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Analysis of Single phase inverter with Boost Converter and Photovoltaic module

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Abstract

Now a day's renewable energy like solar, wind becomes very popular. To convert solar energy into electrical energy inverter is an one of the main components. The performance of inverter is different for different pulse width modulation techniques. In this project a single phase inverter is interfaced with photovoltaic module and Boost converter. The main objective of this project is to analyze a single phase inverter for different pulse width modulation techniques like Sine Triangle Pulse Width Modulation, Bus Clamping Pulse Width Modulation technique. Also different DC-DC converter has been designed and simulated. Boost converter is considered to boosting of photovoltaic voltage. After analysis it has been observed that the bus clamping pulse width modulation technique is better as compared to conventional Sine triangle pulse width modulation technique in respect to load current ripple.

Keywords: DC-DC Converter, Single Phase Inverter, Pulse Width Modulations, PV , Matlab.

Introduction

- Voltage source inverter is very popular in different applications. Figure

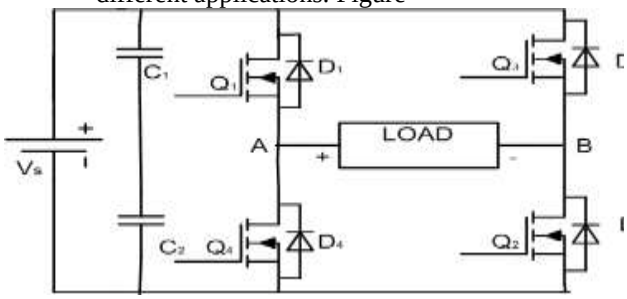

Figure. 1.1 Single phase voltage source inverter.

- Depending on different pulse width modulation techniques the performance of voltage source inverter is different. The power circuits for a single phase full bridge voltage source inverter. It has two legs. Each leg has two power semiconductors switches like Q_1 and $Q_2$for first leg and Q_3 and Q_4 for second leg. There are also different Pulse All content should be written in English and should be in 2 column. width modulations techniques. They are sine triangle pulse width modulation technique, Bus clamping modulation pulse width modulation technique and Harmonic injection pulse width modulation technique.
- Now days, renewable energy likes solar energy, wind energy is very popular. Solar energy into Electrical energy their needs a dc-dc converter to boost up the solar panel voltage. There are different types of dc-dc converter like Buck converter, Boost converter, Buck Boost converter, Cuk converter and Sepic converter.Single phase inverter is interfaced with photovoltaic module and Boost converter in this project.

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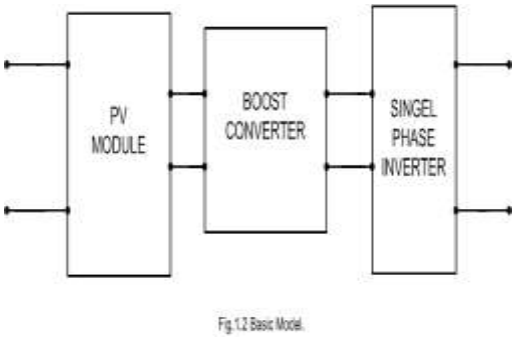

Figure. 1.2 Basic model of this paper.

- In this project the single phase inverter is analysed for different conventional pulse width modulation technique like Unidirectional Sine triangle pulse width modulation and advanced type of pulse width modulation technique like bus clamping pulse width modulation technique.
- In literature there is a few study of single phase inverter for advance type pulse width modulation technique.

Dc-Dc converter

In this a step up or pwm boost converter. It consists of dc input voltage source Vd, inductor VL, switch S, diode D, capacitor C and resistance R. When switch is in on-state then the current increases linearly and the diode D is off at that time. When switch S is turned off the energy stored in the inductor is released through the diode to the output RC circuit. In this output voltage is greater than input voltage.

