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IMPLEMENTATION OF FLYBACK MICRO INVERTER WITH DUAL TRANSFORMER TO ACHIEVE HIGH EFFICIENCY FOR PHOTOVOLTAIC APPLICATIONS

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ABSTRACT

This In this paper a flyback micro inverter with dual transformer is proposed to achieve high efficiency for photovoltaic applications this venture will protect the converter by using filters then the overall system performance may also get improved with reduced number of switches. The need for renewable energy sources is on the rise because of the acute energy crisis in the world today. The statics predict that solar energy systems in particular will grow exponentially in the future. Inverters, which are DC-AC power electronic converters, are an important component of any system. These PV inverters are part of the power conversion infrastructure that converts the power available from PV panels to AC that can be fed to the grid. The flyback switch is a source protecting device which will protect the source side components from over voltage and other power fluctuations. The adaptive snubber is a previous method which will need more number of switches [MOSFET] for its operation. In this paper we implement a flyback with dual transformer concept to improve the efficiency and its overall performance.

Key word: *flyback, photovoltaic, micro inverter.*

I. INTRODUCTION

Photovoltaic (PV) micro-inverters have gained an important attention for grid-connected PV system applications for the period of the past few years because of enhanced energy harvest, pleasant "Plug-N-Play" operation, and improved modularity and elasticity. Various inverter topologies for PV micro-inverters applications have been introduced in the literature that carry out the maximum power point tracking (MPPT) of PV module, high step-up voltage magnification, output current shaping, and galvanic isolation. Among them, the flyback-based micro-inverter is one of the smartest solutions due to its simple structure and control and also inherent galvanic isolation.

Renewable sources of energy are becoming more popular due to environmental concerns and the need for more energy. The use of renewable energy was 1684 million tons of oil equivalent (Mtoe) in 2010, accounting for 13% of global primary energy demand. Electricity generation from wind grew by 27% and solar photovoltaic (PV) by 42% per year on average during this period. There are three general types of inverter architectures: central inverters, string inverters, and microinverters. A solar micro-inverter, or simply micro inverter, is a device used in photo voltaic that converts direct current (DC) generated by a single solar module to alternating current (AC). The output from several micro inverters is combined and often fed to the electrical grid. Micro inverters contrast with conventional string and central solar inverters, which are connected to multiple solar modules or panels of the PV system.

Traditionally, central inverter technology is used to overcome the low voltage generated by photovoltaic (PV) arrays. However, in residential applications, the energy yield is jeopardized due to mismatches and partial-shading. Distributed maximum power point tracking (dmppt) architectures, in both dc–dc and dc–ac systems, improve the energy harvesting capability by means of a module-integrated converter. Despite no isolated solutions have been presented for both dc– dc optimizers and ac-module applications, the use of a transformer is widespread providing flexibility, an adequate voltage boost and compliance with safety standards.

There are three general types of inverter architectures: central inverters, string inverters, and microinverters.

1. Central inverter -This inverter architecture is the standard choice for high-power PV systems because it is the simplest and cheapest option as just a few inverters are used with many PV modules. Typically, the central inverter system has comparatively better or equal efficiency than the other architectures, but it misses maximum power point operation for each module due to shading and clouding effects which decreases the overall efficiency of the system. String inverters represent a compromise between central and micro inverters.
2. String inverter-It is used for just one string of modules (8 to 10 solar panels) so that multiple string inverters are connected together to form a larger systems. Although small number of inverters are required for a large PV system but it also suffers from the shading and clouding effects. Therefore, efficiency of the overall system is low.

Micro inverter- This inverter architectures, each solar panel has its own inverter that performs power conversion for each module. Micro-inverter architectures are more expensive than the other two, but offer the highest power optimization and design flexibility and also avoid a single point of failure. The main focus of this thesis is on micro-inverters, particularly micro-inverters that are based on the flyback converter topology.

II. RELATED WORK

Single-phase grid-connected PV inverters present similarities with application and control, power decoupling strategies as well as topologies from PFC have been adapted to PV inverters. A buck converter connected between the solar panel and the grid using an unfolded stage, thus working as a current source, as in the boost converter in PFC applications, if the buck converter is operated in the boundary(BCM) between continuous (CCM) and discontinuous conduction mode (DCM) the injected current to the grid is proportional to the grid voltage. By analyzing the average current value in a switching cycle, it can be concluded that this is possible if the off-time is kept constant.

