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Switched Coupled Quasi Z Source Inverter for Photovoltaic Power Generation System

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Abstract: *This paper presents new topology of quasi z source inverter which inherits from z source inverter. By using quasi z source network inverter draws constant current from solar panel and makes it suitable for photovoltaic (PV) application system as output from PV array varies. It also features low component rating and constant DC current from source. The Proposed quasi Z Source Inverter (qZSI) does voltage boost or buck and single stage of inversion with high efficiency and reliability. In order to verify these, theoretical analysis and simulation are performed. The MATLAB/Simulink based simulations demonstrate the betterment of the proposed scheme.*

Keywords: *Pv, Matlab, Qzsi, Zsi*

I. Introduction

Generally The Photovoltaic generation system is most developing alternative source of energy because of scarcity of energy resources and most abundant energy available. Still reduced use of solar energy is mainly due to cost and lack of continuous supply form PV cells []. As voltage source inverter is buck converter it needs the high input voltage than output so inverter rating must be high. So when PV panel is used with inverter it leads to low rating and it does not produce desired output for connected to the load. The Z source inverter (ZSI) can be used with solar panel for various applications as it does voltage boost and inversion in single stage. Quasi z source inverter has been developed from z source inverter and the proposed system analyzes the solar panel gives the input to the quasi z source inverter. By using this topology inverter draws constant current form PV array irrespective of varied temperature and radiation from sun. It also provides low component rating and constant DC current from source and it provides single stage of voltage boost or buck and DC to AC conversion with high efficiency. It is realized from simulation results and it is well suited for PV application system.

II. Proposed System

A. BLOCK DIAGRAM

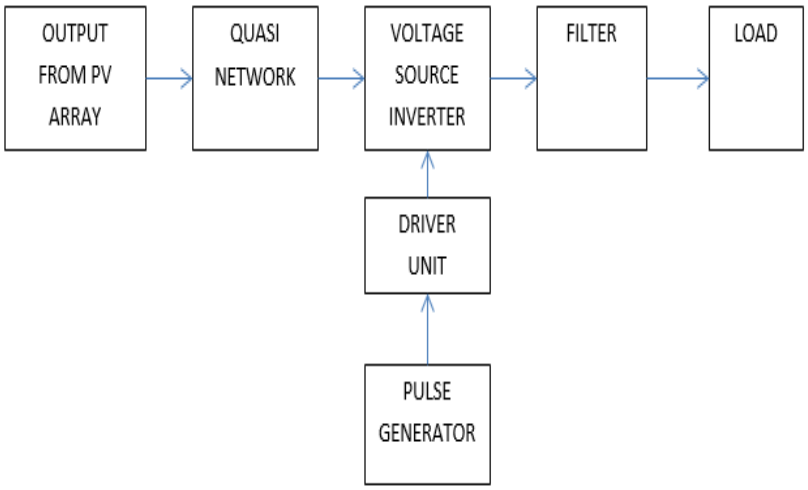

Fig.1 Block Diagram for Proposed System

B. CIRCUIT CONFIGURATION AND DESCRIPTION

The Z source inverter (ZSI) is reported to be suitable for the residential PV system because of the capability of voltage boost and inversion in single stage shown in Fig.2. Recently many new system of quasi Z source inverter (qZSI) which has been derived from the original Z source inverter. The quasi Z source inverter draws constant current from the PV panel and also capable to handle wide input voltage shown in Fig.3. This network utilizing the shoot through state to boost DC bus voltage by gating both upper and lower switches of the phase leg and produce desired output. This system improves the reliability by shoot through due to misgatting which no longer can destroy the circuit. Thus it provides a Low cost, Reliable and High efficiency single stage structure for buck and boost conversion, also it inherits all the qualities and advantage of Z source inverter, It possesses continuous input current, Reduced stress and lower component ratting.

