Installation, Operation, and Maintenance

Air-Cooled Adaptive Frequency™ Drive with Tracer AdaptiView™ Control

Models: AFDG

X39641139030

⚠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.

August 2011

AFDG-SVU01C-EN

Warnings, Cautions and Notices

Warnings, Cautions and Notices. Note that warnings, cautions and notices appear at appropriate intervals throughout this manual. Warnings are provide to alert installing contractors to potential hazards that could result in personal injury or death. Cautions are designed to alert personnel to hazardous situations that could result in personal injury, while notices indicate a situation that could result in equipment or property-damage-only accidents.

Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

ATTENTION: Warnings, Cautions and Notices appear at appropriate sections throughout this literature. Read these carefully:

⚠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-including industry replacements for CFCs such as HCFCs and HFCs.

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. 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

Refrigerant under Positive Pressure!

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. 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.

⚠WARNING

Proper Field Wiring and Grounding Required!

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 electrical codes. Failure to follow code could result in death or serious injury.

⚠WARNING

Personal Protective Equipment (PPE) Required!

Installing/servicing this unit could result in exposure to electrical, mechanical and chemical hazards.

- **Before installing/servicing this unit, technicians MUST put on all Personal Protective Equipment (PPE) recommended for the work being undertaken. ALWAYS refer to appropriate MSDS sheets and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate MSDS sheets and OSHA guidelines for information on allowable personal exposure levels, proper respiratory protection and handling recommendations.**
- **If there is a risk of arc or flash, technicians MUST put on all Personal Protective Equipment (PPE) in accordance with NFPA 70E or other country-specific requirements for arc flash protection, PRIOR to servicing the unit.**

Failure to follow recommendations could result in death or serious injury.

Trademarks

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 Danfoss automation global technical service personnel who are familiar with the features described.

The instructions in this manual outline the procedures for operating the 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: BAS-SVX21A-EN VLT HVAC drive high power operations instructions.

Cabinet Servicing

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

NOTICE:

Do Not Megohm Test!

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

⚠WARNING

Hazardous Voltage w/Capacitors!

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

⚠WARNING

Capacitors must be allowed to discharge!

Each time power is removed, allow at least 40 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. Failure to disconnect power and discharge capacitors before servicing could result in death or serious injury.

Motor Checks

1. Check the motor for proper horsepower and voltage ratings. Verify that the chiller rated load amps do not exceed the nameplate rating of the controller.
2. Check that the motor terminals are correctly connected to the controller's power terminals for the proper voltage and motor rotation.

NOTICE:

Disconnect Motor Leads!

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

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 assure incoming power to the drive is phased A, B, C.

AFDG 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 CenTraVac™ Technical Support for assistance if needed.

⚠WARNING

Hazardous Voltage!

Be sure all enclosure doors are closed and properly secured with fasteners when operating equipment. Failure to follow these instructions could result in death or serious injury.

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.
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.

⚠WARNING

Bypassed Electrical Interlocks!

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

4. Check to see that the AFDG is properly ground to earth. See “Grounding the Cabinet,” p. 20 in “Input Power and Control Wiring,” p. 19.

⚠WARNING

Ground Wire!

All field-installed wiring must be completed by qualified personnel. All field-installed wiring must comply with NEC and applicable local codes. Failure to follow this instruction could result in death or serious injuries.

⚠WARNING

Insert Control Boards or Fuses!

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

⚠WARNING

Hazardous Service Procedures!

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. Failure to follow all of the recommended safety warnings provided, could result in death or serious injury.

⚠WARNING

Hazardous Voltage w/Capacitors!

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

- **Before working on the controller, check to be sure capacitors are discharged with a dc voltmeter on the 1000V scale. Charged capacitors require at least 40 minutes to discharge to less than 50Vdc after line power is removed.**
- **Before proceeding with the startup procedure, disconnect and lockout all incoming power to the drive controller!**

Failure to follow all of the recommended safety warnings provided, could result in death or serious injury.

Introduction

AFDG Information

The AFDG air-cooled Adaptive Frequency Drive is a pulse width modulated (PWM) design. It is designed for 460/480/575-volt application. This drive converts ac power to dc power and back to ac power. The incoming 460/480/575 volts are converted to a constant 650 Vdc by a rectifier bridge (SCRs and diodes), and into a section of capacitors that are used to store the DC voltage. The dc output feeds the inverter IGBTs that switch at predetermined time 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.

The DC voltage is fixed at 700 Vdc. A variable output is accomplished by PWM control within the inverter by the IGBTs which are basically transistors that turn on and off in response to the gate driver.

A combination of two distinct operating modes make up the AFDG control within the chiller's UC800 control. First by controlling the inlet vanes, and second by modulating impeller speed from 38 to 60 hertz. The IGBTs control the speed in response to the UC800 compressor control signal. Circuit breakers, surge capacitors and ground faults are standard on all AFDG units.

Some of the basic principles of the drive are:

- Minimum efficiency of 97 percent at rated load and 60 Hz.
- Unit displacement power factor of 0.96 at all loads.
- Low starting current.
- The current never exceeds the rated load amps.
- The AFDG varies the motor speed in response to the speed command from the UC800 control.

The CenTraVac 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 Tracer AdaptiView display will indicate "alarm" and an "alarm message."

Model Number

Trane Service Model Number

An example of a typical model number is:

AFDG0035HA0B00C2B

Model Number Digit Identification

Model number digits are selected and assigned in accordance with the following definitions using the model number example shown above:

A = (1st digit)

F = (2nd digit)

D = (3rd digit)

G = (4th digit) Development Sequence

G = Air-Cooled

0035 = (5th, 6th, 7th, and 8th digit) Adaptive Frequency Drive Size

Use Rated Load Amps (RLA) value

H = (9th digit) Unit Voltage

F = 460V-60Hz-3Ph

G = 480V-60Hz-3Ph

H = 575V-60Hz-3Ph

J = 600V-60Hz-3Ph

S = Special

A0 = (10th, and 11th digit) Design Sequence

A0 = Original design

B0 = AdaptiView

D0 = Chokes

E0 = CT Requirement on SSRLs of 730, 780, 850, 890, 945, and 1050

F0 = Drive Bus Bars on SSRLs of 730, 780, 850, 890, 945, and 1050

B = (12th digit) AFD Mounting Location

B = Remote Mounted

0 = (13th digit) Agency Listing

0 = UL & CUL

0 = (14th digit) Special Options

0 = None

Model Number

C = (15th digit) Frame size (SRRL)

A = 155
B = 192
C = 242
D = 290
E = 344
F = 400
G = 450
H = 500
J = 570
K = 630
L = 730
M = 850
N = 945
P = 1060
R = 1260
T = 190
U = 240
V = 302
W = 361
X = 443
Y = 540
Z = 590
1 = 678
2 = 780
3 = 890
4 = 1050
5 = 1160
6 = 1380
7 = 1530

2 = (16th digit) Connection Type

2 = Standard Circuit Breaker
4 = High Interrupting Breaker
8 = Fused Disconnect Switch
S = Special

B = (17th digit) Control Power Option

B = Control Power Transformer 4kVA

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 AFDG 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 drives can be kept clean and dry.
- The area chosen should allow the space required for proper air flow. An 8 inch (20.32 cm) minimum clearance is required above the cabinet.
- Be sure that the NEMA 1 enclosure is installed away from oil, coolants, or other airborne contaminants.
- Do not install the drive above 1000 meters (3300 feet) without derating output power. For every 1000 meters (3300 feet) above 1000 meters (3300 feet), derate the output current 4%.
- Line frequency is 60 Hz.
- Line Voltage is 460/480/575 volts; variation are within ±10%.
- Non-corrosive location.
- Verify that the drive location will meet the environmental conditions specified in Table 1.

