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Efficient Operation of Dc-Dc Converter Using Cuk and Sepic Topology for the Application of Photovotaic System

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ABSTRACT

In this work, an efficient Cuk and SEPIC topology combined DC-DC converter proposed for photovoltaic applications. The proposed converter controlled using enhanced droop controller.The proposed Cuk Sepic combination uses only a single switch with magnetics cores to couple the input and output inductors. Due to droop control, the PV power extraction capability greatly improved and considerably reduces ripple current. The proposed converter implemented using MATLAB and compared against existing topologies

1. INTRODUCTION

Design of DC-DC converter is an important task in photovoltaic applications. Today renewable energy applications need efficient and high gain DC converters. Till now, various converter topologies have been proposed like cascaded boost, coupled inductor,landsman,bidirectional and voltage shift converters. But,they suffered froma complex structure and low efficiency.

High voltage converters got the greatest attention due to its power flowmanagement capability and effective DC transforming.With the aid of efficient DC converters the renewable and energy distribution systems directly connected to a high DC power system.

In this work proposed a new DC-DC converter with droop controller for high voltage applications. Chapter 2 described a survey related to the DC-DC converter. Chapter 3 explain about the proposed system. Chapter 4 and 5 describes the result and conclusion.

2. RELATED WORK

Various converter topologies proposed by various researchers for high voltage and renewable source applications.

Shen, H et al 2017 have proposed a hybrid Z source converter for photovoltaic application with stronger boosting capabilities. The conventional z source converter modified to get a higher voltage and names as hybrid z source converter. The proposed converter implemented and tested for various testing modes.Du, S et al 2018 have designed a new type transformerless high-voltage DC-DC converter for DC grids. The proposed converter contains an upper arm and a lower arm with the transformerless structure in order to produce a high grain output. MATLAB Simulink model used to verify the efficiency of the proposed converter

Lung-Sheng Yang et al 2009 have proposed a high step-up transformerless dc–dc converters for PV application. The proposed converters has two inductors and simple structure by a single power stage used. The prototype has been implemented and verified

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Grbovic, P. J et al 2010 have implemented a three-level nonisolated dc–dc converter for high voltage applications. A prototype of 5.5-kW prototype was designed and verified.Siwakoti, Y. P et al 2015 have proposed a new dc-dc converter topology called "quasi-Y-source dc-dc converter" . It combines the advantage of Y-source converter. It has the advantages of drawing less continuous current from the source. Implementation results prove the suitability of the proposed converter for high boost dc-dc converter application

Gui-Jia Su et al 2008 have designed a low-cost dc–dc converter for PV applications. It reduces the number of switches with the dutycycle ratios around the value of 1/3. The utilization of half bridges increases power level.The prototype of 4.5 kW has been implemented and verified

Torkan, A et al 2018 have proposed a high gain z-source based dc-dc converter for water pump application .Additionally, high competence, low cost and less voltage stress make it suitable for photo-voltaic applications. The proposed dc-dc converter is evaluated experimentally for converting 24 V DC input to 300 V DC output at 100 W and to validate the simulation results

Kenzelmann, S., et al 2015 haveintroduced a galvanic isolated bidirectional DC/DC converter with DC power flow control. By the usage of frequency transformation permits copper reduction and loss reduction. The internal power balancing technique proved in the experiment.Pesce, C et al 2016 have proposed a modified Flyback Converter (FC) by serially connecting FC isolated cells and conductance in parallel. In order to control conversion range Proportional+Integral (PI) controller has been used. The prototype of 1kW with PSIM platform implemented and verified

Lakshmi, M et al 2018 have presented a non-isolated high gain dc–dc converter without the use of voltage multiplier cell (VMC) . The proposed converter based hybrid switched capacitor technique with the operating modes of discharging/charging mode. Further, steady-state analysis performed using two different duty ratios. The prototype of 100W, 20/200V prototype has been developed and verified. Nathan, K. S et al 2018 have proposed animproved DC-DC converter by combining Cuk and SEPIC converters for solar photovoltaic (PV) applications. The proposed converter uses single switch combinedwith magnetics cores to connect the input and output inductors to reduce the input current ripple from PV system. Additional, a 1 kW prototype is also implemented tovalidate the converter's efficiency. Xing, Z., et al 2016 have proposed a quasi-square-wave (QSW) modulation method to design a high gain converter .By QSW, the efficiency of converter improved and switching loss also gets reduced. Additionally, a capacitor voltage balancing control approach is proposed.