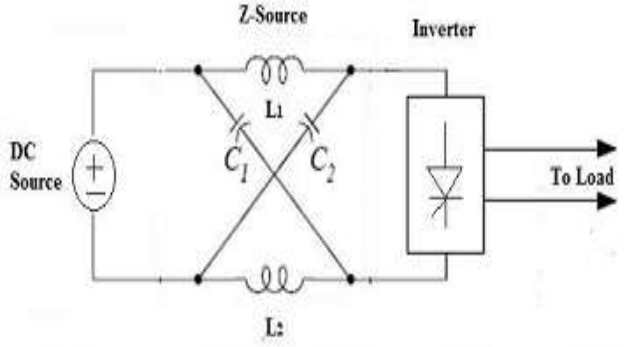

Fig.2 Analysis of Z source Inverter

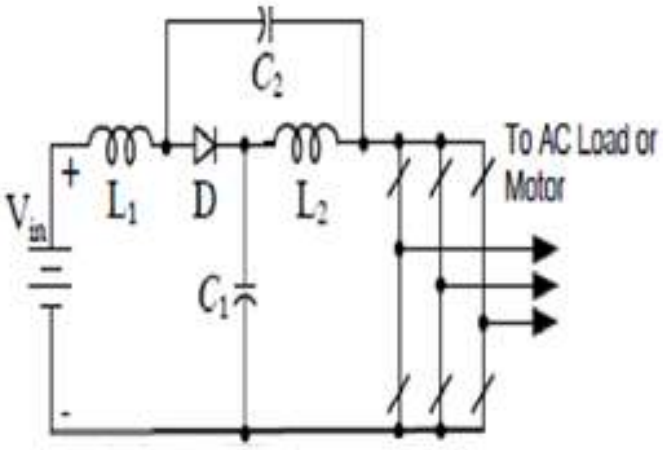

Fig.3 Quasi Network

C. MODE ANALYSIS

The Quasi Z source is same manner as the traditional Z source inverter in which two types of operation take place that is

- Shoot Through stage
- Non Shoot Through stage

Which make the system as more efficient in usage. In the Non Shoot Through stage the inverter bridge is depicted from the DC side is equivalent to the current source whereas in traditional voltage source inverter it is forbidden, Because it cause short circuit and prevents the damage of the device.

The Quasi Z source inverter has a unique LC and diode network connected to the inverter bridge which modifies the operation of the circuit allowing the Shoot Through stage shown in Fig.4. This network provides the boost up of the DC link voltage.

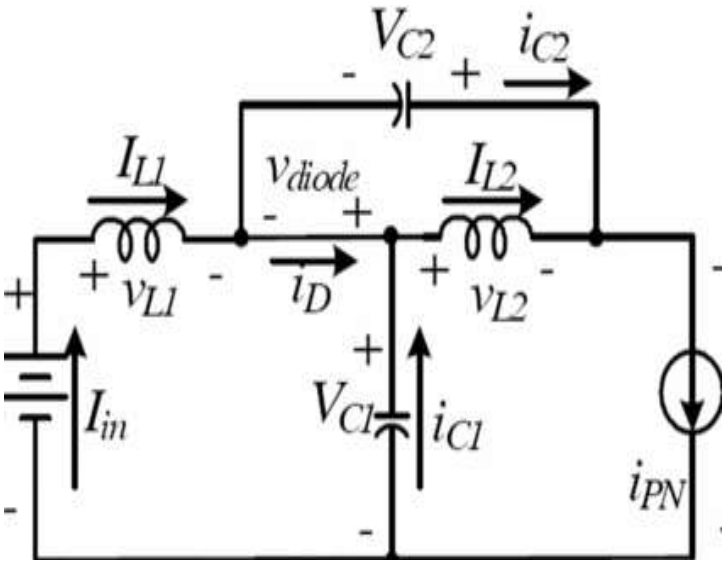

Fig.4 Non Shoot Through Stage

The voltage and current polarities are depicted in the above Fig.4. Assuming, During one switching cycle is T, the interval of shoot through state is T_0, non shoot through state is T_1 thus the total period is D= $T_0 \div T_1$.

The two capacitor in Z source inverter(ZSI) can be able to sustain the same high voltage, while voltage on the C_2 qZSI is lower capacitor ratting .

The ZSI has discontinues input current boost mode, while the input current of qZSI is continues due to input inductor L_1,which will efficiently reduce the input stress.

III. Design of Quasi Network

A. INDUCTOR DESIGN

During non shoot through mode capacitor voltage is always equal to input whereas voltage across inductor is zero. During shoot through mode there is linear increase in current across inductor and voltage across inductor and capacitor is equal. Average current through inductor is given by,

$$I_L = \frac{P}{V_{dc}} - - - - - - (1)$$

Where,

P - is total power

V_{dc} - is input voltage

The Maximum current flows through inductor only when maximum shoot through happens that results in maximum ripple current.

The Average capacitor voltage is given by

$$V_C = \left(1 - \frac{T_0}{T}\right) * \frac{V_{dc}}{1 - \frac{2T_0}{T}} - - - - - - (2)$$

$$L_1 = L_2 = \left(0.1 * 10 * \frac{300}{10.67}\right) = 3mH$$

B. CAPACITOR DESIGN

The Capacitor absorbs voltage ripple and maintains constant voltage.

In shoot through state capacitor charges inductor and current through inductor and capacitor is equal.

$$V_c = \left(I_{L(avg)} T_s\right) * \left(\frac{1}{C}\right) - - - - - - (3)$$

- Capacitor voltage ripple is 0.17%.

$C = 6.67 * 0.1 * 10(300 * 0.0017) = 3.401\mu F$

Therefore quasi network consists of inductance and capacitance values as 3mH and 1000µF.

