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SOLAR GRID-TIED INVERTER, WITH BATTERY BACK-UP FOR EFFICIENT SOLAR ENERGY HARVESTING

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ABSTRACT
Solar energy is the only source to be trusted for sustainable energy creation. The performance of the solar based systems is enhanced by cluster of the research carried out to in last decade. Researchers have worked hard for performance improvement of the solar system in last decade and still the research is going on. Authors have proposed the grid connected inverter system application with maximum power point tracking for the performance improvement of the system. The main motive of this study is to present and implement the efficiency enhancement approach of the grid connected system. The power electronics converters have been utilized for effective identification of the operating point. The system is implemented in the MATLAB environment with simulink.

KEYWORDS: MPPT, Photovoltaic, Converter

INTRODUCTION

Solar energy is gaining importance day by day while world population and consequently, power demand is increasing.[1] To cater the ever increasing power demand, solar energy could prove to be really effective, especially in countries like India, where we have better sun availability throughout the year.[2] Moreover, the production of electricity through fossil fuels has increased air pollution globally to an alarming extent. Carbon Dioxide and oxides of sulphur and nitrogen, commonly called SOx and NOx respectively, are inadvertent products of combustion process.[3] The solar energy fulfills all requirements of a better source of energy generation. It's up to us to devise efficient mechanisms to utilize this intercepted power.[4] One way is to use solar panels to convert the energy of photons into electrical energy and after storing some of it as back-up power, supply the rest of it to the power grid.[5] The different stages of a grid connected photovoltaic system will be discussed here.

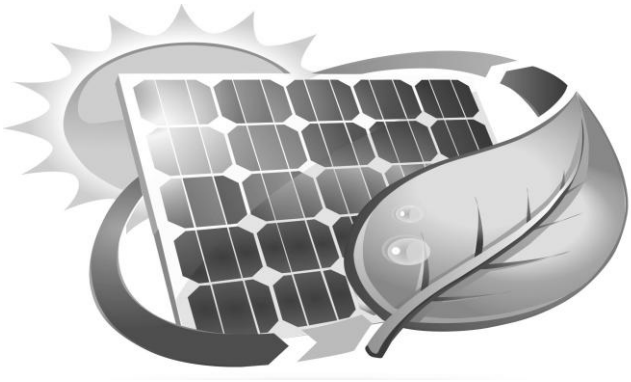

Fig 1 Solar Energy System

GRID CONNECTED SYSTEMS

The grid tied systems have been proven better performance. The Solar panels, A.C. sources, inverters and meters are the main parts of these systems. Battery banks may be used to make the better availability of electricity for continuous period. The generation cost is high but it is still useful in coming future to fulfill the

electricity demand. The improvement in the performance of the batteries in the present era has supported the grid tie technology.

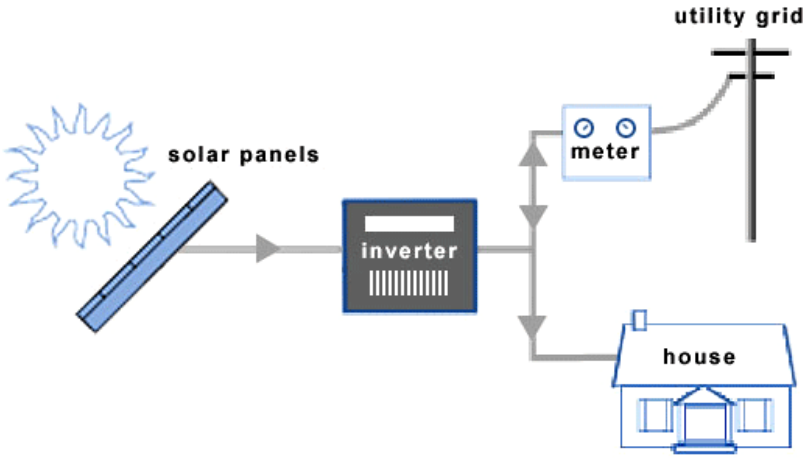

Fig 2. Grid-Tied Solar Systems

SCOPE OF THE STUDY

Studies [3] have shown that the fixed structure of the switched capacitor network but to greatly reduce the efficiency of the converter between the input and output voltages. Switched capacitor and switch inductance CUK converter is easy to integrate thus has an attractive prospect. CUK converter topology of switched capacitor and inductor determines its intrinsic voltage ratio. In fact, the topology of the maximum voltage is the ideal case ratio.