Zheng, Y et al have proposeda single-inductor multiple-output (SIMO) auto-buck-boost dc-dc converter. They also propose backwards Vx1 control algorithm and frequency-control loop algorithm for boosting and buck mode. The proposed converter achieves an efficiency of more than 91% .Wang, B et al 2016 have presented a model predictive voltage control (MPVC) technique for the DC-DC converter. The proposed method is capable to reduce a cross regulation problem .Implementation results indicate that the proposed methodassurances low cross regulation for various loads.Cui, S et al 2018 have proposed an isolated bidirectional soft-switching dc-dc converter by combining two-level converters in parallel and a modular multilevel converter (MMC) on the HV side. A dedicated control method also proposed to improve the gain and efficiency.

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3. PROPOSED SYSTEM

This work proposed an improved DC-DC converter, by integrating the Cuk and SEPIC converters for PV applications. The converter uses magnetics cores to connect the input and output inductors, to reduce an input current ripple .

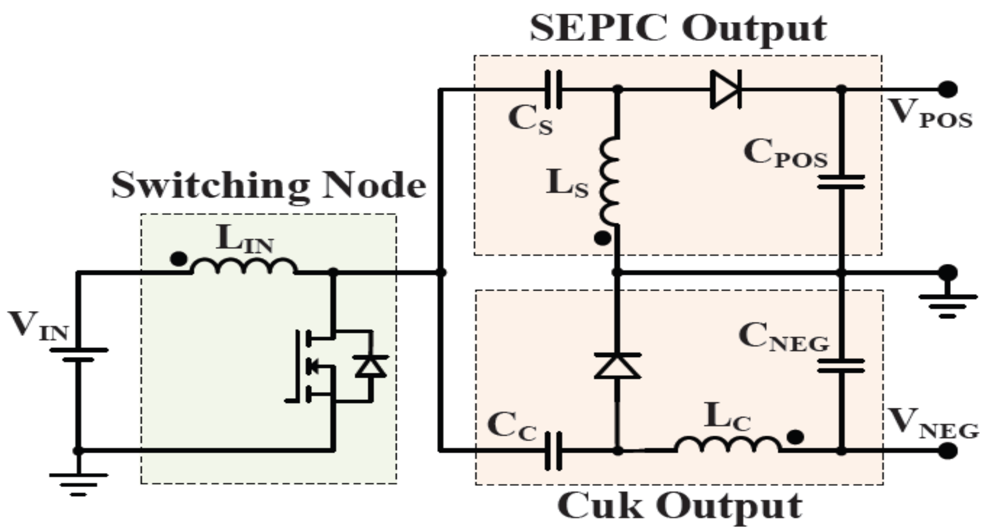

Figure 1.Combined Cuk-SEPIC (CCS) converter

The proposed converter, shown in Fig 1. During the ON state, all inductors are charging and the capacitors are discharging. When the OFF state, the inductor currents redirect into the diodes and the capacitors charge while the discharge of the inductor. The PWM pulses are controlled by droop controller as shown in Fig 2.

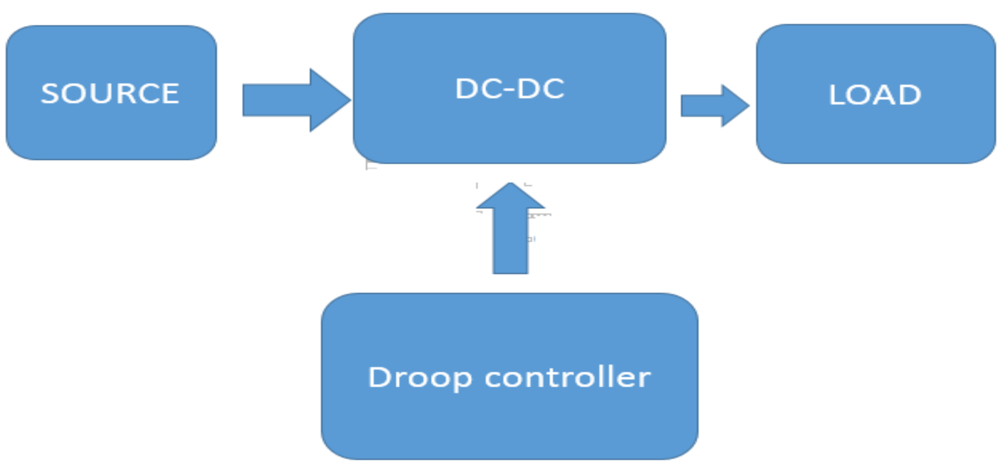

Figure 2.Proposed system

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One of most general control technique is droop control method. This work aims to control the voltage level and power sharing of the converters using droop index and also maximum power point tracking for improved performance.

