Comparison of dc-dc converters with SEPIC converter for wind driven Induction generators

Chanchal Verma[#1], B.Anjanee Kumar[*2]

M.E.(Power Eletronics),RITEE,Raipur,C.G, INDIA[#1]
Assistant Professor ,RITEE,Raipur,C.G,INDIA[#2]

Abstract
In this paper the comparison is done between the different dc-dc converter wit SEPIC converters for wind driven energy. The converter shows different output but the SEPIC gives the appropriate output which is needed. This paper considers the comparison in terms of THD (Total Harmonics Distortion) and power for wind energy as input. When wind energy is taken as input, the input is not consistent, means the wind doesn't flow in uniform speed, so, it needs dc-dc converter for which can convert the voltage in appropriate without damaging the system and components and equipment because this minor damage will cause heavy loss in order to SEPIC converter gives best results.
Keywords - *Dc-Dc converters, SEPIC converter, Wind energy and THD (Total Harmonics Distortion).*

INTRODUCTION

Nowadays SEPIC is used widely for better performance for conversion of voltage Some application of converter only need to buck or boost the voltage and can simply use the corresponding to input sometimes the output are not according to input. Then in that case, it is usually use best to convert that can decrease or increase the voltage Buck-Boost is cheaper but they heat up and having only a capacitor and inductor which causes high amount of input current ripple and this will create high amount of harmonics and its remedy is expensive and thus this makes buck-boost converter very expensive component too. And the major issue with the buck-boost is that they invert the voltage and all these can be eliminated through the Cuk converter but Cuk will create ample amount of electrical stress on components this can result in device failure or overheating .SEPIC will solve above problems easily without any harm to components and also cheap solution to problems and less electrical stress and overheating.

By using PMSG,the system gains high efficiency and secure for normal operation. use of permanent magnets for the excitation consumes no extra electrical power. The PMSG based wind turbine followed by power electronics circuits such as rectifier etc finally feeding to DC microgrids.
The diode bridge rectifier is used to convert AC into variable DC then this variable DC is converted into fixed Dc by the SEPIC converter and this SEPIC converter will reduce the THD (Total Harmonic Distortion).

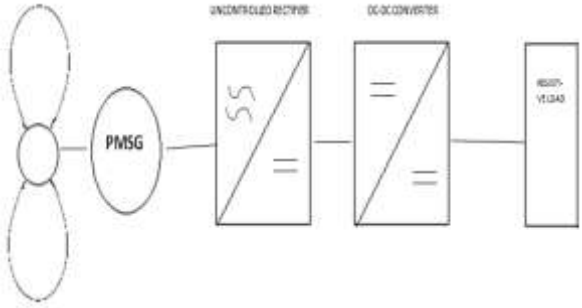

Fig (1):- Block diagram of WECS system.

Generally the dc-dc converter is divided into four categories and the fifth one is SEPIC converter.

Buck converter:-

Generally it is used for step down the voltage i.e. it gives output voltage less than input voltage when switching frequency is more and the duty ratio is less than 50%then the buck converter is used.

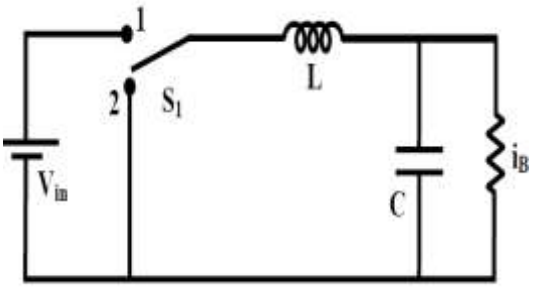

Fig (2):- Circuit schematic of a buck converter.

Boost converter:-

The boost converter is used when a higher output voltage than the input voltage is required .It contains ripple in converter which works with light load .It is generally used in discontinuous mode.

