Installation, Operation, and Maintenance

AFDK - Liquid-Cooled Adaptive Frequency™ Drive

Tracer AdaptiView™ or CH530/CH531 Control

This document applies to service offering application only.

⚠SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

October 2023

SO-SVU001A-EN

Introduction

Read this manual thoroughly before operating or servicing this unit.

Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.
NOTICE	Indicates a situation that could result in equipment or property-damage only accidents.

Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants.

Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.

WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury. Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate SDS and OSHA/GHS (Global Harmonized System of Classification and Labeling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

WARNING

Follow EHS Policies!

Failure to follow instructions below could result in death or serious injury.

- **All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Trane personnel should always follow local regulations.**

Copyright

Trademarks

Revision History

Document updated to reflect Service Offering number.

Table of Contents

General Information

About this Manual

This manual is intended for use by experienced service personnel, qualified electrical personnel, Trane service personnel, and Rockwell Automation global technical service personnel who are familiar with the custom liquid-cooling features described.

The instructions in this manual outline the procedures for installing the Trane Adaptive Frequency™ Drive. Operation and maintenance of the controls are also explained in this manual.

Other Required Manuals

The following publication ships with the Trane Adaptive Frequency™ Drive from the factory: *LiquiFlo 2.0 AC Drive User Manual* (D2-3496-2 and D2-3518-1, or the most recent revisions).

Cabinet Servicing

For information regarding the servicing of drive components please refer to the appropriate Rockwell literature.

Service Information

This equipment should be installed, adjusted and serviced by qualified electrical maintenance personnel who are familiar with the construction and operation of the equipment and the hazards involved, as defined in the National Electrical Code. Trane assumes no liability for installation or service procedures performed by unqualified personnel.

Parts Ordering Information

Refer to the model number printed on the Trane Adaptive Frequency™ Drive nameplate when ordering replacement parts or service for the drive. When ordering parts, contact the local Trane Parts Office in your area. For service, contact a qualified service organization.

Overview

AFDK Information

The AFDK Adaptive Frequency™ Drive is a pulse width modulated (PWM) design incorporating both an IGBT (Insulated Gate Bipolar Transistor) active rectifier and inverter. The drive may be refrigerant-cooled when ordered as a replacement for a AFDE Adaptive Frequency Drive. Otherwise, it may be water-cooled by a water-to-water or water-to-air heat exchanger. It is designed for 460/480-volt application. This drive converts ac power to dc power and back to ac power. The incoming 460/480 volts are converted to a constant 700 volts dc by the active rectifier, and a section of capacitors is used to store the dc voltage. A variable output is accomplished by PWM control within the inverter. The dc output feeds the Inverter IGBTs that switch on and off in response to the gate driver to change the dc input voltage to a symmetrical ac output voltage of desired magnitude and frequency. The output frequency range is 38 to 60 hertz.

A combination of two distinct operating modes make up the AFDK control within the chillers UC800 or DynaView™ control. The controls can control the inlet vanes, and they can also modulate impeller speed from 38 to 60 hertz. The IGBTs control the speed in response to the UC800 or DynaView compressor control signal. Circuit breakers, surge capacitors, and ground fault protection are standard on all AFDK units.

Some of the basic features of the drive are:

- Less than or equal to 5 percent current harmonic distortion (TDD).
- Minimum efficiency of 97 percent at rated load and 60 Hz.
- Unit displacement power factor of 0.99 or better.
- Low inrush current.
- The current never exceeds the full load amps.
- The AFDK varies the motor speed in response to the speed command from the UC800 or DynaView control.

The CenTraVac™ chiller control panel has full control of the unit operation, including the start/stop functions. If you encounter a fault condition or an alarm on the drive, the chiller display will indicate alarm and an alarm message.

This manual covers the features and specifications that are unique to the Adaptive Frequency Drives being produced for Trane. Only product information is covered here that supplements that presented in the standard Liqui-Flo instruction manuals that ship with the unit.

Model Number Descriptions

Model Number Description

Digit 1, 2, 3 – Adaptive Frequency™ Drive

AFD

Digit 4 – Aftermarket LF2

K

Digit 5, 6, 7, 8 – Nameplate RLA

Digit 9 – Voltage

F = 460 Volt, 60 Hz, 3 Phase
G = 480 Volt, 60 Hz, 3 Phase

Digit 10, 11 – Design Sequence

A0

Digit 12 – Cooling Type

A = Refrigerant cooled
B = Water to Water cooled
C = Water to Air cooled

Digit 13 – Agency Listing

1 = UL and C UL Listed

Digit 14 – AFD Frame Size

A = 405
B = 600
C = 900
D = 1200

Digit 15 – Hose and Fittings

0 = None
1 = 30-ft. Hose and Fitting
2 = 60-ft. Hose and Fitting
3 = 120-ft. Hose and Fitting

Digit 16 – Reserved for Future Use

0 = Blank

Digit 17 – Reserved for Future Use

0 = Blank

TRANE

Drive and Cabinet

Enclosure Rating

The Trane® cabinet has a NEMA 1 enclosure rating:

NEMA 1: Vented. Intended for general-purpose indoor applications.

Environmental Conditions

Important: *Location of the AFDK is important if proper performance and normal operating life is to be expected. Therefore, unless designed for special environments, the controller should be installed in an area where the following conditions exist.*

- Verify that NEMA 1 enclosure is installed where it can be kept clean and dry, away from oil, coolants, or other airborne contaminants. The enclosure must be installed in a non-corrosive location.
- The area chosen should allow the space required for proper air flow. Adequate clearance for air circulation around the enclosure is a 6-inch (15.25 cm) minimum clearance required wherever vents are located in the cabinet.
- The area chosen should allow for service clearance in front of the enclosure. Three feet (0.91 m) is recommended for door swing and working space; more space may be required by local building codes or for service equipment, such as hoists used for drive replacement. Because codes and equipment may vary, determine the amount of space required for each specific installation.
- Do not install the drive over 1000 meters (3300 feet) above sea level without derating output power. For every 91.4 meters (300 feet) over 1000 meters (3300 feet) above sea level, derate the output current 1 percent.
- Line frequency is 60 Hz.
- Line voltage is 460 or 480 volts; variation must be within ±10 percent.
- Verify that the drive location will meet the environmental conditions specified in Table 1.

Table 1. Environmental conditions

Condition	Specification
Operating Temperature (inside NEMA 1 enclosure)	0°C to + 55°C (32° to 131°F)
Ambient Temperature (outside NEMA 1 enclosure)	0°C to + 40°C (32°F to 104°F)
Storage Temperature (Ambient)	-40°C to 65°C (40°F to 149°F)
Humidity	5% to 95% (non-condensing)

Identifying Trane AFDK Cabinet Components

The Trane AFDK cabinets have the following main components. Refer to Figure 1, p. 9 and Figure 2, p. 11 for Frame 3, and Figure 3, p. 12, Figure 4, p. 13 and Figure 5, p. 15 for Frame 4.

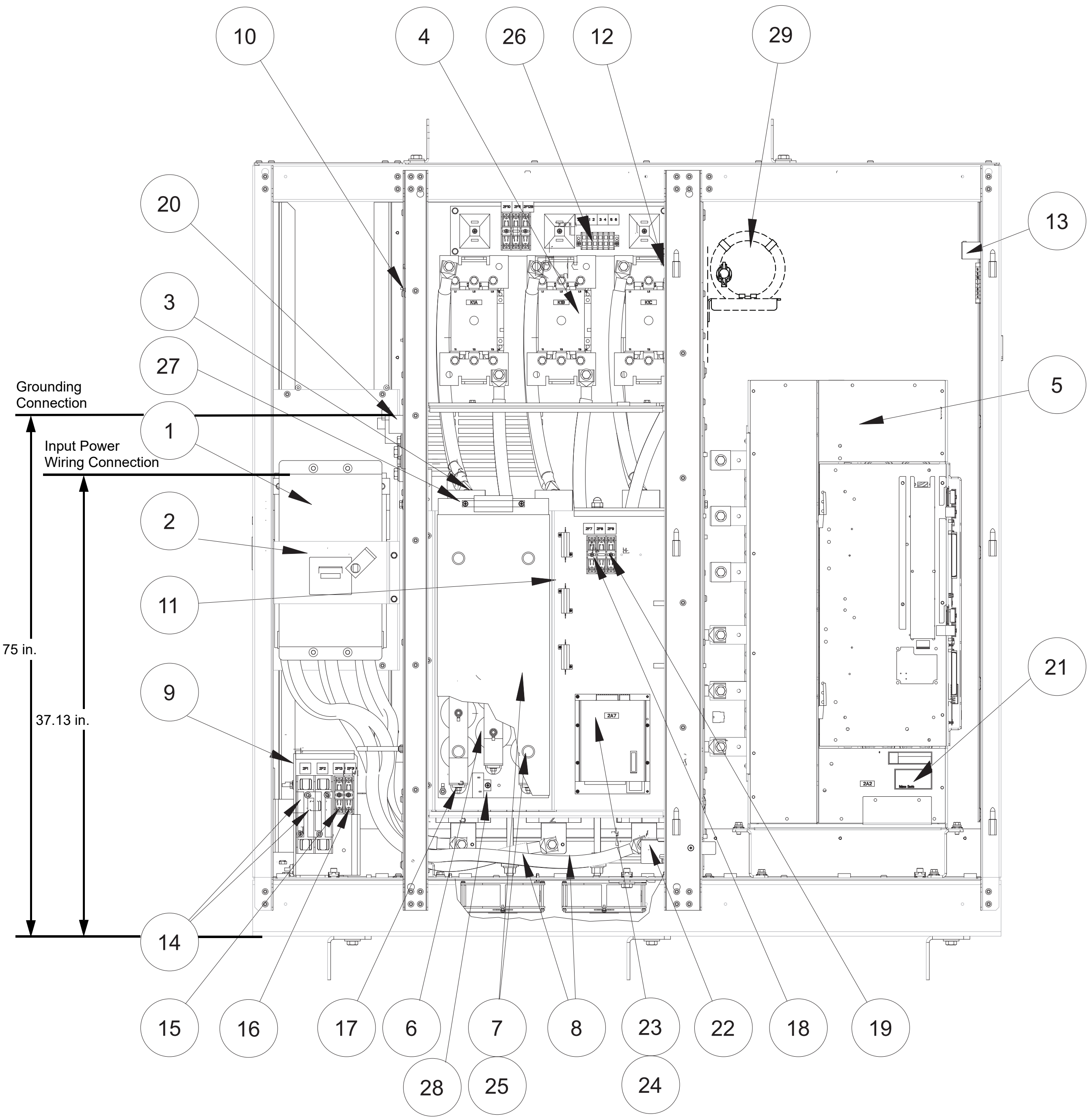
Drive Cabinet Component Locations

Frame 3 Units (405, 600 A)

The main drive components for a Frame 3 unit are listed below. Each numbered item corresponds to a number in Figure 1, p. 9.

1. Circuit breaker, 600 V
2. Circuit breaker operating mechanism
3. Inductor
4. AC contactor
5. Power module assembly (refer to Figure 2, p. 11 and Figure 3, p. 12 for details)
6. Input filter capacitor assembly
7. Input filter capacitor guard panel
8. Fans, 115 Vac, inductor (2)
9. Transformer, 3 kVA
10. Fan, 115 Vac, contactor
11. Resistors, 100k Ohms, 50 W
12. Pre-charge resistors
13. Relay, pump, and control power terminals
14. Fuse, class RK-5, 600 V, 15A (2)
15. Fuse, class CC, 600 V, 25A (1)
16. Fuse, class CC, 600 V, 5A (1)
17. Fuse, class T, 500 V, 150 A (3)
18. Fuse, class CC, 600 V, 20 A (3)
19. Fuse, class CC, 600 V, 1 A (3)
20. Ground lug, 2-600 MCM
21. Nameplate, power module
22. Door inter-lock
23. Line sync, PCB assembly
24. Line sync, PCB cover
25. Plastic knob
26. Terminal block, fans, 6-position
27. 1 Microfarad capacitor (1 ìF)
28. Metal oxide varistor (m.o.v.)
29. Magnetic choke

Figure 1. Drive components locations: Frame 3 units[a]



(a) Material courtesy of Rockwell.

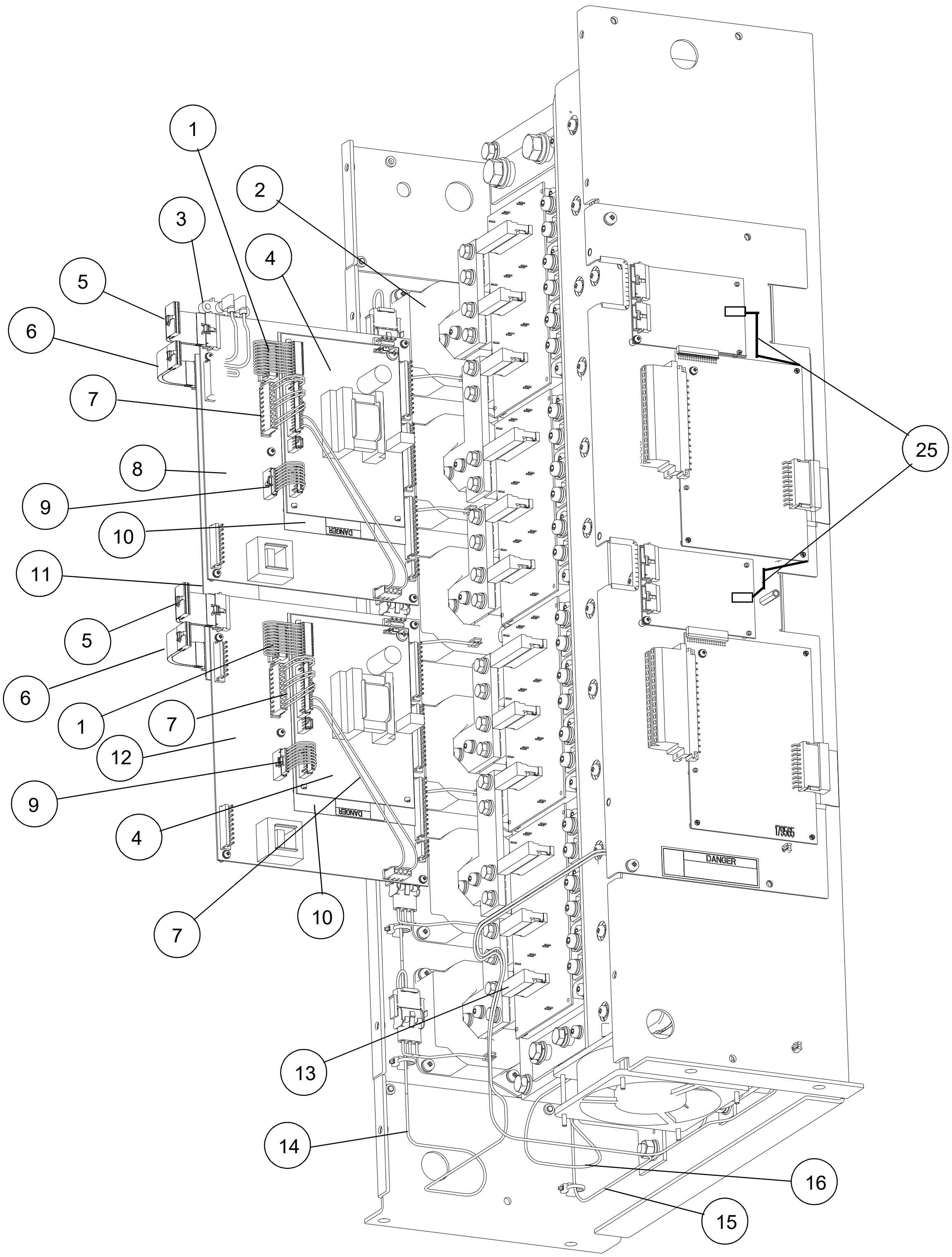
Power Module Component Locations

Frame 3 Units (405, 600 A)

The main power module components for a Frame 3 unit are listed below. Each numbered item corresponds to a number in Figure 2, p. 11 or Figure 3, p. 12.

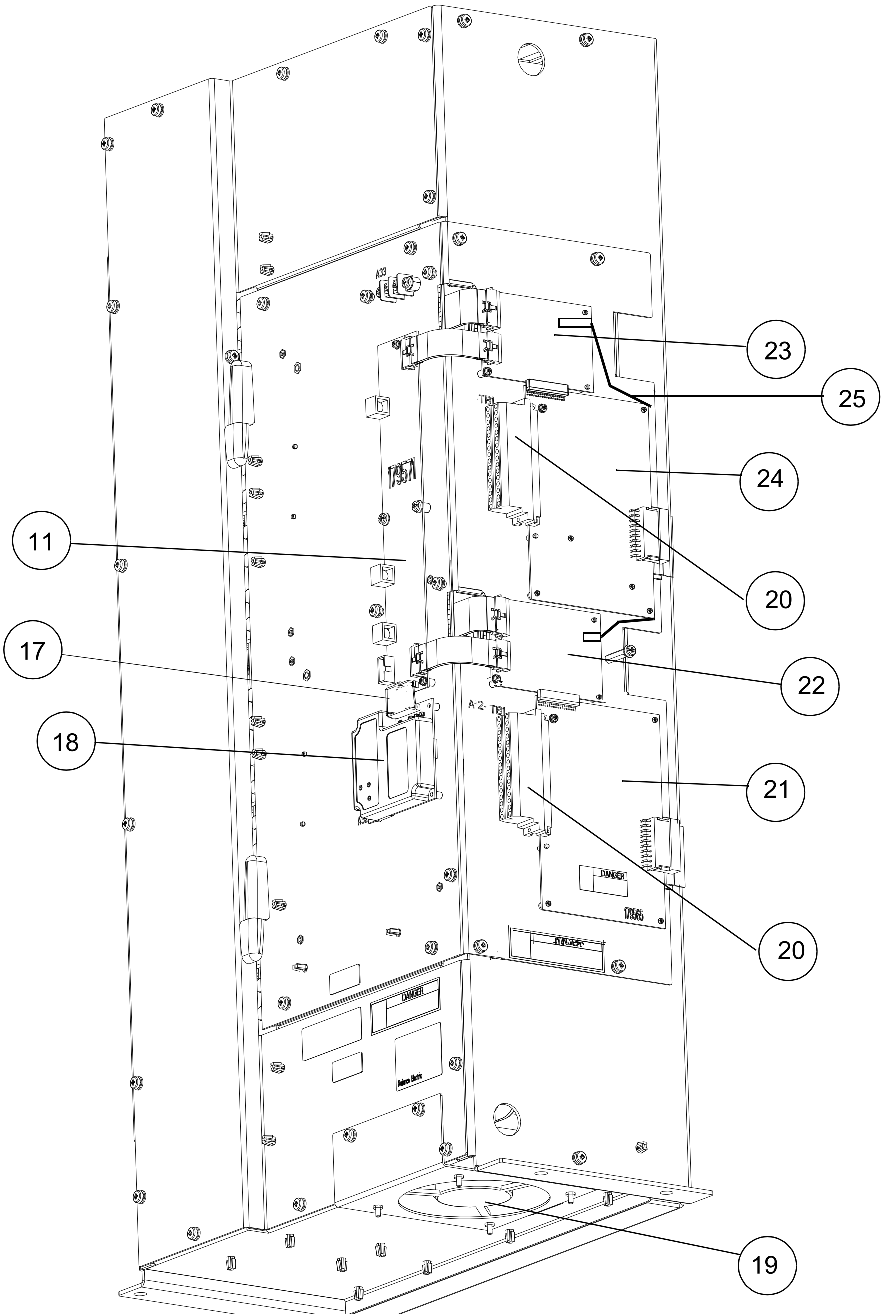
1. Wire harness assembly, power supply, logic
2. Current feedback device, 1000 A
3. Terminal block, 2-position
4. 80 W power supply assembly
5. Cable assembly, 40-pin, 0.050 in pitch, flex film
6. Cable assembly, 30-pin, 0.050 in pitch, flex film
7. Wire harness assembly, power supply, upper gate
8. Inverter power interface assembly
9. Wire harness assembly, power supply, lower gate
10. Insulation sheet
11. DPI communications interface
12. Rectifier power interface assembly
13. Wire harness assembly, gate driver
14. Wire harness assembly, current feedback device
15. Wire harness assembly, line sync.
16. Wire harness assembly, dc bus bleeder resistors
17. Cable assembly, 20-pin, 0.050-in. pitch, flex film
18. RS-485 communications assembly (RECOMM)
19. Internal fan
20. Connector, terminal block, 32-pin
21. ac line I/O assembly
22. Rectifier control assembly
23. Inverter control assembly
24. Standard I/O board (optional)
25. Synchronization cable

Figure 2. Power module component locations door open: Frame 3 units[a]



(a) Material courtesy of Rockwell.

Figure 3. Power module component locations door closed: Frame 3 units[(a)]



(a) Material courtesy of Rockwell.

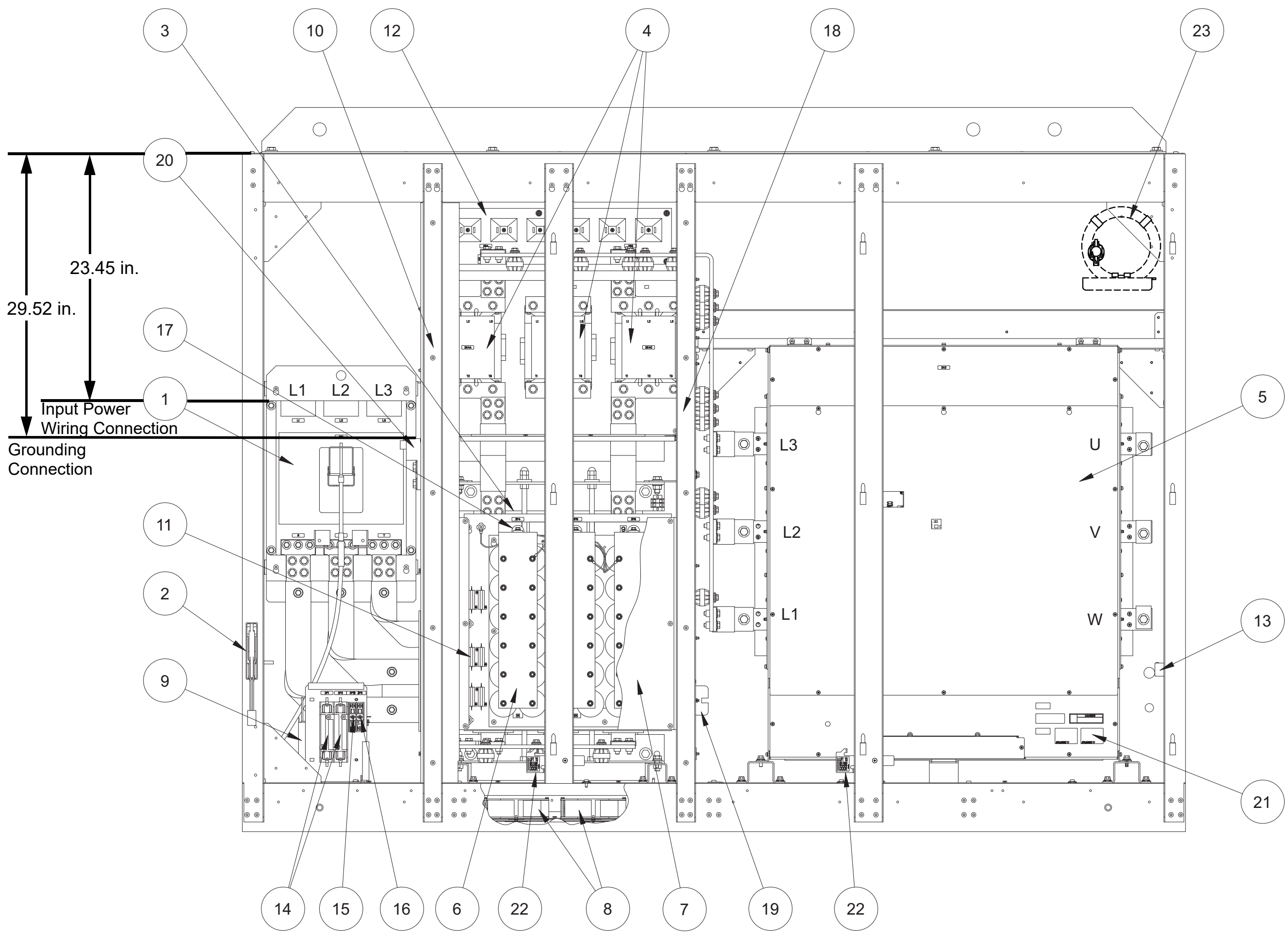
Drive Cabinet Component Locations

Frame 4 Units (900, 1200 A)

The main drive components for a Frame 4 unit are listed below. Each numbered item corresponds to a number in Figure 4.

1. Circuit breaker, 600 V
2. Circuit breaker operating mechanism
3. Inductor
4. AC contactor
5. Power module assembly (refer to Figure 5, p. 15 and Figure 6, p. 16 for details)
6. Input filter capacitor assembly
7. Input filter capacitor guard panel
8. Fans, 115 Vac, inductor (4)
9. Transformer, 3 kVA
10. Fan, 115 Vac, contactor
11. Resistors, 100k Ohms, 50 W
12. Pre-charge resistors
13. Relay, pump, and control power terminals
14. Fuse, class RK-5, 600 V, 10 A (2)
15. Fuse, class CC, 600 V, 25 A (1)
16. Fuse, class CC, 600 V, 10 A (1)
17. Fuse, class T, 600 V, 300 A (3)
18. Fuse, class CC, 600 V, 20 A (3)
19. Fuse, class CC, 600 V, 1 A (3)
20. Ground lug, 2–600 MCM
21. Nameplate, power module
22. Door inter-lock (2)
23. Magnetic choke

Figure 4. Drive component locations: Frame 4 units[(a)]



(a) Material courtesy of Rockwell.

Power Module Component Locations

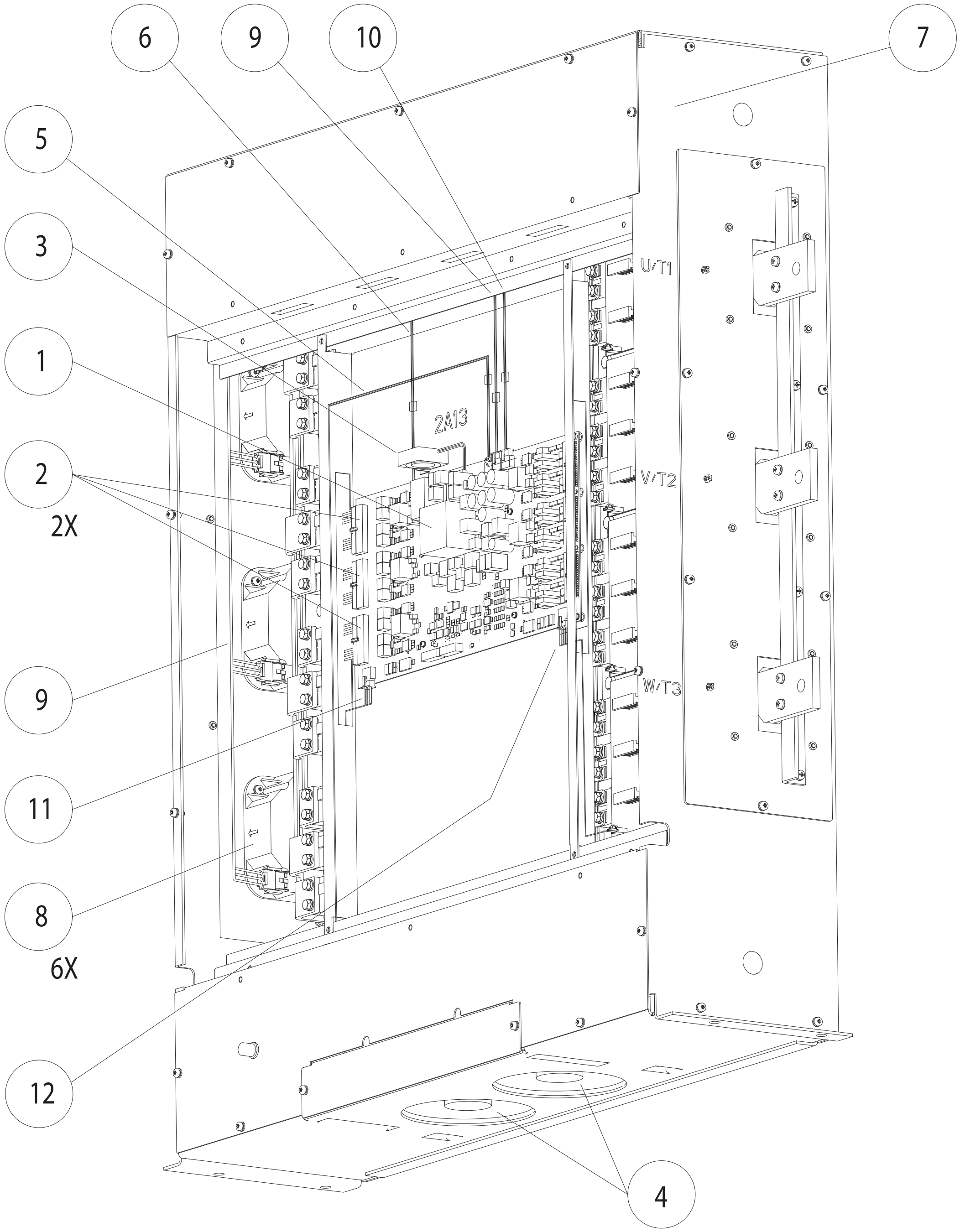
Frame 4 Units (900, 1200 A)

The main power module components for a Frame 4 unit are listed below. Each numbered item corresponds to a number in Figure 5, p. 15 or Figure 6, p. 16.

1. Combined power PCB assembly, 900 Amps

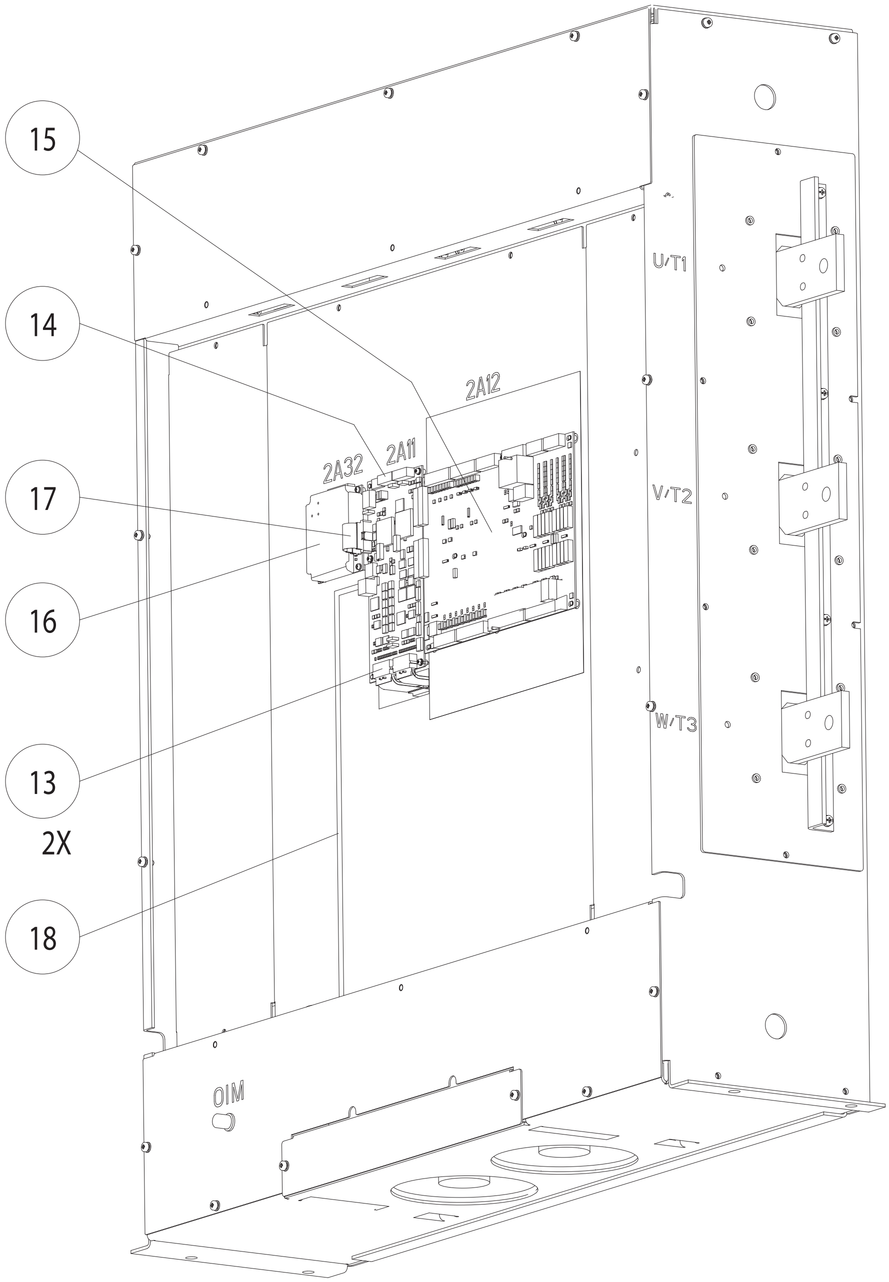
   Combined power PCB assembly, 1215 Amps
2. Wire harness assembly, gate driver
3. Internal fan, 24 Vdc
4. Internal fan, 24 Vdc
5. Wire harness assembly, internal fan
6. Wire harness assembly, dc power
7. Wire harness assembly, dc bus resistors (under top cover)
8. Current feedback device, 2000 A
9. Wire harness assembly, current feedback device, rectifier side
10. Wire harness assembly, current feedback device, inverter side
11. Wire harness assembly, RTD, recitifier side
12. Wire harness assembly, RTD, inverter side
13. Cable assembly, 40-Pin
14. Combined control PCB assembly
15. Combined I/O PCB assembly
16. RS-485 communications assembly (RECOMM)
17. Cable assembly, 20-pin
18. Cable, mini DIN, 8 pos., male/male, 1 meter long

Figure 5. Power module component locations IO and control panel removed: Frame 4 units(a)



(a) Material courtesy of Rockwell.

Figure 6. Power module component locations front panel removed: Frame 4 units(a)



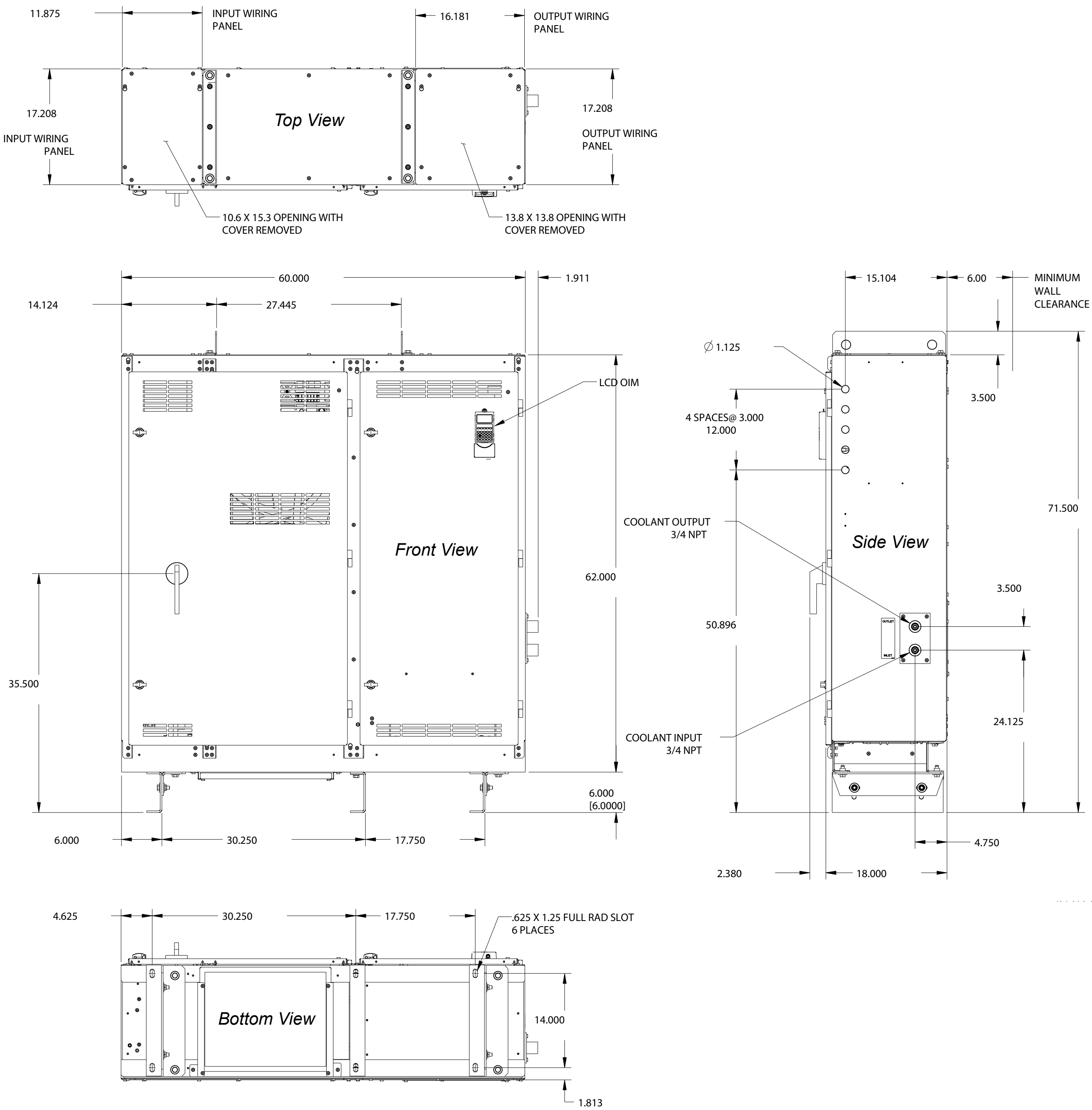
(a) Material courtesy of Rockwell.

About the Cabinet

This section provides cabinet dimension information and shows where the wire entry areas and liquid-cooling connection points are located.

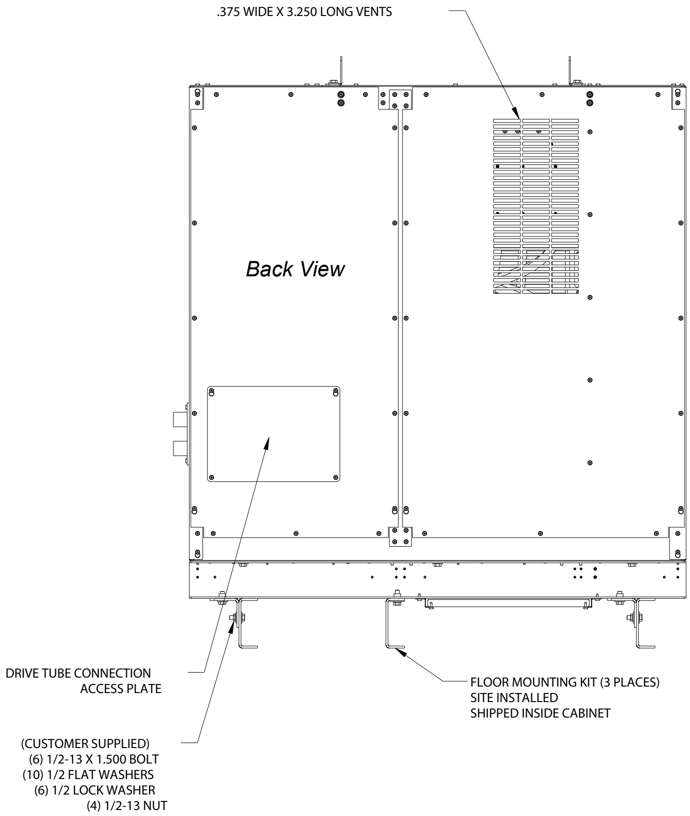
Figure 7, p. 17 and Figure 8, p. 18 show overall dimensions for Frame 3 units; Figure 9, p. 19 and Figure 10, p. 20 show overall dimensions for Frame 4 units.

Figure 7. Drive cabinet dimensions: Frame 3 (dimensions shown in inches)[(a)]



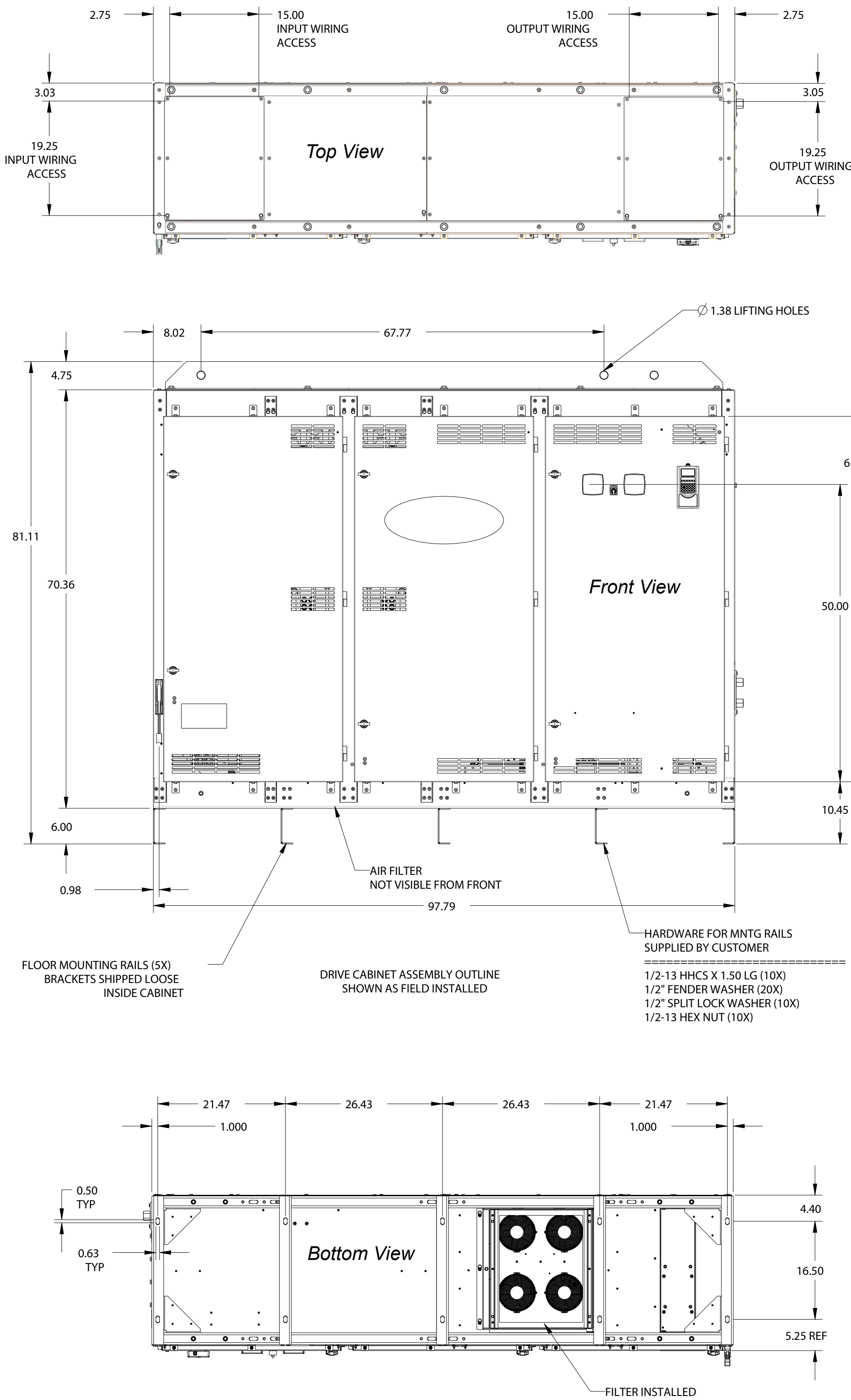
(a) Material courtesy of Rockwell.

