

Single Phase PWM Inverter With Close Loop Dc-Dc Boost Converter For Solar Application

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Abstract: *this paper presents with the design and development of close loop dc-dc boost connected single phase PWM inverter for stand-alone solar application with the help MATLAB simulation.*

In this paper effective method is used to implement single phase solar two level PWM inverter by using solar cell or (dc-battery). Solar cell converts solar energy into electrical energy. This electrical energy is in DC form. This dc voltage is boosted using dc to dc boost converter with the help of close loop so, any change in solar irradiation, output of close loop dc-dc boost converter would be constant. Here converter will be used to convert 24 volts to convert 326 volts. This boosted dc voltage is fed with the two level PWM inverter and that converts dc voltage into ac voltage. The output of inverter is given to low-pass filter which will give 230 volts (RMS), 50Hz pure sinusoidal output. And finally this output is given to the load.

Key words: close loop dc-dc boost converter, PWM inverter and simulation.

I. INTRODUCTION

With the increasing of the world's energy shortage and environmental pollution

problems, protecting the energy and the environment becomes the major problems for human beings. Thus the development and application of clean renewable energy, such as solar, wind, fuel cell, tides and geothermal heat etc., are getting more and more attention. Among them, solar power will be dominant because of following factors: (1) increasing efficiency of solar cells (2) manufacturing technology improvement (3) economies of scale. As predicted by [1], the solar will provide the electricity up to 64% of the total energy by the end of this century.

In PV based inverter we cannot get constant dc output from solar panel due to variation in solar irradiation during morning to evening. As the solar panel voltage varies according to weather so to make output of dc-dc boost converter constant close loop control of dc-dc boost converter is required.

II BLOCK DIAGRAM OF THE SYSTEM

Fig1. Shows a basic schematic block diagram for single phase PV based inverter for small-scale stand-alone generation plant for household electric supply.

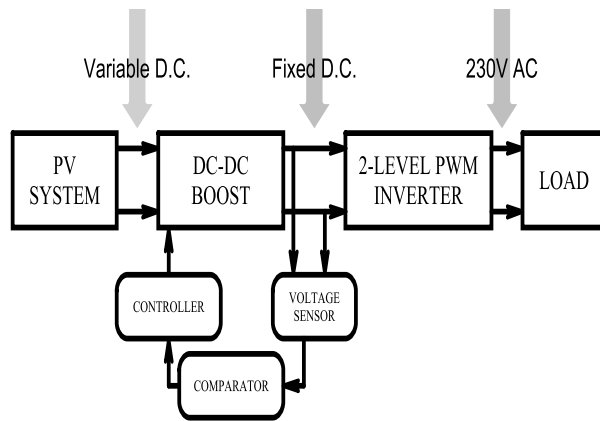


Fig 1. basic schematic block diagram for single phase PV system

Block diagram of single phase solar inverter is shown in Fig 1. Solar panel gives small range DC output and it is necessary to step up this output that is why dc-dc boost converter is required. So, dc to dc boost converter converts variable input (18V to 24V) dc voltage to fixed 326V dc with the help of close loop so, any dc input (18V to 24V) boost converter output would be constant. This dc voltage is converted to ac voltage using two levels PWM inverter and inverter gives 230 volts (RMS). It is also called distribution side generation. [2] A distributed power unit can be connected directly to the consumer or to a utility's transmission or distribution system

III. CLOSE LOOP DC-DC BOOST CONVERTER

The following four parameters are needed to calculate the power stage [3]-[4]:

- (1). Input Voltage Range: V_{in} (min) and V_o (max) = 18 to 24 volts
- (2). Nominal Output Voltage: $V_o = 326$ volt
- (3). Maximum Output Current: I_{out} (max) = 1.4A.

(4). Integrated Circuit used to build the boost converter.

To achieve constant output from boost converter close loop is necessary fig.2 shows close loop dc-dc boost converter. For that purpose designed value of inductor and capacitor should be $L = 0.00003H$ and $C = 0.0001F$ respectively.

In close loop PI controller is program to control the Pulse Width Modulator (PWM) like the function of function generator and added by the feedback control [5]. The circuit operates when the boost circuit get a input power of 24Vdc from the solar panel and the circuit element are construct to produce an output voltage of 326Vdc.

PI is program to produce suitable PWM to the driver of power switches (MOSFET) and the output is then feedback to the controller to compare to a desired output value as shown below.

