



# SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore - 641 107

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 19EE504 SPECIAL ELECTRICAL MACHINES

III YEAR / Vth SEMESTER EEE

Unit 1 - PMBLDC

By

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## BLDC MOTOR- Drives

### Unipolar drive:

- Current in stator phase windings is passed in only one direction
- Three switches are used for three phase windings.

### Bipolar drive:

- The motor is driven by the direction change of the current flowing through the phase windings in particular periods.
- The current flowing through the winding groups changes direction during the commutation process.
- Each phase winding is controlled by two switching elements.

## BLDC MOTOR: UNIPOLAR AND BIPOLAR DRIVES

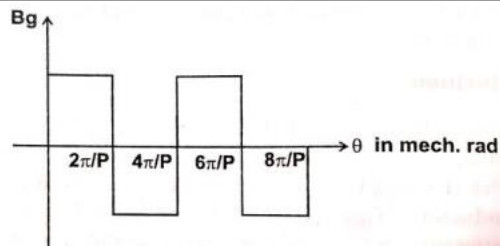
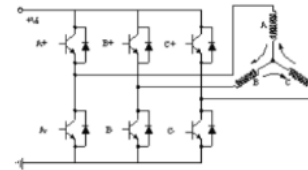
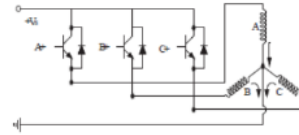


Fig. 5.11: Airgap flux density distribution in 180° BLPM SQW motor.

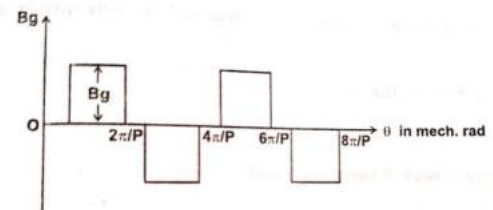
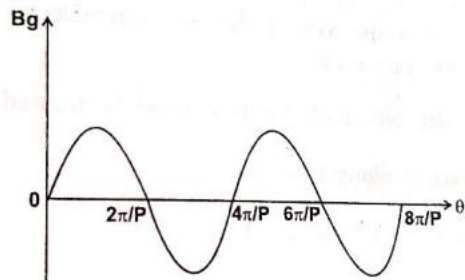
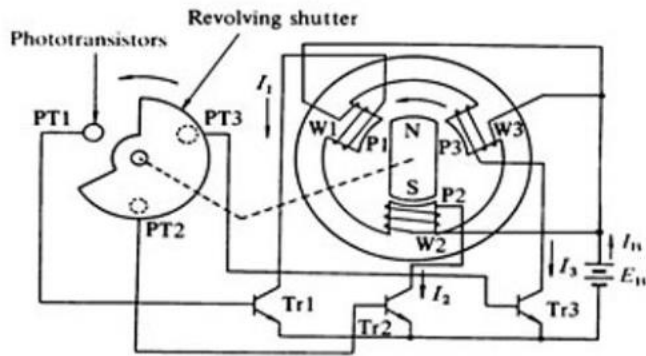


