# A NOVEL DESIGN OF SEPIC OPERATION OF AN DC-DC CURRENT SOURCE CONVERTER USING WECS

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***ABSTRACT:*** *A high step-up resonant dc-dc converter with ripple-loose input modern-day for renewable strength structure. We use an enter-current doubler and a switching mechanism hired at an output-voltage doubler to gain high step-up voltage benefit without having to use a transformer with excessive turn ratio. A lively-clamp circuit established at the primary facet suppresses the surge voltage at the switch additives and recycles the power stored in the leakage inductance. A resonance that happens on the secondary side of the converter is used to reduce the turn-off contemporary and switching loss notably, and to acquire excessive power conversion efficiency. The enter current ripple declines to zero theoretically due to the fact the duty cycle of the primary-aspect switches is always set to zero.5 no matter the input voltages and load versions. The circuit operations, constant-country analysis, and layout guideline of the proposed converter are also presented. A six hundred-W prototype converter has been fabricated to demonstrate the overall performance of the proposed converter.*

***Key Words: :*** *Current source converter, efficiency, wind mill, dc to dc converter, battery, SEPIC converter, wind electricity conversion gadget.*

## I. Introduction

Renewable are now the arena's quickest-growing strength resources and are expected to increase by using 2.6 % consistent with yr via 2040. via 2040, coal, herbal gasoline, and renewable strength sources are anticipated to provide more or less identical stocks (28%– 29%) of the sector power generation. The renewable strength resources along with photovoltaic panel, thermoelectric generator, and gasoline-mobile stack generate low voltages and require low-contemporary ripple to enlarge their lifestyles span, so that they require distinctly-efficient dc-dc converter which can offer high step-up conversion with low input-current ripple over the whole range of operation.

To gain high step-up conversion, some converters use a transformer with high flip ratio, however this transformer has massive leakage inductance and parasitic capacitance which can reason excessive voltage or modern-day spike at the strength gadgets. further, to reduce input cutting-edge ripple, a converter with non-stop input cutting-edge is preferred due to the fact because the ripple decreases, the conduction loss of the primary-side switches and the size of the enter electrolytic capacitors can be decreased. current-fed kind converters can meet most of those requirements and are consequently widely utilized in renewable power structures. A converter designed with an input-contemporary doubler in conjunction with an lively-clamp circuit and an output-voltage doubler has low conduction loss on the number one aspect due to the fact the input present day doubler divides the input modern-day into inductor currents, and the output-voltage doubler is prepared with a series–resonant circuit that may flip off the output diodes while modern is zero.

A quasi-resonant cutting-edge-fed converter with excessive performance makes use of an active-clamp circuit in the primary aspect to generate quasi-resonant operation, thereby lowering the switching loss and modern strain, and putting off the reverse recovery trouble of the diodes inside the voltage doubler. This converter is commonly used for low strength applications as it is based handiest on two switches at the number one facet. Interleaved cutting-edge-fed twin-active-bridge dc-dc converters have been proposed to in addition reduce the enter-current ripple. But the responsibility cycle of the switches used at the primary aspect varies with the input voltage and output load, and the present day ripple can not be zero for the complete range of operation. additionally, the interleaved shape may additionally improve the general price because it increases the quantity of components and calls for a complex control set of rules.

Use of multi-degree converters has been proposed. In a boost cellular with full bridge dc-dc converter gives ripple-loose enter current, and a voltage doubler at the secondary side increases the voltage gain while not having to use a high flip ratio transformer. a lift converter on the number one aspect can notably lessen the enter-cutting-edge ripple, however high voltage advantage can be finished by using using its collection connection with a SEPIC converter and by the usage of the coupled inductors. Multi-degree converters can reap high voltage advantage and ripple-unfastened input modern-day, but they require extra interface circuitry, which might also reduce power conversion performance.

## II. Existing System

In offshore wind farms, the medium voltage (MV) permanent magnet synchronous generator based wind system are in cascaded connection to obtain the range of high voltage direct current (HVDC). The overall control unit of pulse width modulation (PWM) based current source converter (CSC) in wind farms. The control units are, one for the onshore wind farms and another control unit for the offshore wind farms. The major factor for the generator side converter is to get MPPT from different wind speed loads.

