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Investigation on performance of solar photovoltaic fed hybrid semi impedance source converters

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ABSTRACT

Normally the output voltage of the solar photovoltaic panel is very low; it varies widely under the influence of environment and climatic conditions. In this paper the combination of each power system and the output of the dc-dc converters are regulated by some kind of increased dc input voltage. The structure of the dc-dc converter is also very important for photo voltaic power systems. Various voltage raising technologies have indeed been thoroughly tested to date, such as rectifier circuit, managed to switch inductance, capacity to change, coupled inductance, impedance matching, and spiralled raising technologies. However, these processes are both dynamic with poor accuracy and greater cost. The effectiveness of the hybrid semi impedance source converter is greater.

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1. Introduction

In the near future, the rapid decline in the cost of electrical energy equipment and the elimination of fossil fuels will allow as much use as possible of solar photovoltaic energy produced for various applications. Water pumping, the stand-alone application of the solar photovoltaic system produced electricity [4]. A great deal of attention is currently being paid to irrigated agriculture in the fields, domestic applications and commercial applications. While a number of studies have been conducted throughout the field of solar photovoltaic array [1] power generation, incorporating various Dc-dc converters and motor drives, the impedance Source converter, coupled with a permanent magnet brushless DC (BLDC) generator,[4] has not been directly explored to date for the construction of such a system. [1]. However, the impedance Source converter has been used in some other solar photovoltaic based applications. Moreover, the topology of the solar photovoltaic array [2] BLDC driven water pump with Z Source converter has been documented and its importance has been more or less discussed. However, experimental validation is lacking and there is no comprehensive literature review the scientific innovation and originality of the work recorded have been obscured by comparison with the current topologies [3].

The impedance source converter is a fairly recent converter topology with a buck-boost voltage (Figs. 1-4) capability. In the Z-channel inverter, a symmetric lattice LC filter is inserted between the dc-link and the dc-voltage channel. The inverter is capable of boosting or buck voltage in dc-ac inversion and is capable of producing variable voltage and frequency ac output voltages. In Z-source converters, the input current is discontinuous and the voltage stress across the switch is more and also there is no more ground. To overcome this limitations quazi z-source converter is used. When the source and the load are interchanged [6].

Impedance-source (ZS) converters and their different derivatives are other options for high-level applications and have gained a great deal of interest. Quasi-impedance-source (qZS) network is an interesting structure that provides continuous input current and a common ground between input and output. Thanks to its attractive characteristics, the qZS network is commonly used for the construction of new architectures. For example, hybrid ZS converters obtained by combining ZS and qZS networks are implemented in and a cascaded qZS network is created. In addition, the qZS network has been used in many separate dc-dc converters [5–9]. A new high step up non-isolated converter based on a qZS network using switched capacitors and a voltage multiplier cell has recently been introduced. A different qZS-based structure can be found in. Despite their high voltage gain, they contain many passive components, and hard-switching operation will reduce their performance.

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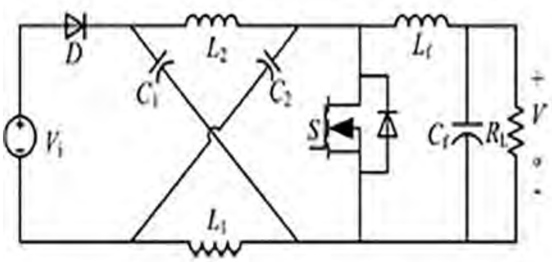

Fig. 1. Traditional Quazi-z-source Dc-dc converter.

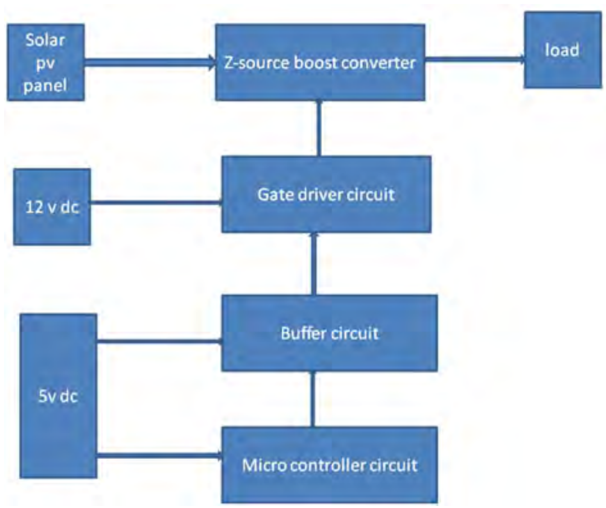

Fig. 2. Block diagram for z-source boost converter.

