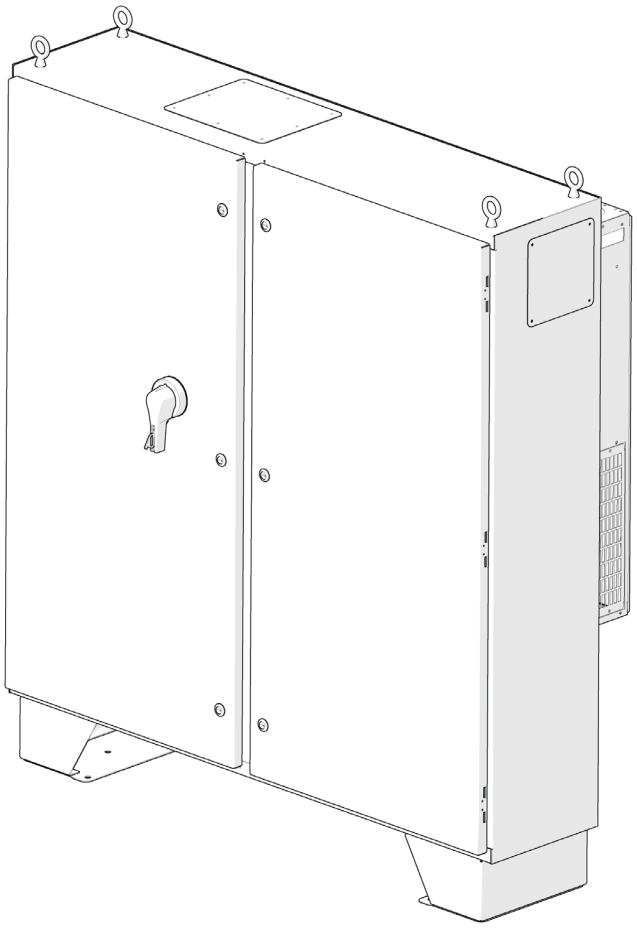
Installation and Maintenance Manual IOM 1369

Group: Chiller
Part Number: IOM1369
Date: September 2023

Fixed Speed Starters and VFDs for Centrifugal Chillers

Low and Medium Voltages

Solid State, Across the Line, and Variable Frequency Drives



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Introduction

The purpose of this manual is to provide the site operator with sufficient information to understand the operating state of the motor/starter, access motor operating data, and to recognize and deal with faults. Starter setpoints are factory set or set at startup by the Daikin Applied startup technician. Owner/operator adjustment of setpoints is discouraged.

NOTE: Installation and maintenance are to be performed only by licensed, if required by local codes and regulations, or qualified personnel who are familiar with local codes and regulations and are experienced with this type of equipment.

⚠ DANGER

LOCKOUT/TAGOUT all power sources prior to service, pressurizing, de-pressuring, or powering down the unit. Failure to follow this warning exactly can result in serious injury or death. Disconnect electrical power before servicing the equipment. More than one disconnect may be required to denergize the unit. Be sure to read and understand the installation, operation, and service instructions within this manual.

⚠ WARNING

Electric shock hazard. Improper handling of this equipment can cause equipment damage, personal injury, or death. This equipment must be properly grounded. Connections to and service of the MicroTech control panel must be performed only by personnel that are knowledgeable in the operation of the equipment being controlled.

⚠ WARNING

Polyolester Oil, commonly known as POE oil is a synthetic oil used in many refrigeration systems, and may be present in this Daikin Applied product. POE oil, if ever in contact with PVC/CPVC, will coat the inside wall of PVC/CPVC pipe causing environmental stress fractures. Although there is no PVC/CPVC piping in this product, please keep this in mind when selecting piping materials for your application, as system failure and property damage could result. Refer to the pipe manufacturer's recommendations to determine suitable applications of the pipe.

⚠ CAUTION

Static sensitive components. A static discharge while handling electronic circuit boards can cause damage to the components. Discharge any static electrical charge by touching the bare metal inside the control panel before performing any service work. Never unplug any cables, circuit board terminal blocks, or power plugs while power is applied to the panel.

Hazard Identification Information

⚠ DANGER

Danger indicates a hazardous situation, which will result in death or serious injury if not avoided.

⚠ WARNING

Warning indicates a potentially hazardous situations, which can result in property damage, personal injury, or death if not avoided.

⚠ CAUTION

Caution indicates a potentially hazardous situations, which can result in minor injury or equipment damage if not avoided.

NOTICE

Notice indicates practices not related to physical injury.

NOTE: Indicates important details or clarifying statements for information presented.

General Description

Solid State and Across the Line Starters

Motor starters can be unit-mounted at the factory on low voltage chillers and can be free-standing on all sizes. Larger size chillers with medium voltage applications are only available with free-standing.

These starters are completely automatic and require no operator intervention (other than clearing and resetting faults) to perform their function of providing a controlled connection of the compressor motor to the power supply.

Low and medium voltage starters have similar software characteristics and are discussed together in their operating section. However, some parameters and data are different. Where this occurs, separate tables and figures are provided.

The starters are characterized by their control software, known as “Control.” Certain electrical operating data for these low voltage starters is transmitted to the chiller and can be viewed on the operator touch screen if the “Full Metering Option” has been ordered.

Variable Frequency Drives

While known and specified for their ability to control compressor motor speed for efficiency enhancement, VFDs also perform starting and motor protection functions.

WSC single and WDC/WCC dual compressor chillers can be equipped with VFDs. A VFD starts the compressor motor and modulates compressor speed in response to load, evaporator pressure, and condenser pressure, as sensed by the chiller microprocessor. VFDs are most effective during reduced load and/or lower compressor lift.

NOTE: VFDs are available only from Daikin Applied and when purchased as part of the original chiller purchase.

Basic Electrical Terms

Bypass contactor: Contactors that bypass auto-transformers, reactors, or SCRs, and allow full power to reach the motor directly.

Closed transition: A reduced voltage starter characteristic when the motor is NOT temporarily disconnected from the line during the transition from starting mode to operating mode. The electrical load is transferred to resistors during the transition phase and the second inrush spike is suppressed

Full load amps (FLA): The maximum amps the motor is designed for.

Inrush current: The amount of current that a specific motor and starter combination will draw during start-up. Normal inrush current will be substantially less than LRA for all starter types, except for across-the-line starters.

Interrupting capacity: The maximum fault current that a circuit breaker or fused disconnect can successfully interrupt. As the rating increases, the construction becomes heavier duty. For disconnect switches with fuses, the rating is based on 0 to 600 volts.

For circuit breakers, the voltage and amperage relationship is considered with interrupting capacity decreasing as voltage increases.

Locked rotor amps (LRA): The amount of current that a specific motor will draw at startup, when full voltage is applied across the line. The LRA may be 6 to 8 times FLA, or possibly higher in some cases.

Low Voltage: Voltages up to 575 volts

Medium Voltage: Voltages from 2,400 volts to 6,600

Open transition: A reduced voltage starter characteristic occurring when the motor is temporarily disconnected from power at the time the starter changes from the starting mode to the final running mode. A second smaller inrush spike will occur. Daikin Applied does not recommend use of this type of starter.

Rated load amps (RLA): Actual amperage that the motor draws for a specific application. Centrifugal compressor motors operate at a RLA significantly below their maximum full load amps. RLA is used to determine electrical component sizing such as wire size and disconnect switches.

Starting torque: Minimum torque required to begin the motor’s rotation.

Withstand rating: There is a period of time that the short circuit current passes to the shorted circuit before the protection device can open. This time can be as long as 0.020 seconds (one cycle). The withstand rating of a starter is the maximum short circuit current that it can pass safely without emitting sparks or debris.

Model Identification

Full model numbers are as shown below followed by two digits representing the unit's Rated Load Amps (RLA), such as RRSS14

RVSS	low voltage, solid state, free-standing
MVSS	medium voltage, solid state, free-standing
MVAT	medium voltage, across-the-line, free-standing
MVSS	medium voltage solid state, free-standing
FL	low voltage, VFD, free-standing

Environmental Conditions

Ambient Temperature	32° to 104°F (0°C to 40°C, derate up to 50°C)
Storage Temperature (Ambient)	32° to 131°F (0°C to 55°C)
Humidity	5% to 95% (non-condensing)

NOTE: AC line distribution system capacity not to exceed 100,000 amps symmetrical available fault current.

Do not install the drive above 1000 meters (3300 feet) without derating output power. For every 91.4 meters (300 feet) above 1000 meters (3300 feet), derate the output current 1% (with a max derate of 10%).

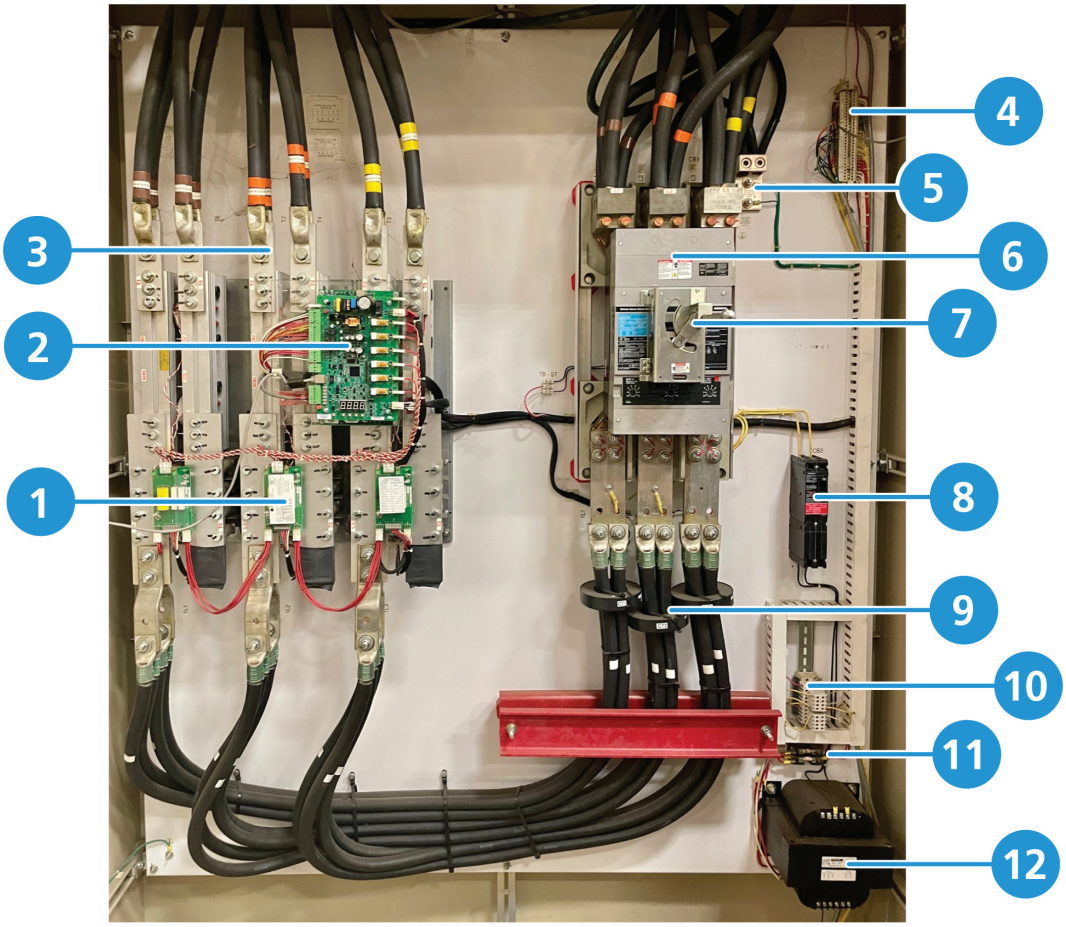
Standard NEMA 1 type VFDs must be installed indoors in an area that is not exposed to direct water spray. Do not install in areas where the ambient temperature falls below 32 ° F (0 ° C) or exceeds 104 ° F (40 ° C) unless this was noted at the time of order placement and special precautions were taken to protect against these abnormal temperatures. Contact Daikin Applied Factory Service for operation outside these conditions. VFDs reject heat into the surrounding space as shown below:

Environmental Requirements

Provisions should be provided in the starter enclosure to ensure that the temperature inside the enclosure never rises above 122°F (50°C) or the starter could be damaged or the life of the starter could be reduced. Storage temperature limits are -4°F to 155°F (-20°C to 70°C)

Internal Components - Fixed Speed Starter

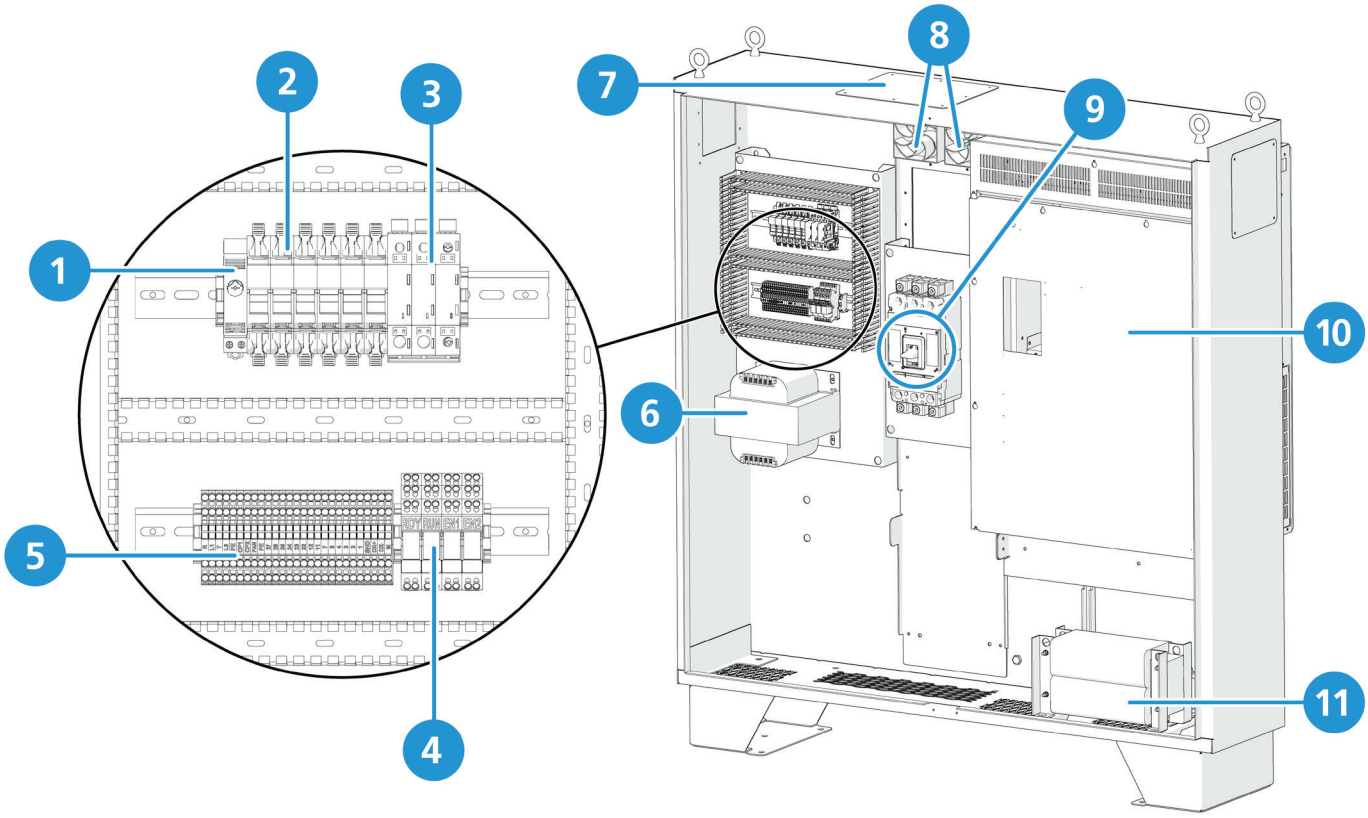
Figure 1: Internal Components - Fixed Speed Starter



Number	Component
1	SRCs
2	MX3 Controller
3	Motor Lugs
4	Terminal Strip
5	Grounding Lug
6	Line Side Lugs
7	Disconnect Switch
8	Control Transformer Fuses (Primary)
9	Current Transducers x 3
10	Control Relays
11	Control Transformer Fuses (Secondary)
12	Control Transformer