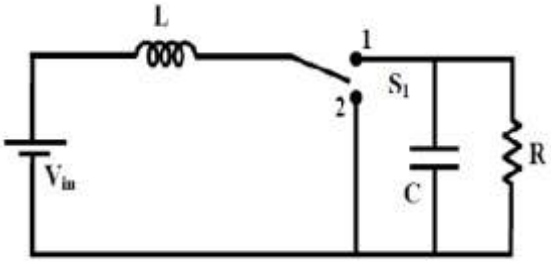

Fig (3):- Circuit schematic of a Boost converter.

Buck-Boost converter:-

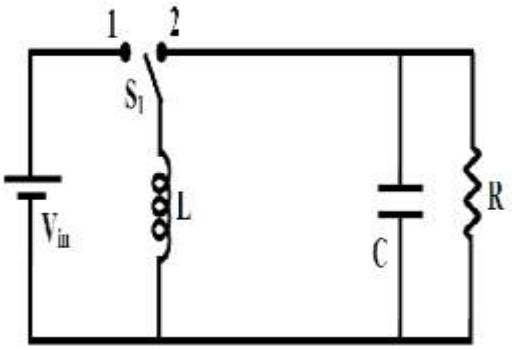

Fig (4):- Circuit schematic of a Boost-Buck converter.

Here single inductor and capacitor is used .this converter does not invert the polarity of the output voltage in relation to the polarities of the input. The output voltage can be either greater or smaller than input voltage.

This converter requires the use of two active switches and is designed by combining a buck converter and boost converter in same topology .due to this design this converter can work as buck only or boost only at a time. The main drawback is complex system which increases the costs.

Cuk converter:-

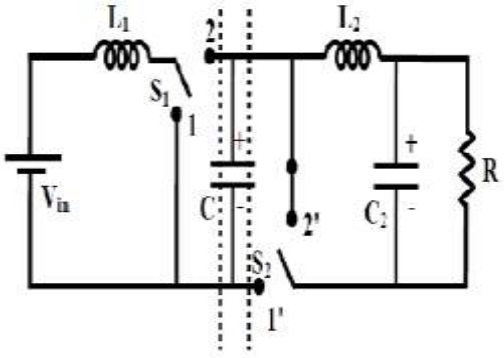

Fig (5):- Circuit schematic of a Cuk converter.

The three basic converter are combined together, than we get one converter that is Cuk converter. Output voltage can be either greater or less than input voltage. The main disadvantage of cuk is that it inverts the voltage. And the THD is also high.

SEPIC converter:-

The SEPIC is a modification of the basic Boost and the Cuk converter. It is superior to the other converters both in terms of the input current purity and efficiency. It shows very little overshot, or ringing. And also the switching loss is reduced. The output noise and a power stage that can be operated at a much higher frequency than that of the other converters will also be decreased. We will get non inverted output voltage with the help of SEPIC converter.

SEPIC topology:-

The single-ended primary-inductance converter (SEPIC) is a DC-DC-converter topology that provides a positive regulated output voltage from an input voltage that varies from above to below the output voltage. This type of conversion is handy when the designer uses voltages (e.g., 12 V) from an unregulated input power supply such as a low-cost wall wart. It requires two inductors; making the power-supply footprint quite largeThe coupled inductor not only provides a smaller footprint but also, to get the same inductor ripple current, requires only half the inductance required for a SEPIC with two separate inductors.

The single-ended primary-inductor converter (SEPIC) is a type of DC-DC converter allowing the electrical potential (voltage) at its output to be greater than, less than, or equal to that at its input. The output of the SEPIC is controlled by the duty cycle of the control transistor.

