A NON-ISOLATED MODULAR INVERTER TOPOLOGY ON   A DC BUS SYSTEM

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Abstract - In the present trend, the usage of photovoltaic power generation keeps on increasing due to non-availability of nonrenewable sources. Nowadays, the generation of solar power is increasing, but the efficiency of Photovoltaic (PV) is limited. Generally conventional boost converters are used to increase the voltage of PV, but it is not widely used due to its high duty ratio, increased voltage stress, switching losses and increased cost of converter. To overcome above drawbacks, improve the system efficiency and to increase the reliability a modular grid-connected inverter system is proposed. It consists of a modular DC-DC sepicconverter and modular DC-AC converter. Output of the DC-DC sepic converter and input of the DC-AC inverter is connected with a DC bus. Here the Voltage is injected in the grid using inductor filter. The practicability of the proposed system has been verified by simulation results.

Keywords: DC-DC SEPIC converters, Inductor coupled, Photovoltaic module, photo-voltaic generation

I. INTRODUCTION

With the development of community economy and the expansion of power consumption, the Generation of electric energy must be increased to meet the demand. Nevertheless, large-scale power systems, which bring great benefit to society, are potentially dangerous. The CERTS (Consortium for Electric Reliability Technology Solutions) of U.S.A established the concept of micro grid first [1]. Micro grid is a system composed of a micro power and electrical loads, provided important support by the power electronic devices, with electrical and thermal energy of two kinds of energy supply situation.

The micro grid system includes AC micro network system, DC micro network system and AC / DC Micro-grid system[2]. When the concept of micro grid is just proposed, the first thing that comes to mind is AC micro grid. On the basis of AC distribution network, AC micro grid is easier to be realized, more mature than DC micro grid. The disadvantage of AC micro grid is that each distributed generation unit is more complex to be controlled, and it needs to consider the factors of frequency, voltage, reactive power and non-synchronization of each heating power supply, while it requires more than one inverter, so it has higher cost.

The DC micro grid system is more efficiency without reactive power compensation. Most distributed power supplies and electrical energy storage devices output direct current, which must be programmed by inverters to allow AC power to be used in the grid, that process reduces the power utilization substantially[18].

II. RELATED WORKS

Meneses et al [3] Presents a comprehensive review of step-up single-phase non-isolated inverters suitable for ac-module applications. In order to compare the most feasible solutions of the reviewed topologies, a benchmark is set. A discussion of the analyzed topologies regarding the obtained ratings as well as ground currents is presented.

Narasimharaju et al [4] Proposes analysis, and voltage mode control of coupled inductor bidirectional converter. Unfortunately, switches of four and beyond in isolated schemes increase production costs and reduce conversion efficiency, and non-isolated topologies suffer from high voltage/current stress. The battery fed bidirectional converter with controller to regulate the DC link voltage and battery charge voltage is implemented in the Simulink/Matlab environment.

EDELMOSER [5] proposed the conjunction of simple boost- and buck converter stages gives the facility to realize an optimal design for power grid coupled inverters. The reduced voltage stress of each stage can lead to a significant improvement of the system losses.

M.H. Taghvaee et al [6] reviews the state-of-the-art in research works on non-isolated DC–DC buck, boost, buck–boost, Cu´ k and SEPIC converters and their characteristics, to find a solution best suiting an application with Maximum Power Point Tracking.

III. PROPOSED METHODOLOGY

This modular system consists of DC–DC converter modules and DC–AC inverter modules. The output of the source is given to the DC-DC Sepic converter. Sepic converter steps up the DC voltage, MPPT can be easily achieved by using DC –DC converter. The output of the DC-DC Converter is given to the DC bus. In the above system if

any one of the system gets fault, it will not affect the other system and they will continue to operate in good condition. So the overall efficiency will be increased. Here instead of using transformers to fed into the grid two inductors are used to inject the power. In this system the input voltage is

