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H6 TRANSFORMERLESS FULL BRIDGE CONVERTER WITH INTERLEAVED BOOST CONVERTER

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Abstract - *Transformer inverters causes a number of technical challenges in grid-connected PV systems, among which flow of leakage currents is a major problem. In this project, H6 transformer less full- bridge inverter topology is connected with a* ***INTERLEAVED BOOST CONVERTER****. As the input supply from the PV module is low, this interleaved boost converter increases the efficiency of the input supply, thus the desired output range is obtained. One additional switch with conventional full H- Bridge and diode clamping branch make sure the disconnection of PV module from the grid at the freewheeling mode and a clamp the short circuited output voltage at the half of DC input voltage. Therefore, the common mode (CM) leakage current is minimized. Aforementioned transformer less topology is simulated that validates the effectiveness of the converter by Matlab / Simulink.*

Key Words**: Photovoltaic, Interleaved Boost Converter**

1.INTRODUCTION

In these days, the invention and development of new energy sources are increasing due to the poisonous results caused by oil, gas and nuclear cell. This has led the renewable energy sources especially the solar PV systems to the prime position of generation of electricity. Photovoltaic has applications ranging from small power supplies to power grids. With a reduction in system cost PV technology seems to be efficient means of power generation. A solar grid connected power generating system which consists of a solar panel in which the solar cells are arranged to track sunlight, an inverter to convert the DC to AC and the grid. Interleaved power converters can be very beneficial for high performance electrical equipment applications. Reductions of electromagnetic emission along with an increase in efficiency, transient response, and reliability has many advantages to using such converters. This paper evaluates a single phase transformer less interleaved inverter topology called H6, which can minimize the dangerous leakage currents between the solar power generation system and the electrical grid. Meanwhile, the resonant technique process power in a sinusoidal form and the switching devices are perfectly commutated. Therefore, the switching losses and noises can be dramatically reduced. For this reason the resonant converters have drawn a lot of attentions in various applications. Resonant converter topology has been used in telecommunications and aerospace applications and it has been recently proposed for electric vehicles. Secondary batteries are mostly used in the application of residential, industrial, and commercial energy storage systems which store electricity and supply the load for various types of electronic equipment. On the other hand, introducing the power devices with a low voltage/resistance is the only way to reduce the on-state losses. Super junction structures make it possible to decrease the on-state voltage and/or resistance drastically, which has been introduced to MOSFETs and insulated gate bipolar transistors.

2. PROBLEM STATEMENT

In this project, a family of novel Interleaved H6 full-bridge topologies is proposed based on H5 inverters for the transformer less PV grid-tied inverters. The proposed inverter ensures that the freewheeling voltage is clamped to the half of the DC input voltage supply. The PV module is detached from the grid during the freewheeling period by adding an extra switch and a capacitor divider.

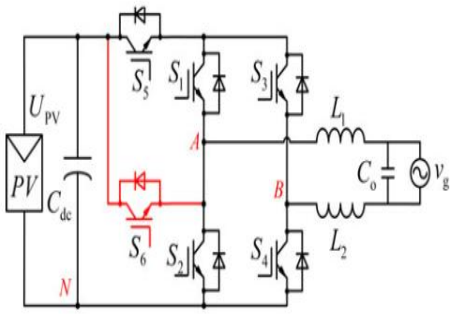

Fig -1: Existing circuit diagram

There is one extra switch in dc side of the H5 topology. When the emitter of S5 is disconnected from S1 and connected to the terminal (A), the inductor current flows through S4 and S5 instead of S1 , S4 , and S5 in the active mode of positive half cycle of the grid voltage. Hence, the conduction loss is reduced. Unfortunately, in the active mode of negative half cycle of the grid voltage, there is no inductor current path, as shown in fig therefore the extra switch S6 is introduced the topology between the positive terminal of the PV array and the terminal (B) to form a new current path. As a result, the circuit structure are confirmed.

