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Grid-Connected PV Inverter with Inductive Dc Link for Three-Phase Transformer Less

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Abstract **- In the last decade solar power technologies became less costly and additional efficient, that have created it to an attractive resolution, being cleaner and additional environmentally friendly energy resource than traditional ones like fossil fuels, coal or nuclear. yet, a PV system continues to be rather more expensive than traditional ones, because of the high producing prices of PV panels, however the energy that drives them -the lightweight from the sun- is free, offered nearly everyplace and can still be present for many years, long in spite of everything non-renewable energy sources are depleted. One in every of the main benefits of PV technology is that it's no moving components. Therefore, the hardware is very robust; it's a long time period and low maintenance necessities. And, most significantly, it's one resolution that gives environmentally friendly power generation. The efficiency of economic PV panels is around 15-20%. Therefore, it's important that the power created by these panels isn't wasted, by using inefficient power electronics systems. The efficiency and reliability of each single-phase and 3 part PV inverter systems is improved using transformer less topologies, however new issues related to escape current and safety need to be dealt with.**

Keywords- **Grid connected PV inverter, solar panel, PWM, MPPT.**

I. INTRODUCTION

Single-String Structure and AC modules To overcome the power mismatch and inefficient MPPT technology, the present inverter technology has been introduced, which is based on processing the power produced by individual strings (single-string technology) or individual modules (AC module). The present technology offers improved performance compared to the past technology in the following ways: Distributed MPP tracking leads to increase in the overall efficiency compared to the centralized inverter. Moreover, the cost of manufacturing and thus the sale price is reduced due to mass production.

It provides the possibility of up-scaling the system due to the modular structure.[1] It is more user friendly because of its straight forward structure with “Plug-and-Play” feature. It is based on forced-commutated DC-AC converters employing IGBTS, resulting in low harmonic content and thus high power quality Transformer and Transformer-less configurations Generally, grid-interfaced inverters use a line-frequency transformer for voltage amplification when the input voltage is low in addition, the transformer provides galvanic isolation and grounding of the PV module.[2] Furthermore, double grounding for single-phase PV inverter topology can be easily realized by interfacing a transformer. However, transformer is considered as an “extra” component when the input voltage is sufficiently high. Therefore, transformer-less inverters have been introduced recently

To avoid increased size, weight, and price due to addition of the transformer. Researchers have proposed transformer-less configuration for single-phase PV inverter with double grounding feature by splitting PV modules into two halves or by modifying the inverter topology [3]. For single-phase transformer-less PV inverter, double grounding feature is easily realized by splitting the PV modules into two parts. A schematic diagram of such PV inverter is Reference [19] proposes a single-stage single-phase transformer-less grid-connected topology which is capable of double grounding feature. The topology proposed in [4] uses only one PV source instead of splitting the PV module into two parts, a single buck-boost converter, and a decoupling capacitor. The argument the authors have made for not splitting the PV source is that there will be a high total harmonic Distortion (THD) if there is a mismatch of power between the two parts. Moreover, there is less utilization of PV source when it is divided.

Transformer and Transformer-less configurations generally, grid-interfaced inverters use a line-frequency transformer for voltage amplification when the input voltage is low In addition, the transformer provides galvanic isolation and grounding of the PV module. Furthermore, double grounding for single-phase PV inverter topology can be easily realized by interfacing a transformer. However, transformer is considered as an “extra” component when the input voltage is sufficiently high. Therefore, transformer-less inverters have been introduced recently to avoid increased size, weight, and price due to addition of the transformer.[5] Researchers have proposed transformer-less configuration for single-phase PV inverter with double grounding feature by splitting PV modules into two halves or by modifying the inverter topology. For single-phase transformer-less PV inverter, double grounding feature is easily realized by splitting the PV modules into two parts.

A schematic diagram of such PV inverter proposes a single-stage single-phase transformer-less grid-connected topology which is capable of double grounding feature. The topology proposed uses only one PV source instead of splitting the PV module into two parts, a single buck-boost converter, and a decoupling capacitor. The argument the authors have made for not splitting the PV source is that there will be a high total harmonic Distortion (THD) if there is a mismatch of power between the two parts. Moreover, there is less utilization of PV source when it is divided. [6]

II. METHODOLOGY

Growing demand for electric power, the restriction of fossil energy sources, air pollution, and the greenhouse effect because of using fossil energy sources are among the reasons indicating the importance of renewable energy sources such as solar and wind power. Cost-effective, reliable, and efficient PV inverters enable the successful utilization of this renewable energy resource. One of the major factors in PV inverters' failures is the usage of electrolytic capacitors. Some efforts have been made to reduce the size of capacitors needed in single-phase inverters and to replace the electrolytic capacitors with the non-electrolytic capacitors. In these methods, however, additional elements are employed and the switching patterns are complex.