Table 1. Environmental conditions

Condition	Specification
Ambient Temperature (outside NEMA 1 enclosure)	-10°C to + 40°C (14°F to 104°F)
Storage Temperature (Ambient)	-25°C to 65°C (-13°F to 149°F)
Humidity	5% to 95% (non-condensing)

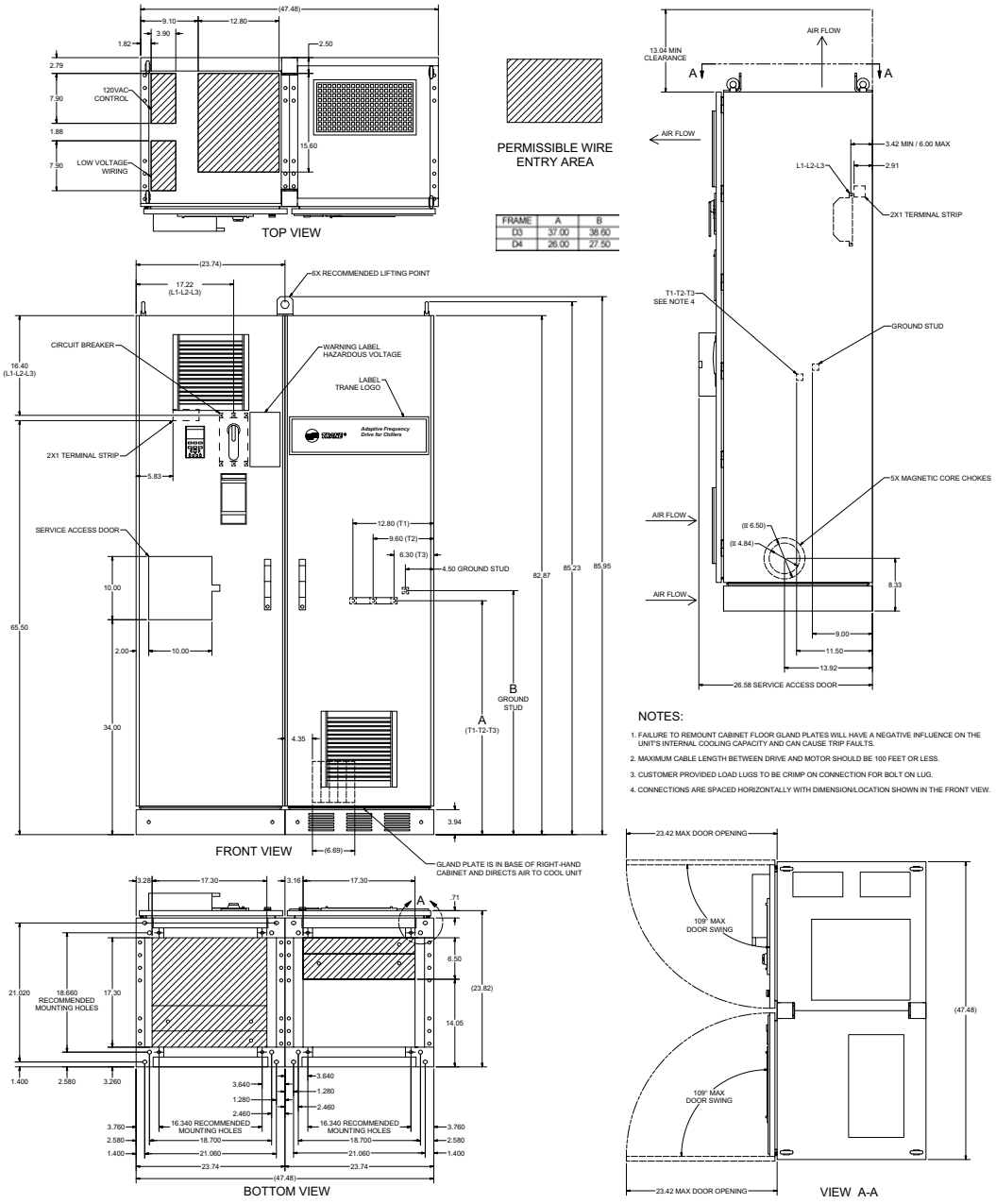
Identifying Trane AFDG Cabinet Components

The Trane AFDG cabinets have the following main components. For convenience, the drive is discussed in two sections, a rectifier (input) and inverter (output) sections.

About the Cabinet

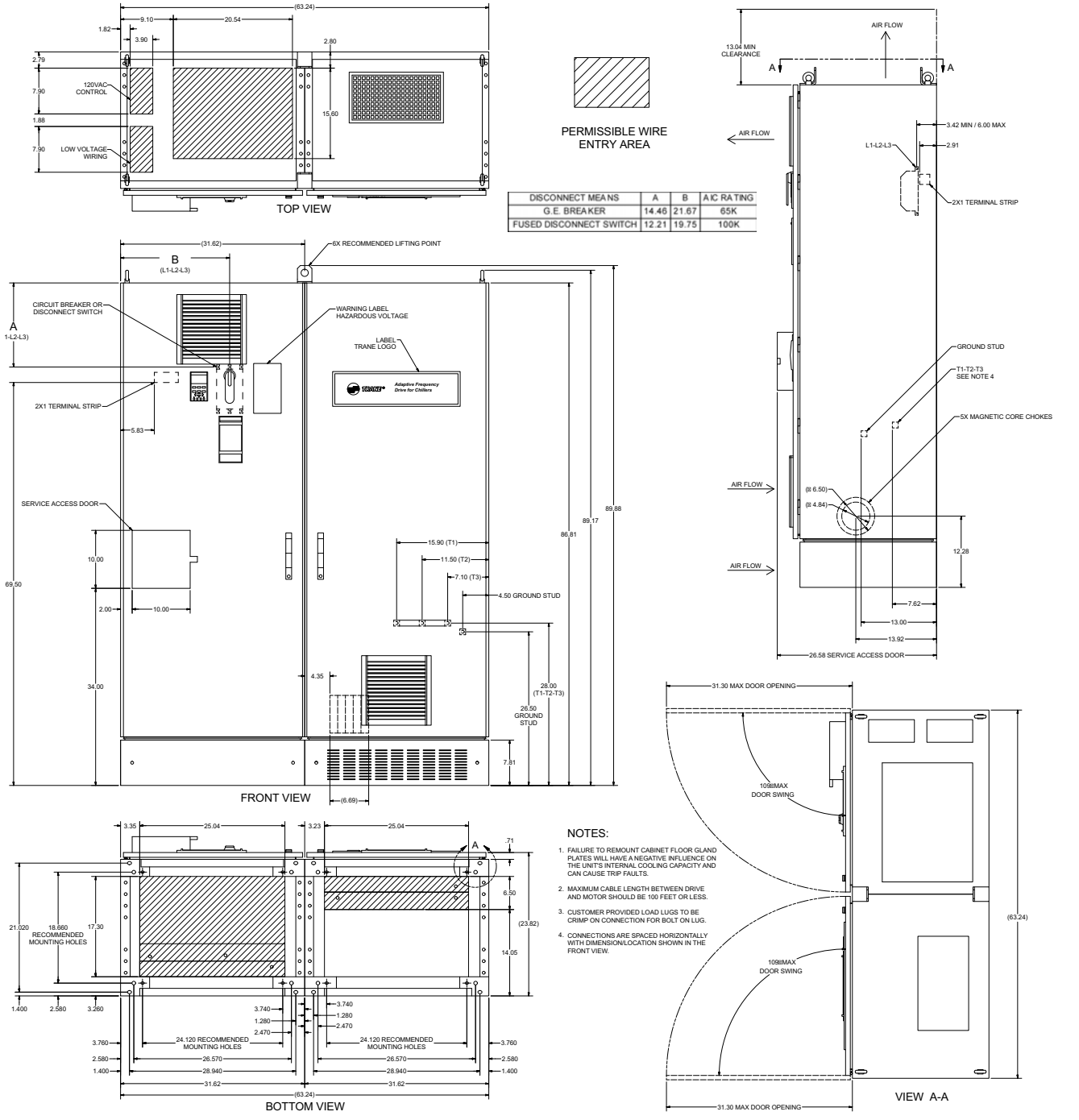
This section provides cabinet dimension information and shows where the wire entry areas are located.