In order to make the CUK converter with switched capacitor and inductor with high efficiency in a wide input voltage dynamic range, There are two power factor correction scheme, one is used to control the input current close to sine this scenario, the circuit operates in continuous conduction mode usually requires double-loop control, due to sampling of the input current, voltage and output voltage, this program is more complex and high cost, limit the use of the method. Another solution is to use the Voltage follower mode, the circuit usually work in discontinuous conduction mode switch is controlled follow the output voltage error signal, this program only requires a voltage control loop. In this sense, switched capacitor and switched inductor CUK converter is better than Buck-Boost Converter.

LITERATURE REVIEW

The Cuk Converter [3] was first introduced to the field of Power Electronics at Power Con 5, in San Francisco, in May of 1978. It was universally hailed as a great advance, and many engineers working in the industry left the conference with high hopes of designing the topology into their products, and securing the benefits it promised. A scant two years later, at Power Con 7 in San Diego, a general revolt against it was led by Rudy Severns. In a largely ad-libbed presentation, he convinced many present that the topology proposed by Drs. Middle rook and Cuk was essentially smoke and mirrors. That is, he denied the existence of a single "Optimum Topology," arguing that the choice of topology should be left to the engineer, and was application dependent. This approach was much more in line with prevailing engineering thinking in that day, and convinced the attendees that each topology had pros and cons, and, so, each excelled in a particular circumstance. In short, choice of topology was spec dependent.

To bolster his presentation, he distributed a compilation of well over 100 switched-mode topologies. This collection remains, today, probably the most complete available. The explanation for this shift in philosophy of design is generally ascribed to personal, professional, political, and financial forces. In truth, I believe that

the reason is far simpler: In the two intervening years, nearly every engineer in the field made some attempt to design one or another of the Boost buck topologies, but failed miserably.

The reason for this failure mystified me for many years, as the Caltech group had gone to considerable lengths to make the design problem an easy one for working engineers. Then I realized that most designers had gone through essentially the same sequence of design attempts. Namely, they had set out to build an Integrated Magnetics Cuk Converter; had been unsuccessful at designing the magnetic piece required, and had fallen back on the coupled inductor converter. There again, the design of the coupled inductor had defeated them, and they had settled for the plain Cuk Converter. Even here, their results were poor at best, and what had started out a winning proposition had resulted in discouragement and despair. (Slobodan 1978). Along the way, these engineers had seen themselves as giving up performance as they shifted from integrated to couple to uncoupled topologies. By the end, they assumed that the resulting breadboard was incapable of outperforming anything, and was thus abandoned.

Table 1: Characteristics of different MPPT techniques

MPPT technique	Convergence speed	Implementation complexity	Periodic tuning	Sensed parameters
Perturb & observe	Varies	Low	No	Voltage
Incremental conductance	Varies	Medium	No	Voltage, current
Fractional V_{oc}	Medium	Low	Yes	Voltage
Fractional I_{sc}	Medium	Medium	Yes	Current
Fuzzy logic control	Fast	High	Yes	Varies
Neural network	Fast	High	Yes	Varies

SINGLE PHASE GRID CONNECTED INVERTER DESIGN

Synchronization [5] is achieved as soon as the magnitude, phase and frequency of output voltage are matched with the corresponding parameters of the grid voltage. In this situation, there is no power flow from GTI to the grid. The next step is getting the power to flow from GTI to the grid. This may be achieved by increasing the voltage magnitude a bit and getting the phase of inverter output to lead the grid voltage in order for both the real and reactive powers to flow into the grid, as per the given equations. Increment of output voltage and getting it to lead the grid voltage are achieved with the help of methods described in the synchronization part.

