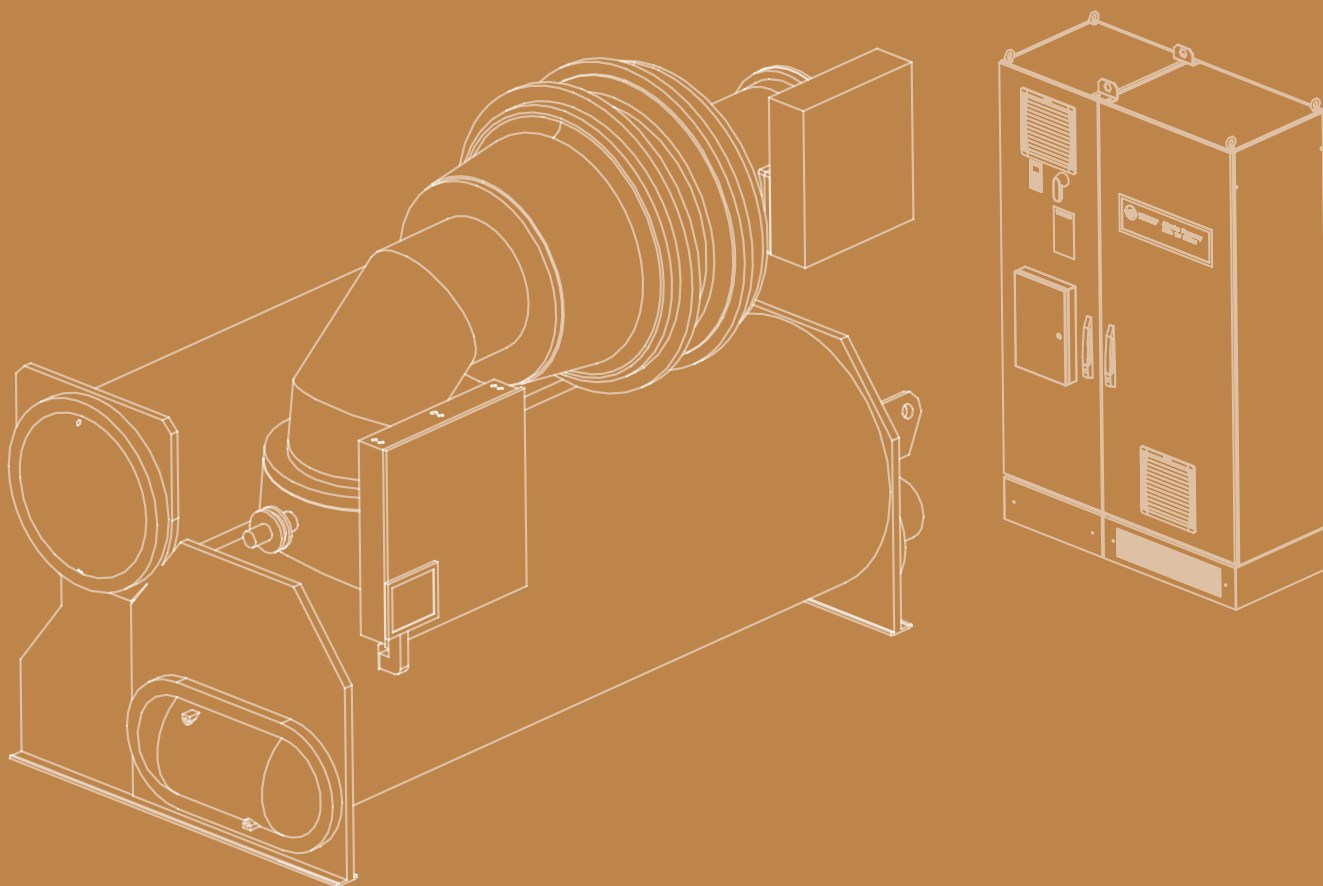




CHILLERS

## REMOTE ADAPTIVE FREQUENCY DRIVE FOR CENTRAVAC®



## WHY USE A TRANE ADAPTIVE FREQUENCY DRIVE (AFD)?

- **RELIABLE, OPTIMIZED COMPRESSOR EFFICIENCY FOR ENERGY SAVINGS IN SPECIFIC APPLICATIONS**

With Trane's advanced microprocessor controls, you can use the Trane air-cooled AFD to maximize chiller efficiency and reduce power consumption by adapting the motor speed to the chiller operating load for optimum compressor efficiency. Here's how:

The reduction of compressor lift is a key factor to the AFD savings potential for centrifugal chillers. Compressor lift is defined as the temperature (pressure) difference between the evaporator and condenser refrigerant temperatures as required for the refrigeration process. Reducing compressor lift can be accomplished by either reducing entering condenser water temperature or resetting leaving evaporator water temperature upwards. As a general rule, reduced lift periods occur in the cooling off season as opposed to the summertime. If the compressor motor speed can be coincidentally reduced, the chiller will consume fewer kW than by solely relying upon traditional inlet guide vanes only at constant speed for chiller unloading.

