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Harmonics Mitigation And Power Factor Correction In Bldc Motor Using Dc-Dc Converter

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Abstract: The Technique to improve the power Factor and harmonics reduction of Brushless DC motor by Power Factor Improvement converter serve an crucial role in the energy conservation, saving and quality improvisation during power transformation. In BLDC motor the AC-DC transition of electrical power is generally required, while this conversion from AC main to DC power. In this Paper DC- DC converter such as Boost converter used as a single stage power factor improvement converter for a BLDC motor fed through a front end uncontrolled rectifier from a single-phase AC mains. The DC-DC converter, here Boost converter shows conformation to power quality international standards with improved performance of BLDC Motor.

Index Terms - Brushless DC motor, Boost Converter, Voltage Source Inverter, PFC

I. INTRODUCTION

Brushless Direct current Motors are one of the best motor types rapidly gaining popularity. BLDC motor are used in various applications such as appliance, aeronautical engineering, consumer electronics, Medical Science, Electrical and electronics automation instrumentation, automotive, equipment and instrumentality. [4]. Brushes are not used in BLDC motor for commutation. BLDC motors are electrically commutated motor. There are Many Advantages of BLDC Motor Compared to Brushed DC Motor and Induction Motor [4].

Better operating life
Reduced noise
Speed Torque Characteristics
Good dynamic response
Better efficiency
Better Speed range
High Reliability
Reduced Maintenance cost

- They can compete on Cost alone Due to Three Major Factor [5]:
  Advances in Magnet Technology
  Improvement in Motor Control Electronics
  Capital investment By BLDC Manufacturers

As a result, brushless DC motors are utilized in a different range of cost sensitive Practical application. BLDC Motors are mentioned as Inside-Out Permanent Motors Because Their Speed-Torque Curves are very similar to the PM Motors. However, BLDC Motors have their Magnets on the Rotating Part of the Motor instead of on Stationary part and Winding on Stationary part. Working operation of a BLDC Motor is related except that the Winding Phases are Switched On and Off Electronically by Means of Control Device. Benefits of Lower Rotor inertia and more efficient Heat Dissipation than DC Brush type Construction. Due to the Assemblage of an Inner Permanent Magnet rotor and Outer Winding offers [4].

Operation of BLDC motor with hall sensor :

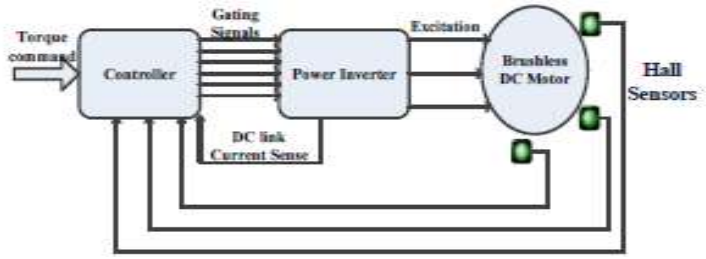


Figure 1: Hall Sensor

The Hall sensors need a power supply. The Voltage May Range from 4Volt to 24Volt. And Current required is 5mAmp to 15mAmp [3].

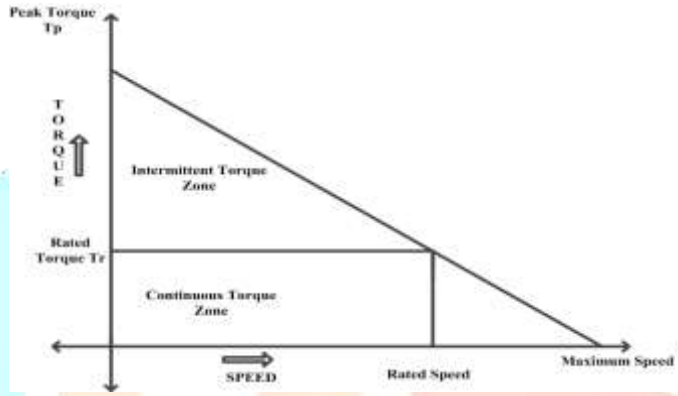


Figure 2: Torque/Speed Characteristics

When Speed Ranges up to the rated Speed then The Torque Remains Constant. The Motor Run Up to The Maximum Speed, Which Can is Up to 150% of Rated Speed but at that Time Torque Starts reducing [3].