2.1 Existing Simulation

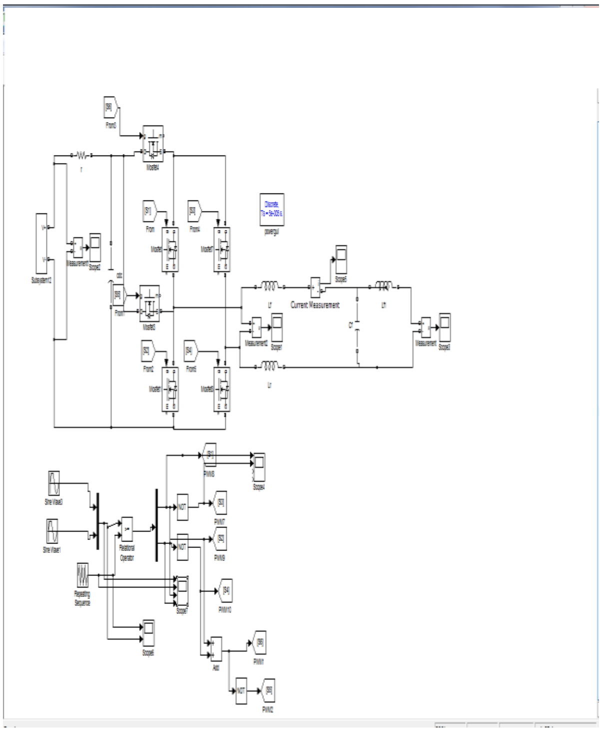

Fig -2: Existing simulation

2.1.1 Simulation Output

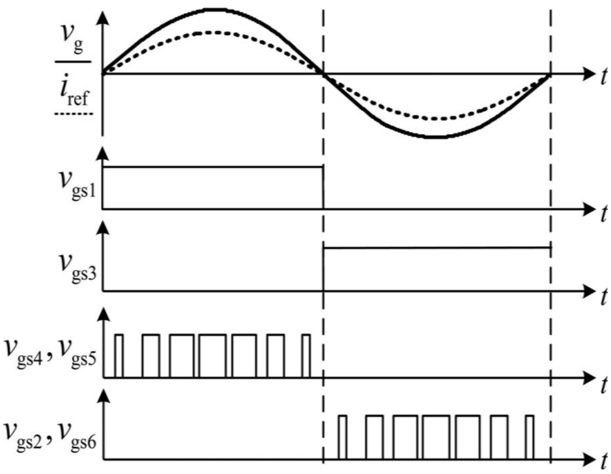

Fig -3: existing simulation output

3. METHODOLOGIES

A. Solar Energy

In the today's climate of the growing energy needs and increasing the environmental concern, alternatives to the use of non-renewable and polluting fossil fuels have to be investigated. One such alternative is solar energy. An array is the assembly of solar-thermal panels or the photovoltaic modules; This panels can be connected either in parallel or series depending on the design objective. Solar panels is typically find use in residential, commercial, institutional, and light industrial applications.

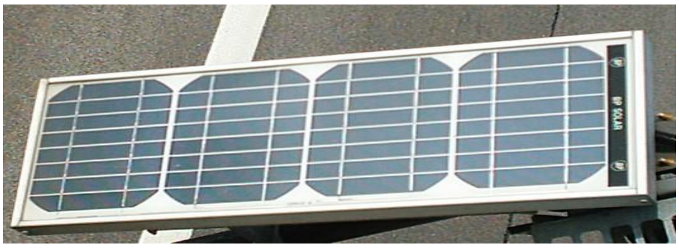

Fig -4: Solar Plate

B. Photovoltaic (PV) Module

The photovoltaic cell is the basic structural unit of the photovoltaic module that generates current carriers when sunlight falls on it. The power generated by these photovoltaic cell is very small. To increase the output power the photovoltaic cells are connected in series or parallel to form photovoltaic module. The basic unit of a photovoltaic module is the solar cell, which consists of a p-n junction and that converts light energy directly into electrical energy. The pv is the light generated current, where Id is the diode current, Rsh is the shunt resistance which describes the leakage current, Rs is the series resistance which describes the voltage drop as the charge carriers migrate from the p-n junction to the electrical contacts.

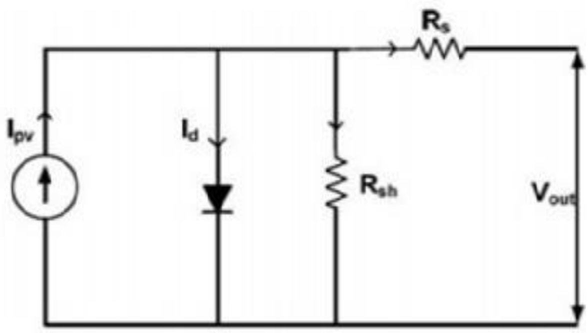

Fig -5: Electrical equivalent circuit of pv cell

Photovoltaic System

Photovoltaic modules generate by the DC current and the voltage. However, to feed the electricity to generate the grid, AC current and the voltage are needed. Inverter is the equipment which used to convert DC to AC. There are the different types of inverter configuration depending upon how the photovoltaic modules are connected to the inverter. The decision on what configuration should be used has to made for each case depending on the environmental and the financial requirements .If the modules are not use to identical or do not work under the same conditions, the MPP is different in each of the panel and the resulting voltage power characteristic has their multiple maxima, which constitutes a problem, because most MPPT algorithms converge to the local maximum which depending on the starting point.

