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An Interleaved High-Power Flyback Inverter with Extended Switched-Inductor Quasi-Z-Source Inverter for Pv Applications

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Abstract: *The analysis and design of single phase inverter for photovoltaic (PV) applications based on interleaved flyback converter topology operating in discontinuous current mode with Extended switched Inductor Quasi Z-Source (ESL-QZS) network. In today's PV inverter technology, the simple and the least-cost advantage of the flyback topology is promoted only at very low power. Therefore, the primary aim of this study is to design the ESL-QZS network in front end and back end as flyback converter, at high power with good performance. A simulation model is developed in the MATLAB simulink. Then, the design is verified for the good performance based on the simulation results.*
Keywords**:** *Flyback Inverter Extended Switched Inductor Quasi Z-Source Network.*

I. Introduction

The solar energy is considered as one of the most renewable and freely available source of energy and the candidate to play a important role in the energy market of the world in the near future. Therefore, the research and development in the solar technology field is in the rise. However, the high cost of technology still limits its usage globally. The low cost is greatly important for commercialization especially in small electric power systems including the residential applications. The primary objective of the study presented in this paper is to contribute to the research and development in the photovoltaic (PV) inverter technology by trying the flyback topology at high power. If it is implementedeffectively with better performance, the developed inverter system can be a low-cost alternative to the isolated grid connected PV inverters in the market.

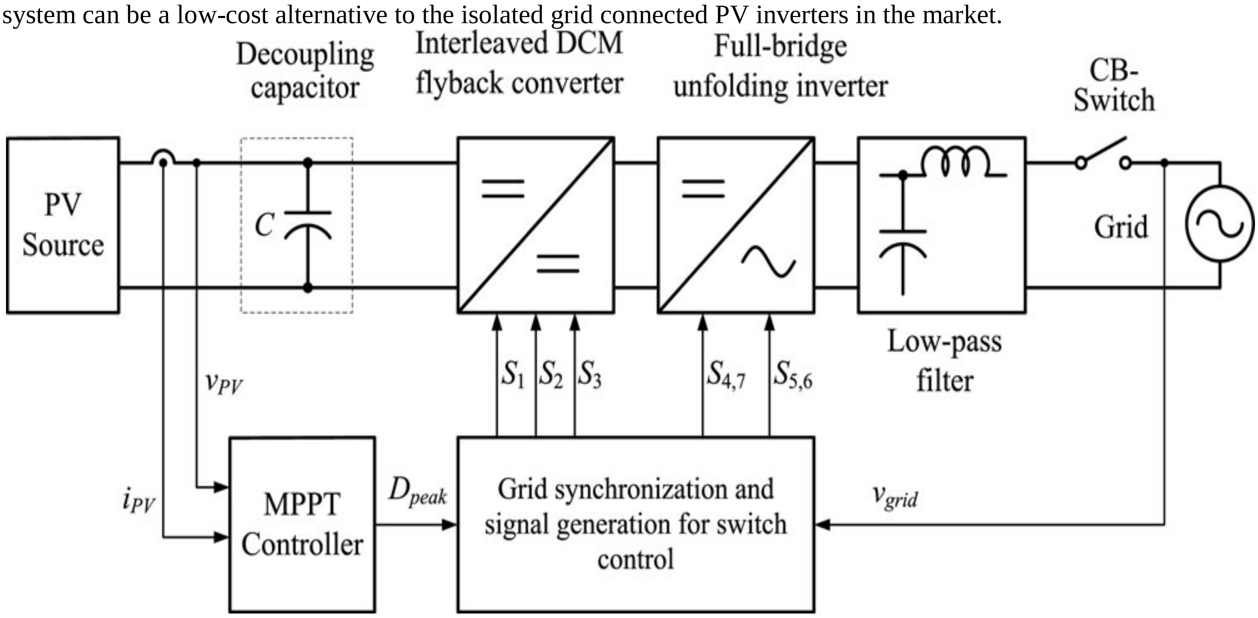

Figure 1. Block Diagram of PV Inverter System based on Interleaved Flyback Converter