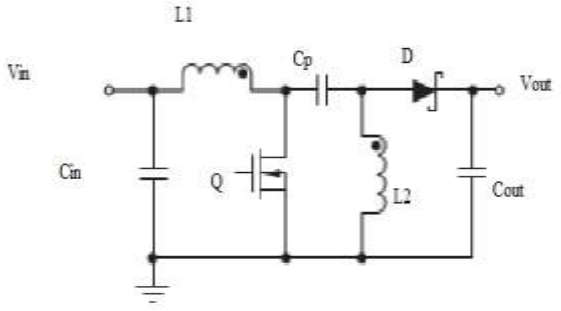

Figure (6):- Simple circuit diagram of SEPIC converter.

A SEPIC is essentially a boost converter followed by a buck-boost converter, therefore it is similar to a traditional buck-boost converter, but has advantages of having non-inverted output (the output has the same voltage polarity as the input), using a series capacitor to couple energy from the input to the output (and thus can respond more gracefully to a short-circuit output), and being

capable of true shutdown: when the switch is turned off, its output drops to 0 V, following a fairly hefty transient dump of charge.

Results and Discussion:-

The figure 7 show the input signal of wind turbine. And the figure shows the result compiled through the MATLAB/SIMULINK.

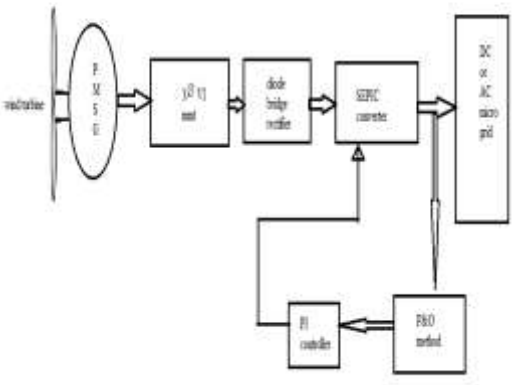

Figure (7):- Block diagram of proposed work.

Wind turbines works on the principle of converting kinetic energy of the wind in to mechanical energy. At input side the 120V has been considered. When wind blows, wind turns the blades, which spin a shaft, which connects to a generator and makes electricity. But the wind speed is not constant it varies ,which is unpredicatable.for this we take Signal given to wind turbine and one input is kept constant that is pitch angle because we can't see this variation in simulation and the wind speed is kept constant .wind speed is directly depends on the rotor speed.

The diode bridge rectifier is employed, it is a electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. Then the ac and dc voltage is measured through the voltage measurement. And then SEPIC converter is employed for buck as well as boost converter. First considering SEPIC as BUCK converter, it will reduce the voltage and give output with the THD percentage. After SEPIC the filter is connected for filtering the harmonics in the output. A proportional Integral (PI) is connected to MOSFET of SEPIC converter untill the DC get buck .After passing through LC filter circuit the DC is smooth and free from ripples and fed to the DC micro grid . For AC micro grid the inverter is employed which will again convert DC into AC.

The procedure will repeat for boosting the voltage and here a powergui is employed to see the THD of buck and boost.

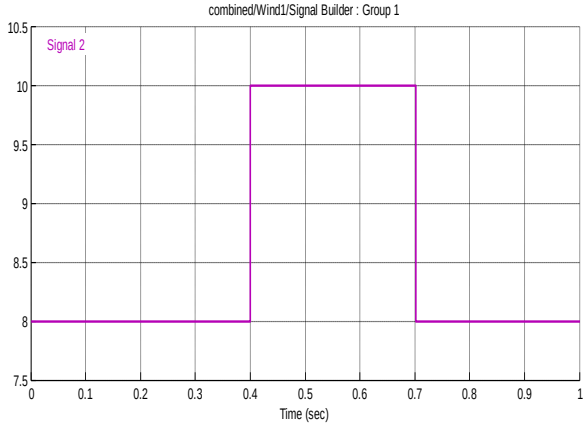

Fig (8):-Input signal to wind turbine.

