Output Voltage Analysis of Three Phase Boost Inverter using Simulink Matlab

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Abstract: The paper proposes a three phase inverter topology. In most applications the output voltage produced by the three phase inverter is insufficient to drive the load. The load demands higher voltage need to drive the load, and to satisfy the voltage/frequency criteria to run the induction motor at its optimum. A six switch three phase boost inverter is designed to drive the load, the inverter output analysis is done by varying different parameters of the of the circuit elements. The boost inverter is mostly needed where the source of power is a renewable energy source i.e., solar energy production, as the produced energy is does not meet the requirement for operation of induction motor. A simulation work is carried out and the conclusion study has been done in this paper.

Keywords: Three Phase Inverter, Boost Inverter, Three phase Boost Inverter, PWM Inverter, Voltage Boost.

I. INTRODUCTION

Power electronic system is very essential part for electrical conversion. The improvements in switching frequency combined with size reduction of the components enable to reduce active components, sizes implying reduction in converter sizes. The three phase inverter drives are mainly developed to control the speed of the three phase induction motor, the Three phase induction motor has been a work horse of the industries. In most of the induction motor applications the speed of the motor is required to be controlled, this can be done by v/f control method. The PWM inverters are the best choice to control the speed of the induction motor. In industrial applications Induction motors are widely used as the load, the harmonic content at the output of the inverter may heat the stator windings of the motor drastically reduce the life span of the induction motor, and also become noisy and torque oscillations in the rotor can lead to mechanical resonance and vibration. Capacitors overheat in the most severe cases, the risk of explosion as the dielectric breaks down. Many other faults towards the control or input side of the Inverter, the Electronic displays and lighting may flicker, circuit breakers can trip, computers fail and meters give false readings. Boost circuits are used widely in many applications, in most of the application the voltage required to drive the load is insufficient, hence the voltage is boosted using boost modules. The boost circuits mostly use inductor to store the energy which intern helps in boosting the output voltage. It is the current in the circuit which increases the voltage since load is always constant for a designed module. Boost converter transfer energy to load at higher voltage than the source voltage. The most concerned environmental issue in the current scenario is the global warming which is caused by huge deposition of carbon monoxide, dioxide, breaking of ozone layer by earlier one and other green house gases. The developed countries had agreed to reduce the production of green house gases at least by 5% a decade ago. This has forced the global power crises to look more towards the sustainable energy systems and development of power generation structures that are based on renewable resources. The popular source of energy among the renewable energy generation is the solar energy harvesting. Huge amount of solar cells are placed together to obtain the large output. The output voltage produced is very low depends on the intensity of sun light, this voltage has to be boosted to higher voltage, this is achieved by using the boost converter circuit. A block diagram is shown in the Fig.1 consists of solar panel Battery to store the energy generated from solar cells and DC to AC boost inverter and a load. The first block solar panels consist of large number of solar panels. The second block is a battery is connected to the solar panels, which is used to store the energy. In the next block a DC to AC boost inverter is constructed to boost the output voltage to 230V. The last block is a Load, it can be a motor or a supply to electrical grids. The voltage produced at the panels is not always constant. But the batteries provide constant voltage to a load.

Many industrial applications employ the renewable energy for their requirement but the cost f the energy generated by solar panel is higher than the other energies and also efficiency of power generated by the solar energy is also less compared to other energies, and also complexity of circuit construction drastically reduced because the energy generated by solar panels are DC voltages, having less harmonic components used for AC loads.

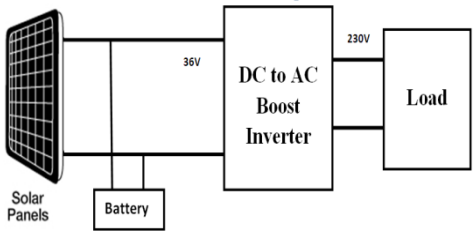

Fig 1: Block Diagram of the renewable energy boost inverter.

II. SYSTEM AND MODULE WORKING

A. Three Phase Boost Inverter:

The Three phase boost inverter consists of six switches. Fig.1 shows the circuit diagram of the three phase boost inverter drive. The IGBT's are used as switches, gating signal to each switch is provided through a pulse generator. Each phase is 120^0 out of phase with each other. The S3 is turned on with a phase delay of 120^0 with respect S1, similarly S5 is tuned on with a phase delay of 120° with respect S3. The switches S1, S3 and S5 are the upper switches and switches S2, S4 and S6 are the lower switches. All the lower switches are the compliments of their respective upper switch. S1, S2 and S3 are the compliments of S2, S4 and S6 respectively. At any instant of time no switches in the same leg can be ON. The switching pattern of the inverter can be studied with "switching on" of one from the lower group and two from the upper group or one from the upper group and two from the lower group are ON. This produces a three phase output power used to drive the load. The Load RL with values R=11Ω and L=43.7mH has been designed to obtain the boost output voltage. The inductors L1,L2 and L3 and the capacitors C1, C2 and C3 are used to provide the necessary boost voltage.

III. RESULTS

The above circuit shown in Fig.2 is constructed and simulated using simulink/matlab. The results are obtained for repetitive trials and values to all the elements. The experiment is carried out in two stages. In the first stage the input voltage is kept constant and for different inductor values the output is noted, shown in Table1.