stepped upto 230v DC using sepic converter and then it is converted to 230V AC using H-Bridge Inverter. The fig 3 shows the circuit diagram of DC-AC inverter where two inductors are connected in each bridge which in turn connected to the utility grid.
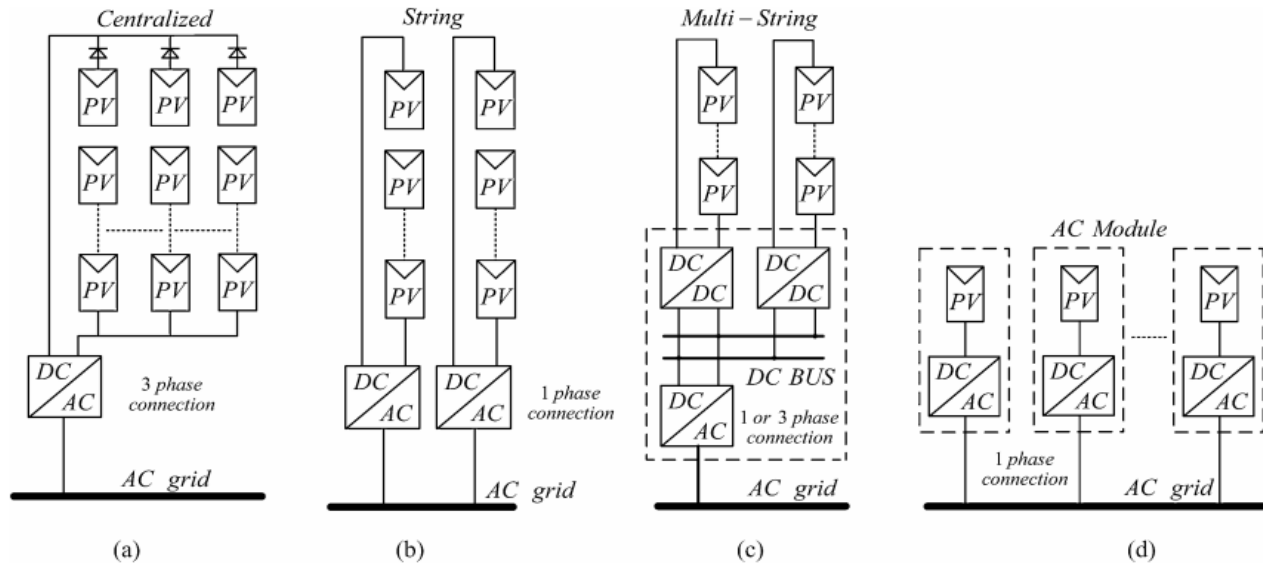

Figure 1. Overview of the configuration of PV generation system

The configurations of a PV generation system are the centralized structure, the string structure, the multistring structure, and the ac-module structure, as shown in Fig. 1

Initially, the interface between Photovoltaic power supply and the grid rely on the centralized inverter technology, as shown on Fig.1(a).. All strings are then connected in parallel to support high power to output[7].

String technology, shown in Fig. 1(b), illustrates effort to solve problems of the previous design. It has a string of inverters connected in series with an AC module. The inverter can be implemented with high voltage MOSFET/IGBT[8]. It is possible to have less PVs in string with voltage amplification by DC-DC sepicconverter or a line frequency transformer, which increases total area.

Multi-string inverter, shown in Fig. 5, features the optimal MPP tracking for a single string of PVs. In this structure, DC-DC sepicconverter[9] is implemented for each string for MPP tracking and power combination of different string to a DC bus. A big power stage works as a grid connected half bridge inverter without transformer.

DESIGN OF THE SEPIC CONVERTER

The single-ended primary-inductor converter—the SEPIC converter—is capable of operating from an input voltage that is greater or less than the regulated output voltage. Aside from being able to function as both a buck and boost, the SEPIC design also has minimal active components, a simple controller, and clamped switching waveforms which provide low noise operation.

It is often identified by its use of two magnetic windings. These windings can be wound on a common core, in the case of a single dual-winding coupled inductor, or they can be two independent inductors. Designers are often unsure of which approach is best and whether there is any real difference between the two. This article looks at each approach and discusses the impact each has on a practical SEPIC converter design.

The following figure shows the basic SEPIC converter with a coupled inductor. When the FET (Q1) turns on, the input voltage is applied across the primary winding. Since the winding ratio is one-to-one, the secondary winding is also imposed with a voltage equal to the input voltage.
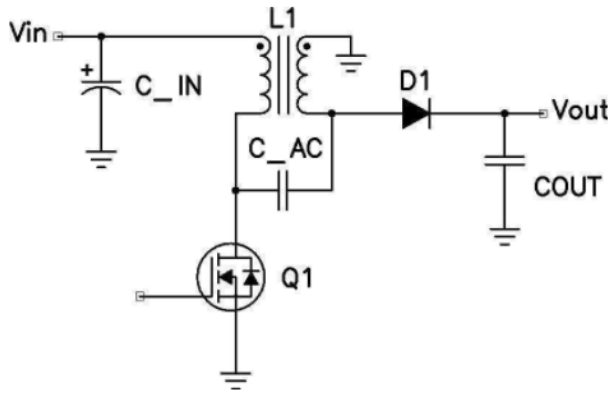
When the FET turns off, the voltage on the windings reverses polarity to maintain current flow. The secondary winding voltage is now clamped to the output voltage when the rectifier conducts to supply current to the output. Through transformer action, this clamps the output voltage across the primary winding. The voltage on the drain of the FET is clamped to the input voltage plus the output voltage. Current flow during the FET off time for both windings is through D1 to the output, with the primary current flowing through the AC capacitor.

IV. SIMULATION RESULTS

In order to check the reliability of the proposed structure the experiment been done using MATLAB. A simulation diagram has been drawn using MATLAB/SIMULINK which consists of two modules .Each modules consists of a separate source, DC-DC converter and DC-AC inverter[11].