THD BOOST :-

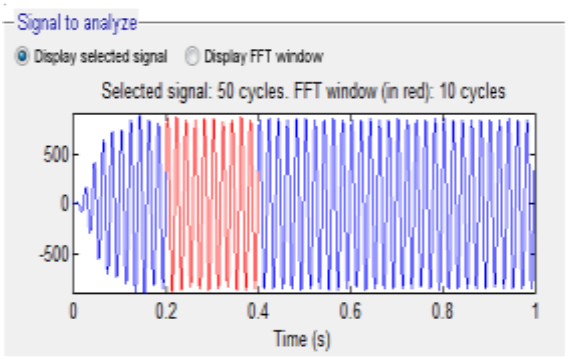

Fig (9):- THD Boost signal.

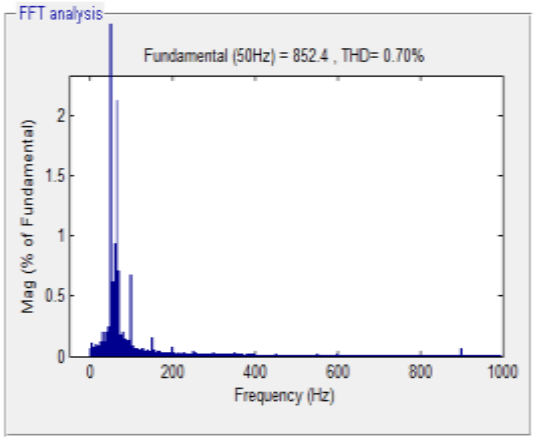

Fig (10):- Graph showing THD of boost SEPIC converter

THD BUCK:-

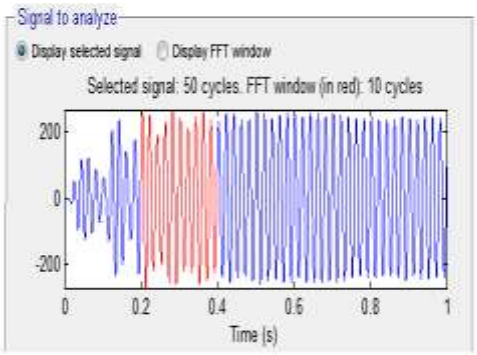

Fig (11):-THD Buck signal

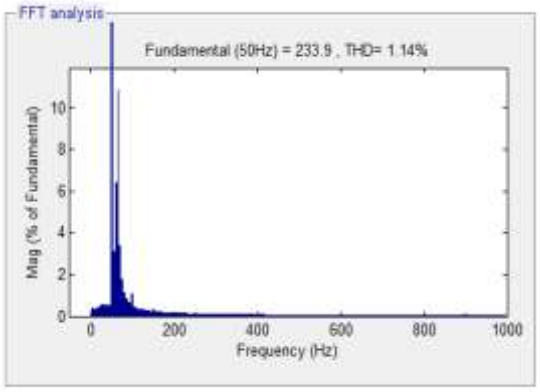

Fig (12):- Graph showing THD of buck SEPIC converter

Table No.1:- comparison of different types of dc-dc converter.

converter	Hz	Voltage	THD %
Buck	**50**	**48V**	**72.49**
Boost	**50**	**48V**	**8.52**
Buck-Boost	**50**	**48V**	**4.24**
Cuk	**50**	**48V**	**14.58**
SEPIC	**50**	**48V**	**1.14**

Conclusion:

The SEPIC converter give best results integrated with the wind energy. The SEPIC converter give lowest THD (Total Harmonic Distortion) as shown in table No.1. By capturing maximum power through P&O method and SEPIC converter {Single Ended Primary Inductor converter} which is capable of giving the Buck and boost voltage as per our need and THD is improved. SEPIC give results in microseconds with improve THD. The SEPIC converter is used to improve THD and also it will reduce the electrical stress on electronic component. And also compare the THD of SEPIC with Buck, Boost ,Buck-Boost, CUK converter, the SEPIC gives better performance in both condition i.e. buck and boost voltage.

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