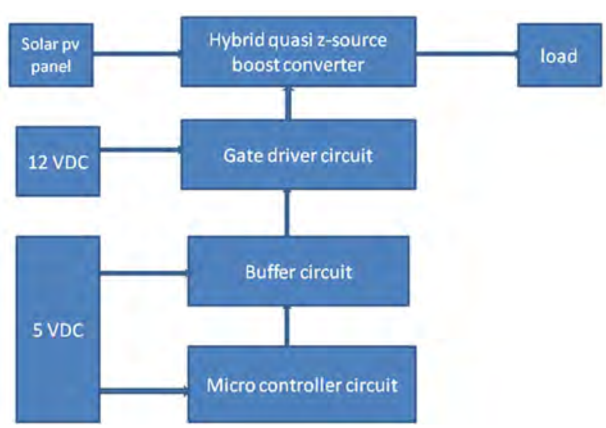

Fig. 3. Block diagram for Hybrid quasi-z-source boost converter.

It has been shown that the qZSIs provide better efficiency than the standard ZSI, and then the relation of the voltage source and the LDC impedance network can be extended to the Z-source dc-dc converter. Comparing the specific voltage source connections in qZSIs, it is noted that both the qZSI with continuous source current and the qZSI with discontinuous source current have similar ground for the voltage source and the inverter bridge. The qZSI with discontinuous source current has a lower voltage C2 impedance network capacitor [10]. For fact, if applied to a dc-dc transformer, the current source voltage would be constant instead of constant. There is no conventional zero condition in the dc-dc converter due to discontinuity. Therefore, a novel quasi-Z-source dc-dc using the link framework of the proposed converter.

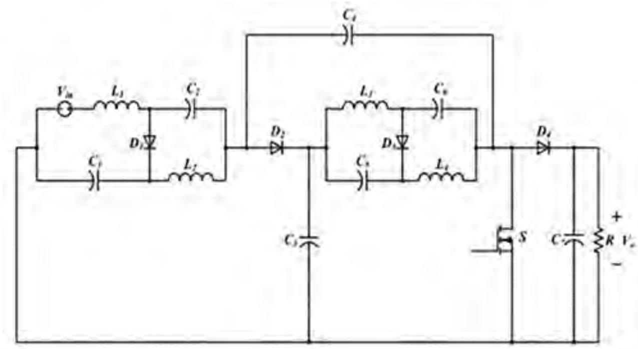

Fig. 4. Combination of two Quazi-Z-Source dc-dc Converter.

It is a dynamic system that displays both continuous and discreet dynamic behavior as a scheme that can either float and jump. In addition, the term "hybrid dynamic system" is used to distinguish hybrid systems from hybrid models. Like those mixing neural nets and fuzzy logic [2], or electrical and mechanical cam shafts. The advantage of the hybrid system is that it incorporates a wider class of systems within its framework, making it more versatile to model complex phenomena. In general, the status of the hybrid system is determined by the values of the continuous variables and the discreet mode. The state changes either continuously, according to the flow condition, or discreetly according to the control graph. Continuous flow is allowed as long as the so-called deformations hold, while discreet transitions occur as soon as the jump conditions are met.