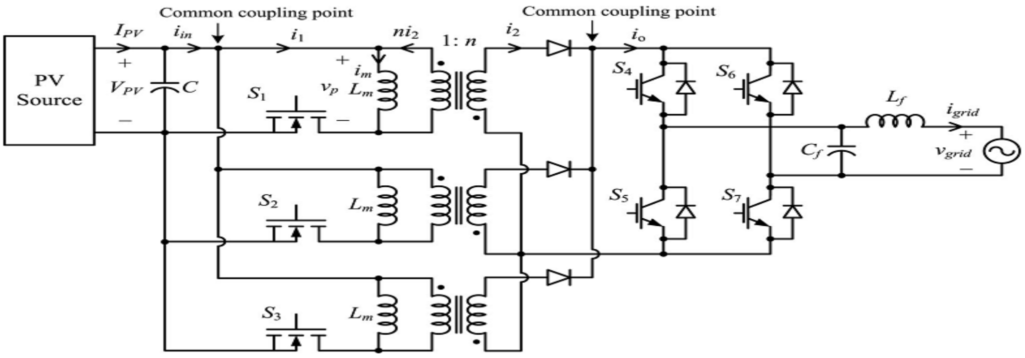

Figure 2.Circuit Diagram of PV Inverter System based on Interleaved Flyback Converter

The flyback converter is recognized as the lowest cost converter among the isolated topologies since it uses the less number of components. This advantage comes from the ability of the flyback topology combining the energy storage inductor and the transformer. In other type of isolated topologies, the energy storage inductor and the transformer are separate elements. While the inductor is used for energy storage, the transformer on the other hand is responsible for energy transfer over a galvanic isolation. The combination of these two components in a flyback topology eliminates the costly energy storage inductor and therefore leads to a reduction in cost and size of theconverter. However, we have to make it clear here that the cost depends on the implementation as much as the selected topology, not in other implementation of the flyback topology leads to a low-cost converter. For this reason, we try to attain the high-power implementation of the flyback topology with good performance, which is our primary research contribution, we will also try to maintain the cost advantage during the final implementation step.

The maximum harvesting of solar energy in this method is the optimal since there is a dedicated maximum power point tracker (MPPT) for each PV panel. In this method, an extended switched-inductor quasi-Z-source inverter (ESL-qZSI) with high boost voltage inversion ability is proposed which combines the SL-qZSI with the traditional boost converter, as well as improves the switched-inductor. Compared with the standard qZSI topologies, the proposed topology reduces the voltage stresses of capacitors, power switches and diodes for the same input and output voltage. Furthermore, the conversion efficiency is improved.

II. Extended Switched Inductor Quasi Z-Source Inverter

In this system an extended switched-inductor quasi-Z-source inverter (ESL-qZSI) is proposed, which combines the new SL-qZSI with classic boost circuit is used along with a interleaved flyback inverter.The ESL-qZSI topology possess high boost ability with the same shoot-through duty ratio than the other topologies to improve the output voltage. For the same input and output voltage, the proposed new SL-qZSI achieves lower voltage stress on capacitors, diodes and power devices to increase the performance. Furthermore, the conversion efficiency of the proposed topology is increased.

Maximum power point tracking is a method that charge controllers use for wind turbines and PV solar systems to maximize power output. The application of MPPT concerns itself only with PV solar. Solar cells have a critical relationship between resistance and temperature that produce a non-linearoutput efficiency which can be analyzed based on the V-I curve. It is the object of the MPPT system to sample the output of the PV cells and apply the proper resistance to obtain maximum power for any environmental conditions. MPPT devices are typically integrated into an electrical power converter system that provides voltage and current conversion, filtering, and regulation for driving various loads, includes power grids, batteries, or motors.