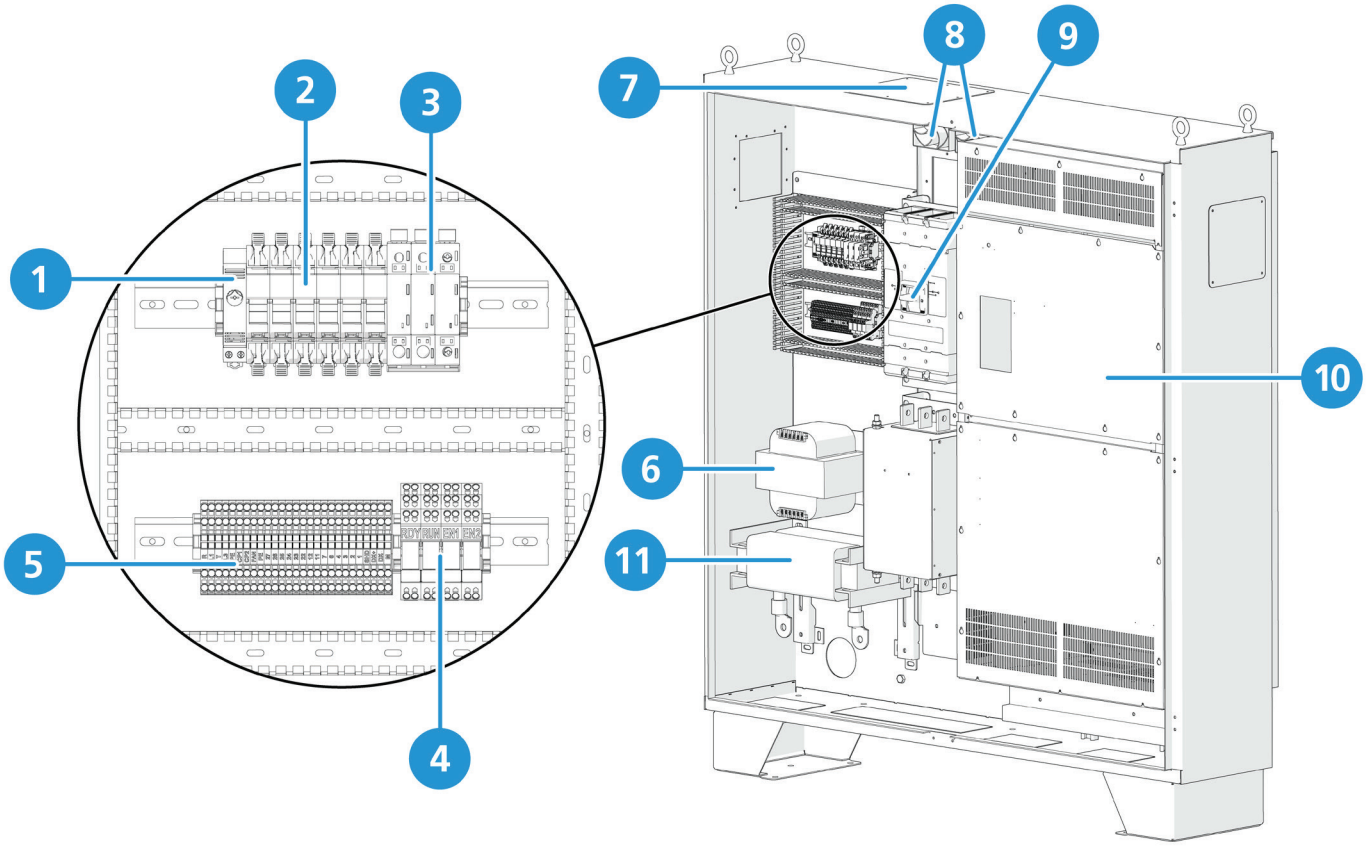
Internal Components - VFD

Figure 2: Internal Components - Cab 1 (CV5)



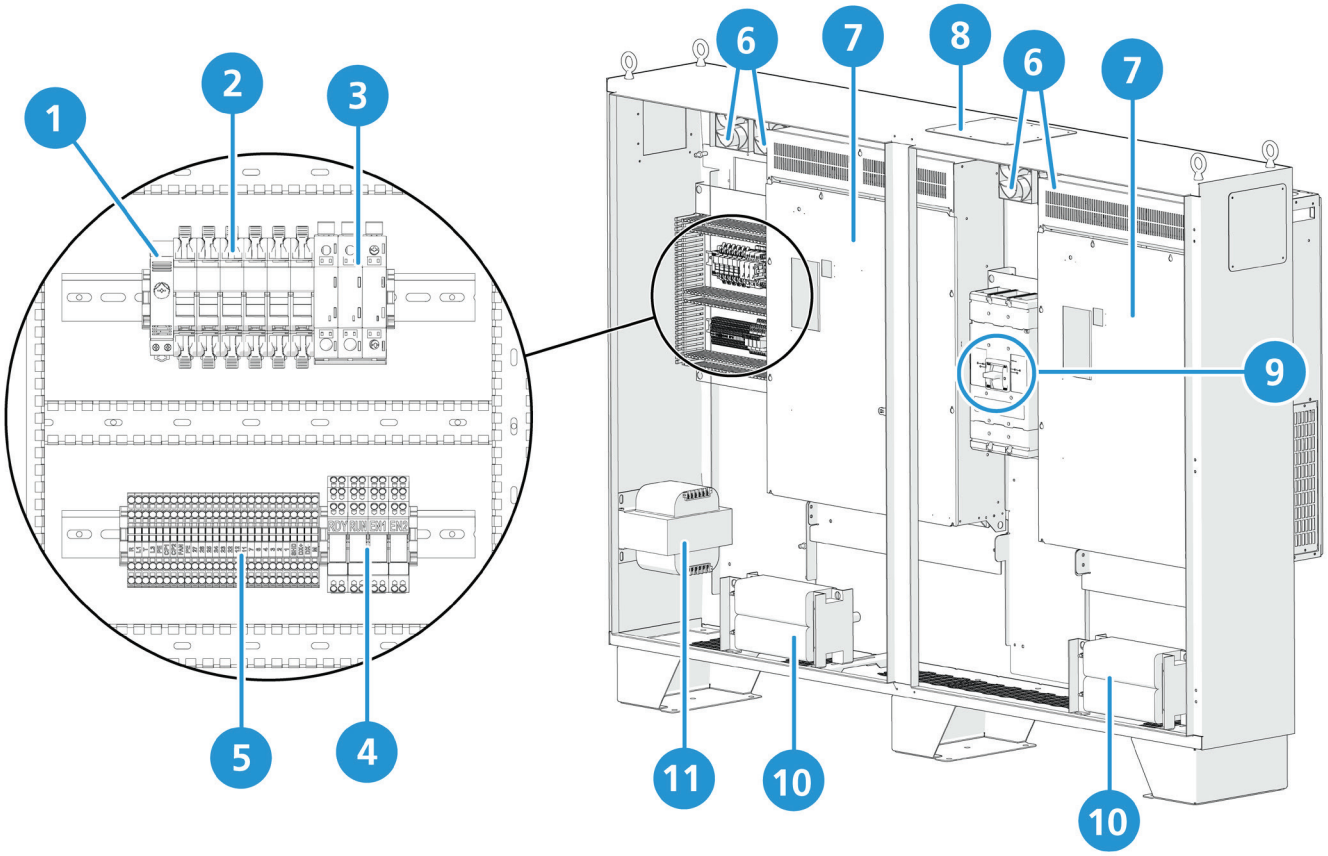
Number	Component
1	Fan Thermostat
2	Fuse Block
3	Surge Protection
4	Control Relay
5	Terminal Block
6	Transformer
7	Power Leaving
8	Control Fan x 2
9	Disconnect Switch
10	VFD
11	DC Reactor

Figure 3: Internal Components - Cab 2 (CV6)



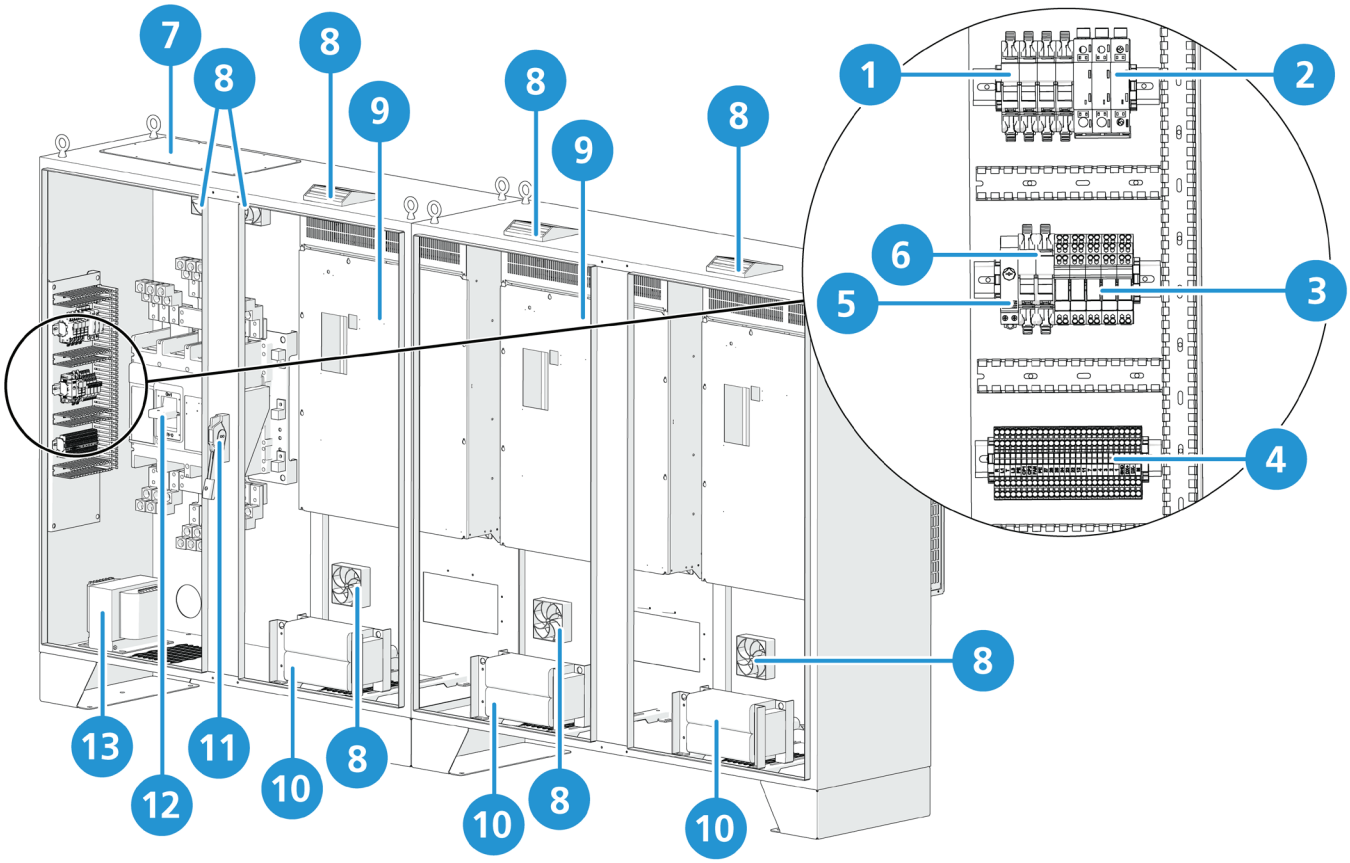
Number	Component
1	Fan Thermostat
2	Fuse Block
3	Surge Protection
4	Control Relay
5	Terminal Block
6	Transformer
7	Leaving Power
8	Control Fan x 2
9	Disconnect Switch
10	VFD
11	DC Reactor

Figure 4: Internal Components - Cab 3 (CV7)



Number	Component
1	Fan Thermostat
2	Fuse Block
3	Surge Protection
4	Control Relay
5	Terminal Strip
6	Control Fan x 4
7	VFDs
8	Power Leaving
9	Disconnect Switch
10	DC Reactor
11	Transformer

Figure 5: Internal Components - Cab 5 (CV8)



Number	Component
1	Fuse Block
2	Surge Protection
3	Control Relay
4	Terminal Bloack
5	Fan Thermostat
6	Fuse Block
7	Power Leaving
8	Control Fan x 8
9	VFD x 3
10	DC Reactor
11	Power Disconnect
12	Disconnect Switch
13	Transformer

Starter Installation

Inspection

Thoroughly inspect the device for possible shipping damage before storing or installing the starter

- Remove the starter from its package and inspect exterior for shipping damage. If damage is apparent, notify the shipping agent and your sales representative.
- Open the enclosure and inspect the starter for any apparent damage or foreign objects. Ensure that all of the mounting hardware and terminal connection hardware is properly seated, securely fastened, and undamaged.
- Ensure all connections and wires are secured.
- Read the technical data label affixed to the starter and ensure that the correct horsepower and input voltage for the application has been purchased.

General Information

Ensure the following:

- The wiring diagram (supplied separately with the starter) is correct for the required application.
- The starter is the correct current rating and voltage rating for the motor being started.
- All of the installation safety precautions are followed.
- The correct power source is available.
- The starter control method has been selected.
- The connection cables have been obtained (lugs) and associated mounting hardware.
- The necessary installation tools and supplies are procured.
- The installation site meets all environmental specifications for the starter NEMA/CEMA rating.
- The motor being started has been installed and is ready to be started.
- Any power factor correction capacitors (PFCC) are installed on the power source side of the starter and not on the motor side.

Failure to remove power factor correction or surge capacitors from the load side of the starter will result in serious damage to the starter that will not be covered by the starter warranty. The capacitors must be connected to the line side of the starter. The up-to-speed (UTS) contact can be used to energize the capacitors after the motor has reached full speed.

Safety Information

Ensure that the installation site meets all of the required environmental conditions.

⚠ DANGER

LOCKOUT/TAGOUT all power sources prior to service, pressurizing, de-pressuring, or powering down the unit. Failure to follow this warning exactly can result in serious injury or death. Disconnect electrical power before servicing the equipment. More than one disconnect may be required to denergize the unit. Be sure to read and understand the installation, operation, and service instructions within this manual.

⚠ WARNING

Electric shock hazard. Improper handling of this equipment can cause equipment damage, personal injury, or death. This equipment must be properly grounded. Connections to and service of the MicroTech control panel must be performed only by personnel that are knowledgeable in the operation of the equipment being controlled.

- LOCK OUT ALL SOURCES OF POWER.
- Install circuit disconnecting devices (i.e., circuit breaker, fused disconnect or non-fused disconnect) if they were not previously installed by the factory as part of the package.
- Install short circuit protection (i.e., circuit breaker or fuses) if not previously installed by the factory as part of the package.
- Follow all NEC (National Electrical Code) and/or C.S.A. (Canadian Standards Association) standards or Local Codes as applicable.
- Remove any foreign objects from the interior of the enclosure, especially wire strands that may be left over from installation wiring.
- Ensure that a qualified electrician installs wiring.
- Ensure that the individuals installing the starter are wearing ALL protective eye wear and clothing.
- Ensure the starter is protected from debris, metal shavings and any other foreign objects.

Mounting Arrangements

Some voltage and starter type configurations can be unit-mounted and wired at the factory, but when the unit-mounted starters are too large to ship on the unit, they are shipped loose with cable kits and mounting brackets for field installation on the unit by others. Additionally, freestanding starters are furnished by Daikin Applied and shipped to the job site for setting and wiring by others. Fixed Speed by Others starters are furnished and installed by others, but must meet Daikin Applied Specification 359999 Rev 29, available at your local Daikin Applied sales office.

Table 1: Starter Mounting Arrangements

Product Line	Starter Type	Mounting Location	Low Voltage (200-575V) Medium Voltage (2400-6600 V) High Voltage (10000-13800V)
WSC	VFD	Unit-mounted	Low Voltage Only
		Free Standing	Low Voltage Only
	SSS	Unit-mounted	Low Voltage Only
		Free-standing	Low and Medium Voltage
	ATL	Unit-mounted	N/A
		Free-standing	Medium Voltage Only
	Fixed Speed by Others		Low, Medium, and High Voltage
WDC	VFD	Unit-mounted	Low Voltage Only
		Free-standing	Low Voltage Only
	SSS	Unit-mounted	Low Voltage Only
		Free-standing	Low and Medium Voltage
	ATL	Unit-mounted	N/A
		Free-standing	Medium Voltage Only
	Fixed Speed by Others		Low, Medium, and High Voltage
WCC	VFD	Unit-mounted	N/A
		Free-standing	Low Voltage Only
	SSS	Unit-mounted	N/A
		Free-standing	Low and Medium Voltage
	ATL	Unit-mounted	N/A
		Free-standing	Medium Voltage Only
	Fixed Speed by Others		Low, Medium, and High Voltage

Depending on size and type, VFDs may be unit-mounted at the factory with power and control wiring factory-installed or free-standing, requiring field mounting remote from the unit and field-wiring of power and control wiring. Because of dimension restrictions for shipping, some unit-mounted VFDs for some large chillers are shipped separate from the unit. Mounting supports are on the unit and pre-assembled cable kits are provided. Make sure that the floor or structural support is adequate to support the weight of the unit shown on the dimension drawing.