Figure 1. Drive cabinet dimensions: Frame D3 and D4



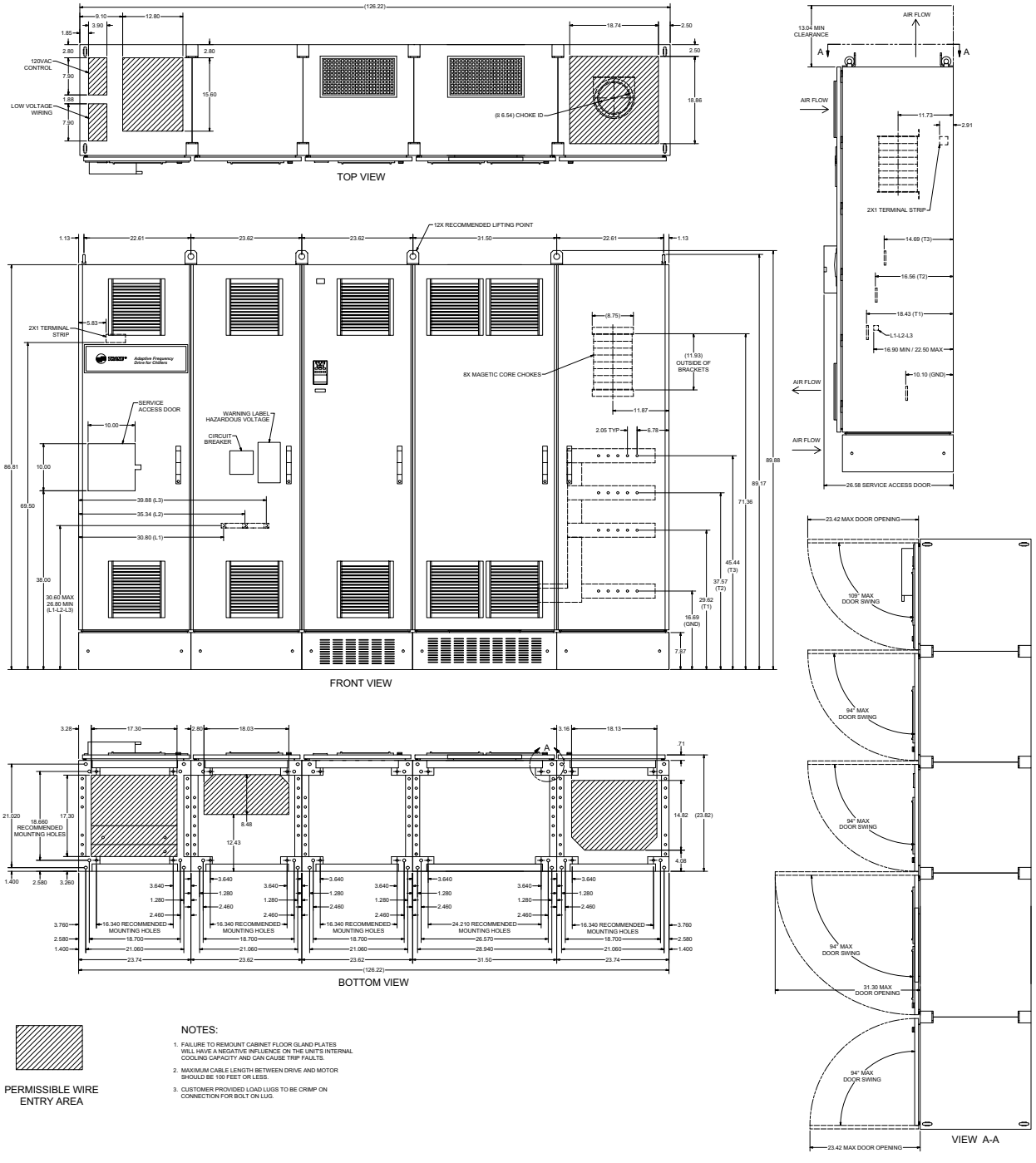
Important: *If wiring to the right-most cabinet, refer to Danfoss manual BAS-SVX21A-EN TR200 IOM for special sealing instructions. The gland plate must be fitted to the frequency converter to ensure the specified protection degree, as well as ensuring proper cooling of the unit. If the gland plate is not mounted, the frequency converter may trip on Alarm 69, Pwr. Card Temp.*

Figure 2. Drive cabinet dimensions: Frame E1 and E2



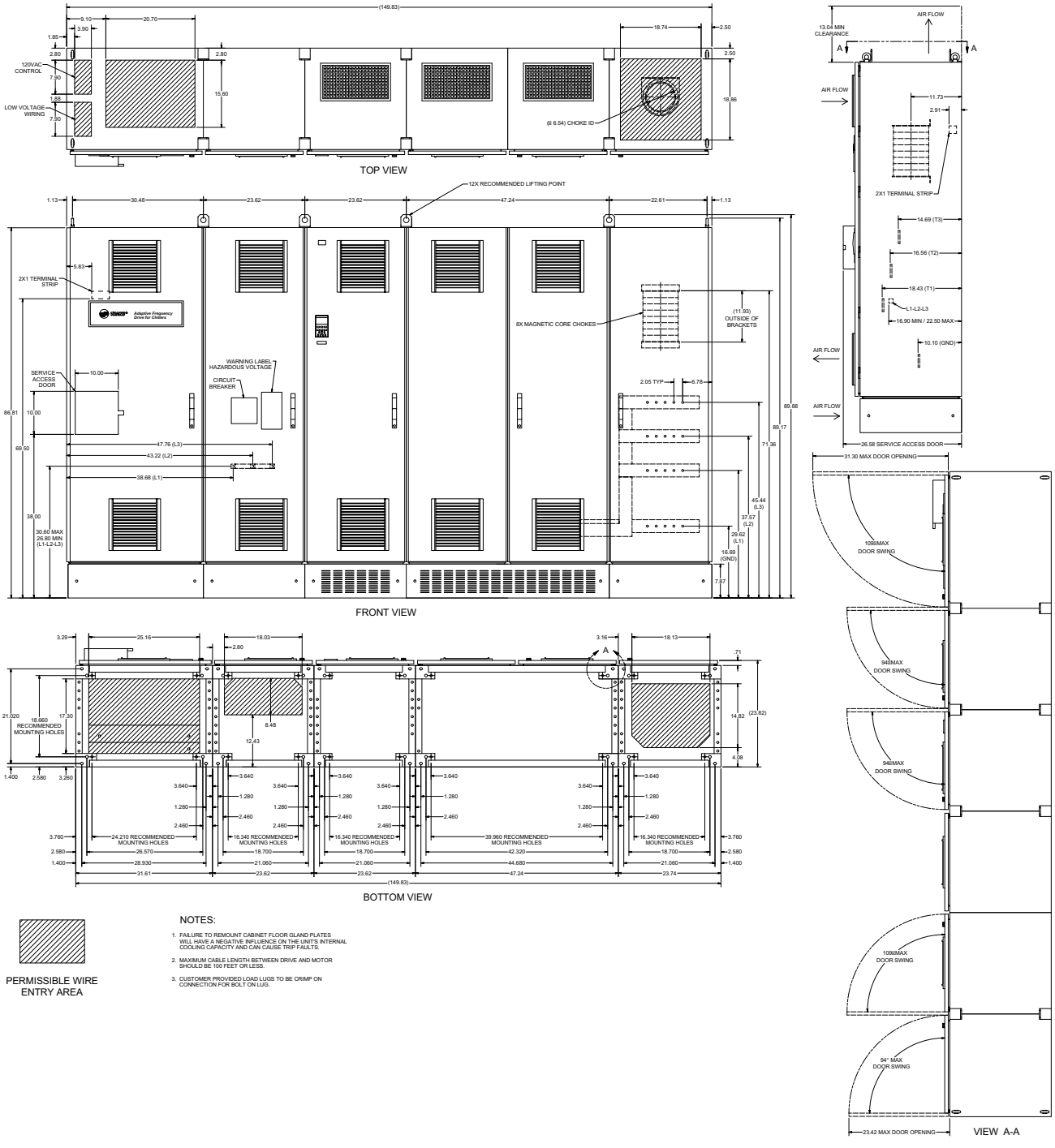
Important: *If wiring to the right-most cabinet, refer to Danfoss manual BAS-SVX21A-EN TR200 IOM for special sealing instructions. The gland plate must be fitted to the frequency converter to ensure the specified protection degree, as well as ensuring proper cooling of the unit. If the gland plate is not mounted, the frequency converter may trip on Alarm 69, Pwr. Card Temp.*

Figure 3. Drive cabinet dimensions: Frame F3



Important: *If wiring to the right-most cabinet, refer to Danfoss manual BAS-SVX21A-EN TR200 IOM for special sealing instructions. The gland plate must be fitted to the frequency converter to ensure the specified protection degree, as well as ensuring proper cooling of the unit. If the gland plate is not mounted, the frequency converter may trip on Alarm 69, Pwr. Card Temp.*

Figure 4. Drive cabinet dimensions: Frame F4



Important: *If wiring to the right-most cabinet, refer to Danfoss manual BAS-SVX21A-EN TR200 IOM for special sealing instructions. The gland plate must be fitted to the frequency converter to ensure the specified protection degree, as well as ensuring proper cooling of the unit. If the gland plate is not mounted, the frequency converter may trip on Alarm 69, Pwr. Card Temp.*