Two possible implementations are proposed for the single stage forward micro inverter, as shown in the figure with unfolding stage and with secondary side switches. In both cases, the primary transistors are high-frequency switched to operate the micro inverter in the boundary mode. Implementation integrates the unfolding stage in the micro inverter power stage, i.e., the secondary side bidirectional switches are line frequency switched according to the grid voltage polarity

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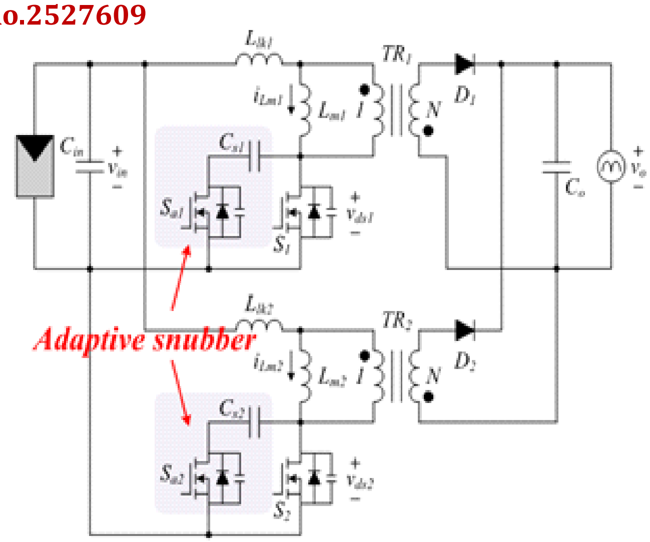

Fig.1 Adaptive snubber for PV application

Thus, two sub circuits are generated as depicted. Therefore, the two primary windings are used either for energy transfer or transformer reset during the corresponding grid half-cycle and the primary to tertiary turns ratio is forced to be the same. Furthermore, both primary windings are designed for the same current stress; hence, a bigger core is needed.

The parallelization in the primary side reduces the current stress in both switches and primary windings of the transformer. The current sharing is guaranteed because of the secondary series connection, although affected by the coupling of the individual transformers. The current stress is also decreased in the secondary side diodes due to the common cathode configuration and the synchronized driving of the primary switches. As a result, SMD devices can be used, a low-profile implementation is feasible and the thermal management is improved, although more devices are needed. The secondary series connection allows achieving the grid voltage using transformers of lower turns ratio. Therefore, the primary to secondary coupling at each transformer can be significantly improved, i.e., primary side current sharing is improved and parameters such as leakage inductance can be reduced, thus improving the off transition of the primary transistors.

III. PROPOSED WORK

The flyback with dual transformer is to improve the system performance and the stability of the photovoltaic inverter. The rate of total harmonic distortion (THD) will also get reduced by this implementation method. The increasing number of switches will increase the firing circuit for the unit that will be reduced by this concept.

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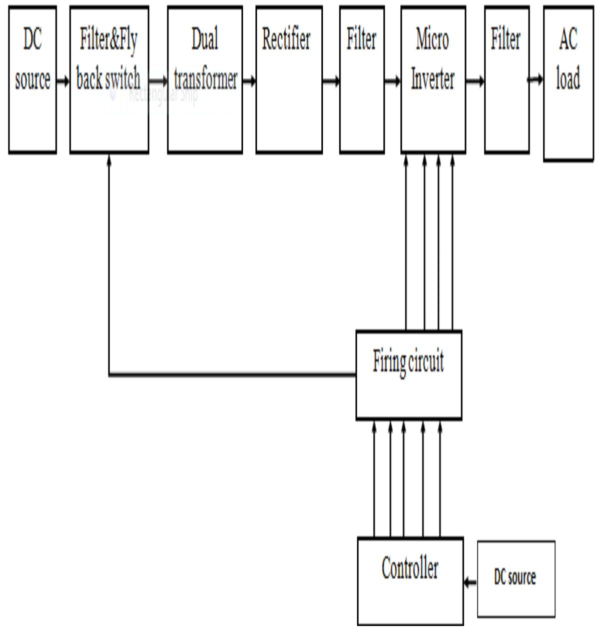

Fig.2 Block diagram of proposed inverter

The block diagram of the system will explain the implementation of the proposed system. The PV panel (or) DC source used here will protect by the rectifier used here. The filter used here was LC filter and it will filter the unwanted DC component coming from the source. The flyback switch is nothing but a switch which will connect with a transformer. The transformer is then connected with a rectifier and filter component. Then the micro inverter will convert the DC in to AC. The output of the inverter will filter out then it is given to the ac load. The controller used here is PIC micro controller then the firing circuit will give the firing pulse to the MOSFET connected with the circuit.

