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Quasi Z Source Cascaded H Bridge Multi Level Inverter using Multi Carrier phase Opposition Disposition

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ABSTRACT: The quasi-Z-source inverter (qZSI) is used to connect to the grid for PV systems. The energy-stored qZSI to overcome this disadvantage and delivers the continuous power to the grid/load. The operating characteristic of the proposed solution is analyzed using multi carrier sinusoidal pulse width modulation. The quasi-Z-source inverter (QZSI) is a single stage power converter derived from the Z-source inverter topology, employing an impedance network which couples the source and the inverter to achieve voltage boost and inversion. The voltage boost and inversion, and energy storage are integrated in a single stage inverter. Simulations of the circuit using simple boost control method have been performed in MATLAB/Simulink and the results are verified.

I. INTRODUCTION

Multilevel inverters include an array of power semiconductors and capacitor voltage sources, the output of which generate voltages with stepped waveforms. Multilevel inverter is widely used in high power applications such as large induction motor drives, UPS systems and Flexible AC transmission Systems. Desired output can be obtained from several levels of input DC voltage sources and also the output levels depends on the number of input DC voltage sources. The multilevel inverters offer several advantages over a conventional two level inverters such as lower semiconductor voltage stress, better harmonic performance, low Electro Magnetic Interference (EMI) and lower switching losses.

But the drawback of MLI is that its output Voltage is limited to the sum of the dc input sources. Therefore, to boost up the voltage, a DC-DC converter is required as a intermediate converter. To overcome this drawback, a Z-source and quasi z source based multi-level inverter can be used which can perform boost or buck operation.

Cascaded H Bridge multilevel inverter with Quasi Z network can be implemented to obtain both inversion and boost capability in a single stage.The output voltage can be controlled using modulation index and shoot through state

II. PROPOSED SYSTEM

The quasi z-source inverter has the capability of boosting and inverting the dc voltage in a single-stage, with less no of switches in comparison with a combination of dc booster and multi-level inverter which has two stages. The output voltage of thequasi z source multilevel inverter can be controlled using modulation index and shoot through state. Cascaded quasi Z–Source Multilevel inverter is analyzed with simple boost control modulation strategy.The control technique have been proposed to insert the shoot-through periods in the traditional switching waveform of power switching devices. Impedance source inverter is an inverter which employs a unique impedance network coupled with the inverter main circuit to the power source. Multilevel inverter output is summation of DC inputs.Quasi z source inverter can realize buck or boost and inversion in a single stage.QZSI has advantages of continuous input current, reduced source stress, and lower component ratings when compared to ZSI.

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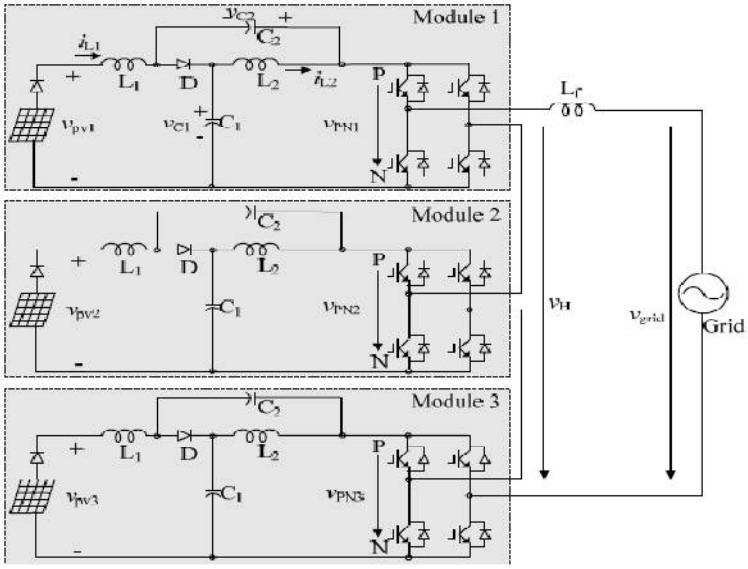

Fig.1: Quasi Z source Cascaded H bridge multi-level inverter

III. OPERATION MODES

- Quasi z source multilevel inverter works in two modes.

1. Non shoot through state.
2. Shoot through state.

1. Non shoot through switching states are

Normal switching states of cascaded H bridge multilevel inverter. Works as normal cascaded h bridge multilevel inverter. $V_{L1} = V_{in} - V_{C1}$, $V_{L2} = -V_{C2}$.