When soft switching is employed in inverters, switching frequency can be increased. As a result, smaller filter elements are used. Thus, the inverter's power density increases. Moreover, soft switching increases the reliability of the inverter because it reduces the stress on the switches. To reach soft switching, several approaches have been proposed based on using ac link instead of dc link. A quasi-dc link converter is introduced. In this converter, soft switching is achieved by switching between states at the intervals where the link voltage is zero.
However, many switches are used in this structure. Partial resonant converter has been introduced in which the resonance of a parallel LC tank and the ac link provides soft switching conditions at the intervals where the link voltage or current is zero. In the partial resonant converter with some modifications has been used in PV applications.

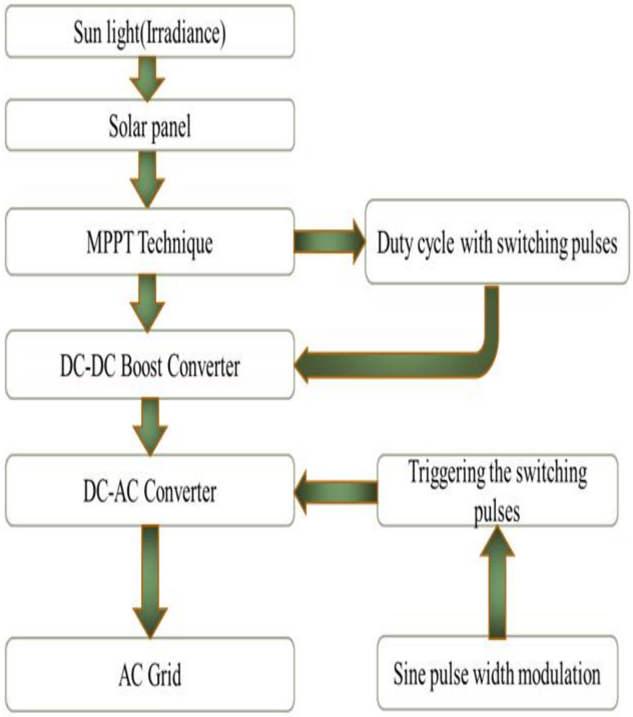

Fig.1. flow chart of proposed method.

However, many switches are used in this structure. Partial resonant converter has been introduced in which the resonance of a parallel LC tank and the ac link provides soft switching conditions at the intervals where the link voltage or current is zero. In the partial resonant converter with some modifications has been used in PV applications. This topology, however, suffers from the dependence of link frequency to the output power. In addition, the control method is not straightforward and the computational burden increases with increase in link frequency. As the voltage of renewable energy sources, such as PV and fuel cell, varies widely in their power range, the buck–boost topology has attracted a lot of attention recently.

Moreover, in transformer less PV inverters, the common-mode current must be rejected. For single-phase applications, multiple topologies have been introduced. In addition, some three-phase inverters based on buck–boost topology have been proposed in the literature. For instance, a three-phase fly back inverter is introduced in with sinusoidal pulse width modulation switching pattern.[7] The same topology has been employed in with space vector modulation (SVM) technique. The work in presents various control methods in current source inverters. For example, in the PV current is controlled to track the MPP, and a modified SVM is used to generate the gate signals. In the MPPT block determines the reference of a PV voltage and then the voltage of a PV panel is regulated to this reference value. In a sliding mode control based on SVM is employed and the PV power is controlled directly to realize the MPPT function.

1. Modules Description

- AC grid
- DC-AC converter
- Sine pulse width modulation (SPWM)
- Solar panel
- MPPT Technique

2. Conclusion Acknowledgement and Appendix

Conclusion section is mandatory and contains advantages, disadvantages, review the main part of research paper and use of research work. If author want to acknowledge someone, then acknowledgement section may include in research paper after conclusion. Appendix section (if required) appears before acknowledgement section.

