the inductances of input filters of PV panel and fuel cell. Using L1 and L2 as in series with input sources change PV and FC modules to current sources. r1 and r2 are $V_{PV's}$ and $V_{FC's}$ equivalent resistance, respectively. R Load is the equivalent resistance of loads connected to the DC bus. S1, S2, S3 and S4 are power switches. Diodes D1, D2, D3 and D4 are used to establish modes, which will be described. Capacitor C1is used to increase output gain and output capacitor Co is performed as output voltage filter. System is operating in continuous conduct mode (CCM) to produce smooth current with least possible amount of current ripple.

Modes of operation:

It has the three following operation states:

1) In first operation state the load is supplied by PV and FC while battery is not used.
2) In second operation state the load is supplied by PV, FC and battery.
3) In third operation state The load is supplied by PV and FC while battery is in charging mode.

IV. SIMULATION RESULTS

A simulation model for multi input boost DC-DC converter fed induction motor is developed using the mat lab/Simulink software is shown in Figure2. The final simulation corresponds to the Simulink model of the battery, ultra capacitor, multi input bidirectional dc-dc converter and load. The three phase inverter is connected with the converter through the dc- link. The required dc-link voltage to the three phase inverter to the induction motor is fed from the Fuel Cell through the boost converter.

International Journal of Electronics, Electrical and Computational System
IJEECS
ISSN 2348-117X
Volume 6, Issue 12
December 2017

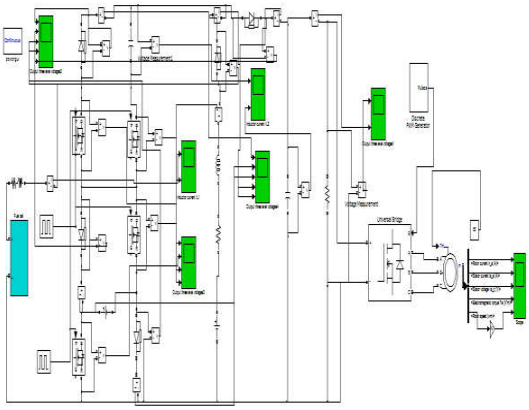

figure2: Simulink model of fuel cell based three input DC-DC boost converter for three phase ac load.

