RESEARCH ARTICLE OPEN ACCESS

Application ofBoost Inverter to Multi Input PV system

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Abstract:
With the shortage of the energy and ever increasing of the oil price, research on the renewable and green energy sources, especially the solar arrays and the fuel cells, becomes more and more important. How to achieve high step- up and high efficiency DC/DC converters is the major consideration in the renewable power applications due to the low voltage of PV arrays and fuel cells. The conventional boost converters increase the harmonics rate and add an extra stage of power conversion. This paper proposes a boost dc-ac inverter that can invert and boost the output voltage in a single stage. In this paper the proposed boost dc-ac inverter is applied to the solar power panels and is simulated using Simulink. The output results of the boost inverter are worthy promising.

I. Introduction:

The massy usage of the fossil fuels, such as the oil, the coal and the gas, result in serious greenhouse effect and pollute the atmosphere, which has great effect on the world. Meanwhile, there is a big contradiction between the fossil fuels supply and the global energy demand, which leads to a high oil price in the international market recently. The energy shortage and the atmosphere pollution have been the major limitations for the human development. How to find renewable energy is becoming more and more exigent. Photovoltaic (PV) sources are one of the significant players in the world's energy portfolio and will become the biggest contributions to the electricity generation among technology with high reliability. The output voltage of the panel isat low level[4]. Hence traditionally we use a boost converter that can suitably increase the output voltage required for the applications. This process involves an added extra stage for this conversion. On the other hand the propose converter hasan advantages that both boosting and inversion is done in the single stage.

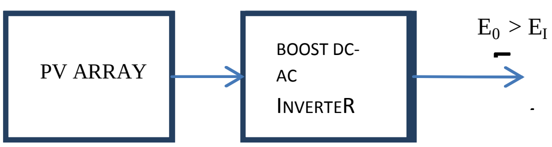

Fig 1: Basic approach of DC-AC conversion

II. Solar cell:

Solar cells, also called photovoltaic or PV cells, change sunlight directly to electricity. When sunlight strikes the solar cell, electrons are knocked loose. They move toward the treated front surface. An electron imbalance is created between the front and back. When the two surfaces are joined by a connector like a wire, a current of electricity travels between the negative and positive sides. Solar energy can be used to heat our homes, heat water, cook our food, and power our lights. Solar cells are used to power calculators and watches as well as lights, refrigerators, and even cars . Typical silicon PV cell is composed of a thin wafer consisting of an ultra-thin layer of phosphorus-doped (N-type) silicon on top of a thicker layer of boron-doped (P-type) silicon. An electrical field is created near the top surface of the cell where these two materials are in contact, called the P-N junction. When sunlight strikes the surface of a PV cell, this electrical field provides momentum and direction to light-stimulated electrons, resulting in a flow of current when the solar cell is connected to an electrical load Regardless of size, a typical silicon PV cell produces about 0.5 – 0.6 volt DC under open-circuit, no-load conditions. The current (and power) output of a PV cell depends on its efficiency and size (surface area), and is Proportional to the intensity of sunlight strikingthe panel.

III. PV-MODULE AND INTERCONNECTION:

Solar cells are rarely used individually. Rather, cells with similar characteristics are connected and encapsulated to form modules (arrays) which, in turn, are the basic building blocks of solar arrays. These arrays can be either be connected in series combination or parallel combination that depends upon requirement. To get required voltagerating, the arrays are connected in series, and to get required current rating, the arrays are connected in parallel as shown in the figure.

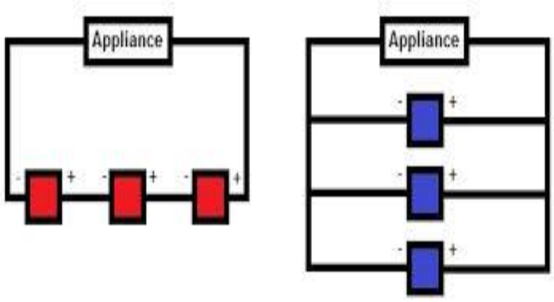

Fig2: interconnection of PV arrays

IV. Boost DC-AC inverter topology

The proposed boost inverter achieves dc-ac conversion, as indicated in Fig. 3, by connecting the load differentially across two dc-dc converters and modulating the dc-dc converter output voltages sinusoidal. A and B represent dc-dc converters. These converters produce a dc-biased sine wave output, so that each source only produces a unipolar voltage. The modulation of each converter is 180 out of phase with the other, which maximizes the voltage excursion across the load. The load is connected differentially across the converters. Thus, whereas a dc bias appears at each end of the load, with respect to ground, the differential dc voltage across the load is zero.. Thus, the dc-dc converters need to be current bidirectional.

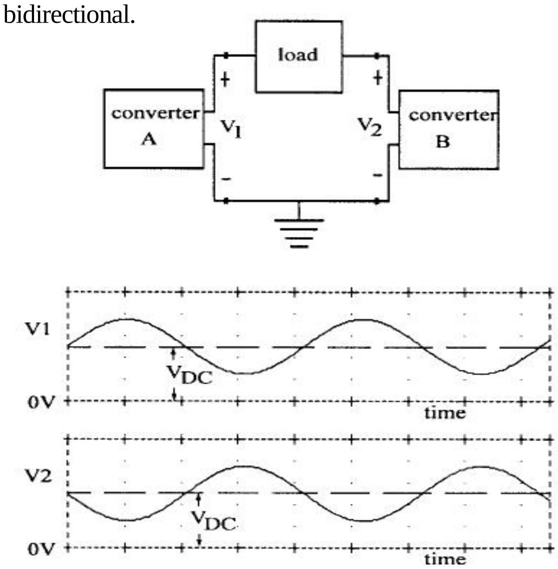

Fig 3.Basic approach for the dc-ac conversion

The current bidirectional boost dc–dc converter is shown in Fig. 5. A circuit implementation of the boost dc–ac converter is shown in Fig. 4. For a dc–dc boost converter, by using the averaging concept, we obtain the voltage relationship for the continuous conduction.

$$\frac{V1}{V\,IN} = \frac{1}{1-D} \quad ------------ \quad (1)$$

where D is the duty cycle. The voltage gain, for the boost inverter, can be derived as follows: assuming that the two converters are 180 out ofphase, then the output voltage is given by[3]

$$V_0 = V_1 - V_2 = \frac{VIN}{1-D} = \frac{VIN}{D} \quad -------------- \quad (2)$$

$$\frac{V0}{VIN} = \frac{2D-1}{D(1-D)} \quad -------------- \quad (3)$$

Boost DC-AC inverter description

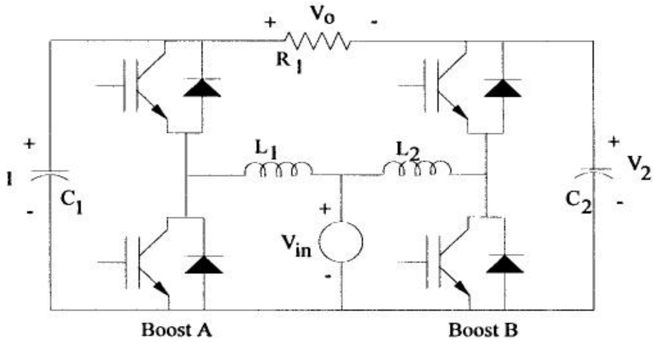

Fig 4: Boost DC-AC inverter

The boost dc-ac converter is shown in Fig. 4. It includes dc supply voltage , input inductors L1& $L_2$and, power switches S_1–S_4 transfer capacitors C1& C_2, and load resistance R_1

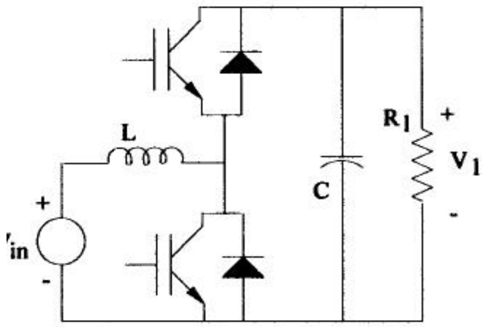

Fig 5.Current bidirectional dc-dc converter

The operation of the boost inverter is better understood through the current bidirectional boost dc-dc converter shown in Fig. 5.

When the switch S_1 is closed and S_2 is and open current i_{L1} rises quite linearly, diode D2 is reverse polarized, capacitor C_1 supplies energy to the output stage, and voltage V_1 decreases. Once the switch S_1 is open and S_2 is closedThe current i_{L1} decrease while capacitor C_1 is recharged. The state-space modeling of the equivalent circuit with state variables and is given by[3]

$$\begin{bmatrix} \frac{di_{L1}}{dt} \\ \frac{dV_1}{dt} \end{bmatrix} = \begin{bmatrix} \frac{-R_a}{L_1} & \frac{-1}{L_1} \\ \frac{1}{C_1} & \frac{-1}{C_1 R_1} \end{bmatrix} \begin{bmatrix} i_{L1} \\ V_1 \end{bmatrix} + \begin{bmatrix} \frac{V_1}{L_1} \\ \frac{-i_{L1}}{C_1} \end{bmatrix} \gamma + \begin{bmatrix} \frac{V_{in}}{L_1} \\ \frac{V_2}{C_1 R_1} \end{bmatrix}$$

$$\dot{v} = \mathbf{A}v + \mathbf{B}\gamma + \mathbf{C}$$

Simulation of DC-AC inverter

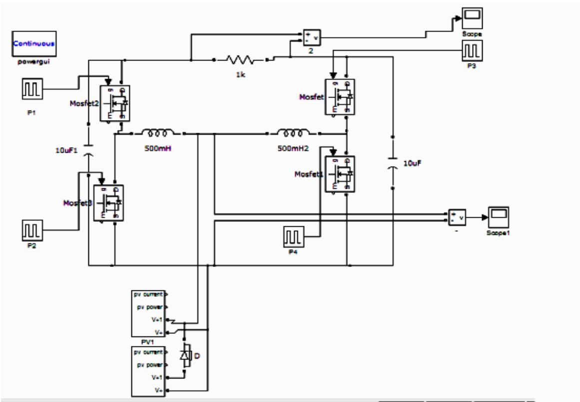

Fig 6:Implementation of DC-AC Inverter with PV pannel

The proposed work is done by connecting the Boost inverter with solar pannels.The entire analysis was done using Matlab-simulink .The simulink model is shown above

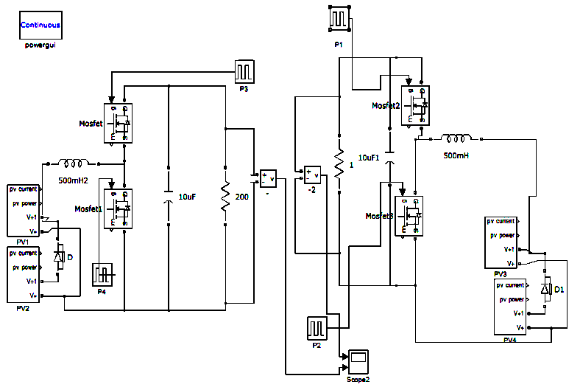

Fig 7:Implementation of current bidirectional converters.

The current bidirectonal converters shown in Fig 5 was implemented in simulink.One of the bidirectional converter output is phase shifted by 180^0.

V. Results:

The load resistance is connected differentially across the converters.Hence the dc voltage is boosted and converted to ac in single stage at the output.