Solar energy is the use of solar energy either directly as thermal energy (heat) or by use of photovoltaic cells in solar panels and transparent photovoltaic glass to produce electricity [11]. Concentrated solar power uses multiple lenses or reflectors to absorb some of the solar thermal energy. Photovoltaic systems usually use the Maximum Power Point (MPPT) technique to continuously provide the highest possible load power while cooling and atmospheric conditions occur. It overcomes the problem of the mismatch between the solar array and the load provided. A simple method of controlling the maximum power points (MPPs) [12] and simply pushing the device to work close to these points is provided. [17] The renewable energy theory is used to derive a large and small signal model and a transfer function. The disadvantages of the state-space-averaging approach can be explained through the use of the proposed model. The TI320C25 Digital Signal Processor (DSP) was used to implement the proposed MPPT controller to control the DC / DC converter in the photovoltaic system [13–15].

The key innovation of this paper is the implementation of a novel strategy to concurrently achieve both the ZVS power switch output and the decreased conduction loss for the qZS diode by replacing it with an active switch. In summary, the proposed high boost dc-dc converter features include simple configuration, sufficiently high voltage gain, smooth operation over the full spectrum of load variations, decreased conduction loss due to synchronous operation, continuous input current, and common ground between input source and output voltage.

2. Existing systems

In the existing systems the Impedance Source Inverter may use a push-through state that would not be allowed through conventional voltage-source inverters to raise the voltage. In order to get access, the power to invert the buck voltage is also maintained. Impedance Source Inverter has quickly becoming the hot research topic due to its buck-boost modulation capability. However with the above advantages, the initial Proposed topology always has certain disadvantages, such as intermittent active power, high power voltage as well as small gain factor . In fact, both the Source impedance and also the battery charger bridge do not share common ground [8]. Numerous new amplification-source transfer functions were introduced in different surveys to address the limitations of the original Impedance source inverter. Among these revised impedance source large networks, the semi-impedance source network is a simple and easy solution.

2.1. Disadvantages of existing systems

High voltage
Pressure and minimal boost factor
Poor efficiency.
Block Diagram for Existing System

3. Proposed system

Three additional combination of impedance source dc-dc converters have been described in a rather way that the latest variant of emerging impedance source converter. In Dc-dc converters, the combination of impedance source networks increased to satisfy the conventional advantages of larger voltage impedance source networks. [9,10]

3.1. Circuit diagram for proposed system

Figure shows the combination of two Quazi-z-source converters. The first semi z source converter is formed by diode D1, inductor L1,L2 and capacitor C1and C2. The second semi z source converter is formed by diode D3, inductor L3,L4 and capacitor C5and C6.

3.2. Modes of operation

In this condition, the device S ON is operated by the corresponding circuit of the proposed converter, whereas the reverse biased D1–D3 are OFF. Assuming that T0 = DT is the 0-state interval in the T-cycle transition. The supply voltage source and the C2 capacitor rupture the power to the L1 inductance. Inductance L2 as well as L3 have been powered by capacitance C1, C3 and C4.

State 0: Each corresponding device of the proposed scheme continues to operate in state 0 and the main Switch is shifted although the diodes D1, D2 and D3 are managed to switch off during this process. Assuming that T0 = DT is the 0-state interval of the T-cycle transition. The input voltage source and the C2 capacitance release the power into the L1 inductance. Inductance L2 and L3 are to be paid [12].

State 1: Each corresponding device of the proposed scheme operating in State 1. Device S is switched off during this process, whereas the output diodes D1, D2, and D3 ON. [16] Suggesting a certain T1 = (1-D) T is the period of 1-state other than the T-cycle. Capacitors C1, C2, C3 and C4 generate electricity, while the input voltage source as well as the L1, L2 and L3 inductance produces the power.

3.3. Working of proposed system

Normally the output voltage of the solar photovoltaic panel is very low; it varies widely under the influence of environment and climatic conditions. The combination of each power system and the output of the dc-dc converters are regulated by some kind of increased dc input voltage. The structure of the dc-dc converter is also very important for photo voltaic power systems. Various voltage raising technologies have indeed been thoroughly tested to date, such as rectifier circuit, managed to switch inductance [13], capacity to change, coupled inductance, impedance matching, and spiralled raising technologies. However, these processes are both dynamic with poor accuracy and greater cost. The effectiveness of the hybrid semi impedance source converter is greater. Some of the advantages of proposed systems are continuous input current, reduced voltage load of the capacitor, high voltage gain, high efficiency decreased conduction losses, common ground between input source and output voltage. Some of the applications in Quazi-z-source converters are Grid application, telecommunications, wind power generation and fuel cells stack systems, adjustable sped drives, variable frequency drives, speed control of induction motor.

