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Design of Switched Boost Converter and VSI Inverter for EV Charging Station

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ABSTRACT: More numbers of electric vehicles and renewable energy resources are integrated into the power system day by day. The aim behind the growth of electric vehicles and renewable energy sources is to make a sustainable and green power system. The major challenge during this conception is that the unstable nature of renewable energy because the energy storage system of the charging system is directly connected to the renewable energy supply. For the uneven and lacking input power condition, the intermediate converter should provide a regulated output at the desired magnitude. This project proposes switched-boost dc-dc converters for the high step-up voltage conversion applications, like renewable energy power generation, uninterruptible power supply. Compared to different dc-dc converters, the planned switched-boost converter, which merges the normal switched-boost network with the switched-capacitor/switched-inductor cells, has the subsequent features: higher output voltage gain, the less variety of passive elements like inductors and capacitors, and lower voltage stress across the output diode and power switches. The structure, operational principle analysis, parameter design, and comparison with different dc-dc converters are analysed. Finally, each simulation and experimental result are given to verify the effectiveness of the proposed converter.

KEYWORDS: switched boost converter, VSI, e-vehicle charging, renewable energy.

I. INTRODUCTION

In the present trend, Renewable energy sources are attractive selections for providing power in places where an association to the utility network is either impossible or unduly pricey. As electrical distribution technology steps into following century, many trends became noticeable which is able to modify the requirements of energy delivery. The ever-increasing energy consumption, soaring worth and exhaustible nature of fossil fuels, and additionally the worsening international atmosphere have created increased interest in green power generation systems. Renewable sources have gained worldwide attention as a result of the fast depletion of fossil fuels in conjunction with growing energy demand. The energy that's collected from renewable resources is termed renewable energy, that is of course replenished on somebody's timescale, like daylight, wind, rain, tides, waves, and geothermic heat. Renewable energy provides energy in four areas like electricity generation, air and water heating/ cooling, transportation, and rural (off-grid) energy services.

II. RELATED WORKS

A Comparative Study on Maximum Power Point Tracking Techniques for Photovoltaic Power Systems (B.Subudhi, R.Pradhan, 2013). In this paper solar output is given to the DC-to-DC converter, because of this it provides constant voltage to the load. Different MPPT techniques are compared in this paper, finally hill climbing algorithm extracts maximum power from the panel. Without DC-to-DC converter it is not a efficient one also its ripple factor is high. Only solar network is not sufficient to provide voltage to the grid.

Experimental Implementation Techniques of P&O MPPT Algorithm for PV Pumping System (NajetRebei, Rabiaa Gammoudi), Ali hmidet 2013). In this paper, a high-performance stand-alone PV generation system for water pumping application is successfully developed. Perturb and observe algorithm has been used for maximum power point tracking. It is a particularly valuable application from an educational perspective due to the challenges associated with designing a system that involves direct interfacing of photovoltaic panels to a load without the inclusion of energy storage. P&O algorithm does not provide constant voltage. Boost converter is not enough to improve the power factor of the system, need higher value of inductance.

Analysis of Unified Output MPPT Control in Subpanel PV Converter System (Feng Wang, Student Member, IEEE, XinkeWu, Member, IEEE, Fred C. Lee, Fellow, 2014). In this paper explores the benefits of distributed MPPT

solution through the use of SPMC structure, which can be seen as the reduced version of the current PV optimizer, connecting each PV cell string with a Buck converter. The simulation and experimental results verify that the proposed SPMC with unified output MPPT control solution exhibits good performance under inhomogeneous and homogeneous irradiances with an enhancement rate of about 20% in power harvest. Buck converter has discontinuous mode of operation. So, losses are high. Grid compensation not included.

