ANALYSIS OF AC/DC/AC CONVERSION PROCESS IN DFIG AND BLDC MACHINE BY USING SEPIC CONVERTER IN THE FRONT END

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ABSTRACT

One of the most common solutions to the problem of feeding a three-phase induction motor from a single-phase line is using AC/DC/AC converter. An AC/DC/AC converter is composed by two stages, rectifying and inverting. The rectifying stage, or front-end, is generally implemented using a diode bridge rectifier or a boost rectifier. This paper evaluates the performance of a Single Ended Primary Inductor Converter(SEPIC) derived Power Factor Correction(PFC) rectifier used as a front-end of an AC/DC/AC converter. The purpose of using a PFC Rectifier as the front-end is to achieve a close to unity power factor and low harmonics content. The circuit is designed from data obtained from a conventional AC/DC/AC converter. The results from the experiments show that, using the PFC rectifier, the power factor is close to unity and the %THD (Total Harmonic Distortion Percentage) is smaller than the obtained using a diode bridge front-end.

Indexing terms/Keywords

Total Harmonic Distortion, SEPIC converter,CCM,DCM.

Academic Discipline And Sub-Disciplines

Electrical Engineering and power quality improvement

SUBJECT CLASSIFICATION

Harmonic reduction technique using SEPIC converter

INTRODUCTION

In developed countries, most of the generated electrical energy is transformed into mechanical energy using electrical motors. Induction motors are the most used motors in industry; they comprise about 90% of the motors, mainly because induction motors have advantages in efficiency and robustness over other electrical motors. Most of the motors are uncontrolled, but the employment of electronically controlled drives is increasing. The first election when designing a single-phase to three-phase converter for the motor is using a single phase to three phases AC/DC/AC topology. The diode bridge rectifier is a popular choice as a frontend for single-phase to three-phase converters see figure 1. However, it has several drawbacks. Naturally has high Total Harmonic Distortion (THD), low Power Factor (PF) and needs a large size capacitor for DC coupling. Efforts have been made to overcome these drawbacks. The most widely extended alternative topology for the front-end of AC/DC/AC drives is the boost rectifier. This topology leads to a close to unity power factor and is simple and efficient. On the other hand, bridgeless boost rectifiers can only bring a voltage greater than the input voltage, isolation between the input and output cannot be easily implemented, there is no current limitation during overload conditions, and the start-up inrush current is high. The alternative we evaluate in this work is the use of the converter introduced in, as front end of an AC/DC/AC circuit, instead of a Diode Bridge Rectifier. The converter introduced in is based on Single Ended Primary Inductor Converter (SEPIC). This work is aimed to evaluate the performance of the systems when this topology is used as a front-end of an AC/DC/AC converter. This converter operates in Discontinuous Conduction Mode (DCM) and exploits its natural Power Factor Correction (PFC) characteristics. We start building and testing a conventional AC/DC/AC converter with a diode bridge as front-end. The results from this experiment are used to choose the values of the components for the SEPIC-derived PFC rectifier in order to get the low total harmonic distortion and high power factor and This is achieved by making the circuit operates in DCM. Then, we build and test the PFC rectifier and take measurements from it at two conditions, start-up and steady state.

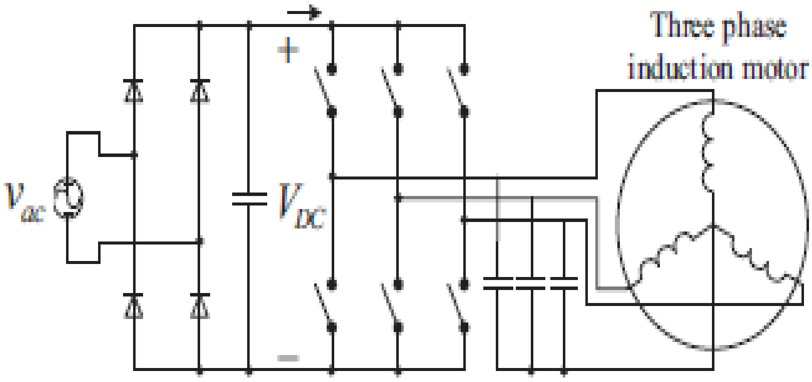

Fig 1: Single Phase to Three Phase Converter

2.EXISTING SYSTEM

The SEPIC converter is operated in discontinuous conduction mode in an existing mode of operation. For a small wind energy conversion system rectifier is a suitable device for electronic energy processing based on permanent magnet synchronous generators. The usage of rectifier introducing low power factor without the usage of input current sensors and current control loops. The wave form of the input current has the same shape of the input voltage. They are in phase with each other.

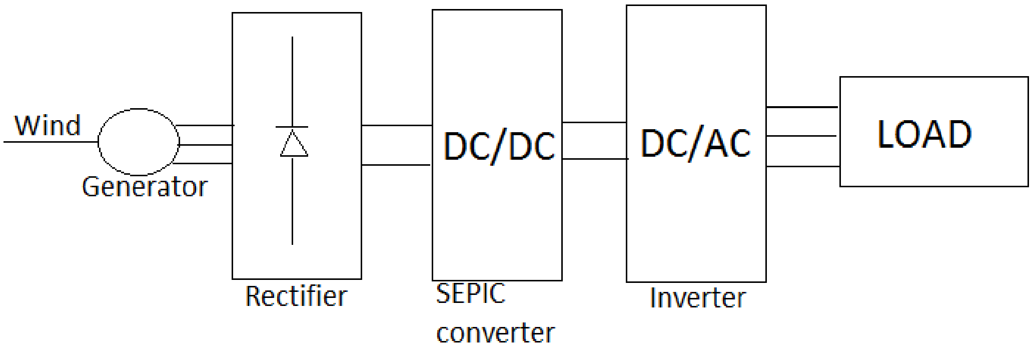

Fig 2 : Block Diagram of SEPIC Converter

From this block diagram the input is generated from the wind. The output from the wind is converted in to the DC by using rectifier. Here we using the DC to DC converter for raising the voltage level to the requirement. The unwanted harmonics is eliminated by the SEPIC converter by the filtering. The harmonic free supply is given to the load. The SEPIC will act as a voltage regulator for maintaining the voltage to the constant level.The SEPIC (Single Ended Primary Inductor Converter) converter allows a range of dc voltage to be adjusted to maintain a constant voltage output. Circuits run best with a steady and specific input. Controlling the input to specific sub-circuits is crucial for fulfilling design requirements. AC-AC conversion can be easily done with a transformer; however dc-dc conversion is not as simple.

3. EFFECTS OF NON-PFC-EQUIPPED CIRCUITS

The capacitor is used as input side filter in Non- PFC power supplies. This could introducing rectification process AC line. It introducing tradeoff between the forward voltage drop and switching speed. If the ultra rectifiers has the switching speed less than the 35ns there should be increase in a forward voltage drop. The power factor correction methods for various power supplies the better performance could be achieved. But the high peak current introducing the unwanted voltage drop in the wiring system so that the generated power could not be fully utilized. The power factor correction is nothing but the reduction of the harmonics and increasing the power factor as nearer to unity. The real power only carried by the fundamental harmonics. The reactive power can be carried out by the high order harmonics. The increasing of power factor can be done by the reduction of the high order harmonics. Drops in the wiring and imbalance problems in the three-phase power delivery system. This means that the full energy potential of the AC line is not utilized. The power factor is typically about 40 to 50 %. Figure 1: C = 100 μF, R = 680 Ω, I_{RMS} = 495 Ma, P = 20 W, S = 43 VA, Q = 38 var, Power factor = 0.464 With the same resistor directly connected to the line terminals or using power factor correction the following results can be achieved: I_{RMS} = 172 Ma, P = 20 W ,S = 20 W, Q = 0 Power factor = 1 This simple example gives a good impression what happens if all electronic equipment is powered without PFC.

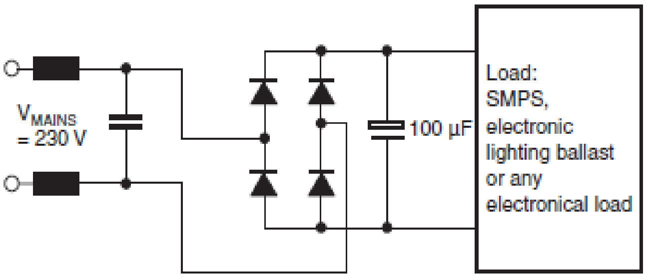

Fig 3 :Standard Bridge Rectification of Line Voltage

4.SEPIC POWER FACTOR CORRECTION RECTIFIER

The simulation diagram of the proposed system is shown in figure4.The power generated from the wind is in form of alternating in nature. Before we supply the power to the load it need a conversion from AC to DC.This conversion is possible by using rectifier that converts the AC in to DC.This output from the rectifier is given to the DC to DC converter for raising its voltage to the required level. The unwanted harmonics can be eliminated by using SEPIC converter and this SEPIC converter which introducing bridgeless power factor correction method with low conduction loss. The SEPIC converter having the so many advantages in transformer isolation, low input current ripple, low magnetic interference, inherent inrush current limitation. The output of the inverter does not having any harmonics so the load is free from harmonics.