Figure 5. Lift point locations

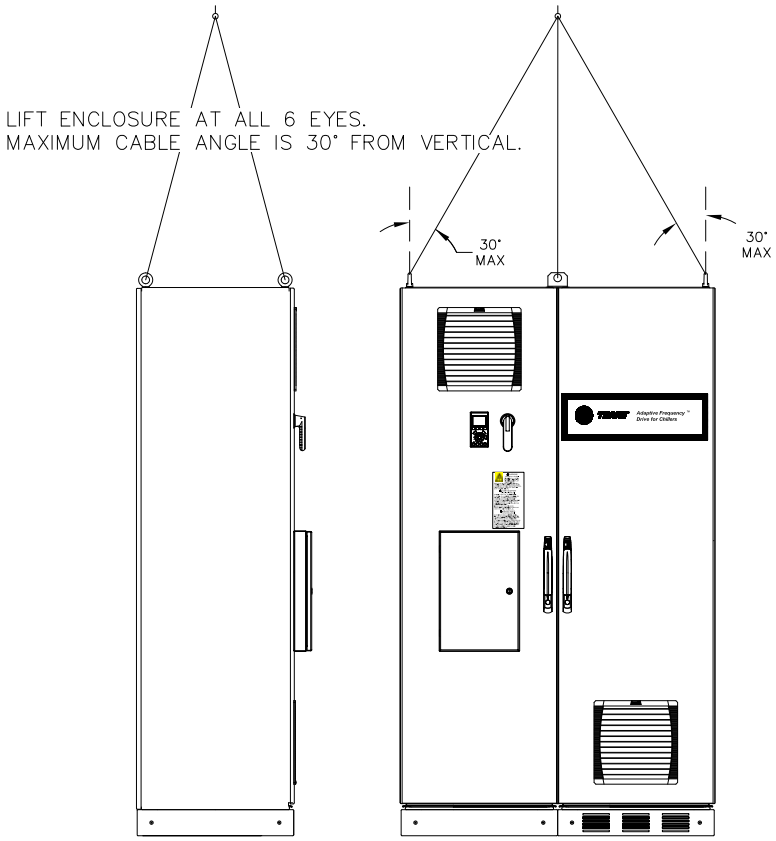


Table 2. Danfoss drive weights

460/480 Volt			575/600 Volt		
Size hp	**Frame**	**Weight**	**Size hp**	**Frame**	**Weight**
150	D3	989	150	D3	989
200	D3	1019	200	D3	1019
250	D4	1121	250	D4	1121
300	D4	1144	300	D4	1145
350	D4	1187	350	D4	1187
450	E2	1504	400	D4	1217
500	E2	1533	450	E2	1504
550	E2	1531	500	E2	1539
600	E2	1634	600	E2	1595
650	F3	2885	650	E2	1681
750	F3	2885	750	F3	2885
900	F3	2885	950	F3	2885
1100	F3	2885	1050	F3	2885
1200	F4	3419	1150	F4	3419
1350	F4	3419	1350	F4	3419

Input Power and Control Wiring

Installing Input Power Wiring Standard Cabinet

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

⚠WARNING

Hazardous Voltage w/Capacitors!

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

NOTICE:

Load Side Wiring!

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. Failure to route the wires through the cores could result in bearing damage.

1. Turn off, lock out, and tag the input power to the drive.
2. Load wires from the drive to the motor must be routed through the common mode choke.

NOTICE:

Equipment Failure!

Do not cut holes in adaptive frequency drive enclosure. Debris falling inside of adaptive frequency drive could cause failure of electronic components. Failure to follow this precaution could result in damaged equipment.

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. Reinstall the cabinet's panel.
6. Connect the three-phase input power leads to circuit breaker terminals L1, L2, and L3. Tighten these connections to 30 ft·lb (40.7 N·m). 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's continuous rated input current.

Refer to submittals for power lug sizes and location along with control wiring specifics for the controller.

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

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.

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 left side and terminates at the control panel's terminal block. Tighten the control wire connections to 7.1 to 8.9 in·lb (0.8 to 1.0 N·m).

Wire Routing

Note: *Wiring from the drive to the motor is required to be routed through the magnetic cores (as illustrated in Figure 6, p. 23).*

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.

⚠WARNING

Hazardous Voltage/Improper Grounding!

The motor controller has a chassis ground that must be connected to an earth ground. Hazardous voltage due to improperly grounded electrical components could result in death or serious injury.

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 left of the breaker.
2. Run a suitable earth ground (completed by field) to the cabinet's ground connection point. The grounding lug is capable of accepting up to 4/0 awg wire. Tighten the ground connections to 375 in·lb (42.4 N·m).

⚠WARNING

Hazardous Voltage/Improper Grounding!

All field-installed wiring must be completed by qualified personnel. All field-installed wiring must comply with NEC and applicable local codes. Failure to follow this instruction could result in death or serious injuries.

NOTICE:

Equipment Damage!

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

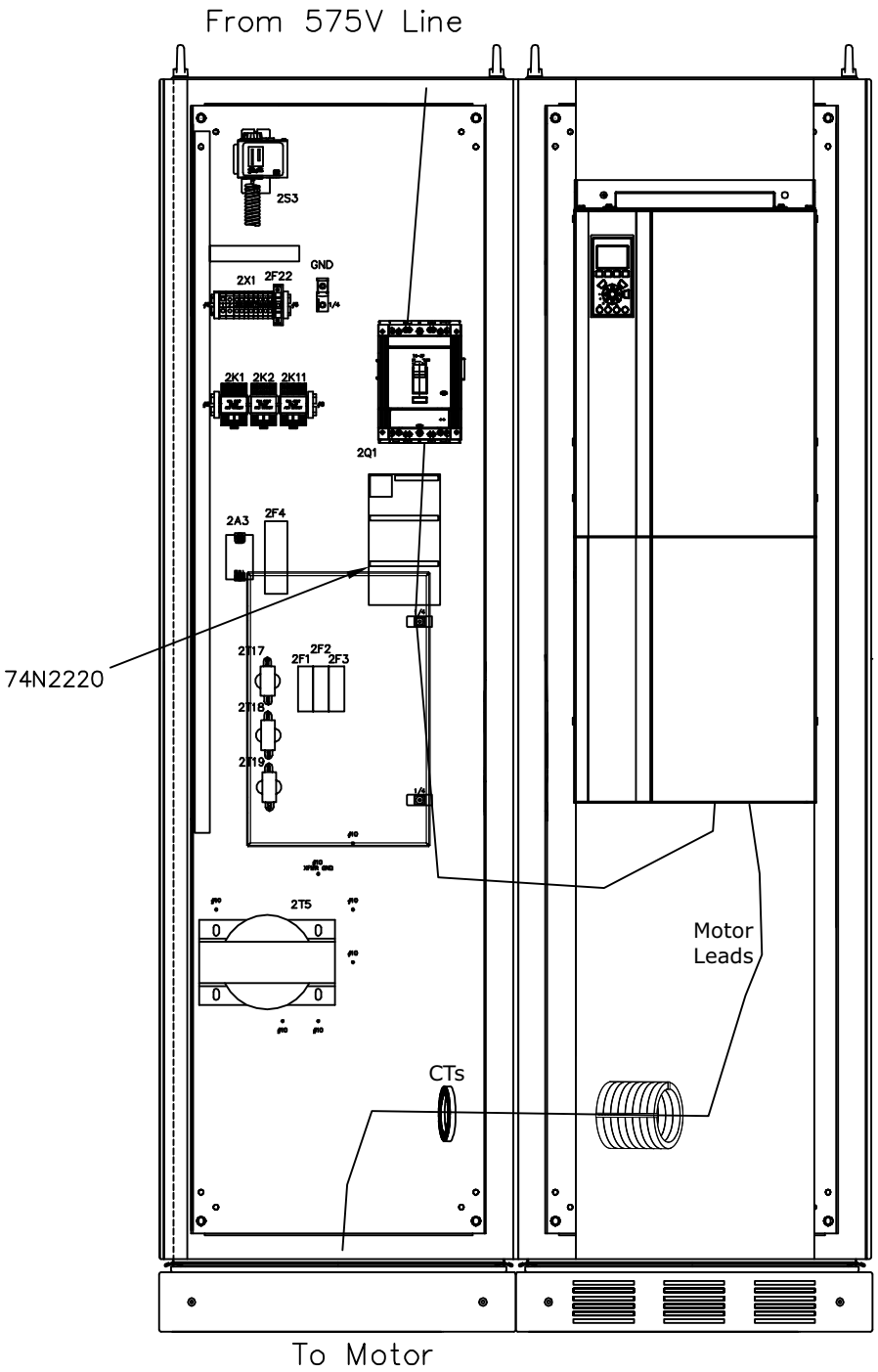
Table 3. Danfoss drive amp ratings

460/480 Volt			575/600 Volt		
Size hp	**Frame**	**Amperage**	**Size hp**	**Frame**	**Amperage**
150	D3	169	150	D3	138
200	D3	213	200	D3	171
250	D4	268	250	D4	215
300	D4	321	300	D4	258
350	D4	394	350	D4	306
450	E2	480	400	D4	356
500	E2	524	450	E2	400
550	E2	603	500	E2	444
600	E2	649	600	E2	507
650	F3	693	650	E2	560
750	F3	791	750	F3	649
900	F3	933	950	F3	756
1100	F3	1031	1050	F3	840
1200	F4	1227	1150	F4	942
1350	F4	1360	1350	F4	1120

Table 4. Drive component list (see Figure 6, p. 23 for drive component layout)

2A1	Starter module, located on the front door, behind the small panel
2A2	Adaptive frequency drive
2A3	Starter power supply
2A10	Starter drive fault input, located on the front door, behind the small panelt
2A11	Speed signal output, located on the front door, behind the small panel
2F1,2,3	Control power primary fusing
2F4	Control power secondary fusing
2F22	Adaptive frequency drive supplemental fusing
2K1	Start contactor
2K2	Run contactor
2K11	Oil pump interlock relay
2Q1	Line potential main circuit breaker
2T1,2,3	Line current transformer
2T5	Control power transformer
2X1,2	Starter panel terminal blocks

Figure 6. Drive component layout (see Table 4, p. 221 for drive component list)



Note: *Wiring from the drive to the motor is required to be routed through the magnetic cores (as illustrated in Figure 6, p. 23).*