Figure 8. Drive cabinet dimensions: Frame 3 (dimensions shown in inches [mm])[a]



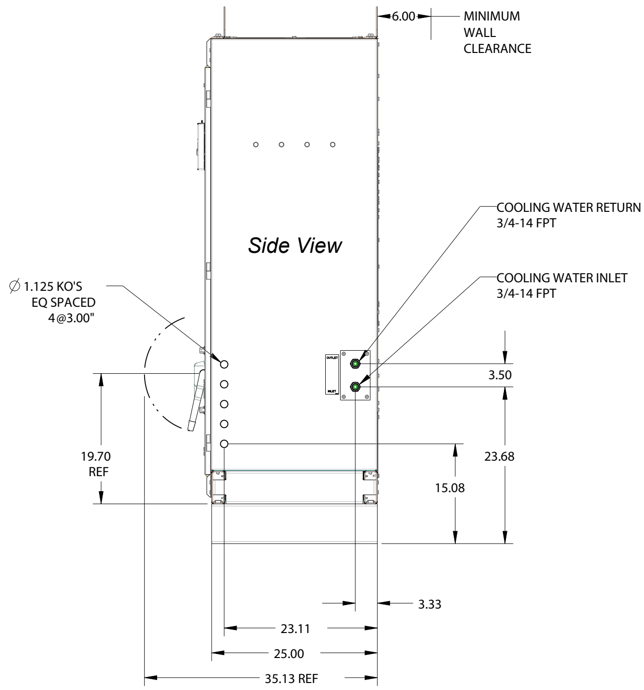
(a) Material courtesy of Rockwell.

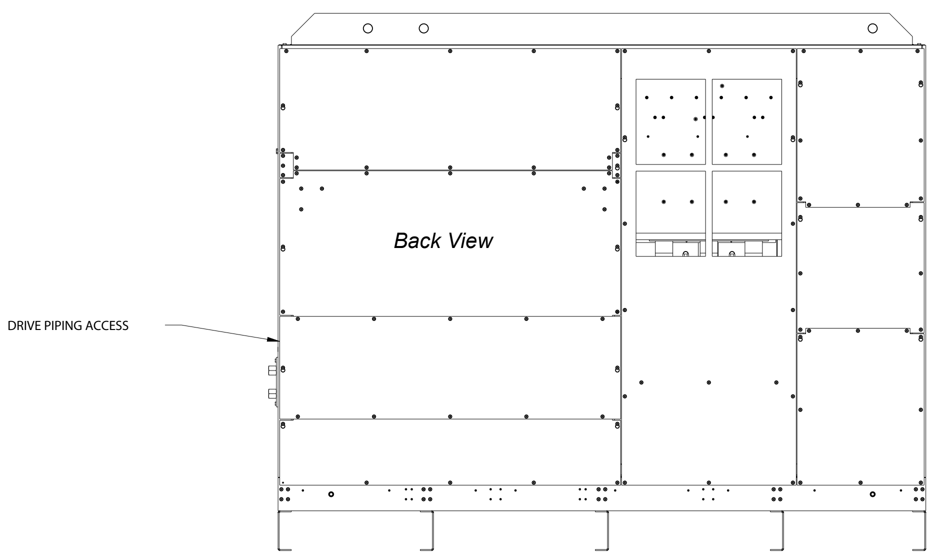
Figure 9. Drive cabinet dimensions: Frame 4 (dimensions in inches)[a]



(a) Material courtesy of Rockwell.

Figure 10. Drive cabinet dimensions: Frame 4 (dimensions in inches)[a]





(a) Material courtesy of Rockwell.

Tools Required

Common hand tools and hand-held power tools are required to perform the retrofit. A trained service technician with a well-stocked tool chest should have all of the necessary tools to perform the job. The following list is a sampling of the tools that one could expect to find inside the technician tool chest:

- Electric drill and bit set
- Hacksaw or reciprocating saw
- Extension cord
- Screwdrivers
- Wrenches
- Ratchet and socket set
- Torque wrench
- Nut driver set
- Wire cutter
- Wire stripper
- Digital multi-meter, with phase detection capability

The following special tools are also required to perform the retrofit:

Note: *Some field provided material will be required to perform the replacement. This is a partial list in addition to normal service tools and hardware.*

- Overhead or portable hoist (minimum 2-ton rated capacity)
- Spreader bar
- Type A to type B USB cable
- Computer having Tracer™ TU version 4.0 or newer

Additional Components

Additional components may be required to perform the AFDK retrofit. These components depend on the options selected and the existing equipment. A list of additional components available from Trane is provided in Table 2. Some of these components may be added to an order depending on the model number selected.

Table 2. Options and accessories

Item	Part number	Description	Qty
1	20600790100	Kit; Valve and Hardware kit for AFDK	1
		Corrosion Inhibitor	1
		Low pressure transducer; (PX) 0–50 PSIA, with integral male global connector	1
		Branching cable; Male to two Female, 39.37-inches long	1
		Extension cable; Male to Female, 39.37-inches long	1
		Shorting buss bar kit; contains 3 bars and 12 x 0.75-16 in. hex jam nuts	1
		Shorting buss bar kit; contains 3 bars and 12 x 0.75-16 in. hex jam nuts	1
		Shorting buss bar kit; contains 3 bars and 12 x 0.75-16 in. hex jam nuts	1
		Shorting buss bar kit; contains 3 bars and 12 x 1.12-12 in. hex jam nuts	1
		Strainer; 3/4 NPTI x 3/4 NPTI w/drain	1
		Valve; Ball, 3/4 copper to copper	2
		Bushing; 1 NPTE x 3/4 NPTI	2
		Adapter; 3/4 FTG x 1/2 M	2
		Adapter; 3/4 FTG x 3/4 M	1
		Adapter; 3/4 FTG x 3/4 F	1
		Valve; Ball, 1/4 copper to copper	1
		Adapter; 1/4 FTG x 1/4 F	1
2	20600080100	Hardware; Primary Loop Fittings	1
		Adapter; 3/4Female JIC Flare X 3/4 ID Hose	8
		Elbow; 3/4NPTE X 3/4 Male JIC Flare, 90°	4
		Clamp; Hose – 1.00 ID	8
		Adapter; 3/4NPTI X 3/4 Male JIC Flare	1
		Elbow; 3/4Female JIC Flare X 3/4 Male JIC Flare, 45°	1
		Elbow; 3/4NPTE X 3/4 Male JIC Flare, 45°	4
3	20600090100	Hardware; Secondary Loop Fittings	1
		Adapter; 3/4Female JIC Flare X 3/4 ID Hose	8
		Elbow; 3/4NPTE X 3/4 Male JIC Flare, 90°	4
		Clamp; Hose – 1.00 ID	8
		Adapter; 3/4NPTI X 3/4 Male JIC Flare	1
		Elbow; 3/4Female JIC Flare X 3/4 Male JIC Flare, 45°	1
		Elbow; 3/4NPTE X 3/4 Male JIC Flare, 45°	4
4	20600880100	Assembly; PUMP/HX Water to Water Frame 3	1
5	20600890100	Assembly; PUMP/HX Water to Water Frame 4	1
6	20600900100	Assembly; PUMP/HX Water to Air Frame 3	1
7	20600910100	Assembly; PUMP/HX Water to Air Frame 4	1
8	HSE01285	Hose; 3/4 ID, Rubber, Cloth Braid, 300 PSI	30 FT
9	HSE01286	Hose; 3/4 ID, Rubber, Cloth Braid, 300 PSI	60 FT
10	HSE01287	Hose; 3/4 ID, Rubber, Cloth Braid, 300 PSI	120 FT
11	CHM00481	Corrosion Inhibitor	1
12	PAI00061	Paint; Executive Beige, Spray	1

In addition to the required components listed in Table 2, motor brushes may optionally be installed. Motor brushes reduce the wear on compressor motor bearings due to the additional stresses from the application of adjustable speed drives. Table 3, p. 22 provides the part numbers necessary for motor brush installation.

Table 3. Motor brush installation part numbers

Compressor family	Motor frame size	Manufacturing date	Brush kit	Inspection cover	Rotor bolt
CVHE	360, 400	Before 9/24/2004	BRU00428	COV03609	KIT12220
		After 9/24/2004	BRU00428	None	None
	440E	Before 9/24/2004	BRU00429	COV03610	KIT12220
		After 9/24/2004	BRU00429	None	None
CVHG	400	Before 9/24/2004	BRU00428	COV03609	KIT12220
		After 9/24/2004	BRU00428	None	None
CVHF	400, 440E, 5000	Before 9/24/2004	BRU00428	COV03610	KIT12220
		After 9/24/2004	BRU00428	None	None

Field - Provided Material

Some field-provided material will be required to perform the AFDK retrofit. A partial list of material is provided below to help the technician plan ahead and to avoid material shortages at the job site.

Note: *The materials required will vary by drive options and application. Wire sizes are recommendations only. All wiring must be sized per local and national building codes.*

- Teflon® paste (for pipe threads)
- Wire, copper, 14 AWG
- Wire, shielded, twisted pair – recommend Belden® type 8760, 18 AWG
- Wire, copper, 4/0 on remote-mounted drives (not required on unit-mounted starters).
- Fasteners to secure enclosure to floor; refer to "Remote-Mounted (Water-Cooled)," p. 24 (not required on unit-mounted starters).
- Loctite® 515 sealant (not required on remote-mounted starters).

Lifting Procedure

The maximum weight of the drive and the enclosure is 1520 lb (689 kg) for Frame 3 and 2800 lb (1270 kg) for Frame 4.

⚠WARNING

Heavy Objects!

Failure to properly lift unit could result in death or serious injury.
Do not use cables (chains or slings) except as shown. Each of the cables (chains or slings) used to lift the unit must be capable of supporting the entire weight of the unit. Lifting cables (chains or slings) may not be of the same length. Adjust as necessary for even unit lift. Other lifting arrangements may cause equipment or property-only damage.

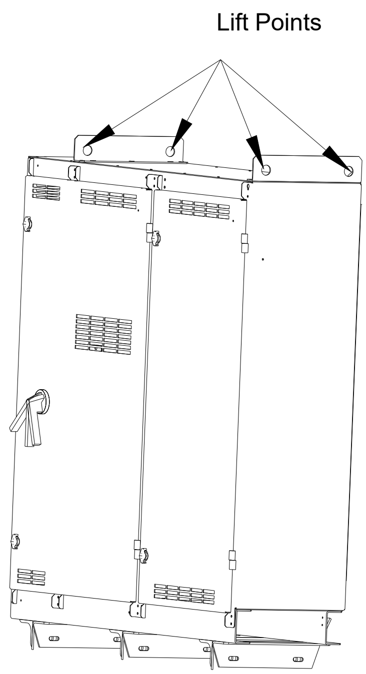
⚠WARNING

Improper Unit Lift!

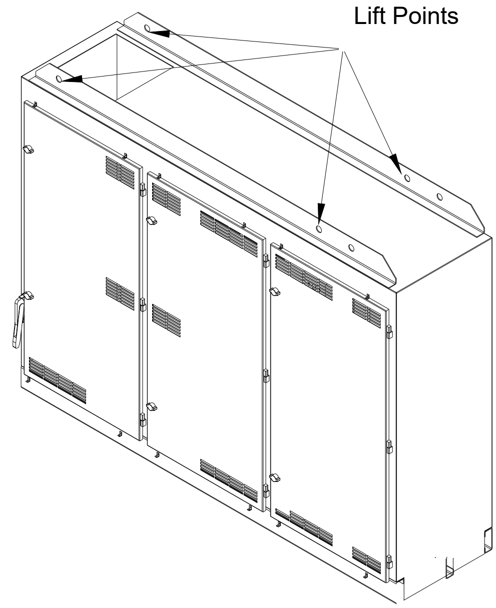
Failure to properly lift unit in a LEVEL position could result in unit dropping and possibly crushing operator/ technician which could result in death or serious injury, and equipment or property-only damage.
Test lift unit approximately 24 inches (61 cm) to verify proper center of gravity lift point. To avoid dropping of unit, reposition lifting point if unit is not level.

Use an overhead or portable hoist (minimum 2-tons rated capacity) and connect it to the enclosure using slings or chains. Rig in a manner that will equalize the load at the pickup points. Use a spreader bar if the angle of the sling or chains is less than 45 degrees relative to the horizontal. Take up the vertical slack. A fork lift truck or similar means of lifting or transporting the drive may also be used if care is taken. See Figure 11, p. 23.

Figure 11. Lift point locations for LiquiFlow 2.0 drives



Frame 3



Frame 4

Mounting

Unit-Mounted (Refrigerant-Cooled)

1. If present, disconnect existing power wiring and ground connection.
2. Remove existing drive following the instructions given in *Liquid Cooled Adaptive Frequency™ Drive with Tracer AdaptiView™ Control Installation, Operation, and Maintenance* (AFDE-SVU02*-EN).

⚠WARNING

Refrigerant under Positive Pressure!

Failure to recover refrigerant to relieve pressure or the use of non-approved refrigerants, refrigerant substitutes, or refrigerant additives could result in an explosion which could result in death or serious injury or equipment damage.
System contains oil and refrigerant and may be under positive pressure. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or refrigerant additives.

3. Carefully lift the drive into place. Do not bump or jolt the drive while lifting. Refer to "Lifting Procedure," p. 22.
4. Replace the mounting hardware used to secure the drive enclosure to the lower mounting brackets. The bolts should be torqued to 21 ft·lb (28.5 N·m).
5. Replace the mounting hardware used to secure the drive enclosure to the motor terminal transition piece or terminal board. The bolts should be torqued to 90 ft·lb (122 N·m).
6. Verify the flange fittings on the cabinet and the CenTraVac chillers tubing are free of dirt, burrs, and excessive nicks.
7. On both the inlet and outlet connections place a new flange gasket over the studs on the back side of the drive.

   Notes:

   - *Coat all gaskets very lightly with Loctite® 515 sealant.*
   - Frame 3 drives (405, 600 A) only: *On the refrigerant inlet connection to the drive, place the inlet orifice plate over the first gasket, then place another new gasket over the orifice plate.*
8. Align the chiller tubing and flanges over the studs on the drive so that the flanges are straight and parallel. Place the proper washers and nuts over the studs and snug them up by hand. Be careful to maintain the parallel alignment of the flanges.
9. Use a socket and torque wrench to further tighten the flange bolts to their proper torques. Tighten the flange bolts in small equal steps to ensure an equal draw-down of the flange onto the gasket.

   Flange Bolt Torques:

   1/2-in. bolts = 90 ft·lb (122.1 N·m)

   5/16-in. bolts = 22 ft·lb (29.9 N·m)
10. Inspect the connection for leaks.
11. Replace the panels and screws on the backside of the drive that cover the refrigerant connections.
12. Reconnect the Flexibar conductors at the motor terminals. The Flexibar connections to the motor terminals should be torqued to 27 ft·lb (36.6 N·m). Refer to "Installing Unit-Mounted Output Conductors," p. 35.
13. Reconnect power, ground, and control wiring connections. Refer to "Input Power and Control Wiring," p. 33.

Remote-Mounted (Water-Cooled)

1. Remove existing power connections and starter.
2. Prepare the location to install the drive.

Important:

- *The length of wire between the AFDK terminals and the motor terminals must be no greater than 250 feet. The maximum piping distance between the AFDK, heat-exchanger assembly, and cooling source are described in "Plumbing," p. 26. Ensure that the location selected will not require wiring or piping distances greater than these defined maximums.*
- *Verify the location meets the requirements described in "Environmental Conditions," p. 8.*
- *Clearances reserved for service and air-flow must be maintained.*

3. Frame 3 drives (405, 600 A) are provided with three floor mounting rails. Frame 4 drives (900, 1200 A) are provided with five floor mounting rails. These rails must be installed and secured to the floor by the following customer supplied hardware:

	Quantity	
	Frame 3	**Frame 4**
Hardware to Install Floor Mounting Rails		
1/2-13 X 1.500 Bolt	6	10
1/2 Flat Washer	10	20
1/2 Lock Washer	6	10
1/2-13 Nut	4	10
Hardware to Secure Enclosure to the Floor		
1/2 x 3-in. Lag Screw	6	10
1/2in. Fender Washer	6	10
1/2-in. Anchor	6	10

4. Attach floor mounting rails to the bottom of the enclosure.
5. Install anchors in floor.
6. Carefully lift the drive into place. Do not bump or jolt the drive while lifting. Refer to "Lifting Procedure," p. 22.
7. Secure the floor mounting rails to the floor using lag screws and washers.

8. Install and connect one of the cooling systems described in “Plumbing,” p. 26.
9. Connect power, ground, and control wiring connections. Refer to “Input Power and Control Wiring,” p. 33.

Plumbing

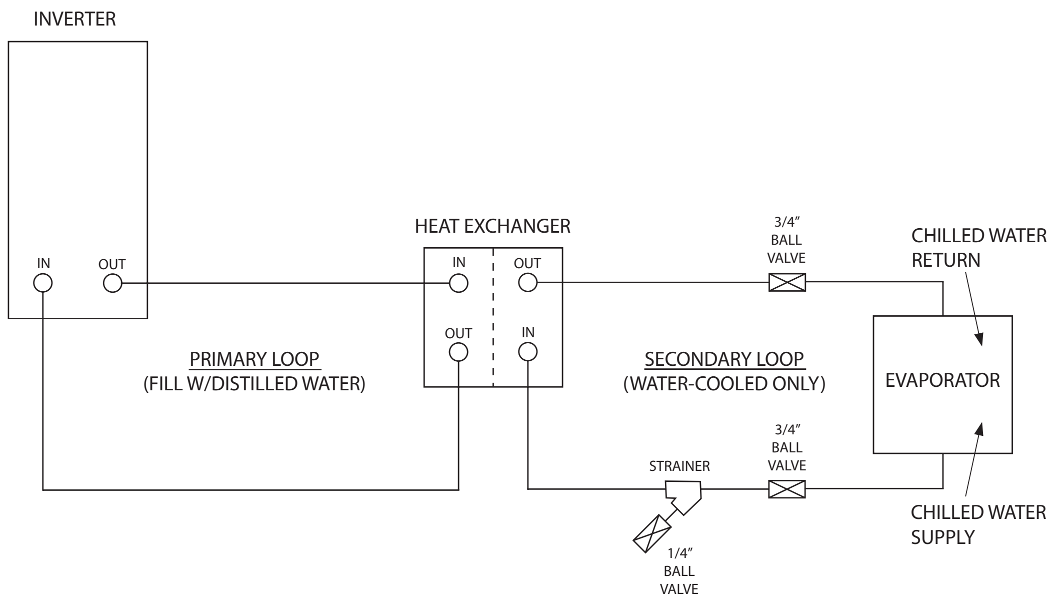
When the AFDK is installed in a remote-mount application, the drive must be cooled by a water-to-water heat exchanger or a water-to-air heat exchanger. The drive must be paired with the correct heat exchanger for proper operation. Table 4 lists the Trane part numbers for the correct heat exchanger. These assemblies include both the heat exchanger and cooling pump.

Table 4. Trane part numbers for heat exchangers

Drive frame	Heat exchanger	
	Water-to-water	**Water-to-air**
Frame 3 Drives (405, 600 A)	020600880100	020600900100
Frame 4 Drives (900, 1200 A)	020600890100	020600910100

Figure 12 shows the typical connections for drive cooling. The minimum size of pipe or hose used in the primary loop is 3/4-in. ID.

Figure 12. Typical connections for drive cooling[(a)]



(a) Material courtesy of DIMPLEX Thermal Solutions.

