PV BASED SINGLE PHASE ZSI USING SHOOT THROUGH TECHNIQUE

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ABSTRACT - This paper presents a single phase impedance source inverter supplied by photovoltaic. limitation of traditional voltage source inverter and current source inverter are remove by using impedance source inverter. This impedance source inverter which is control by the shoot through duty cycle. In this paper the hardware design of single phase light bulb is connected as load to impedance source inverter. The shoot through state is obtained when both lower and upper switches are in same phase and turned ON.

Keyword: ZSI, CSI, VSI etc..

INTRODUCTION

Renewable energy resources has more attractive specially in photovoltaic cell. The solar cell technologies improve the efficiency and reduce the production cost of a photovoltaic cell. Solar cells are used today in many applications such as satellite power systems, battery charging etc. They have many advantages such as less maintenance cost and pollution free. But their installation cost is high and in most applications, it require a power conditioner for load interface. Therefore photo voltaic modules have relatively low conversion efficiency, hence using high efficiency power conditioners overall system cost can be reduced. In Power electronics inverters for renewable energy require both voltage boost and buck capabilities for load current and supply voltage variation. A simple way of implementing boost and buck inverter is to cascade a dc-dc converter to either a boost current source inverter or buck voltage source to form a two stage power conversion solution. This cascaded topology usually gives rise to increased system complexity and reduced reliability. Traditional CSI and VSI support only current buck Direct current to alternating current power conversion and require a relatively complex modulator.

An alternative to the traditional VSI and CSI proposed single stage Z-source inverter. Z-source inverter introduce a unique LC impedance network between its input source and inverter circuitry. power loss is reduced due to low number of switching devices is used. The ZSI has a unique buck-boost capability which gives to output voltage varies from zero to infinity. The range of output voltage is decided on the input voltage. The output voltage range is obtained from a unique switching state termed as shoot through state. The ZSI has two operating mode such as, shoot through mode and non shoot through mode. In impedance source network value of inductor and capacitor play important role. The voltage boost depends on the rating of inductor and capacitor value and also depend on shoot through time period. The value of impedance source network is not calculated properly then the required amount of boost will not be obtained at output side which causes adverse effects in term of rippeles. Different boosting technique are used but in this paper present prototype model use maximum boost control technique is used. In ZSI topologies which ZSI modulation is used is depend on the PV voltage conditions. It is divided in two types such as voltage fed ZSI and current fed ZSI. when the PV voltage is sufficiently higher than peak line-to-line grid voltage then VSI modulation will be used. Then shoot-through switching states will also be used. On the other side when the PV voltage is lower than 0.866 of the peak line-to-line grid voltage then the CSI modulation will be used. Then open-circuit switching state will also be used. This shoot-through switching states and open-circuit switching states are implemented during every vector transition. In VSI and CSI modulation have the same number of switching per switching period.

Solar PV system is divided into two type that are stand-alone PV system and grid connected PV system. PV cells produce electric dc voltage or current or power which cannot be connected directly to the AC grid. Facilitate this connection a power converter that convert DC power delivered at variable voltage and current to AC power, known as grid-tie PV inverter. This grid-tie PV inverter required to have high efficiency. From PV cells achieve full amount of available power. Transmit that power into the grid with the lowest losses. In practical operate at maximum voltage of PV cells. grid-tied PV inverter operate efficiently in the low PV voltage region. Considering efficiency of grid-tied PV inverter use transformerless technology which is suitable solution for reduce solar PV electricity cost. Transformerless grid-tied PV inverter can be single or three phase configuration. For lower PV power generation use single phase inverter (upto 5KW). In three phase inverter used power upto 10-15KW. single phase inverter is low in cost as compared three phase inverter. single phase inverter is highly enhances the reliability of inverter because shoot through can no longer destroy the inverter.

