VIVA-Tech International Journal for Research and Innovation
ISSN(Online): 2581-7280

Volume 1, Issue 4 (2021)
Article No. X
PP XX-XX

VIVA Institute of Technology
9th National Conference on Role of Engineers in Nation Building – 2021 (NCRENB-2021)

VIVA-TECH IJRI
ANNUAL RESEARCH JOURNAL

VIVA-TECH INTERNATIONAL JOURNAL FOR RESEARCH AND INNOVATION
ANNUAL RESEARCH JOURNAL
ISSN(ONLINE): 2581-7280

IMPROVING POWER FACTORS BY USING LANDSMAN CONVERTER IN PMBLDC MOTOR

Shubham Agre, Prashant Khade, Vaibhav kirange
Prof. Pratik Mahale
(Electrical Department, VIVA Institute of Technology,VIRAR,401305)

Abstract : *Brushless DC in most commonly used motors in small scale applications like exhaust fans, Toys etc. The motor is supply by Voltage Source Inverter (VSI) with a dc-dc converter power factor correction circuit (PFC). Performance of dc-dc converters is analyzed and the results are discussed, third converter is best suited converter. By unity power factor the low-cost arrangement are provided. PID Logic Controller is utilized as the Controller for the BLDC motor. The Landsman Converter performs power factor correction and DC voltage control both are in a single controller. PFC converter improve the power quality in AC mains in wide range of speed and input AC voltage. In the PMBLDC Motor the electronic commutator of motor the Voltage Source Inverter is used.*

Keywords – Diode bridge rectifier (DBR), *Discontinuous conduction mode (DCM), Landsman converter, Metal oxide semiconductor field effect transistor (MOSFET), PIC Microcontroller, Power factor correction (PFC), Regulated power supply (RPS) .*

I. INTRODUCTION

This paper is giving the information to improve the Power Factor of PMBLDC Motor. Mainly in ventilating systems to achieve the below, which is difficult in conventional system. Achieve the steady and smooth speed control to maintain the constant Room temperature. Minimize the Harmonics in power system due to the continuous switching millions of ventilating system and main higher efficiency. The ventilating system is energy conserving application which normally uses single phase induction motors for driving of compressor and fans. The efficiency is between 70-80%.

The PMBLDC motor have high efficiency for the compressor application. In the actual system permanent magnet brushless DC motor is replacing single phase induction motor used in air conditioners for driving compressor and fan for its low power utilization. BLDC motor is connected to the Single-phase AC supply through Diode Bridge Rectifiers (DBR) and Smoothing Filters of DC link Capacitor. In this process having various power quality (PQ) disturbances such as poor power factor (PF), increased total harmonic distortion (THD) harmonics which reduces the power quality and causes unwanted electromagnetic interference. High torque ripple is one of drawbacks of BLDC motor.

II. Literature Survey

Shanmugasundram, R., K. Muhammad Zakariah, and N. Yadaiah. "Implementation and performance analysis of digital controllers for brushless DC motor drives." IEEE/ASME transactions on mechatronics 19, no. 1 (2020): 213-224.

This paper presents design and digital implementation of a fuzzy controller for achieving improved performance of Brushless dc (BLDC) servomotor drive. The performance of fuzzy and PID controller-based BLDC servomotor drives is investigated under different operating conditions such as change in reference speed, parameter variations, load disturbance, etc. BLDC servomotors are used in aerospace, instrumentation systems, space vehicles, electric vehicles, robotics, and industrial control applications. In such applications, conventional controllers like P, PI, and PID are being used with the BLDC servomotor drive control systems to achieve satisfactory transient and steady state responses. However, the major problem associated with the conventional PID controller is that the tuned gain parameters obtained for such BLDC servomotor drive control systems do not yield better transient and steady-state responses under different operating conditions such as parameter variations, load disturbances, etc. In this paper, design and implementation of fuzzy controller is presented and its performance is compared with PID controller to show its apability to track the error and usefulness of fuzzy controller in control applications.