Principle mode of operation:

When switch S is on, then inductor L is getting charged. Current through inductor linearly increases and diode is reversed biased. Capacitor supplies load current. Mode 2: When switch S is off. Inductor L current linearly decreases, therefore inductor gets discharged. Diode gets forward biased and capacitors get charged. And load current is supplied by inductor

Figure:

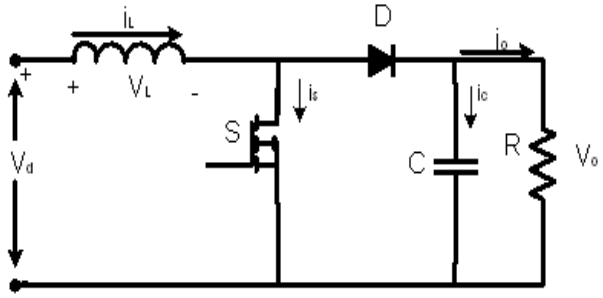

Figure. 1.3 Boost converter circuit.

Single Phase Inverter

Voltage source inverter converts DC voltage to AC voltage. The objective of voltage source inverter is to generate harmonic free sinusoidal output voltage. This is called as single phase bridge inverter or voltage source inverter. This inverter consists of four choppers and four transistors, capacitors are connected across dc link .

Principle of operations:

When transistors Q1 and Q2 are turned on the voltage Vs appears across load. When Q3 and Q4 are turned on then the voltage load gets reversed biased –Vs. When Q1 and Q4 acts then switching devices also starts to acts respectively and vice versa in other case. Basically focuses on conventional and advanced pulse width modulation techniques which includes sine triangle pulse width modulations and Bus clamping pulse width modulations. In this sine triangle pulse width modulation switching frequency is higher than fundamental frequency. Sine triangle pulse width modulation is one of the most popular conventional pulse width modulation technique. In this pulse width modulation technique a low frequency of about (50 hz) signal is known as modulating signal is compared with high frequency (10 khz or above) signal is known as carrier signal. When the modulating signal greater than carrier signal then high switching pulse will generate, on the other hand when the modulating signal is less than carrier signal then low switching pulse will generate. Modulation index is in between 0 and 1.There are two types of sine triangle pulse width modulation for single phase inverter:1.Bipolar sine triangle pulse width modulation.2.Unipolar sine triangle pulse width modulation.

Bipolar sine triangle pulse width modulation: In case of bipolar sine triangle pulse width modulation , the modulating signal m1, is compared with carrier signal generated switching pulses are given to Q1 and Q2. On the other hand the

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modulating signal m2 is compared with carrier, and generated pulses are given to Q3 and Q4.Unipolar pulse width modulation: In case of unipolar pulse width modulation technique the modulating signal m1 is compared with carrier signal and generate switching pulse which is given to Q1.The complementary of this switching pulse is given to Q4.From the other hand the modulating signal m2, is compared with carrier and generated pulse is given to Q3 and opposite to that Q2.

Figure:

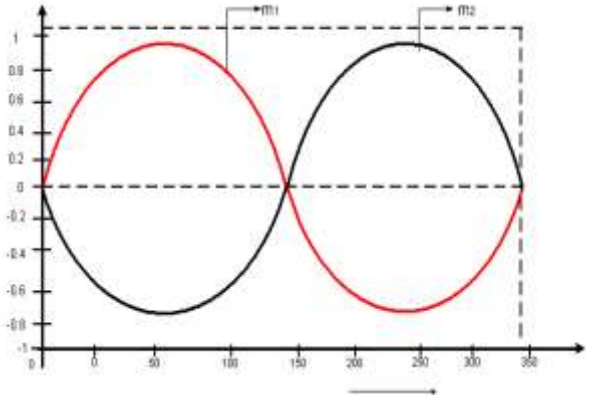
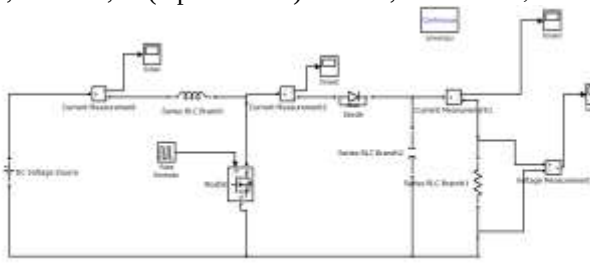