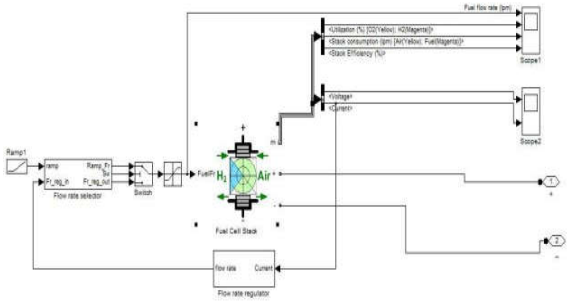

Figure 3: Fuel cell model

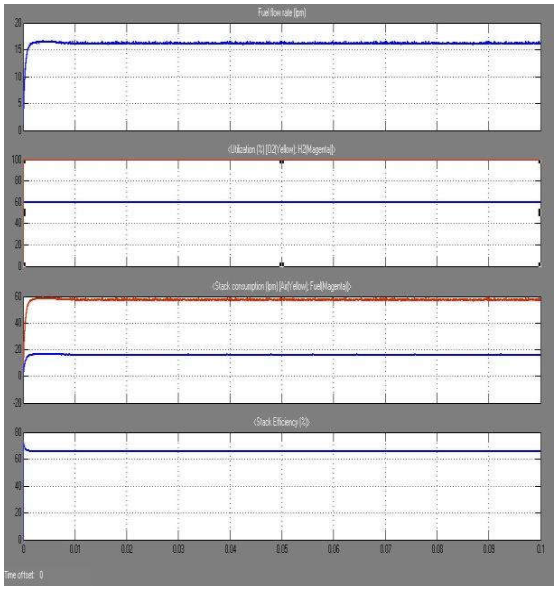

Figure 4: Simulation waveforms of fuel cell model

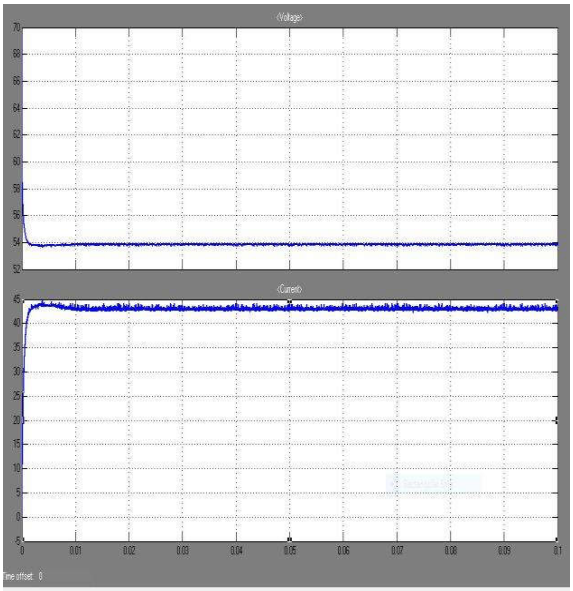

Figure 5: Simulation of voltage and current waveforms.

V.CONCLUSION

The multi input boost DC-DC converter was designed to integrate more than two DC sources with different voltage levels which find application in HEV. The multi input boost converter can control the power flow between each pair of sources. The required voltage to drive a three phase induction motor is obtained by Fuel Cell and multi input DC-DC converter. Instead of using individual converter in hybrid system using multi input boost DC-DC converter is reduces the system size and cost. Therefore proposed converter provides the better efficiency but harmonics presents in voltage source. The performance of the system has been verified by simulation using MATLAB/SIMULINK environment.

VI. REFERENCES

[1] Wang Tieche, and Zheng Ping, "Design Characteristics of the Induction Motor Used for Hybrid Electric Vehicle" IEEE Transactions on Industrial Electronics, pp. 523-527, 2004.

[2] Ali Emadi, and KaushikRajashekara, "Topological Overview of Hybrid Electric and Fuel Cell Vehicular Power System Architectures and Configurations"

IEEE Transactions on Vehicular Technology", Vol. 54, no. 3, pp.763-770, 2005.

[3] Ali Emadi, and Sheldon S. Williamson, "Power Electronics Intensive Solutions for Advanced Electric, Hybrid Electric, and Fuel Cell Vehicular Power Systems", IEEE Transactions on Power Electronics, Vol. 21, no. 3, pp.567-577, 2006.

[4] R.J. Wai, C.Y. Lin, L.W. Liu and Y.R. Chang "High-efficiency single-stage bidirectional converter with multi-input power sources", IEEE Transactions on Industrial Electronics, Vol. 67, No. 8, pp.763-767, 2007.

[5] sKarteek Gummi, and Mehdi Ferdowsi, "Double-Input DC–DC Power Electronic Converters for Electric-Drive Vehicles Topology Exploration and Synthesis Using a Single-Pole Triple-Throw Switch", IEEE Transactions on Industrial Electronics, Vol. 57, No. 2, pp.617-623, 2010.

[6] Baldwin Immanuel T, and Rashmi M R, "A Novel Multi Input Converter for Three Non-Conventional Energy Sources with Reduced Complexity for a Three Phase Induction Motor", IEEE Transactions on Power Electronics, and Communication Engineering, Vol. 41, no. 6, 2014.

[7] C. Zhao, S. D. Round, and J. W. Kolar, "An isolated three-port bidirectional dc-dc converter with decoupled power flow management," IEEETrans. Power Electron., vol. 23, no. 5, pp. 2443–2453, 2008

[8] H. Tao, J. L. Duarte, and M. A.M. Hendrix, "Three-port triple- half- bridge bidirectional converter with zero-voltage switching," IEEE Transaction PowerElectronics., vol. 23, no. 2, pp. 782–792.

[9] S. Liu, X. Zhang, H. Guo, and J. Xie "Multiple input bidirectional dc/dc converter for energy supervision in fuel cell electric vehicles," in Proc. IEEE ICECE, pp. 3890–3893, 2010.

[10] H. Matsuo, W. Lin, F. Kurokawa, T. Shigemizu, and N. Watanabe "Characteristics of the multiple-input dc-dc converter," IEEE Trans. Ind. Electron., vol. 51, no. 3,pp. 625–631, 2004.