The following types of VFD starters are available:

- Free-standing Starter – Customer is responsible for mounting and wiring the VFD at the jobsite. Final power wiring connections from the VFD to the compressor motor terminals must be completed by Daikin Applied service. This type of starter must be secured to the floor or wall.
- Field Installed Unit-mounted Starter – Customer is responsible for mounting and wiring the VFD on the unit. Power cables from the VFD to the compressor motor terminals are provided by the factory. Final power wiring connections from the VFD to the compressor motor terminals must be completed by Daikin Applied service.
- Factory Installed Unit-mounted Starter – VFD is mounted and wired to the compressor by the factory

Receiving and Setting

Since unit-mounted starters and VFDs are wired at the factory, this section will only apply to free-standing units.

All Daikin Applied free-standing centrifugal starters and VFDs are shipped FOB factory and all claims for handling and shipping damage are the responsibility of the consignee.

Use extreme care when rigging the starter to prevent damage. See the certified dimension drawings included in the job submittal for the center of gravity of the unit. Consult the local Daikin Applied sales office for assistance if the drawings are not available.

Fastening rigging hooks to the four lifting eyes located on the top of the unit.

Location and Mounting

Consider the following guidelines:

- Verify that enclosure drives can be kept clean and dry
- The area chosen should allow the space required for proper air flow. A minimum of 16-inch clearance is required wherever vents are located.
- Be sure that the enclosure is installed away from oil, coolants, or other airborne contaminants.
- Verify that the drive location meets the environmental conditions specified below

Clearance

Starters or VFDs must be mounted on a level concrete or steel base and must be located to provide adequate service. Local codes or the National Electric Code (NEC) can require more clearance in and around electrical components and must be checked.

Mounting

Provide a floor or structural support adequate to support the full weight of the unit.

Standard NEMA 1 and NEMA 12 starters must be installed indoors in an area that is not exposed to direct water spray. Do not install in areas where the ambient temperature falls below 32°F (0°C) or exceeds 104°F (40°C) enclosed, or 122°F (50°C) open unless this was noted at the time of order placement and special precautions were taken to protect against these abnormal temperatures.

Heatsink temperatures can run as high as 158°F (70°C) during normal operation. Do not mount the starter in contact with any material that cannot accept this heat. The starter must be mounted with the heat sink fins oriented vertically in an area that will not experience excessive shock or vibration

Rigging in Field-Mounted and Free-Standing Units

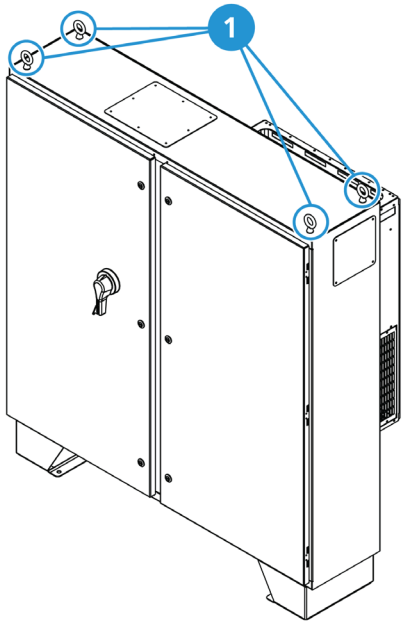
⚠ CAUTION

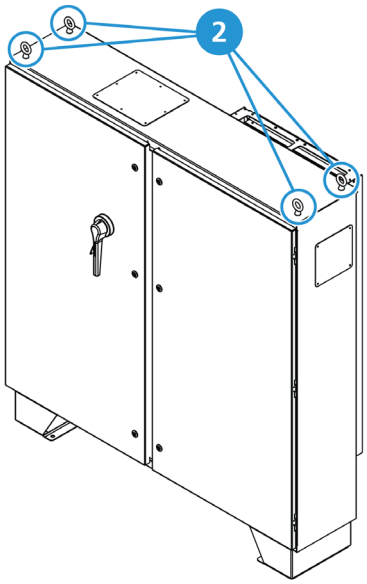
Tipping Hazard: Extreme care must be used when rigging the equipment to prevent damage. See the certified dimension drawings included in the job submittal for the center of gravity of the panel. Consult the local Daikin Applied sales office for assistance if the drawings are not available

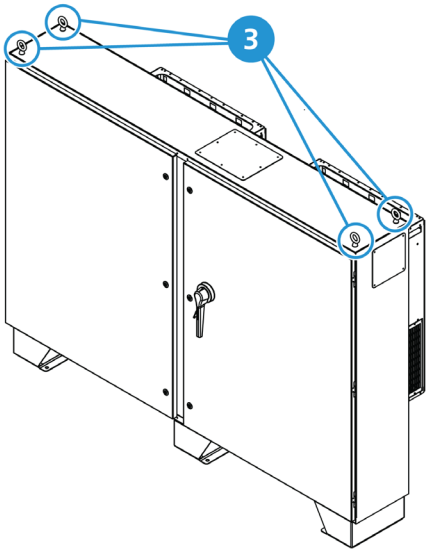
1	Cabinet 1 Lifting Points
2	Cabinet 2 Lifting Points
3	Cabinet 3 Lifting Points
4	Cabinet 5 Lifting Points

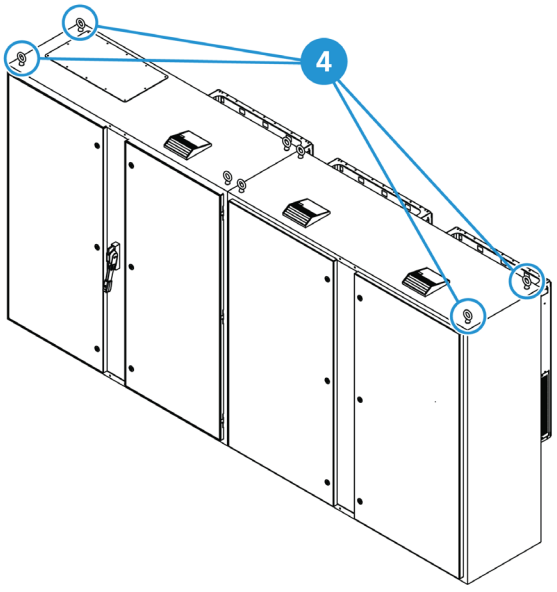
Use the following procedure to lift and mount the drive:

1. Using an overhead or portable hoist (minimum 2 ton rated capacity), attach a free-fall chain to the chain secured to the drive. Take up any vertical slack in the chain.
2. Using the hoist, lift the drive from the horizontal shipping pallet.
3. Position the drive. Ensure proper fastening to floor or wall.
4. Machine or floor-mount the drive enclosure using 1/2-inch bolts, grade 5 or better, with compression washers.









Field Power Wiring for Fixed Speed Starters

Power wiring between the starter and the compressor motor terminals must be field supplied and installed on units with free-standing starters. See the field wiring diagram on page 21. Wiring, fuse and wire size must be in accordance with the National Electric Code (NEC).

Standard NEMA motor starters require modification to meet Daikin Applied specifications. Refer to Daikin Applied specification 7359999 Rev 29 which is available on www.DaikinApplied.com.

⚠ CAUTION

Voltage unbalance not to exceed 2% with a resultant current unbalance of 6 to 10 times the voltage unbalance per NEMA MG-1, 1998 Standard. This is an important restriction that must be followed to avoid equipment damage.

⚠ WARNING

Qualified and licensed electricians must perform wiring. Electric shock hazard. Improper handling of this equipment can cause equipment damage, personal injury, or death.

Power wiring to compressors must be in proper phase sequence. Motor rotation is set up for clockwise rotation facing the lead end with phase sequence of 1-2-3. Care must be taken that the proper phase sequence is carried through the starter to compressor. With the phase sequence of 1-2-3 and L1 connected to T1 and T6, L2 connected to T2 and T4, and L3 connected to T3 and T5, rotation is proper. See diagram in terminal box cover.

The Daikin Applied start-up technician will check the phase sequence.

NOTE: Do not make final connections to motor terminals until wiring has been checked and approved by a Daikin Applied technician.

⚠ CAUTION

Connections to terminals must be made with copper lugs and copper wire to avoid possible equipment damage. Under no circumstances should a compressor be brought up to speed until proper sequence and rotation have been established. Serious damage can result if the compressor starts in the wrong direction. Such damage is not covered by product warranty

Safety Precautions

⚠ WARNING

An incoming disconnect must be locked open before wiring or servicing the starter, motor, or other related equipment. Shock hazard exists. Pressing the Stop push-button on the chiller control panel does not remove AC mains potential. Improper handling of this equipment can cause equipment damage, personal injury, or death. The equipment must only be serviced by qualified personnel fully familiar with the equipment.

⚠ WARNING

For safety of maintenance personal as well as others who might be exposed to electrical hazards associated with maintenance activities, the safety related work practices of NFPA 70, Part II, should always be followed when working on electrical equipment. Improper handling of this equipment can cause equipment damage, personal injury, or death.

The opening of the branch circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of electrical shock, current carrying parts and other components of the starter should be inspected and replaced if damaged.

Power Factor Capacitors, Surge Capacitors and Lightning Arrestors

These devices MUST NOT be used with solid state starters. The SCR's in the starter will be damaged by the di/dt levels created.

General Wiring Practice

1. Never connect input AC power to the VFD motor output terminals T1/U1, T2/V2 or T3/W3.
2. Power wiring to the motor must have the maximum possible separation from all other wiring. Do not run control wiring in the same conduit; this separation reduces the possibility of coupling electrical noise between circuits. Minimum spacing between metallic conduits containing different wiring groups should be three inches (76 mm).
3. Minimum spacing between different wiring groups should be six inches (152 mm).
4. Wire runs outside of an enclosure should be run in metallic conduit or have shielding/armor with equivalent attenuation.
5. Different wire groups should cross at 90 degrees whenever power and control wiring cross.
6. Different wire groups should be run in separate conduits.
7. 100,000 AIC fused disconnect is provided as standard Adhere to NEC or local electrical codes.
8. The National Electrical Code and Canadian Electrical Code requires that an approved circuit disconnecting device be installed in series with the incoming AC supply in allocation readily accessible to personnel installing or servicing this equipment. If a disconnect switch is not supplied with the starter, one must be installed.
9. Wiring connections are made either through the top or back of the enclosure. Wire runs should be properly braced to handle both starting and fault currents. Size power cable per local electrical codes. Long lengths of cable to the motor of over 150 feet must be de-rated.

Before applying main power:

The starter has been fully tested before leaving the factory to help a rapid and problem-free start-up. Before applying power to the starter, consult the start-up checklist below.

1. Inspect starter and remove any foreign matter.
2. Inspect the starter for any shipping damage.
3. Ensure that all electrical connections are as per the system schematics supplied with the starter and/or connection diagrams.
4. Ensure that all connections are properly tightened.
5. Test L to T resistance of each phase and ensure that it is greater than 50 kohms. Reverse leads and test again.
6. Check that the gate to cathode resistance of each SCR is between 8 and 50 ohms.
7. Check the resistance of all power and motor leads to ground to ensure that there is no foreign matter present or damage to the insulation which can short one or more of the phases to ground.
8. Apply 120 Vac control voltage to the starter.

Medium Voltage - Solid State and Across-the-Line Starters

Incoming and outgoing connections are NEMA 2-hole pattern, ½-inch, 1 ¾-inch apart, as defined by NEMA Standard CC!-2 Bus Tabs per phase.

Compressor Motor Connections

Power wiring connections at the motor are “spark plug” type terminals with threaded copper bar, sized per the following table.

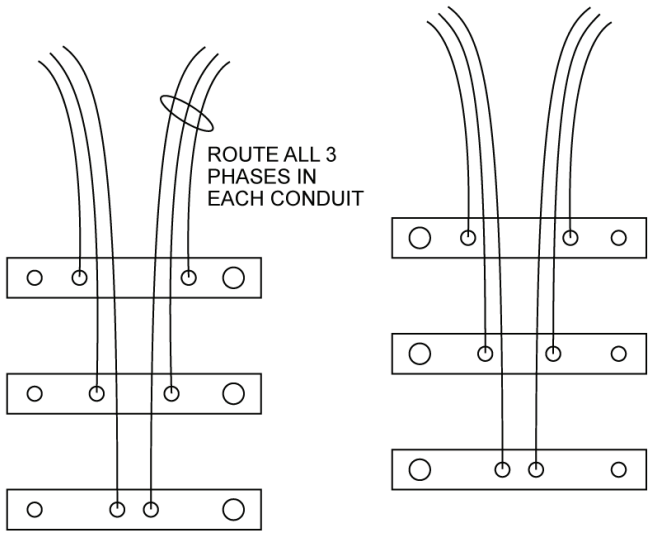
Type/Size	Comp. Size	Terminal Size
Low Voltage to 750 A, to 575V	CE 063-126	0.635-11 UNC-2A, 1.88 in. long
Med. Voltage to 275 A, to 4160 V	CE 063-126	0.375-16 UNC-2A, 0.97 in. long
Hi Voltage to 275 A, to 7200 V	CE 063-126	0.375-16 UNC-2A, 1.00 in. long

NOTE: Connections on applications above 750A will have terminal buss bars with 3/8 in. holes. See details on following page.

Power Wiring over 750 Amps

Use 3/8 dia. Cadmium plated steel bolt, nut and lockwasher. Torque to 20 ft-lbs. Copper wire and lugs must be used.

Figure 6: Power Wiring over 750 Amps



Field Control Wiring

Control wiring is required between the starter and the unit for three purposes:

1. Transmit start and stop commands from the unit to the starter.
2. Transmit electrical information concerning motor operation from the starter to the unit control system.
3. Supply control power from the starter transformer to the unit control panels.

General Practice

Signal wiring refers to wires connected to the control terminals that are below 15V.

- Shielded wire is required to prevent electrical noise interference from causing improper operation or nuisance trips.
- Signal wire should be rated for at least 300V.
- Keep signal wire as far away as possible from control and power wiring.

Control Power Wiring

Control wiring is wiring connected to the control terminal strip that carry 24V to 220V.

- Use only UL or CSA recognized wire.
- Use copper wire rated for 60/75°C.

The control circuit on the Daikin Applied centrifugal packaged chiller is designed for 115-volts. Control power can be supplied from three different sources:

- If the unit is supplied from the factory with a unit-mounted starter, the control circuit power supply is factory-wired from a transformer located in the starter.
- A free-standing starter furnished by Daikin Applied or by the customer to Daikin Applied specifications, will have a control transformer in it and requires field wiring to

terminals in the compressor terminal box.

- Power can be supplied from a separate circuit and fused at 20 amps inductive load. The control circuit disconnect switch must be tagged to prevent current interruption. Other than for service work, the switch is to remain on at all times in order to keep oil heaters operative and prevent refrigerant from diluting the oil.

⚠ DANGER

If a separate control power source is used, the following must be done to avoid severe personal injury or death from electrical shock. Place a notice on the unit that multiple power sources are connected to the unit. Place a notice on the main and control power disconnects that another source of power to the unit exists.

Separate Power Source

Chiller control power usually comes from a control transformer located in the starter and factory or field wired to the chiller control panel. In the event a separate transformer supplies control voltage, it must be rated at 3 KVA, with an inrush rating of 12 KVA minimum at 80% power factor and 95% secondary voltage. For control wire sizing, refer to NEC. Articles 215 and 310. In the absence of complete information to permit calculations, the voltage drop should be physically measured.

Table 2: Control Power Line Sizing

Maximum Length, ft (m)	Wire Size (AWG)	Maximum Length, ft (m)	Wire Size (AWG)
0 (0) to 50 (15.2)	12	120 (36.6) to 200 (61.0)	6
50 (15.2) to 75 (22.9)	10	200 (61.0) to 275 (83.8)	4
75 (22.9) to 120 (36.6)	8	275 (83.8) to 350 (106.7)	3

NOTE: Maximum length is the distance a conductor will traverse between the control power source and the unit control panel.