Identification of problem :

A permanent magnet BLDC motor has the developed torque which is directly proportional to motors current and motors back-emf which is produced in motor is proportional to the speed of BLDC motor. Therefore, a constant current in BLDC motor stator windings with variable voltage across its terminals remain constant torque in a permanent magnet BLDC motor under variable speed condition.

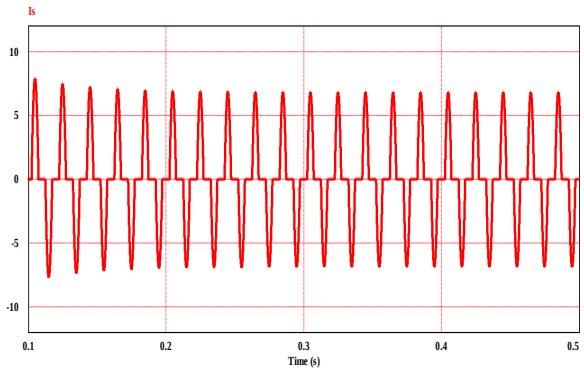


Figure 3 : Current waveform at AC mains without PFC

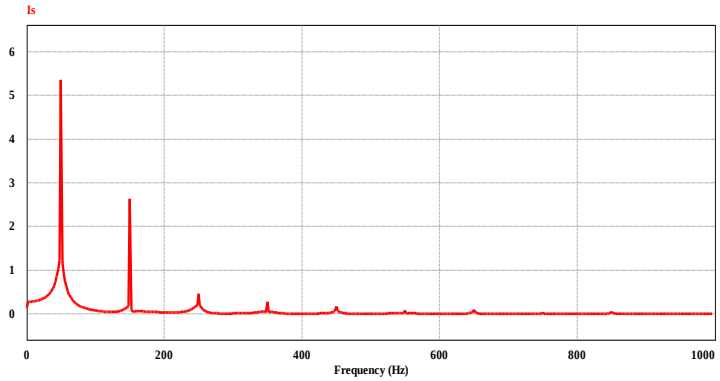


Figure 4 : BLDCM drive Harmonic Spectra without PFC

Table 1: Problem Identification Data

Supply Voltage(Vs)	230V
Supply Current(Is)	3.74A
Fundamental frequency	50Hz
(%)THD of Is	62.53%
Power Factor	0.77

Solution using boost converter:

Simulation is carried out in PSIM simulator. In which the DC link voltage of inverter is controlled by PWM as shown in figure no 5. In which the reference single is compare with actual signal and this output is given to MOSFET (switch of boost converter) In case of inverter control. It is done by PI controller. In which inverter is controlled by proportional gain block shown in Figure 5.

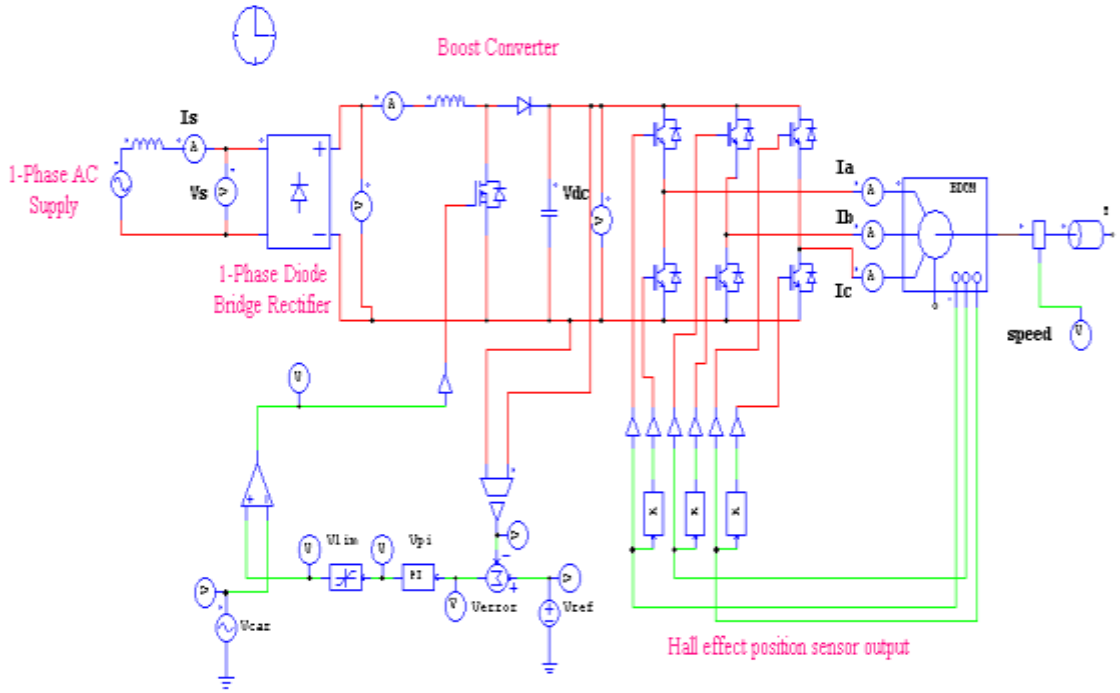
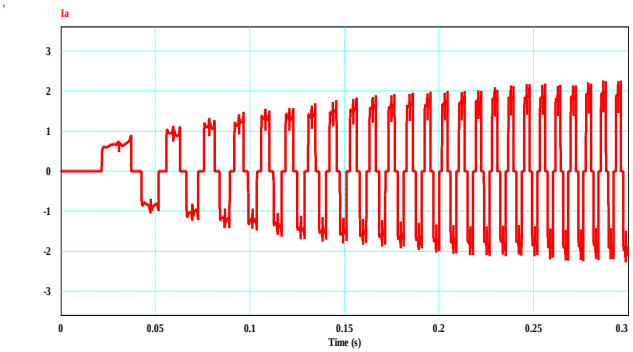


