



REVOLUTIONIZING HVAC SYSTEMS: THE IMPACT OF HIGH-EFFICIENCY MOTOR DRIVERS

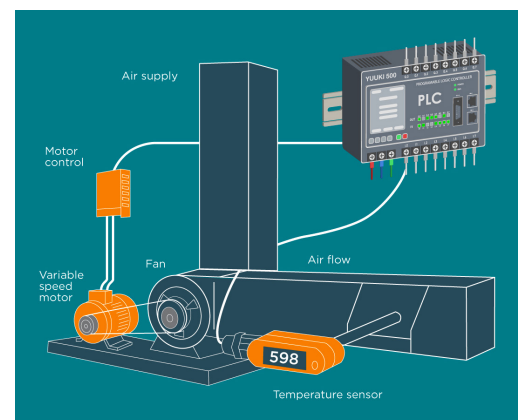
High-efficiency motor drivers are indispensable for optimizing the intricate operations of heating, ventilation, and air conditioning (HVAC) systems. These drivers propel the motors responsible for operating cooling tower fans, compressors, boiler pumps, and other vital components, efficiently converting electricity into mechanical energy while minimizing losses. Their role in enhancing energy efficiency, system performance, and longevity cannot be overstated.

TE Connectivity (TE) stands at the forefront of providing high-quality magnet wire solutions for these motor drivers, commonly known as variable-frequency drives (VFDs). With TE solutions, electric motor manufacturers can engineer VFDs tailored to withstand the demanding environments of commercial and industrial HVAC operations, delivering substantial cost savings and performance benefits.

Although VFDs typically incur a modest premium of 5-10% over standard motor controls, their potential to yield energy savings ranges from 35-60% in commercial HVAC systems.¹ This makes them an attractive investment for businesses managing large buildings, industrial facilities, and campus networks. Manufacturers can assist customers in understanding the return on investment (ROI) through detailed calculations that elucidate payback periods and total cost of ownership.²

However, certain VFD configurations and system setups may necessitate the expertise of skilled technicians to navigate complex installation and programming requirements. Additionally, the introduction of harmonic distortion into the electrical grid by some VFDs may mandate the use of supplementary equipment to mitigate potential issues. Buyers must collaborate closely with their manufacturing partners to select appropriate solutions and ensure meticulous installation and servicing.

USING VARIABLE-FREQUENCY DRIVES IN HVAC TECHNOLOGY



ENERGY SAVINGS AND IMPROVED COMFORT

Many governments and utilities offer rebates and incentives for installing energy-efficient appliances like heat pumps. For example, Federal Clean Energy Tax Credits in the United States cover 30% of the cost of heat pumps, with additional funding for consumer home energy rebate programs. State governments are also setting ambitious targets, such as quadrupling the number of heat pumps in U.S. homes by 2030.³

High-efficiency motors and their drivers are revolutionizing heat pump systems, bringing about significant changes in energy savings, improved comfort and performance, extended system life, and compliance with regulations. Compared to traditional fixed-speed motors, high-efficiency models can save 15-40% energy consumption.² This is achieved through variable-speed drives (VFDs), which adjust motor speed based on real-time needs, eliminating wasted energy from constant full-speed operation. This translates to lower operating costs, reduced carbon footprint, and potential utility bill savings. More precise control of airflow and temperature leads to more consistent and comfortable conditions in the space. This means fewer temperature fluctuations, better humidity control, and improved occupant satisfaction. Additionally, advanced motor designs reduce noise and vibration, creating a quieter and more peaceful environment.



Some advanced VFDs can communicate with smart electrical grids, allowing for dynamic adjustments based on energy demand and cost fluctuations, further optimizing energy efficiency. Modern systems enable remote monitoring of motor performance and diagnostics, allowing for proactive maintenance and preventing potential issues before they impact operations. Integrating high-efficiency motors with building automation systems allows for intelligent control and optimization of the entire HVAC ecosystem, leading to further efficiency gains and cost savings. While initial costs might be higher, the long-term benefits of high-efficiency motors and VFDs in HVAC systems are undeniable. They represent a significant step towards a more sustainable, efficient, and comfortable built environment.

