

# Improvement of Output Power for Wind Driven Induction Generator using SEPIC Converter

Chanchal Verma, B. Anjaneer Kumar

**Abstract:** This paper deals with dc-dc converter known as SEPIC stands for single ended primary inductor converter. SEPIC is integrated with wind energy in order to maximize the performance of the system. With the help of simple method of tracking maximum power from wind energy to extract maximum power. Basically wind energy is used to generate electricity and the wind is not in uniform speed. So, by using different electronic components .The main part is dc-dc converter and by using SEPIC in place of normal dc-dc converter the output power i.e. THD will enhanced .Here DBR is used to convert AC to DC. The SEPIC can perform both bucks as well as boost converter. It gives the result in microseconds. The simple algorithm is the main advantage of the proposed work. The output is shown in DC microgrid and AC microgrid. It is for the small scale WECS.The work is supported with experimental results and also the output i.e. THD is calculated and compared with Cuk converter.

**Keywords:** MPPT, SEPIC (single ended primary inductor converter), THD, wind energy.

## I. INTRODUCTION

Nowadays the pollution level is high so, by keeping this in mind the scientist searches option through which the electricity is produced and the environment gets no harm. By using wind, sunlight and hydro power the electricity is generated. In this paper wind energy is taken as they do not cause much pollution to environments and it is available everywhere .The wind maybe very high in some places and very low and sometime no wind is there .so, by keeping all this in mind the work is proposed. The wind energy is chosen because of its safe, clean, abundantly and permanently available every nation in the world. For connecting different types of load to distributed generation systems, a dc bus is commonly used with suitable power electronic controller which forms dc microgrid. In dc microgrid the absence of reactive power, no harmonic losses, less electronic conversion stages and also easy to connect the storages devices are advantage of Dc microgrid. The PMSG and SEIG are suitable choices for small scale wind generators employed in dc microgrid [1]. In proposed work PMSG is used which will give high efficiency yield. It doesn't need additional power supply for the magnet field and it is highly reliable due to absence of mechanical components.

Manuscript published on 30 August 2016.

\* Correspondence Author (s)

Chanchal Verma, M.E., Department of Power Electronics, Raipur Institute of Technology, Raipur (Chhattisgarh)-492101 India.

B. Anjaneer Kumar, Assistant Professor, Department of Electronics and Tele-Communication, Raipur Institute of Technology, Raipur (Chhattisgarh)-492101 India.

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an open access article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

MPPT important term in renewable source as it is not only maximizing the system's efficiency but also to minimize the payback period of the installation cost. In wind energy MPPT is used to improve the generator speed with respect to wind velocity which blocks the wind turbine to maximize the power.

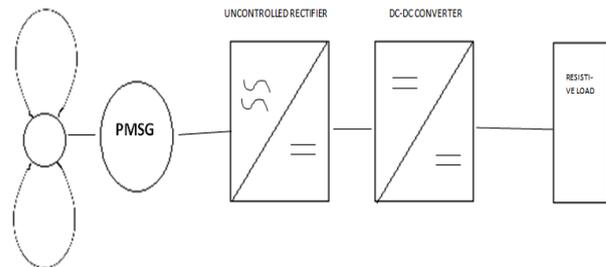


Fig (1):- Block Diagram of WECS

The wind turns the blades of wind turbine which spin a shaft which connects to generator. The DBR (Diode bridge Rectifier) is connected and it will convert the generate voltage into AC to DC and then, with the help of dc-dc converter it will convert it to desired voltage. In place of dc-dc converter, SEPIC converter (Single Ended Primary Inductor Converter) is employed. SEPIC have many advantages over common dc-dc converter. The objective of this paper is to integrate wind energy with SEPIC converter for better voltage in DC voltage in microgrid. This will provide a secure and dependable connected loads.

In past few researchers are described the performance of the dc microgrid system with different voltage levels and suitable power electronics interface ,based on efficiency ,voltage drop etc. considering various factor stated above they concluded that the low voltage system (24/48V) gives optimal performance low power applications (1).

## II. MATERIAL AND METHODOLOGY

### 1) Wind energy:-

The Wind energy is available everywhere and it is great source to produce electricity. Wind energy which is safe, clean and also affordable energy .Wind energy posse's Kinetic energy and this kinetic energy is used to produce electricity. Wind energy is type of solar energy .solar energy is responsible for the blowing of wind. With the help of wind turbine the kinetic energy of wind is captured and passes to the generator which produce electricity.

# Improvement of Output Power for Wind Driven Induction Generator using SEPIC Converter

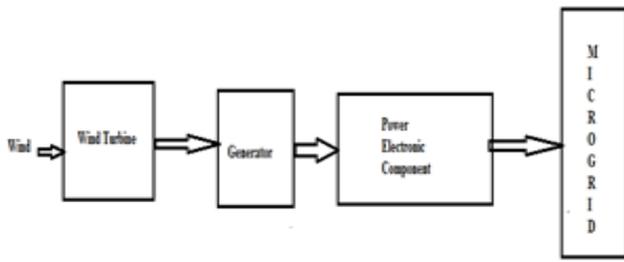


Fig (2):- Block diagram of wind energy.

