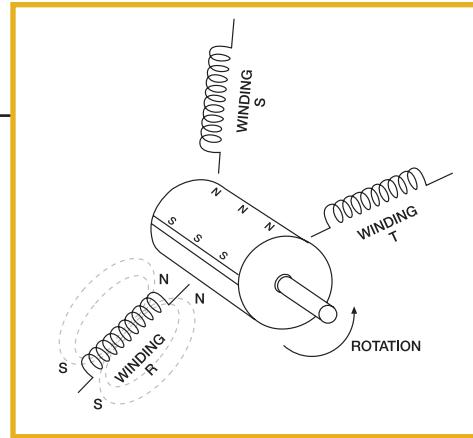# msd 101

Electronic commutation

Brushless motors are no different than ac or dc motors in that they rely on the interaction of magnetic fields to generate torque, and hence, motion. They are unique, however, both in construction and in the way they manipulate their torque-producing fields.

Brushless motors rely on semiconductor switches to turn stator windings on and off at the appropriate time. The process is called electronic commutation, borrowing on terminology used for the mechanism in dc motors, called a commutator, that switches current from winding to winding, forcing the rotor to turn.

The rotor in a typical brushless motor incorporates a four-pole permanent magnet and a smaller "sensor" magnet. The stator, on the other hand, consists of a three-phase, Y-connected winding and three Hall-effect sensors. The sensor magnet turns the Hall-effect sensors "on" and "off," indicating the position of the shaft. With this information, the controller is able to switch current to each winding at the optimum timing point.

questions & answers

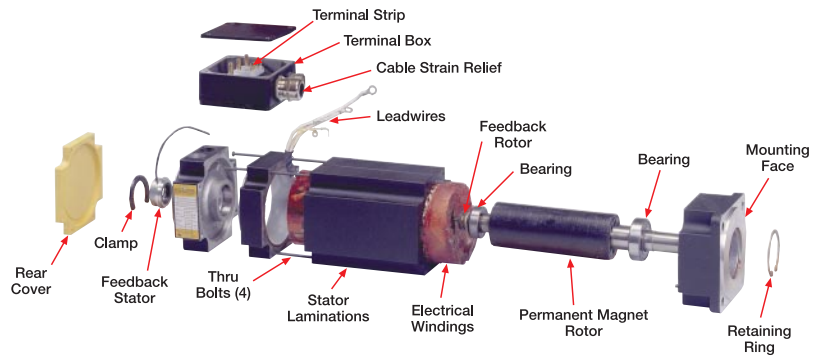**Q.** Is only one winding energized at a time?

A. In a three phase Y-connected stator, two or three windings may be energized at once. This makes efficient use of windings and develops higher motor torque.

Q. What type of power is applied to the coils?

A. Most brushless motor controls employ pulse width modulation (PWM) techniques to keep electronic devices cooler, thus allowing for smaller components.

Q. Are Hall sensors used exclusively?

A. Although Hall sensing is quite common, many industrial applications use electronic commutation schemes with resolver or encoder feedback.

Playing catch-up

A brushless motor is like an "inside out" dc motor, having a permanent-magnet rotor and a stator consisting of several windings. Applying power to winding "R," for example, sets up a field that reacts with the magnets on the rotor. This causes the rotor to move until the S pole of the magnet aligns with the N pole of the stator. However, if current is switched from winding "R" to winding "S" and then "T," the rotor will continue to move, making a complete revolution.

What makes brushless motors go

Brushless dc motors rely on a combination of sensors, magnets, and electronic devices to switch winding current. These components perform the same function as mechanical commutators used on standard dc motors, but without physical contact. Not only are they frictionless, they're also clean (no carbon dust), quiet (in terms of electrical noise), and maintenance free.

This material provided by John Mazurkiewicz, Product Manager, Baldor Electric Co., Fort Smith, Ark.
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