RESEARCH ARTICLE OPEN ACCESS

Cost effective solar Inverter

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ABSTRACT
Solar energy the most efficient, eco-friendly and abundantly available energy source in the nature. It can be converted into electrical energy in cost effective manner. In recent years, the interest in solar energy has risen due to surging oil prices and environmental concern. In many remote or underdeveloped areas, direct access to an electric grid is impossible and a photovoltaic inverter system would make life much simpler and more convenient. With this in mind, it is aimed to design, build, and test a solar panel inverter. This inverter system could be used as backup power during outages, battery charging, or for typical household applications. The main components of this solar system are solar cell, dc to dc boost converters, and inverter. Sine wave push pull inverter topology is used for inverter. In this topology only two MOSFETs are used and isolation requirement between control circuit and power circuit is also less which helps to decrease the cost of solar inverter.
Keywords – MOSFET – Metal oxide semi-conductor field effect transistor, PCS- Power conditioning system

I. INTRODUCTION

Solar PV-based generation does have its drawbacks but it's having more advantages to over shadow that drawback. Therefore in India and particularly Gujarat having great potential to generate solar electrical power generation solar power generation was increased by 20 to 25% in last 20 year. Solar photovoltaic (PV) cells convert sunlight directly to electricity without pollutant emission. This electricity generation is effected by physical and environmental parameters such as the solar radiation and cell temperature on PV cell. PV power supplied to the utility grid is gaining more and more attention nowadays, hence various standard mentioned by different grid monitoring authorities are has to be follow. This standard are deals with issues as power quality, detection of islanding operation, DC current injection etc. Different utility are follow the different standards which are depend on the nation, national policy, types of utility, types of consumer, power rating etc. Numerous inverter circuits and control schemes can be used for PV PCS. However, depending on the characteristics of the PV panels, the total output voltage from the PV panels varies greatly due to different temperature, irradiation conditions, and shading and clouding effects. Thus, the input voltage of a residential PV inverter can vary widely, for example from 200 to 500V, and can be quite different from the desirable 400-V level.

Therefore, a dc–dc converter with either step-up function or step down function or even both step-up and step-down functions is needed before the dc–ac inverter stage.

II. OPERATION OF SOLAR INVERTER

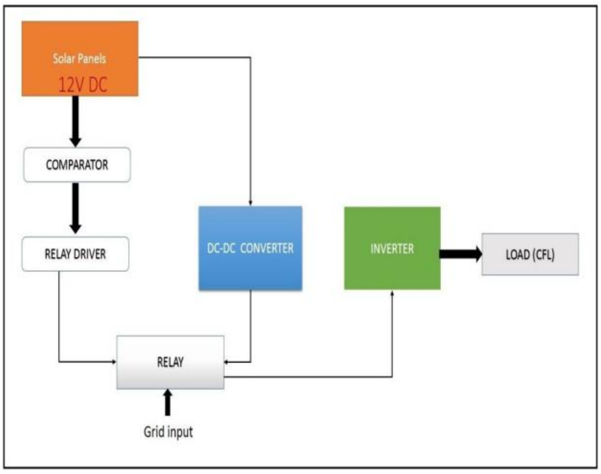


Fig.1 Block diagram of solar inverter

SOLAR PANEL: A panel designed to absorb the sun's rays as a source of energy for generating electricity or heating.

COMPARATOR: An electronic circuit for comparing two electrical signals.

RELAY: An electrical device, typically incorporating an electromagnet, which is activated by a current or signal in one circuit to open or close another circuit.

DC-DC CONVERTER: It is usually a Buck-Boost converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude. It is equivalent to a fly back converter using a single inductor instead of a transformer.

INVERTER: An apparatus which converts direct current into alternating current.

III. BUCK-BOOST CONVERTER

The average output voltage Vo is less than or greater than the input voltage Vs of converter, it will be decided by value of k and its voltage equation is written as under. Output voltage of this converter is having opposite polarity than the input voltage hence it also known as Inverting converter. The circuit arrangement of buck boost converter is shown in Fig. 2

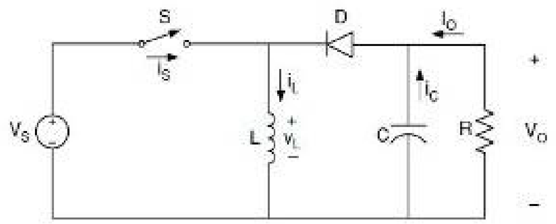


Fig.2 Basic schematic of a Buck-Boost Converter.

