



## Variable Capacity Modulation Goes Digital



*Copeland Scroll Digital™ and Copeland Discus™ digital compressors deliver precise matching of capacity with refrigeration load*

One of the biggest challenges food retailers and foodservice operators face is precisely matching compressor capacity to the actual refrigeration load required. Poorly matched refrigeration systems lead to many problems, including: food degradation due to wide fluctuations in temperatures; high energy consumption due to high in-rush currents from excessive compressor start/stop cycles; and increased maintenance and replacement costs due to unnecessary wear and tear.

In traditional supermarket rack refrigeration systems, multiple compressors are centralized in a parallel rack design that circulates refrigerant throughout

the store. To produce the necessary refrigeration load on a typical day, these compressors are subject to hundreds of start/stop cycles.

### **Mechanical Modulation Methods**

Attempts to modulate compressor capacity to match load have been successful to varying degrees, but each method presents inherent challenges. Uneven rack systems are designed to better match the refrigeration load using compressors with varying capacities (20K, 40K, 60K BTU/hr), but this method still results in high cycling rates and does not offer the desired temperature precision.

A second capacity modulation option is to change the system's tubing and install a hot gas-bypass system that fluctuates with evaporator pressures and temperatures. However, this is not as energy efficient and often unreliable.

Manufacturers have even combined variable speed drives and compressor technology to achieve the desired level of modulation. While this is an effective form of capacity modulation, variable speed technology may be considered cost-prohibitive. And since the solution includes both the variable drive and the compressor, replacement costs can be a concern.

## A Perfect Match

Although relatively new to commercial refrigeration, digital compressors have already earned a reputation as an invaluable alternative to traditional rack refrigeration and mechanical modulation methods. At Emerson Climate Technologies, we've pioneered this technology (or

approach) into our Copeland Scroll™ and Copeland Discus digital compressor lines that deliver unprecedented temperature precision and energy efficiencies.

Each compressor platform achieves these benefits through a digital modulation capability that allows for infinite capacity adjustments within specific modulation ranges — in our Copeland

Scroll Digital and Copeland Discus digital lines, that range is 10 to 100 percent. This means that instead of having to cycle on and off to match capacity, the compressors are capable of adjusting their output to precisely match the load. It's a revolutionary concept that offers many advantages in commercial refrigeration applications.

## Digital Technology Advantages

**Precise temperature control** — Digital modulation allows temperatures to be controlled within +/- 0.5 degrees Fahrenheit. In today's increasingly competitive foodservice, supermarket and transport industries, this provides the assurance that operators are maintaining the highest quality of perishable food items. Precise temperature and pressure control also allows for a true steady state of operation, better enabling the benefits of lowering condensing temperatures to improve the efficiency of the entire system when combined with an electronic expansion valve.

**Bottom line:** Precise temperature control reduces food shrinkage, preserves brand reputations and improves the operator's profit margins.

**Reduced power and energy consumption** — By matching the refrigeration load requirements from 10 to 100 percent, digital compressor technology consumes only the energy needed to meet the load. Reduced compressor cycling saves energy from in-rush startup currents and persistent consumption from running at full capacity. This also enables operators to increase the set point, resulting in minimized defrost cycles. Compared to other methods of modulation, digital compression is much more energy efficient and less costly to implement.

**Bottom line:** Operators can expect as much as 10 percent energy reduction (up to 30 percent compared to hot gas-bypass systems).

**Increased system reliability** — Digital modulation greatly reduces cycling rates, which results in significantly less refrigeration system wear and tear. This not only extends the life of compressors but also reduces component failure points in rack systems such as tubes and contactors.

**Bottom line:** Digital compression technology provides up to 50 percent reduction in compressor start/stop cycling in parallel rack applications, allowing for reduced maintenance costs and improved system reliability.

**Digital retrofit capability** — One digital compressor can be used as the lead compressor when paired with fixed capacity scroll or semi-hermetic compressors on a parallel rack. Digital modulation fills in the gaps on uneven parallel rack applications, allowing refrigeration system capacity to fluctuate to meet the load requirements in a supermarket. This supplements the existing rack to dramatically improve the system's load matching capability.

**Bottom line:** Operators can experience the benefits of digital compression by installing a single compressor on a traditional rack system. Digital technology allows stores to dramatically reduce compressor cycling, from cycling frequencies in the hundreds to the teens.

**Meet energy targets in foodservice** — The DOE is imposing significant energy reductions on walk-ins, reach-ins and ice machines by 2017 and subsequent years. In multiplex refrigeration designs, a digital compressor can be used to run multiple fixtures throughout a restaurant or convenience store. Applications that traditionally require multiple compressors can be reduced to one or two digital compressors (perhaps one for medium-temperature and one for low-temperature applications) using a much lower refrigerant volume. Digital modulation has enough capacity to match the load of each fixture and/or allow the number of fixtures running to match the load requirements of the store at a given time. This intelligent, lean refrigeration architecture can be further optimized with electronic expansion valves to lower the condensing temperatures, reduce compression ratios and save energy.

**Bottom line:** Foodservice operators can lower their compressor investment and achieve energy efficiency targets with digital compressors.

**New refrigerant friendly** — Digital technology is available for the emerging class of refrigerants: new A1 refrigerants (such as recently approved R-448A and R-449A); R-744 in subcritical applications; and new blends as they become available.

**Bottom line:** Emerson has worked, and will continue to work, to ensure compatibility with the next generation of refrigerants.