IV. Simulation Results

SIMULINK model has been built in MATLAB for PV generation system for analysis and parameters for simulation are shown in I. Table.

The SIMULINK model of quasi z source inverter with PV array fetched network along with inverter and filter circuit are shown in Fig.4.

I.TABLE
Design Parameter of Proposed System

PARAMETER	VALUE	UNIT
Input Voltage (V_{in})	25	V
Inductor (L_1)	3	mH
Inductor (L_2)	3	mH
Capacitor (C_1)	1000	µF
Capacitor (C_2)	1000	µF
LC Filter (L_F & C_F)	0.06 & 90	H & µF

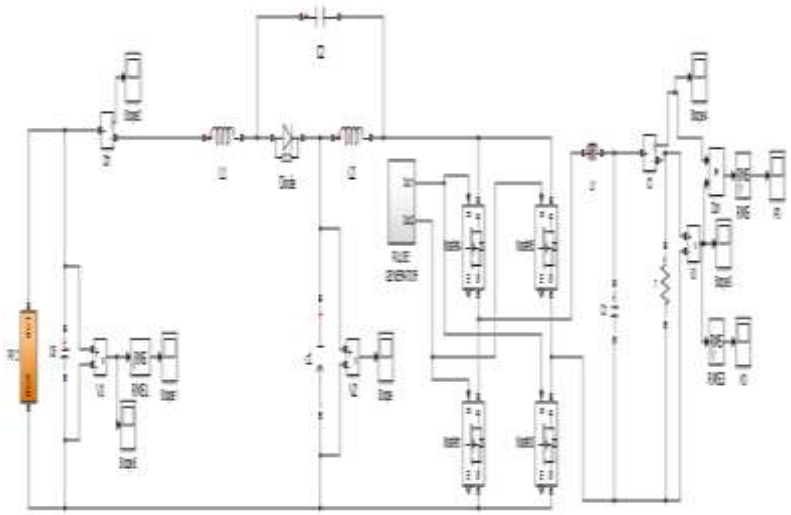

Fig.4 Simulation for the Proposed System

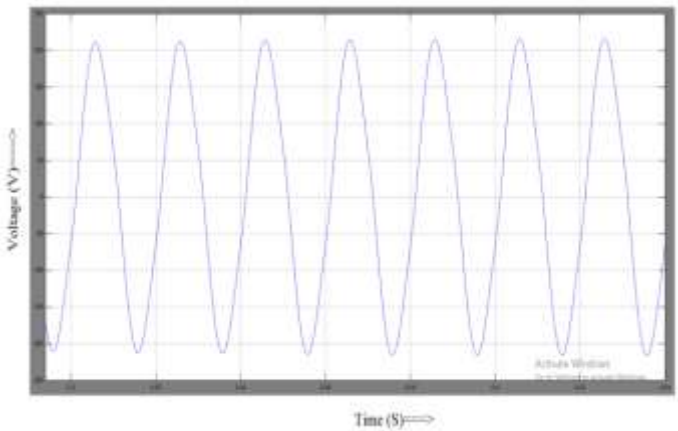

Fig.5 Output Voltage of Proposed System

The above Fig.5 shows the Output Voltage waveform. In this waveform the maximum voltage attains 280V.

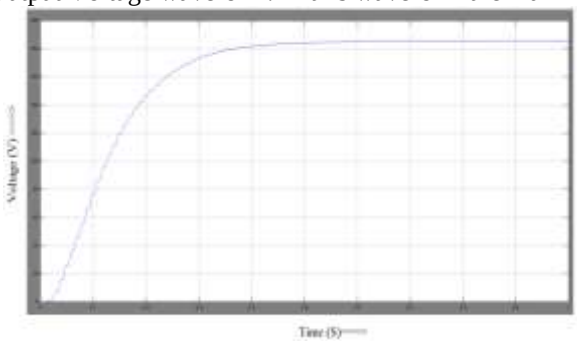

Fig.6 Output RMS Voltage of Proposed System

The above Fig.6 shows the Output RMS Voltage waveform. In this waveform the maximum voltage attains 185V.

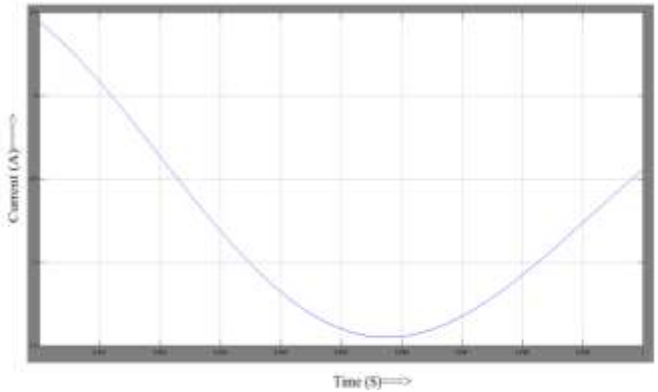

Fig.7 Output Current of Proposed System

The above Fig.7 shows the Output Current waveform. In this waveform the maximum current attains 0.47A.