NOTE: Panel terminal connectors will accommodate up to number 10 AWG wire. Larger conductors will require an intermediate junction box.

The Unit On/Off switch located in the Unit Control Panel should be turned to the “Off” position any time compressor operation is not desired.

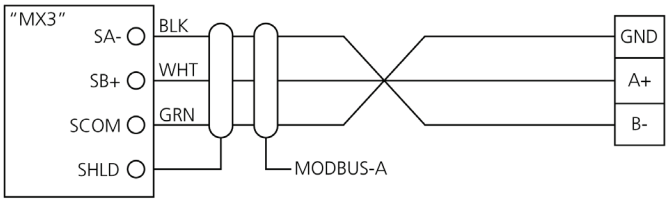
Low Voltage - Solid State Starters

Control wiring for low voltage starters is per the wiring diagram. If the optional “Full Metering Display” has been ordered, the following section will apply.

Full Metering Option

Free-standing, solid state, and across-the-line starters require field wiring to activate the optional ammeter display or full metering display option on the chiller’s operator interface panel. The wiring is from the control board in the starter to the compressor controller.

Figure 7: Wiring for Optional Display



NOTE: The serial card location is in the lower-center of the compressor controller located in the chiller control panel. The “MX3” is located in the starter.

NOTE: The connections are (-) to (-), (+) to (+) and SCOM to GND with a shield connection on the starter terminal board.

NOTE: Cable is Belden 9841 or equal (120 OHM characteristic impedance)

Field Power Wiring for Variable Frequency Drives

Grounding the Drive

⚠ WARNING

To prevent physical injury, death, increased electromagnetic interference and equipment malfunction:

- Ground the drive, motor and adjoining equipment to ensure personnel safety in all circumstances, and to reduce electromagnetic emission and interference.
- Make sure that grounding conductors are adequately sized as required by safety regulations.
- In a multiple-drive installation, connect each drive separately to protective earth (PE).
- To minimize EMC emissions, make a 360° high frequency grounding of cable entries at the cabinet lead-through in order to suppress electromagnetic disturbances.

In addition, connect the cable shields to protective earth (PE) in order to meet safety regulations.

To ground the drive, do the following:

1. Open the door of the enclosure.
2. Run a suitable equipment grounding conductor per the NEC from the drive enclosure ground lug to earth ground. Tighten these grounding connections to the proper torque.
3. Close the door of the enclosure.

Safety Precautions

⚠ WARNING

An incoming disconnect must be locked open before wiring or servicing the starter, motor, or other related equipment. Shock hazard exists. Pressing the Stop push-button on the chiller control panel does not remove AC mains potential. Improper handling of this equipment can cause equipment damage, personal injury, or death. The equipment must only be serviced by qualified personnel fully familiar with the equipment.

⚠ WARNING

For safety of maintenance personal as well as others who might be exposed to electrical hazards associated with maintenance activities, the safety related work practices of NFPA 70, Part II, should always be followed when working on electrical equipment. Improper handling of this equipment can cause equipment damage, personal injury, or death.

Electrical codes require that all equipment (VFD, motor, operator station, etc.) be properly grounded. An incoming disconnect must be locked in a disconnect position before wiring or servicing the starter, motor, or other related equipment. The equipment must only be serviced by qualified personnel fully trained and familiar with the equipment.

The opening of the branch circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of electrical shock, current carrying parts and other components of the starter should be inspected and replaced if damaged.

Equipment is at line voltage when AC power is connected Pressing the Stop push-button does not remove AC line potential. All phases must be disconnected before it is safe to work on machinery or touch motor terminals and control equipment parts.

Startup

In the startup mode, all panels can be run up to 80% of the RLA capacity when equipped with two additional air filters. These filters are mounted over the existing intake and exhaust fans and should be cleaned as often as necessary. Overheating may occur if filters are not cleaned or replaced in a timely manner. The “over-temperature” warning will flash on the keypad display and the unit will go through orderly shutdown if not serviced. The extra filters may be removed after the startup phase. Filters are needed on all intake fans.

Power Wiring in Free-Standing and Field-Installed, Unit-mounted VFDs

Wiring, fuse and wire size must be in accordance with local codes and the National Electric Code (NEC).

⚠ CAUTION

Voltage unbalance not to exceed 2% with a resultant current unbalance of 6 to 10 times the voltage unbalance per NEMA MG-1, 1998 Standard. This is an important requirement to avoid excessive motor or drive heating.

⚠ WARNING

Qualified and licensed electricians must perform wiring. Electric shock hazard. Improper handling of this equipment can cause equipment damage, personal injury, or death.

Power wiring to compressors must be in proper phase sequence. Motor rotation is set up for clockwise rotation facing the lead end with phase sequence of 1-2-3. Care must be taken that the proper phase sequence is carried through the VFD to the compressor. With the phase sequence of 1-2-3 and L1 connected to T1 and T6, L2 connected to T2 and T4, and L3 connected to T3 and T5, rotation is proper. See diagram in terminal box cover. The Daikin Applied start-up technician will check the phase sequence.

⚠ CAUTION

Connections to terminals must be made with copper lugs and copper wire.

Care must be taken when attaching leads to compressor terminals.

NOTE: Do not make final connections to motor terminals until wiring has been checked and approved by a Daikin Applied technician.

Under no circumstances should the compressor be started unless proper sequence and rotation has been established by Daikin Applied Factory Service. Serious damage will result if the compressor starts in the wrong direction. Such damage is not covered by product warranty

Power Factor Correction Capacitors

Do not use power factor correction capacitors with centrifugal chillers with a compressor VFD. Doing so can cause harmful electrical resonance in the system. Correction capacitors are not necessary since VFDs inherently maintain high power factors.

General Wiring Practice (Free-Standing Models Only)

1. Never connect input AC power to the VFD motor output terminals T1/U1, T2/V2 or T3/W3.
2. Power wiring to the motor must have the maximum possible separation from all other wiring. Do not run control wiring in the same conduit; this separation reduces the possibility of coupling electrical noise between circuits. Minimum spacing between metallic conduits containing different wiring groups should be three inches (76 mm).
3. Minimum spacing between different wiring groups should be six inches (152 mm).
4. Wire runs outside of an enclosure should be run in metallic conduit or have shielding/armor with equivalent attenuation.
5. Different wire groups should cross at 90 degrees whenever power and control wiring cross.
6. Different wire groups should be run in separate conduits.
7. 100,000 AIC fused disconnect is provided as standard. Adhere to NEC or local electrical codes.
8. Wiring connections are made either through the top or back of the enclosure. Wire runs should be properly braced to handle both starting and fault currents. Size power cable per local electrical codes. Long lengths of cable to the motor of over 150 feet must be de-rated.

Table 3: Recommended Wiring between Free-standing VFD and Motor Terminals

Lug Wire Size	Lug Wire Size	Disconnect Size	Cabinet Size
(2) #2- 600MCM	5/8”	3/8”	Cabinet 1
(4) #2- 600MCM	5/8”	3/8”	
(2) #2- 600MCM	5/8”	3/8”	
(4) #2- 600MCM	5/8”	3/8”	
(2) #2- 600MCM	5/8”	3/8”	
(4) #2- 600MCM	5/8”	3/8”	
(2) #2- 600MCM	5/8”	3/8”	
(4) #2- 600MCM	5/8”	3/8”	

Lug Wire Size	Lug Wire Size	Disconnect Size	Cabinet Size
(2) #2- 600MCM	5/8”	3/8”	Cabinet 1
(4) #2- 600MCM	5/8”	3/8”	Cabinet 2
(4) #2- 600MCM	5/8”	3/8”	
(4) #2- 600MCM	5/8”	3/8”	Cabinet 3
(4) #2- 600MCM	5/8”	3/8”	
(4) #2- 600MCM	5/8”	3/8”	Cabinet 5
(4) #2- 600MCM	5/8”	3/8”	
(8) #2- 600MCM	5/8”	3/8”	

Power Wiring for Free-standing VFD Starters

Power wiring connections at the motor are hermetic feed through type terminals with threaded posts, sized per the following table.

Table 4: Recommended Wiring for Grounding and Power

Wire Size (Gauge)	Ground Stud Size	Die Color	Type P(power) G(Ground)
4	1/4	Gray	G
4	3/8	Gray	G
2	1/4	Green	G
2	3/8	Green	G
2	1/2	Green	P
2	5/8	Silver	P
1/0	1/4	Black	G
1/0	3/8	Black	G
1/0	1/2	Black	P
1/0	5/8	Black	P
2/0	3/8	Orange	G
2/0	1/2	Orange	G,P
2/0	5/8	Orange	P
3/0	½	Purple	P
3/0	5/8	Purple	P
4/0	½	Yellow	P
4/0	5/8	Yellow	P
250MCM	½	White	P
250MCM	5/8	White	P
350MCM	½	Blue	P
350MCM	5/8	Blue	P

Figure 8: Wiring Connection for VFD without Bus Bars

NOTE: Figures are for reference only.

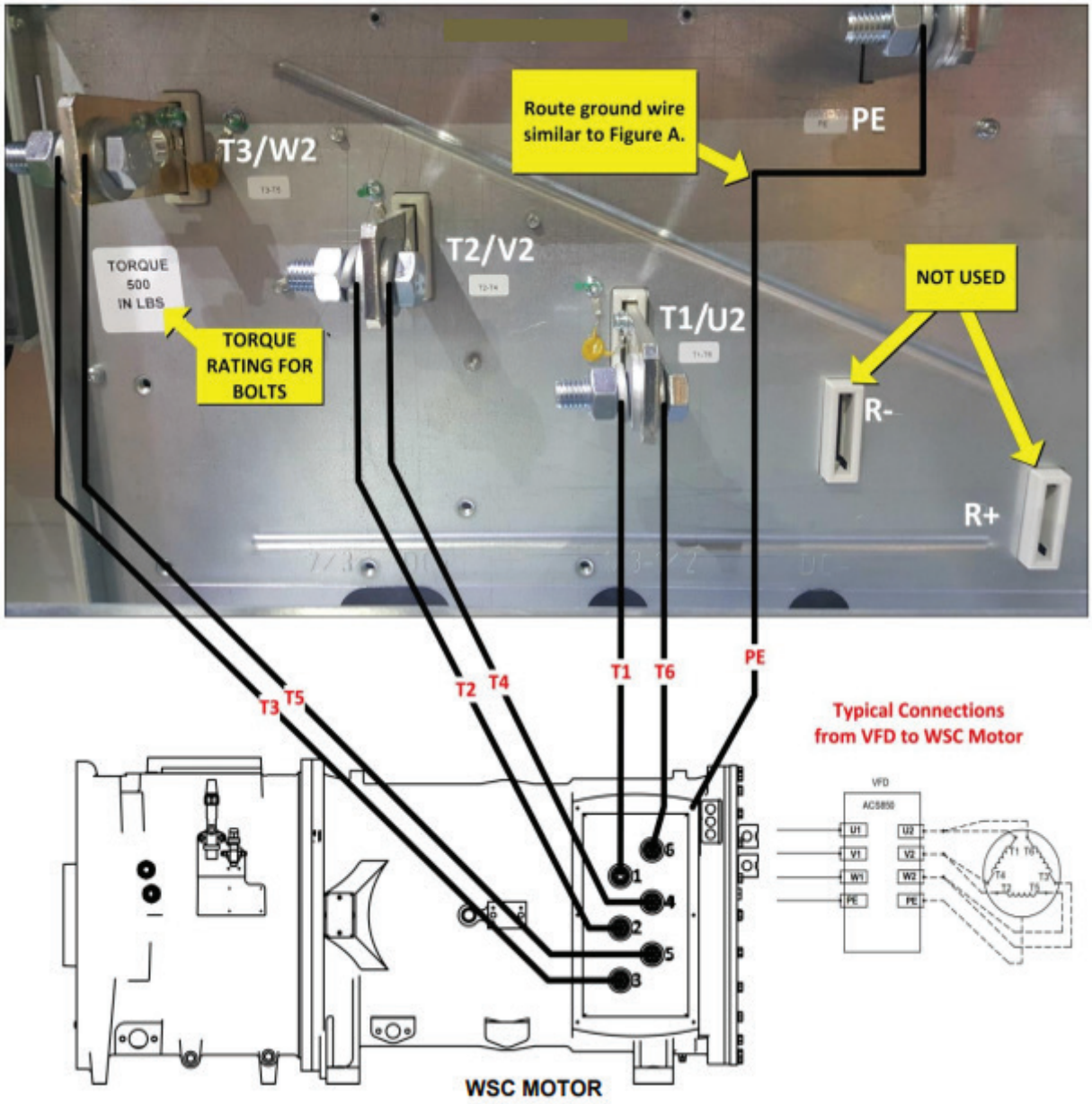
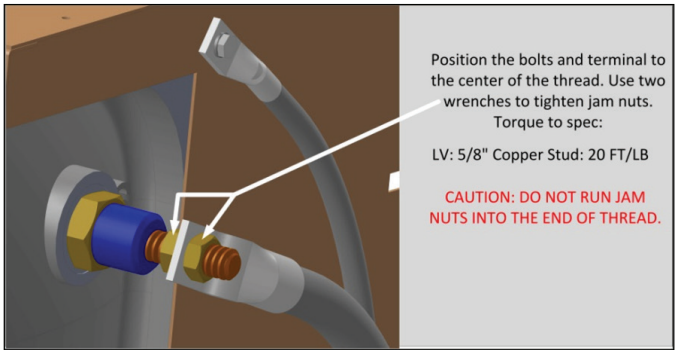


Figure 9: Installation Information and Bus Bar Usage

NOTE: Figures are for reference only.



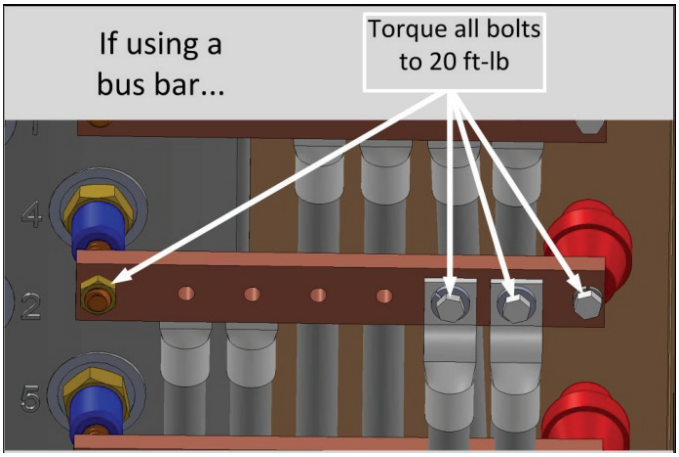
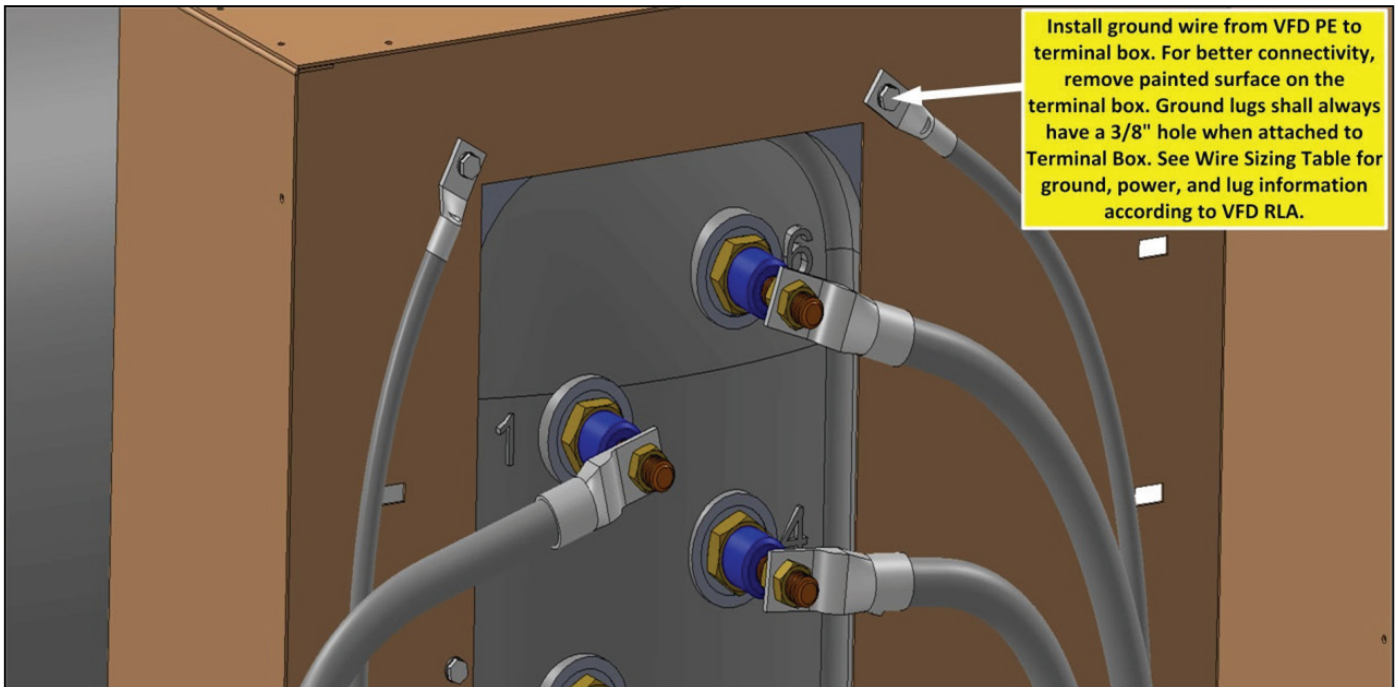