Figure 7. Common mode choke

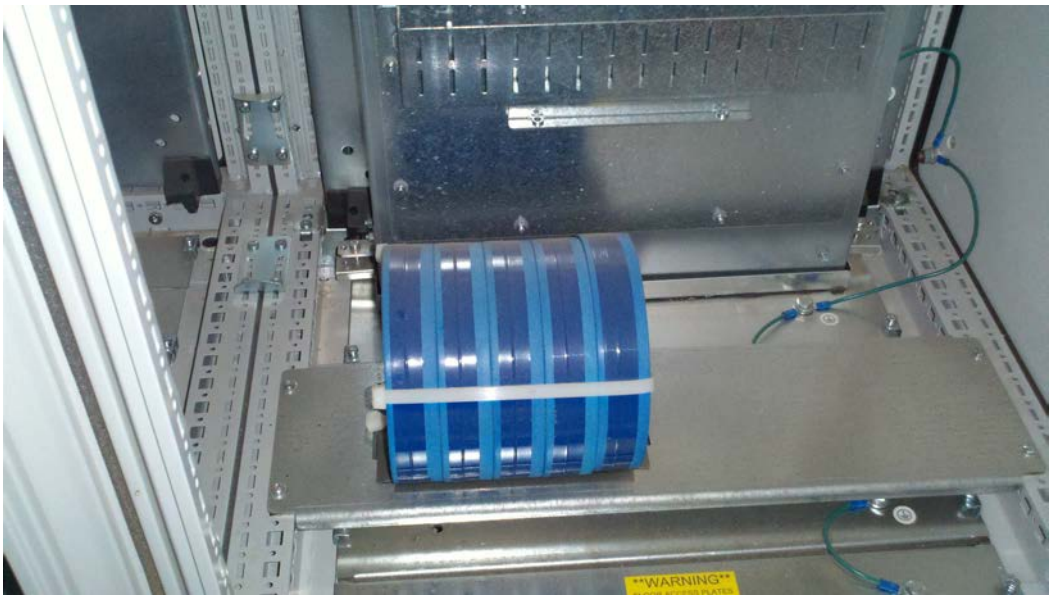
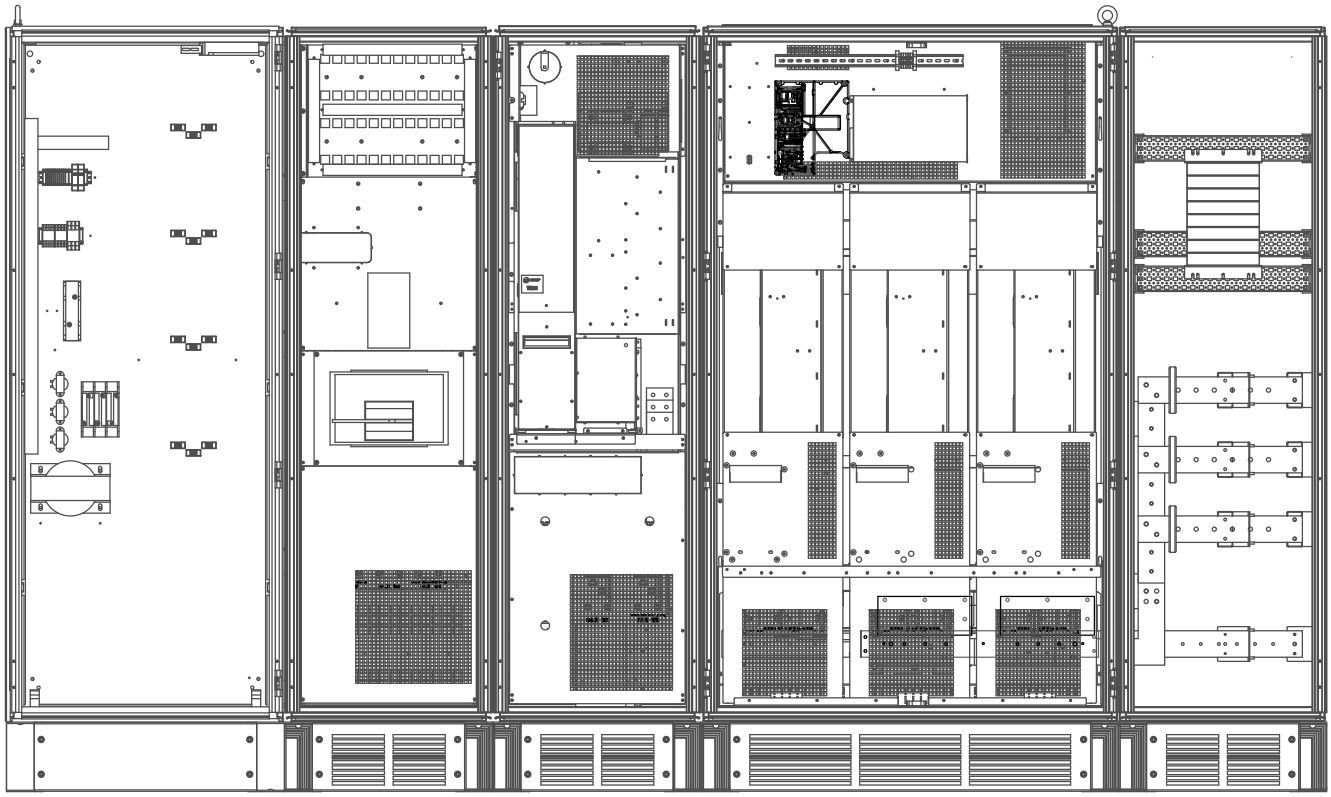


Figure 8. Open assembly (no doors): F4 Units (F3 Units are similar, but have only two inverters)



UC800 AFD Operation

Adaptive Frequency Drive Control

Introduction

Achieving Efficiency

Adjustable speed impeller control is used to improve CenTraVac 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 Tracer UC800 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, reestablish stabile operating conditions, and adjust the control boundary to avoid surge in the future.

Chiller and AFD Sequence of Operation

In the UC800, 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 UC800's AFD 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

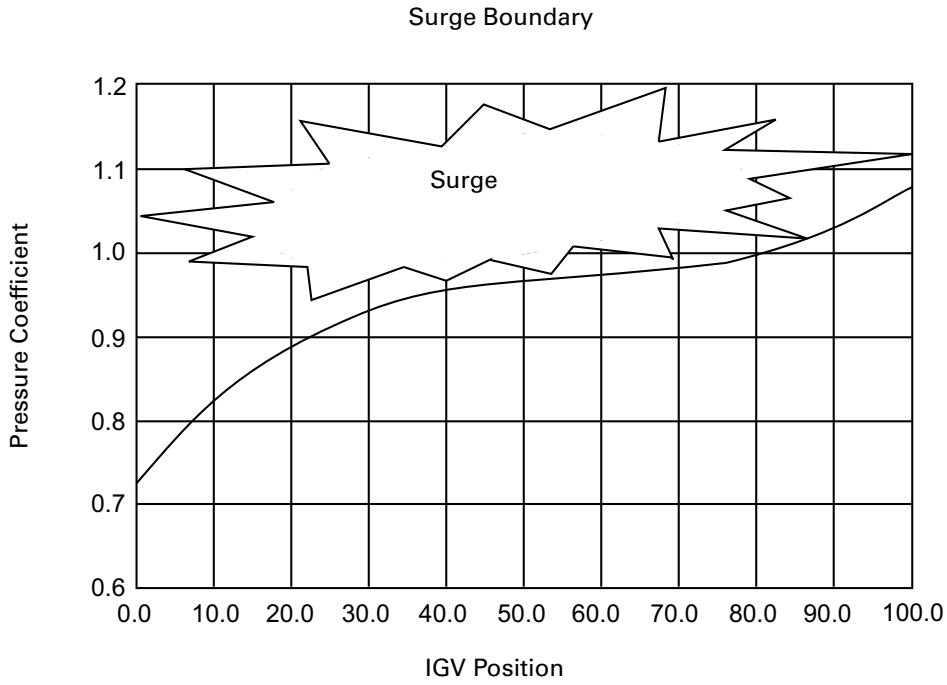
The non-dimensional pressure coefficient is derived based on turbo machinery principles. Fundamentally, the pressure coefficient is the ratio between the potential energy based on the pressure rise across the compressor and the kinetic energy of the refrigerant at the compressor discharge. This normalized 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 effeciency, follow a tower relief schedule at part loads.

Surge Boundary

Surge boundary is a non-linear, empirically derived function of the compressor load. For the UC800, the compressor pressure coefficient boundary is defined as a function of IGV position as shown on Figure 9.

