Franklin Electric

EN ENGLISH

CERUS X-DRIVE

Installation and Operation Manual

Firmware Version 1.1

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CERUS® X-DRIVE

INSTALLATION AND OPERATION MANUAL

Firmware Version 1.1

Franklin Electric Co., Inc.

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Franklin Electric
Technical Publications
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SAFETY INSTRUCTIONS

Hazard Messages

This manual includes safety precautions and other important information in the following formats:

⚠ DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ 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 personal injury.

NOTICE

Indicates a potentially hazardous situation which, if not avoided could result in damage to equipment or other property.

IMPORTANT: Identifies information that controls correct assembly and operation of the product.

NOTE: Identifies helpful or clarifying information.

This symbol alerts the user to the presence of dangerous voltage inside the product that might cause harm or electrical shock.

This symbol alerts the user to the presence of hot surfaces that might cause fire or personal injury.

Before Getting Started

This equipment should be installed and serviced by technically qualified personnel who are familiar with the correct selection and use of appropriate tools, equipment, and procedures. Failure to comply with national and local electrical and plumbing codes and within Franklin Electric recommendations may result in electrical shock or fire hazard, unsatisfactory performance, or equipment failure.

Read and follow instructions carefully to avoid injury and property damage. Do not disassemble or repair unit unless described in this manual.

Failure to follow installation or operation procedures and all applicable codes may result in the following hazards:

⚠ WARNING

High voltages capable of causing severe injury or death by electrical shock are present in this unit.

- To reduce risk of electrical shock, disconnect power before working on or around the system. More than one disconnect switch may be required to de-energize the equipment before servicing.
- Make sure the ground terminal is connected to the motor, control enclosures, metal plumbing, and other metal near the motor or cable using wire no smaller than motor cable wires.

⚠ CAUTION

Risk of bodily injury, electric shock, or property damage.

- This equipment must not be used by children or persons with reduced physical, sensory or mental abilities, or lacking in experience and expertise, unless supervised or instructed. Children may not use the equipment, nor may they play with the unit or in the immediate vicinity.
- Equipment can start automatically. Lockout-Tagout before servicing equipment.
- This equipment produces high temperatures during normal operation. Use caution when contacting surfaces.
- Operation of this equipment requires detailed installation and operation instructions provided in this manual for use with this product. Read entire manual before starting installation and operation. End User should receive and retain manual for future use.
- Keep safety labels clean and in good condition.

Product Specific Precautions

⚠WARNING

High voltages capable of causing severe injury or death by electrical shock are present in this unit.

- Do not remove VFD cover for wiring or periodic inspections while power is applied, or the unit is in operation.
- Capacitors inside the drive can still hold lethal voltage even after power has been disconnected. ALWAYS check if DC bus charge LED is off and DC voltage on the terminals DC (+1) and DC (-) is less than 30VDC before working on VFD wiring. The DC bus capacitors may hold high-voltage charge for several minutes after the VFD power is disconnected.
- Perform wiring after VFD has been mounted. Otherwise, electric shock or bodily injury can occur.
- Do not apply power to a damaged VFD or to VFD with missing parts.
- Do not use VFD if power or motor cable is damaged.
- Do not handle the VFD or control devices with wet hands or when standing on a wet or damp surface, or in water.

⚠CAUTION

Risk of bodily injury, electric shock, or property damage.

- Install VFD on a non-flammable surface. Do not place flammable materials nearby.
- Disconnect the input power if VFD has been damaged.
- Do not touch VFD after shutting down or disconnecting it. It can remain hot for a few minutes.
- Do not allow lint, paper, wood chips, dust, metallic chips or other foreign material into the drive.
- Some VFD parameters are set as default to automatically start VFD in some applications. Disable these parameters if automatic start is not safe for personnel or equipment.
- If restart after fault reset is selected, the VFD can start automatically after fault reset.
- If required, provide an emergency mechanical brake to prevent any hazardous conditions if VFD fails during operation.

NOTICE

Risk of damage to drive or other equipment.

- Install and wire VFD according to the instructions in this manual.
- Take protective measures against ESD (Electrostatic Discharge) before touching control boards during inspection, installation or repair.
- Do not connect power factor correction capacitors, surge suppressors, or RFI filter to the VFD output.
- Check if input power voltage is within acceptable range before applying power to VFD.
- Set correct motor data from the motor nameplate and overload protection parameters for proper motor overload protection.
- Do not modify VFD internal components and circuits.
- Power factor capacitors and generators may become overheated and damaged due to harmonics distortion created by VFD.
- The use of any disconnecting device (contactor, disconnect etc.) in motor circuit during VFD run can cause damage to VFD power components. Stop VFD before opening the motor circuit with disconnect or contactor.
- Use, if possible, an inverter rated or motor with insulation Class F or higher. For submersible pump motors, use Class B or higher. The VFD generates high frequency output pulses with spikes, which can deteriorate motor winding insulation and eventually damage the motor. The longer distance to the motor the higher amplitude of these voltage spikes will be applied to motor winding. Any cables with paralleled wires will increase the amplitude of these spikes at motor terminals.
- VFD can operate motor at frequencies higher than 50HZ or 60Hz. Verify the maximum allowed speed with motor and machinery manufacturers prior to increasing output frequency because it can overheat motor or damage machinery.

PRODUCT INFORMATION

Description

The Cerus X-Drive is a variable frequency drive (VFD) designed to control and protect three phase motors in industrial, municipal, and agricultural sites. The X-Drive family offers an extensive range of amperage and configuration options, making it versatile enough for nearly any constant or variable torque application.

Industry standard application settings are pre-configured for submersible or centrifugal pumps, supply or exhaust fans, cooling towers, vacuum pumps, and constant torque motors. In addition, many input/output and control options are available for application specific features, such as PID speed control, pressure control, temperature or fluid level controls, and scheduling.

Native Modbus and BACnet communication protocols allow integration with many automated control and building management systems. In addition, an optional Bluetooth communication card provides access for programming, operating, and monitoring the drive using the FE Connect for Cerus X-Drive Mobile App. Refer to "Optional Extension Cards" on page 95.

Features

Configuration

- Compatible with three-phase induction or permanent magnet motors
- Extensive selection of models available. Refer "Models" on page 12.
- Easy setup with built-in application defaults
- Many programmable Input/Output terminal options
- Available NEMA 1, NEMA 3R, UL Type 1, IP21, or 4X enclosure offerings

Application-specific features

- Sleep mode
- Damper control
- Lubrication for hollow-shaft motors
- Pipe fill mode
- Broken pipe protection
- Screen clean
- Multi-motor control

Operation

- Integrated HOA functionality
- Integrated display with keypad control of all functions
- Real-time fault logging with date and time stamps

Protection

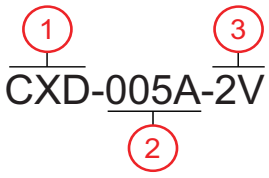
- Protection against short circuit, incorrect wiring, surges, underload, overload, drive overheat, under-voltage, over-voltage, phase loss, phase imbalance, output open phase, overpressure, sensor fault, etc.
- The X-Drive allows your motor to gradually ramp up and down, saving equipment from sudden, harsh rushes of current that can shorten its lifespan

Communication

- RS-485 communications (Modbus, BACnet) for remote control or monitoring
- Bluetooth connectivity with optional FE Connect Communication Card

Models

Model Number Codes



1. **Product Family:**
   Cerus X Drive series
2. **Amperage Ratings:**
   5 to 930 A
3. **Input Voltage**
   2V = 200/230 V
   4V = 460 V
   6V = 575 V

	Frame A	Frame B	Frame C
200V \ 230V	CXD-005A-2V CXD-007A-2V CXD-010A-2V CXD-015A-2V CXD-021A-2V	CXD-031A-2V CXD-046A-2V CXD-061A-2V	CXD-075A-2V CXD-090A-2V CXD-105A-2V
460V	CXD-003A-4V CXD-004A-4V CXD-005A-4V CXD-008A-4V CXD-010A-4V CXD-013A-4V CXD-018A-4V	CXD-024A-4V CXD-032A-4V CXD-038A-4V	CXD-045A-4V CXD-060A-4V CXD-073A-4V
575V	CXD-003A-6V CXD-004A-6V CXD-006A-6V	CXD-009A-6V CXD-012A-6V CXD-018A-6VA CXD-024A-6V	CXD-030A-6V CXD-036A-6V CXD-045A-6V
	Frame D	**Frame E**	**Frame F**
200V \ 230V	CXD-146A-2V CXD-180A-2V	CXD-215A-2V CXD-276A-2V CXD-322A-2V	
460V	CXD-091A-4V **(D0)** CXD-110A-4V **(D0)** CXD-150A-4V CXD-180A-4V	CXD-220A-4V CXD-260A-4V	CXD-310A-4V CXD-370A-4V
575V \ 690V	CXD-054A-6V CXD-067A-6V	CXD-086A-6V CXD-104A-6V CXD-125A-6V CXD-150A-6V	CXD-180A-6V (690 V) CXD-220A-6V (690 V)
	Frame G	**Frame H**	**Frame H (690)**
460V	CXD-460A-4V CXD-530A-4V	CXD-616A-4V CXD-683A-4V CXD-770A-4V CXD-930A-4V	
575V \ 690V	CXD-290A-6V (690 V) CXD-350A-6V (690 V)		CXD-430A-6V CXD-465A-6V CXD-590A-6V CXD-675A-6V

UNPACKING AND INSPECTION

Transportation and Storage

NOTICE

Risk of damage to VFD or other equipment.

- Do not stack VFD boxes higher than standard 48" cube height when palleting for storage.
- Do not place heavy items on VFD.
- Do not drop VFD or subject it to hard impact.
- Dispose of VFD properly as industrial equipment waste.

The VFD should be stored in the shipping carton or crate before installation, in a controlled environment that meets the following requirements:

Storage Temperature	-25 to 70 °C (-13 to 158 °F)
Location	Pollution Degree 2 Environment
Relative Humidity	95% Maximum relative humidity (non-condensing)

The performance of capacitors in the drive will degrade if not charged occasionally. It is recommended to charge a stored drive every 2 years to restore the performance of the capacitors.

NOTE: If the VFD is kept in storage for longer than 2 years, when powering the drive, use an adjustable AC power source (ex. AC autotransformer) to charge the drive at 70 to 80% of the rated voltage for 30 minutes (do not run the drive). Then, charge the drive at 100% of rated voltage for an hour (do not run the drive).

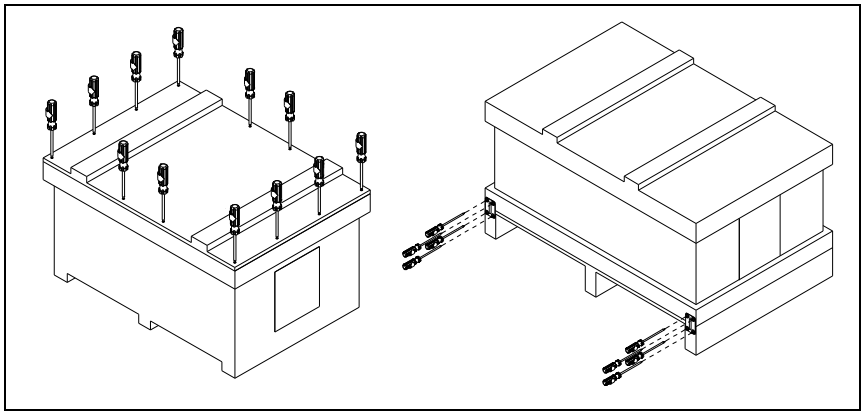
Unpacking

⚠ CAUTION

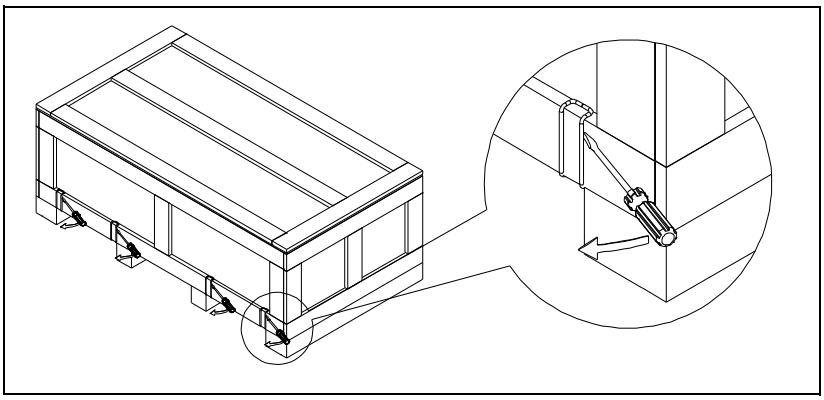
Risk of personal injury or damage to VFD or other equipment.

- Use suitable lifting equipment, in good condition, rated for at least 5 times the weight of the VFD. Refer to "Specifications" on page 141 for the weight of each drive by frame size.

1. Inspect exterior of package for shipping damage. If there is damage, notify the shipping agent and your sales representative.
2. Make sure the part number and product ratings on the identification label are correct for the application.
3. When possible, remove the VFD cover and make sure the product ratings on the nameplate match the package label.
4. The VFD comes in various forms of shipping crates. If applicable, remove the top and side fasteners from the packaging.



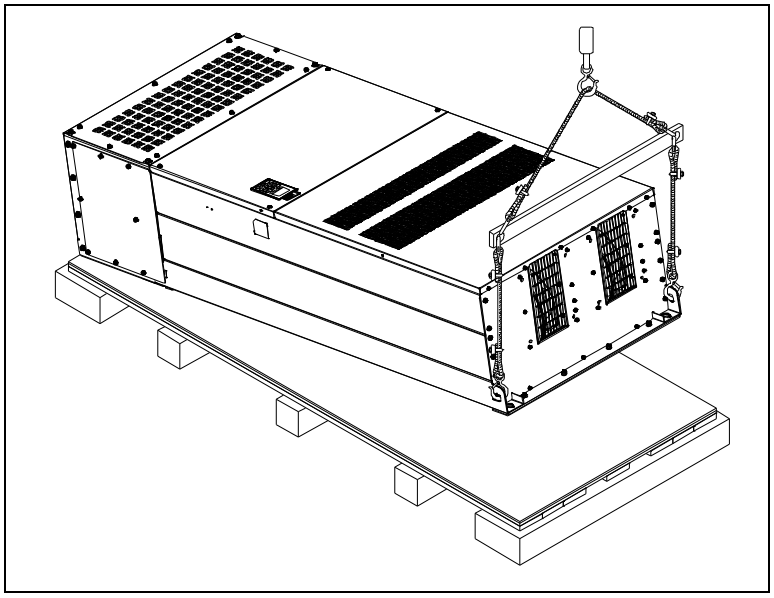
5. Some crates are secured with clips. Remove clips with a suitable prying tool.
6. Remove the crate cover, foam packing inserts, owner's manual, and any other items inside the crate.
7. Remove fasteners securing the drive to the pallet.
8. Inspect the VFD for damage.
9. Allow the drive to remain on the pallet until you are ready to install it in the permanent location. Refer to"Mounting the Drive" on page 18.



Lifting

When removing large VFDs from the pallet, use suitable lifting equipment connected to the lifting holes at the top outer edges of the unit.

Use a spreader bar the same width as the drive so the lifting cables are straight up and down.



INSTALLATION PLANNING

NOTICE

Risk of damage to VFD, or malfunction can occur.

- An incorrectly applied or installed VFD can result in system malfunction or reduction in product life as well as component damage. You must read and understand this manual thoroughly before proceeding with installation.

Refer to the following table when planning installation of the Cerus X-Drive VFD.

1	2	3	4	5	6
Plan System Goals	**Identify Options**	**Select Control Methods**	**Install VFD Hardware**	**Install Wiring**	**Program Parameters**
Intended Function • Air Handling • Fluid Circulation • Constant Pressure • Pressure Boosting • Irrigation • Dewatering • Carwashes • Conveyors • Crushers • Grinders Hardware Application • Supply Fan • Exhaust Fan • Cooling Tower • Centrifugal Pump • Submersible Pump • Vacuum Pump • Constant Torque	Automation • Damper Control • Sleep mode • Timers • Scheduling Protection • Shutdown • Redundancy • Broken Pipe • Fire Override Maintenance • Screen clean • Lubrication Multi-Motor Control • Equal Run Time • Soft Start • Lead/Lag • Rotation	Hand/Off/Auto • Keypad • Panel Mounted • Remote Transducer (PID) • Temperature • Pressure • Vacuum • Flow Switches • Potentiometer • Float • On/Off • Speed control Communications • BMS/PLC • Modbus • BACnet • Drive-to-drive • Bluetooth	Location • Inside • Outside Climate control • Temperature • Moisture Distance • Wire sizes • Filtering requirements Measurements • Clearance • Drilling	Conduit • Routing • Separation High Voltage • Grounding • Inputs • Outputs Control circuits • Analog inputs • Switched inputs • Voltage inputs • Programmable outputs • Communication	Basic • Application • Motor ratings • Setpoints • Limits I/O setup • Input functions • Output functions • Scaling Option settings • Enable features • Set targets

1. The planned usage of the overall system will determine which options and control methods are appropriate, as well as how the VFD should be installed and programmed. Refer to "Operation" on page 63 for examples of how the system might be used.
2. System options define and automate features that support the intended operation. These features may require specialized control methods and programming. For more details, refer to "Control Options" on page 63, "Standard Operation with an Automated Control System" on page 66,and "Protection Features" on page 75.
3. The X-Drive supports many different methods for automating motor speed control. Refer to "Example Configurations" on page 43 for possible control setups.
4. The overall function of the system directly affects where and how the VFD should be mounted. Refer to "Physical Installation" on page 17 for guidelines.
5. The selected motor application, along with the control method(s), determines how the VFD should be connected. Refer to "Electrical Installation" on page 33 for more information.
6. The VFD can be quickly and easily programmed for most standard operations. Refer to "Setting Operating Parameters" on page 48. Advanced features or options may require additional parameter adjustments to achieve the desired performance. Refer to "Advanced Application Options" on page 79 and "Parameter Reference Tables" on page 115.

Basic VFD Configuration

The following table includes the most commonly used devices in a motor control branch operated by a VFD. Adequate peripheral devices and correct connections are essential for proper VFD operation.

	AC Power Source	Use single- or three-phase power source with voltage within the permissible range of VFD input power rating.
	MCCB, Fuses, or Franklin Electric Manual Motor Starters	Select circuit breakers or fuses in accordance with NEC and applicable local codes.
	Inline Magnetic Contactor	Do not use input power contactor for frequent starting and stopping the VFD, otherwise VFD power components can be damaged.
	AC Line Reactor or Harmonic Filter	A line reactor provides some degree of surge protection and decreases a level of harmonic distortion in the power line. It is recommended when power source kVA rating is more than 10 times higher than VFD rating. A Harmonic filter provides a higher level of harmonic mitigation. Integrated DC Chokes are included in VFD models larger than Frame C, equivalent to a 3% AC line reactor.
	EMI/RFI Filter	Install an EMI/RFI filter to decrease VFD Electromagnetic and Radio Frequency Interference with operation of sensitive electronic equipment.
	Variable Frequency Drive	Install VFD with proper orientation, ventilation, spacing etc. according to the requirements described in this manual with all necessary protective and filtering devices to provide long and reliable VFD operation.
	AC Load Reactor or Output Filter (460 V and higher)	Install a load (output) reactor or an output filter to protect motor windings if distance from VFD to a motor is in the range 45-100 feet. Install output dV/dt filter for a range of 100-1000 feet (800 feet for submersible pumps), or a sine wave filter for greater distances.
 	Three Phase AC Induction Motors or Permanent Magnet Motors, including Franklin Electric pump motors	The X-Series VFD is not compatible with servomotors. Opening the motor circuit by disconnect or contactor during VFD run can damage VFD power components.

NOTICE

Risk of damage to VFD, or malfunction can occur.

- Do not install a magnetic contactor or motor disconnect in the motor circuit for start/stop or emergency stop purpose. Opening the motor circuit while the VFD is running may cause VFD failure.

PHYSICAL INSTALLATION

Environmental Requirements

NOTICE

Risk of damage to VFD, or malfunction can occur due to improper handling, installation, or environment.

- Do not mount VFD on equipment with excessive vibration.
- Install in a location where temperature is within the range of product rating.
- Do not mount VFD in direct sunlight or near other heat sources.
- The VFD should be mounted in a Pollution Degree 2 environment. If VFD will be installed in an environment with a high probability of dust, metallic particles, mists, corrosive gas or other contaminants, the VFD must be mounted inside an appropriate electrical enclosure with proper NEMA, UL Type, or IP rating and adequate cooling.
- When two or more VFDs are installed in a ventilated enclosure, the cooling system should provide adequate airflow for all the VFDs. Do not install VFD above another heat source (another VFD, inductive reactors, etc.).

The VFD must be installed and used in a controlled environment that meets the following requirements:

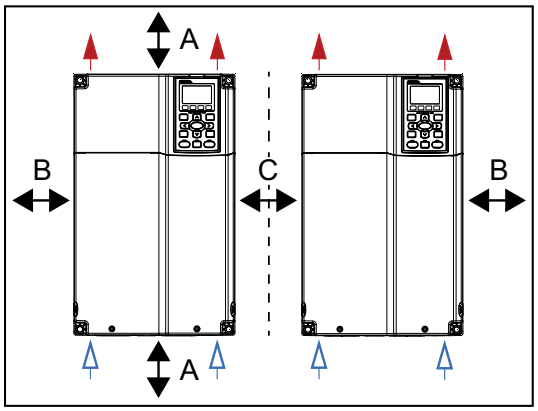
Ambient Temperature	50 °C (122 °F) UL Open Type/IP20 (Top cover must be removed.) 40 °C (104 °F) in NEMA 1 / UL Type 1 / IP20 enclosure.
Location	Pollution Degree 2 Environment.
Altitude	1000m (3281 ft) above sea level. De-rate current 1% per 100 m (328 ft) from 1000 to 2000 m (3281-6562ft). Consult Technical Support for installations above 2000 m.
Relative Humidity	95% Maximum relative humidity (non-condensing)
Vibration	1.0mm, peak to peak value range from 2 Hz to 13.2 Hz 0.7G-1.0G range from 13.2 Hz to 55 Hz 1.0G range from 55 Hz to 512 Hz.

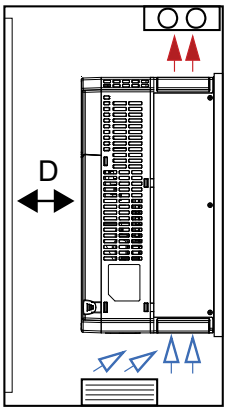
The drive electronics are air-cooled. Provide enough clearance for airflow around the VFD. See minimum mounting clearance table below for different VFD frame sizes.

Mount VFD vertically (top up) for proper heat dissipation.

Do not mount VFD in direct sunlight or near other heat sources.

Do not block cooling vents or airflow with any panel components or wires. Prevent debris from adhering to the heat sink.





Frame Size	A	B	C*	D
A, B, & C	60 mm/2.4 in.	30 mm/1.2 in.	30 mm/1.2 in.	0 mm/0.0 in.
D, E, & F	100 mm/3.9 in.	50 mm/2.0 in.	100 mm/3.9 in. total	0 mm/0.0 in.
G	200 mm/7.9 in.	100 mm/3.9 in.	200 mm/7.9 in.	0 mm/0.0 in.
H	350 mm/ 13.8 in.	0 mm/0.0 in.	0 mm/0.0 in.	200 mm/7.9 in.

* For frames sizes D, E, & F, install a metal separator between side-by-side drives. Barrier depth must match the VFD depth.

Mounting the Drive

⚠ CAUTION

Risk of bodily injury or damage to drive or other equipment.

- The drive should be mounted on a structure such as a wall or post capable of supporting the weight of the unit. Refer to "Specifications" on page 141 for drive weight.
- Install VFD on a non-combustible surface.
- Ensure suitable mounting hardware is used when installing the drive.
- Do not install the drive on unreinforced drywall.
- Use suitable lifting equipment, in good condition, rated for at least 5 times the weight of the drive.

The mounting location should have nearby access to the electrical supply and access to the motor wiring. Refer to "Electrical Installation" on page 33.

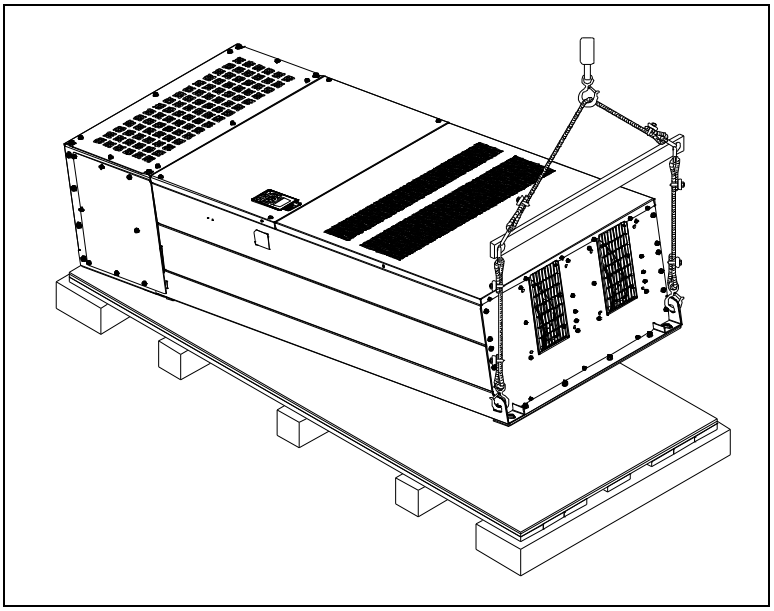
Use lag screws or bolts appropriate for supporting the weight of the drive.

1. Mount the drive using the mounting holes on the back side of the drive enclosure.
2. Screws at the top must attach to a solid structure such as a stud or brace.
3. All screw hole locations should be used to ensure the drive is securely mounted.

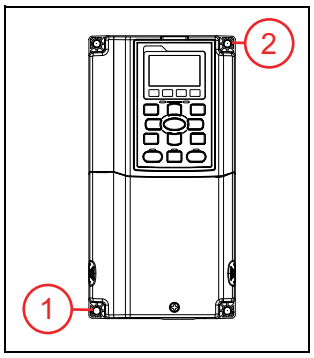
IMPORTANT: Do not drill holes in the drive.

When removing large drives from the pallet, use suitable lifting equipment connected to the lifting holes at the top outer edges of the drive.

1. Use a spreader bar the same width as the drive so the lifting cables are straight up and down.
2. Slowly lift the drive from the pallet.
3. Use lifting equipment to place the drive in the desired installation location.



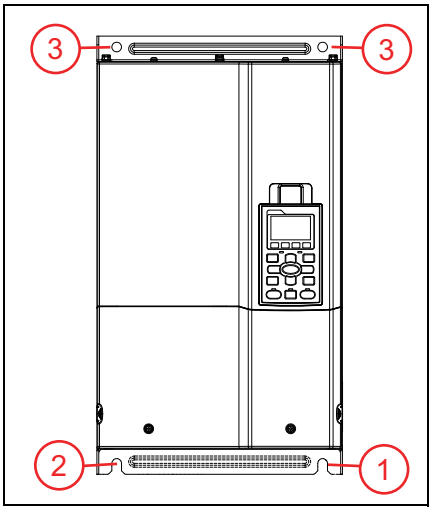
Mounting Frames A, B, and C



These frames have four corner mounting holes on the drive. Refer to "Drive Dimensions" on page 26 for mounting hole locations and sizes.

1. Have one person hold the drive in location while another installs the lag screws in each corner, ensuring they go into a solid stud or brace. Install the lower left lag screw first.
2. Place a level on top of the drive. When level, install the upper right corner lag screw.
3. Install the remaining two lag screws.

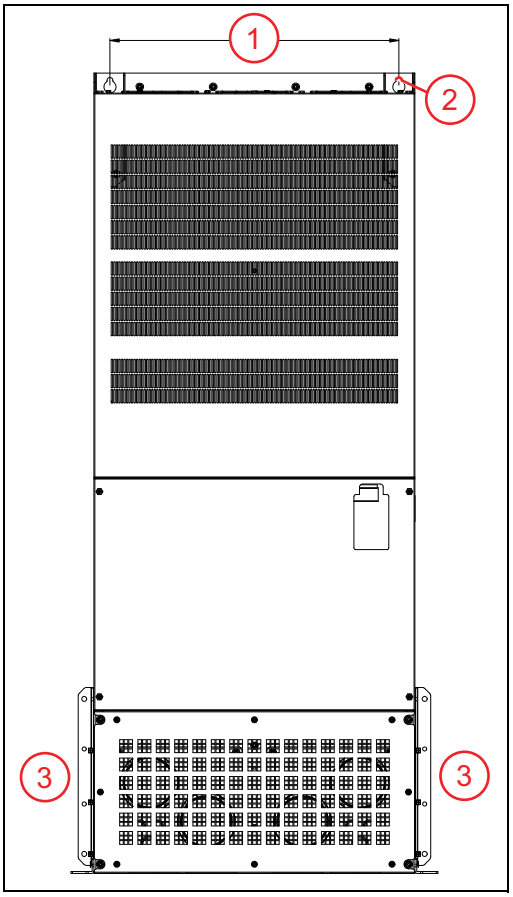
Mounting Frames D0, D, and E



These frames have four corner mounting holes on the drive. The bottom two holes are U-shaped slots, allowing the drive to be lowered onto pre-installed lag screws. Refer to "Drive Dimensions" on page 26 for mounting hole locations and sizes.

1. Install two lag screws for the bottom locations, ensuring they are level and enter a solid stud or brace.
2. Use a lifting device to lower the U-shaped mounting slots onto the bottom lag screws. The conduit box is not shown in this image to better show the bottom mounting slots.
3. Hold the drive tight against the backing board, and install the remaining two lag screws in the top mounting holes.

Mounting Frames F, G, and H



These frames include two keyhole shaped mounting holes at the top, allowing the drive to be set onto pre-installed lag screws. Refer to "Drive Dimensions" on page 26 for mounting hole locations and sizes.

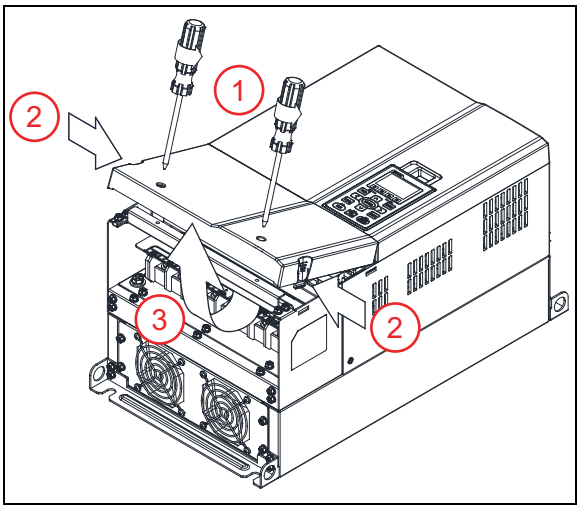
1. Install two lag screws for the top locations, ensuring they are level and enter a solid stud or brace.
2. Use a properly sized lifting device to lower the top keyhole shaped mounting slots onto the lag screws.
3. Hold the drive tight against the backing board, and install the remaining lag screws in the bottom mounting holes, ensuring they enter a solid stud or brace.

Conduit Box Installation

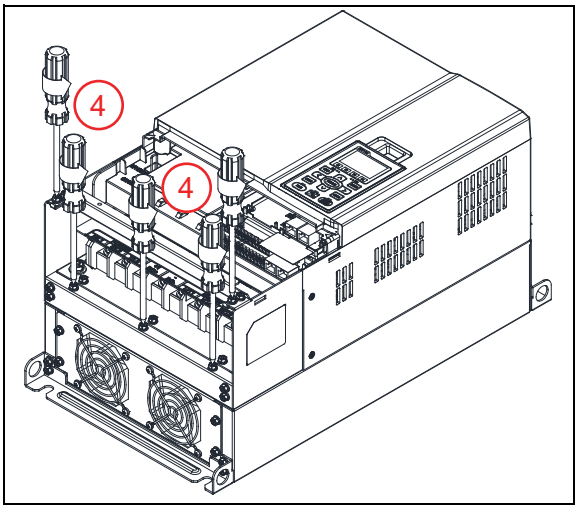
Frames A, B and C do not require an added conduit box.

Frames D0 and D Conduit Box Installation

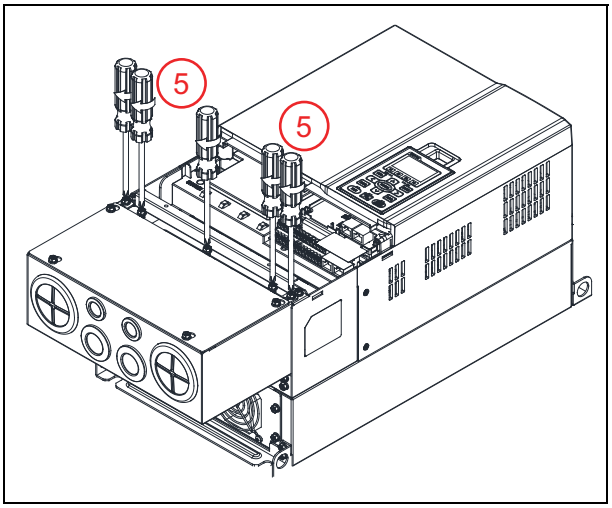
1. Loosen two lower drive cover screws.
2. Press the tabs on each side of the cover.
3. Remove the cover.



4. Remove five screws.

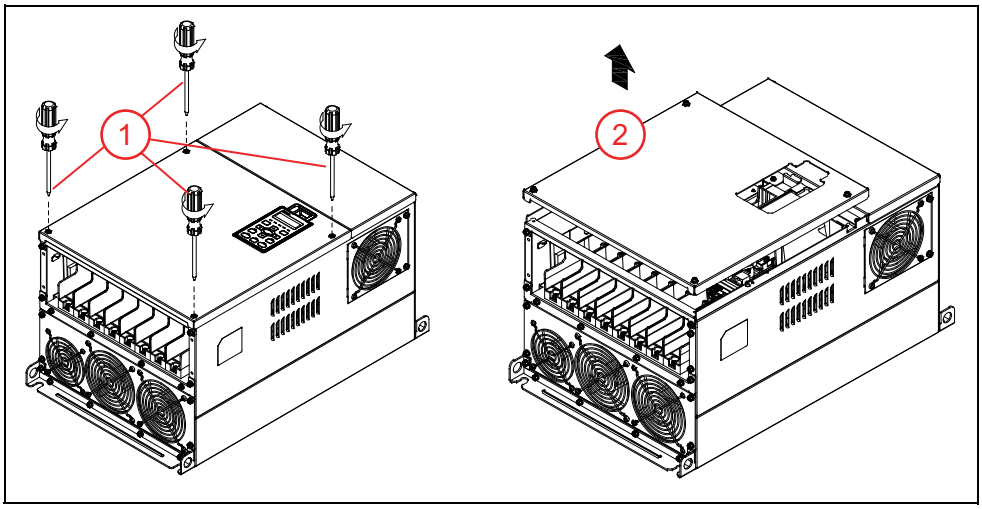


5. Install the conduit box with five screws. Tighten to a torque of 24-26 kg-cm / 20.8-22.6 lb-in. / 2.4-2.5 Nm.
6. Replace the lower drive cover and rotate to the closed position. Secure with two screws from step 1. Tighten to a torque of 12-15 kg-cm / 10.4-13 lb-in. / 1.2-1.5 Nm.

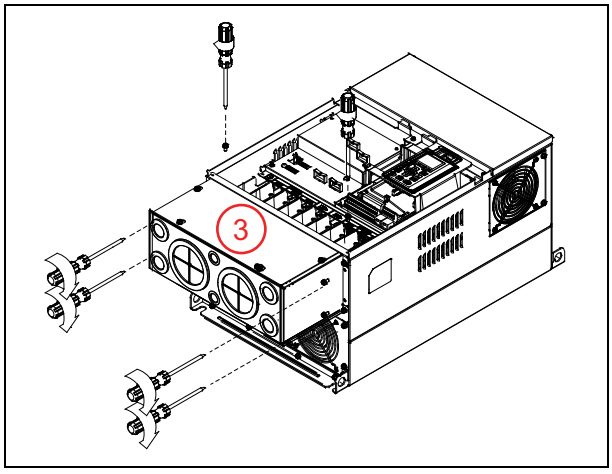


Frame E Conduit Box Installation

1. Loosen four lower drive cover screws.
2. Remove the cover.

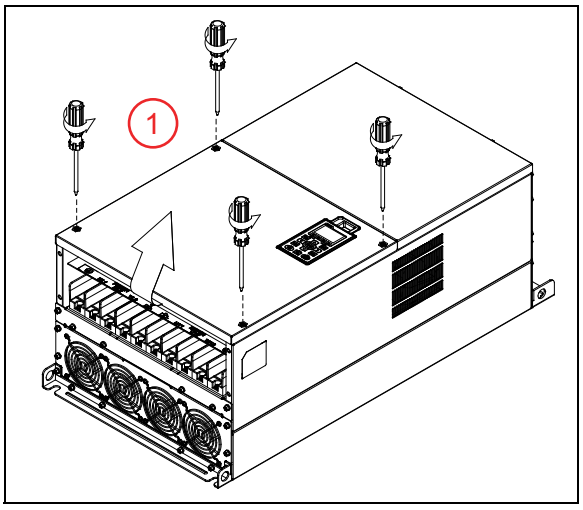


3. Install the conduit box with six screws. Tighten to a torque of 24-26 kg-cm / 20.8-22.6 lb-in. / 2.4-2.5 Nm.
4. Replace the cover and secure with screws from step 1. Tighten to a torque of 12-15 kg-cm / 10.4-13 lb-in. / 1.2-1.5 Nm.

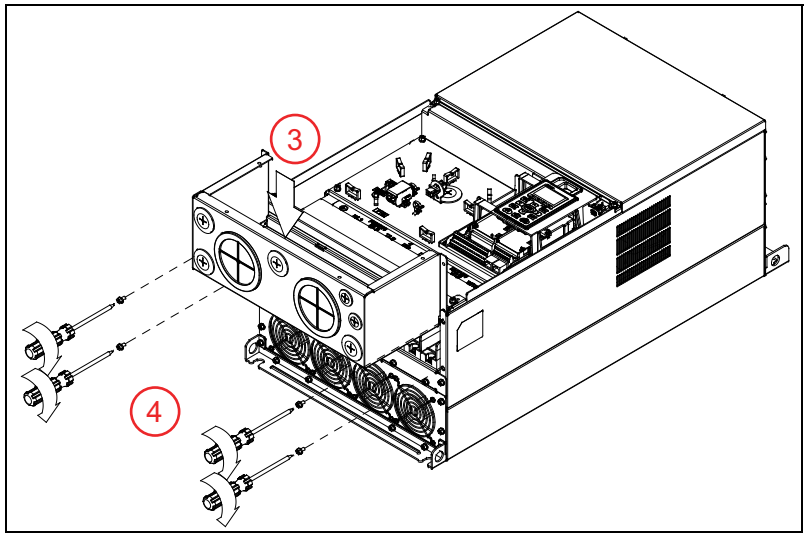


Frame F Conduit Box Installation

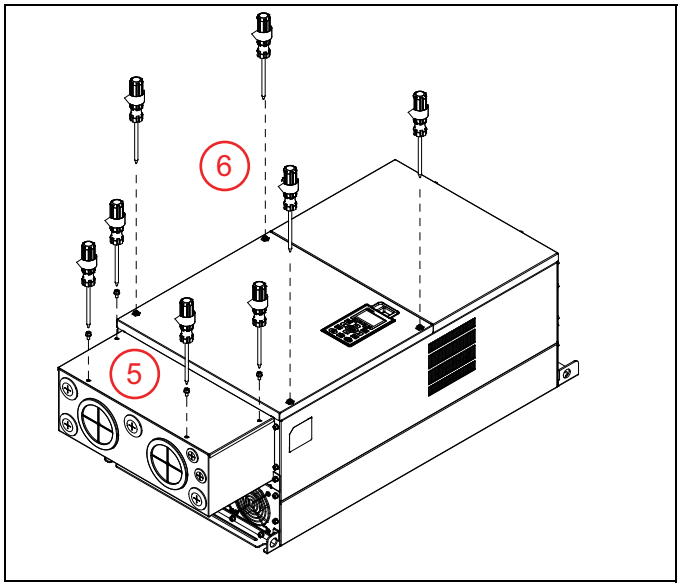
1. Remove four lower drive cover screws.
2. Remove the cover from the drive.
   Remove four screws from the conduit box cover.



3. Align the conduit box flanges behind the flanges of the drive bottom.
4. Secure the conduit box to the drive (flange to flange) with four screws.
   Tighten the screws to a torque of
   24-26 kg-cm / 20.8-22.6 lb-in. / 2.4-2.5 Nm.

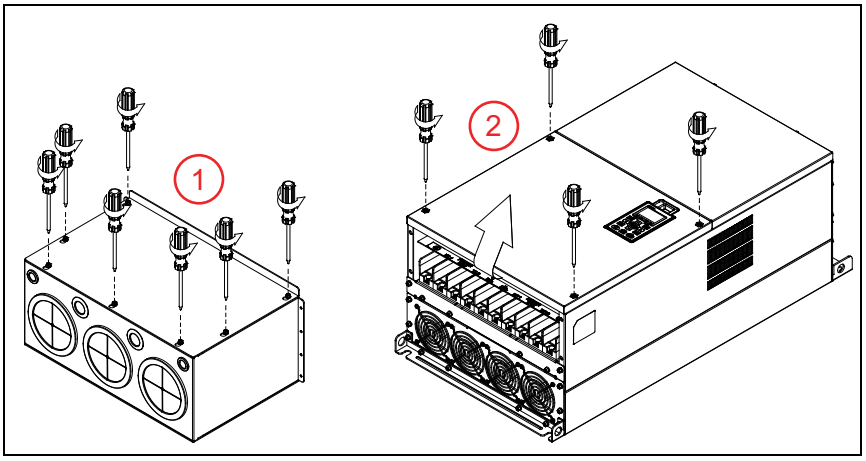


5. Install the conduit box cover using four screws from step 2.
   Tighten to a torque of
   13-16 kg-cm / 20.8-22.6 lb-in. / 2.4-2.5 Nm.
6. Replace the cover and secure with four screws from step 1.
   Tighten to a torque of
   12-15 kg-cm / 10.4-13 lb-in. / 1.2-1.5 Nm.

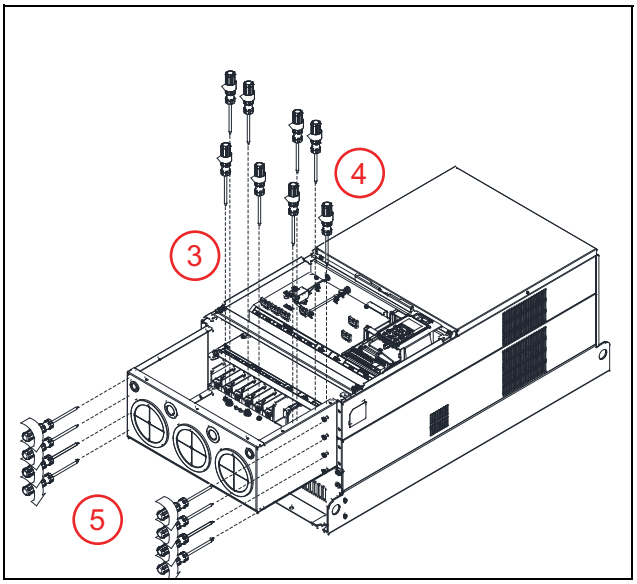


Frame G Conduit Box Installation

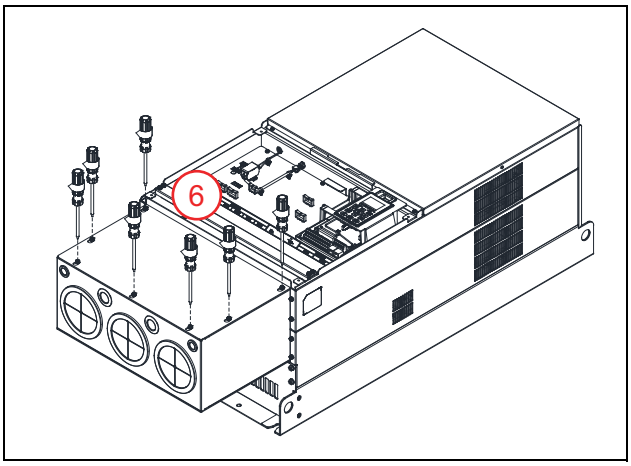
1. Loosen seven conduit box cover screws, slide it forward, and remove the cover.
2. Loosen four lower drive cover screws. Remove the cover.



3. Remove the eight screws identified.
4. Align the conduit box with the flanges of the drive. Reinstall the eight screws from step 3.
   M5 Screw torque: 24-26 kg-cm / 20.8-22.6 lb-in. / 2.4-2.5 Nm
   M8 Screw torque: 100-120 kg-cm / 86.7-104.1 lb-in. / 9.8-11.8 Nm
5. Secure further with eight screws.
   M5 Screw torque: 24-26 kg-cm / 20.8-22.6 lb-in. / 2.4-2.5 Nm
   M8 Screw torque: 100-120 kg-cm / 86.7-104.1 lb-in. / 9.8-11.8 Nm

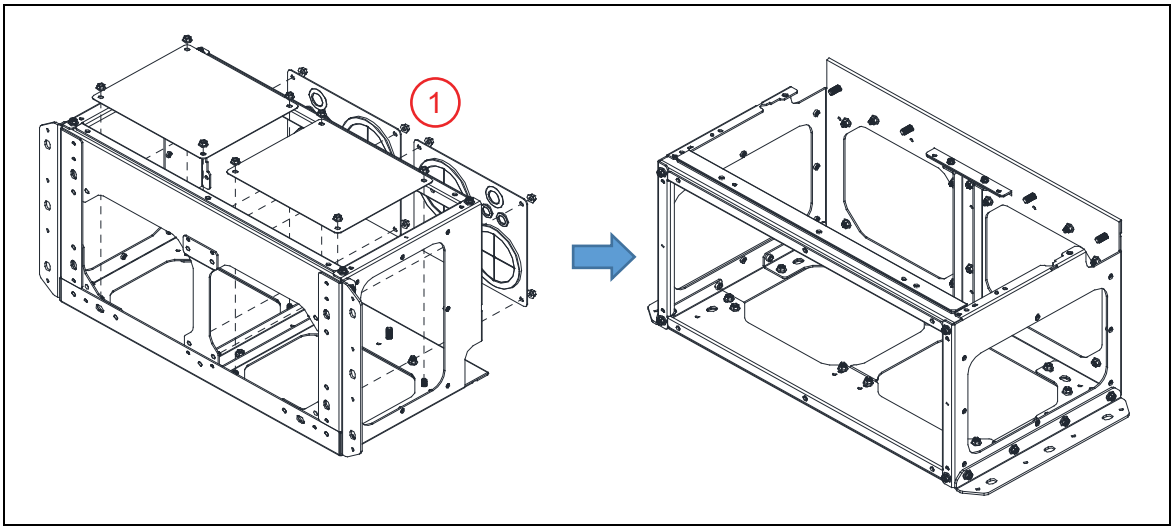


6. Set the conduit box cover on the conduit box and slide it toward the conduit knockouts. Tighten the screws to a torque of 24-26 kg-cm / 20.8-22.6 lb-in. / 2.4-2.5 Nm.
7. Place the cover back on the drive, and tighten the screws to a torque of 12-15 kg-cm / 10.4-13 lb-in. / 1.2-1.5 Nm.

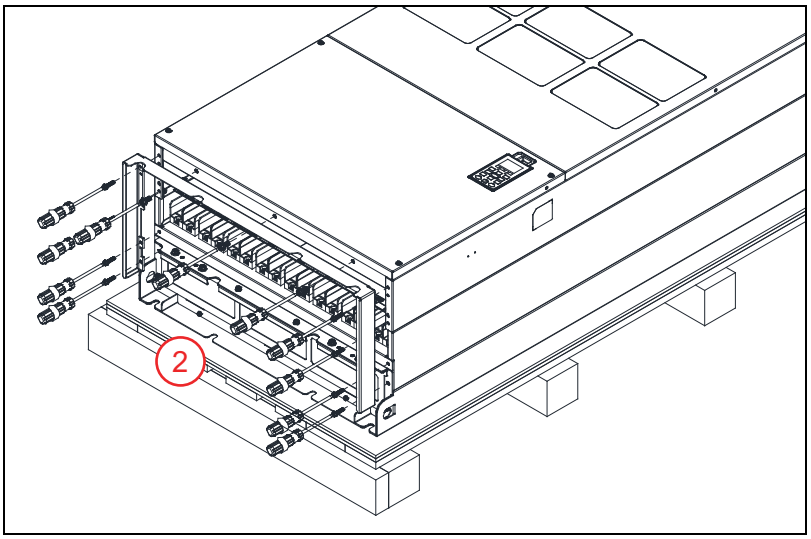


Frame H Conduit Box Installation

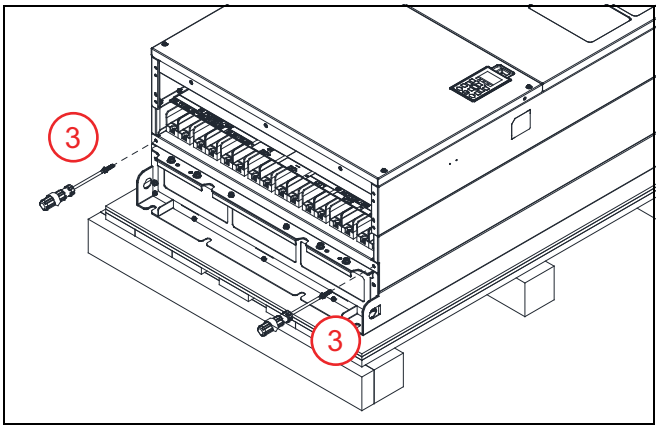
1. Remove all screws holding the covers of the conduit box kit and remove the covers.



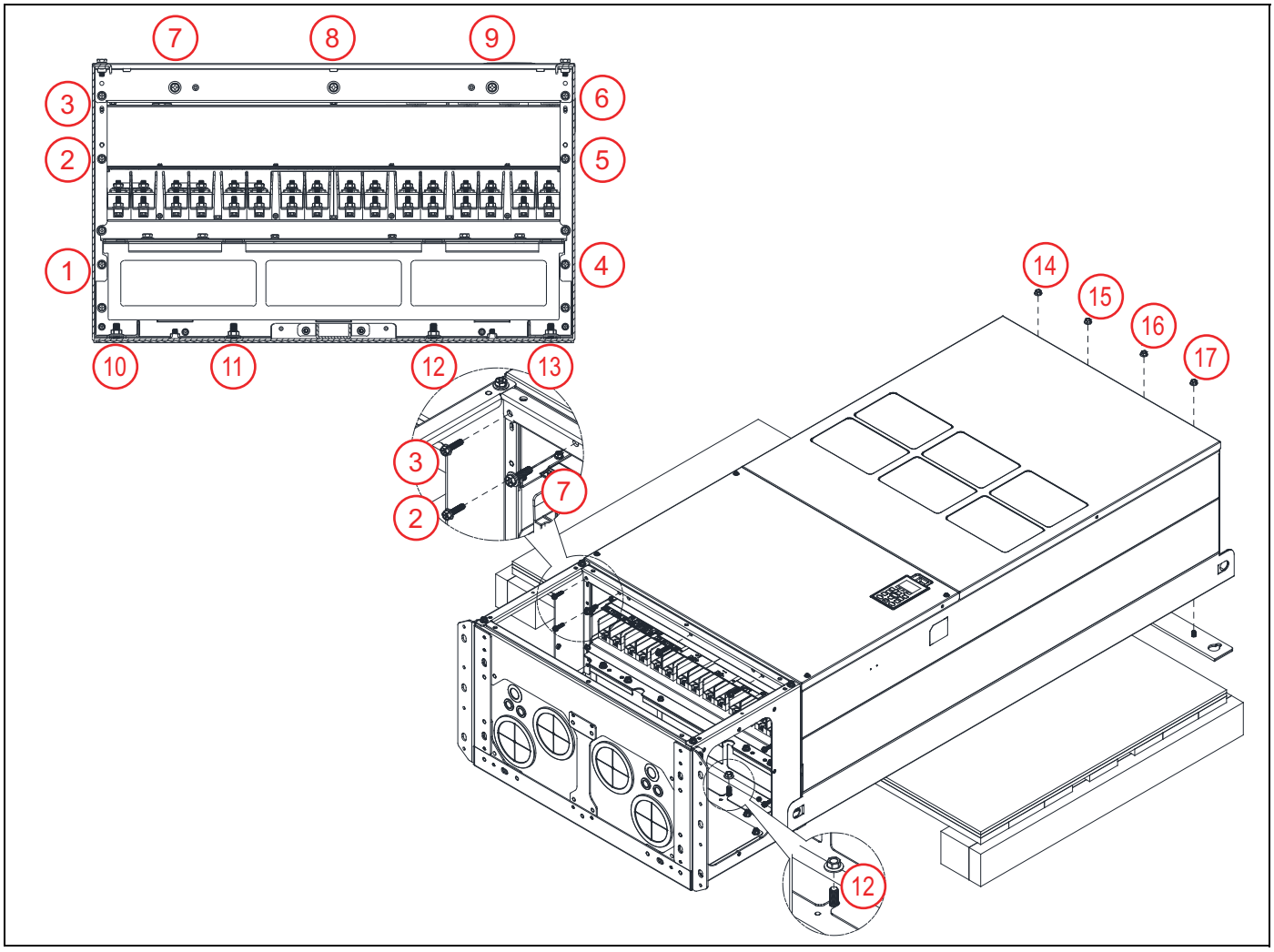
2. Remove the screws shown from the bottom of the drive and remove the bracket.



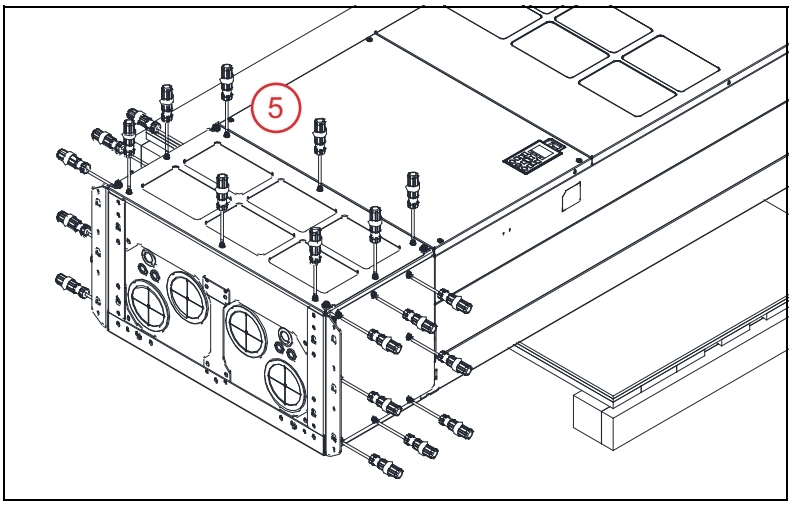
3. Fasten the M6 screws to two locations. Tighten screws to a torque of 35-45 kg-cm / 30.3-39 lb-in. / 3.4-4.4 Nm.