Figure 10: Ground Terminal Instructions

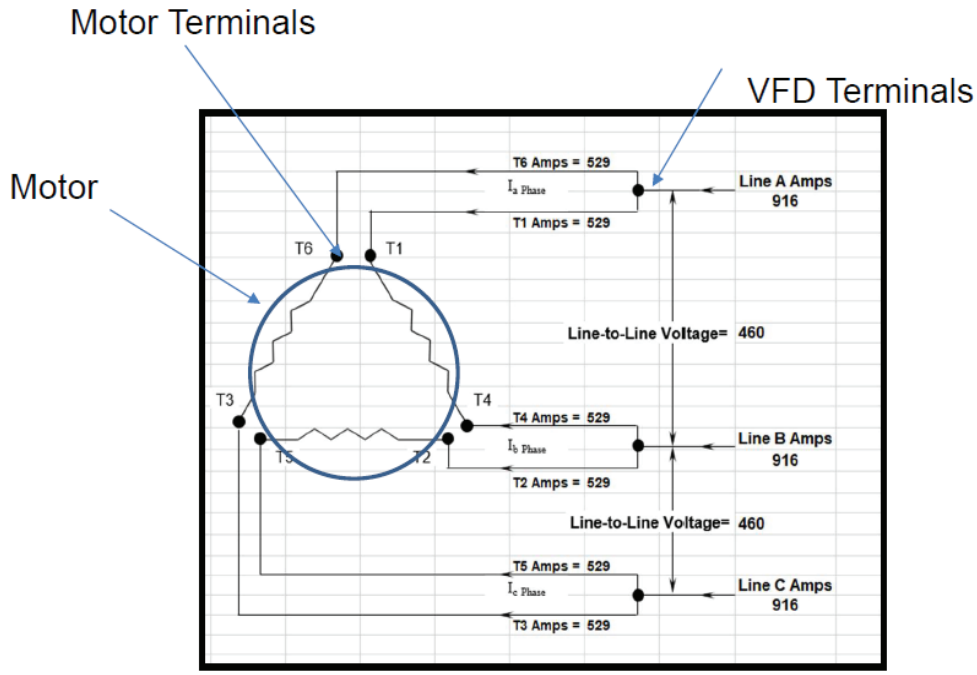


Wire Sizing with Bus Bars

Wire Sizing is impacted when bus bars are used on the motor terminals. See Figure 11.

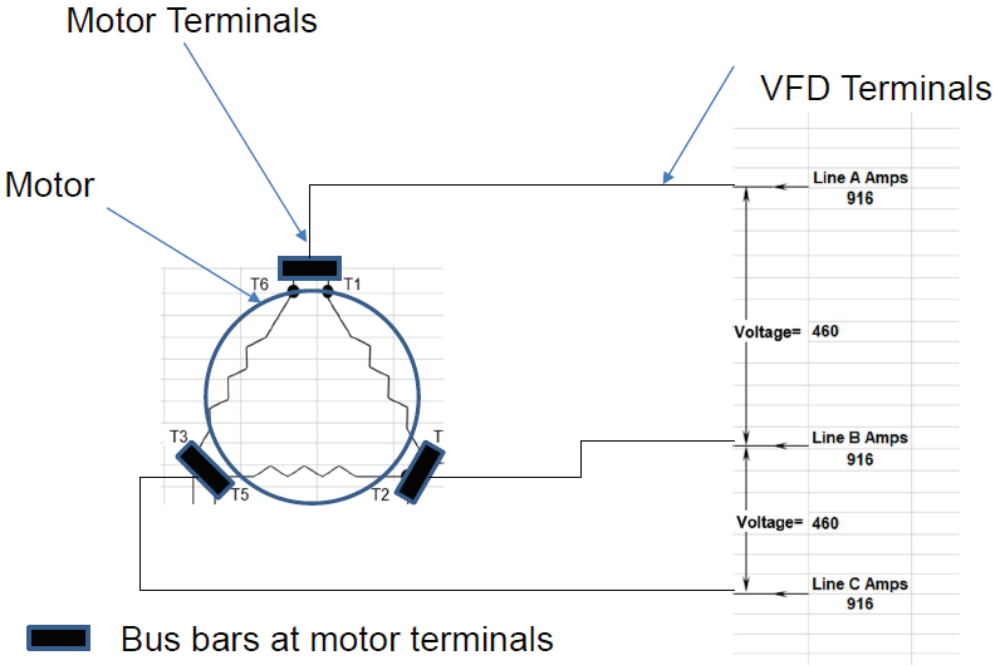
NOTE: Examples below are for refence only/

Figure 11: Wire Sizing when Using Bus Bars on Motor Terminals



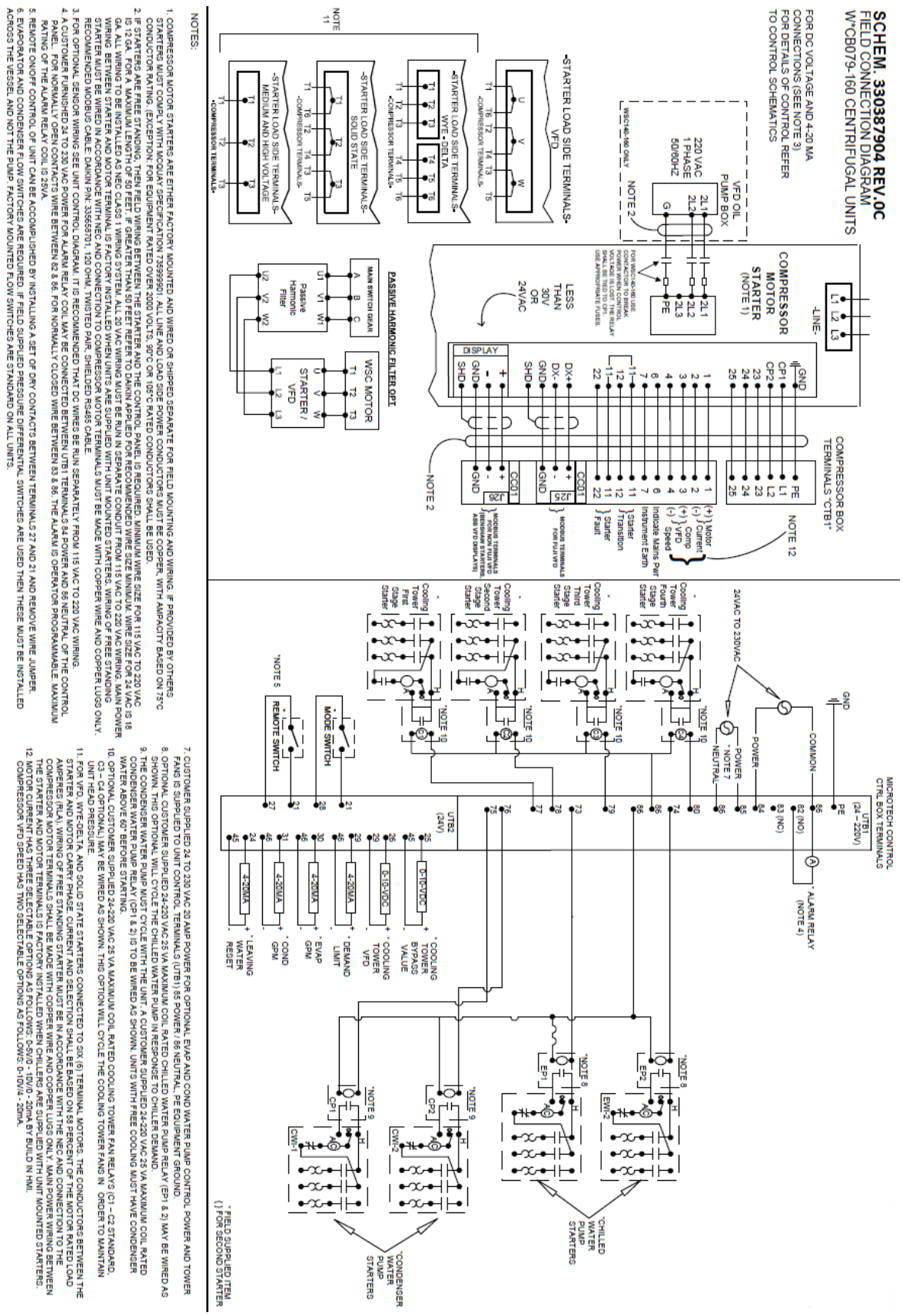
If the motor cables are terminated at the VFD (no bus bars), cables are sized for 15.5% higher currents (example: 1058A vs. 916A)

Figure 12: Bus Bars at Motor Terminals



If bus bars are used, cables are sized for less current going to the VFD (Example 1058A vs. 916A)

Figure 13: Centrifugal Wiring Schematic



NOTES:

1. COMPRESSOR MOTOR STARTERS ARE EITHER FACTORY MOUNTED AND WIRED OR SHIPPED SEPARATE FOR FIELD MOUNTING AND WIRING. IF PROVIDED BY OTHERS STARTERS MUST COMPLY WITH MCQUAY SPECIFICATION 735999901. ALL LINE AND LOAD SIDE POWER CONDUCTORS MUST BE COPPER, WITH AMPACITY BASED ON 75°C CONDUCTOR RATING. (EXCEPTION: FOR EQUIPMENT RATED OVER 2000 VOLTS, 90°C OR 105°C RATED CONDUCTORS SHALL BE USED.
2. IF STARTERS ARE FREE STANDING, THEN FIELD WIRING BETWEEN THE STARTER AND THE CONTROL PANEL IS REQUIRED. MINIMUM WIRE SIZE FOR 115 VAC TO 220 VAC IS 12 GA. FOR A MAXIMUM LENGTH OF 50 FEET. IF GREATER THAN 50 FEET REFER TO DAIKIN APPLIED FOR RECOMMENDED WIRE SIZE MINIMUM WIRE SIZE FOR 24 VAC IS 18 GA. ALL WIRING TO BE INSTALLED AS NEC CLASS 1 WIRING SYSTEM. ALL 20 VAC WIRING MUST BE RUN IN SEPARATE CONDUIT FROM 115 VAC TO 220 VAC WIRING. MAIN POWER WIRING BETWEEN STARTER AND MOTOR TERMINAL IS FACTORY INSTALLED WHEN UNITS ARE SUPPLIED WITH UNIT MOUNTED STARTERS. WIRING OF FREE STANDING STARTER MUST BE WIRED IN ACCORDANCE WITH NEC AND CONNECTION TO COMPRESSOR MOTOR TERMINALS MUST BE MADE WITH COPPER WIRE AND COPPER LUGS ONLY. RECOMMENDED MODBUS CABLE: DAIKIN P/N: 335658701, 120 OHM, TWISTED PAIR, SHIELDED RS485 CABLE.
3. FOR OPTIONAL SENSOR WIRING SEE UNIT CONTROL DIAGRAM. IT IS RECOMMENDED THAT DC WIRES BE RUN SEPARATELY FROM 115 VAC TO 220 VAC WIRING.
4. A CUSTOMER FURNISHED 24 TO 230 VAC POWER FOR ALARM RELAY COIL MAY BE CONNECTED BETWEEN UTB1 TERMINALS 84 POWER AND 86 NEUTRAL OF THE CONTROL PANEL. FOR NORMALLY OPEN CONTACTS WIRE BETWEEN 82 & 86. FOR NORMALLY CLOSED WIRE BETWEEN 83 & 86. THE ALARM IS OPERATOR PROGRAMMABLE. MAXIMUM RATING OF THE ALARM RELAY COIL IS 25VA.
5. REMOTE ON/OFF CONTROL OF UNIT CAN BE ACCOMPLISHED BY INSTALLING A SET OF DRY CONTACTS BETWEEN TERMINALS 27 AND 21 AND REMOVE WIRE JUMPER.
6. EVAPORATOR AND CONDENSER FLOW SWITCHES ARE REQUIRED. IF FIELD SUPPLIED PRESSURE DIFFERENTIAL SWITCHES ARE USED THEN THESE MUST BE INSTALLED ACROSS THE VESSEL AND NOT THE PUMP. FACTORY MOUNTED FLOW SWITCHES ARE STANDARD ON ALL UNITS.
7. CUSTOMER SUPPLIED 24 TO 230 VAC 20 AMP POWER FOR OPTIONAL EVAP AND COND WATER PUMP CONTROL POWER AND TOWER FANS IS SUPPLIED TO UNIT CONTROL TERMINALS (UTB1) 85 POWER / 86 NEUTRAL. PE EQUIPMENT GROUND.
8. OPTIONAL CUSTOMER SUPPLIED 24-220 VAC 25 VA MAXIMUM COIL RATED CHILLED WATER PUMP RELAY (EP1 & 2) MAY BE WIRED AS SHOWN. THIS OPTIONAL WILL CYCLE THE CHILLED WATER PUMP IN RESPONSE TO CHILLER DEMAND.
9. THE CONDENSER WATER PUMP MUST CYCLE WITH THE UNIT. A CUSTOMER SUPPLIED 24-220 VAC 25 VA MAXIMUM COIL RATED CONDENSER WATER PUMP RELAY (CP1 & 2) IS TO BE WIRED AS SHOWN. UNITS WITH FREE COOLING MUST HAVE CONDENSER WATER ABOVE 60° BEFORE STARTING.
10. OPTIONAL CUSTOMER SUPPLIED 24-220 VAC 25 VA MAXIMUM COIL RATED COOLING TOWER FAN RELAYS (C1 - C2 STANDARD, C3 - C4 OPTIONAL) MAY BE WIRED AS SHOWN. THIS OPTION WILL CYCLE THE COOLING TOWER FANS IN ORDER TO MAINTAIN UNIT HEAD PRESSURE.
11. FOR VFD, WYE-DELTA, AND SOLID STATE STARTERS CONNECTED TO SIX (6) TERMINAL MOTORS, THE CONDUCTORS BETWEEN THE STARTER AND MOTOR CARRY PHASE CURRENT AND SELECTION SHALL BE BASED ON 58 PERCENT OF THE MOTOR RATED LOAD AMPERES (RLA). WIRING OF FREE STANDING STARTER MUST BE IN ACCORDANCE WITH THE NEC AND CONNECTION TO THE COMPRESSOR MOTOR TERMINALS MUST BE MADE WITH COPPER WIRE AND COPPER LUGS ONLY. MAIN POWER WIRING BETWEEN THE STARTER AND MOTOR TERMINALS IS FACTORY INSTALLED WHEN CHILLERS ARE SUPPLIED WITH UNIT MOUNTED STARTERS.
12. MOTOR CURRENT HAS THREE SELECTABLE OPTIONS AS FOLLOWS: 0-5VG - 10V/0 - 20mA BY BUILD IN HMI. COMPRESSOR VFD SPEED HAS TWO SELECTABLE OPTIONS AS FOLLOWS: 0-10V/4 - 20mA.

Solid State Starter Control and Operation (MX3)

General

The startup of Daikin Applied centrifugal chillers, including the starters, is performed by Daikin Applied authorized and trained technicians. They review the starter connections, phase sequence, and settings prior to starting the chiller.

Setting a freestanding starter and power and control wiring from it to the chiller is the responsibility of the owner/contractor. See the installation and power and control wiring sections of this manual before commencing installation.