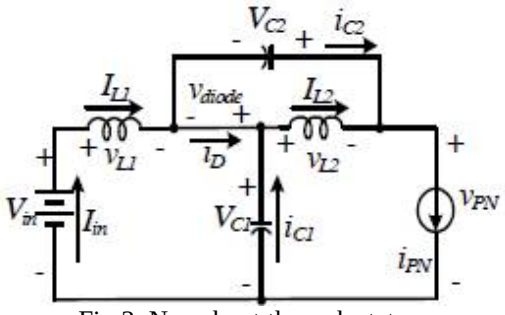

Fig.2: Non-shoot through state

Shoot through state

Switches of same leg of h bridge conducts.Voltage across load is zero.Capacitor c2 discharges through the inductor L1.Boosting of voltage is done

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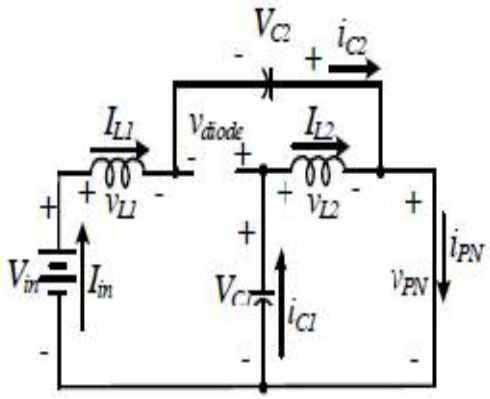

Fig.3: Shoot through state

$$v_{L1} = V_{C2} + V_{in}\ ,\ v_{L2} = V_{C1}$$
$$v_{PN} = 0\ ,v_{diode} = V_{C1} + V_{C2}$$

The multi carrier sinusoidal PWM method is used for the control of the quasi Z source multilevel inverter. Phase opposition disposition method is used for the modulation

Modulation index M $= \frac{A_{ref}}{\frac{n-1}{2} * A_{tri}}$

Where n is the number of levels of inverter and A_{triis} amplitude of triangular carrier wave and A_{ref} is amplitude of reference sine wave.

Shoot through duty ratio D = 1-M

Boost factor B = $\frac{1}{1-2D}$

Voltage Gain G = MB = $\frac{M}{2M-1}$

Simple boost technique is used.In shoot through states, the inductors in the impedance networks are charged by the capacitors while in the non-shoot-through states these inductors along with input DC source discharge through the load. Hence the output voltage is boosted.In Simple Boost technique, the triangular carrier wave will be compared with a constant DC line to produce shoot through. The shoot through states will be produced if the carrier wave amplitude is greater than the DC line.

IV. SIMULATION STUDY RESULTS

The quasi Z source cascaded h bridge multilevel inverter is simulated with multi carrier phase disposition method Modulation index is taken as 0.8 and shoot trough duty ratio as 0.2.the figure shows simulation circuit diagram of quasi Z source cascaded h bridge multilevel inverter.

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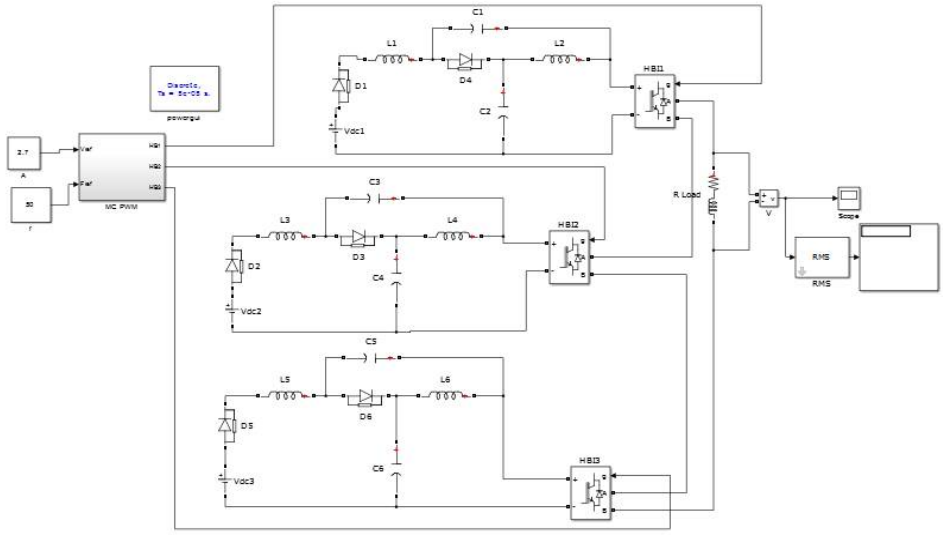

Fig 4: Simulation circuit diagram

Multicarrier phase disposition sinusoidal PWM is used for the control of quasi Z source multilevel inverter and is given in the figure below. The absolute value of sine is taken so instead of six carrier only three carriers are used.