4. Install the conduit box to the drive using the following screws and nuts tightened to a torque of:
   M6 Screws 1 - 6: 55-65 kg-cm / 47.7-56.4 lb-in / 5.4-6.4 Nm
   M8 Screws 7 - 9 and Nuts 14 - 17: 100-110 kg-cm / 86.7-95.4 lb-in / 9.8-10.8 Nm
   M10 Nuts 10 - 13: 250-300 kg-cm / 216.9-260.3 lb-in / 24.5-29.4 Nm

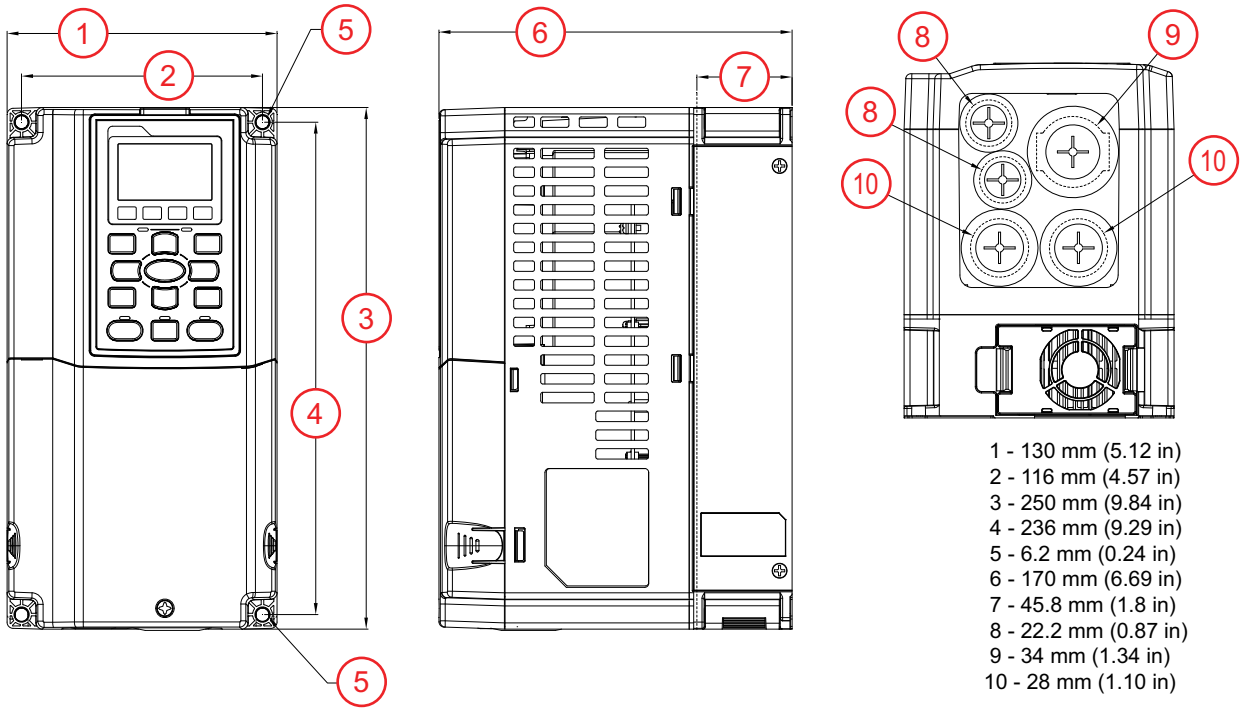


5. Replace the covers and screws removed in Step 1 to the original locations. Tighten to a torque of 35-45 kg-cm / 30.3-39 lb-in. / 3.4-4.4 Nm.



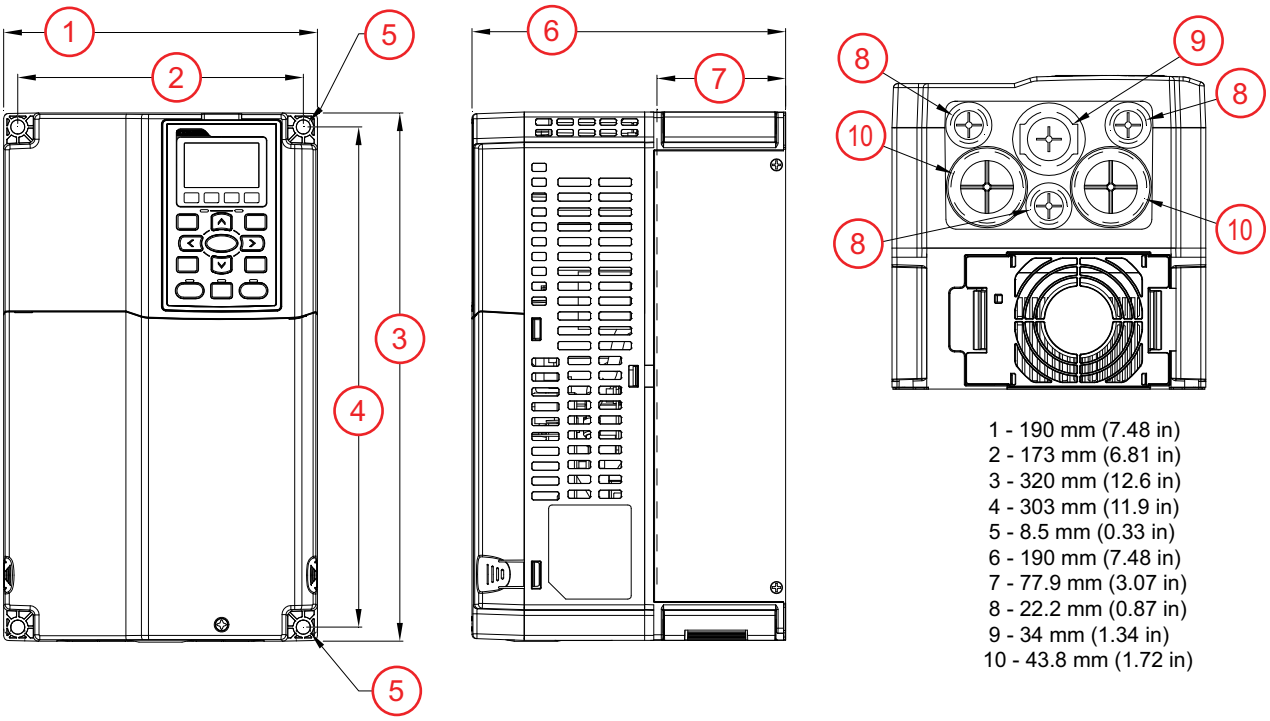
Drive Dimensions

Frame A



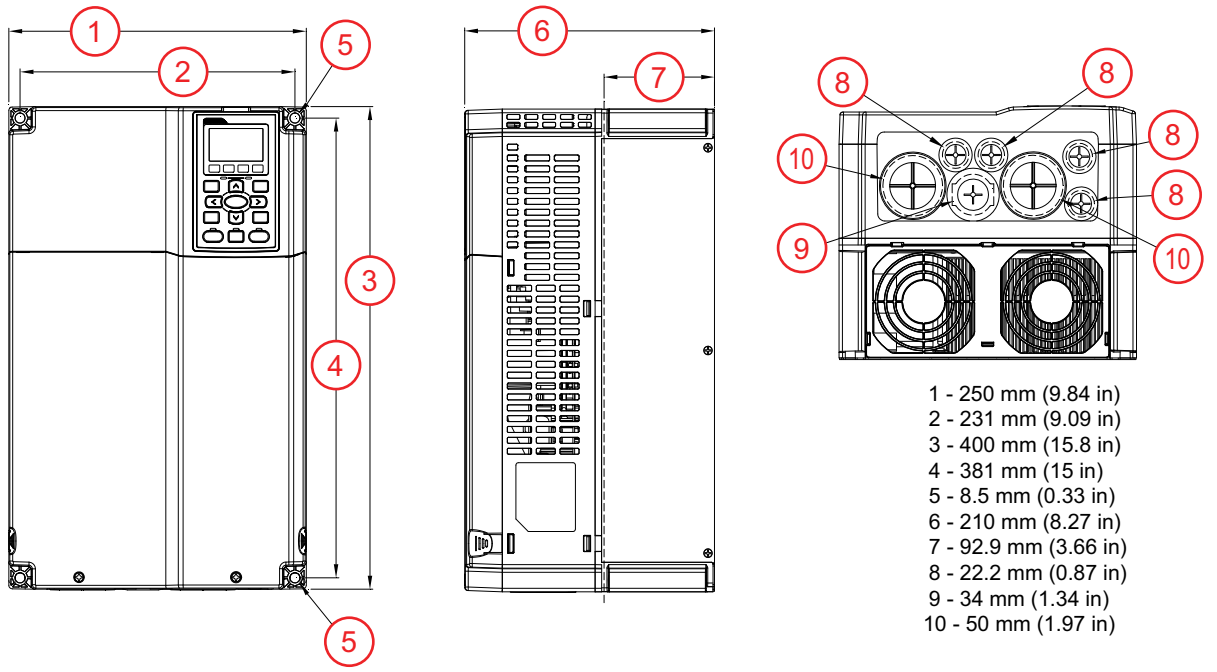
1 - 130 mm (5.12 in)
2 - 116 mm (4.57 in)
3 - 250 mm (9.84 in)
4 - 236 mm (9.29 in)
5 - 6.2 mm (0.24 in)
6 - 170 mm (6.69 in)
7 - 45.8 mm (1.8 in)
8 - 22.2 mm (0.87 in)
9 - 34 mm (1.34 in)
10 - 28 mm (1.10 in)

Frame B



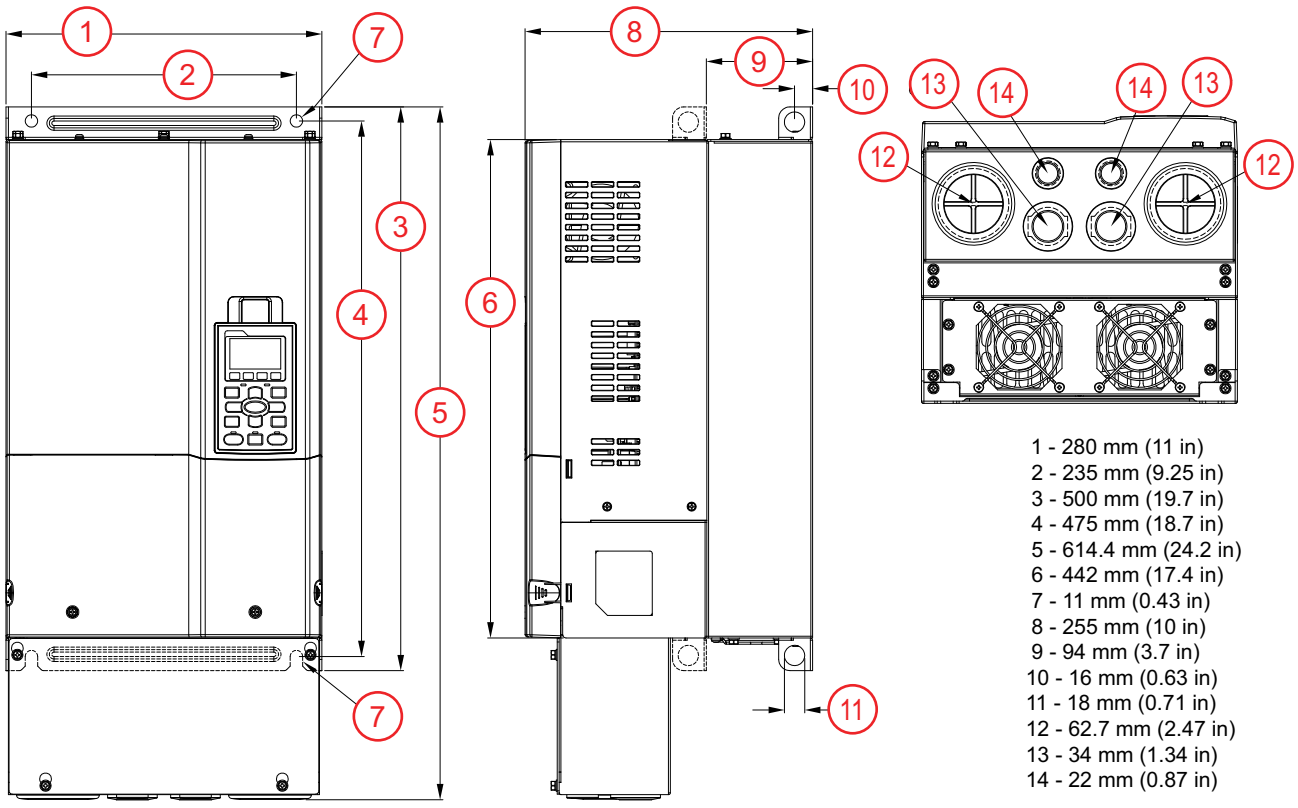
1 - 190 mm (7.48 in)
2 - 173 mm (6.81 in)
3 - 320 mm (12.6 in)
4 - 303 mm (11.9 in)
5 - 8.5 mm (0.33 in)
6 - 190 mm (7.48 in)
7 - 77.9 mm (3.07 in)
8 - 22.2 mm (0.87 in)
9 - 34 mm (1.34 in)
10 - 43.8 mm (1.72 in)

Frame C



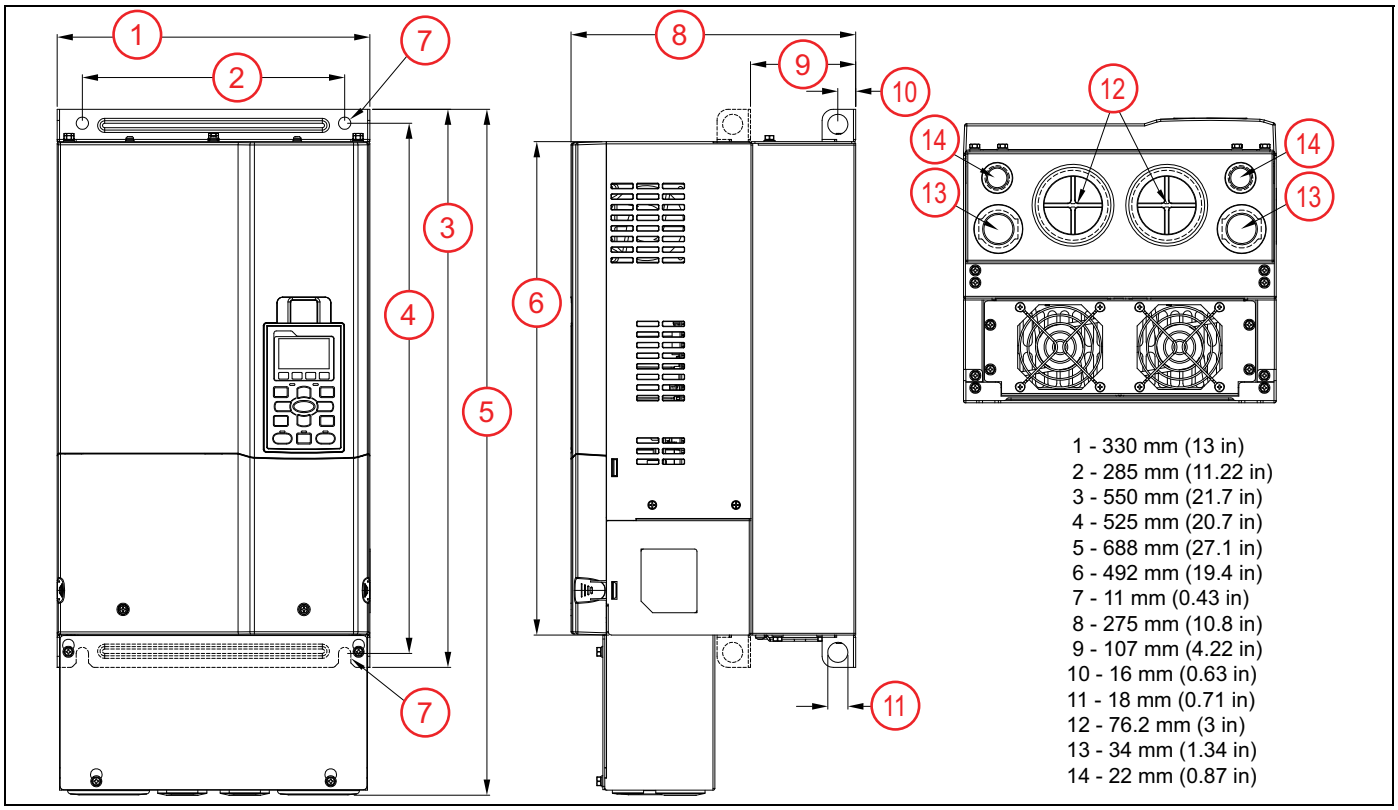
1 - 250 mm (9.84 in)
2 - 231 mm (9.09 in)
3 - 400 mm (15.8 in)
4 - 381 mm (15 in)
5 - 8.5 mm (0.33 in)
6 - 210 mm (8.27 in)
7 - 92.9 mm (3.66 in)
8 - 22.2 mm (0.87 in)
9 - 34 mm (1.34 in)
10 - 50 mm (1.97 in)

Frame D0



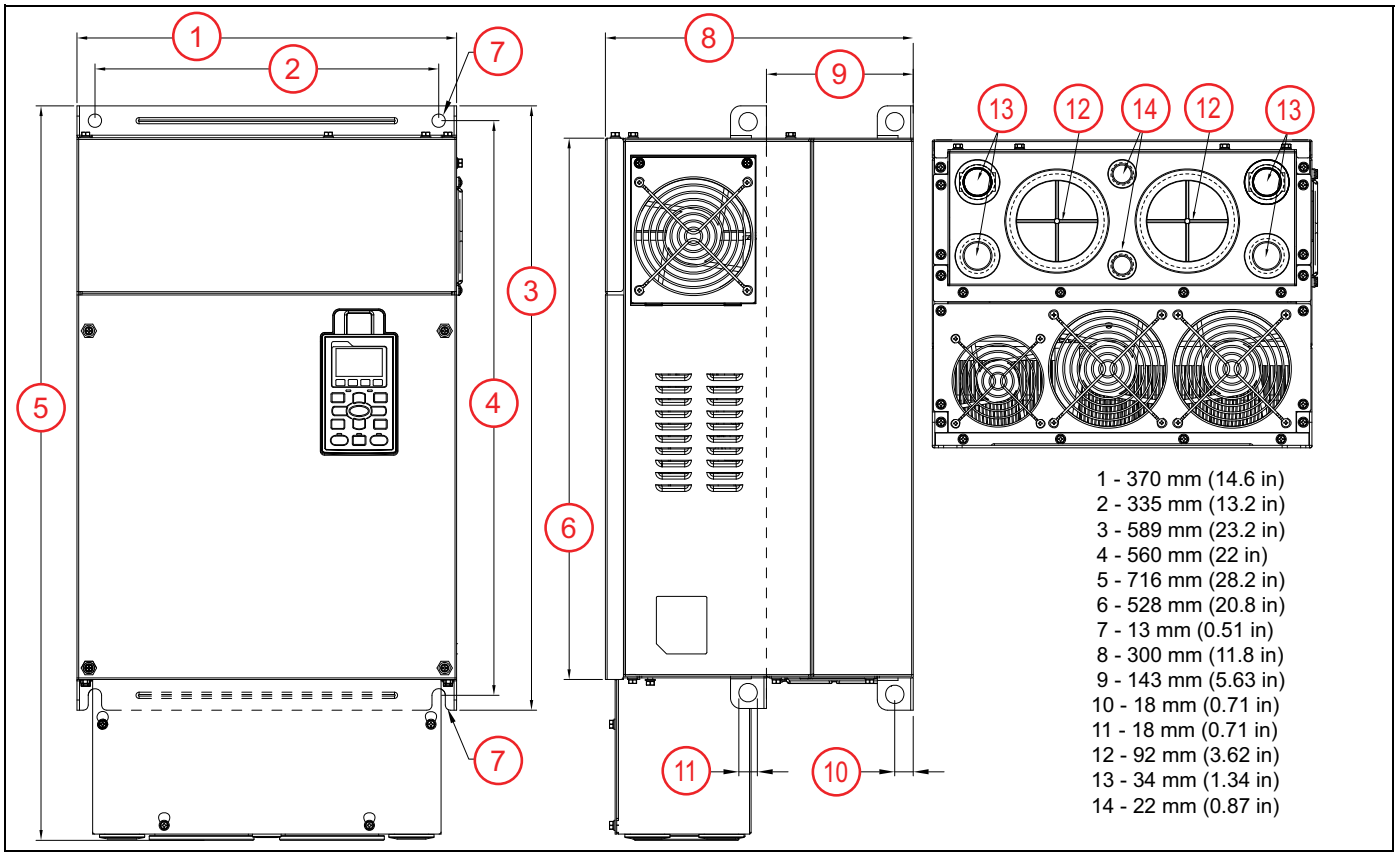
1 - 280 mm (11 in)
2 - 235 mm (9.25 in)
3 - 500 mm (19.7 in)
4 - 475 mm (18.7 in)
5 - 614.4 mm (24.2 in)
6 - 442 mm (17.4 in)
7 - 11 mm (0.43 in)
8 - 255 mm (10 in)
9 - 94 mm (3.7 in)
10 - 16 mm (0.63 in)
11 - 18 mm (0.71 in)
12 - 62.7 mm (2.47 in)
13 - 34 mm (1.34 in)
14 - 22 mm (0.87 in)

Frame D



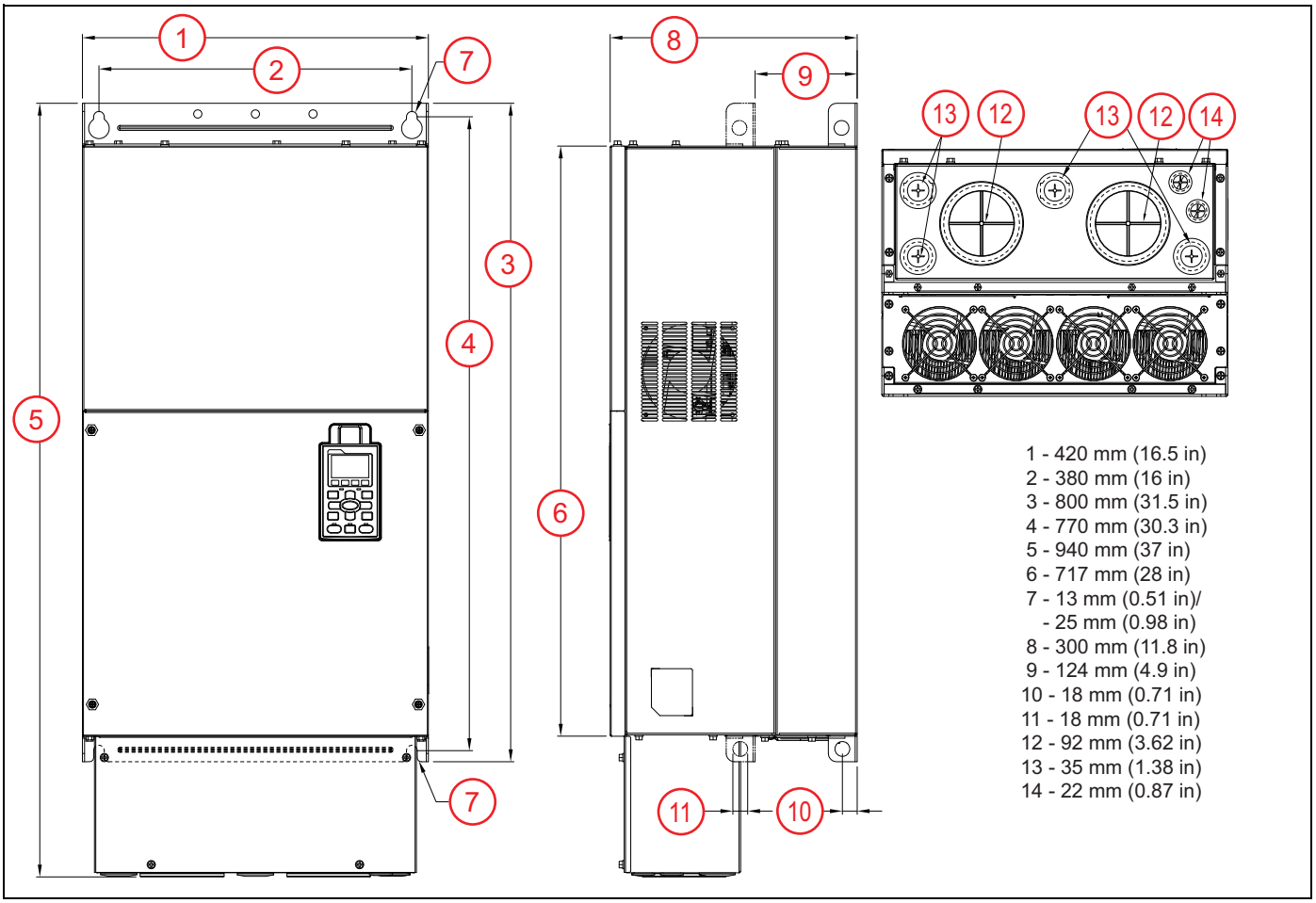
1 - 330 mm (13 in)
2 - 285 mm (11.22 in)
3 - 550 mm (21.7 in)
4 - 525 mm (20.7 in)
5 - 688 mm (27.1 in)
6 - 492 mm (19.4 in)
7 - 11 mm (0.43 in)
8 - 275 mm (10.8 in)
9 - 107 mm (4.22 in)
10 - 16 mm (0.63 in)
11 - 18 mm (0.71 in)
12 - 76.2 mm (3 in)
13 - 34 mm (1.34 in)
14 - 22 mm (0.87 in)

Frame E



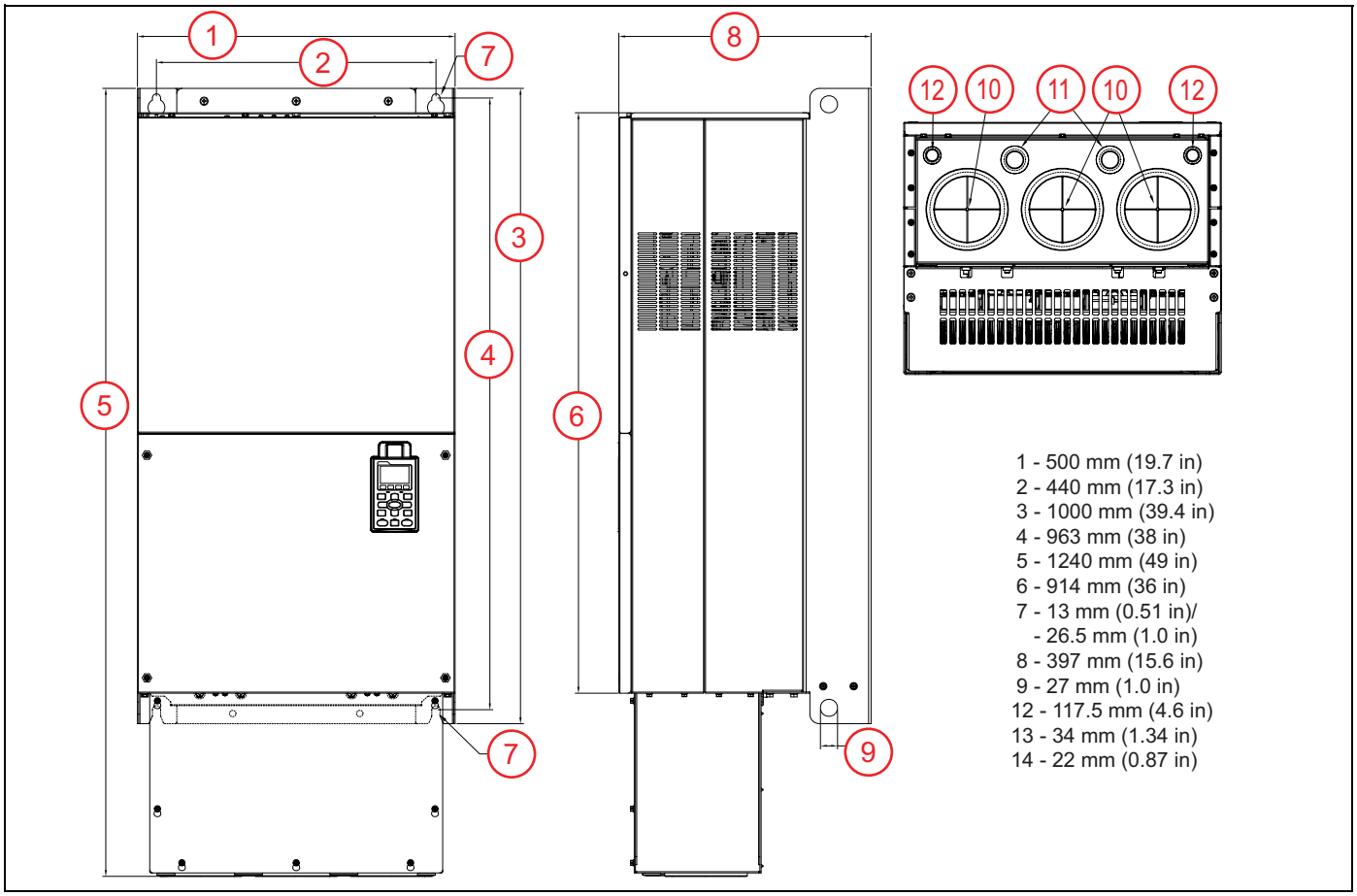
1 - 370 mm (14.6 in)
2 - 335 mm (13.2 in)
3 - 589 mm (23.2 in)
4 - 560 mm (22 in)
5 - 716 mm (28.2 in)
6 - 528 mm (20.8 in)
7 - 13 mm (0.51 in)
8 - 300 mm (11.8 in)
9 - 143 mm (5.63 in)
10 - 18 mm (0.71 in)
11 - 18 mm (0.71 in)
12 - 92 mm (3.62 in)
13 - 34 mm (1.34 in)
14 - 22 mm (0.87 in)

Frame F



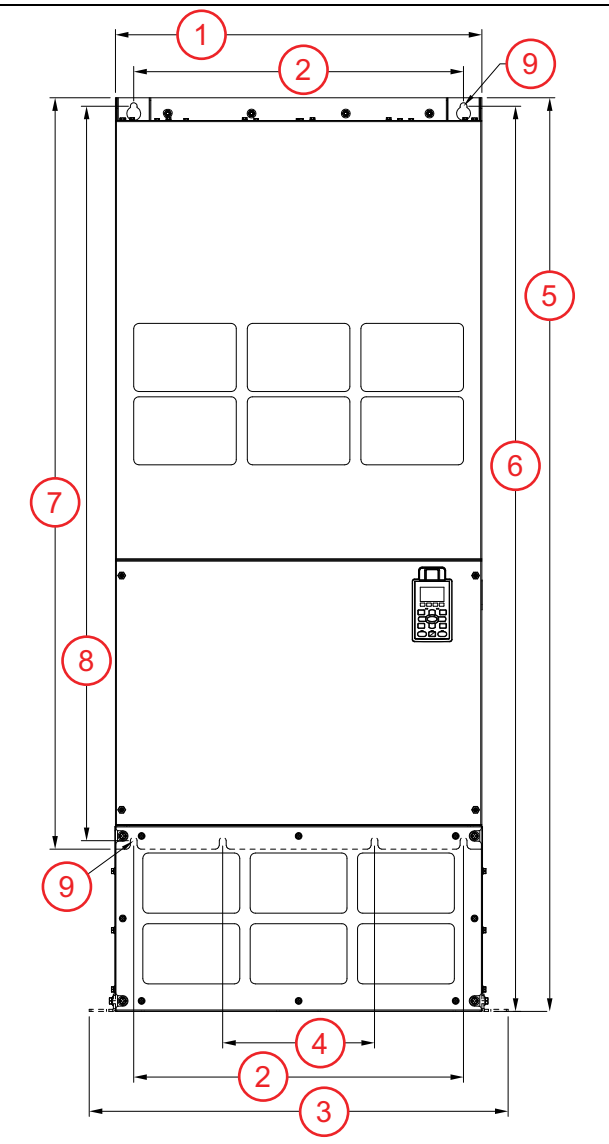
1 - 420 mm (16.5 in)
2 - 380 mm (16 in)
3 - 800 mm (31.5 in)
4 - 770 mm (30.3 in)
5 - 940 mm (37 in)
6 - 717 mm (28 in)
7 - 13 mm (0.51 in)/
- 25 mm (0.98 in)
8 - 300 mm (11.8 in)
9 - 124 mm (4.9 in)
10 - 18 mm (0.71 in)
11 - 18 mm (0.71 in)
12 - 92 mm (3.62 in)
13 - 35 mm (1.38 in)
14 - 22 mm (0.87 in)

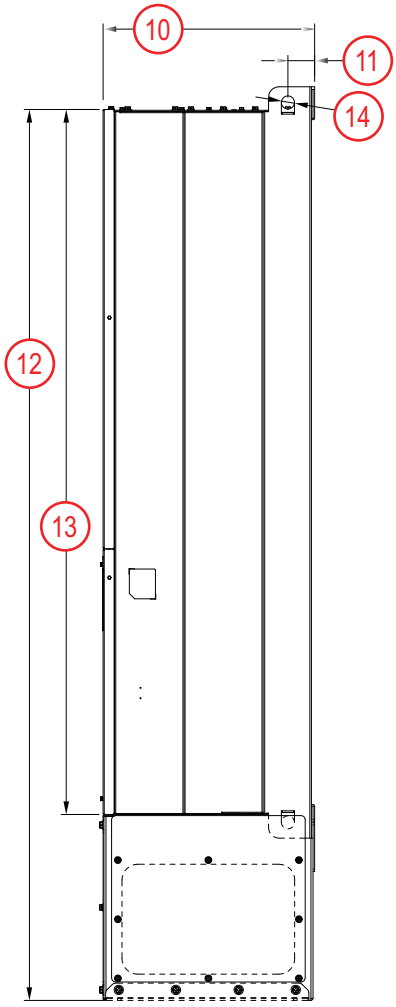
Frame G

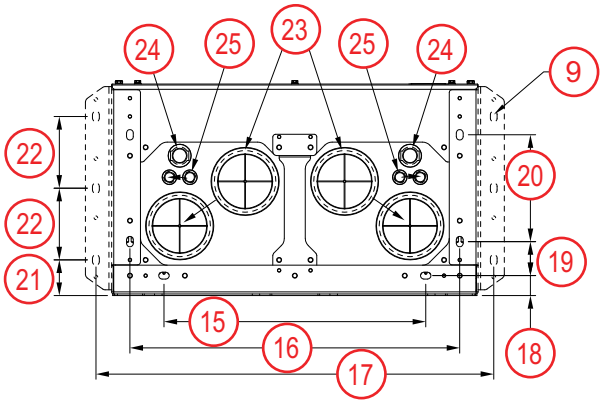


1 - 500 mm (19.7 in)
2 - 440 mm (17.3 in)
3 - 1000 mm (39.4 in)
4 - 963 mm (38 in)
5 - 1240 mm (49 in)
6 - 914 mm (36 in)
7 - 13 mm (0.51 in)/
- 26.5 mm (1.0 in)
8 - 397 mm (15.6 in)
9 - 27 mm (1.0 in)
12 - 117.5 mm (4.6 in)
13 - 34 mm (1.34 in)
14 - 22 mm (0.87 in)

Frame H

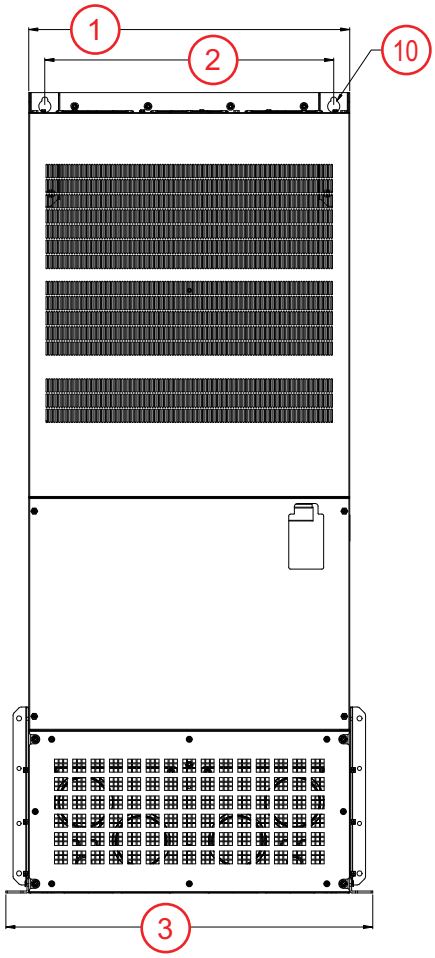


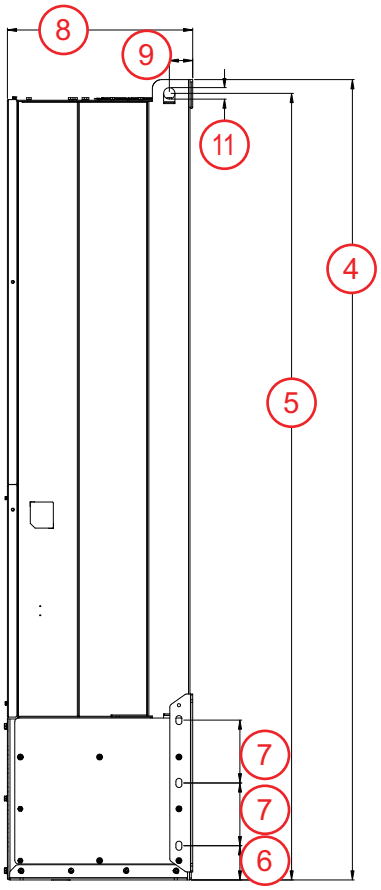


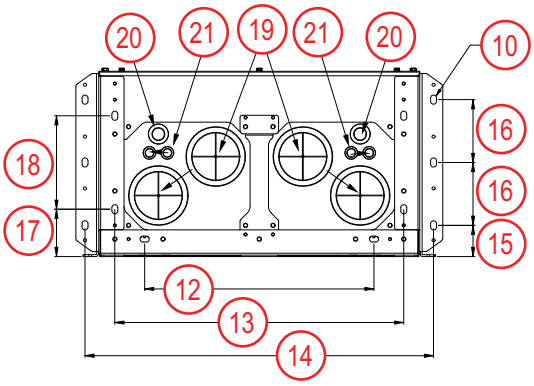


1 - 700 mm (27.6 in)
2 - 630 mm (24.8 in)
3 - 800 mm (31.5 in)
4 - 290 mm (11.4 in)
5 - 1745 mm (68.7 in)
6 - 1729 mm (68.1 in)
7 - 1435 mm (56.5 in)
8 - 1403 mm (55.2 in)
9 - 13 mm (0.51 in)/
- 26.5 mm (1.04 in)
10 - 398 mm (15.7 in)
11 - 45 mm (1.8 in)
12 - 1701 mm (67 in)
13 - 1347 mm (53 in)
14 - 25 mm (1 in)
15 - 500 mm (19.7 in)
16 - 630 mm (24.8 in)
17 - 760 mm (30 in)
18 - 38 mm (1.5 in)
19 - 65 mm (2.6 in)
20 - 204 mm (8 in)
21 - 68 mm (2.7 in)
22 - 137 mm (5.4 in)
23 - 117.5 mm (4.6 in)
24 - 34 mm (1.3 in)
25 - 22 mm (0.87 in)

Frame H (690 V)



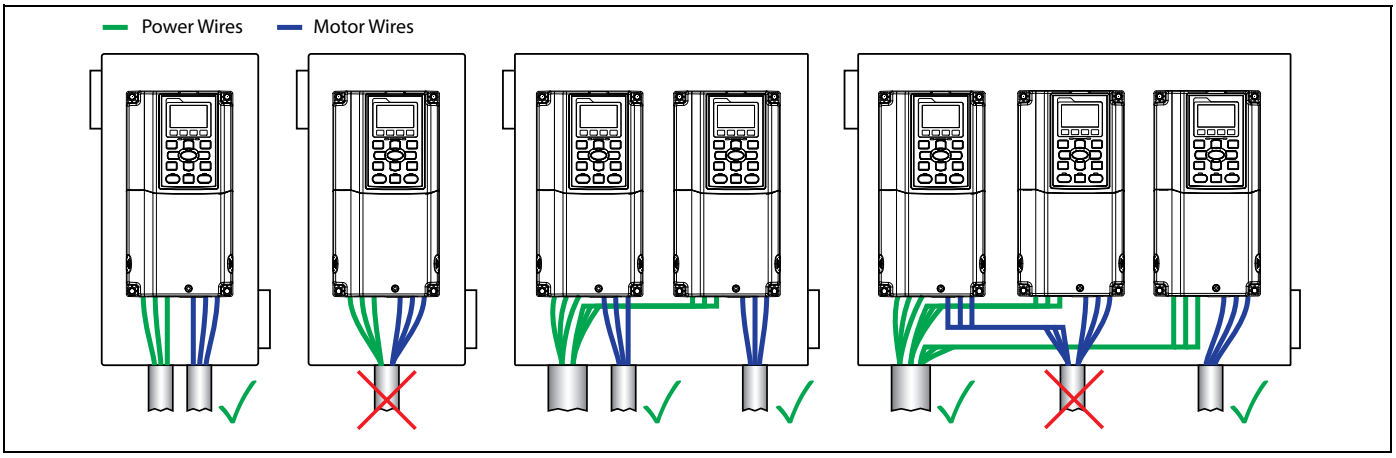




1 - 700 mm (27.6 in)
2 - 630 mm (24.8 in)
3 - 800 mm (31.5 in)
4 - 1745 mm (68.7 in)
5 - 1715 mm (67.5 in)
6 - 42.5 mm (1.7 in)
7 - 109 mm (4.3 in)
8 - 404 mm (15.9 in)
9 - 51 mm (2 in)
10 - 13 mm (0.51 in)/
- 26.5 mm (1.04 in)
11 - 25 mm (0.98 in)
12 - 500 mm (19.7 in)
13 - 630 mm (24.8 in)
14 - 760 mm (30 in)
15 - 68 mm (2.7 in)
16 - 137 mm (5.4 in)
17 - 103 mm (4.1 in)
18 - 204 mm (8 in)
19 - 117.5 mm (4.6 in)
20 - 34 mm (1.3 in)
21 - 22 mm (0.87 in)

ELECTRICAL INSTALLATION

Wiring Guidelines



NOTICE

Risk of damage to VFD, or malfunction can occur.

Follow all wire routing and grounding instructions carefully. Inductive currents caused by parallel wiring, or close proximity between high voltage and control wiring can cause unexpected behaviors.

- Do not run input power and motor wires in the same conduit.
- Do not run motor wires from multiple VFDs in common conduit.
- Do not run control wiring parallel with high voltage wiring.
- Do not run VFD wiring parallel with building or facility wiring.
- Do not use aluminum wires for VFD connections.
- Do not install power factor correction capacitors, surge suppressors, or RFI filters on the VFD output.
- Do not install a magnetic contactor or disconnect in the motor circuit.
- Do not leave wire fragments, metal shavings or other metal objects inside the VFD.
- Improper splicing or damage to motor cable insulation may expose the conductor(s) to moisture and can produce motor cable failure.
- For retrofit application, check the integrity of power and motor leads. This requires measuring the insulation resistance with a suitable megohm-meter.

1. Mount the drive as close as possible to the service entrance panel. Connect directly to the service entrance, not to a sub-panel.
2. Use a dedicated branch circuit for the drive. Verify that the circuit is equipped with a properly-sized circuit breaker or fuse.
3. Separate input power and motor wiring by at least 8 in. (20.3 cm).
4. Cross over other branch circuits and facility wiring at a 90° angle. If necessary to run wires in parallel, separate by at least 8 in. (20.3 cm).
5. All control wiring—sensors, switches, transducers, etc.—should be in a separate conduit routed individually, not parallel, from high voltage wiring. In addition, any shielded cables should be properly grounded.
6. Treat Open-Delta power configuration (two-transformer utility bank) as single-phase power and size VFD and power wiring accordingly.
7. Install a line reactor for VFDs in pump systems with dedicated service transformer to protect VFD from transient power surges and provide some degree of harmonics distortion mitigation.

Branch Circuit Protection

Integral solid-state short circuit protection does not provide branch circuit protection. Branch Circuit Protection must be provided in accordance with the National Electrical Code (NEC) and applicable local codes; or equivalent as determined by Authorities Having Jurisdiction (AHJ). The drive shall be protected by Listed Class J fuses, listed inverse-time circuit breakers, or Franklin Electric Manual Motor Starters.

Short-circuit current rating (SCCR): The drive is suitable for use on a circuit capable of delivering not more than 100,000 symmetrical amperes (rms) when protected by suitable Class J fuses. Rated fuse current shall be maximum 3 times the motor output full-load current (FLA) rating. Rated circuit breaker current shall be maximum 2.5 times the motor output FLA rating when using polyphase AC motors. For all other motors, refer to NEC Sec 430 and the Franklin Electric Aim Manual. When protected by a circuit breaker and placed in a panel, drive SCCR is as follows:

VFD Output Rating	Short Circuit Rating
Up to 50 HP (0 to 37.3 kW)	5,000 Amperes (rms)
51 to 200 HP (39 to 149 kW)	10,000 Amperes (rms)
201 to 400 HP (150 to 298 kW)	18,000 Amperes (rms)
401 to 600 HP (299 to 447 kW)	20,000 Amperes (rms)
601 to 900 HP (448 to 671 kW)	42,000 Amperes (rms)

Fuse and Circuit Breaker Sizing

See the table below for maximum current ratings of fuses and circuit breakers per NEC.

NOTE: Follow local or regional regulations for specific requirements.

Model		Input Current		Class J Fuse Size	Breaker Size
		Constant Torque	Variable Torque		
200V \ 230V	CXD-005A-2V	3.9 A	6.4 A	15 A	15 A
	CXD-007A-2V	6.4 A	9.6 A	20 A	20 A
	CXD-010A-2V	12 A	15 A	30 A	30 A
	CXD-015A-2V	16 A	22 A	40 A	40 A
	CXD-021A-2V	20 A	25 A	50 A	50 A
	CXD-031A-2V	28 A	35 A	60 A	60 A
	CXD-046A-2V	36 A	50 A	100 A	100 A
	CXD-061A-2V	52 A	65 A	125 A	125 A
	CXD-075A-2V	72 A	83 A	150 A	150 A
	CXD-090A-2V	83 A	100 A	200 A	200 A
	CXD-105A-2V	99 A	116 A	225 A	225 A
	CXD-146A-2V	124 A	146 A	250 A	250 A
	CXD-180A-2V	143 A	180 A	300 A	300 A
	CXD-215A-2V	171 A	215 A	400 A	400 A
	CXD-276A-2V	206 A	276 A	450 A	450 A
	CXD-322A-2V	245 A	322 A	600 A	600 A

Model		Input Current		Class J Fuse Size	Breaker Size
		Constant Torque	Variable Torque		
380V \ 480V	CXD-003A-4V	3.5 A	4.3 A	10 A	10 A
	CXD-004A-4V	4.3 A	6.0 A	10 A	10 A
	CXD-005A-4V	5.9 A	8.1 A	15 A	15 A
	CXD-008A-4V	8.7 A	12.4 A	25 A	25 A
	CXD-010A-4V	14 A	16 A	30 A	30 A
	CXD-013A-4V	15.5 A	20 A	40 A	40 A
	CXD-018A-4V	17 A	22 A	40 A	40A
	CXD-024A-4V	20 A	26 A	50 A	50 A
	CXD-032A-4V	25 A	35 A	60 A	60 A
	CXD-038A-4V	35 A	42 A	75 A	75 A
	CXD-045A-4V	40 A	50 A	100 A	100 A
	CXD-060A-4V	47 A	66 A	125 A	125 A
	CXD-073A-4V	63 A	80 A	150 A	150 A
	CXD-091A-4V	74 A	91 A	175 A	175 A
	CXD-110A-4V	101 A	110 A	250 A	250 A
	CXD-150A-4V	114 A	150 A	300 A	300 A
	CXD-180A-4V	157 A	180 A	300 A	300 A
	CXD-220A-4V	167 A	220 A	400 A	400 A
	CXD-260A-4V	207 A	260 A	500 A	500 A
	CXD-310A-4V	240 A	310 A	600 A	600 A
	CXD-370A-4V	300 A	370 A	600 A	600 A
	CXD-460A-4V	380 A	460 A	800 A	800 A
	CXD-530A-4V	400 A	530 A	1000 A	1000 A
	CXD-616A-4V	494 A	616 A	1200 A	1200 A
	CXD-683A-4V	555 A	683 A	1350 A	1350 A
	CXD-770A-4V	625 A	770 A	1500 A	1500 A
	CXD-930A-4V	866 A	930 A	1600 A	2000 A
575V \ 600V	CXD-003A-6V	3.1 A	3.8 A	7 A	7 A
	CXD-004A-6V	4.5 A	5.4 A	10 A	10 A
	CXD-006A-6V	7.2 A	10.2 A	15 A	15 A
	CXD-009A-6V	12.3 A	14.9 A	25 A	25 A
	CXD-012A-6V	15 A	16.9 A	32 A	32 A
	CXD-018A-6V	18 A	21.3 A	50 A	50 A
	CXD-024A-6V	22.8 A	26.3 A	63 A	63 A
	CXD-030A-6V	29 A	36 A	70 A	70 A
	CXD-036A-6V	36 A	43 A	80 A	80 A
	CXD-045A-6V	43 A	54 A	100 A	100 A
	CXD-054A-6V	54 A	65 A	100 A	100 A
	CXD-067A-6V	65 A	81 A	125 A	125 A
	CXD-086A-6V	66 A	84 A	175 A	175 A
	CXD-104A-6V	84 A	102 A	200 A	200 A
	CXD-125A-6V	102 A	122 A	250 A	250 A
	CXD-150A-6V	122 A	147 A	300 A	300 A

Model		Input Current		Class J Fuse Size	Breaker Size
		Constant Torque	Variable Torque		
575V \ 690V	CXD-180A-6V	148 A	178 A	350 A	350 A
	CXD-220A-6V	178 A	217 A	400 A	400 A
	CXD-290A-6V	222 A	292 A	450 A	450 A
	CXD-350A-6V	292 A	353 A	500 A	500 A
	CXD-430A-6V	353 A	454 A	700 A	700 A
	CXD-465A-6V	388 A	469 A	800 A	800 A
	CXD-590A-6V	504 A	595 A	1250 A	1250 A
	CXD-675A-6V	681 A	681 A	1400 A	1400 A

Wire Sizing

Size power wire to maintain a voltage drop less than 2% at VFD or motor terminals.

Frame A: Use only copper conductors rated for at least 75 °C and 600 V. Use cable with a 90 °C rating if ambient environment is greater than 50 °C.

Frame B and above: Use only copper conductors rated for at least 75 °C and 600 V. Use cable with a 90 °C rating if ambient environment is greater than 40 °C (30 °C for models CXD-061A-2V, CXD-105A-2V, CXD-370A-4V, or CXD-930A-4V).

460 and 575 V applications: Install a load (output) reactor to protect motor windings if distance from VFD to a motor is in the range 45-100 feet. Install output dV/dt filter for a range 100-1000 feet (800 feet for submersible pumps) or a sine wave filter for greater distances.

Motor Cable Lengths for Submersible Pumping Applications

Refer to the Franklin Electric AIM Manual for wire gauge and distance information.

NOTE: Output reactors or filters are not required for 200/230V applications.

Suggested Maximum Motor Cable Lengths for Non-Submersible Applications

NOTE: Output reactors or filters are not required for 200/230V applications.

Model		Without output reactor	With output reactor	With dV/dt Filter
380V \ 480V	CXD-003A-4V	13.7 m (45 ft)	30.5 m (100 ft)	305 m (1000 ft)
	CXD-004A-4V			
	CXD-005A-4V			
	CXD-008A-4V			
	CXD-010A-4V			
	CXD-013A-4V			
	CXD-018A-4V			
	CXD-024A-4V			
	CXD-032A-4V			
	CXD-038A-4V			
	CXD-045A-4V			
	CXD-060A-4V			
	CXD-073A-4V			
	CXD-091A-4V			
	CXD-110A-4V			
	CXD-150A-4V			
	CXD-180A-4V			
	CXD-220A-4V			
	CXD-260A-4V			
	CXD-310A-4V			
	CXD-370A-4V			
	CXD-460A-4V			
	CXD-530A-4V			
	CXD-616A-4V			
	CXD-683A-4V			
	CXD-770A-4V			
	CXD-930A-4V			

	Model	Without output reactor	With output reactor	
525V \ 600V	CXD-003A-6V	13.7 m (45 ft)	30.5 m (100 ft)	305 m (1000 ft)
	CXD-004A-6V			
	CXD-006A-6V			
	CXD-009A-6V			
	CXD-012A-6V			
	CXD-018A-6V			
	CXD-024A-6V			
	CXD-030A-6V			
	CXD-036A-6V			
	CXD-045A-6V			
	CXD-054A-6V			
	CXD-067A-6V			
	CXD-086A-6V			
	CXD-104A-6V			
	CXD-125A-6V			
	CXD-150A-6V			
690V	CXD-180A-6V			
	CXD-220A-6V			
	CXD-290A-6V			
	CXD-350A-6V			
	CXD-430A-6V			
	CXD-465A-6V			
	CXD-590A-6V			
	CXD-675A-6V			

Power Wiring Connections

⚠WARNING

Contact with hazardous voltage could result in death or serious injury.

- Disconnect and lock out all power before installing or servicing equipment.
- Always check if DC bus charge LED is off and DC voltage on the terminals DC (+1) and DC (-) is less than 30VDC before working on VFD wiring. The DC bus capacitors may hold high-voltage charge for several minutes after the VFD power is disconnected.
- Connect the motor, the drive, metal plumbing, and all other metal near the motor or cable to the power supply ground terminal using wire no smaller than motor cable wires.
- All wiring must comply with the National Electrical Code and local codes.