V. Conclusion

This paper analyses quasi z source inverter which is derived from z source inverter as it includes all advantages of z source inverter. Quasi z source inverter has advantage of reduced component rating and continuous current source.

As solar panel is used with quasi network it encourages usage of solar energy as network gives continuous DC current source for various applications of photo voltaic generation system. With MATLAB simulation output is produced approximately 280V.

The PV generation system is one of promising technique as it increases efficiency of proposed topology as it does single stage of boost and dc to ac conversion with reduced cost.

The Proposed Quasi Z source Inverter system characteristics are analyzed with the help of waveform.

References

[1] Pravin P.Kalubarme,"Quasi -Z-source inverter for photovoltaic power generation systems",India International Journal Of Innovation In Engineering Research And Technology [IJIERT] Issn:2394-3696 Volume1, Issue Dec -2014.

[2] R. Vidhya , R. Aarthi , M. ArunKarthick, B. Aswanth Karthik,P.Hariprakash," Design and implementation of Quasi -Z-Source inverter for off grid photovoltaic Systems", International Journal of computer Science and Mobile Computing ISSN 2320-088X IJCSMC,Vol.4, Issue.3,March,2015,pg.626-633.

[3] Yuan Li, Joel Anderson,Fang Z .peng, and Dichen Liu, "quasi -Z- Source Inverter for Photovoltaic Power Generation Systems", IEEE Transaction on Industry Applications, Vol.19,pp.918-924,2009.

[4] P. C. Loh, D. M. Vilathgamuwa, Y. S. Lai, G. T. Chua, and Y. Li, "Pulse width modulation of Z-source inverters," in Conf. Rec. IEEE-IAS Annu. Meeting, Seattle, WA, 2004, pp. 148–155.

[5] S. Rajakaruna and Y. R. L. Jayawickrama, "Designing Impedance Network of Z-Source Inverters", IEEE Transactions on Industry Applications, vol.42,no.3,pp.1-6,May/June2006.

[6] Poh Chiang Loh, D. M. Vilathgamuwa, Y. S. Lai, G. T. Chua and Y. W.Li, "Pulse-width modulation of Z-source inverters", IEEE Transactions on Power Electronics, Vol. 20, pp. 1346-1355, November 2005.

[7] Fang ZhengPeng, "Z-Source Inverter", IEEE Transactions on Industry Applications, Vol.39,No.2, pp. 504-510, March/April 2003.

[8] MiaosenShen, Alan Joseph,Jin Wang, Peng.F.Z and Donald.J.Adam, "Comparison of Traditional inverter and Z-source inverter", IEEE Trans. Power Electron.,pp.1692-1698 2005.

[9] Haitham Abu-Rub, Quasi-Z-Source Inverter-Based Photovoltaic Generation System With Maximum Power Tracking Control Using ANFIS, ,Senior Member, IEEE, AtifIqbal, Senior Member,IEEE, Sk. Moin Ahmed, Member,IEEE, Fang Z. Peng,Fellow,IEEE, Yuan Li,Member,IEEE, and GeBaoming, Member,IEEE.

[10] W. Bin, J. Pontt, J. Rodriguez, S. Bernet, and S. Kouro, "Current-source converter and cycloconverter topologies for industrial medium-voltage drives," IEEE Trans. Ind. Electron., vol. 55, no. 7, pp. 2786–2797, Jul. 2008

[11] D. N. Zmood and D. G. Holmes, "Improved voltage regulation for currentsource inverters," IEEE Trans. Ind. Appl., vol. 37, no. 4, pp. 1028–1036, Jul./Aug. 2001

[12] H. Xu, F. Z. Peng, L. Chen, and X. Wen, "Analysis and design of Bidirectional Z-source inverter for electrical vehicles," in Proc. 23rd IEEE Annu. Appl. Power Electron. Conf. Expo., (APEC'08), pp. 1252–1257.

[13] M. Zhu, K. Yu, and F. L. Luo, "Switched inductor Z-source inverter," IEEE Trans. Power Electron., vol. 25, no. 8, pp. 2150–2158, Aug. 2010.

[14] R. Strzelecki, M. Adamowicz, N. Strzelecka, and W. Bury, "New type T-Source inverter," in Proc. Compat. Power Electron., (CPE'09), pp. 191– 195.

[15] F. Gao, L. Poh Chiang, R. Teodorescu, and F. Blaabjerg, "Diode-assisted buck-boost voltage-source inverters," IEEE Trans. Power Electron., vol. 24, no. 9, pp. 2057–2064, Sep. 2009.

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