## 2) SEPIC topology:-

The SEPIC stands for Single Ended Primary Inductor Converter which is also descriptive: "Secondary Polarity Inverted Cuk"(7).

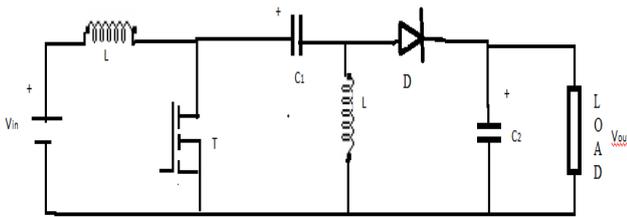


Fig (4):- The basic SEPIC Topology

The basic relation can be explaining as by considering the two inductors to have average null voltage across themselves. If the link capacitor has a voltage  $V_c$  across itself (consider it to be reasonably constant) then for the input inductor, the volt-secs during the ON and OFF periods of the switch are:

$$V_{in}.T_{ON}=(V_c-V_{out}-V_{in})T_{OFF} \quad (1)$$

$$\text{Or, } V_c=V_{out}-V_{in}(1/T_{OFF}) \quad (2)$$

For the output inductor,

$$V_{cc}.T_{ON}=V_{out}.T_{OFF} \quad (3)$$

Eliminating,  $V_c$  and writing

$$T_{ON}=\left(\frac{\partial}{1-\partial}\right) V_{in} \quad (4)$$

The turns ratio is and the coupling is very tight. For such a coupled transformer SEPIC, equating the positive and negative volt-secs for the two inductors,

$$(V_{in}.K.V_c).T_{ON}=(V_{out}+V_c-V_{in}-K.V_{out}).T_{OFF} \quad (5)$$

For the input inductor, and

$$(V_c-K.V_{in}).T_{ON}=[V_{out}-K(V_{out}+V_c-V_{in})].T_{OFF} \quad (6)$$

## 3) Block diagram:-

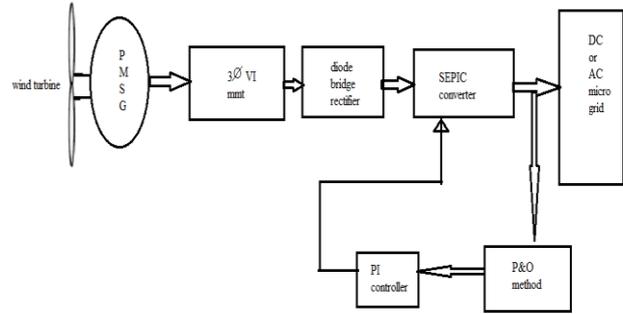


Fig (5):- Block Diagram of proposed work.

In proposed work the SEPIC converter is employed in place of dc-dc converter. SEPIC converter .The wind will rotate the blades of wind turbine and this will rotate the shaft which is connected to the generator and the electricity is produced through the wind energy. By using the kinetic energy of wind the electricity is produced. At last using DC and AC microgrid for showing output.P&O method is use to capture maximum power point from wind.PI controller is used for error analysis. The P stands for Proportional which gives fast response and I stands for Integral which gives zero steady state error.

The SEPIC converter has many advantages over normal dc-dc converter. SEPIC converter gives non inverting polarity, easy to drive switch and low input pulsations. In output by employing the DC as well as AC microgrid, shows the buck and boost of voltage and the THD of SEPIC converter. It is recently being used as dc-dc converter in the modern industrial applications in order to maintain the voltage. The voltage can be buck and boost with SEPIC converter simultaneously at different load like DC & AC microgrid.The simulation of proposed EPIC converter is accomplished using MATLAB/SIMULINK at version matlab2010.The THD is calculated of SEPIC converter at buck and boost condition.

## III. RESULTS AND TABLES

The speed of wind is not constant and it varies from region to region and this states that the electricity produce will not same at all the time. Here PMSG is employed for better performance. PMSG gives higher efficiency, high power density at cheap cost. PMSG convert the AC into DC.

In proposed work, the MPPT algorithm P&O method is used, by using the SEPIC converter the voltage can buck and boost in microseconds which are efficient and also reduce electrical stress on the electronics components which are employed in the circuit. 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 until the DC get buck .After passing through LC filter circuit the DC is smooth and free from ripples and fed to the DC microgrid . 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 power gui is employed to see the THD of buck and boost.

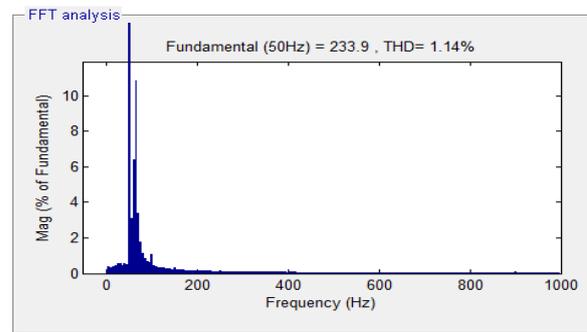


Fig (7.b):- THD of buck SEPIC converter.