Fig. 1.4 Sinusoidal modulating signals for two legs

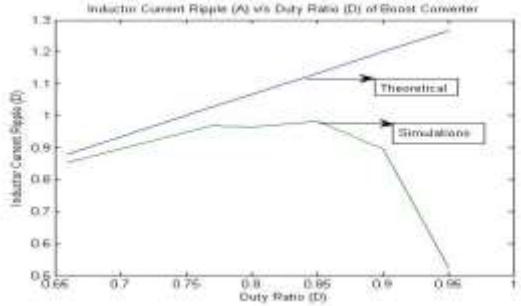
Simulations design Boost Converter

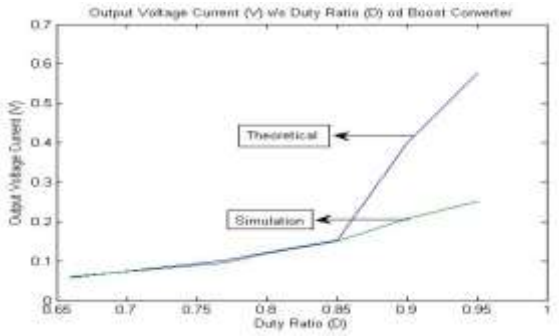
Specifications:

Vin = 5V, Vout = 15 V , f = 25khz, L = 150 ,C = 220,D = 0.66, Ia (input current) = 0.5A , R = 30ohm,



Results / output:





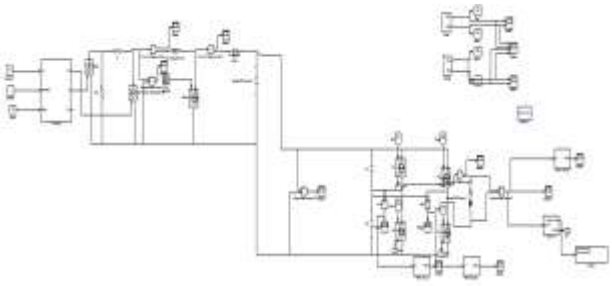
Hence, we conclude that inductor current ripple is maximum at duty ratio (D) = 0.5.

Output voltage ripple is maximum for duty ratio (D) = 0.5. The theoretical results verified with simulation results.

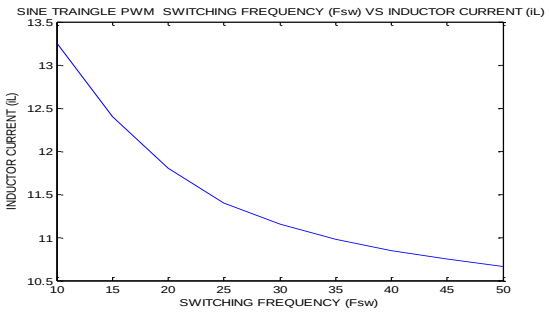
Interfacing

Interfacing with sine triangle pulse width modulations.

Simulation model of sine triangle pulse width modulation interfaced with Photovoltaic module and boost converter. Specifications: Input voltage = 15V, Switching frequency (fsw) = 25khz ,Modulation index = 0.8 Following results drawn.



Results / output:



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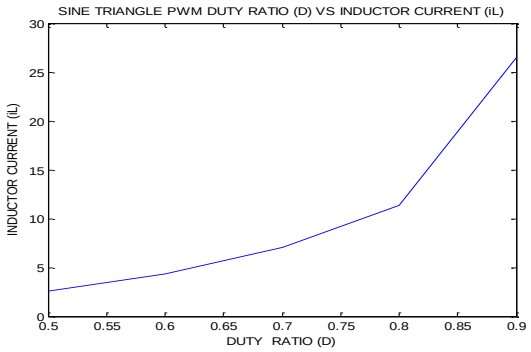

After interfacing of sine triangle pulse width modulation with photo voltaic module with boost converter following graphs were plot.

Conclusion

From The above studies the following conclusions have been reached.

The graph theoretical and simulations study of Boost converters are verified.

The current ripple of Boost converter is maximum as duty ratio 0.5.

Photo voltaic module has been implemented.

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