A BL-CSC Converter Fed BLDC Motor Drive with Power Factor Correction

ABSTRACT:

This paper presents a power factor correction (PFC) based bridgeless-canonical switching cell (BL-CSC) converter fed brushless DC (BLDC) motor drive. The proposed BL-CSC converter operating in a discontinuous inductor current mode is used to achieve a unity power factor at the AC mains using a single voltage sensor. The speed of BLDC motor is controlled by varying the DC bus voltage of the voltage source inverter (VSI) feeding BLDC motor via a PFC converter. Therefore, the BLDC motor is electronically commutated such that the VSI operates in fundamental frequency switching for reduced switching losses. Moreover, the bridgeless configuration of CSC converter offers low conduction losses due to partial elimination of diode bridge rectifier at the front end. The proposed configuration shows a considerable increase in efficiency as compared to the conventional scheme. The performance of the proposed drive is validated through experimental results obtained on a developed prototype. Improved power quality is achieved at the AC mains for a wide range of control speeds and supply voltages. The obtained power quality indices are within the acceptable limits of IEC 61000-3-2.

KEYWORDS:

1. BLDC Motor
2. BL-CSC Converter
3. DICM
4. PFC
5. Power Quality

SOFTWARE: MATLAB/SIMULINK

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CIRCUIT DIAGRAM:

Fig. 1. Proposed BL-CSC converter fed BLDC motor drive

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EXPECTED SIMULATION RESULTS:

![Diagram](image-url)

Fig. 2. Performance of the proposed drive at rated condition with supply voltage as 220V and DC link voltage as (a) 310V and (b) 70V.

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Fig. 3. Waveforms of (a) inductor’s currents and (b) intermediate capacitor voltage with supply voltage at rated load on BLDC motor with DC link voltage as 310V and supply voltage as 220V.

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Fig. 4. Stress on PFC converter switches and its enlarged waveforms during its operation at rated conditions.
Fig. 5: Recorded dynamic performance of the proposed drive at rated load on BLDC motor during (a) starting at $V_{dc}=50V$, (b) speed control during change in DC link voltage from 100V to 170V and (c) sudden change in supply voltage from 250V to 180V.

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CONCLUSION:

A PFC based BL-CSC converter fed BLDC motor drive has been proposed with improved power quality at the AC mains. A bridgeless configuration of a CSC converter has been used for achieving reduced conduction losses in PFC converter. The speed control of BLDC motor and power factor correction at AC mains has been achieved using a single voltage sensor. The switching losses in the VSI have been reduced by the use of fundamental frequency switching by electronically commutating the BLDC motor. Moreover, the speed of BLDC motor has been controlled by controlling the DC link voltage of the VSI. The proposed drive has shown an improved power quality at the AC mains for a wide range of speed control and supply voltages. The obtained power quality indices have been found within the acceptable limits of IEC 61000-3-2. A satisfactory performance of the proposed drive has been obtained and it is a recommended solution for low power applications.

REFERENCES: