Abstract
This paper observes a new technique drive for speed control of BLDC motor. In this mode, it has both voltage and current, observes the line voltage waveform to a certain period. With this we can achieve the deduction in harmonics with lower order, along with this there may be improvement of cosine angle of voltage and current and is not having both voltage and current sensing devices. Front-end SEPIC and a switch in series with each phase is proposed for driving a permanent magnet brushless dc (BLDC) motor with unipolar currents. The supply voltage can be obtained for better current regulation, which is an advantage of having lower voltage applications. The SEPIC converter is designed to operate in the irregular conduction mode for an ac supply. The present topology is simulated and verified by using MATLAB/SIMULINK.

INTRODUCTION
In this we are using BLDC motors, have gained with popular range. These motors are used in various types such as appliances, automotive, aerospace, consumer, medical, industrial areas. From the name itself these motors are not use brush for commutation, but they have commutated electronically [1-3]. As compared to BLDC motors and induction motors, BLDC motors have better speed and high dynamic response, high efficiency, noiseless operation, high speed range. The main technique is cost minimization which is the only one for manufacturing and application of BLDC motors in variable speed drives. BLDC motors having conventionally excited nature having bipolar current which obtained a six-switch inverter, but unipolar motor needs fewer electronic parts and use a simpler circuit. The simplest unipolar drive consisting of single switch in series or dump resistor is given in Fig.1. This drive is not efficient because the energy is dissipated which is presented in the phases [4-5]. The performance of the c-dump converter is given in Fig. 2, which offers regenerative control mode. A buck converter dependent on BLDC motor drive was proposed. Both these topologies obtained a greater voltage than what is applied to the motor phases during turn-on condition. While this is the existence for the SRM motor to obtain a fast turn-off of the currents to avoid negative torque spikes, it is not so for the BLDC motor. In fact, by allowing the currents having period-shaving torque reflections can be deduced. It has the lower voltage on the dump capacitor. A threewhich converter having the unipolar nature having ac supply operation. But it wants the changes in the windings and a split-capacitor voltage balancing controlscheme.

![Fig.1.Simpleunipolarconverter](image1.png)

![Fig.2.C-dumpconverter](image2.png)

BLDC motors have many advantages, having dc brushes on induction motors. A few of these are:

- Good speed having torque characteristics
- Dynamic response with high nature
- Good efficiency
- Life period is long
- Operation without noise
- Higher speed ranges

The triggering angle for each phase is 120° by electrical angle. Each operating period is called one step. Therefore, they are having two phases to conduct current [6, 7]. In order to obtain torque the inverter should be triggered per 60° so that production of current is related with Back EMF. The triggering timing is required having rotor position which can be required by hall sensors or estimation from motor i.e., the BackEMF on the coil of the motor if it is sensor less system.

**PROPOSED CONTROL STRATEGY**

The planned converter with four controlled switches and diodes is given in Fig. 4. The front-end consists of a SEPIC comprising L1 and L2; switch S1 and the capacitors C1,C2. The diode D1 is placed in the reverse path having the positive direction because to deduce the flow of current during the interval of negative Back-EMF. Since there is only oneswitch per phase, the currents are unidirectional. The diodes DA, DB, and DC serve to free wheel the winding currents when the switches are turned off during current regulation and phase commutation. The output of the converter is used to energize the phases of motor, and the voltage of capacitor C1 is used to demagnetize the phases during turn-off and for current control. Each phase is energized by turning on the corresponding switch in series with it.

This applies a voltage of \( -V_{C1} \) across the machine winding, enabling a fast decay of the phase current. For proper magnetizing of the phase having conduction interval and to prevent conduction during periods of negative Back-EMF, the instantaneous value of \( V_{C1} \) should be higher than the peak value of the Back-EMF \( E \), or

\[
V_{C1} > E \quad (1)
\]

By applying mesh loop,

\[
V_{in} = V_{L1} + V_{C1} + V_{L2} \quad (2)
\]

Since the average voltages in the inductor is zero, and as when diode is in conduction we get

\[
V_{in} = V_{C1}
\]

![Fig.3. Basic BLDC motor control system with position sensors](image)

![Fig.4. Schematic of SEPIC](image)