Singh, Sanjeev, and Bhim Singh. "A voltage-controlled PFC Cuk converter-based PMBLDCM drive for air- conditioners." IEEE transactions on industry applications 48, no. 2 (2019): 832-838. This paper deals with a CUK dc-dc converter as a single-stage power-factor-correction converter for a permanent-magnet (PM) brushless dc motor (PMBLDCM) fed through a diode bridge rectifier from a single-phase ac mains. A three-phase voltage-source inverter is used as an electronic COMMUTATOR to operate the PMBLDCM driving an air- conditioner compressor. The speed of the compressor is controlled to achieve optimum air-conditioning using a concept of the voltage control at dc link proportional to the desired speed of the PMBLDCM. The stator currents of the PMBLDCM during step change in the reference speed are controlled within the specified limits by an addition of a rate limiter in the reference dc link voltage. The proposed PMBLDCM drive (PMBLDCMD) is designed and modeled, and its performance is evaluated in MATLAB-SIMULINK environment. Simulated results are presented to *demonstrate an improved power quality at ac mains of the PMBLDCMD system in a wide range of speed and input ac voltage. Test results of a developed controller are also presented to validate the design and model of the drive.*

Bist, Vashist, and Bhim Singh. "PFC Cuk converter-fed BLDC motor drive." IEEE transactions on Power Electronics 30, no. 2 (2019): 871-887

This paper deals with a power factor correction (PFC)-based CUK converter-fed brushless dc motor (BLDC) drive as a cost-effective solution for low-power applications. The speed of the BLDC motor is controlled by varying the dc-bus voltage of a voltage source inverter (VSI) which uses a low frequency switching of VSI (electronic commutation of the BLDC motor) for low switching losses. A diode bridge rectifier followed by a CUK converter working in a discontinuous conduction mode (DCM) is used for control of dc-link voltage with unity power factor at ac mains. Performance of the PFC CUK converter is evaluated under four different operating conditions of discontinuous and continuous conduction modes (CCM) and a comparison is made to select a best suited mode of operation. The performance of the proposed system is simulated in a MATLAB/SIMULINK environment and a hardware prototype of the proposed drive is developed to validate its performance over a wide range of speed with unity power factor at ac mains.

Wang, Haoyu, Yichao Tang, and Alireza Khaligh. "A bridgeless boost rectifier for low-voltage energy harvesting applications." IEEE transactions on power electronics 28, no. 11 (2018): 5206-5214.*In this paper, a* single-stage ac–dc power electronic converter is proposed to efficiently manage the energy harvested from electromagnetic micro scale and meso scale generators with low-voltage outputs. The proposed topology combines a boost converter and a buck-boost converter to condition the positive and negative half portions of the input ac voltage, respectively. Only one inductor and capacitor are used in both circuitries to reduce the size of the converter. A 2 cm × 2 cm, 3.34-g prototype has been designed and tested at 50-kHz switching frequency, which demonstrate 71% efficiency at 54.5 mW. The input ac voltage with 0.4-V amplitude is rectified and stepped up to 3.3-V dc. Detailed design guidelines are provided with the purpose of minimizing the size, weight, and power losses. The theoretical analyses are validated by the experiment results.

III. METHODOLOGY

The following is the design methodology for the project Induction motor protection using PLC.

