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Switched Boost Inverter for Induction Motor Drive Application

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Abstract

Switch Boost Inverter (SBI) is a single stage DC to AC power converter and it is derived from the Z - source inverter. SBI converter can possible to supply both DC and AC loads simultaneously from a single DC input source. The specialty of SBI is it can work either in buck or boost mode operations with a wide range of obtainable output voltages from a given input voltage, unlike the traditional buck-type voltage source inverter. The DC-AC inverters usually operate on Pulse Width Modulation (PWM) method. PWM inverter is utilized to keep the output voltage of the inverter at the rated voltage independent of the output load. Here a single phase induction motor is driven by the inverter circuit. The output waveforms are taken in each step and analyzed.

Keywords; *Pulse width Modulation (PWM), Z source inverter, Switched boost inverter*

I. INTRODUCTION

The consumption of fossil fuels, not just exhausts these normal non-sustainable power sources, but also dangers the individual and environmental health. The sustainable power source like solar are more reliable, flexible, huge and unlimited with almost zero emissions and these splendid highlights have presented them as promising options for petroleum derivatives. Additionally it provides power to remote areas where there is no grid connection. But the output from PV panel is DC power. So to drive the AC loads, inverter is required. There are many techniques that can be used to convert DC to AC. In this project we have designed a Switch Boost Inverter for AC load application.

II. . PROBLEM DEFINITION

The ordinary Z source inverter utilizes a impedance network to couple the converter circuit to the power source. For this reason, it has two capacitors and two inductors. This passive components add weight and size to the inverter. To reduce the weight and size, another topology is considered and is called Switched boost inverter.

2.1 Methodology

The ZSI utilizing X-formed LC impedance system is bulky.But ZSI has the disadvantage of utilizing more and cumbersome passive parts. In this way SBI topology has been proposed to decrease the quantity of passive components, consequently it can be utilized in low power applications where size and weight matters. The block diagram is shown in Fig 1.

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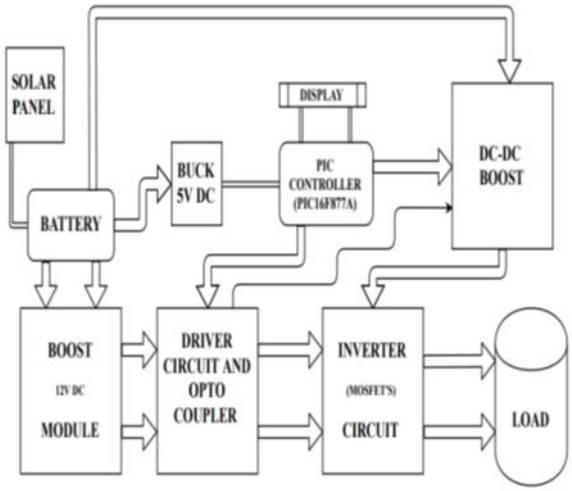

Fig 1. Block Diagram

Boost module:

The boost modules here used are CN6009. The input to the boost module is from a 12V battery. The boost modules boost the 12V DC into 18V DC and again regulate into 12V DC for steady output voltage. The output from DC modules are fed into MOSFET driver circuit.

Mosfet driver circuit:

The MOSFET driver circuit consist of optocoupler and MOSFET driver. The optocoupler consists of light emitting diode and an integrated photon detector and is used for input-output electrical isolation. The low-delay and transition times in MOSFET driver circuit make it ideal to drive the MOSFETs for switching power supplies, DC to DC converter.

Inverter circuit:

The inverter circuit consists of four MOSFETs (IRF840N). The MOSFETs acts as a switch to convert the DC input voltage into AC output voltage. The switching frequency is provided by PIC microcontroller through MOSFET driver circuit. The output AC voltage is fed into the load.

Switched boost inverter

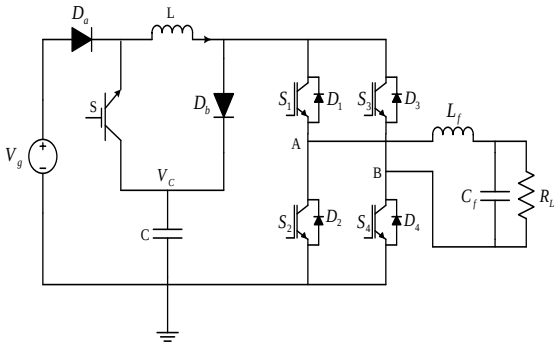

Figure 2. Structure of SBI topology

2.2 Hardware Model:

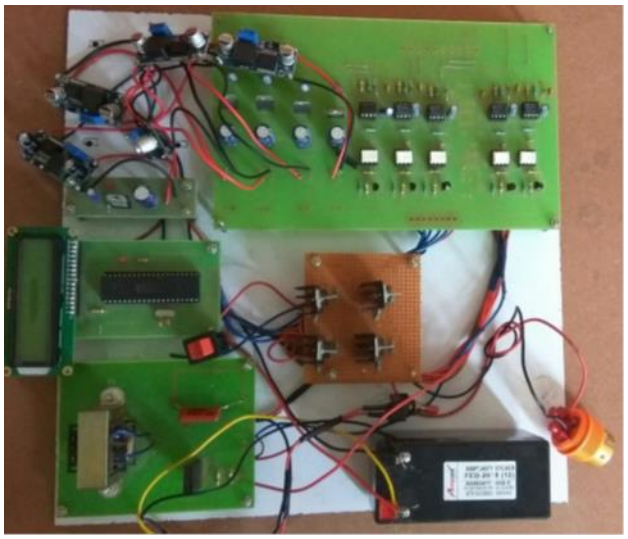

Fig 3. Hardware model

Hardware	Specification
Solar panel	12 V, 5W - (4 No.s parallel connected)
Battery	12 V, 1.3 A
Microcontroller	16F877A
Gate driver circuit	ICL 7667, 18V
Mosfet	IRF840 (8A, 500V), IRF250 (30A, 200V)
Optocoupler	6N135
Regulator	LM7805C (5V), LM7812C (12V)
Load	0.25 HP Single phase Induction motor