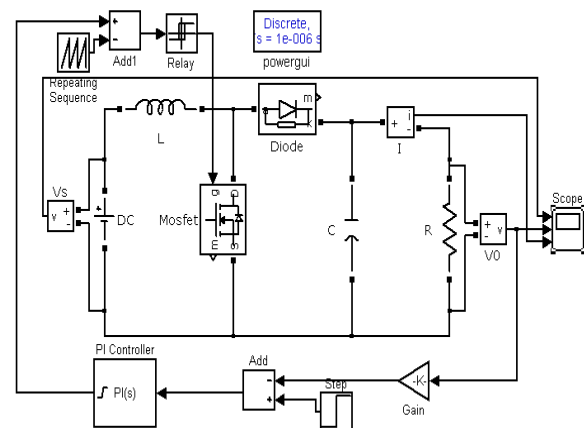


Fig.2 close loop boost converter

IV OUTPUT RESULTS OF CLOSE LOOP DC-DC BOOST CONVERTER

Fig.2.1, fig.2.2 and fig.2.3 shows output result of close loop dc-dc boost converter. Here we observed that output

voltage waveform for different input voltage. In fig. 2.1 input voltage $V_{in} = 18V$, we got output voltage $V_{out} = 320V$, in fig. 2.2 input voltage $V_{in} = 22V$, we got output voltage $V_{out} = 322V$ and in fig.2.3 input voltage $V_{in} = 24V$, we got output voltage $V_{out} = 325V$ as shown bellow.

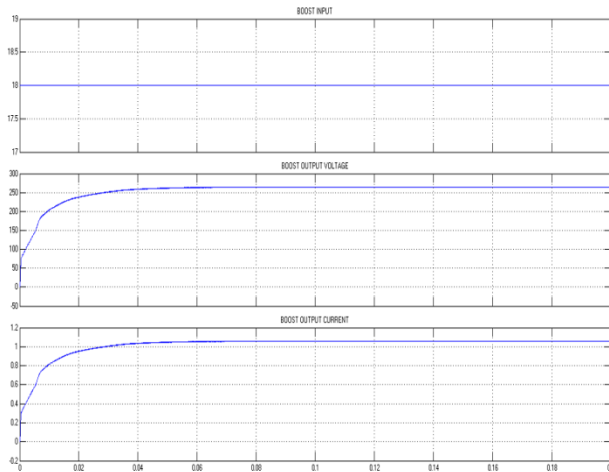


Fig. 2.1 close loop boost output waveform ($V_{in}=18$)

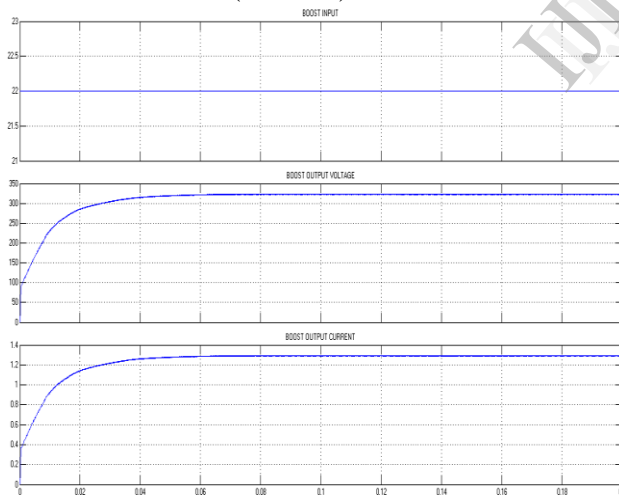


Fig. 2.2 close loop boost output waveform ($V_{in}=22$)

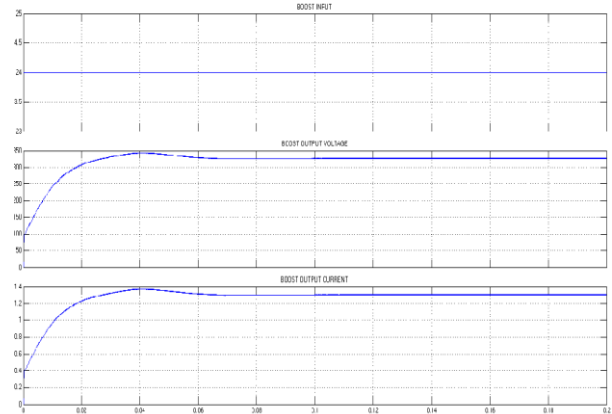


Fig. 2.3 close loop boost output waveform ($V_{in}=24$)

From above fig. 2.1, 2.2 and 2.3 we observed that in close loop dc-dc boost converter output voltage is almost constant with change input voltage in the range (18V to 24V).

