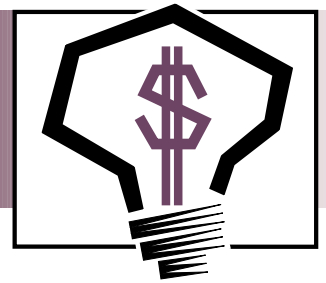


INVENTIONS & INNOVATION

Project Fact Sheet



SIMPLE CONTROL FOR SINGLE-PHASE AC INDUCTION MOTORS IN HVAC SYSTEMS

BENEFITS

- Offers potential annual savings of 2.9 million Btu of electricity per residential installation
- Offers potential total annual savings of 1.9 trillion Btu by 2010
- Adjusts air flow to air temperature continuously
- Lowers energy consumption 20% to 60% over single-speed systems
- Features drop-in design for simple replacement of existing units
- Offers reliable, inexpensive closed-loop programming without using digital, micro, or other electronic processors
- Increases heat-exchanger efficiency and furnace performance

APPLICATIONS

The primary market for an air-moving motor system with continuously variable-speed control is the residential HVAC sector. Although the new technology is directly applicable to a wide range of electric motor uses, its developers will focus initially on this specific application, where it has known benefits, cost thresholds, and market potential. When a generic residential-scale HVAC system is successfully implemented, development of much larger commercial systems will require simply scaling up the power of the output devices.

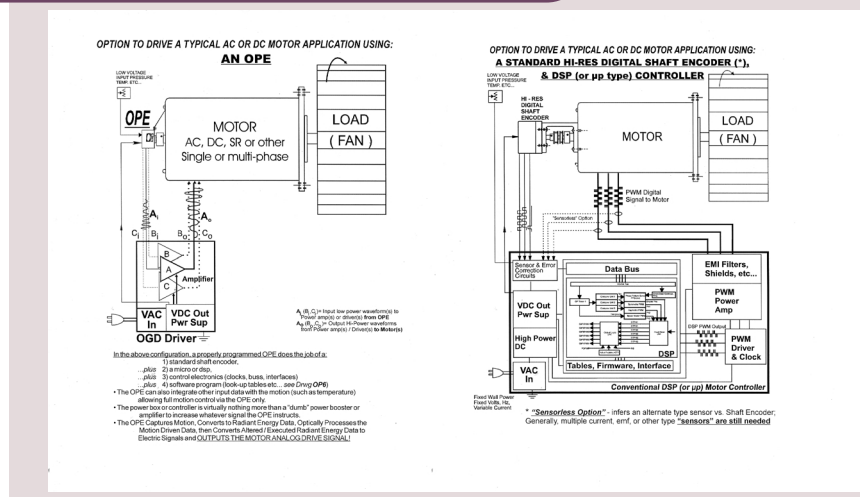
OPTICAL/GRAPHICAL PROGRAMMING REDUCES ENERGY USE AND COST AND PROVIDES VARIABLE (ADAPTIVE) SPEED CONTROL

Electric motors account for as much as 50% of the total energy use in the United States. Because of the inefficient design and operation of the common fixed-speed motor, much of this energy is actually wasted. In the United States alone, millions of these single-speed AC motors are in use. If they were equipped with controls to vary their speed and torque to match their workload, major energy savings would be achieved.

Use of variable-speed instead of single-speed motors in heating, ventilation, and air conditioning (HVAC) systems has significantly reduced energy consumption and audible noise while improving comfort and air quality. However, most efforts have coupled new motors with digital controls, using complex, unit-specific system designs to make the motor and controls compatible. These custom digital solutions are not translatable for use with other motors and systems and are often far more costly than the units they displace.

A new approach, using the optically programmable control, offers a universal, simple, and low-cost solution for HVAC systems, including those with single-speed AC motors. The unit will be a complete functioning fan subsystem. This fan unit will offer adaptive airflow that will track/follow air temperature. These units will be drop-in replacements for standard, fixed-speed AC motor fans. Early variable-speed control tests using these systems have shown reductions of 20% to 60% in AC fan motor electricity consumption.

