Three Phase Impedance Source Inverter PWM Control for Solar Power Generation

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***Abstract*- Photovoltaic source (PV) has become the most promising DC sources of the future. We use inverter to convert the dc output of Solar cell to AC in order to utilize it for AC appliances. But the traditional inverters operate in either buck mode or boost mode not in buck-boost mode. Also traditional inverters provides dead band which causes distortion in the output current. The defects of conventional inverters are conquer in the impedance source (Z- Source) inverter. The impedance network injected between the input DC source and inverter six switches will offer the advantage of boosting the DC voltage. Through the impedance network the inverter is capable to buck-boost the input voltage. The elimination of dead band reduces the output current distortion and improves the efficiency.**

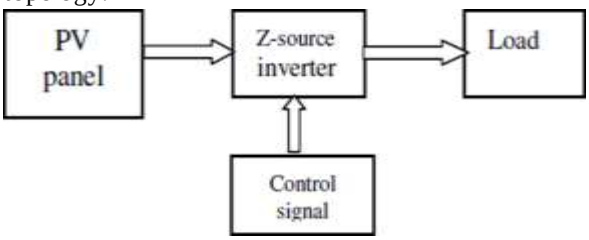
Index Terms- Comparison between Z-source inverter with VSI & CSI Inverters, Z- Source inverter , Pulse Width Modulation. Design of components.

INTRODUCTION

Renewable energy has been gaining its importance due to their small scale, low maintenance, pollution free and clean source of energy than fossil fuel which cause great impact on environment. The photovoltaic technology becomes more popular due to these reasons. PV cells provides consistent DC output. The solar cells are made by semiconductor materials such as silicon. The shortcomings of conventional power generation can be overcome by the renewable energy resources.

The conventional inverters can operate in either buck mode or in boost mode not in buck-boost mode. The output voltage of a photovoltaic cell will vary depending upon the falling light intensity. In conventional inverters the two switches of the same leg cannot be turned on simultaneously. The turn on of two switches of the same leg will short circuit the DC supply called shoot through, which will destroy the inverter. Hence a dead band is provided between the turning on and turning off of the complimentary power switches of the same leg. During dead band time no switches will be on. So this creates distortion in output current of inverter. So both voltage source inverter and current source inverter are not efficiently suitable for solar power generation. In Z-Source inverter an impedance network is injected between the input supply and inverter switches. This impedance network helps to boost the output voltage. The Z-Source inverter exploits the shoot through to boost the voltage output. During turning on of both the superior and inferior switches of same leg the Z-Source inverter works as a boost converter. Because of the usage of shoot through there is no need of dead band so distortion of output current is eliminated.

The Z-Source inverter reduces the cost of inverter by eliminating the need of extra switch which is used in conventional inverters to boost the output voltage. The impedance network behaves like a second order filter to reduce voltage ripples more efficiently than the capacitor filter used in the conventional inverter. The inductor used in the impedance network reduces the inrush current and harmonics which appear on output. The Z-Source inverter concept is applicable to AC to AC, AC to DC, DC to DC, DC to AC power topology.



II - PHOTOVOLTAIC CELL(PV CELL)

PV cells are made by using semiconductor materials, such as silicon. In case of solar cells, a semiconductor

wafer of very thin size is specially treated to form an electric field, positive o and negative. When light falls on the solar cell, electrons are knocked loose from the atoms in the semiconductor material. If the circuit is closed the induced voltage will create an electric current flow. This electrical energy can be used to power a load. The equivalent circuit is shown below. The voltage and current ratings will depend upon the number of solar cells connected in series and parallel respectively.