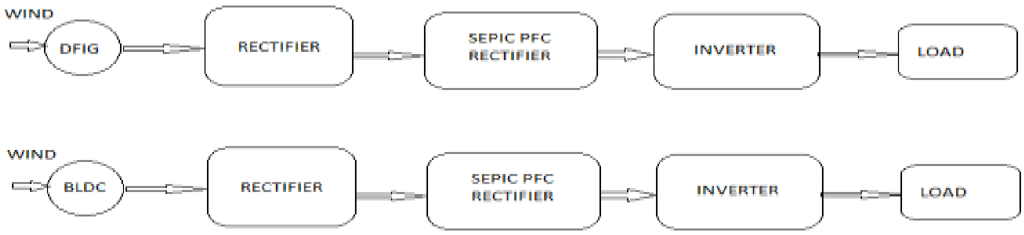

Fig 4 : Proposed Block Diagram

The use of SEPIC PFC converter eliminates the requirement of filter for the unwanted harmonics in the supply. The output of SEPIC converter is given to the inverter which will convert the DC supply to AC. The bridgeless PFC circuits based on SEPIC with low conduction losses.Unlike the boost converter, the SEPIC converters offer several advantages in PFC applications, such as easy implementation of transformer isolation, inherent inrush current limitation during start-up and overload conditions, lower input current ripple, and less electromagnetic interference (EMI) associated with the DCM .By using SEPIC PFC rectifier, The output of inverter does not have any unwanted harmonics so it is given to the load

