AUSTRALIAN JOURNAL OF BASIC AND APPLIED SCIENCES

ISSN:1991-8178 EISSN: 2309-8414
Journal home page: www.ajbasweb.com

High Gain Multi Input Converter for Induction Motor Drive Systems

[1]S. Durairaj, [2]Dr. Y Rabinson, [3]Dr. P. Sridharan

[1]*Assistant Professor/EEE, Tamilnadu College of Engineering, Karumathampatti, Coimbatore-641659*
[2]*Director, RVS Technical Campus, Coimbatore*
[3]*Associate Professor, Mechanical Engineering, Maharaja Engineering College, Avinashi-641654*

Address For Correspondence:
S.Durairaj ,Assistant Professor/EEE, Tamilnadu College of Engineering, Karumathampatti,Coimbatore-641659
E-mail: madthusafalt@gmail.com

ARTICLE INFO

Article history:
Received 10 October 2015
Accepted 30 November 2015 Available online 24 December 2015

Keywords:
Single Pole Triple Throw Switch, Voltage Multiplier, Switched Capacitor, Coupled Inductor

ABSTRACT

Renewable sources such as photovoltaic, fuel cells etc have received great attention. One of the input voltages is obtained from these renewable sources and the other input is provided by a dc source. DC-DC converters are used to boost the low voltage levels to high voltage levels. In this, a modified boost converter is used where diode and capacitor are cascaded together. It uses a multi port converter so can draw continuous current. Thus low ripple current and reduced voltage stress can be obtained. This converter is connected to the induction motor which makes them appealing in application such as water pumping system. The design and simulation results are presented with Vin=20V and Vout=400V.

INTRODUCTION

Now a day's Renewable sources such as photovoltaic, fuel cell etc are employed world wide. As environmental contamination and energy shortage are low renewable energy has received great attention. These renewable sources are used as input voltage in various applications. DC-DC converters are used to boost the low voltage dc to a high level. So, various converters such as boost, buck, etc., are used to boost the low voltage levels, but it contains large duty ratios. So high current stress can be obtained. Because of this, efficiency is reduced. This results in high current stress which will finally leads to diode reverse recovery problem. So, to overcome these disadvantages, transformers or coupled inductors are used. But due to the complexicity of the circuit and as the leakage inductance is large, voltage spikes occur. After classical converters, different converter has been introduced. Boosting in done in single stage for increasing the efficiency. So low cost and compact size can be obtained (Jain *et al*., 2007). Converters with Single Pole Triple Throw Switch are used to increase the efficiency and reducing the cost (Gummi *et al*., 2008).

By using a dead time between two switching command in the multi input converter makes the dynamic system gets improved (Prabhala *et al*., 2009). An active ripple reduction technique is proposed in fuel cell by adding a current loop control into the existing voltage loop control system thus reducing the ripple current (Liu and J. S. Lai 2007). A high efficiency high step up voltage with a clamp mode converter is proposed which adds two pairs of additional capacitors and diodes to achieve high step-up voltage gain. It has low conduction losses. Clamping circuit clamps the voltage across the circuits (Ping Hsieh *et al*., 2011). Non-isolated dc dc converter with a voltage multiplier is proposed thus providing high static gain and high (Prudente *et al*., 2008). An interleaved high step up converter with voltage lift capacitor technique and voltage multiplier module is proposed which extends the voltage gain and increases the voltage conversion ratio (Kuo-Ching *et al*.,2013). Then, a high step up converter with voltage multiplier module is proposed which contains a clamping circuit to obtain soft

Open Access Journal
Published BY AENSI Publication
© 2017 AENSI Publisher All rights reserved
This work is licensed under the Creative Commons Attribution International License (CC BY).http://creativecommons.org/licenses/by/4.0/

Open Access

ToCite ThisArticle: S.Durairaj Dr. Y Rabinson Dr.P.Sridharan -High Gain Multi Input Converter for Induction Motor Drive Systems *Aust. J. Basic & Appl. Sci., 9(35): 377-382, 2015*

commutation, thus reducing the voltage stress and increases the flexibility (Sanghyuk *et al*., 2013). Thus a conventional interleaved boost converter integrated with a voltage multiplier module. The voltage multiplier module is composed of switched capacitors and coupled inductors. To extend step up gain coupled inductors are used. Voltage conversion ratio is increased by using switched capacitors (Kuo-Ching *et al*., 2014). Thus an interleaved high step-up converter integrated with winding cross coupled inductors (WCCI) and voltage multiplier cells is proposed. Voltage stress can be reduced and voltage multiplier cells absorb the voltage spikes (Wuhua *et al*.,2012). Because of these reasons, it is necessary to find new converters which have to overcome these various disadvantages.This paper presents a modified boost converter which uses as a high gain dc dc converter in which diode and capacitor are cascaded together to boost up the voltage (.Prabhala *et al*., 2015). The major advantages are high voltage gain, low voltage stress and low current ripple. The converter is then connected to a induction motor (shown in fig 1.) which can be used for water pumping system.