Photovoltaic cell

PV cells are made of semiconductor materials, such call as silicon. For solar cells, a thin semiconductor water is specially treated to form an electric field, that is positive on one side and negative on the other. When the light energy strikes the solar cell, and electrons are knocked loose from the atoms in the semiconductor material. If the electrical conductors are attached to the positive and the negative sides, forming the electrical circuit, the electrons can be captured in the form of

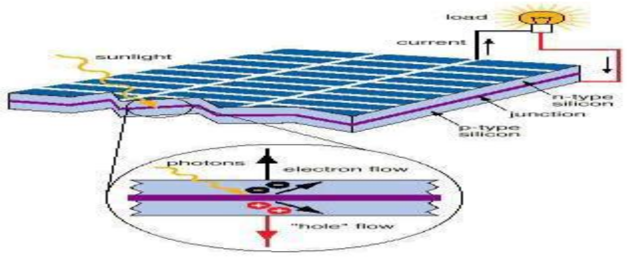

Fig -6: Photovoltaic cell

an electric current that is, electricity. This electricity can then be used to power a load. A photovoltaic cell can either be a circular or square in construction.

Interleaved Boost Converter

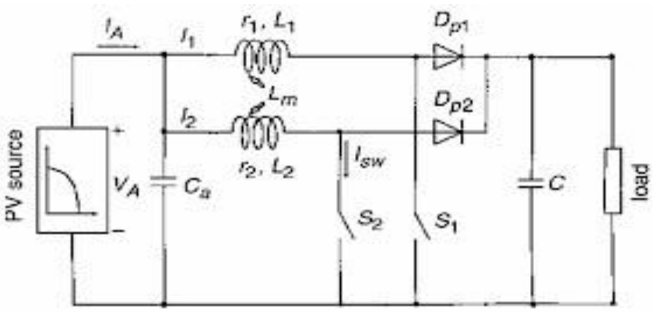

Fig-7: Interleaved boost converter

Interleaved boost converter step up the input supply. In this converter as the current gets split into two parallel paths, the inputs voltage also gets amplified. As a result for a low input supply, by using this interleaved boost converter, the input voltage gets amplified and the circuit gets better performance. Here in this converter. There is two inductor along with a diode. Thus the given input from the pv panel gets split up and goes into two parallel path of the inductor. Thus the inductor gets charged. While discharging of both the inductor, the voltage get amplified and thus we get efficiency of the system.

Pulse Width Modulation

Pulse Width Modulation refers to the method which is carrying information in a train of pulses and the information being encoded in the width of the pulses. The pulses have constant amplitude but their duration varies in the direct proportion to the amplitude of analog signal. The output voltage control is easier with the PWM than other schemes and can be achieve without any additional components. The lower order harmonics are either minimized or eliminated all together. The filtering requirements are minimized as the lower order harmonics is to be used eliminated and higher order harmonics are filtered easily.

4. RELATED WORK

In this project, a family of novel Interleaved H6 full-bridge topologies is proposed based on H5 inverters for the transformer less PV grid-tied inverters. The proposed inverter ensures that the freewheeling voltage is clamped to the half of DC input voltage and PV module is separated from the grid during the freewheeling period by adding an extra switch and a capacitor divider. The extra switch is inserted to the H5 topology for forming a new current path and for the purpose of the reducing conduction loss. Therefore, in the active modes, the inductor current of the proposed H6 topology flows by two switches during one of the half line periods and through three switches during another half-line period. The proposed of H6 topology have achieved the minimum conduction loss and also has featured with low leakage currents.In this paper, a 2-phase interleaved converter is proposed. As already well known, the input current and output voltage ripple of interleaved dc-dc converter can be minimized by virtue of interleaving operation.