5.SIMULATION DIAGRAM

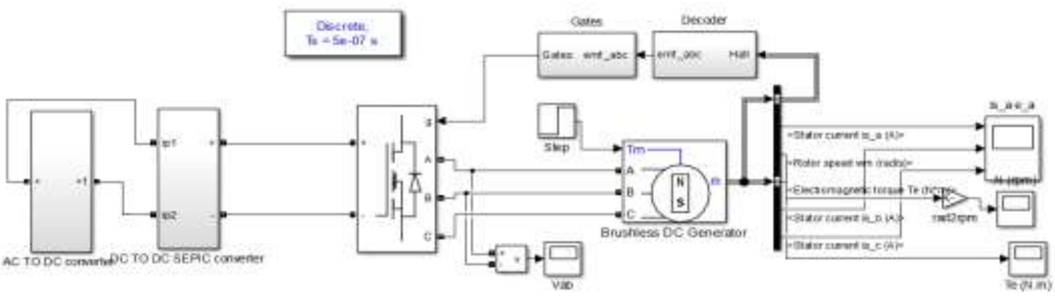

Fig 5:Simulink Model For BLDC

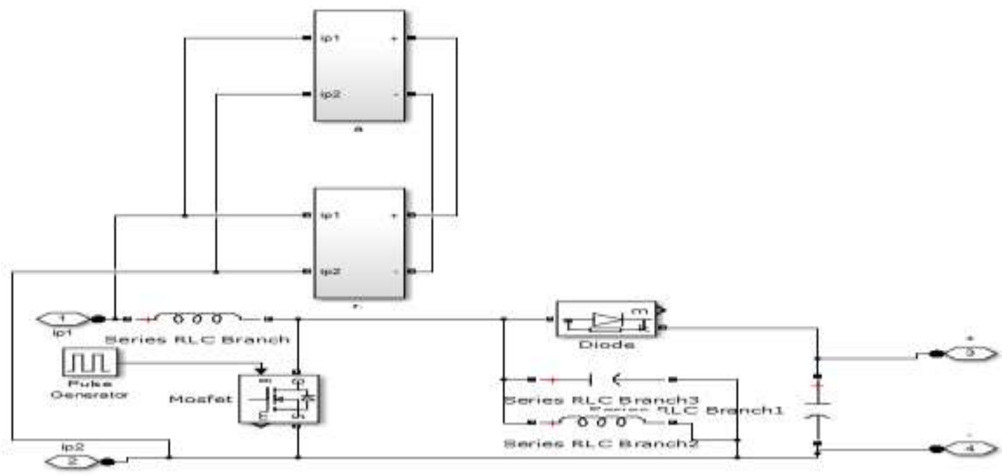

Fig 6: Simulink model for SEPIC PFC rectifier with DFIG&BLDC

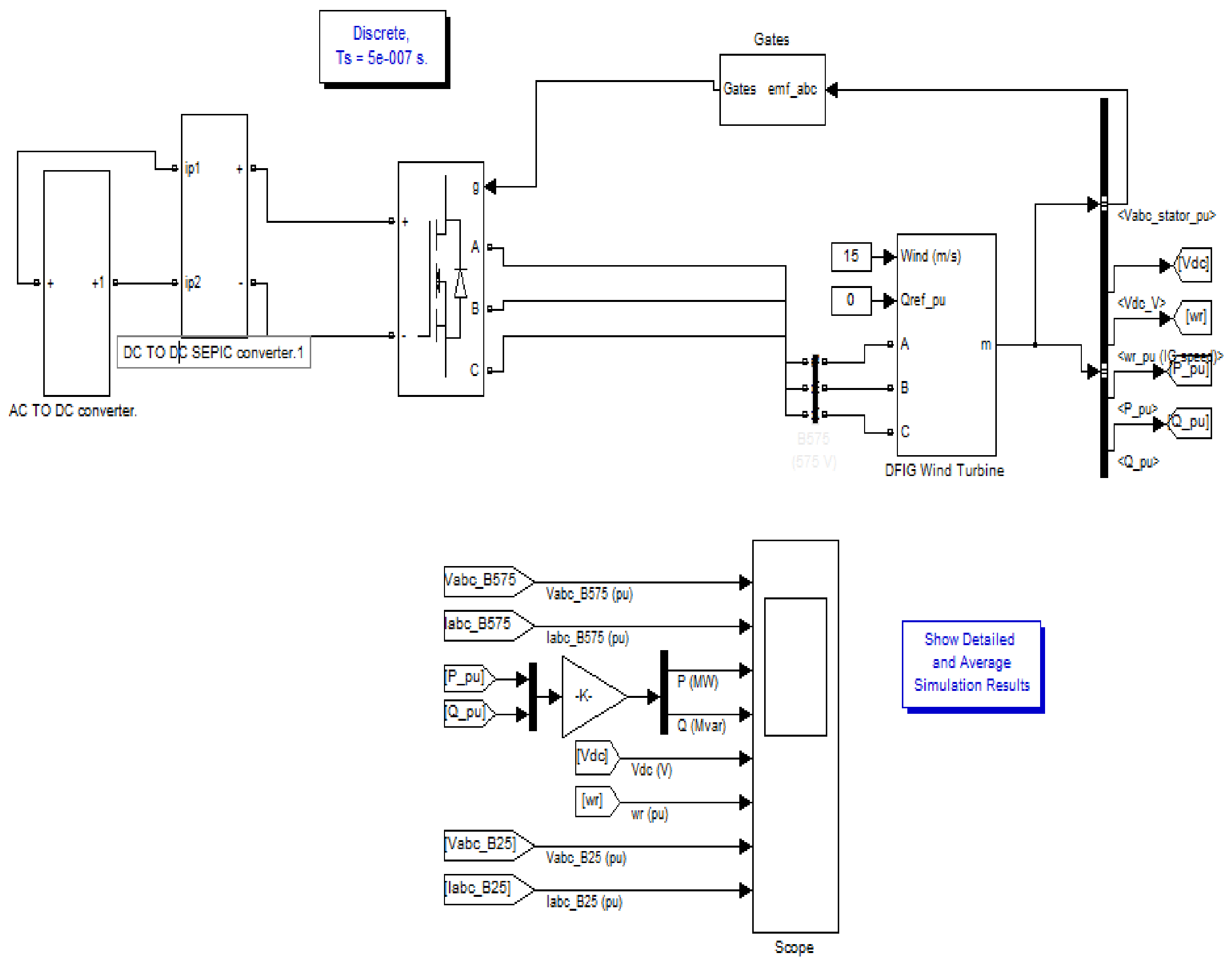

Fig 7: Simulink Model for DFIG

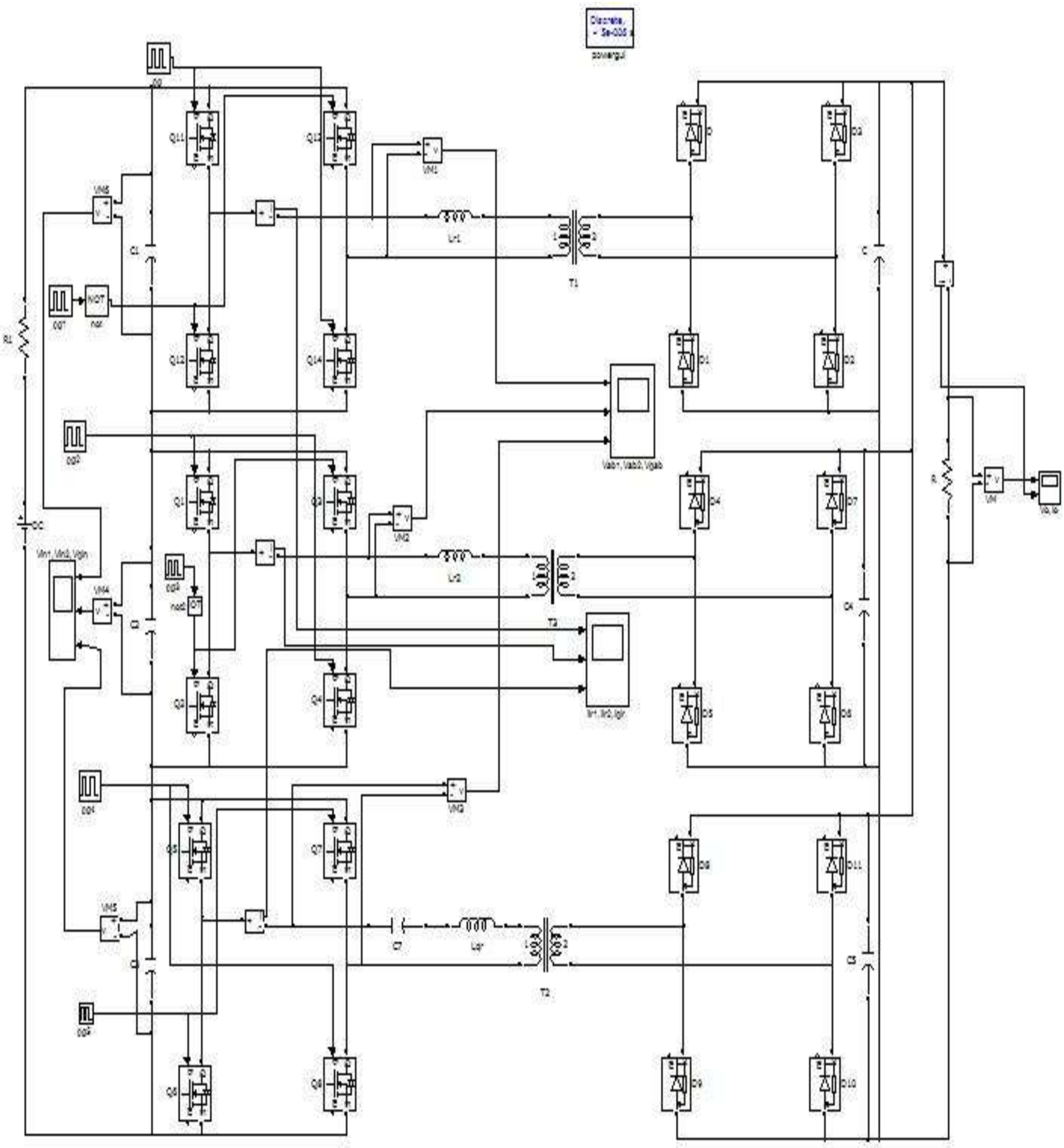

Fig 8: Simulink diagram for SEPIC as PFC Rectifier

SIMULATION RESULTS

SIMULATION RESULT FOR DFIG

Below displayed characteristics curve all are show performance for DFIG used in wind system by using SEPIC PFC rectifier as shown in figure5. All the results are characterized by the MATLAB Simulink. And also this diagram shows phase voltage, phase current, output power, reactive power for DFIG wind generator.