4. RESULT AND VERIFICATION

The proposed topology has been implemented and verified using MATLAB Simulink model. The results used to validate the functionsand operations of a converter .The results indicate that greater reductions in ripples and efficiency of boosted output .the below figure 3 to 6showSimulink model and input-output voltages.

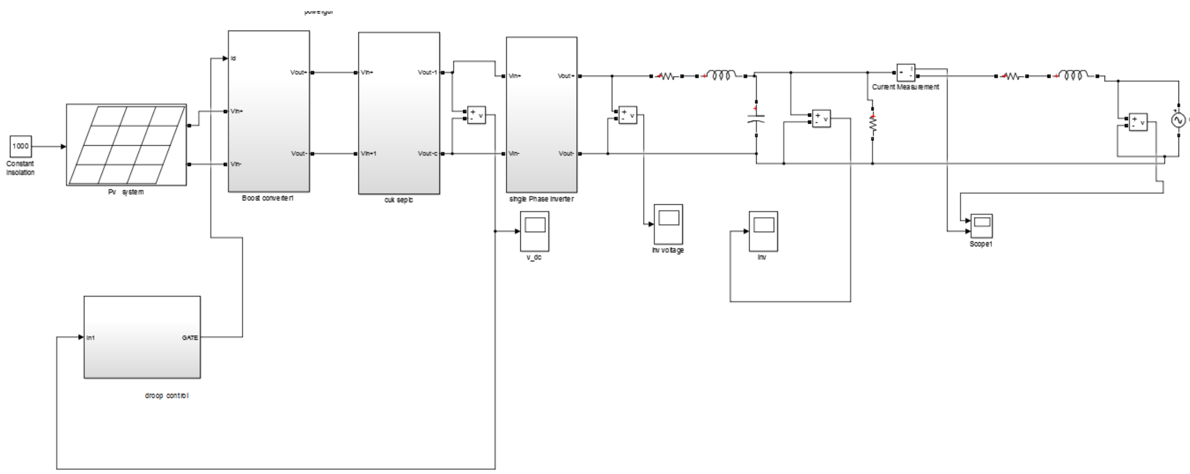

Figure 3. Overall Simulink

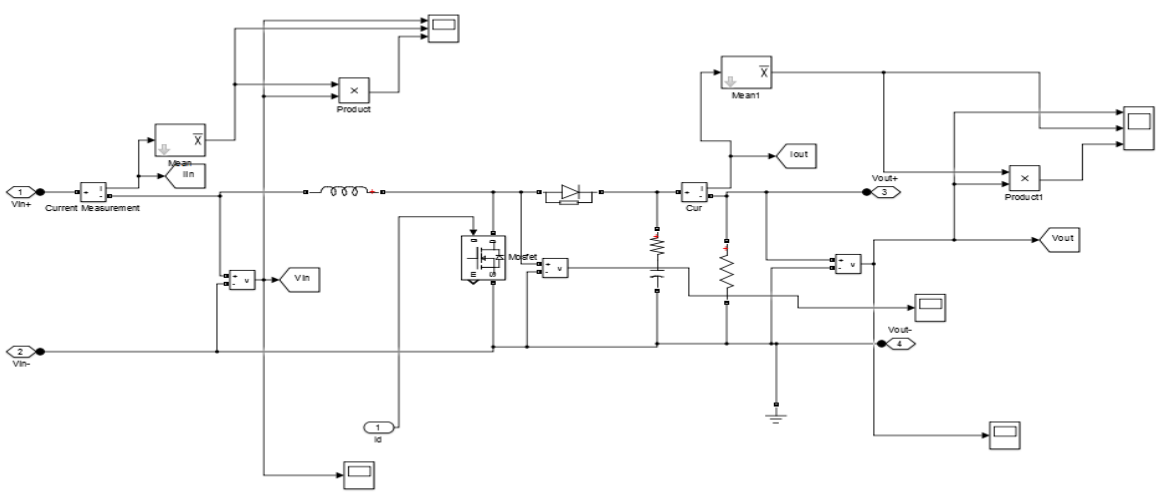

Figure 4. Converter section

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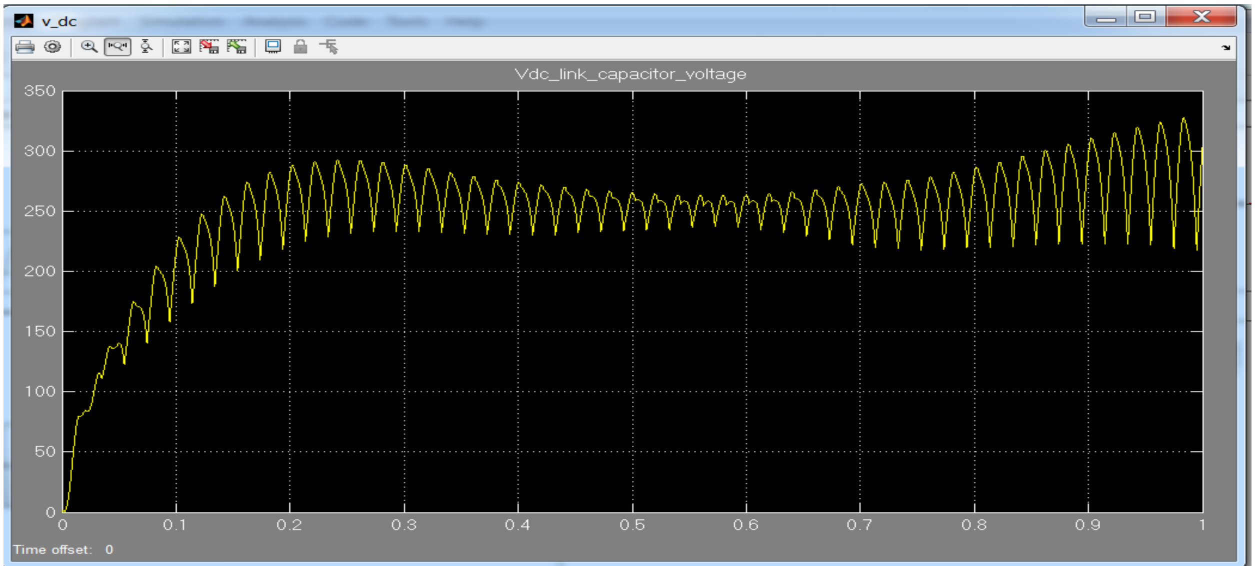