To provide proper cooling, the piping used to connect the heat exchanger to the drive and cooling supply must not be too long. Because the size and routing of the pipe or hose used affects the pressure drop and flow of the system, the maximum distance must be calculated for each installation. Table 5, p. 26 contains the available head pressure for each heat-exchanger assembly, and Table 6, p. 27 contains the pressure information associated with commonly used parts for constructing the cooling loops.

To calculate the maximum piping distance for the primary loop, complete the following steps:

1. Select the available pump head fromTable 5, p. 26.
2. Use Table 6, p. 27 to locate the pressure drop at minimum flow due to the heat exchanger, drive, and fittings used. Subtract the sum of these values from the available pump head and save this result.
3. Use Table 6, p. 27 to locate the pressure drop at minimum flow due to each foot of tubing that is planned to be used in the primary loop. Divide the value obtained in Step 2, p. 26 by this number. The result of this calculation is the maximum length of tubing that may be used in the secondary loop.

   Note: *The maximum length of tube includes both the supply tube and return tube. The distance between the drive and heat exchanger should be half the maximum tube length or less.*

4. Verify that the distance needed for installation does not exceed the maximum distances obtained by this calculation.

   Note: *If the calculated distance using 3/4-inch tubing does not provide an adequate distance for installation, recalculate the maximum distance using 1-inch tubing and fittings.*

Table 5. Available pump head (ft of water)

	Frame 3	Frame 4
Air-Cooled	140	90
Water-Cooled	100	70

Table 6. Pressure drops for primary loop components at minimum flow (ft of water)

	Frame 3	Frame 4
	405 A and 600 A	900 A and 1200 A
Air-Cooled Heat Exchanger	3	12
Water-Cooled Heat Exchanger	3	12
Drive	23	23
3/4-in. Tube (each foot)	0.17	0.68
1-in. Tube (each foot)	0.043	0.17
3/4-in. Straight Coupling	0.55	2.2
3/4-in. 45° Coupling	0.62	2.4
3/4-in. 90° Coupling	0.62	2.4
3/4-in. 90° Elbow Adapter	0.32	1.3
3/4-in. 45° Elbow Adapter	0.17	0.68
1-in. Straight Coupling	0.16	0.62
1-in. 45° Coupling	0.18	0.71
1-in. 90° Coupling	0.18	0.71
1-in. 90° Elbow Adapter	0.11	0.43
1-in. 45° Elbow Adapter	0.058	0.23

The flow in the secondary loop is established by the pressure drop across the chiller evaporator. To calculate the maximum piping distance for the secondary loop, complete the following steps:

1. Measure the available pressure between the inlet and the outlet of the chiller evaporator. This value will vary from chiller to chiller due to equipment and system differences.
2. Use Table 7 to locate the pressure drop at minimum flow due to the heat exchanger and fittings used. Subtract these values from the available pressure and save this result.
3. Use Table 7 to locate the pressure drop at minimum flow due to each foot of tubing that is planned to be used in the secondary loop. Divide the value obtained in Step 2, p. 27 by this number. The result of this calculation is the maximum length of tubing that may be used in the secondary loop.

   Note: *The maximum length of tube includes both the supply tube and return tube. The distance between the chiller and heat exchanger should be half the maximum tube length or less.*
4. Verify that the tube length needed for installation does not exceed the maximum tube length obtained by this calculation.

   Note: *If the calculated distance using 3/4-inch tubing does not provide an adequate distance for installation, recalculate the maximum distance using 1-inch tubing and fittings.*

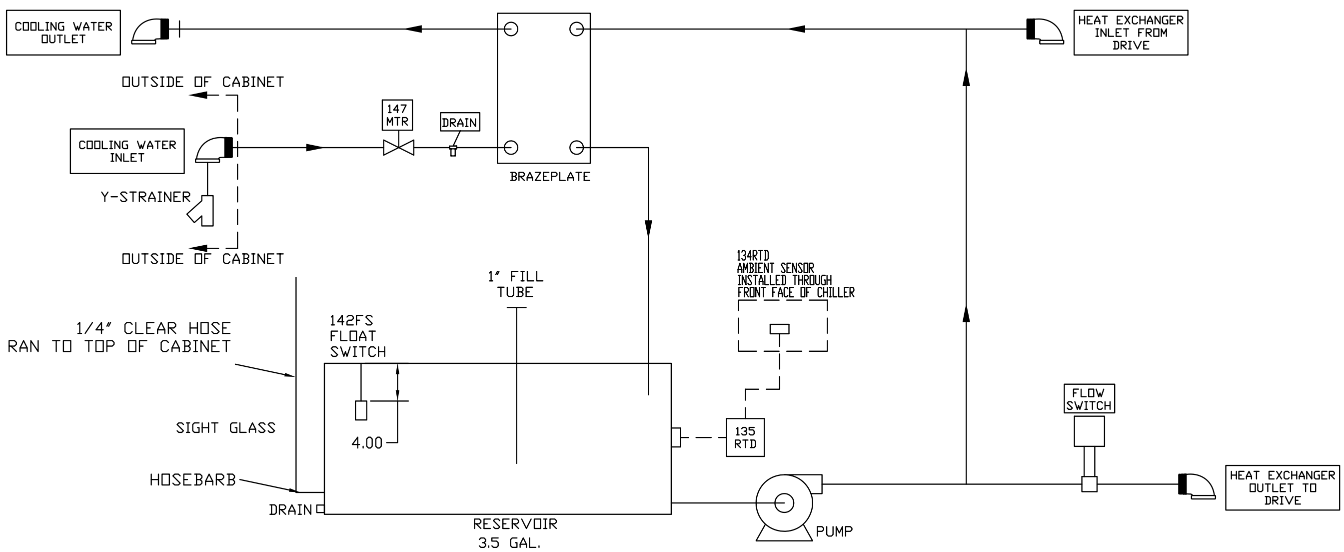
Table 7. Pressure drops for secondary loop components at minimum flow (ft of water)

	Frame 3		Frame 4	
	405 A	600 A	900 A	1200 A
Water-Cooled Heat Exchanger	1	1.8	3	6.5
3/4 in. Tube (each foot)	0.066	0.14	0.23	0.47
1 in. Tube (each foot)	0.017	0.035	0.058	0.12
3/4 in. Straight Coupling	0.21	0.44	0.73	1.5
3/4 in. 45° Coupling	0.24	0.49	0.82	1.7
3/4 in. 90° Coupling	0.24	0.49	0.82	1.7
3/4 in. 90° Elbow Adapter	0.12	0.26	0.43	0.89
3/4 in. 45° Elbow Adapter	0.066	0.14	0.23	0.47
1 in. Straight Coupling	0.061	0.13	0.21	0.44
1 in. 45° Coupling	0.069	0.14	0.24	0.5
1 in. 90° Coupling	0.069	0.14	0.24	0.5
1 in. 90° Elbow Adapter	0.042	0.086	0.14	0.3
1 in. 45° Elbow Adapter	0.022	0.046	0.077	0.16

Water-to-Water Heat Exchanger

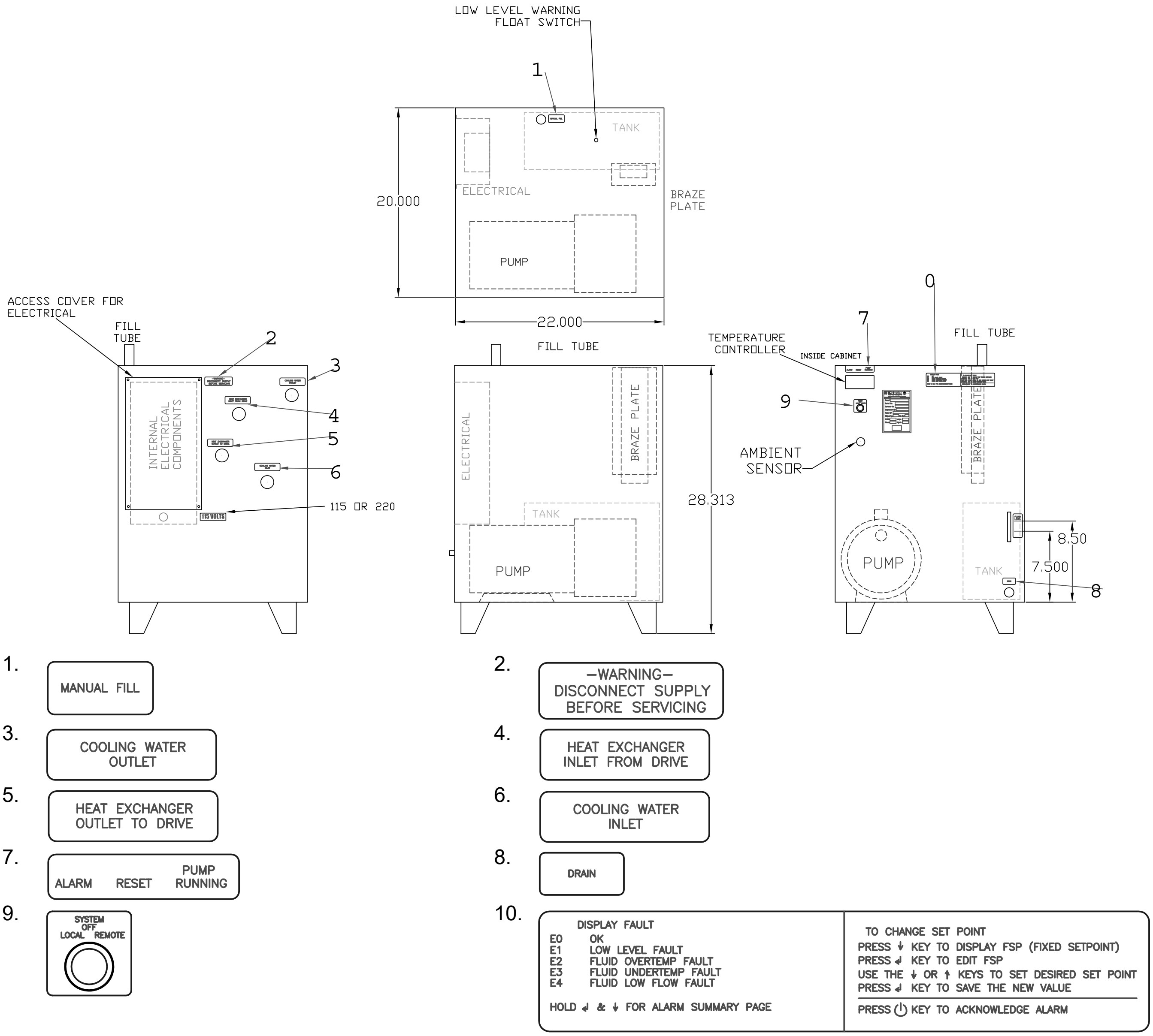
Figure 13 shows the piping diagram of the heat-exchanger assembly. Figure 14, p. 29 shows the dimensions of the heat exchanger assembly as well as the locations of piping and electrical connections.

Figure 13. Water-to-water heat exchanger piping diagram[a]



(a) Material courtesy of DIMPLEX Thermal Solutions.

Figure 14. Heat exchanger layout diagram (dimensions in inches)[(a)]



(a) Material courtesy of DIMPLEX Thermal Solutions.

Installation

1. Ensure the unit is placed on a flat, level, hard surface in a location that allows adequate room for servicing per local codes. The weight of both water-cooled heat exchangers is 350 lb. Attach the assembly to the floor using the hardware in Table 8.

Table 8. Installation hardware

Hardware	Qty
3/8 x 3-in. Lag screw	4
3/8-in. Fender washer	4
3/8-in. Anchor	4

2. Connect process fluid lines to the proper fittings. Make sure that the flow of fluid to and from the unit cannot be shut off or blocked while the system is in operation.
3. Table 9, p. 30 details the connections. Some of the necessary fittings may be included in the accessory kits shipped separately from the drive (refer to "Additional Components," p. 21).

   Note: *For NPTE fittings, use Teflon® paste (recommended) or Teflon tape. If using tape, wrap threads of fitting with two complete wraps of the Teflon tape. Wrap in clockwise direction when viewed from the pipe thread end. Do not use Teflon tape or other sealant on JIC portion of fittings.*

Table 9. Water-to-water heat exchanger connections

Attachment point	Fitting(s) required
Pump outlet	• 90° elbow, 3/4 NPTE x 3/4 male JIC
AFD panel outlet	• 90° elbow, 3/4 NPTE x 3/4 male JIC
AFD panel inlet	• 90° elbow, 3/4 NPTE x 3/4 male JIC
Heat exchanger inlet	• 90° elbow, 3/4 NPTE x 3/4 male JIC
Heat Exchanger outlet (top right of Heat Exchanger)	• Adapter, 3/4 NPTI x 3/4 male JIC • Elbow, 45°, 3/4 female JIC x 3/4 male JIC
Control valve inlet or HX inlet (bottom right of bulkhead)	• Elbow, 45°, 3/4 NPTE x 3/4 male JIC
Evaporator or condenser high side (assumes using 1/2-in. tapped connection)	• Adapter, 3/4 FTG x 1/2 NPTE • Ball valve, 3/4 copper to copper • Adapter, 3/4 FTG x 3/4NPTE • Strainer, 3/4 NPTI x 3/4 NPTI w/ 1/4 drain. • 45° elbow, 3/4 NPTE x 3/4 male JIC
Evaporator or condenser low side (assumes using 1/2-in. tapped connection)	• Adapter, 3/4 FTG x 1/2 NPTE • Ball valve, 3/4 copper to copper • Adapter, 3/4 FTG x 3/4 NPTI • 45° elbow, 3/4 NPTE x 3/4 male JIC

4. Connect power leads to main disconnect (refer to Figure 14, p. 29 for power connection location). Wiring should match power requirements on the assembly nameplate in accordance with local codes (refer to Table 10).

Table 10. Heat exchanger power requirements

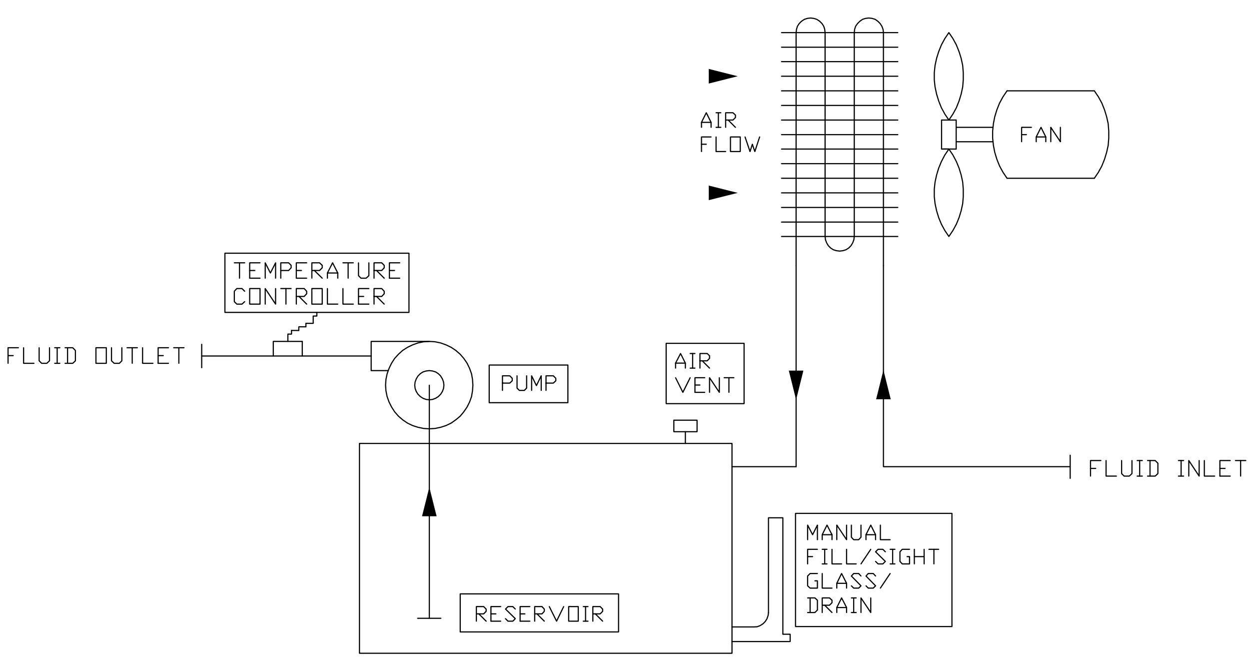
Heat Exchanger	FLA	Volts/Phase/Hz
020600880100	10 A	115/1/60
020600890100	10 A	115/1/60

5. Wire the customer remote contact connection to the pump control relay in the drive enclosure. This connection gives the drive control of the cooling assembly (refer to "Standard Control Wiring," p. 37, for AFDK termination location and requirements).
6. Fill the reservoir tank through the manual fill port to a level between the two black indicators on the sight glass. The process fluid in the primary cooling loop should be distilled water treated with an inhibitor solution. The secondary water loop may be filled with condenser water. For a more detailed description of process fluids including addition of inhibitor solution, refer to "Corrosion," p. 32.
7. Turn the control switch to **ON** position. The circulating pump should begin rotation.
8. Continue circulating pump for five minutes to allow air in system to be vented.
9. Ensure all process fluid lines and shutoff valves are open and the system is able to flow freely. Re-check the fluid level in the system before continuing with the start-up and note start-up pressure on fluid ports as a baseline.

Water-to-Air Heat Exchanger

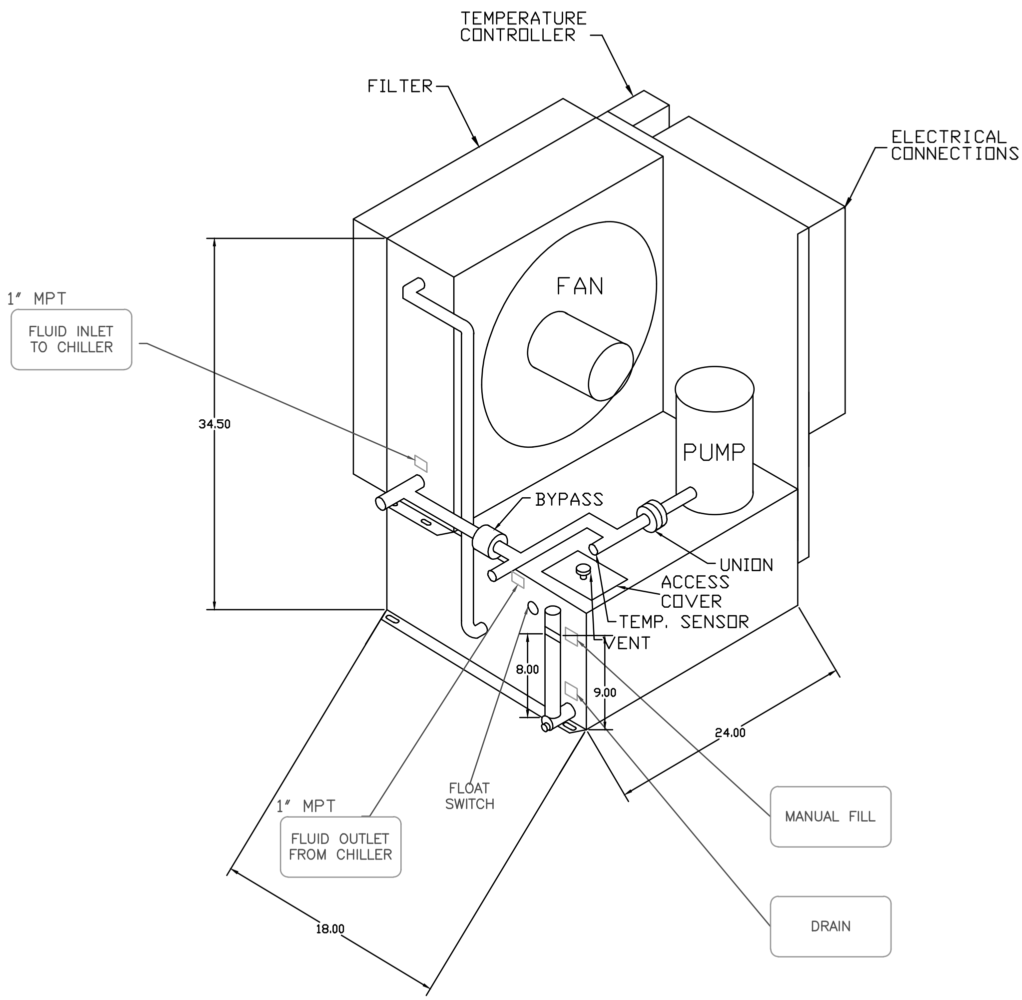
Figure 15 shows the piping diagram of the heat-exchanger assembly. Figure 16, p. 31 shows the dimensions of the heat exchanger assembly as well as the locations of piping and electrical connections.

Figure 15. Water-to-air heat exchanger piping diagram[a]



(a) Material courtesy of DIMPLEX Thermal Solutions.

Figure 16. Heat exchanger layout diagram (dimensions in inches)(a)



(a) Material courtesy of DIMPLEX Thermal Solutions.

Installation

1. Ensure the unit is placed on a flat, level, hard surface in a location that allows adequate room for servicing per local codes. The weight of the Frame 3, air-cooled heat exchanger is 325 lb; the weight of the Frame 4, air-cooled heat exchanger is 525 lb. The assembly requires a minimum of 3 feet of free space on both the air inlet and outlet. Attach the assembly to the floor using the hardware in Table 11.