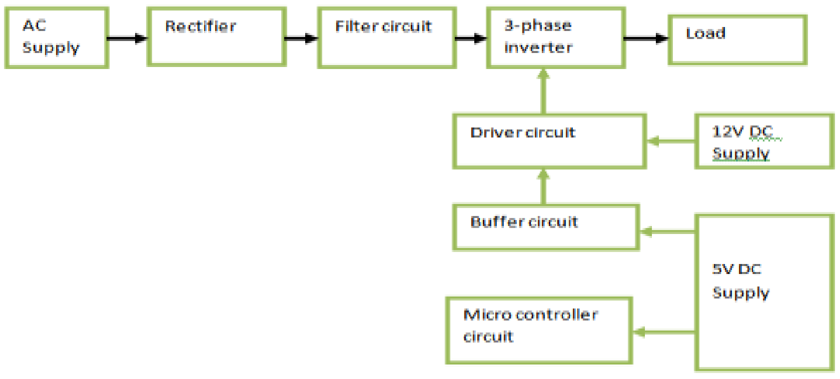


Fig. 1. Block diagram

The reference dc link current is small to reduce the operation losses. At low dynamic performance during low wind speed which lower the system losses. In wind energy system, they does not require a faster dynamic response there is small change in the output power of turbine generator system due to large inertia. By implementing the modular MFTs required high insulation with high power modular MFT of the insulation HVDC level at 300kv and higher.

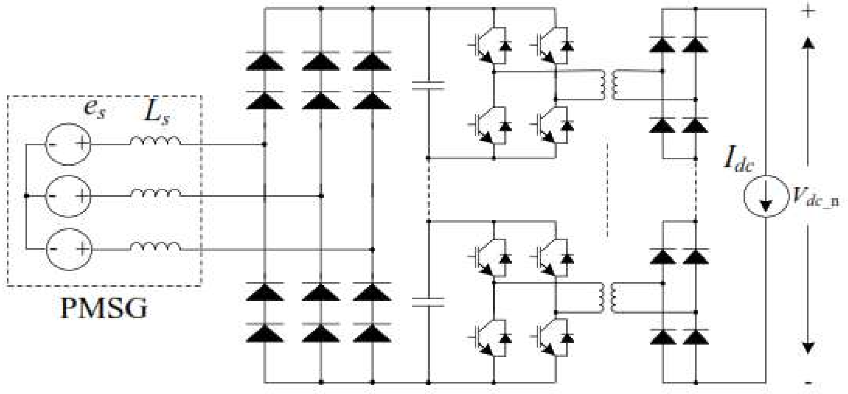


Fig. 2. Circuit diagram

Fig. 2. shows that, there is a need for the low reference dc link current for the filter capacitor ($C_f$). The real power is reduced at low wind speed ranges of 0-0.4pu, resulting constant dc link current by the reactive current in the capacitors. The active current should be increased at the higher wind speed level. For a current source converter at double bridge, the range of the filter capacitor ($C_f$) is 0.15pu to 0.3pu.

## III. Proposed System

Here, we step up the input voltage through the DC-DC converter through the operation of single ended primary inductor converter (SEPIC) for to increase the range of output power and to maintain the power ranges. For the clear operation of the system, the direct current is converted to alternating current through the current source inverter. By the level of wind speed, the given input power is to be differed for the system. To regulate the incoming low level or high level power, the primary inductor plays a vital role to regulate the input power even if they are having a lower wind speed or higher wind speed.