Figure 9. Pressure coefficient surge boundary



AFD Speed Control

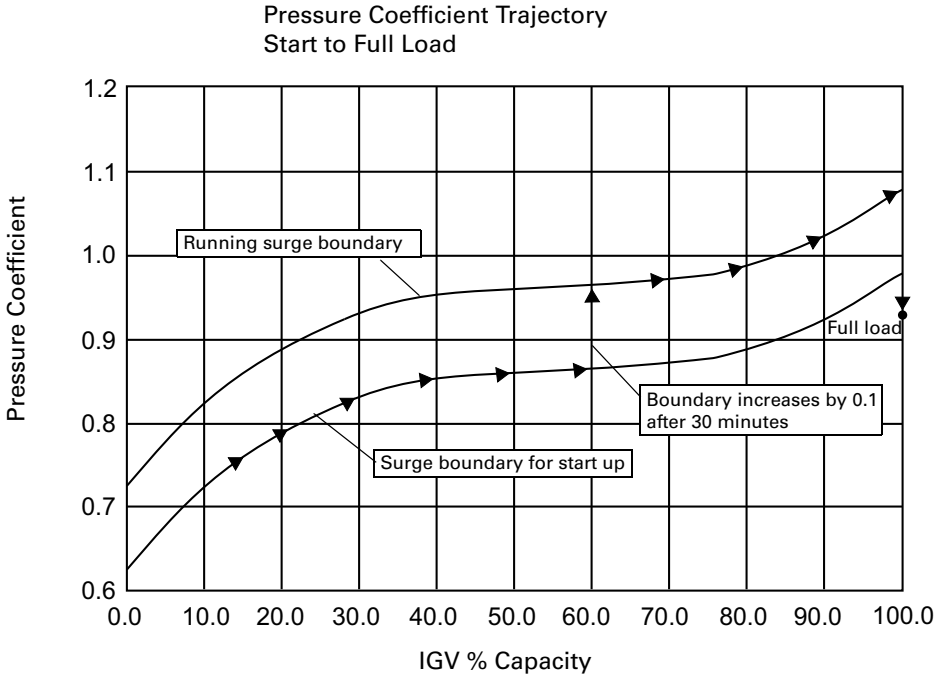
UC800 control utilizes an enhanced control method capable of simultaneously adjusting compressor speed and inlet guide vane position to achieve the desired chiller capacity and pressure coefficient. At the heart of the control is a match model that describes the relationship between control parameters 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. This is possible because of the increased performance of the microprocessor available with the UC800.

Startup

The starting speed for AFD under UC800 control will vary depending upon the pressure ratio across the compressor. The UC800 predicts the condensing pressure during startup and sets the AFD at a speed that will support the predicted pressure ratio across the compressor. The UC800 makes this correction by converting condenser water temperature to a pressure and comparing it to a measured pressure. The UC800 uses the greater of the two pressures for the initial speed command. After the compresser runs for a few minutes, the actual condenser pressure is used. The speed will be adjusted every 5 seconds in response to changing pressure ratio and load requirements.

On startup, 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 over 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 10. Startup surge boundary



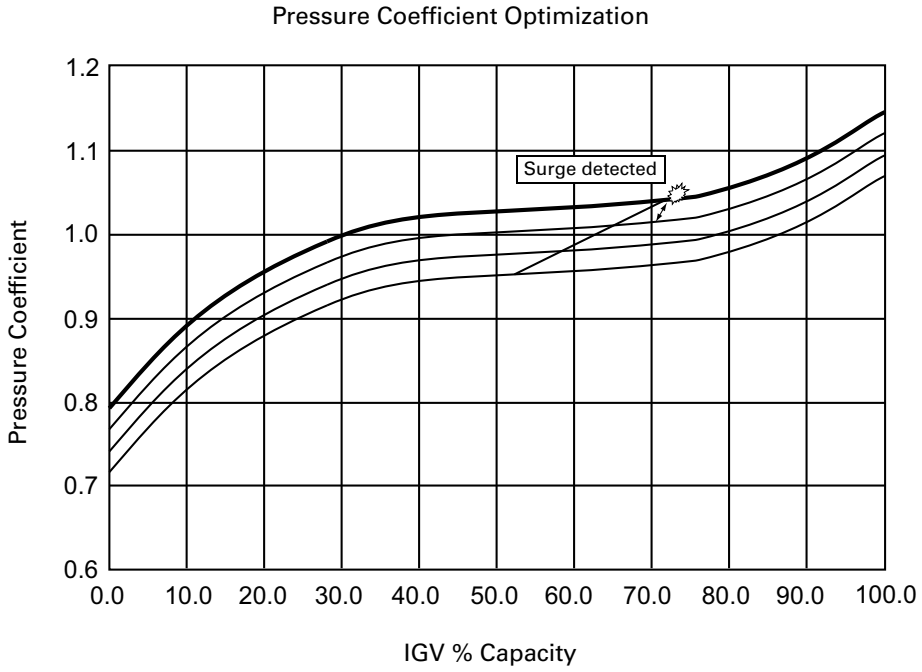
Re-optimization

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 criterions are met.

1. After startup 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 11. Boundary re-optimization



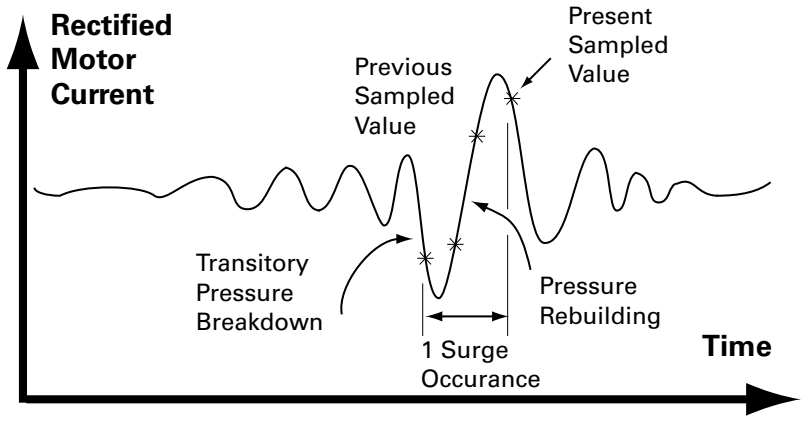
Surge Recovery

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 12 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 12. Motor current signature representing surge



UC800 Interface to Adaptive Frequency Drive

The UC800 provides a "Start" contact closure output to command the Adaptive Frequency Drive to begin its start sequence. A 2–10 Vdc analog speed signal output is provided by the UC800 to provide a speed reference to the AFDG. The UC800 also provides both "Fault" and "Up-to-Speed" (transition complete) contact closure inputs for variable frequency drive starters.

At start of the compressor motor, a signal corresponding to normal line frequency (Full Speed) is applied to the speed signal input of the drive.