4. Simulation and experimental results

4.1. Matlab

MATLAB (Matrix Laboratory) is a latest generation high-level programming language and immersive platform for technical computing, image processing and web development. MATLAB has also been developed by Math Works. Allows matrix manipulation; function and data plotting; algorithm implementation; user interface development; interface with programs written in other languages, such as C, C++, Java, and FORTRAN; Analyse data; build algorithms; and create models and applications. This includes a variety of built-in commands and math functions that help you measure calculations, generate graphs, and perform numerical methods [16].

4.2. Simulation circuit components and ratings

Table 1 shows the ratings of the component used to simulate the proposed system. The component ratings are chosen carefully as per design calculations associated with quasi Impedance source converter.

Fig. 5 shows the MATLAB Simulink model of the proposed system. A DC source of voltage rating 30 V is estimated as the Solar PV input to the converter under discussion. The impedance source capacitance and Inductance are rated as 350µF and 480µH based on the design calculations of the quasi impedance source converters.

The converter output is obtained at the terminals of an output condenser of rating 480µF. A linear static load of 100 W is connected at the output of the simulated circuit.

4.3. Result and discussion

Fig. 6 shows the simulation output waveform of the proposed system. It is observed that the Output voltage boosts to a voltage level of about 380 V. The settling time of the output voltage depends on the controller chosen for generating and maintaining pulses for the MOSFET switches used and the modulation technique emphasized. In the simulation Output the waveform settles to the required voltage of 380 V in 0.9 sec and it can be further improved by choosing proper controllers. It is also observed that the switching frequency of the controller is fixed at 25 KHz. Such

Table 1
Simulation Circuit Components Ratings.

Components	Rating
Input voltage	10–30 V
Impedance source capacitance	350µF
Impedance source inductance	480µH
Output condenser	480µF
High load	100 W
Frequency switching	25 kHz
Diodes	MUR460