III.MICROGRID

Interconnection of two or more sources of renewable generation like wind generation, photovoltaic power, electric cell, and microturbine generator to get power to local load and or connecting to grid/microgrid forms Hybrid Energy Systems. Due to the characteristics of solar power and wind energy, the electrical power generation of the PV array and also the turbine are like the reliability of combined power generation which is far higher in comparison to the power generated by a separate supply. A large battery bank is required for the load so most power is drawn from Wind and photovoltaic array. Recently, DC grids are resurging due to the growth and deployment of renewable DC power sources and also the advantage for DC loads in commercial, industrial, and residential applications. To integrate with the varied distributed generators DC microgrid has been proposed. However, AC sources got to be converted into DC before connected to a DC grid and DC/AC inverters are needed for conventional AC loads. When power is often absolutely provided by renewable power sources. HV long-distance transmission is not any longer necessary. AC Microgrids are proposed to facilitate the association of renewable power sources to AC systems. However, the photovoltaic (PV) panel's DC output power must be converted into AC using DC/DC boosters and DC/AC inverters hook up with an AC grid. In an AC grid, embedded AC/DC and DC/DC converters are needed for various home and office facilities to supply different dc voltages. A hybrid AC/DC microgrid is proposed during this paper to scale back multiple processes of reverse conversions in a separate AC or DC grid and to facilitate the association of varied renewable AC and DC sources and loads to the power grid. The coordination control schemes among various modes are proposed to harness most power from renewable power sources to attenuate power transfer between AC and DC networks and to keep up the stable operation of both AC and DC grids under variable supply and demand conditions once the hybrid grid operates in both grid-tied and islanding modes. The advanced power electronics and control technologies employed can create a future grid much smarter. thanks to the very fact that solar and wind generation is intermittent and unpredictable in nature, higher penetration of their types within the existing grids could cause and build high technical challenges, especially to weak grids or stand-alone systems without correct and enough storage capability. By integrating the two renewable resources into an optimum combination, the impact of the variable nature of solar and wind resources are going to be partially resolved and therefore the overall system becomes more reliable and economical to run. There are several configurations that present a review over the state of the art of both grid-connected and stand-alone hybrid solar and wind systems.

IV.BLOCK DIAGRAM

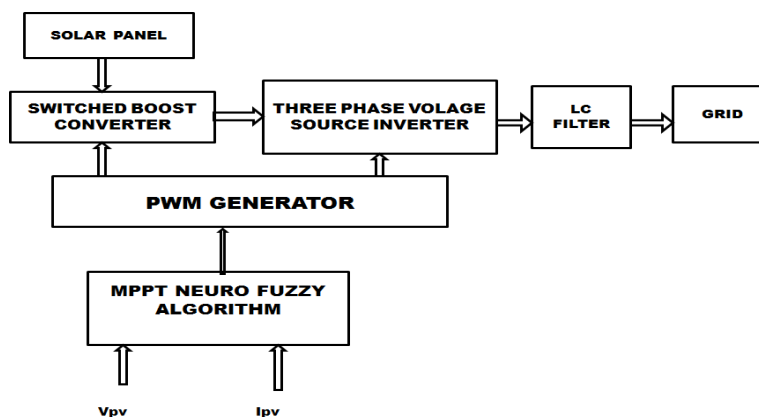


Fig 1. Proposed System Block Diagram

The computation of solar power systems consists of Photovoltaic (PV) installation, during which energy is redeemed within the public electricity grid or power are often provided exactly to electrical equipment. For the betterment of the efficiency of PV array within the photovoltaic system, there's a requirement for power electronic conversion and also the firmness of the system. the power circuit contains a boost Converter (high step-up) DC to DC converter and an inverter with multilevel to transform DC to AC in these systems, because the voltage of the grid is pulsating (AC) in nature. the need of the control circuit is to urge constant (DC) voltage at the output with PV systems output voltage at load side, it's continually varying in nature. this is often the analysis of a Grid-connected solar energy plant with a DC boost converter using MPPT.

V. WORKING PROCESS

In our project we use renewable energy (solar energy) for charging EV the output voltage from solar array is connected to charge boost convertor it converts low dc voltage to high dc voltage. the power received by solar energy isn't fixed so we use pic controller using fuzzy drop control algorithm for fixed output. Additional dc voltage from solar power is convertor in to ac voltage using 3 phase VSI inverter for the aim of supplying to the grid.

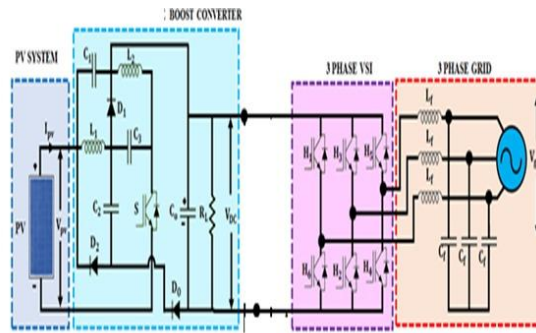


Fig 2. Switched Boost Converter

The switched boost converter employs a switched-capacitor circuit augmented with the major converter circuit to the power source, thus providing unique features that can't be attained by the normal voltage-source inverter. A high voltage gain single switch boost converter for sustainable energy applications using coupled inductor cells and switched capacitor.

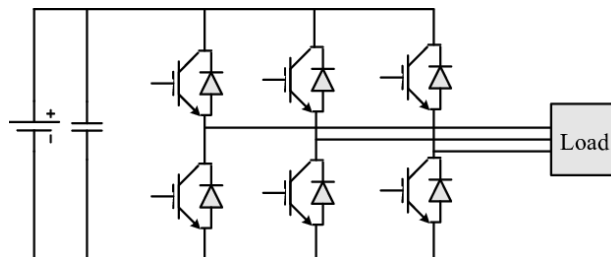


Fig 3. Voltage source inverter

Voltage Source Inverters (VSI) feed the output inverter section from an approximately constant-voltage source. the required quality of the current output waveform determines which modulation technique must be selected for a given application. The output of a VSI consists of discrete values.