HVAC GLOBAL MARKET TRENDS



Growing demand for **energy-efficient** solutions and rising trend for smart homes



Environment-friendly HVAC systems **cost-efficient** solutions for end users



IoT is changing the use of HVAC systems both in residential and commercial areas



Smart HVAC growing due to demand in building automation

COMPONENTS SOLUTIONS FOR MOTOR DRIVES



Components used inside today's HVAC systems can help with the goals of optimizing energy usage, reliability, and compatibility with system requirements. For example, MAG-MATE terminals from TE Connectivity feature an insulation displacement contact (IDC) that creates a gas-tight magnet wire termination without wire stripping, soldering, or welding. Standard MAG-MATE terminals support 34-12 AWG magnet wires, and smaller versions are available for fine gauge wire. They are available in a variety of styles including poke-in, poke-in tab, splice, crimp wire barrel, solder post and others. TE provides specifications to incorporate cavities for these unique terminations into coil bodies or other custom housings.



Another variety of wire contacts from TE Connectivity are AMPLIVAR terminals and splices, which feature a serrated barrel design to pierce and displace magnet wire insulation, producing superior metal-to-metal compression crimp joints with excellent strength and reliability. With new application tooling, splices can be bussed together in virtually infinite combinations. The crimp results in a solderless and airtight connection without the contaminants, cold solder points, weld burns and wire embrittlement associated with thermal termination. Common applications include electric motors and compressors.



Like MAG-MATE terminals, the SIAMEZE terminal system from TE Connectivity features IDC technology to achieve a secure metal-to-metal interface without stripping magnet wire. The SIAMEZE terminal has a compact design intended for more space-constrained motor systems and features an optional Lead Lok to secure lead wires with high retention force. Applicable to automated or manual assembly, the system achieves stable, gas-tight connections of either copper or aluminum magnet wire, without the need for pre-stripping.



Single wall heat shrink tubing insulates, provides strain relief, and helps protect against mechanical damage and abrasion. The heat shrink tubing offers a high-performance alternative to standard approaches for insulation, such as taping and molding in place.

The tubing comes in a range of sizes, colors, and materials. When heated, it shrinks to conform to the size and shape of the underlying material, making installation fast and easy.

ADVANCES TO ENHANCE VFD EFFICIENCY AND CAPABILITIES

Incorporating Variable Frequency Drives (VFDs) into HVAC systems, including heat pumps, can lead to significant energy savings, enabling operators to meet energy efficiency goals and regulatory standards.

Ongoing advancements in the marketplace are poised to enhance the capabilities of VFD technology further. Alongside leveraging the Industrial Internet of Things (IIoT) and Artificial Intelligence (AI) to enhance monitoring, efficiency, and control, operators can harness edge computing to execute control tasks in real time. Additionally, cybersecurity measures are being implemented to safeguard interconnected devices, while augmented reality is facilitating technicians in guiding maintenance duties effectively.

PARTNERING WITH TE TO DEPLOY VFDs IN HVAC SYSTEMS

Leading enterprises actively seek ways to enhance the efficiency and effectiveness of HVAC operations across various settings, from buildings to industrial facilities and networks. Through strategic partnerships with TE, facilities teams and operators can deploy VFDs integrated with TE magnet wire solutions and heat shrink tubing, thereby driving energy efficiency and cost savings and improving overall visibility and control.



¹ Jon Mosterd, "VFDs & Their Growing Impact on Total Cost of Ownership," article, *Pumps & Systems*, May 5, 2023, <https://www.pumpsandsystems.com/vfds-their-growing-impact-total-cost-ownership>

² Deana Fu, "How VFD Technology Results in Energy Savings," article, *Pumps & Systems*, April 7, 2021, <https://www.pumpsandsystems.com/how-vfd-technology-results-energy-savings>

³ Energy Government, "Making Our Homes More Efficient: Clean Energy Tax Credits for Consumers," Office of Policy, December 21, 2022 <https://www.energy.gov/policy/articles/making-our-homes-more-efficient-clean-energy-tax-credits-consumers>

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