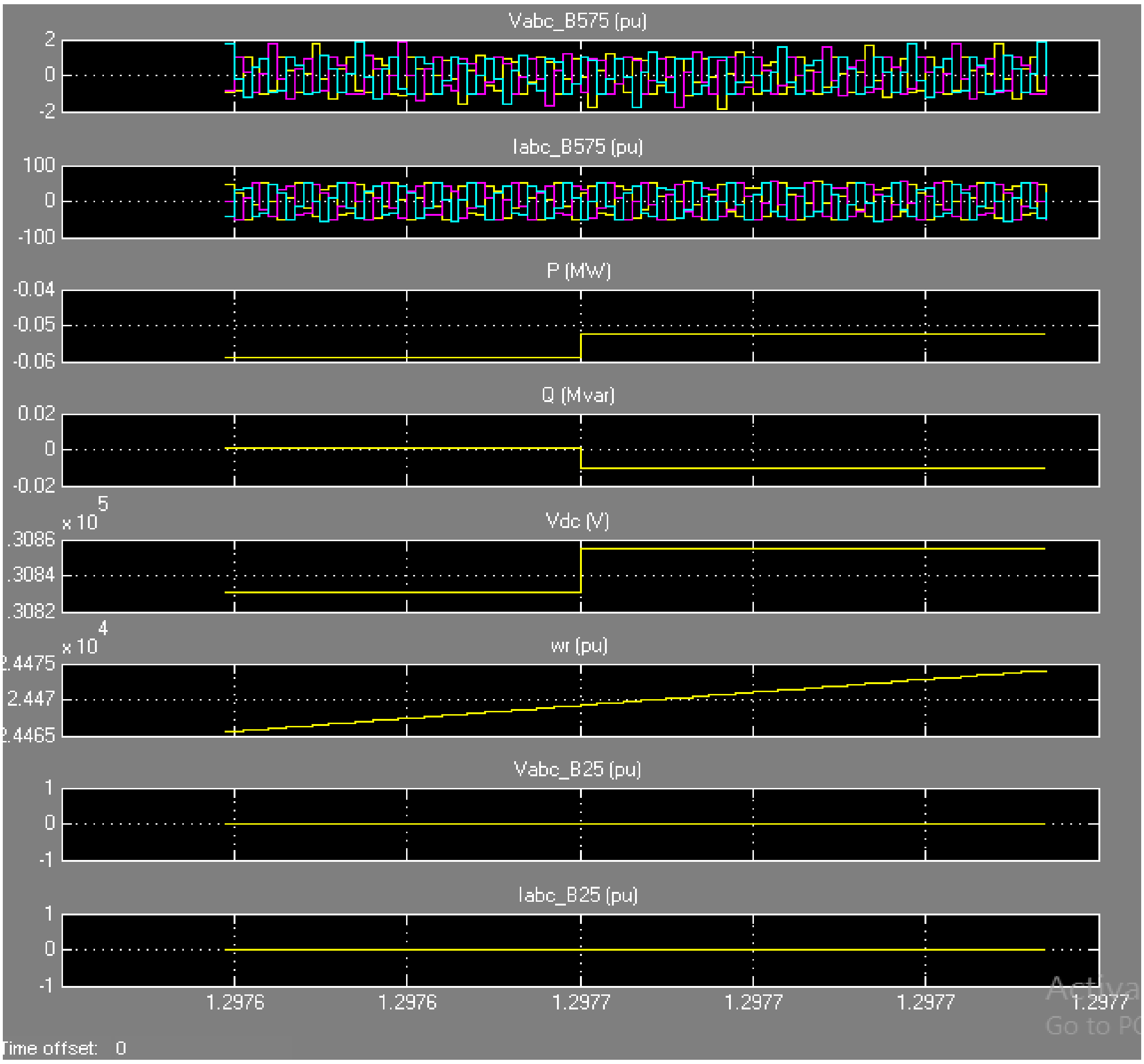

Fig 9: Simulation Output for DFIG

SIMULATION RESULT FOR BLDC

Thus characteristics curve all are performed by BLDC used in wind power system as shown in figure 6,7,8.This diagram consists of electromagnetic torque, rotor speed; voltage and current are examined by using BLDC machine. The Simulink model has the good results for settling time in the wind power system by using DFIG and BLDC machine for better efficiency, and also the simulation result is very quickly attained.