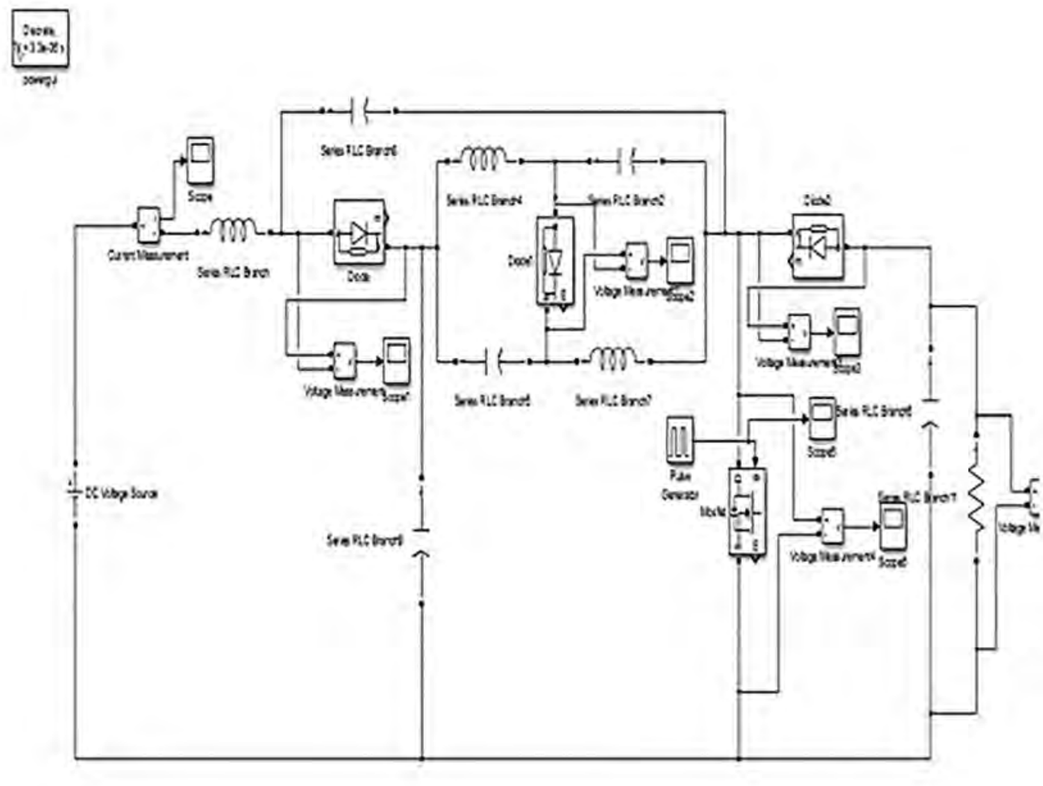

Fig. 5. Matlab modelling for proposed system.

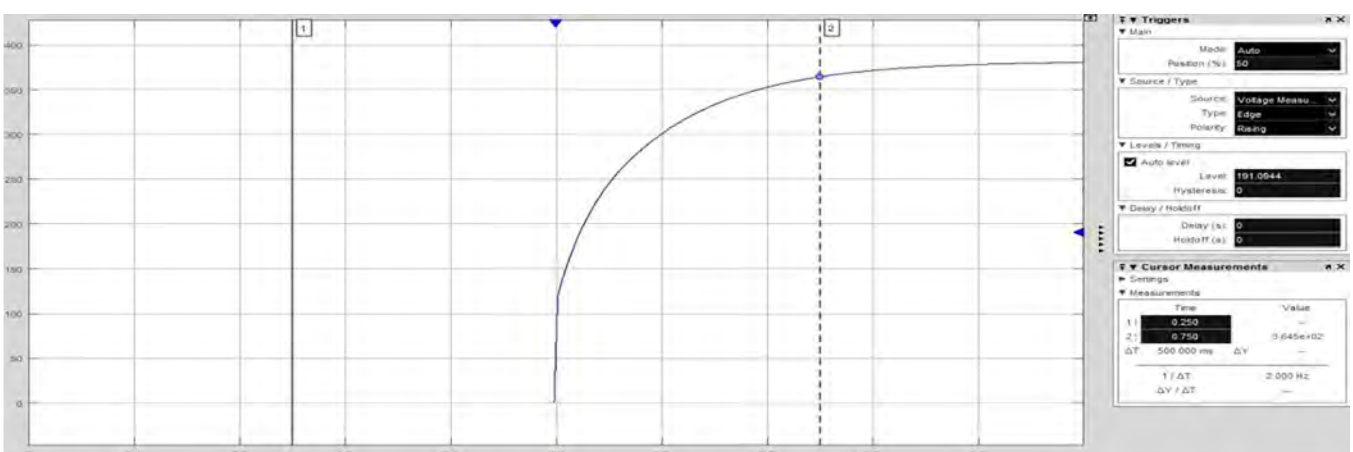

Fig. 6. Simulation Output.

fast switching will further smoothen the output waveform to yield output with reduced distortion. Also the output filter capacitor ensures further reduction in the ripples and gives out the desired DC output of 380 V.

5. Conclusion

The proposed scheme use combination of impedance source networks, created by a combination of conventional Impedance source networks. Aside from the large incremental capacity, the proposed combination impedance source networks preserve all the advantages of traditional impedance source networks, such as constant input current, decreased capacitance line voltage. There may be a discontinuity of input current and voltage and current voltage throughout the conventional impedance source network. To address the above mentioned problem, a modified and integrated impedance source network is constructed which can be used for the same application as conventional z-source networks with improved reliability, reliability and even cost-effectiveness.