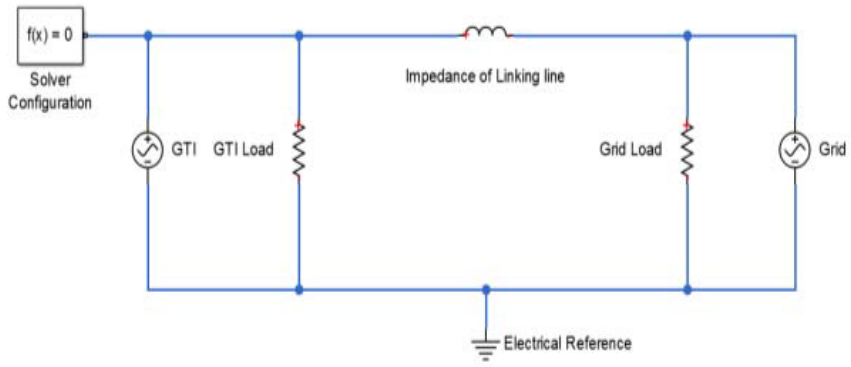

Fig 3.Simulink circuit to demonstrate power flow

TESTING OF THE SYSTEM WITH AND WITHOUT FILTERS

Case 1 : PV-MPPT-CUK-GRID-THD without using filter

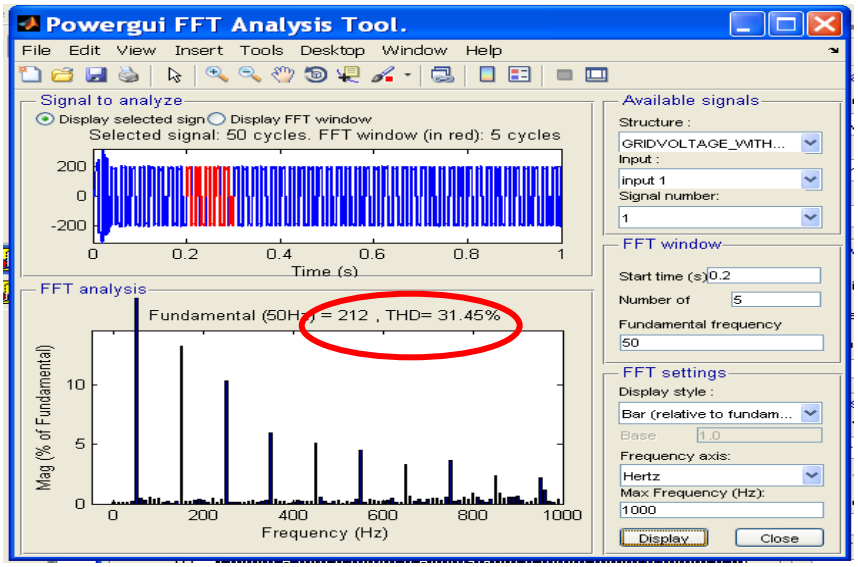

Fig:4 PV MMPT Cuk Grid THD without filter

In this mode, the above figure shows the PV MMPT Cuk Grid THD without filter filters the (THD) total harmonic distortion are 31.45%

Case 2 : PV-MPPT-CUK-GRID-THD with using filter

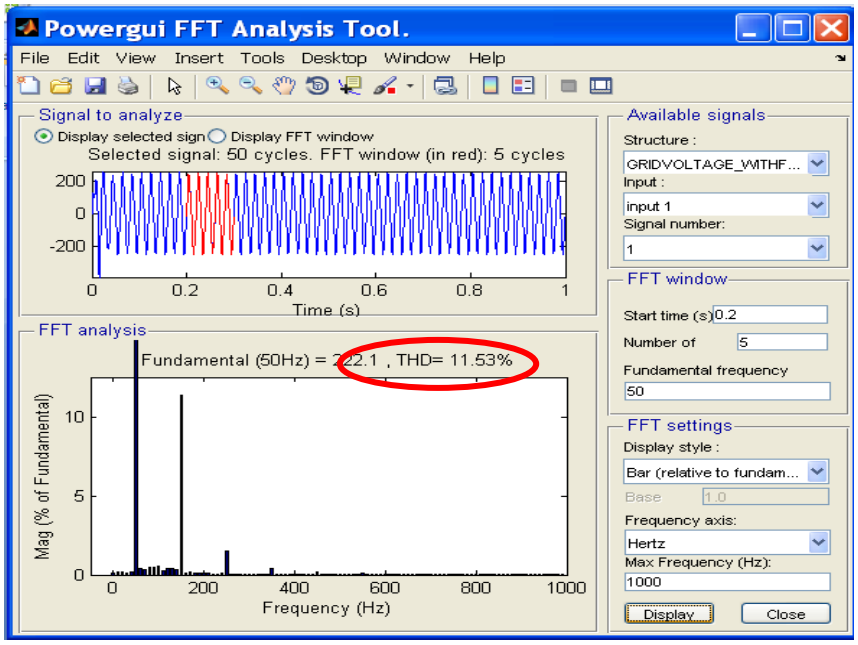

Fig 5: PV MMPT Cuk Grid THD with filters

In this mode, the above figure shows the PV MMPT Cuk Grid without using the filters the (THD) total harmonic distortion are 11.53%

APPLICATIONS

For this considered soar grid tied inverter system, it is observed that the Cuk Converter improves the efficiency of the solar energy in solar grid tied inverter system in the same manner; this method can be applied for the other systems.

This method can be used by the system designer for planning and improving the voltage stability by proper selection of Cuk converter and allocating it at most profitable position

CONCLUSION

MPPT is implemented with perturb and observe algorithm in this paper. The authors have proposed the analysis of the solar grid connected inverter with and without filter. Traditional of CUK converter devices to withstand voltage and current stress is very small. Although traditional CUK converter can achieve soft switching, but its defects are obvious: Have to wait until after the completion of the resonant inductor discharge allowed shut off the main switch. Therefore, the main switch duty cycle can't be less than the resonance time, thus limiting the minimum voltage output.

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