Interleaved Fly back Inverter with for Photovoltaic Application

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Abstract— In This Project presents a design and an implementation of an isolated grid connected micro inverter system that is based on an interleaved fly back topology. The developed system gets input from a 250 W PV panel, converts the dc energy into ac and connects it to the grid. This work covers the simulation aspect of developing the above mentioned system where extensive simulations are performed in order to find and optimize values of desired parameters and simulate the overall system. The CCM (Continues Conduction Mode) of operation for the fly back converter is preferred as it generates considerably less amount of the current ripple at converter output when compared to DCM operation and less amount of power loss. A feedback loop with a PI controller is incorporated into the design in order to properly stabilize the system. Simulation results demonstrated that the developed system generates sinusoidal voltage and current signals of 50 Hz in frequency with desired amplitudes at the output of the system. Connection of generated ac waveforms to the grid is accomplished by means of a PLL block. THD of the grid current is found as 11.57% due to spikes at zero crossing.

I. INTRODUCTION

Utilization of the power generation system that depend on solar energy in both industrial and residential areas has greatly increased in recent years due to its being a renewable and clean source of energy. These systems have proven to be reliable over years, as they require small maintenance fees and cause no danger to the nature. Taking into consideration that the life expectancy of PV panels with today's technology well excess 25 years and solar energy is available at almost everywhere, usage of the micro grid systems is expected to increase in the future. Micro grids are small-sized energy generating units in which energy is obtained from mostly renewable sources such as the solar or wind energy and then converted into grid frequency ac energy which is either directly utilized by the local network or supplied to the grid. There have been numerous studies in order to improve the cost an efficiency of such systems and develop optimum design for them in recent years. Tamyurek and Kirimer developed a low cost micro grid system with interleaved fl yback topology where the dc energy obtained from PV panels is converted into sinusoidal ac energy and connected to the grid. Both PLECS (Piecewise Linear Electrical Circuit Simulation) and Simulink are used to generate models of their system. DCM (Discontinuous Conduction Mode) operation of the converter is preferred in order to achieve fast dynamic response and guaranteed stability of the system operation. No feedback loop is utilized in their system other than the feedback block embedded in the PLL algorithm. Optimization of various design parameters was done using simulations. The experimental part of their work was accomplished by building and evaluating a small prototype of simulated system for 1 KW output power which is suitable to be used in small residential areas. By applying an MPPT technique based on perturb & observe algorithm, they had achieved 97% of PV panel efficiency with 86% inverter static efficiency. They have reported a THD of 3.86% for the output current of the converter and close to unity power factor for their design. As a continuation study of their earlier work, Tamyurek and Kirimer increased the power level of their previously developed system to 2 KW by going through several design improvements. They have reported 90.16% inverter efficiency, 4.42% THD for grid current and 0.998 pf for their improved design. The DCM mode of the converter operation and the open loop control of the overall system were again preferred in this later design. The goal of this study is to develop a simulation model of a micro grid system that obtains dc energy from a PV panel and converts it into an ac energy using the interleaved flyback converter in order to supply it to the grid. The CCM mode of operation is utilized in the flyback topology since it provides less ripple at the output current and leads to less power loss. In order to overcome the stability problem that might occur because of CCM mode of operation, a feedback loop with a PI controller is incorporated into the design.. The following studies are performed in prior to this study by us in order to develop a proper background to this work The remaining parts of this work are organized as follows. Section 2 gives detailed description of each sub-block of the overall system including theoretical background for interleaved flyback topology.

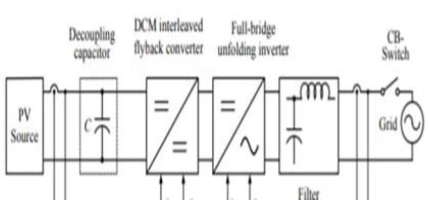
II. OBJECTIVE

Cost Minimization: The primary objective is often to minimize the overall cost of the hybrid renewable energy system. This involves considering the capital costs of different components (solar panels, wind turbines, energy storage systems), operational and maintenance costs, and the costs associated with integrating and managing different renewable sources. Energy Reliability and Availability: Ensure a reliable and continuous power supply by optimizing the system to meet the energy demand at all times. This involves determining the right mix of renewable sources and storage capacity to ensure energy availability during periods of low renewable generation.

