A Zeta Converter-Fed BLDC Motor Drive with Power Factor Correction

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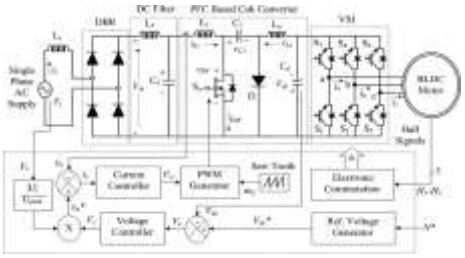
Abstract : A zeta converter is utilized in order to extract the maximum available power from the SPV array. The proposed control algorithm eliminates phase current sensors and adapts a fundamental frequency switching of the voltage source inverter (VSI), thus avoiding the power losses due to high frequency switching. No additional control or circuitry is used for speed control of the BLDC motor. The speed is controlled through a variable DC link voltage of VSI. An appropriate control of zeta converter through the incremental conductance maximum power point tracking (INC-MPPT) algorithm offers soft starting of the BLDC motor.

I. INTRODUCTION

A DC-DC converter is used for MPPT of a SPV array as usual. Two phase currents are sensed along with Hall signals feedback for control of BLDC motor, resulting in an increased cost. The additional control scheme causes increased cost and complexity, which is required to control the speed of BLDC motor. Moreover, usually a voltage source inverter (VSI) is operated with high frequency PWM pulses, resulting in an increased switching loss and hence the reduced efficiency. However, a Z-source inverter (ZSI) replaces DC-DC converter Contrary to it, ZSI also necessitates phase current and DC link voltage sensing resulting in the complex control and increased cost.

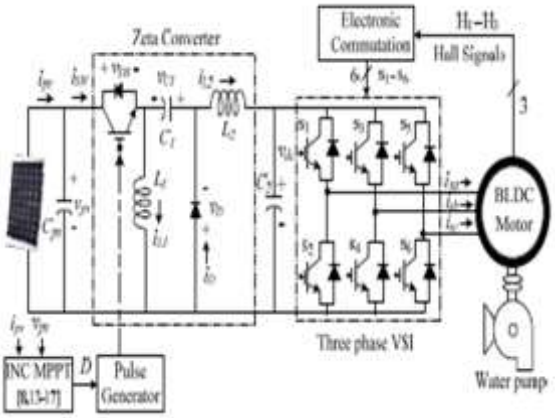
Existing circuit diagram



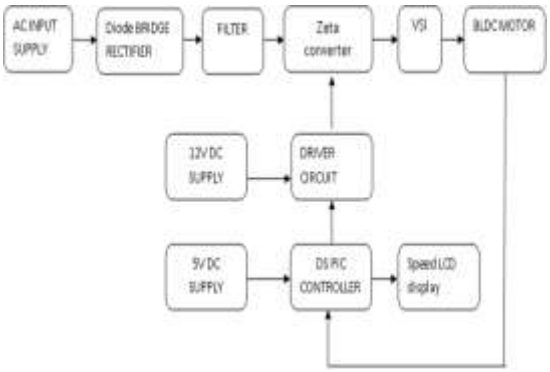
II. PROPOSED SYSTEM

A zeta converter is utilized in order to extract the maximum power available from a SPV array, soft starting and speed control of BLDC motor coupled to a water pump. Due to a single switch, this converter has very good efficiency and offers boundless region for MPPT. This converter is operated in continuous conduction mode resulting in a reduced stress on its power devices and components. Furthermore, the switching loss of VSI is reduced by adopting fundamental frequency switching resulting in an additional power saving and hence an enhanced efficiency. The speed of BLDC motor is controlled, without any additional control, through a variable DC link voltage of VSI. Moreover, a soft starting of BLDC motor is achieved by proper initialization of MPPT algorithm of SPV array.

Proposed circuit diagram



Block Diagram



PFC Cuk Converter-Fed BLDC Motor Drive

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.

An Adjustable-Speed PFC Bridgeless Buck–Boost Converter-Fed BLDC Motor Drive

This paper presents a power factor corrected (PFC) bridgeless (BL) buck–boost converter-fed brushless direct current (BLDC) motor drive as a cost-effective solution for low-power applications. An approach of speed control of the BLDC motor by controlling the dc link voltage of the voltage source inverter (VSI) is used with a single voltage sensor. This facilitates the operation of VSI at fundamental frequency switching by using the electronic commutation of the BLDC motor which offers reduced switching losses.

