

Extended Boost Converters Using MPPT and Voltage Balancing Control for Photovoltaic quasi-Z-Source Inverter

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Abstract- This project presents a control strategy for the operation of solar energy generation integrated with grid. The photovoltaic voltage and PV current need to be sensed to perform maximum power point tracking (MPPT) control. In this paper, the MPPT control and the voltage balancing control with sensing only inductor current is proposed. It should be noted here that this paper provides a general coverage of the extended boost voltage-fed quasi Z-Source Inverters with continuous input current. All the topologies to be discussed and analyzed have a common property the input inductor L1 that buffer the source current. It means that during the continuous conduction mode the input current of the converter never drops to zero, thus featuring the reduced stress of the input voltage source. capacitor Assisted Extended Boost qZSI.

I. INTRODUCTION

The three-level boost-type converters have the advantage of the low voltage stress, the low inductor current ripple, and the low switching loss. Therefore, the three-level boost converters are widely used in the modern power electronics applications, such as ac/dc PFC application dc/dc PV applications, the fuel-cell applications and the wind energy application. By properly setting the sampling instants of the inductor current sensor, the average inductor current and the voltage imbalance can be detected by the proposed sampling strategy. It means that sensing only PV current (i.e., the inductor current) is able to achieve both MPPT function and the voltage balancing function. Then, both the MPPT and voltage balancing control will be achieved only by using the proposed sampling strategy of sampling the inductor current values. results are provided to verify the proposed methods.

Quasi-Z-source inverter (qZSI) is a new promising power conversion technology perfectly suitable for interfacing of renewable (i.e., photovoltaic, wind turbines) and alternative (i.e., fuel cells) energy sources. To design the Quasi-Z-source inverter (qZSI) with reduced switches used for dc-ac conversion it is utilized for load applications and to grid.

II. THREE-LEVEL BOOST-TYPE CONVERTER

The three-level boost converter for high- efficiency photovoltaic power conditioning system. Different from the existing two-level high boost converter, it has the advantage of high voltage gain and thus it is easy to make a high voltage from a low voltage. The three-level boost converter reduces the reverse recovery losses of the diodes and increases the overall power efficiency. Experimental results show the high performance for resistive load and grid-connected power condition system.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Special Issue 6, May 2015

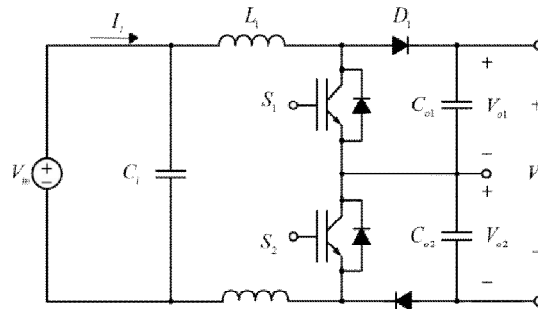


Fig.1 Schematic of three level boost converter

Fig 1 shows the circuit diagram of a three level boost converter. The development trend of photovoltaic PCS is valuing the increase of the capacity and high performance and efficacy. Comparing the proposed three-level boost converter with the conventional two-level converter, three-level converter has the advantages that the voltage gain is increased doubled, and the voltage across the switching element and a diode is to be halved. Also, it has the advantage to equivalently maintain the output voltages of V_{o1} and V_{o2} by controlling the midpoint and to realize the multi-level inverter.

III. QUASI-Z-SOURCE INVERTER

The quasi z-source inverter (QZSI) is a single stage power converter derived from the Z-source inverter topology, employing a unique impedance network the maximum obtainable output voltage cannot exceed the dc input, since they are buck converters and can produce a voltage lower than the dc input voltage. Both Z-source inverters and quasi-Z-source inverters overcome these drawbacks; by utilizing several shoot-through zero states. A zero state is produced when the upper three or lower three switches are fired simultaneously to boost the output voltage. Sustaining the six permissible active switching states of a VSI, the zero states can be partially or completely replaced by the shoot through states depending upon the voltage boost requirement.