Table 11. Installation hardware

Hardware	Qty
3/8 x 3-in. Lag screw	4
3/8-in. Fender washer	4
3/8-in. Anchor	4

2. Connect process fluid lines to the proper fittings. Make sure that the flow of fluid to and from the unit cannot be shut off or blocked while the system is in operation.

3. Table 12 details the connections. Some of the necessary fittings may be included in the accessory kits shipped separately from the drive (refer to "Additional Components," p. 21).

   Note: *For NPTE fittings, use Teflon® paste (recommended) or Teflon tape. If using tape, wrap threads of fitting with two complete wraps of the Teflon tape. Wrap in clockwise direction when viewed from the pipe thread end. Do not use Teflon tape or other sealant on JIC portion of fittings.*

Table 12. Water-to-air heat exchanger connections

Attachment Point	Fitting(s) Required
Pump outlet	90° elbow, 1 NPTI x 3/4 male JIC
AFD panel outlet	90° elbow, 3/4 NPTE x 3/4 male JIC
AFD panel inlet	90° elbow, 3/4 NPTE x 3/4 male JIC
Heat exchanger inlet	90° elbow, 1 NPTI x 3/4 male JIC

4. Connect power leads to main disconnect (refer to Figure 16, p. 31 for power connection location). Wiring

should match power requirements on the assembly nameplate in accordance with local codes (refer to Table 13).

Table 13. Heat exchanger power requirements

Heat Exchanger	FLA	Volts/Phase/Hz
020600900100	3 A	460/3/60
020600910100	5.1 A	460/3/60

5. Wire the customer remote contact connection to the pump control relay in the drive enclosure. This connection gives the drive control of the cooling assembly (refer to “Standard Control Wiring,” p. 37, for AFDK termination location and requirements).
6. Fill the reservoir tank through the manual fill port to a level between the two black indicators on the sight glass. The process fluid in the primary cooling loop should be distilled water treated with an inhibitor solution. For a more detailed description of process fluids including addition of inhibitor solution, refer to “Corrosion,” p. 32 and associated table from p. 104 of *Liquid Cooled Adaptive Frequency™ Drive* Operation and Maintenance (AFDB-OM-1C).
7. Turn the control switch to **ON** position. The circulating pump and fan should begin rotation. Verify the fan draws air through the coil.
8. Continue circulating pump for five minutes to allow air in system to be vented.
9. Ensure all process fluid lines and shutoff valves are open and the system is able to flow freely. Re-check the fluid level in the system before continuing with the start-up and note start-up pressure on fluid ports as a baseline.

Corrosion

The heat exchanger used in the application is stainless steel which is resistant to pitting and micro-galvanic corrosion in most conditions of operation. However, one can never do enough to completely prevent corrosion. Therefore, we have provided guidelines for water quality that would minimize the risk of corrosion and fouling.

Important: *The heat exchanger and components of the cooling loops must be cleaned and rinsed without fail immediately after shutdown.*

In addition, corrosion of copper components can be reduced if the pH of the water is maintained between 7.5 and 9.0, oxygen content is maintained below 0.1 ppm. Compounds such as hydrogen sulfide, ammonia, and compounds with chlorides must be avoided at all costs in the cooling loops. Water containing hydrazine is very good for prevention of corrosion of iron and copper.

Note: *Ammonia cannot be used in cooling tower water for this application.*

Recommended concentration limits for impurities in water to prevent micro-galvanic corrosion of unalloyed or galvanized iron is included in Table.

Note: *These values are only recommended values and cannot be considered as guarantees. Consult water quality specialists for ultimate authority.*

Table 14. Concentration limits of impurities in water

Ph	7.5 to 9.0
SO_4-	<90 ppm
Total hardness	4.0 to 8.0 dH
Fe^{3+}	<0.3 ppm
H_2S	<50 ppb
PO_4^{3}	<2.0 ppm
NH_3	<0.5 ppm
HCO_3-/SO_4	>1.25
Cl-	<100 ppm
Temperature	<45°C
Oxygen content	<0.1 ppm
Total dissolved solids	500 ppm of $CaCO_3$
Free chlorine	<0.4 ppm

Maintenance

Proper maintenance is the key to extending the life of the unit. Establish a regular schedule of maintenance depending on the amount of use and the environment. Units that are within environments that are very dirty or dusty will require more attention.

1. The process fluid should be clean and free of contaminants. Check for debris or contaminants in the reservoir which could reduce the efficiency.
2. Fluid filters should be clean to allow for proper flow and pressure in the system. An increased fluid pressure on the system may indicate a dirty filter. Replacement of fluid filters should be done at regular intervals to keep the fluid system clean and free flowing. Inspect fluid filters shortly after initial start-up of the chiller and to establish a baseline.
3. A proper fluid level (between the indicators on sight glass) should be maintained in the reservoir at all times. Visually check for fluid leaks throughout system.
4. Water-to-water heat exchangers equipped with cleanable exchangers are supplied with pressure gauges on the IN and OUT fluid ports. Note normal PSI at start-up and document as baseline (7–20 psi is normal, depending on design).

   Note: *If the pressure increases from start-up pressure by more than 5 psi, the heat exchanger requires service.*
5. Water-to-air heat exchangers may require cleaning on a periodic basis. To clean, blow compressed air or steam in a reverse direction through the coil.

Input Power and Control Wiring

Wire Sizing

Care should be taken to see that all interconnection wiring and ground wiring is sized and installed in conformance with the National Electrical Code (NEC), the National Fire Protection Association (NFPA), or the Canadian Electrical Code (CEC) as applicable, and other appropriate local codes. Refer to controller and motor nameplates for electrical data. Refer to Table 16, p. 34 for the cable ranges of the input power circuit breaker and Table 17, p. 37 for cable rages of the remote-mounted drive output wiring.

Cabinet Wire Routing

All wiring should be installed in conformance with the applicable local, national, and international codes (for example, NEC/CEC). Control wiring enters the cabinet through the right side and terminates at the control panel terminal block. Tighten the control wire connections to 7.1 to 8.9 in·lb (0.8 to 1.0 N·m).

Torquing Electrical Power Connections

Use a torque wrench to tighten power connections. A torque wrench eliminates the human element and provides proper hardware tightening.

Proper torque for connections depends on both the bolting materials and the metals being connected. Strand migration will occur when the copper is under prolonged pressure.

Electrical power terminations should be rechecked for tightness when the apparatus is first installed and periodically afterwards. The conductor could flow under prolonged pressure. Thermal cycling will be greater during the first few months in operation.

Most hardware used for making a bolted electrical joint will be low carbon steel. The hardware does not carry electrical current but holds the two conducting surfaces together under pressure. When properly torqued, the slight elongation of the bolt or screw acts to maintain pressure on the electrical joint. The thermal expansion of steel is less than that of the conducting metals, which is usually copper.

The pressure at the electrical joint will vary slightly during thermal cycling and reduces somewhat when there is cold flow in the conducting metals. Re-torquing will re-establish the surface pressure, which is essential to keeping a low resistance drop between the two conducting surfaces and avoiding eventual failure.

Table 15. Torque value for AFDK output to motor

Bolt Size	Torque Value
3/8 in.	30 ft·lb (40.7 N·m)

NOTICE

Equipment Damage!

When tightening connections at the drive terminals, take care not stress the IGBTs. The IGBTs are connected to the other end of the terminal bar, and stressing them could cause equipment damage.

Installing Input Power Wiring Standard Cabinet

Use the following steps to connect ac input power to the cabinet:

⚠WARNING

Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

NOTICE

Line Side Wiring!

Failure to route the wires through the cores could result in bearing damage.
The electrical wiring from the drive output to the motor must be routed through the magnetic cores. The cores are used to protect the motor bearings.

1. Turn off, lock out, and tag the input power to the drive.
2. Remove the input wiring access panel from the top left of the drive enclosure. Refer to Figure 7, p. 17, Figure 8, p. 18, Figure 9, p. 19, and Figure 10, p. 20 for the exact location and dimensions of the input wiring access panels.

NOTICE

Equipment Failure!

Failure to follow this precaution could result in damaged equipment.
Do not cut holes in Adaptive Frequency™ Drive enclosure. Debris falling inside of Adaptive Frequency Drive could cause failure of electronic components.

3. Once removed, drill the wire routing holes in the panel. These wire routing holes are the only entry points for input power wiring into the cabinet.

4. Install the appropriate conduit hubs.
5. Re-install the cabinet top panel.
6. Connect the three-phase input power leads to circuit breaker terminals L1, L2, and L3. Tighten these connections to the values given in Table 16. Use only copper-conductors for the input power leads.

   Input power wiring should be copper and should be sized according to applicable codes to handle the drive continuous rated input current.

Important: *Power connections should be re-torqued after the first three to six months of operation and on an annual basis thereafter.*

Table 16. Circuit breaker terminal specifications

Frame size	Cable range	Wire binding screw torque
Frame 3 Drives (405, 600 A)	(3) 3/0 to 500 KCM	25 ft·lb (34 N·m)
Frame 4 Drives (900, 1200 A)	(4) 500 to 1000 KCM	45.8 ft·lb (62.1 N·m)

Grounding the Cabinet

Note: *Follow Applicable Codes! The user is responsible for conforming to all applicable, local, national, and international codes. Failure to observe this precaution could result in damage to, or destruction of, the equipment.*

Use the following steps to ground the cabinet:

1. Open the left-hand enclosure door of the drive. The grounding stud is located just above and to the right of the breaker.
2. Run a suitable earth ground (completed by field) to the cabinet ground connection point. The grounding lug is capable of accepting up to 2–600 MCM wire. Tighten the ground connections to 375 in·lb (42.4 N·m).

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury.
All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.

NOTICE

Equipment Damage!

Failure to observe this precaution could result in damage to the equipment.
Do not route signal and control wiring with power wiring in the same conduit. This can interfere with drive operation.

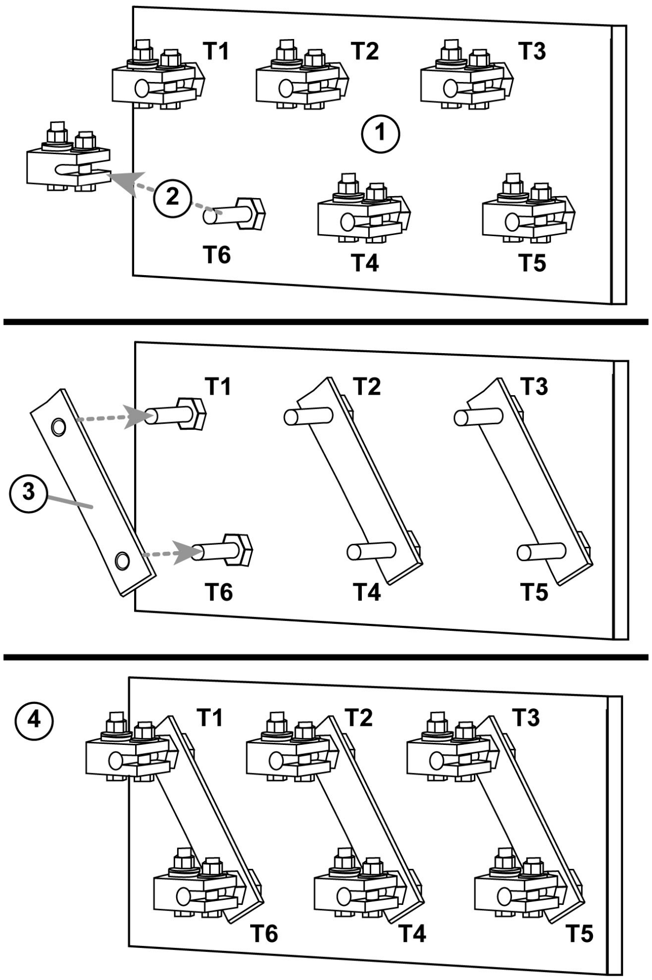
An input disconnect circuit breaker is factory-installed in the cabinet. Verify that the available fault current is less than the interrupting rating on the circuit breaker nameplate, which is 65,000 amps at 480 volts ac.

Installing Shorting Busbars

Note: *Shorting busbars must be installed since the AFDK is a three-lead device while the starter was a six-lead device. The wires must be connected (shorted) at both ends (at the AFDK and at the motor terminals) to ensure that there is no difference in potential between the two paired leads caused by different wire lengths. Some existing starters may have this done already.*

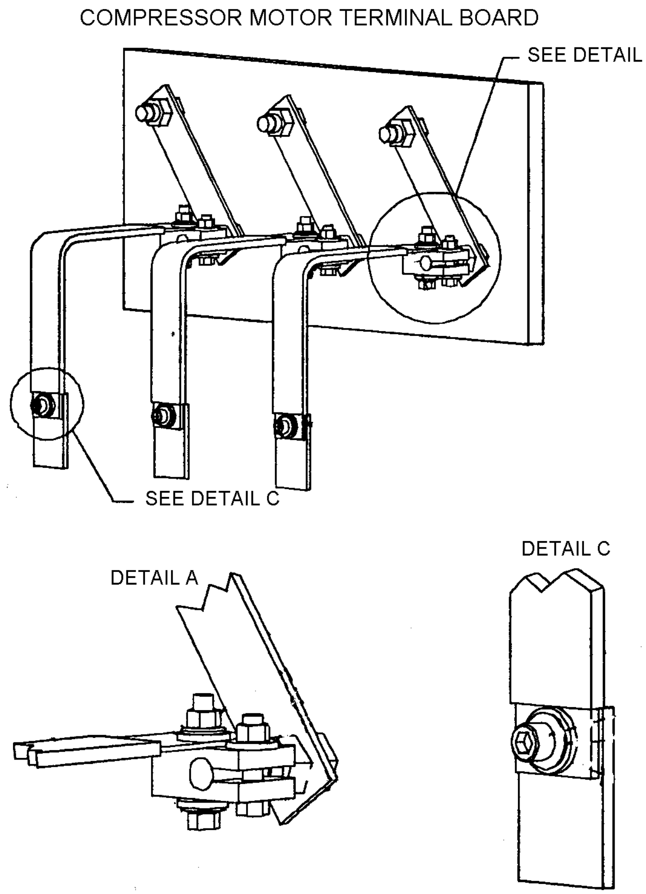
1. Remove the motor terminal lug from all six terminals on the compressor motor terminal board.
2. Install the three busbars provided, one each between the following motor terminal pairs
   a. T1 - T6
   b. T2 - T4
   c. T3 - T5
3. Re-install all of the motor terminal lugs.

Figure 17. Busbar installation on compressor motor terminal board



1. Compressor motor terminal board
2. Remove motor terminal lugs (from all 6 terminals).
3. Install shorting busbars across the motor terminal pairs as shown.
4. Motor terminal lugs re-installed

Figure 18. Motor connection assembly

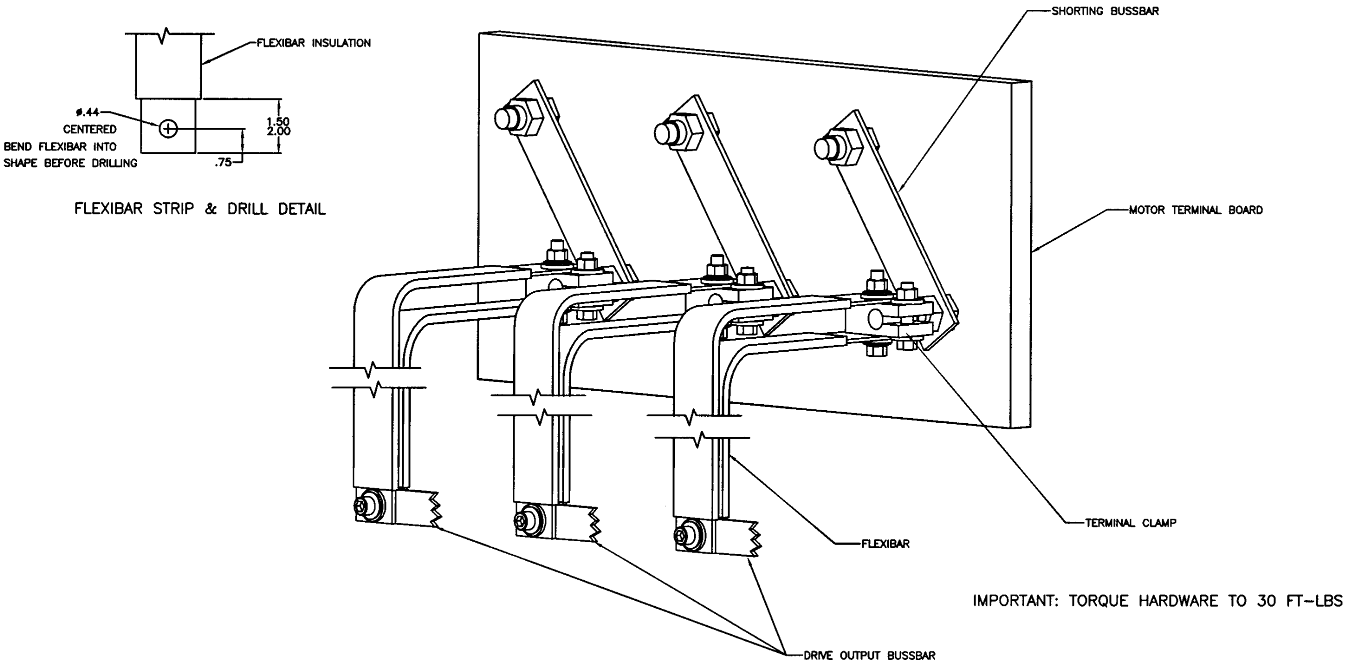


Installing Unit-Mounted Output Conductors

Unit-mounted drives are connected to the motor by Flexibar conductors.

1. Verify shorting bus bars are installed on motor terminals as described in "Installing Shorting Busbars," p. 34.
2. Verify Flexibar conductors are routed through the provided magnetic choke.
3. The Flexibar connections to the motor terminals should be torqued to 27ft·lb (36.6N·m); refer to Figure 18 and Figure 19, p. 36 for configuration.

Figure 19. 1000 hp AFD motor connection detail



Installing Remote-Mounted Output Wiring

⚠WARNING

Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

NOTICE

Load Side Wiring!

Failure to route the wires through the cores could result in bearing damage.
The electrical wiring from the drive output to the motor must be routed through the magnetic cores. The cores are used to protect the motor bearings.

1. Turn off, lock out, and tag the input power to the drive.
2. Remove the output wiring access panel from the top right of the drive enclosure. Refer to Figure 7, p. 17, Figure 8, p. 18, Figure 9, p. 19, and Figure 10, p. 20 for the exact location and dimensions of the output wiring access panels.

NOTICE

Equipment Failure!

Failure to follow this precaution could result in damaged equipment.
Do not cut holes in Adaptive Frequency™ Drive enclosure. Debris falling inside of Adaptive Frequency Drive could cause failure of electronic components.

3. Once removed, drill the wire routing holes in the panel. These wire routing holes are the only entry points for input power wiring into the cabinet.
4. Install the appropriate conduit hubs.
5. Re-install the cabinet top panel.
6. Install shorting busbars on compressor motor terminals; refer to "Installing Shorting Busbars," p. 34.
7. Connect the motor power leads to the AFD terminals U, V, and W. Table 17, p. 37 describes the cable ranges of the output lugs on the drive. Motor leads must be routed through the magnetic choke provided. The choke may be reinstalled in the vertical position for easier wire installation.

   Output power wiring should be only copper conductors and should be sized according to applicable codes.

Important: *Power connections should be re-torqued after the first three to six months of operation and on an annual basis thereafter.*

Table 17. Drive terminal specifications

Frame Size	Cable Range	Wire Binding Screw Torque
Frame 3 Drives (405, 600 A)	(2) 1 to 500 KCM	25 ft·lb (34 N·m)
Frame 4 Drives (900, 1200 A)	(2) 1/0 to 750 KCM	25 ft·lb (34 N·m)

Standard Control Wiring

⚠WARNING

Hazardous Voltage with Improper Grounding!

The motor controller has a chassis ground that MUST be connected to an earth ground. You MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes. Hazardous voltage due to improperly grounded electrical components could result in death or serious injury.

Table 18 indicates the typical control wiring for AFDK installation. Four knockouts have been provided on the left side of the AFDK enclosure for control and communication wires. For exact locations, refer to Figure 7, p. 17 and Figure 8, p. 18 for Frame 3 units and refer to Figure 9, p. 19 and Figure 10, p. 20 for Frame 4 units.