TABLE I PARAMETERS OF SIMULATION DIAGRAM

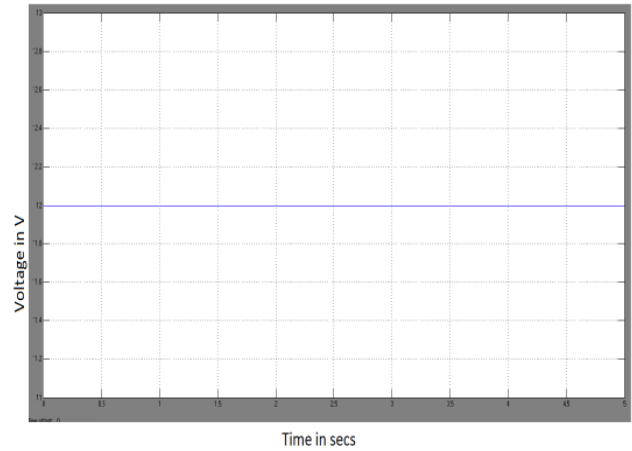| S.no	Parameters	Value
1	Input voltage	12V
2	Resistance (converter side)	10Ω
3	Capacitance	15µF
4	Output voltage	230V
	Frequency	50Hz

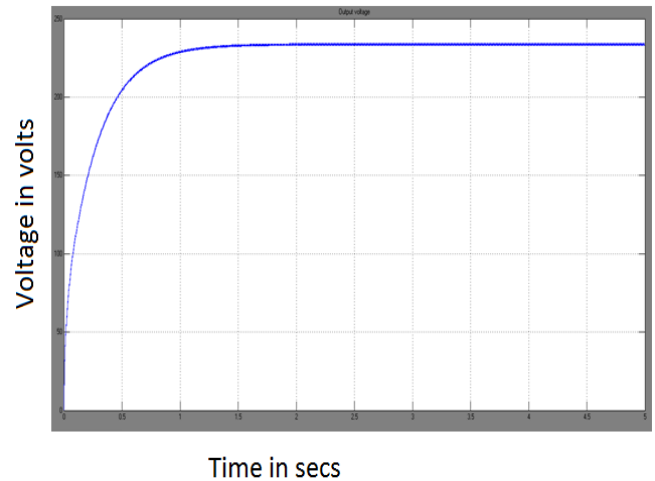

Figure 2. Input voltage

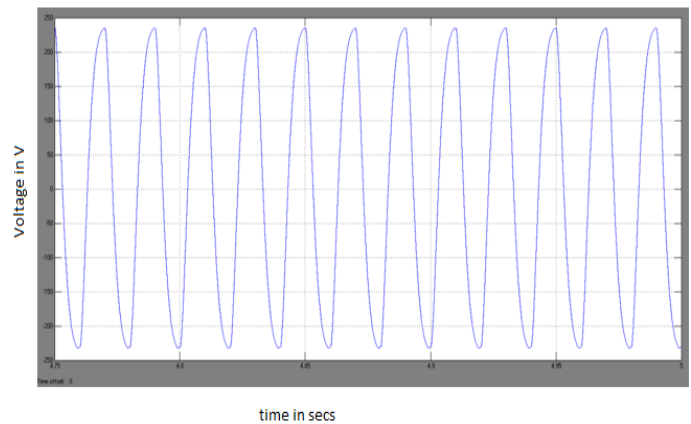Figure 3. Output voltage of DC-DC Converter

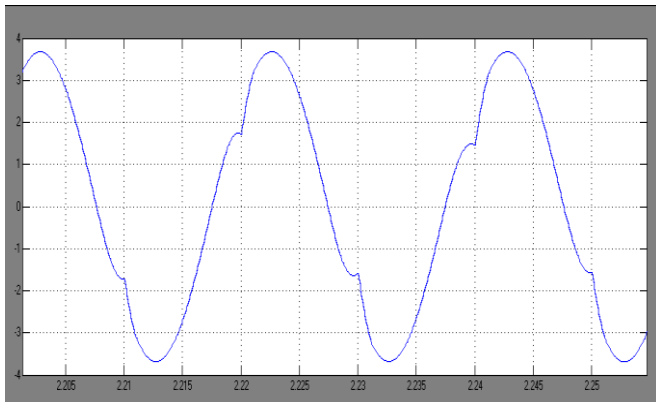Figure 4. Output voltage of DC-AC Inverter

Figure 5. Output current of DC-AC Inverter

The Fig 6 shows the Input voltage which is 12VDC. The Fig 7 shows the Output voltage of DC-DC Converter which is 230VDC. The Fig 8 shows the Output voltage of Output voltage of DC-AC Inverter which is 230V AC.

CONCLUSION

A modular grid-connected PV generation system is proposed in this paper. A control method of current decoupling for parallel-operated inverters and an optimal control strategy for system-efficiency enhancement are presented. The nature, structure, and simple operation of the new topology were evaluated by the experimental results,

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