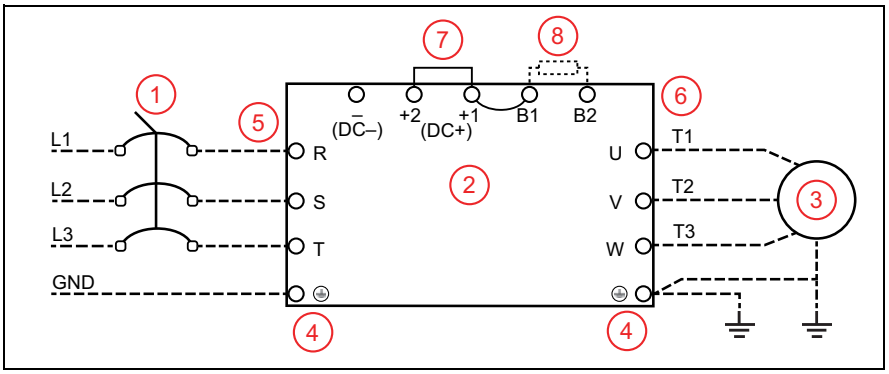
NOTICE

Risk of damage to VFD, or malfunction can occur.

- Do not connect input power to VFD output terminals U, V, and W otherwise VFD can be damaged.
- Ensure that the system is properly grounded all the way to the service entrance panel. Improper grounding may result in loss of voltage surge protection and interference filtering.
- Do not connect any wires except dynamic braking resistor to (B1) and (B2) terminals.
- Do not remove the jumper between terminals (2+) and (1+) except for dynamic braking unit or DC link choke, otherwise the VFD can be damaged.
- When using a general GFCI (Ground Fault Circuit Interrupter), select a current sensor with sensitivity of 200mA or above and not less than 0.1-second operation time to avoid nuisance tripping.

Power Wiring Diagram

1. Branch Protection, Power
2. VFD
3. Motor
4. Ground Terminals
5. Power input terminals
6. Output to Motor terminals
7. Jumper (optional DC reactor, dynamic brake or DC choke unit)
8. Optional brake resistor terminals



Use ring type terminals for the VFD power wiring.

Power line ground and motor ground wires should be connected to designated ground terminals.

Three-phase power, including Open-Delta, must be connected to the R(L1), S(L2), and T(L3) terminals. Proper phase sequencing is not required.

- For single-phase power, connect L1 to R and L2 to S terminals.
- G and H frame VFDs have double-pole power terminals or lugs to accommodate two smaller gauge wires.

Connect three-phase motor wires to the U(T1), V(T2), and W(T3) terminals. When in forward rotation, the motor shaft should turn clockwise when viewed from the motor to the load. If rotation is not correct, reverse any two motor leads.

Frame A: Power terminals accept wire sizes up to 8 AWG and should be tightened to a torque of 17.4 in-lbs (1.96 Nm).

Frame B: Power terminals accept wire sizes up to 4 AWG and should be tightened to a torque of 30.4 in-lbs (3.43 Nm).

Frame C: Power terminals accept wire sizes up to 1/0 AWG and should be tightened to a torque of 69.4 in-lbs (7.84 Nm).

Frame D0: Power terminals accept wire sizes up to 2/0 AWG and should be tightened to a torque of 69.4 in-lbs (7.84 Nm).

Frame D: Power terminals accept wire sizes up to 300 MCM or 4/0 AWG and should be tightened to a torque of 156 in-lbs (18 Nm).

Frame E: Power terminals accept wire sizes up to 4/0 AWG*2 and should be tightened to a torque of 174 in-lbs (20 Nm).

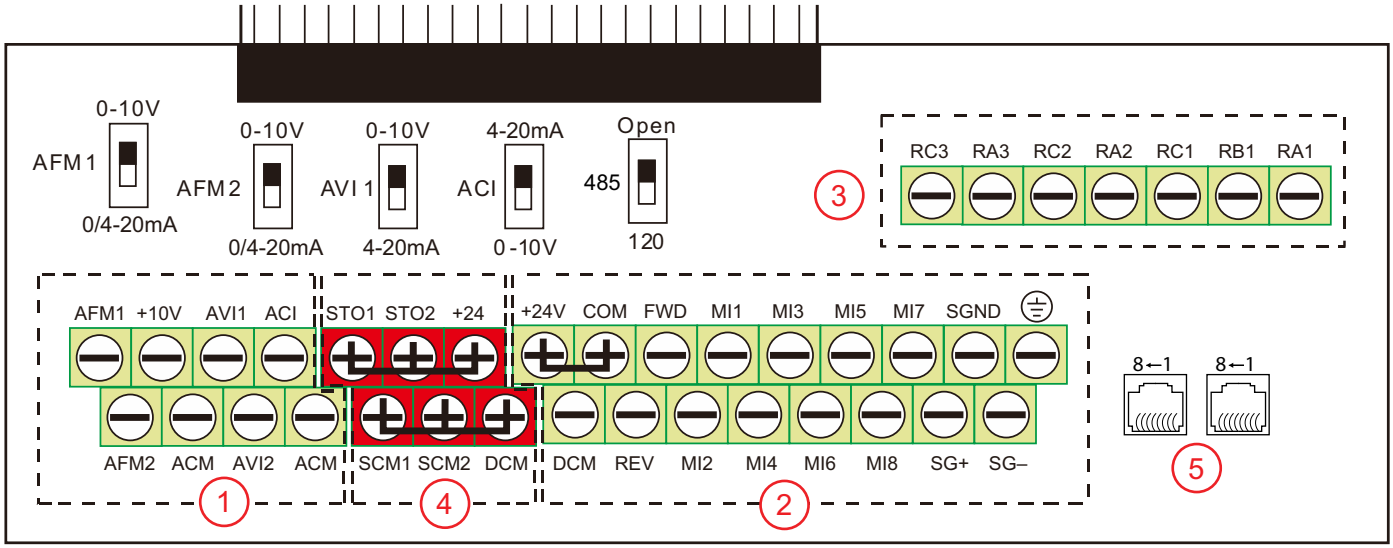
Frame F: Power terminals accept wire sizes up to 300 MCM*2 or 4/0 AWG*2 and should be tightened to a torque of 156 in-lbs (18 Nm).

Frame G: Terminals R, S & T accept wire sizes up to 250 MCM*4 and should be tightened to a torque of 156 in-lbs (18 Nm). Terminals U, V, & T accept wire sizes up to 500 MCM*2 and should be tightened to a torque of 354 in-lbs (40 Nm).

Frame H: Power terminals accept wire sizes up to 350 MCM*4 and should be tightened to a torque of 156 in-lbs (18 Nm).

Control Circuit Connections

Terminal Identification



The control board is divided into 5 groups of terminals and connectors, plus a group of micro switches that control individual terminal configurations.

- Always insulate bare control or shield wires with shrink tubing or electrical tape to prevent short circuit.
- The ideal length of stripped wire for control terminals is 5 mm.

1. **Analog Inputs/Outputs** – These connections are used for transducers, sensors, and control systems such as a BAS, BMS, or PLC. Use shielded cable with shield connected to the ground ⏚ terminal. Terminals accept 26~16 AWG (0.13~1.3mm^2) wires, and should be tightened to a torque of 1.73 lb-in (0.19 Nm).
   - **ACI** is a 0-10 VDC or 4-20 mA input, adjustable by micro switch. Set **[I0–00]** to match the switch setting. Default = 4-20 mA.
   - **AVI1** is a 0-10 VDC or 4-20 mA input, adjustable by micro switch. Set **[I0–05]** to match the switch setting. Default = 0-10 V.
   - **AVI2** is a 0-10VDC input.

     When an input source has been connected, select the appropriate terminal in either **Auto Speed Ref [SET–07]**, **Hand Speed Ref [SET–09]**, or **PID F/B Source [SET–18]**.
   - **AFM1 & AFM2** are programmable, multi-function analog outputs. Refer to **[I0–59]** and **[I0–61]** for options. Each output can be set by micro switch to 0-10V (min load 5k Ω at 2 mA) or 0/4-20 mA (max load 500 Ω).
   - **+10V** terminal (with common ACM) provides a +10 VDC 50 mA power supply for input devices.
   - **ACM** terminals are the common for analog inputs, outputs and +10 VDC power supply. All ACM terminals are connected internally.

     IMPORTANT: DCM and ACM terminals are isolated from each other and from the ground. Do not connect these terminals to earth ground, which can cause electrical noise in control circuits and unstable VFD operation.

2. **Digital Inputs & RS-485 Communication** – These connections provide input for a wide selection of switches or programmable controls. Use shielded cable or twisted wires for 24 VDC digital control circuits wiring and separate these wires from the main power and motor wiring and other high voltage circuits. Terminals accept wire sizes from 26~16 AWG (0.2~1.5mm^2), and should be tightened to a torque of 6.9 lb-in (0.78 Nm).

   NOTES:
   - Digital inputs are configured for NPN (Sink) mode by default, with a jumper across +24 and COM terminals. Refer to "NPN and PNP Digital Inputs Configuration" on page 46.
   - All digital inputs can be re-programmed from Normally Open to Normally Closed.
   - Digital inputs are activated by voltage 11 VDC or greater. Maximum input voltage rating is 27 VDC at 3.5 mA.

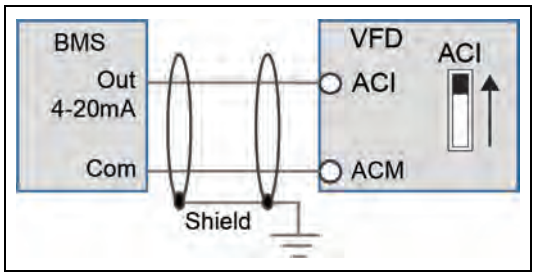
   - **MI1-MI8** are programmable, multi-function digital inputs that can be used for a variety of switching features with common terminal DCM. Refer to **[I0-21]** through **[I0-28]** for options.
   - **FWD & REV** are dedicated Forward and Reverse run commands. If any digital input is programmed for FWD or REV, corresponding dedicated FWD or REV input will be disabled automatically.
   - **SG+, SG-, & SGND** are RS485 communication terminals for PLC, Modbus, or BACnet. Use **[PLC-23]** to set the com type. Termination resistance is controlled by micro switch. Set the 485 switch to the **Down** position to connect 120 Ω termination resistance for long distance or for an electrically noisy environment.
   - **+24** terminal provides 24 VDC (with DCM common) 50 mA power for digital control circuits and 150 mA for external transducers.
   - **COM** terminal is a digital inputs common. By default, it is connected by jumper to +24 to configure NPN (Sink) mode.
   - **DCM** is the internal 24 VDC power supply common.
   - ⏚ Earth ground. Use this terminal to connect shield wires.

     IMPORTANT: DCM and ACM terminals are isolated from each other and from the ground. Do not connect these terminals to earth ground, which can cause electrical noise in control circuits and unstable VFD operation.

3. **Relay Outputs** – These are configurable, multi-function, dry contact relays. Refer to **[I0-47]** through **[I0-49]** for options. Terminals accept wire sizes from 26~16 AWG (0.2~1.5mm^2), and should be tightened to a torque of 4.3 lb-in (0.49 Nm).
   - Relays ratings are 1.25A at 250 VAC, or 3A at 30 VDC.
   - RA1-RB1-RC1 is a single-pole, double throw relay. RA1-RC1 is N.O. (normally open), and RB1-RC1 is N.C. (normally closed).
   - RA2-RC2 and RA3-RC3 are independent single pole, single throw, normally open relays.
4. **Safety Off Inputs** – These connections provide emergency stop control from an external system. By default, the inputs are closed through jumper wires, allowing the drive to run.
5. **RJ-45 Sockets** – These connections are communication terminals for PLC, Modbus, or BACnet. Use **[PLC-23]** to set the Com Type. Then set both Speed Reference and Run Command to **RS485**. Both RJ-45 sockets are connected internally.

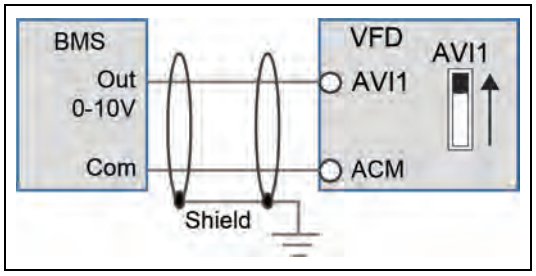
Example Configurations

4-20mA Speed Control Signal from an External BMS or PLC:



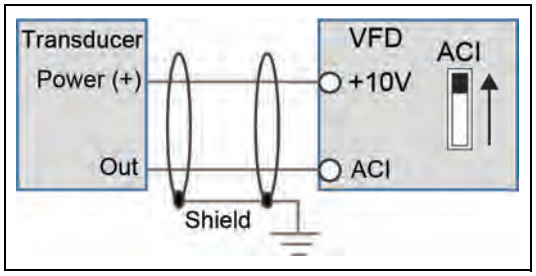
- Connect the BMS or PLC output signal to the ACI or AVI1 terminal. The ACI micro switch should be in the **UP** position. If using the AVI1 terminal, the AVI1 micro switch should be **DOWN**.
- Connect the BMS Com wire to the ACM terminal (signal ground).
- Any shield wire should be connected to ⏚ Earth ground.
- **ACI Input Select [I0–00]** or **AVI1 Input Select [I0–05]** should be set to the correct signal type.
- **Auto Speed Reference [SET–07]** should be set to the chosen input.

0-10V Speed Control Signal from an External BMS or PLC:



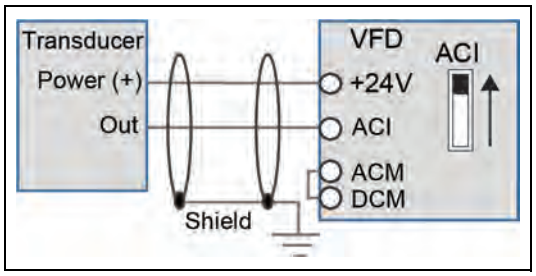
- Connect the BMS or PLC output signal to the AVI1, AVI2, or ACI terminal. The AVI1 micro switch should be in the **UP** position. If using the ACI terminal, the ACI micro switch should be **DOWN**.
- Connect the BMS Com wire to the ACM terminal (signal ground).
- Any shield wire should be connected to ⏚ Earth ground.
- **AVI1 Input Select [I0–05]** or **ACI Input Select [I0–00]** should be set to **0-10V**.
- **Auto Speed Reference [SET–07]** should be set to the chosen input.

4-20mA Transducer with VFD 10 VDC Power:



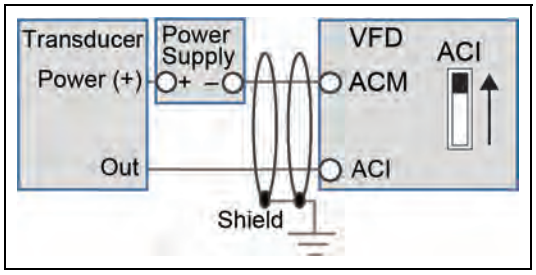
- Connect the transducer positive (Ppower) wire to the VFD +10V terminal.
- Connect the transducer output (Out) wire to the ACI or AVI1 terminal. The ACI micro switch should be in the **UP** position. If using the AVI1 terminal, the AVI1 micro switch should be **DOWN**.
- Any shield wire should be connected to ⏚ Earth ground.
- **ACI Input Select [I0–00]** or **AVI1 Input Select [I0–05]** should be set to the correct signal type.
- **Auto Speed Reference [SET–07]** should be set to **PID Output**, **PID Feedback Source [SET–18]** should be set to the chosen input, and **PID Feedback Units [SET–19]** should be set to the appropriate scale (psi, temp, flow, etc.).

4-20mA Transducer with VFD 24 VDC Power:



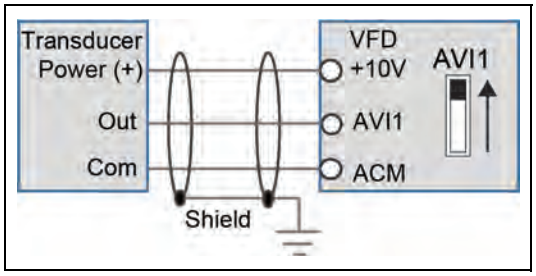
- Connect the transducer positive (Power) wire to the VFD +24V terminal.
- Connect the transducer output (Out) wire to the ACI or AVI1 terminal. The ACI micro switch should be in the **UP** position. If using the AVI1 terminal, the AVI1 micro switch should be **DOWN**.
- Use a jumper wire to connect the ACM and DCM terminals.
- Any shield wire should be connected to ⏚ Earth ground.
- **ACI Input Select [I0–00]** or **AVI1 Input Select [I0–05]** should be set to the correct signal type.
- **Auto Speed Reference [SET–07]** should be set to **PID Output**, **PID Feedback Source [SET–18]** should be set to the chosen input, and **PID Feedback Units [SET–19]** should be set to the appropriate scale (psi, temp, flow, etc.).

4-20mA Transducer with External 24 VDC Power:



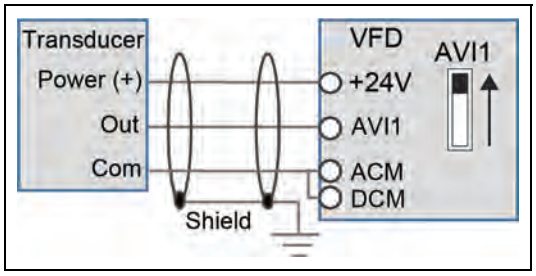
- Connect the transducer positive (Power) wire to the external source positive [+24V]. Connect the external source negative to the VFD ACM terminal.
- Connect the transducer output (Out) wire to the ACI or AVI1 terminal. The ACI micro switch should be in the **UP** position. If using the AVI1 terminal, the AVI1 micro switch should be **DOWN**.
- Any shield wire should be connected to ⏚ Earth ground.
- **ACI Input Select [I0–00]** or **AVI1 Input Select [I0–05]** should be set to the correct signal type.
- **Auto Speed Reference [SET–07]** should be set to **PID Output**, **PID Feedback Source [SET–18]** should be set to the chosen input, and **PID Feedback Units [SET–19]** should be set to the appropriate scale (psi, temp, flow, etc.).

0-10VDC Transducer with VFD 10 VDC Power:



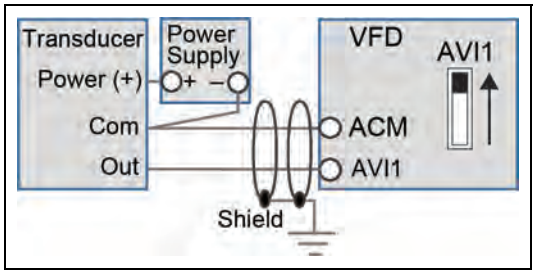
- Connect the transducer positive (Power) wire to the VFD +10V terminal.
- Connect the transducer output (Out) wire to the AVI1, AVI2, or ACI terminal. The AVI1 micro switch should be in the **UP** position. If using the ACI terminal, the ACI micro switch should be **DOWN**.
- Connect the transducer Com wire to the ACM terminal (signal ground).
- Any shield wire should be connected to ⏚ Earth ground.
- **AVI1 Input Select [I0–05]** or **ACI Input Select [I0–00]** should be sset to **0-10V**.
- **Auto Speed Reference [SET–07]** should be set to **PID Output**, **PID Feedback Source [SET–18]** should be set to the chosen input, and **PID Feedback Units [SET–19]** should be set to the appropriate scale (psi, temp, flow, etc.).

0-10VDC Transducer with VFD 24 VDC Power:



- Connect the transducer positive (Power) wire to the VFD +24V terminal.
- Connect the transducer output (Out) wire to the AVI1, AVI2, or ACI terminal. The AVI1 micro switch should be in the **UP** position. If using the ACI terminal, the ACI micro switch should be **DOWN**.
- Connect the transducer Com wire to the ACM terminal (signal ground).
- Use a jumper wire to connect the ACM and DCM terminals.
- Any shield wire should be connected to ⏚ Earth ground.
- **AVI1 Input Select [I0–05]** or **ACI Input Select [I0–00]** should be set to **0-10V**.
- **Auto Speed Reference [SET–07]** should be set to **PID Output**, **PID Feedback Source [SET–18]** should be set to the chosen input, and **PID Feedback Units [SET–19]** should be set to the appropriate scale (psi, temp, flow, etc.).

0-10VDC Transducer with External 24 VDC Power:

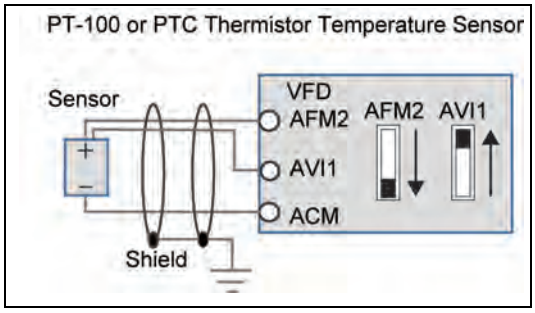


- Connect the transducer positive (Power) wire to the external source positive [+24V].
- Connect the transducer Com wire to the external source negative.
- Connect the transducer output (Out) wire to the AVI1, AVI2, or ACI terminal. The AVI1 micro switch should be in the **UP** position. If using the ACI terminal, the ACI micro switch should be **DOWN**.
- Any shield wire should be connected to ⏚ Earth ground.
- **AVI1 Input Select [I0–05]** or **ACI Input Select [I0–00]** should be set to **0-10V**.
- **Auto Speed Reference [SET–07]** should be set to **PID Output**, **PID Feedback Source [SET–18]** should be set to the chosen input, and **PID Feedback Units [SET–19]** should be set to the appropriate scale (psi, temp, flow, etc.).

Temperature Protection or PID Control with PT-100 or PTC Sensor:

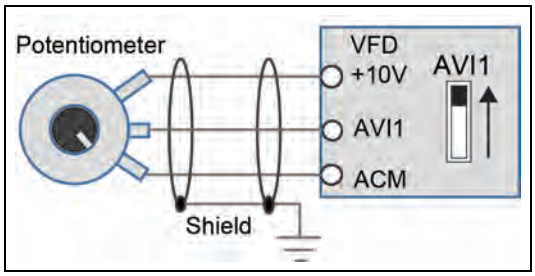
- Connect the sensor Positive wire to the AFM2 terminal. Place the AFM2 micro switch in the **DOWN** position.
- Connect the sensor Negative wire to the ACM terminal.
- Use a jumper wire to connect the AFM2 and AVI1 terminals. The AVI1 micro switch should be in the **UP** position.
- Any shield wire should be connected to ⏚ Earth ground.

For specific parameter setups, please call Technical Support.



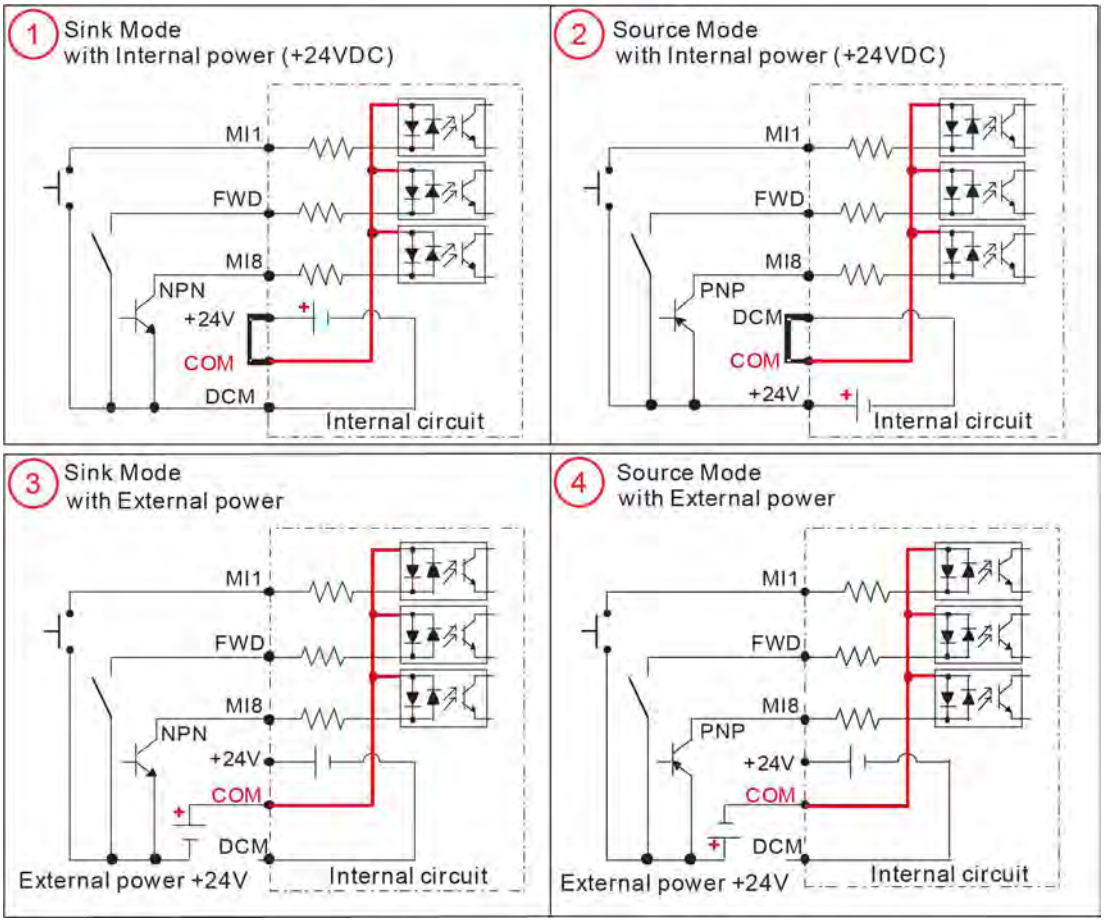
Speed Control using 0-10 VDC Potentiometer:

- Connect the potentiometer Positive wire to the VFD +10V terminal.
- Connect the potentiometer Output wire to the AVI1, AVI2, or ACI terminal. The AVI1 micro switch should be in the **UP** position. If using the ACI terminal, the ACI micro switch should be **DOWN**.
- Connect the potentiometer Com wire to the ACM terminal (signal ground).
- Any shield wire should be connected to ⏚ Earth ground.
- **AVI1 Input Select [I0–05]** or **ACI Input Select [I0–00]** should be set to **0-10V**.
- **Auto Speed Reference [SET–07]** or **Hand Speed Reference [SET–09]** should be set to the chosen input.



NPN and PNP Digital Inputs Configuration

Cerus X-Series drive control can be configured to Sink (NPN) or Source (PNP) modes by providing proper wiring and installing/removing jumper on terminals +24, COM and DCM.



The picture above shows four possible digital inputs configurations:

1. **Sink (NPN) mode with internal 24VDC power source (Default).** Install jumper between +24 and COM terminals. Connect dry contact or NPN transistor output from external control device to desired digital input and DCM terminals. When contact is closed or transistor is in conducting state, digital input will be activated by internal power supply.
2. **Source (PNP) mode with internal 24VDC power source.** Install jumper between DCM and COM terminals. Connect dry contact or PNP transistor output from external control device to desired digital input and +24 terminals. When contact is closed or transistor is in conducting state, digital input will be activated by internal power supply.
3. **Sink (NPN) mode with external 24VDC power source.** Remove any jumpers between +24 and COM or DCM and CM terminals. Connect positive terminal of external power supply to COM terminal. Connect dry contact or NPN transistor output from external control device to desired digital input and negative terminal of external power supply. When contact is closed or transistor is in conducting state, digital input will be activated by external power supply.
4. **Source (PNP) mode with external 24VDC power source.** Remove any jumpers between +24 and COM or DCM and CM terminals. Connect negative terminal of external power supply to COM terminal. Connect dry contact or PNP transistor output from external control device to desired digital input and positive terminal of external power supply. When contact is closed or transistor is in conducting state, digital input will be activated by external power supply.

DRIVE PROGRAMMING

Using the Keypad

LCD Display Screen

Function Keys provide access to (**F1**) Jog Function, (**F2**) View Mode, and (**F3**) Fault history.

The **HAND** LED indicates when the VFD is in Hand mode.

The **Back** key returns display to the previous screen. From the first MENU screen, this key displays a basic drive menu.

Left and Right Arrow keys allow navigation between parameter groups, cursor movement when setting a value, and for increment of numeric values.

The **HAND** key places the VFD in Hand mode when keypad control is enabled.

The **START** key starts the motor when keypad control is enabled. The LED indicates that a Start command is present.

The **FWD/REV** key selects motor direction when enabled. The LED lights either green or red to indicate selection.

The **ESC** key returns to the Home Screen from any menu.

The **RUN** LED indicates that power is being sent to the motor.

Up and Down Arrow keys allow navigation within a parameter group.

The **MENU** key provides access for editing all parameter groups. Pressing **BACK** from this screen displays a basic drive menu.

The **ENTER** key places the VFD in programming mode and confirms changes to parameters.

The **AUTO** key places the VFD in Auto mode when keypad control is enabled.

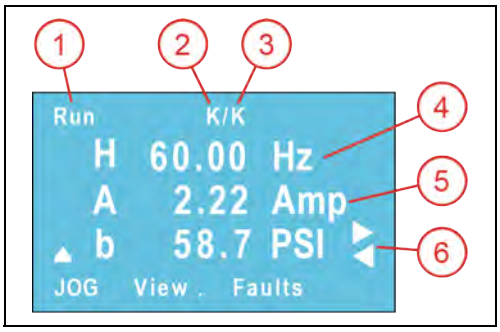
The **STOP/RESET** key stops the motor when keypad control is enabled, or if enabled in remote mode. The LED indicates that the VFD is stopped. RESET can be used to clear some faults.

Home Screen Display Options

1. Operating Status
- Run/Stop
- Limit by PID 2
- Ctrl by PID 2
- Stopped by AI
- Backspin Timer
- Lubrication
- Limit by Level
- Limit by Temp
- Stall

2. Command Source
- K = Keypad
- T = Terminal control
- R = RS485
- O = Option board

3. Frequency Source
- K = Keypad/PID
- V1 = from AV1
- V2 = from AV2
- C = from ACI
- R = RS485
- O = Option board
- 1-15 = Step speed
- J = Jog frequency



4. User Selectable Display Line 1. Use Arrow and Enter keys to step through selections and to change setpoints.
- H = Output speed when running (Hz).
- P = PID Setpoint in application based units (PSI, inWC, etc.) **[SET–21]**. This is adjustable using the keypad.
- F = Keypad Speed Reference (Hz) when SET–07 or SET–09 is set to Keypad. This is adjustable using the keypad.

5. User Selectable Display Line 2. Other options available through **[VFD–48]**.

6. User Selectable Display Line 3. Use Arrow keys to step through choices. This display corresponds to choices in **[SET–57]**.

Setting Operating Parameters

Enter Required Parameters Before Starting VFD

1. **Application [SET–00]:** Use the keypad to select the type of application the drive will control. When a selection has been made, application related parameters will be automatically updated to proper defaults. Enter the following parameters to ensure best performance for the specific installation.

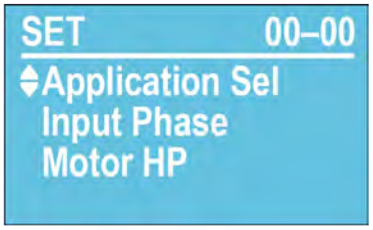
   NOTE: The **BASIC** application provides standard VFD control with start/stop command from keypad and speed reference from a remote analog signal. For systems using a transducer or other control sensors, choose the relevant motor type to ensure that correct defaults are set.

   NOTE: When using a **MagForce** or other permanent magnet motor application, refer to "Operation with Permanent Magnet Motors" on page 79.

2. **Input Phase [SET–01]:** Verify that the setting matches the type of power supply— 3-phase (default).
3. **Motor Horsepower [SET–02]:** Enter the rated horsepower from the motor nameplate.
4. **Motor FLA (SFA) [SET–03]:** Enter the FLA (Full Load Amps) rating from the motor nameplate; or, enter SFA (Service Factor Amps) if using a submersible pump motor.
5. **Motor RPM [SET–04]:** Enter the rated motor RPM from the motor nameplate.
6. **Motor Voltage [SET–05]:** Enter the rated voltage from the motor nameplate.

Main Menu

Set Menu



Verify Default Settings

After the initial parameters have been entered, the following default settings should be checked and adjusted to ensure expected operation. Refer to the "Default Settings Tables" on page 50 for a list of automatically populated settings per application.

1. **VFD Max Freq [VFD–00]:** The highest frequency (speed) allowable. If running a MagForce pump, this should be set to the calculated electrical frequency corresponding to the target pump RPM. Refer to "Setup MagForce Pump Motor" on page 80.
2. **VFD Base Freq [VFD–02]:** This should be set to the motor nameplate frequency rating.
3. **Auto Speed Ref [SET–07]:** Select the source of frequency (speed) setpoint the drive will use when in Auto mode.
   - When using one of the analog inputs with an automated BAS, BMS, or PLC system, be sure to configure the terminal for the correct impedance. Refer to "Terminal Identification" on page 41.
   - When using feedback from an analog sensor, such as a transducer, select PID Output. When PID mode is selected, additional parameters must be verified for setpoints, inputs, and limits.
   - When set to Keypad, the drive will run at the Keypad Speed Reference (F on display).
4. **Auto Run Command [SET–08]:** Select the source of RUN command when VFD is in Auto Mode—Keypad or external.
5. **Hand Speed Ref [SET–09]:** Select the source of frequency (speed) setpoint the drive will use when in Hand mode. PID is disabled in Hand mode. Be sure to configure any selected input terminals for the correct impedance.
   - When set to Keypad, the drive will run at the Keypad Speed Reference (F on display).
6. **Hand Run Command [SET–10]:** Select the source of RUN command when VFD is in Hand Mode—Keypad or external.
7. **Acceleration Time [SET–11]:** Enter a time in seconds for drive to ramp up from stop to maximum frequency. Recommended defaults are 2 seconds for submersible pump motors and 20 seconds for most other applications. Additional acceleration curves can be added for more precise control through selected frequency ranges. Refer to "Acceleration/Deceleration Control" on page 71.

8. **Deceleration Time [SET–12]:** Enter a time in seconds to slow down from maximum frequency to stop. Recommended defaults are 2 seconds for submersibles and 30 seconds for surface/boost pumps. This setting is only effective when **Stop Mode [SET–16]** is set to **Decelerate**. Additional deceleration curves can be added for more precise control through selected frequency ranges. Refer to "Acceleration/Deceleration Control" on page 71.
9. **Low Frequency Limit [SET–13]:** The lowest frequency (speed in Hz) allowed by the VFD in any mode.
10. **High Frequency Limit [SET–14]:** Enter the highest frequency (speed in Hz) allowed by the VFD in any mode.
11. **PID Mode [SET–17]:** Enables or disables PID control, either direct or inverse.
12. **PID Feedback Source [SET–18]:** Selects an input terminal for PID Feedback source. Be sure to configure the terminal for the correct impedance.
13. **PID Feedback Unit [SET–19]:** Selects a measurement unit for PID feedback.
14. **Feedback Max [SET–20]:** Enter the maximum reading of the feedback source. This is used to scale the sensor. For example: if using a 0–200 psi transducer, enter 200.
15. **PID Setpoint [SET–21]:** Enter the desired value for the drive to maintain in PID mode, running in Auto. This parameter can also be changed through keypad control.
16. **PID Low Frequency Limit [SET–22]:** PID frequency output will be limited to this value.
17. **PID High Frequency Limit [SET–23]:** PID frequency output will be limited to this value.
18. **Language:** Select a desired language for the display. Press the **Menu** button and then press the **Back** button. Use the **Down** keys to display **Set Language**.
19. **Clock:** Set current time and date. This setting is used to record real-time data for faults, parameter changes, etc. Press the **Menu** button and then press the **Back** button. Use the **Down** keys to display **Set Time**.

Verify Control Terminal Settings

For each type of control hardware that has been connected to the system—sensors, switches, BAS, etc., make sure that the matching function parameters have been identified for the input terminals. For more information, refer to "Example Configurations" on page 43 or to "Parameter Descriptions > I/O Menu" on page 122.

Enter or Verify Optional Settings

If using any of the optional features available in the system, make sure that all related parameters are set for the desired operation. Refer to the application descriptions in "Operation" on page 63 for information about these features:

- **Automation features:** Refer to "Standard Operation with an Automated Control System" on page 66.
- **Protection features:** Refer to "Protection Features" on page 75.
- **Communications features:** Refer to "Communications" on page 85.
- **Multi-Motor applications:** Refer to "Multi-Motor (MMC) Relay Control for Pump Applications" on page 84.

For more details on individual parameter settings, refer to "Parameter Reference Tables" on page 115.

Default Settings Table – SET Menu

Parameters in highlighted rows are reset when the application is changed **[SET–00]**.

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
SET-01	Input Phase	3-Phase	3-Phase	3-Phase	3-Phase	3-Phase	3-Phase	3-Phase	3-Phase	3-Phase	3-Phase
SET-02	Motor HP	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating
SET-03	Motor FLA (SFA)	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating
SET-04	Motor RPM	1750	1750	1750	1750	1750	3450	1750	1750	3450	3600
SET-05	Motor Voltage	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating
SET-06	Carrier Frequency	2 kHz	2 kHz	2 kHz	2 kHz	2 kHz	2 kHz	2 kHz	2 kHz	2 kHz	2 kHz
SET-07	Auto Speed Ref	ACI Analog	PID Output	PID Output	PID Output	PID Output	PID Output	PID Output	ACI Analog	ACI Analog	PID Output
SET-08	Auto Run Cmd	Digital Inpt	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad
SET-09	Hand Speed Ref	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad
SET-10	Hand Run Cmd	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad
SET-11	Accel Time	20 Sec	20 Sec	20 Sec	20 Sec	20 Sec	2 Sec	20 Sec	20 Sec	20 Sec	2 Sec
SET-12	Decel Time	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec	2 Sec	30 Sec	30 Sec	30 Sec	2 Sec
SET-13	Low Freq Limit	20 Hz	20 Hz	20 Hz	20 Hz	20 Hz	30 Hz	20 Hz	0 Hz	40 Hz	60 Hz
SET-14	High Freq Limit	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	115 Hz	115Hz
SET-15	Load Rotation	FWD Only	FWD Only	FWD Only	FWD Only	FWD Only	FWD Only	FWD Only	FWD Only	FWD Only	FWD & REV
SET-16	Stop Mode	Coast	Coast	Coast	Coast	Decel	Coast	Coast	Decel	Coast	Coast
SET-17	PID Mode	Disable	PID Direct	PID Inverse	PID Inverse	PID Direct	PID Direct	PID Direct	PID Direct	PID Direct	PID Direct
SET-18	PID F/B Source	ACI	ACI	ACI	ACI	ACI	ACI	ACI	ACI	ACI	ACI
SET-19	PID F/B Unit	PSI	inWC	inWC	°F	PSI	PSI	inWC	PSI	inWC	PSI
SET-20	PID F/B Max	1 PSI	1 inWC	1 inWC	150 °F	100 PSI	100 PSI	407 inWC	100 PSI	1 inWC	100 PSI
SET-21	PID Setpoint	0.5 PSI	0.5 inWC	0.5 inWC	76 °F	60 PSI	60 PSI	60 PSI	60 PSI	0.5 inWC	60 PSI
SET-22	PID Lo Hz Limit	20 Hz	20 Hz	20 Hz	20 Hz	20 Hz	30 Hz	20 Hz	20 Hz	40 Hz	60 Hz
SET-23	PID Hi Hz Limit	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	115Hz	115Hz
SET-24	PID P-Gain	1%	1%	1%	1%	2%	2%	1%	1%	1%	2%
SET-25	PID I-Time	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	0.5 Sec	1 Sec	0.5 Sec
SET-26	Sleep Mode	Disabled	Disabled	Disabled	Disabled	Sleep Only	Sleep Only	Disabled	Disabled	Disabled	Sleep Only
SET-27	Sleep Check Time	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec
SET-28	Sleep Delay Time	6 Sec	6 Sec	6 Sec	6 Sec	6 Sec	6 Sec	6 Sec	6 Sec	6 Sec	6 Sec
SET-29	Sleep Boost Value	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
SET-30	Sleep Boost Timer	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec
SET-31	Wake-Up Level	0.5 PSI	0.5 inWC	0.5 inWC	75 °F	55 PSI	55 PSI	55 inWC	55 PSI	0.5 inWC	55 PSI
SET-32	Sleep Bump Timer	5 Sec	5 Sec	5 Sec	5 Sec	5 Sec	5 Sec	5 Sec	5 Sec	5 Sec	5 Sec
SET-33	Pipe Fill Timer	0 Min	0 Min	0 Min	0 Min	0 Min	0 Min	0 Min	0 Min	0 Min	3 Min
SET-34	Pipe Fill Exit Level	0.4 PSI	0.4 inWC	0.4 inWC	74 °F	25 PSI	25 PSI	25 inWC	25 PSI	0.4 inWC	25 PSI
SET-35	Pipe Fill Freq	47 Hz	47 Hz	47 Hz	47 Hz	47 Hz	47 Hz	47 Hz	47 Hz	95 Hz	95 Hz
SET-36	Broken Pipe Level	0 PSI	0 inWC	0inWC	0 °F	15 PSI	15 PSI	0 inWC	0 PSI	0.4 inWC	15 PSI
SET-37	Broken Pipe Freq	59.5 Hz	59.5 Hz	59.5 Hz	59.5 Hz	59.5 Hz	59.5 Hz	59.5 Hz	59.5 Hz	114 Hz	114 Hz
SET-38	Broken Pipe Delay	180 Sec	180 Sec	180 Sec	180 Sec	180 Sec	180 Sec	180 Sec	180 Sec	180 Sec	180 Sec
SET-39	OverPress Set	Disabled	Disabled	Disabled	Disabled	OP Auto Reset	OP Auto Reset	Disabled	OP Auto Reset	Disabled	OP Auto Reset
SET-40	Overpressure Lvl	1 PSI	1 inWC	1 inWC	80 °F	80 PSI	80 PSI	80 inWC	80 PSI	1 inWC	80 PSI
SET-41	Underload Select	By Current	By Current	By Current	By Current	By Current	By Current	By Current	By Current	By Torque	By Torque
SET-42	Underload Level	45%	45%	45%	45%	45%	70%	45%	45%	45%	70%
SET-43	Underload Freq	30 Hz	30 Hz	30 Hz	30 Hz	30 Hz	59 Hz	30 Hz	20 Hz	40 Hz	60 Hz
SET-44	Underload Delay	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec
SET-45	ULD Recovery T	0 Min	0 Min	0 Min	0 Min	30 Min	30 Min	0 Min	0 Min	0 Min	30 Min
SET-46	ULD Recovery Cnt	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
SET-47	High Load Select	By Current	By Current	By Current	By Current	By Current	By Current	By Current	By Current	By Torque	By Torque

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
SET-48	High Load Level	110%	110%	110%	110%	110%	110%	110%	150%	110%	110%
SET-49	High Load Freq	20 Hz	20 Hz	20 Hz	20 Hz	20 Hz	30 Hz	20 Hz	20 Hz	40 Hz	60 Hz
SET-50	High Load Delay	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	5 Sec
SET-51	HLD Recovery T	0 Min	0 Min	0 Min	0 Min	0 Min	0 Min	0 Min	0 Min	0 Min	0 Min
SET-52	HLD Recovery Cnt	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
SET-53	ACC Change Freq	0 Hz	0 Hz	0 Hz	0 Hz	0 Hz	0 Hz	0 Hz	0 Hz	0 Hz	60 Hz
SET-54	Second ACC	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	5 Sec
SET-55	Second DCC	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	5 Sec
SET-56	ACC/DCC Hyster	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz
SET-57	User Display	PID Feedback	PID Feedback	PID Feedback	PID Feedback	PID Feedback	PID Feedback	PID Feedback	PID Feedback	PID Feedback	PID Feedback
SET-58	PLC Menu	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
SET-59	ADV2 Menu Hide	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
SET-60	HOA Mode Source	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad

Default Settings Table – VFD Menu

Parameters in highlighted rows are reset when the application is changed **[SET–00]**.

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
VFD-00	VFD Max Freq	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	115Hz	115 Hz
VFD-01	VFD Start Freq	0.50 Hz	0.50 Hz	0.50 Hz	0.50 Hz	0.50 Hz	0.50 Hz	0.50 Hz	0.50 Hz	0.50 Hz	0.50 Hz
VFD-02	VFD Base Freq	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	120 Hz	120 Hz
VFD-03	V/F Pattern	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear
VFD-04	Step Freq-1	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-05	Step Freq-2	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-06	Step Freq-3	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-07	Step Freq-4	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-08	Step Freq-5	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-09	Step Freq-6	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-10	Step Freq-7	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-11	Step Freq-8	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-12	Step Freq-9	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-13	Step Freq-10	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-14	Step Freq-11	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-15	Step Freq-12	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-16	Step Freq-13	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-17	Step Freq-14	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-18	Step Freq-15	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-19	ACC-2 Time	40 Sec	40 Sec	40 Sec	40 Sec	40 Sec	2 Sec	40 Sec	40 Sec	40 Sec	2 Sec
VFD-20	DEC-2 Time	40 Sec	40 Sec	40 Sec	40 Sec	40 Sec	2 Sec	40 Sec	40 Sec	40 Sec	2 Sec
VFD-21	ACC-3 Time	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec
VFD-22	DEC-3 Time	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec
VFD-23	ACC-4 Time	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec
VFD-24	DEC-4 Time	40 Sec	40 Sec	40 Sec	40 Sec	40 Sec	40 Sec	40 Sec	40 Sec	40 Sec	40 Sec
VFD-25	S Start Time 1	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
VFD-26	S Start Time 2	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
VFD-27	S End Time 1	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
VFD-28	S End Time 2	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
VFD-29	Skip Freq 1 High	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-30	Skip Freq 1 Low	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-31	Skip Freq 2 High	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-32	Skip Freq 2 Low	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
VFD-33	Skip Freq 3 High	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-34	Skip Freq 3 Low	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-35	VFD Duty Select	Variable Torque	Variable Torque	Variable Torque	Variable Torque	Variable Torque	Variable Torque	Variable Torque	Constant Torque	Variable Torque	Variable Torque
VFD-36	Reset Restart	Enable	Enable	Enable	Enable	Enable	Enable	Enable	Disable	Enable	Enable
VFD-37	DC Brake CurLvl	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
VFD-38	DC Time at Run	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
VFD-39	DC Time at Stop	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
VFD-40	DC Stop Freq	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-41	Dwell T at Acc	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
VFD-42	Dwell Hz at Acc	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-43	Dwell T at Dec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
VFD-44	Dwell Hz at Dec	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
VFD-46	ID Code	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
VFD-47	VFD Rated Amps	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating
VFD-48	Display Select	Frequency Command	Frequency Command	Frequency Command	Frequency Command	Frequency Command	Frequency Command	Frequency Command	Frequency Command	Frequency Command	Frequency Command
VFD-49	Firmware Version	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
VFD-50	Disp Filter A	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec
VFD-51	Disp Filter KPD	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec
VFD-52	FW Date	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
VFD-53	Jog ACC Time	20 Sec	20 Sec	20 Sec	20 Sec	20 Sec	2 Sec	20 Sec	20 Sec	20 Sec	2 Sec
VFD-54	Jog DEC Time	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec	2 Sec	30 Sec	30 Sec	30 Sec	2 Sec
VFD-55	JOG Frequency	6.0 Hz	6.0 Hz	6.0 Hz	6.0 Hz	6.0 Hz	6.0 Hz	6.0 Hz	6.0 Hz	6.0 Hz	6.0 Hz
VFD-56	Zero-speed Mode	Standby	Standby	Standby	Standby	Standby	Standby	Standby	Standby	Standby	Standby
VFD-57	Power-on Start	Enable	Enable	Enable	Enable	Enable	Enable	Enable	Disable	Enable	Enable

Default Settings Table – I/O Menu

Parameters in highlighted rows are reset when the application is changed **[SET–00]**.

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
IO-00	ACI Input Sel	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA
IO-01	ACI Loss Trip	Decel Stop	Decel Stop	Decel Stop	Decel Stop	Decel Stop	Decel Stop	Decel Stop	Decel Stop	Decel Stop	Decel Stop
IO-04	ACI Filter T	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec
IO-05	AVI1 Input Sel	0-10V	0-10V	0-10V	0-10V	0-10V	0-10V	0-10V	0-10V	0-10V	0-10V
IO-09	AVI1 Filter T	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec
IO-10	AVI2 Filter T	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec
IO-11	PID Filter Time	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec
IO-12	PID Delay Time	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
IO-13	AI Upper Level	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
IO-14	AI Lower Level	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
IO-20	DI Filter	0.005 Sec	0.005 Sec	0.005 Sec	0.005 Sec	0.005 Sec	0.005 Sec	0.005 Sec	0.005 Sec	0.005 Sec	0.005 Sec
IO-21	MI1 Define	Speed-L	Speed-L	Speed-L	Speed-L	Speed-L	Speed-L	Speed-L	Speed-L	Speed-L	Speed-L
IO-22	MI2 Define	Speed-M	Speed-M	Speed-M	Speed-M	Speed-M	Speed-M	Speed-M	Speed-M	Speed-M	Speed-M
IO-23	MI3 Define	Speed-H	Speed-H	Speed-H	Speed-H	Speed-H	Speed-H	Speed-H	Speed-H	Speed-H	Speed-H
IO-24	MI4 Define	Fault Reset	Fault Reset	Fault Reset	Fault Reset	Fault Reset	Fault Reset	Fault Reset	Fault Reset	Fault Reset	Fault Reset
IO-25	MI5 Define	E-Stop	E-Stop	E-Stop	E-Stop	E-Stop	E-Stop	E-Stop	E-Stop	E-Stop	E-Stop
IO-26	MI6 Define	XCEL-L	XCEL-L	XCEL-L	XCEL-L	XCEL-L	XCEL-L	XCEL-L	XCEL-L	XCEL-L	XCEL-L
IO-27	MI7 Define	None	None	None	None	None	None	None	None	None	None
IO-28	MI8 Define	None	None	None	None	None	None	None	None	None	None
IO-29	FO Enable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
IO-30	FO Frequency	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	115 Hz	115 Hz

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
IO-31	FO Fault Retry	10	10	10	10	10	10	10	10	10	10
IO-32	FO Retry Delay	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec
IO-33	FO Mode & Reset	PID Off Auto	PID On Auto	PID On Auto	PID On Auto	PID On Auto	PID On Auto	PID On Auto	PID Off Auto	PID Off Auto	PID On Auto
IO-34	FO PID Setpoint	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IO-35	E-Stop Mode	Coast Stop	Coast Stop	Coast Stop	Coast Stop	Coast Stop	Coast Stop	Coast Stop	Coast Stop	Coast Stop	Coast Stop
IO-36	Damper Mode	Disable	Enable	Enable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
IO-37	Damper T-Delay	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec
IO-38	No-Flow Mode	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
IO-39	Prime Time	20 Sec	20 Sec	20 Sec	20 Sec	20 Sec	20 Sec	20 Sec	20 Sec	20 Sec	20 Sec
IO-40	No-Flow Freq	20 Hz	20 Hz	20 Hz	20 Hz	20 Hz	30 Hz	20 Hz	20 Hz	40 Hz	60 Hz
IO-41	Lube/S-Clean	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
IO-42	S-Clean Timer	60 Min	60 Min	60 Min	60 Min	60 Min	60 Min	60 Min	60 Min	60 Min	60 Min
IO-43	Pre-Lube Timer	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec	30 Sec
IO-44	Run-Lube Timer	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
IO-45	Post-Lube Timer	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
IO-46	DI NO/NC	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.
IO-47	Relay RA1	Fault	Fault	Fault	Fault	Fault	Fault	Fault	Fault	Fault	Fault
IO-48	Relay RA2	Run	Run	Run	Run	Run	Run	Run	Run	Run	Run
IO-49	Relay RA3	FDT-4	FDT-4	FDT-4	FDT-4	FDT-4	FDT-4	FDT-4	FDT-4	FDT-4	FDT-4
IO-50	CNT Attained 0	0	0	0	0	0	0	0	0	0	0
IO-51	CNT Attained 1	0	0	0	0	0	0	0	0	0	0
IO-52	FDT-2 Freq	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz
IO-53	FDT-2 Bandwdth	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz
IO-54	FDT-3 Freq	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz
IO-55	FDT-3 Bandwdth	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz	2.0 Hz
IO-56	I Hi/Lo Setting	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IO-57	FDT-4/5 Setting	3.0 Hz	3.0 Hz	3.0 Hz	3.0 Hz	3.0 Hz	3.0 Hz	3.0 Hz	3.0 Hz	3.0 Hz	3.0 Hz
IO-58	Relay NO/NC	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.	N.O.
IO-59	AFM1 Out Select	Output Hz	Output Hz	Output Hz	Output Hz	Output Hz	Output Hz	Output Hz	Output Hz	Output Hz	Output Hz
IO-60	AFM1 Gain	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
IO-61	AFM2 Out Select	ACI %	ACI %	ACI %	ACI %	ACI %	ACI %	ACI %	ACI %	ACI %	ACI %
IO-62	AFM2 Gain	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
IO-63	AFM1 mA Select	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA
IO-64	AFM2 mA Select	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA	4-20mA
IO-65	AFM1 Filter Time	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec
IO-66	AFM2 Filter Time	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec	0.01 Sec
IO-67	MO by AI Level	AVI1	AVI1	AVI1	AVI1	AVI1	AVI1	AVI1	AVI1	AVI1	AVI1
IO-68	Fault Out Opt 1	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
IO-69	Fault Out Opt 2	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
IO-70	Fault Out Opt 3	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
IO-71	Fault Out Opt 4	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
IO-72	FO Bypass	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
IO-73	FO Bypass Delay	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
IO-74	D-Inputs Status	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
IO-75	D-Relays Status	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
IO-77	Spare Max Value	1.0	1.0	1.0	150	200	200	200	200	200	200
IO-78	Spare AI Select	AVI1	AVI1	AVI1	AVI1	AVI1	AVI1	AVI1	AVI1	AVI1	AVI1

Default Settings Table – ADV Menu

Parameters in highlighted rows are reset when the application is changed **[SET–00]**.