Fig. 5.12: Air gap flux density distribution in 120° BLPM SQW motor



## BLDC MOTOR: UNIPOLAR DRIVES



## BLDC MOTOR: BIPOLAR DRIVES

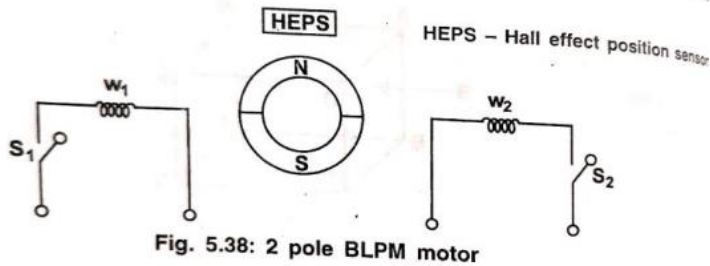
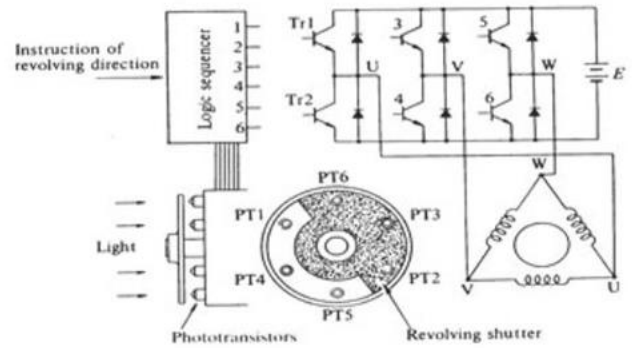
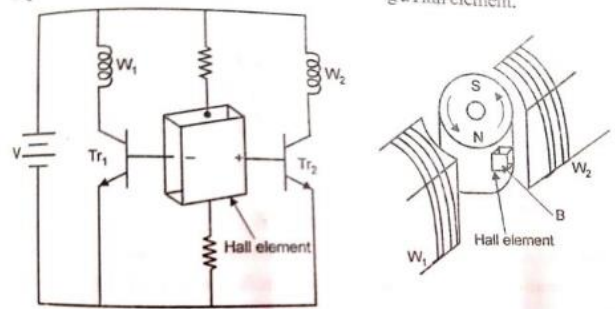


Fig. 5.38: 2 pole BLPM motor



### 3. Two phase winding and two pulse BLPM motor:

Stator has two phase windings which are displaced by 180° electrical. Electrical connections are as shown in fig. 5.44. It makes use of two semiconductor switches.

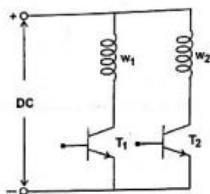


Fig. 5.44: Two phase winding and two pulse motor

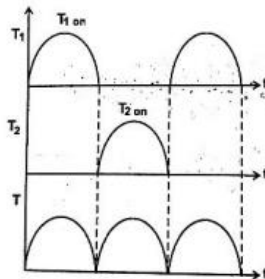


Fig. 5.45: Torque waveform

### 4. Three phase winding and three pulse BLPM motor:

The stator has 3φ windings as shown in fig. 5.46 whose areas are displaced by 120° elec. apart. Each phase windings is controlled by a semiconductor switch which is operated depending upon the position of the rotor. Three position sensors are required for this purpose.

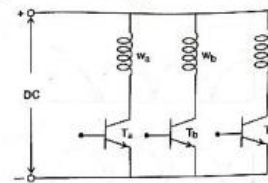


Fig. 5.46: 3 phase, 3 pulse BLPM motor.

### 5. Three phase six pulse BLPM motor:

Most commonly used. It has 3 phase windings and six switching devices as shown in fig. 5.47.

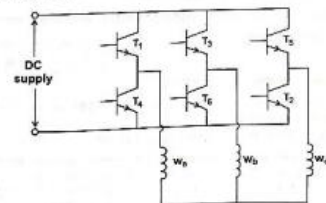


Fig. 5.47: 3-phase six pulse BLPM motor.

## Advantages of BLDC Motor

BLDC motor has several advantages over conventional DC motors and some of these are

- It has no mechanical commutator and associated problems
- High efficiency due to the use of permanent magnet rotor
- High speed of operation even in loaded and unloaded conditions due to the absence of brushes that limits the speed
- Smaller motor geometry and lighter in weight than both brushed type DC and induction AC motors
- Long life as no inspection and maintenance is required for commutator system
- Higher dynamic response due to low inertia and carrying windings in the stator
- Less electromagnetic interference
- Quiet operation (or low noise) due to absence of brushes

### **Disadvantages of Brushless Motor**

- These motors are costly
- Electronic controller required control this motor is expensive
- Not much availability of many integrated electronic control solutions, especially for tiny BLDC motors
- Requires complex drive circuitry
- Need of additional sensors

### **Applications of Brushless DC Motors (BLDC)**

**Brushless DC Motors (BLDC) are used** for a wide variety of application requirements such as varying loads, constant loads and positioning applications in the fields of industrial control, automotive, aviation, automation systems, health care equipments, etc. Some specific applications of BLDC motors are

- Computer hard drives and DVD/CD players
- Electric vehicles, hybrid vehicles, and electric bicycles
- Industrial robots, CNC machine tools, and simple belt driven systems
- Washing machines, compressors and dryers
- Fans, pumps and blowers