III. METHODOLOGY

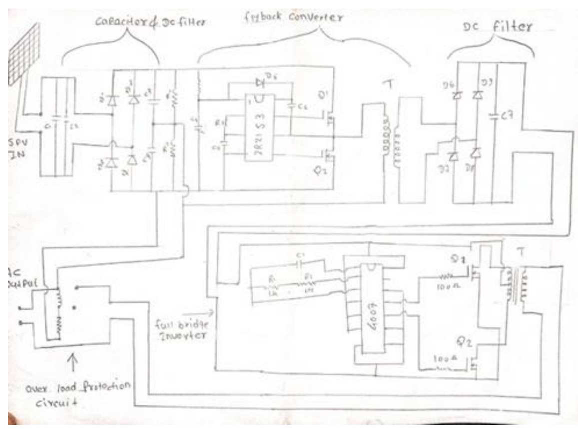
A. Working:

The project methodology for implementing an interleaved flyback inverter for photovoltaic applications involves several key steps. Initially, thorough research is conducted to gather requirements for the photovoltaic system and the inverter.



Following this, the system architecture is designed, encompassing the interleaved flyback inverter topology, control strategy, and component selection. Components like MOSFETs, diodes, capacitors, and inductors are carefully selected based on simulation results and application needs. A prototype is then developed, tested, and validated under different load conditions and solar irradiance levels. Subsequent optimization efforts focus on improving efficiency, reducing losses, and enhancing overall performance. Comprehensive documentation of the design process, simulation outcomes, prototype development, and testing results is crucial. Finally, the inverter is integrated into the photovoltaic system, deployed for real-world applications, and subjected to ongoing monitoring and maintenance. Collaboration with domain experts and adherence to safety standards are emphasized throughout the methodology.

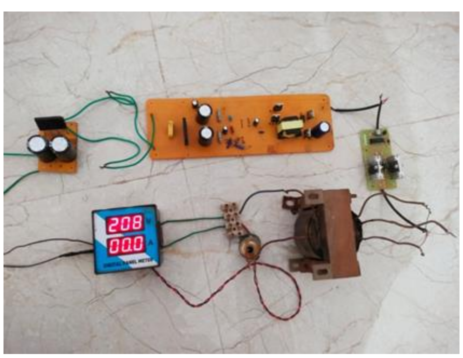
B. CIRCUIT DIAGRAM



The systems consist of the main five blocks as shown in figure 1 i.e. PV module, DC/DC converter, DC/AC converter, Filter circuit and Control system IC2153. The photovoltaic (PV) source formed by the combined combination of parallel and series connections of PV cells, which converts solar energy into electrical energy and give to DC/DC converter integrating with decoupling capacitor this can further increase the voltage level. The DC power output from converter supplied to full-bridge inverter network that transforms the converter's DC Output to an AC output by using the MOSFET conversion technique PWM. The low-pass filter decreases the harmonic efficiency of the output current of the inverter. Photovoltaic power and voltage input were regulated in the first case. Secondly, technological supervision was carried out to transform direct current (DC) into alternating (AC) power for grid controller injection. Bridge inverter with intertwined glide converters. The current & voltage of PV source depends on solar radiations available through- out the day. The maximum power point monitoring algorithm is used to obtain the full power to the photovoltaic array using interlaced voltage converters, full PV performance is derived from just one point of operation, named maximum power point. P&O algorithm are being used for due to in simplicity, unsettle duty ratio and adjust to the DC link power among with the photovoltaic array.

C. RESULT AND MODEL

The implementation of an interlived flyback inverter in photovoltaic applications has shown promising results in enhancing the efficiency and reliability of solar power systems. By integrating the interlived flyback topology, which utilizes multiple transformers and interleaved switching, with photovoltaic arrays, the system can achieve higher conversion efficiencies, reduced switching losses, and improved power quality. This approach addresses challenges such as voltage fluctuations and power losses commonly encountered in traditional inverters, especially under varying solar irradiance levels. Moreover, the interlived flyback inverter offers scalability and adaptability, making it suitable for a wide range of photovoltaic installations, from residential rooftops to large-scale solar farms. Overall, the combination of interlived flyback technology with photovoltaics presents a promising avenue for advancing the efficiency and performance of solar energy systems, contributing to the widespread adoption of renewable energy sources.



CONCLUSION

In conclusion, integrating interlived flyback inverters with photovoltaic applications holds great promise for enhancing efficiency, reliability, and performance in solar power systems, offering significant benefits for both residential and commercial installations.

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