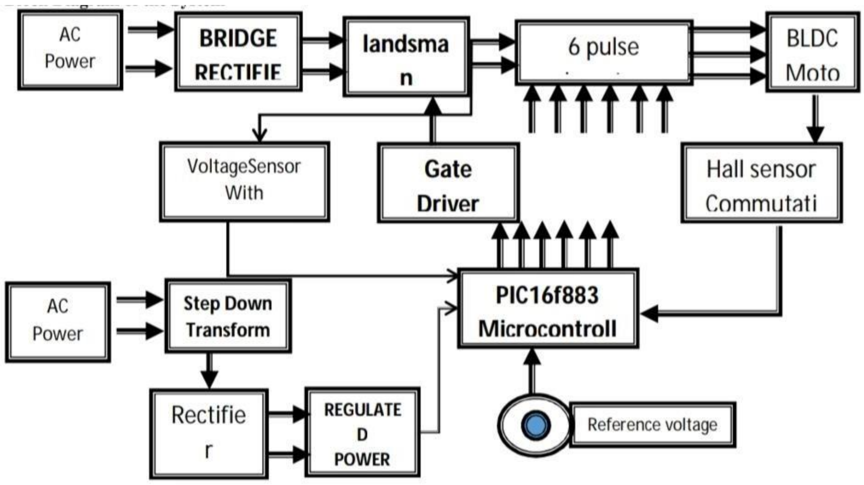


Fig.no.8.1. Block Diagram of the System

1. Block Diagram

The block diagram set-up is shown. The experimental set-up consists of four components. MOSFET power inverter, BLDC Motor, RF Transmitter and Receiver units. The hall sensors are used to generate three signals according to the rotor positions. Here the Single-Phase AC source is used as an input. Further it will be passed to the controlled rectifier where it will be converted AC supply to DC supply. The filter is provided is used to remove the harmonics in the rectified DC source. Then it will be passed through the single phase to three phase inverters. It converted uncontrolled DC to pulsated or controlled DC.

The controlled DC current is used to run the BLDC motor. The rotor position is sense by the Hall Effect sensor and this signal is amplified. The set speed is transmitted by the RF transmitter and at the receiving end, the receiver receives this analog value on a single data line and transmitted this data to the decoder. It will convert the single bit data to the eight-bit data. After this data gives to the microcontroller further processing. Here the controller compares the reference set speed and the actual speed and it varies according to it and determines the error speed and generates the control signal which sends them to the MOSFET inverter circuits. These signals are applied to the windings which is used to operate the switching operation in the power inverter. Then the speed of the BLDC motor is controlled by using the microcontroller.

2.Mathematical Modeling

The duty ratio (D) for buck-boost configuration is same for Landsman converter and expressed as

$$D = \frac{V_{dc}}{v_{in} + V_{dc}} = \frac{V_{dc}}{\left|V_m Sin\left(\omega t\right)\right| + V_{dc}}$$

The inductor's critical value (Lic) is calculated as

$$L_{ic1,2} = \frac{R_{in} V_{dc} D}{2 v_{in} f_S} = \left(\frac{V_S^2}{P_i}\right) \frac{V_{dc}}{2 v_{in} f_S} \left(\frac{V_{dc}}{v_{in} + V_{dc}}\right)$$

The value for DC capacitor can be designed as

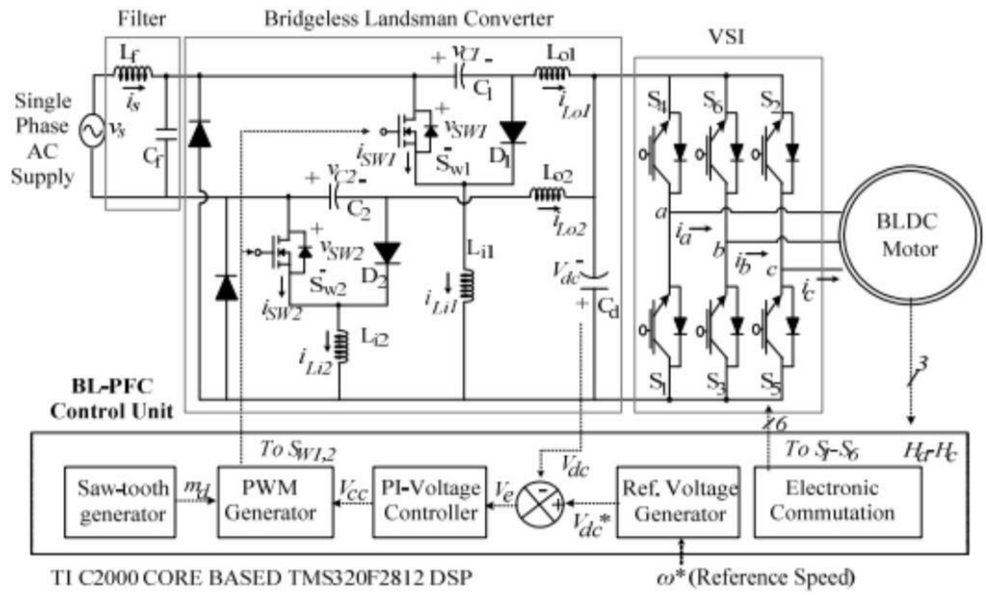
$$C_d = \frac{I_{dc}}{2\omega \Delta V_{dc}} = \frac{\left(P_i / V_{dc}\right)}{2\omega \Delta V_{dc}} = \frac{P_i}{2\omega \Delta V_{dc}^{2}}$$