When O<K<0.5-Converter operate in Buck Mode.
0.5<K<1- Converter operate in Boost mode.
0.5=k- Converter operate in Ideal mode.

$$Va = Vs \frac{K}{(1-k)}$$

IV. OPERATING PRINCIPLE BUCK-BOOST CONVERTER

The circuit is designed to achieve maximum efficiency from the current components and quality, and on the other to be as simple as possible, and be used for different purposes, such as an under voltage 24V vehicles. At the beginning of the circuit is 24V DC power connector CN1, CN2 and the diode D1, which allows you to connect the circuit at either polarity. As a regulator such as 7812, the circuit provides a fixed voltage of 12V to power the controller LM324, Pulse-width modulator (PWM) and a temperature controller. PWM is responsible for the modulation of the duration of the rectangular pulse at the outputs S1, S2, the current signal is proportional to the voltage at the terminals of VSF output circuit (output voltage source) and input module, these findings constitute a positive feedback loop module they output voltage is achieved by changing the value of the trimmer P1 in PWM. The temperature control module is responsible for maintaining the temperature of the power MOSFET and a circuit within permissible [18], the controller reduces the energy consumption and the noise from the fan by stopping it when it is not needed. Power is based on the controller for the MOSFET. This component contains everything needed for control and regulation of the power MOSFET in the circuit half-bridge. The signal from the PWM is included in the contact module IC1 through two diodes, which combine the two output signals s1, s2, and a compensating resistor R3, the resulting signal - a square wave with a fixed frequency modulated 70kGts duration from 0 up to a maximum of 98%, depending on the voltage + 12V.
The rectangular signal is amplified amplifier stages T1, T2, T3, filtered through inductor L2 to a high inductive ferrite toroid core, which is often used in power supplies that are included on the filter output signals and voltages, as far as possible to eliminate the high-frequency component (high frequency). DC breaking voltage source. Once the voltage at L1 is rectified by a group of diodes D10, D11 Schottky type with a high efficiency, diode locking occurs with a small internal resistance and a higher operating frequency to be used in switching power supplies. At the end of the chain is filtered and stabilized by means of electrolytic capacitors C10, C11. The end result a stable and high quality power supply voltage.

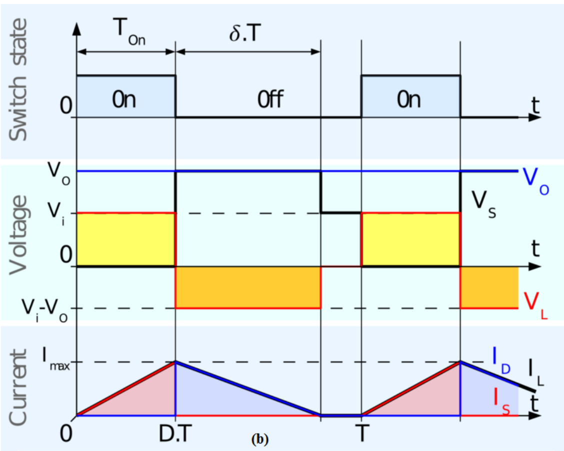


Fig.3 Waveforms of current and voltage in a boost converter operating in continuous mode

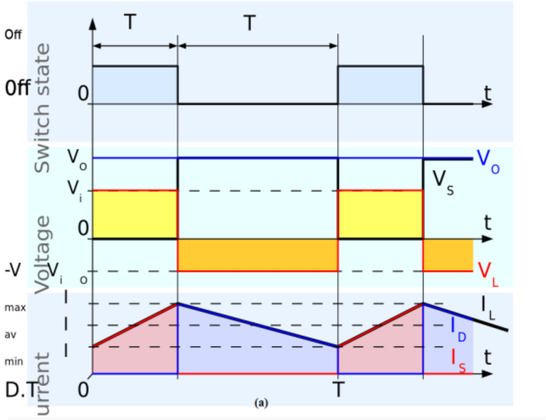


Fig.4 Waveforms of current and voltage in a boost converter operating in discontinuous mode.

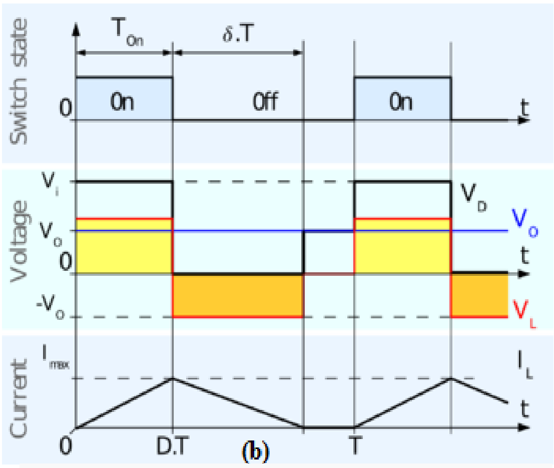


Fig.5 Waveforms of current and voltage in a buck converter operating in continuous mode.

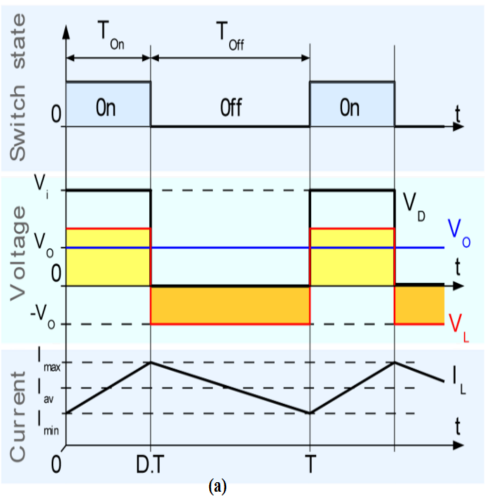


Fig.6 Waveforms of current and voltage in a buck converter operating in discontinuous mode.

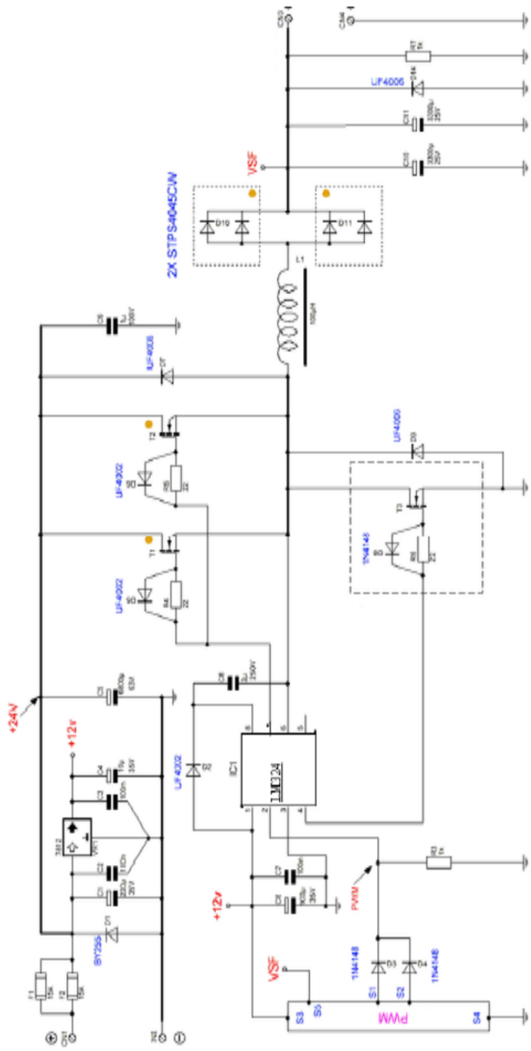


Fig.7 Buck-Boost Converter

V. WORKING PRINCIPLE OF INVERTER

An inverter is a device that changes or inverters direct current (DC) input to alternating current (AC) output. It doesn't "create" or "make" electricity, just changes it from one form to another. DC in is changed to AC out. The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the power is provided by the DC source. DC to AC inverters efficiently transform a DC power source to a high voltage AC source, similar to power that would be available at an electrical wall outlet. Inverters [12] are used for many applications, as in situations where low voltage DC sources such as batteries, solar panels or fuel cells must be converted so that devices can run off of AC power. One example of such a situation would be converting electrical power from a car battery to run a laptop, TV or cellophane.