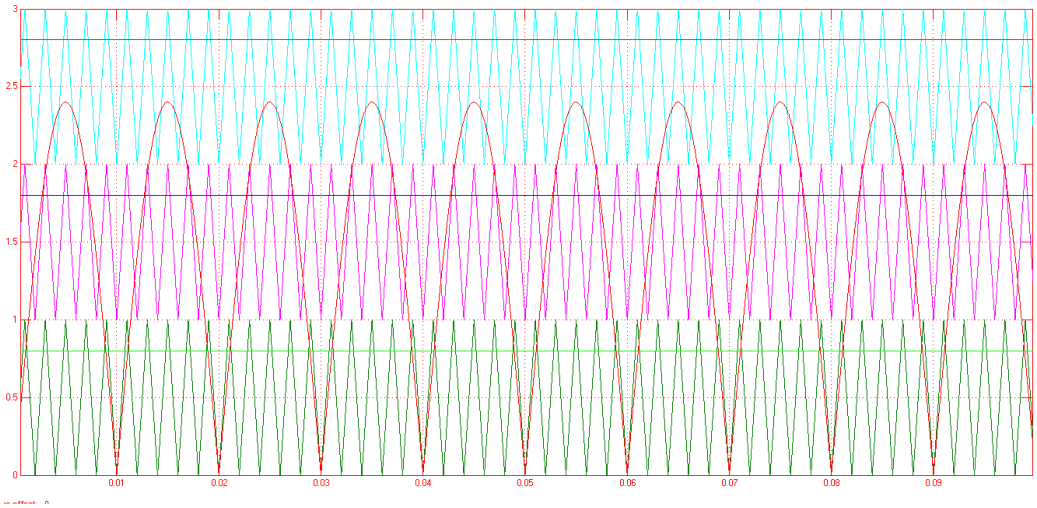

Fig 5: Multicarrier phase disposition PWM

The figure below shows the output of the quasi Z source cascaded h bridge multilevel inverter with 6V input across each bridge. The RMS value of output voltage is obtained as 24 V.

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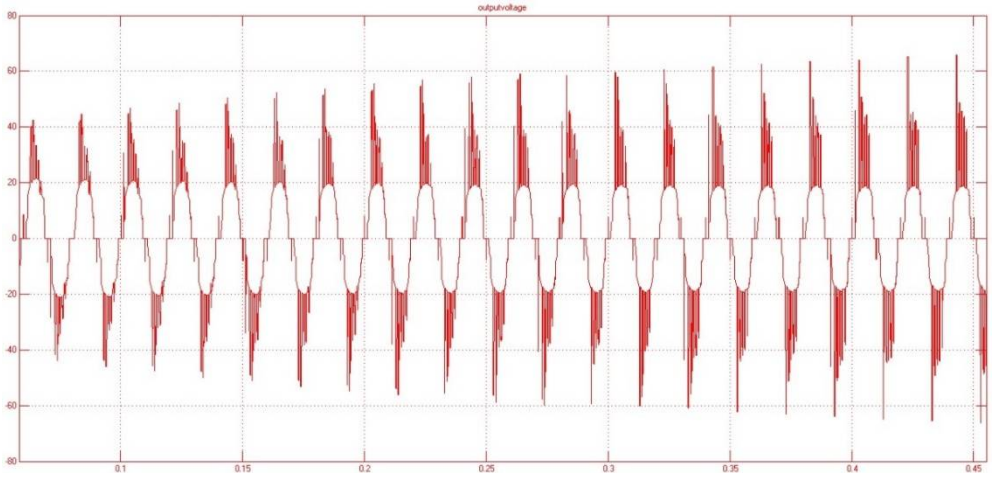

Fig 6 : Output voltage across the load

V. CONCLUSION

The control techniques such as Simple Boost Control (SBC) is applied to for the seven level Quasi Z-source inverter The simulations have been developed in Matlab/Simulink environment for seven levelQuasi Z-source inverter with R L load. Boosting of the output voltage is obtained. Input voltage across each bridge is taken to be 6V and the output obtained is 24V. THD is measured to be 42 %. The experimental set up has been made and tested with 6V input. QZSI inherits all the advantages of the ZSI. It can buck or boost avoltage with a given boost factor. It is able to handle a shoot throughstate,and therefore it is more reliable than the traditional VSI. It isunnecessary to add a dead band into control schemes, which reduces theoutput distortion. In addition, there are some unique merits of the QZSIwhen compared to the ZSI.

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