Brushless DC motor Introduction

Similarly speaking, a BLDC motor is considered to be a high performance motor i.e. capable of providing large amounts of torque over a vast speed range. BLDC motors are a derivative of the most commonly used DC motor, the brushed DC motor, and they share the same torque & speed performance curve characteristics. The major difference between the two is the use of brushes. BLDC motors do not have brushes (hence the name “brushless DC”) and must be electronically commutated.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>DC brush motor</th>
<th>BLDC motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical structure</td>
<td>Field magnets on stator</td>
<td>Field magnets on rotor similar to the AC synchronous motor</td>
</tr>
<tr>
<td>Distinctive feature</td>
<td>Simple construction</td>
<td>Long lasting &amp; No maintenance</td>
</tr>
<tr>
<td>Commutation method</td>
<td>Mechanical contact between brushes and commutator</td>
<td>Electronic switching using transistors</td>
</tr>
<tr>
<td>Rotors run position</td>
<td>Automatically by brushes</td>
<td>Hall element, Optical encoder</td>
</tr>
<tr>
<td>Reversing method</td>
<td>By reverse of terminal voltage</td>
<td>Rearranging logic sequence</td>
</tr>
</tbody>
</table>

**Advantages of DC motors**
- Low initial cost
- Simple control of motor speed

**Disadvantages of DC motor**
- Low Life - span for high intensity uses
- High maintenance
- High noise & Low reliability
- Low efficiency

**Advantages of BLDC EC motors**
- Long life span (about 5000Hrs. or more)
- Little or no maintenance
- High efficiency & High reliability
- High power-to-volume ratio

**Disadvantages of BLDC EC motors**
- High initial cost
- Additional motor speed controller
Brushless DC motor introduction

On the basis of magnet mounting:

A) In runner motor:
- In runner have an axle which rotates within a stationary housing.
- Rotor is mounted on the axle and rotates inside the surrounding stator.
- Rotor is comprised of segmented permanent magnets with alternating magnetic poles i.e. S and N poles respectively.
- In this motors are possible with two combinations i.e. with hall sensor and without hall sensor.

H) With Hall sensor

<table>
<thead>
<tr>
<th>Flange</th>
<th>Stator Assembly</th>
<th>Rotor Assembly</th>
<th>PCB With Hall Sensor</th>
<th>Back Side Cover</th>
</tr>
</thead>
</table>

3 Sensors embedded in stator
Hall sensors detect angular position of motor
These signals enable the driver circuitry to find the optimal switching time for the 3 windings.

S) Without Hall sensor

<table>
<thead>
<tr>
<th>Flange</th>
<th>Stator Assembly</th>
<th>Rotor Assembly</th>
<th>Internal Controller</th>
<th>Back Side Cover</th>
</tr>
</thead>
</table>

No sensors in stator
Instead of Hall sensor signals back EMF signals commuted
Control is shifted to the back EMF sensing

B) Out runner motor:
- Split-barrel design that is comprised of a base (non-rotating stator) and a drum (rotating rotor)
- Drum holds the internal permanent magnets and is fastened to the axle.
- The drum, axle and internal magnets all form the Rotor.
- Inside the drum, and attached to the base, is the Stator and Coil Windings.
- The rotor magnets act as an insulator, thereby reducing the rate of heat dissipation from the motor.
- Due to the location of the stator windings, outer rotor designs typically operate at lower duty cycles or at a lower rated current.
- The primary advantage of an outer rotor BLDC motor is relatively low detent torque.