4.1 Block Diagram

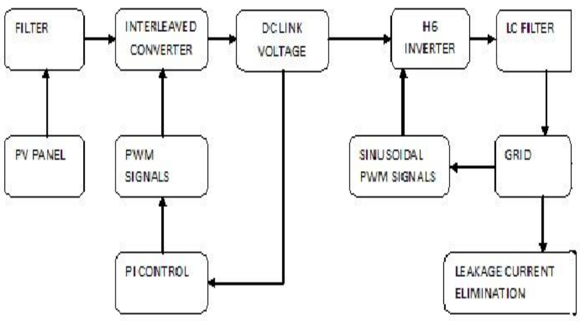

Fig -8: Block diagram of proposed system

Block Diagram explanation

Input supply: Solar Energy

Filter: It is used to remove unwanted or undesired frequencies from a signal.

GRID: An electric grid in a network of synchronized power providers and consumers that are connected by transmission and distribution lines is operated by one or more control centers. When most people talk about the power "grid" they're referring to the transmission system for electricity.

Inverter: operates from a dc voltage source or a dc current source and converts it into ac voltage or current.

PWM generator: It is used to generate PWM pulses to make a switching signal.

Converter: convert the voltage of an electric device which is usually alternating current (AC) to direct current (DC).

B. Simulink - Circuit diagram

The interleaved dc-dc converter consists of two parallel connected boost converter units, which are controlled by the phase-shifted switching function (interleaved operation). Since this converter has two parallel units, the duty cycle for each and every unit is equal to (Vout-Vin)/Vout, and it is same for each unit due to parallel configuration. A phase shift always be implemented between the timing signals of the first and the second switch. Since there is two units parallel are a converter, the phase shift value is 180°.

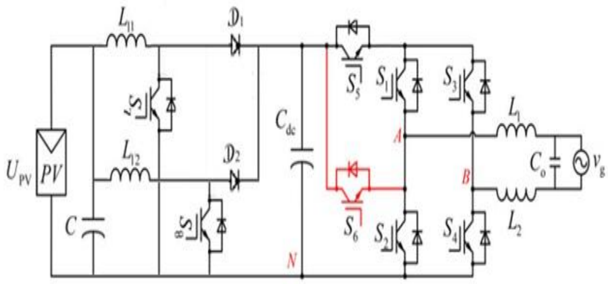

Fig-9: Simulink of proposed circuit diagram

Simulation explanation

In this project, an interleaved boost converter- H6 full-bridge topology is proposed. The proposed inverter implement that the freewheeling voltage are clamped to the half of the DC input voltage side. The PV module is separated from the grid during the freewheeling period which is done by adding an extra switch and a capacitor divider into the connection. Here the extra switch is inserted to H5 topology for forming a new current path and for the purpose of reducing conduction loss. Therefore, during the active modes, the inductor current from the proposed H6 topology flows through the two switches during one of the half cycle periods and through three switches during another half-cycle period. Here proposed H6 topology has achieved the lowest minimum conduction loss, and also has featured along with low leakage current. During this study, a 2-phase interleaved converter is proposed.