In the rare instances where a starter is being replaced after the chiller has been in service, Daikin Applied service is not automatically involved but can be contracted to supervise the starter installation.

The chiller controller starts and stops the compressor motor as required and is the only way to start it.

Starter Controller

The MX3 starter control has a 2x16 character, back-lit LCD display/keypad that is mounted on the starter door, remotely from the MX3 control card inside the starter cabinet.

Figure 14: MX3 Display/Keyboard

Description of the LEDs on the Keypad

The keypad provides three LED indicators (upper right-hand corner) in addition to the 2x16 character display. The LEDs provide starter status information.

LED	State	Indication
STOP	On	Stopped
	Flashing	Faulted
RUN	On	Running and up to speed
	Flashing	Running and not up to speed (ramping, decelerating)
ALARM	Flashing	Alarm condition, If continues a fault occurs

NOTE: By default, the [STOP] key is always active, regardless of selected control source (Local Source and Remote Source parameters). It may be disabled by using the Keypad Stop Disable (I/O 26) parameter.

Key Functions

Key	Function
start	The control logic is arranged such that only a command from the chiller's MicroTech controller will start the compressor. This start command has no effect on operation.
↑	Increase the value of a numeric parameter. Select the next value of an enumerated parameter. It scrolls forward through a list of parameters within a group (when the last parameter is displayed, it scrolls to the beginning of the list). When a list of faults is displayed, it moves from one fault to the next. When a list of events is displayed, it moves from one event to the next. When the starter is in the Operate Mode, pressing [UP] allows you to change which group of meter values is monitored.
↓	Decrease the value of a numeric parameter. Select the previous value of an enumerated parameter. It scrolls backward through a list of parameters within a group (when the first parameter is displayed, it scrolls to the end of the list). When a list of faults is displayed, it moves from one fault to the previous fault. When a list of events is displayed, it moves from one event to the previous event. When the starter is in the Operate Mode, pressing [DOWN] allows you to change which group of meter values is monitored.
←	When editing a numeric parameter, the [LEFT] arrow key moves the cursor one digit to the left. If cursor is already at the most significant digit, it returns to the least significant digit on the right. When in Menu mode, the [LEFT] arrow allows groups to be scrolled through in the opposite direction of the [MENU] Key.

Key	Function
enter	Stores the change of a value. When in Fault History, [ENTER] key scrolls through information logged when a fault occurred. When in Event History, [ENTER] key scrolls through information logged when an event occurred. When an alarm condition exists, [ENTER] scrolls through all active alarms.
menu	Repeatedly pressing [MENU] scrolls between the operate screen and the available parameter groups. When viewing a parameter, pressing [MENU] jumps to the top of the menu. The first seven parameters groups are for setpoints and not used by the operator once set at commissioning.
stop reset	The [STOP/RESET] key halts the operation of the starter (Stop Key). If a fault has occurred, the [STOP/RESET] key is used to clear the fault (Reset Key). The [STOP/RESET] key always halts the operation of the starter if the control source is set to “Keypad”. If the Control Source (QST 04/QST 05) is not set to “Keypad”, the [STOP/RESET] key may be disabled using the Keypad Stop Disable (I/O 26) parameter.

Alphanumeric Display

The remote LCD keypad and display uses a 32-character alphanumeric LCD display. All starter functions can be accessed by the keypad. The keypad allows easy access to starter programming with parameter descriptions on the LCD display.

Power Up Screen

On power up, the software part numbers are displayed for a few seconds. Pressing any key immediately changes the display to the operate screen.

Operate Screen

The operate screen is the main screen. The operate screen is used to indicate the status of the starter, if it’s running, what state it’s in, and display the values of Meter 1 and Meter 2, which are selectable.

The Operate Screen is divided into five sections:

- Sections A and B display status information.
- Sections C and D display the meters selected by the Meter 1 and 2 parameters or by scrolling.
- Section S displays the source for the start command.

Table 5: Operate Screen

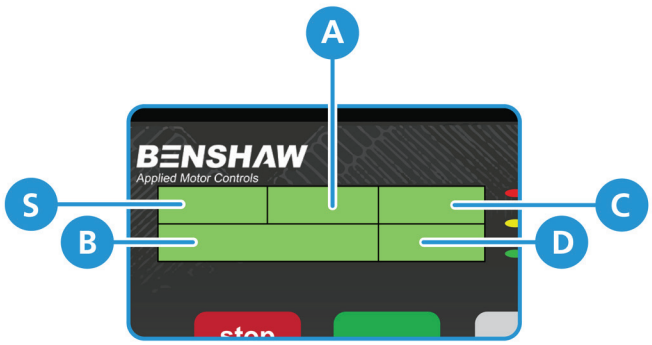


Table 6: Contents, operate Screen Section A

Display	Description
NoL	L1, L2, L3 no present
Ready	Starter ready to run
Alarm	A fault condition is present. If it continues, a fault occurs
Run	Starter is running

Table 7: Contents, operate Screen Section B

Display	Description
Stopped	Starter is stopped and no Faults
Fault	Starter tripped on a Fault
Heater	Starter is on an heating motor
Kick	Starter is applying licl current to the motor
Accel	Starter is accelerating the load
Kick 2	Starter is applying kick current to the motor in Ramp 2
Accel 2	Starter is accelerating the load in Ramp 2
Run	Starter is in Run mode and Ramp Time has expired
UTS	Starter is Up to Speed
Control	Phase Control or Current Follower mode
Decel	Starter is decelerating the load
Slow Spd Fwd	Preset slow speed forward
Slow Spd Rev	Preset slow speed reverse
Braking	DC Injection Braking
PORT	Power Outage Ride Through

Table 8: Contents, operate Screen Section S

Display	Description
K	Keypad Control
T	Terminal Block Wiring Control
S	Serial Communication Connection Control

Meter Pages

Any meter value may be viewed by on the meter pages. There are 19 “Meter Pages” that are easily accessed to view all of the meter information. These meter pages are scrolled through by pressing the [UP] or [DOWN] down arrows from the operate screen.

Fault Log Screen

Information regarding each fault is available through the remote MX3 LCD display.

- FL#: = Fault Log Number. FL1 is the most recent fault and FL9 is the oldest fault.
- Fault ## = Fault Code
- NNN… = Fault Name, or the condition when the fault occurred.

Press [MENU] until you get to the FL1 parameter.

Pressing the [UP] and [DOWN] keys navigates through older and newer faults in the log.

When you get to your fault on the screen begin pressing the [ENTER] key repeatedly. This will rotate through the steps below to show the conditions the starter was in when the fault occurred.

Enter Step	
1	Fault Description.
2	Status when the fault occurred, Run, Stopped, Accel. etc.
3	Status when the fault occurred, Run, Stopped, Accel. etc.
4	The L2 current at the time of the fault
5	The L3 current at the time of the fault.
6	L1-2 voltage at the time of the fault.
7	L2-3 voltage at the time of the fault.
8	L3-1 voltage at the time of the fault.
9	kW at the time of the fault.
10	Frequency at the time of the fault.
11	Run time since last run time reset.

Fault Screen

When a Fault occurs, the main screen is replaced with a fault screen. The screen shows the fault number and the name of the fault. The main status screen is not shown until the fault is reset.

The STOP LED flashes when a fault occurs.

Resetting Faults

When a fault occurs, the fault number will be displayed on the starter control screen. Go to Fault Code Troubleshooting Charts beginning on page 36 to ascertain possible remedies and correct them. To reset from a fault condition, press the [stop/reset] button on the starter controller. Failure of the unit to restart indicates that the fault has not been properly fixed and further intervention is required.

Event Recorder

An event is anything that changes the present state of the starter. Examples of events include a start, a stop, an overload alarm or a fault.

The event recorder stores the last 99 events.

Press [MENU] until you get to the E01 parameter.

Pressing [UP] or [DOWN] will scroll through the last 99 events and displays the event or fault code on top, and the event or fault that changed the starter's state on the bottom.

Pressing [ENTER] gives the starter state condition at the time of event.

Press [ENTER] again to give you the time of the event.

Press [ENTER] again to give you the date that the event occurred.

NOTE: After pressing [ENTER] you can shift through all the different starter states, times and dates by using the [UP] and [DOWN] arrows.

Lockout Screen

When a lockout is present, one of the lockout screens will be displayed. The main status screen is not shown until the lockout is cleared.

Alarm Screen

When an alarm is present, the word "Alarm" is displayed on the operate screen. Pressing the [ENTER] key displays more information about the alarm.

Viewing Data

Starter information is available on the starter-mounted LED as explained beginning on page 34. If the optional "Full Meter Display" (available only on low voltage starters) is ordered with the unit, power information will also be available on the chiller's operator interface touchscreen, as explained below.

Table 9: Operating Parameters

Parameter	Description	Default	Units
LCD			
QST 01	Motor Full Load Amps	10	RMS Amps
QST 02	Motor Service Factor	1.15	-
QST 03	Motor Running Overload Class	10	-
QST 04	Local Source	Terminal	-
QST 05	Remote Source		-
QST 06	Initial Motor Current 1	100	%FLA
QST 07	Maximum Motor Current 1	600	%FLA
QST 08	Ramp Time 1	15	Seconds
QST 09	Up To Speed Time	20	Seconds
CFN 01	Start Mode	Current Ramp	
CFN 02	Ramp Time 1	15	Seconds
CFN 03	Initial Motor Current 1	100	%FLA
CFN 04	Maximum Motor Current 1	600	%FLA
CFN 05	Ramp Time 2	15	Seconds
CFN 06	Initial Motor Current 2	100	%FLA
CFN 07	Maximum Motor Current 2	600	%FLA
CFN 08	Initial Voltage/Torque/Power	25	%
CFN 09	Maximum Torque/Power	105	%
CFN 10	Acceleration Ramp Profile	Linear	

Parameter	Description	Default	Units
CFN 11	Kick Level 1	Off	%FLA
CFN 12	Kick Time 1	1.0	Seconds
CFN 13	Kick Level 2	Off	%FLA
CFN 14	Kick Time 2	1.0	Seconds
CFN 15	Stop Mode	Coast	
CFN 16	Decel Begin Level	40	%
CFN 17	Decel End Level	20	%
CFN 18	Decel Time	15	Seconds
CFN 19	Deceleration Ramp Profile	Linear	
CFN 20	DC Brake Level	25	%
CFN 21	DC Brake Time	5	Seconds
CFN 22	DC Brake Delay	0,2	Seconds
CFN 23	Slow Speed	Off	%
CFN 24	Slow Speed Current Level	100	%FLA
CFN 25	Slow Speed Time Limit	10	Seconds
CFN 26	Slow Speed Kick Level	Off	%FLA
CFN 27	Slow Speed Kick Time	1.0	Seconds
PFN 01	Over Current Trip Level	Off	%FLA
PFN 02	Over Current Trip Delay Time	0.1	Seconds
PFN 03	Under Current Trip Level	Off	%FLA
PFN 04	Under Current Trip Delay Time	0.1	Seconds
PFN 05	Current Imbalance Trip Level	12	%
PFN 06	Current Imbalance Trip Delay Time	10	Seconds
PFN 07	Residual Ground Fault Trip Level	Off	%FLA
PFN 08	Zero Sequence Ground Fault Trip Level	Off	Amps
PFN 09	Ground Fault Trip Time	3.0	Seconds
PFN 10	Over Voltage Trip Level	Off	%
PFN 11	Under Voltage Trip Level	Off	%
PFN 12	Over/Under Voltage Trip Time	0.1	Seconds
PFN 13	Phase Loss Time	0.2	Seconds
PFN 14	Over Frequency Trip	72	Hz
PFN 15	Under Frequency Trip	23	HZ
PFN 16	Frequency Trip Time	0.1	Seconds
PFN 17	PF Lead Trip Time	Off	
PFN 18	PF Lag Trip Level	Off	
PFN 19	PF Trip Time	10.0	Seconds
PFN 20	Backspin Timer	Off	Minutes
PFN 21	Time Between Starts	Off	Minutes
PFN 22	Starts per Hour	Off	
PFN 23	Auto Fault Reset Time	Off	Seconds
PFN 24	Auto Fault Reset Count Limit	Off	
PFN 25	Controlled Fault Stop Enable	On	
PFN 26	Speed Switch Trip Time	Off	Seconds
PFN 27	Motor PTC Trip Time	Off	Seconds
PFN 28	Independent Starting/Running Overload	Off	
PFN 29	Motor Starting Overload Class	10	
PFN 30	Motor Running Overload Class	10	

Parameter	Description	Default	Units
PFN 31	Motor Overload Hot/Cold Ratio	60	%
PFN 32	Motor Overload Cooling Time	30.0	Minutes
PFN 33	Motor OL Alarm Level	90	%
PFN 34	Motor OL Lockout Level	15	%
PFN 35	Motor OL Auto Lockout Level	Off	%
I/O 01	DI 1 Configuration	Stop	
I/O 02	DI 2 Configuration	Off	
I/O 03	DI 3 Configuration	Off	
I/O 04	DI 4 Configuration	Off	
I/O 05	DI 5 Configuration	Off	
I/O 06	DI 6 Configuration	Off	
I/O 07	DI 7 Configuration	Off	
I/O 08	DI 8 Configuration	Off	
I/O 09	Digital Fault Input Trip Time	0.1	Seconds
I/O 10	R1 Configuration	Fault	
I/O 11	R2 Configuration	Off	
I/O 12	R3 Configuration	Off	
I/O 13	R4 Configuration	Off	
I/O 14	R5 Configuration	Off	
I/O 15	R6 Configuration	Off	
I/O 16	Analog Input Trip Type	Off	
I/O 17	Analog Input Trip Level	50	
I/O 18	Analog Input Trip Delay Time	0.1	
I/O 19	Analog Input Span	100	
I/O 20	Analog Input Offset	0	
I/O 21	Analog Output Function	Off	
I/O 22	Analog Output Span	100	
I/O 23	Analog Output Offset	0	
I/O 24	Inline Configuration	3.0	Seconds
I/O 25	Bypass / 2M Confirm	2.0	Seconds
I/O 26	Keypad Stop Disable	Enabled	
I/O 27	Power On Start Selection	Disabled	
RTD 01	RTD Module #1 Address	Off	
RTD 02	RTD Module #2 Address	Off	
RTD 03	RTD1 Group	Off	
RTD 04	RTD2 Group	Off	
RTD 05	RTD3 Group	Off	
RTD 06	RTD4 Group	Off	
RTD 07	RTD5 Group	Off	
RTD 08	RTD6 Group	Off	
RTD 09	RTD7 Group	Off	
RTD 10	RTD8 Group	Off	
RTD 11	RTD9 Group	Off	
RTD 12	RTD10 Group	Off	
RTD 13	RTD11 Group	Off	
RTD 14	RTD12 Group	Off	
RTD 15	RTD13 Group	Off	
RTD 16	RTD14 Group	Off	
RTD 17	RTD15 Group	Off	

Parameter	Description	Default	Units
RTD 18	RTD16 Group	Off	
RTD 19	Stator Alarm Level	200	°C
RTD 20	Bearing Alarm Level		
RTD 21	Other Alarm Level		
RTD 22	Stator Trip Level		
RTD 23	Bearing Trip Level		
RTD 24	Other Trip Level		
RTD 25	RTD Voting	Off	
RTD 26	RTD Motor OL Biasing	Off	
RTD 27	RTD Bias Minimum Level	40	°C
RTD 28	RTD Bias Mid Point Level	130	°C
RTD 29	RTD Maximum Level	155	°C
FUN 01	Meter 1	Ave Current	
FUN 02	Meter 2	Ave Volts	
FUN 03	CT Radio	288:1	
FUN 04	Phase Order	Insesitive	
FUN 05	Rated Voltage	480	RMS Volt
FUN 06	Motor Rated Power Factor	-0.92	
FUN 07	Starter Type	Normal	
FUN 08	Heater Level	Off	%FLA
FUN 09	Energy Saver	Off	
FUN 10	PORT Fault Time	Off	Seconds
FUN 11	PORT Bypass Hold Time	Off	Seconds
FUN 12	PORT Recovery Method	Fast Recover	
FUN 13	Tachmeter Full Speed Voltage	5.00	Volts
FUN 14	Tachometer Loss Time	1.5	Seconds
FUN 15	Tachometer Loss Action	Fault	
FUN 16	Communication Address	1	
FUN 17	Communication Baud Rate	19200	bps
FUN 18	Communication Timeout	Off	
FUN 19	Communication Byte Framing	Even, 1 Stop	
FUN 20	Software 1 MX3 Card 1	810023-02-01	
FUN 21	Software 2 MX3 Card 2	810024-01-01	
FUN 22	Miscellaneous Commands	None	
FUN 23	Time and Date Format	mm/dd/yy 12hr	
FUN 24	Time	Present Time	
FUN 25	Date	Present Date	
FUN 26	Passcode	Off	
FL1-9	Fault Log		
E01-99	Event Log		

VFD Control and Operation (MicroTech II)

General Description

The following describes the software for centrifugal chillers with variable speed drive and the MicroTech II controller.