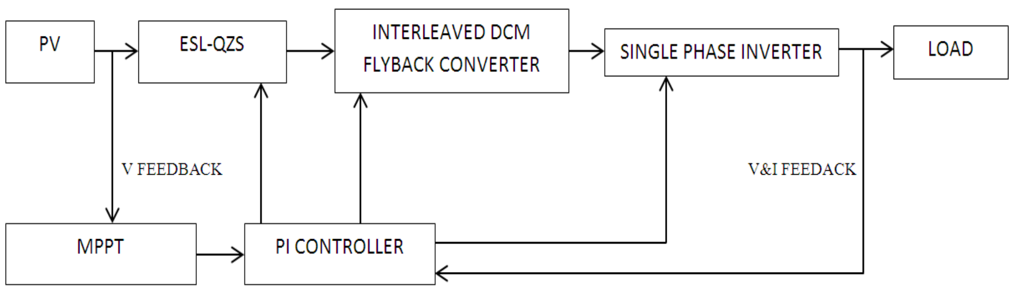

Figure 3. Block diagram of ESL-QZS interleaved flyback inverter

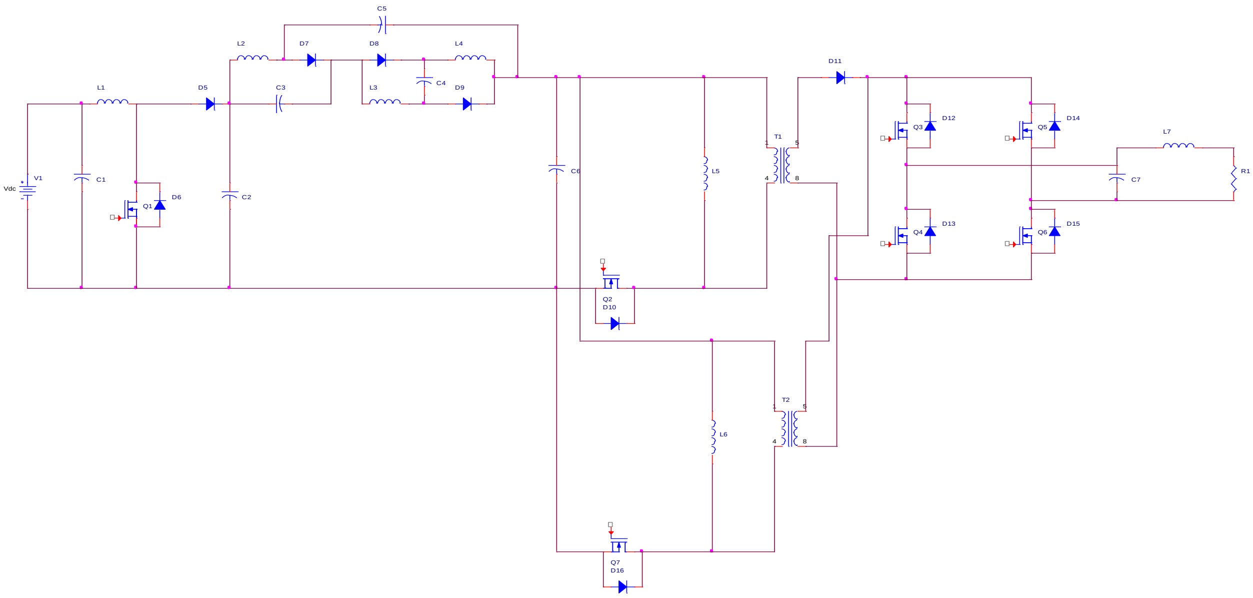

Figure 4.Circuit diagram of ESL-QZS interleaved flyback inverter

We use Extended Switch Inductor Quasi Z-source Inverter (ESL-QZSI) which has high boost ability with continuous input current and Offers lower voltage stress across capacitor, switching devices as well as diodes for the same input and output voltage.We use P&O algorithm for MPPT controller. The improvement in the proposed algorithm is observed for very fast, fast and slow changing environment in terms of improved time response and reduced oscillation under steady state response.PI controller is used for the guarantee set point overshoot. The efficiency of the system is high compared to the existing system.

