Brushless Blower Technology 101

Variable speed blowers offer a unique solution to several medical device systems requiring a fluctuating air flow. However, device designers are unlikely to be all that familiar with it. Therefore, this article outlines the key features of blowers that are used in medical devices, explains why brushless is preferred over brush commutated, and reviews the applications in which the blowers are most commonly used.

(Dc Blower.)

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Opportunities abound in the world of medical devices and healthcare equipment for designers to prescribe variable-speed blowers. Among notable applications:

- Respiratory equipment-Blowers perform in ventilators and sleep apnea machines to deliver forced air to a patient's lungs.
- Therapeutic beds-Many bed applications engage blowers both for inflation of the mattress (for therapeutic support) and to sustain airflow across a patient's skin.
- Dental aspirators-Blowers exhibiting high vacuum capabilities enable HVE (high-volume extraction) of particles during drilling procedures.
- Fume evacuation devices-Blowers serve to remove smoke plume and bio-contaminants during cauterizing and/or electrosurgery operations.

Although every application presents particular operating and performance demands, all variable-speed blowers in medical applications and settings ideally should provide high-purity air, minimize maintenance requirements, offer high efficiency and long life with little noise, and fit within ever-shrinking design envelopes. Designers can achieve positive outcomes in meeting these requirements by specifying brushless technology for blower applications.

'Brushless' Benefits

The heart of a variable-speed brushless blower is the brushless DC motor, which carries distinct advantages over brush-commutated types.

A brushless DC motor operates by converting electrical energy into mechanical energy through the interaction of two magnetic fields. A permanent magnet assembly produces one field and an electrical current flowing in the motor windings produces the other field. The relationship between these two fields results in a torque that rotates the rotor. As the rotor turns, the current in the polyphase winding is commutated-or switched-to produce a continuous torque output. In short, brushless motors achieve commutation electronically via a permanent-magnet rotor, wound stator, and rotor-position sensing scheme.

(Variable-Speed Brushless.)

This method of achieving commutation is in stark contrast to brush-commutated motors. Brush DC motors use brushes (typically graphite with metal content) as part of the commutation process and ongoing brush wear (caused by the interface between brush and commutator) is the leading cause of premature motor failure. A secondary cause of failure can be attributed to dust from brushes contaminating the motor's bearings. This effectively reduces bearing life and, in turn, restricts motor life.

Even the conventional mounting configuration of brushes to DC motor assemblies can add to the headaches. The usual method involves soldering the brushes onto standard cantilever springs. This spring design, however, results in force levels diminishing over time, often ending in premature motor failure.

The foregone conclusion is that brushless motor technology is the way to go. These blowers exhibit:

- Greater life expectancy-Medical equipment applications typically require long life. Brushless DC blowers can address this need by providing service life expectancies in excess of 10,000 hours. In contrast, the expected lifetime for brush-commutated DC types collapses dramatically to 2,000 to

5,000 hours of operation, due to brush wear.

- No contaminants or sparking-Brushless DC blowers bypass risks associated with the carbon dust generated by brush types. Such contamination cannot be tolerated in medical applications. In addition, from the safety perspective, brush technology provides an added spark-free advantage.

- Flexibility in size and speed-Blowers driven by technologies other than brushless DC motors (including AC induction motors) fail to offer the necessary size and speed ranges required for the applications. High rotational speeds for brushless DC motors often will be limited only by the mechanical integrity of the rotor construction, speed-related internal losses, and bearing selection. Speeds in excess of 10,000 rpm (and even much higher) are possible (with appropriate designs) and speeds below 1,000 rpm can be achieved, depending upon drive capabilities.