SYSTEM DESIGN

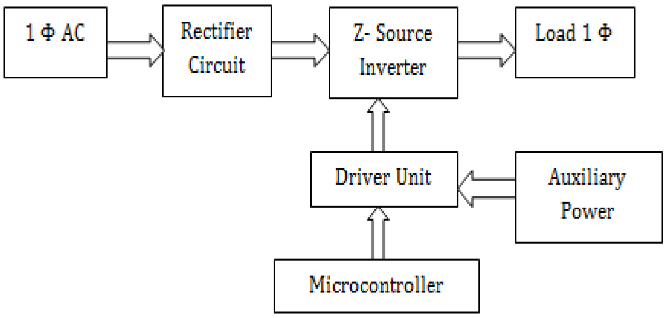

Figure 1: General block diagram of the proposed system

General block diagram of the proposed system is shown in Figure 1 . It explains the whole story about the devices installed and their function in prototype system. The project can be served into two parts: the hardware part and the software part . The overall block diagram of the entire system is shown in the figure1.1. The impedance source inverter has fabricated using IGBT switches and associated circuits and microcontroller. The major components present in the proposed inverter are Impedance network, axillary power supply, phase lock loop synchronization, microcontroller, IGBT, voltage regulator . The operation of the inverter is to boost DC input voltage by means of Z network. The detailed components found in the experimental setup are as Z-network use 4mH inductor and 47μF capacitor. In Driver Circuit use IRF244. In Power and protection circuit use IC UC 3843 and BC 547. IGBT is use for swiches. The complete hardware setup of the proposed inverter is shown with lamp load. IGBT use for the purpose of DC to AC inverter is to convert DC voltage to pure sinusoidal output voltage in applications such as UPS, Solar inverter and frequency converter. The switching frequency of the highside and lowside is 20 KHZ to 60 KHZ respectively. In this software of MPLAB is used for program.

Requirement of Z-Network Components

In Traditional source inverter DC capacitor is the energy storage and filtering element to suppress voltage ripple and store temporary storage and dc inductor is storage or filtering element to suppress current ripple and stored temporary storage. The Z source network is a combination of capacitor and inductor. This combine circuit is the energy storage or filtering element for the Z source inverter. The Z source network provide a second order filter and its more effective to suppress V and I ripples than C or L.

In Z source network considering additional filtering and energy storage by the capacitor it should require less inductance and smaller size compared with traditional source.

For z-source inverter Several control methods have been proposed such as simple control, maximum boost control, and maximum constant boost control. Compared with a traditional voltage source inverter, the Z-source inverter has an extra switching state which is shoot-through. During the shoot-though state, the output voltage to the load terminals is zero, the same as traditional zero states. Therefore, to maintain sinusoidal output voltage, the active-state duty ratio has to be maintained and some or all of the zero states turned into shoot-through state.

HARDWARE

The main hardware figure is shown below in figure 1. In this main hardware prototype model use major component such as IGBT, auxiliary power supply, DSP, microcontroller, LCD and ZSI are connected.