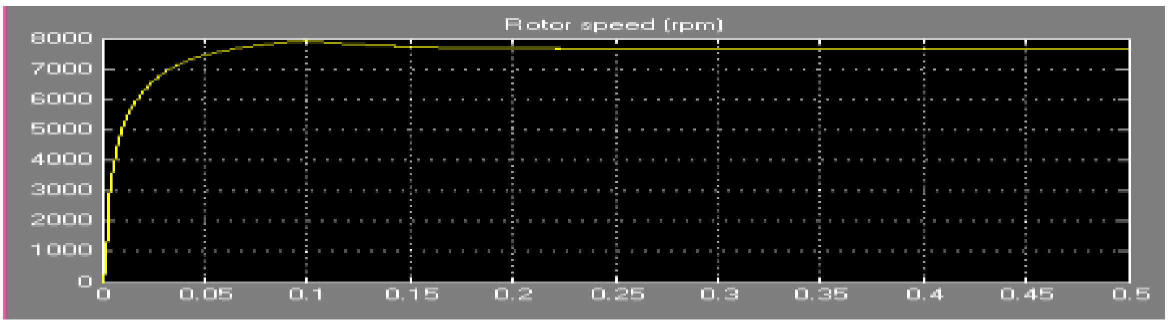

Fig 10: Rotor Speed for BLDC Machine

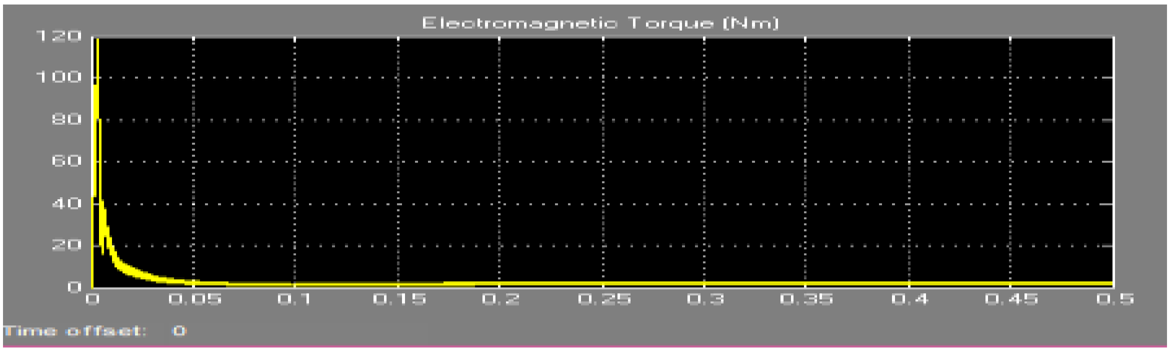

Fig 11: Electromagnetic Torque for BLDC

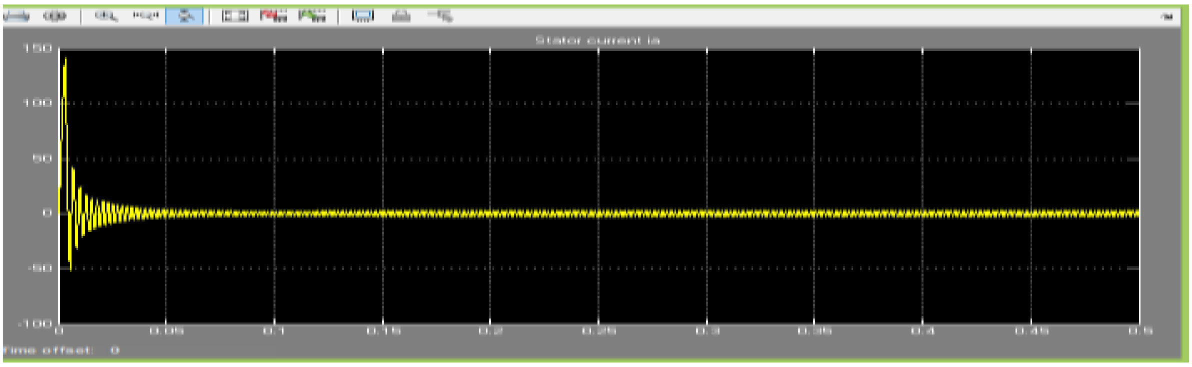

Fig 12: Stator Current for BLDC Machine

6.CONCLUSION

The performance of a SEPIC (Single Ended Primary Inductor Converter) derived PFC (Power Factor Correction) rectifier used as a front-end of an AC/DC/AC converter is an efficient manner. The SEPIC converter is used to improve the power factor and also reducing the harmonic content in a single phase to three conversion process

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