Figure 5 : Simulation of Boost Converter fed VSI Based BLDC Motor



Phase Current Waveform

Figure 5 (a): Current Waveform of Phase a (IA)

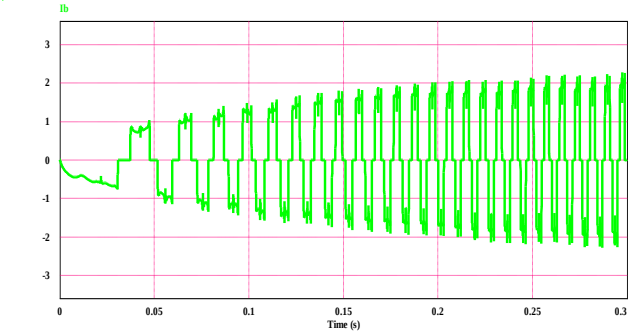


Figure 5 (b): Current Waveform of Phase B (I)

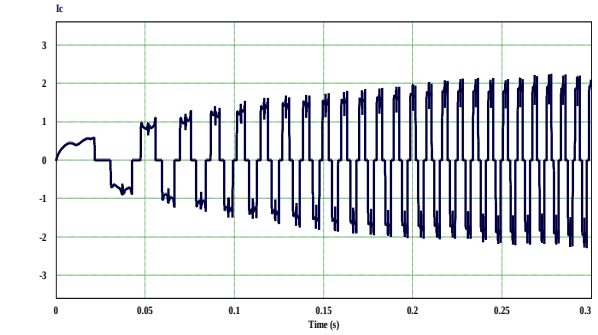


Figure 5 (c): Current Waveform of Phase(IC)

- **FFT Analysis of Supply Current**

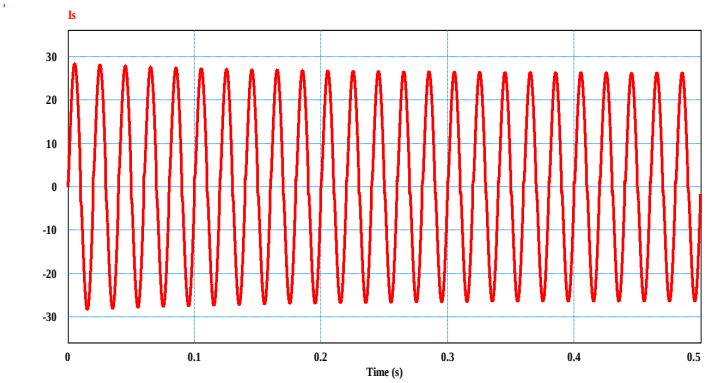


Figure 5 (d): Supply Current

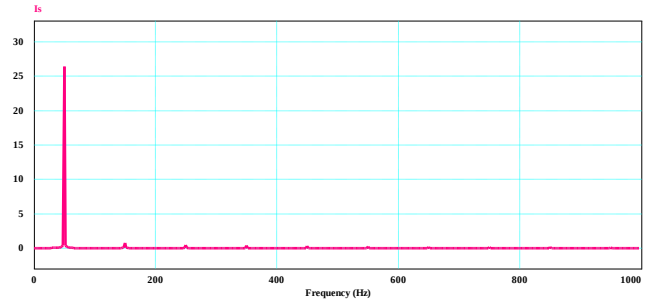


Figure 5 (e): FFT Analysis of Supply Current

- Supply Current and Voltage Waveform.