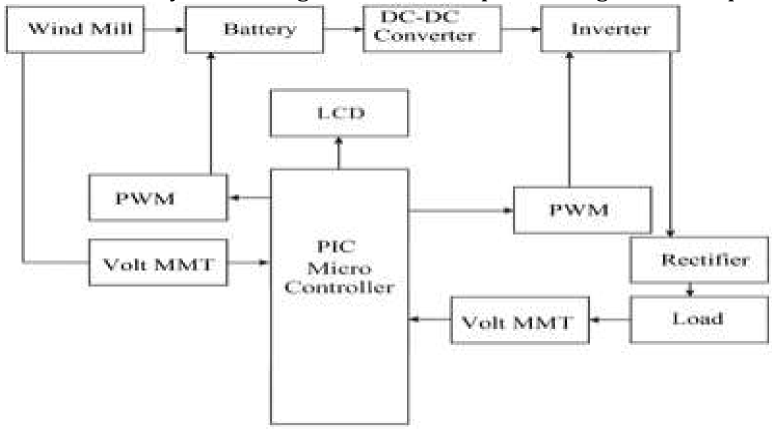


Fig. 3. Block diagram

For the system, the permanent magnet dc generator (PMDCG) is used to increase our voltage level rapidly. But, we normally use medium voltage (MV) permanent magnet synchronous generator (PMSG) for to maintain the excitation level. It increase our system reliability, efficiency, and having non-inverted output voltage. They should be available at both the offshore wind farms and onshore wind farms. They are commonly used to convert the mechanical power output of steam turbines, gas turbines, reciprocating engines and hydro turbines into electrical power for the grid. Some designs of Wind turbines also use this generator type.

**IV. Simulation Results**

It is the wind energy conversion system, that are generating the electric power at the range of 400pu volts even they are connected at load condition. From the wind system, the level of output that are boosted up by the transformer for the input level of voltage even they are low wind speed condition. The boosted output voltage are the input to the current source inverter which converts the dc voltage to ac voltage. Then the ac voltage are rectified by the rectifier unit to the dc output voltage.

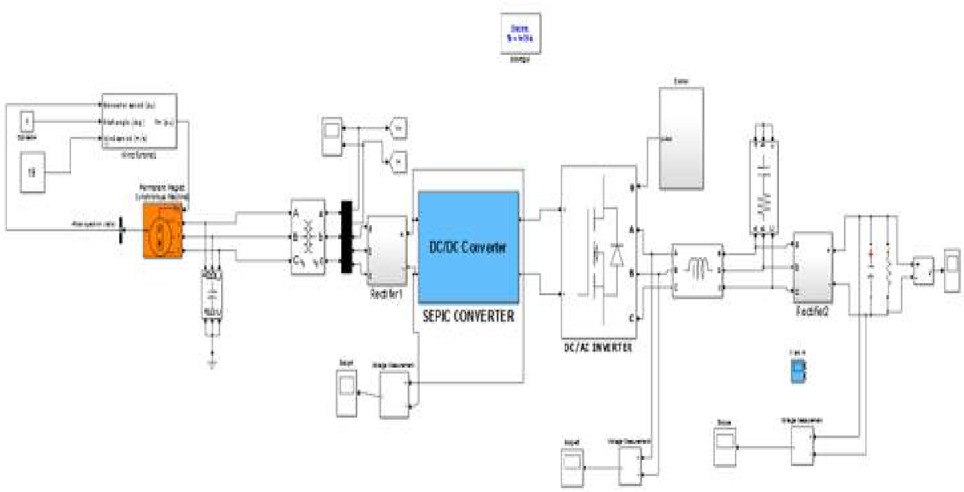


Fig. 1. Simulation diagram

Here, it is the transformer output which having the magnetizing inductance ($L_m$) of 500pu and having the magnetizing resistance ($R_m$) of 500pu from the wind energy system. It is almost the range of input level of the system. So, it's the input level of the SEPIC converter which operates upto a desired level that shown in the figure 1. Here, the transformer that are connected to the wind energy system and get the input from the wind system. The output level of the transformer is the input to the rectifier unit for the conversion of ac voltage to the dc voltage.