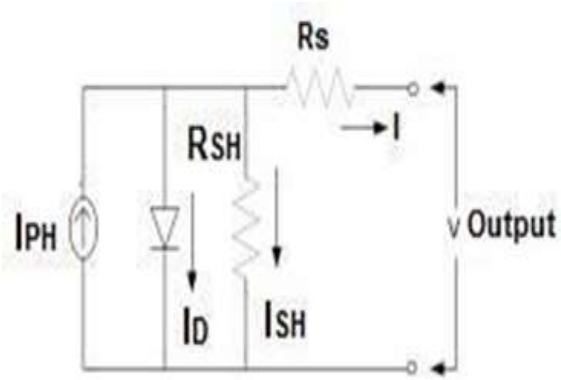


Fig1 -Equivalent circuit

III. COMPARISON BETWEEN VSI, CSI, ZSI

Between the input and switches will help to buck-boost the supply The conventional inverter VSI is a type of inverter which its have a low impedance input voltage source and its output voltage is independent of load. Hence, the V-source inverter is a buck (step-down) inverter for DC-to-AC power conversion and the V-source converter is a boost (step-up) rectifier (or boost converter) for AC-to-DC power conversion. In applications where over drive is desirable and the available dc voltage is limited; an additional dc-dc boost converter is needed to obtain a desired ac output. CSI is a type of inverter which its have high impedance input current source and its output current is independent of load. Therefore, the CSI inverter is a boost inverter for DC-to-AC power conversion and the I-source converter is a buck rectifier (or buck converter for AC-to-DC power conversion. They are either a buck or a boost converter and cannot be a buck–boost converter that is, their obtainable output voltage range is limited to either greater than or smaller than the input voltage. Their main circuits cannot be interchangeable. Both these conventional inverters can either work in buck mode or in boost mode not in buck-boost mode. The output voltage of solar cell is varying according to the intensity of falling light. So for the efficient use of solar cell the inverter which is using at solar power generation should have the capability to buck - boost the supply . In conventional inverters the two switches of the same leg cannot conduct at the similar time. The turn on of two switches of the same leg will create a short circuit to the input supply and that will damage the entire inverter. This is called shoot through. In order to prevent shoot through a dead band is provided in between the turning on and turning off of the two complementary switches of the same leg. During dead band no switches will be conducting, so the dead band causes distortion in the output current. The voltage of conventional inverters can be boosted by using an external boost converter in between the input supply and inverter switches. But the usage of additional switch increases the cost also the dualistic configuration decreases the conversion efficiency. In other words, neither the voltage source converter main circuit can be used for the I-source converter, nor vice versa. They are vulnerable to the EM noise in terms of reliability. Thus in order to overcome the above drawbacks and the difficulties that are in conventional inverter are overcome in impedance source inverter.

The voltage source inverter circuit cannot be used for the current source converter and vice versa. In order to overcome the limitations of traditional inverter, a z-source inverter uses a source network to replace the traditional dc-link voltage distortion while operating with either the small source inductor or light load. This decreases the performance of the inverter output voltage. The Z-Source inverter utilizes the shoot through so no need of dead band, the elimination of dead band reduces the distortion of output current. The impedance network injected in be.

The paper summarizes the objectives of ZSI performance

The z - network of inductors and capacitors eliminates all the beyond stated problems and it do not requires extra switch. The networks behave like a second order filter to reduce voltage ripples more effectively than capacitor used in traditional inverter. The inductor in a z network reduces the inrush current and harmonics in the current. It is a distinct configuration and it has capability to recover the output voltage of the inverter

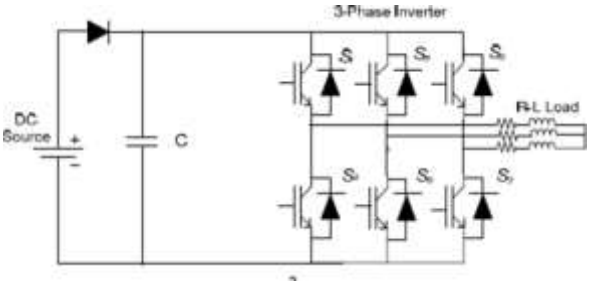


Fig 1: conventional VSI

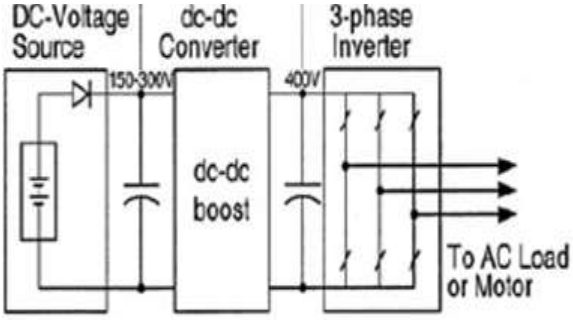


Fig 2: representation of dc-dc boost invereter

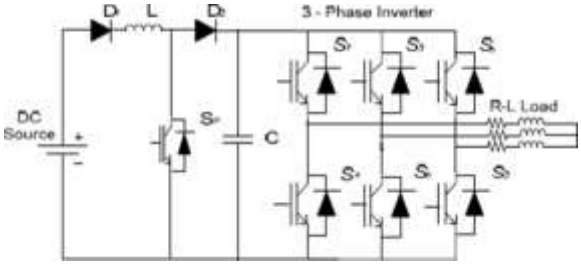


Fig 3: dc-dc boost inverter circuit

The middle portion of fig 3 is an external boost converter connected in between the input supply and three phase inverter switches. The inductor L helps to boost the voltage.