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A Review of the Fly back Micro Inverter Used to Integrate Fuel Cells with a Single Phase Grid

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ABSTRACT

Sustainable power source is going to assume a significant job later on vitality situation. All the current topologies utilize number of middle of the road arranges before change of DC contribution to the AC yield to the lattice side. For this sort of transformation, effectiveness is low and number of intensity parts are likewise extremely high. In this paper, a minimal effort high effectiveness basic DC-AC flyback inverter is proposed. The proposed converter comprises of a straightforward flyback converter followed by a basic full extension inverter with inactive snubber in the essential. The methods of activity of the converter alongside the plan of the converter with the snubber is talked about. Exploratory outcomes from reproductions are introduced too.

Keywords: Single Phase Grid, Micro Inverter, Fuel Cells.

1. Introduction

Energy crisis in recent times and rising environmental concern are making renewable energy sources more and more important. In the year of 2014, the use of renewable energy was 2610.6 million tons of oil equivalent (Mtoe), responsible for 30% of world energy consumption [1]. The energy produced from maximum available renewable energy or those under research work (like Fuel Cell) is in DC form. The generation system can be locally grid connected or by using long range transmission. If the system is locally connected we need to step up or step down the voltage for a particular voltage level [2-6]. When appliances are connected to the local grid too we need different voltage levels for different applications, thereby necessitating the use of a DC-DC converter.

Our existing single phase grid is compatible with alternating current and the appliances are also made in that fashion. For this type of system we cannot directly integrate the DC generation system or renewable generation system. In order to integrate renewable energy systems with the existing single phase grid, energy conversion is needed from DC to AC. The first step is to make the DC to a particular voltage level using a DC-DC converter and then DC-AC conversion is done using an inverter. The feasibility of the inverter depends upon the DC-DC converter efficiency and the capability to withstand high voltage surge and inrush current. Considering all available topologies [7-9] and existing converter models, it is seen that flyback converter is the most suitable model for the PV micro inverter. With its simplicity and low cost it is the best choice of DC-DC converter for integration with inverters for low power level applications. The operation of conventional flyback inverter [10-13] is very simple and the conduction mode of the primary flyback converter is mainly DCM. The transformer acts like an inductor and provides an added advantage of isolating the high voltage output side from the low voltage input side. The primary side of the transformer charges when the primary side switch is on and it discharges when the primary switch it off and gives supply to the inverter.

In the existing system the main problem is with the efficiency of the overall system and huge stress on the main primary side switch. So to overcome that problem a new micro inverter topology has been proposed and detailed operation, design criterion and feasibility has been discussed in the later sections.

Nomenclature

f_s	switching frequency	V_{in}	input voltage
DCM	discontinuous conduction mode	V_{g_p}	grid voltage
PV	Photo voltaic	r.m.s.	root mean square
THD	total harmonic distortion	P_o	output power
C_{clamp}	clamping capacitor	I_{IP}	input current

2. Proposed Fly back Inverter Scheme

Generally a flyback micro inverter is connected with low DC voltage (i.e. around 45 Volt) at the input side. Due to low voltage at the input, the losses at the time of turning on are less compared to high voltage switching as energy stored in the output capacitance of the switch is less. Though this flyback micro inverter is a low power converter, current flowing through the primary side (input) of the transformer may be quite high. This case happens when the flyback micro inverter is designed to operate in such a fashion that the transformer is demagnetized fully before ending each switching cycle. If the switch is turned off with this high current, there will be high turn off losses.

The primary side switch turn off losses can be reduced by implementing a snubber circuit that cuts down the voltage rise rate across the switch at the time of turning off and hence reduces the voltage-current product of the switch. This has been incorporated in the proposed converter.

In Fig. 1 the proposed flyback micro inverter model has been shown. The primary side of the transformer of the proposed micro inverter is just like a simple DC-DC flyback converter.

It has only one switch S_1. For reduction of switching losses and increasing the converter efficiency, a snubber circuit has been introduced in the primary side of the converter. The snubber circuit consists of capacitor C_{clamp} and diode D_1. The secondary side of the converter is a simple full bridge inverter with four switches. At the output of the inverter, a L-C filter has been used to produce a sinusoidal wave which is fed to the grid. Due to the filter circuit, there is negligible amount of THD in the output of the inverter.

The basic operating principle that should be followed by the micro inverter for the production of accurate alternating waveform in the grid side is that the flyback transformer should be fully discharged before starting of the next switching cycle. The switches in the secondary side S_{01}, S_{02}, S_{03}, S_{04} must operate properly to get an appropriate AC waveform which must be synchronized with the grid. S01 and S02 is turned to transfer energy to grid and to produce output with positive polarity. S03 and S04 are turned on to transfer energy to grid side and to generate output with negative polarity. The output filter circuit smoothens out the inverter output and produces a sinusoidal wave which can be fed to the grid.

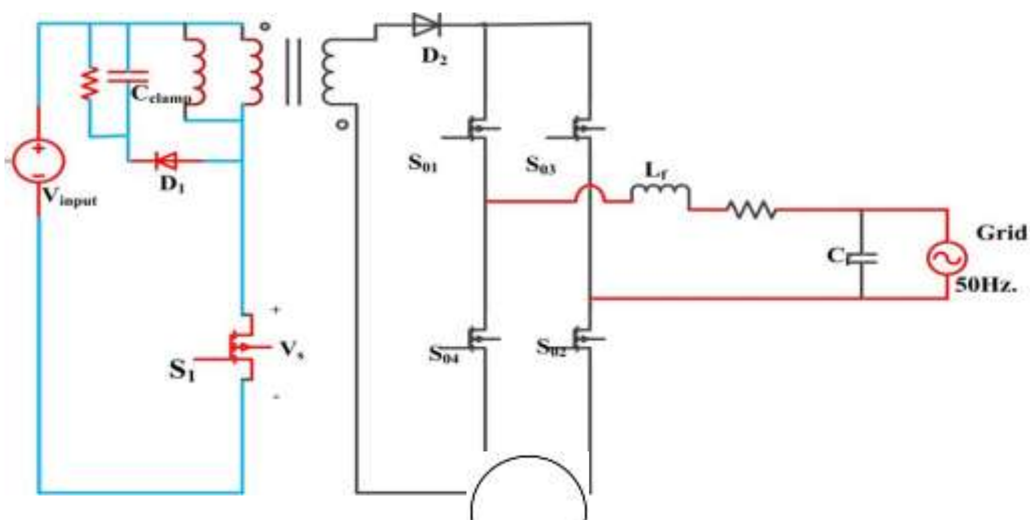

Figure 1 Schematic diagram of the proposed converter

3. CONCLUSIONS

There are three types of architecture available among inverters, each with their own merits and demerits. They are central inverter, string inverter and micro-inverter. The focus of the thesis is on micro-inverter. The main objective of the paper is to make a cost effective, efficient micro-inverter in comparison with the existing topologies. With the help of a clamping circuit, the stress of the primary switch has been reduced which has led to lesser switching losses. Therefore, overall efficiency of the system has been increased. The circuit is very simple, compact and economical. The overall system design and operation has been discussed. The proposed converter gives output voltage with only 0.42% T.H.D. which is as per IEEE-519 standard. The proposed converter is very much suitable for integrating renewable energy sources like fuel cells and solar PVs with the existing grid. In the future, when DC grids become the norm, the converter can be used without the inverter at the output side.

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