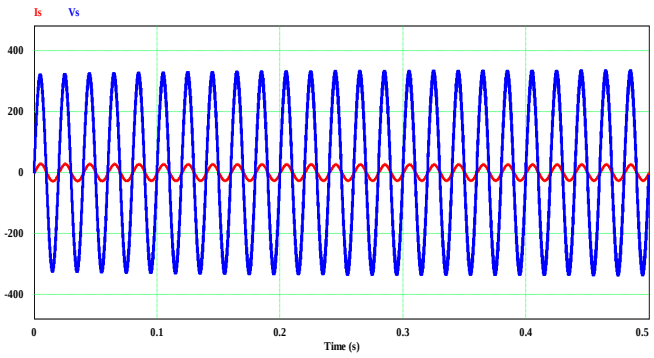


Figure 5 (f): Supply Voltage and Current Waveform

Figure 5 (f) shows the relation between voltage and current. From the simulation result it is clear that power factor is near to unity (0.99).

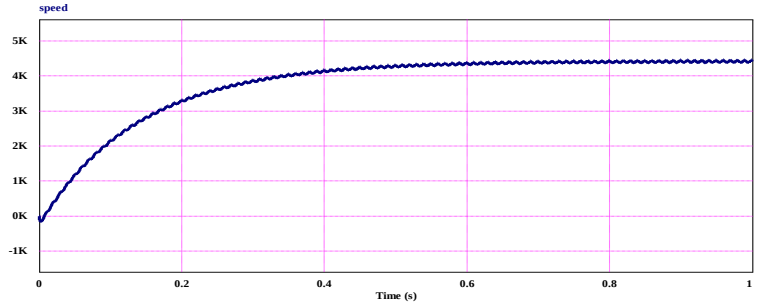


Figure 5 (g): Speed Waveform of BLDC Motor

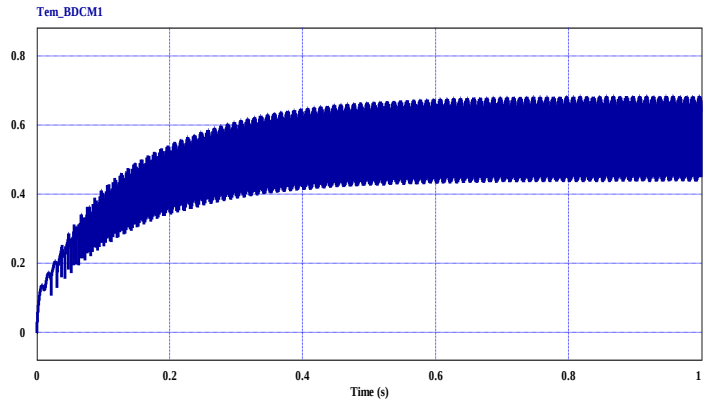


Figure 5 (h): Torque Waveform of BLDC Motor

Table 2: Result Data

Supply Voltage(Vs)	230V
Supply Current(Is)	18.38A
Fundamental Frequency	50Hz
THD of Supply Current	**4.77%**
Power Factor	**0.99**

Conclusion :

In this paper, the DC-DC Converters like Boost Converter for BLDC motor is observed. The DC-DC converter for power quality improvement in Brushless DC Motor drives are design and their performance is simulated in PSIM. The speed of Brushless DC motor has been a directly proportionate to the DC link output voltages there for a linear speed control is achieved during controlling the DC link output voltage. The result of practical confirmed that THD in AC supply source current is minimized and power Factor is improved near unity with the help of DC - DC Boost Converter as per International power quality standards.

Appendix :

Power rating = 1500 Watt, Voltage rating = 300 Volt, Current rating = 5 Amp, No. of Poles-4, Stator Resistance(R) =11.9Ohms, Stator Self Inductance (L) = 0.00207H, Vpk / krpm = 32.38, Vrms / krpm = 22.9.

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