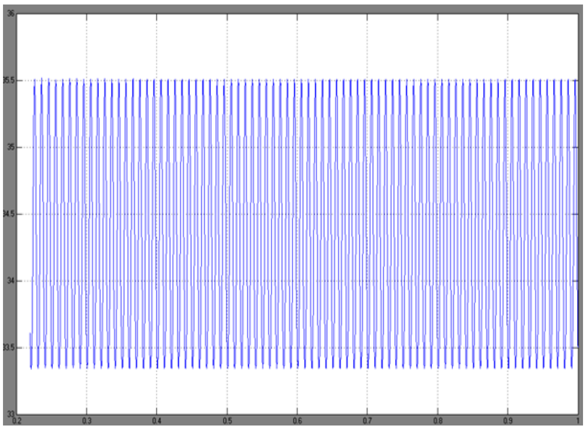

Fig 8:Output of solar pannel E_I = 34.5 V

Temperature	irradiance	O/P voltage
25^0C	1000	34.2 V

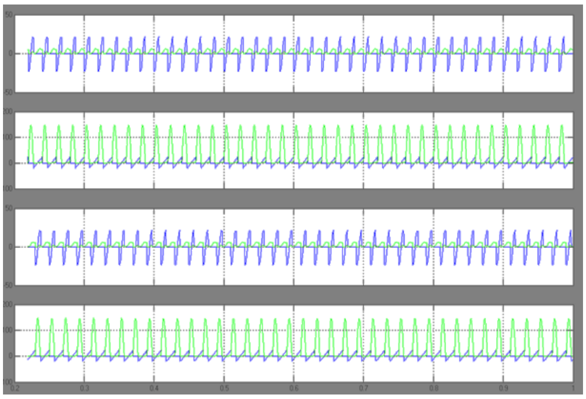

Fig 9: Switching voltages across the devices(S_1-S_4).

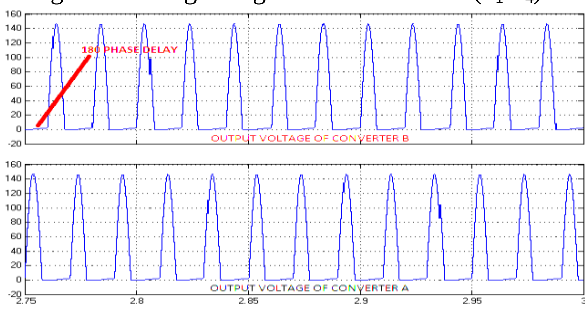

Fig 10: Output voltages of each current bidirectional converters B & A respectively.

The output voltages of the current bidirectonal converters (converter A& converter B) were shown above.. These converters produce a dc-biased sine wave output, so that each source only produces a unipolar voltage. The modulation of each converter is 180 out of phase with the other, which maximizes the voltage excursion across the load. The load is connected differentially across the converters.

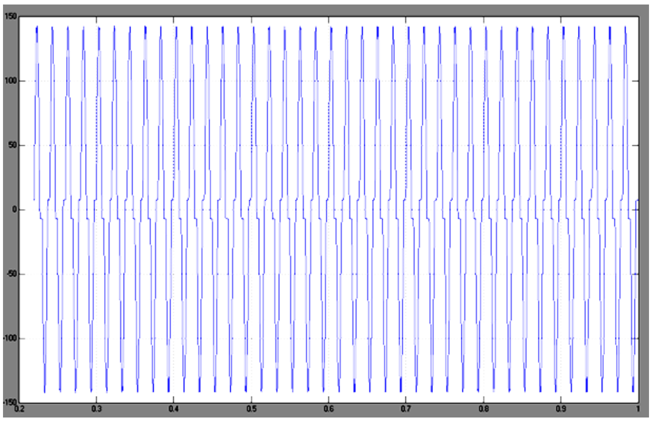

Fig 11: Output (E_0) AC voltage across the load.

Input from PV pannel	O/P voltage of inverter
34.2 V-DC	150V-AC

VI. Conclusion:

The boost DC-AC inverter was applied to PVarray and simulated.The output of inverter is 150 V–AC obtained in single stage of power conversion(i.e.,boosting the voltage and conversion from DC-AC) was achieved in same stage .The proposed work could be beneficial to low voltage AC –appliances,solar UPS systems and low rating 1-Ø AC motors.

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