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
ADV-00	Upper Bound Int	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ADV-01	PID Out Limit	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ADV-02	Password Input	0	0	0	0	0	0	0	0	0	0
ADV-03	Parameter Reset	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
ADV-05	Password Lock	Unlocked	Unlocked	Unlocked	Unlocked	Unlocked	Unlocked	Unlocked	Unlocked	Unlocked	Unlocked
ADV-06	Acc/Dec Type	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear
ADV-07	Acc/Dec Format	Unit 0.1 sec	Unit 0.1 sec	Unit 0.1 sec	Unit 0.1 sec	Unit 0.1 sec	Unit 0.1 sec	Unit 0.1 sec	Unit 0.1 sec	Unit 0.1 sec	Unit 0.1 sec
ADV-08	Energy Saving	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
ADV-09	EnergySave Gain	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ADV-10	MMC Mode	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
ADV-11	Motor Quantity	1	1	1	1	1	1	1	1	1	1
ADV-12	Aux Mtr Stop Hz	0	0	0	0	0	0	0	0	0	0
ADV-13	Alt Run Time	720 min	720 min	720 min	720 min	720 min	720 min	720 min	720 min	720 min	720 min
ADV-14	S-Start ON Dly	1 sec	1 sec	1 sec	1 sec	1 sec	1 sec	1 sec	1 sec	1 sec	1 sec
ADV-15	S-Start Off Dly	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec
ADV-16	Mtr Switch Tmr	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec
ADV-17	Mtr Switch Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	115 Mz	115 Hz
ADV-18	Lag Start Freq	59.5 Hz	59.5 Hz	59.5 Hz	59.5 Hz	59.5 Hz	59.5 Hz	59.5 Hz	59.5 Hz	114 Hz	114 Hz
ADV-19	Lag Start Delay	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec
ADV-20	Lag Start Level	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
ADV-21	Lead Freq Drop	10 Hz	10 Hz	10 Hz	10 Hz	10 Hz	10 Hz	10 Hz	10 Hz	10 Hz	10 Hz
ADV-22	MMC Dec Time	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec
ADV-23	Lag Stop Freq	35 Hz	35 Hz	35 Hz	35 Hz	35 Hz	35 Hz	35 Hz	35 Hz	50 Hz	70 Hz
ADV-24	Lag Stop Delay	4 Sec	4 Sec	4 Sec	4 Sec	4 Sec	4 Sec	4 Sec	4 Sec	4 Sec	4 Sec
ADV-25	Lag Stop Level	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
ADV-26	Lead Freq Bump	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz	0.0 Hz
ADV-27	MMC Accel Time	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec
ADV-28	Power on Delay T	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec	10 Sec
ADV-29	Run Delay Timer	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
ADV-30	Backspin Timer	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
ADV-34	Min Run Timer	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
ADV-55	AVR Select	Enable	Enable	Enable	Enable	Enable	Enable	Enable	Enable	Enable	Enable

Default Settings Table – PROT Menu

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
PROT-00	Decel Method	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
PROT-01	Preheat Level	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PROT-02	Preheat Duty	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
PROT-03	LV Level	By VFD rating	By VFD rating	By VFD rating	By VFD rating	By VFD rating	By VFD rating	By VFD rating	By VFD rating	By VFD rating	By VFD rating
PROT-04	OV Stall level	By VFD rating	By VFD rating	By VFD rating	By VFD rating	By VFD rating	By VFD rating	By VFD rating	By VFD rating	By VFD rating	By VFD rating
PROT-05	OV Stall Prevent	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard
PROT-06	SW Brake V Lvl	By VFD model	By VFD model	By VFD model	By VFD model	By VFD model	By VFD model	By VFD model	By VFD model	By VFD model	By VFD model
PROT-07	OCA Level	120%	120%	120%	120%	120%	120%	120%	120%	120%	120%
PROT-08	OCN Level	120%	120%	120%	120%	120%	120%	120%	120%	120%	120%
PROT-10	Auto Restarts	3	3	3	3	3	3	3	3	3	3
PROT-11	AutoRetry Delay	120 Sec	120 Sec	120 Sec	120 Sec	120 Sec	120 Sec	120 Sec	120 Sec	120 Sec	120 Sec
PROT-12	OL-2 Type	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
PROT-13	OL-2 Level	120%	120%	120%	120%	120%	120%	120%	120%	120%	120%
PROT-14	OL-2 Delay	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
PROT-16	ETH Type	Self Cooled	Self Cooled	Self Cooled	Self Cooled	Self Cooled	Self Cooled	Self Cooled	Self Cooled	Self Cooled	Self Cooled
PROT-17	ETH Delay	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec
PROT-18	OH Warn	105 °C	105 °C	105 °C	105 °C	105 °C	105 °C	105 °C	105 °C	105 °C	105 °C
PROT-19	PTC Select	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run
PROT-20	PTC Level	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
PROT-21	OPO Trip	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
PROT-22	OPO Delay	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec
PROT-23	OPO Current	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
PROT-24	OPO Decel	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
PROT-25	LvX Auto Reset	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
PROT-26	IPO Check	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec
PROT-27	IPO Ripple	By VFD voltage	By VFD voltage	By VFD voltage	By VFD voltage	By VFD voltage	By VFD voltage	By VFD voltage	By VFD voltage	By VFD voltage	By VFD voltage
PROT-28	IPO Trip	Alarm and Decel	Alarm and Decel	Alarm and Decel	Alarm and Decel	Alarm and Decel	Alarm and Decel	Alarm and Decel	Alarm and Decel	Alarm and Decel	Alarm and Decel
PROT-29	Derating Type	Carrier by I_T	Carrier by I_T	Carrier by I_T	Carrier by I_T	Carrier by I_T	Carrier by I_T	Carrier by I_T	Carrier by I_T	Carrier by I_T	Carrier by I_T
PROT-30	PT100 Level 1	5 V	5 V	5 V	5 V	5 V	5 V	5 V	5 V	5 V	5 V
PROT-31	PT100 Level 2	7 V	7 V	7 V	7 V	7 V	7 V	7 V	7 V	7 V	7 V
PROT-32	PT100 L- 1 Freq	0 Hz	0 Hz	0 Hz	0 Hz	0 Hz	0 Hz	0 Hz	0 Hz	0 Hz	0 Hz
PROT-33	PT100 L- 1 Delay	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec
PROT-34	Ground Fault Lvl	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
PROT-35	G-Fault Delay	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec
PROT-36	STO Alarm Type	STO Latching	STO Latching	STO Latching	STO Latching	STO Latching	STO Latching	STO Latching	STO Latching	STO Latching	STO Latching
PROT-37	IPF S-Search	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
PROT-38	Max IPF Time	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec	2 Sec
PROT-39	SS Current Lmt	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
PROT-40	SS After Fault	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
PROT-42	SS Normal Start	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
PROT-43	Spd Search Gain	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%
PROT-44	IPF Restart Dly	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec
PROT-45	Fan Control	At power up	At power up	At power up	At power up	At power up	At power up	At power up	At power up	At power up	At power up
PROT-46	Last Flt Freq	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PROT-47	Last Flt IGBTT	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PROT-48	Last Flt Cap T	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PROT-49	Last Flt MFI	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PROT-50	Last Flt MFO	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PROT-51	1st Fault	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PROT-52	2nd Fault	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PROT-53	3rd Fault	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PROT-54	4th Fault	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PROT-55	5th Fault	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PROT-56	6th Fault	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PROT-57	ULD Min Torque	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
PROT-58	HLD Min Torque	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%

Default Settings Table – COMM Menu

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
Comm-00	COM1 Address	1	1	1	1	1	1	1	1	1	1
Comm-01	COM1 Speed	9.6 Kbps	9.6 Kbps	9.6 Kbps	9.6 Kbps	9.6 Kbps	9.6 Kbps	9.6 Kbps	9.6 Kbps	9.6 Kbps	9.6 Kbps
Comm-02	COM1 Loss	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Comm-03	COM1 Loss	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
Comm-04	COM1 Protocol	8, N, 1 RTU	8, N, 1 RTU	8, N, 1 RTU	8, N, 1 RTU	8, N, 1 RTU	8, N, 1 RTU	8, N, 1 RTU	8, N, 1 RTU	8, N, 1 RTU	8, N, 1 RTU
Comm-05	Response Delay	2 ms	2 ms	2 ms	2 ms	2 ms	2 ms	2 ms	2 ms	2 ms	2 ms
Comm-06	Main Frequency	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz
Comm-07	Block Transfer 1	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-08	Block Transfer 2	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-09	Block Transfer 3	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-10	Block Transfer 4	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-11	Block Transfer 5	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-12	Block Transfer 6	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-13	Block Transfer 7	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-14	Block Transfer 8	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-15	Block Transfer 9	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-16	Block Transfer 10	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-17	Block Transfer 11	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-18	Block Transfer 12	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-19	Block Transfer 13	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-20	Block Transfer 14	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-21	Block Transfer 15	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-22	Block Transfer 16	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h	0000h
Comm-23	Com Decoding	20xx	20xx	20xx	20xx	20xx	20xx	20xx	20xx	20xx	20xx
Comm-24	BACnet MAC ID	10	10	10	10	10	10	10	10	10	10
Comm-25	BACnet Speed	38.4 Kbps	38.4 Kbps	38.4 Kbps	38.4 Kbps	38.4 Kbps	38.4 Kbps	38.4 Kbps	38.4 Kbps	38.4 Kbps	38.4 Kbps
Comm-26	Device ID Lo	10	10	10	10	10	10	10	10	10	10
Comm-27	Device ID Hi	0	0	0	0	0	0	0	0	0	0
Comm-28	Max Address	127	127	127	127	127	127	127	127	127	127
Comm-29	Password	0	0	0	0	0	0	0	0	0	0
Comm-30	Com Card ID	No Card	No Card	No Card	No Card	No Card	No Card	No Card	No Card	No Card	No Card
Comm-31	Comm Card FW	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
Comm-32	Product code	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
Comm-33	Error code	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
Comm-34	D-Net Card Addr	1	1	1	1	1	1	1	1	1	1
Comm-35	D-Net Speed	500 Kbps	500 Kbps	500 Kbps	500 Kbps	500 Kbps	500 Kbps	500 Kbps	500 Kbps	500 Kbps	500 Kbps
Comm-36	D-Net Type	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard	Standard
Comm-37	M-bus IP Type	Static IP	Static IP	Static IP	Static IP	Static IP	Static IP	Static IP	Static IP	Static IP	Static IP
Comm-38	IP Address 1	0	0	0	0	0	0	0	0	0	0
Comm-39	IP Address 2	0	0	0	0	0	0	0	0	0	0
Comm-40	IP Address 3	0	0	0	0	0	0	0	0	0	0
Comm-41	IP Address 4	0	0	0	0	0	0	0	0	0	0
Comm-42	Address Mask 1	0	0	0	0	0	0	0	0	0	0
Comm-43	Address Mask 2	0	0	0	0	0	0	0	0	0	0
Comm-44	Address Mask 3	0	0	0	0	0	0	0	0	0	0
Comm-45	Address Mask 4	0	0	0	0	0	0	0	0	0	0
Comm-46	G-way Address 1	0	0	0	0	0	0	0	0	0	0
Comm-47	G-way Address 2	0	0	0	0	0	0	0	0	0	0
Comm-48	G-way Address 3	0	0	0	0	0	0	0	0	0	0
Comm-49	G-way Addr 4	0	0	0	0	0	0	0	0	0	0
Comm-50	MBus TCP Pass L	0	0	0	0	0	0	0	0	0	0
Comm-51	MBus TCP Pass H	0	0	0	0	0	0	0	0	0	0

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
Comm-52	MBus Card Reset	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Comm-53	MBus TCP Config	IP Filter	IP Filter	IP Filter	IP Filter	IP Filter	IP Filter	IP Filter	IP Filter	IP Filter	IP Filter
Comm-54	MBus TCP Status	0	0	0	0	0	0	0	0	0	0
Comm-55	Set Comm Card	0	0	0	0	0	0	0	0	0	0

Default Settings Table – PLC Menu

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
PLC-00	DI used by PLC	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PLC-01	DO used by PLC	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PLC-02	Analog by PLC	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
PLC-03	PLC Buffer 0	0	0	0	0	0	0	0	0	0	0
PLC-04	PLC Buffer 1	0	0	0	0	0	0	0	0	0	0
PLC-05	PLC Buffer 2	0	0	0	0	0	0	0	0	0	0
PLC-06	PLC Buffer 3	0	0	0	0	0	0	0	0	0	0
PLC-07	PLC Buffer 4	0	0	0	0	0	0	0	0	0	0
PLC-08	PLC Buffer 5	0	0	0	0	0	0	0	0	0	0
PLC-09	PLC Buffer 6	0	0	0	0	0	0	0	0	0	0
PLC-10	PLC Buffer 7	0	0	0	0	0	0	0	0	0	0
PLC-11	PLC Buffer 8	0	0	0	0	0	0	0	0	0	0
PLC-12	PLC Buffer 9	0	0	0	0	0	0	0	0	0	0
PLC-13	PLC Buffer 10	0	0	0	0	0	0	0	0	0	0
PLC-14	PLC Buffer 11	0	0	0	0	0	0	0	0	0	0
PLC-15	PLC Buffer 12	0	0	0	0	0	0	0	0	0	0
PLC-16	PLC Buffer 13	0	0	0	0	0	0	0	0	0	0
PLC-17	PLC Buffer 14	0	0	0	0	0	0	0	0	0	0
PLC-18	PLC Buffer 15	0	0	0	0	0	0	0	0	0	0
PLC-19	PLC Buffer 16	0	0	0	0	0	0	0	0	0	0
PLC-20	PLC Buffer 17	0	0	0	0	0	0	0	0	0	0
PLC-21	PLC Buffer 18	0	0	0	0	0	0	0	0	0	0
PLC-22	PLC Buffer 19	0	0	0	0	0	0	0	0	0	0
PLC-23	PLC Com Type	Modbus 485	Modbus 485	Modbus 485	Modbus 485	Modbus 485	Modbus 485	Modbus 485	Modbus 485	Modbus 485	Modbus 485
PLC-24	PLC force to 0	0	0	0	0	0	0	0	0	0	0
PLC-25	PLC Address	2	2	2	2	2	2	2	2	2	2

Default Settings Table - Option Menu

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
Option-00	M10 Define	None	None	None	None	None	None	None	None	None	None
Option-01	M11 Define	None	None	None	None	None	None	None	None	None	None
Option-02	M12 Define	None	None	None	None	None	None	None	None	None	None
Option-03	M13 Define	None	None	None	None	None	None	None	None	None	None
Option-04	M14 Define	None	None	None	None	None	None	None	None	None	None
Option-05	M15 Define	None	None	None	None	None	None	None	None	None	None
Option-06	Relay exp. RA10	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Option-07	Relay exp. RA11	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Option-08	Relay exp. RA12	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Option-09	Relay exp. RA13	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Option-10	Relay exp. RA14	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Option-11	Relay exp. RA15	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Option-12	Relay exp. RA16	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Option-13	Relay exp. RA17	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Option-14	Relay exp. RA18	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Option-15	Relay exp. RA19	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Option-16	Relay exp. RA20	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
Option-17	IO Card Type	No Card	No Card	No Card	No Card	No Card	No Card	No Card	No Card	No Card	No Card

Default Settings Table – ADV2 Menu

Parameters in highlighted rows are reset when the application is changed **[SET–00]**.

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
ADV2-00	PID D-Gain	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
ADV2-01	Sleep Ctrl By	PID Output	PID Output	PID Output	PID Output	PID Output	PID Output	PID Output	PID Output	PID Output	PID Output
ADV2-03	Mtr Brake Delay	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
ADV2-04	AFM1 Rev Value	0-10 V	0-10 V	0-10 V	0-10 V	0-10 V	0-10 V	0-10 V	0-10 V	0-10 V	0-10 V
ADV2-05	AFM2 Rev Value	0-10 V	0-10 V	0-10 V	0-10 V	0-10 V	0-10 V	0-10 V	0-10 V	0-10 V	0-10 V
ADV2-06	AFM1 DC Lvl	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
ADV2-07	AFM2 DC Lvl	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
ADV2-08	Analog Curve	3x AIs 3-Point	3x AIs 3-Point	3x AIs 3-Point	3x AIs 3-Point	3x AIs 3-Point	3x AIs 3-Point	3x AIs 3-Point	3x AIs 3-Point	3x AIs 3-Point	3x AIs 3-Point
ADV2-09	AVI1 Low Value	0	0	0	0	0	0	0	0	0	0
ADV2-10	AVI1 Low %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
ADV2-11	AVI1 Mid Value	5	5	5	5	5	5	5	5	5	5
ADV2-12	AVI1 Mid %	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
ADV2-13	AVI1 High Value	10	10	10	10	10	10	10	10	10	10
ADV2-14	AVI1 High %	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ADV2-15	ACI Low Value	4	4	4	4	4	4	4	4	4	4
ADV2-16	ACI Low %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
ADV2-17	ACI Mid Value	12	12	12	12	12	12	12	12	12	12
ADV2-18	ACI Mid %	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
ADV2-19	ACI High Value	20	20	20	20	20	20	20	20	20	20
ADV2-20	ACI High %	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ADV2-21	AVI Low Value	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V
ADV2-22	AVI Low %	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
ADV2-23	AVI Mid Value	5 V	5 V	5 V	5 V	5 V	5 V	5 V	5 V	5 V	5 V
ADV2-24	AVI Mid %	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
ADV2-25	AVI High Value	10 V	10 V	10 V	10 V	10 V	10 V	10 V	10 V	10 V	10 V
ADV2-26	AVI High %	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ADV2-27	dEb Offset V	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating
ADV2-28	dEb Mode Select	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable	Disable
ADV2-30	PID Mode Select	Serial	Serial	Serial	Serial	Serial	Serial	Serial	Serial	Serial	Serial
ADV2-31	PID Unit Format	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	0.1	0.1
ADV2-32	PID Ref Source	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad	Keypad
ADV2-52	LD Set Point	0.5 (unit)	0.5 (unit)	0.5 (unit)	70 (unit)	70 (unit)	70 (unit)	70 (unit)	70 (unit)	70 (unit)	70 (unit)
ADV2-53	LD Max Freq	48 Hz	48 Hz	48 Hz	48 Hz	48 Hz	48 Hz	48 Hz	48 Hz	96 Hz	96 Hz

Default Settings Table - Motor Menu

CODE	Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque	PM Motor	MagForce
Motor-00	Motor A Tuning	None	None	None	None	None	None	None	None	None	None
Motor-01	Motor Rs Value	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating	By VFD Rating
Motor-02	Motor Rr Value	0 Ohm	0 Ohm	0 Ohm	0 Ohm	0 Ohm	0 Ohm	0 Ohm	0 Ohm	0 Ohm	0 Ohm
Motor-03	Motor Lm Value1	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH
Motor-04	Motor Lx Value	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH
Motor-05	Control Method	VF	VF	VF	VF	VF	VF	VF	VF	Sensorless	Sensorless
Motor-06	Motor Type	Induction	Induction	Induction	Induction	Induction	Induction	Induction	Induction	PM-SPM	PM-IPM
Motor-07	PM Poles	4	4	4	4	4	4	4	4	4	4
Motor-08	PM Inertia	By Motor Rating	By Motor Rating	By Motor Rating	By Motor Rating	By Motor Rating	By Motor Rating	By Motor Rating	By Motor Rating	By Motor Rating	By Motor Rating
Motor-09	PM Rs	0 Ohm	0 Ohm	0 Ohm	0 Ohm	0 Ohm	0 Ohm	0 Ohm	0 Ohm	0 Ohm	0 Ohm
Motor-10	PM Ld	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH
Motor-11	PM Lq	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH	0 mH
Motor-12	PM PG Angle	0 degree	0 degree	0 degree	0 degree	0 degree	0 degree	0 degree	0 degree	0 degree	0 degree
Motor-13	PM Ke Coeff	By Motor Data	By Motor Data	By Motor Data	By Motor Data	By Motor Data	By Motor Data	By Motor Data	By Motor Data	By Motor Data	By Motor Data
Motor-14	Rotor Zeroing	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	1/4 FLA Current	1/4 FLA Current
Motor-15	Torque Filter T	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec	0.5 Sec
Motor-16	Slip Filter T	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec	0.1 Sec
Motor-17	Torque Cmp Gain	0	0	0	0	0	0	0	0	20	0
Motor-18	Slip Cmp Gain	0	0	0	0	0	0	0	0	1.0	1.0
Motor-19	Slip Dev Level	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Motor-20	Slip Dev Det T	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec	1 Sec
Motor-21	Over Slip Trip	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run	Alarm and Run
Motor-22	Motor Hunt Gain	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Motor-23	Auto restart	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec	60 Sec
Motor-24	I/F Current	40%	40%	40%	40%	40%	40%	40%	40%	80%	40%
Motor-25	PM Bandwidth HS	5 Hz	5 Hz	5 Hz	5 Hz	5 Hz	5 Hz	5 Hz	5 Hz	6 Hz	5 Hz
Motor-26	PMSVC Fltr Gain	1	1	1	1	1	1	1	1	1	1
Motor-27	Freq I/F to PM	20 Hz	20 Hz	20 Hz	20 Hz	20 Hz	20 Hz	20 Hz	20 Hz	30 Hz	30 Hz
Motor-28	Freq PM to I/F	20 Hz	20 Hz	20 Hz	20 Hz	20 Hz	20 Hz	20 Hz	20 Hz	30 Hz	30 Hz
Motor-29	I/F fltr time	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec	0.2 Sec
Motor-30	Angle Det Pulse	1	1	1	1	1	1	1	1	1	1
Motor-31	Zero voltage T	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec	0 Sec
Motor-32	Injection Freq	500 Hz	500 Hz	500 Hz	500 Hz	500 Hz	500 Hz	500 Hz	500 Hz	500 Hz	500 Hz
Motor-33	Injection V	15 V	15 V	15 V	15 V	15 V	15 V	15 V	15 V	15 V	15 V
Motor-34	Run Time Min	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
Motor-35	Run Time Days	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only	Read Only
Motor-36	Motor PF	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.96	0.96
Motor-37	PM Trq Comp I/F	20	20	20	20	20	20	20	20	20	20
Motor-38	PM Trq Comp SVC	0	0	0	0	0	0	0	0	0	0
Motor-39	DC-Tun Curr P	300	300	300	300	300	300	300	300	300	300
Motor-40	DC-Tun Curr I	50	50	50	50	50	50	50	50	50	50

INSTALLATION TESTING

Rotation Check

Start VFD in forward direction and check the motor rotation. If the motor is running backwards, disconnect power to the VFD and reverse any two motor leads to change the motor rotation.

- For submersible pumps or other applications that cannot be checked visually, rotation can be determined by evaluating performance. For example, if the system is not building the expected pressure, or the motor is running at less than 80% FLA or SFA at full speed, or if current does not go down as expected, it may be running backwards.
- Performance comparisons can also be made using the Load Rotation settings available in the drive. Refer to "Forward or Reverse Selection" on page 64.

IMPORTANT: Do not use the Load Rotation setting to correct a motor that is running backwards because of incorrect wiring.

Feedback Checks

Check the motor run current on the VFD display while running at full speed. If it is higher than motor FLA (or SFA), check motor wiring and for any mechanical problems (valves, dampers, etc.) that could create extra load on the motor shaft.

When running in PID mode, check to see that transducer feedback (i.e. pressure) matches any gauges that may be installed. If the target is not accurate, verify that the transducer scaling (Feedback Max) has been set correctly.

Performance Checks

If PID is disabled, run the system and vary speed from VFD Low Frequency Limit to VFD High Frequency Limit. Monitor output current, which should not exceed motor FLA or SFA. Check that equipment produces the proper output (air flow, water flow, etc.) at nominal speed.

If PID is enabled, run the system with constant demand. Then change demand and monitor how system pressure or temperature reaches the setpoint value. If the system responds very slowly, or very quickly with overshooting, PID parameters P-Gain and I-Time should be adjusted.

If multiple acceleration/deceleration curves have been programmed, verify that motor performs as expected.

Sleep Mode Check (Pump Applications)

All default settings related to Sleep mode have been calculated for best system performance for most applications. However, some well conditions may require a slight adjustment.

During system setup it is recommended to test the Sleep feature by closing a main valve to simulate a no-demand condition. The system should be running at normal demand, maintaining pressure setpoint, then flow should be decreased slowly until stopped.

- If the system does not enter Sleep mode, it may be necessary to increase the **PID Lo Hz Limit [SET–22]** to ensure that system pressure reaches **PID Setpoint [SET–21]** (plus boost, if enabled).
- If, during normal operation, the system enters Sleep mode, but cycles on and off rapidly as it nears the Setpoint, it may be necessary to slightly lower the **PID Lo Hz Limit [SET–22]** to prevent Sleep mode problems.

Refer to "Sleep Mode with Pressure Boost" on page 68.

OPERATION

Control Options

Hand/Auto Controls

The drive can be operated in either **HAND** or **AUTO** mode as follows:

- **HAND** mode runs the motor based on **Hand Speed Ref [SET–09]** (frequency source) and **Hand Run Cmd [SET–10]** (command source). Defaults for both settings are Keypad, which runs the motor at a fixed speed (**Keypad Setpoint**) set on the Home Screen. Both settings can be reprogrammed for external control. PID control is disabled in Hand mode.
- **AUTO** mode runs the motor based on **AUTO Speed Ref [SET–07]** (frequency source) and **AUTO Run Cmd [SET–08]** (command source). The speed reference default is set per application. The run command default is Keypad. Both settings can be reprogrammed as required.

There are several options to consider for operation of the VFD through external HOA controls:

HOA Mode Source [SET–60]: This setting selects whether Hand/Auto control will come from the Keypad, a Digital Input, or Communications. When switching modes with the keypad, the VFD will stop, and will start when the **Start** key is pressed. When switching modes with a DI or Comm source, the VFD will start based on the presence of a run command.

- **Keypad (Default):** The VFD Keypad HOA buttons, including **Start** and **Stop**, are fully functional.
- **Digital Input:** Enables HOA control through an external switch wired to two digital inputs [MI1 to MI8]. These inputs should be set to **26_Hand** and **27_Auto** through parameters **[I0–21 to 28]**. HOA mode is then determined as follows:

26_HOA Hand	27_HOA Auto	HOA Mode
Open	Open	OFF
Closed	Open	Hand
Open	Closed	Auto
Closed	Closed	OFF

- **RS485 Serial:** Enables HOA control through Modbus communications.
- **Com Card:** Enables HOA control through BACNet communications. The combinations of 0x2002 bit 3 and bit 4 are defined as follows:

Bit 3	Bit 4	HOA Mode
0	0	No change
1	0	Hand
0	1	Auto
1	1	OFF

Hand Speed Ref [SET–09]: Source of Speed Reference in Hand mode. When in Hand mode, PID is disabled and the VFD frequency is based on the following inputs:

- **Keypad (Default):** VFD runs at a fixed frequency set on the Home Screen.
- **RS485 Serial:** Frequency input through Modbus control.
- **AVI1 Analog:** Input from external controller, potentiometer, or other device.
- **ACI Analog:** Input from external controller, potentiometer, or other device.
- **AVI2 Analog:** Input from external controller, potentiometer, or other device.
- **COM Card:** Frequency input through communications protocol.

Hand Run Command [SET–10]: Source of Run Command in Hand mode. VFD starts based on input from:

- **Keypad (Default):** Run command from Start/Stop buttons.
- **Digital Input:** Run command from digital input FWD or REV terminal.
- **RS485:** Run command from RS485 interface. Keypad STOP is disabled.
- **Com Card:** Run command from communications card.
- **Ext HOA in Hand:** Run command from digital input [IO-21~28] set to HAND.

Auto Speed Ref [SET–07]: Source of Speed Reference in Auto mode. VFD runs at a frequency based on the following inputs:

- **Keypad:** VFD runs at a fixed frequency set on the Home Screen.
- **Up/Down DI:** Digital input increases or decreases speed when DI terminals [IO-21~28] set to Up and Down.
- **AVI1 Analog:** Input from external controller, potentiometer, or other device.
- **ACI Analog:** Input from external controller, potentiometer, or other device.
- **AVI2 Analog:** Input from external controller, potentiometer, or other device.
- **RS485 Serial:** Frequency input through Modbus control.
- **COM Card:** Frequency input through communications protocol.
- **PID Output:** VFD speed reference will be provided by PID control based on the difference between **PID Setpoint [SET–21]** and transducer feedback values.

  IMPORTANT: When PID Mode is selected, additional parameter settings should be verified to ensure correct operation. Refer to "Standard Operation with PID Feedback Control" on page 66 for more information.

Auto Run Command [SET–08]: Source of Run Command in Auto mode. VFD starts based on input from:

- **Keypad (Default):** Run command from Start/Stop buttons.
- **Digital Input:** Run command from digital input FWD or REV terminal.
- **RS485:** Run command from RS485 interface. Keypad STOP is disabled.
- **Com Card:** Run command from communications card.
- **Ext HOA in Auto:** Run command from digital input [IO-21~28] set to AUTO.

Forward or Reverse Selection

This feature provides the ability to change the direction of rotation of a motor used in an industrial application. The direction can be set using either the keypad **FWD/REV** button, or by setting the following parameter:

Load Rotation [SET–15]: Setting this parameter to **FWD & REV** enables the keypad button. Selection of either **FWD Only** or **REV Only** permanently sets the direction and disables the keypad button. This provides protection to prevent a motor from running in a direction that could damage equipment, such as a pump or fan.

IMPORTANT: Do not use the Load Rotation setting to correct a motor that is running backwards because of incorrect wiring.

Jog Feature

The Jog feature provides the ability to activate a motor momentarily. The command can be executed using either the keypad **F1** button, or switches connected to a digital input.

- When using the keypad, the motor direction depends on the **Load Rotation [SET–15]** setting. Digital inputs can be set to either forward or reverse.
- The jog command cannot be used when the drive is running.
- When the jog command is active, other run commands are unavailable.

Jog Frequency [VFD–55]: This sets the speed the motor will run when the jog command is active.
Jog ACC Time [VFD–53]: This sets the acceleration time from 0 Hz to **[VFD–55]**.
Jog DEC Time [VFD–55]: This sets the deceleration time from **[VFD–55]** to 0 Hz.

FWD Jog [IO–21 through 28]: To execute a forward jog command externally, connect a momentary switch to one of the Digital Inputs (MI1–8) and set the corresponding parameter to **21 FWD Jog**.
REV Jog [IO–21 through 28]: To execute a reverse jog command externally, connect a momentary switch to one of the Digital Inputs (MI1–8) and set the corresponding parameter to **22 REV Jog**.

NOTE: If an external HOA switch is set to **OFF**, the keypad **F1** button is disabled.

Step Frequencies

The VFD can be operated in a selection of up to 15 user defined pre-set frequencies (speeds) through a combination of switched digital inputs [IO-21~28]. These speeds are defined through parameters **[VFD–04 to 18]**.

When a run command is present, selection of a step frequency overrides any previously active speed reference.

The switching combinations for step frequency selection are as follows:

Input Selection				Parameter	Step Speed
Speed L	Speed M	Speed H	Speed X		
1	0	0	0	[VFD-04]	Speed 1
0	1	0	0	[VFD-05]	Speed 2
1	1	0	0	[VFD-06]	Speed 3
0	0	1	0	[VFD-07]	Speed 4
1	0	1	0	[VFD-08]	Speed 5
0	1	1	0	[VFD-09]	Speed 6
1	1	1	0	[VFD-10]	Speed 7
0	0	0	1	[VFD-11]	Speed 8
1	0	0	1	[VFD-12]	Speed 9
0	1	0	1	[VFD-13	Speed 10
1	1	0	1	[VFD-14]	Speed 11
0	0	1	1	[VFD-15]	Speed 12
1	0	1	1	[VFD-16]	Speed 13
0	1	1	1	[VFD-17	Speed 14
1	1	1	1	[VFD-18]	Speed 15

Shutdown

The Shutdown feature uses a Digital Input signal **[MI1 through MI8]** from an external source to stop VFD output in the event of an emergency. The VFD will trip on Shutdown when the DI signal is activated. This function overrides all other functions and VFD cannot be started with any HOA change until stop signal is removed.

Two options are available for restarting:

Latching Mode [IO–21 through 28]: The Shutdown signal must be removed and the Shutdown fault must be manually reset; no auto restarts or retries are available. The VFD can then be restarted with a **RUN** command. To enable this function, connect the external emergency stop signal to one of the Digital Inputs (MI1–8) and set the corresponding parameter to **36 Shutdown Latched**.
Non-Latching Mode [IO–21 through 28]: If a **RUN** command is present when the Shutdown signal is removed, the VFD will restart based on HOA mode. To enable this function, connect the external emergency stop signal to one of the Digital Inputs (MI1–8) and set the corresponding parameter to **35 Shutdown N-Latch**.

Only one Digital Input can be set to Shutdown.

Standard Operation with an Automated Control System

In many VFD applications, including ventilation, water supply, or irrigation, motor speed is often determined by an automated system such as a BAS, BMS, or PLC. These systems provide control information to the VFD either through a communications protocol such as Modbus or BACnet, or through direct electrical connection to one of the analog input terminals.

When the drive is in **AUTO** mode, it runs the motor at a variable frequency based on information from the automation system through the input selected in **Auto Speed Ref [SET–07]**.

Standard Operation with PID Feedback Control

A PID controlled application, such as a fan system or a constant pressure pump system, uses feedback from a transducer to measure system performance against a user defined Setpoint (target) to control motor speed. The VFD can use several types of measurement, including pressure, flow, level, air volume, temperature, speed, etc.

For example:

- In a pumping application, the default measurement unit is **PSI**. As user demand (flow) causes pressure changes, the drive varies the output frequency (motor speed) to maintain pressure at the target setpoint. When the drive determines a no-demand condition, it enters Sleep mode and stops the motor.
- In a fan application, the default measurement unit is **inWC** (air pressure).

When the drive is in **AUTO** mode, it runs the motor at a variable frequency based on a comparison between the **PID Setpoint [SET–21]** and feedback from the PID transducer, up to the **PID Hi Hz Limit [SET–23]**. PID operation is disabled in **HAND** mode.

When basic setup is complete, including motor specifications, verify or set the following parameters for PID operation:

Auto Speed Ref [SET–07]: This should be set to **PID Output**.
Auto Run Command [SET–08]: Select source of Run Command, either Keypad or external. If using a Digital Input (M1-8) with a switch, set the terminal to **FWD** (or **REV**) **[I0–21 ~ 28]**.
PID Mode [SET–17]: Set to **PID Direct** for most PID operations (exceptions are noted in the tables).
Feedback Source [SET–18]: Set to the terminal used for transducer connection. Make sure impedance is set correctly.
PID Feedback Units [SET–19]: Set to the appropriate measurement unit for the transducer type.
PID Feedback Max [SET–20]: Set to the maximum rating of the transducer.
PID Setpoint [SET–21]: Set to the desired measurement target.
Sleep Mode [SET–26]: This should be enabled for most pump applications, and **Disabled** for most HVAC applications.
PID P-Gain [SET–24]: Proportional Gain controls motor speed adjustments based on the proportional difference between the PID setpoint and PID feedback. Higher settings result in faster response. However, if the value is too high, it may cause system oscillation and instability. Used along with PID I-TIme [SET-25] to smooth and balance system response.
PID I Time [SET–25]: Integral Time determines PID response time. Lower values increase system response to the feedback signal, which reduces overshoot, but may cause system oscillation if set too low. Greater values provide slower response, which may cause overshoot of the setpoint and oscillation of output frequency.

Damper Control (HVAC Applications)

The VFD can provide a relay output to open a damper actuator before starting a fan motor. When enabled, the damper relay output is activated when the system receives a **RUN** command and the motor will start based on the following configurations:

- **With Damper Limit Switch:** If any Digital Input **[I0–21 through 28]** is set to **Damper Limit Sw** and the VFD receives a **RUN** command, the damper relay is activated and when the damper limit switch is closed (damper is fully open and DI is activated), the VFD will start the motor.

  If the limit switch is not closed within the **Damper Time Delay [I0–37]**, the VFD will trip on Damper Fault. If at any point during run mode damper limit switch is open for more than 2 seconds, the VFD will trip on Damper Fault. VFD will try to restart based on the retry number setting **[PR0T–41]**.
- **Without Damper Limit Switch.** If no Digital Input is configured for a damper limit switch and the VFD receives a **RUN** command, the damper relay is activated and when **Damper Time Delay [I0–37]** is complete, the VFD will start the motor. There is no damper fault detection because there is no damper limit switch feedback.

NOTE: If any other delay timer is set and the VFD receives a **RUN** command, the damper relay will start after the first timer expires.

During run mode the damper relay stays activated. When a **STOP** command is received, the damper relay will be deactivated only in VFD stop state. If stop mode is set to deceleration, the relay will be deactivated after VFD reaches zero speed (0.00Hz).

Set the following parameters to use the Damper Control function:

Damper Mode [I0–36]: This setting enables or disables damper mode. When enabled, the damper relay is activated before every start, including auto restarts.
Damper T-Delay [I0–37]: This setting provides a run time delay without a damper limit switch; or, provides a Damper Fault delay for systems that include a damper limit switch. The delay should be greater than damper opening time.
Damper Output Terminal [I0–47 through 49]: Connect the damper actuator to one of the Relay Outputs (RA1–3), and set the corresponding parameter to **38 Damper Output**.
Damper Limit SW Terminal [I0–21 through 28]: If the system includes a damper limit switch, connect the switch to one of the Digital Inputs (MI1–8) and set the corresponding parameter to **34 Damper Limit SW**.

Fireman's Override

Fireman's Override provides the ability to force the drive to run in an emergency situation.

In FO mode, if Damper Mode is enabled **[I0–36]**, the damper relay output will be activated, but damper time delay **[I0–37]** will be reduced by half before VFD starts. The VFD will not monitor a Damper Switch, if present, and no damper faults will be available. Set the following parameters to use the Fireman's Override function:

FO Input Terminal [I0–21 through 28]: Connect the Fireman's Override switch to one of the Digital Inputs (MI1–8) and set the corresponding parameter to either **32 FO with RUN Cmd** or **33 FO w/o RUN Cmd**.
FO Enable [I0–29]: This setting enables Fireman's Override in either Forward or Reverse.
FO Frequency [I0–30]: Setpoint for non-PID operation during Fire Override.
FO Fault Retry [I0–31]: Number of fault resets allowed during Fire Override.
FO Retry Delay [I0–32: Delay until restart during Fire Override.
FO Mode & Reset [I0–33]: Sets control method and reset method during Fire Override: PID Off Manual, PID Off Auto, PID On Manual, or PID On Auto.
FO PID S-Point [I0–34]: Setpoint for PID operation during Fire Override.
FO Bypass [I0–72]: Enables Bypass for Fire Override.
FO Bypass Delay [I0–73]: Time delay between Fire Override becoming active and enabling relay output.

Pump Application Features

Sleep Mode with Pressure Boost

The Sleep feature monitors pressure and frequency to detect a no-demand condition, at which point it stops the motor. The Sleep Feature also has the option to boost system pressure by a set amount before stopping.

The Sleep feature works only in Auto mode using PID. PID2 operation does not have Sleep function.

The following parameters control Sleep functions:

Sleep Mode [SET–26]: This setting enables or disables sleep mode and the sleep plus boost option. The default value for submersibles and surface/boost applications is **Sleep Only**. If a pressure boost is desired while the system is at rest, select **Sleep + Boost** and set a **Sleep Boost Value [SET–29]**.
Sleep Check Time [SET–27]: Time delay (sleep check cycle time) before each Sleep Check procedure. Default = 10 sec.
Sleep Delay [SET–28]: Delay before VFD triggers Sleep Mode when all other conditions are met. Default = 6 sec.
Sleep Boost Value [SET–29]: Value added to original setpoint to provide pressure boost—0.0 to 10.0% of Feedback Max Value [SET–20]. Default = 3%.
Sleep-Boost Timer [SET–30]: Timer that limits sleep boost duration if Sleep Boost setpoint is not reached—5 to 120 seconds. Default = 10 sec.
Wakeup Level [SET–31]: Sets a wakeup level for VFD to quit Sleep mode and start running—0.0 to [SET-21]. Default = 55 PSI.
Sleep Bump Timer [SET–32]: Sets a duration time for pressure bump to increase system pressure as part of the no-demand calculation. Default = 5 sec.
No Flow Mode [IO–38]: If a flow switch is installed on one of the Digital Inputs (MI1–8) and [IO-38] is set to Sleep, the flow switch becomes an additional condition for sleep mode. If Sleep Delay timer has started and at any time before the timer expires the flow switch opens, the VFD will immediately go to either sleep mode (no Sleep Boost) or to Sleep Boost mode (with S-boost enabled).

All default settings related to Sleep mode have been calculated for best system performance for most applications. However, some well conditions may require a slight adjustment.

During system setup it is recommended to test the Sleep feature by closing a main valve to simulate a no-demand condition. The system should be running at normal demand, maintaining pressure setpoint, then flow should be decreased slowly until stopped.

- If the system does not enter Sleep mode, it may be necessary to increase the **PID Lo Hz Limit [SET–22]** to ensure that system pressure reaches **PID Setpoint [SET–21]** (plus boost, if enabled).
- If, during normal operation, the system enters Sleep mode, but cycles on and off rapidly as it nears the Setpoint, it may be necessary to slightly lower the **PID Lo Hz Limit [SET–22]** to prevent Sleep mode problems.

Pipe Fill Feature

This feature automates the process of building pressure in an empty pipe system at a reduced speed before the VFD switches to PID control. This can reduce water hammer in some systems, and can also help prevent an Underload fault if the drive runs for an extended period at low pressure. The VFD must be running with PID Control in Auto mode for this feature to be active.

Set the following parameters to activate the Pipe Fill Feature:

Pipe Fill Timer [SET–33]: Pipe Fill mode exit timer to switch to PID control.

- Enter a time between 0.1 and 60 minutes to allow the pipe system to fill.
- If set to 0.0, Pipe Fill is disabled.
- When the timer expires, the VFD cancels Pipe Fill mode and switches to PID control, regardless of whether [SET–34] pressure has been reached.

Pipe Fill Exit Level [SET–34]: Pipe Fill mode exit pressure to switch to PID control.

- Enter a pressure setting between 0 and the PID Setpoint [SET–21] (default = 25 psi).
- During Pipe Fill mode, if pressure reaches the set value, VFD switches to PID control.

Pipe Fill Freq [SET–35]: Pipe Fill mode High frequency limit setting.

- Range is between PID Low Freq Limit [SET–22] and PID Hi Hz Limit [SET–23] (default = 47 Hz).
- The Pipe Fill mode frequency should be equal to or greater than [SET–22] +2 Hz to provide enough system pressure at the end of pipe fill mode to switch to PID control.

Upon start, if system pressure is less than [SET–34], VFD will ramp up to Low Freq Limit + 2 and start pipe fill mode.

- If system pressure is less than 0.5 x [SET–34], the frequency reference will be increased at a rate of 0.5 Hz per second.
- If system pressure is equal to or greater than 0.5 x [SET–34] but less than 0.6 x [SET–34], the frequency reference will stay at the current value.
- If system pressure is equal to or greater than 0.6 x [SET–34] but less than [SET–34] setting, the frequency reference will be decreased at a 0.5Hz per second rate. However, the rate will not be decreased below PID Low Hz Limit [SET–22] +2 Hz.
- If at any point system pressure is equal to or greater than [SET–34], VFD will cancel Pipe Fill mode and switch to PID control.

Lubrication Relay

The VFD has the capability to automatically activate a lubrication solenoid for line shaft turbine pumps, or for industrial machines with an external lubrication supply, before starting the motor.

Timers are available to enable lubrication before, during, or after running the motor, in any combination.

To enable the lubrication function, set the following parameters:

Lubrication Output Terminal [IO–47 through 49]: Connect the lubrication actuator to one of the Relay Outputs (RA1–3), and set the corresponding parameter to **41 Lube/S-Clean**.
Lube/S-Clean [IO–41]: Select the **Lubrication** option.
Pre-Lube Timer [IO–43]: 0 to 6000 seconds. This setting determines relay activation time after a run command is received and before the VFD starts. When the timer expires, the lubrication solenoid will be deactivated and the VFD will start the motor. If a stop command is received, or the VFD trips during Pre-lubrication, the relay will be deactivated and the timer accumulated value will be reset.
Run-Lube Timer [IO–44]: 0 to 6000 seconds. This setting determines relay activation time while the VFD is running.

- When set to a value greater than 0 and less than 6000, the relay will be activated at VFD start and will deactivate when the timer expires. If the VFD stops while the timer is active, the relay will deactivate and the timer will be reset.
- If the timer is set to the maximum 6000 sec, the relay will be activated during run mode until the VFD stops (no timing). If the VFD stops or trips, the relay will deactivate.

Post-Lube Tmr [IO–45]: 0 to 6000 seconds. This setting determines relay activation time after the VFD comes to a stop (0 Hz).

Screen Clean Relay

When water is pumped from a lake or pond, the suction screen requires periodic cleaning. The VFD can automate this process by providing a relay output to an external solenoid valve that will discharge pressurized water to clean the screen.

This feature works only in run mode in HOA Hand or Auto. If HOA is in OFF, or the VFD stops or trips on a fault, the Clean Screen mode will be deactivated and related timers will be reset.

The VFD provides a one minute (non-adjustable) cleaning pulse at every start. When the cleaning pulse is done, the **S-Clean Timer [IO–42]** starts. When the timer ends, another cleaning pulse is activated. This cycle continues until the VFD stops.

To enable the Clean Screen function, set the following parameters:

Screen Clean Output Terminal [IO–47 through 49]: Connect the lubrication actuator to one of the Relay Outputs (RA1–3), and set the corresponding parameter to **41 Lube/S-Clean**.
Lube/S-Clean [IO–41]: Select the **Screen Clean** option.
S-Clean Timer [IO–42]: 0 to 600 minutes. Time between cleaning pulses.

Timers

IMPORTANT: If two or more timers are activated with different time settings, the greater value timer will override other timers with a similar function.

Power On Run Delay

This timer provides run delay at VFD power-up with run command present to prevent multiple starts during power surges.

Set the following parameter to activate this feature:

Power On Delay [ADV–28]: Range from 0 to 6000 sec. (Default=10sec). When set to 0 sec, it is disabled.

When set to a value greater than 0 and VFD is powered up in any HOA mode, the timer will start counting and VFD start will be disabled until the timer expires.

Run Delay Timer (For Auto Mode)

This timer provides a delay at every VFD start when a run command is applied. The timer takes effect before every VFD start by run command, auto-restarts, fault reset, sleep wake-up, etc.

NOTE: FO (Fire Override) mode will disable this timer.

Set the following parameter to activate this feature:

Run Delay Timer [ADV–29]: Range from 0 to 6000 sec. (Default=0 sec). When set to 0 sec, it is disabled.

When set to value greater than 0 and VFD receives a start command, wakes up, auto resets, or restarts after a fault reset, the Start Delay timer will start counting. During timer counting, start is disabled and the VFD cannot be started in Hand or Auto mode. Stop command, Sleep mode, or tripping on a fault will reset this timer.

Minimum Run Timer

The Minimum Run timer delays VFD stop when a run command is removed. This timer is useful in vacuum pump, pressure washer and similar applications.

Submersible motors should run for a minimum of one minute to dissipate heat build-up from starting current.

Set the following parameter to activate this feature:

Minimum Run [ADV–34]: Range from 0 to 6000 seconds. When set to 0 sec, it is disabled.

When set to value greater than 0 and VFD is started in Auto mode, Minimum Run timer will start counting. During timer counting, VFD will continue to run even if start command is removed.

Shutdown feature will override this timer.

Backspin Timer

The Backspin timer is designed to protect the VFD from tripping when starting a reverse spinning motor caused by water backflow through a pump (no check valve) right after it was stopped.

Set the following parameter to activate this feature:

Backspin Timer [ADV–30]: Range from 0 to 6000 seconds. When set to 0 sec, it is disabled.

When set to value greater than 0 and VFD stops, Backspin timer will start counting. During backspin time, VFD is disabled and cannot be started in Hand or Auto mode.

Performance Control Features

Acceleration/Deceleration Control

Standard Rates

The VFD accelerates and decelerates a motor at a controlled rate based on the following parameters:

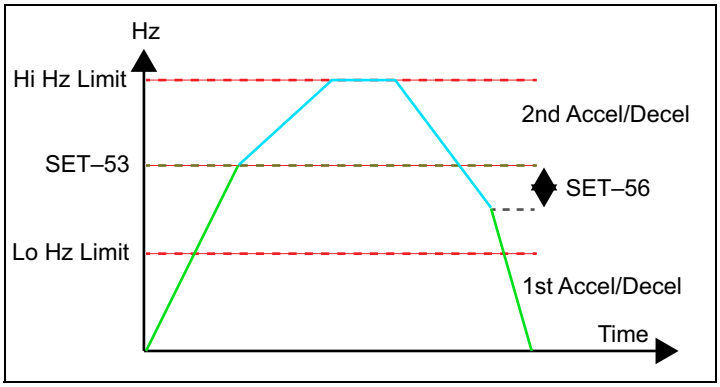
Accel Time [SET–11]: Time in seconds for the drive to accelerate from 0 Hz to maximum frequency.
Decel Time [SET–12]: When **Stop Mode [SET–16]** is set to Decelerate, time in seconds to slow down from maximum frequency to 0 Hz.

The defaults for these parameters are determined by the **Application [SET–00]** setting, but can be adjusted as required.

IMPORTANT: Setting acceleration or deceleration times that are too short may trigger over-current or over-voltage faults. Use of a suitable brake resistor can help with short deceleration times.

Change by Frequency

Acceleration and deceleration speeds can be modified when the VFD reaches a target frequency. For example: It may be desirable to start a motor quickly, as with a submersible pump, and then slow the response at higher speeds.

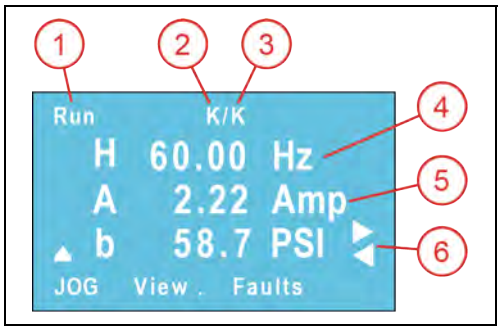


The VFD starts at the Standard rate and switches to **Second ACC [SET–54]** and **Second DCC [SET–55]** when it reaches **ACC Change Freq [SET–53]**. When the VFD decreases frequency below **[SET–53]**-**[SET–56]** it will switch back to the Standard rates.

ACC Change Freq [SET–53]: Frequency to switch from first acceleration/deceleration rate to second acceleration/deceleration rate.
Second ACC [SET–54]: Time in seconds for drive to accelerate from 0 Hz to maximum frequency. This rate takes effect when frequency is above **[SET–53]**. Default = 60 sec.
Second DEC [SET–55]: When **Stop Mode [SET–16]** is set to Decelerate, time in seconds to slow down from maximum frequency to 0 Hz. This rate takes effect when frequency is above **[SET–53]**. Default = 60 sec.
ACC/DEC Hyster [SET–56]: Hysteresis added to **[SET–53]** in changing the deceleration rate. This setting is subtracted from **[SET–53]** to delay the switch back to the **[SET–12]** rate. Default = 1.0 Hz.

Monitoring Functions

Home Screen Status Displays



The Home Screen displays default and user-selectable information about the operational status of the VFD. The keypad **ESC** key returns to the Home Screen from any menu.

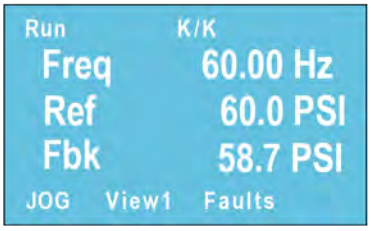
1. **Operating Status:** This field indicates the system actions currently active:
   - Run/Stop
   - Limit by PID 2
   - Ctrl by PID 2
   - Stopped by AI
   - Backspin Timer
   - Lubrication
   - Limit by Level
   - Limit by Temp
   - Stall
2. **Command Source:** This field identifies the currently configured source for RUN commands:
   - K = Keypad
   - T = Terminal control
   - R = RS485
   - O = Option board
3. **Frequency Source:** This field identifies the currently configured source for speed (frequency) control:
   - K = Keypad/PID
   - V1 = from AV1
   - V2 = from AV2
   - C = from ACI
   - R = RS485
   - O = Option board
   - 1-15 = Step speed (DI)
   - J = Jog frequency
4. **User Selectable Display Line 1:** Use Arrow and Enter keys to step through selections and to change setpoints.
   - (H) Actual output speed when running (Hz) for both **HAND** and **AUTO** modes.
   - (F) Keypad Setpoint (Hz) for **HAND** mode. This is adjustable using the keypad. In **AUTO** mode, the running frequency is displayed.
   - (P) PID Setpoint in application based units (PSI, inWC, etc.) **[SET–21]**. This is adjustable using the keypad.
5. **User Selectable Display Line 2:** Displays Output Current by default. Other user options are available through **[VFD–48]**:
   - 0_Freq Command
   - 1_Output Frequency
   - 2_Multi-Fn Display
   - 3_Output Current
6. **User Selectable Display Line 3:** Use Arrow keys to step through choices. This display corresponds to choices in **[SET–57]**. Refer to "Parameter Descriptions > SET Menu" on page 115 for a complete list of options.

View Screens

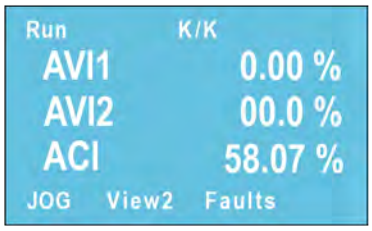
In addition to the Home Screen status information, nine predefined user information screens are available. From any menu location, press the keypad **F2** key repeatedly to cycle through the view screens.

View Screen 1: This screen displays the following:

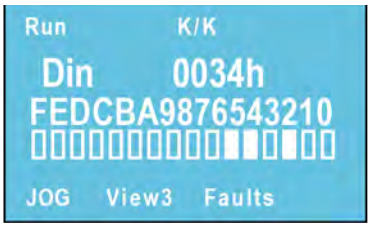
- Freq = The actual output frequency (Hz) at the time
- Ref = The PID target setpoint [SET-21]
- Fbk = The actual feedback level from the transducer.

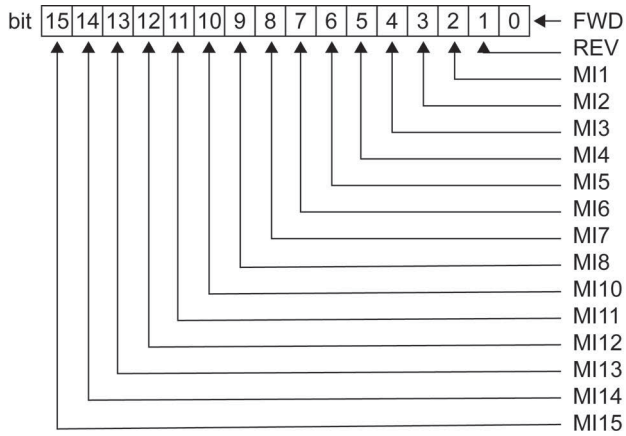


View Screen 2: This screen displays feedback from the analog inputs as a percentage.

