

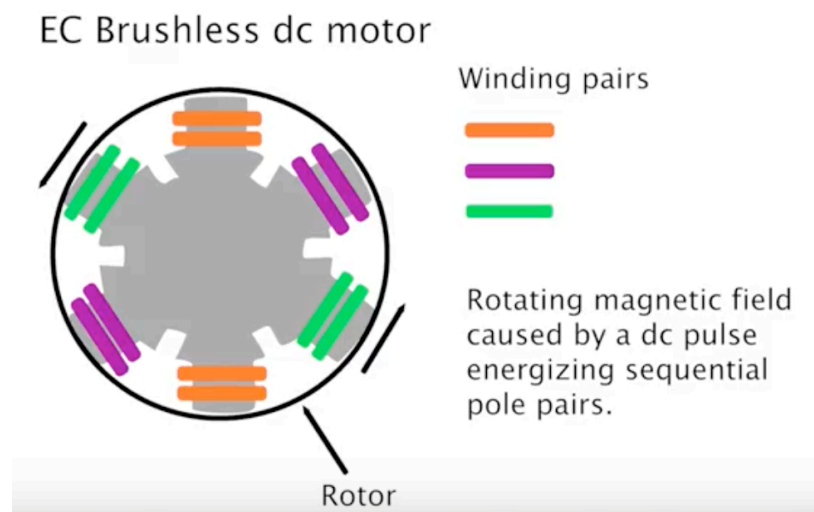


About EC Fans

Energy conservation is of ever increasing importance in today's world. The U.S. Department of Energy has determined that about 25% of the primary energy consumption in the residential and commercial sectors is used by electric motor-driven systems and components in appliances and equipment. Replacing existing equipment with advanced energy-efficient motors results in a substantial reduction in energy usage and cost. EC (electronically commutated) fans represent a significant advancement in power savings technology, providing cooling and air flow solutions for today's demanding applications that require increased electrical efficiency.

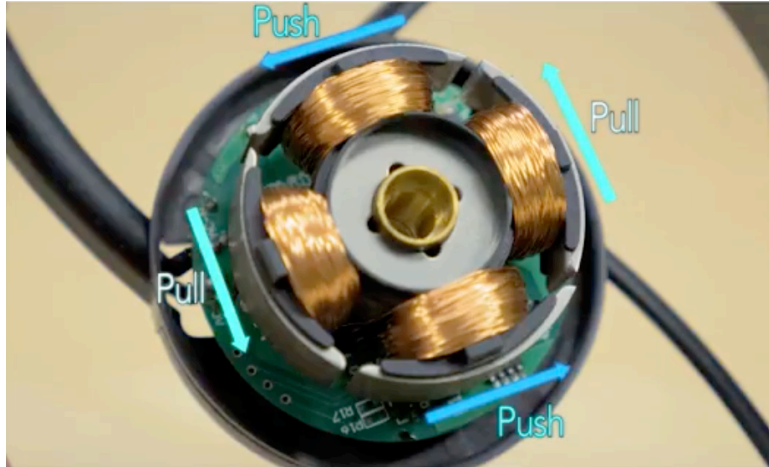
What Are EC Fans

EC fans are powered by brushless DC motors, which are also known as EC motors. DC motors can be up to 30% more efficient than AC motors due to its inherent design that uses permanent magnets to generate a secondary magnetic field rather than copper windings. Brushless DC motors are typically 85-90% efficient while brushed DC motors are generally in the range of 75-80% efficient; the brushed motors lose efficiency from brush friction. The increased efficiency of the brushless motor means that less energy is lost as heat, while more energy is turned into rotational force and therefore power.



EC motors are controlled by external or onboard electronics that convert the incoming AC power signal to the DC voltage needed by the motor. The electronic circuitry performs the function of the mechanical commutation that switches the direction of the

current and the magnetic field polarity to induce the motor's rotation. The design allows for more accurate and efficient motor control, as adjusting the power to the EC motor controls the EC fan speed, thereby improving performance.



Why Use EC Fans

EC fans can be used in most applications where AC fans are used, as long as the interface between the fan and the device is left unchanged. When this interface is properly designed, EC fans can be used as “drop-in” replacements for AC fans. Compared to AC fans, EC fans are the same size while offering the same or higher airflow capacity — all with significantly less power.

A large portion of the energy efficiency of EC fans occurs because they have built-in variable speed control. Since the relationship between the fan speed and the power required by the fan is a cube function, small reductions in the fan speed lead to large reductions in the power requirement. Precisely controlling the fan speed to match the airflow demand of the application can result in substantial energy savings.

High efficiency EC fans have gained popularity and are being used in applications where there is a need to meet energy efficiency regulations, yet they offer other advantages as well. EC motors avoid the sparking and potential electromagnetic interference of brushed motors. They have longer service life due to the smaller heat losses and lower operating temperatures. The lower operating temperature means that the fan does not have to do extra work to remove wasted heat that is generated by the motor itself. When compared to AC motors, which tend to have peak efficiency at a single speed, EC motors offer a wide operating window of fairly constant efficiency over a range of speeds due to their variable fan speed control. In addition, EC motors require little to no maintenance and provide increased reliability. Since EC fans have lower operating costs, this leads to shorter payback periods for new equipment.