Figure 13. Drive frequency vs. speed reference signal

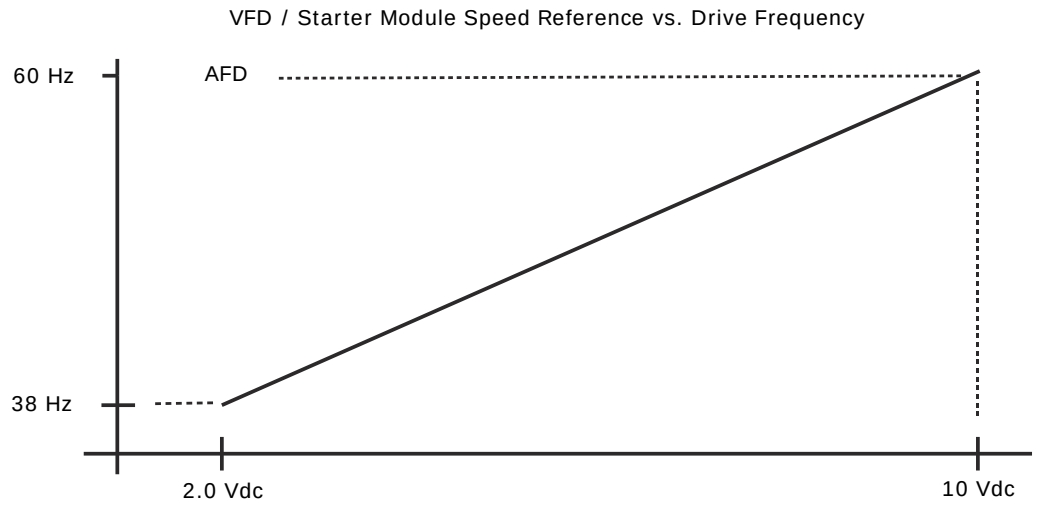
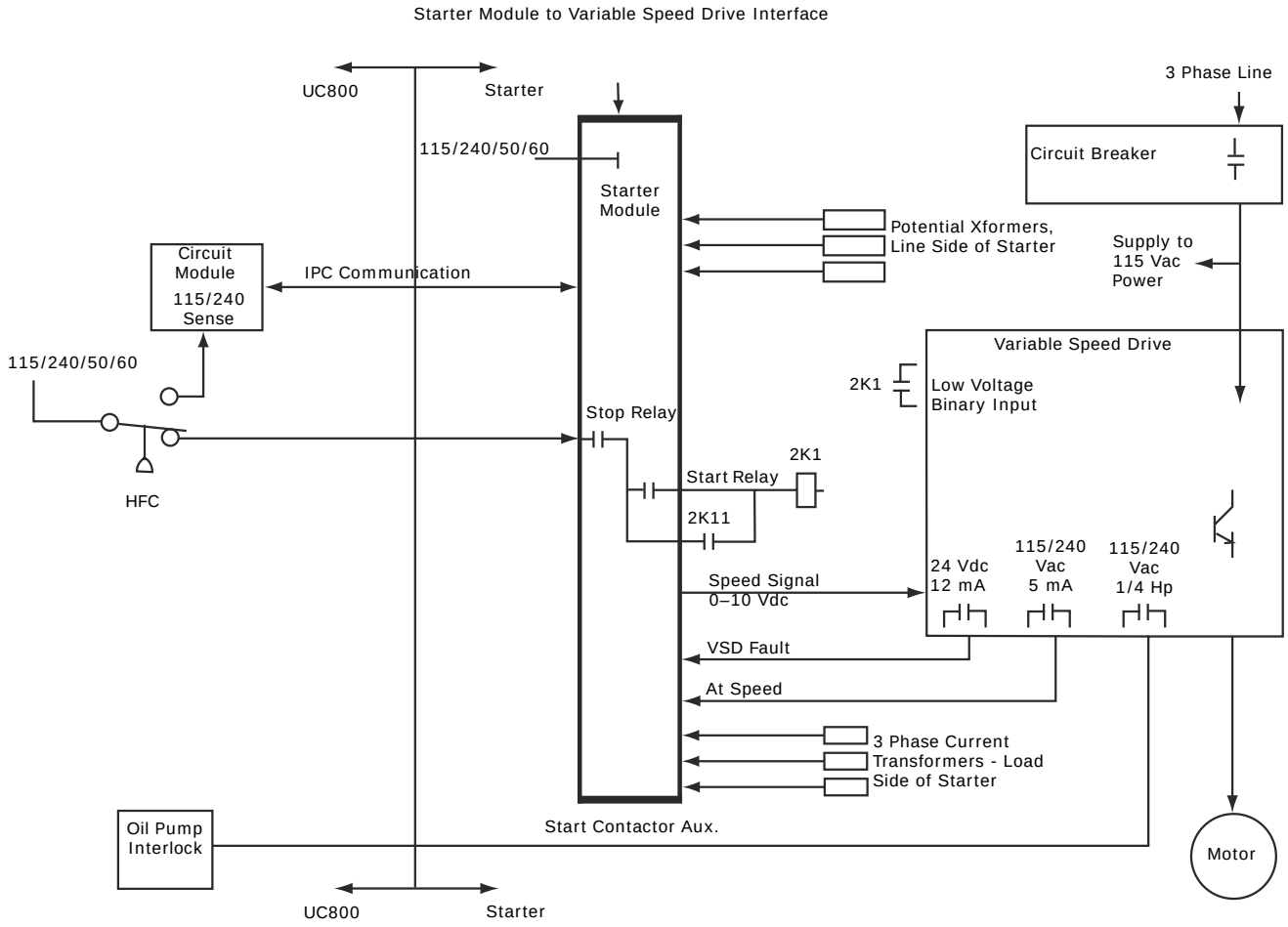


Figure 14. Starter module to unit mounted inverter interface block diagram



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.

Table 5. The following AFD information is available from the AdaptiView display:

AdaptiView Display	MENU items	Units	Comments
Reports - Motor (AFD items)	AFD Frequency	Hz	
Settings - Mode Overrides	Oil Pump Manual Control	Auto/On	Oil pump manual control
	Chiller Control Signal	Auto/Manual	Manual control allows the user to override the automatic signal and manually drive the Compressor Control Signal from 0–100%. 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.

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.

AdaptiView Operator Interface

For the operator's 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 Tracer AdaptiView's MOTOR target area on the home page. Refer to the *Tracer AdaptiView™ Display for CenTraVac Chillers, Daily Operations* manual (CTV-SVU01D-EN, or most recent version) 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 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's "Service Tool" USB plug-in port (this port is extended to exterior of the control panel cabinet for easy access).

Tracer TU's software provides access to that particular machine's configuration settings, customizable limits, status, and up to 60 active or historic alarms. A technician can interact with an individual device or a group of devices for advanced troubleshooting. For more information on Tracer TU, visit your local Trane Service company, or Trane's website at www.Trane.com.

Use Tracer TU when a factory or startup setting requires field alterations.

Table 6. 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:
1. Use only Factory Defaults. Defaults other than above may effect chiller reliability
2. **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 7. Tracer TU: Field Startup 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 8. 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 9. Tracer TU: Configuration view: Starter Expanding section

UC800 Starter Type: Set to Remote-Mount Non-Comm AFD				
Configuration of Drive **Note:** These items are factory set, and checked at unit commissioning. Do not change without authorization				
Description	**Range**	**Default**	**Units**	**Notes**
Stop Delay	1–30	3	Seconds	Set to 30
Unit Voltage	180–15000	460	Volts	Nameplate Data
Voltage Transformer Ratio	0–700	20	(a)	Nameplate Data [VTRA]
Rated Load Amps	0–2500	500	Amps	Nameplate Data [RLA(b)]
CT Meter Scale	0–2000	0		Nameplate Data [CTMS]
Current Unbalance Trip Point	15–100	30	Percent	
Current Unbalance Grace Period	10–255	90	Seconds	
Maximum Acceleration Time	6–64	6	Seconds	Set to 30
Acceleration Shutdown Action	Shutdown Transition	Shutdown		
Overload Type	Exponential Linear	Linear		
Phase Reversal	Enable Disable	Enable		(Set to Disable)(a)
Contactor Integrity	Enable Disable	Disable	(a)	(a)
Phase Reversal Grace Period	20–100	700	Seconds	Set to 1000
Surge Protection	Enable Disable	Enable	(a)	(a)
Momentary Power Loss	Enable Disable	Enable	(a)	Set to Disable
Restart Inhibit Stop to Start Time	0–255	30	Seconds	Use the default
Surge Sensitivity	0–100	20	Percent	(a)
Power Loss Reset Time	0–255	60	Seconds	Also Minimum Time Off: Stop to Start.
RTD Type	750 ohm @ 75°F 100 ohm @ 0°C	75 ohm		

(a) Use only the factory settings for this application as they are specific to the sales order. Instability and faults may occur by using other settings and is not recommended. Contact your local Trane Representative for service when necessary.
(b) Compressor motor RLA.

AFDG Startup Procedure

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 CenTraVac Technical Support for assistance if needed.

⚠WARNING

Hazardous Voltage!

Be sure all enclosure doors are closed and properly secured with fasteners when operating equipment. Failure to follow these instructions could result in death or serious injury.

The air-cooled adaptive frequency drive is remote-mounted on CVHE/CVHF/CVHG units. It is programmed completely in the factory. Follow the procedure below when starting the water chiller and drive.

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

   Complete all items on the commissioning checklist and in the startup procedures for the CVHE/CVHF/CVHG as defined in the operation maintenance manual or other applicable manual.

⚠WARNING

Hazardous Voltage w/Capacitors!

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

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 ten (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. Failure to observe this precaution could result in death or serious injury.

2. Check the following on the drive:
   a. Make sure input wire sizing to the drive is sized correctly based on unit nameplate voltage, and connected as noted in this manual.
   b. Check the drive ground connection as detailed in "Input Power and Control Wiring," p. 19, 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.
4. AFDG control checkout: Use the Tracer TU service tool.
   a. Confirm the drive LLID has been properly bound and is recognized by the unit controls. If two starter LLIDs are shown, *unbind both* and then rebind the starter LLID.
   b. CHILLER Setpoints: As with any new chiller, first check out all UC800 setpoints for the Chiller.
   c. AFD Setpoints: Check out all AFD setpoints (refer to "Drive Settings," p. 34).
   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 AFDG air-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.*
5. In order to view the AFDG configurable settings, go to the Chiller Configuration tab in the Tracer TU service tool and select the AFD expanding section.
6. 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's main DC bus must be charged in order for the drive LLID to be recognized or bound. Close the drive disconnect and apply line power to the drive.
   b. With a laptop connected to the chiller and with Tracer TU running, enter the binding view menu of Tracer TU and locate the "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, wave magnet on the LLID and light the "service" LED.
   d. On the Tracer TU screen, select the "yes" button to indicate the LLID has been selected.
   e. When properly bound, exit the binding view.
   f. Perform any remaining startup items.
7. When ready, start the drive from the Tracer AdaptiView display.
8. Check the AFDG chiller drive response to the UC800. Initially, the drive will go to 38 hertz and stay there until the CenTraVac vanes open based on load. The drive will change the speed from there based on load demand.
9. Document all information on the Startup log.

Drive Settings

Refer to Table 10 for a list of items that need to be set in the frequency drive at startup. For additional information, refer to the programming manual that is shipped with the drive. The programming manual includes a detailed section that discusses accessing the parameters in the drive.

