© 2020 IJSRST | Volume 5 | Issue 7 | Print ISSN : 2395-6011 | Online ISSN: 2395-602X

4th National Conference on Advances in Engineering and Applied Science
Organized by : Anjuman College of Engineering and Technology (ACET) Nagpur, Maharashtra, India, In association with
International Journal of Scientific Research in Science and Technology

Desingning Of Cuk And Sepic Converter As Power Factor Preregulator

Sayali Sawarkar, Prof. Rashmi Singh
Department of Electrical engineering Vidarbha Institute of Technology, Nagpur, Maharashtra, India

ABSTRACT

As the matter of concern due to huge electricity demand some improved conversion system are used for the improvement of power generation in this paper. The SEPIC and Cuk convertors which are working as power factor pre - regulators (PFP) have many desirable in discontinuous mode (DCM). In this paper we are designing the operation of both convertors as DCM-PFP. The SEPIC and Cuk are used with the solar energy, wind energy and fuel cell energy conversion system for improved electricity production. The combination of the Cuk and SEPIC convertors eliminate the need of additional input filters to filter out the high frequency harmonics. These type of DC to DC convertors are used in the applications where the output voltage is considerably greater than the input voltage. The Cuk and SEPIC convertors have certain advantages over the other conventional convertors such as: both Cuk and SEPIC convertors works as a voltage follower (i.e. it does not need any current loop), its power factor is unity theoretically and the input current ripple is obtained at designing stage. The results are simulated, verified and presented using MATLAB Simulink software.
Keywords: Cuk, SEPIC, converter.

I. INTRODUCTION

In the present era, due to these increasing demand in the fossil fuels which are being depleted and with the increasing concern of the global warming conditions, many of us are foccusing and taking the step forward for the sustainable energy sources for the existing world to preserve it for the future generations. These energy sources can be wind, solar, hydro or fuel cell which has capabilities of meeting our present energy demands. These all sources are having their own advantages fo better energy production and have some of their drawbacks or say limitations due to their intermittent nature that makes them unreliable.

In this paper we are using wind energy, solar energy and fuel cell energy sytem with the Cuk and SEPIC converters topology. When any of the sources are unavailable or insufficient for meeting the load requirement then the another energy sources can be compensated for that period of operation. We are also using the hybrid of wind and solar energy system with Cuk and SEPIC converters topology. The desing of Cuk and SEPIC converter as power factor preregulator has been proposed in this paper and also further explained.

Conventionally, we used Full Bridge Rectifiers and large input filter capacitors. However, there are a few major disadvantages regarding it, for ex. the value of peak input currents is very high and also harmonics are present in the line. The power factor is very low. Thus, the power available to the user is less in addition to line noise and peak currents. The solution

for the above mentioned problems is to use dc-dc converters along with bulk capacitors and diode bridge rectifiers. By controlling dc-dc converters properly, power factor is controlled giving rise to the name power factor preregulators (PFP).

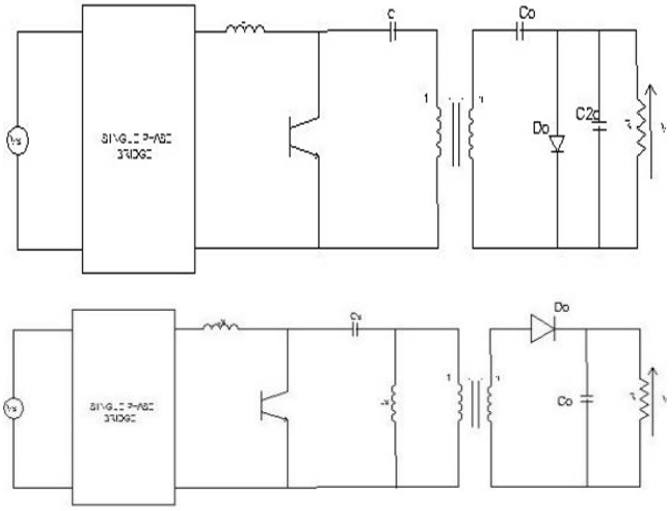
Power factor regulator in additional has two feedback loop that include: an input current loop and an output voltage loop. At the input the input current loop acts as the current sink and at the output the output voltage loop acts as the dc voltage source.