Controlling compressor speed to meet both load and lift requirements is critical to maintaining chiller reliability and meeting energy savings expectations. Trane-patented AFD Adaptive Control™ logic safely allows inlet guide vane and speed control combinations that optimize operation based on system load and lift requirements.

- **TRANE TECHNOLOGY**

The same Trane technology and expertise that set the standards for unsurpassed reliability in chillers and microprocessor controls has developed and set the operating parameters for the AFD. The Trane AFD comes as a complete, free-standing package that includes the necessary controls and programming needed for operation. Each Trane Adaptive Frequency Drive arrives completely programmed with all chiller control communication logic installed.

- **TAKE ADVANTAGE OF SINGLE-SOURCE RESPONSIBILITY**

Trane provides its customers with single-source responsibility for start-up, training and service of the chiller as well as the AFD.

- **AVOID THE NEED FOR TRANSFORMERS WHEN USING 575 AND 600 VOLT APPLICATIONS**

Most of the low-voltage AFDs in the industry are designed to work at 460/480 volts only. In HVAC chiller applications where 575/600 volts are present, therefore, a transformer is typically needed. With Trane's 575/600 volt AFD, a transformer is not required, thereby eliminating the associated extra design time, space requirements, installation costs and energy losses.

## HOW IT WORKS: CONTROL OF THE CHILLER MOTOR

Trane Adaptive Frequency drives act to soft start the chiller. They accomplish this soft start with minimal starting amps because they control the voltage and frequency delivered to the chiller motor. They also provide for adjustment of the chiller compressor operating speed. They do so by regulating the output voltage in proportion to the output frequency to provide a nominally constant rate of voltage to frequency as required by the characteristics of the compressor motor. Motor speed is proportional to this applied frequency.

The Trane AFD is a voltage source, pulse-width modulated (PWM) design. It consists of three basic power sections:

- **Rectifier**—constructed of silicon controlled rectifiers (SCR), which convert the incoming utility AC sine wave into DC voltage that will be stored in the DC bus section
- **DC Bus Section**—a capacitor bank that is used to store energy for use within the inverter section
- **Inverter IGBTs**—use the pulse width modulation (PWM) method to convert the DC voltage from the capacitor bank into a synthesized output AC voltage that controls both the voltage and frequency applied to the motor



Output voltage and current waveforms for the Trane PWM drive are in a series of pulses forming the output voltage waveform. This is where the term “pulse-width modulated” comes from. Due to the high frequency of these voltage pulses, output current closely approximates a true sinusoidal waveform. This modulated wave shape provides excellent motor operation over the entire speed range.

# TRANE REMOTE ADAPTIVE FREQUENCY DRIVE DESIGN

## STANDARD DESIGN FEATURES

### Remote (Free-standing) for New & Retrofit Installations

The compact design of the Trane AFD allows it to be mounted in a variety of locations to meet restrictive existing equipment room space allocations. The AFD is designed for front access only and ships completely factory tested and wired. The enclosure is rated NEMA 1; however, a NEMA 12 dust-tight and drip-proof option is available. Line power connections are typically in top, and load power is out the bottom. Other arrangements are available based on application requirements.

### Integrated with Trane Chiller Controls

Trane-patented AFD control logic is integrated with the CenTraVac chiller controls to optimize chiller efficiency, reliability and drive performance.

### Built-in Control Power Transformer

The AFD has its own integrated control power transformer, eliminating the need for separate power connections for auxiliaries on the chiller.

### BAS Compatible

Customers can obtain the key parameters and diagnostics via the unit control system interface.

### Air-Cooled for Simplicity Before Design

This approach avoids the complexity and maintenance issues associated with remote liquid cooled designs.

### Built-in Motor Protection

Advanced electronic motor overload protection eliminates the need for motor overload relays. Output short circuit and ground fault protection are also standard.

### Mains Protection

As standard, the Trane AFD meets Burst (5/50 ns) to standard EN6100-6-2 up to 4kV and Surge (1.2/50 us) to standard UL508 up to 6 kV.

### Electromagnetic Compatibility (EMC)

As standard, the Trane AFD meets conducted emissions to standard EN61000-6-2 test level EN/IEC55001 Class C3 and radiated emissions to standard EN61000-6-2 test level EN/IEC61800-3 category C3.

### Simplified Solid-State Pulse-Width Modulated Design

Trane AFDs are fully solid state, with no contactors, resistors or fuses. They use wireless technology for simplicity and reliability and feature a 97% minimum and up to 98.5% wire-to-wire efficiency, among the highest in the industry.