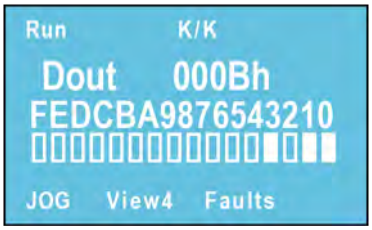


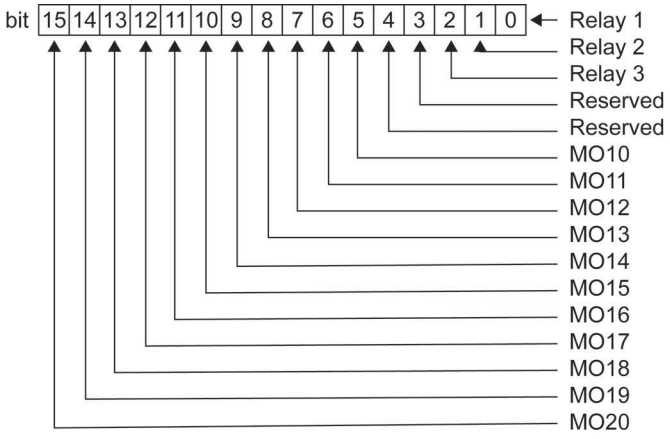
View Screen 3: This screen displays the status of the multi-function (digital) inputs in hex format. Solid boxes indicate that the input is active.





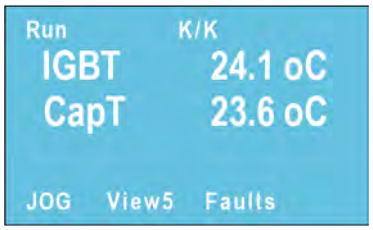
View Screen 4: This screen displays the status of the multi-function (digital) outputs in hex format. Solid boxes indicate that the output is active.





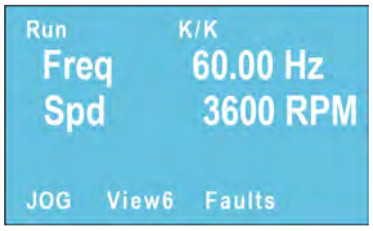
View Screen 5: This screen displays the following:

- Temperature of the IGBTs in °C
- Temperature of the capacitors in °C.



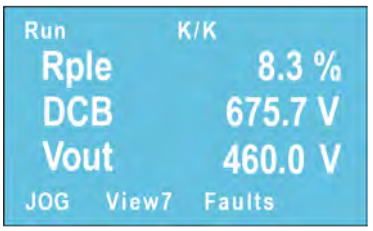
View Screen 6: This screen displays the following:

- The actual output frequency (Hz) at the time
- The actual motor speed (RPM) at the time.



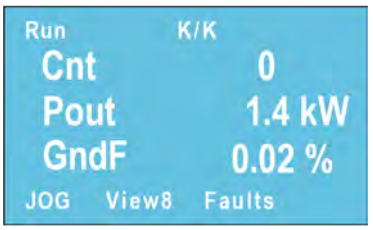
View Screen 7: This screen displays the following:

- DC-Bus voltage ripple
- DC-Bus voltage
- Output voltage.

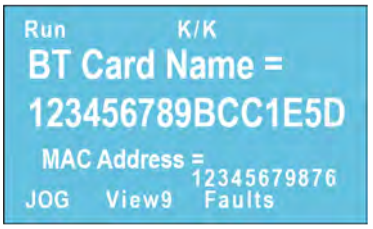


View Screen 8: This screen displays the following:

- Counter value
- Output power
- Ground fault.



View Screen 9: If an FE Connect Bluetooth communication card has been installed, this screen displays the code for connecting with the mobile application.

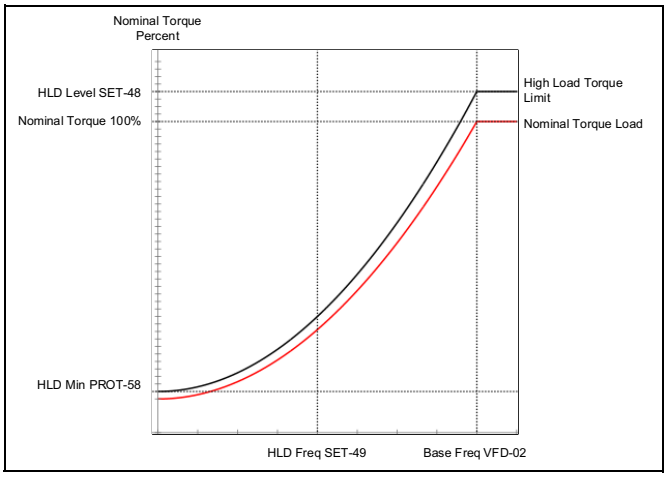


Protection Features

High Load Detection

High Load Detection (HLD) protects the VFD and equipment against damage from an over-torque condition. Two options are available:

- **HLD by Current:** The VFD trips when current is above **HLD Level [SET-48]** with frequency equal to or greater than **HLD Freq [SET-49]** for a duration of **HLD Delay [SET-50]**.
- **HLD by Torque:** The VFD calculates a High Load Torque Limit curve across the full frequency range based on motor parameters, VFD Base Frequency, and HLD settings. The VFD then trips when torque rises above this curve with frequency equal to or greater than **HLD Freq [SET-49]** for a duration of **HLD Delay [SET-50]**. This feature is primarily used for centrifugal loads such as centrifugal pumps or fans. It is not recommended for progressive cavity pumps or constant torque loads.



To enable High Load Detection, adjust the following parameters:

HLD Select [SET–47]: Disable, By Current, or By Torque.
HLD Min Torque [PROT–58]: Only if using HLD by Torque, set minimum torque level percentage at 0 Hz. Default = 10%.
HLD Level [SET–48]: For HLD by Current, set as a percentage of motor FLA (SFA) (default = 110%). For HLD by Torque, set as a percentage of nominal torque at base frequency. If all conditions are met, VFD will trip above this level.
HLD Frequency [SET–49]: Set minimum frequency for HLD by Current or Torque detection.
HLD Delay [SET–50]: Delay range from 0 to 360 seconds. When timer expires, if current or torque is still above limits and frequency is still above [Set–49], VFD will trip based on [Set–47].
HLD Recovery Time [SET–51]: 0 to 720 min (default = 0 min). If timer is set to value greater than 0 minutes, VFD will restart after timer expires. If set to 0 and the VFD trips, manual or remote reset is required (no auto retries).

If the VFD trips the first time on high load, it will restart after the Recovery timer expires. If VFD trips again, the timer value will be doubled. The VFD will continue restart attempts, doubling the timer value until it reaches 720 minutes (12 hours). Then every restart will be in 720 min. **HLD Recover Cnt [SET–52]** displays the countdown before the next restart attempt.

When the VFD finally runs without tripping for 180 sec, the recovery timer will be reset to original setting and at next high load trip VFD will wait for original [Set–51] time value.

If the run command is removed, or HOA is set to OFF, the high load feature is canceled and the [Set–51] timer is reset to its original setting.

Fine Tune Settings for HLD by Torque

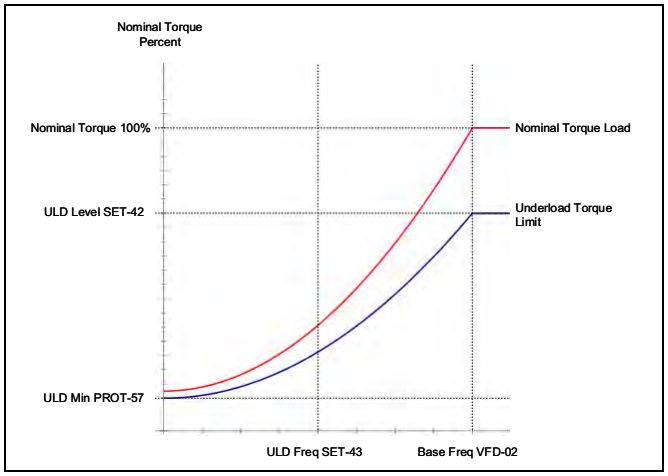
1. Verify accuracy of Motor FLA (SFA) [Set–03], Motor Voltage [Set–05], and VFD Base Freq [VFD–02]. These values determine nominal torque.
2. Adjust HLD Frequency [Set–49] to be equal to minimum operational frequency [Set–13] or [Set–22].
3. Run motor at minimum frequency and verify water movement for pump or air movement for fans.

4. While running at the motor at minimum frequency, determine whether VFD trips on HLD:
   - If system trips on HLD using default HLD Level [Set–48], increase level by 3% until system does not trip.
   - If system does NOT trip using default HLD Level [Set–48], decrease the level by increments of 3% until system trips, then increase back by 3%.
5. If nuisance tripping occurs, increase HLD Min Torque [Prot–58] by increments of 1%.
6. Adjust HLD Delay [Set–50] to duration acceptable for operation.

Underload Protection (Dry Well or Belt Loss)

Underload Detection (ULD) monitors motor current and frequency to protect against conditions such as a dry well, broken pump, or broken drive belt. Two options are available:

- **ULD by Current:** The VFD trips when current reading is less than set value and speed is equal or greater than set value, the VFD will trip on ULD.
- **ULD by Torque:** The VFD calculates an Underload Torque Limit curve across the full frequency range based on motor parameters, VFD Base Frequency, and ULD settings. The VFD then trips when torque falls below this curve with frequency equal to or greater than **ULD Freq [SET-43]** for a duration of **ULD Delay [SET-44]**. This feature is primarily used for centrifugal loads such as centrifugal pumps or fans. It is not recommended for progressive cavity pumps or constant torque loads.



To enable Underload Protection, adjust the following parameters:

Prime Time [IO–39]: Some pump applications require time for the pump to self-prime before the load stabilizes. This setting adds a 0 to 6000 second delay before the VFD starts monitoring for Underload or No-Flow conditions, which protects against nuisance faults. The delay operates at any VFD start, in both Hand and Auto modes, including Run, Wake, Restart, or Reset commands.
ULD Select [SET–41]: Disable, By Current, or By Torque.
ULD Min Torque [PROT–57]: If using ULD by Torque, set minimum torque level percentage at 0 Hz. Default = 10%.
ULD Level [SET–42]: For ULD by Current, set as a percentage of motor FLA (SFA) (default = 45%). For ULD by Torque, set as a percentage of nominal torque at base frequency. If all conditions are met, VFD will trip below this level.
ULD Frequency [SET–43]: Set minimum frequency for ULD by Current or Torque detection.
ULD Delay [SET–44]: Delay range from 1 to 360 seconds (default = 2 sec). When timer expires, if current is still below [Set–42] or torque is still below ULD Torque Limit curve and frequency is still above [Set–43], VFD will trip based on [Set–41].
ULD Recovery Time [SET–45]: 0 to 720 min (default = 30 min). If timer is set to value greater than 0 minutes, VFD will restart after timer expires. If set to 0 and the VFD trips, manual or remote reset is required (no auto retries).

For dry well protection, **Recovery Time** should be long enough to allow the well to be filled. If VFD trips the first time on Underload, it will restart after the Recovery timer expires. If VFD trips again, the timer value will be doubled. The VFD will continue restart attempts, doubling the timer value until it reaches 720 minutes (12 hours). Then every restart will be in 720 min. **ULD Recover Cnt [SET–46]** displays the countdown before the next restart attempt.

When VFD finally runs without tripping for 180 sec, the recovery timer will be reset to original setting and at next underload trip VFD will wait for well fill for original [Set–45] time value.

If the run command is removed, or HOA is set to OFF, the Underload feature is canceled and the [Set–45] timer is reset to its original setting.

Fine Tune Settings for ULD by Torque

1. Verify accuracy of Motor FLA (SFA) [Set–03], Motor Voltage [Set–05], and VFD Base Freq [VFD–02]. These values determine nominal torque.
2. Adjust ULD Frequency [Set–43] to be equal to minimum operational frequency [Set–13] or [Set–22].
3. Run motor at minimum frequency and verify water movement for pump or air movement for fans.
4. While running the motor at minimum frequency, determine whether VFD trips on ULD:
   - If system trips on HLD using default ULD Level [Set–42], decrease level by 03% until system does not trip.
   - If system does NOT trip using default ULD Level [Set–42], increase the level by increments of 3% until system trips, then decrease back by 3%.
5. If nuisance tripping occurs, lower ULD Min Torque [Prot–57] by increments of 1%.
6. Adjust ULD Delay [Set–44] to duration acceptable for operation.
7. Adjust ULD Recovery Time [Set–45] to a duration that fills-up well enough to allow motor to run minimum time before another ULD trip.

Overpressure

The Overpressure feature stops the VFD when PID feedback exceeds a set value in either Hand or Auto.

To enable this feature, adjust the following parameters:

OverPress Set [SET–39]: Disable, OP Trip, or OP Auto Reset.

- When enabled, if PID Feedback exceeds OverPress Level [SET–40], the VFD trips on Overpressure fault.
- If setting is OP Trip, manual or remote reset is required. If Reset Restart [VFD–36] is enabled and a run command is present, the VFD will restart when reset.
- If setting is OP Auto Reset, the VFD will restart when PID feedback falls below Wake-Up Level [SET–31] and a run command is still present.

OverPress Level [SET–40]: Overpressure trigger level in PID feedback units, 0.0 to SET-20 (Unit) PID F/B Max.

No Flow Protection

The VFD can monitor a system flow switch to provide pump protection and more reliable sleep mode operation.

Flow Switch Terminal [IO–21 through 28]: Connect the flow switch to one of the Digital Inputs (MI1–8) and set the corresponding parameter to **37 Flow Switch**.
No Flow Mode [IO–38]: Disabled, Trip, or Sleep. Default = Disabled.
Prime Time [IO–39]: Some pump applications require time for the pump to self-prime before the load stabilizes. This setting adds a 0 to 6000 second delay before the VFD starts monitoring for Underload or No-Flow conditions, which protects against nuisance faults. The delay operates at any VFD start, in both Hand and Auto modes, including Run, Wake, Restart, or Reset commands.
No Flow Freq [IO–40]: Range from PID/VFD Freq Low Limit to PID/VFD Freq High Limit. Default= 20.0Hz or 40Hz based on application.

When [IO–38] is set to **Trip** and the VFD runs at a frequency greater than [IO–40] longer than [IO–39] with the flow switch contact open, the VFD will trip on No Flow Fault. If the switch closes during the delay, the delay timer will be reset and will start again if the flow switch contact opens again.

When [IO–38] is set to **Sleep**, the flow switch will become an additional condition for sleep mode. When VFD runs with PID control and determines that all sleep mode conditions are met and the flow switch is open during Sleep delay, VFD will go into sleep mode.

Broken Pipe Protection (for Pump Applications)

The VFD has the ability to detect a broken pipe in the system. The VFD must be running with PID Control in Auto mode for this feature to be active.

To enable this feature, adjust the following parameters:

Broken Pipe Level [SET–36]: 0.0 to PID F/B Max [Set–20]. Setting of 0.0 disables the feature. When pressure falls below this level and VFD continues to run above [Set–37], delay timer [SET-38] starts.
Broken Pipe Freq [SET–37]: PID Low Freq [Set–22] to PID High Freq [Set–23] (default = 59.5 Hz).
Broken Pipe Delay [SET–38]: 0.0 to 6000 seconds (default = 180 sec). If either of the first two conditions is removed, the timer will reset. If the timer expires with both conditions still active, the VFD will trip on Broken Pipe fault.

Manual or remote reset is required.

ADVANCED APPLICATION OPTIONS

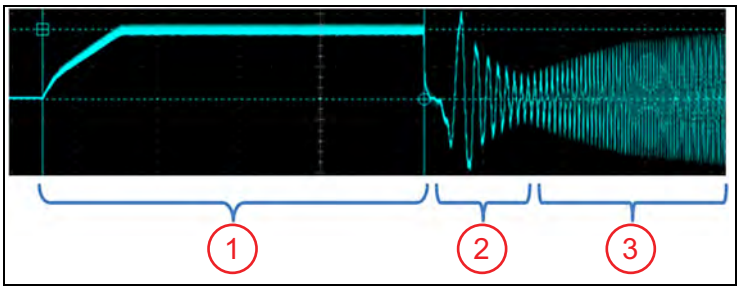
Operation with Permanent Magnet Motors

Permanent magnet (PM) motors are different than induction motors in that PM motors have magnets installed in the rotor. A PM motor is more efficient than an induction motor because the PM motor does not need power to magnetize the rotor. Therefore, a PM motor uses less input power to create the same shaft power.

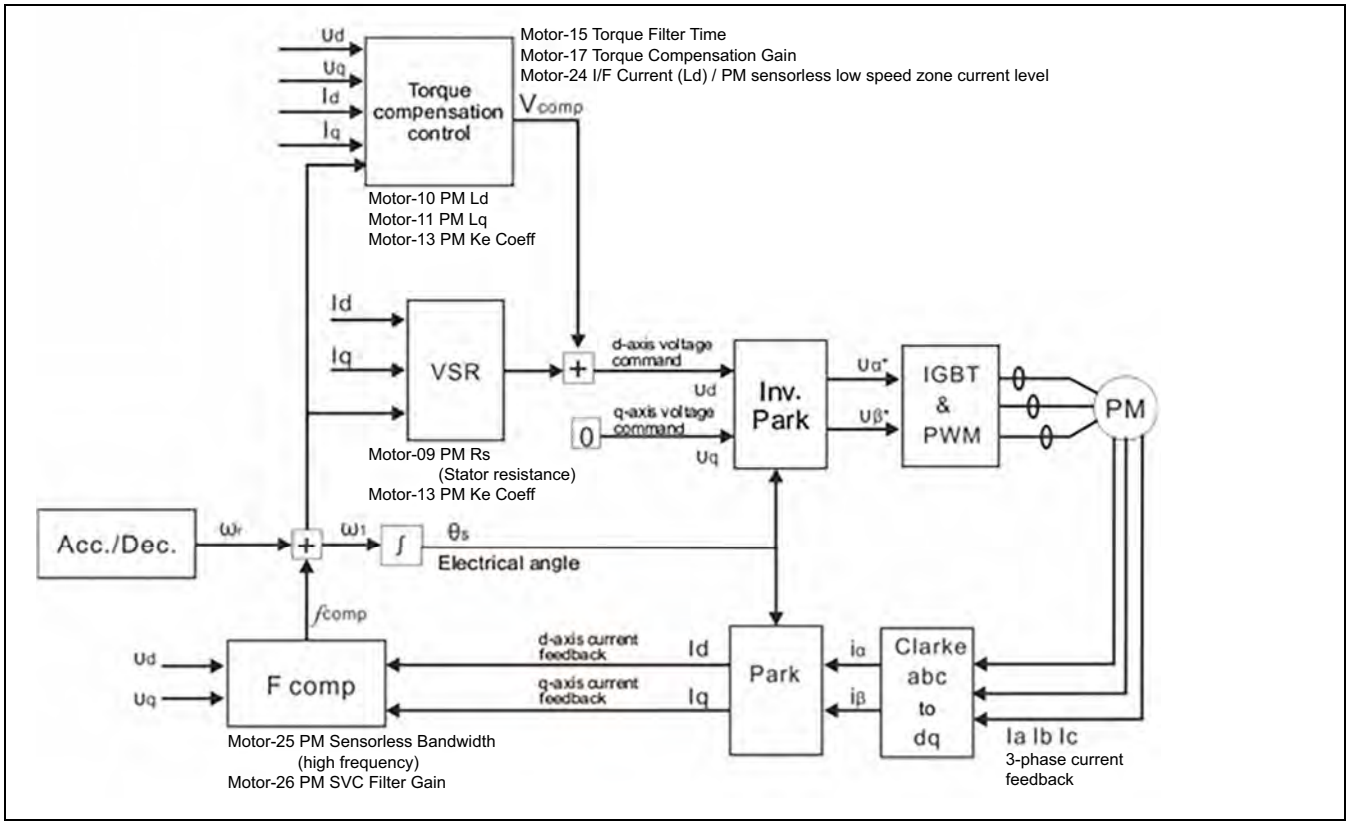
Internal PM motors (IPM) have the magnets installed in the rotor laminations rather than on the surface of the laminations, which are called surface PM motors (SPM).

The X-Drive controls PM motors using Sensorless Vector Control (SVC). SVC can also be used to control induction motors. SVC is different than scalar (VF) mode in that the drive uses feedback of the 3-phase current to regulate current at startup and adjust frequency of operation for torque compensation.

PM SVC operation has a sequence of three steps:



1. DC Alignment – A DC current and voltage is applied to the motor to align the rotor to the magnetic poles. This alignment requires 3 seconds.
2. I/F Control – A controlled current start of the motor is performed. This technique provides higher starting torque than VF mode.
3. Advance V/F Control – With the motor started, frequency compensation stabilizes the current load. Torque compensation adjusts output voltage to correct for torque control.



Setup MagForce Pump Motor

Franklin Electric MagForce motors use an internal permanent magnet motor (IPM) design with 4-pole construction and synchronous speed. This means the electrical frequency is the same speed as the shaft speed with no slip in the rotor. Since the motor has 4 poles, the electrical frequency running the motor will need to be twice that of a 2-pole motor for same desired RPM.

MagForce motors are rated to operate up to 3600 RPM in North America or 3000 RPM in the EU, and not to exceed the maximum SFA rating of the motor. To run pumps at their rated speed, use the pump RPM calculation "Poles x RPM / 120 = Electrical Frequency (Hz)" in order to set the **VFD Max Freq [VFD–00]**.

Pump RPM	Electrical Frequency
3600	4 x 3600 / 120 = 120 Hz
3450	4 x 3450 / 120 = 115 Hz
3525	4 x 3525 / 120 = 117.5 Hz
3000	4 x 3000 / 120 = 100 Hz
2850	4 x 2850 / 120 = 95 Hz
2938	4 x 2938 / 120 = 98 Hz

Use the following steps to configure an X-Drive for use with a MagForce:

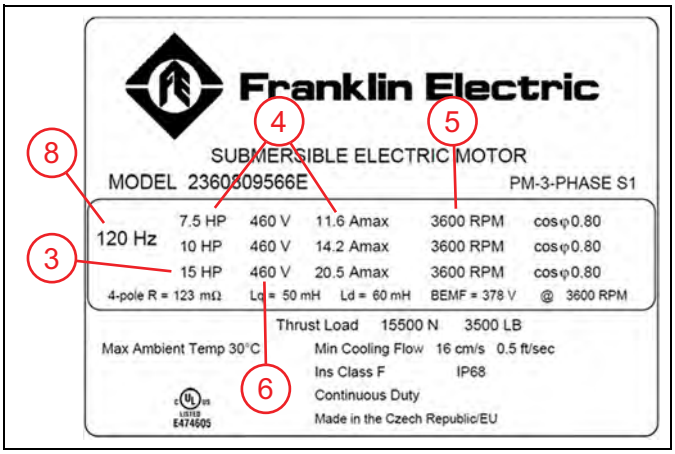
Basic Setup

IMPORTANT: If the VFD has been used in a previous application, the drive parameters should be completely reset using **Parameter Reset [ADV–03]**, option **4_Reset all Param**.

1. **Application [SET–00]:** Set to option 9_MagForce. This selection assumes the use of a 4-pole, 3-phase PM motor running at 120 Hz and automatically updates all relevant parameters to the proper defaults.

   IMPORTANT: The MagForce application should **ONLY** be used with Franklin Electric MagForce motors. Do **NOT** use this selection with other permanent magnet motors.

2. **Input Phase [SET–01]:** Verify that the setting matches the type of power supply— 3-phase (default).
3. **Motor Horsepower [SET–02]:** Enter the maximum rated horsepower from the motor nameplate.
4. **Motor FLA (SFA) [SET–03]:** Set to the current rating on the nameplate associated with the power rating of the pump.
5. **Motor RPM [SET–04]:** Enter the rated motor RPM from the motor nameplate.
6. **Motor Voltage [SET–05]:** Enter the rated voltage from the motor nameplate.
7. **VFD Max Freq [VFD–00]:** The highest frequency allowable. This should be set to the calculated electrical frequency corresponding to the target pump RPM in the table above.



8. **VFD Base Freq [VFD–02]:** This should be set to the motor nameplate frequency rating.
9. **Carrier Freq [SET–06]:** This should be set to 4 kHz for sine filters and 2 kHz for dV/dt filters.

Permanent Magnet Specific Parameters

For MagForce applications, the drive automatically sets:

- **Control Method [Motor–05]:** This should be **2_Sensorless** Vector Control.
- **Motor Type [Motor–06]:** This should be **2_PM-IPM**.
- **PM Poles [Motor–07]:** This should be **4** for a MagForce motor.
- **PM Inertia [Motor–08]:** This value is automatically calculated.

Motor Specific Parameters

For MagForce applications, the drive automatically sets:

- **PM Rs [Motor-09]:** Motor stator resistance.
- **PM Ld [Motor-10]:** Motor inductance d-axis.
- **PM Lq [Motor-11]:** Motor inductance q-axis.
- **PM Ke Coeff [Motor-13]:** Motor parameter Ke (Vphase, rms / krpm).

Autotune Characteristic Parameters

For MagForce applications, autotune is not needed. However, if the drive consistently exceeds the motor current specification during DC Alignment and I/F control, then an autotune may be needed. Refer to "Autotune Characteristic Parameters" on page 82.

Tune motor control – DC Alignment

For MagForce applications, no adjustments are needed. However, if there are problems during DC Alignment, refer to "Tune motor control – DC Alignment" on page 82.

Tune motor control - I/F Control

For MagForce applications, no adjustments are needed. However, if there are problems during I/F Control, refer to "Tune motor control - I/F Control" on page 82.

Tune motor control - PM Control

For MagForce applications, no adjustments are needed. However, if there are problems during PM Control, refer to "Tune motor control - PM Control" on page 83.

Setup Non-Franklin Electric PM Motors

The X-Drive can be programmed to operate general purpose permanent magnet motors through the following procedure:

Basic Setup

IMPORTANT: If the VFD has been used in a previous application, the drive parameters should be completely reset using **Parameter Reset [ADV–03]**, option **4_Reset all Param**.

1. **Application [SET–00]:** Set to option 8_PM Motor. This selection assumes the use of a 4-pole, 3-phase PM motor running at 120 Hz and automatically updatesrelevant parameters to the proper defaults.

   IMPORTANT: Do **NOT** use the MagForce selection with non-Franklin Electric permanent magnet motors.
2. **Input Phase [SET–01]:** Verify that the setting matches the type of power supply— 3-phase (default).
3. **Motor Horsepower [SET–02]:** Enter the maximum rated horsepower from the motor nameplate.
4. **Motor FLA (SFA) [SET–03]:** Enter the rated motor FLA, found on the motor nameplate.
5. **Motor RPM [SET–04]:** Enter the rated motor RPM from the motor nameplate.
6. **Motor Voltage [SET–05]:** Enter the rated voltage from the motor nameplate.
7. **VFD Max Freq [VFD–00]:** The highest frequency (speed) allowable.
8. **VFD Base Freq [VFD–02]:** This should be set to the motor nameplate frequency rating.
9. **Carrier Freq [SET–06]:** This should be set to 4 kHz for sine filters and 2 kHz for dV/dt filters. Carrier frequency should be at least 1.5 times the resonant frequency of the filter.

Permanent Magnet Specific Parameters

Enter motor parameters unique to the installation:

- **Control Method [Motor–05]:** This should be **2_Sensorless** Vector Control.
- **Motor Type [Motor–06]:** Set to **1_PM-SPM** or **2_PM-IPM**.
- **PM Poles [Motor–07]:** Set the number of poles in the motor. (Poles = Base Freq x 120 / RPM.)
- **PM Inertia [Motor–08]:** If unknown, use the value calculated by the drive.

Motor Specific Parameters

Input motor characteristic parameters. If any motor characteristic parameters are unknown besides PM PG Angle [Motor-12], then an autotune is required to measure these values.

- **PM Rs [Motor-09]:** Motor stator resistance. If unknown, leave blank.
- **PM Ld [Motor-10]:** Motor inductance d-axis. If unknown, leave blank.
- **PM Lq [Motor-11]:** Motor inductance q-axis. If unknown, leave blank.
- **PM PG Angle [Motor-12]:** Motor offset angle. If unknown, leave blank.
- **PM Ke Coeff [Motor-13]:** Motor control coefficient. If unknown, leave blank.

Autotune Characteristic Parameters

1. If a sine filter is connected to output of drive, either disconnect the capacitors or remove sine filter between drive and motor cable so that motor cable is directly connected to the drive. Make sure all power to the drive is disconnected before changing wiring.
2. Set **Motor A-Tuning [Motor-00]** to **3_SPM No-Rotation** or **4_IPM No-Rotation**. If a load is on the motor and cannot be removed, then a "no-rotation" option should be selected. Remove load from the motor to then use "Rotating."
    a. An autotune "no-rotation" will output high frequency into the motor to calculate the motor impedance values but not the Ke Coeff.
    b. An autotune with rotation will do same as "no-rotation" and then turn the rotor of the motor to calculate the Ke Coeff (Vphase, rms / krpm).
3. Start Autotune by initiating a start command.
4. Once Autotune is complete, the drive will populate PM characteristic parameters.
5. If using a sine filter, reconnect filter between drive and motor cable.

Tune motor control – DC Alignment

Related parameters:

- **I/F Current [Motor-24]:** Percentage of nominal motor current [SET-03] used to regulate output current during DC current during PM DC Alignment.
- **DC-Tun Curr P [Motor-39]:** Proportional gain value regulating DC current during DC Alignment of PM motor.
- **DC-Tun Curr I [Motor-40]:** Integral gain regulating DC current during DC Alignment of PM motor.

The DC Alignment process rarely needs adjusting. However, if the motor is not aligning properly, the user may detect unexpected high current loads, or an unusual rumbling sound at low frequency. This might occur when the motor leads are very long (> 3000 ft) or high load prevents motor movement. In this case, start by increasing the I/F Current [Motor-24], and then DC-Tun Curr P [Motor-39] if necessary.

Tune motor control – I/F Control

Related parameters:

- **I/F Current [Motor-24]:** Percentage of nominal motor current [SET-03] used to regulate AC current during I/F Control.
- **Freq I/F to PM [Motor-27]:** When increasing frequency, the frequency to switch modes from I/F mode to PMSVC mode.

- **Freq PM to I/F [Motor-28]:** When decreasing frequency, the frequency to switch modes from PMSVC mode to I/F mode.
- **I/F Fltr Time [Motor-29]:** Low-pass filter time of current being commanded from I/F Current [Motor-24].

The drive regulates current level at I/F Current as frequency ramps up to Freq I/F to PM. Once above this frequency, the Advance V/F Control becomes active. Ramping down to Freq PM to I/F switches out of Advance V/F Control to I/F current regulation. The current regulation averages current value base on I/F fltr time.

If the motor load does not rotate up to Freq I/F to PM, the I/F Current needs to increase. If the I/F Current is at maximum without load rotating, reduce I/F current to below 100% and set acceleration rate to a higher value. If more torque is required, increase switching frequency **[SET-06]**.

Tune motor control – PM Control

Related parameters:

- **Torque Filter T [Motor-15]:** Response time in controlling torque to motor.
- **Torque Cmp Gain [Motor-17]:** Gain value for output voltage increase to compensate for voltage drop on stator resistance at high motor loads in torque compensation function. For PM motors, max value is 5000. Setting Torque Cmp Gain to 0 will remove I/F control and disable stability.
- **PM Bandwidth HS [Motor-25]:** Allowable frequency bandwidth around desired frequency in order to adjust operating frequency to prevent vibrations in motor operation.
- **PMSVC Fltr Gain [Motor-26]:** Gain value in adjusting the operating frequency from the desired frequency to prevent vibrations in motor operation.
- **PM Trq Comp I/F [Motor-37]:** PM Torque Compensation in I/F Mode.
- **PM Trq Comp SVC [Motor-38]:** PM Torque Compensation in SVC Mode (Advance V/F Control).

IMPORTANT: **PM Trq Comp I/F** and **PM Trq Comp SVC** are only operable in MagForce application. PM Motor Application uses **Torque Cmp Gain**.

The drive outputs nominal voltage based on desired frequency. Frequency compensation (stabilizer) is quickly adjusting the desired frequency to prevent overcurrent or high voltage on DC bus. The torque compensation control is adjusting output voltage to ensure rotor magnetization is at correct level for desired torque with respect to operating frequency. The switching frequency should be increased by at least 1.5 times the resonant frequency of the sine filter.

PM motors can be unstable with no loads at high frequencies. If there is a light or no load, the Torque Cmp Gain will need to be increased until stability is achieved. Increasing the switching frequency helps in providing stability. If a more precise output frequency is desired, lower the PM Bandwidth HS.

Multi-Motor Configurations

Several multi-motor configurations are available:

- Equal Run Time
- Soft Start Mode
- Lead-Lag
- Run Time Alt
- Rotate Lead

Multi-Motor (MMC) Relay Control for Pump Applications

The multi-motor configuration for constant pressure systems provides control for up to 4 pump motors (8 with optional I/O board) in a Lead, Lag configuration.

The VFD controls speed of the Lead pump using its own PID feedback loop and the VFD motor output. If the Lead pump cannot maintain setpoint pressure, the VFD uses relay outputs to trigger Lag pumps through a starter, soft-starter, or another VFD. Relay output function **[I0–47, –48, or –49 etc.]** should be set to **47_MMC Out**. The lowest number relay set to MMC will be Lag 1.

This feature does not provide an alternation or Lead pump replacement in case of pump or VFD failure.

To enable Lead, Lag Relay Control, set the following parameters:

MMC Mode [ADV–10]: Set to **3_Lead-Lag**.
Lag Start Freq [ADV–18]: When the lead pump runs above this frequency, it sets the first condition for starting a Lag pump. Range is **Lag Stop Freq [ADV–23]** to **PID Hi Hz Limit [SET–23]**. Default = 59.5 Hz.
Lag Start Delay [ADV–19]: Sets a delay time to start Lag pump when both frequency and pressure conditions are met. Default = 10 sec.
Lag Start Level [ADV–20]: Sets a percentage below **PID F/B Max [SET–20]** (pressure) to calculate **MMC Below Setpoint** as the second condition for starting a Lag pump. Range is 0.1 to 10%. Default = 2%.
MMC Below Setpoint = [SET–21] – {[SET–20] x [ADV–20]/100}.
Lead Freq Drop [ADV–21]: **PID Hi Hz Limit [SET–23]** drop value with **[ADV–22]** at Lag pump start to prevent system overpressure condition. Default = 10 Hz.
MMC Decel Time [ADV–22]: Sets the deceleration time for the **[ADV–21]** frequency drop. Default = 2 sec.
Lag Stop Freq [ADV–23]: When the Lead runs below this frequency, it sets the first condition for stopping Lag pumps. Default = 35 Hz.
Lag Stop Delay [ADV–24]: Sets a delay time to stop Lag pump when both frequency and pressure conditions are met. Default = 4 sec.
Lag Stop Level [ADV–25]: Sets a percentage above **PID F/B Max [SET–20]** (pressure) to calculate **MMC At Setpoint** as the second condition for stopping a Lag pump. Default = 0.3%.
MMC At Setpoint = [SET–21] + {[SET–20] x [ADV–25]/100}.
Lead Freq Bump [ADV–26]: **PID Lo Hz Limit [SET–22]** increase value with **[ADV–27]** at Lag pump stop to prevent system underpressure condition. Range is 0 to [SET–23]*0.4. Default = 0 Hz.
MMC Accel Time [ADV–27]: Sets the acceleration time for the **[ADV–26]** frequency bump. Default = 2 sec.

Lag Pump Start sequence: If the Lead motor runs at a speed equal or greater than **[ADV–18]** with system pressure less than **MMC Below Setpoint** for **[ADV–19]** delay, the VFD will decrease **PID High Freq Limit [SET–23]** by **[ADV–21]** value for **[ADV–22]** time and then activate relay output to start the first Lag Pump in sequence. After a non-adjustable 1 sec delay, the VFD will change **[SET–23]** to its original value and check for Lag Start/Stop conditions. If demand is still high, the VFD will repeat Lag Start sequence for additional Lag pumps.

Lag Pump Stop sequence: If the Lead motor runs at a speed equal or less than **[ADV–23]** with system pressure equal or greater than **MMC At Setpoint** for **[ADV–24]** delay, the VFD will increase **PID Lo Hz Limit [SET–22]** by **[ADV–26]** value for **[ADV–27]** time and then it will deactivate relay output to stop the first Lag Pump. After a non-adjustable 1 sec delay, the VFD will change **[SET–22]** to its original value and check for Lag Start/Stop conditions. If demand is still low, the VFD will repeat Lag Stop sequence for additional Lag pumps. If all Lag pumps are stopped, the VFD will check for Sleep Mode conditions.

If the VFD run command is removed during MMC operation, all Lag pump relays will deactivate in sequence with a 1 sec delay between each relay. The delay will protect from voltage surges in the power line when Lag pumps stop. The VFD will then stop the Lead based on the selected method (Decel or Coast).

If the VFD trips on a fault during MMC operation, the VFD will immediately deactivate all Lag pump relays and it will coast stop.

COMMUNICATIONS

FE Connect for Cerus X-Drive Mobile Application

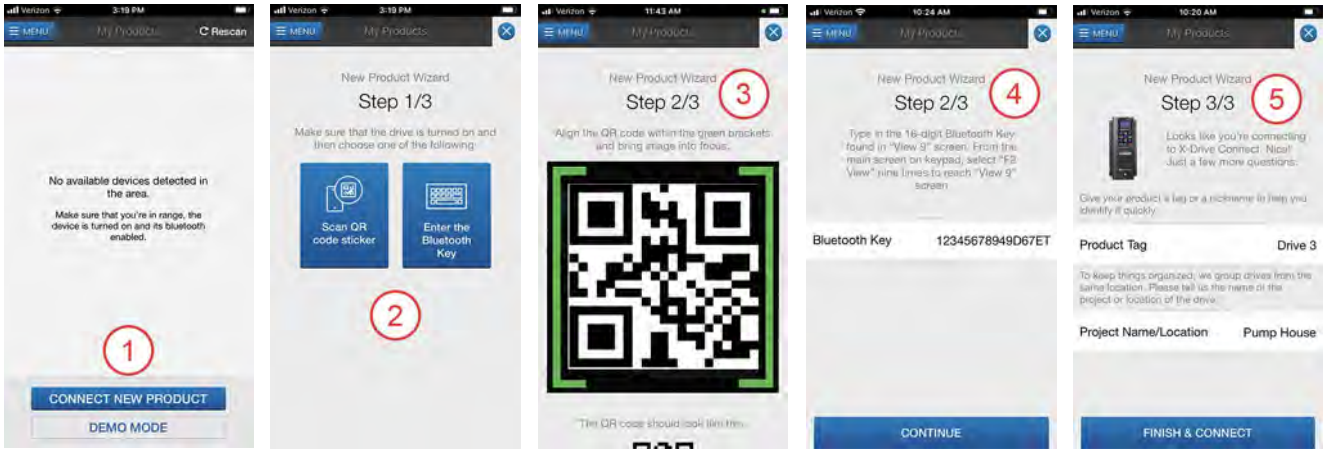
The FE Connect app for X-Drive is an intuitive way to wirelessly configure and control your VFD. It provides features such as:

- Simple, application-based setup for quick and easy startup
- Informational dashboard for visual monitoring of system performance
- Mobile control mode for easy Hand mode operation
- In-app troubleshooting with fault time and date logging
- Email system logs directly to FE support

In your mobile device's app store, search for FE Connect. Locate and install the X-Drive specific version of the app.

NOTE: To use the app, you must install and configure an accessory X-Drive FE Connect Bluetooth communication card in the VFD. Refer to "Optional Extension Cards" on page 95.

Setup Bluetooth Connection

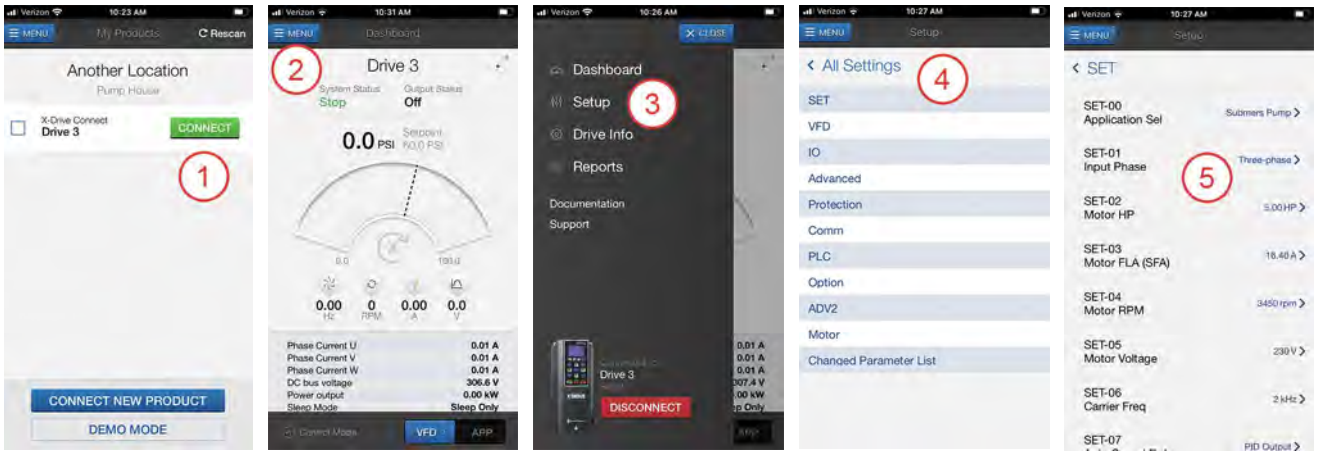


After installing the X-Drive Connect app on your device, use the following procedure to connect to a X-Drive:

1. From the Home screen, tap **Connect New Product**.
2. On the **New Product Wizard** screen, tap either **Scan QR Code Sticker** or enter the **Bluetooth Key**.
3. If using the scanning tool, center the QR code on the Bluetooth card in the screen.
4. If using the **Bluetooth key**, press the **F2** button on the drive keypad nine times to display the BT Card Name screen. Enter the key number shown into the app.
5. Enter a Name and Location to identify the drive within the app.

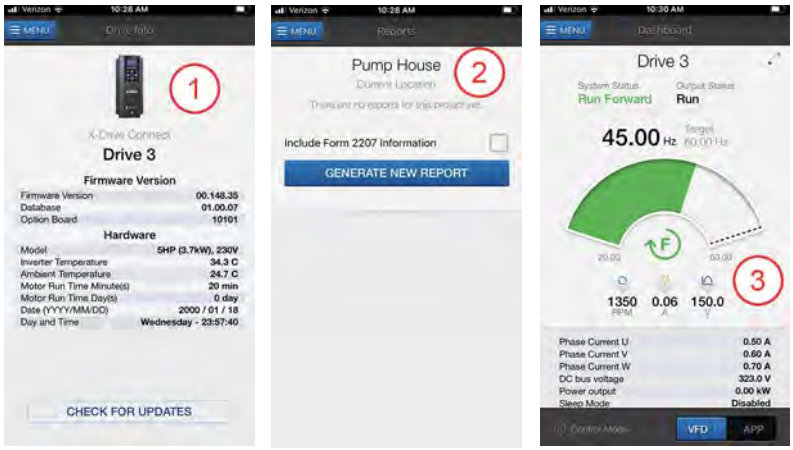
Tap **Finish & Connect** to complete the connection.

Using the Mobile App



Use the following procedure to program an X-Drive that has been paired with the app.

1. On the **My Products** screen, tap the name of the desired drive to connect to the device and enter the Dashboard.
2. Tap the **MENU** button to for a list of options.
3. Tap **Setup** to change VFD settings, then tap **All Settings** to display the complete parameters lists.
4. From here, you will be able to program and verify all drive settings. Refer to "Setting Operating Parameters" on page 48 for more information about settings.



When setup programming is complete, many more features are available within the app for both controlling the drive and fine tuning its performance.

1. Drive Info display
2. Reports Generator screen
3. Dashboard display. Use the Control Mode slider at the bottom to switch control of the drive between the keypad and the mobile app.

Modbus Communication

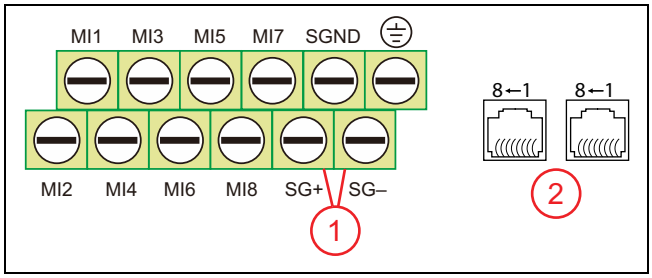
The VFD can be controlled and monitored through the Modbus RTU protocol over an RS-485 connection. Modbus follows a simple client-server model. Server devices perform data read/write requests, which are issued from a client device such as a Programmable Logic Controller (PLC) or Building Management System (BMS). Assignable addresses for server devices range from an address of 1 to a theoretical maximum of 247.

As a server device, the VFD communicates all data using only 16-bit holding registers. Addressing for the registers is partitioned into blocks that are multiples of 100 to group functionally similar data. If the drive is configured to accept commands via remote communications, it can be commanded to start, stop, run at a specified output frequency, target a setpoint in PID control, and reset faults.

Modbus addresses can be found in the parameter tables throughout this publication.

X-Drive Configuration for Modbus

Use the X-Drive's internal COM1 Port to connect to a Modbus network. COM1 can be accessed either through terminals SG+ and SG– (1) or through one of the RJ45 connectors (2). RJ45 pins 4 and 5 are connected in parallel with SG+ and SG– and pins 3 and 6 are parallel with SGND and Ground.



The X-Drive can also communicate with a Modbus network through Ethernet, if an accessory Ethernet Communication card is installed in the VFD. Refer to "Optional Extension Cards" on page 95.

To enable Modbus communications, set the following parameters:

Communication Parameters Setup

- **PLC Menu [SET–58]:** Use this setting to enable the PLC menu.
- **PLC Com Type [PLC–23]:** Set to **0_Modbus 485**. This enables Modbus on COM1 with the format RTU 8, N, 1. When Modbus is enabled, BACnet communication, and PLC communication are disabled on COM1.
- **COM1 Address [COMM–00]:** If the AC motor drive is controlled by RS-485 serial communication, the communication address for this drive must be set via this parameter and each AC motor drive's communication address must be different.
- **COM1 Speed [COMM–01]:** This parameter is for selecting the RS485 communication transmission speed. Set 4.8K, 9.6K, 19.2K, 38.4K, 57.6K and 115.2K. If the value is not one of these 6 types, it will be replaced by 9.6K.
- **COM1 Loss [COMM–02]:** Sets the action when communication errors occur.
- **COM1 Loss Delay [COMM–03]:** Setting for communication timeout detection.
- **COM1 Protocol [COMM–04]:** RS485 Protocol: Data Bits - Parity - Stop Bits - Message Format
- **Response Delay [COMM–05]:** Duration VFD waits before responding to received communication.
- **Main Frequency [COMM–06]:** When Auto Speed Ref [SET-07] is set to RS485 Interface, the last frequency command is stored in this parameter. After rebooting from an abnormal turn-off or momentary power loss, the VFD will continue operation with last frequency.

System Parameters Setup

- **HOA Mode Source [SET–60]:** Set to **2_RS485 Serial**. This enables Modbus to switch between Hand and Auto modes.
- **Auto Speed Ref [SET–07]:** Set to **5_RS485 Serial**. This enables Modbus to control the speed when in Auto mode.
- **Auto Run Cmd [SET–08]:** Set to **2_RS485 Serial**. This enables Modbus to initiate a Run Command in Auto mode.
- **Hand Speed Ref [SET–09]:** Set to **1_RS485 Serial**. This enables Modbus to control the speed when in Hand mode.
- **Hand Run Cmd [SET–10]:** Set to **2_RS485 Serial**. This enables Modbus to initiate a Run Command in Hand mode.

ModBus Commands and Data Addresses

ModBus	Display Name
8192	Run Command
8193	Frequency Command
8194	Fault Reset
8448	Error Code
8449	Drive Status
8450	Frequency Command Value
8451	Output Frequency
8452	Output Current
8453	DC-Bus Voltage
8454	Output Voltage
8455	Multi-Step Speed
8456	Reserved
8457	Counter Value
8458	Power Factor Angle
8459	Torque
8460	Motor Speed
8461	Reserved
8462	Reserved
8463	Output Power
8470	Multi-Function Display
8475	Maximum Operating Frequency
8479	Decimal Portion of Output Current
8704	Output Current
8705	Counter Value
8706	Output Frequency
8707	DC-Bus Voltage
8708	Output Voltage
8709	Power Angle
8710	Motor Power
8711	Motor Speed
8712	Torque
8713	Reserved
8714	PID Feedback Value
8715	AVI1 Input Value Percentage
8716	ACI Input Value Percentage
8717	AVI2 Input Value Percentage
8718	IGBT Temperature
8719	Ambient Temperature
8720	Digital Input Status
8721	Digital Output Status
8722	Multi-Step Speed Being Executed
8723	CPU Pin Status for Digital Inputs
8724	CPU Pin Status for Digital Outputs
8725	Reserved
8726	Reserved
8727	Reserved
8728	Reserved
8729	Counter Overload Time Percentage
8730	GFF Percentage
8731	DC Bus Ripple
8732	PLC Register D1043 Data
8733	Reserved
8734	User Page Display
8735	Output Value of Output Frequency Coefficient Calculation
8736	Number of Motor Revolutions While Running
8737	Operating Position of the Motor
8738	VFD Cooling Fan Speed
8739	Control Mode
8740	Carrier Frequency Status
8741	Reserved
8742	Drive Status
8743	Reserved
8744	Reserved
8745	Power
8746	Reserved
8747	Reserved
8748	Reserved
8749	Reserved
8750	PID Reference Value
8751	PID Offset Value
8752	PID Output Frequency
8753	Hardware ID
9729	Digital Input Status
9730	Digital Input Status Continued
9793	Digital Output Status
9825	AVI1 Proportional Value
9826	ACI Proportional Value
9827	AVI2 Proportional Value
9835	Expansion Card AI10 Percentage
9836	Expansion Card AI11 Percentage
9889	AFM1 Output Proportional Value
9890	AFM2 Output Proportional Value
9899	Expansion Card AO10 Percentage
9900	Expansion Card AO11 Percentage

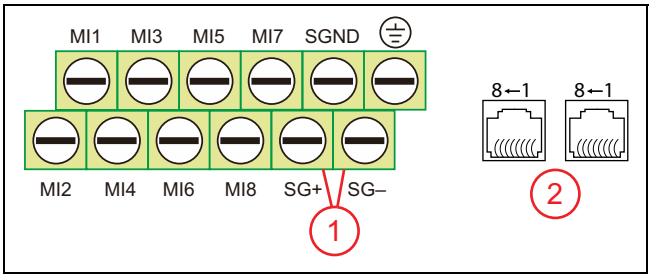
BACnet Communication

The VFD can be controlled and monitored through the BACnet MS/TP protocol over an RS-485 connection. The VFD operates as an MS/TP master device, for which the protocol can support addressing for up to 128 master devices in a single MS/TP network.

BACnet conveys control and monitoring data as a collection of BACnet objects. The X-Drive BACnet protocol supports 3 object types: Device, Analog Value (AV), and Binary Value (BV). The Read Property and Write Property services can be used to interface to these objects. If the drive is configured to accept commands via remote communications, it can be commanded to start, stop, run at a specified output frequency, target a setpoint in PID control, and reset faults.

X-Drive Configuration for BACnet

Use the X-Drive's internal COM1 Port to connect to a BACnet network. COM1 can be accessed either through terminals SG+ and SG– (1) or through one of the RJ45 connectors (2). RJ45 pins 4 and 5 are connected in parallel with SG+ and SG– and pins 3 and 6 are parallel with SGND and Ground.



To enable BACnet communications, set the following parameters:

Communication Parameters Setup

- **PLC Menu [SET–58]:** Use this setting to enable the PLC menu.
- **PLC Com Type [PLC–23]:** Set to **1_BACnet**. This enables BACnet on COM1 with the format RTU 8, N, 1. When BACnet is enabled, Modbus communication, and PLC communication are disabled on COM1.
- **BACnet MAC ID [COMM–24]:** This should be set to BACnet's MS/TP station number—default = 10. Range = 0 to 127.
- **BACnet Speed [COMM–25]:** This should be set to the BACnet communication baud rate—default = 38400. Range = 9600, 19200, 38400, or 76800 bps.
- **Device ID Lo [COMM–26]** and **Device ID Hi [COMM–27]:** The combination of these two parameters is the Device Object Identifier. COMM–26 is usually set as the unique device number in the trunk. COMM–27 is usually set to the trunk or building floor number. Refer to "BACnet Device ID Setup" on page 91.
- **Max Address [COMM–28]:** This is the maximum number of Master nodes available in the trunk. Communications will be faster if the setting is equal or close to the actual number of Master devices.
- **Password [COMM–29]:** Enter the BACnet password. If setup is successful, the keypad will display 8888.

System Parameters Setup

- **HOA Mode Source [SET–60]:** Set to **2_RS485 Serial**. This enables BACnet to switch between Hand and Auto modes.
- **Auto Speed Ref [SET–07]:** Set to **5_RS485 Serial**. This enables BACnet to control the speed when in Auto mode.
- **Auto Run Cmd [SET–08]:** Set to **2_RS485 Serial**. This enables BACnet to initiate a Run Command in Auto mode.
- **Hand Speed Ref [SET–09]:** Set to **1_RS485 Serial**. This enables BACnet to control the speed when in Hand mode.
- **Hand Run Cmd [SET–10]:** Set to **2_RS485 Serial**. This enables BACnet to initiate a Run Command in Hand mode.

BACnet Device ID Setup

The BACnet Device Object Identifier is the combination of **Device ID Lo [COMM-26]** and **Device ID Hi [COMM-27]**, representing the lower and upper hexadecimal values respectively.

The **Device ID Lo [COMM-26]** value is usually a unique device number in the trunk. It must be within a range from 0 to 65535. The **Device ID Hi [COMM-27]** is usually set to the trunk or building floor number, and must be a value within a range from 0 to 63.

The calculation of the BACnet Device ID is **[COMM-27]** * 65536 + **[COMM-26]**. This value must be within a range from 0 to 4194303.

- If the BACnet Device ID is less than 65536, no calculation is needed; **[COM-27]** is always 0 and **[COM-26]** equals the BACnet Device ID.

  For example, if the BACnet ID is 10025, set **[COMM-27]** to 0 and **[COMM-26]** to 10025.

- For a BACnet Device ID greater than 65535, calculate the BACnet ID / 65536 to get a value with a remainder. To figure out the remainder value, take BACnet Device ID - (value * 65536). Set **[COMM-27]** to the calculated value and [COMM-26] to the remainder.