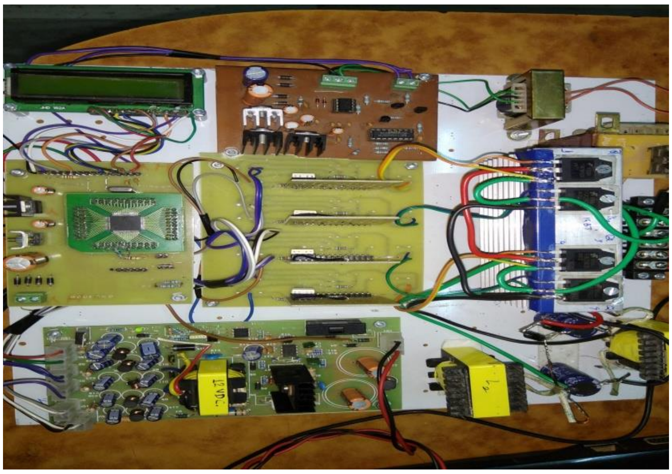

Figure 2

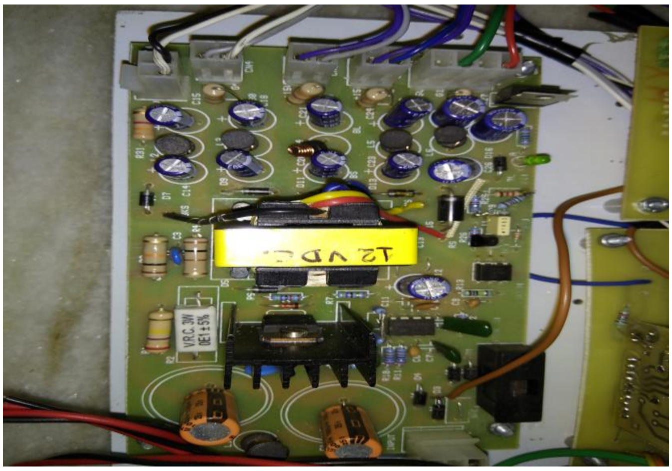

Figure 3

The auxiliary power supply circuit is shown in figure 3.In auxiliary power supply use four different isolated supply. One supply is given to the DSP and another supply is from main supply.

Figure 4

The above figure 4 shows connectivity of Microcontroller with PWM.

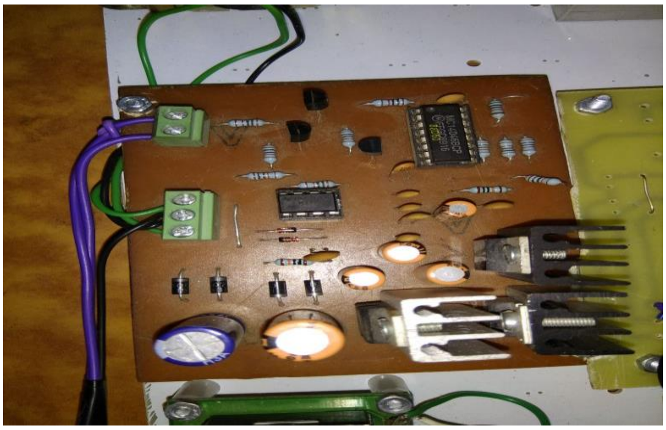

Figure5

In above figure 5, the voltage regulator is used for giving 5V supply at the output of LM311.

RESULTS AND DISCUSSION

The results obtain from the parameter shown in table 1. The hardware setup was fed from AC mains using transformer. The input AC was rectified to DC. The output of rectifier through a capacitor was connected to the impedance network and then to bridge inverter using IGBT.

Figure 6 SQUARE WAVEFORM

Figure 7 GATE PWM WAVEFORM

Figure 8 GATE SHOOT THROUGH WAVEFORM

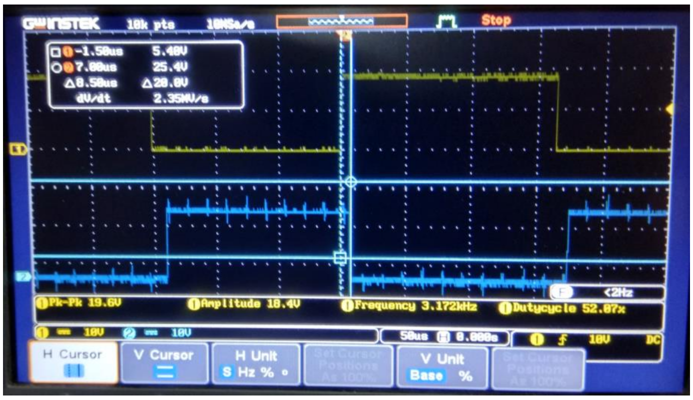

Figure 9 SIMPLE INVERTER GATE WAVEFORM

Figure 10 FINAL OUTPUT WAVEFORM

Table 1: Z Components

Sr. No.	Components	Values
1.	L1=L2	4mH
2.	C1=C2	47μF
3.	Switching frequency and modulation index	6.4Khz and 1.2
4.	Resistive load	50 Watt
5.	DC supply	34 V

CONCLUSION

The high power output of the Z source inverter proves that flexibility and reliable conversion which cannot be achieve by traditional source inverter. Z source inverter undergo single stage power conversion while in traditional inverter it is two stage. It help in prevent the damage of inverter circuit during short circuit condition and also use to boost the output voltage.

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