Variable Frequency Drive (VFD) Control

Digital output NO1, (terminal J12) on the compressor controller is wired to the CR relay (Compressor Relay). The CR relay energizes the MCR (Motor Control Relay) which enables the variable frequency drive instead of a standard motor. Analog output Y1 (terminal J4) on the compressor controller provides the speed setpoint signal to the VFD. The output is a 0-10 VDC analog output signal, hard wired to the VFD.

There is no feedback signal required from the variable frequency drive to the MicroTech II controller to indicate the speed of the motor. The actual percent motor speed is within 1% of the analog output signal from the MicroTech II controller.

Digital Input ID9 (terminal J7) on the compressor controller is wired to the Vane Open switch (VO switch) that indicates when the vanes are 100% open. If the switch is open, the status of the vanes is Not Open. If the switch is closed, the status of the vanes is Open.

Or

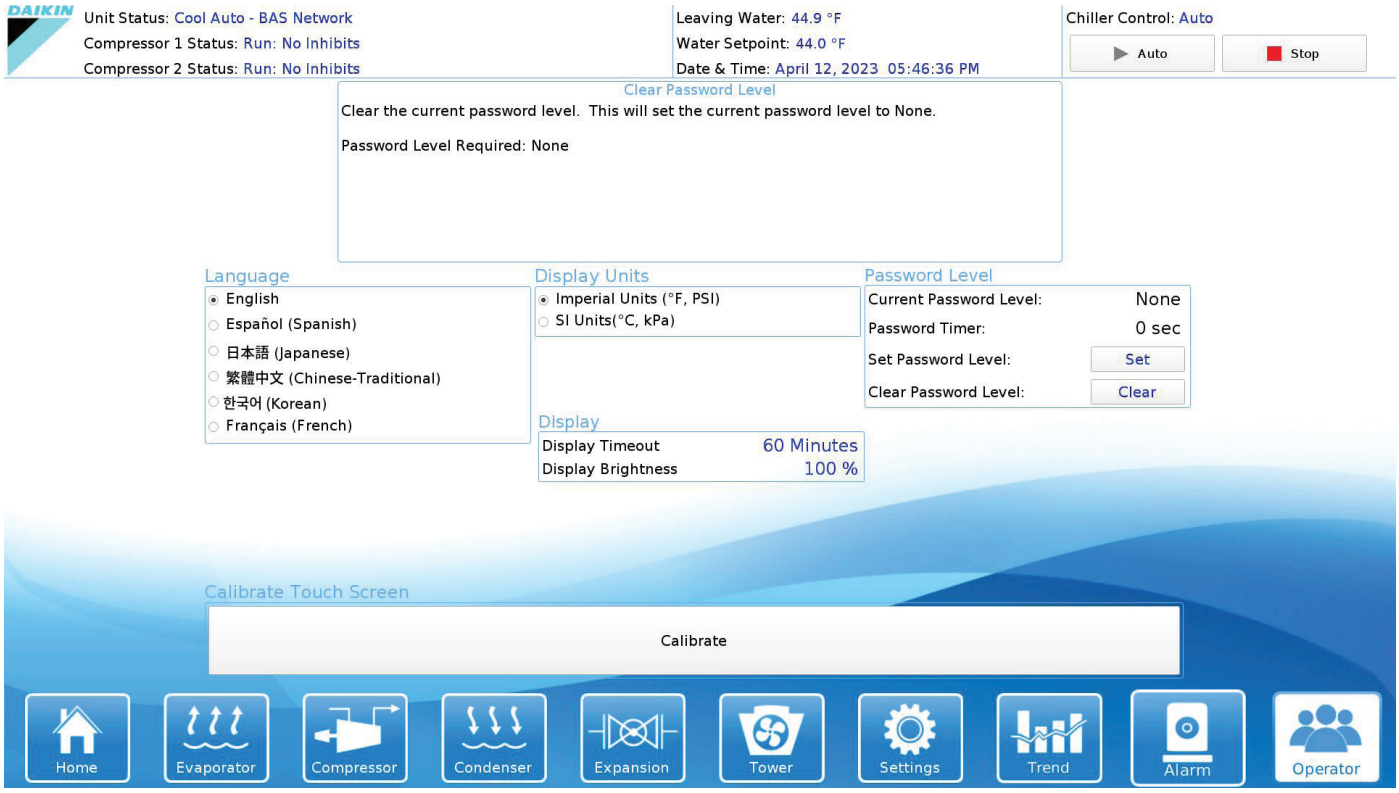
If the compressor controller pulses a load output for the vanes to load for a cumulative time of 300 seconds (user adjustable), the MicroTech II controller will assume the compressor is fully loaded the same as if the V.O. switch closed (one unload pulse will reset the timer).

Sequence of Operation

Compressor Off

The VFD is turned off, the speed output is 0%, and the vanes are closed. If the chiller is turned on and if there is a load, the chiller will go through its start sequence. The MCR will be energized, the speed signal will be set to minimum speed, and the VFD will start the compressor. When the compressor starts, it will be in the VFD Running, hold speed, adjust vanes mode.

Figure 15: MicroTech II Operator Panel Interface



VFD Running, Hold Minimum Speed, Adjust Vanes

The VFD remains on, the command speed is held at Minimum Speed, and the vanes are modulated to maintain the Active LEWT Setpoint. As the load increases; if the vane open switch closes or the MicroTech II controller pulses the vanes open for a cumulative 300 seconds (default), and the LEWT is greater than the active setpoint, the mode switches to “VFD Running Adjust Speed, Open Vanes”. Otherwise, the controller stays in this mode with the speed at Minimum Speed and the vanes being controlled to satisfy the Active LEWT Setpoint.

VFD Running, Adjust Speed, Open Vanes:

The VFD remains on, the speed output is modulated to maintain the Active LEWT Setpoint, and the vanes are driven to the open position. As the load decreases, if the speed equals the lift temperature control speed and the LEWT is less than the active LEWT setpoint, the mode switches to “VFD Running, Hold Minimum Speed, Adjust Vanes”. Otherwise, the controller stays in this mode.

Compressor Shutdown

The VFD remains on, the speed output remains constant, and the vanes are driven closed (shutdown unload state). This state is used during a routine shutdown of the chiller. If there is a rapid shutdown caused by a fault alarm, the MCR will be immediately de-energized, the speed signal will go to zero, and the compressor state will go directly to Postlube.

WDC, Dual Compressor VFD Operation

The MicroTech II controller has the capability to control a dual compressor VFD chiller or multiple stand alone VFD chillers with interconnecting network communications, including all compressor staging and load balance functions. (See OMCentrifMicro II for set up of multiple compressor staging).

General Dual Compressor VFD Operation

The first compressor starts and runs as a single VFD compressor controlling speed and vane position based on LEWT (Leaving Evaporator Water Temperature). When the capacity of the first compressor reaches “Full Load” and LEWT is greater than stage delta, and the slope (pull down rate) is less than the user adjustable minimum rate setpoint, the next compressor will be enabled.

Dual Compressor Unit Stage Down

When “Compressor Capacity” exceeds calculated system load (internal algorithm), the “next off” compressor will be disabled. When the “next off” compressor is disabled, the controller will unload the compressor by closing the vanes (shutdown unload) to unload the compressor. The load balance function will make the other compressor follow. When the shutdown unload timer expires, or the vane close switch closes (whichever occurs first), the MCR will de-energized, and the controller will transition to the post lube sequence. At the end of the post lube timer, the oil pump will be turned off and the controller will transition to the off sequence.

Interface Panel Screens, MT II

Figure 16: Settings View - Motor

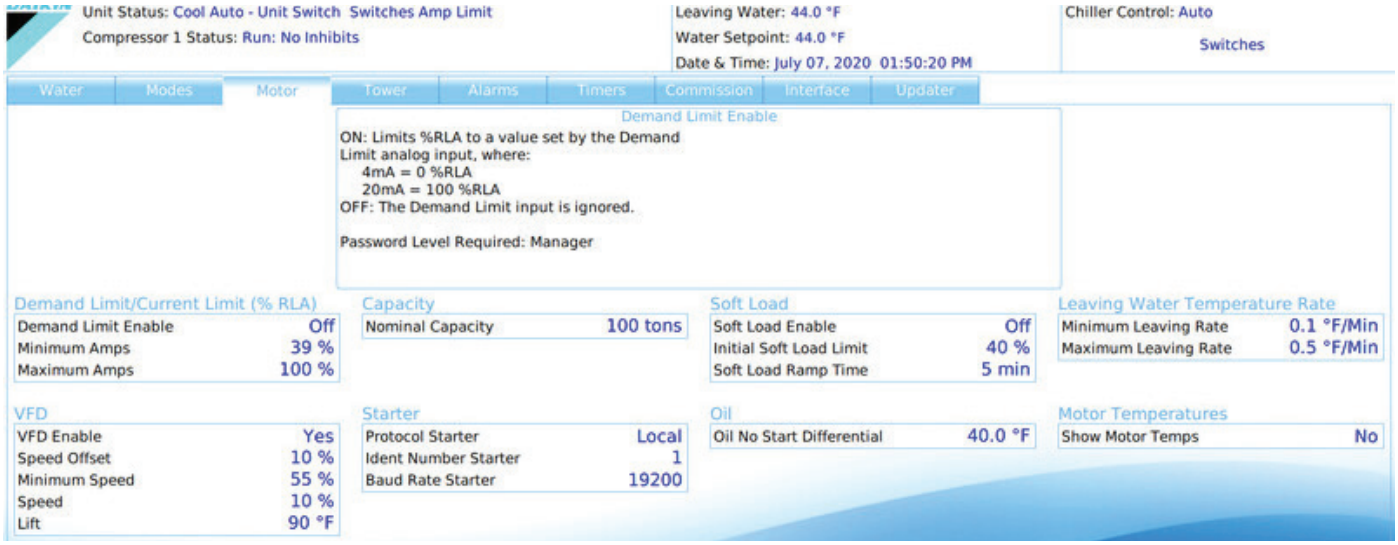


Table 10: Motor Setpoints

Description	Default	Range	PW	Comments
Nominal Capacity	100 tons	0-2000 tons	T	Sets nominal capacity rating of an individual compressor for staging decisions.
Oil No Start Differential	40.0 °F	30 TO 60 °F	M	Compressor Start: Sets minimum delta between oil sump temp and evaporator saturated temp. Oil Heat Control: Sets ON control point @ evaporator LWT + Setpoint + 10F or Sets OFF control point @ evaporator LWT + Setpoint + 20F
Soft Load Enable	Off	Off, On	M	
Initial Soft Load Limit	40%	10 TO 100%	M	Initial %RLA for soft load ramp up
Soft Load Ramp Time	5 min	1 TO 60 min	M	Time period for up to 100% from limit
Show Motor Temps	No	No, Yes	T	Setting for displaying motor temps on HMI screen
Max Leaving Water Temp Rate	0.5 °F/min	0.1 to 5.0 °F/min	M	Sets LWT rate above which capacity increase is inhibited
Min Leaving Water Temp Rate	0.1 °F/min	0.1 to 5.0 °F/min	M	Sets value below which an additional compressor can stage on.
Demand Limit Enable	OFF	ON, OFF	M	ON: Limits %RLA to a value set by the Demand Limit analog input, where: 4 mA = 70 %RLA 20 mA = 100 %RLA OFF: The Demand Limit input is ignored.
Minimum Amps	39%	5 to 80%	M	Sets %RLA below which unloading is inhibited
Maximum Amps	100%	10 to 100%	M	Sets %RLA above which capacity increase is inhibited. Unloading is forced at 5% above this value.
VFD Enable	No	Yes	M	Sets if the motor is controlled by a VFD
VFD Speed Offset	10%	0 to 20%	M	
VFD Minimum Speed	55%	0 to 100%	M	Minimum that can be set is VFD Low Speed Limit
VFD Speed	10%	0 to 100%	M	Sets speed portion of Speed/Lift ratio setpoint where Speed is at 0 Lift.
Lift	90 °F	30 to 90 °F	M	Sets lift portion of Speed/Lift ratio setpoint where Lift is at 100% Speed.
Protocol Starter	Local	Local, Remote, MODBUS, D3, MX3, Iso-Mtr-T MX_MV	T	Communication protocol with compressor starters
Ident Number Starter	1	0-200	T	Identification numbers for starters
Baud Rate Starter	19200	1200, 2400, 48, 00, 9600, 19200	T	

Table 11: MicroTech II Settings and Ranges (Single Compressor)

MicroTech II VFD	Default Setpoint	Range	Keypad Location	HMI Locations
Motor Current	Comp. Nameplate RLA	N/A	UC-SC-(4)	N/A
Motor Current Threshold (1)	5%	1 to 20%	UC-SA-(4)	Set-Alarms-(12)
Minimum Amp Setpoint (2)	10%	5 to 100%	UC-SC-(1)	Set -Motor-(2)
Maximum Amp Setpoint	100%	0 to 100%	UC-SC-(1)	Set -Motor-(3)
VFD	Yes	yes/no	UC-SU-(10)	Set -Motor-(9)
Minimum Speed	70%	70 to 100%	UC-SU-(10)	Set -Motor-(10)
Speed	50% (@ 0°F lift, “Y” axis	Setpoint 11 on Panel 1 (setpoint 14 on Panel 2) sets the % speed at 0 degrees F Lift, point A.	UC-SU-(10)	Set -Motor-(11)
Lift	40°F (@100% speed, X axis	Setpoint 12 on Panel 1 (setpoint 15 on Panel 2) sets the lift in degrees F at the 100 % speed point, point B.	UC-SU-(10)	Set -Motor-(12)

NOTE: Motor Current Threshold, current at which a low current fault occurs.

NOTE: Minimum Amp Setpoint, Minimum unloading amp setpoint.

NOTE: The HMI is the preferred place to adjust setpoints. The unit controller is the second choice and the compressor controller should never be used.

Table 12: MicroTech II, Settings and Ranges (Multiple Compressor Includes Duals)

MicroTech II VFD	Default Setpoints	Range	Keypad	HMI Locations
Max Comp. On	2 for Dual	1 to 16	UC-SC-(2)	Modes-(9)
Stage Delta	1°F	0.5 to 5.0°F	UC-SC-(3)	Water-(6)
Nominal Capacity	Unit Design Tons	N/A	UC-SC-(5)	Motor-(14)
Unload Timer (1)	030 sec	10 to 240 sec.	UC-SC-(6)	Timers-(6)
Min LWT Rate	0.1°F	0.0 to 5.0°F	UC-SC-(7)	Motors-(7)

NOTE: This must be set longer than the mech. vane speed to unload the compressor.

Code:

UC	Unit Controller
HMI	Human Machine Interface
A	Alarm Menu Keypad Or OITS Screen
C	Compressor Menus
CC	Compressor Controller
V	View Menu Keypad or OITS Screen
S	Set Menu Keypad or OITS Screen
U	Unit-mounted

Example:

Setpoint location for VFD Minimum speed = UC-SU-(10). The location would be the Unit Controller, Set Unit Setpoints Menu, Screen 10. OITS locations are S = Setpoint screen, “Alarms” or “Motor”, and the number of the setpoint on the screen.

Additional Setpoints, the following two setpoints are at Technician level and are located at UC-SC-(8) and not on the OITS. They are for exclusive use of factory trained service technicians.

VFD Mode = Auto (auto/manual), this allows the VFD speed output signal to be manually controlled for testing, or to be automatic for normal operation. The MicroTech II controller will not allow the speed signal to go below the calculated lift control speed.

VFD Speed Manual Setpoint = 100%, When the unit is started for the first time, and set up for design, or to check the operation and performance of the unit, it is necessary to run the unit at a constant fixed speed of 100%. To accomplish this, set the VFD Minimum Speed to 100% [UC-SU-(10) or OITS-S-Motor-(10)], then set up and adjust the unit. When testing is complete, set the minimum speed back to the original setpoint. Do not leave the drive minimum speed set to 100%, as it will prevent the controller from providing a speed signal variation for optimum efficiency.