V TWO LEVEL PWM INVERTER

PWM signal is generated by feeding a reference and a carrier signal through a comparator which creates the output signal based on the difference between the two inputs. The reference is a sinusoidal wave at the frequency of the desired output signal. The carrier wave is a triangle or 'saw tooth' wave which operates at a frequency significantly greater than the reference wave. When the carrier signal exceeds the reference the output is at one state, and when the reference exceeds the carrier the output is at the opposite state. Fig.3 shows simulation of two level H-bridge inverter with PWM [6]-[7].

Filter block are required for getting nearer sine wave. A low-pass filter is an electronic filter that passes low-frequency signals and attenuates (reduces the amplitude of) signals with frequencies higher than the cutoff frequency the actual

amount of attenuation for each frequency varies from filter to filter [8].

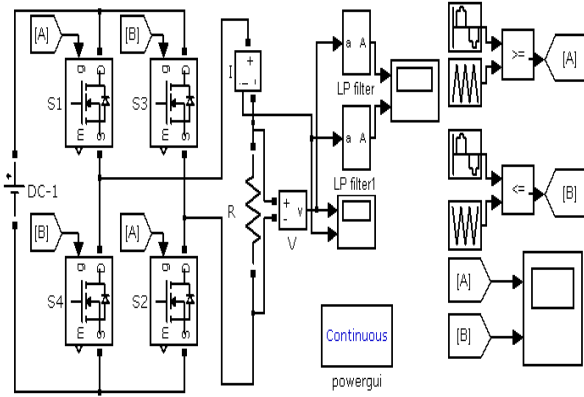


Fig.3 simulation of two level H-bridge inverter with PWM

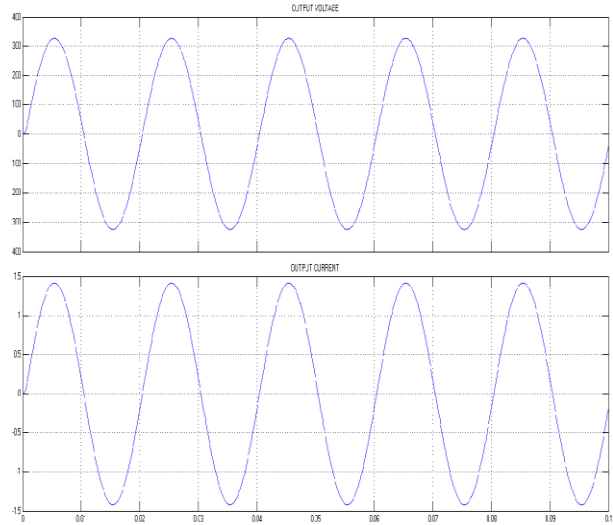


Fig.3.2 filtered output of two levels H-bridge inverter with PWM.

VI SIMULATION RESULTS OF TWO LEVEL PWM INVERTER

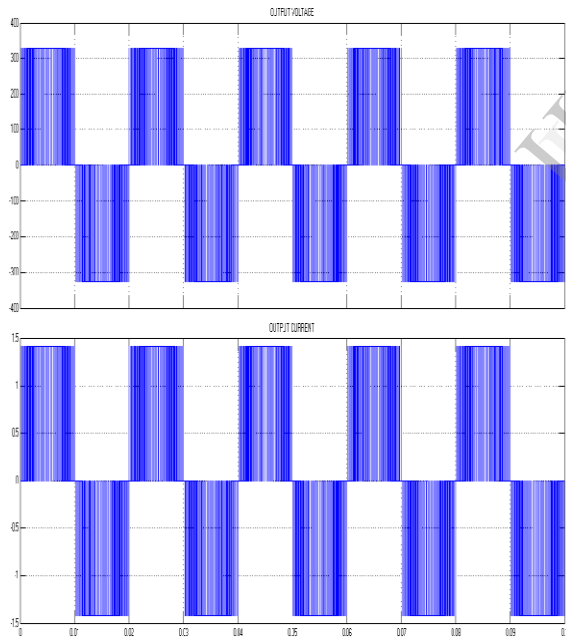


Fig.3.1 output of two level H-bridge inverter with PWM

From the above simulation results we observed that by using PWM technique we got desired output voltage waveform with the help of filter. Here we got 324V output voltage and it is a peak value. So, its RMS value is 230V.