### Near Unity Power Factor

Trane AFDs offer a 0.96 (0.98 at full load) displacement power factor across the load range by design. This favorable power factor is significant to local utilities and will usually avoid penalty charges and the need for additional power correction.



### Standard Factory Mounted Circuit Breaker

The standard breaker has an AIC rating of 65,000 amps and the enclosure has a short circuit rating of 65,000 amps per UL 508, suitable for most building electrical designs.



### Minimal Inrush Current

Large starting currents are avoided by keeping the startup torque just large enough to meet the load. Trane AFDs are programmed to start the compressor motor from a very low frequency and voltage. This “soft start” prevents excessive uncontrolled startup torque and inrush currents.

### Variable Torque, Soft Start

Trane AFDs are variable torque devices that provide the torque necessary to meet the requirements of the load. The compressor motor is started using low frequency and low voltage, then slowly brought up to speed by increasing frequency and voltage at the same ratio. This method reduces motor heating and risk of motor damage.

### Minimized Line Harmonics

The VFD uses a 5% DC-link reactor which is split between the positive and negative rails of the DC bus to minimize power line harmonics. The reactor is a non-saturating (linear) type that provide full harmonic filtering throughout the entire load range.

### OPTIONAL FEATURES:

- 100,000 AIC circuit breaker and enclosure 100,000 amp short circuit rating
- NEMA UL Type 12 enclosure

# SPECIFICATIONS

## INPUT POWER

- 460/60/3 +/- 10%
- 480/60/3 +/- 10%
- 575/60/3 +/- 10%
- 600/60/3 +/- 10%

## OUTPUT PERFORMANCE

- Displacement power factor of 0.98 (minimum efficiency of 97% at rated load and 60 Hz)
- 1–60 hertz, factory set min. 38 Hz via UCP
- 110% current limit, factory set to 100% via UCP

## DESIGN

- AC to DC rectifier: silicon controller rectifiers (SCR)
- 5% DC bus reactor to minimize line side harmonics
- DC to AC inverter: IGBT inverter
- Voltage and current regulated, sine-coded PWM

## ENVIRONMENT

- Operating temperature: 32°F to 104°F (0°C to 40°C)
- Storage temperature: -4°F to 149°F (-20°C to 65°C)
- Humidity: 95% non-condensing
- Max. elevation: 3280' (1000 m) rated output current
- Derate 4%/3280' over rated alt. up to 9840' (3000m)

## CODES AND STANDARDS

- UL508
- NEC
- IEEE
- NEMA
- cUL

## STANDARD DESIGN FEATURES

- Microprocessor control logic
- Patented Trane chiller controls interface logic
- Aircooled heat sink
- NEMA1 enclosure tested to a short circuit rating of 65,000 amps, with padlockable door mounted circuit breaker with AIC rating of 65,000 amps

## OUTPUT DISPLAYED VIA CHILLER CONTROL PANEL

- Fault
- Line side kW
- Input line kW
- Output frequency
- Input line voltage
- Output load amps
- Motor speed (RPM)
- Transistor temperature

## MOTOR OVERLOAD PROTECTION

- Overtemperature
- Overvoltage
- Undervoltage
- Phase loss
- Phase reversal
- Phase imbalance
- Output line-to-line short circuit
- Output line-to-ground short circuit



# DIMENSIONS

	460 VAC		575 VAC		(Inches)			
Frame	Power (hp)	Max. Amps	Power (hp)	Max. Amps	Width	Depth	Height	Weight (lbs.)
D3 / D4	150–350	394	150–400	356	48	24	86	1220
E2	450–600	649	450	400	56	24	90	1635
			500–650	560	64	24	90	1680
F3	650–750	791	750–1050	840	103	24	90	2885
	950–1050	1031			119	24	90	3185
F4	1150–1350	1360	1150–1550	1258	142	24	90	3720







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## JUST AS IMPORTANT AS WHAT'S IN YOUR VFD...



## ...IS WHAT'S BEHIND IT

And behind every Trane Variable Frequency Drive you will find a world leader in HVAC equipment, controls and services. Whether preinstalled on Trane equipment, field applied or retrofit, the Trane TR Series VFD comes with the most important feature of all—our proven capabilities throughout the life of your facilities:

### Design

- Right application
- Right product

### Installation

- Properly installed
- On time

### Operation

- Meet or exceed expectations
- Performance savings

### Service

- Minimize downtime
- Provide support

We have a dedicated team of professionals located at over 150 local offices in the US and Canada and a network of over 200 parts centers to get you what you want, when you need it. To learn more about our drives and what's behind them, visit [www.trane.com/vfd](http://www.trane.com/vfd).

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Supersedes

New

For more information, contact your local Trane office or e-mail us at [comfort@trane.com](mailto:comfort@trane.com)

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