  For example, if the BACnet Device ID is 842334, then 842334 / 65536 equals value 12 with a remainder. The remainder value is calculated out by 842334 - (12 * 65536) = 55802. Therefore, **[COMM-27]** should be set to 12 and **[COMM-26]** should be set to 55802.

BACnet Objects

Commandable Analog Value Objects

Object Number	R/W	Object Name	Object Description	Unit
AV 000	RW	Reserved	–	–
AV 001	RW	FreqRefValue	Frequency Reference Value	Hz
AV 002 through AV 010	RW	Reserved	–	–
AV 011 through AV 026	RW	Block Transfer	Block transfer mapping 1 to 16	Dependent

Status Analog Value Objects (Read Only)

Object Number	R/W	Object Name	Object Description	Unit
AV 027 through AV 030	R	Reserved	–	–
AV 031	R	Output Frequency	Output Frequency Value	Hz
AV 032 through AV 034	R	Reserved	–	–
AV 035	R	Output Torque	Output Torque	%
AV 036 through AV 038	R	Reserved	–	–
AV 039	R	Status Word	VFD Status Word from BV 16 through BV 31	–
AV 040	R	Reserved	–	–
AV 041	R	Drive Type Code	Drive Type Code	–
AV 042	R	Warning Code	Warning/Alarm Code	–
AV 043	R	Error Code	Error/Fault Code	–
AV 044	R	Output Current	Output/Motor Current	Amperes
AV 045	R	DC Bus Voltage	DC Bus Voltage	VDC
AV 046	R	Output Voltage	Output Voltage	VAC
AV 047	R	Count Value	Accumulated TRG DI Counter Value	–
AV 048	R	Power Factor	Output Power Factor	–
AV 049	R	Output Power	Output Power	kW
AV 050	R	IGBT Temperature	IGBT Temperature	° C
AV 051	R	Caps Temperature	DC Bus Capacitors Temperature	° C
AV 052	R	Carrier Frequency	Actual Carrier Frequency	kHz

Object Number	R/W	Object Name	Object Description	Unit
AV 053	R	PID F/B Value	PID Feedback Value	%
AV 054	R	Overload Rate	Overload Value	%
AV 055	R	GND Fault Level	Ground Fault Trip Level	%
AV 056	R	DC Bus Ripples	DC Bus Ripples Amplitude	Volts
AV 057	R	Fan Speed	VFD Cooling Fan Speed	%
AV 058	R	Motor Speed	Actual Motor Speed	RPM
AV 059	R	kWh	Kilowatts per hour	kWh
AV 060	R	Step Frequency	Step Frequency ID number	–
AV 061	R	AVI1 Input Value	AVI1 Analog Input Reading	%
AV 062	R	ACI Input Value	ACI Analog Input Reading	%
AV 063	R	AVI2 Input Value	AVI2 Analog Input Reading	%
AV 064	R	Digital IN Status	Digital Inputs Status [IO–46]	–
AV 065	R	Digital OUT Status	Digital Outputs Status [IO–58]	–
AV 066	R	CPU DI Pin Status	CPU Pins from Digital INs Status	–
AV 067	R	CPU DO Pin Status	CPU Pins to Digital OUTs Status	–
AV 068	R	PLC D1043 Status	PLC Register D1043 Status	–

Commandable Binary Value Objects

Object Number	R/W	Object Name	Object Description
BV 000	RW	Freq Active CMD	0_Frq CMD=0Hz 1_Frq CMD= FreqRefValue
BV 001	RW	FWD/REV CMD	0_Forward 1_Reverse
BV 002	RW	Reserved	–
BV 003	RW	Stop CMD	0_None 1_Stop (Decelerate to 0Hz)
BV 004	RW	Hold SPD	0_None 1_Stay at Current Frequency
BV 005	RW	Reserved	–
BV 006	RW	Q-Stop CMD	0_None 1_Quick Stop
BV 007	RW	Power Out CMD	0_Power OFF (Coast to Stop) 1_Power ON (Run)
BV 008 through BV 014	RW	Reserved	–
BV 015	RW	Reset	0_None 1_Reset Fault

Status Binary Value Objects (Read Only)

Object Number	R/W	Object Name	Object Description
BV 016	R	At CMD Freq	0_Out Frq ? CMD Frq1_Out Frq = CMD Frq
BV 017	R	Direction	0_Forward 1_Reverse
BV 018	R	Warning	0_None 1_Warning Active
BV 019	R	Error/Fault	0_None 1_Error/Fault Active
BV 020 through BV 021	R	Reserved	–
BV 022	R	Q-Stop Mode	0_None 1_Q-Stop Active
BV 023	R	Power OUT	0_Power OUT Off 1_Power OUT On (Run)
BV 024 through BV 031	R	Reserved	–

ACCESSORIES

Optional Extension Cards

⚠WARNING

Contact with hazardous voltage could result in death or serious injury.

- Disconnect and lock out all power before installing or servicing equipment.
- Use extreme caution and take necessary safety measures if opening the cover at any time while drive is powered.

A selection of accessory extension cards is available to add additional functionality to the X-Drive, including:

10000004840 X-Drive FE Connect Communication Card: This card adds Bluetooth communication to the drive, providing the ability to program, control, and monitor the VFD using the X-Drive FE Connect mobile application. When the card is installed, and the drive is powered on, parameter **Com Card ID [Comm-30]** should identify **6_FELE BT Card**. Refer to "FE Connect for Cerus X-Drive Mobile Application" on page 85 to connect the mobile app to the drive.

CMC-EIP01 Ethernet Communication Card: This card supports Ethernet IP and Modbus TCP protocols. To install the card into the VFD, refer to "Extension Card Installation" on page 97 and "Setup Optional Ethernet Communication Card" on page 101. Refer to "Modbus Communication" on page 87 for additional parameters and configuration information.

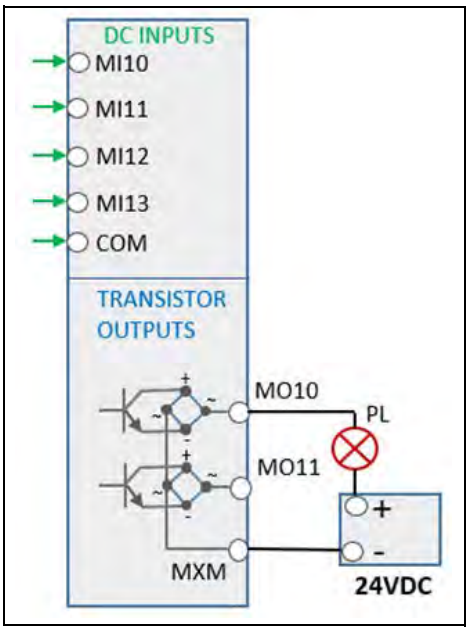
Once configured, the LED Indicators on the drive give the status of the network, parameters, and VFD power:

LED	Light Status	Indication	Required Action
NS	Green & red alternate	Network self-test mode	None
	Solid green	CIP connection established	None
	Blinking green	No CIP connection at power-on	None
	Solid red	IP duplicate / conflict	Check IP Settings
	Blinking red	COMMS loss / Time-out	Check COMMS setting
	OFF	No connection to network	Check network connection
MS	Green & red alternate	Drive in self-test mode	None
	Solid green	Parameters are set	None
	Blinking green	Parameters are not yet set	Finish setting parameters
	Solid red	VFD hardware failure	Check with FE support
	Blinking red	VFD/COMMS card error	Check parameters setting
	OFF	No power	Check if VFD is powered
Power	ON	Power is normal	None
	OFF	No power	Check if VFD is powerd
Link	ON	Transmit/receive is normal	None
	OFF	No connection to network	Check network connection

EMC-D42A Extension DC I/O Card: This card adds four Digital Inputs, MI10–MI13 with COM common terminal and two polarity insensitive Transistor Outputs with MXM common terminal.

MI10–MI13 inputs functionality is programmable through parameters **[OPTION–00 to 03]**. Ratings are the same as VFD inputs MI1–MI8. The COM terminal should be connected the same way as VFD COM terminal. For default VFD DIs configuration it should be connected to +24V terminal.

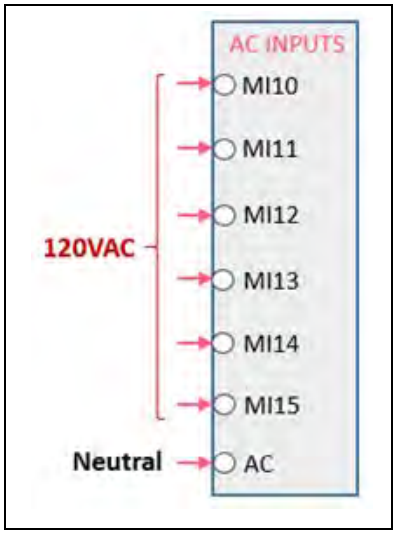
MO10–MO11 outputs functionality is programmable through **[OPTION–00 to 03]**. Ratings are 48 VDC at 50 mA maximum. The MXM terminal should be connected to the common terminal of external power source and MO10 and MO11 to the load (Example: PL pilot light on the diagram).



EMC-611A Extension AC Input Card: This card adds six Digital Inputs, MI10–MI15 with AC common terminal (Neutral).

MI10–MI13 inputs functionality is programmable through parameters **[OPTION–00 to 05]**.

Ratings are 100-130VAC, 47-63Hz, 27k impedance. Response time for ON is 10ms and for OFF is 20ms.

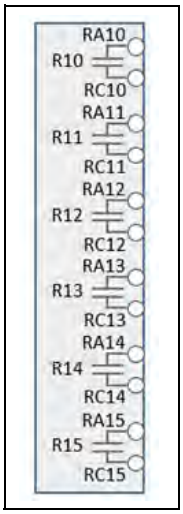


EMC-R6AA Extension Relay Card: This card adds six Relay Outputs, R10–R15 with SPST (single-pole single-throw) form A (N.O.) contacts.

R10–R15 relay functionality is programmable through parameters **[OPTION–06 to 16]**.

Contact ratings for:

- Resistive load 3A at 250VAC and 5A at 30VDC
- Inductive load (COS 0.4) 1.2A at 250VAC and 2A at 30VDC



Extension Card Installation

⚠WARNING

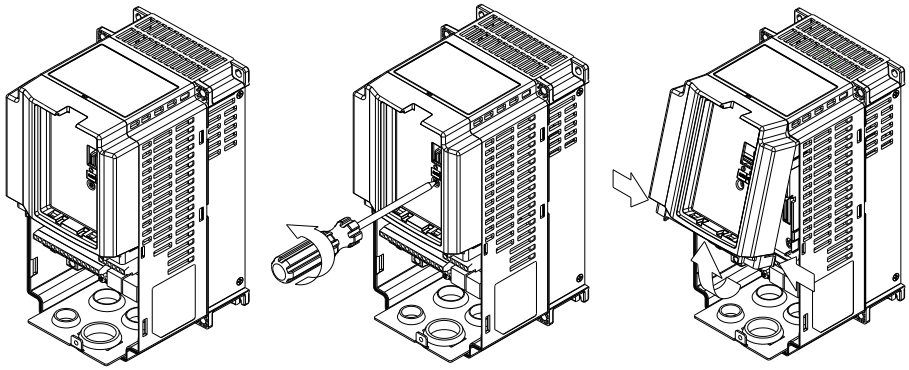
Risk of bodily injury or damage to drive or other equipment. Contact with hazardous voltage could result in death or serious injury.

- Disconnect and lock out all power before installing or servicing equipment.
- Capacitors inside the drive can still hold lethal voltage even after power has been disconnected. ALWAYS check if DC bus charge LED is off and DC voltage on the terminals DC (+1) and DC (-) is less than 30VDC before working on VFD wiring. The DC bus capacitors may hold high-voltage charge for several minutes after the VFD power is disconnected.
- Extension cards cannot be replaced with power applied. Damage to VFD may occur.

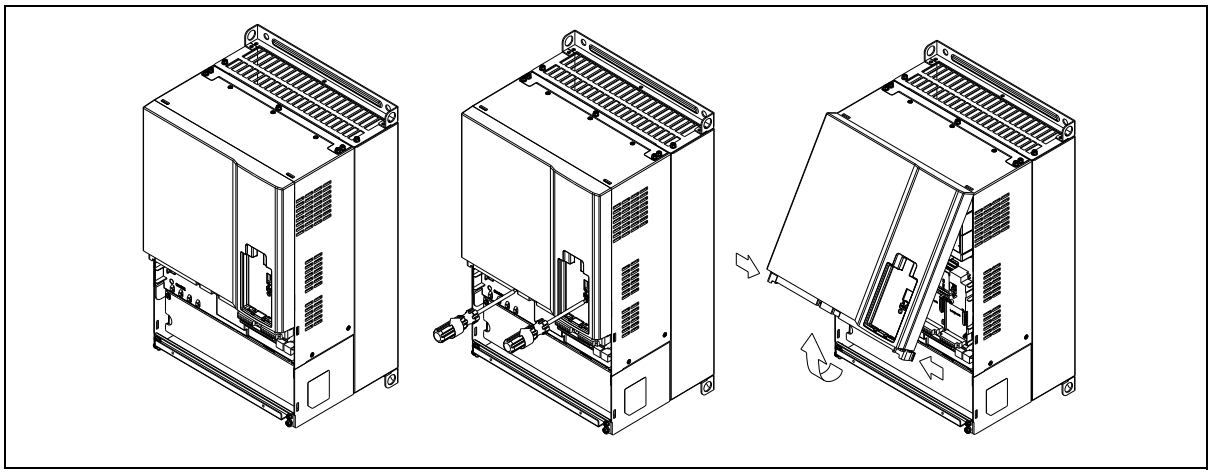
Use the following procedure to install an optional extension card:

1. Remove power from the drive and wait until voltage has safely discharged from the DC bus.
2. Remove the digital keypad.
3. Remove the front cover as shown.

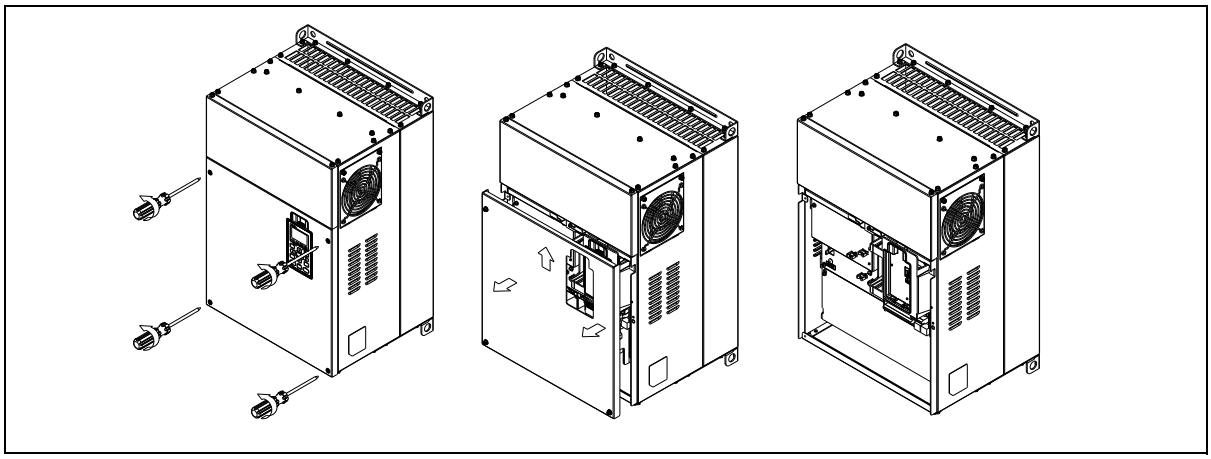
Frame A through C



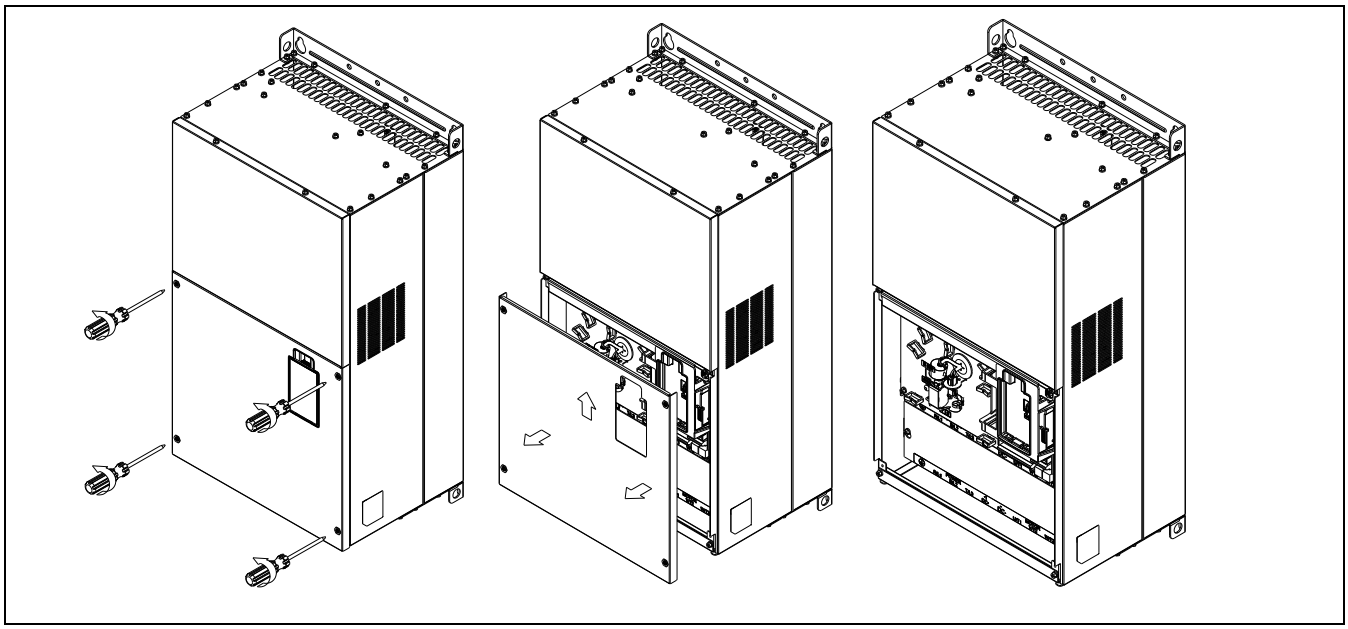
Frame D



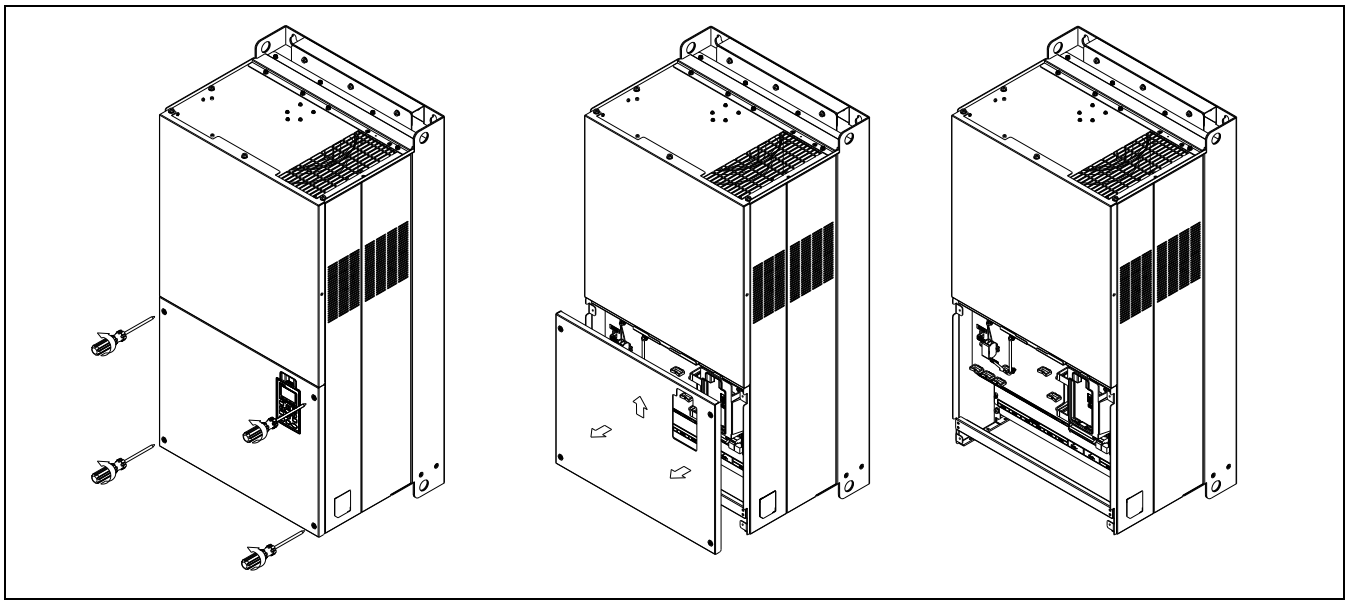
Frame E



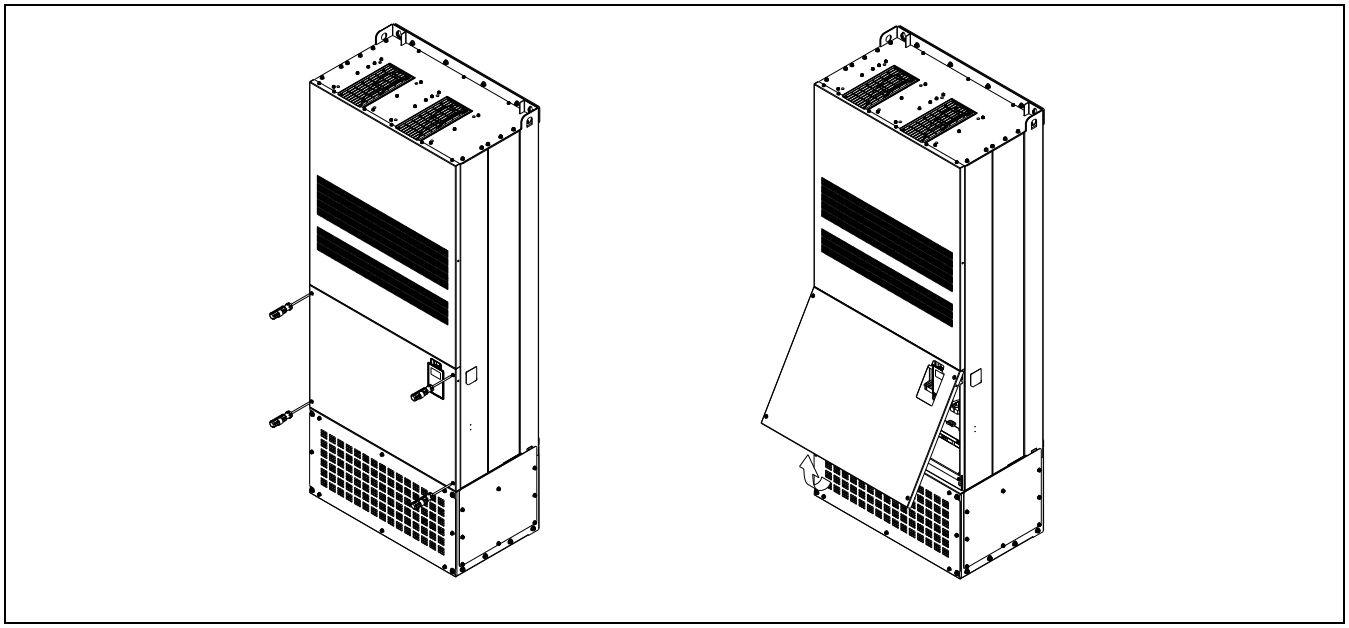
Frame F



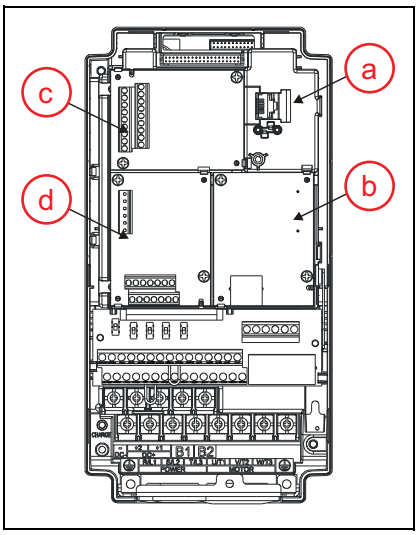
Frame G



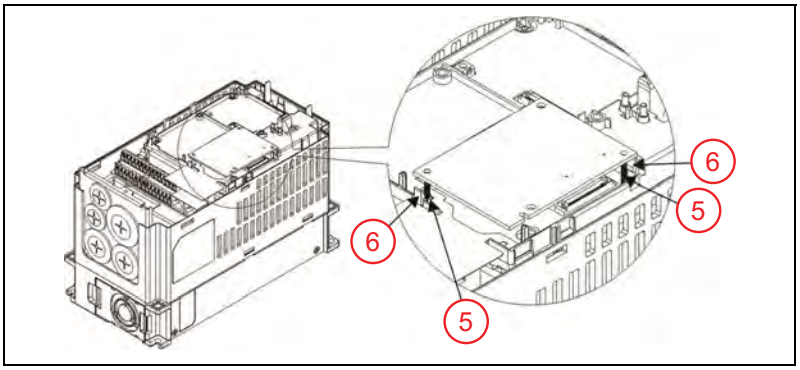
Frame H



4. Locate slot for card installation.
   a. RJ45 socket for digital keypad
      - For a CMC-EIP01 Ethernet Communication Card, connect the communication cable to this port.
   b. Communications card slot
      - Bluetooth
      - Ethernet
   c. Input/Output extension card slot
   d. Not currently used

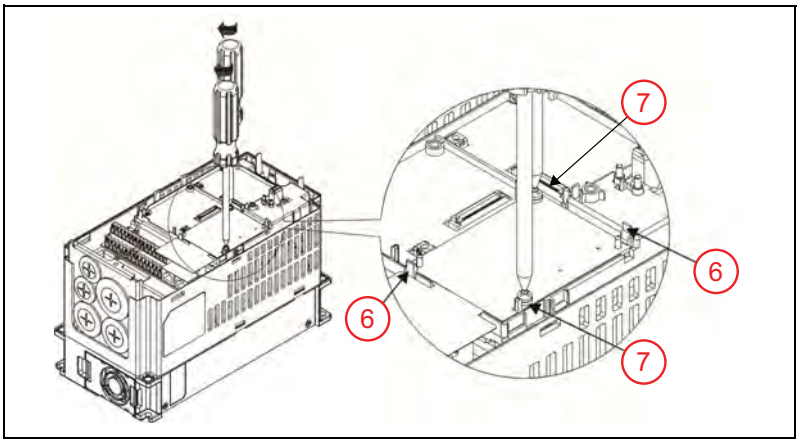


5. Align holes in card over the positioning pins.
6. Press down on the card until retaining clips snap into place.



7. When clips are secure, install retaining screws and tighten to a torque of 6-8 kg-cm / 5.2-7 lb-in. / .59-.79 Nm.

Once an extension card has been installed, it must be activated to be recognized by the system. The activation procedure differs depending on the type of card. For more information, refer to "Optional Extension Cards" on page 95.



Setup Optional Ethernet Communication Card

Install the card following the instructions in "Extension Card Installation" on page 97.

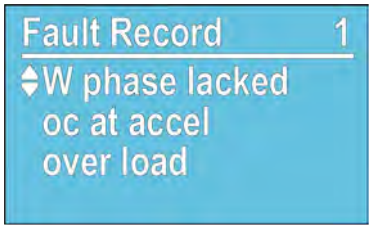
1. Verify card detection.
   - Check **Com Card ID [COMM–30]** to determine whether a Communications Card has been installed and recognized by the drive. A value of **No Com Card** indicates that a card has not been detected.
   - To activate the card in the drive, set **Comm Card [COMM–55]** to **2h (bit 1 on)**. This will detect the installed card and automatically change **[COMM–30]** to **Ethernet/IP**.
2. Download card values to the drive.
   - Set **MBus Card Reset [COMM–52]** to **1_Enable**. This populates default values from the card into the appropriate drive parameters. For example:
     – IP Address: 192.168.1.5 to **[COMM–38 through 41]**
     – Address Mask: 255.255.255.0 to **[COMM–42 through 45]**
     – Gateway Address: 192.168.1.1 to **[COMM–46 through 49]**
   - When complete, **[COMM–52]** will automatically return to **0_Disable**.
3. Adjust settings as required for the network and upload to card.
   - Use **[COMM–38 through 49]** to set each address segment.
   - When complete, set **MBus TCP Config [COMM–53]** to **2_I-net Par On**. This loads the new addresses to the card, enabling communication with the network.

MAINTENANCE

Troubleshooting

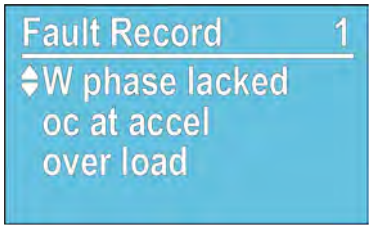
Error Messages: When the drive detects a fault or warning, an error message displays on the screen showing the current problem condition. In some cases the fault can be cleared by pressing the Stop/Reset button.

Fault Records: In addition, the drive records up to 30 of the most recent faults. These can be accessed by pressing the **F3** key. Use the arrow keys to scroll through the list. For more information about a selected fault, press the **Enter** key to display details about the occurrence, including date, time, output frequency, output current, and other related data.



NOTE: Fault records can also be located through **[PROT-51 to 56]**, or by pressing **Menu/Back/Down/Fault**.

Using the displayed fault title, refer to the following table for troubleshooting details.



Diagnostic Fault Codes

Fault	Description	Corrective Action
Analog current input loss (ACE)	• ACI loss	• Check the ACI wiring • Check if the ACI signal is less than 4mA
Auto-tuning error (AUE) (AUE 1-4)	• Error during motor auto tuning • No feedback current • Motor phase loss • No load current • Leakage inductance	• Restart tuning • Check motor capacity and parameter settings • Accel/Decel times too short • Check cabling between drive and motor
Braking fault (bF)	• Brake resistor fault	• If the fault code is still displayed on the keypad after pressing "RESET" key, please call technical support.
Broken Pipe (BKPI)	• Low pressure with high frequency	• Check piping for leaks • Verify parameter settings
CAN bus Add Err (CAdE)	• CANopen station address error	• Reset address
CAN bus Index Err (CIdE)	• CANopen index error	• Reset index
CAN bus off (CbFE) (CFrE)	• CANopen bus off error • CANopen memory error	• Check Comm card installation • Check communications settings • Check wiring and grounding for possible interference • Make sure communication circuit is wired in series • For CFrE error, reset parameters and station address
cc HW error (Hd0)	• Current Clamp detection error	• Cycle the power. If fault code is still displayed on the keypad, please call technical support.
CPU Trap 0 error (TRAP)	• CPU instruction error	•

Fault	Description	Corrective Action
Damper Fault (DPR)	• Damper limit switch has not closed in time to start fan motor; or, switch has opened for more than 2 seconds while motor is running.	• Check limit switch connections and function • Check damper relay connections and damper function • Verify all damper related parameters
Dec Energy Back (dEb)	• Deceleration energy backup error. When ADV2-28 is not disabled and power is off or momentarily off, VFD will display dEb during accel./decel. stop.	• Check if input power is stable
Derating Error (oL3)	• The VFD detects excessive drive output current.	• Check if the motor is overloaded.
EEPROM read err (cF2)	• Internal memory cannot be read.	• Press "RESET" key • Reset all parameters to default • If error still exists, please call Technical Support..
EEPROM write err (cF1)	• Internal memory cannot be programmed.	• Press "RESET" key • Reset all parameters to default • If error still exists, please call Technical Support.
Emergency stop (EF1)	• Emergency stop	• When a multi-function input terminal (MI1 to MI6) is set to emergency stop and the contact is closed, the AC motor drive stops output U, V, W and the motor coasts to stop. • Press RESET after condition has been corrected.
External Fault (EF)	• External Fault	• Input EF (N.O.) on external terminal is closed to GND. Output U, V, W will be turned off. • Give RESET command after fault has been cleared.
Ground fault (GFF)	• Output current exceeds [PROT-34] for more than [PROT-35] time delay. **NOTE:** This protection is provided for VFD, not to protect user.	• Check the wiring connections between the VFD and motor for possible short circuits, also to ground. • Check for possible poor insulation at the output. • Verify grounding of communication circuit • Ensure separation of communication circuits and high-voltage wiring • Check whether the IGBT power module is damaged.
Guarding T-out (CGdE)	• CANopen guarding error. When CANopen Node Guarding detects that one of the slaves does not respond.	• Increase guarding time and detection times. • Verify wiring and grounding of communication circuit. • Make sure communication circuit is wired in series. • Use CANopen cable or add terminating resistance.
Heartbeat T-out (CHbE)	• CANopen heartbeat error. When CANopen Heartbeat detects that one of the slaves does not respond.	• Increase heartbeat time • Verify wiring and grounding of communication circuit. • Make sure communication circuit is wired in series. • Use CANopen cable or add terminating resistance.
Heat Sink oH (oH2)	• Capacitance temperature causes heatsink overheating.	• Ensure that the ambient temperature falls within the specified temperature range. • Make sure heat sink is not obstructed. Check if the fan is operating • Check if there is enough ventilation clearance for the drive.
High Load (HLD)	• Current or Torque is above [SET-48] HLD Level and [SET-49] HLD Frequency.	• Refer to "High Load Detection" on page 75.
Ias sensor Err (cd1)	• U-phase output error	• Cycle the power. If error still exists, please call Technical support.
Ibs sensor Err (cd2)	• V-phase output error	• Cycle the power. If error still exists, please call Technical support.
Ics sensor Err (cd3)	• W-phase output error	• Cycle the power. If error still exists, please call Technical support.

Fault	Description	Corrective Action
IGBT over heat (oH1)	• IGBT temperature exceeds protection level	• Ensure that the ambient temperature falls within the specified temperature range. • Make sure that the ventilation holes are not obstructed. • Remove any foreign objects from the heatsinks and check for possible dirty heat sink fans. • Check the fan and clean it. • Provide enough spacing for adequate ventilation.
InrCom Time Out (ictE)	• Internal communication time-out	• Check Comm card installation • Check communications settings • Check wiring and grounding for possible interference
Internal BT (CardiBTc)	• Bluetooth card error	• Check card installation and [Comm-30] Comm Card ID
Lv at accel (LvA)	• DC BUS voltage is less than PROT-03 during acceleration	• Check if the input voltage is normal • Check for possible sudden load • Adjust setting of PROT-03
Lv at decel (Lvd)	• DC BUS voltage is less than PROT-03 during deceleration	• Check if the input voltage is normal • Check for possible sudden load • Adjust setting of PROT-03
Lv at normal SPD (Lvn)	• DC BUS voltage is less than PROT-03 in constant speed	• Check if the input voltage is normal • Check for possible sudden load • Adjust setting of PROT-03
Lv at stop (LvS)	• DC BUS voltage is less than PROT-03 at stop	• Check if the input voltage is normal • Check for possible sudden load • Adjust setting of PROT-03
MC Fault (ryF)	• Electromagnet switch error. Electric valve switch error when executing Soft Start. (Frame E and above.)	• Do not disconnect RST when drive is still operating.
Motor overheat (oH3)	• The internal temperature of the VFD exceeds the setting of PROT-20 (PTC level) or PROT-31 (PT100 level 2).	• Make sure that the motor is not obstructed. • Ensure that the ambient temperature falls within the specified temperature range. • Change to a higher power motor.
No Flow (NOFL)	• No water flow (pump application)	• Refer to "No Flow Protection" on page 78.
oc at accel (ocA)	• Over current during acceleration. Output current exceeds 2.4 rated current during acceleration.	• Short-circuit at motor output: Check for possible poor insulation at the output. • Acceleration Time too short: Increase the Acceleration Time. • VFD output power is too small for the application.
oc at decel (ocd)	• Over current during decelration. Output current exceeds 2.4 rated current during deceleration.	• Short-circuit at motor output: Check for possible poor insulation at the output. • Acceleration Time too short: Increase the Acceleration Time. • VFD output power is too small for the application.
oc at normal SPD (ocn)	• Over current at normal speed. Output current exceeds 2.4 rated current during constant speed.	• Short-circuit at motor output: Check for possible poor insulation at the output. • Acceleration Time too short: Increase the Acceleration Time. • VFD output power is too small for the application.
oc at stop (ocS)	• Over-current at stop. Hardware failure in current detection	• Please call technical support.
oc HW error (Hd1)	• Over-current detection error	• Reboots the power. If fault code is still displayed on the keypad, please call technical support.
occ HW error (Hd3)	• IGBT short-circuit detection when power is ON	• Reboots the power. If fault code is still displayed on the keypad, please call technical support.
Over load (OL)	• Overload	•

Fault	Description	Corrective Action
OL-2 (OL-2)	• Overload	•
ov at accel (ovA)	• DC BUS over-voltage during acceleration (230V: 410VDC; 460V: 820VDC; 575V: 1116VDC; 690V: 1318VDC).	• Check if the input voltage falls within the rated VFD input voltage range. • Check for possible voltage transients. • If DC BUS over-voltage is due to regenerative voltage, increase the acceleration time or add an optional brake resistor.
ov at decel (ovd)	• DC BUS over-voltage during deceleration (230V: 410VDC; 460V: 820VDC; 575V: 1116VDC; 690V: 1318VDC).	• Check if the input voltage falls within the rated VFD input voltage range. • Check for possible voltage transients. • If DC BUS over-voltage is due to regenerative voltage, please increase the Deceleration Time or add an optional brake resistor.
ov at normal SPD (ovn)	• DC BUS over-voltage at constant speed (230V: 410VDC; 460V: 820VDC; 575V: 1116VDC; 690V: 1318VDC).	• Check if the input voltage falls within the rated VFD input voltage range. • Check for possible voltage transients. • If DC BUS over-voltage is due to regenerative voltage, please increase the Deceleration Time or add an optional brake resistor.
ov at stop (ovS)	• Over-voltage at stop	• Check if the input voltage falls within the rated VFD input voltage range. • Check for possible voltage transients.
ov HW error (Hd2)	• Hardware failure in voltage detection	• Reboots the power. If fault code is still displayed on the keypad, please call technical support.
Over slip error (oSL)	• Slip exceeds Motor-19 setting and time exceeds Motor-20 setting.	• Check if motor parameter is correct (please decrease the load if overload • Check the settings of Motor-19 and Motor-20.
Over-torque 1 (ot1)	• Current exceeds detection criteria.	• Check whether the motor is overloaded. • Check whether motor rated current setting (SET-03) is suitable.
Over-torque 2 (ot2)	• Current exceeds detection criteria.	• Check whether the motor is overloaded. • Check whether motor rated current setting (SET-03) is suitable.
Overpressure (OPRS)	• Overpressure	•
Password error (Pcod)	• Password is locked.	• Power off and restart the driver before entering the correct password
PC err address (CE2)	• Illegal data address	• Check if the communication address is correct
PC err command (CE1)	• Communication command is illegal	•
PC err data (CE3)	• Illegal data value	•
PC slave fault (CE4)	• Data is written to read-only address	• Check if the communication address is correct
PC time-out (CE10)	• Modbus transmission time-out	•
Phase lacked (OrP)	• Phase Loss protection	• Check that all 3 input phases are connected without loose contacts. • For models 40hp and above, please check if the AC input circuit fuse.
PID Fbk error (AFE)	• PID loss (ACI)	• Check the wiring of the PID feedback • Check the PID parameters settings
Rotor Pos Error (RoPd)	• Initial rotor position detection error	•
S1-emergy stop (S1)	• Emergency stop for external safety	•
Short-circuit (occ)	• Short-circuit is detected between upper bridge and lower bridge of the IGBT module	• Please call technical support.
Shutdown (SHDN)	•	•
STO (STO)	• Safe Torque Off function active	•

Fault	Description	Corrective Action
STO Loss 1 (STL1)	• STO1–SCM1 internal loop detection error	•
STO Loss 2 (STL2)	• STO2–SCM2 internal loop detection error	•
STO Loss 3 (STL3)	• STO1~SCM1 and STO2~SCM2 internal hardware detect error	•
Thermal relay 1 (EoL1)	• Electronics thermal relay 1 protection	• Check the setting of electronics thermal relay (Prot-17).
Thermal relay 2 (EoL2)	• Electronics thermal relay 2 protection	•
Thermo 1 open (tH1o)	• IGBT over-heat protection error	• Please call technical support.
Thermo 2 open (tH2o)	• Capacitance over-heat protection error	• Please call technical support.
U phase lacked (OPHL)	• Output phase loss (Phase U)	•
Under Ampere (uC)	• Low current detection	• Check SET-42, SET-44, SET-41.
Underload (ULD)	• Underload	• Refer to "Underload Protection (Dry Well or Belt Loss)" on page 76.
V phase lacked (OPHL)	• Output phase loss (Phase V)	•
W phase lacked (OPHL)	• Output phase loss (Phase W)	•
Watchdog (WDTT)	•	•
Y-delta connect (ydc)	• Y-connection/Δ-connection switch error	• Check the wiring of the Y-connection/Δ-connection

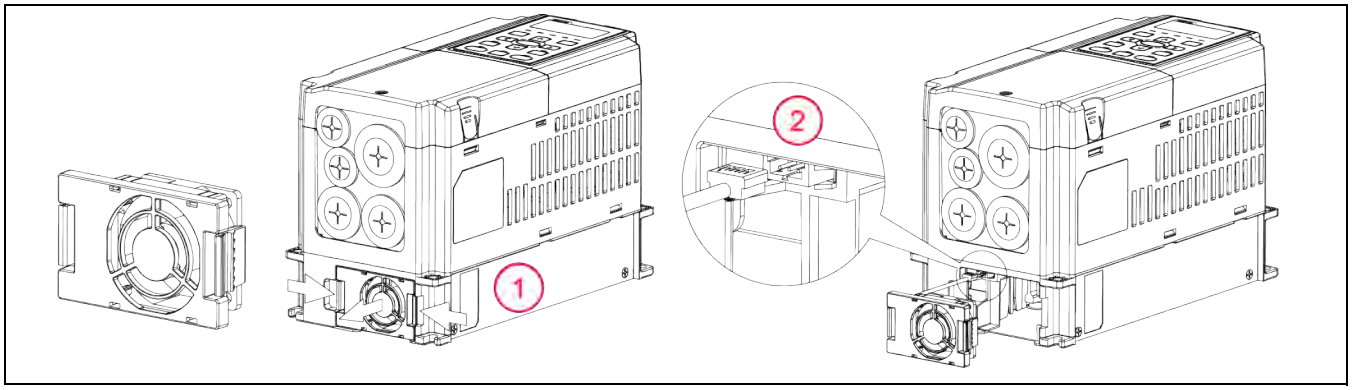
Fan Replacement

⚠WARNING

Risk of bodily injury or damage to drive or other equipment. Contact with hazardous voltage could result in death or serious injury.

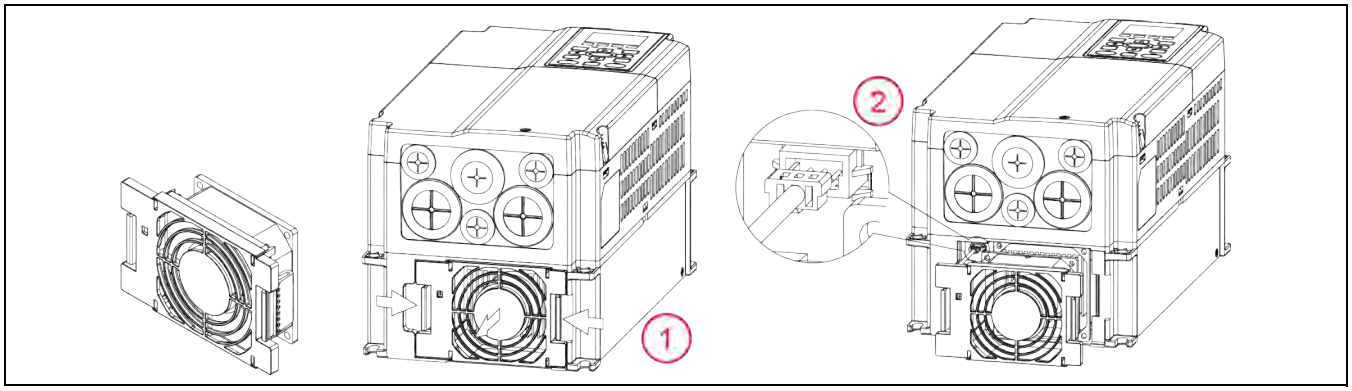
- Disconnect and lock out all power before installing or servicing equipment.
- Capacitors inside the drive can still hold lethal voltage even after power has been disconnected. ALWAYS check if DC bus charge LED is off and DC voltage on the terminals DC (+1) and DC (-) is less than 30VDC before working on VFD wiring. The DC bus capacitors may hold high-voltage charge for several minutes after the VFD power is disconnected.
- Fans cannot be replaced with power applied. Damage to VFD may occur.

Frame A Heat Sink Fan



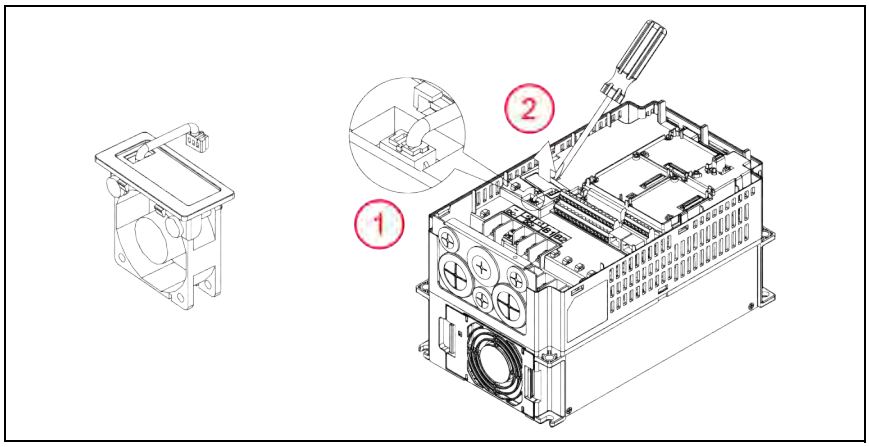
1. Press the tabs on both sides of the fan to release and slide out the fan.
2. Disconnect the power connector before completely removing the fan.

Frame B Heat Sink Fan



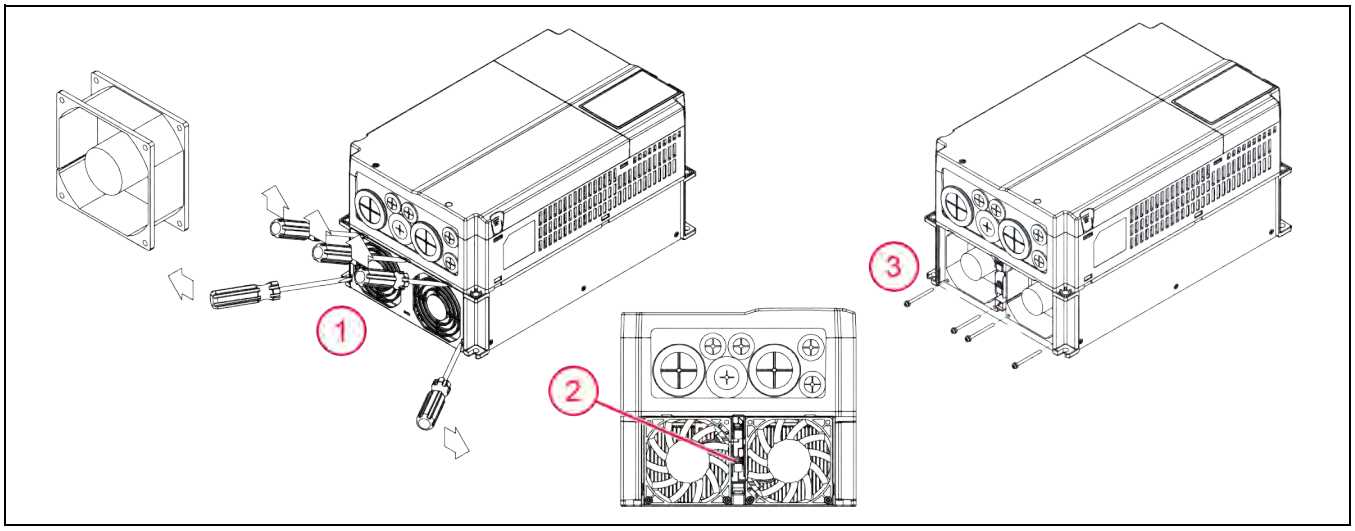
1. Press the tabs on both sides of the fan to release and slide out the fan.
2. Disconnect the power connector before completely removing the fan.

Frame B and C Capacitor Fan



1. Disconnect fan power connector.
2. Lift the fan out using a flathead screwdriver.

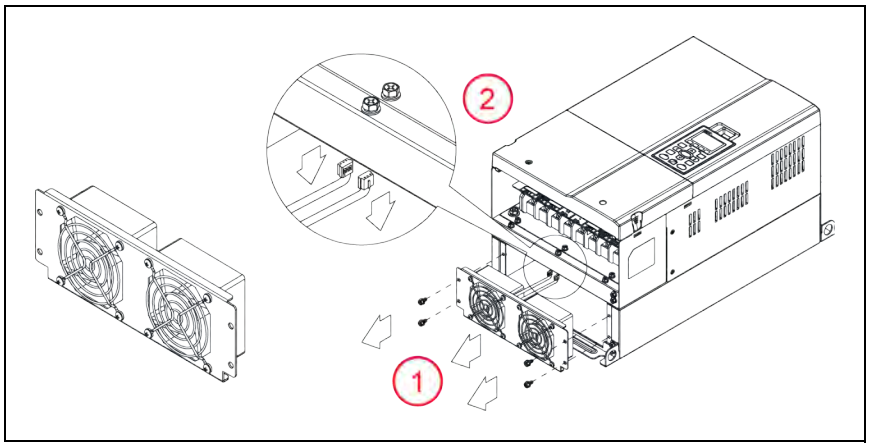
Frame C Heat Sink Fan



Some Frame C models use one fan and some use two.

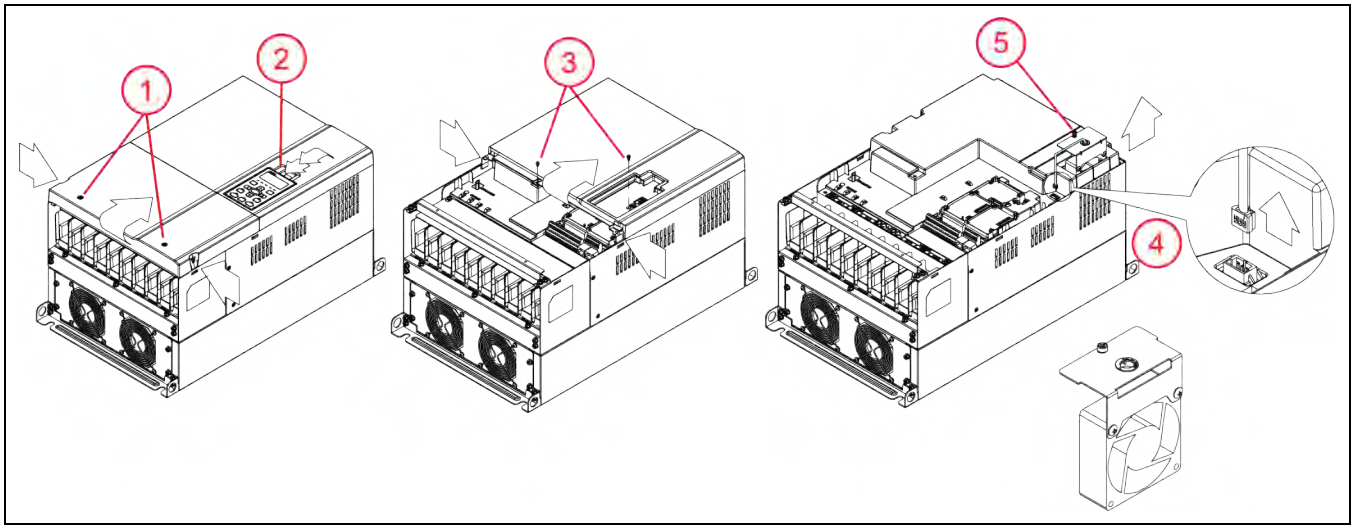
1. Before removing fans, remove the cover using a flathead screwdriver.
2. Disconnect fan power connectors.
3. Remove screws and remove fans. When replacing screws, tighten to a torque of 8.67 to 10.4 in. lbs. (0.98 to 1.18 Nm).
4. When installing new fans, make sure label faces the inside of the drive.

Frame D Heat Sink Fan



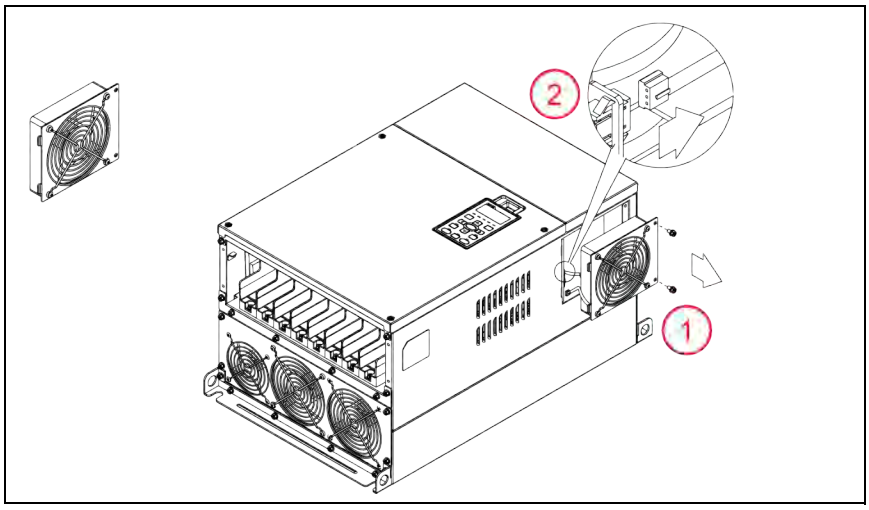
1. Remove four screws to release and slide out the fan assembly. When replacing screws, tighten to a torque of 20.8 to 22.1 in. lbs. (2.35 to 2.5 Nm).
2. Disconnect the power connectors before completely removing the fan.