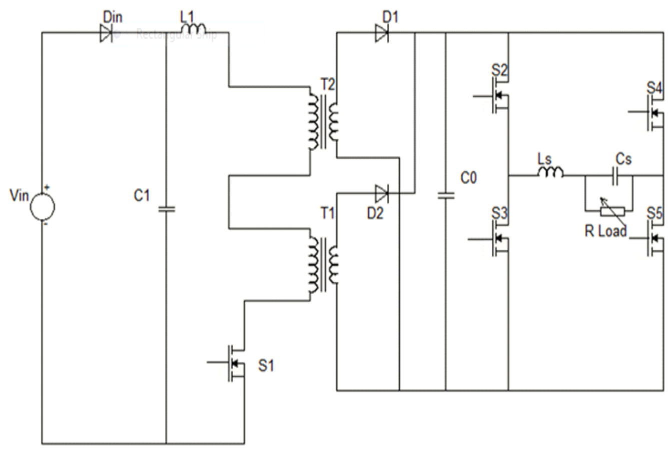

Fig.3 Circuit diagram of proposed inverter

The flyback converter is used in both AC/DC and DC/DC conversion with the galvanic isolation between the input and any of the outputs. The flyback converter is a buck-boost converter with the inductor split to form a transformer, so that the voltage ratios are multiplied with an additional advantage of isolation. When driving for example a plasma lamp or a voltage multiplier the rectifying diode of the boost converter is left out and the device is called a flyback transformer.

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The term H-Bridge is derived from the typical graphical representation of such a circuit. An H bridge is built with four switches. When the switches S1 and S4 are closed and S2 and S3 are open a positive voltage will be applied across the load. By opening S1 and S4 switches and closing S2 and S3 switches, this voltage is reversed, allowing reverse operation of the load.

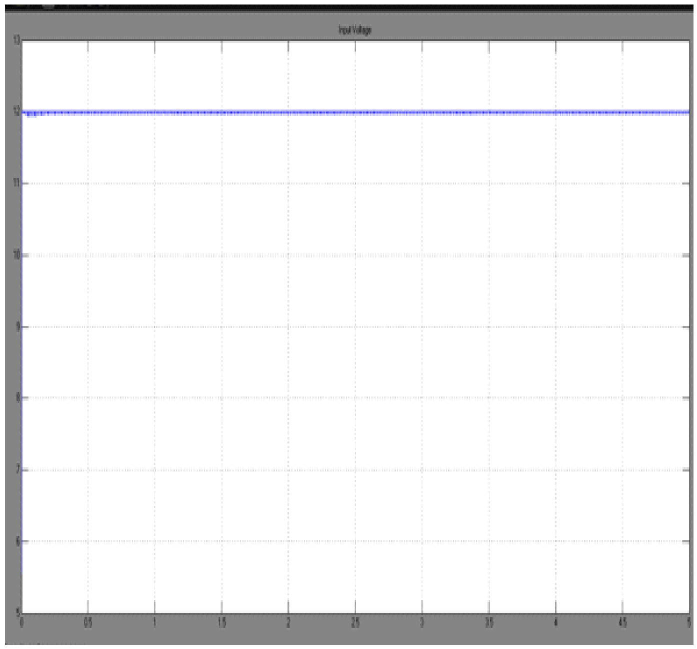

Fig.4 Input pulse waveform for flyback switch

The input pulse and the gate pulse of the proposed flyback inverter is shown in the fig. 4 and fig. 5 respectively. The constant 12V was given as an input for the flyback switch and the overall system. Similarly the gate pulse for the MOSFET switches is also given to the circuit.