Controls

Table 13: ACS 880 Parameters

Parameters	Name	Setting	Description
10.24	R01 source	Ready run	Selects a drive signal to be connected to relay output RO1.
10.27	R02 source	Running	Selects a drive signal to be connected to relay output RO2.
10.30	R03 source	Fault (-1)	Selects a drive signal to be connected to relay output RO3.
12.18	AI1 max	10 v	Defines the minimum value for analog input AI1
12.19	AI1 scaled at AI1 min	0	Defines the real internal value that corresponds to the minimum analog input AI1
12.20	AI1 scaled at AI1 max	60/50 Hz-3600/3000	Defines the real internal value that corresponds to the maximum analog input AI1
13.12	AO1 source	Motor current (4)	01.07 Motor current Measured (absolute) motor current in A.
13.16	AO1 filt time	0.100 s	Defines the filtering time constant for analog output AO1
13.20	AO1 out at AO1 src max	20.000 mA	Defines the maximum output value for analog output AO1
13.19	AO1 out at AO1 src min	0.0 mA	Defines the minimum output value for analog output AO1.
13.18	AO1 src max	(2)x rated motor current	Defines the real value of the signal (selected by parameter 15.01 AO1 src)
13.17	AO1 src min	0	Defines the real value of the signal (selected by parameter 15.01 AO1 src)
16.17	Local control disable	Yes	Enables/disables local control (start and stop buttons on the control panel, and the local controls on the PC tool).
20.03	Ext1 in1 source	DI1	Selects source 1 for parameter 20.01 Ext1 commands.
21.03	Stop mode	Coast	Selects the way the motor is stopped when a stop command is received.
22.11	Speed ref1 source	AI1 scaled	Selects speed reference source 1. 12.12 AI1 scaled value
22.13	Speed ref1 function	Ref1	Signal selected by 22.11 Speed ref1 source is used as speed reference 1 as such
23.12	Acceleration time 1	10	Defines acceleration time 1 as the time required for the speed to change from zero to the speed value defined by parameter 19.01 Speed scaling.
30.11	Minimum speed	0 rpm	Defines the minimum allowed speed.
30.12	Maximum speed	60/50 Hz-3600/3000 rpm	Defines the maximum allowed speed.
35.11	Temperature 1 source	Estimated temperature	Selects the source from which measured temperature 1 is read.
35.12	Temperature 1 fault limit	221F	Defines the fault limit for temperature monitoring function 1.
35.51	Motor load curve	108%	When the parameter is set to 100%, the maximum load is equal to the value of parameter 99.06 Mot nom current
35.52	Zero speed load	108%	Defines the maximum motor load at zero speed of the load curve
35.55	Mot therm time	256 sec	The thermal time for a Class 10 trip curve is 350 s, for a Class 20 trip curve 700 s, and for a Class 30 trip curve 1050 s
96.01	Language	English	The keypad setup language
96.16	Unit selection	0001 0101	Selects the unit of parameters indicating power, temperature and torque.
99.03	Motor type	Asynchronous	Asynchronous motor. Three-phase AC induction motor with squirrel cage rotor.
99.04	Motor ctrl mode	Scalar	Scalar control
99.06	Mot nom current	*****	Rated name plate amps. Note: This is the motor full load value from the Daikin Applied motor drawing, not the chiller rating point
99.07	Mot nom voltage	*****	Rated name plate voltage. Note: This is the line side voltage
99.08	Mot nom freq	*****	Rated name plate freq. Note: This is the line frequency, not chiller rating point drive-output freq.
99.09	Mot nom speed	*****	Rated name plate speed, RPM. Note: 3550 for 60 Hz line freq or 2950 for 50 Hz Line freq
99.10	Mot nom power	*****	Rated name plate HP. Note: This is the motor full load value from the Daikin Applied motor drawing, not the chiller rating point
99.16	Motor phase order	U V W	Switches the rotation direction of motor.

Table 15: Fuji VG Presets

NOTE: Drive settings not controlled via the chiller code.

Function Code	Description	Setting
y97	Stored Data	1 = Temporary
y98	Bus Link Function (Mode sel)	X
y99	Loader Link Func (Mode sel)	0
H30	Link Function	3
H31	Port2 ModBus Addr # (1-127)	1-3 (Drive ID #)
H32	Comm Loss Response	2
H33	Comm Loss Detection Time	10 sec
H34	Baud Rate	1 (19200)
H35	Data Bits	0 = 8bits
H36	Parity (0= None, 2 Stop bits)	0 = None
H37	Stop Bits (0= None, 2 Stop bits)	Fixed at 2 Stop bits
H38	Comm Loss Timeout	10 sec
H39	Delayed Response	0
H40	Protocol Selection	2= ModBus RTU
S05	Max Hz (500.0 or 600.0)	
S06	Univ DO Terminal - Comm	
S08	Acceleration Time F07	
S09	Acceleration Time F08	
S10	Torq Level 1 (F40)	
S11	Torq Level 2 (F41)	
S12	Run Command 2	Not Used
S13	Universal Analog Output	-16384 to 16384 (-10 to 10VDC)
E01	Digital input X01 Configuration	7 = BX (coast to stop)
E03	Digital input X03 Configuration	24 = Link Enable
E04	Terminal Function (NC/NO)	See VG User's Manual
	LE - Link Enable (Digital Input #3)	Must be energized. See VG User's Manual
	BX - Coast to Stop (Digital Input #1)	Must be energized. See VG User's Manual

Table 16: Fuji Ace and Mega Presets

NOTE: Drive settings not controlled via the chiller code.

Function Code	Description	Setting
H30	Link Function (Port2)	8= RS-485 (port 2) Freq & Run Cmd
y98	Bus Link Function (Mode sel)	0 = Hollow H30 Spd & Run Command
y99	Loader Link Function (Mode sel)	1 Freq-hollow Loader - Run follow H30,y98
y01	ModBus Addr # (1-255)	Drive ID #1
y02	Comm Loss Response	1: Trip with Alarm Er-8 after running for the period specified by timer y03
y03	Comm Loss Detection Time	10 sec
y04	Port 2 Baud Rate	3 (19200)
y05	Data Bits	0 = 8bits
y06	Parity (0= None, 2 Stop bits)	3= None, 1 Stop bits
y07	Stop bit Selection	0=2 bits
y08	Comm Loss Timeout	10 sec
y09	Delayed Response	0
y10	Protocol Selection	0 = Modbus RTU
y11	ModBus Addr # (1-255)	Id #1
y12	Comm Loss Response	1: Trip with Alarm Er-8 after running for the period specified by timer y13
y13	Comm Loss Detection Time	10 sec
y14	Port 2 Baud Rate	3 (19200)
y15	Data Bits	3 (19200)
y16	Parity (0= None, 2 Stop bits)	3= None, 1 Stop bits
y17	Stop bit Selection	0=2 bits; 1=1 bit
y18	Comm Loss Timeout	10 sec
y19	Delayed Response	0
y20	Protocol Selection	0= ModBus RTU
Y97	y 97 - Stored Data	1=Temporary
S05	S05 - Max Hz (50.0 or 60.0)	60.0
S07	S07 - Univ DO Terminal - Comm	
H03	H03 -Data Initialization	11 - Initialize para (excluding Comm Vars)
P99	Motor 1 Type selectioon	1-HP rating Ims 0-Fuji Std IM, 8-series ; 4- Other Ims 20- Other PMSMs; 21- Fiji Std PMSM, GNB-series
S09	S09 - Acceleration Time F08	
S10	S11 - Torq Level 2 (F41)	
S11	S11 - Torq Level 2 (F41)	
S12	S12 - Univ AO Terminal - Comm	
S13	S13 - PID command - Term Comm.	
S14	S14 - Alarm Reset command	
S19	S19 - Speed Command r/min	
F60	F60 Display Monitor Output Units	1 = Hp (0 = kW)
P04	P04 Auto tunning	0 disabled
F14	F14 Pwr Loss Restart	0 disabled
F42	F42 Drive Control (0= V/f w/o slip Comp)	
F44	F44 Current Limiter (Level)	default 130%
H04	H04 Auto-Reset	0 disabled
H101	H101 Destination Initialized before Op	Americas (5) 60.0Hz
E03	E03 - Digital input X03 Configuration	24 = Link Enable
E01	E01 - Digital input X01 Configuration	7 = BX (coast to stop)
	LE - Link Enable (Digital Input #3)	Must be energized
	BX - Coast to Stop (Digital Input #1)	Must be energized

Maintenance

⚠ CAUTION

Take extreme caution in cleaning and replacing all equipment and components to prevent injury or equipment damage.

Prevent dust and debris from entering the drive during installation. For usual cleaning, use a vacuum cleaner with antistatic hose and nozzle. Using a normal vacuum cleaner creates static discharges which can damage circuit boards.

⚠ WARNING

Only qualified electricians are allowed to install and maintain the drive. Improper handling of this equipment can cause equipment damage, personal injury, or death. Never work on the drive, motor cable or motor when main power is applied.

- After disconnecting the input power, always wait for 5 min to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable. Dangerous voltages may still be present before this time.
- Measure with a multimeter (impedance at least 1 Mohm) that voltage between drive input phases U1, V1 and W1 (also terminals UDC+ and UDC-) and the frame is close to 0 V. Ensure no voltage is between the terminals/drive input phases and the ground.
- Do not work on the control cables when power is applied to the drive or to the external control circuits. Externally supplied control circuits may cause dangerous voltages inside the drive even when the main power on the drive is switched off.
- Do not make any insulation or voltage withstand tests on the drive or drive modules.

Cabinet

Cleaning the interior:

1. Stop the drive
2. Ensure that the drive is disconnected from the power line and all other precautions have been taken into consideration as listed above.
3. When necessary, clean the interior of the cabinet with a soft brush and a vacuum cleaner.

Heatsink

The module heatsink fins pick up dust from the cooling air. The drive runs into “over-temperature” warnings flashing on the display and faults if the heatsink is not cleaned regularly. It is recommended to vacuum and clean the heatsink annually.

Cleaning the interior:

1. Stop the drive
2. Make sure that the drive is disconnected from the power line.
3. Undo the fastening screws of the handle plate of the drive module. This will reveal the service hatch.
4. Remove the service port plate and the service hatch from the drive
5. Vacuum the interior of the heatsink from the opening
6. Blow clean compressed air (not humid or oily) upwards from the opening and, at the same time, vacuum from the top of the drive module.

Fans

The actual lifespan depends on the running time of the fan, ambient temperature and dust concentration. Fan failure can be indicated by increasingly noisy fan bearings and a gradual rise to the heatsink temperature in spite of cleaning. All components should be checked annually for dustiness/corrosion, and the quality of the supply voltage.

Circuit board compartment cooling fan replacement

To replace the circuit board compartment cooling fan, do the following:

1. Stop the drive and remove the drive module out of the cabinet. When handling the boards (located on top of the drive), wear a grounding wrist band.
2. Undo the fastening screw of the fan enclosure.
3. Unplug the power supply cable of the fan.
4. Install the new fan in reverse order to the above

Main cooling fan replacement

To replace the main cooling fans, do the following:

1. Stop the drive
2. Remove the drive module out of the cabinet. For easier removal of the main fan, remove lower baffle
3. Open the support legs of the pedestal
4. Undo the two screws that fasten the fan assembly plate
5. Open and lower the swing out frame
6. Disconnect the power supply wires of the fans
7. Remove the fan assembly from the drive module
8. Undo the fastening screws of the fan(s) and remove the fan(s) from the assembly plate
9. Install the new fan(s) in reverse order to the above

Standard drive module replacement

- Handle the drive module carefully— Lift the drive module only by the lifting lugs.
- Use safety shoes with a metal toe cap to prevent foot injury.
- To prevent a tip hazard when moving unit to the floor, open the support legs by pressing each leg a little down (1, 2) and turning it aside. Whenever possible secure the module also with chains.

Do not tilt the drive module (A). It is heavy and its center of gravity is high. The module overturns from a sideways tilt of 5 degrees. Do not leave the module unattended on a sloping floor.

1. Stop the drive.
2. Remove the clear plastic shrouds on the power cables and parts in front of the drive module (if present).
3. Disconnect the power cables.
4. Disconnect the power supply, BGDR and fiber optic cables from the drive module.
5. Remove the screws that attach the drive module to the cabinet at the top and behind the front support legs. Attach the extraction ramp to the cabinet base with two screws.
3. To prevent the drive module from falling, attach its top lifting lugs with chains with chains to the cabinet frame.
4. Pull the drive module carefully out of the cabinet preferably with help from another person
5. Install the new module in reverse order to the above.

NOTE: The motor cable terminals on the drive are at a dangerously high voltage when the input power is on, regardless of whether the motor is running or not.

The brake control terminals (UDC+, UDC-, R+ and R- terminals) carry a dangerous DC voltage (over 500 V).

Depending on the external wiring, dangerous voltages (115 V, 220 V or 230 V) may be present on the terminals of relay outputs (X2) or Safe torque off (X6).

The Safe torque off function does not remove the voltage from the main and auxiliary circuits.

Preventive Maintenance

During Commissioning

- Torque all power connections during commissioning, including prewired equipment.
- Check all control wiring for loose connections.
- If fans are installed, check for proper operation.

One Month After Commissioning

- Re-torque all power connections, including pre-wired equipment.
- If fans are installed, check for proper operation.

After First Month of Operation

- Re-torque all power connections, including pre-wired equipment annually.
- Clean accumulated dust with clean compressed air.
- Inspect cooling fans, if present, every three months.
- Clean or replace air vent filters every three months.

Troubleshooting

⚠ DANGER

DC bus capacitors retain hazardous voltages after input power has been disconnected. After disconnecting input power, wait five (5) minutes for the DC bus capacitors to discharge and then check the voltage with a voltmeter to ensure the DC bus capacitors are discharged before touching any internal components. Failure to observe this precaution could result in severe bodily injury or death.

The drive can display two kinds of error codes; alarms and faults, to signal a problem detected during self-tuning or drive operation. The LED status will flash green indicating normal operation. If blinking green, an alarm is active and a red LED indicates a fault is active. When the fault has been removed, the motor can be restarted. If a reset is required, press the RESET key on the control panel or PC tool, or by switching the supply voltage off for short period of time.

Alarm Codes

An alarm condition is signified by a two- or three-letter code flashing on the display. The drive will continue to operate during the alarm condition. The cause of the alarm should be investigated to check that it does not lead to a fault condition. The alarm code remains on the display as long as the alarm condition exists and clears when the condition causing it is corrected. Alarms can be monitored via alarm words 08.05 Alarm logger1 … 08.18 Alarm word4. Alarm information is lost at power switch off or fault reset.

Table 17: Commonly Used Alarm Codes in Starters and VFDs

COMPR STOP - Motor Current Low	COMPR STOP - Phase Reversal
COMPR STOP - No Starter Transition	COMPR STOP - Line Voltage High
COMPR STOP - Starter Fault	COMPR STOP - Line Voltage Low
COMPR STOP - Current High with Compr OFF	COMPR STOP - Ground Fault
COMPR STOP - Motor Current Overload	COMPR STOP - Compressor Comm Loss
COMPR STOP - Motor Current Imbalance	
COMPR STOP - Phase Loss	COMPR STOP - Starter Comm Loss

Fault Codes

When a fault is detected, it is stored in the fault logger with a time stamp. The fault history stores information on the 16 latest faults of the drive. Full details and help text are available in the logger to assist in making corrective action. Parameters 08.01 Active fault and 08.02 Last fault store the fault codes of the most recent faults, stored at the beginning of a power switch off.

Identifying Alarm Codes and Corrections

VFD drive alarm parameters are shown in the Note that the alarm code will only be displayed for as long as the problem exists. Once the problem has been corrected, the alarm code will disappear from the display. Refer to the VFD firmware manual for alarm and fault definitions and corrective actions.

Identifying Fault Codes and Recovering

Access the fault blogger for recent faults and actions to correct them. To clear a single fault that has occurred so that the drive can be started again, correct any problems indicated by the fault code and press the STOP/RESET key on the keypad, or assert the fault reset from the selected control source. Because multiple faults can occur and only the first will be displayed, you must access the error log repeatedly in order to view all of the faults that have occurred and correct them. NOTE: If extensive troubleshooting or corrective actions are necessary, only properly trained and qualified technicians should be used.

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Now that you have made an investment in modern, efficient Daikin Applied equipment, its care should be a high priority. For training information on all Daikin Applied HVAC products, please visit us at www.DaikinApplied.com and click on Training, or call 540-248-9646 and ask for the Training Department.

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