III. MPPT ALGORITHM

Maximum power point tracking (MPPT) is an rule enforced in photovoltaic (PV) inverters to continuously change the impedance seen by the solar battery to stay the PV system operational at, or on the point of, the peak power point of the PV panel under variable conditions, like ever-changing solar irradiance, temperature, and load. Engineers developing solar inverters implement MPPT algorithms to maximise the facility generated by PV systems. The algorithms control the voltage to confirm that the system operates at “maximum power point” (or peak voltage) on the facility voltage curve, as shown below. MPPT algorithms are generally utilized in the controller styles for PV systems.

The algorithms account for factors like variable irradiance (sunlight) and temperature to ensure that the PV system generates most power in any respect times. Maximum power point tracking may be a technique used normally with wind turbines and photovoltaic (PV) solar systems to maximise power extraction under all conditions. Though solar energy is principally lined, the principle applies typically to sources with variable power: as an example, optical power transmission and thermo picture voltaics. PV solar systems exist in many various configurations with reference to their relationship to inverter systems, external grids, battery banks, or alternative electrical masses.

No matter the last word destination of the solar energy, though, the central drawback addressed by MPPT is that the efficiency of power transfer from the cell depends on each the number of daylight falling on the solar panels and also the electrical characteristics of the load.[8] Because the quantity of daylight varies, the load characteristic that provides the best power transfer efficiency changes, in order that the efficiency of the system is optimized once the load characteristic changes to stay the facility transfer at highest efficiency. This load characteristic is termed the maximum power point and MPPT is that the method of finding now and keeping the load characteristic there. Electrical circuits may be designed to present impulsive loads to the photovoltaic cells and so convert the voltage, current, or frequency to suit alternative devices or systems, and MPPT solves the matter of selecting the most effective load to be given to the cells so as to induce the most usable power out. Solar cells have a posh relationship between temperature and total resistance that produces a non-linear output efficiency which might be analyzed supported the I-V curve. It’s the aim of the MPPT system to sample the output of the PV cells and apply the correct resistance (load) to get most power for any given environmental conditions.[9] MPPT devices are generally integrated into an electrical power device system that gives voltage or current conversion, filtering, and regulation for driving varied loads, as well as power grids, batteries, or motors.

- Solar inverters convert the DC power to AC power and should incorporate MPPT: such inverters sample the output power (I-V curve) from the star modules and apply the right resistance (load) therefore on get most power.
- The facility at the MPP (Pmpp) is that the product of the MPP voltage (Vmpp) and MPP current (Impp).

MPPT controllers are used for locating most output power through adjusting duty cycle in favour of the boost convertor that's load impedance match with supply impedance.[10] There are totally different techniques won’t to track the maximum power point. Few of the foremost widespread Techniques are

Perturb and observe (hill climbing method)

1. Neural networks
2. Fuzzy logic

IV. RESULT

The proposed inverter, the inductor L is a parallel dc link between the input and output. SBu and SBd are used to transfer energy from the PV panel to an inductor L, and S1–S6 are used to transfer energy from the inductor L to the grid. Among 16 switching combinations related to eight switches, 14 switching actions are done under soft-switching condition.

The proposed inverter has two operating modes: charging and discharging. In charging mode, the switches and all other switches are OFF. Since the inductor (or link) current is zero at first, the switches are turned ON under the ZCS condition and the link current iL increases with a constant slope. Here, it is also assumed that v ac > 0 and the switches S3 and S4 are turned ON. In this mode, because of voltage polarity of input and output sides, the series diodes remain OFF and no current is established at the output side. This mode continues until the link current reaches a predetermined value. The discharging mode commences when the switches. During this mode, the link

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current is injected to the output phases through the output switches S3 and S4. These switches are held on until the link current reduces to zero and after that the switches are turned OFF under the ZCS condition. However under the hard-switching condition.

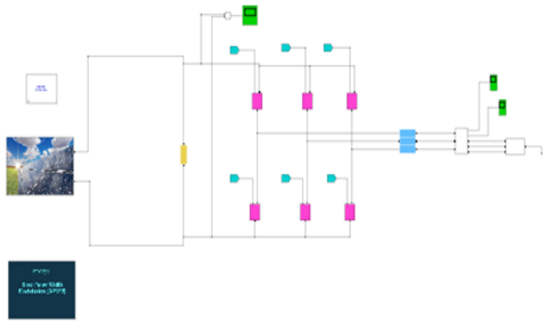

Fig.2. Simulink Model of Proposed System.