Why to operate in discontinuous mode:

Here in continuous mode whenever there is energy transfer, the current in the inductor never reaches zero value, while in the discontinuous conduction mode, current do reach the zero level. If the peak of inductor current is less than the inductor current dc component, the current in the diode will always be above zero and it will turn ON forcibly when switch is OFF. Whereas, if the peak of ripple of inductor current is more than the dc component of inductor current, total current is zero value while the diode starts conducting. The diode stops conducting and inductor current will be zero value till switch is gated. Therefore, discontinuous conduction mode is formed. Therefore, in discontinuous conduction mode, value of inductance will be less than whatever is the value for continuous conduction mode. When the same power flows through both the convertor the requirement of inductor current is always more in discontinuous conduction mode as compared to the continuous conduction mode. Therefore, we find that discontinuous conduction mode is more efficient than continuous conduction mode.

In order to implement power factor preregulator, the Cuk and SEPIC convertor are advantageous that too particularly in SEPIC and Cuk convertor.

In order to implement power factor preregulator, the Cuk and SEPIC convertor are advantageous that too particularly in SEPIC and Cuk convertor.



II. CUK CONVERTER

Some type of power conversion capability is required for storage or other DC component to be used on conjunction with AC loads. The DC/DC converter needs to have a wide input voltage range to regulate the constant output voltage, although we are considering that the output characteristics of photovoltaic cell has a wide voltage range depending on the operating condition of a photovoltaic cell. The major consideration in the renewable application due to the low voltage of PV array and fuel cell is to achieve high step-up and high efficiency DC/DC converters. The purpose of dc-dc converter is insuring the impedance adaptation between the photovoltaic source. Generally, a PV PCS uses either a single string converter or a multilevel module integrated converter (MIC) for operation. Each of these approaches has its both advantages and disadvantages while performing the given operation. A series connection of a module integrated DC–DC converter output with a photovoltaic panel was proposed for a high conversion efficiency and low cost photovoltaic module. The output voltage of the photovoltaic panel was connected to the output

capacitor of the fly-back converter and thus, the converter output voltage was added to the output voltage of the photovoltaic panel. Only between the PV panel voltage and the required total output voltage the isolated DC-DC converter generates difference voltage. While following this method there is reduction in the power level of the DC–DC converter which enhances energy conversion efficiency compared with a conventional DC–DC converter. The Cuk converter (pronounced *Chook*) is a type of DC/DC converter that has an output voltage magnitude that is either greater than or less than the input voltage magnitude. Basically, it is essentially a boost converter followed by a buck converter with a capacitor to couple the energy.

With inverting topology, the output voltage of non-isolated Cuk is typically also inverting, and can be lower or higher than the input similar to the buck–boost converter. Unlike most other types of converters which uses an inductor, this converter uses a capacitor as its main energy-storage component. This converter is named after Slobodan Cuk of the California Institute of Technology, who first presented the design.

Advantages Of Cuk Converter

1) Cuk converters have advantages like it requires reduced hardware and aso has good output voltage regulation.
2) Cuk converters are having high power efficiency.
3) Higher order dc-dc converters, such as the Cuk converter, have a significant advantage over other inverting topologies since they enable low voltage ripple on both the input and the output sides of the converter.
4) The Cuk converter can either operate in continuous or discontinuous current mode as with other DC-DC converters.
5) In order to reduce the switching losses across the switches, the soft switching has been implemented for all the three active switches of modified Cuk converter, which results in high conversion efficiency at high-frequency operation, improved transient, and and also there is steady state response without significant increase in voltage and current stresses on switches discontinuous voltage mode.

