User Guide

Remote-Mounted Medium Voltage Air-Cooled Adaptive Frequency™ Drive with Tracer AdaptiView™ Control

Model: AFDJ

X39641166050

⚠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 2022 **AFDJ-SVU01G-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-including industry replacements for CFCs and HCFCs such as saturated or unsaturated HFCs and HCFCs.

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.**

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⚠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.**

⚠WARNING

Refrigerant May Be Under Positive Pressure!

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

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Factory Training

Factory training is available through Trane University™ to help you learn more about the operation and maintenance of your equipment. To learn about available training opportunities contact Trane University™.

Online: www.trane.com/traneuniversity

Phone: 855-803-3563

Email: traneuniversity@trane.com

Revision History

Updated motor terminal connection figure in the Wiring chapter.

Table of Contents

Overview

⚠WARNING

Hazardous Service Procedures!

Failure to follow all precautions in this manual and on the tags, stickers, and labels 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 following instructions: Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors 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

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury. Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized.

All electrical circuits shall be treated as energized until all lockout/tagout procedures are in place and the circuit has been tested to verify that it is de-energized. The medium voltage motor terminal box cover must not be removed if power is present, or if there is a possibility that power may be present. Working on energized medium voltage circuits is not an approved practice for normal HVAC maintenance or service.

⚠WARNING

Hazardous Voltage w/Capacitors!

Failure to follow instructions below 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.If this equipment is interlocked with other equipment, 115 volt AC may be present in the cabinet even though the main power is disconnected. Interlock signals must be deactivated by qualified personnel prior to any work in the cabinet. Verify with an appropriate voltmeter that all capacitors have discharged, and interlock signals have been deactivated from all circuits

⚠WARNING

Capacitors Must be Allowed to Discharge!

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

Important:

- *Before servicing, disconnect all power sources and allow at least 40 minutes for capacitors to discharge.*
- *All electrical enclosures-unit or remote-are IP2X.*

CE for MV Drives

⚠WARNING

Lockout/Tagout Before Removing Touch-Safe Covers!

Failure to follow instructions regarding touch-safe covers could result in death or serious injury.

Touch-safe covers inside panels are there for protection and may be removed if necessary for service only and only after disconnection of main power supply. Before removing any touch-safe cover, ensure that there is no line power first. Removal of touch-safe covers is at the customer/service personnel's own risk. After any service is completed, if the touch-safe covers have been removed, they need to be put back in to ensure safety and protection.

Important:

- *All Trane-supplied remote drives used in conjunction with CVHH or CDHH Trane chillers will be CE-compliant per EU directives and IEC standards to which the CVHH and CDHH chillers also comply. All Trane-supplied remote starters and drives must be used with CVHH or CDHH Trane chillers to ensure CE compliance*
- *For remote drives, basic details are provided on drive nameplate. Please refer to the chiller unit nameplate located on the chiller-mounted control panel for details on wire sizing (minimum current ampacity) and overcurrent protection sizing upstream of unit (maximum overcurrent protection).*
- *Always refer to as-built schematic wiring diagram and the chiller* Installation, Operation, and Maintenance *manual located inside the chiller-mounted control panel (regardless of unit or remote-mounted starter or drive) for details on wiring, safety, installation, and warnings.*
- *Customers are responsible for all field wiring with respect to EMC and EMI interference. Customers are responsible for mitigating the risks associated with EMC and EMI interference that can occur as a result of customer-provided field wiring as dictated by international, national, and local codes. This also implies that for remote-mounted drives, customers are responsible for the entire field wiring into the drive as well as between the drive and the chiller/compressor terminals with respect to EMC and EMI interference. It also implies that customers are responsible for incoming power wiring to the drive with respect to EMC and EMI interference.*

All customer wiring, including power wiring to drives, must be separated: 24–27 Vdc, 110–120 Vac, 460 V, and 2300–6600 Vac each must be in separate conduit runs.

For remote drives interfacing with Trane CVHH and CDHH chillers, all wiring must be run in conduit. Any Ethernet cables being used by the customer to interface with the Trane chiller must be shielded Ethernet cabling.

The customer is required to provide an overcurrent protective device upstream of all drives in accordance with IEC standards and/or any applicable national and local and codes.

Service personnel must use proper PPE for servicing and must also use proper lockout/tagout procedures during servicing: lock the drive disconnect handle before servicing to prevent accidental pulling of disconnect handle at the drive panel.

In addition, service personnel should disconnect the main supply disconnecting device upstream of the drive *before* performing any service on any part of the chiller.

Checks

Motor Checks

NOTICE

Do Not Megohm Test!

Using a megger to perform continuity checks in the drive equipment could result in damage to the controller circuitry.

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!

Failure to disconnect all motor leads at the AFD prior to megging the motor could result in 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.

AFDJ Checks

NOTICE

Perform Visual Inspection!

The conditions noted below could cause equipment damage. 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.**

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!

Failure to close all enclosure doors and properly secure with fasteners before operating equipment could result in death or serious injury due to hazardous voltage.

Important:

- *Before servicing, disconnect all power sources and allow at least 40 minutes for capacitors to discharge.*
- *All electrical enclosures-unit or remote-are IP2X.*

Safety Precautions

1. This equipment must be adjusted and serviced by qualified 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!

Failure to follow instructions below 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.

4. Check to see that the AFDJ is properly ground to earth. Refer to “Grounding the Cabinet,” p. 38 in “Input Power, Drive-to-Motor, and Control Wiring,” p. 37.

⚠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

Insert Control Boards or Fuses!

Do not remove or insert control boards or fuses while input power is connected to the controller because doing so could result in death, serious injury, and equipment damage.

Important:

- *Before servicing, disconnect all power sources and allow at least 40 minutes for capacitors to discharge.*
- *All electrical enclosures-unit or remote-are IP2X.*
- *Specific safety training for medium-voltage (MV) equipment, specialized tools and instruments for working on MV products, and enhanced personal protective equipment (PPE) that is designed to mitigate the hazards of arc flash injuries are required for working on the products described in this literature. Only medium-voltage trained, certified engineers are allowed to work on MV products.*

Please refer to Rockwell’s MV product manual for details on recommendations to be followed for different components.

Rockwell Medium Voltage PowerFlex 7000 Drives

⚠WARNING

Read and Understand All Safety Procedures in this Manual!

Failure to read and understand the following information could result in death or serious injury. The information contained in this section of the manual is very important. It describes safety procedures that MUST be followed. For your safety you MUST read and understand them. If you have any questions, please contact your local Trane/Rockwell office.

Typical Configurations

The Trane-supplied Medium Voltage PowerFlex® 7000 drives is available in two air-cooled versions, called Frames: 1) 7000

A-Frame, and 2) 7000 B-Frame. Each Frame is specified based on the physical size and horse power (HP) or KW rating of the equipment. Generally, A-Frame is the smallest frame air-cooled drive, and B-Frame is the largest air-cooled drive. The following Rockwell Safe Electric Work Practices (SEWP) applies to typical configurations for PowerFlex 7000 drives regardless of the frame size[1].

Cabinet

Cabinet Energy Sources

A typical PowerFlex 7000 drive has a main medium voltage power supply and two other secondary control voltages power supply. In addition, a customer may specify a configuration with additional energy sources such as a UPS back-up power supply.

- Your responsibility is to look for all sources of hazardous energy to confirm the drive you will service or maintain matches the drawing.
- You must identify each source of power supplied to the cabinet and implement steps to control the each power source prior to performing your work.
- Other safety measures may have to be implemented for work such as removing cabinet tray covers/power cages to check the condition of “snubber capacitors” prior to performing the work.

Cabinet Design

Medium voltage cabinet doors are key interlock controlled and designed to open in sequence.

- Cabinet doors must only be opened in the engineered sequence and must be treated as if they are live until de-energization is verified.
- Control voltage cabinet door are black in color and can be opened without a key. The inside of the control voltage cabinet must be treated as if they are live until de-energization is verified.

The key interlocking scheme is a cornerstone of the safety devices built into a product. You are not authorized to work on, and must refuse to work on any installed MV product where the key interlocks are missing, damaged or compromised in any way. Keys can never be duplicated without the owner of the product signing a waiver. Service personnel should never be in possession of their own duplicate keys.

Match the personal protective equipment (PPE) you use to the voltage level and the hazard category to make sure that you have the correct protection for the specific work you are doing. The PPE must be adequate to protect against shock as well as arc flash injury.

Cabinet Voltage Levels

For the purpose of medium voltage technical work, medium voltage is defined as 1,000–15,000 volts. Rockwell Automation medium voltage products presently range from 2,300–7,200 volts. The control voltage is defined as 600 volts or less. It is typically 480 or 120 volts. Some cabinets also have 5–24 Vdc power supply hooked up to them for logic circuit boards or indicator meters.

The voltages upstream to the Rockwell medium voltage product can be higher than 7,200 volts. You are not authorized/trained or equipped to work on these systems. The customers’ staff that are trained and authorized to de-energize the equipment must be used for this work.

PowerFlex 7000 Medium Voltage Cabinet

Medium Voltage Power De-energization

Drive, Disconnect, or Breaker

- Put on the Personal Protective Equipment (PPE) necessary to protect from the shock and arc flash hazards from both medium and control voltages.
- Disconnect the MV input power source to the PowerFlex 7000 drive cabinets by placing the drive control; disconnect handle or circuit breaker switch in the “off” position.
  - Apply the Lockout-Tagout device(s) and lock(s).
  - The drive cabinet doors are locked and the input power control box must remain closed when de-energizing the MV power source.
    - Placing the control, handle or switch in the “Off” position should de-energized the power only down stream from the cabinet.
    - Medium voltage power remains energized upstream of the control, handle or switch.
- Use a properly rated meter to verify the medium voltage power on the downstream side of the drive/disconnect/breaker is de-energized.
  - Follow meter test procedures to confirm the meter is reading accurately prior to verifying de-energization.

[1] Rockwell also manufactures a C-Frame, which is liquid-cooled, but which is larger than our applications.

⚠WARNING

Hazardous Voltage w/Capacitors!

Failure to follow instructions below 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.If this equipment is interlocked with other equipment, 115 volt AC may be present in the cabinet even though the main power is disconnected. Interlock signals must be deactivated by qualified personnel prior to any work in the cabinet. Verify with an appropriate voltmeter that all capacitors have discharged, and interlock signals have been deactivated from all circuits

⚠WARNING

Capacitors Must be Allowed to Discharge!

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

Important:

- *Before servicing, disconnect all power sources and allow at least 40 minutes for capacitors to discharge.*
- *All electrical enclosures-unit or remote-are IP2X.*
- Remove the key from the de-energized drive/disconnect/breaker and use the key control procedure to open the MV cabinet access door(s).
- Use a medium voltage rated Potential Indicator tool ("hot stick") to confirm the medium voltage power inside the PowerFlex 7000 cabinet is de-energized.
  - Follow Potential Indicator tool test procedures to confirm the tool is working properly prior to verifying de-energization.
- The PPE for medium voltage safety can only be removed once the MV power de-energization is verified and confirmed. The PPE for control voltage can only be removed once the control voltage de-energization is verified.

Control Voltage Power De-energization

⚠WARNING

Read and Understand All Safety Procedures in this Manual!

Failure to read and understand the following information could result in death or serious injury. The information contained in this section of the manual is very important. It describes safety procedures that MUST be followed. For your safety you MUST read and understand them. If you have any questions, please contact your local Trane/Rockwell office.

- Wear the PPE that is necessary to protect from the shock and arc flash hazards.
- Disconnect the control voltage. Apply the lockout lock(s) and/or the tagout device(s).
- Identify the PowerFlex 7000 cabinet control power supply.
  - The source may be a disconnect switch on an electric circuit, an input contactor mounted on the side of the cabinet or similar power disconnect device.
  - Identify other sources of control voltage by reviewing the system drawings and looking at the equipment for secondary power sources.
- Some cabinets are equipped with a UPS battery backup 120 volt AC power supply for control voltage.
  - The control voltage from the UPS battery backup will not be de-energized by disconnecting the control voltage disconnect switch. It is designed to energize once the primary control voltage source is de-energized.
  - Use the PPE necessary to protect against UPS power.
- Use a properly rated meter to verify the control voltage power on the downstream side of the disconnect device is de-energized.
- Place the control voltage from the Rockwell Automation installed circuit breaker on the panel inside the control voltage supply cabinet in the "off" position.
  - The circuit breakers are normally located at the bottom of the circuit breaker terminal block strip.
  - Lockout-Tagout the switch. If a lockout is not feasible then tagout the circuit breaker to warn other people working in the same area not to turn the switch back on as it will re-energize the control circuit and may cause harm or injury to the person working on the equipment.
- If the primary and secondary control voltage sources are not de-energized during the work, you must continue to use your PPE while performing the work.

Back-feed Sources of Hazardous Electrical Energy

⚠WARNING

Read and Understand All Safety Procedures in This Manual!

Failure to read and understand the following information could result in death or serious injury. The information contained in this section of the manual is very important. It describes safety procedures that MUST be followed. For your safety you MUST read and understand them. If you have any questions, please contact your local Trane/Rockwell office.

- Back-feed power caused by a fan that rotates from ambient wind blowing on it, electric motor(s) rotating when equipment manually moves it and other potential sources of back-feed power may be downstream from the MV cabinet.
  - Identify sources of potential back-feed power downstream from the MV cabinet.
  - Prevent back-feed power by locking, blocking or by other measures to positively control back-feed power sources.
- Verify these sources are positively controlled to prevent back-feed.

General Information

About This Manual

This manual is intended for use by experienced service personnel, qualified electrical personnel, Trane service personnel, and Rockwell 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

Rockwell provides drive-size order-specific literature that ships with the drive from the Rockwell factory.

Cabinet Servicing

For information regarding the servicing of drive components, please refer to the appropriate Rockwell literature that ships with the drive.

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.

Scope of Installation and Commissioning Responsibilities

Table 1. Scope of installation and commissioning responsibilities

Item	Others	Trane	Rockwell	See Figures/Pages
Chiller (provided by Trane)		X		
Inspect chiller for shipping damage	X	Assist if any questions		
Drive (provided by Trane from Rockwell)			Direct ship from Rockwell	
Inspect drive for shipping damage	X			
Provide drive foundation	X			
Uncrate/package drive and inspect	X			
Rig drive into place	X			
Provide power wires and installation to drive and terminate:	X			
• Line 3-phase voltage to drive; be sure to do this before fan shroud installation (A-Frame only)				
• Fan 3-phase voltage to drive (B-Frame)				
• Drive to motor power wiring				
• Control power drive to chiller; interconnect (LV)				
Install fan shroud boxes	X			
Install resistor box	X			
Provide adequate ventilation for heat rejection of drive	X			
Precommision chiller; refer to chiller IOM forms		X		
Fill out drive precommision check sheet	Assist Trane	X		
Precommision drive		X	Assist	
Apply 120 V		Assist	X	
Apply power (3-phase)		Assist	X	
Check/Configure drive controls setpoints with Trane Service Tool		X	Assist	
3-phase power (DO NOT APPLY)			Present at start-up	
Drive/chiller start-up		Assist	X	
Annual inspections		X	X	As specified

About the AFDJ Drive

The AFDJ Trane Adaptive Frequency Drive is an air-cooled drive which utilizes Pulse Width Modulation (PWM) high switching frequency Symmetric Gate Commutated Thyristors (SGCT). Both the inverter and the rectifier use SGCTs, and both operate at optimal switching frequency to minimize the switching losses. These SGCTs are an integration of the power semiconductor and the gate driver electronics. The close proximity of the gate driver and power semiconductor provides a superior switching pattern that prevents the drive from producing high levels of line current harmonics and minimizes snubber requirements. The Total Harmonic Distortion (THD) of the input current is within IEEE-519 harmonic guidelines. Both current and voltage waveforms are near sinusoidal, reducing stress on the motor windings.

A combination of two distinct operating modes make up the control within the chiller's UC800 control: first, by controlling the inlet guide vanes and second, by modulating the impeller speed from 38–60 hertz. The drive controls the speed in response to the UC800 compressor control signal.

The CenTraVac control panel has full control of unit operation, including the start and stop functions. If a fault condition is encountered, or an alarm on the drive, the Tracer AdaptiView display will indicate "alarm" and an "Alarm message".

Other Features

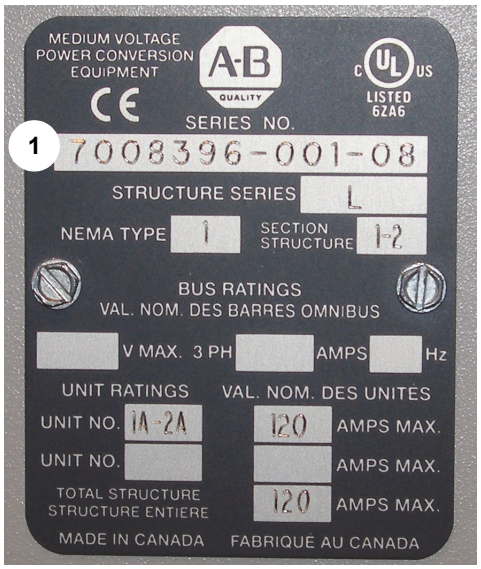
- Totally isolated low voltage and medium voltage compartments.
- Mechanical and electrical interlocks between the drive and input disconnecting means.
- Double offset ventilation pattern on the drive doors to ensure operator safety.
- Input Voltage Tolerance: ±10% of Nominal Line Voltage
- Input Frequency: 50/60 Hz, ±10%
- Output Voltage Rating: 0–2300, 0–3300, 0–4160, 0–6600
- Input Protection: Metal Oxide Varistors
- Control Method: Sensorless Direct Vector (Full Vector Control Optional)
- Ambient Temperature: 32°F–104°F (0°C– 40°C)
- Cooling: Forced Air
- Relative Humidity: 95% Non-condensing
- Altitude: 3300 feet (1000 m) above sea level without derating.

Drive Identification

The drive has a Trane model number and a Rockwell series number. Both these are extremely important when identifying the drive for service or parts. Refer to "Model Number," p. 14 for more information about the Trane model number.

The Rockwell series number is shown on the Rockwell drive nameplate (see Figure 1), which is located on the outside of the drive enclosure. This series number should be available for reference in any correspondence with Trane and/or Rockwell. The chiller series number and chiller sales order number should also be available for reference.

Figure 1. Example: MV Rockwell drive nameplate



Note: This 700XXXX-XXX-XX number identifies the drive. Always have this number ready when service is required.

Model Number

Trane Service Model Number

An example of a typical chiller starter model number is:

AFDJ0035HA0B00CD

Model Number Digit Identification

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

Digit 1, 2, 3 — CenTraVac Starter

AFD= Adaptive Frequency Drive

Digit 4— Development Sequence

J = Medium Voltage Air-Cooled

Digit 5, 6, 7, 8 — Starter Size

Use Rated Load Amps (RLA) value

Digit 9 — Unit Voltage

K = 2300V-60Hz-3Ph
L = 2400V-60Hz-3Ph
N = 4160V-60Hz-3Ph
P = 3300V-60Hz-3Ph
X = 6600V-60Hz-3Ph
V = 3300V-50Hz-3 Ph
W = 6000V-50Hz-3 Ph
Z = 6600V-50Hz-3 Ph
S = Special

Digit 10, 11 — Design Sequence

A0 = First Design

Digit 12 — Starter Type

B = Remote Mounted

Digit 13 — Agency Listing

0 = UL and CUL Listed (Standard on All Units)
1 = CE

Digit 14 — Special Options

0 = None
S = Special Options

Digit 15 — VFD Frame Size (SSRL)

A = 40
B = 50
C = 60
D = 61
E = 70
F = 80
G = 81
H = 90
J = 93
K = 100
L = 105
M = 120
N = 140
P = 160
R = 185
T = 215
U = 250
V = 285
W = 325
X = 375
Z = 53

Digit 16 — Display

0 = None
D = Display

Cabinet

The cabinet has a NEMA 1 enclosure rating.

Environmental Conditions

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

- Verify that the NEMA 1 enclosure can be kept clean and dry.
- The area chosen should allow the space required for proper air flow. Refer to Table 2, p. 15 and Table 3, p. 16. Ensure the equipment room addresses the heat rejections requirements.
- Be sure the enclosure is installed in a non-corrosive location that is away from oil, coolants, or other airborne contaminants.
- Verify and maintain design hertz and voltage inputs.

Table 2. A-Frame weights[(a)] and heat rejection

Subframe	Line Voltage	VFD Amps	hp	kW	Max. Heat Rejection		Weight	
					Btu/h	kW	lb	kg
94	3300 V - 50/60 Hz	81	500	373	68000	19.9	6500	2948
94	3300 V - 50/60 Hz	93	560	418	72000	21.1	6500	2948
94	3300 V - 50/60 Hz	105	600	448	76000	22.3	6500	2948
94	3300 V - 50/60 Hz	120	750	560	94000	27.5	6500	2948
94	3300 V - 50/60 Hz	140	800	597	101000	29.6	6500	2948
94	4160 V - 60 Hz	61	450	336	74000	21.7	6500	2948
94	4160 V - 60 Hz	70	500	373	76000	22.3	6500	2948
94	4160 V - 60 Hz	81	600	448	80000	23.4	6500	2948
94	4160 V - 60 Hz	93	700	522	84000	24.6	6500	2948
94	4160 V - 60 Hz	105	800	597	87000	25.5	6500	2948
94	4160 V - 60 Hz	120	900	671	110000	32.2	6500	2948
94	4160 V - 60 Hz	140	1000	746	116000	34.0	6500	2948
110	6600 V - 50/60 Hz	40	500	373	87000	25.5	7500	3402
110	6600 V - 50/60 Hz	53	600	448	92000	27.0	7500	3402
110	6600 V - 50/60 Hz	61	750	560	98000	28.7	7500	3402
110	6600 V - 50/60 Hz	70	900	671	104000	30.5	7500	3402
110	6600 V - 50/60 Hz	81	1000	746	110000	32.2	7500	3402
110	6600 V - 50/60 Hz	93	1200	895	116000	34.0	7500	3402

(a) Weights do not include 500 lb (226.8 kg) maximum shipping skid.

Table 3. B-Frame weights[a] and heat rejection

Subframe	Line Voltage	VFD Amps	hp	kW	Max. Heat Rejection		Weight	
					Btu/h	kW	lb	kg
166	2300/2400 V - 60 Hz	160	700	522	78000	22.9	11770	5339
174	2300/2400 V - 60 Hz	185	800	597	83000	24.3	11270	5112
174	2300/2400 V - 60 Hz	215	900	671	90000	26.4	11270	5112
174	2300/2400 V - 60 Hz	250	1000	746	108000	31.7	11270	5112
174	2300/2400 V - 60 Hz	285	1250	933	115000	33.7	11270	5112
174	2300/2400 V - 60 Hz	325	1500	1119	122300	35.8	11270	5112
174	2300/2400 V - 60 Hz	375	1750	1306	133000	39.0	11270	5112
182	3300 V - 50/60 Hz	160	1000	746	104000	30.5	14120	6405
182	3300 V - 50/60 Hz	185	1100	821	110000	32.2	14120	6405
182	3300 V - 50/60 Hz	215	1250	933	123000	36.0	14120	6405
182	3300 V - 50/60 Hz	250	1500	1119	144000	42.2	14120	6405
182	4160 V - 60 Hz	160	1250	933	110000	32.2	14120	6405
182	4160 V - 60 Hz	185	1450	1082	117000	34.3	14120	6405
182	4160 V - 60 Hz	215	1500	1119	126000	36.9	14120	6405
182	4160 V - 60 Hz	250	2000	1492	164000	48.1	14120	6405
190	6600 V - 50/60 Hz	105	1250	933	126000	36.9	12270	5566
190	6600 V - 50/60 Hz	120	1500	1119	138000	40.4	12270	5566
197	6600 V - 50/60 Hz	140	1750	1306	151000	44.3	18070	8196
197	6600 V - 50/60 Hz	160	2000	1492	160000	46.9	18070	8196
197	6600 V - 50/60 Hz	185	2250	1679	175000	51.3	18070	8196
197	6600 V - 50/60 Hz	215	2750	2052	193000	56.6	18070	8196
205	6600 V - 50/60 Hz	250	3000	2238	241000	70.6	18070	8196
205	6600 V - 50/60 Hz	285	3600	2686	266000	78.0	18070	8196

(a) Weights do not include 500 lb (226.8 kg) maximum shipping skid.

A-Frame and B-Frame Notes

General Notes

Note: *Refer to Figure 3, p. 18 through Figure 12, p. 24.*

1. Connections are spaced horizontally with dimension/ location shown in the front view.
2. NEMA 1 enclosure.
3. Maximum remote distance between drive and chiller is 150 ft (45.72 m).

Cable Notes

1. Top entry conduit openings standard.
2. Field-configurable for bottom entry line power.
3. All cable connections are bolted type; lugs provided by others.
4. Cable space designed for non-shielded cable or shielded cable with prefabricated stress cones.
5. Maximum line shielded cable size is 1/0 MCM, one per phase for top entry; or 1/0 MCM, one per phase for bottom entry. For AWG/MCM equivalents in mm^2, refer to Table 7, p. 37.

   Maximum load shielded cable size is 500 MCM, two per phase for top entry; or 500 MCM, two per phase for bottom entry. For AWG/MCM equivalents in mm^2, refer to Table 7, p. 37.
6. Maximum line non-shielded cable size is 1/0 MCM, one per phase for top entry; or 1/0 MCM, one per phase for bottom entry. For AWG/MCM equivalents in mm^2, refer to Table 7, p. 37.

   Maximum load non-shielded cable size is 500 MCM, two per phase for top entry; or 500 MCM, two per phase for bottom entry. For AWG/MCM equivalents in mm^2, refer to Table 7, p. 37.

Shipping Note

- Mounted on a (500 lb [226.8 kg] max) wooden skid with provisions for a fork truck. Lifting means also supplied on top.

Table 4. A-Frame: Dimensions (see Figure 2, p. 17 through Figure 6, p. 20)

Subframe		A	B	C	D	E	F	G	H	J	K	L	M	N
94	in.	94.49	33.07	11.35	16.35	21.35	14.63	19.13	23.63	14.29	27.38	21.57	44.92	35.42
	mm	2400	840	288	415	542	372	486	600	363	695	548	1141	900
110	in.	110.24	44.88	15.28	20.28	25.28	18.56	23.06	27.56	18.22	39.20	25.50	56.74	47.24
	mm	2800	1140	388	515	642	471	586	700	463	996	648	1441	1200

Figure 2. A-Frame: Top view, in. (mm)

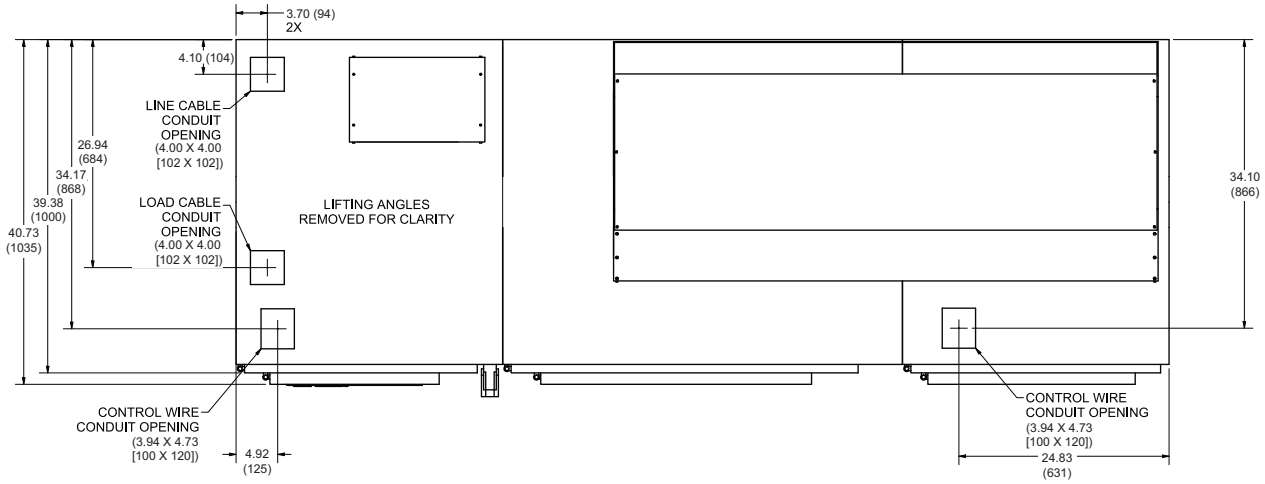


Figure 3. A-Frame: Front view, in. (mm)

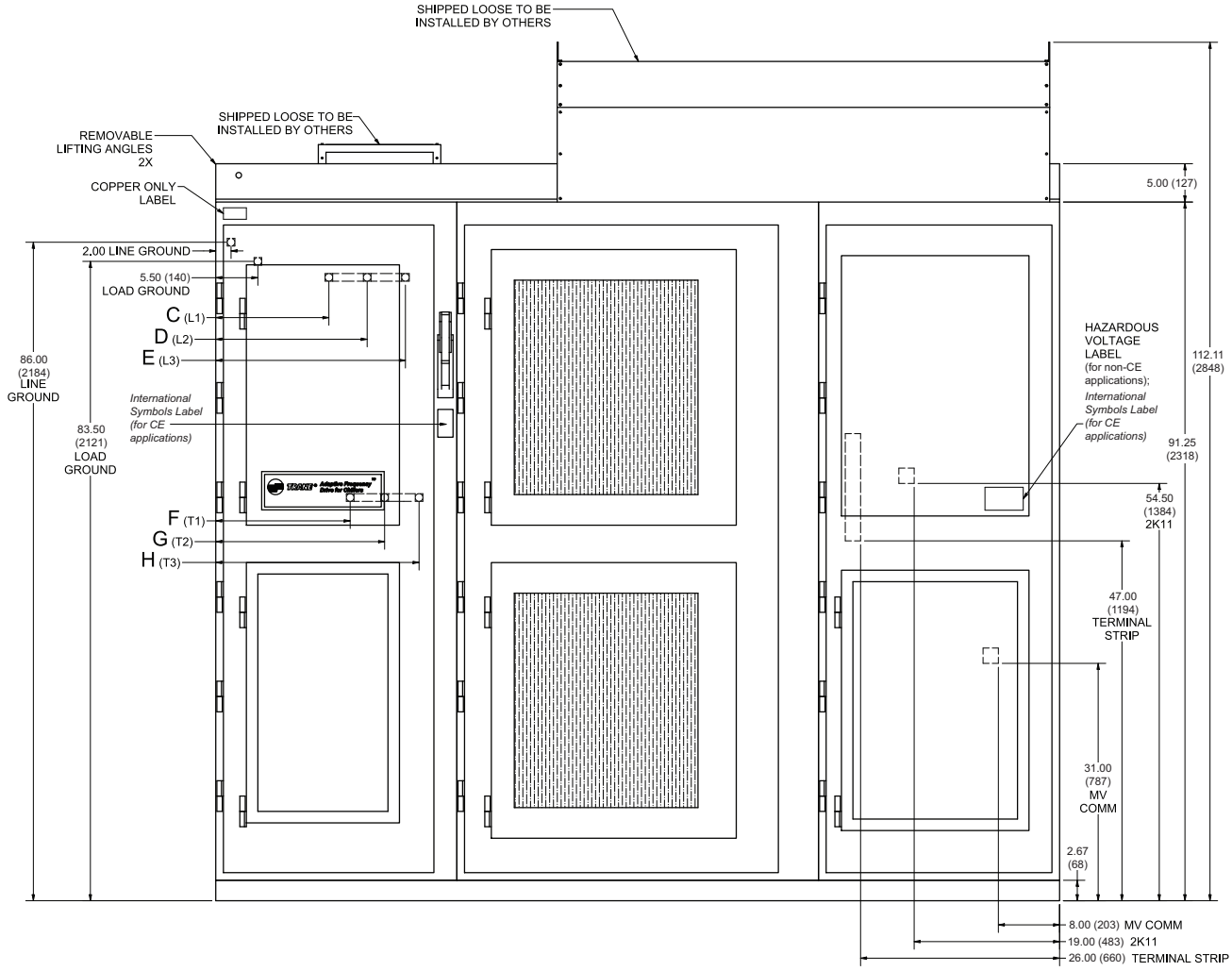


Figure 4. A-Frame: Bottom view, in. (mm)

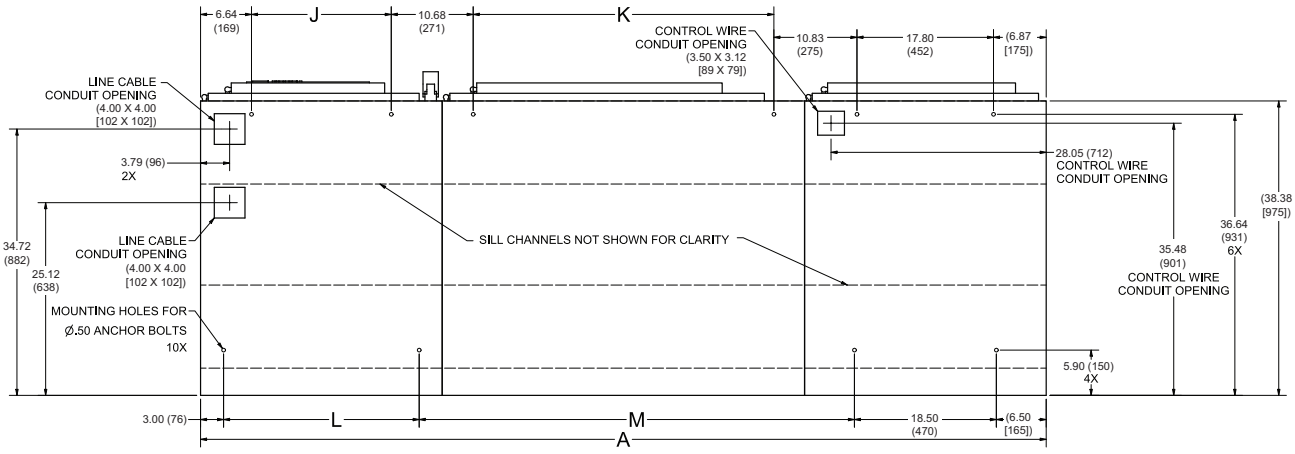


Figure 5. A-Frame: Door-swing requirements

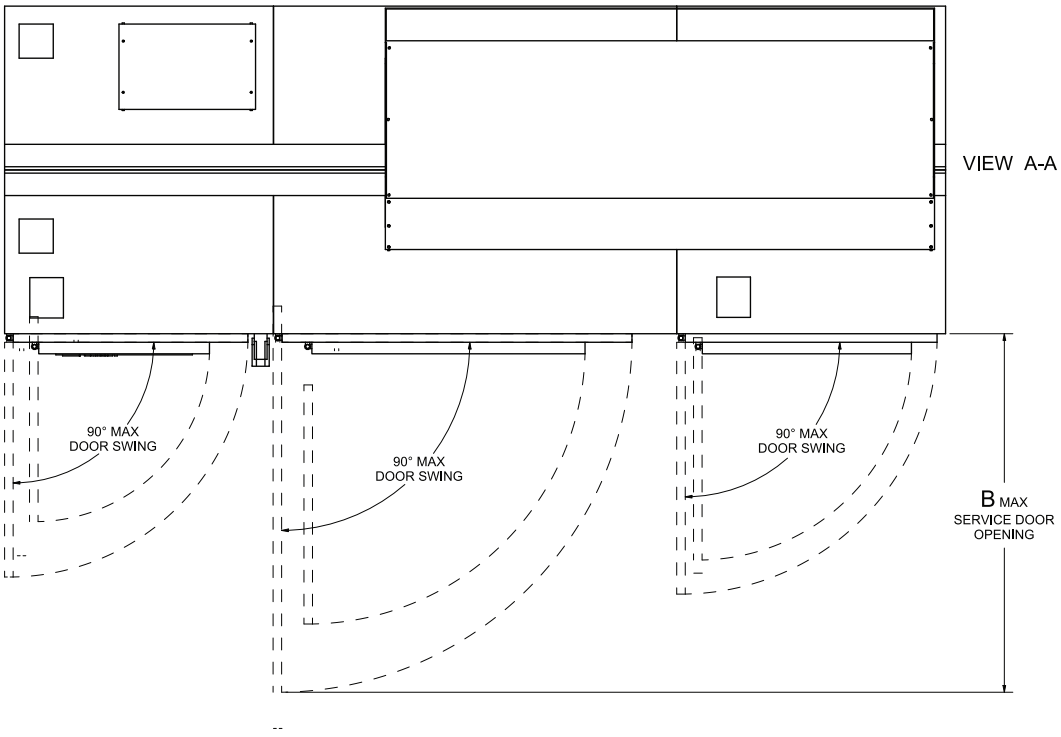


Figure 6. A-Frame: Right-hand view, in. (mm)

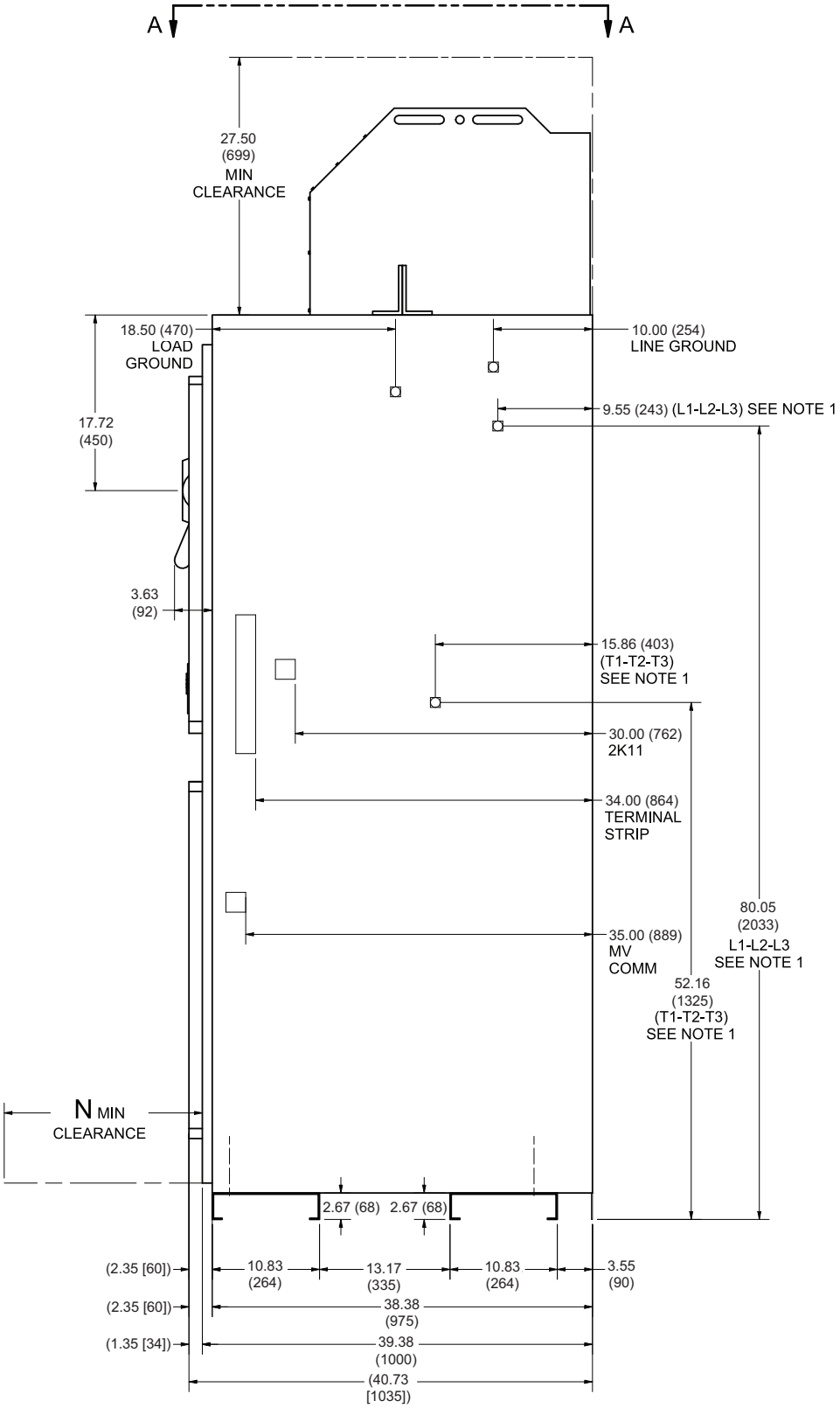


Figure 7. A-Frame: Interior view, major components, in. (mm)

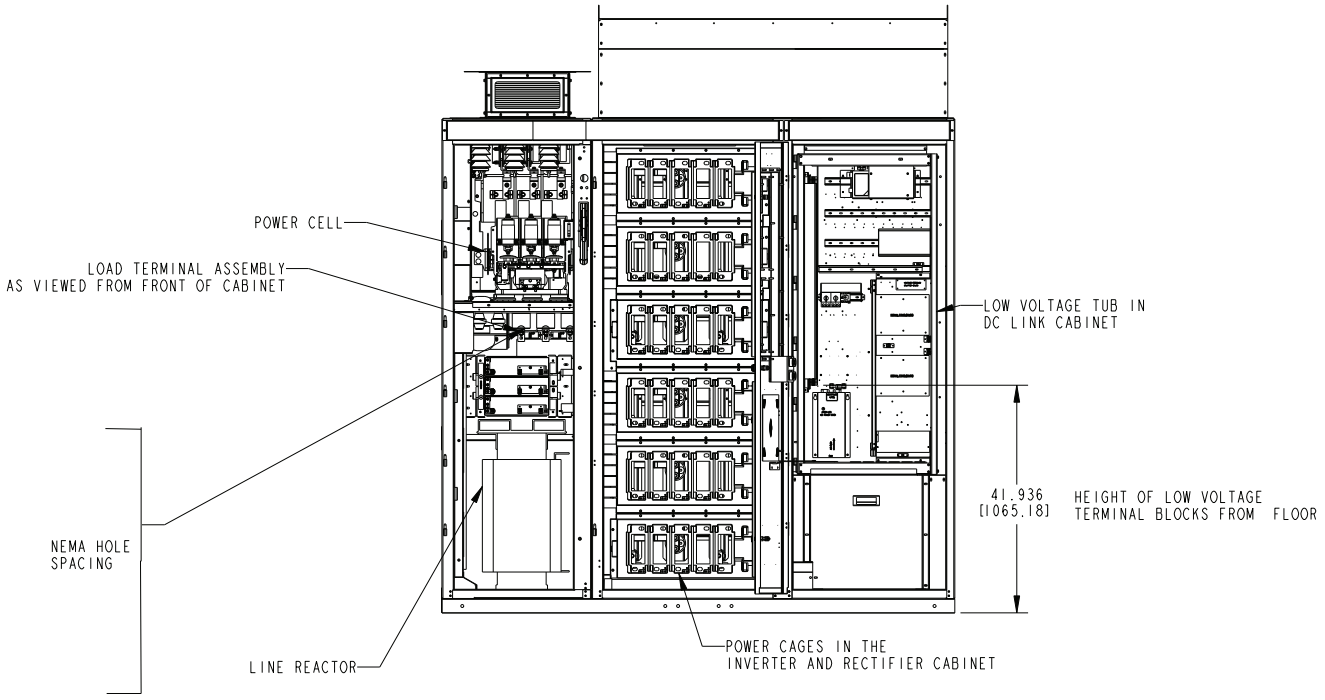


Table 5. B-Frame: Dimensions in inches (see Figure 8, p. 22 through Figure 12, p. 24)

Subframe		A	B	C	D	E	F	G
166	in.	165.92	161.00	28.90	24.96	20.96	35.44	33.07
	mm	4214	4089	734	634	532	900	840
174	in.	173.80	168.89	28.90	24.96	28.85	35.44	33.07
	mm	4415	4290	734	634	733	900	840
182	in.	181.67	176.76	28.90	32.84	28.82	39.37	37.01
	mm	4614	4490	734	834	732	1000	940
190	in.	189.54	184.63	28.90	40.72	28.84	47.24	44.88
	mm	4814	4690	734	1034	732	1200	1140
197	in.	197.42	192.49	28.90	40.72	36.70	47.24	44.88
	mm	5014	4889	734	1034	932	1200	1140
205	in.	205.29	200.35	36.76	40.72	36.70	47.24	44.88
	mm	5214	5089	934	1034	932	1200	1140

Figure 8. B-Frame: Top view, in. (mm)

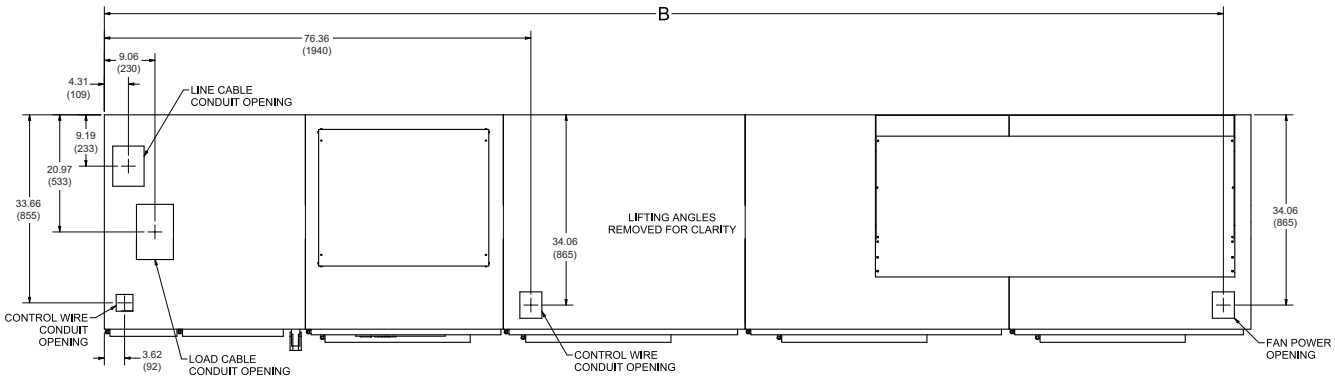


Figure 9. B-Frame: Front view, in. (mm)

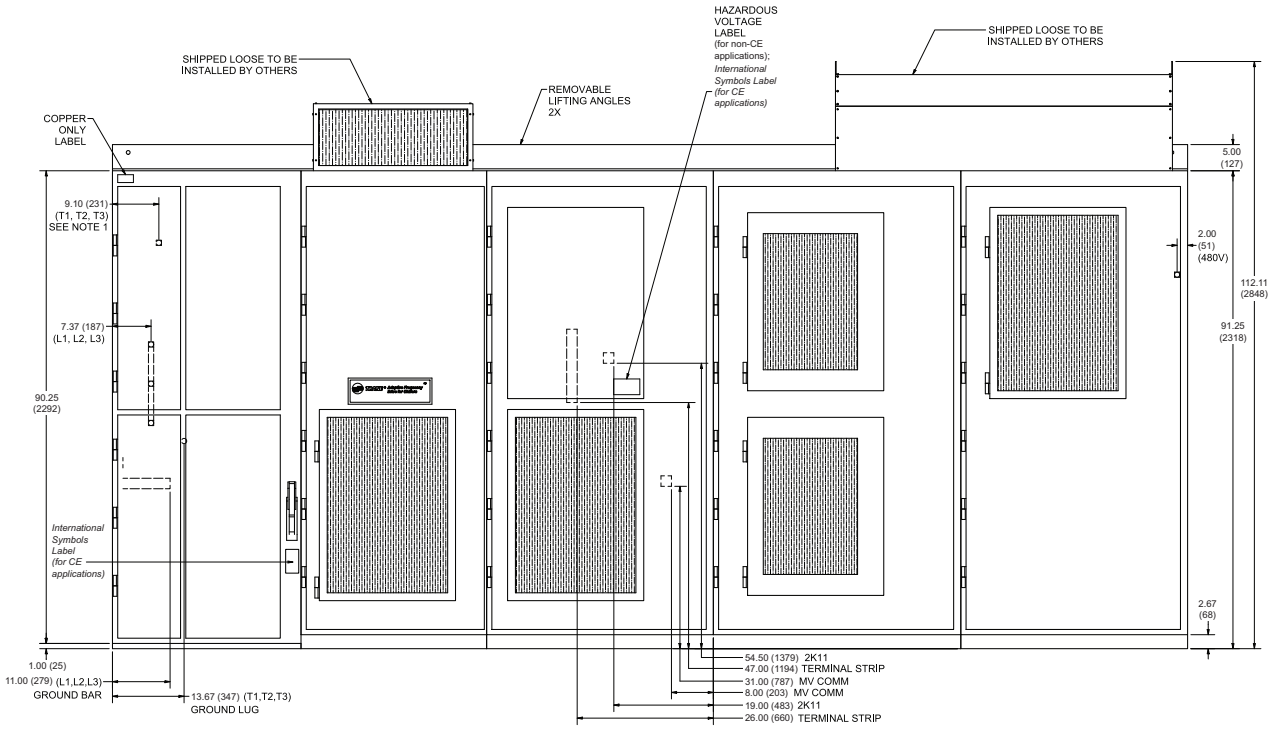


Figure 10. B-Frame: Bottom view, in. (mm)

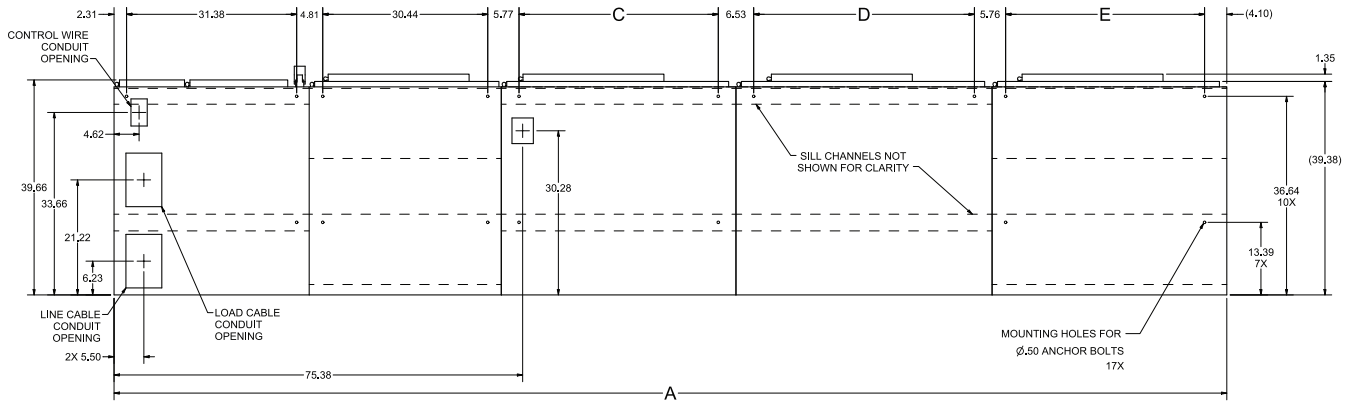


Figure 11. B-Frame: Door-swing requirements

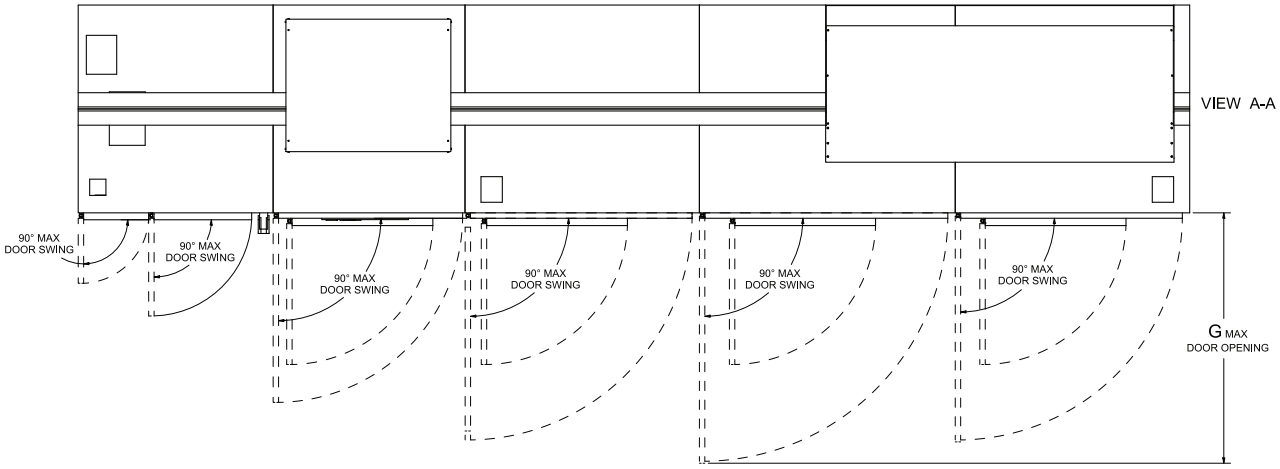


Figure 12. B-Frame: Right-hand view, in. (mm)

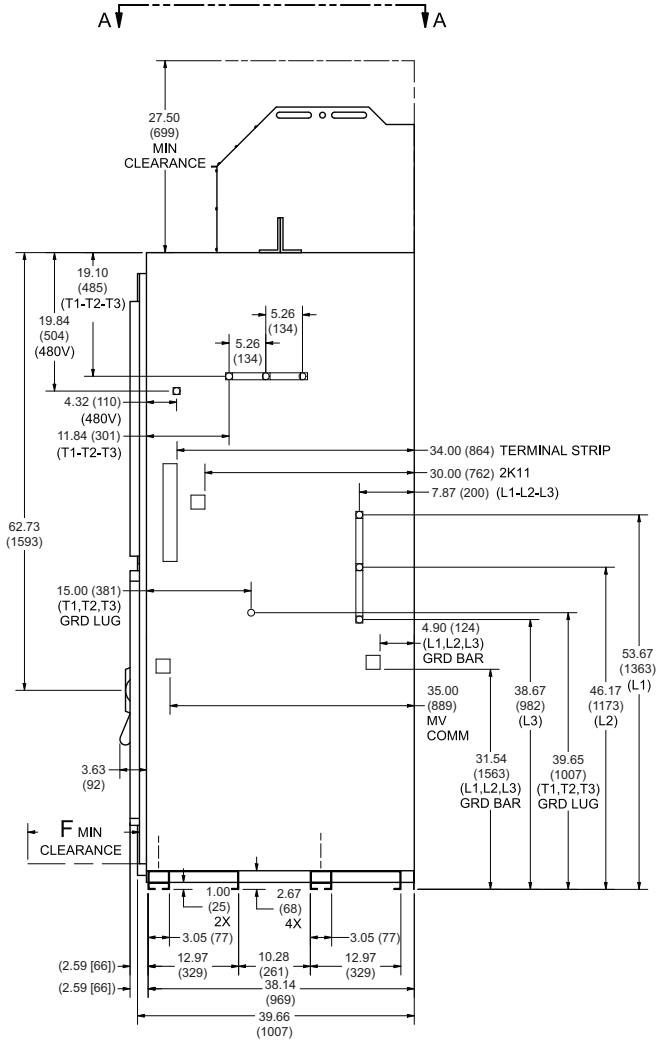
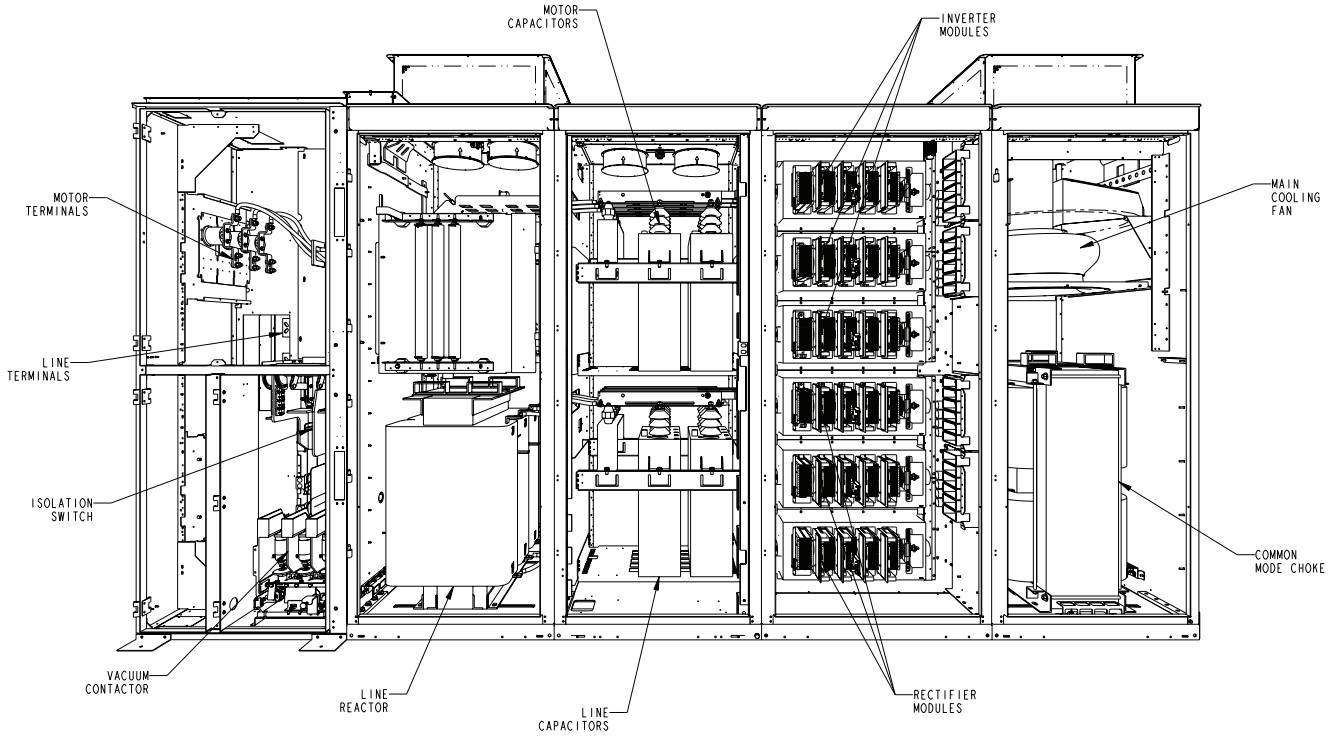


Figure 13. B-Frame: Interior view, major components



Pre-Installation

Receipt Inspection

Scope

This document pertains to the Bulletin 7000 family of medium voltage drives. Additional procedures may apply for specific equipment. Please refer to other documentation provided with the equipment.

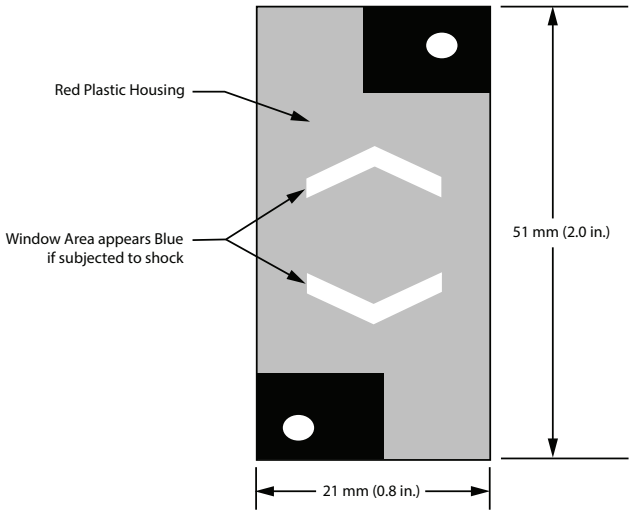
Receiving

Upon receiving the drive, remove the packing and check for damage that may have occurred during shipping. Report any damage immediately to the claims office of the carrier as soon as possible after receipt of the drive. Rockwell Automation will offer reasonable assistance to the customer in resolving such damage claims.

Both A-Frame and B-Frame drives utilized on Trane applications ship in a one-piece assembly/structure. Two additional boxes accompany the drives; these boxes contain other components, such as the fan shrouds, resistor box, and mounting fasteners. Keep all of these drive packages together.

A shock indicator is installed on the inside of the converter door for variable speed drives. The shock indicator will show blue in the chevron-shaped area if that shock level was attained during transit.

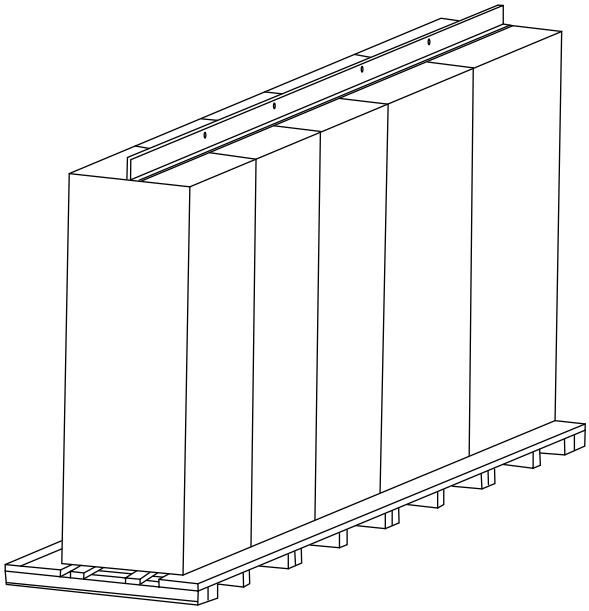
Figure 14. Shock indicator



If the shock indicator is blue, contact Rockwell Automation Product Support Group in Cambridge, Ontario, Canada. There is a greater possibility of the drive having sustained internal damage if it has been subjected to this level of physical shock during the shipping and installation process.

If the indicator shows that no shock was attained, full inspection and verification, in accordance with the commissioning process is still essential.

Figure 15. PowerFlex 7000 drive wrapped in clear plastic on wooden skid with lifting angles



Export Crating

If the drive has been delivered in export crating (see Figure 16, p. 26), the top lifting angles may have been removed and stored inside the crate. Cables are outside of crate for pulling crate out of container. Not all export crating will be exactly as shown. Refer to instructions supplied with crating.

Figure 16. Export crating

Locate pair of lifting angles inside export crating (see Figure 17, p. 27).

⚠WARNING

Install Lifting Angles Before Moving Drive!

Failure to install pair of lifting angles prior to moving the drive could result in death or serious injury and/or equipment damage.

Figure 17. Location of pair of lifting angles in export crate

1. Pair of lifting angles (2) and hardware

Handle the lifting angles with care. Most versions are very heavy (refer to Table 6, p. 27 for dimensions and weights).

Table 6. Examples of various dimensions and weights of lifting angles

Length Each		Dimensions		Weight Each	
ft	m	in.	mm	lb	kg
9.8	3	2.5 x 2 x 0.375	63 x 50 x 10	30	13
23	7	5 x 3 x 0.375	125 x 75 x 10	230	105
23	7	7 x 4 x 0.375	175 x 100 x 10	308	140

Ensure lifting angles are installed prior to moving the drive. Install supplied hardware as shown in Figure 18, p. 27 and Figure 19, p. 27. Torque the supplied imperial 5/8-in.-11 hardware to 100 ft·lb (135 N·m). Requires socket or adjustable wrench.

Important: *Lifting angle should be removed only when the drive is in its final location. The lifting angles are retained with hardware. These hardware bolts need to be reinstalled in their holes in the top of the drive to prevent the ingress of foreign matter into the enclosure.*

Figure 18. Installation of fasteners from lifting angle to drive (four 5/8 in.-11 bolts per individual drive cabinet, supplied)

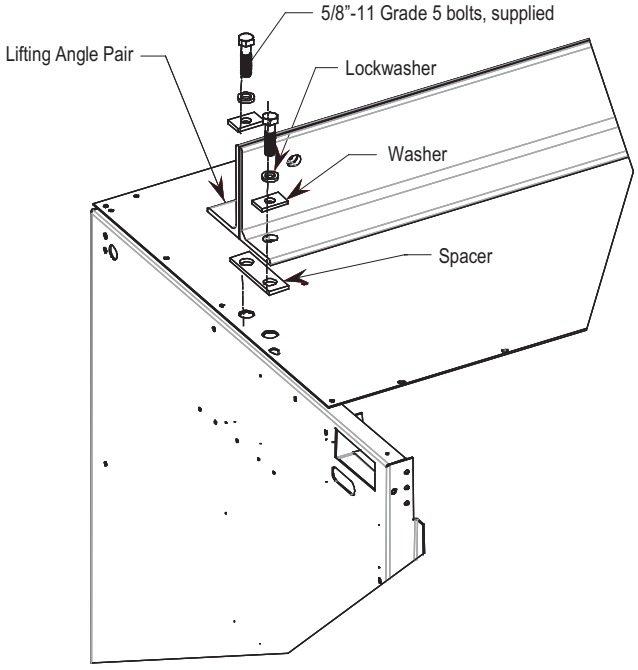
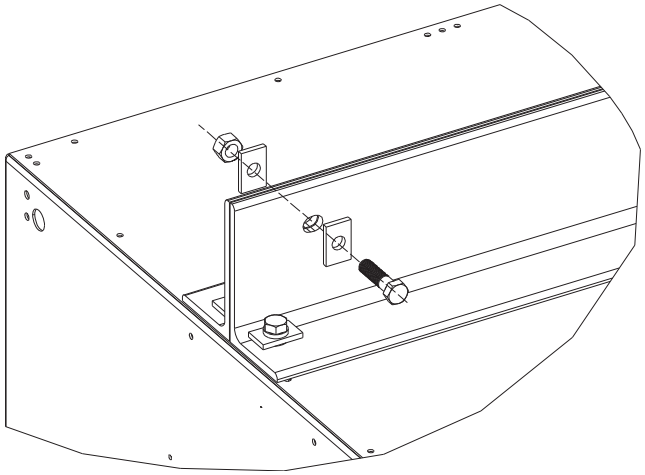


Figure 19. Bolt lifting angles together; all vertical slots to be bolted



The lifting angles hold the cabinets together to prevent separation and damage during drive movement by riggers to final installation area. Lifting angles have to be removed for final attachment of cooling fans and fan enclosures.

Accessories

Accessory items may be shipped with the drive. During the post-delivery inspection, all accessories or loose items listed on the shipping documentation should be located before moving the drive to an installation or storage area.

Magnetic devices such as DC link, common mode choke, or line reactors may be shipped separately from the drive because of weight. Install after final placement of the drive.

Rigging

General Handling Procedures for Medium Voltage Drives

PowerFlex 7000

⚠WARNING

Improper Drive Lift or Move!

Failure to follow instructions below could result in death or personal injury and/or damage to the drive. Never attempt to lift or move the drive by any means other than the handling methods listed in this publication.

Approximate Weights: 5,000 to 25,000 lb (2,300 to 11,300 kg)

- Keep the drive in an upright position. Some units are top-heavy and may fall over if they are tilted too far.
- Ensure that all drive doors are closed and latched before moving the equipment.
- Keep the drive bolted to the shipping skid to minimize the possibility of it tipping. Do not remove the wood skid and top lifting angle until the drive is at the installation area. If the drive has been export crated, the pair of lifting angles are located inside the crate. Re-install the pair of lifting angles on top of drive.

Rigging Contractor

It is strongly recommended that professional jiggers with suitable rated lifting equipment should be contracted to move the drive to its final installation site.

Important: *It is extremely important that the customer installation duties are performed correctly. Any errors will cause damage to the drive and delays in commissioning.*

Overhead Lifting

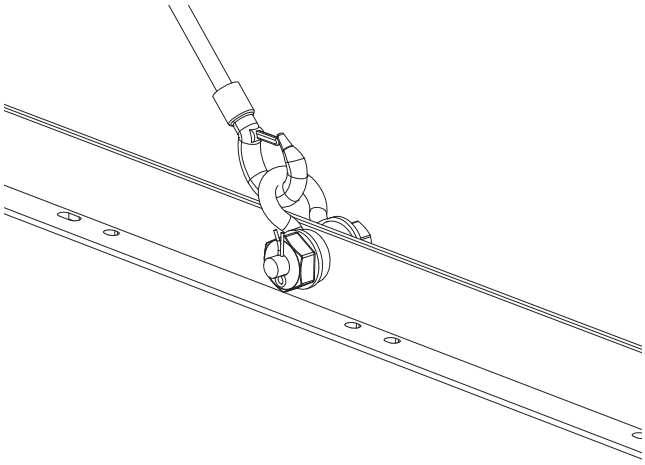
⚠WARNING

Heavy Objects!

Failure to follow instructions below or properly lift unit could result in unit dropping and possibly crushing operator/technician which could result in death or serious injury, and equipment or property-only damage. Ensure that all the lifting equipment used is properly rated for the weight of the unit being lifted. Each of the cables (chains or slings), hooks, and shackles 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.

1. Use shackles in the holes of the lifting angles and use safety hooks in the shackles (see Figure 20, p. 28). Do not pass slings or cables through the holes of the lifting angles. Use only 1.5 in. (38 mm) diameter holes for shackles.

Figure 20. Shackle attached to drive lifting angle



2. The angle between the lifting cables is not to exceed 45° from vertical (see Figure 21, p. 29).
3. A spreader bar may also be used to lift the equipment.

Important: *Ensure that the spreader beam has a load rating adequate for the equipment.*

⚠WARNING

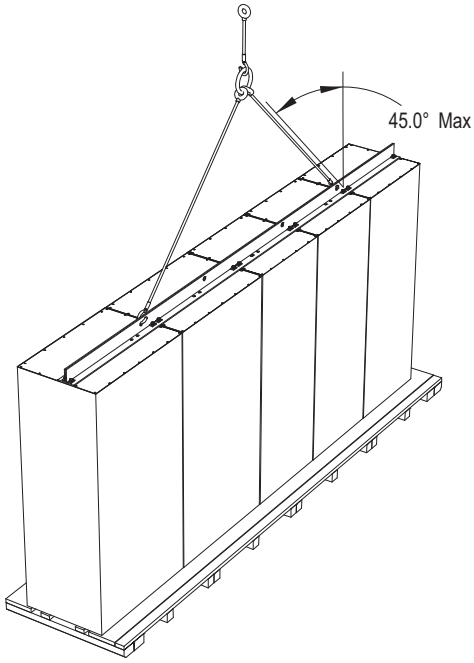
Improper Unit Lift!

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.

Note: *The lift points on the drive may not be equidistant from the center of gravity.*

4. Select or adjust the rigging lengths to compensate for the weight distribution of the load. Maintain the equipment in an upright position.
5. To minimize risk, the drive should only be lifted high enough to clear obstacles. There will be some tilt due to uneven weight distribution within the drive.

Figure 21. Overhead lifting



⚠WARNING

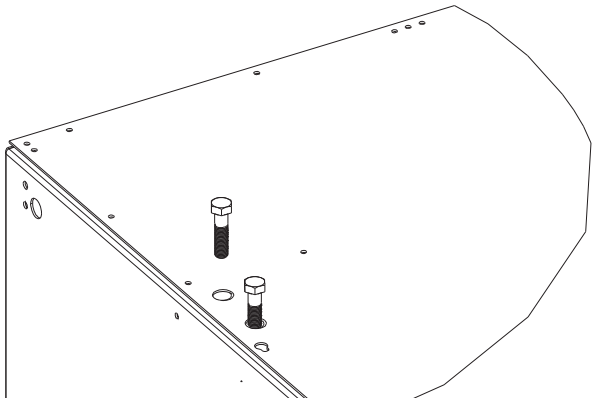
Do Not Tilt Drive!

Tilting the drive could cause heavy items to shift, which could result in death, personal injury or equipment damage. Do not tilt the drive! Drive must remain vertical. Drives may contain heavy components that are mounted for vertical support.

Removal of Lifting Angles

Lifting angles should be removed only when the drive is in its final location. The lifting angles are retained with hardware. These hardware bolts need to be reinstalled in their holes in the top of the drive to prevent the ingress of foreign matter into the enclosure (see Figure 22).

Figure 22. Insert bolts



Drive mounting instructions are provided in the Rockwell literature that shipped with the drive.

⚠WARNING

Drive Mounting Instructions!

Failure to correctly anchor the cabinet could result in death or serious injury and equipment damage. Refer to Rockwell's technical drawings and installation manual for drive mounting instructions. Contact the area Rockwell Automation sales office if you do not have these documents.

Storage

NOTICE

Equipment Damage!

Failure to follow storage recommendations could result in equipment-only damage. Read this section carefully and follow all recommendations for drive storage.

Important: *Store the drive in the following conditions if the equipment will not be installed immediately after receiving it:*

- Store the drive in a clean, dry, dust-free environment.
- Storage temperature should be maintained between -4°F to 149°F (-20°C to 65°C). Occasionally, liquid-cooled drives are provided with coolant that has a freezing point higher than -4°F (-20°C). Check the freeze point of the coolant by reading the label on coolant drum and ensure that the storage temperature does not go below that point. Relative humidity must not exceed 95 percent, non-condensing. It is recommended that the equipment be stored in a heated/climate-controlled building with regulated air circulation to avoid damage.

Notes:

  – Remove all packaging from the drive while storing it to prevent condensation from damaging the equipment. However, keep the drive covered during any construction to protect from dust and debris.

  – For export-crated drives, desiccant for two-month storage (from date of shipment) is supplied as standard. Desiccant for longer storage times has to be specified at time of order. Drive may be left in export crating until desiccant expires.

- Factory-installed space heaters are recommended to prevent condensation if storage temperature fluctuates or if humidity exceeds 85 percent.

⚠WARNING

Combustible Material!

Failure to remove loose packing or flammable material could result in death or serious injury or property damage. If storing medium voltage enclosure outdoors with electrical heating to prevent condensation, remove any loose packing or flammable material from the drive prior to powering the space heaters. Loose packing or flammable material could result in a fire hazard.

- Medium voltage enclosures are designed for indoor use and are not shipped with sufficient packaging for outdoor storage. Make sure that adequate protection is provided for the equipment if stored outside. Temporary electrical heating to prevent condensation should be installed. Space heaters rated at approximately 150 watts per cabinet are adequate for most enclosures. To avoid fire hazard, remove any loose packing or flammable material from the drive prior to powering the space heaters.

Planning

Ensure that it is possible to move the equipment into place. Check that all ceiling, door heights and turning distances are adequate.

Neutral Resistor Assembly (A-Frame only)

Neutral resistors ship separately and require installation in the field only with A-Frame medium-volt drives. Resistors are wired from the line capacitor neutral to the motor capacitor neutral; refer to submittal wiring diagrams for more information.

Figure 23. Hood assembly for neutral resistor

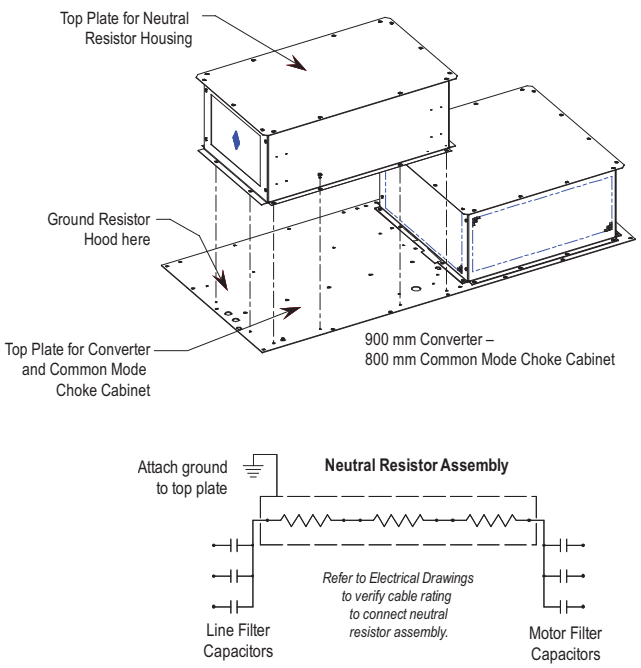
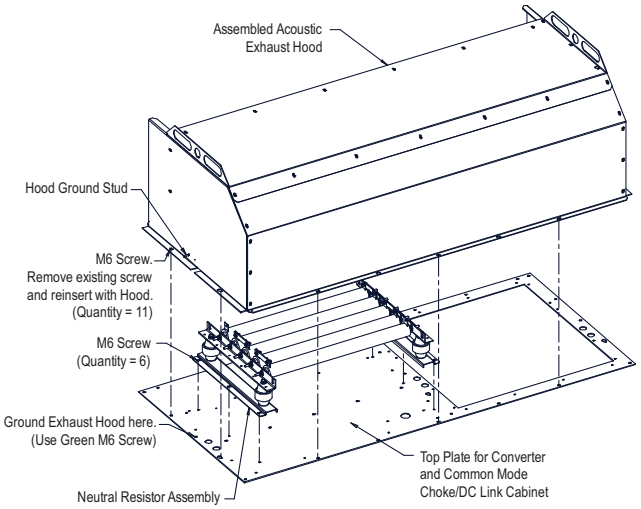


Figure 24. Acoustic hood assembly for neutral resistor



Installation of Neutral Resistor Assembly

Note: *Valid only for A-Frame configuration.*

On top of the converter cabinet, a sheet metal enclosure containing power resistors is to be installed.

1. Locate the resistor assembly on top of the cabinet as shown in Figure 23, p. 30. (For acoustic hood assembly, refer to Figure 24.)
2. Affix the assembly to the top plate using M6 thread forming screws provided.

3. Remove the top plate of the resistor assembly to permit access to the wiring connection points.
4. Connect the resistor wiring and per the electrical diagram provided with the drive, a typical connection diagram is shown in Figure 23, p. 30. Ensure that the resistor wiring is routed through the hole having a plastic bushing to protect the wire insulation. The neutral resistor assembly housing has a ground connection that is to be connected to the top plate of the drive.
5. Re-install the top plate of the neutral resistor housing.

Re-installing a Common Mode Choke (CMC)

Re-installing the Common Mode Choke (CMC) is only required in instances in which the CMC ships separately; refer to Table 9, p. 49 for more information.

Safety

⚠WARNING

Heavy Objects!

Failure to follow all requirements below could result in death or serious injury. Do not use cables (chains or slings) except as shown (see Figure 27, p. 32). 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.

Follow all lifting requirements:

- **Only lift the CMC as high as needed to clear barriers, etc.**
- **Never walk under or place any part of your body under the equipment being lifted.**
- **Restrict access to the work area during the lifting and handling of the CMC.**
- **The VFD enclosure is NOT suitable for lifting with the CMC installed. It still can be rolled or slid into its final position with the CMC installed.**

Background

For the largest air-cooled Direct-to-Drive VFDs, the Common Mode Chokes (CMCs) are relatively heavy (5000 lb [2268 kg] or more). In order to ease handling of the VFD enclosure, the CMCs are shipped separately and the contractor and/or customer must reinstall the CMC into the VFD enclosure on site. The CMC is completely installed and tested at the factory before shipment, then removed for shipment.

Definitions

VFD Enclosure: The entire VFD metal cabinet assembly. This consists of a number of cabinet sections, each with its own front access door.

Common Mode Choke (CMC): The DC Link Inductor that is electrically connected between VFD rectifier and inverter to provide the DC source to the inverter and address Common Mode Voltage.

CMC Cabinet Section: Part of the overall VFD enclosure. This cabinet section houses the CMC. It is located at the far right of the overall VFD enclosure (looking from the front).

Dimension Drawings: These are part of the project-specific drawing set supplied for each individual factory order. They show the VFD enclosure front elevation, roof and floor plans, as well as general information.

CMC Lifting Provisions: Two series of in-line metal rungs (one series for each fork of the forklift) welded to the top of the CMC frame.

CMC Isolation Mounting Strips: These reduce the noise that could be caused by the operation of the CMC, by isolating the base of the CMC from the VFD Enclosure floor. These black rubber strips are placed between the CMC and the floor of the CMC Cabinet.

Air Baffles: These help to direct the airflow (induced by the cooling fan) through the core of the CMC. These are two clear rigid corrugated plastic sheets trimmed to fit around the CMC. One is placed in front and one is placed behind the CMC.

Siting

Move the VFD Enclosure and the CMC close to the area where the VFD will be installed.

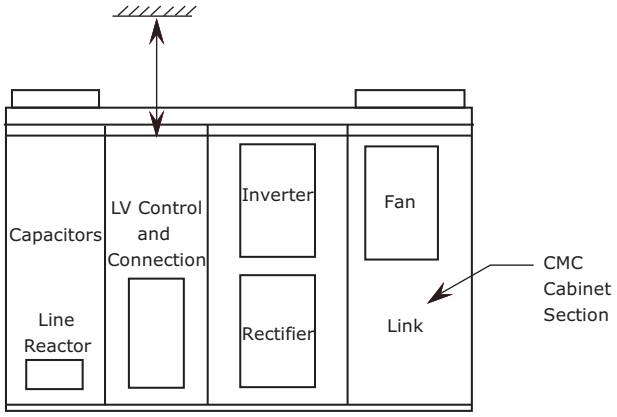
Important: *Please note that the CMC should be installed through the rear of VFD enclosure and a fork lift is typically required to install the CMC. Therefore, adequate space is required above and behind the VFD enclosure for the fork lift. Usually where the VFD is finally installed, adequate rear or overhead clearance is restricted. Therefore, the installation of the CMC typically must be performed before final placement of the VFD enclosure.*

The CMC could be removed from the front of the enclosure but this requires additional disassembly of interior barriers in the structure.

Removing CMC Cabinet Access Plates

Refer to the Dimensional Drawings supplied with the VFD. The cabinet section that houses the CMC is designated on the drawing as “LINK” (right-hand side of the overall VFD enclosure – looking from the front). A typical example is shown in Figure 25.

Figure 25. Typical dimension drawing excerpt



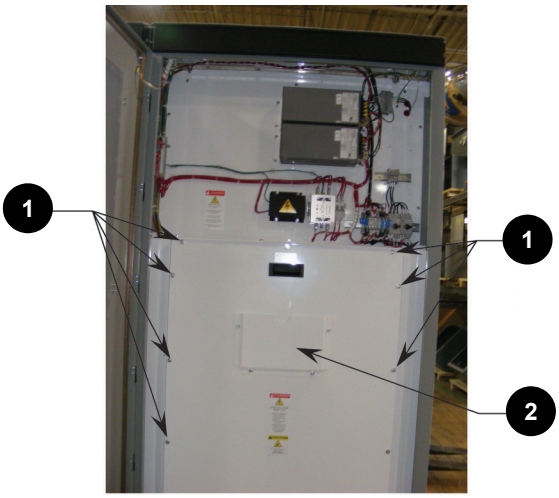
The rear of the CMC cabinet section has three cover plates (top to bottom). Remove the taptite screws that secure the center plate first; then also remove the top and bottom plates. Please note that there are small seams on the top and bottom horizontal outer edges of these plates that are sealed with silicone. A small tube of silicone is included in a cardboard box typically located behind the black low voltage compartment door. This can be used to reseal these seams after the CMC is reinstalled and the cover plates replaced.

Open the front door of the CMC cabinet section by turning the three hex key door latches counter-clockwise (located along the right vertical edge of the door). Behind the door is a large interior white metal barrier plate (see Figure 26). Remove the bolts (the nuts behind are held captive) around the periphery of this plate that secure this barrier to gain access to the front of the CMC compartment located behind the barrier.

Ensure reinstallation of this barrier after the CMC is installed.

Removing CMC Cabinet Access Plates

Figure 26. Front CMC barrier plate

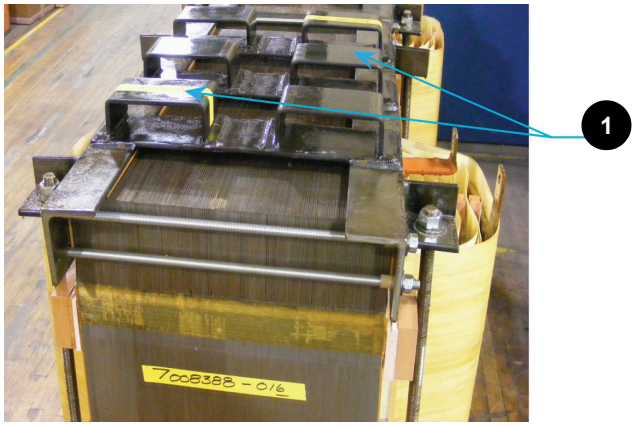


1. Bolts to be removed (not all indicated for clarity)
2. Remove this barrier

Preparing the CMC

Remove the four mounting bolts that secure the CMC to the wooden shipping skid (these bolts mount through the same mounting holes that are used to secure the CMC to the floor of the CMC cabinet section). Insert the forks of the fork lift into the CMC lifting provisions welded to the top of the CMC (see Figure 27). Lift the CMC slightly off the wooden skid, remove the skid, and then lower to the ground.

Figure 27. Provisions for fork lift forks

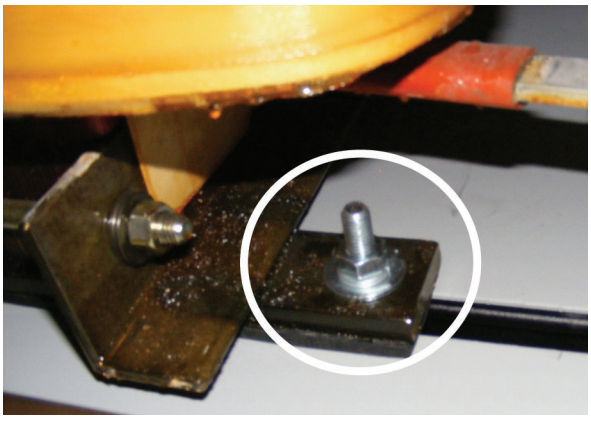


1. CMC lifting provisions

Preparing the CMC Cabinet

The CMC mounts to the floor of the CMC cabinet section by four bolts near each corner of the CMC (see Figure 28, p. 32). The bolts and hardware are pre-installed in the CMC cabinet section. The CMC isolation mounting strips are also secured by these bolts for shipping (see Figure 38, p. 35). Make sure to remove the washers, nuts, and mounting strips first (leave the four bolts in place). The front and rear pair of bolts are mounted in horizontal slots across the front and across the rear of the cabinet to allow for slight left-to-right movement. This makes it easier to mate the bolts to the holes in the base of the CMC assembly.

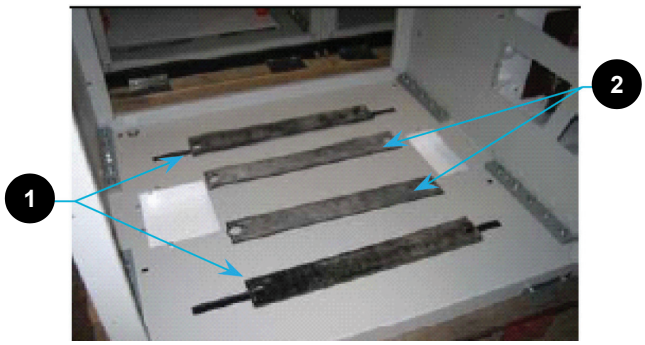
Figure 28. Mounting detail of CMC to cabinet floor



The six supplied black rubber CMC isolation mounting strips (approximately 3 in. wide x 1/4 in. thick [2.54 cm wide by

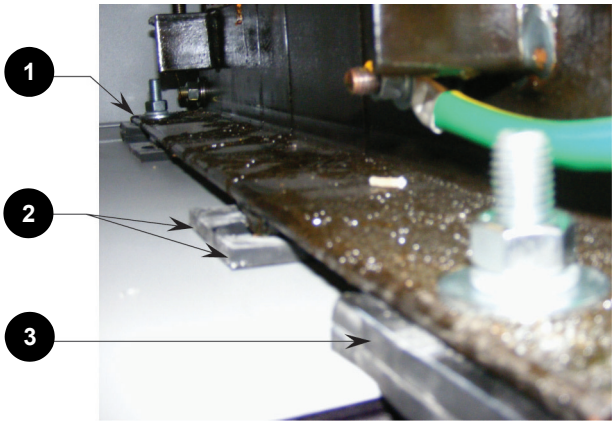
6.4 mm thick]) must be placed between the CMC cabinet floor and the CMC to reduce noise due to vibration. Two layers are placed between the front pair and rear pair of mounting bolts (over the horizontal slots), and single layers are placed under each of the two weld straps (parallel to the pair of mounting bolt strips) towards the center of the CMC. Measure the position of the weld straps and pre-position these strips (see Figure 29 and Figure 30, p. 33) on the floor of the CMC cabinet before the installation of the CMC.

Figure 29. Positioning of CMC isolation mounting strips



1. Two layers
2. Single layer

Figure 30. CMC isolation mounting strip positions under installed CMC

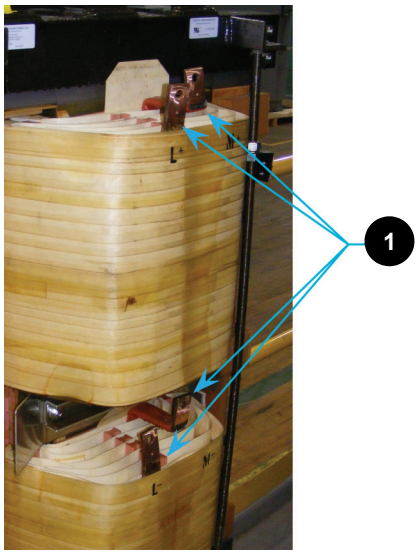


1. Two layers under rear mounting bolt pair
2. Single layer under each weld strap
3. Two layers under front mounting bolt pair

Installing the CMC

Ensure that the CMC is oriented correctly so the four side-mounted electrical termination lug pads (designated M+, M-, L+, and L-) on the CMC (see Figure 31) are facing towards the four power cables in the CMC cabinet (with the same designations). These electrical connections will be made after the CMC is installed in the CMC cabinet.

Figure 31. Position of the cable termination lug pads on CMC



1. CMC cable termination lug pads

Ensure to leave a minimum of a 3-in. (2.54 cm) clearance between the right hand side sheet and the right side of the CMC (referenced from the front). Use the air baffles as a template to ensure proper orientation of the CMC in the CMC cabinet.

Lift the CMC with the fork lift (remember the proper orientation). Just lift the CMC high enough to clear the front level of the CMC cabinet floor plate (see Figure 32, p. 34). Slowly move the fork lift /CMC into the CMC cabinet until the upwards-facing four mounting bolts in the CMC cabinet align with the four mounting holes on the base of the CMC. Then slowly lower the CMC until it is firmly resting on the rubber mounting strips on the floor of the CMC cabinet (see Figure 33, p. 34).

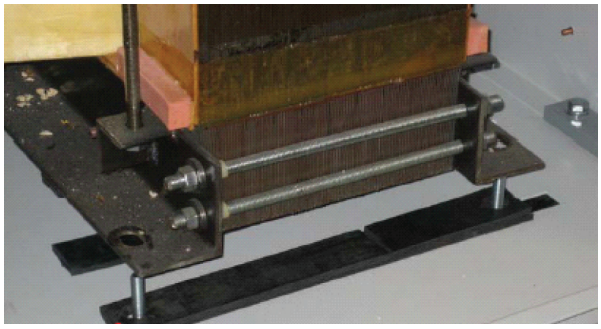
Use the air baffles as a template to verify that the CMC is oriented in the proper position in the CMC cabinet. Reposition the CMC until the air baffles fit between the side walls of the CMC cabinet and the CMC.

Important: *DO NOT MODIFY THE AIR BAFFLES TO FIT. The air baffles are sized to ensure optimal placement of the CMC in the CMC cabinet section.*

Lower the forks until they are clear of the CMC lifting provisions and back the fork lift forks slowly out of the CMC cabinet. Secure the mounting hardware (see Figure 28, p. 32, Figure 30, p. 33 and Figure 39, p. 36).

Figure 32. Inserting the CMC into the CMC cabinet

Figure 33. Lowering the CMC on CMC isolation mounting strips/mounting bolts



⚠WARNING

Proper Field Wiring and Grounding Required!

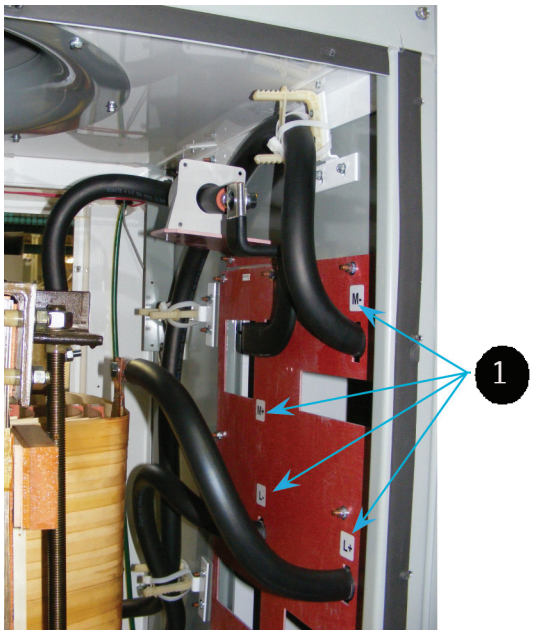
Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding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

Important:

- *Before servicing, disconnect all power sources and allow at least 40 minutes for capacitors to discharge.*
- *All electrical enclosures-unit or remote-are IP2X.*

Connect the four power cables (designated M+, M-, L+, and L-) in the CMC cabinet to the identically designated cable termination lug pads on the CMC (see Figure 34 and Figure 39, p. 36).

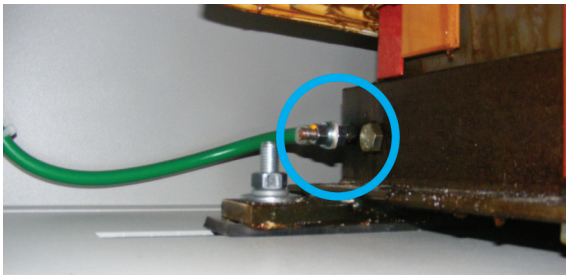
Figure 34. CMC power cable orientation



1. Power cable designations (matched to CMC cable termination pad designations)

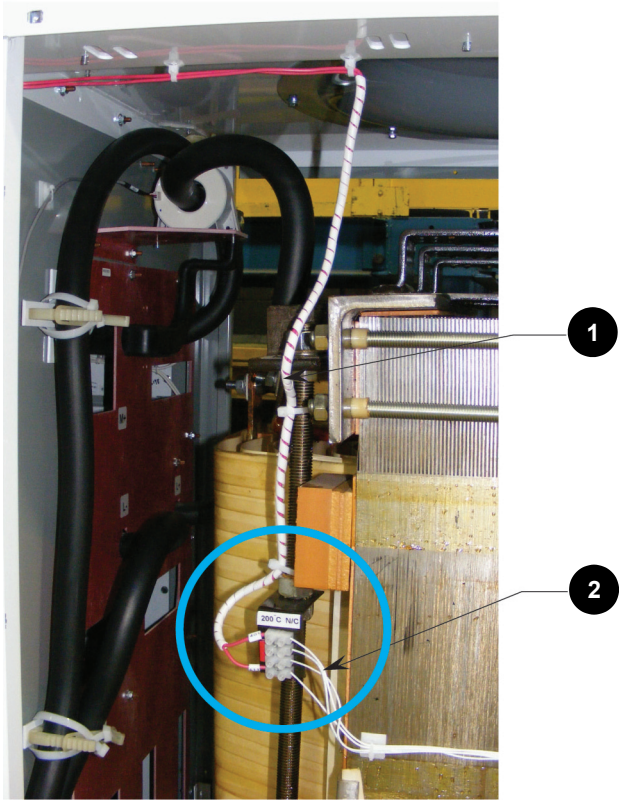
Connect the green ground cable lug to the ground connection bolt on the base of the CMC (see Figure 35).

Figure 35. Ground cable termination



Connect the thermistor cable to the connection terminal assembly (see Figure 36).

Figure 36. Thermistor terminal blocks and connection cable

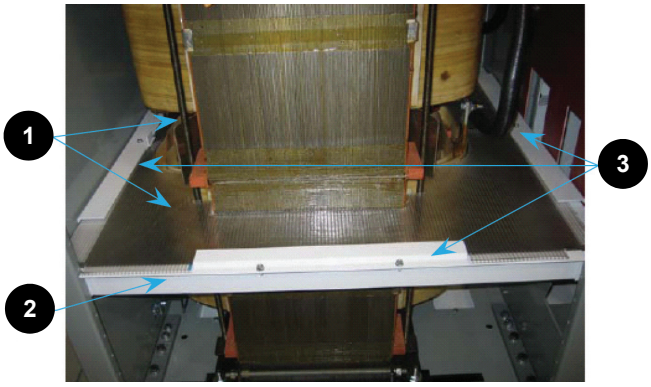


1. Thermistor cable connection
2. Thermistor terminal assembly

Two clear plastic air baffles (to optimize airflow through the CMC) will be supplied. These mount horizontally and are placed on top of four white metal baffle supports that attach around the perimeter of the CMC cabinet (see Figure 37). They are secured when the retaining brackets are placed on top of the baffles and affixed with taptite screws.

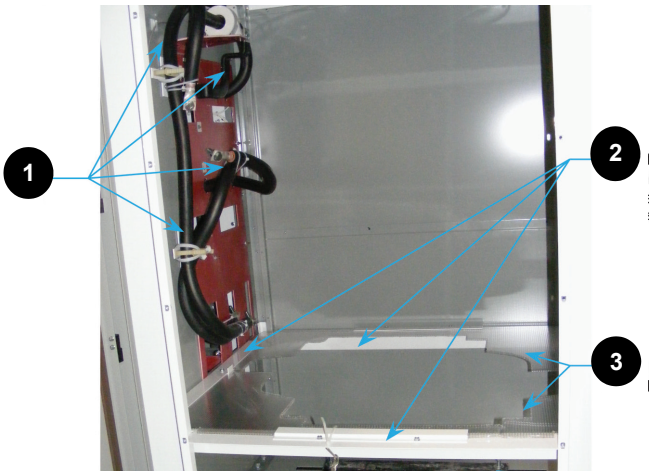
Note: *The rear baffle support must be removed before installing the CMC.*

Figure 37. Air baffles and mounting assembly (rear view)



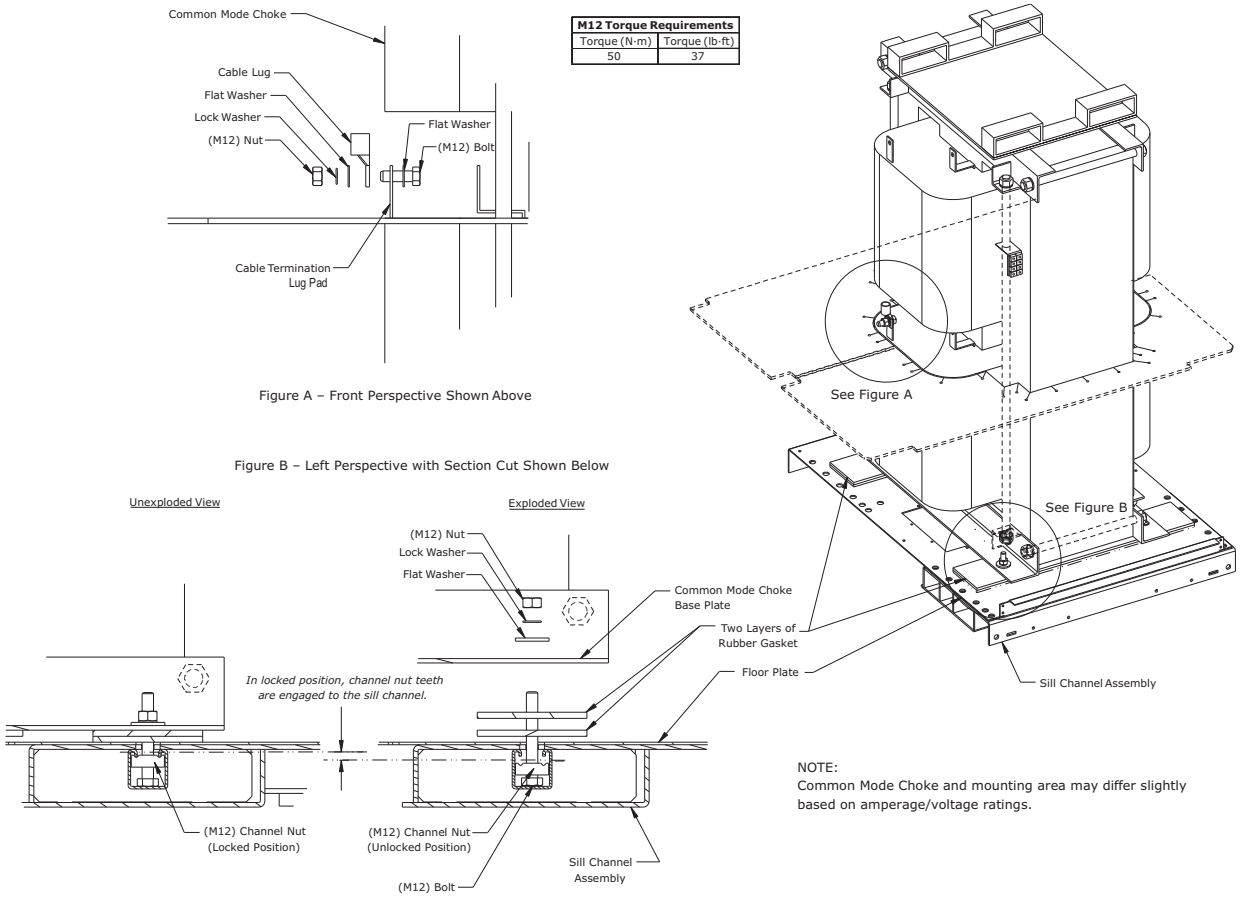
1. Air baffles
2. Rear baffle support
3. Baffle retaining brackets

Figure 38. Front view of CMC cabinet as shipped (front barrier plate removed for photograph)



1. Four CMC power cables
2. Air baffle retaining brackets (3 of 4 shown)
3. Two air baffles

Figure 39. Front view of Common Mode Choke (with detailed hardware connection diagrams)



Wiring

Input Power, Drive-to-Motor, and Control Wiring

This section explains the required field wiring for each chiller motor and drive.

Note: *For Duplex™ chillers, this will be required for both Circuit 1 and Circuit 2.*

For AWG/MCM equivalents in mm^2, refer to Table 7:

Table 7. Wire sizing reference

AWG/MCM	mm^2 equivalent
22	0.32
21	0.35
20	0.5
18	0.75
17	1.0
16	1.5
14	2.5
12	4
10	6
8	10
6	16
4	25
2 or 1	35
1/0	50
2/0	70
2/0 or 3/0	95
4/0 or 250	120
300	150
350 or 400	185
450 or 500	240

Note: AWG = American Wire Gauge

Important: *Customers are responsible for all field wiring in compliance with local, national, and/or international codes.*

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.

Important:

- *Before servicing, disconnect all power sources and allow at least 40 minutes for capacitors to discharge.*
- *All electrical enclosures-unit or remote-are IP2X.*

1. Turn off, lock out, and tag the input power to the drive.
2. Remove the plate from the section of the drive enclosure where the wires will enter.

NOTICE

Equipment Failure!

Debris falling inside of adaptive frequency drive could cause failure of electronic components.

Do not cut holes in adaptive frequency drive enclosure.

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

⚠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.

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

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!

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

Important:

- *Before servicing, disconnect all power sources and allow at least 40 minutes for capacitors to discharge.*
- *All electrical enclosures-unit or remote-are IP2X.*

Grounding the Cabinet

⚠WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury. A ground wire must be connected to the enclosure. The motor frame must also be grounded to the drive controller. 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.

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

Use the following steps to ground the cabinet:

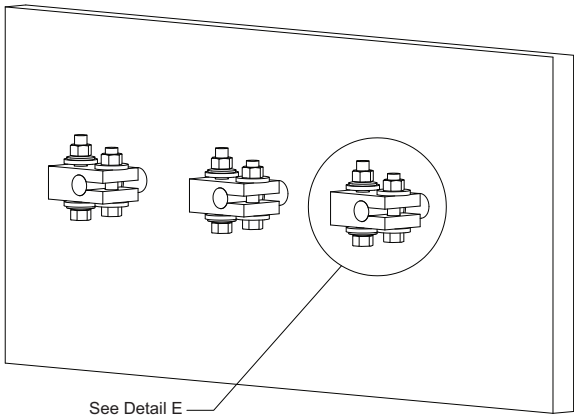
1. Open the left-hand enclosure door of the drive. The grounding stud is located just above and to the left of the breaker.
2. Run a suitable earth ground completed by field) to the cabinet's ground connection point. The grounding lug is capable of accepting up to 4/0 AWG wire. For AWG/MCM equivalents in mm^2, refer to Table 7, p. 37. Tighten the ground connections to 375 in·lb (42.4 N·m).

NOTICE

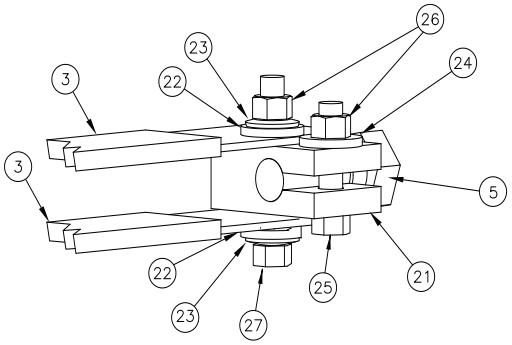
Equipment Damage!

Failure to follow instructions below 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.

Figure 40. Motor terminal connection

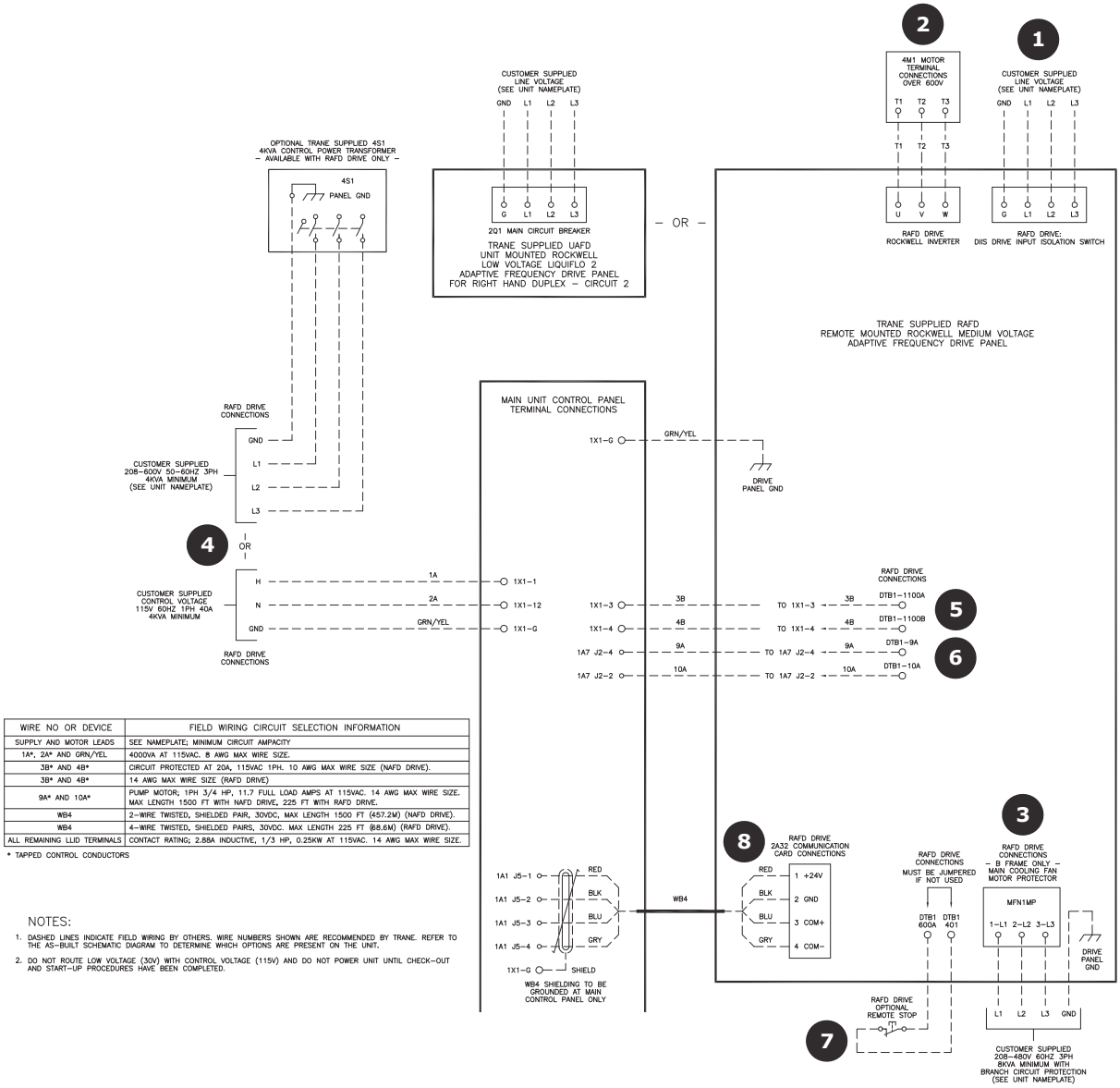


MEDIUM VOLTAGE (2300-6600V)
RATR, RPIR, RXL, CSOL, CATR, CPIR, CXL, CVAC OR AFDJ



Detail P

Figure 41. RAFD (AFDJ) MV Drive field connection diagram(a)



1. Line power
2. Motor-to-drive power
3. Fan power (B-frame)
4. Chiller control power
5. HPC Interlock
   - For low voltage drives TR200 , circuit is protected at 20 Amps, 120 vac, 10 AWG max wire size.
   - For medium voltage drives, Dry contact 14 AWG max wire size.
6. Oil pump interlock
7. Jumper required or remote stop switch
8. Chiller-to-drive communication link

(a) For AWG/MCM equivalents in mm^2, refer to Table 7, p. 37.

.Figure 42 illustrates the scope of field wiring for the chiller and drive. Figure 43, p. 41 illustrates the various field wiring to the drive.

Figure 42. Chiller and PowerFlex 7000 remote configuration

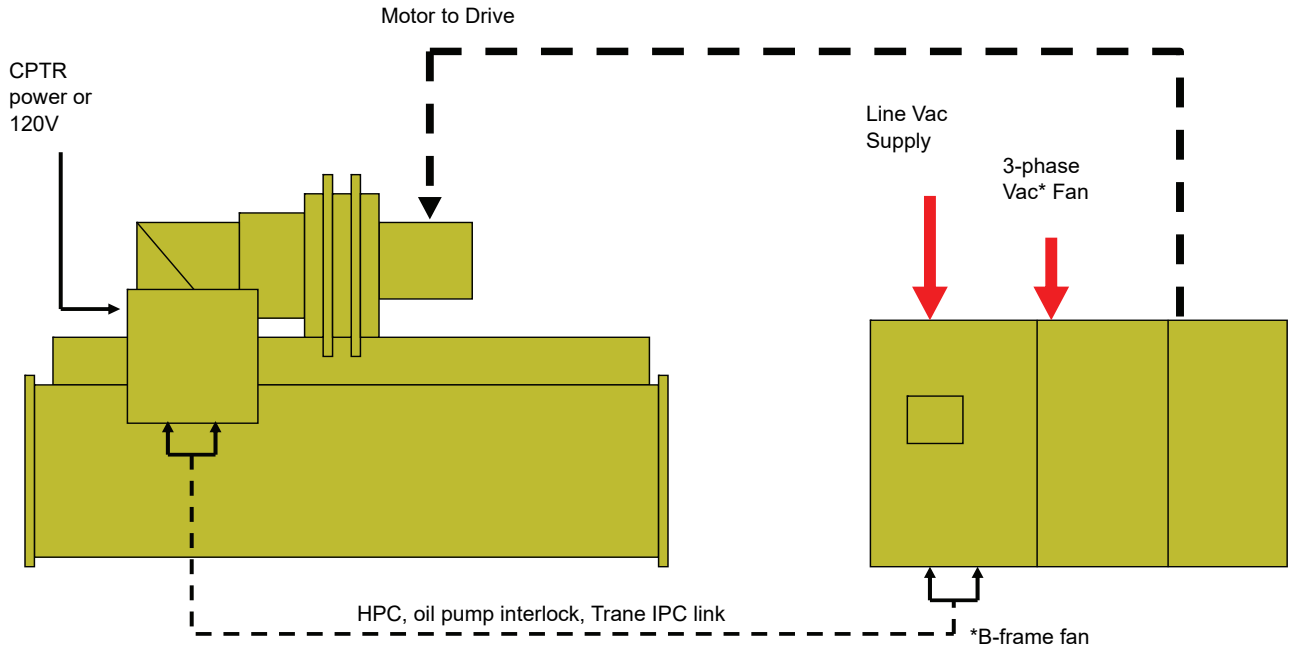
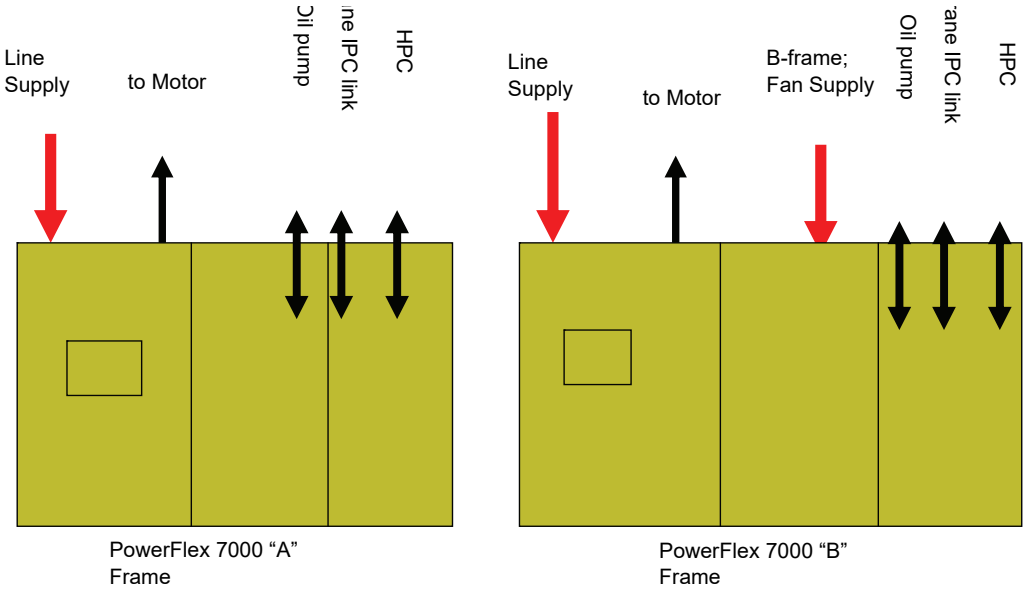


Figure 43. PowerFlex 7000: Scope of input voltages to/from drive



See sales order for line voltage and other options

Detailed Field Wiring Points

Input Power and Interconnection Wiring

Table 8 identifies the required power wiring and control wiring related to the MV Drive[1]. The Overview illustrates the scope of the field drive related wiring (see Figure 43, p. 41). There are seven (A-Frame) or nine (B-Frame) different drive related items listed in Table 8. The eighth item (on B-Frame drives) requires fan three-phase power whereas A-Frame drives receive internal fan power. The MV drive provides 115 Vac as required for its internal circuits; however, it does not provide the 115 Vac to power up the chiller. Therefore, either the chiller requires external 115 Vac or the CPTR transformer requires its line voltage. Refer to sales order specifications. Items 1 through 8 are identified on Figure 41, p. 40.