A PFC-Based BLDC Motor Drive Using a Canonical Switching Cell Converter

This paper presents a power factor correction (PFC)- based canonical switching cell (CSC) converter-fed brushless dc motor (BLDCM) drive for low-power household applications. The speed of BLDCM is controlled by varying the dc-bus voltage of voltage source inverter (VSI). The BLDCM is electronically commutated for reduced switching losses in VSI due to low-frequency switching.

An Improved Method to Control the Speed and Flux of PM-BLDC Motors

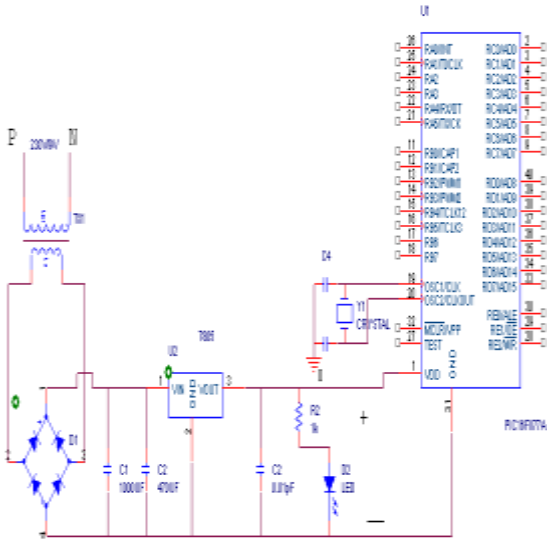
Permanent Magnet Brushless DC (PM-BLDC) motors have become quite widespread and are utilized to serve for a variety of industrial purposes, because of their simple structure, high reliability and ease of control. Space Vectors theory is one of the most widely used methods which is implemented for controlling PM-BLDC. Supposing that each space vector refers to a unique arrangement of switch states, this theory calculates speed (or torque) error and stator flux error, compared to reference parameters.

CONTROLLER-PIC

PIC stands for Peripheral Interfacing Controller

We are using PIC 16F877A for producing switching pulses to multilevel inverter. The PIC microcontroller are driven via the driver circuit so as to boost the voltage triggering signal to 9V.To avoid any damage to micro controller due to direct passing of 230V supply to it we provide an isolator in the form of optocoupler in the same driver

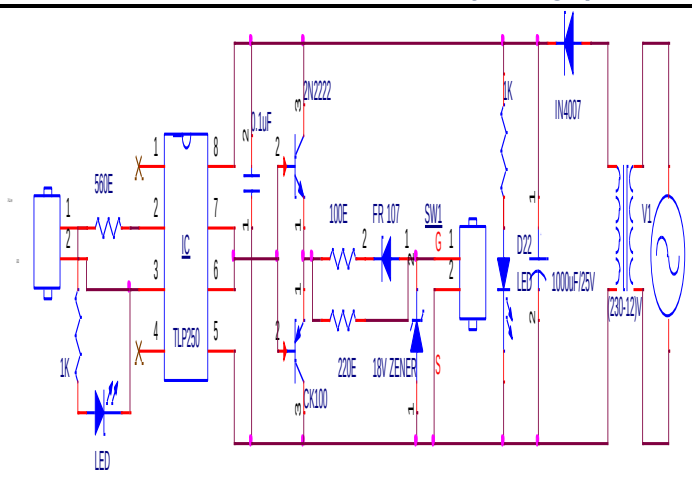
PIC CIRCUIT



BUFFER IC –CD4050

The CD4050BC hex buffers are monolithic complementary MOS (CMOS) integrated circuits constructed with N- and P-channel enhancement modetransistors. These devices feature logic level conversion using only one supply voltage (VDD). The input signal high level (VIH) can exceed the VDD supply voltage when these devices are used for logic level conversions. These devices are intended for use as hex buffers, CMOS to DTL/ TTL converters, or as CMOS current drivers, and at VDD = 5.0V, they can drive directly two DTL/TTL loads over the full operating temperature range.