![Fig.5. Equivalent circuits of each machine phase when (a) switch is on and (b) when the diode is conducting](image)
From (1) and (2), we observe the highest back-emf at highest speed of the motor, which is given by

$$E_{\text{max}} = V_{\text{in}}$$

Observing the pulsations in the intermediate capacitor voltage is negligible. The maximum operating speed is then given by $W_{\text{max}} = V_{\text{in}}/K_e$ where $K_e$ is the phase Back-EMF constant of the motor. If the motor is induced and generated at this maximum speed it gives torque repulsions on it. The minimum voltage $V_{\text{dc}}$ required is

$$V_{\text{dc}} = E + I R_s + L_s (dI/dt)$$

where series resistance and series inductance are the phase resistance and inductance, and $I_s$ phase current. The switching frequency and hence it has losses at the range of lower speeds can be minimized by bucking the induced voltage having input to lower levels at the output. At higher speeds, the current regulation having power losses especially during turn on. The ability of the converter to boost the required input voltage having current-regulated operation of the drive at larger speeds. This feature makes particularly available for less voltage dc applications such as automotive circuits.

The converter having front-end can be available for operation either in the regular triggering mode (CCM) or in the irregular conduction mode (DCM). In CCM the voltage conversion ratio is given by

$$m = \frac{V_{\text{dc}}}{V_{\text{in}}} = D/(1-D)$$

where D is the duty cycle of $S_1$. In DCM, its voltage conversion ratio is given by

$$m_d = \frac{V_{\text{dc}}}{V_{\text{in}}} = D/\sqrt{K}$$

Where $K=2L_1L_2/RT(L_1+L_2), R$ is the equivalent load resistance and $T$ is the time period of switch $S_1$. The limits of $K$ between CCM and DCM, $K_{\text{crit}}$ can be calculated ($m=m_d$) as

$$K_{\text{crit}} = (1-D)^2$$

The SEPIC operates in CCM when $K>K_{\text{crit}}$ and in DCM when $K<K_{\text{crit}}$. In both CCM and DCM operation, $V_{\text{dc}}$ can be regulated at a value bigger or lower than the input voltage $V_{\text{in}}$. For the controls viewpoint, it is advantageous to be the SEPIC operating in the same mode below all load conditions.

By the operation of the SEPIC front-end in DCM the following desirable characteristics are obtained. The converter behaves like voltage follower, that means the supply current follows the supply voltage and the theoretical cosine angle of voltage and current is unity.

**BLOCK DIAGRAM OF THE DRIVE SYSTEM**

The figure of the drive system implementation is given in Fig.7. AC supply is rectified using diode bridge and changed to DC supply. This DC power is regulated using SEPIC. This DC-DC converter is applied to minimize the harmonics in the input current. Then the DC power is supplied to BLDC motor through unipolar inverter. The rotor position is detected by hall sensors, and the position information is used to determine the phase winding to be excited. The speed of the motor is derived from the position inputs and is compared with the speed reference to create the current references. Hysteresis control is used to observe the phase currents to the reference current. The dc bus voltage is regulated by PWM of the switch $S_1$. The motor shaft is coupled to a hysteresis brake acting as a load.
MATLAB BASED MODEL:
The simulation block diagram for unipolar motor load for present topology is given in fig.8.

RESULTS AND DISCUSSION
A PI controller is used to compare the reference and actual speed and generates the current reference. The Back EMF having the reversed direction of the energized voltage. Back electromotive force having three factors:
• Rotor having angular velocity
• Rotor magnets have been generated by magnetic field
• Stator windings having number of turns
The operation of the present topology has been verified by simulation.

SIMULATION RESULTS

Fig.9. Waveform for Input Voltage

Fig.10. Waveform for Input Current

Fig.11. Waveform for Speed

Fig.12. Waveform for Stator back EMF

Fig.13. Waveform for Stator Current ia

Fig.14. Waveform for Torque without using filter

Fig.15. Waveform for Torque using filter
CONCLUSION
It is based on a SEPIC operating in DCM has been proposed for unipolar excitation of BLDC motors. The planned scheme has the following advantages.
1. The planned converter uses only four controlled switches, all of which are referenced to ground. This considerably simplifies their gate drive circuitry and results in minimizing the cost and compact in size.
2. It is having input dc voltage to have the current-regulated operation of the drive.
3. The current has input state naturally follows the supply voltage to a certain extent, reducing the amount of low order harmonics and resulting in low THD.
4. Eliminates the possibility of shoot-through faults which could occur in bipolar converters.
5. Lower triggering and turn on losses because of the presence of only one switch and diode per phase as opposed to two in the bipolar case.

REFERENCES