Quasi-Z-source inverters (QZSI) acquire all the advantages of traditional Z-Sources inverter

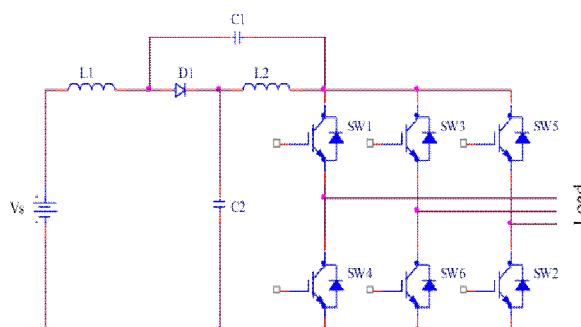


Fig. 2 Quasi- Z source inverter

The impedance network couples the source and the inverter to achieve voltage boost and inversion in a single stage. By using this new topology, the inverter draws a constant current from the PV array and is capable of handling a wide input voltage range. It also features lower component rating.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Special Issue 6, May 2015

ACTIVE MODE

In the non-shoot through mode, the switching pattern for the QZSI is similar to that of a VSI. The inverter bridge, viewed from the DC side is equivalent to a current source. , the input dc voltage is available as DC link voltage input to the inverter, which makes the QZSI behave similar to a VSI.

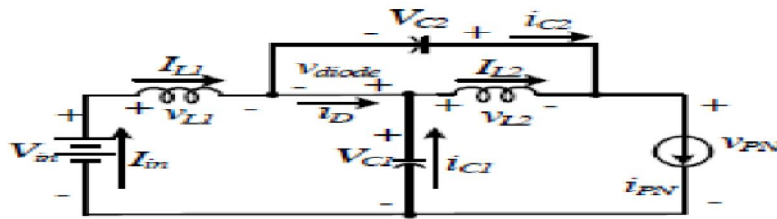


Fig 3 Equivalent circuit of QZSI in Active mode

SHOOT THROUGH MODE

In the shoot through mode, switches of the same phase in the inverter bridge are switched on simultaneously for a very short duration. The source however does not get short circuited when attempted to do so because of the presence LC network, while boosting the output voltage. The DC link voltage during the shoot through states, is boosted by a boost factor, whose value depends on the shoot through duty ratio for a given modulation index.

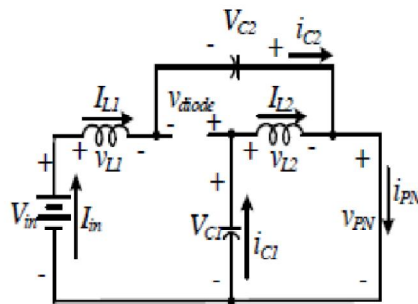


Fig 4 Equivalent circuit of QZSI in Shoot through Mode

PROPOSED OVERALL SIMULATION DIAGRAM

The simulation model is shown in figure 5.1. The proposed model simulation explains PV input given to three level boost converter which converts dc-dc gives as the output. The converter having the inductor circuits which is the current is flown through the circuit. Then only the inductor current is sensed for MPPT control and voltage control. Gate pulse is given to controller circuit is proposed model circuit model which the dc output is obtained from it. Then the circuit is extended for quasi z-source inverter to obtain ac output to the grid and also to run the three phase induction at rated speed. These are simulated by using MATLAB/SIMULINK.

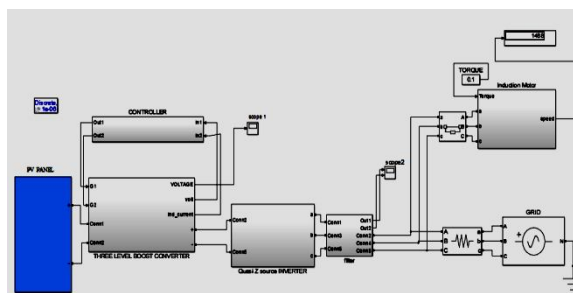


Fig 5 proposed Overall Simulation Diagram

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Special Issue 6, May 2015

TABLE I PARAMETERS OF PV PANELS

Maximum power	480W
Voltage at maximum power	100V
Current at maximum power	4.8A
Open-circuit voltage	117.64V
Short-circuit current	5.33A

TABLE II PARAMETERS OF PV-FED THREE-LEVEL CONVERTER

DC voltage bus	200V
Inductor L	1mH
Capacitor C_1	2420 μ F
Capacitor C_2	1980 μ F
Switching period T_s	12.5 μ s
Deviation Δv_{cont1}	0.002
Controller parameter k_i	0.000025

OUTPUT VOLTAGE WAVEFORM FOR THREE LEVEL BOOST CONVERTER.

The output voltage waveform for three level boost converters is shown in fig 6.3. The output waveform explains boost up output voltage from PV panel. Waveform is drawn for voltage versus time in sec which is having three level output.

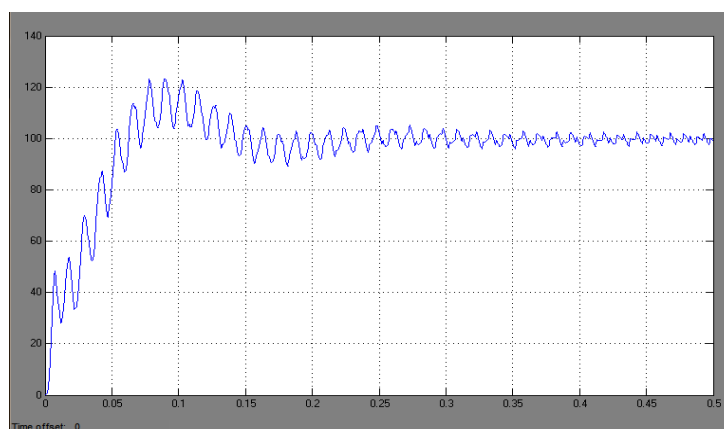


Figure 6 output voltage waveform for three level boost converter.

OUTPUT VOLTAGE AND CURRENT WAVEFORM FROM QUASI Z -SOURCE INVERTER

The figure 7 shows the output current and voltage waveform for quasi z-source inverter. This is proposed output waveform which is the voltage and current waveform versus time sec. 230 v AC obtained from inverter is used for load.

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(An ISO 3297: 2007 Certified Organization)

Vol. 4, Special Issue 6, May 2015

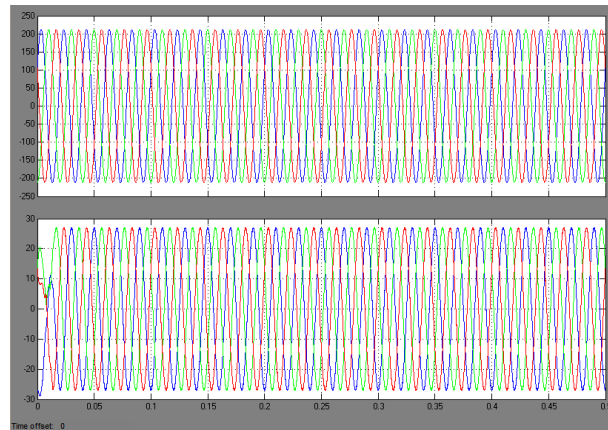


Fig 7 output voltage and current waveform for proposed method.

IV. CONCLUSION

In this paper, the MPPT and the voltage balancing control methods for three-level boost-type converter with extended quasi z source inverter is proposed. By the proposed sampling strategy, the information of the PV power and the voltage imbalance can be provided for the proposed control methods. The simulation and experimental results show that the proposed methods with only sensing the inductor current are able to achieve the desired functions. The proposed methods reduce the sensor count and save the cost. In addition, the proposed voltage balancing control loop can be extended to inverter circuits which needs to avoid voltage imbalance.

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