DRIVER CIRCUIT



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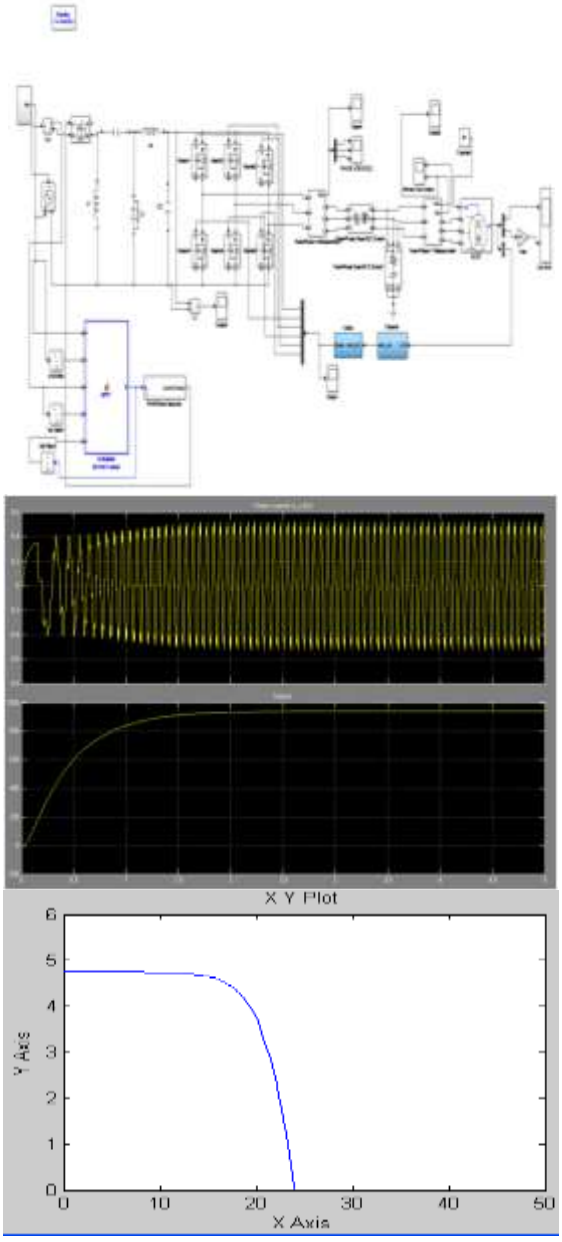
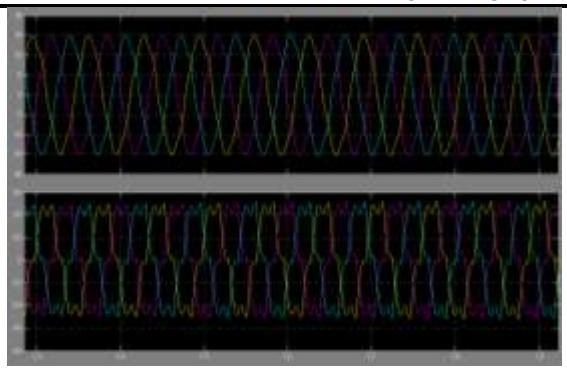
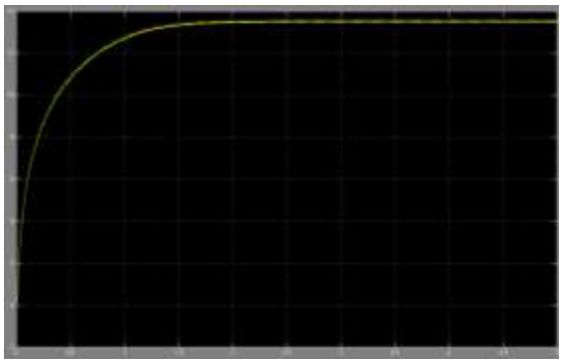
SIMULATIONRESULTS







III. CONCULSION

A cuk converter VSI-fed BLDC motordrive has been designed for achieving a unity PF at acmain for the development of the low-cost PFC motor for numeros low-power equipments such fan ,blowers,water pumps, etc.The speed of the BLDC motor drive has been controlled by varying the dc-link voltage of VSI ,which allows the VSI to operate in the fundamental frequency switching mode for reduced switching losses. For different mode of the ck converter operating in the CCM and DCM have been explored for the development of the BLDC motor drive with unity PF at ac mains. A detailed comparison of all mode of operation has been presented on the basis of feasibility in design and the cost constraint in the development of such drive for low-power application.

REFERENCES

[1] PFCcuk converter Fed BLDC motor drive.
[2] An improved method to control the speed and flux of PM-BLDC motor.
[3] An Adjustable-Speed PFC Bridgeless Buck–Boost Converter-Fed BLDC Motor Drive.
[4] A PFC-Based BLDC Motor Drive Using a Canonical Switching Cell Converter