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Efficient Single Phase Transformerless Inverter For Grid-Tied Pvg System With Reactive Power Control

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ABSTRACT

Transformer-less photovoltaic (PV) inverters are the major functional units of modern grid-connected PV energy production systems. In general, two power conversion stages are required when low-voltage unregulated photovoltaic (PV) output is conditioned to generate AC power.

In this paper, the boost inverter topology that achieves both boosting and inversion functions in a single stage is used as a building block to develop a three phase grid connected PV system which offers high conversion efficiency, low-cost and compactness.

The proposed system employs a modified modulation scheme for the three phase boost inverter to control both active and reactive power injected to the grid. This modified modulation scheme enhances the boosting capability of the boost inverter and improves the THD of the grid injected current.

INTRODUCTION

With exhaustion of natural resources and accelerated demand of conventional energy, the problems of energy shortage and environmental pollution in the world have become of much importance that forced the planners and policy makers to look for alternative resources. The deregulation of electricity markets and requirement to reduce greenhouse gas emission from the conventional electric power generation makes the distributed generation (DG) renewable energy systems gain a great opportunity as a new means of power generation that meet the accelerated demand for electric energy.

Additionally, this trend has been increasing in recent years due to the substantial benefits of DG power systems such as diversification of power sources, reduction in transmission and distribution losses, and improved reliability [3]. Among all the various DG technologies, solar photovoltaic systems are rapidly growing in electricity markets due to the declining cost of PV modules, increasing efficiency of PV cells, manufacturing technology enhancements and economics of scale. Furthermore, the grid-connected PV systems can effectively solve the problem of environment pollution and is expected to play a major role in the world's future energy portfolio. The PV modules output is typically DC. Hence, a DC/AC conversion with boosting stage is mandatory.

Conventional Voltage Source Inverters (VSI), referred to as buck inverters, are probably the most common power converter topology employed in such systems. Intrinsically, the peak AC output voltage of VSIs is always lower than the input DC voltage. To consider the VSI topology in the grid-connected PV systems, the low output voltage of the PV panels requires a pre-boosting stage in order to match the grid connection requirements. A two-stage power conversion system is thus typically used. Two common configurations are mostly employed. The first configuration uses an intermediate DC-DC boost converter before the DC-AC grid interface inverter.

This adds significant complexity and hardware to the power conversion system. Alternatively, the second configuration uses an output transformer to not only step up the inverter output voltage but also to avoid the injection of DC components into the grid. With the latter configuration, the inverter will be more compact and more affordable.

EXISTING SYSTEM:

The main focus of this paper is to propose a new topology that can be implemented using MOSFET switches with high reliability, efficiency, and low leakage current even when inject reactive power.

In this paper, a new high efficiency transformer less topology is proposed for grid-tied PV system with reactive power control. The new topology structure and detail operation principle with reactive power flow is described.

The high frequency common mode (CM) model and the control of the proposed topology are analyzed. The inherent circuit structure of the proposed topology does not lead itself to the reverse recovery issues even when inject reactive power which allow utilizing MOSFET switches to boost the overall efficiency. The CM voltage is kept constant at midpoint of dc input voltage, results low leakage current.

PROPOSED SYSTEM

The boost inverter topology that achieves both boosting and inversion functions in a single stage is used as a building block to develop a three phase grid connected PV system which offers high conversion efficiency, low-cost and compactness.

The proposed system employs a modified modulation scheme for the three

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phase boost inverter to control both active and reactive power injected to the grid. This modified modulation scheme enhances the boosting capability of the boost inverter and improves the THD of the grid injected current.

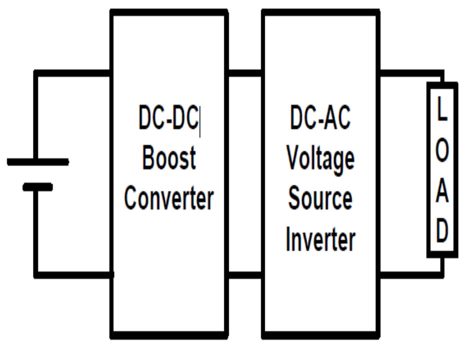
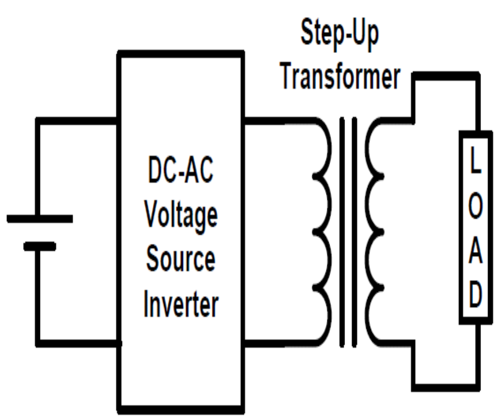


Fig:3.1 Two stage power conversion system using DC-DC boost converter



Two stage power conversion system using output step-up transformer.

CONCLUSION

A new modulation technique is proposed not only to obtain the same boosting range, when third harmonic injection is employed, but also to improve the THD of the output voltage. A simulation case study is carried out to compare the three modulation techniques and to verify the operation characteristics of the proposed system. A three-phase single power stage grid-connected PV system based on the boost inverter topology with modified modulation scheme is proposed in this paper. Generally, this converter topology offers a single power stage with higher efficiency over conventional two-stage topologies. Using sinusoidal modulation or employing third harmonic injection to improve the boosting capability generally result in an asymmetrical output wave and a relatively high THD in the output voltage especially during very high duty cycles.

Alternatively in this paper, a new modulation technique is proposed not only to obtain the same boosting range, when third harmonic injection is employed, but also to improve the THD of the output voltage. A simulation case study is carried out to compare the three modulation techniques and to verify the operation characteristics of the proposed system. In summary, the grid connected PV system with the modified voltage reference has a number of attractive features such as enhanced boosting capability, lower THD of the grid injected current, lower average switching frequency and reduced peak voltage on both capacitors and switching devices.

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