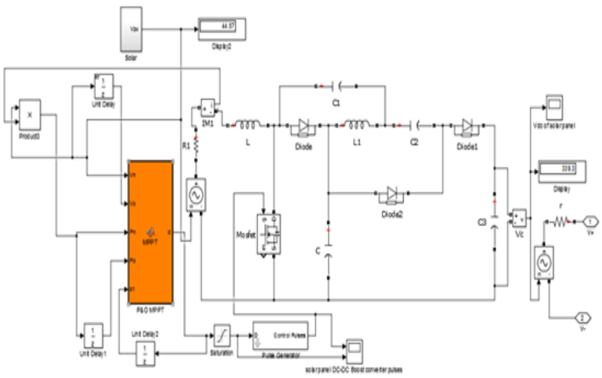

Fig.3. MPPT model.

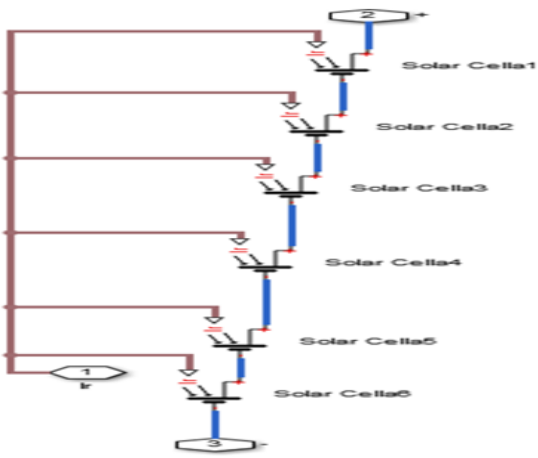

Fig.4. Solar cell.

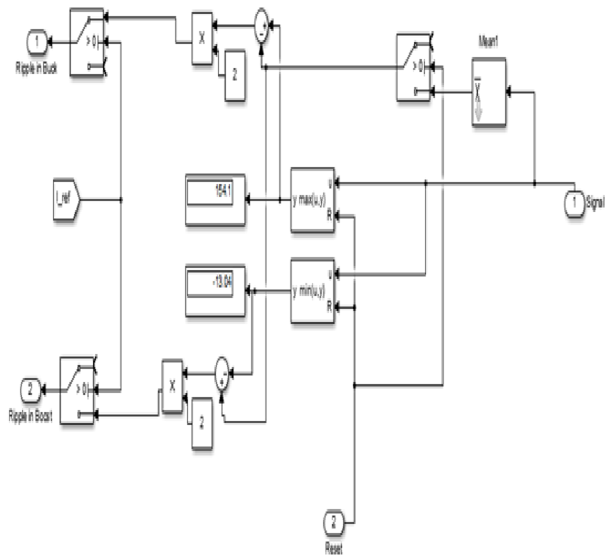

Fig.5. Buck Boost Sub System.

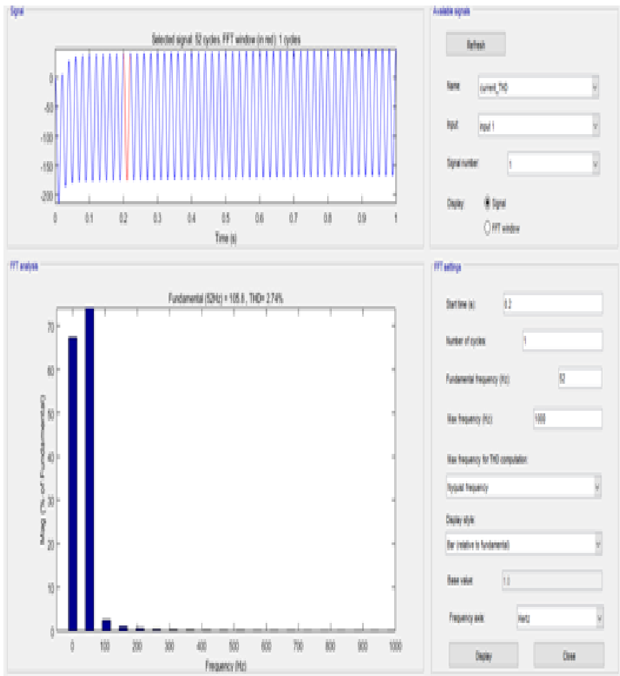

Fig.6. FFT Analysis.

V. CONCLUSION

A reliable three-phase grid-connected PV inverter is proposed. Using a configuration based on a buck–boost inverting dc/dc converter, interesting features are achieved. By increasing the link frequency, THD of injected current is decreased and smaller filter elements are needed. In addition, no common-mode current would be established and just one current sensor would be enough for the control function. A simple control strategy and also a novel MPPT method are proposed.

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