Frame D Capacitor Fan



1. Remove two screws and press the tabs on both sides to remove the lower cover. When replacing screws, tighten to a torque of 10.4 to 13 in. lbs. (1.18 to 1.47 Nm).
2. Press the top of the keypad and remove the keypad.
3. Remove two screws and press the tabs on both sides to remove the upper cover. When replacing screws, tighten to a torque of 5.2 to 6.9 in. lbs. (0.59 to 0.78 Nm).
4. Disconnect fan power connector.
5. Remove one screw and pull out the fan. When replacing the screw, tighten to a torque of 8.9 to 10.4 in. lbs. (1.0 to 1.18 Nm).

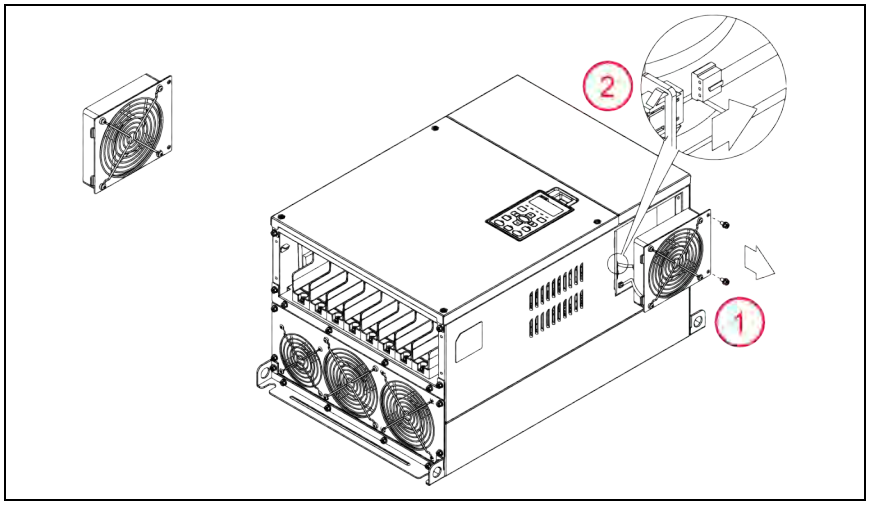
Frame E Heat Sink Fan



Frame E models use multiple heat sink fan styles. Be sure to order the correct part when replacing the fan.

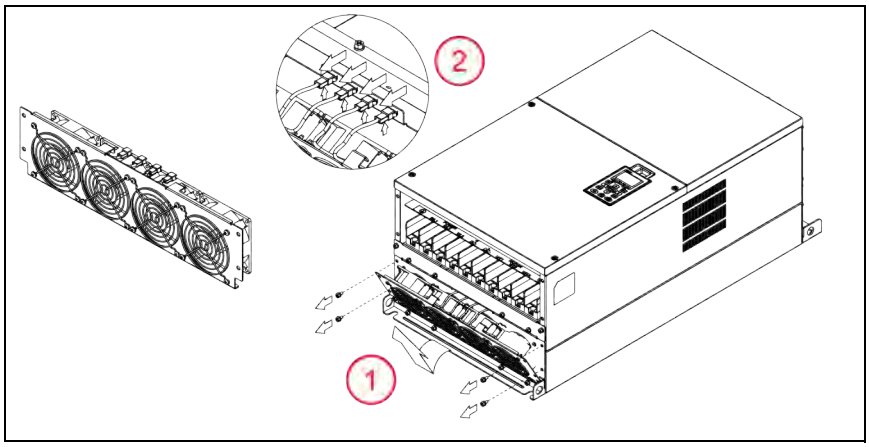
1. Remove four screws to release and slide out the fan assembly. When replacing screws, tighten to a torque of 20.8 to 22.1 in. lbs. (2.35 to 2.5 Nm).
2. Disconnect the power connectors before completely removing the fan.

Frame E Capacitor Fan



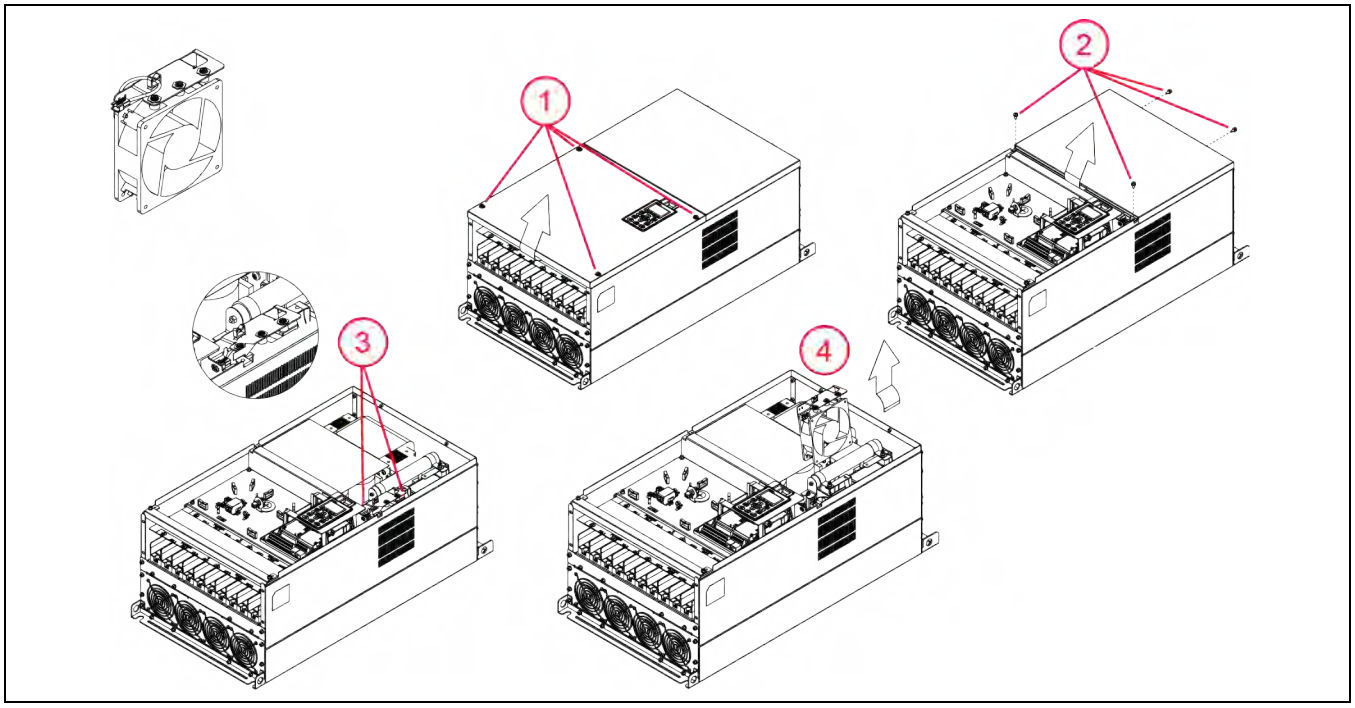
1. Remove four screws to release and slide out the fan assembly. When replacing screws, tighten to a torque of 20.8 to 22.1 in. lbs. (2.35 to 2.5 Nm).
2. Disconnect the power connectors before completely removing the fan.

Frame F Heat Sink Fan



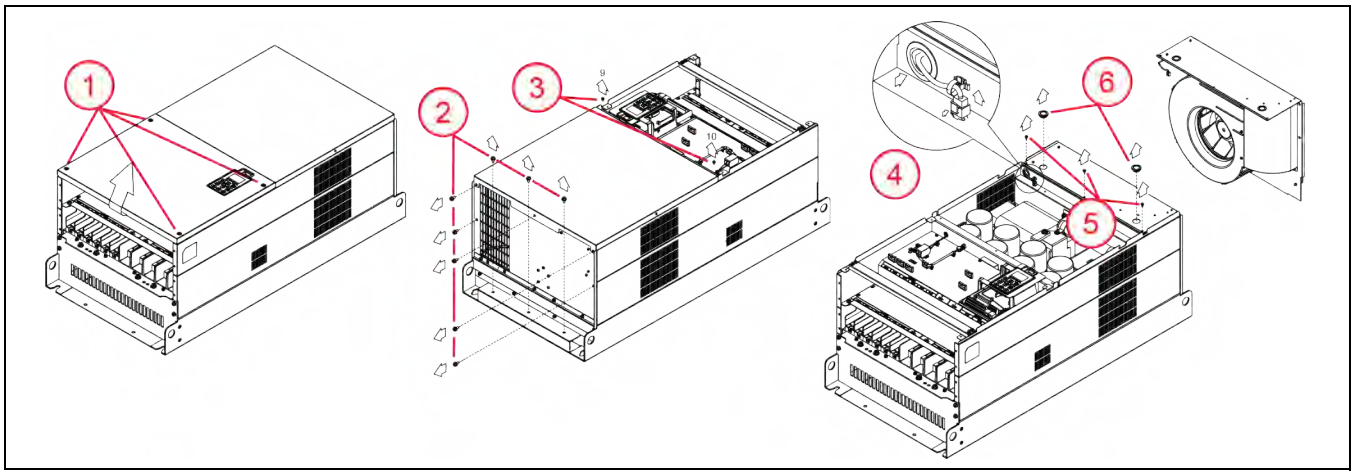
1. Remove four screws to release and slide out the fan assembly. When replacing screws, tighten to a torque of 10.4 to 13 in. lbs. (1.18 to 1.47 Nm).
2. Disconnect the power connectors before completely removing the fan.

Frame F Capacitor Fan



1. Remove four screws and remove the lower cover. When replacing screws, tighten to a torque of 10.4 to 13 in. lbs. (1.18 to 1.47 Nm).
2. Remove four screws and remove the upper cover. When replacing screws, tighten to a torque of 20.8 to 22.1 in. lbs. (2.35 to 2.5 Nm).
3. Disconnect fan power connector and remove three screws. When replacing the screw, tighten to a torque of 20.8 to 22.1 in. lbs. (2.35 to 2.5 Nm).
4. Pull out the fan.

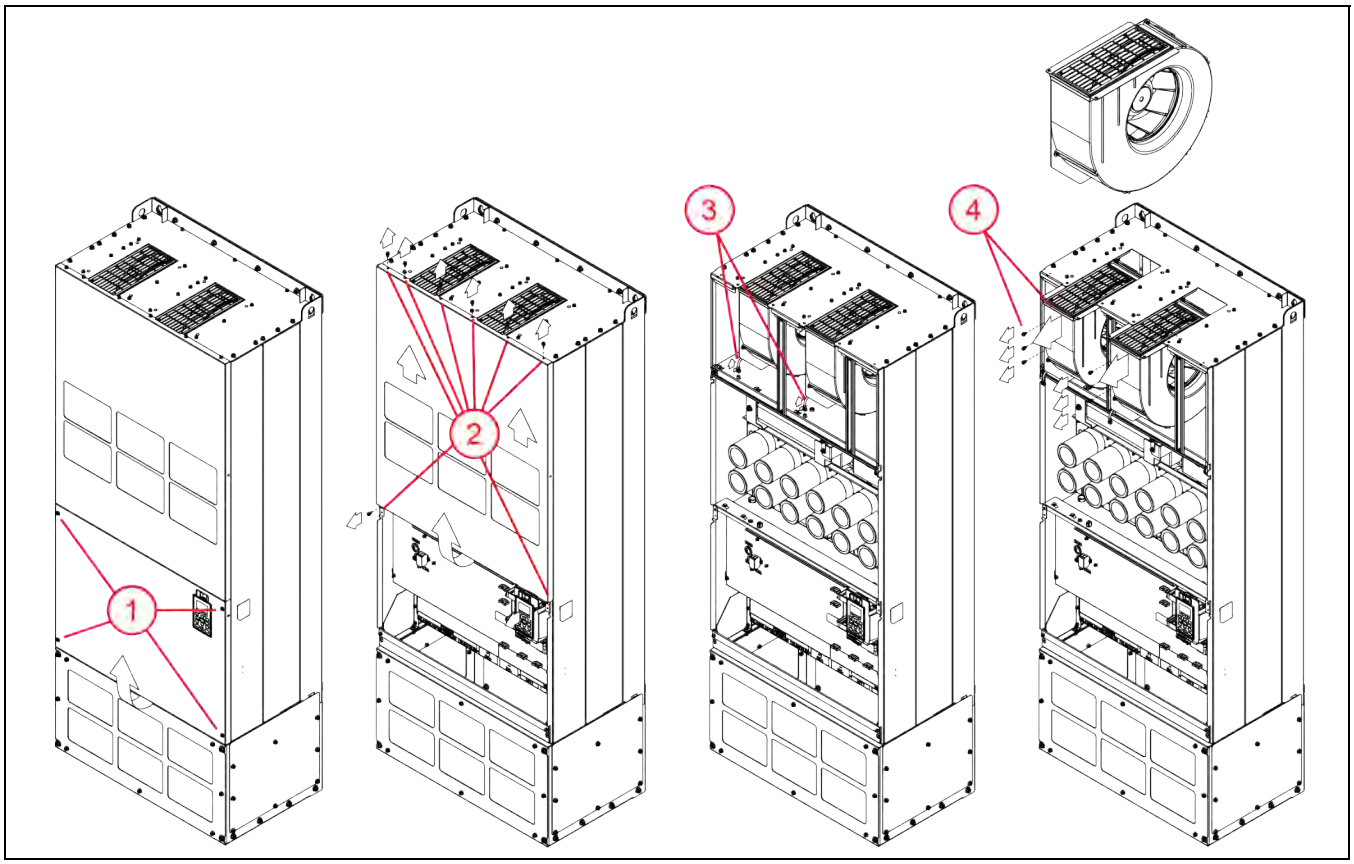
Frame G Heat Sink Fan



1. Remove four screws and remove the lower cover. When replacing screws, tighten to a torque of 10.4 to 13 in. lbs. (1.18 to 1.47 Nm).
2. Remove eight screws from the top cover. When replacing screws, tighten to a torque of 30 to 34.5 in. lbs. (3.4 to 3.9 Nm).
3. Remove two screws from the bottom of the upper front cover. When replacing screws, tighten to a torque of 12 to 14 in. lbs. (1.37 to 1.57 Nm).

   Remove upper front cover.
4. Release clip and disconnect fan power connector.
5. Remove three screws from fan. When replacing the screws, tighten to a torque of 12 to 14 in. lbs. (1.37 to 1.57 Nm).
6. Remove protective covers and pull out the fan by placing fingers through the lifting holes.

Frame H Heat Sink Fan



1. Remove four screws and remove the lower front cover. When replacing screws, tighten to a torque of 12 to 14 in. lbs. (1.37 to 1.57 Nm).
2. Remove eight screws and remove the upper front cover. When replacing screws, tighten to a torque of 20.8 to 22.1 in. lbs. (2.35 to 2.5 Nm).
3. Disconnect two fan power connectors.
4. Remove three screws from each fan and pull out the fans. When replacing the screws, tighten to a torque of 20.8 to 22.1 in. lbs. (2.35 to 2.5 Nm).

PARAMETER REFERENCE TABLES

Parameter Descriptions > SET Menu

AR = Adjustable while Running.

CODE	Mod Bus	AR	Display Name	Range	Description
SET-00	0000	N	Application Sel	0_Basic 1_Supply Fan 2_Exhaust Fan 3_Cooling Tower 4_Centrifugal Pump 5_Submersible Pump 6_Vacuum Pump 7_Constant Torque Motor 8_PM Motor 9_MagForce	Mechanical application the VFD is running. Must be set when powered up the first time. Selection automatically adjusts many default parameters to common values for the application. Additional adjustments may be required for optimum performance. Refer to the application descriptions in "Standard Operation with an Automated Control System" on page 66 for more information. **Important:** Whenever the application is changed, many default parameters are changed. Be sure to verify settings to ensure proper operation. Refer to the Default Settings tables in "Default Settings Tables" on page 50.
SET-01	0001	N	Input Phase	0_Three-Phase 1_Single-Phase	The VFD is capable of using a 3-Phase or Single-Phase input power source, but should be derated for Single-Phase input power.
SET-02	0002	N	Motor HP	0.5~655 HP	Default is set based on VFD rating. User should enter the rated motor HP, found on the motor nameplate.
SET-03	0003	N	Motor FLA/SFA	1/10 of max capacity~999.9A	Default is set based on VFD rating. User should enter the rated motor FLA, found on the motor nameplate. If [SET-00] is set to Submersible, enter the SFA rating from the motor nameplate. All internal overload protection features for the VFD and motor are calculated based on the value in this parameter.
SET-04	0004	N	Motor RPM	0-3600 RPM	Rated Motor RPM from motor nameplate when running at nameplate frequency.
SET-05	0005	N	Motor Voltage	230V: 0 to 255 V 460V: 0 to 510 V 575V: 0 to 637 V 690V: 0 to 720 V	Rated voltage of the motor, found on the motor nameplate. The VFD can produce output voltage equal to or less than input power voltage.
SET-06	0006	Y	Carrier Freq	2.0 to 15.0 kHz Varies by VFD rating	VFD switching frequency. Higher frequencies create more precise wave forms, but generate higher heat. Lower frequencies run cooler, but could potentially cause audible noise, which can be eliminated by adjusting this carrier frequency during stop or run mode.
SET-07	0007	N	Auto Speed Ref	0_Keypad 1_Up/Down DI 2_AVI1 Analog Input 3_ACI Analog Input 4_AVI2 Analog 5_RS485 Serial 6_Com Card 7_PID Output	Source of speed reference when in Auto mode. Keypad input. Digital Input when DI terminal [IO-21~28] set to Up and Down. Analog input from BMS, PLC, Potentiometer or other control device. RS-485 Interface Communications card control. PID output. When PID mode is selected, additional parameters must be verified for setpoints, inputs, and limits.
SET-08	0008	N	Auto Run Cmd	0_Keypad 1_Digital Input 2_RS485 Serial 3_Com Card 4_Ext HOA in Auto	Source of Run Command in Auto mode. Keypad: Run command from Start/Stop button. Digital Input: Run command from digital input FWD or REV terminal. Keypad STOP is disabled. RS485 Serial: Run command from RS485 interface. Keypad STOP is disabled. Com Card: Run command from communications card. This does not include CANopen card. Ext HOA in Auto: Run command from digital input [IO-21~28] set to HOA AUTO (when HOA is in Auto position).

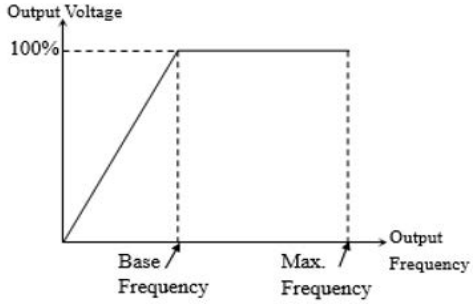
CODE	Mod Bus	AR	Display Name	Range	Description
SET-09	0009	N	Hand Speed Ref	0_Keypad 1_RS485 Serial 2_AVI1 Analog 3_ACI Analog 4_AVI2 Analog 5_Com Card	Source of speed reference when in Hand mode. Keypad input. RS-485 Interface Analog input from BMS, PLC, Potentiometer or other control device. Communications card control. When in Hand mode, PID is disabled.
SET-10	0010	N	Hand Run Cmd	0_Keypad 1_Digital Input 2_RS485 Serial 3_Com Card 4_Ext HOA in Hand	Source of Run Command in Hand mode. Keypad: Run command from Start/Stop button. Digital Input: Run command from digital input FWD or REV terminal. Keypad STOP is disabled. RS485 Serial: Run command from RS485 interface. Keypad STOP is disabled. Com Card: Run command from communications card. This does not include CANopen card. Ext HOA in Hand: Run command from digital input [IO-21~28] set to HOA HAND (when HOA is in Hand position).
SET-11	0011	Y	Accel Time	0 to 600 Sec	Time in seconds for the drive to accelerate from 0 Hz to maximum frequency. Default depends on Application [SET-00] and VFD HP rating.
SET-12	0012	Y	Decel Time	0 to 600 Sec	When Stop Mode is set to Decelerate, time in seconds to slow down from maximum frequency to 0 Hz. Default depends on Application [SET-00] and VFD HP rating.
SET-13	0013	Y	Low Freq Limit	0.0 to SET-14 (Hz)	The lowest frequency (speed) allowable. If speed control falls below setting, motor will continue to run at this limit.
SET-14	0014	N	High Freq Limit	SET-13 to VFD-00 (Hz)	The highest frequency (speed) allowable. If speed control signal goes higher, motor will continue to run at this limit.
SET-15	0015	N	Load Rotation	0_FWD & REV 1_FWD Only 2_REV Only	Allows the motor to run in the forward and reverse direction. Setting it to a specific direction prevents injury or damage to equipment.
SET-16	0016	N	Stop Mode	0_Decel to stop 1_Coast to stop	Determines how the motor is stopped when a STOP command is initiated. Decel to stop: VFD decelerates frequency to minimum output frequency and then stops. Coast to stop: VFD stops the output instantly and motor free runs until it comes to a complete standstill.
SET-17	0017	N	PID Mode	0_Disable 1_PID Direct 2_PID Inverse	PID control allows the VFD to maintain a process value (pressure, temperature etc.) by varying the output frequency based on the difference between a set point and actual feedback value. Direct: Output decreases as feedback increases. Inverted: Output increases as feedback increases.
SET-18	0018	N	PID F/B Source	0_ACI 1_AVI1 2_AVI2	Selects an analog input terminal for PID Feedback source.
SET-19	0019	N	PID F/B Unit	0_PSI 1_inWC 2_Feet 3_°F 4_CFM 5_GPM 6_% 7_Cust 8_inHg 9_m 10_mBar 11_Bar 12_kPa 13_°C 14_LPM 15_CMH	Measurement unit selection for feedback signal.
SET-20	0020	N	PID F/B Max	0.0 to (variable) (Unit)	PID Sensor (Transducer) maximum rating based on transducer range.
SET-21	0021	Y	PID Setpoint	0.0 to SET-20 (Unit)	Set the desired value for PID (pressure, temperature, GPM, etc.).

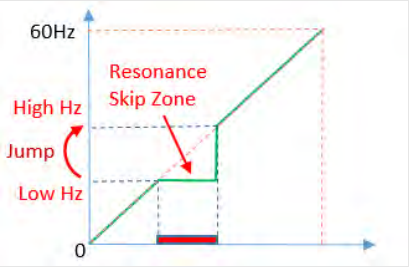
CODE	Mod Bus	AR	Display Name	Range	Description
SET-22	0022	Y	PID Lo Hz Limit	SET-13 to SET-23 (Hz)	Low frequency limit in PID mode. PID Low Frequency is limited by Low Frequency [SET-13] and PID High Frequency [SET-23].
SET-23	0023	N	PID Hi Hz Limit	SET-22 to VFD-00 (Hz)	High frequency limit in PID mode. PID High Frequency is limited by High Frequency [SET-14] and PID Low Frequency [SET-22].
SET-24	0024	Y	PID P-Gain	0 to 100%	Proportional-Gain determines PID control sensitivity. Greater values provide more sensitivity. However, if set too high, the system may create an output frequency oscillation and instability. Used along with PID I-TIme [SET-25] to smooth and balance system response.
SET-25	0025	Y	PID I-Time	0.0 to 100 Sec	Integral-Time determines PID response time. Lower values increase system response to the feedback signal, which reduces overshoot, but may cause system oscillation if set too low. Greater values provide slower response, which may cause overshoot of the setpoint and oscillation of output frequency.
SET-26	0026	Y	Sleep Mode	0_Disabled 1_Sleep Only 2_Sleep + Boost	Sleep Mode selection for pressure controlled systems, such as pumping applications. Sleep+Boost increases the process control value (pressure) before going to sleep.
SET-27	0027	Y	Sleep Check Time	5 to 120 Sec	Time delay (sleep check cycle time) before each Sleep Check process.
SET-28	0028	Y	Sleep Delay	0 to 3000 sec	Delay before VFD triggers Sleep Mode state when all other conditions are met.
SET-29	0029	Y	Sleep Boost Value	0 to 10%	Value added to original setpoint to provide a pressure boost before entering sleep.
SET-30	0030	Y	Sleep Boost Timer	5 to 120 Sec	Limits duration of sleep boost operation if Sleep Boost set-point is not reached.
SET-31	0031	Y	Wake-Up Level	0.0 to SET-21	Sets a wakeup level for VFD to quit Sleep mode and start running.
SET-32	0032	Y	Sleep Bump Timer	5 to 120 Sec	Sets a duration time for pressure bump to increase system pressure.
SET-33	0033	Y	Pipe Fill Timer	0.0 to 60 Min	Pipe Fill mode exit timer to switch to PID mode. If set to 0.0 min, pipe fill is disabled.
SET-34	0034	Y	P-Fill Exit Lvl	0.0 to SET-21 (PSI)	Pipe Fill mode exit level to switch to PID mode.
SET-35	0035	Y	Pipe Fill Freq	SET-22 to SET-23	Pipe Fill mode high frequency limit setting.
SET-36	0036	Y	Broken Pipe Lvl	0.0 to SET-21 (PSI)	Pressure setting that starts Broken Pipe timer before VFD trips on Broken Pipe fault.
SET-37	0037	Y	Broken Pipe Frq	SET-22 to SET-23	If VFD is running above this speed with pressure below [SET-36], Broken Pipe Delay timer starts.
SET-38	0038	Y	Broken Pipe Dly	0 to 6000 Sec	If Broken Pipe Delay timer runs longer than this setting, VFD trips on Broken Pipe fault.
SET-39	0039	Y	OverPress Set	0_Disabled 1_OP Trip 2-OP Auto Reset	Overpressure set OP Trip: Trip requires manual reset OP Auto Reset: Auto Restart occurs when pressure drops 5% below PID setpoint.
SET-40	0040	Y	OverPress Level	0.0 to SET-20 (Unit)	Level the process signal (pressure) reaches to cause an overpressure condition.
SET-41	0041	N	ULD Select	0_Disabled 1_By Current 2_By Torque	Underload Detection protects against conditions such as a dry well, broken pump, or broken drive belt. Refer to "Underload Protection (Dry Well or Belt Loss)" on page 76.
SET-42	0042	Y	ULD Level	15 to 115%	Underload Level set as a percentage of FLA(SFA) or nominal torque. If current or torque is below this level and frequency is above ULD Frequency [SET–43] for longer than ULD Delay [SET–44] timer, VFD will trip on ULD.
SET-43	0043	Y	ULD Frequency	0.0 to SET-22 (Hz)	If motor runs above ULD Frequency, VFD compares operating current or torque with ULD Level [Set–42] to test for ULD condition.
SET-44	0044	Y	ULD Delay	0 to 360 Sec	Underload Delay timer before trip.
SET-45	0045	Y	ULD Recovery T	0 to 720 Min	Underload Recovery TIme. VFD will restart from ULD trip after this time. If it trips again, time will be doubled up to 720 min. If set to 0, fault must be manually reset.
SET-46	0046	N	ULD Recover Cnt	0 to 720 Min	Decrementing counter of recovery time from an ULD trip before VFD attempts to restart motor (Read Only).

CODE	Mod Bus	AR	Display Name	Range	Description
SET-47	0047	N	HLD Select	0_Disabled 1_By Current 2_By Torque	High Load Detection protects the VFD and motor against damage from an over-torque condition. Refer to "High Load Detection" on page 75.
SET-48	0048	Y	HLD Level	75 to 200%	High Load Detection level, set as a percentage of FLA(SFA) or nominal torque. If current or torque is above this level and frequency is above HLD Frequency [Set–49] for longer than HLD Delay [Set–50] timer, VFD will trip on HLD.
SET-49	0049	Y	HLD Frequency	0.0 to SET-23 (Hz)	If motor runs above HLD Frequency, VFD compares operating current or torque with HLD Level [Set–48] to test for HLD condition.
SET-50	0050	Y	HLD Delay	0 to 360 Sec	High Load Delay timer before trip.
SET-51	0051	Y	HLD Recovery T	0 to 720 Min	High Load Recovery TIme. VFD will restart from HLD trip after this time. If it immediately trips again, time will be doubled up to 720 min. If set to 0, fault must be manually reset.
SET-52	0052	Y	HLD Recover Cnt	0 to 720 Min	Decrementing counter of recovery time from a HLD trip before VFD attempts to restart motor (Read Only).
SET-53	0053	Y	ACC Change Freq	(Variable)	Frequency to switch from first accel/decel rate to second accel/decel rate.
SET-54	0054	Y	Second ACC	0 to 600 Sec	Time in seconds for drive to accelerate from 0 Hz to maximum frequency. Second acceleration occurs when frequency is above ACC Change Freq [SET-53]. For example, submersibles have to be accelerated up to 30hz in 1 second but they can accelerate from 30hz to 60hz much slower. So, we would adjust Set-53 to 30hz and the drive would follow the Set-11 ACC time up to 30hz and the Set-54 ACC time above 30hz.
SET-55	0055	Y	Second DEC	0 to 600 Sec	When Stop Mode is set to Decelerate, time in seconds to slow down from maximum frequency to 0 Hz. Second deceleration occurs when frequency is above ACC Change Freq [SET-53]. VFD returns to main DEC time when frequency is below [Set-53]-[Set-56]
SET-56	0056	Y	ACC/DEC Hyster	0.0 to SET-53 (Hz)	Hysteresis added to ACC Change Freq [SET-53] in changing the deceleration rate. When frequency is decreasing across ACC Change Freq [SET-53], the frequency has to reach ACC Change Freq [SET-53] - ACC/DEC Hyster [SET-56] to use first ACC/DEC [SET-11-12].
SET-57	0057	Y	User Defined	0_Output Current (A) 1_Counter Value (c) 2_Output Freq (H) 3_DC-Bus Voltage (u) 4_Output Voltage (E) 5_Output Power (P) 6_Motor Speed (r) 7_PID Feedback (b) 8_AVI1 Value (1) 9_ACI Value (2) 10_AVI2 Value (3) 11_IGBT Temp °C (i) 12_CAP Temp °C (c) 13_D-Input Status (i) 14_D-Out Status (o) 15_Ground Flt Lvl (G) 16_DC Bus Ripple (r) 17_PLC Data D1043 (C) 18_Fan Speed (F) 19_VFD Status (6) 20_kWh Display (J) 21_PID Setpoint (L)	Sets the parameter to display on third line of keypad (display alias).
SET-58	0058	Y	PLC Menu	0_Disable 1_Enable	Allows access to the PLC group of parameters.
SET-59	0059	Y	ADV2 Menu	0_Disable 2_Enable	Allows access to the ADV2 group of parameters.
SET-60	0060	Y	HOA Mode Source	0_Keypad 1_Digital Input 2_RS485 Serial 3_Com Card	Sets the input that selects between Hand-Off-Auto.

Parameter Descriptions > VFD Menu

AR = Adjustable while Running.

CODE	Mod Bus	AR	Display Name	Range	Description
VFD-00	0256	N	VFD Max Freq	0 to 599 Hz	The highest frequency (speed) allowable when running a motor in non-PID mode. If speed control signal goes higher, motor will not exceed this limit. If running a MagForce pump, this should be set to the calculated slip frequency corresponding to the target pump RPM. Refer to "Setup MagForce Pump Motor" on page 80.
VFD-01	0257	N	VFD Start Freq	0-10 Hz	Frequency the VFD initially starts to output. When start frequency is higher than the minimum output frequency, VFD output will be from start frequency to the setting frequency.
VFD-02	0258	N	VFD Base Freq	VFD-01 to VFD-00 (Hz)	Set to the motor nameplate frequency rating. VFD provides full output voltage at this frequency. 
VFD-03	0259	N	V/F Pattern	0_Linear 1_1.5 Power 2_Squared 3_V/F Curve 1 4_V/F Curve 2 5_V/F Curve 3 6_V/F Curve 4 7_V/F Curve 5 8_V/F Curve 6 9_V/F Curve 7 10_V/F Curve 8 11_V/F Curve 9 12_V/F Curve 10 13_V/F Curve 11 14_V/F Curve 12 15_V/F Curve 13	V/F curve can be selected from 15 kinds of default settings. 0_Linear pattern maintains a linear V/Hz ratio for constant torque applications. 2_Squared pattern maintains a squared V/Hz pattern, ideal for fan or pump applications.
VFD-04	0260	Y	Step Freq-1	0.0 to 600 Hz	Command frequency determined by Multi-function Input Terminals. Refer to "Step Frequencies" on page 65.
VFD-05	0261	Y	Step Freq-2	0.0 to 600 Hz	See [VFD-04].
VFD-06	0262	Y	Step Freq-3	0.0 to 600 Hz	See [VFD-04].
VFD-07	0263	Y	Step Freq-4	0.0 to 600 Hz	See [VFD-04].
VFD-08	0264	Y	Step Freq-5	0.0 to 600 Hz	See [VFD-04].
VFD-09	0265	Y	Step Freq-6	0.0 to 600 Hz	See [VFD-04].
VFD-10	0266	Y	Step Freq-7	0.0 to 600 Hz	See [VFD-04].
VFD-11	0267	Y	Step Freq-8	0.0 to 600 Hz	See [VFD-04].
VFD-12	0268	Y	Step Freq-9	0.0 to 600 Hz	See [VFD-04].
VFD-13	0269	Y	Step Freq-10	0.0 to 600 Hz	See [VFD-04].
VFD-14	0270	Y	Step Freq-11	0.0 to 600 Hz	See [VFD-04].
VFD-15	0271	Y	Step Freq-12	0.0 to 600 Hz	See [VFD-04].
VFD-16	0272	Y	Step Freq-13	0.0 to 600 Hz	See [VFD-04].
VFD-17	0273	Y	Step Freq-14	See [VFD-04].	See [VFD-04].
VFD-18	0274	Y	Step Freq-15	0.0 to 600 Hz	See [VFD-04].
VFD-19	0275	Y	ACC-2 Time	0.0 to 600 Sec	Alternate acceleration rate for use with automated Acc/Dec type [ADV-06].
VFD-20	0276	Y	DEC-2 Time	0.0 to 600 Sec	Alternate deceleration rate for use with automated Acc/Dec type [ADV-06].

CODE	Mod Bus	AR	Display Name	Range	Description
VFD-21	0277	Y	ACC-3 Time	0.0 to 600 Sec	Alternate acceleration rate for use with automated Acc/Dec type [ADV-06].
VFD-22	0278	Y	DEC-3 Time	0.0 to 600 Sec	Alternate deceleration rate for use with automated Acc/Dec type [ADV-06]
VFD-23	0279	Y	ACC-4 Time	0.0 to 600 Sec	Alternate acceleration rate for use with automated Acc/Dec type [ADV-06].
VFD-24	0280	Y	DEC-4 Time	0.0 to 600 Sec	Alternate deceleration rate for use with automated Acc/Dec type [ADV-06]
VFD-25	0281	Y	S Start Time 1	0.0 to (variable) Sec	S-curve acceleration time leaving initial frequency.
VFD-26	0282	Y	S Start Time 2	0.0 to (variable) Sec	S-curve acceleration time approaching next frequency.
VFD-27	0283	Y	S End Time 1	0.0 to (variable) Sec	S-curve deceleration time leaving initial frequency.
VFD-28	0284	Y	S End Time 2	0.0 to (variable) Sec	S-curve deceleration time approaching next frequency.
VFD-29	0285	N	Skip Freq 1 High	0.0 to 599 Hz	Used to bypass mechanical system resonance frequencies. If the received speed reference is in the skip zone, VFD will run at Low Skip Freq until speed reference is at or above High Skip Freq. Then, speed will be ramped up based on acceleration time. 
VFD-30	0286	N	Skip Freq 1 Low	0.0 to 599 Hz	Low frequency in skip zone 1.
VFD-31	0287	N	Skip Freq 2 High	0.0 to 599 Hz	High frequency in skip zone 2.
VFD-32	0288	N	Skip Freq 2 Low	0.0 to 599 Hz	Low frequency in skip zone 2.
VFD-33	0289	N	Skip Freq 3 High	0.0 to 599 Hz	High frequency in skip zone 3.
VFD-34	0290	N	Skip Freq 3 Low	0.0 to 599 Hz	Low frequency in skip zone 3.
VFD-35	0291	N	VFD Duty Select	0_Variable Torque 1_Constant Torque	0_Variable Torque (Light Duty) 01_Constant Torque (Normal Duty) VFD Rated Amps [VFD-47] and Over-Current levels [PROT-07-08] are affected by this setting.
VFD-36	0292	Y	Reset Restart	0_Disable 1_Enable	The VFD will automatically initiate operation once fault is cleared and run command is received.
VFD-37	0293	Y	DC Brake Lvl	0.0 to 100%	Level of DC Brake Current output to the motor during start-up and stopping.
VFD-38	0294	Y	DC Time at Run	0.0 to 60 Sec	Duration of the DC Brake current after a run command to apply DC current to motor to force stop motor for a stable start.
VFD-39	0295	Y	DC Time at Stop	0.0 to 60 Sec	Duration of the DC Brake current after a stop command to apply DC current to the motor inorder to force stop the motor.
VFD-40	0296	Y	DC Stop Freq	0.0 to 599 Hz	Frequency when DC Brake will begin during deceleration.
VFD-41	0297	Y	Dwell T at Acc	0.0 to 600 Sec	When increasing in frequency to Dwell Frequency at Accel, the duration to then hold at frequency before continuing to increase frequency.
VFD-42	0297	Y	Dwell Hz at Acc	0.0 to 599 Hz	Frequency to hold when increasing in frequency.
VFD-43	0299	Y	Dwell T at Dec	0.0 to 600 Sec	When decreasing in frequency to Dwell Frequency at Decel, the duration to then hold at frequency before continuing to decrease frequency.
VFD-44	0300	Y	Dwell Hz at Dec	0.0 to 599 Hz	Frequency to hold when decreasing in frequency.

CODE	Mod Bus	AR	Display Name	Range	Description
VFD-46	0302	N	ID Code	4_1 HP (0.75 kW), 230 V 5_1 HP (0.75 kW), 460V 6_2 HP (1.5 kW), 230V 7_2 HP (1.5 kW), 460V 8_3 HP (2.2 kW), 230V 9_ 3HP (2.2 kW), 460V 10_5 HP (3.7 kW), 230V 11_5 HP (3.7 kW), 460V 12_7.5 HP (5.5 kW), 230V 13_7.5 HP (5.5 kW), 460V 14_10 HP (7.5 kW), 230V 15_10 HP (7.5 kW), 460V 16_15 HP (11 kW), 230V 17_15 HP (11 kW), 460V 18_20 HP (15 kW), 230V 19_20 HP (15 kW), 460V 20_25 HP (18.5 kW), 230V 21_25 HP (18.5 kW), 460V 22_30 HP (22 kW), 230V 23_30 HP (22 kW), 460V 24_40 HP (30 kW), 230V 25_40 HP (30 kW), 460V 26_50 HP (37 kW), 230V 27_50 HP (37 kW), 460V 28_60 HP (45 kW), 230V 29_60 HP (45 kW), 460V 30_75 HP (55 kW), 230V 31_75 HP (55 kW), 230V 32_100 HP (75 kW), 230V 33_100 HP (75 kW), 460V 34_125 HP (90 kW), 230V 35_125 HP (90 kW), 460V 37_150 HP (110 kW), 460V 39_175 HP (132 kW), 460V 41_215 HP (160 kW), 460V 43_250 HP (185 kW), 460V 45_300 HP (220 kW), 460V 47_375 HP (280 kW), 460V 49_425 HP (315 kW), 460V 51_475 HP (355 kW), 460V 53_536 HP (400 kW), 460V 90_4 HP (3.0 kW), 230V 91_4 HP (3.0 kW), 460V 93_5.5 HP (4.0 kW), 460V 505_2.0HP (1.5kW), 575V 506_3.0HP (2.2kW), 575V 507_5.0HP (3.7kW), 575V 508_7.5HP (5.5kW), 575V 509_10HP (7.5kW), 575V 510_15HP (11kW), 575V 511_20HP (15kW), 575V 612_25HP (18.5kW), 690V 613_30HP (22kW), 690V 614_40HP (30kW), 690V 615_50HP (37kW), 690V 616_60HP (45kW), 690V 617_75HP (55kW), 690V 618_100HP (75kW), 690V 619_125HP (90kW), 690V 620_150HP (110kW), 690V 621_175HP (132kW), 690V 622_215HP (160kW), 690V 626_425HP (315kW), 690V 628_536HP (400kW), 690V 629_600HP (450kW), 690V 631_745HP (560kW), 690V 632_840HP (630kW), 690V 686_265HP (200kW), 690V 687_333HP (250kW), 690V	Displays the identity code of the VFD (Read Only).

CODE	Mod Bus	AR	Display Name	Range	Description
VFD-47	0303	N	VFD Rated Amps	(Variable)	Current rating of drive with respect to Light Duty and Normal Duty [VFD-35] (Read Only).
VFD-48	0304	Y	Display Select	0_Freq Command 1_Output Frequency 2_Multi-Fn Display 3_Output Current	Sets the parameter that appears on second line of display.
VFD-49	0305	N	Firmware Version	(Variable)	VFD software version (Read Only).
VFD-50	0306	Y	Disp Filter A	0.001 to 65.535 Sec	Minimizes the current fluctuation displayed by digital keypad.
VFD-51	0307	Y	Disp Filter KPD	0.001 to 65.535 Sec	Minimizes the display value fluctuation displayed by digital keypad.
VFD-52	0308	N	FW Date	(Variable)	VFD software version date (Read Only).
VFD-53	0309	Y	Jog Accel Time	0.0 to (variable) Sec	Acceleration time in jog operation to increase frequency to jog frequency.
VFD-54	0310	Y	Jog Decel Time	0.0 to (variable) Sec	Deceleration time in jog operation to decrease frequency to 0Hz.
VFD-55	0311	Y	JOG Frequency	0.0 to 600 Hz	Frequency commanded for jog operation.
VFD-56	0312	N	Zero-speed Mode	0_Standby 1_Hold by DC Brake 2_Min Frequency	When commanded frequency is less than frequency min: Standby: VFD stays at 0Hz. Hold by DC Brake: apply DC Brake by minimium voltage Frequency Min: VFD runs motor at minimium frequency.
VFD-57	0313	Y	Power-on Start	0_Disable 1_Enable	When enabled, the VFD will automatically initiate operation after powered-on with run command.

Parameter Descriptions > I/O Menu

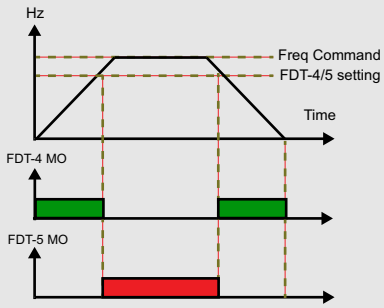
AR = Adjustable while running.

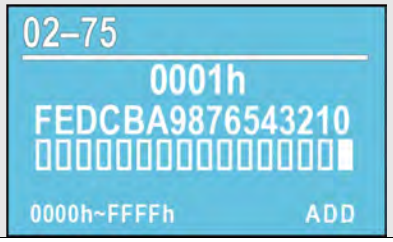
CODE	Mod Bus	AR	Display Name	Range	Description
IO-00	0512	N	ACI Input Sel	0_0-10V 1_0-20mA 2_4-20mA 3_PTC 4_PT100	Selects the format of the input signal expected at the ACI input terminals based on the type of control device to be connected—transducer, sensor, controller, etc. This setting must correspond with ACI micro switch.
IO-01	0513	N	ACI Loss Trip	0_Disable 1_Hold Speed 2_Decel Stop 3_Trip Stop	Selects operation when ACI signal is lost. VFD runs at previous speed (2 sec before signal loss VFD will restart when signal present VFD will stay tripped until reset
IO-04	0516	Y	ACI Filter T	0 to 20 Sec	ACI time filter for noisy analog signal.
IO-05	0517	N	AVI1 Input Sel	0_0-10V 1_0-20mA 2_4-20mA 3_PTC 4_PT100	Selects the format of the input signal expected at the ACI input terminals based on the type of control device to be connected—transducer, sensor, controller, etc. This setting must correspond with AVI1 micro switch.
IO-09	0521	Y	AVI1 Filter T	0 to 20 Sec	AVI1 time filter for noisy analog signal. The delay time helps buffer interference that could cause error in the signal input. Longer times improve signal confirmation, but the response time is delayed.
IO-10	0522	Y	AVI2 Filter T	0 to 20 Sec	AVI2 time filter for noisy analog signal. The delay time helps buffer interference that could cause error in the signal input. Longer times improve signal confirmation, but the response time is delayed.
IO-11	0523	Y	PID Filter Time	0.1 to 300 Sec	PID feedback signal time filter for noisy analog signal. The delay time helps buffer interference that could cause error in the signal input. Longer times improve signal confirmation, but the response time is delayed.
IO-12	0524	Y	PID Delay Time	0 to 35 Sec	Time delay for frequency command.
IO-13	0525	Y	AI Upper Level	-100 to 100%	High level limit of analog input.
IO-14	0526	Y	AI Lower Level	-100 to 100%	Low level limit of analog input.
IO-20	0532	Y	DI Filter	0 to 30 Sec	Response time of digital input terminals MI1~MI8. The delay time helps buffer interference that could cause error in the signal input. Longer times improve signal confirmation, but the response time is delayed.

CODE	Mod Bus	AR	Display Name	Range	Description
IO-21	0533	Y	MI1 Define	0_No Function 1_Speed-L 2_Speed-M 3_Speed-H 4_Speed-X 5_Fault Reset 6_Jog Speed 7_Hold Speed 8_XCEL-L 9_XCEL-M 10_Ext. Trip 12_AVI1 Analog Spd 13_ACI Analog Spd 14_AVI2 Analog Spd 16_Digital Up 17_Digital Down 18_PID Disable 19_CLR CNT 20_Input CNT (MI6) 21_FWD Jog 22_REV Jog 25_E-Stop 26_HOA HAND 27_HOA AUTO 28_Drive Enabled 29_PLC mode bit 0 30_PLC mode bit 1 32_FO with RUN Cmd 33_FO w/o RUN Cmd 34_Damper Limit Sw 35_Shutdown N-Latch 36_Shutdown Latched 37_Flow Switch 40_Aux Motor-1 OFF 41_Aux Motor-2 OFF 42_Aux Motor-3 OFF 43_Aux Motor-4 OFF 44_Aux Motor-5 OFF 45_Aux Motor-6 OFF 46_Aux Motor-7 OFF 47_All Aux Mtr Off	MI1 Default = Speed-L 1_Multi-step speed command 1. Refer to "Step Frequencies" on page 65. 2_Multi-step speed command 2. Refer to "Step Frequencies" on page 65. 3_Multi-step speed command 3. Refer to "Step Frequencies" on page 65. 4_Multi-step speed command 4. Refer to "Step Frequencies" on page 65. 5_Use to reset fault after cause is corrected 6_Changes speed in jog mode to value set in VFD-55 7_When active, VFD will hold current speed 8_ACC/DEC time will be changed to VFD-19 and VFD-20 9_ACC/DEC time will be changed to VFD-21 and VFD-22 10_Trips VFD by external protective device and requires reset 12_In non-PID mode, changes speed reference to AVI1 13_In non-PID mode, changes speed reference to ACI 14_In non-PID mode, changes speed reference to AVI2 16_Increases speed reference when SET-07 is set to (1) 17_Decreases speed reference when SET-07 is set to (1) 18_Disables PID and switches speed reference to keypad 19_Clears pulse counter accumulated value (MI6 only) 20_Pulse counter input (MI6 only) 21_Jog Command Forward 22_Jog Command Reverse 25_VFD stops by Emergency Stop device (requires reset) 26_External HOA Hand position contact 27_External HOA Auto position contact 28_Enables and disables the drive (not a run command) 29_ PLC Function Disable 29 and 30=(0) or Run 29= (1) 30_ PLC Function Disable 29 and 30=(0) or Stop 30= (1) 32_VFD will start in FO Mode by FO DI and Run Command 33_VFD will start in FO Mode by FO DI (No Run Command) 34_When damper is closed, Damper LSW DI is activated 35_Activates Shutdown. When inactive, VFD operates normally 36_Activates Shutdown. Requires reset to operate normally 37_Detects water or air flow by Flow Switch 40_Aux Motor-1 in MMC mode is off sequence 41_Aux Motor-2 in MMC mode is off sequence 42_Aux Motor-3 in MMC mode is off sequence 43_Aux Motor-4 in MMC mode is off sequence 44_Aux Motor-5 in MMC mode is off sequence 45_Aux Motor-6 in MMC mode is off sequence 46_Aux Motor-7 in MMC mode is off sequence 47_All Aux Motors in MMC mode are off sequence
IO-22	0534	Y	MI2 Define	See [IO-21]	MI2 Default = Preset Speed-M
IO-23	0535	Y	MI3 Define	See [IO-21]	MI3 Default = Preset Speed-H
IO-24	0536	Y	MI4 Define	See [IO-21]	MI4 Default = Fault Reset
IO-25	0537	Y	MI5 Define	See [IO-21]	MI5 Default = Emergency Stop
IO-26	0538	Y	MI6 Define	See [IO-21]	MI6 Default = XCEL-L (ACC-2/ DEC-2 Time)
IO-27	0539	Y	MI7 Define	See [IO-21]	MI7 Default = HOA Hand
IO-28	0540	Y	MI8 Define	See [IO-21]	MI8 Default = HOA Auto
IO-29	0541	N	FO Enable	0_Disable 1_FWD Operation 2_REV Operation	Enables Fireman's Override mode in either forward or reverse.
IO-30	0542	Y	FO Frequency	SET-13 to SET-14 (Hz)	Preset frequency for non-PID Fireman's Override mode.
IO-31	0543	Y	FO Fault Retry	0 to 10	Number of auto-retries during fault in Fireman's Override mode
IO-32	0544	Y	FO Retry Delay	0 to 6000 Sec	Delay of auto-retries during fault in Fireman's Override mode
IO-33	0545	N	FO Mode & Reset	0_PID Off Manual 1_PID Off Auto 2_PID On Manual 3_PID On Auto	Sets control method and reset method for Fireman's Override mode. For example, (1)-FO mode no-PID and auto return to normal operation.
IO-34	0546	Y	FO PID S-Point	0 to 100%	PID Setpoint in Fireman's Override mode (when IO-33 is 2 or 3)

CODE	Mod Bus	AR	Display Name	Range	Description
IO-35	0547	Y	Ext. Trip Mode	0_Coast Stop 1_Decel Stop	Determines how the motor is stopped when an Emergency STOP or External Trip command is initiated. Decel to stop: VFD decelerates frequency to minimum output frequency and then stops. Coast to stop: VFD stops the output instantly and motor free runs until it comes to a complete standstill.
IO-36	0548	Y	Damper Mode	0_Disable 1_Enable	Enables damper control feature.
IO-37	0549	Y	Damper T-Delay	0 to 6000 Sec	Provides a run time delay without a damper limit switch; or, provides a Damper Fault delay for systems that include a damper limit switch. The delay should be greater than damper opening time.
IO-38	0550	Y	No-Flow Mode	0_Disable 1_Trip 2_Sleep	The VFD can monitor a system flow switch to provide pump protection and more reliable sleep mode operation. If any digital input is set to Flow Switch in parameters I/O-21-28 and VFD runs longer than time set in IO-39 at frequency above setting in IO-40 with open Flow Switch, VFD will trip on No Flow fault.
IO-39	0551	Y	Prime Time	1 to 6000 Sec	Duration motor runs until No Flow or Underload protection becomes active.
IO-40	0552	Y	No-Flow Freq	0.0 to (variable) Hz	0.0 to High Freq Limit [SET–14] for V/F control 0.0 to PID Hi Hz limit [SET–23] for PID control
IO-41	0553	Y	Lube/S-Clean	0_Disabled 1_Lubrication 2_Screen Clean	Select Lubrication for machines requiring external lubrication control via solenoid or Screen Clean for actuating a solenoid to clear the suction screen.
IO-42	0554	Y	S-Clean Timer	0 to 600 Min	Determines a time period before next 1-minute cleaning pulse.
IO-43	0555	Y	Pre-Lube Timer	0 to 6000 Sec	Determines Pre-lubrication time before VFD starts.
IO-44	0556	Y	Run-Lube Timer	0 to 6000 Sec	Lube relay will be activated at VFD start (run state) and after timer expires it will be deactivated.
IO-45	0557	Y	Post-Lube Timer	0 to 6000 Sec	Lube relay is activated and post-lube timer starts when VFD stops (reaches 0.00Hz) whether it coasts to stop or decelerates.
IO-46	0558	Y	DI NO/NC		Sets the digital inputs numbered in hex format to either N.O. or N.C. configuration. The configuration is in binary format Bit0, Bit1, Bit2, etc. corresponding to FWD, REV, DI1, DI2, etc. from the right to the left. Empty box indicates that Relay is N.O. and solid box that it is N.C. Example below shows Hex value=2 and solid box (N.C. contact configuration) for Bit1 DI (Rev). If contact wired to DI Rev is open, DI is activated. When contact is closed, DI will be deactivated. 

CODE	Mod Bus	AR	Display Name	Range	Description
IO-47	0559	Y	Relay RA1	0_No Function 1_Run 2_FDT-1 3_FDT-2 4_FDT-3 5_FDT-4 6_FDT-5 7_Drive Ready 8_Fault 9_VFD Overheat 11_PID F/B Loss 12_Counter Done 13_Pre-Count Done 14_Alarm 15_FWD CMD 16_REV CMD 17_Analog Trigger 19_Overcurrent 2 22_Fireman O-ride 23_Bypass 24_Motor-1 Out 25_Motor-2 Out 26_Motor-3 Out 27_Motor-4 Out 28_Motor-5 Out 29_Motor-6 Out 30_Motor-7 Out 38_Damper Output 41_Lube/S Clean 42_ACI Loss 44_Hand Mode 45_Auto Mode 47_MMC Out 49_At High Current 50_At Low Current	RA1 Default = Fault 1_During Run Mode 2_When frequency reference value is achieved 3_On above [IO-52] freq and Off below [IO-52]-[IO-53] freq 4_On above [IO-54] freq and Off below [IO-54]+[IO-55] freq 5_On up to FDT-4/5 freq 6_On above FDT-4/5 freq 7_When drive is powered and ready (no faults) 8_When drive has tripped on any fault 9_When VFD temperature reaches trip level 11_When PID feedback source signal value is abnormal 12_When pulse counter achieves the counter set-value 13_When pulse counter achieves pre-count value 14_When alarm is triggered by any alarm condition 15_When VFD operates in Forward direction 16_When VFD operates in Reverse direction 17_When analog signal reaches a trigger level 19_When VFD trips on Overcurrent 2 22_When Fireman's Override mode is activated 23_When drive switches from Soft-Start mode to Bypass 24_When Motor-1 is enabled in MMC control 25_When Motor-2 is enabled in MMC control 26_When Motor-3 is enabled in MMC control 27_When Motor-4 is enabled in MMC control 28_When Motor-5 is enabled in MMC control 29_When Motor-6 is enabled in MMC control 30_When Motor-7 is enabled in MMC control 38_When Damper motor output is activated 41_When Lube or Screen Clean solenoid output is activated 42_When ACI analog input signal value is abnormal 44_When VFD control is in Hand mode 45_When VFD control is in Auto mode 47_Aux motor start output in MMC control 49_When current reaches High Current trigger level 50_When current is below Low Current trigger level
IO-48	0560	Y	Relay RA2	See [IO-47]	RA2 Default = Run
IO-49	0561	Y	Relay RA3	See [IO-47]	RA3 Default = FDT-4
IO-50	0562	Y	CNT Attained 0	0 to 65500	Active increment counter triggered by MI6 when IO-26 is set to 20:Input CNT. After completion of counting, the relay output becomes active if IO-47,48, or 49 is set to 13:PreCount Done. The relay becomes active for 1msec. The counter then returns to 0. When the display shows c5555, the drive has counted 5,555 times. If display shows c5555*, it means that real counter value is between 55,550 to 55,559.
IO-51	0563	Y	CNT Attained 1	0 to 65500	Increment counter triggered by MI6 when IO-26 is set to 20:Input CNT. After completion of counting, the relay output becomes active if IO-47,48, or 49 is set to 12:Count Done. The relay stays active for same number of counts then becomes inactive. The cycle then repeats.
IO-52	0564	Y	FDT-2 Frequency	0.0 to 600 Hz	Once VFD output frequency is within the range of (FDT-2 Frequency - FDT-2 Bandwidth) and (FDT-2 Frequency + FDT-2 Bandwidth), then relay output becomes active if IO-47, 48, or 49 is set to 3:FDT-2.
IO-53	0565	Y	FDT-2 Bandwidth	0.0 to 600 Hz	This bandwidth represent half the frequency span in FDT-2 Frequency detection.
IO-54	0566	Y	FDT-3 Frequency	0.0 to 600 Hz	Once VFD output frequency is within the range of (FDT-3 Frequency - FDT-3 Bandwidth) and (FDT-3 Frequency + FDT-3 Bandwidth), then relay output becomes active if IO-47, 48, or 49 is set to 4:FDT-3.
IO-55	0567	Y	FDT-3 Bandwidth	0.0 to 600 Hz	This bandwidth represent half the frequency span in FDT-3 Frequency detection.