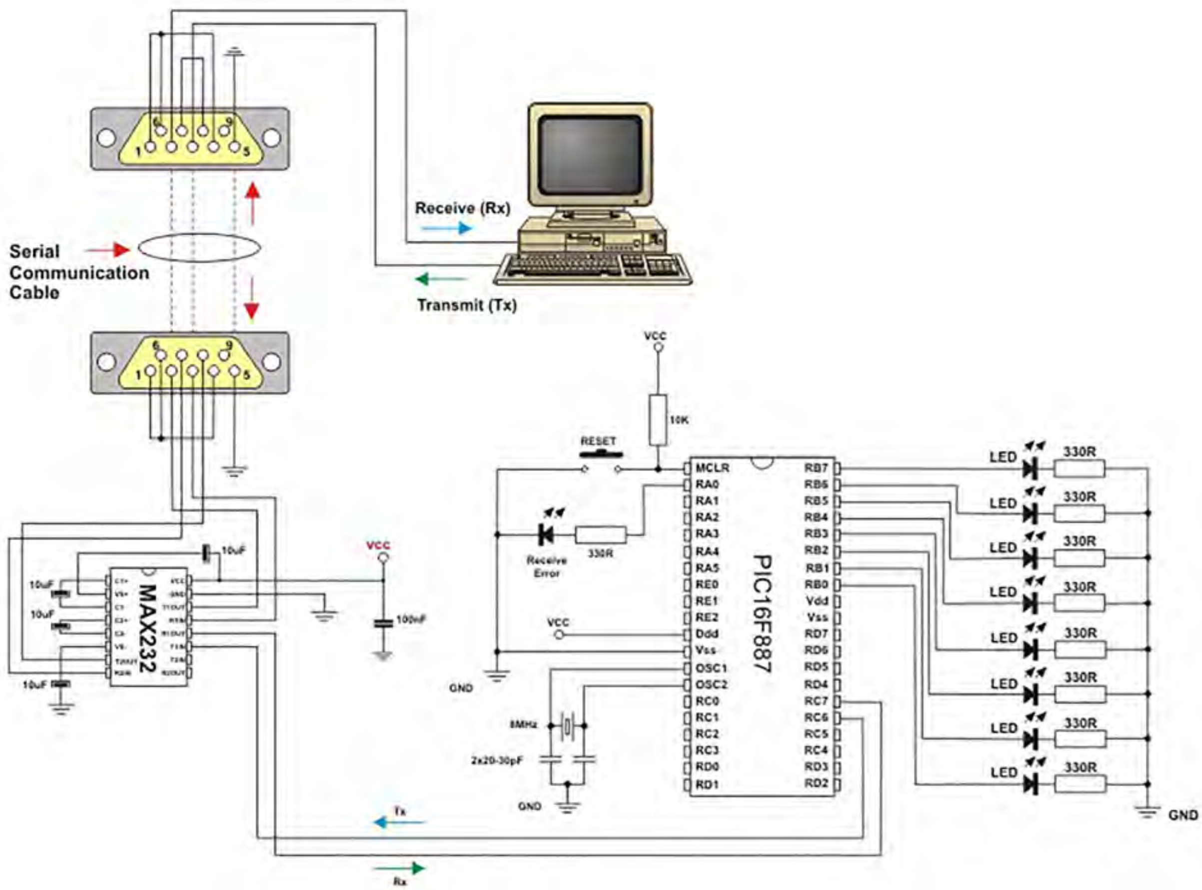

Fig. 7. Digital information systems Pin diagram.

CRediT authorship contribution statement

P. Sabarish: Conceptualization, Methodology. **R. Karthick:** . **A. Sindhu:** Data curation. **N. Sathiyanathan:** Software, Validation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A.

A.1 Solar photovoltaic panel

A photovoltaic panel that absorbs the sun's rays as a source of energy for the generation of electricity or heating.

Specification

High Power	5 W
Open voltage circuit	20.9 V
Input Voltage	12 V
Execution Current	0.56A
Existing Current	0.25A

A.2 Digital information systems

The standard allows connection to the computer. The software operates in the following way: every byte obtained by digital signals is displayed using LED diodes connected to port B and is then automatically returned to the transmitter. Fig. 7 shows DSP pin diagram.

Fig. 8. Hardware Output.

A.3 Hardware output

Fig. 8 shows the hardware arrangement of the proposed system which comprises of all the components explained in the block diagram.

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Further Reading

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