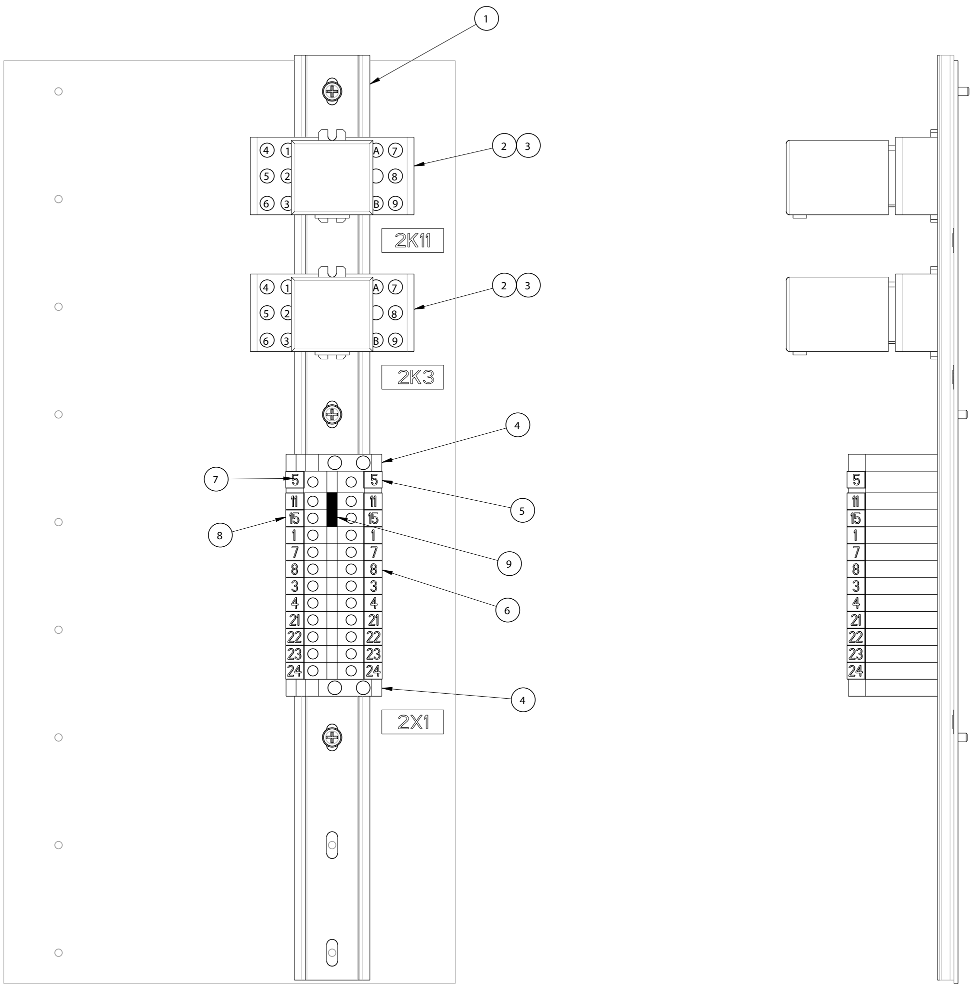
Table 18. CVHE, CVHF, and CVHG standard wiring requirements AFD control wiring (between the chiller and the starter)

AFD Starter to Control Panel Control Wiring	Starter Panel Terminations	Control Panel Terminations[(a)]	Comment
AFD 120 volts ac Power Supply (hot)	2X1-1	1X1-1	
AFD 120 volts ac Power Supply (neutral)	2X1-15	1X1-12	
Ground	2X1-11	1X1-18 or gnd	Panel ground
Oil Pump Interlock (2K11)	2X1-7, 2X1-8	1A7 to J2-4, J2-2	Normally Open
Condenser High Pressure Cutout (3S1)	2X1-3, 2X1-4 (shield to 2X1-5)	NA	Normally Closed. Operates the gate kill input on 2A33
Recomm Bus +24 V	2A32-1	1A1-J4-1	4-wire bus WB2 connects to power supply module 1A1, terminals J4-1, 2, 3, and 4
Recomm Bus Ground	2A32-2	1A1-J4-2	
Recomm Bus Com +	2A32-3	1A1-J4-3	
Recomm Bus -	2A32-4	1A1-J4-4	

(a) Termination numbers may differ if the controls are CH531 or a Tracer AdaptiView™ controls upgrade.

Control wiring should be terminated at the terminal block provided. The location of the control terminal block is called out as item 13 on Figure 1, p. 9 for Frame 3 units and item 13 on Figure 4, p. 13 for Frame 4 units. Figure 20, p. 38 shows an expanded view of the terminal block provided for control wiring. Field-installed control wiring should be routed so that it is segregated from factory installed wiring, unless the conductors of both circuits will be insulated for the maximum voltage of either circuit.

Figure 20. Expanded view of terminal block[(a)]



1. Din Rail
2. Relay Socket
3. Relay
4. End Barrier
5. Ground Terminal Block
6. Terminal Block
7. Tab
8. Tab
9. Jumper

(a) Material courtesy of Rockwell.

Communications wires should be terminated at the communication card (recomm) provided on the drive. The location of the communication card is called out as item 18 on Figure 3, p. 12 for Frame 3 units and item 16 on Figure 6, p. 16 for Frame 4 units. Field-installed communications wiring should be routed so that it is segregated from all other wiring.

Refer to specific chiller documentation for exact control panel connection locations.

In remote-mount applications, the AFDK must also be wired to control the drive-cooling assembly. 2X1-23 and 2X1-24 provide a normally open contact. When drive cooling is required, the contact will close and begin the cooling system operation.

The accurate pressure readings required by the chiller controls to enable the most efficient operation of the chiller with the retrofitted AFDK drive can only be effectively measured with a pressure transducer.

A condenser pressure transducer and associated communications cables are included in the Valve and Hardware kit for AFDK (020600790100). Mount the device and connect to the IPC bus. With a laptop connected to the chiller and with Tracer® TU or TechView™ running, enter the binding view menu. Highlight the device name, press bind button, and then select the physical device with a south pole magnet.

AFD Operation

Adaptive Frequency Drive Control

Introduction

Achieving Efficiency

Adjustable speed impeller control is used to improve CenTraVac™ chiller efficiency at part-load while tower relief is available. This occurs because the addition of the variable frequency drive gives the chiller control an extra degree of control freedom. The combination of inlet guide vane position and variable speed creates the possibility to control both chiller capacity and compressor efficiency. By manipulating speed and inlet guide vane position, it is possible to adjust the aerodynamic loading on the compressor to operate in a region of higher efficiency.

Challenges

There are challenges associated with achieving high efficiency. The region of higher efficiency is near the compressor surge boundary. Surge occurs when the compressor can no longer support the differential pressure required between the evaporator and condenser. Reducing compressor speed can improve efficiency; however, at some point the reduced impeller speed does not add enough dynamic pressure to the discharged refrigerant. When the total pressure (static + dynamic) leaving the compressor is less than the condenser pressure, refrigerant will start to flow backwards from the condenser. The flow reversal from the condenser to the compressor discharge creates a sudden loss of the dynamic pressure contribution from the compressor. Refrigerant flows backwards through the compressor creating an unpleasant audible noise. Surge is avoided when possible because it causes a loss of efficiency and cooling capacity if the compressor is allowed to cycle in and out of surge for an extended period.

Solutions

The adjustable speed control algorithm of the control was developed to operate near the surge boundary by periodically testing to find the surge boundary and then holding conditions at an optimal distance from surge. Once the optimal operating condition is found the algorithm can avoid the surge in the future. When surge is detected, a surge recovery routine makes adjustments to move out of surge, reestablishes stable operating conditions, and adjusts the control boundary to avoid surge in the future.

Chiller and AFD Sequence of Operation

The chiller/AFD sequence of operation is identical to a standard fixed speed chiller. Chiller capacity control, safeties, and limits work in the same manner regardless of whether an AFD is present.

The speed control algorithm will simultaneously set Inlet Guide Vane (IGV) position and compressor speed to achieve a desired compressor loading command while holding a fixed margin of safety between the compressor operating point and compressor surge. In order to quantify nearness to surge, a non-dimensional parameter called compressor pressure coefficient is used as a measure of surge potential. Decreasing motor speed increases the compressor pressure coefficient. The goal of the AFD control algorithm is to reduce speed enough to increase the pressure coefficient to the surge boundary.

Compressor Pressure Coefficient

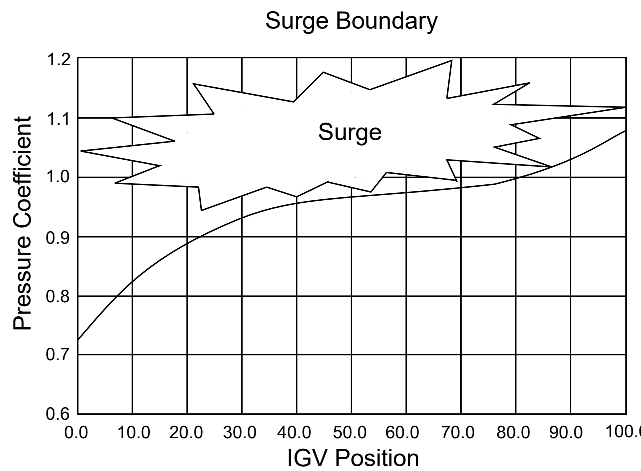
The non-dimensional pressure coefficient is derived based on turbo machinery principles. Fundamentally, the pressure coefficient is the ratio between the potential energy based on the pressure rise across the compressor and the kinetic energy of the refrigerant at the compressor discharge. This normalized equation uses enthalpy change across the compressor as a measure of potential energy and compressor parameters such as average impeller diameter, speed, and number of stages, to determine kinetic energy.

The kinetic energy can be reduced by reducing the condenser pressure. To achieve condenser pressure reduction, reduce the temperature of the entering tower water. To obtain the best efficiency, follow a tower relief schedule at whenever practical. For assistance with optimizing tower relief, contact Trane controls personnel.

Surge Boundary

Surge boundary is a non-linear, empirically derived function of the compressor load. The compressor pressure coefficient boundary is defined as a function of IGV position as shown on Figure 21.

Figure 21. Pressure coefficient surge boundary



AFD Speed Control

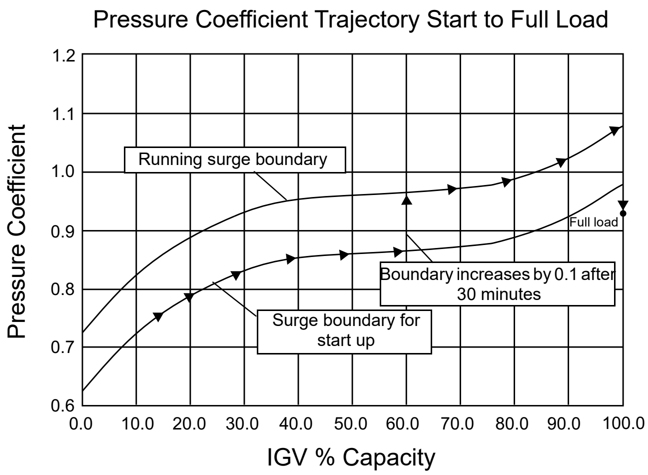
The chiller control utilizes an enhanced control method capable of simultaneously adjusting compressor speed and inlet guide vane position to achieve the desired chiller capacity and pressure coefficient. At the heart of the control is a match model that describes the relationship between control parameters and actuators. This model has converted a complicated multi variable control problem to a system of algebraic equations. The equations cannot be solved directly, so a binomial search algorithm is used iteratively to find a solution. A new solution is found every 5 seconds.

Start-up

The starting speed for the AFD will vary depending upon the pressure ratio across the compressor. For most starts, the pressure ratio will be small and the AFD will start at its minimum speed. The speed will be adjusted every 5 seconds in response to changing pressure ratio and load requirements.

On start-up, shell pressures and temperatures may not correspond to saturated conditions. To avoid potential surge on start, the boundary pressure coefficient will be reduced by 0.2 below the last running condition and after 40 minutes adjusts itself towards the last running condition. This allows for the stabilization of pressures and water loop conditions. After reaching this condition the control will do a re-optimization.

Figure 22. Start-up surge boundary



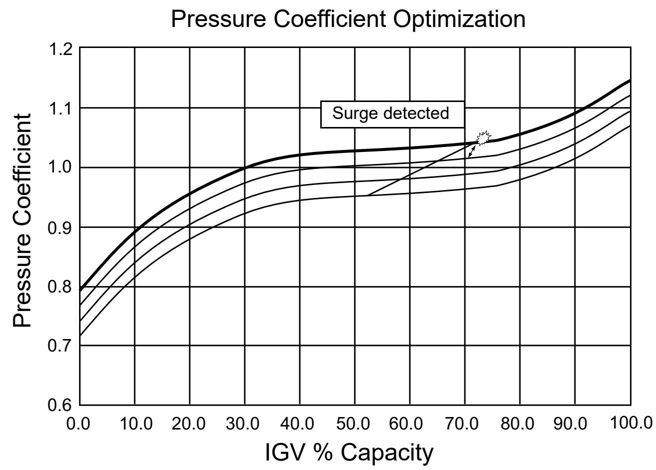
Re-optimization

The AF Surge Boundary Offset Coefficient is a user settable parameter to be used for adjusting the surge boundary either higher or lower. In addition to being user settable, the surge control algorithm will periodically readjust this boundary. This re-optimization will occur when any of three different criteria are met.

1. After start-up stabilization the control will re-optimize unless the surge is detected in that time period.
2. Every 30 minutes, the control will compare the current IGV position with the IGV position at the end of the last re-optimization time and, if greater than the user adjustable sensitivity, will re-optimize.
3. When the re-optimization timer expires.

The control is re-optimized by increasing the AF Surge Boundary Offset Coefficient every minute until surge occurs. When surge occurs, the control will go into surge recovery until the surge flag is removed and all of the re-optimization timers will reset.

Figure 23. Boundary re-optimization



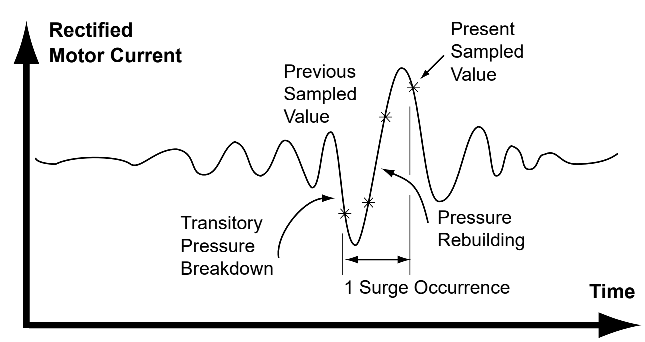
Surge Recovery

When surge occurs, the pressures in the evaporator and condenser shells can become erratic. Surge recovery is needed to force conditions out of this unstable operating point. This is accomplished by reducing the pressure coefficient every 90 seconds of continuous surge. In addition, when the surge flag is set, the compressor speed command is increased by 1 Hz every 5 seconds until the surge condition clears. When the surge flag is removed, the speed command will relax back to the speed needed to raise the pressure coefficient to the new surge boundary.

Surge Detection

Surge detection control logic monitors changes in compressor motor current. A surge occurrence leaves a characteristic motor current signature as shown in Figure 24. This signature is formed because the transitory pressure breakdown between the condenser and evaporator causes a sudden reduction in compressor motor load. As the pressures equalize, the compressor begins to quickly load, increasing the motor current.

Figure 24. Motor current signature representing surge



Interface to Adaptive Frequency Drive

Communications between the chiller control and the AFD are handled via the Machine Bus (M-bus) connected to the RS-485 AFD Comm Interface module. Signals digitally sent over the M-bus include start, stop, speed change, and drive faults.

At start of the compressor motor a signal corresponding to the starting frequency (38 Hz) is sent to the drive.

The digital speed signal is set-up such that the AFD operates over a 38-60 Hz frequency range.

AFD faults are sent over the M-bus to the UC800 or DynaView™ controls for communication on the chiller display.

High Pressure Cutout–The inverter accepts a NC HPC switch at terminals 2X1-3 and 2X1-4. In the event of a chiller high pressure condition, the HPC switch will open and the drive shall shutdown and de-energize the motor.

Output contacts are required to control the load of the oil pump motor and the cooling circulating pump. The contacts are normally open, and close when the AFD energizes the motor.

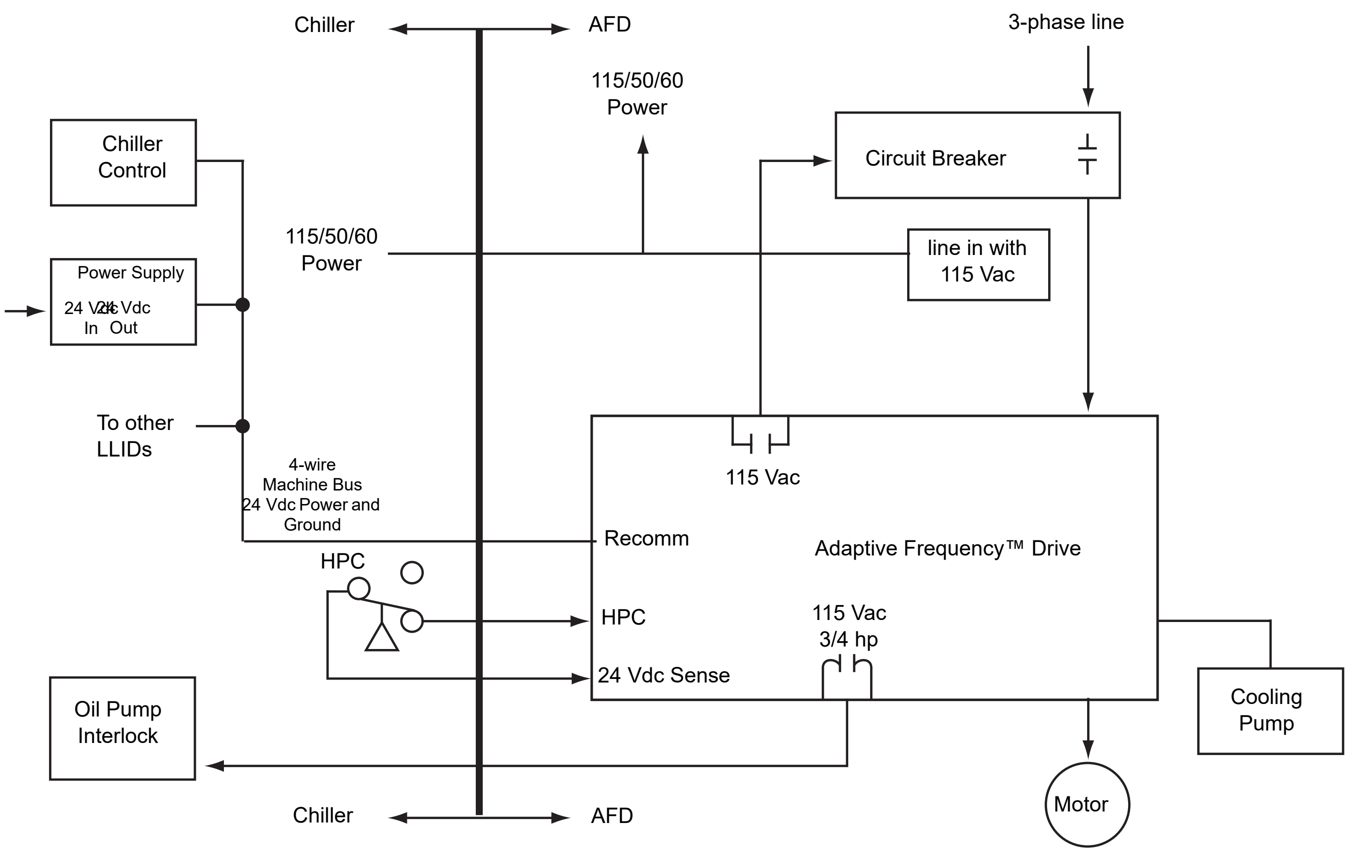
Note: *Unlike locked rotor amps associated with electromechanical starters, the phase currents are not expected to rise above 85 percent RLA prior to 1.6 seconds following the sending of the speed signal, after which they then remain above 85 percent RLA until the compressor motor has come up to speed.*

An Up-to-Speed signal must occur before the Maximum Acceleration Timer times out (plus 15 seconds) or a MANUAL RESET (MMR) alarm will occur.

The block diagram (see Figure 25) shows the communication of the starter module to Unit Mounted Inverter Interface controls interconnecting circuits.

The Oil Pump Interlock load is 115 volts ac, 3/4 hp reset.

Figure 25. Chiller control to remote-mounted inverter interface block diagram



Service Interface

AFD Operator Interface

Chiller information is tailored to operators, service technicians, and owners. When operating a chiller, there is specific information you need on a day-to-day basis–setpoints, limits, alarm information, and reports.

When servicing a chiller, you need different information and usually more of it–historic and active alarms, configuration settings, and customizable control algorithms, as well as operation settings.

By providing two different tools–one for daily operation and one for periodic service–everyone has easy access to pertinent and appropriate information.

Table 19. The following AFD information is available from within the DynaView™:

Tracer AdaptiView™ display or DynaView display	MENU items	Units	Comments
Reports - Motor (AFD items)	AFD Frequency	Hz	
	AFD Speed	RPM	
	AFD Transistor Temp	F/C	
Settings - Mode Overrides	OIL Pump Manual Control	Auto/On	Oil/refrigerant/(AFD water pump) manual control
	Compressor Control Signal	Auto/Manual	Manual control allows the user to override the automatic signal and manually drive the Compressor Control Signal from 0 to 100%. The limits and safeties remain active. The compressor control signal controls a calculated combination vanes position and drive speed for leaving water control signal.

Note: Both motor report and mode overrides contain chiller content along with the AFD related items identified above.

Once the new AFDK is installed, some parameters settings may need to be changed for proper operation. Please contact Global Parts Technical Services to request a drive parameter sheet. The drive parameter sheet will contain a list of chiller-specific parameter settings that may be directly loaded using TechView™ or Tracer™ TU. To contact Global Parts Technical Services, send a message to ATechnicalService@trane.com. Please provide the serial numbers for the chiller, control panel (if CH531 or Tracer AdaptiView™ upgrade), and the AFDK when making your request.

