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## Technical Library

### Smooth Operator: Slotless, Brushless Motors Deliver Efficiency with Economy



For many designers, brushless and brush-commutated motors offer completely different advantages. Conventional wisdom holds that brushless motors provide high speed and fast acceleration, generate less audible noise and electromagnetic interference, and require low maintenance. Brush-commutated

motors, on the other hand, afford smooth operation and greater economy. However, recent improvements in brushless motor technology and manufacturing are challenging conventional wisdom and allowing designers to select brushless motors that combine the traditional advantages of both types.

#### Design Advantages

The key to smooth brushless performance centers around a new slotless stator. In a traditional brushless motor, copper wires are wound through slots in a laminated steel core (Figure 1). As magnets pass by the lamination shoes, they have a greater attraction to the iron at the top of the laminations than to the air gap between shoes. This uneven magnetic pull causes cogging, which affects motor vibration and noise. In the new brushless ELCOM II™ motors from Harleysville-Pa.-based Pittman, copper wires are wound against slotless laminations and held with adhesive. This design yields smooth rotation and virtually eliminates cogging.

Additionally, a slotless design significantly reduces damping losses. In both slotted and slotless motors, eddy currents are induced as the magnets and laminated iron pass each other, resulting in damping losses. These currents are weaker in a slotless motor because the distance between the laminated iron and magnets is greater than in a slotted motor. With low damping losses, slotless, brushless motors achieve more efficient operation.

Because the design advantages of the ELCOM II are combined with innovative manufacturing techniques, slotless motors from Pittman also provide greater economy. The motors allow designers to select a cost-effective brushless component that meets a variety of application requirements.

#### Slotless Applications

Designers usually select a brushless motor for high-speed, low-maintenance applications. Typical niches for these motors include computer peripherals, mass storage systems, and test and measurement, medical, and clean-room equipment. With the new slotless design, brushless motors also meet the needs of specific applications in these and other areas.

For fine control and smooth motion, designers of medical equipment can use a slotless, brushless motor in machines that precisely meter and pump fluids into delicate areas -- such as eyes. In medical imaging equipment, slotless, brushless motors decrease banding by providing smoother operation at low speeds. Airplane controls supply smoother feedback to pilots. And, by eliminating cogging, the new motors reduce ergonomic problems associated with hand-held production tools.

With the development of the slotless design, brushless motors meet a wider range of application requirements. New slotless, brushless motors from Pittman offer fast acceleration, low maintenance, and smooth operation at brush-motor prices. With applications ranging from imaging equipment to surgical drills, the slotless design has made the brushless motor a smooth operator.

#### Figure 1

In a traditional brushless motor, copper wires are wound through slots in a laminated steel core. A slotless, brushless design features copper wires wound against the laminations and held with adhesive. This design yields smooth rotation and virtually eliminates cogging.

#### Cross View Comparison Of Brushless Motors