This process is summarized briefly below:

1. To access the parameters, press the **Main Menu** key.
2. If required, enter the password (**999**).
3. To select a parameter group, use the up/down arrow keys to highlight the parameter group, and then press the **Enter** key to access that group.
4. Use the up/down arrow keys to access the parameter number, and then press the **OK** key.
5. Use the up/down arrow keys to change the parameter, and then press the **OK** key to change the setting.

6. If the chiller does not start (e.g., phase loss acceleration time), perform an AMA:
   a. Change the following parameters:
      - 0-40 Hand on key; set to enable.
      - 0-41 Off key; set to enable.
      - 5-12 Terminal 27 digital input; set to 0, no function.
   b. Go to parameter 1-29 automatic motor adaptation (AMA) and enter 1 to enable complete AMA.
   c. Press the hand key “on” to start the AMA. The display should now begin to show the steps completing; there are approximately 16 steps that need to be completed.
   d. Once the AMA is finished, the display will read, “Press OK to finish AMA.” Press OK.

Important: *After the AMA is completed, reset the parameters back to their original settings.*

Table 10. Job specific settings

Group	Parameter	Description	Value
1	20	Motor kW	Set to nameplate CPKW
1	22	Motor voltage	Nameplate voltage
1	24	Motor Current	Set to nameplate TVA
1	25	Motor Nominal speed	Set to nameplate TRPM
1	30	Stator Resistance	Set to nameplate SRES[a]
1	35	Main Reactance	Set to nameplate MGRE
4	16	Torque limit mode	Set to maximum
4	18	Current limit	Set to maximum

(a) Nameplate SRES is stated in micro-ohms (μΩ), but the value must be input in ohms (Ω); convert before inputting.

Refer to Table 11, p. 36 for a list of items that are programmed in the drive at the factory for use with Trane® chillers. In the event that the drive needs to be reset, these parameters need to be reprogrammed into the drive.

To reset the drive to the Danfoss defaults, perform the following procedure.

1. Disconnect power to the drive, and wait for the display to shut down.
2. While powering up the drive, press and hold the following keys: **Status**, **Main**, and **OK**.
3. After 5 seconds, release the keys.

After the drive is reset, reprogram the items listed in Table 11, p. 36.

Table 11. Trane default settings

Group	Parameter	Description	Setting
0	20	Display line 1.1 small	DC link voltage (1630)
0	21	Display line 1.2 small	Analog input (1662)
0	22	Display line 1.3 small	Heat sink temp (1634)
0	23	Display line 2 large	Power Kw (1610)
0	24	Display line 3 large	Freq Hz (1613)
0	40	Hand on key	Disabled (0)
0	41	Off key	Disabled (0)
0	60	Main Menu password	999
0	61	Access to main menu w/o password	Read only (1)
1	03	Torque characteristics	Variable torque (1)
1	23	Motor frequency	60 Hz
3	03	Maximum Reference	60 Hz
3	41	Ramp 1 ramp up time	10 sec
3	42	Ramp 2 ramp down time	20 sec
4	12	Motor speed low limit	38 Hz
4	14	Motor speed high limit	60 Hz
5	12	Terminal 27 digital input	Coast inverse (2)
5	40	Function Relay	Alarm (9)
6	10	Terminal 53 low voltage	2 volts
6	14	Terminal 53 low Ref./Feedb. value	38 Hz
6	15	Terminal 53 High Ref./Feedb. value	60 Hz
14	20	Reset Mode	Automatic reset x 2
14	21	Automatic Restart Time	60 sec.

Startup 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 & Hz	
Amps	
Motor Data:	
Manufacturer	
Type & Frame	
Drawing #	
Serial Number	
Nameplate Data:	
RLA	
KW	
Volts & Hz	

Prestart Checks	Date Checked
Drive Grounded	
Motor Rotation	
Drive Chassis Grounded	
Control Wiring Tight	
Drive Connections are Tight	
Verified Settings	

Comments:

Tracer TU: Service Setpoints View: AFD	Default	Setting
AFD Control	Auto	
Re-Optimization Sensitivity	20%	

UC800 Starter Type: Remote Mount Non-Communicating 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	*	
CT Meter Scale	0	
Stop Delay	3	
Motor NP RLA	*	
Voltage Transformer Ratio	20	
Current Unbalance Trip Point	30	
Acceleration Time	30	
Acceleration Shutdown Action	Shutdown	
Overload Type	Linear	
Phase Reversal	Enable	
Contactor Integrity	Disable	
Phase Reversal Grace Period	700	
Surge Protection	Enable	
Momentary Power Loss	2000	
Restart Inhibit Stop to Start	30	
Surge Sensitivity	20	
Power Loss Reset	15	
RTD Type	75	

*Must be set per sales order variable.

Test Log Date:	Log 1	Log 2
AFD Output Power (KW)		
Speed		
Frequency		
Tracer TU Field Startup 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		

Recommended Periodic Maintenance and Inspection

Visual Inspection—Power Removed

⚠WARNING

Hazardous Voltage w/Capacitors!

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

1. Ensure the door interlocks are present and working.
2. Verify the safety ground connections to the door panels are securely connected.
3. Inspect power wire cables and devices to assure no abrasion is occurring from vibrations against chassis of cabinets, or other edges.
4. 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.
5. Inspect the interior of the drive for any signs of moisture entry or leakage.
6. 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.).
7. Closely inspect the motor terminal board for any signs of leakage, arcing, etc.
8. Check ALL cable/lug/terminal connections inside the drive enclosure. Ensure all are clean and tight, and not rubbing against each other anywhere.

⚠WARNING

Live Electrical Components!

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. Failure to follow all electrical safety precautions when exposed to live electrical components could result in death or serious injury.

Operational Inspection—Power Applied

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 LCP 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 alarm histories for any indications of operational problems.

Do this every 1–12 months depending on operating environment

To properly diagnose service issues for Adaptive Frequency drives for centrifugal chillers equipped with AFDG starters. All UC800 chillers will be equiped with the LCP as standard on the drive power module. This is for service only and NEVER for machine operation.

Do as needed.

Replace the magnetic choke if there is physical damage (for example, cracks).

Chiller Operator Display Content

Refer to *Operations Guide: Tracer AdaptiView™ Display for Water-Cooled CenTraVac™ Chillers* (CTV-SVU01C-EN, or the most recent version) for Tracer AdaptiView display information.

Important: *Please note that the 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.*

Troubleshooting

Troubleshooting

In the event that there is a problem with the drive, a starter diagnostic appears on the Tracer AdaptiView display. This occurs when the drive fault contacts open in the drive on the 2A10 module. If this occurs, the next step is to refer the the AFD LCP (local control panel) to determine the type of fault that has occurred in the drive.

The drive displays three types of faults:

- **Warning**

  A warning or alarm is signaled by the LEDs on the front of the AFD by a code on the LCP.

  A warning indicates a condition that may require attention or a trend that may eventually require attention, and will remain active until the cause is no longer present. Under some circumstances, motor operation may continue.

- **Trip**

  A trip is the action when an alarm has appeared. The trip removes power to the motor and, after the condition has been cleared, can be reset by pressing the **Reset** button. The event that caused an alarm cannot damage the AFD or cause a dangerous condition.

  After its cause has been rectified, an alarm must be reset to restart operation.

- **Trip Lock**

  A trip lock is an action when an alarm occurs that may cause damage to the AFD or equipment. Power is removed from the motor, and a trip lock can only be reset after the condition is cleared by cycling power.

  Once the problem has been rectified, only the alarm continues flashing until the AFD is reset.

⚠WARNING

Hazardous Voltage w/Capacitors!

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

1. Collect alarm and parameter information.
   a. DO NOT cycle unit power or reset the controls. Leave AFD and UC800 in their present states.
   b. Record all UC800 active and historic alarms. Make a full chiller service report.
   c. Document and check all applicable parameter settings. This information can be verified from the chiller nameplate, and by referring to this manual.
   d. In the Binding view of the Tracer TU service tool, verify there is a green face indicating that the Starter LLID is bound.
   e. 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's sales order and serial numbers, & the drive's serial and model numbers.

3. Troubleshooting

a. Measure and record the DC bus (via the Local Control Panel (LCP)).

b. Check ALL wiring (tightness, ribbon cables fully seated, proper phasing, etc.)

c. Refer to the Danfoss manuals for further troubleshooting information.

Wiring Schematics

For reference, an as-built schematic wiring diagram and a field wiring connection diagram are located inside the main control panel door of the chiller.

Trane optimizes the performance of homes and buildings around the world. A business of Ingersoll Rand, the leader in creating and sustaining safe, comfortable and energy efficient environments, Trane offers a broad portfolio of advanced controls and HVAC systems, comprehensive building services, and parts. For more information, visit www.Trane.com.

Trane has a policy of continuous product and product data improvement and reserves the right to change design and specifications without notice.

AFDG-SVU01C-EN 05 Aug 2011
Supersedes AFDG-SVU01B-EN (01 May 2010)

We are committed to using environmentally conscious print practices that reduce waste.