Figure 5. Boosted voltage

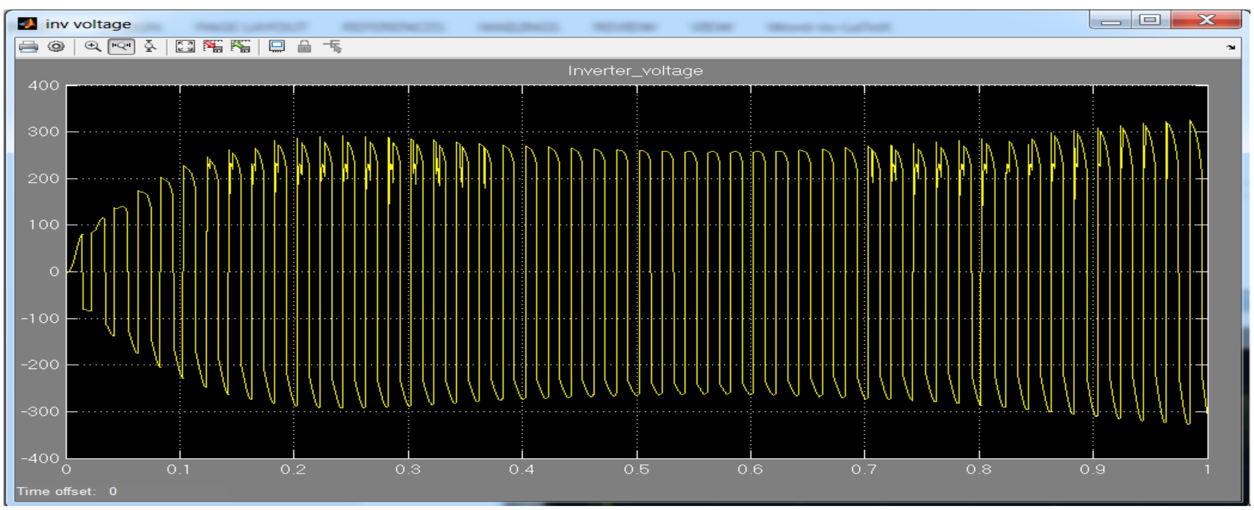

Figure6. Output voltage

CONCLUSION

By integrating two different topologies, the proposed converter achieves bipolar output conversion from single input with only one switch. It has the advantages of connecting to the grid without the need of a transformer. From the MATLAB simulation results observed that the converter shows high gain with the ripple current reductions of 79-94%.

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