CH530/CH531 Operator Interface

The chiller DynaView™ is the operator interface for the Adjustable Frequency Drive (AFD). For the operator day-to-day operational information, DynaView displays up to seven lines of data (English or SI units) simultaneously on the 1/4 VGA touch-sensitive screen. Logically organized groups of information–chiller modes of operation, active diagnostics, settings, and reports put information conveniently at your fingertips. The AFD status can be viewed from the DynaView MOTOR Reports menu listing. Refer to the appropriate chiller control *Operation and Maintenance* manual for a detailed list.

TechView Chiller Service Tool (Laptop Computer)

TechView™ is a portable laptop computer control panel interface for the service technician or advanced operator. When you need more detailed information about a Trane chiller, connect your laptop computer (with the TechView software installed in it) to the DynaView™ plug-in port.

The TechView software user interface provides access to that particular machine configuration settings, customizable limits, status, and up to 60 active or historic diagnostics. Any PC that meets the system requirements may download up-to the-minute DynaView and TechView software from the Trane website: www.trane.com

TechView is utilized when a factory or start-up setting requires field alterations. The adjustable AFD settings listed below are adjustable via TechView. All others are set to defaults predetermined for this application as based on laboratory testing.

Once the new AFDK is installed, some parameters settings may need to be changed for proper operation. Please contact Global Parts Technical Services to request a drive parameter sheet. The drive parameter sheet will contain a list of chiller-specific parameter settings that may be directly loaded using TechView. To contact Global Parts Technical Services, send a message to ATechnicalService@trane.com. Please provide the serial numbers for the chiller, control panel (if CH531 or Tracer AdaptiView™ upgrade), and the AFDK when making your request.

Table 20. TechView™: Status view: Motor

Chiller Motor information, then AFD information as shown: Use down arrow to scroll to AFD items.	
AFD Output Power	**KW**
Winding Temp 1	F/C
Winding Temp 2	F/C
Winding Temp 3	F/C
AFD Transistor Temperature	F/C
AFD Speed	RPM
AFD Frequency	Hz
AFD Frequency Command	Hz
AF Boundary Pressure Coefficient	X.XX
AF Pressure Coefficient	X.XX
AF Re-Optimization Time Remaining	Hrs/Mins
AFD DC Bus Voltage	Vdc
AFD Last Diagnostic Code (decimal)	number

Table 21. TechView™: Setpoint View: Starter tab

(for CH530 Main Processor Control Algorithm settings)				
Description	**Min**	**Max**	**Factory Default**	**Units**
AFD Re-Optimization Timer	1	255	12	Hours
AFD Re-Optimization Sensitivity	0	100	10%	Percent
AF Boundary Pressure Coefficient Y Intercept	0.01	2.00	0.40	N/A
AF Boundary Pressure Coefficient Y Intercept Max - Cprs	0.01	2.00	2.00	N/A
ADF Maximum Frequency	0	60	60	Hertz (Hz)
AFD Minimum Frequency	0	60	38	Hertz (Hz)

Notes: Use only Factory Defaults. Defaults other than above may effect chiller reliability.

1. **AF Re-optimization Timer** - The re-optimization timer is a time based parameter for determining when to re-optimize the surge boundary. This timer runs only when the compressor is running and gets reset when a surge condition occurs or the compressor is shutdown.
2. **AF Boundary PC Y-Intercept** - The Boundary Pressure Coefficient (BPC) Y-intercept value is used to adjust the magnitude of the BPC. This value is unique because in can be changed by the user as well as internally by the control algorithm. The BPC Y-intercept is adjustable from 0.01 to 2.0 in increments of 0.01
3. **AF Boundary PC Y-Intercept** - Maximum The Boundary Pressure Coefficient (BPC) Y-intercept is never allowed to exceed a maximum value. This value is a manual way to control the aggressiveness of the efficiency optimizing procedure.
   For example, as this value is lowered the probability of encountering a surge decreases but so does the potential efficiency improvements at a given operating condition. The Boundary Pressure Coefficient (BPC) Y-intercept maximum is adjustable from 0.001 to 2.0 in increments of 0.01.
4. **AF Re-optimization Sensitivity** - Every 30 minutes the optimizing algorithm will compare the current value of the inlet guide vane position to the value that was stored after the last re-optimization. If the difference is greater than the AF Re optimization Sensitivity setting, re-optimization will occur. This value is adjustable from 0 to 100%, where 0 would guarantee re-optimization every 30 minutes and 100% would guarantee no re-optimization.

Table 22. TechView™: Manual override view

(TechView CH530 Main Processor Manual Control				
Oil Pump Control Also turns on AFD coolant pump)	Auto	Manual	Monitor Values Oil Tank Pressure Oil Pump Discharge Pressure Oil Differential pressure Oil Pump OVerride Time Remaining	Manual Control of Oil/Coolant Pump will time out after 10 min
Inlet Guide Vanes (IGV) and AFD Control	Auto	Manual Targets: XX% steps XX Hertz	IGV Position first Stage (%) IGV Position First Stage (Steps) AFD Speed: AFD Frequency	Upon selection of Manual, used can enter individually target for vanes position and, or, AFD Speed commands
			XX Hertz	
			Xxxx Amps	

Table 23. TechView™: Configuration view: Starter tab

Configuration of Drive[a]				
Description	**Range**	**Default**	**Units**	**Notes**
Surge Detection	0 = disable, 1 = enable	1		
Surge Sensitivity	0 to 100	20	%	
Power Loss Reset Time	0 to 255	60	s	
Motor NP Volts (VOLT)	180 to 480	460	Vac	
Motor NP FLA (TVA)	0 to 1200	0	Amps	Nameplate Data
Motor NP RLA (NMRA)	1 to 2000	1	Amps	Nameplate Data
Motor NP Power (CPKW)	0 to 1000	0	KW	Nameplate Data
Motor NP Hertz (HRTZ)	5 to 250	60	Hz	Nameplate Data
Motor NP RPM (TRPM)	60 to 24000	3600	RPM	Nameplate Data
Stator Resistance (SRES)	0 to 10,000,000	0	microOhms	Nameplate Data
Flux Current Ref. (FAMP)	0 to 1200	0	Amps	Nameplate Data
Acceleration Time	1 to 255	30	s	
Deceleration Time	1 to 255	30	s	
Current Limit (STCL)	1 to 3200	1 (1.12xNMRA)	Amps	Nameplate Data
Current Limit Gain	0 to 5000	10		
Power Loss Mode	1 = decel	decel		
Power Loss Time	0 to 25	0	Sec.	
Flying Start Enable	0 = disable, 1 = enable	0		Enabled is not recommended
Flying Start Gain	20 to 32767	2000		
Use Trane Defaults	No, Yes	Yes		Yes required for mst applications No will allow non-Trane application defaults to be utilized for all other drive parameters not accessible via TechView
RTD Type	750 ohm @ 75°F 100 ohm @ 0°C	75 ohm		

Note: Use only above Defaults as these are the factory tested settings for this application. Instability and Faults may occur with use of other settings and are not recommended. Contact your local Trane Representative for service when necessary.

(a) These items must be set to the values given on the drive parameter sheet for proper operation. To request a drive parameter sheet, send a message to ATechnicalService@trane.com. Please provide the serial numbers for the chiller, control panel (if CH531), and the AFDK when making this request.

Tracer AdaptiView Operator Interface

The chiller Tracer AdaptiView™ display is the operator interface for the Adjustable Frequency Drive (AFD). For the operator day-to-day operational information, Tracer AdaptiView displays data (English or SI units) simultaneously on the 12-inch, color touch-sensitive screen. Logically organized groups of information–chiller modes of operation, active alarms, settings, and reports put information conveniently at your fingertips. The AFD status can be viewed from the Tracer AdaptiView MOTOR target area on the home page. Refer to *Tracer AdaptiView™ Display for Water-cooled CenTraVac™ Chillers Operations Guide* (CTV-SVU01*-EN) for more information on the Tracer AdaptiView display.

Tracer TU Service Tool (Laptop Computer)

Tracer™ TU is software installed on a portable laptop computer and used, by the service technician or advanced operator, to interface with the UC800 or DynaView controller on the CenTraVac™ chiller. When you need more detailed information about a Trane® chiller, connect your laptop computer (with the Tracer TU software installed) to the UC800 or DynaView Service Tool USB plug-in port (this port is extended to exterior of the control panel cabinet for easy access).

Tracer TU software provides access to that particular machine configuration settings, customizable limits, status, and up to 60 active or historic alarms. Any PC that meets the system requirements may install the most recent release of the Tracer TU software.

Use Tracer TU when a factory or start-up setting requires field alterations. All adjustable AFD settings (see Table 24, p. 45 to Table 29, p. 46) are available via Tracer TU. All others are set to defaults predetermined for this application as based on laboratory testing.

Once the new AFDK is installed, some parameters settings may need to be changed for proper operation. Please contact Global Parts Technical Services to request a drive parameter sheet. The drive parameter sheet will contain a list of chiller-specific parameter settings that may be directly loaded using Tracer TU. To contact Global Parts Technical Services, send a message to ATechnicalService@trane.com. Please provide the serial numbers for the chiller, control panel (if CH531 or Tracer AdaptiView™ upgrade), and the AFDK when making your request.

Table 24. Tracer™ TU: Unit status view: motor expanding section

Motor winding temperature 1	F/C
Motor winding temperature 2	F/C
Motor winding temperature 3	F/C

Table 25. Tracer™ TU: Unit status view: af expanding section

AFD DC bus voltage	Vdc
AFD last diagnostic code (decimal)	number
AFD output power	KW
AFD transistor temp	F/C
Boundary pressure coefficient	None
Frequency	Hz
Frequency command	Hz
IGV and AF control	
Re-optimization time remaining	Hrs/Mins
Speed	RPM

Table 26. Tracer™ TU: Service setpoints view: adjustable frequency drive setpoints section

Description	Min	Max	Factory Default	Units
AF Control	N/A	N/A	(Auto, Fixed) **Auto**	N/A
Re-Optimization Sensitivity	0	100	20%	Percent

Notes:

- *Use only drive parameter sheet settings; other settings may affect chiller reliability.*
- *AF Re-optimization Sensitivity - Every 30 minutes the optimizing algorithm compares the current value of the inlet guide vane position to the value that was stored after the last re-optimization. If the difference is greater than the AF Re optimization Sensitivity setting, re-optimization occurs. This value is adjustable from 0 to 100%, where 0 would guarantee re-optimization every 30 minutes and 100% would guarantee no re-optimization.*

Table 27. Tracer™ TU: Field start-up view: Adjustable frequency drive section

Description	Min	Max	Factory Default	Units
Maximum Frequency	38	60	60	Hertz (Hz)
Minimum Frequency	38	60	38	Hertz (Hz)
AFD Surge Capacity Increase	0	5	1	Hertz (Hz)

Table 28. Tracer™ TU: Unit status overrides

There is no specific view for overrides. If an item is available for override, the Override icon displays.				
Frequency Command			AFD Frequency:	When Manual is selected, the user can enter AFD Frequency commands

Table 29. Tracer™ TU: Configuration view: Starter expanding section

Configuration of Drive

Note: These items must be set to the values given on the drive parameter sheet for proper operation. To request a drive parameter sheet, send a message to ATechnicalService@trane.com. Please provide the serial numbers for the chiller, control panel (if Tracer AdaptiView™ upgrade), and the AFDK when making this request.

Description	Range	Default	Units	Notes
Restart Inhibit Stop to Start Time	0 to 255	30	Seconds	Use the default
Surge Protection	0 = disable, 1 = enable	1		
Surge Sensitivity	0 to 100	20	%	
Power Loss Reset Time	0 to 255	60	Seconds	Also Minimum Time Off: Stop to Start.
Unit Line Voltage	180 to 480	[a]	Vac	Nameplate Data
Motor NP FLA (TVA)	0 to 1200	[a]	Amps	Nameplate Data
Motor NP RLA	1 to 2000	[a]	Amps	Nameplate Data
Motor NP Power	0 to 1000	[a]	KW	Nameplate Data
Motor NP Hertz	5 to 250	[a]	Hz	Nameplate Data
Motor NP RPM	60 to 24000	[a]	RPM	Nameplate Data
Stator Resistance	0 to 10,000,000	[a]	micro-ohms	Nameplate Data
Flux Current Ref.	0 to 1200	[a]	Amps	Nameplate Data
Acceleration Time	1 to 99	30	Seconds	
Deceleration Time	1 to 99	30	Seconds	
Starter Current Limit	1 to 3200	1 (1.12xNMRA)[a]	Amps	Nameplate Data
Current Limit Gain	0 to 5000	10		
Power Loss Mode	decel, coast	decel		
Power Loss Time	0 to 25	0	Seconds	Default is 0, if you encounter AFD power loss try 5 sec.
Flying Start	0 = disable, 1 = enable	0		Enabled is not recommended
Flying Start Gain	20 to 32767	2000		
Use Trane Defaults	No, Yes	Yes		Yes required for most applications. No allows non-Trane application defaults to be used for all other drive parameters not accessible via the Tracer TU service tool.
RTD Type	750 ohm @ 75°F 100 ohm @ 0°C	75 ohm		

(a) Use only the drive parameter sheet settings for this application as they are specific to the chiller. Instability and faults may occur by using other settings and is not recommended. Contact Global Parts Technical Services for service when necessary.

AFDK Pre-start-Up Checks

⚠WARNING

Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

- **Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged. If this equipment is interlocked with other equipment, 115 volt ac may be present in the cabinet even though the main power is disconnected. If this is the case, these interlock signals should be deactivated before any work is performed on this equipment. Suitable warning tags or disconnects should be added to these circuits and all circuits should be tested before attempting to energize or service the controller.**
- **Each time power is removed, allow at least 10 minutes for dc units to discharge after power is disconnected before servicing. Use extreme caution when applying power. Equipment terminals and other internal parts of the controller are at line voltage when ac power is connected to the controller. All ungrounded conductors of the ac power line must be disconnected from the controller before it is safe to touch any internal parts of this equipment.**

⚠WARNING

Hazardous Service Procedures!

Failure to follow all of the recommended safety warnings provided, could result in death or serious injury.
The maintenance and troubleshooting procedures recommended in this section of the manual could result in exposure to electrical, mechanical or other potential safety hazards. Always refer to the safety warnings provided throughout this manual concerning these procedures. When possible, disconnect all electrical power including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. When necessary to work with live electrical components, have a qualified licensed electrician or other individual who has been trained in handling live electrical components perform these tasks.

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury.
All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.

NOTICE

Do Not Megohm Test!

Failure to follow the above precaution could cause damage to the controller circuitry.
Do not use a megger to perform continuity checks in the drive equipment.

Motor Checks

1. Check the motor for proper horsepower and voltage ratings. Verify that the motor full load amps do not exceed the nameplate rating of the controller.

NOTICE

Disconnect Motor Leads!

Failure to do so could cause equipment damage.
Disconnect all motor leads prior to megging the motor.

2. Check that the motor terminals are correctly connected to the controller power terminals for the proper voltage and motor rotation.
3. Use an ohmmeter to check for any short circuits between the motor frame and the motor power leads. If a short circuit exists, it must be corrected before proceeding.

Controller Checks

1. Check that local, state and national electric codes have been observed for the installation and wiring of this equipment.
2. Check that all external power wiring has been properly routed through the cabinet.
3. Check all input power and output power connections for tightness.
4. Check the chassis ground and other connections for tightness.
5. Check all external control connections (this includes the operator station connections) for tightness.

6. Check to ensure that incoming power to the drive is phased A, B, C.

AFDK Checks

NOTICE

Perform Visual Inspection!

Before powering up this drive for the first time conduct a visual inspection for the following:

- **Shipping damage.**
- **Signs of moisture.**
- **Signs of debris or dust from storage.**
- **Signs of corrosion on components and/or enclosure.**

These conditions could cause equipment damage. Do not power up equipment if you have concerns regarding equipment condition. Upon initial power up, remain in the area for the first two hours of operation and observe the chiller and drive for any abnormalities. Contact Global Parts technical support for assistance if needed.

Safety Precautions

1. This equipment should be adjusted and serviced by qualified electrical maintenance personnel familiar with the construction and operation of the equipment and the hazards involved.
2. Be sure the input disconnect is in the correct position, either **ON** or **OFF** depending on the work to be performed.

⚠WARNING

Bypassed Electrical Interlocks!

Failure to do so could result in death, serious injury or equipment damage.
The electrical interlocks provide machine and personal protection. If deactivated or bypassed for servicing, use extreme caution when performing the start-up. Return all interlocks to operation when the start-up is completed.

3. Check the status of the drive shutdown interlocks, if used. These interlocks can be limit switches, guards or safety switches installed around the driven machine or the system interface controller.
4. Check to see that the AFDK is properly grounded to earth. See “Grounding the Cabinet,” p. 34 in “Input Power and Control Wiring,” p. 33.

AFDK Start-Up Procedure

⚠WARNING

Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

- **Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged.**
- **DC bus capacitors retain hazardous voltages after input power has been disconnected. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized. after disconnecting input power, wait 10 minutes for the dc capacitors to discharge and then check the voltage with a voltmeter to ensure the dc bus capacitors are discharged before touching any internal components.**
- **Be sure all enclosure doors are closed and properly secured with fasteners when operating equipment.**

⚠WARNING

Live Control Boards and Fuses!

Failure to follow this instruction could result in death or serious injury or equipment damage.
Do not remove or insert control boards or fuses while input power is connected to the controller.

Follow the procedure below when starting the water chiller and drive.

1. The UC800 or DynaView™ is the primary controller for the CenTraVac™ chiller and is located in the control panel. The UC800 or DynaView starts, stops, and monitors all unit and AFDK run functions.

   Complete all items on the commissioning checklist and in the start-up procedures for the CVHE, CVHF, and CVHG as defined in the operation maintenance manual or other applicable manual.

2. Check the following on the drive:

   a. 460/480 volt input wiring to the drive is sized correctly and connected as noted in this manual.

   b. Check the drive ground connection as detailed in the "Input Power and Control Wiring," p. 33; check cabinet wire routing and grounding.

3. Check all drive wiring and connections in the drive to make sure they are tight and free of any shipping damage.

   AFDK control checkout: Use Tracer™ TU or TechView™ service software, as appropriate.

   a. Confirm the drive LLID has been properly bound and is recognized by the unit controls.

   b. CHILLER Setpoints: As with any new chiller, first check out all UC800 or DynaView setpoints for the chiller.

   c. AFD Setpoints: Check out all AFD setpoints.

   d. AFD Configuration: Verify the correctness of the Sales Order specific setpoints in the Starter Configurations for AFD Starters. These settings are specific to unit/ motor combination in the drive. All of the remaining settings are factory-determined default setpoints that are the same on all AFDK water-cooled drives.

   Note: *If the set values do not match, contact the local Trane Service agency first, or the La Crosse Business Unit Technical Service Department. The correct values are listed on the unit nameplate shipped with each unit.*

4. In order to view the AFDK configurable settings:

   In Tracer TU, go to the Chiller Configuration tab and select the AFD expanding section.

   In TechView, go to the Configuration View and then go to the Starter tab.

5. If the drive LLID is not found or if it is necessary to re-bind the drive LLID, follow the procedure below.

   a. The drive main DC bus must be charged in order for the drive LLID to be recognized or bound. Close the drive enclosure doors and reapply line power to the drive.

   For CH530/531 only: If the disconnect is open and you are using an external 115 V control power source to energize the unit controls, reinstall fuse 2F1 and 2F2 to **back-feed** power to the drive and energize the DC bus.

   b. With a laptop connected to the chiller and with Tracer® TU or TechView running, enter the binding view menu of Tracer TU or TechView and locate the **AFD Starter** LLID in the menu. Select the **Bind** button for the AFD Starter LLID.

   c. The screen **Is the device alone selected?** displays. In the AFD, depress the **service** button on the LLID and light the **service** LED.

   Note: *You do not use a magnet to bind the AFD Starter LLID.*

   d. On the Tracer TU or TechView screen, select the **yes** button to indicate the LLID has been selected.

   e. When properly bound, exit the binding view.

   f. Perform any remaining start-up items.

6. When ready, start the drive from the Tracer AdaptiView™ display, or from the DynaView operator interface of the CH530/531 panel.

7. Check the AFDK chiller drive response to the UC800 or DynaView. Initially, the drive will go to 38 hertz and stay there until the CenTraVac chiller vanes open based on load. The drive will change the speed from there based on load demand.
8. Document all information on the Start-up log.