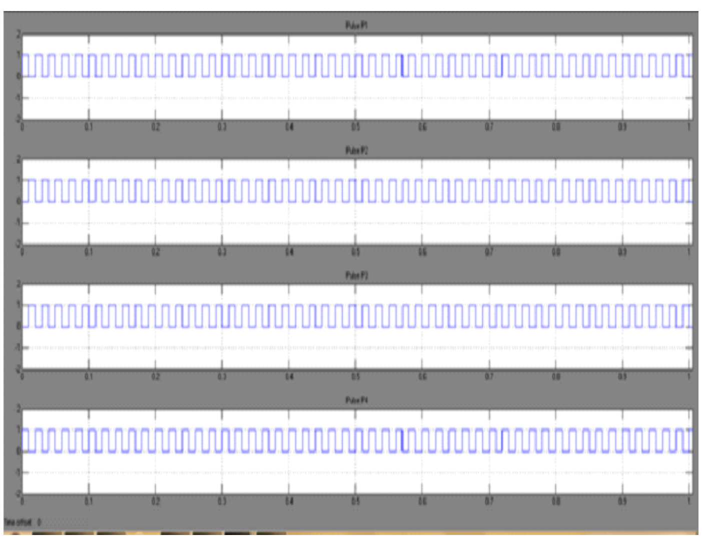

Fig.5 Gate pulse waveform of the flyback inverter

IV. SIMULATION RESULTS

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The output waveform of the proposed system will be shown in the fig. 6. The given 12V input will get raised in to 120V with the help of step-up transformer. That is the transformer used here is 1:10 ratio transformer. The output wave form will explain the transition of the proposed system. That is the output of the proposed system will give raise to the fluctuation less system design using flyback concept. Compare to the existing system the proposed system will have low THD level.

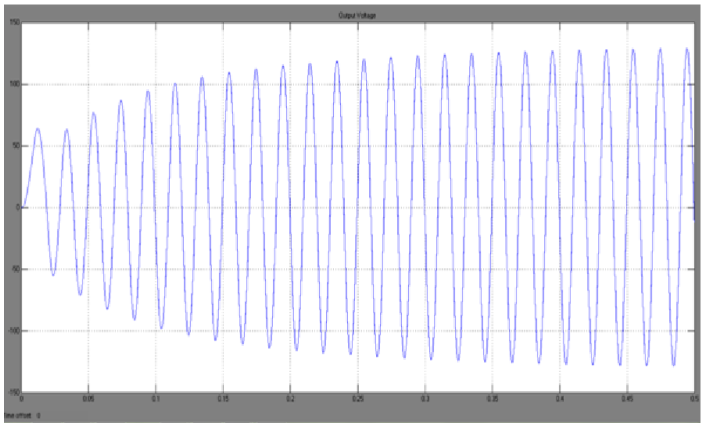

Fig.6 Output pulse waveform of the flyback inverter

The figure 5.9 will explain the comparison of THD level between existing system and proposed system. In the existing system the number of MOSFET will be high that is in the adaptive snubber there is four MOSFET with four capacitors are used as a filter. The adaptive snubber is nothing but a filter with a combination of capacitor and MOSFET. This will improve the number of firing circuit. And that will increase the amount of THD rate in the existing system compare to the proposed system. In the proposed system the disadvantage in the existing systems topology will get changed with the help of flyback topology. Here the number of MOSFET will be getting reduced in the proposed system with improved topology. The THD rate of the existing system will be between 20 to 25 percentages that is 24.2%. But in the proposed system the THD rate will get reduced and the percentage of THD will be between 0 to 5 percentages that is 2.4%. This will be obtained in the proposed flyback micro inverter topology.

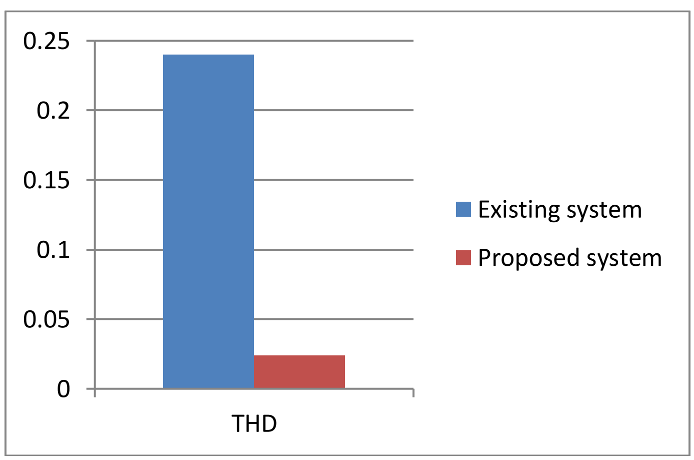

Fig.7 THD level comparison between existing and proposed system

V. CONCLUTION AND FUTURE WORK

As a goal of the present work is to achieve high efficiency for PV application. This venture will be most efficient way to get high efficiency output. Here the number of switches is getting reduced with the help of flyback switch concept. The percentage of THD will also be very less in the proposed system compare to the existing system. The result of the existing system and the proposed system were compared and proved that the proposed system was best and economic.

The new, innovative and hybrid modulation techniques may be used to solve the problem in this field instead of the proposed modulation technique. The simulation process may be performed in any other software platforms instead of the proposed MATLAB environment. The new, innovative topology may be performed by any other leading and recent modulation techniques.

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