Table 8.

Reference #	
	1. **Three-phase line voltage supply to MV drive. (Voltage per sales order.)** L1 to L1 L2 to L2 L3 to L3 Grd to Grd
	2. **MV drive to CTV motor terminals. Figure 41, p. 40 illustrates the connection to the chiller motor terminals.** U to T1 V to T2 W to T3
	3. **B-Frame MV drive only: Main Cooling Fan three-phase supply (208 or 408, as specified)** L1 to L1 L2 to L2 L3 to L3 Grd to Grd
	4. **Chiller Control power** Chiller control power can be supplied at 115 Vac if without the CPTR transformer, or at a specified voltage if the step down transformer CPTR is specified. Models CDHF, CDHG, CVHE, CVHF, and CVHG 4a) Without CPTR—Connect 115 Vac 40 amps 4 kVA: L1 to 1X1-1 Wire #1A L2 to 1X1-2 Wire #2A Ground to 1X1-G Ground wire 4b) With CPTR transformer—Connect sales order specified voltage: L1 to 4S1-L1 L3 to 4S1-L3 Ground to Ground Models CDHH and CVHH With CPTR transformer—Connect sales order specified voltage: L1 to 6Q1-L1 L2 to 6Q1-L2 Ground to Ground
	5. **High pressure cutout interlock to GateKill (Dry contact input; apply no external power)** Models CDHF, CDHG, CVHE, CVHF, and CVHG 1X1-3 to DTB1-1100A; wire #3B 1X1-4 to DTB1-1100B; wire #4B Models CDHH and CVHH 1X1-3 to DTB1-1100A; wire #9E 1X1-4 to DTB1-1100B; wire #4E
	6. **Oil pump interlock (115 Vac circuit; apply no external power)** Models CDHF, CDHG, CVHE, CVHF, and CVHG 1A7-J2-4 to DTB1-9A Wire #9A 1A7-J2-2 to DTB1-10A Wire #10A Models CDHH and CVHH 1X1-10 to DTB1-9A Wire #6F 1X1-21 to DTB1-10A Wire #53F
	7. **Remote stop interlock (Must be jumpered if not used)** DTB1-401 DTB1-600A

[1] Refer to the chiller *Installation, Operation, and Maintenance* manual for chiller control wiring requirements.

Table 8. (continued)

8.	**Communications 4-wire chiller interprocessor communication link**	
	Models CDHF, CDHG, CVHE, CVHF, and CVHG	Models CDHH and CVHH
	1A1-J5-1 to 2A32-1 (Red)	1T2-J5-1 to 2K36-1 (Red)
	1A1-J5-2 to 2A32-2 (Black)	1T2-J5-2 to 2K36-2 (Black)
	1A1-J5-3 to 2A32-3 (Blue)	1T2-J5-3 to 2K36-3 (Blue)
	1A1-J5-4 to 2A32-4 (Gray)	1T2-J5-4 to 2K36-4 (Gray)
	Shield-Ground one end at the chiller control panel end only.	**Shield-Ground one end at the chiller control panel end only.**
9.	**Pre-trip status from customer-supplied breaker**	
	D-501A	
	D-501C	

Figure 41, p. 40 illustrates the eight preceding items (input power and interconnection wiring) and Figure 40, p. 39 illustrates the CTV motor terminals supplied on the chiller motor terminal ground.

UC800 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 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

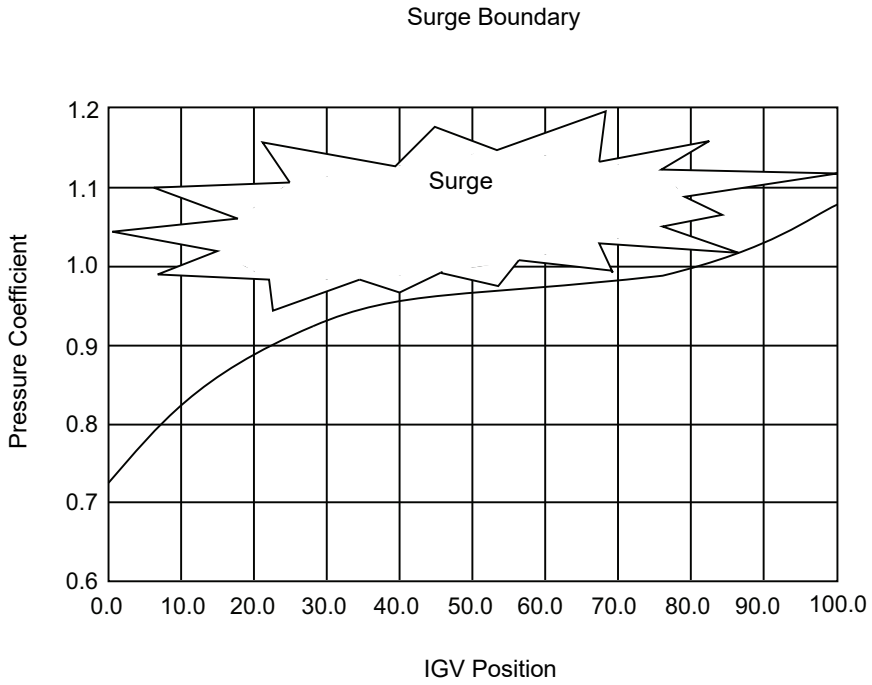
The non-dimensional pressure coefficient is derived based on turbo machinery principles. Fundamentally, the pressure coefficient is the ratio between the potential energy based on the pressure rise across the compressor and the kinetic energy of the refrigerant at the compressor discharge. This normalized 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 efficiency, 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 44.

Figure 44. Pressure coefficient surge boundary



AFD Speed Control

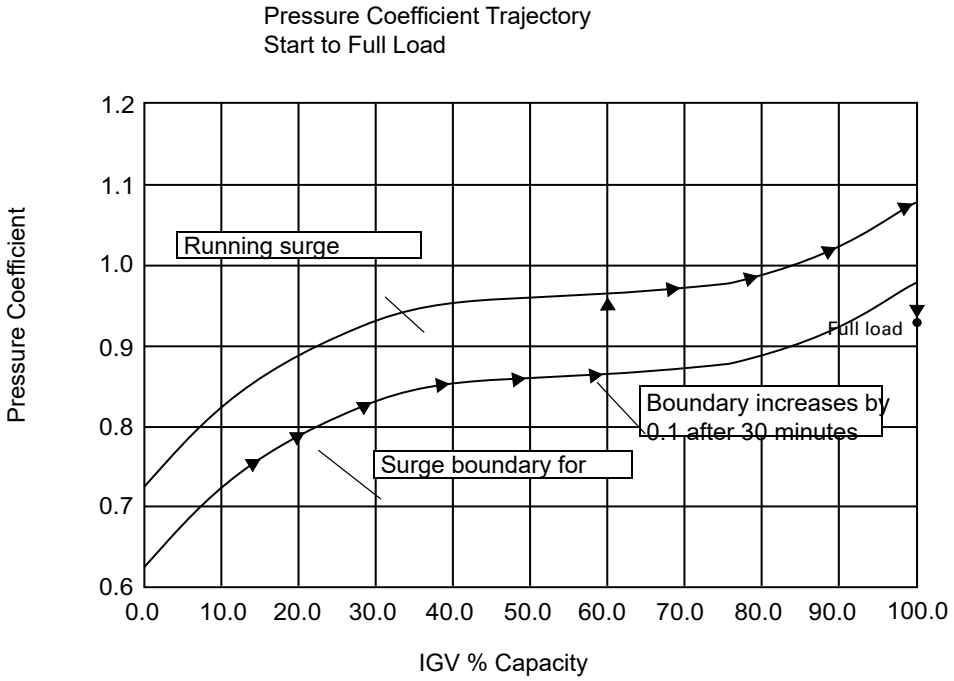
UC800 control utilizes an enhanced control method capable of simultaneously adjusting compressor speed and inlet guide vane position to achieve the desired chiller capacity and pressure coefficient. At the heart of the control is a match model that describes the relationship between control parameters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

Start-Up

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 start-up 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 compressor 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 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 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 45. Start-up surge boundary



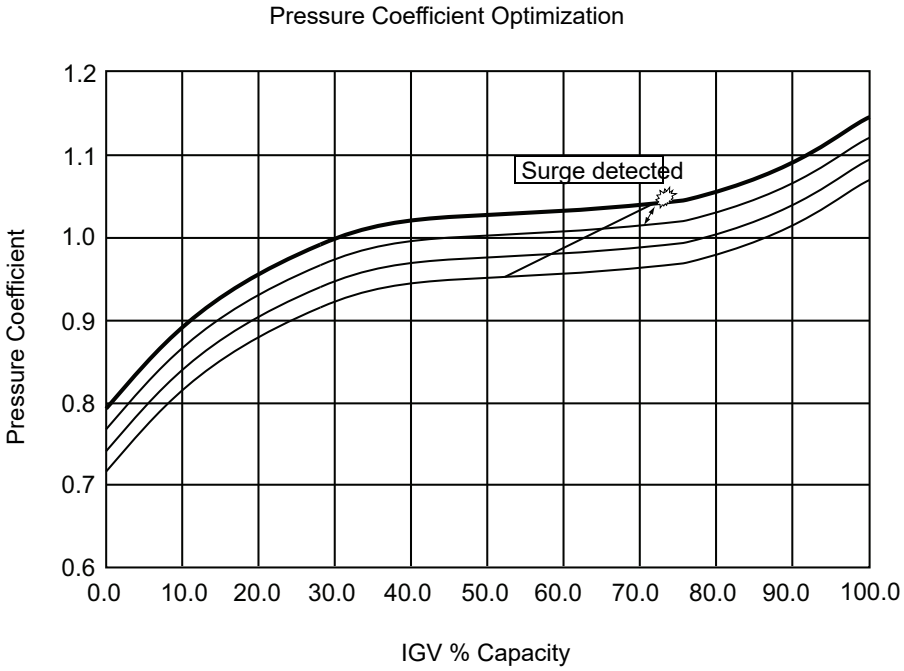
Re-optimization

The AF Surge Boundary Offset Coefficient is a user set-able parameter to be used for adjusting the surge boundary either higher or lower. In addition to being user set-able, 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.

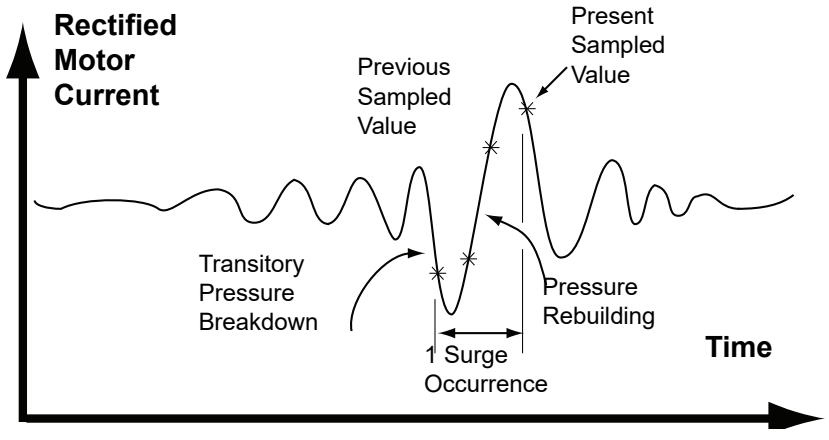
Figure 46. Boundary re-optimization



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.

Figure 47. Motor Current Signature Representing Surge



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 47. 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.

UC800 Interface to Adaptive Frequency Drive

Communications between the UC800 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 controls for communication on the Tracer AdaptiView display.

High Pressure Cutout—The inverter accepts a NC HPC switch. In the event of a chiller high pressure condition, the HPC switch opens, the drive shall shut down and de-energize the motor.

Output contacts are required to control the load of the refrigerant/oil pump motor and the cooling circulating pump. The contacts are Normally Open, and closed when the AFD energizes the motor.

Pre-Commissioning Start-Up

Trane AFDJ MV Drive

Check List

Prior to pre-commissioning start-up, it is imperative for Rockwell and Trane to receive a completed copy of the "PowerFlex "A" or "B" Frame Pre-Commissioning Check List" as soon as possible. The check list is included at the end of this manual, and also as a separate form, AFDJ-AFD001*-EN).

Table 9. CMC (common mode choke) ships separate from the drive (Frame B only)

Voltage (V)	Frequency (Hz)	Current (A)	Duty (Normal/Heavy)
4160	50	375	Normal
		430	Normal
6600	50/60	215	Normal
		250	Normal
		285	Normal
		185	Heavy

Commissioning

NOTICE

Perform Visual Inspection!

The conditions listed below could cause equipment damage. 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.**

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!

Failure to close all enclosure doors and properly secure with fasteners before operating equipment could result in death or serious injury due to hazardous voltage.

Important:

- *Before servicing, disconnect all power sources and allow at least 40 minutes for capacitors to discharge.*
- *All electrical enclosures-unit or remote-are IP2X.*

Start-up Commissioning Services

Start-up will be performed at the customer's site. Rockwell Automation requests a minimum of four weeks' notice to schedule each start-up. The local Trane office will request Rockwell start-up upon completion and readiness as per the pre-commissioning checklist.

The standard Rockwell Automation work hours are between 8:00 am and 5:00 pm EST (8 h/day) Monday through Friday, not including observed holidays. Additional working hours are available on a time and material basis.

Note: *Do not apply power to the drive prior to Rockwell site visit. Damages resulting from improper wiring and power-up will not be covered by warranty.*

Drive Commissioning

1. A pre-installation meeting with the customer to review:
   - The Rockwell Automation Start-up Plan
   - The Start-up Schedule
   - The Drive(s) installation requirements
2. Inspect the drive's mechanical and electrical devices.
3. Verify internal connections within the drive and verify wiring.
4. Verify critical mechanical connections for proper torque requirements.
5. Verify and adjust mechanical interlocks for permanent location.
6. Confirm all inter-sectional wiring is connected properly.
7. Re-verify control wiring from any external control devices.
8. Confirm cooling system is operational.
9. Verification of proper phasing from input voltage source to drive.
10. Confirm cabling of drive to motor, isolation transformer, and line feed.
11. Collect test reports indicating megger/hi-pot test has been performed on line and motor cables.
12. Control power checks to verify all system inputs such as starts/stops, faults, and other remote inputs.
13. Apply medium voltage to the drive and perform operational checks.

Note: *At this point, coordinate with Rockwell so that unit is charged and oil pump is working.*

14. Bump motor for rotation check and tune drive to the system attributes. (If the load is unable to handle any movement in the reverse direction, the load should be uncoupled prior to bumping the motor for directional testing).
15. Run the drive motor system throughout the operational range to verify proper performance.

Note: *Customer personnel will be required on-site to participate in the start-up of the system.*

16. Log operation of chiller and drive for start-up documentation.

Start-Up Test Log

Complete the start-up test log (see p. 50) upon chiller drive commission by Rockwell. It is recommended that you retain a copy for future reference.

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: 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)[a]	Yes	
RTD Type (see order)		
*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		

(a) Trane recommends setting parameters #84 (Torque Limit Motoring) and #85 (Torque Limit Braking) 5 percent higher than calculated.

Note: *Trane recommends setting parameters #84 (Torque Limit Motoring) and #85 (Torque Limit Braking) 5 percent higher than calculated.*

Start-Up Test Log

Maintenance

Preventive Maintenance Check List

The preventive maintenance activities on the PF7000 Air-Cooled Drive (“A” Frame or “B” Frame) can be broken down into two categories:

- Operational Maintenance—can be completed while the drive is running.
- Annual Maintenance—should be completed during scheduled downtime.

Operational Maintenance

This process really involves only one task: Changing or Cleaning the Air Filters. The PF7000 drives require consistent, unrestricted airflow to keep the power devices cool. The air filter is the main source of blockage in the air path.

The drive will provide an air filter alarm whenever the pressure differential across the devices drops to a drive-specific level. Referring to the Air Filter Block parameter, this can be anywhere from 7 percent to 17 percent blocked, depending on the heatsink and device configuration. This may seem like a small number, but it takes significant blockage to begin to lower the voltage from the pressure sensor. The percentage is a measure of voltage drop, and should not be viewed as a percentage of the opening that is covered. They are not related linearly.

Note: *Once you receive an Air Filter Warning, you should immediately make plans to change or clean the filter. You should still have days or weeks until the drive reaches an Air Filter Fault, but this is dependent on site-specific particle conditions. This can be done while the drive is running. Always contact Trane Services and/or refer to the drive literature supplied with the MV drive.*

Annual Maintenance

As the name implies, these maintenance tasks should be performed on an annual basis by a qualified MV drive technician. These are recommended tasks, and depending on the installation conditions and operating conditions, you may find that the interval can be lengthened. For example, we do not expect that torqued power connections will require tightening every year. Due to the critical nature of the applications run on MV drives, the key word is preventive. Investing approximately 8.0 hours per year on these tasks is time well spent in adding insurance against unexpected downtime.

Initial Information Gathering by Qualified MV Drive Technician

Some of the important information to be recorded via Rockwell Service tool includes:

- Print Drive Setup
- Print Fault/Warning Queues
- Save Parameters to NVRAM
- Save Parameters to Operator Interface
- Circuit Board Part Numbers / Serial Numbers / Revision Letters[1]

Physical Checks (NO Medium Voltage and NO Control Power)

⚠WARNING

Hazardous Voltage!

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

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

Important:

- *Before servicing, disconnect all power sources and allow at least 40 minutes for capacitors to discharge.*
- *All electrical enclosures-unit or remote-are IP2X.*
- Power Connection Inspection
  - Inspect PF7000 drive, input/output/bypass contactor sections, and all associated drive components for loose power cable connections and ground cable connections: torque them to the required torque specifications.
  - Inspect the bus bars and check for any signs of overheating/discoloration and tighten the bus connections to the required torque specifications.
  - Clean all cables and bus bars that exhibit dust build-up.
  - Use torque sealer on all connections.
- Carry out the integrity checks on the signal ground and safety grounds.
- Check for any visual/physical evidence of damage and/or degradation of components in the low voltage compartments.
  - This includes Relays, Contactors, Timers, Terminal connectors, Circuit breakers, Ribbon cables, Control

[1] This only needs to be recorded if parts have been modified or changed since the last Preventive Maintenance activities.