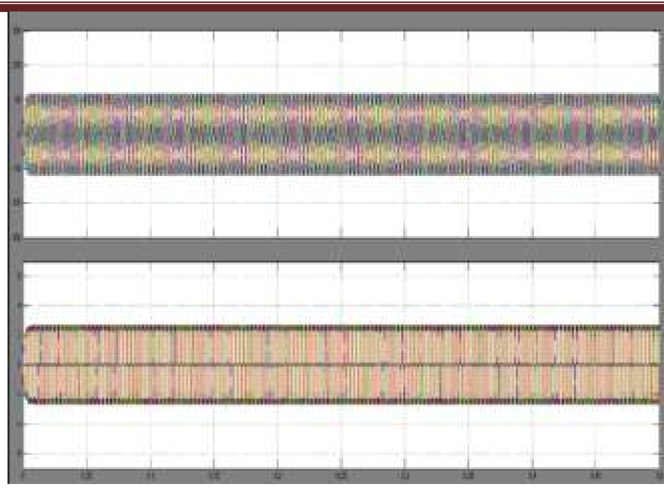

Fig. 2. Transformer output waveform

Here, the each rectifier unit has the output waveform, the foremost rectifier unit that are connected to the transformer gives an output at the range of approximately 115pu volts with the resistance ($R_{on}$) of 0.001pu ohm at the forward voltage ($V_f$) range of 0.8 volts.

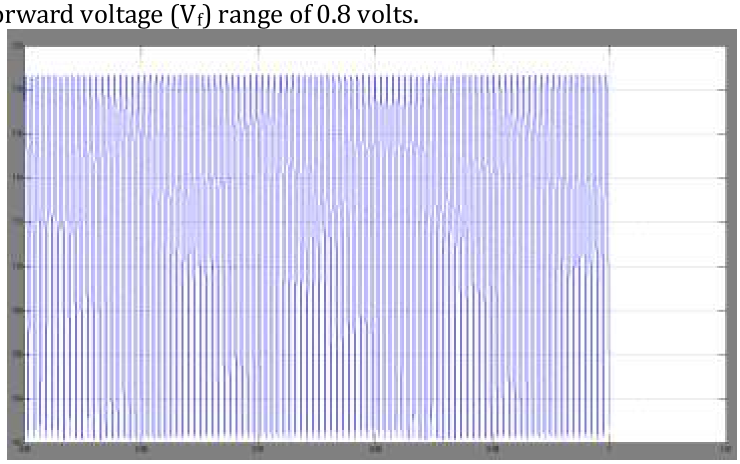

Fig. 3. Waveform of rectifier 1

It is the output waveform for the rectifier unit 2 that shows in the figure 4. They almost connected to the single ended primary inductor converter (SEPIC) and to the resistive load which got the output voltage at the range of 400pu volts. The rectifier units are having the resistance ($R_{on}$) of 0.001pu ohm at the forward voltage ($V_f$) range of 0.8 volts. Here, the diodes act as a rectifier unit. When the rectifier unit reaches the forward voltage, then the diode will conduct.

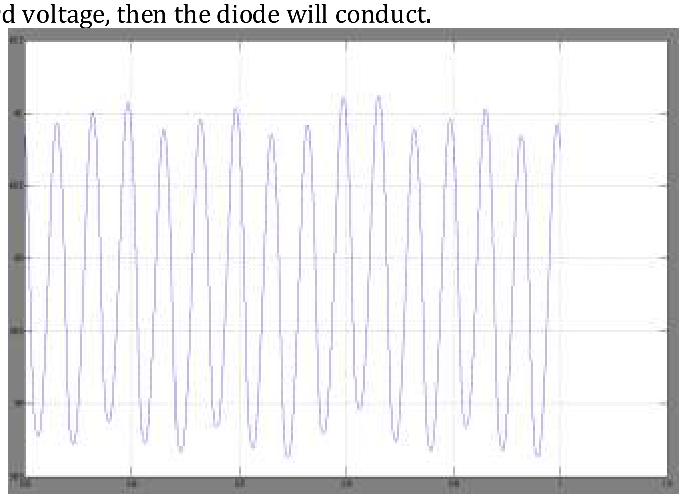

Fig. 4. Waveform of rectifier 2

The SEPIC converter inverts the voltage level that boost up the incoming voltage to obtain a output voltage at the range of 400pu volts that are shown in the figure 5. These converter are operated with the primary inductor of $6e^{-6}$ henry, the input resistance at the range of 45pu ohm and output resistance at the range of 50pu ohm with the snubber capacitance (Cs) of 250pu farads. When the diode reaches the duty cycle, then able to conduct and start the converter process.

