Design of Cuk Converter using PI Controller for Renewable Energy Sources

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Abstract- *The aim of the project is to improve the reliability and efficiency of energy storage elements such as inductors and capacitors etc. Here the new three phase inverter is based on Cuk converter. As buck-boost converter is not efficient as seen at the output of three phase inverter. So this disadvantage is reduced by the Cuk converter. The system is more integrated having non electrolytic capacitors for filtering energy sources. When using simple control circuitry reduces harmonics present in the output which improves the efficiency as well as reduces total cost. As point tracking operations needs the continuous current for its purpose like photovoltaic applications which is accomplished by using this three phase inverter.*

Keywords- Cuk converter, Proportional integral controller, The phase inverter, Renewable energy sources.

I. INTRODUCTION

There are many forms of renewable energy .Some energy resources depends on sunlight while most resources depends in one way. Solar energy is the direct conversion of sunlight using panels or collectors. Wind and hydroelectric power are the direct result of differential heating of the Earth's surface which leads to air moving about (wind) and precipitation forming as the air is lifted. Biomass energy is stored sunlight contained in plants.

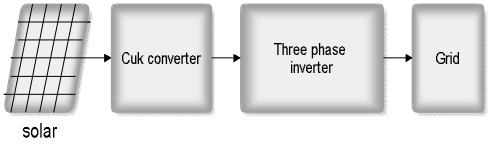

Figure 1. Basic Block Diagram

Renewable energy facilities generally require less maintenance than traditional generators. Their fuel being derived from natural and available resources reduces the costs of operation. Renewable energy projects can also bring economic benefits to many regional areas, as most projects are located away from large urban centers and suburbs of the capital cities. These economic benefits may be from the increased use of local services as well as tourism. One major advantage with the use of renewable energy is that as it is renewable it is therefore sustainable and so will never run out.

Solar energy can be converted directly into other forms of energy, such as heat and electricity. Solar energy is used for heating water for domestic use, space heating of buildings, drying agricultural products, and generating electrical energy. The strength of the solar energy available at any point on the earth depends, on the day of the year, the time of day, and the latitude of the collection point. The amount of energy collected can be further changed depending on the orientation and shape of the object doing the collection. As known every energy sources needs storation but here we haven't store any kind of energy bt rather than that we have cascaded the solar energy as a input to Cuk converter so storing helps to reduce the cost of system. There are many types of power converters AC to DC (rectifires), AC to AC(transformers), DC to AC(inverters), DC to DC(choppers) also now as switching regulators.

As we know for every electrical power systems there is a need of inverters and converters as well as the energy storage components like capacitors and inductors. In CSI(current source inverter) DC input current is greater than AC output current and in VSI(voltage source inverter) AC output voltage is lesser than DC input voltage and this properties is requirement of the said system so Cuk converter is used. Now for regulation purpose we have used the proportional integral controller. Which means the proportional integral converter regulates the output voltage of Cuk converter as it is connected in series with Cuk converter.

Also the output of Cuk converter is given to three phase inverter. Three phase inverter which converts DC supply into AC supply. And the final output of the three phase inverter is given to the grid or load.

II. LITERATURE REVIEW

For efficient operation in any working condition for optimizing the boost inverter dynamics sliding mode control is proposed [1]. The robustness for plant parameter variations which leads to invariant dynamics and steady-state response in

the ideal case has become the most advantage of sliding mode control over the classical control schemes. the proposed system incorporates battery-based energy storage and a dc–dc bidirectional converter to support the slow dynamics of the FC[2].

Various circuit topologies are presented, compared, and evaluated against the requirements of power decoupling and dual-grounding, the capabilities for grid-connected or/and stand-alone operations, and specific DG applications in this paper, along with the identification of recent development trends of single-phase inverters for distributed power generators[3]. These requirements have driven the inverter development toward simpler topologies and structures, lower component counts, and tighter modular design.

The three topological classes of dc-to-dc converters, totaling nine converters (each class with three buck, boost, and buck–boost voltage transfer function topologies), which offer continuous input and output energy flow, applicable and mandatory for renewable energy source, maximum power point tracking and maximum source energy extraction[4]. Converter time domain simulations and experimental results for the converters support and extol the concepts and analysis is explained [4].

The novel technique for efficiently extracting the maximum output power from a solar panel under varying meteorological is proposed[5]. The methodology is based on connecting a pulse-width-modulated (PWM) dc/dc SEPIC or Cuk converter between a solar panel and a load or battery bus conditions is presented[5]. The converter operates in discontinuous capacitor voltage mode whilst its input current is continuous. The tracking capability of the proposed technique has been verified experimentally with a 10-W solar panel at different insolation (incident solar radiation) levels and under large-signal insolation level changes[5]. Cuk-derived (one-end two-quadrant) converter is analyzed which makes it possible to control the voltage across the machine (and therefore the speed) from zero to three times of the input voltage[6].

III. CONCLUSION

As we have analyze the performance of Cuk converter using proportional converter. Usually in systems like power systems when the load is high the input us taken from renewable energy sources. But disadvantage of this type of input is, it is not in the form of regulated so to avoid this we have used the converters that boosts the current. When the current is boosted and the and if distortion occurs due to high frequency signal it is necessary to increase the capacity of capacitance and inductance. And due to this distortion we have to face many losses like cost is increases, leakage current losses increases, magnetic and conductance losses also increases. And this is reduced using Cuk converters with proportional inverters which converter have the two switch, two capacitor, two inductor which are share the stress, maximize the output and reduces the current leakage losses. It has many advantages for pv application. Because of their control complexity and disadvantages regarding to leakage current losses, conductance losses, capacitance losses and magnetic losses etc the high value of converters are avoided for inverters.

Here the proportional integral inverters are used to regulate the output. Which means the proportional integral converter regulates the output voltage of Cuk converter as it is connected in series with Cuk converter. As well as this inverter increases the accuracy and efficiency for the system. As this proportional inverter is used to reduce the harmonics which is present in the Cuk converter.

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