EC fans are ideal for use in major home appliances such as refrigerators, freezers, ovens, range hoods, microwaves, dishwashers and clothes washer-dryers. Originally used only in high-end appliances, they are now used in high volume/mass market appliances due to

their energy savings advantages (i.e., their higher efficiencies). Additional applications may include air conditioning units, heat pumps, furnace fans, dehumidifiers, beverage vending machines, automatic icemakers, commercial appliances, commercial chillers, duct fans for ventilation, condenser units and extraction fans for removing smoke and exhaust.

However, the biggest uses for motor-driven elements in both the residential and commercial sectors are refrigeration and HVAC (heating, ventilation and air conditioning).



Market Requirements for Energy Usage

In the consumer appliance market, government eco-design regulations and marketplace requirements for energy efficiency standards are driving design considerations. Energy efficiency has become one of the performance specifications for new appliances. The high electrical efficiency of EC fans aids in meeting these requirements.

In the U.S. market, the Department of Energy (DOE) is responsible for upholding the minimum energy efficiency standards for household appliances that were established in 1987 as the National Appliance Conservation Act. Labeling appliances with the ENERGY GUIDE, which lists energy consumption, efficiency and operating cost information, falls under the Federal Trade Commission. The ENERGY STAR label, a voluntary program under the Environmental Protection Agency, has even more strict requirements on energy savings. The Building Technologies Office of the DOE has outlined potential energy savings using EC motors in commercial and residential equipment.

Some energy conservation standards have been established so far, while others are in process. Examples of some of these standards are as follows:

- Residential refrigerators and freezers – 76 FR 57516 (September 15, 2011)
- Residential clothes dryers – 80 FR 16309 (March 27, 2015 – proposed rule)
- Commercial and industrial fans and blowers – 81 FR 75742 (November 1, 2016 – proposed rule)

- Residential mechanical ventilation system fans – 82 FR 2857 (January 10, 2017)

In the global market, the European Union established two eco-design directives on minimum energy efficiency requirements. Directive 2005/32/EC sets the requirements for energy-using products (EuP) such as household appliances, while directive 2009/125/EC extends the requirements for energy-related products (ErP) which help to reduce electrical usage, such as insulation materials.

Several energy conservation standards have been established, and others are under consideration:

- Household refrigerators – Commission Regulation (EC) No 643/2009
- Household dryers – Commission Regulation (EU) No 932/2012
- Domestic ovens, cook tops, and range hoods – Commission Regulation (EU) No 66/2014
- Professional refrigeration units (storage cabinets, blast cabinets, condensing units and process chillers) – Commission Regulation (EU) 1095/2015

Applications

In considering the energy usage of home appliances, those that operate continuously, such as refrigerators and freezers, provide the best opportunity for energy savings.

Improvements on features such as seals and compressors, the usage of vacuum panels for added insulation, and the switch to LED lighting made some reduction in energy consumption for these appliances. However, the use of EC motors and fans offers the best opportunity for energy savings. Motors and fans are used both inside the refrigerator, to circulate air around the coils and maintain specified temperatures, and outside, to cool air around the condenser.

Range hoods provide another opportunity for using EC fans. While not in continuous operation, the function of a range hood, or exhaust hood, is to remove heat, steam, fumes, smoke, odors, grease and airborne particles in the area above a cooktop by means of an electric fan. The fan needs to be sufficiently powerful to remove all these potential contaminants while not being so noisy that it is never used. EC fans provide both of these functions in a more energy-efficient way. Dual-speed range hoods provide even greater energy savings as the appropriate fan speed can be selected as needed.

Clothes dryers and washer-dryer combos (which, while more common in the European market, are growing in popularity in the U.S. market) are a third example of home appliances where EC fans provide a great benefit. EC fans are used to bring hot air into the dryer to remove moisture from the clothing. The humid air is either sent out through an exhaust vent or passed by a heat exchanger to remove moisture through condensation before more hot air enters the dryer. Increases in air flow performance are provided by

EC fans, and this improves the energy efficiency of these appliances, while their lower noise level improves customer satisfaction.

Central air conditioning systems use several motors, one each for the compressor, the outdoor fan and the indoor blower. A similar indoor blower is used in furnace systems to circulate air throughout the ductwork. Replacing existing AC fans with more energy-efficient EC fans offers the highest potential savings due to the variable fan speed motor, although maximum energy savings can only be achieved if the entire system, including the compressor, is designed for variable speed. Also, running a furnace fan at a reduced speed may require it to operate for a longer time period, reducing some of the savings.

Summary

EC fans are being used to meet the more stringent energy efficiency standards in place in both the U.S. and European markets. By maintaining the same interface between the fan and the appliance, EC fans can be used as drop-in replacements for less efficient AC fans. EC motors can drive both axial and radial fans, as needed by the specific application. Orion Fans will be introducing a family of EC fans and blowers offering low power, dual speed, energy-efficient cooling solutions. Ranging in sizes from 60mm to 280mm, some of these EC series fans feature universal voltage input making them easy to design in for a wide variety of applications. They offer energy savings of up to 50%, enabling customers to meet energy-consumption requirements from agencies like ENERGY STAR. Additional models and sizes of EC fans will be available from Orion Fans throughout 2018.