Wires, etc.; Causes could be corrosion, excessive temperature, or contamination.

– Clean all contaminated components using a vacuum cleaner (DO NOT use a blower), and wipe clean components where appropriate.

- **Check for any visual/physical evidence of damage and/or degradation of components** in the medium voltage compartments (inverter/rectifier, cabling, DC Link, contactor, load break, harmonic filter, etc).
  – This includes main cooling fan, power devices, heatsinks, circuit boards, insulators, cables, capacitors, resistors, current transformers, potential transformers, fuses, wiring, etc.; Causes could be corrosion, excessive temperature, or contamination.
  – Verify torque on heatsink bolts (electrical connections to bullet assemblies) is within specifications (13.5 N·m).
  – Clean all contaminated components using a vacuum cleaner (DO NOT use a blower), and wipe clean components where appropriate.

    Note: *An important component to check for contamination is the heatsink. The fine grooves in the aluminum heatsinks can capture dust and debris.*

  – Carry out the physical inspection and verification for the proper operation of the contactor/isolator interlocks, and door interlocks.
  – Carry out the physical inspection and verification for the proper operation of the key interlocks.
  – Carry out the cleaning of the fans and ensure that the ventilation passages are not blocked and the impellers are freely rotating without any obstruction.
  – Carry out the insulation meggering of the drive, motor, isolation transformer/line reactor, and the associated cabling.
  – Check clamp head indicator washers for proper clamp pressure, and adjust as necessary.

Control Power Checks (No Medium Voltage)

⚠WARNING

Live Electrical Components!

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

When it is necessary to work with live electrical components, have a qualified licensed electrician or otherindividual who has been properly trained in handling live electrical components perform these tasks.

Important:

- *Before servicing, disconnect all power sources and allow at least 40 minutes for capacitors to discharge.*
- *All electrical enclosures-unit or remote-are IP2X.*
- Apply Control power to the PowerFlex drive, and test power to all of the vacuum contactors (input, output, and bypass) in the system, verifying all contactors can close and seal in.
- Verify all single-phase cooling fans for operation.
- This includes the cooling fans in the AC/DC Power supplies and the DC/DC converter.
- Verify the proper voltage levels at the CPT (if installed), AC/DC Power Supplies, DC/DC converter, isolated gate power supply boards.
- Verify the proper gate pulse patterns using Gate Test Operating Mode.
- If there have been any changes to the system during the outage, place the drive in System Test Operating Mode and verify all functional changes.

Final Power Checks Before Restarting

- Ensure all cabinets are cleared of tools, and all component connections are back in place and in the running state.
- Put all equipment in the normal operating mode, and apply medium voltage.
- If there were any input or output cables removed, verify the input phasing, and bump the motor for rotation.
- If there were any changes to the motor, input transformer, or associated cabling, you will have to retune the drive to the new configuration using autotuning.
- Save all parameter changes (if any) to NVRAM.
- Run the application up to full speed/full load, or to customer satisfaction.
- Capture the drive variables while running, in the highest access level if possible.

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

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. First to alert the operator that a alarm exists, and second 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's severity. The severity hierarchy is:

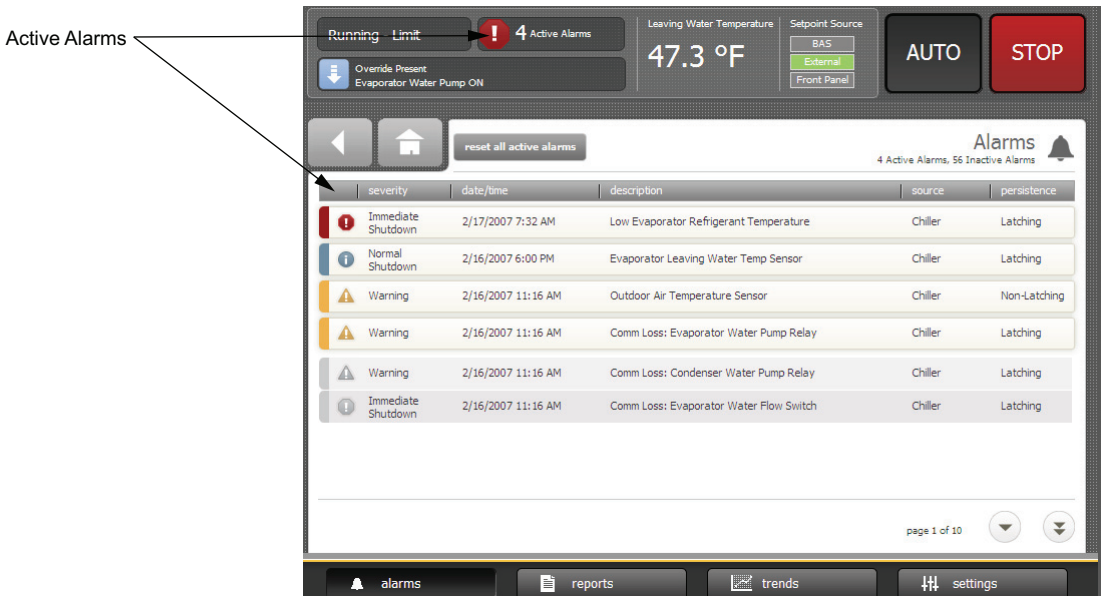
- Immediate shutdown (highest priority and displays first)
- Normal shutdown
- Warning
- Unknown (lowest priority and displays last)

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 the laptop computer loaded with the Tracer TU service tool software directly to the UC800 controller to view the AFD last diagnostic code (refer to Table 10, p. 54 for detailed information on which AFD settings you can see using Tracer TU).

Figure 48. Tracer AdaptiView alarms screen



Troubleshooting

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

1. Collect alarm and parameter information.
   a. DO NOT cycle unit power or reset the controls. Leave the AFD and the UC800 in their present states.
   b. Record the "AFD Last Diagnostic Code" using Tracer TU. This value is available under the Unit Status tab, in the AF (Adjustable Frequency) expanding box.
   c. Record all UC800 active and historic alarms. Make a full chiller service report.
   d. Document and check all applicable parameter settings. This information can be verified off of the chiller nameplate, and by referring to this manual.
   e. In the Binding view of the Tracer TU service tool, verify there is a green circle indicating that the AFD Recomm Starter LLID is properly bound.
2. Collect Chiller Information.
   a. Note the following chiller information:
      - Operating mode and any sub-mode (i.e., 100 percent or 75 percent 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, and the drive's serial and model numbers.

3. Troubleshooting
   a. Note drive information and codes from drive display.
   b. Refer to the Rockwell manuals for further troubleshooting information.
   c. Contact Trane Service Company for assistance.

Table 10 coordinates the chiller's Tracer AdaptiView drive diagnostics and the Rockwell MV drive diagnostics fault and reference MV drive fault code. For additional information on the faults, refer to the Rockwell PowerFlex 7000 MV AC Drive Technical Data section (Chapter 3) of the manual that shipped with the drive. Only qualified technicians should attempt any troubleshooting of the drive and chiller. Contact your local Trane Service agency to request service and/or additional support. Trane can contact the appropriate technical service group for additional support if necessary.

Table 10. IOM Tracer AdaptiView and drive diagnostics

Chiller Tracer AdaptiView Diagnostic	MV Drive Diagnostic	Drive Fault Code
Drive Overcurrent	DCLnkOvrCur	113
Drive Overcurrent	Line OvrCur	112
Drive Overcurrent	Mtr OvrCur	96
Drive Overcurrent	RNeut OvrCur	115
Drive Overtemp	DCLinkOvrTmp	34
Drive Overtemp	InvHSnkOvTmp	178
Drive Overtemp	RecHSnkOvTmp	146
Drive Overtemp	TxReacOvrTmp	33
Drive Overtemp (when available)	Amb OvTmp	182
Fatal	InvHeartbeat	132
Fatal	RecHeartbeat	190
General	Amb LoTmp	183
General	Aux Protn	37
General	Drv OvrLoad	144
General	Inp IsoClsd	173
General	Inp IsoOpen	170
General	InpCtctrOpen	166
General	Input Protn1	32
General	Input Protn2	36
General	InvHSnk Sens	181
General	InvHSnkLoTmp	179
General	LineHarmonic	119
General	Mtr LoadLoss	104
General	Mtr OvrSpeed	102
General	Mtr OvrVolt	97
General	Mtr Stall	103
General	MtrNeuOvrVol	98
General	MtrSlipRange	106
General	No Out Ctctr	169
General	Out IsoClsd	174
General	Out IsoOpen	171
General	OutCtctrOpen	167
General	RecHSnk Sens	149

Table 10. IOM Tracer AdaptiView and drive diagnostics

Chiller Tracer AdaptiView Diagnostic	MV Drive Diagnostic	Drive Fault Code
General	RecHSnkLoTmp	147
General	RNeutOvrLoad	145
Ground Fault	Gnd OvrCur	114
Ground Fault	LineNeuOvVol	118
High Bus	Inv OvrVolt	160
High Bus	Line OvrVolt	116
High Bus	Rec OvrVolt	117
I/O Board	DC Neut VSB	461
I/O Board	Idc HECS Con	191
I/O Board	Inv A2D Conv	189
I/O Board	InvAnaSlfTst	186
I/O Board	Main VSB	459
I/O Board Fault	Rec A2D Conv	131
I/O Board Fault	RecAnaSlfTst	128
Ignore	Slv1VolUnBal	121
Ignore	Slv2VolUnBal	122
Motor Overload	Mtr OvrLoad	101
Motor Short	Motor Protn	35
Output Phase Loss	Mtr CurUnbal	100
Output Phase Loss	Mtr FlxUnbal	99
Power Interface Controller	InvFbrOptCfg	187
Power Interface Controller	InvHSnkFbrOp	180
Power Interface Controller	RecFbrOptCfg	129
Power Interface Controller	RecHSnkFbrOp	148
Power Loss	MstrCurUnBal	123
Power Loss	MstrVolUnBal	120
Power Structure	MV Gate Test	165
Power Structure	MV Sys Test	164

LED Usage

There are seven LEDs (four small and three large) on the RECOMM-TRANE board.

The three large LEDs are used as follows:

- RX—The hardware turns on this LED when it detects RS485 activity.
- TX—The hardware turns on this LED when it is enabled to transmit on the RS485 network.
- SERVICE SELECTED

The four small LEDs are used as follows:

- Port—Indicates the state of the DPI connection. Follows standard conventions.
- Module—Solid Green when application code is running, off otherwise.
- 485—Off when firmware detects no valid IPC3 messages; 0.5 second timeout.

Flashes green when firmware detects valid IPC3 messages but the communications loss timer has expired since the last message directed at the RECOMM-TRANE.

Solid green after a message directed at the RECOMM-TRANE has been received and the communications loss timer has not expired.

- 24V—The hardware turns on this LED (green) when there is +24 V on connector J4.

  The IPC3 network provides power to the RS485 drivers and receivers over J4.

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PowerFlex “A” or “B” Frame Pre-Commissioning Check List

Remote-Mounted Medium Voltage Air-Cooled Adaptive Frequency™ Drives:
PowerFlex 7000 (Model: AFDJ)
PowerFlex 6000T (Model: VFDB)

⚠WARNING

Safety Alert!

Failure to follow instructions below could result in death or serious injury. In addition to the following tasks, you MUST:

- **Follow all instructions in the unit’s *Installation, Operation, and Maintenance* manual, including warnings, cautions, and notices.**
- **Perform all required tasks in any applicable Service Alerts and Service Bulletins.**
- **Review and understand all information provided in Submittals and Design Specifications.**

⚠WARNING

Hazardous Service Procedures!

Failure to follow all precautions in this manual and on the tags, stickers, and labels 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 following instructions: Unless specified otherwise, disconnect all electrical power including remote disconnect and discharge all energy storing devices such as capacitors 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

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 Labelling 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

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.

Instructions

It is imperative for Rockwell and Trane to receive the following check list information filled out as soon as possible and sent to Rockwell Medium Voltage Center of Expertise in Cambridge, Ontario, Canada office and to the regional Trane Technical Support Team to assure scheduling is not a problem (see contact information below for more information).

Note: *A pre-commissioning check sheet is required for each drive and compressor being prepared for start-up. In the case of multiple simplex chillers, this means that a pre-commissioning sheet for each chiller and drive is required. In the case of a Duplex chiller, two pre-commissioning copies are required: once for Circuit 1 (left-hand) and a second for Circuit 2 (right-hand).*

Important:

- *The average start-up by Rockwell takes approximately three days to complete.*
- *You must specify the language for warning labels in the pre-commissioning check list (see next page).*
- ***Rockwell requires four weeks notice to make arrangements.***

After completing the pre-commissioning check list, fax or e-mail to the appropriate regional Rockwell and Trane office:

North America Region
Rockwell • E-mail: mvsupport_technical@ra.rockwell.com • Phone: (440) 646-3434 or (888) 382-1583 (choose options 3, 5, and enter code 513) ***Note:*** *The end user requires a valid Tech Connect contract to get support from Rockwell.*
Trane • Fax: (608) 787-3024 • E-mail: TechSupportLaCrosse@trane.com

Europe Middle East Africa Region
Rockwell • E-mail: mvsupport_services@ra.rockwell.com
Trane • E-mail: EMEAtechnicalsupport@trane.com

Table 7. Torque requirements for threaded fasteners[(a)]

			Torque	
Diameter	**Pitch**	**Material**	**ft·lb**	**N·m**
M2.5	0.45	Steel	0.32	0.43
M4	0.7	Steel	1.3	1.8
M5	0.8	Steel	2.5	3.4
M6	1	Steel	4.4	6.0
M8	1.25	Steel	11	14
M10	1.5	Steel	21	29
M12	1.75	Steel	37	50
M14	2	Steel	60	81
1/4 in.	20	Steel S.A.E. 5	9.0	12
3/8 in.	16	Steel S.A.E. 2	20	27

(a) Unless otherwise specified, use the values of torque in this table in maintaining the equipment.

Once all points of the check list are complete, initial each check box and provide the date. (It will be necessary to review this with the electrician or electrical contractor.)

Photocopy the check list and fax the copy to the Medium Voltage Center of Expertise (MVCOE) and to Trane Technical support along with the planned start-up date.

Upon receiving this check list, the Rockwell MVCOE group will contact the site to finalize arrangements for a start-up engineer to travel to site. The field service agency and Rockwell are to also coordinate the visit with La Crosse CTV Technical Service.

PowerFlex "A" or "B" Frame Pre-Commissioning Check List

Please complete (print) this **Pre-Commissioning Check List** and when complete, fax or e-mail to Rockwell and Trane (contact information provided on preceding page):

Required: Specify Language for Warning Labels! _____

FROM: **Date:**

Name:

Trane Service Company: **Pages:**

Trane Regional Fax:

Rockwell Regional E-mail: **Trane Regional E-mail:**

Trane Chiller Serial Number: _____

Trane Chiller Sales Order Number: _____

MV Drive Serial Number: _____

Rockwell GMS Service Engineer Requested (YES): _____

Scheduled Commissioning Date[a]: _____

(a) ***Important:***
The average start-up by Rockwell takes approximately three days to complete.
Rockwell requires four weeks notice to make arrangements.

1. Receiving and Unpacking

Initials	Date		
		☐	The drives have been checked for shipping damage upon receiving.
		☐	Check the shock indicator; call Trane Service and Rockwell support to notify if damaged.
		☐	After unpacking, the item(s) received are verified against the bill of materials.
		☐	Any claims for breakage or damage, whether concealed or obvious, are made to the carrier by the customer as soon as possible after receipt of shipment. Any claims shall be issued according to local legislation.
		☐	All packing material, wedges, or braces are removed from the drive.

2. Installation / Mounting

Initials	Date		
		☐	The drive is securely fastened in an upright position, on a level surface. Seismic zones require special fastenings; consult Rockwell.
		☐	Lifting angles have been removed.
		☐	Bolts have been inserted into original location on top of drive (leakage of cooling air).
		☐	All contactors and relays have been operated manually to verify free movement.
		☐	For model 7000, frame A only, install neutral resistors. Not applicable for PF6000T model VFDB.

3. Safety

Initials	Date		
		☐	All mechanical interlocks and door Ram Interlocks are tested for proper functionality and are not defeated or damaged.
		☐	All Kirk key interlocks are installed and tested for proper functionality.
		☐	The grounding of the drive should be in accordance with CEC (Canadian Electrical Code), NEC (National Electrical Code), IEC regulations, and/or local regulations. ***Note:*** *To be completed by Electrical Contractor.*
		☐	If the drive has an isolation transformer, the transformer enclosure and/or frame must be bonded to system ground at a minimum of two locations.
		☐	If the drive has an isolation transformer, the wye secondary neutral point must not be grounded.
		☐	If shipping splits exist in the line-up, the ground bus between cabinets has been installed.

4. Control Wiring

Initials	Date		
		☐	All low voltage wiring entering the drive is labeled, appropriate wiring diagrams are available, and all customer interconnections are complete.
		☐	Oil pump interlock complete
		☐	All AC and DC circuits are run in separate conduits.
		☐	All wire sizes used are selected by observing all applicable safety and CEC/NEC/IEC regulations. ***Note:*** *To be completed by Electrical Contractor.*
		☐	All 3-phase control wiring is with in specified levels and has been verified for proper rotation, UVW.
		☐	All single-phase control wiring is within specified levels and has grounded neutrals.
		☐	Pre-trip status from customer-supplied breaker.

5. Power Wiring

Initials	Date		
		☐	The power cable connections to the drive, motor and isolation transformer adhere to CEC, NEC, IEC, or appropriate local standards and/or regulation. ***Note:*** *To be completed by Electrical Contractor.*
		☐	The cable terminations, if stress cones are used, adhere to the appropriate standards.
		☐	Appropriate cable insulation levels are adhered to, as per Rockwell Automation specifications (refer to the tables on page 2–29 of Rockwell's User Manual for cable insulation requirements).
		☐	All shields for shielded MV cables must be grounded at both ends.
		☐	If shielded MV cables are spliced, the shield must remain continuous and insulated from ground.
		☐	All wire sizes used are selected by observing all applicable safety and CEC/NEC/IEC regulations.
		☐	All power connections are torqued as per Rockwell Automation Specifications (refer to the Torque Requirements listed in Table 7, p. 2).
		☐	All customer power cabling has been Meggered or Hi-Pot tested before connecting to drive system.
		☐	Power wiring phase rotation has been verified per the specific electrical diagrams supplied by Rockwell Automation.

6. Drive Line-up Status

Initials	Date		
		☐	The medium voltage and low voltage power is available for start-up activities.
		☐	Strongly recommended that full load is available for full-load testing at start-up. Drive Commissioning final setup requires full load.

Notes or Comments:

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.

Trane has a policy of continuous product and product data improvement and reserves the right to change design and specifications without notice. We are committed to using environmentally conscious print practices.

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Supersedes AFDJ-ADF001B-EN (May 2020)

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