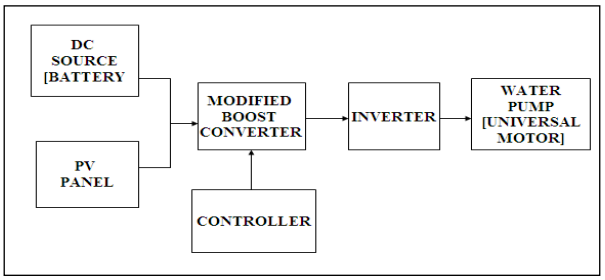

Fig. 1: Block Diagram

Multi Input Converter:

Structure:

A modified boost converter is proposed in which diode and capacitor is cascaded together. There are four voltage multiplier stages in which two boost stages are integrated together at the input. An overlap time is present for the normal converter. So in order to avoid the overlap time the converter operates in three modes of operation.

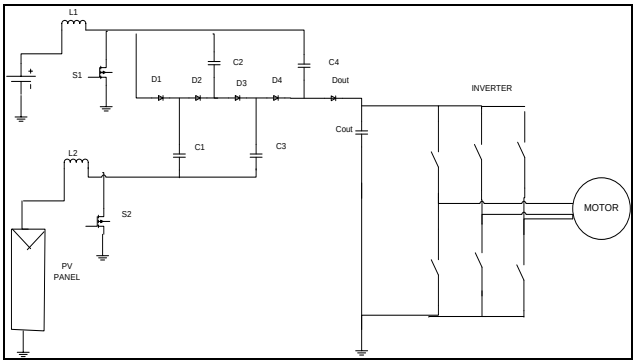

Fig. 2: Circuit diagram of modified boost converter

Mode 1:

In this mode, S1 and S2 are ON at the same time. Vin1 and Vin2 input sources are used for charging the inductor. The diode is reverse biased and output capacitor is used for supplying to the load

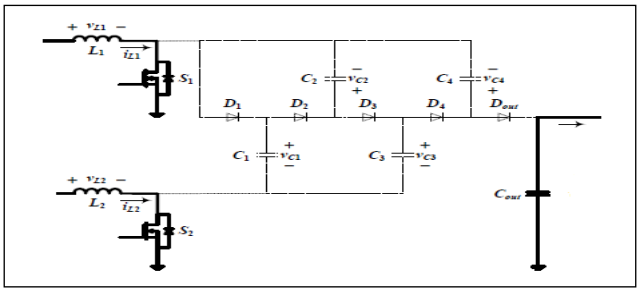

Fig. 3: Mode 1 operation

Mode 2:

In this mode, switch S2 is ON and switch S1 is OFF. As there are four stages forward biasing the output diode thus charging the output capacitor.

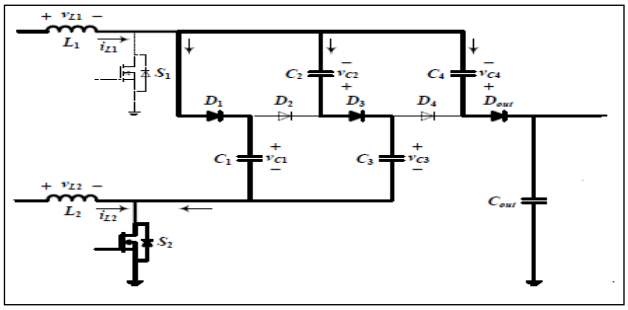

Fig. 4: Mode 2 operation

Mode 3:

In this mode, S1 is ON and S2 is OFF. As there are four stages reverse biasing the output diode and output capacitor is used for supplying the load.

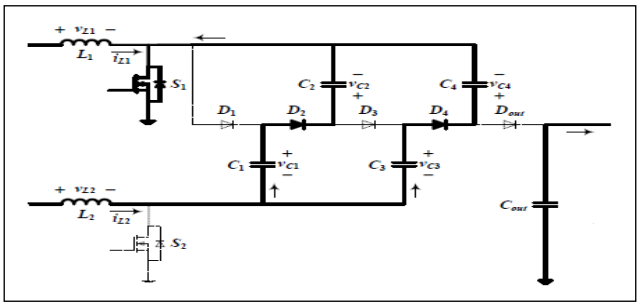

Fig. 5: Mode 3 operation

Control Strategy:

For controlling the converter, the measured voltage is the feed back signal and compared with reference voltage. The difference voltage error is applied to the PI controller to generate a control voltage which controls the power converter and produces the desired voltage. This voltage and the repeating sequence voltage is given to a relational operation for generating the pulses. This pulse is given to the gate of the MOSFET switch

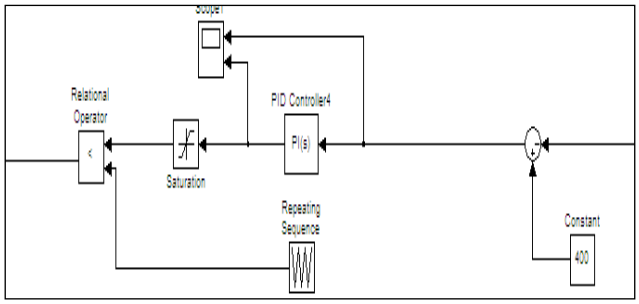

Fig. 6: PI Controller

Design Consideration:

The charge is transferred progressively from input to the output by charging the VM stage capacitors. The output voltage equation of the VM capacitor stages depends upon the number of N stages. If d1 and d2 have the same value, the equation for the output voltage is

$$Vo = \frac{(N+1)Vin}{(1-D)} \quad (1)$$

The inductor currents in both the boost stages depend on the number of VM stages.

The average inductor current in each boost is given by

RESULTS AND DISCUSSION

In open loop the voltage will not be constant for load variations on the motor so a closed loop technique is implemented. For controlling the converter, the measured voltage is the feed back signal and compared with reference voltage. The difference voltage error is applied to the PI controller to generate a control voltage which controls the power converter and produces the desired voltage. This voltage and the repeating sequence voltage is given to a relational operation for generating the pulses. This pulse is given to the gate of the MOSFET switch

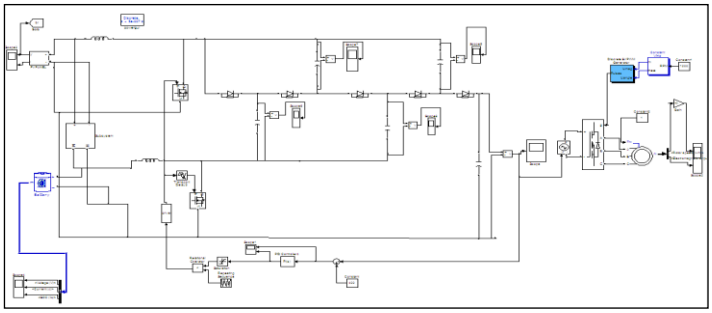

Fig. 7: Simulation Model of Multi Input Dc-Dc Converter With High Gain For Solar Powered Systems

Table 1: Boost Converter Parameters

Parameters	Value
Input voltage	25V
Output voltage	30V
Duty ratio, D	0.2593
Inductor, L	1.7Mh
Capacitor, C	3300Mf
Switching frequency	5KHz
Output voltage ripple	0.0159V
Inductor current ripple	0.48V

The photovoltaic system supplies the power to the converter. Battery accumulates the excess energy created by the pv system. For charging and discharging the battery, a boost converter is used. So, by giving an input voltage of 25V, 30V output voltage can be obtained with a switching frequency of 5 kHz

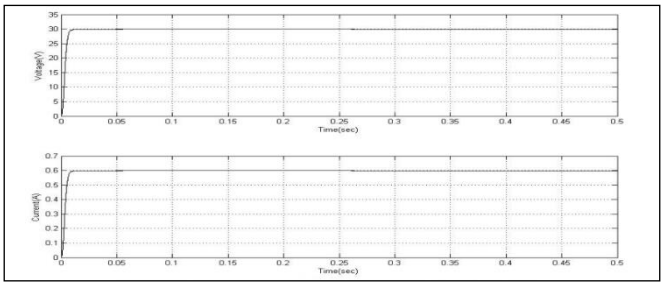

Fig. 8: Simulation Result of Boost Converter for Battery Charging

Table 2: Modified Boost Converter Parameters

Parameters	Value
Input voltage	20V
Output voltage	400V
Duty ratio, D	0.75
Inductor, L1, L2	100μH
Capacitor, C1, C2, C3, C4	20μF
Switching frequency	100KHz

The output voltage of the converter is 400V by giving an input voltage of 20V.For the VM stage capacitors, the ripple current will be higher, therefore capacitor of 20μF, 450 is selected which has a ripple current rating of 29 A