Table (1):- Comparison of CUK converter with SEPIC converter THD

Types of converter	Input voltage	Output voltage	THD
CUK converter	130V	48V	14.58%
SEPIC buck converter	120V	48V	0.70%
SEPIC boost converter	120V	48V	1.14%

#### IV. CONCLUSION

In this paper, SEPIC converter with wind energy is integrated and shown the output in DC microgrid, in place of DC microgrid can also apply AC microgrid. 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. In proposed work 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 CUK converter, the SEPIC gives better performance in both condition i.e. buck and boost voltage.

#### REFERENCES

1. Nayanar, V., Kumaresan, N. and Ammasai Gounden, N., "A single sensor based MPPT controller for wind driven Induction Generators Supplying DC Microgrid", IEEE Transactions on Power Electronics, Vol.31, Issue: 2, pp1161 – 1172, feb. 2016.
2. A.Yazdani and P.P. Dash, "A control methodology and characterization of dynamics for a photovoltaic (PV) system interfaced with a distribution network," IEEE Tans. Power Del., vol.23, no.3, pp.1538-1551, jul 2009.
3. H.Li and Z. Chen, " Overview of different wind generator systems and their comparisons," IEEE Renew. Power Gener., vol.2, no.2, pp123-138, jun.2008.
4. Monica Chinchilla, Santiago Arnaltes, Juan Carlos Burgos: "Control of permanent magnet generators applied to variable speed wind energy systems connected to the grid", IEEE Transaction on energy conversion, vol.21, NO.1, MARCH 2006.
5. K. Padmanabham and K. Balaji Nanda Kumar Reddy: " A New MPPT Control Algorithm for Wind Energy Conversion System", (IJERT) ISSN: 2278-0181 ,Vol. 4 Issue 03, March-2015
6. Gayathri Deivanayaki. VP, Dhivyabharathi. R, Surbhi. R and Naveena. P." comparative analysis of bridgeless CUK and SEPIC converter." IJICSE, vol.3, issue1, jan-feb 2016, pp15-19.
7. Notes of IIT, Kharagpur, DC to DC Converters, Module -3.

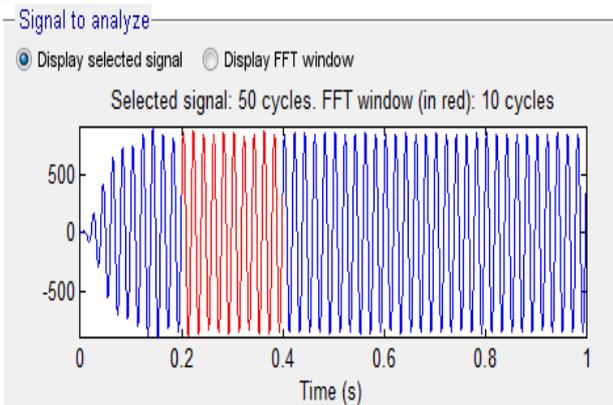


Fig (6.a):- signal of boost SEPIC converter.

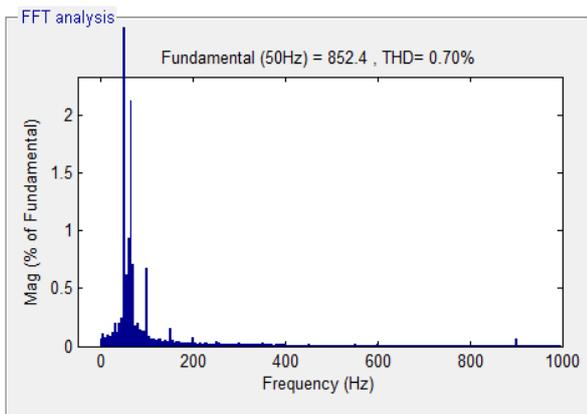


Fig (6.b):- THD of boost SEPIC converter

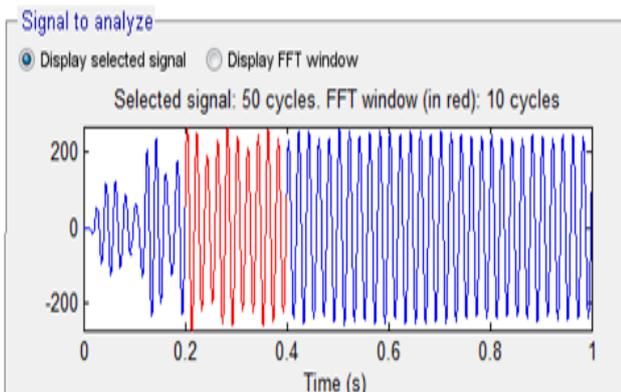


Fig (7.a):- Signal of buck converter.