III. SEPIC CONVERTER

The single-ended primary-inductance converter (SEPIC) is a DC/DC-converter topology that varies from the above to below the output voltage and also provides a positive regulated output voltage from an input voltage. This type of conversion is handy and reliable when the designer uses voltages (e.g., 12 V) which are from an unregulated input power supply such as a low-cost wall wart. Unfortunately, the SEPIC topology is difficult to understand which requires two inductors, and which makes the power-supply footprint quite large. Recently, several inductor manufacturers began selling off-the-shelf coupled inductors in a single package at a cost which is only slightly higher than that of the single inductor comparably. The coupled inductor not only provides a smaller footprint but also, requires only half the inductance which is required for a SEPIC with two separate inductors to get the same inductor ripple current.

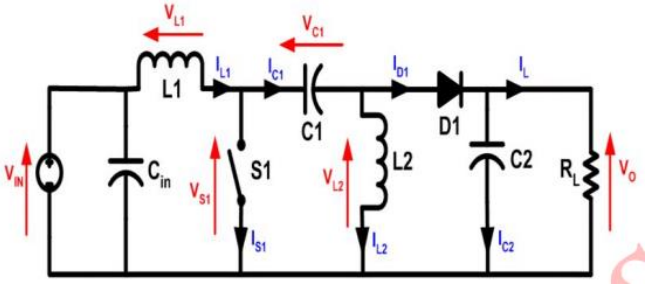


Fig 1. SEPIC CONVERTOR

A wind turbine or said to be the wind energy converter is a device that converts the wind's kinetic energy energy into electrical energy with the help of the generator. Electrical power is normally generated either with an induction generator or with a synchronous generator. Conversion of mass requires that the amount of air entering and exiting a turbine must be equal. Synchronous generators are typically interconnected to the grid through power electronics converters and different types of other electronics devices which are used to produce the energy. Power output is typically between 10KW to 2.5 MW and wind power is captured using a blade that is connected to the rotor of a generator. The power is generated only when the wind blows in the desired direction to blow the blades of the wind turbine. Like photovoltaic systems, there are no fuel costs, but periodic maintenance of the wind turbines is required for the better performance fo the system. The wind turbines need regular maintainace to stay reliable and available to generate to generate energy 98% of the time.

IV. CONCLUSION

The perfect preregulators are Cuk and SEPIC converter working as power factor preregulators. Here we see that the ripples in the input current is limited by proper design and choosing an adequate amount of input inductor. High input quality current is guaranteed by properly choosing capacitor. The experimental results have confirmed the validity of the analysis and design approaches present here. The two converters are such that they can be used individually as well as in the hybrid form and thus provide the flexibility of the operations.

V. REFERENCES

[1]. A.Sudharshan, M.Yohan, R.V.R.S.K.Shrujan, Y. Gayathri,"A Hybrid Wind-Solar Energy System Using Cuk-Sepic Fused Converter". A. Sudharshan et al Int. Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 3, Issue 6, Nov-Dec 2013, pp.287-293

[2]. P.Ponmani,Ms.S.DivyaPriya,"Hybrid Solar-wind Energy System With MPPT Using Cuk-sepic Fused Converter",International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181,Vol. 4 Issue 01,January-2015.

[3]. R. W. Erickson, "Some Topologies of High Quality Rectifiers" in the Proc. of the First International Conference on Energy, Power, and Motion Control, May 1997.

[4]. D. S. L. Simonetti, J. Sebasti´an, and J. Uceda, "The Discontinuous Conduction Mode Sepic and ´ Cuk Power Factor Preregulators: Analysis and Design" IEEE Trans. On Industrial Electronics, vol. 44, no. 5, 1997.

[5]. J. Marques, H. Pinheiro, H. Grundling, J. Pinheiro "A Survey on Variable-Speed Wind Turbine System," Proceedings of Brazilian Conference of Electronics of Power, vol. 1, pp. 732-738, 2003.

[6]. S.Venkatanarayanan,M.R.M NANTHINI,"Design and implementation of SEPIC and boost converters for wind and fuel cell applications,"International journal of innovative research in science,engineering and technology.