The minimum DC voltage is a critical for the proposal of DC link capacitor and is given by

$$C_d = \frac{P_{min}}{2\omega \Delta V_{dcmin}^{2}}$$

Volume 1, Issue 4 (2021)
Article No. X
PP XX-XX

IV. FIGURES AND TABLES



CONCLUSION

The power factor correction is successfully executed by using the Landsman Converter. Due to improve the power factor this circuit not only provides better power quality, but also the converter removes the ripple form the smooth DC output. The PID controller increases application range of the motor by increasing the reliability. The motor is used in areas such as aerospace, aircraft and mining applications. The NFLC is used to control the motor speed and the Landsman Converter is used for the power factor improvement. Due to this the Landsman Converter is found to provide better power quality. The Analysis has been done for Continuous conduction in the Landsman Converter as both are not capable of self. A sample model is implemented in laboratory and detailed experimental studies are carried out. It is observed that the experimental results are consistent with the simulation results.

AC and motor operated on the 24V maximum in the BLDC motor. The voltage control is implemented for the simulation. And we calculate the power factor from active power and apparent power. In Hardware we use the input as 24V AC and 12V for motor operation is utilized. The voltage control will be implemented. The power factor is depending upon the input voltage and Current.

REFERENCES

[1] Baszynski, M., Pirog, S.: A novel speed measurement method for a high-speed BLDC motor based on the signals from the rotor position sensor, *IEEE Trans. Ind. Inf., 2019, 10, (1), pp. 8491*

[2] Chen, Y.T., Chiu, C.L., Jhang, Y.R., et al.: A driver for the single-phase brushless DC fan motor with hybrid winding structure, *IEEE Trans. Ind. Electron., 2019 60, (10), pp. 43694375*

[3] De, S., Rajne, M., Poosapati, S., et al.: Low-inductance axial flux BLDC motor drive for more electric aircraft, *IET Power Electron., 2018, 5, (1), pp. 124133*

[4] Emrani, A., Amini, M.R., Farzaneh-Fard, H.: Soft single switch resonant buck converters with inherent PFC feature, *IET Power Electron., 2019, 6, (3), pp. 516522*

[5] Gieras, J.F., Wing, M.: Permanent magnet motor technologydesign and application (Marcel Dekker Inc., New York, *2017*)

[6] Gopalarathnam, T., Toliyat, H.A.: A new topology for unipolar brushless DC motor drive with high power factor, *IEEE Trans. Power Electron., 2012, 18, (6), pp. 13971404 26 Bist, V., Singh, B.:*

[7] Ho, T.Y., Chen, M.S., Yang, L.H., et al.: The design of a high-power factor brushless DC motor drive. *2012 Int. Symp. Computer, Consumer and Control, 46 June 2012, pp. 345348*

[8] Huber, L., Zhang, J., Jovanovic, M.M., et al.: Generalized topologies of single-stage input-current-shaping circuits, *IEEE Trans. Power Electron., 2011, 6, pp. 508513*

[9] Hung, C.W., Lin, C.T., Liu, C.W., et al.: A variable-sampling controller for brushless DC motor drives with low- resolution position sensors, *IEEE Trans. Ind. Electron., 2011, 54, (5), pp. 28462852*

[10] Hwang, C.C., Li, P.L., Liu, C.T., et al.: Design and analysis of a brushless DC motor for applications in robotics, *IET Electr. Power Appl., 2018 6, (7), pp. 385389*