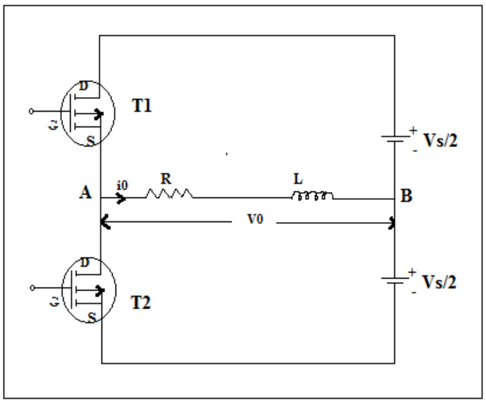


Fig.8 Single Phase half bridge Inverter

Fig.8 shows the circuit diagram of Single Phase half bridge Inverter the two MOSFET T1 & T2 are used as switching devices [22]. MOSFET T1 conducts 0 to T/2. Hence the output voltage is positive it is Vs/2. In the above circuit when current flows from point A to B in the load, MOSFET T2 conducts from T/2 to T and T1 is OFF.

When T2 conducts current flows from point B-A in the load, the output voltage is –Vs/2 this is negative half cycle of output.

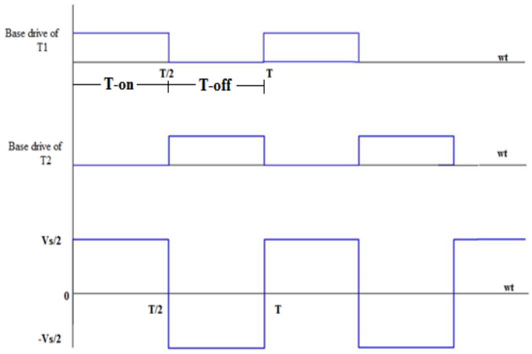


Fig.9 Waveform of single phase half bridge inverter

VI. MEASURED PARAMETERS

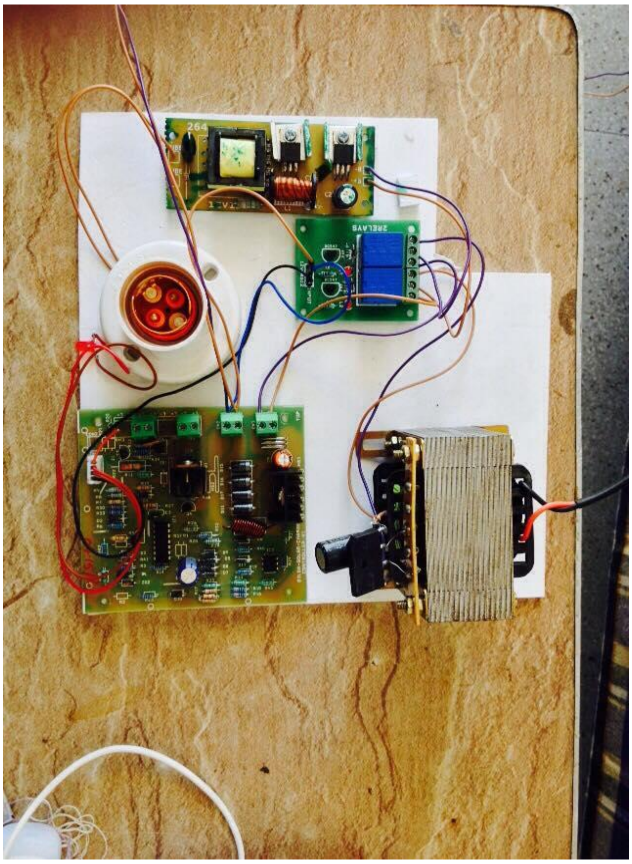
1.	Input voltage	12V (DC)
2.	Output Voltage	203V (AC)
3.	Input Current	0.83A
4.	Output Current	0.0217A
5.	Input Power	12*0.83=10W
6.	Output Power	230*0.0217=5w

VII. CONCLUSION

A high efficiency boost-buck converter based single stage PV inverter is proposed. The first converter part operates in either boost or buck mode; thus, it has a wide input voltage range, which is good for PV application. The second inverter part is composed with unfolding circuit based on the direction of the grid. Therefore from power processing point of view, this inverter is a single stage inverter. Because it processes power either as a buck converter or a boost converter, high efficiency can be achieved.

The smaller capacitance leads to lower Maximum Power Point Tracking (MPPT) efficiency. Thus, at the end of the electrolytic capacitors' lifetime, the capacitors won't fail to work but the change in capacitance will reduce the MPPT efficiency and will reduce the whole system's efficiency as well.

REAL TIME IMAGE



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