MOTOR FAN BLOCK DIAGRAM COMPARISON OF NEW OPTICAL PROGRAM CONTROL SYSTEM VS. A DIGITAL SIGNAL PROCESSOR CONTROLLER



Opto Generic Devices' optical/graphical programming encoder is a universal, simple, low cost, and energy saving solution for HVAC fan motor control.



Project Description

Goal: Produce several motor subsystems with variable speeds that are within 30% of the price of fixed-speed units that produce the same mechanical work.

The new trend in HVAC system design is integration of variable-speed motors, which offer many benefits, including enormous energy savings. Currently available variable-speed systems make use of digital control technology, which creates a range of new problems such as increased complexity, reduced reliability, and motor-incompatible digital signals that can cause motors to run hot and generate electrical noise.

The closed-loop control using optical/graphical programming offers a blanket solution to the inherent problems associated with digital controls, while improving the performance and enhancing the functionality of off-the-shelf AC motors. This innovative, optically programmed technique has been seamlessly attached to a variety of motors and machines.

Opto Generic Devices, Inc. (OGD), is developing this new technology with the help of a grant funded by the Inventions and Innovation Program in the U.S. Department of Energy's Office of Industrial Technologies. Optical programming expands OGD's new sensor technology from feedback-only to the equivalent of a microprocessor, signal controller, and sensor combined.

Progress and Milestones

- Design, assemble, and characterize complete packaged blower-fan subsystems.
- Measure parameters to evaluate energy efficiency, power factor, winding, heating, torque irregularities, noise, and mechanical performance.
- Refine the optical program and circuit to meet the goals of energy savings, low noise, and optimum mechanical performance.
- Re-test and re-evaluate operation of refined subsystems and get feedback from testers and potential clients on system performance.
- Update business plan to reflect lessons learned from the testing process.

Economics and Commercial Potential

In 1999, the U.S. market for fixed-speed blower fans in the HVAC industry was more than 8 million units, putting the sales for this sector alone in the hundreds of millions of dollars. Even more intriguing are the 80 million units presently installed in the United States. OGD's low-cost, field-retrofit, plug-compatible approach makes this huge installed base a nearly exclusive market for its unique variable-speed system. Most competing control solutions fit only new HVAC systems designed specifically for them.

Even with their known problems, sales of digital variable-speed control systems are increasing, and several studies predict sustained growth. While energy savings often justify the adoption of these relatively expensive systems, the better climate control, comfort, and convenience they afford have significantly driven consumer acceptance. Almost everyone in the HVAC industry will affirm that variable-speed systems are the inevitable future for all HVAC systems. The costs and problems of the digital solution, not lack of market interest, have hampered adoption.

A typical fixed-speed furnace blower fan can only run at full speed and can consume 500 W per hour. When the unit shuts off and then is restarted, the AC motor will consume as much as six times full power (which can cause lights to dim). Variable-speed systems can provide energy savings greater than 50% compared with these extremely inefficient traditional systems.

OGD's technology could save 2.9 million Btu of electricity per 5K unit installation each year. First sales of the technology are expected by 2004. Based on 1.5% market penetration by year 2010, annual savings would be 1.9 trillion Btu with 640,000 units installed. Market penetration of 30% by year 2020 will save 15.4 trillion Btu from 5,300,000 units.



The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

FOR PROJECT INFORMATION, CONTACT:

Opto Generic Devices, Inc.
174 Pumpkin Hook Road
P.O. Box OGD
Van Hornesville, NY 13475
Phone: (315) 858-1002
Fax: (315) 858-1003
Email: ogd3@ogd3.com

FOR PROGRAM INFORMATION, CONTACT:

Lisa Barnett
Program Manager
Inventions and Innovation Program
U.S. Department of Energy
1000 Independence Ave., SW
Washington, DC 20585-0121
Phone: (202) 586-2212
Fax: (202) 586-7114
lisa.barnett@ee.doe.gov

FOR PROJECT UPDATES:

Visit our home page at
www.oit.doe.gov/inventions

Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, DC 20585-0121



Order# I-OT-806
September 2001