VI. WAVEFORMS

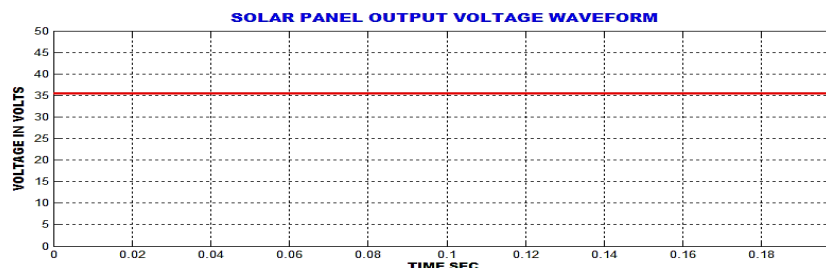


Fig 4. Input Voltage of the converter.

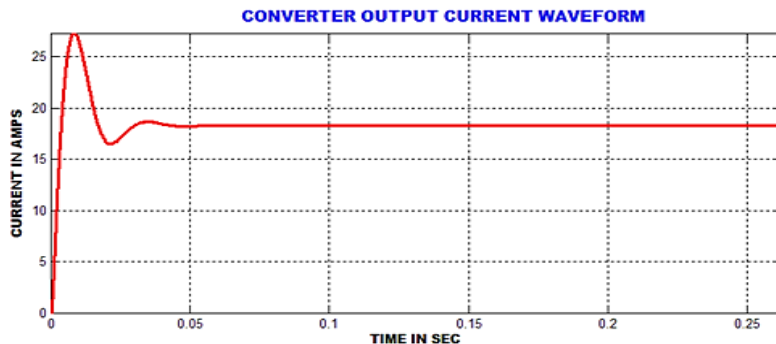


Fig 5.Input current of the converter.

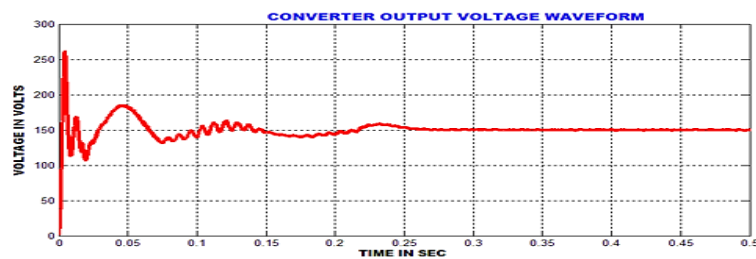


Fig 6.Output voltage of the converter.

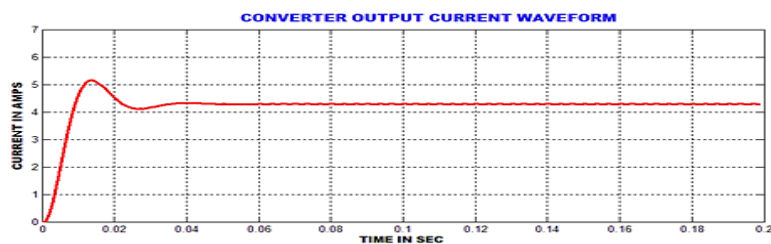


Fig 7.Output current of the converter.

VII. ADVANTAGES

- Switched boost converter can achieve higher voltage gain with a small duty ratio.
- The proposed converters have a low voltage stress across the output diode and power switches.
- It can be easily extended to produce a very high voltage gain.
- Ability to disconnect from utility grid during disturbance and operate independently.

VIII. APPLICATIONS

- To charge the electric vehicles like electric cars, bikes, trains etc.,
- To power household applications.
- It can able to supply the excess power to the grid.
- It can storage energy and we can able to use it later during the power shutdown.

IX. CONCLUSION

The project proposed a grid-connected electric vehicle charging module integrated into renewable energy for preserving the traditional energy resources also on ensure sustainable development of the society. A high step-up single switch dc/dc converter supported integrating coupled inductor and switched-capacitor is proposed. The operation principle, parameters design, and comparison with other dc-dc converters are described intimately. as compared to other converters, the proposed switched boost converter can do a higher voltage gain with a little duty ratio. The proposed converters have low voltage stress across the output diode and power switches. additionally, it is often easily extended to supply a really high voltage gain. A module was developed with a solar array with an output of 9V, and it stepped up using switched boost converter to 40V. The inverter provides an output voltage of 120V. The result shows that this process will increase the reliability of the EV charging system.

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