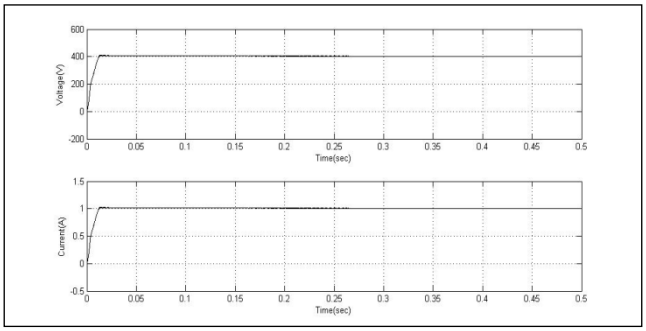

Fig. 9: Simulation Result of Multi Input Dc-Dc Converter With High Gain For Solar Powered Systems

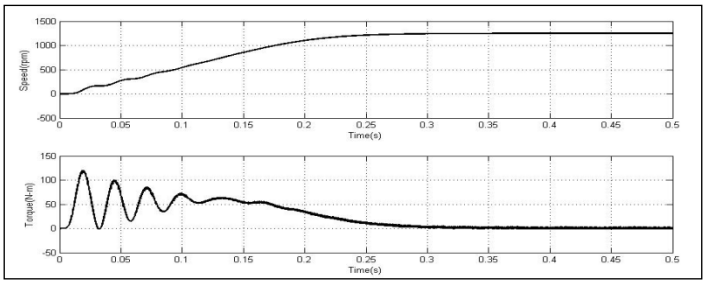

Fig. 10: Speed and Torque Waveform of Multi Input Dc-Dc Converter with High Gain for Solar Powered Systems

The speed and torque waveform of the motor is shown in figure 10. The speed set point is set to 1200rpm. But the max speed achieved from this model is approximately 1250prm as shown in Fig (10). The noise produced in the PWM inverter is also observed in the electromagnetic waveform Te. However motor inertia prevents this noise from appearing in the motor's speed waveform

Conclusion:

In this paper, multi input dc dc converter with high gain has been proposed. Proposed converter is based on diode capacitor stages. As it has two input sources, it can be used to draw continuous power. So low ripple current and reduced voltage stress can be obtained. The proposed converter is connected to a induction motor for solar water pumping applications. From the simulation analysis it can be found that the proposed converter can provide higher output than expected. Stress is reduced by providing

different number of voltage multiplier stages. The efficiency is improved from analyzing the speed torque waveform of the multi input converter.

REFERENCES

Gummi, K and M. Ferdowsi, 2008. Synthesis of double-input dc-dc converters using single pole triple throw switch as a building block, Proc. IEEE Power Electronics Specialists Conf., pp: 2819-2823.

Jain, S. and V. Agarwal, 2007. A single-stage grid connected inverter topology for solar PV systems with maximum power point tracking, IEEE Trans. Power Electron., 22: 19281940.

Kuo-Ching Tseng and Chi-Chih Huang, 2014. High step-up high-efficiency interleaved converter with voltage multiplier module for renewable energy system, IEEE Trans. Ind Electron., 61(3): 1311-1319.

Kuo-Ching Tseng, Chi-Chih Huang, and Wei-Yuan Shih, 2013. A high step-up converter with a voltage multiplier module for a photovoltaic system, IEEE Trans. Power Electron., 28(6): 3047-3057.

Liu, C. and J.S. Lai, 2007. Low frequency current ripple reduction technique with active control in a fuel cell power system with inverter load, IEEE Trans. Power Electron., 22(4): 1429-1436.

Prabhala, V.A., K.V.S. Poria Fajri, P. Gouribhatla, 2015. A Dc-Dc Converter with High Voltage Gain and Two Input Boost Stages,IEEE Transactions on Power Electronics, 26(4): 1127-1136.

Prabhala, V.A.K., D. Somayajula and M. Ferdowsi, 2009. Power sharing in a double- input buck converter using dead-time control, in Proc. IEEE Energy Conversion Congress and Exposition (ECCE), San Jose, USA, pp: 2621-2626.

Prudente,_tscher, Emmendoerfer, P.G., E.F. Romaneli and R. Gules, 2008. Voltage multiplier cells applied to non-isolated DC-DC converters, IEEE Trans. Power Electron., 23(2): 871-887.

Sanghyuk Lee, Pyosoo Kim and Sewan Choi., 2013. High step-up soft-switched converters using voltage multiplier cells,IEEE Trans. Power Electron, 28(7): 3379-3387.

Wuhua Li, Yi Zhao, Jiande Wu and Xiangning He., 2012. Interleaved high step-up converter with winding-cross-coupled inductors and voltage multiplier cells , IEEE Trans. Power Electron., 27(1): 133-143.

Yi-Ping Hsieh, Jiann-Fuh Chen, Tsorng-Juu Liang and Lung-Sheng Yang, 2011. A novel high step-up DC–DC Converter for a microgrid system, IEEE Trans. on Power Electronics, 26(4): 1127-1136.