VII SIMULATION RESULTS OF CLOSE LOOP DC-DC BOOST CONNECTED INVERTER

Fig. 4 shows whole system simulation. Here, two levels PWM inverter is directly connected with the close loop dc-dc boost converter. The circuit operates when the boost circuit get a input power of (18V to 24V) dc from the solar panel and it gives output voltage of 326Vdc and which is directly connected with the inverter to getting 230V(RMS) ac voltage waveform.

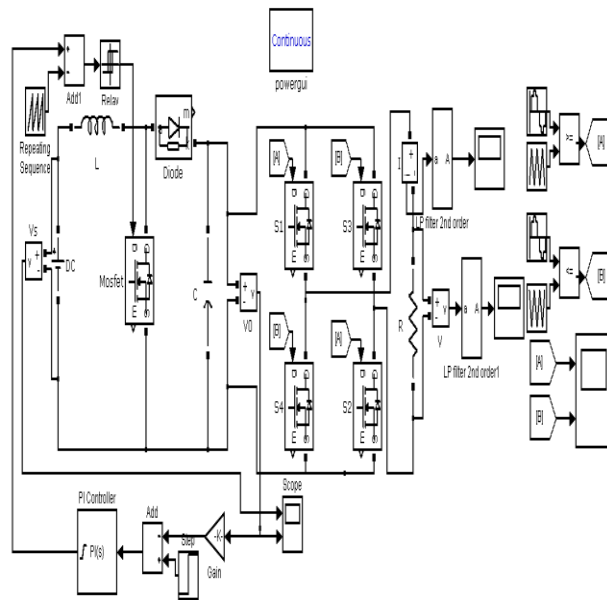


Fig.4 close loop dc-dc boost converter connected inverter.

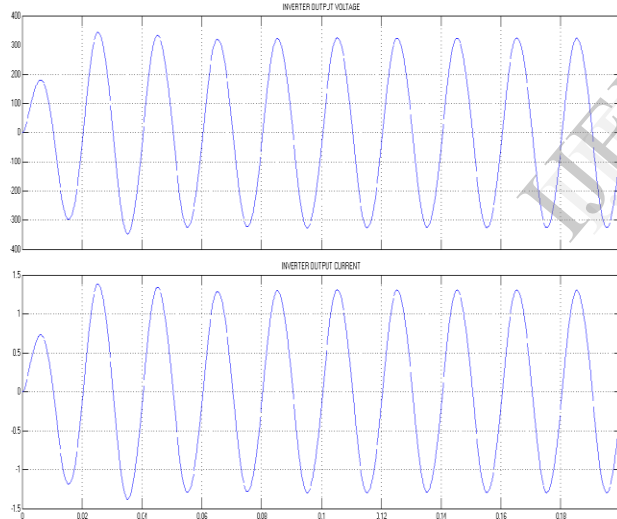


Fig. 4.1 output waveform of two level PWM inverter with using R-C filter block.

VIII CONCLUSION

From the simulation of close loop dc-dc boost converter we kept output dc voltage constant and get desired output

results from the inverter. Single phase PV based dc-dc close loop boost connected inverter is low cost compact in size and easy to installation

IX REFERENCE

[1] German Advisory Council on Global Change WBGU Berlin 2003 www.wbgu.de; Renewable Energy Policy Network for the 21st Century, Renewable, Global Status Report 2006.

[2] Distributed Power Coalition of America. "What is Distributed Power?" <http://www.distributedgeneration.com/dpca/what.html>.

[3] K.B. Khanchandani , and M.D. Singh, *Power Electronics*, New Delhi: Tata Mcgrawhill, 2005.

[4] Texas Instruments.Application Report of SLVA372B–November 2009–Revised July 2010 Basic Calculation of a Boost Converter's Power Stage Low Power DC/DC Application by Brigitte Hauke

[5] "Analysis of Boost Converter Using PI Control Algorithms" Mitulkumar R. Dave and K.C. Dave.

[6] K.B. Khanchandani , and M.D. Singh, *Power Electronics*, New Delhi: Tata Mcgrawhill, 2005

[7] "power electronics"(sinusoidal pulse width modulation) K.B.. khanchandani second edition page no:557.

[8] Texas Instruments. Application Report of Active Low-Pass Filter Design.