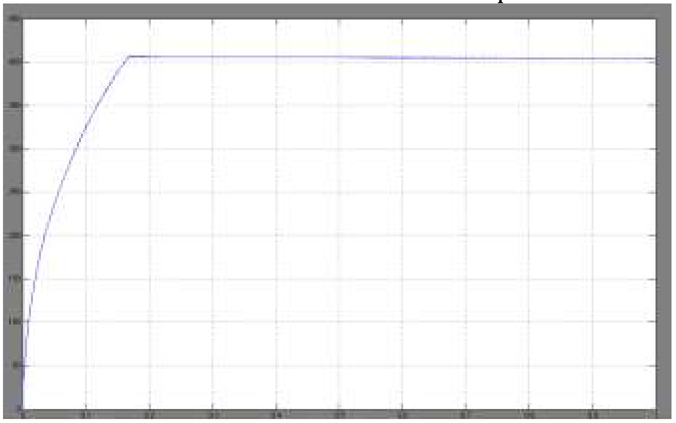

Fig. 5. Output waveform of SEPIC converter

For the inverter, we use MOSFET here for the operation and switching process. The output range of the inverter is about 400pu volts which are having the resistance at the range of $1e^5$ ohms. The figure 6 shows the inverted output voltage which depends upon the duty cycle of an switching device called MOSFET. That inverter got the input from the SEPIC converter i.e. the boosted voltage.

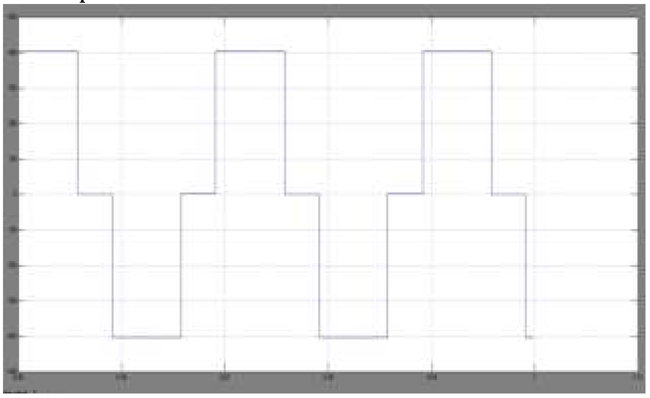

Fig. 6. Output waveform for inverter

It is the overall output from the wind energy conversion system that are almost obtained at the rectifier units which having the resistance of 0.001pu ohm and the snubber resistance ($R_s$) of 500pu ohm, then the output obtained at the range of 400 volts with the connection of loads are shown in the figure 7. The SEPIC converter performs an operation to boost up the input voltage level to get the high range of output voltage through the inductor that are connected in series. At the output, the process can occur in the period of saturation.

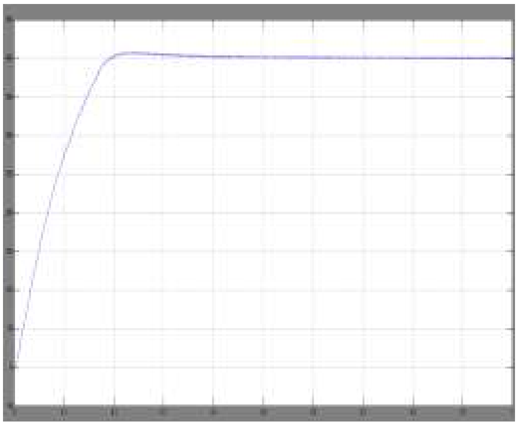

Fig. 7. Output voltage with load

## V. Conclusion

In this paper, the performance of current source inverter based cascade connected with the SEPIC converter contributes to the significant voltage level. By the SEPIC converter, it performs both the operation of step up process and step down process which depends upon the requirement. There is no non-inverted output voltage, even though it also increases the output voltage compared to the input voltage and the efficiency of the system. The total installed and individual capacity of wind turbines have both been steadily increasing in the last four decades-mainly driven by the needs for more renewable energies and also constantly to lower the cost of energy. The wind power nowadays plays much more important role in the energy supply system. Compared with the conventional control unit, they increases the output power with the improved efficiency and flexibility. The advantages are as follows:

1. The switching loss should be reduced due to the usage of less number of switching devices.
2. Harmonics are reduced at the filtering process done by capacitor ($C_f$).
3. The efficiency of the system should be increased 10% at the range of 91%.

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