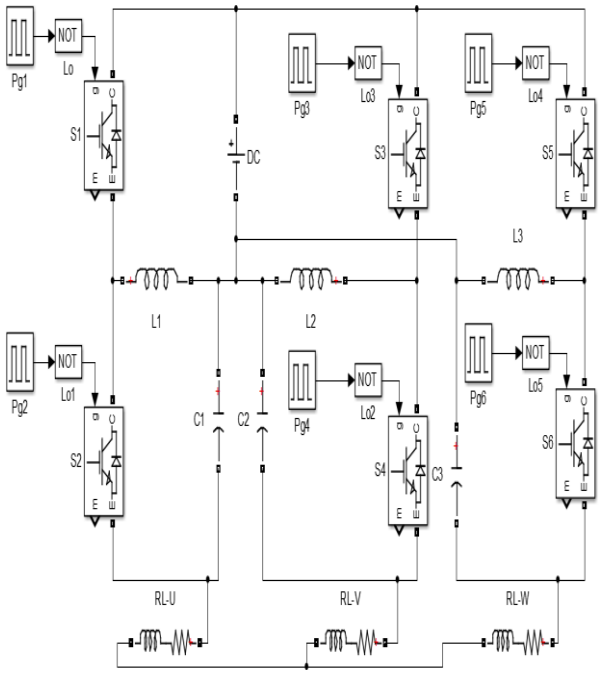

Fig 2: Three Phase Boost Inverter

Table 1: Constant Input voltage with inductor variation

V_{in}	Capacitor C1=C2=C3	Inductor L1=L2=L3	V_{out}
100V	2000µF	2mH	435V
		3mH	336V
		4mH	239V
		5mH	176V

The second stage of of the experent is carried out by varying the input voltage and the inductor such that the ouput voltage remain the same. Table2 shows the simulated values and results.

Table 2: Constant output voltage with input and inductor variation

V_{out}	Capacitor C1=C2=C3	V_{in}	Inductor L1=L2=L3
230V	2000µF	50	1.8mH
		60	2.47mH
		70	3.1mH
		80	3.52mH
		90	3.81mH
		100	4.1mH

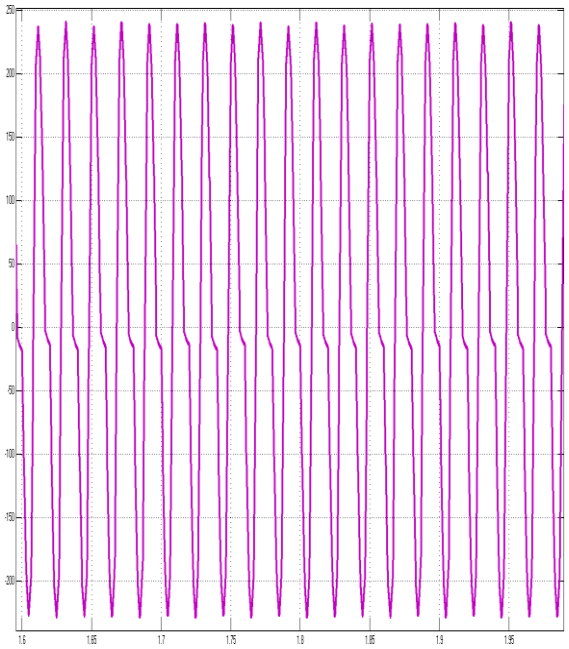

Fig 3: Line to line voltage wave form of Boost Inverter Drive

The Fig.3 shows the output voltage of the line to line voltage of the three phase boost inverter for L1=L2=L3= 4mH, C1=C2=C3=2000µF, V_{in}=100V and Vout=239V.

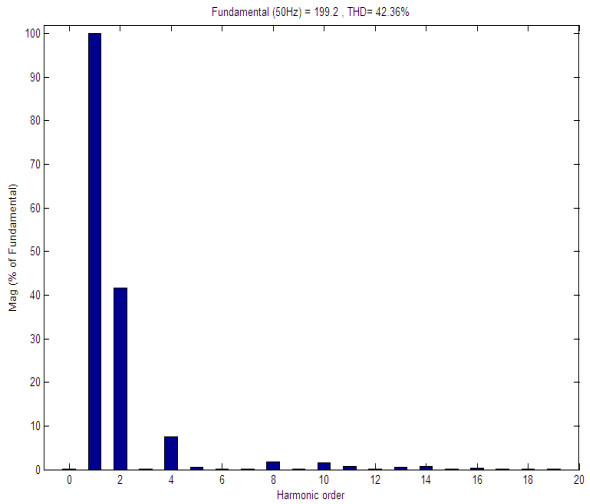

Fig 4:THD and Harmonics of line to line output voltage.

IV. CONCLUSION

The study of three phase boost inverter has been carried out by simulation. The experiment is carried out in two stages in the first stage input voltage is kept constant and variation in the output voltage is observed. As the inductor is varied the output voltage is increased, the output voltage is boosted to different values. In the second stage the input voltage is varied but the inductor value is also varied such that the output remains constant at 230V. The boost inverter eliminates the need for a DC-DC converter. The boost inverter directly boosts the voltage to a required voltage. Hence reducing the cost and bulkiness of converter and inverter modules in power generation is done.

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