III. Simulation And Results

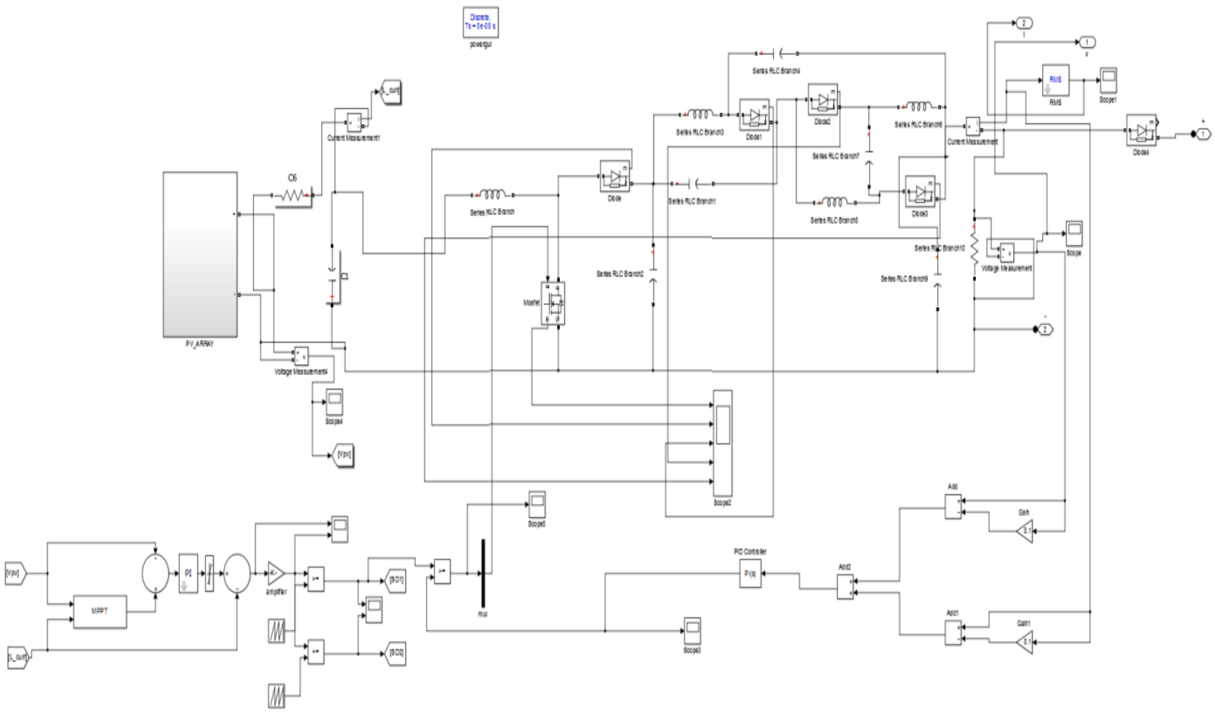

Figure 5.Simulink diagram of PV Array with ESL-ZQSI

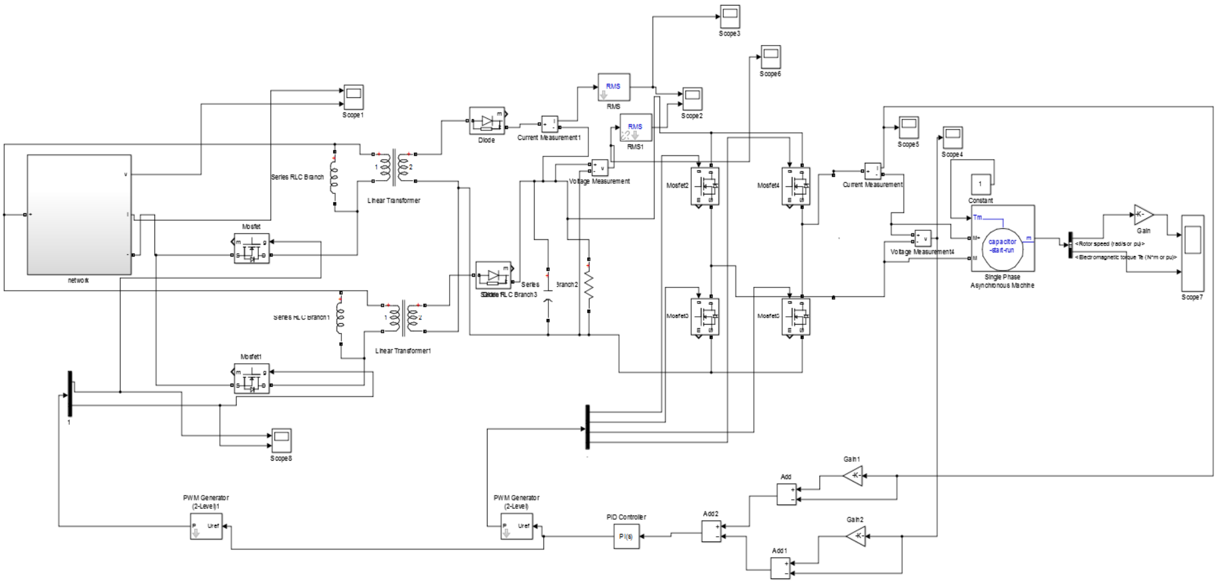

Figure 6.Simulink of Interleaved Flyback Inverter

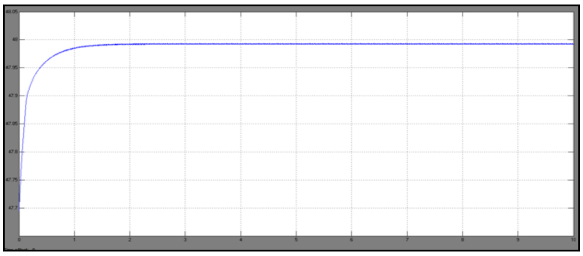

Figure 7.Input Voltage waveform of ESL-QZSI Interleaved Flyback Inverter
X axis represents Time and Y axis represents Voltage, Input Voltage-48V

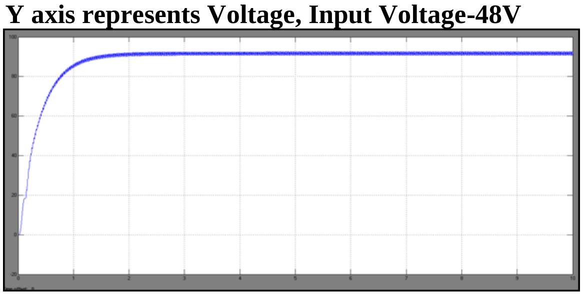

Figure 8. Output Voltage waveform of ESL-QZSI
X axis represents Time and Y axis represents Voltage,Output voltage-92V

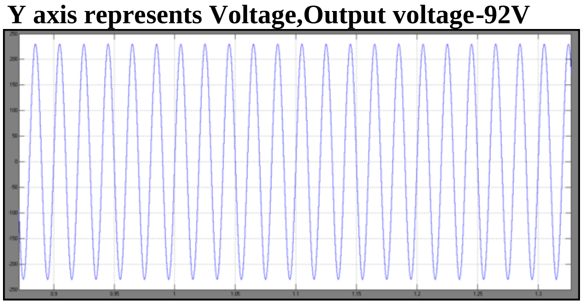

Figure 9. Output Voltage waveform of the Interleaved Flyback inverter
X axis represents Time and Y axis represents Voltage,Output voltage-230V

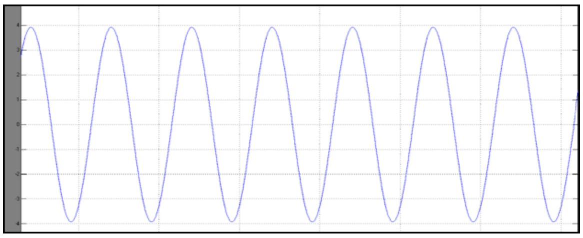

Figure 10.Output current waveform of Interleaved Flyback Inverter
X axis represents Time and Y axis represents Current, Output Current-4A

IV. Conclusion

The new PV based single phase inverter for high voltage application by including interleaved flyback inverter and ESL-QZ Source network is introduced. By these systems the output efficiency is high, voltage stresses on the capacitance are low, harmonics are less and the stability of the system is attained in fast response. By this the PV based application systems increases with cost effective and with good life time. We have designed the module using MATLAB simulink and verified the output which has high efficiency with low input from PV source.

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