Start-Up Test Log

Water-Cooled CenTraVac Chiller with Tracer AdaptiView Control and Adjustable Frequency Drive (AFD) Starter

Job Name: ______________________________

Job Location: ______________________________

Sales Order Number: ______________________________

Chiller Serial Number: ______________________________

Chiller Model Number: ______________________________

AFD Serial Number: ______________________________

AFD Model Number: ______________________________

Ship Date: ______________________________

Start Date: ______________________________

Starter Date:	
Manufacture	
Type	
Vender ID	
Model Number	
Volts and Hz	
Amps	
Motor Data:	
Manufacturer	
Type and Frame	
Drawing Number	
Serial Number	
Nameplate Data:	
RLA	
KW	
Volts and Hz	
Prestart Checks	**Date Checked**
Drive Grounded	
Motor Rotation	
Drive Chassis Grounded	
Control Wiring Tight	
Drive Connections are Tight	
Verified Settings	

Comments:

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Tracer™ TU: Service Setpoints View: AFD	Default	Setting
AFD Control	Auto	
Re-Optimization Sensitivity	20%	
UC800 or DynaView™ Starter Type: Unit Mount AFD Tracer TU: Configuration View: Starter	**Trane Default**	**Setting**
Restart Inhibit Stop to Start Time	30	
Surge Protection	enable	
Surge Sensitivity	20	
Power Loss Reset Time	60	
Unit Line Voltage	*	
Motor NP FLA (TVA)	*	
Motor NP RLA	*	
Motor NP Power	*	
Motor NP Hertz	*	
Motor NP PRM	*	
Stator Resistance	*	
Flux Current Ref.	*	
Acceleration Time	30	
Deceleration Time	30	
Starter Current Limit	*	
Current Limit Gain	10	
Power Loss Mode	Decel	
Power Loss Time	0	
Flying Start	Disable	
Flying Start Gain	2000	
Use Trane Defaults (for all other AFD parameters not accessible via Tracer TU)	Yes	
RTD Type	75	
*Must be set per sales order variable.		
Test Log Date:	**Log 1**	**Log 2**
Tracer TU Unit Status View: AF		
AFD Output Power (KW)		
Speed		
Frequency		
AFD Transistor temp		
Tracer TU Field Start-up View: AFD		
Maximum Frequency	60	
Minimum Frequency	38	
AFD Surge Capacity Increase	1	
Tracer TU Status View: Motor		
Average Line Current		
Starter Average Phase Voltage		
Starter Load Power Factor		
Motor Winding #1 temp		
Motor Winding #2 temp		
Motor Winding #3 temp		

Water-Cooled CenTraVac Chiller with CH530/CH531 Control and Adjustable Frequency Drive (AFD) Starter

Job Name: ______________________
Job Location: ______________________
Sales Order Number: ______________________
Chiller Serial Number: ______________________
Chiller Model Number: ______________________

AFD Serial Number: ______________________
AFD Model Number: ______________________
Ship Date: ______________________
Start Date: ______________________

Starter Date:	
Manufacture	
Type	
Vender ID	
Model Number	
Volts and Hz	
Amps	
Motor Data:	
Manufacturer	
Type and Frame	
Drawing Number	
Serial Number	
Nameplate Data:	
RLA	
KW	
Volts and Hz	
Prestart Checks	**Date Checked**
Motor Grounded	
Motor Rotation	
Drive Chassis Grounded	
Control Wiring Tight	
Drive Connections are Tight	
Verified Settings	

Comments:

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TechView™: Setpoint View: AFD	**Default**	**Setting**
AFD Control	Auto	
AFD Re-Optimization Sensitivity	10%	
TechView: Configuration View: Starter Type: AFD	**Trane Default**	**Setting**
Surge Detections	enable	
Surge Sensitivity	20	
Power Loss Reset Time	60	
Motor NP Volts	460	
Motor NP FLA (TVA)	0	
Motor NP RLA	1	
Motor NP Power	0	
Motor NP Hertz	60	
Motor NP PRM (TRPM)	3600	
Stator Resistance (SRES)	0	
Flux Current Ref. (FAMP)	0	
Acceleration Time	30	
Deceleration Time	30	
Current Limit	1	
Current Limit Gain	10	
Power Loss Mode	Decel	
Power Loss Time	0	
Flying Start Enable	disable	
Flying Start Gain	2000	
Use Trane Defaults (for all other AFD parameters not accessible via TechView)		
Test Log Date:		
TechView Status View: Motor	**Log 1**	**Log 2**
% RLA Average		
Amps Average		
Volts Average		
Load PF		
Power KW		
Winding #1 temp		
Winding #2 temp		
Winding #3 temp		
AFD Speed		
AFD Freq		
AFD Transistor temp		

Troubleshooting

Tracer® AdaptiView™ Alarms

When an active alarm is present, it is identified in the **Active Alarms** area in the upper left corner of the Tracer AdaptiView™ display. This serves two purposes: to alert the operator that an alarm exists, and to provide navigation to the Alarms list.

Clicking on the active alarms causes the Alarms list to display. All active alarms are listed first and ordered by the alarm severity. The severity hierarchy is:

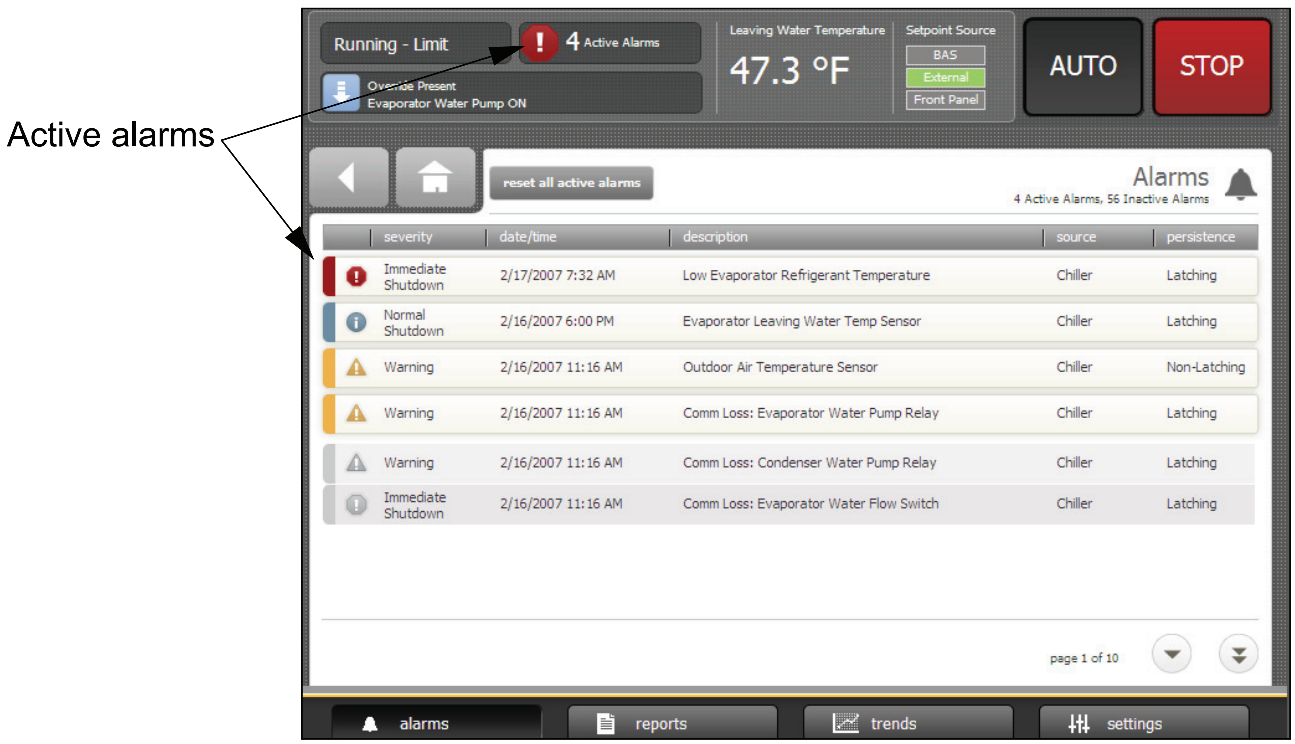
- Immediate shutdown (highest priority and displays first)
- Normal shutdown
- Warning
- Unknown (lowest priority and displays last)

Active alarms are followed by any historical alarms. These appear gray on the screen. The alarms button at the bottom of the screen flashes between two colors depending on the severity of the highest priority alarm (i.e., Immediate shutdown alarms cause the button to flash between red and black, and Normal shutdown alarms cause the button to flash between yellow and black).

Clicking directly on any of the active alarms links to a screen that explains the alarm and provides possible solutions.

You can also connect a laptop computer loaded with the Tracer® TU service tool software directly to the UC800 or DynaView™ controller to view the AFD last diagnostic code.

Figure 26. Tracer AdaptiView™ alarms screen



CH530/531 Diagnostic Annunciation

When an active diagnostic is present, an **Alarms** key will be added to the persistent display area. This key will serve two purposes. The first purpose will be to alert the operator that a diagnostic exists. The second purpose is to provide navigation to a diagnostic display screen.

The diagnostic screen is accessible by touching the **Alarms** enunciator. A message description will be provided.

A scrollable list of the last (up to 10) active diagnostics will be presented. Performing a **Reset All Active Diagnostics** will reset all active diagnostics regardless of type, machine, or starter. The scrollable list will be sorted by time of occurrence.

If a diagnostic warning is present, the **Alarms** key will be present but not flashing. If a diagnostic shutdown (normal or immediate) is present, the **Alarms** key will be displayed and flashing. If no diagnostics exist, the **Alarms** key will not be present.

The additional information icon to the right of the most recent diagnostic will display a sub-screen listing the operating mode at the time of the last diagnostic and its possible sub modes. The table of alarm messages and fault codes indicates potential Drive Diagnostic DynaView™ messages.

The Trane service tool, TechView™, can be utilized to view the last AFD diagnostic code from with in the Motor Reports screen last menu item. Table 30, p. 55 also provides additional information as referenced to the TechView reference.

Figure 27. Unit control panel DynaView diagnostic screen

Troubleshooting

This section can assist in field troubleshooting LiquiFlo 2.0 drives, and can provide information, which others can use to help you troubleshoot the drive.

> **⚠WARNING**
>
> **Hazardous Voltage w/Capacitors!**
>
> **Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with an appropriate voltmeter that all capacitors have discharged.**

1. Collect alarm/diagnostic and parameter information.
   a. Do not cycle unit power or reset the controls. Leave the AFD and UC800 or DynaView™ in their present states.
   b. Record the AFD Last Diagnostic Code using Tracer™ TU or TechView™, as appropriate.

      In Tracer TU, this value is available under the Unit Status tab, in the Motor expanding box. In TechView, this value is available in the Status view, under the Motor tab.
   c. Record all UC800 or DynaView active and historic alarms/diagnostics. Make a full chiller service report.
   d. Document and check all applicable parameter settings. This information can be verified from the chiller nameplate, and by referring to this manual.
   e. In the Binding view of the Tracer TU or TechView service tool, verify there is a green face indicating that the AFD Recomm Starter LLID is bound.
   f. If an Operator Interface Module (OIM) is available, record any drive diagnostics found.
2. Collect Chiller Information.
   a. Note the following chiller information:
      - Operating mode and any sub-mode (i.e., 100% or 75% load etc.)
      - Number of chiller starts, and hours of operation.
      - Time since last diagnostic shutdown (<1 minute, <1 hour, >1 hour, etc.)
   b. What was the chiller state at the time of the failure? (Chiller starting? Running low load? Running full load? etc.)
   c. Record the chiller sales order and serial numbers, and the drive serial and model numbers.
3. Troubleshooting
   a. Measure and record the DC bus (via the Operator Interface Module [OIM]).
   b. Check ALL wiring (tightness, ribbon cables fully seated, proper phasing, etc.)
   c. Refer to the Rockwell manuals for further troubleshooting information (manuals D2-3518-1 and D2-3496-2, or the most recent revisions).
   d. If possible, use the Rockwell OIM and provide the following drive parameter information:
      - LiquiFlo 2.0 (inverter) Parameters 49, 50, 209, 210, 224, 225, 226, 227, 228, 229, 230, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 262, 263, 264, 265, 266, 267, 268, and 269.
4. Drive Over Temperature
   a. Measure refrigerant pump discharge pressure and compare to the condenser pressure. It should be 10 to 15 psid.
   b. Measure drive coolant line delta-T.
   c. Record parameters 120, 121, and 122 from the active rectifier.
   d. Operate the condenser at or below design temperature. Elevated tower water temperatures will raise drive temperatures.
   e. The ambient temperature must remain below specification (refer to Table 1, p. 8). Make sure the fan grills are clean and operational.
   f. Do not place manuals or prints below the power module as this can block air flow.

Alarm Messages and Fault Codes

Tracer AdaptiView™ note: The AFD Last Diagnostic Code value is available using Tracer™ TU. This value is located under the Unit Status tab, in the Motor expanding box.

Table 30. Alarm messages and fault codes

Tracer AdaptiView alarm or DynaView™ diagnostic	Tracer TU or TechView™ Last Diag Code	Drive Fault	Tracer AdaptiView alarm or DynaView™ diagnostic	Tracer TU or TechView™ Last Diag Code	Drive Fault
General	2	Auxiliary Input	I/O Board Fail	121	I/O Comm Loss
Power Loss	3	Power Loss	I/O Board Fail	122	I/O Board Fail[a]
Power Loss	4	Under Voltage	I/O Board Fail	123	Invtr Unk IO Brd[b]
High Bus	5	Over Voltage	Drive Overcurrent	197–199	Invtr Dsat U-, V-, W-[b]
Motor Overload	7	Motor Overload	Drive Overcurrent	200–202	Invtr Dsat U, V, W[a]
Drive Overtemp	8	Invtr Base Temp	Drive Overcurrent	200–202	Invtr Dsat U+, V+, W+[b]
Drive Overtemp	9	Invtr IGBT Temp	Drive Overcurrent	203–205	Invtr Over Cur U, V, W
Drive Overcurrent	12	HW OverCurrent	Power Board Fail	206	Invtr HW Unused[a]
Ground Fault	13	Ground Fault	Estop	207	Invtr Gate Kill
General	24	Decel Inhibit	Drive Overcurrent	208–210	Rctfr Dsat R, S, T[a]
General	25	OverSpeed Limit	Drive Overcurrent	208–210	Rctfr Dsat R+, S+, T+[b]
General	29	Analog in Loss	Drive Overcurrent	211–213	Rctfr Over Cur R, S, T
Power Board Fail	30	NTC Demux Fail[b]	Drive Overcurrent	214	Reactor Temp
General	31	Inv Temp Switch[b]	Power Board Fail	215	Rctfr HW Unused[a]
General	33	Auto Rstrt Tries	Ground Fault	216	Rctfr Gnd Fault
Phase Loss	35	Current Fbk Lost	Drive Overtemp	217	Rctfr Base Temp
Drive Overcurrent	36	SW OverCurrent	Drive Overtemp	218	Rctfr IGBT Temp
Phase Loss	37	Motor I Imbalance	Drive Overcurrent	219	Rctfr IT Overld
Motor Short	38	Phase U to Grnd	Drive Overcurrent	220	Rctfr 12T Overld
Motor Short	39	Phase V to Grnd	Power Loss	221	Ride Thru Abort
Motor Short	40	Phase W to Grnd	High Bus	222	High AC Line
Motor Short	41	Phase UV Short	Power Loss	223	Low DC Bus
Motor Short	42	Phase VW Short	High Bus	224	Rctfr Over Volt
Motor Short	43	Phase WU Short	Power Loss	225	Input I Imbalance
General	48	Params Defaulted	Power Loss	226	Input V Imbalance
Drive Overcurrent	63	Shear Pin	Power Loss	227	AC Line Lost
Drive Overcurrent	64	Drive Overload	General	228	Line Feq Lost
Power Structure Fail	70	HW Fault	Control Board NVS	229	Rctfr Checksum
Ignore	71–75	Port 1–5 Adapter	Power Structure Fail	230	Invtr HW Unk
General	77	Volts Range	Power Structure Fail	231	Rctfr HW Unk
General	78	FluxAmps Rang	General	232	Rctfr Not OK
General	79	Excessive Load	General	233	Precharge Closed
General	80	AutoTune Aborted	General	234	Precharge Opened
General	81–85	Port 1–5 DPI Loss	Power Board Fail + Control Board NVS	235	Rctfr Pwr Board
General	87	IXo Voltage Range	I/O Board Fail	236	Rctfr IO Board
Control Board NVS	100	Parameter Chksum	General	237	Not at Voltage
Control Board NVS	101	UserSet1 Chksum	DPI Communication	238	Rctfr Not Login
Control Board NVS	102	UserSet2 Chksum	General	239	Power Phased ACB
Control Board NVS	103	UserSet3 Chksum	Estop	240	Rctfr Gate Kill[b]
Power Board Fail	104	Pwr Brd Chksum1	Drive Overcurrent	241–243	Rctfr Dsat R-, S-, T-[b]
Power Board Fail	105	Pwr Brd Chksum2	Power Board Fail	244	Rctfr NTC Demux[b]
Power Unit HW+ Control Board NVS	106	Incompat MCB-PB	I/O Board Fail	245	Rctfr Unk IO Brd[b]
Control Board NVS	107	Replaced MCB-PB	DPI Communication	246	Rctfr DPI Comm[b]
General	120	I/O Mismatch[a]	General	247	CarrSync Lost

Note: Fault Numbers not listed are reserved for future use.

(a) Fault available on Frame 3 drives only
(b) Fault available on Frame 4 drive only

For additional information regarding descriptions and corrective actions refer to the Rockwell instruction manuals D2-3518-1 and D2-3496-2 (or the most recent revisions).

Recommended Periodic Maintenance and Inspection

Visual Inspection – Power Removed

⚠WARNING

Hazardous Voltage w/Capacitors!

Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects and discharge all motor start/run capacitors before servicing. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharge of capacitors. Verify with a CAT III or IV voltmeter rated per NFPA 70E that all capacitors have discharged.

1. *On refrigerant-cooled drives:* Check the refrigerant coolant lines and two-bolt flange drive connections to ensure they are tight and do not leak.

   On water-cooled drives: Verify cooling circuit is free of leaks and the heat exchanger system is operating properly.
2. Ensure the door interlocks are present and working.
3. Verify the safety ground connections to the door panels are securely connected.
4. Inspect power wire cables and devices to assure no abrasion is occurring from vibrations against chassis of cabinets, or other edges.
5. Ensure the drive interior and exterior is clear of any dust or debris. Fans, circuit boards, vents etc. must be clean. Only use a vacuum for cleaning. Do NOT use compressed air.
6. Inspect the interior of the drive for any signs of moisture entry or leakage.
7. Visually inspect all drive components and wiring. Look for signs of heat or failure (look for swelled or leaking capacitors, discolored reactors or inductors, broken pre-charge resistors, smoke or arc trails on MOVs and capacitors, etc.).
8. Closely inspect the motor terminal board for any signs of leakage, arcing, etc.
9. Check ALL cable/lug/terminal connections inside the drive enclosure. Ensure all are clean and tight, and not rubbing against each other anywhere.
10. Check any bypass or pre-charge contactors. Confirm the contacts are in serviceable condition and that the contactor operates smoothly.
11. Re-seat all ribbon cable or control wire plugs to ensure all are snug and tight.
12. Verify 2A6 filter cap assembly fuses 2F6, 2F5, and 2F4 are not swelled or leaking.
13. Check the magnetic choke for physical damage (e.g., cracks).

Operational Inspection – Power Applied

⚠WARNING

Live Electrical Components!

Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.
During installation, testing, servicing and troubleshooting of this product, it may be necessary to work with live electrical components. Have a qualified licensed electrician or other individual who has been properly trained in handling live electrical components perform these tasks.

1. Verify the drive cabinet cooling fans are operating.

   This should be done from outside the enclosure, by looking into the cabinet at door and cabinet vents, to avoid electrical hazards.

   Note: *The power module fan comes on with power. Other fans cycle with drive operation.*
2. Check historic fault codes using OIM connected to the AFD.
3. Check configuration settings and confirm all proper settings are still present in the controls.
4. Review the diagnostic history.
5. Make Chiller Service report to document all setpoints.
6. Check the UC800 or DynaView™ alarm histories for any indications of operational problems.

Do this every 1 to 12 months depending on operating environment

To properly diagnose service issues for Adaptive Frequency™ Drives for centrifugal chillers equipped with LF 2.0 (AFDK) starters, and Operator Interface Module (OIM) and special cable are required. All UC800 or DynaView™ chillers will be equipped with the OIM as standard on the drive power module. This is for service only and NEVER for machine operation. These items are available from Trane with the following part numbers:

OIM (Operator Interface Module): MOD01352

Cable for OIM: CAB01034

Do as needed.

Replace any parts that show signs of physical damage.

Chiller Operator Display Content

Refer to *Tracer® AdaptiView™ Display for CenTraVac™ Water-cooled Chillers User Guide* (CTV-SVU01*-EN) for Tracer AdaptiView™ display information.

Important: *Tracer AdaptiView displayed voltage is **line side input voltage**, whereas current and power factor are **load side data**. Therefore, these are not used together to calculate kW; Tracer AdaptiView kW is communicated from the drive to the chiller panel, and represents input power to the drive.*

Wiring Schematics

Table 31. Wiring diagrams

Type	Number
Unit Mounted Adaptive Frequency™ Drive 405–608 A LiquiFlo 2, Frame 3	2311-0453
Unit Mounted Adaptive Frequency Drive 900–1210 A LiquiFlo 2, Frame 4	2311-0454
Field Connection Diagram - Simplex - Trane Supplied Adaptive Frequency Drive	2311-0565
Remote Mounted Adaptive Frequency Drive 405–608 A LiquiFlo 2, Frame 3	2309-7647
Remote Mounted Adaptive Frequency Drive 900–1210 A LiquiFlo 2, Frame 4	2309-7646

Note: Wiring diagrams are available via e-Library.

Trane - by Trane Technologies (NYSE: TT), a global climate innovator - creates comfortable, energy efficient indoor environments for commercial and residential applications. For more information, please visit trane.com or tranetechnologies.com.

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SO-SVU001A-EN 13 Oct 2023
Supersedes AFDK-SVU01C-EN (May 2020)