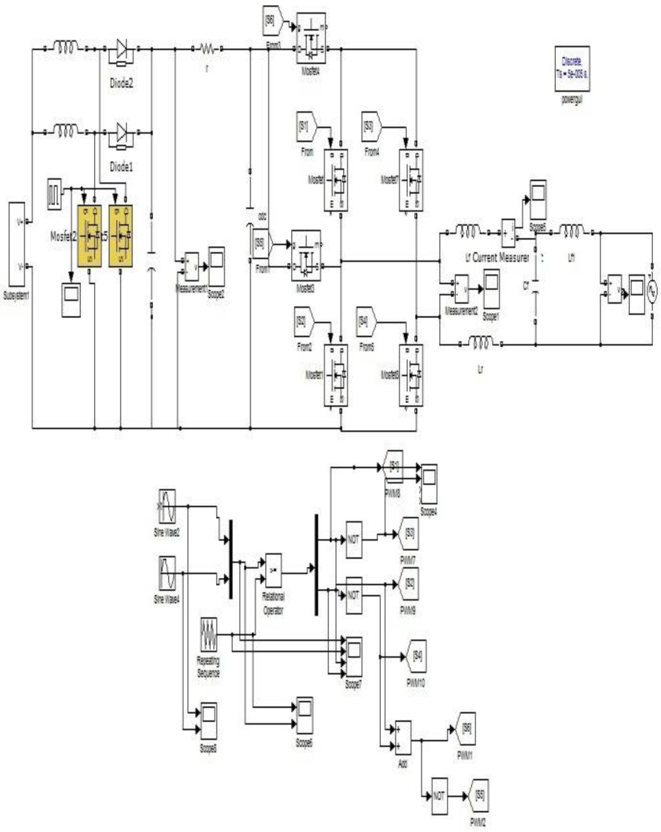

Fig -10: Proposed simulation

Simulation Output

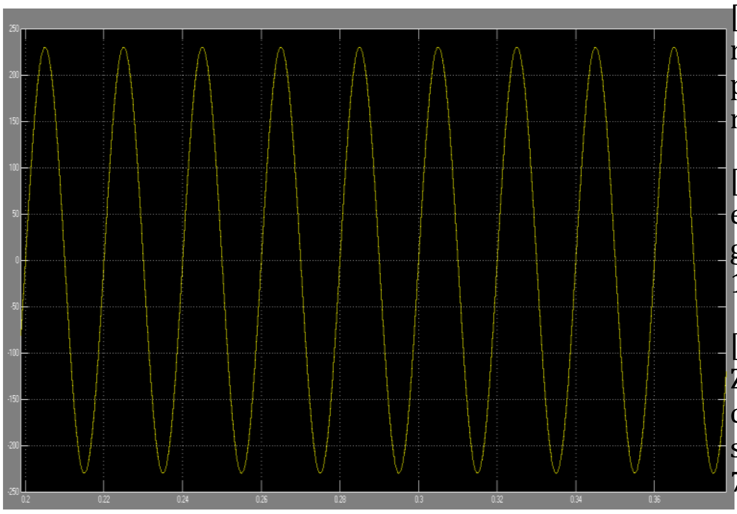

Fig -11: Proposed simulation output

C. FFT analysis of simulation output

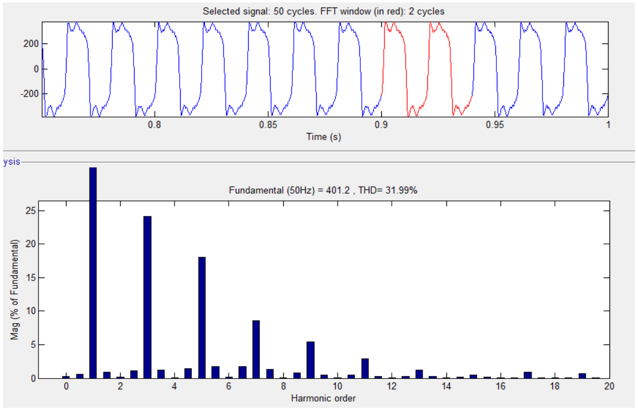

Fig-12: FFT analysis of output

5. CONCLUSION

Here we conclude a new interleaved H6 inverter is designed and simulation results are verified. In existing H6 inverters are used for to convert the solar energy into ac voltage. Now the interleaved converter are added to increase the output voltage even the solar input is low. In H6 inverter 400V panel is used but in interleaved converter only 180V is used to give the input voltage. This will increase the system efficiency and also reduced the required input voltage.

REFERENCES

[1] S. B. Kjaer, J. K. Pederson, and F. Blaabjerg, "A review of single-phasegrid-connected inverters for photovoltaic modules," *IEEE Trans. Ind.Appl.*, vol. 41, no. 5, pp. 1292–1306, Sep/Oct. 2005.

[2] F. Blaabjerg, Z. Chen, and S. B. Kjaer, "Power electronics as efficientinterface in dispersed power generation systems," *IEEE Trans. PowerElectron.*, vol. 19, no. 5, pp. 1184–1194, Sep. 2004.

[3] B. Sahan, A. N. Vergara, N. Henze, A. Engler, and P. Zacharias, "A singlestage PVmodule integrated converter based on a low-power current sourceinverter," *IEEE Trans. Ind. Electron.*, vol. 55, no. 7, pp. 2602–2609, Jul.2008.

[4] M. Calais, J. Myrzik, T. Spooner, and V. G. Agelidis, "Inverters for singlephase grid connected photovoltaic systems—An overview," in *Proc. IEEEPESC*, 2002, vol. 2, pp. 1995–2000.

[5] F. Blaabjerg, Z. Chen, and S. B. Kjaer, "Power electronics as efficientinterface in dispersed power generation systems," *IEEE Trans. PowerElectron.*, vol. 19, no. 5, pp. 1184–1194, Sep. 2004.

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