Table 1. Hardware specifications

2.3 Circuit Explanation:

The 12V battery is used as an input to the four DC boost modules. The 12V gets boosted into 18V DC

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and is again regulated to 12V DC for steady supply of voltage. The buck module is used as an input to the PIC microcontroller. The 12V is given to MOSFET driver and opto coupler circuit. The PIC 16F877A is pre-programmed to perform both the boost and inverter operation. The inductor in the boost circuit is triggered by PWM and the boosted output from inductor is stored in the capacitor. From the capacitor the DC voltage is fed into inverter circuit which is driven by PIC and MOSFET driver circuit. The AC output voltage is given to inductor load.

III. ALGORITHM

1. Start the process.

2. Initialize the Microcontroller, PWM and LCD.

3. Set the timer1 higher and lower values.

4. After setting the timer values, get the timer values. It is set to run in continuous while loop.

5. Interrupt routine is established to generate the PWM.

6. Time period of PWM is determined by the values in PR2 register and duty cycle of PWM is determined by values in the register CCPR1L & CCP1CON.

7. The generated PWM signal is send to both the Boost circuit and Inverter circuit.

8. The output from the Inverter circuit drives the load.

9. Stop the process.

3.1 Flow Chart

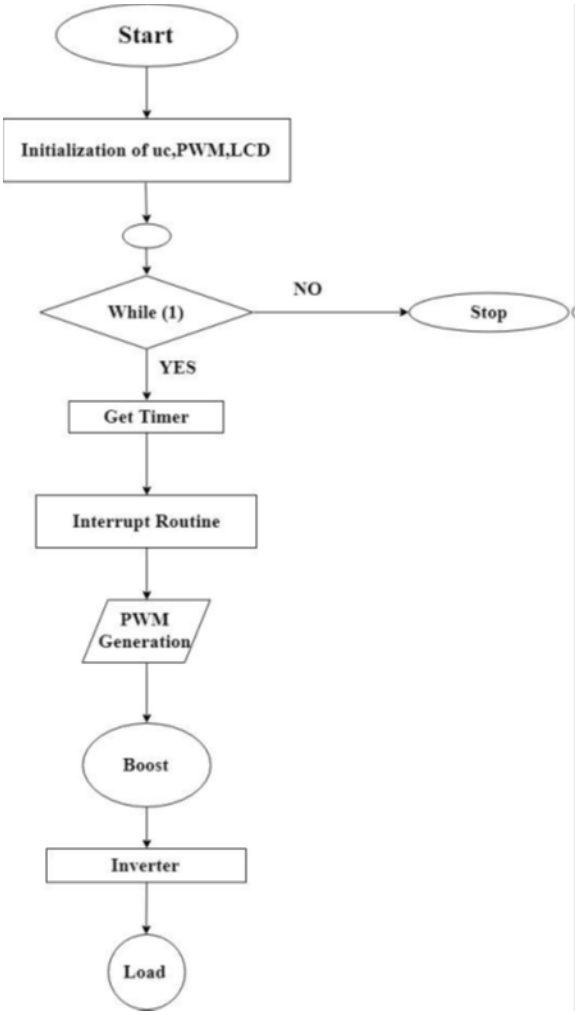

Fig 4 . Flowchart

IV. RESULTS

Fig 5. Boost circuit output waveform

The picture shows that regular interval of charging and discharging is happening in the output circuit.

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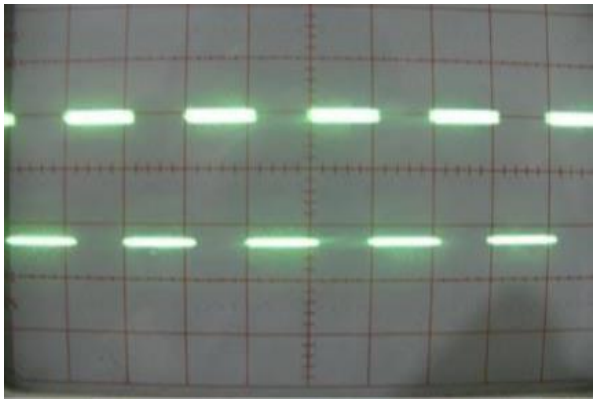

Fig 6.Inverted AC output voltage

The above picture depicts the square wave which is suitable to drive the AC load. The output is controlled by the PWM generated by the microcontroller. If the value of PWM is varied, the output voltage is also varied.

V. CONCLUSION:

The inverted AC output voltage is controlled by the PWM pulses generated in the microcontroller. By varying the switching frequency of PWM pulses, the output voltage can also be varied. The SBI exhibits good output characteristics compared to ZSI inverter topology. This model can be used for low power applications with less number of passive components and also for renewable energy like solar where AC supply is not available.

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