CODE	Mod Bus	AR	Display Name	Range	Description
IO-56	0568	Y	I Hi/Lo Setting	0 to 100%	When any relay is set to (49) At High Current in IO-47~49 and motor current is at or above IO-56 set level (% of FLA), corresponding relay will be activated. When any relay is set to (50) At Low Current in IO-47~49 and motor current is below IO-56 set level (% of FLA), corresponding relay will be activated
IO-57	0569	Y	FDT-4/5 Setting	0.0 to 60 Hz	Frequency setting for FDT-4 and FDT-5 functions. 
IO-58	0570	Y	Relay NO/NC		Sets the relay outputs numbered in hex format to either N.O. or N.C. configuration. The configuration is in binary format Bit0, Bit1, Bit2, etc. corresponding to RA1, RA2, etc. from right to left. Empty box indicates that Relay is N.O. and solid box that it is N.C. Example below shows solid box (N.C. contact configuration) for Bit0 DO (RA1). The physical N.O. contact of RA1 relay is always closed (relay is activated) until the selected function in IO-47~49 is activated, then contact will be open. 
IO-59	0571	Y	AFM1 Out Select	0_Output FREQ 1_Output AMP (rms) 2_Output voltage 3_DC Bus voltage 4_Power Factor 5_Power 6_AVI1 % 7_ACI % 8_AVI2 % 9_Constant Output	Defines functionality of Analog Output 1 (AFM1).
IO-60	0572	Y	AFM1 Gain	0 to 500%	Adjusts the analog voltage level output of AFM1.
IO-61	0573	Y	AFM2 Out Select	See [IO-59]	Defines functionality of Analog Output 2 (AFM2).
IO-62	0574	Y	AFM2 Gain	0 to 500%	Adjusts the analog voltage level output of AFM2.
IO-63	0575	Y	AFM1 mA Select	0_0-20mA output 1_4-20mA output	Selects current range of AFM1 output.
IO-64	0576	Y	AFM2 mA Select	0_0-20mA output 1_4-20mA output	Selects current range of AFM2 output.
IO-65	0577	Y	AFM1 Filter Time	0 to 20 Sec	Noise filtering of AFM1 output.
IO-66	0578	Y	AFM2 Filter Time	0 to 20 Sec	Noise filtering of AFM2 output.
IO-67	0579	Y	MO by AI Level	0_AVI1 1_ACI 2_AVI2	When input signal selected is higher than AI Upper Level [IO-13], then MO becomes active. Once input signal decreases below AI Lower Level [IO-14], then MO becomes inactive.

CODE	Mod Bus	AR	Display Name	Range	Description
IO-68	0580	Y	Fault Out Opt 1	0.0 to 65535	Select fault codes that activate relay output when fault becomes active. Displays fault code groups in hex format as follows: Bit0 = Current fault Bit1 = Voltage fault Bit2 = Overload fault Bit3 = System fault Bit4 = PID Feedback fault Bit5 = EXI fault Bit6 = Communication fault Relay output [IO-47-49] must be set to (8) Fault. 
IO-69	0581	Y	Fault Out Opt 2	0.0 to 65535	See [IO-68]
IO-70	0582	Y	Fault Out Opt 3	0.0 to 65535	See [IO-68]
IO-71	0583	Y	Fault Out Opt 4	0.0 to 65535	See [IO-68]
IO-72	0584	Y	FO Bypass	0_Disable Bypass 1_Enable Bypass	Enables Bypass for Fire Override.
IO-73	0585	Y	FO Bypass Delay	0 to 6550 Sec	Time delay between Fire Override becoming active and enabling relay output for FO indication.
IO-74	0586	N	D-Inputs Status		Displays status of digital inputs numbered in hex format. The input status is in binary format. Empty box indicates that N.O. DI is deactivated and solid box that it is activated. It shows DIs FWD, REV, DI1, DI2... status from the right to the left Bit0=1, Bit1=2, Bit3=4, Bit4=8, Bit5=16, etc. Example below shows hex value=5 and solid boxes (activated) for Bit0 (value=1) DI (FWD) and Bit2 (value=4) DI (DI1). The contacts wired to those inputs should be closed to deactivate input and open to activate it. 
IO-75	0587	N	D-Relays Status		Displays status of digital outputs (DOs) numbered in hex format. The output status is in binary format. Empty box indicates that output Relay is deactivated and solid box that it is activated. It shows DOs RA1, RA2... status from the right to the left Bit0, Bit1, Bit2, Bit3, etc. Example below shows hex value=1 and solid box (activated) for Bit0 (RA1). The N.O. contact of RA1 relay is closed until selected function is activated. 
IO-77	0589	N	Spare Max Value	0 to 60000	Range of spare transducer
IO-78	0590	N	Spare AI Select	0_AVI1 1_ACI 2_AVI2	Analog input for spare transducer

Parameter Descriptions > ADV Menu

AR = Adjustable while running.

CODE	Mod Bus	AR	Display Name	Range	Description
ADV-00	0768	Y	Upper Bound Int	0 to 100%	Upper limit for the integral gain (I), which limits the output frequency. Upper Limit Freq = VFD Max Freq Main [VFD-00] x Upper Bound Int [ADV-00]. Too large integral value will cause a slow response to sudden load changes. This could cause motor stall or machine damage.
ADV-01	0769	Y	PID Out Limit	0 to 110%	Maximum PID command limit. Percentage of Maximum Output Frequency [VFD-00].
ADV-02	0770	Y	Password Input	0 to 65535	Password protect from modifying parameters.
ADV-03	0771	N	Parameter Reset	0_Disabled 1_Write protect 2_ 3_Reset KWH 4_Reset all Param 5_Reset M Run T	Select stored data to be reset.
ADV-05	0773	Y	Password Lock	0_Unlocked 1_Locked	When setting password protection for the first time, set password in Password Input [ADV-02] and then Password Lock [ADV-05] becomes 1-Locked. To permanently disable password protection, unlock parameters by entering password in Password Input [ADV-02] and then set Password Lock [ADV-05] to 0-Unlocked. If drive is unlocked by a password and password lock is not set to 0-Unlocked, the next reboot of the VFD will lock the VFD again.
ADV-06	0774	Y	Acc/Dec Type	0_Linear Acc/Dec 1_Auto Acc/L-Dec 2_L-Acc/Auto Dec 3_Auto Acc/Dec 4_Lin, Auto Stall	Provides automated acceleration and deceleration with stall prevention. 0_Linear Acc/Dec: Accelerates and decelerates according to the setting of SET-11~12 and VFD-19~24. 1_Auto Acc/L-Dec: Auto detects the load torque and accelerates for the fastest acceleration time and smoothest start current. Deceleration is linear according to setting of SET-11-12 and VFD-19-24. 2_L-Acc/Auto Dec: Linear acceleration according to setting SET-11~12 and VFD-19~24. Auto detects the load re-generation and stops the motor smoothly with the fastest decel time. 3_Auto Acc /Dec: Auto detects load for smoothest operation for acceleration and deceleration. 4_Lin, Auto Stall: Stall prevention by auto accel./decel being limited by SET-11~12 and VFD-19~24.
ADV-07	0775	N	Acc/Dec Format	0_Unit 0.01 Sec 1_Unit 0.1 Sec	Precision of acceleration and deceleration.
ADV-08	0776	Y	Energy Saving	0_Disable 1_Enable	When the output frequency is constant, the output voltage will auto decrease by the load reduction. The drive will operate with minimum power.
ADV-09	0777	Y	E-Saving Gain	10 to 1000%	Determines speed of adjusting output voltage in relationship to load reduction. If the motor oscillates or has a quick temperature rise, the value should be increased.
ADV-10	0778	N	MMC Mode	0_Disabled (default) 1_Equal Run Time 2_Soft Start mode 3_Lead-Lag 4_Run Time Alt 5_Rotate Lead	Type of operation for Multi-Motor Control.
ADV-11	0779	N	Motor Quantity	1 (default) to 7	Number of motors in MMC relay control setup. Limit is 3 without I/O card. When I/O card is installed, selections 1-7 are available.
ADV-12	0780	N	Aux Mtr Stop Hz	0 to VFD-00	When output frequency is less than value and remains for duration of ADV-15, motors will be shut down one by one.
ADV-13	0781	N	Alt Run Time	0.0 to 60000 Min	Duration of running a motor before switching to another motor.
ADV-14	0782	N	S-Start ON Dly	0.0 to 3600 Sec	Delay time before switching on motor.
ADV-15	0783	N	S-Start Off Dly	0.0 to 3600 Sec	Delay time before switching off motor.

CODE	Mod Bus	AR	Display Name	Range	Description
ADV-16	0784	Y	Mtr Switch Tmr	0.0 to 3600 Sec	When output duration reaches value, the system will start preparing to switch motors.
ADV-17	0785	Y	Mtr Switch Hz	Set-22 to Set 23 (Hz)	When the output frequency reaches value, the system will start preparing to switch motors.
ADV-18	0786	Y	Lag Start Freq	ADV-23 to Set-23	Running above ADV-18 frequency is one of the conditions for starting Lag pump. Lag Start Frequency parameter is used for ADV-10 selection (3) Lead-Lag MMC control. Default= 59.50Hz.
ADV-19	0787	Y	Lag Start Delay	0.0 to 600 Sec	Sets a delay time to start Lag pump when both frequency and pressure conditions are met.
ADV-20	0788	Y	Lag Start Level	0.1 to 10%	Sets percentage of [Set-20 PID F/B Max] value to determine [MMC Below Setpoint] level for Lag pump starting. ADV-20 parameter is used for ADV-10 selection (3) Lead-Lag MMC control.
ADV-21	0789	Y	Lead Freq Drop	0.0 to SET-23 (Hz)	PID High Frequency Limit drop value with ADV-22 Decel Time at Lag pump start to prevent system overpressure condition. ADV-21 parameter is used for ADV-10 selection (3) Lead-Lag MMC control.
ADV-22	0790	Y	MMC Decel Time	0.0 to 600 Sec	Sets deceleration time for PID High Frequency limit value change from [Set-23 PID High Freq Limit] to [Set-23 PID High Freq Limit]-[ADV-21] at Lag pump start. ADV-22 parameter is used for ADV-10 selection (3) Lead-Lag MMC control.
ADV-23	0791	Y	Lag Stop Freq	SET-22 to ADV-18 (Hz)	Running below ADV-23 frequency is one of the conditions for stopping Lag pump. This parameter is used for ADV-10 selection (3) Lead-Lag MMC control.
ADV-24	0792	Y	Lag Stop Delay	0.0 to 600 Sec	Sets delay time to stop Lag pump when both frequency and pressure. ADV-24 parameter is used for ADV-10 selection (3) Lead-Lag MMC control.
ADV-25	0793	Y	Lag Stop Level	0.1 to ADV-20 (%)	Sets percentage value of [Set-20 PID F/B Max] value to determine [MMC At Setpoint] level for Lag pump stopping. ADV-25 parameter is used for ADV-10 selection (3) Lead-Lag MMC control.
ADV-26	0794	Y	Lead Freq Bump	0.0 to (SET-23)*0.4 Hz	PID Low Freq Limit increase value with ADV-27 Accel Time at Lag pump stop to prevent system underpressure condition. ADV-26 parameter is used for ADV-10 selection (3) Lead-Lag MMC control.
ADV-27	0795	Y	MMC Accel Time	0.0 to 600 Sec	Sets acceleration time for PID Low Frequency limit value change from [Set-22 PID Low Freq Limit] to [Set-22 PID Low Freq Limit]+[ADV-26] at Lag pump stop.
ADV-28	0796	Y	Power on Delay	0.0 to 6000 Sec	This timer provides run delay at VFD power-up with run command present to prevent multiple starts during power surges.
ADV-29	0797	Y	Run Delay Timer	0.0 to 6000 Sec	This timer provides a delay at every VFD start when run command is applied. Timer starts before every VFD start by run command, auto-restarts, fault reset, sleep wake-up, etc. FO (Fire Override) mode will disable this timer.
ADV-30	0798	Y	Backspin Timer	0.0 to 6000 Sec	Duration after stop state that the drive disables output. Protects drive from motor backspinning due to column of water backflowing through pump.
ADV-34	0802	Y	Min Run Timer	0.0 to 6000 Sec	Once drive starts motor, the motor continuously runs for this length of time even though a stop command is present.
ADV-55	0823	Y	AVR Select	0_Enable AVR 1_Disable AVR 2_Disable AVR Dec	Auto Voltage Regulation automatically regulates the drive output voltage to the motor rated voltage.

Parameter Descriptions > PROTECTION Menu

AR = Adjustable while running.

CODE	Mod Bus	AR	Display Name	Range	Description
PROT-00	1024	N	Decel Method	0_Normal 1_Over Fluxing 2_Traction Energy	0_VFD follows SET-12 Deceleration time 1_VFD prevents DC bus Over voltage by over-fluxing the motor at PROT-14 voltage. The Decel time can be longer than SET-12 value. 2_VFD prevents DC Bus Over voltage by changing output frequency and voltage. The Decel time can be longer than SET-12 value.
PROT-01	1025	Y	Preheat Level	0 to 100%	Percentage of nominal current applied to the motor as DC voltage to heat the VFD and motor. Slowly increase the percentage to reach the sufficient preheating temperature.
PROT-02	1026	Y	Preheat Duty	0 to 100%	Sets output current cycle of preheating, which corresponds to 0-10 seconds. 0% - no output current 50% - 5 seconds OFF and 5 seconds ON 100% - continuous output current
PROT-03	1027	Y	LV Level	(Varies with VFD rating)	Sets the Low Voltage (Lv) level. Recommended setting is motor voltage minus 10%. If incoming power varies too much, the setting may need to be 15% less than motor voltage. If DC bus voltage drops to Lv level, the VFD stops output to the motor with motor free run to stop. If fault occurs during acceleration, deceleration, constant speed, or stop, then fault indication is LvA, Lvd, Lvn, and LvS, respectively. Manual reset is required. To enable auto restart after a momentary power loss, consult PROT-37 and PROT-38 for VFD handling of fault. The hysteresis recovery level is based on VFD frame size and VFD voltage rating.
PROT-04	1028	Y	OV Stall level	(Varies with VFD rating)	Set Over-Voltage Stall Level. If braking unit or braking resistor is connected, set level to 0 to disable.
PROT-05	1029	Y	OV Stall Prevent	0_Standard 1_Advanced	Set Over-Voltage Stall Prevention operation. 0:Standard - Frequency maintains during deceleration. 1:Advanced - Frequency increases during acceleration, deceleration, or constant speed.
PROT-06	1030	Y	SW Brake V Lvl	(Variable)	Sets the DC-bus voltage at which the DC Brake is activated. Defaults are based on VFD Rating.
PROT-07	1031	Y	OCA Level	0 to 130%	Set Over-Current during Acceleration level. Value is based on VFD's rated current and selection of VFD-35 for Light Duty or Normal Duty.
PROT-08	1032	Y	OCN Level	0 to 130%	Set Over-Current during Operation level. Value is based on VFD's rated current and selection of VFD-35 for Light Duty or Normal Duty.
PROT-12	1036	Y	OL-2 Type	0_Disable 1_Alarm at Speed 2_Trip at Speed 3_Alarm at Run 4_Trip at Run	Select Overload Detection operation. Setting 1 and 2 protects from Overload once VFD reaches constant speed. Setting 3 and 4 protects from Overload throughout run of the motor.
PROT-13	1037	Y	OL-2 Level	10 to 200%	Set Overload Detection level with respect to the rated current of the VFD.
PROT-14	1038	Y	OL-2 Delay	0.0 to 60 Sec	Duration output current exceeds the overload detection level causing an Overload condition. The hysteresis for the Overload condition is 5% of detection level.
PROT-16	1040	Y	ETH Type	0_Disable 1_Self Cooled 2_Force Cooled	Set type of motor for Electronic Thermal Relay protection. For 1:Self-Cooled, the motor rated current percentage level is 40% at 0Hz and linear increases to 100% at motor rated frequency.
PROT-17	1041	Y	ETH Delay	30 to 600 Sec	Sets time the output current is higher than 150% before tripping on electronic thermal overload. The overload level with respect to time is based on I^2t curve.
PROT-18	1042	Y	OH Warning	0.0 to 110 °C	Set Heat Sink Over-heat warning level. When temperature exceeds 110C, the drive stops with an IGBT over-heat fault. Cooling fan is activated when temperature reaches 15C less than value. The cooling fan deactivates for 35C less than value.

CODE	Mod Bus	AR	Display Name	Range	Description
PROT-19	1043	Y	PTC/PT100 Sel	0_Alarm and Run 1_Alarm and Decel 2_Alarm and Coast 3_Disabled	Set operation when PTC, PT100, or KTY84 exceed level 2.
PROT-20	1044	Y	PTC Level	0 to 100%	Set detection level of PTC. The corresponding value for 100% is the analog input maximum value
PROT-21	1045	Y	OPO Trip	0_Alarm and Run 1_Alarm and Decel 2_Alarm and Coast 3_Disabled	Select operation for Output Phase Loss.
PROT-22	1046	Y	OPO Delay	0 to 65.535 Sec	Duration of output phase loss until operation occurs.
PROT-23	1047	Y	OPO Current	0 to 100%	Set level of output phase loss.
PROT-24	1048	Y	OPO Decel	0 to 65.535 Sec	DC Brake Time of output phase loss.
PROT-25	1049	Y	LvX Auto Reset	0_Disable 1_Enable	Set low voltage fault operation to auto reset. Once DC bus voltage returns, the VFD clears fault and restarts motor.
PROT-26	1050	Y	IPO Check Time	0.0 to 600 Sec	Set how often to check for input phase loss.
PROT-27	1051	Y	IPO Ripple	(Varies with VFD rating)	An input phase loss is detected when DC bus ripple is higher than IPO Ripple for duration of IPO Check plus 30 seconds.
PROT-28	1052	Y	IPO Trip	0_Alarm and Decel 1_Alarm and Coast	Operation when input phase loss is detected.
PROT-29	1053	Y	Derating Type	0_Carrier by I_T 1_Limit Current 2_Limit Carrier	Set how the VFD derates itself. 0 - Limit the carrier wave to reach max load current and temperature. 1 - Limit the current to use max carrier frequency. 2 - Limit the carrier wave to reach max load current and temperature except when output current is the derating ratio x 130% of output current in light load.
PROT-30	1054	Y	PT100 Level 1	0.0 to 10 V	Level the PT100 reaches for duration for PT100 L-1 Delay causing drive to back frequency down to PT100 L-1 Freq.
PROT-31	1055	Y	PT100 Level 2	0.0 to 10 V	Level the PT100 reaches causing PTC Select [Prot-19] operation.
PROT-32	1056	Y	PT100 L-1 Freq	0.0 to 599 Hz	Frequency the VFD reduces to after reaching PT100 Level 1 for duration of PT100 L-1 Delay.
PROT-33	1057	Y	PT100 L-1 Delay	0.0 to 6000 Sec	Duration PT100 has to be above PT100 Level 1 to cause frequency reduction to PT100 L-1 Freq.
PROT-34	1058	Y	Gnd Fault Lvl	0 to 6553.5%	Percentage of light-load current that current phase unbalance has to reach for duration of G-Fault Delay [Prot-35] for ground fault to occur.
PROT-35	1059	Y	Gnd-Fault Delay	0 to 6553.5 Sec	Duration of current phase unbalance for ground fault to occur.
PROT-36	1060	Y	STO Alarm Type	0_STO Latching 1_STO Non-Latch	
PROT-37	1061	Y	IPF S-Search	0_Disable 1_At Last Freq 2_At Min Freq	Speed search treatment after Instantaneous Power Failure (IPF).
PROT-38	1062	Y	Max IPF Time	0 to 20 Sec	Duration power loss has to occur for output to be turned off (coast stop).
PROT-39	1063	Y	SS Current Lmt	20 to 200%	Following a momentary power loss, the drive will start speed search operation if the output current is greater than PROT-39 value.
PROT-40	1064	Y	SS After Fault	0_Disable 1_At Last Freq 2_At Min Freq	Speed search treatment after fault,
PROT-41	1065	Y	Auto Restarts	0 to 10	Number of auto restart attempts after fault.
PROT-42	1066	Y	SS Normal Start	0_Disable 1_At Max Freq 2_At Start Freq 3_At Min Freq	Speed search treatment for normal start command.
PROT-43	1067	Y	Spd Search Gain	1 to 200%	Voltage gain percentage for speed search operation. Reduce value if overload or overcurrent fault occurs.
PROT-44	1068	Y	IPF Restart Dly	0 to 5 Sec	Delay for restart after an Instantaneous Power Failure. Set value high enough to allow residual regeneration voltage to disappear.

CODE	Mod Bus	AR	Display Name	Range	Description
PROT-45	1069	Y	Fan Control	0_At Power-Up 1_Delayed Stop 2_During Run 3_By Temperature 4_Disabled	Determines operation of fan. Recommend not to set to 4-Disabled since this will reduce performance of drive.
PROT-46	1070	Y	Last Flt Freq	0.0 to SET-14 Hz	Output frequency at last fault (Read Only)
PROT-47	1071	Y	Last Flt IGBTT	-3277 to 3276.7 °C	IGBT temperature at last fault (Read Only)
PROT-48	1072	Y	Last Flt Cap T	-3277 to 3276.7 °C	Capacitance temperature at last fault (Read Only)
PROT-49	1073	Y	Last Flt MFI	(Read Only)	Status of Multi-function input terminals at last fault
PROT-50	1074	Y	Last Flt MFO	(Read Only)	Status of Multi-function output terminals at last fault
PROT-51	1075	Y	1st Fault	(Read Only)	First register of fault listing.
PROT-52	1076	Y	2nd Fault	(Read Only)	Second register of fault listing.
PROT-53	1077	Y	3rd Fault	(Read Only)	Third register of fault listing.
PROT-54	1078	Y	4th Fault	(Read Only)	Fourth register of fault listing.
PROT-55	1079	Y	5th Fault	(Read Only)	Fifth register of fault listing.
PROT-56	1080	Y	6th Fault	(Read Only)	Sixth register of fault listing.
PROT-57	1081	Y	ULD Min Torque	5% to SET-42	Sets minimum torque level % at 0Hz when using Underload Torque.
PROT-58	1082	Y	HLD Min Torque	PROT-57 to SET-48	Sets minimum torque level % at 0Hz when using High load Torque.

Parameter Descriptions > COMM Menu

AR = Adjustable while running.

CODE	Mod Bus	AR	Display Name	Range	Description
Comm-00	1280	Y	COM1 Address	1 to 254	RS485 address of VFD.
Comm-01	1281	Y	COM1 Speed	4.8 to 115.2 Kbps	RS485 baud rate. All devices on RS485 communication must have the same baud rate.
Comm-02	1282	Y	COM1 Loss	0_Alarm and Run 1_Alarm_Decel 2_Alarm_Coast 3_Disable	Select operation when communication is lost.
Comm-03	1283	Y	COM1 Loss Delay	0.0 to 100 Sec	Duration of communication loss before initiating operation.
Comm-04	1284	Y	COM1 Protocol	1_7, N, 2 for ASCII 2_7, E, 1 for ASCII 3_7, O, 1 for ASCII 4_7, E, 2 for ASCII 5_7, O, 2 for ASCII 6_8, N, 1 for ASCII 7_8, N, 2 for ASCII 8_8, E, 1 for ASCII 9_8, O, 1 for ASCII 10_8, E, 2 for ASCII 11_8, O, 2 for ASCII 12_8, N, 1 for RTU 13_8, N, 2 for RTU 14_8, E, 1 for RTU 15_8, O, 1 for RTU 16_8, E, 2 for RTU 17_8, O, 2 for RTU	RS485 Protocol: Data Bits - Parity - Stop Bits - Message Format
Comm-05	1285	Y	Response Delay	0.0 to 200 ms	Duration VFD waits before responding to received communication.
Comm-06	1286	N	Main Frequency	0.0 to 599 Hz	When Auto Speed Ref [SET-07] is set to RS485 Interface, the last frequency command is stored in this parameter. After rebooting from an abnormal turn-off or momentary power loss, the VFD will continue operation with last frequency.

CODE	Mod Bus	AR	Display Name	Range	Description
Comm-07	1287	Y	Block Transf 1	0000h to FFFFh	Block transfer allows selection of a group of parameters for transfer through communication code 03H.
Comm-08	1288	Y	Block Transf 2	0000h to FFFFh	See [Comm-07]
Comm-09	1289	Y	Block Transf 3	0000h to FFFFh	See [Comm-07]
Comm-10	1290	Y	Block Transf 4	0000h to FFFFh	See [Comm-07]
Comm-11	1291	Y	Block Transf 5	0000h to FFFFh	See [Comm-07]
Comm-12	1292	Y	Block Transf 6	0000h to FFFFh	See [Comm-07]
Comm-13	1293	Y	Block Transf 7	0000h to FFFFh	See [Comm-07]
Comm-14	1294	Y	Block Transf 8	0000h to FFFFh	See [Comm-07]
Comm-15	1295	Y	Block Transf 9	0000h to FFFFh	See [Comm-07]
Comm-16	1296	Y	Block Transf 10	0000h to FFFFh	See [Comm-07]
Comm-17	1297	Y	Block Transf 11	0000h to FFFFh	See [Comm-07]
Comm-18	1298	Y	Block Transf 12	0000h to FFFFh	See [Comm-07]
Comm-19	1299	Y	Block Transf 13	0000h to FFFFh	See [Comm-07]
Comm-20	1300	Y	Block Transf 14	0000h to FFFFh	See [Comm-07]
Comm-21	1301	Y	Block Transf 15	0000h to FFFFh	See [Comm-07]
Comm-22	1302	Y	Block Transf 16	0000h to FFFFh	See [Comm-07]
Comm-23	1303	N	Com Decoding	0_20xx 1_60xx	Select address starting range for communication via RS485, CANopen, and Communication Card.
Comm-24	1304	N	BACnet MAC ID	0 to 127	BACnet address of VFD.
Comm-25	1305	N	BACnet Speed	9.6 to 76.8 Kbps	BACnet baud rate.
Comm-26	1306	N	Device ID Lo	0 to 65535	BACnet Device ID L
Comm-27	1307	N	Device ID Hi	0 to 63	BACnet Device ID H
Comm-28	1308	N	Max Address	0 to 127	BACnet max address.
Comm-29	1309	N	Password	0 to 65535	BACnet password.
Comm-30	1310	N	Com Card ID	0_No Com Card 1_DevNet Slave 2_P-bus DP Slave 3_CANopen S/M 4_Mbus-TCP Slave 5_E-Net/IP Slave 6_FELE BT Card	Identification of installed communication card.
Comm-31	1311	N	Com Card FW	N/A	Firmware version of communication card.
Comm-32	1312	N	Product code	N/A	Part number of communication card.
Comm-33	1313	N	Error code	N/A	Error status of communication card.
Comm-34	1314	Y	D-Net Card Addr	(Variable)	DeviceNet or Profibus address of VFD.
Comm-35	1315	Y	D-Net Speed	0_125 Kbps 1_250 Kbps 2_500 Kbps 3_1 Mbps	DeviceNet baud rate.
Comm-36	1316	Y	D-Net Type	0_Standard 1_Special	DeviceNet Standard is when D-Net Speed [Comm-35] is set to 125Kbps, 250Kbps, and 500Kbps in standard speeds. DeviceNet Special is for other speeds similar to CANopen.
Comm-37	1317	Y	M-bus IP Type	0_Static IP 1_DHCP	Set the Modbus TCP IP manually with Static IP or automatically by host control with DHCP.
Comm-38	1318	Y	IP Address 1	0 to 65535	First (most significant) octet of IP address. (0-255) XXX.---.---.---
Comm-39	1319	Y	IP Address 2	0 to 65535	Second octet of IP address. (0-255) ---.XXX.---.---
Comm-40	1320	Y	IP Address 3	0 to 65535	Third octet of IP address. (0-255) ---.---.XXX.---
Comm-41	1321	Y	IP Address 4	0 to 65535	Fourth (least significant) octet of IP address. (0-255) ---.---.---.XXX

CODE	Mod Bus	AR	Display Name	Range	Description
Comm-42	1322	Y	Address Mask 1	0 to 65535	First (most significant) octet of Mask address. (0-255) XXX.---.---.---
Comm-43	1323	Y	Address Mask 2	0 to 65535	Second octet of Mask address. (0-255) ---.XXX.---.---
Comm-44	1324	Y	Address Mask 3	0 to 65535	Third octet of Mask address. (0-255)
Comm-45	1325	Y	Address Mask 4	0 to 65535	Fourth (least significant) octet of Mask address. (0-255) ---.---.---.XXX
Comm-46	1326	Y	G-way Address 1	0 to 65535	First (most significant) octet of Gateway address. (0-255) XXX.---.---.---
Comm-47	1327	Y	G-way Address 2	0 to 65535	Second octet of Gateway address. (0-255)
Comm-48	1328	Y	G-way Address 3	0 to 65535	Third octet of Gateway address. (0-255)
Comm-49	1329	Y	G-way Address 4	0 to 65535	Fourth (least significant) octet of Gateway address. (0-255)
Comm-50	1330	Y	MBus TCP Pass L	0 to 99	Communication card password for Modbus TCP (Low word)
Comm-51	1331	Y	MBus TCP Pass H	0 to 99	Communication card password for Modbus TCP (High word)
Comm-52	1332	Y	MBus Card Reset	0_Disable 1_Reset	Sets the communication card to default values for Modbus TCP.
Comm-53	1333	Y	MBus TCP Config	0_None 1_IP Filter 2_I-net Par On 3_---- 4_Login Pass	Once IP address parameters are set, then set Modbus TCP Config to 1:Internet Parameters to load parameters. Once login password is set, then set Modbus TCP Config to 2:Login Password to load password.
Comm-54	1334	N	MBus TCP Status	N/A	When the communication card is set with a password, this bit is enabled, When the password is cleared, this bit is disabled.
Comm-55	1335	N	Set Comm Card	0 to 65535	Enables an optional Ethernet/IP card, which disables Bluetooth. Set bit 1 to ON to enable the Ethernet card. Set to OFF to disable the card and allow Bluetooth. 

Parameter Descriptions > PLC Menu

CODE	Mod Bus	Display Name	Range	Description
PLC-00	1536	DI used by PLC	0 to 65535	Status of PLC external input terminal.
PLC-01	1537	DO used by PLC	0 to 65535	Status of PLC external output terminal.
PLC-02	1538	Analog by PLC	0 to 65535	Status of PLC external analog output terminals.
PLC-03	1539	PLC Buffer 0	0 to 65535	Used for PLC or HMI programming.
PLC-04	1540	PLC Buffer 1	0 to 65535	Used for PLC or HMI programming.
PLC-05	1541	PLC Buffer 2	0 to 65535	Used for PLC or HMI programming.
PLC-06	1542	PLC Buffer 3	0 to 65535	Used for PLC or HMI programming.
PLC-07	1543	PLC Buffer 4	0 to 65535	Used for PLC or HMI programming.
PLC-08	1544	PLC Buffer 5	0 to 65535	Used for PLC or HMI programming.
PLC-09	1545	PLC Buffer 6	0 to 65535	Used for PLC or HMI programming.
PLC-10	1546	PLC Buffer 7	0 to 65535	Used for PLC or HMI programming.
PLC-11	1547	PLC Buffer 8	0 to 65535	Used for PLC or HMI programming.
PLC-12	1548	PLC Buffer 9	0 to 65535	Used for PLC or HMI programming.
PLC-13	1549	PLC Buffer 10	0 to 65535	Used for PLC or HMI programming.

CODE	Mod Bus	Display Name	Range	Description
PLC-14	1550	PLC Buffer 11	0 to 65535	Used for PLC or HMI programming.
PLC-15	1551	PLC Buffer 12	0 to 65535	Used for PLC or HMI programming.
PLC-16	1552	PLC Buffer 13	0 to 65535	Used for PLC or HMI programming.
PLC-17	1553	PLC Buffer 14	0 to 65535	Used for PLC or HMI programming.
PLC-18	1554	PLC Buffer 15	0 to 65535	Used for PLC or HMI programming.
PLC-19	1555	PLC Buffer 16	0 to 65535	Used for PLC or HMI programming.
PLC-20	1556	PLC Buffer 17	0 to 65535	Used for PLC or HMI programming.
PLC-21	1557	PLC Buffer 18	0 to 65535	Used for PLC or HMI programming.
PLC-22	1558	PLC Buffer 19	0 to 65535	Used for PLC or HMI programming.
PLC-23	1559	PLC Com Type	-12_PLC Control -10_Internal Master -8_Internal Slave 8 -7_Internal Slave 7 -6_Internal Slave6 -5_Internal Slave 5 -4_Internal Slave 4 -3_Internal Slave 3 -2_Internal Slave 2 -1_Internal Slave 1 0_Modbus 485 1_BACnet	Setup PLC controller for single VFD or with multiple VFD's.
PLC-24	1560	PLC force to 0	0 to 65535	Defines reset value of the frequency command before PLC scans time sequence. Bit0 Before PLC scan, set up PLC target frequency=0 Bit1 Before PLC scan, set up PLC target torque=0. Bit2 Before PLC scan, set up the speed limit of torque control mode=0.
PLC-25	1561	PLC Address	1 to 254	Address of PLC with respect to communication link.

Parameter Descriptions > Option Menu

AR = Adjustable while running.

CODE	Mod Bus	AR	Display Name	Range	Description
Option-00	1792	N	M10 Define	0_No Function 1_Speed-L 2_Speed-M 3_Speed-H 4_Speed-X 5_Fault Reset 6_Jog Speed 7_Hold Speed 8_XCEL-L 9_XCEL-M 10_Ext. Trip 12_AVI1 Analog Spd 13_ACI Analog Spd 14_AVI2 Analog Spe 16_Digital Up 17_Digital Down 18_PID Disable 19_CLR CNT 20_Input CNT (MI6) 21_FWD Jog 22_REV Jog 25_E-Stop 26_HOA HAND 27_HOA AUTO 28_Drive Enabled 29_PLC mode bit 0 30_PLC mode bit 1 32_FO with RUN Cmd 33_FO w/o RUN Cmd 34_Damper Limit Sw 35_Shutdown N-Latch 36_Shutdown Latched 37_Flow Switch 40_Aux Motor-1 OFF 41_Aux Motor-2 OFF 42_Aux Motor-3 OFF 43_Aux Motor-4 OFF 44_Aux Motor-5 OFF 45_Aux Motor-6 OFF 46_Aux Motor-7 OFF 47_All Aux Mtr Off	Defines functionality of input MI10 on I/O extension card. 1_Multi-step speed command 1 2_Multi-step speed command 2 3_Multi-step speed command 3 4_Multi-step speed command 4 5_Use to reset fault after cause is corrected 6_Changes speed in jog mode to value set in VFD-55 7_When active, VFD will hold current speed 8_ACC/DEC time will be changed to VFD-19 and VFD-20 9_ACC/DEC time will be changed to VFD-21 and VFD-22 10_Trips VFD by external protective device and requires reset 12_In non-PID mode, changes speed reference to AVI1 13_In non-PID mode, changes speed reference to ACI 14_In non-PID mode, changes speed reference to AVI2 16_Increases speed reference when SET-07 is set to (1) 17_Decreases speed reference when SET-07 is set to (1) 18_Disables PID and switches speed reference to keypad 19_Clears pulse counter accumulated value (MI6 only) 20_Pulse counter input (MI6 only) 21_Jog Command Forward 22_Jog Command Reverse 25_VFD stops by Emergency Stop device (requires reset) 26_External HOA Hand position contact 27_External HOA Auto position contact 28_Enables and disables the drive (not a run command) 29_ PLC Function Disable 29 and 30=(0) or Run 29= (1) 30_ PLC Function Disable 29 and 30=(0) or Stop 30= (1) 32_VFD will start in FO Mode by FO DI and Run Command 33_VFD will start in FO Mode by FO DI (No Run Command) 34_When damper is closed, Damper LSW DI is activated 35_Activates Shutdown. When inactive, VFD operates normally 36_Activates Shutdown. Requires reset to operate normally 37_Detects water or air flow by Flow Switch 40_Aux Motor-1 in MMC mode is off sequence 41_Aux Motor-2 in MMC mode is off sequence 42_Aux Motor-3 in MMC mode is off sequence 43_Aux Motor-4 in MMC mode is off sequence 44_Aux Motor-5 in MMC mode is off sequence 45_Aux Motor-6 in MMC mode is off sequence 46_Aux Motor-7 in MMC mode is off sequence 47_All Aux Motors in MMC mode are off sequence
Option-01	1793		M11 Define	See [Option-00]	Defines functionality of input MI11 on I/O extension card.
Option-02	1794		M12 Define	See [Option-00]	Defines functionality of input MI12 on I/O extension card.
Option-03	1795		M13 Define	See [Option-00]	Defines functionality of input MI13 on I/O extension card.
Option-04	1796		M14 Define	See [Option-00]	Defines functionality of input MI14 on I/O extension card.
Option-05	1797		M15 Define	See [Option-00]	Defines functionality of input MI15 on I/O extension card.

CODE	Mod Bus	AR	Display Name	Range	Description
Option-06	1798		Relay exp. RA100	0_No Function 1_Run 2_FDT-1 3_FDT-2 4_FDT-3 5_FDT-4 6_FDT-5 7_Drive Ready 8_Fault 9_VFD Overheat 11_PID F/B Loss 12_Counter Done 13_Pre-Count Done 14_Alarm 15_FWD CMD 16_REV CMD 17_Analog Trigger 19_Overcurrent 2 22_Fireman O-ride 23_Bypass 24_Motor-1 Out 25_Motor-2 Out 26_Motor-3 Out 27_Motor-4 Out 28_Motor-5 Out 29_Motor-6 Out 30_Motor-7 Out 38_Damper Output 41_Lube/S Clean 42_ACI Loss 44_Hand Mode 45_Auto Mode 47_MMC Out	RA1 Default = Fault 1_During Run Mode 2_When frequency reference value is achieved 3_On above [IO-52] freq and Off below [IO-52]-[IO-53] freq 4_On above [IO-54] freq and Off below [IO-54]+[IO-55] freq 5_On up to FDT-4/5 freq 6_On above FDT-4/5 freq 7_When drive is powered and ready (no faults) 8_When drive has tripped on any fault 9_When VFD temperature reaches trip level 11_When PID feedback source signal value is abnormal 12_When pulse counter achieves the counter set-value 13_When pulse counter achieves pre-count value 14_When alarm is triggered by any alarm condition 15_When VFD operates in Forward direction 16_When VFD operates in Reverse direction 17_When analog signal reaches a trigger level 19_When VFD trips on Overcurrent 2 22_When Fireman's Override mode is activated 23_When drive switches from Soft-Start mode to Bypass 24_When Motor-1 is enabled in MMC control 25_When Motor-2 is enabled in MMC control 26_When Motor-3 is enabled in MMC control 27_When Motor-4 is enabled in MMC control 28_When Motor-5 is enabled in MMC control 29_When Motor-6 is enabled in MMC control 30_When Motor-7 is enabled in MMC control 38_When Damper motor output is activated 41_When Lube or Screen Clean solenoid output is activated 42_When ACI analog input signal value is abnormal 44_When VFD control is in Hand mode 45_When VFD control is in Auto mode 47_Aux motor start output in MMC control
Option-07	1799		Relay exp. RA11	See [Option-06]	Defines functionality of output relay RA11 on I/O extension card.
Option-08	1800		Relay exp. RA12	See [Option-06]	Defines functionality of output relay RA12 on I/O extension card.
Option-09	1801		Relay exp. RA13	See [Option-06]	Defines functionality of output relay RA13 on I/O extension card.
Option-10	1802		Relay exp. RA14	See [Option-06]	Defines functionality of output relay RA14 on I/O extension card.
Option-11	1803		Relay exp. RA15	See [Option-06]	Defines functionality of output relay RA15 on I/O extension card.
Option-12	1804		Relay exp. RA16	See [Option-06]	Defines functionality of output relay RA16 on I/O extension card.
Option-13	1805		Relay exp. RA17	See [Option-06]	Defines functionality of output relay RA17 on I/O extension card.
Option-14	1806		Relay exp. RA18	See [Option-06]	Defines functionality of output relay RA18 on I/O extension card.
Option-15	1807		Relay exp. RA19	See [Option-06]	Defines functionality of output relay RA19 on I/O extension card.
Option-16	1808		Relay exp. RA20	See [Option-06]	Defines functionality of output relay RA20 on I/O extension card.
Option-17	1809		IO Card Type	No Definition EMC-BPS01 No Definition No Definition EMC-D611A EMC-D42A EMC-R6AA No Definition	Defines I/O card type.

Parameter Descriptions > ADV2 Menu

AR = Adjustable while running.

CODE	Mod Bus	AR	Display Name	Range	Description
ADV2-00	2048	N	PID D-Gain	0 to 1 sec	Differential gain value for PID operation.
ADV2-01	2049	Y	Sleep Ctrl By	0_PID Output 1_PID F/B	When set to Output, units become Hz. When set to Feedback, units become %.
ADV2-03	2051	Y	Mtr Brake Delay	0.0 to 65 Sec	Delay after start command when the corresponding multi-function output terminal (10: DC Brake) will be OFF.
ADV2-04	2052	Y	AFM1 Rev Value	0_0-10 V 1_0 V 2_5-0 V	0_0-10V: AFM1 output is 0-10V when in REV. 1_0V: AFM1 output is 0V when in REV, 0-10V in FWD direction. 2_5-0V: AFM1 output is 5-0V when in REV, 5-10V in FWD direction.
ADV2-05	2053	Y	AFM2 Rev Value	0_0-10 V 1_0 V 2_5-0 V	0_0-10V: AFM2 output is 0-10V when in REV. 1_0V: AFM2 output is 0V when in REV, 0-10V in FWD direction. 2_5-0V: AFM2output is 5-0V when in REV, 5-10V in FWD direction.
ADV2-06	2054	Y	AFM1 DC Lvl	0 to 100%	Used with Multi-Function Output IO-59 set to 2:Output voltage. Output emits constant voltage 0 to 100% corresponding to 0-10V.
ADV2-07	2055	Y	AFM2 DC Lvl	0 to 100%	Used with Multi-Function Output IO-61 set to 2:Output voltage. Output emits constant voltage 0 to 100% corresponding to 0-10V.
ADV2-08	2056	Y	Analog Curve	0_Regular Curve 1_AVI1 3-Point 2_ACI 3-Point 3_AVI1+ACI 3 Point 4_AVI2 3 Point 5_AVI1+AVI2 3 Point 6_ACI+AVI2 3 Point 7_3x AIs 3-Point	The analog input signal can be setup for linear curve or 3-point (piece-wise) curve corresponding voltage/current input to frequency output. If using AVI1, ADV2-09 < ADV2-11 < ADV2-13. If using ACI, ADV2-15 < ADV2-17 < ADV2-19. If using AVI2, ADV2-21 < ADV2-23 < ADV2-25. If analog input is not selected, the analog input uses bias and gain to set the linear curve. The output frequency will become 0% when the analog input value is lower than low point setting.
ADV2-09	2057	Y	AVI1 Low Value	(Variable)	Lowest analog input value for AVI1 that corresponds to frequency output of ADV2-10.
ADV2-10	2058	Y	AVI1 Low %	-100 to 100%	Frequency output corresponding to ADV2-09 input.
ADV2-11	2059	Y	AVI1 Mid Value	(Variable)	Middle analog input value for AVI1 that corresponds to frequency output of ADV2-12.
ADV2-12	2060	Y	AVI1 Mid %	-100 to 100%	Frequency output corresponding to ADV2-11 input.
ADV2-13	2061	Y	AVI1 High Value	(Variable)	Highest analog input value for AVI1 that corresponds to frequency output of ADV2-14.
ADV2-14	2062	Y	AVI1 High %	-100 to 100%	Frequency output corresponding to ADV2-13.
ADV2-15	2063	Y	ACI Low Value	(Variable)	Lowest analog input value for ACI that corresponds to frequency output of ADV2-16.
ADV2-16	2064	Y	ACI Low %	-100 to 100%	Frequency output corresponding to ADV2-15 input.
ADV2-17	2065	Y	ACI Mid Value	(Variable)	Middle analog input value for ACI that corresponds to frequency output of ADV2-18.
ADV2-18	2066	Y	ACI Mid %	-100 to 100%	Frequency output corresponding to ADV2-17 input.
ADV2-19	2067	Y	ACI High Value	(Variable)	Highest analog input value for ACI that corresponds to frequency output of ADV2-20.
ADV2-20	2068	Y	ACI High %	-100 to 100%	Frequency output corresponding to ADV2-19.
ADV2-21	2069	Y	AVI2 Low Value	0 to 10 V	Lowest analog input value for AVI2 that corresponds to frequency output of ADV2-22.
ADV2-22	2070	Y	AVI2 Low %	-100 to 100%	Frequency output corresponding to ADV2-21 input.
ADV2-23	2071	Y	AVI2 Mid Value	0 to 10 V	Middle analog input value for AVI2 that corresponds to frequency output of ADV2-24.
ADV2-24	2072	Y	AVI2 Mid %	-100 to 100%	Frequency output corresponding to ADV2-23 input.
ADV2-25	2073	Y	AVI2 High Value	0 to 10 V	Highest analog input value for AVI2 that corresponds to frequency output of ADV2-26.
ADV2-26	2074	Y	AVI2 High %	-100 to 100%	Frequency output corresponding to ADV2-25.

CODE	Mod Bus	AR	Display Name	Range	Description
ADV2-27	2075	Y	dEb Offset V	0 to 200 V	Decel Energy Backup Error (dEb) Offset Voltage that the DC Bus reduces by to initiate dEb operation. Varies by VFD Rating.
ADV2-28	2076	Y	dEb Mode Select	0_Disable 1_Auto Dec/Stop 2_AutoDec/Restart	Select Decel Energy Backup Error (dEb) operation when DC Bus voltage drops by ADV2-27. This feature is used to detect power loss.
ADV2-30	2078	Y	PID Mode Select	0_Serial PID 1_Parallel PID	0_Serial: VFD uses conventional PID control structure. 1_Parallel: Proportional, Integral, and Derivative gains are independent.
ADV2-31	2079	N	PID Unit Format	0_1 1_0.1 2_0.01	Select precision of PID operation.
ADV2-32	2080	N	PID Ref Source	0_Keypad 1_AVI1 Analog 2_ACI Analog 3_AVI2 Analog 4_RS485	Select source of PID setpoint.
ADV2-52	2100	Y	LD Set Point	SET-19 to (variable)	Adjustable setting for Low Demand pressure set-point from 0 to [Set-20 F/B Max]x 0.95. It can be adjusted to lower or higher than HD (Main) pressure set-point value to provide desired pressure and prevent overpressure trip at pump start in Low Demand situation.
ADV2-53	2101	Y	LD Max Freq	SET-23 to SET-22	PID High Frequency Limit setting for Low Demand. Adjust to lower frequency setting to prevent overpressure trips during run but enough to maintain pressure at LD Set-point.

Parameter Descriptions > Motor Menu

AR = Adjustable while running.

CODE	Mod Bus	AR	Display Name	Range	Description
Motor-00	2304	N	Motor A-Tuning	0_None 1_IM Rotating 2_IM No-Rotation 3_SPM No-Rotation 4_IPM No-Rotation	Performs a motor test to measure the motor characteristics. Select motor type Induction Motor (IM) or Permanent Magnet (PM) motor and if the motor is allowed to rotate during autotune operation.
Motor-01	2305	N	Motor Rs Value	0.0 to 65.535 Ohm	Induction Motor rotor resistance
Motor-02	2306	N	Motor Rr Value	0.0 to 65.535 Ohm	Induction Motor stator resistance
Motor-03	2307	N	Motor Lm Value	0.0 to 6553.5 mH	Induction Motor rotor inductance
Motor-04	2308	N	Motor Lx Value	0.0 to 6553.5 mH	Induction Motor stator inductance
Motor-05	2309	N	Control Method	0_VF 1_____ 2_Sensorless	Determines the control method of the motor as either a volts to frequency relationship (Induction Motor) or Sensorless Vector Control (SVC) (Permanent Magnet).
Motor-06	2310	N	Motor Type	0_Induction Motor 1_PM-SPM 2_PM-IPM	Identifies the type of motor being used. PM-SPM: Surface Permanent Magnet Motor PM-IPM: Internal Permanent Magnet Motor
Motor-07	2311	N	PM Poles	0 to 65535	Identifies the number of poles in Permanent Magnet Motor.
Motor-08	2312	N	PM Inertia	0.0 to 6553.5 Kg*m^2	Identifies the inertia in Permanent Magnet Motor. This value is automatically calculated.
Motor-09	2313	N	PM Rs	0.0 to 65.535 Ohm	Permanent Magnet Motor stator resistance.
Motor-10	2314	N	PM Ld	0.0 to 655.35 mH	Permanent Magnet Motor inductance d-axis.
Motor-11	2315	N	PM Lq	0.0 to 655.35 mH	Permanent Magnet Motor inductance q-axis.
Motor-12	2316	Y	PM PG Angle	0 to 360 degree	Permanent Magnet Motor offset angle.
Motor-13	2317	Y	PM Ke Coeff	0 to 65535	Coefficient for optimal PM motor control
Motor-14	2318	Y	Rotor Zeroing	0_Disabled 1_1/4 FLA Current 2_Hi Freq Inject 3_Pulse Inject	Permanent Magnet Motor rotor initial angle position detection method. Recommendation: "2" for IPM; "3" for SPM. If there is a bad effect, then set as "1".

CODE	Mod Bus	AR	Display Name	Range	Description
Motor-15	2319	Y	Torque Filter T	0.001 to 10 Sec	Response time in controlling torque to motor.
Motor-16	2320	Y	Slip Filter T	0.001 to 10 Sec	Response time in controlling slip compensation.
Motor-17	2321	Y	Torque Cmp Gain	0 to 10*	Gain value for output voltage increase to compensate for voltage drop on stator resistance at high motor loads in torque compensation function. For PM motors max value is 5000.
Motor-18	2322	Y	Slip Cmp Gain	0 to 10	Gain value for output frequency increase to provide slip compensation at high motor loads
Motor-19	2323	Y	Slip Dev Level	0 to 100%	Slip percentage level to cause over slip trip. Setting of 0 is No Detection.
Motor-20	2324	Y	Slip Dev Det T	0 to 10 Sec	Duration slip percentage has to be at before causing over slip trip.
Motor-21	2325	Y	Over Slip Trip	0_Alarm and Run 1_Alarm and Decel 2_Alarm and Coast 3_Disabled	Operation when over slip trip occurs.
Motor-22	2326	Y	Motor Hunt Gain	0 to 10000	Gain value in detecting shaft speed of a synchronous motor. A sudden load change can cause shaft speed to fluctuate.
Motor-23	2327	Y	Auto restart	0 to 6000 sec	If the number of internal faults defined by [Prot-41] occurs within this duration, then an auto restart of the VFD will occur.
Motor-24	2328	Y	I/F Current	0 to 150%	Percentage of nominal motor current [SET-03] used to regulate AC output current during I/F control and DC current during PM DC Alignment.
Motor-25	2329	Y	PM Bandwidth HS	0 to 600 Hz	Allowable frequency bandwidth around desired frequency in order to adjust operating frequency to prevent vibrations in motor operation.
Motor-26	2330	Y	PMSVC Fltr Gain	0 to 655.35 Sec	Gain value in adjusting the operating frequency from the desired frequency to prevent vibrations in motor operation.
Motor-27	2331	Y	Freq I/F to PM	0 to 599 Hz	When increasing frequency, the frequency to switch modes from I/F mode to PMSVC mode.
Motor-28	2332	Y	Freq PM to I/F	0 to 599 Hz	When decreasing frequency, the frequency to switch modes from PMSVC mode to I/F mode.
Motor-29	2333	Y	I/F fltr time	0 to 6 Sec	Low-pass filter time of current being commanded from I/F Current [Motor-24].
Motor-30	2334	Y	Angle Det Pulse	0 to 3	Value is a multiplier of nominal motor current which is magnitude of pulse during the angle detection. This is only used when Rotor Zeroing [Motor-14] is set to 2 or 3.
Motor-31	2335	Y	Zero voltage T	0 to 60 Sec	Duration the output is 0V to establish a static startup. Once the system is at a static startup. The VFD can accurately estimate angles. This parameter is applicable when SS Normal Start [Prot-42] is not set to 0.
Motor-32	2336	Y	Injection Freq	0 to 1200 Hz	Frequency used to determine angle of motor during High Frequency Injection. Injection Frequency should be at least 100Hz larger than motor's nominal frequency. Carrier frequency should be 10 times larger than Injection Frequency.
Motor-33	2337	Y	Injection V	0 to 200 V	Voltage used to determine angle of motor during High Frequency Injection.
Motor-34	2338	N	Run Time Min	0 to 1439 min	Minutes of the motor run time. Less than 60 seconds is not recorded.
Motor-35	2339	N	Run Time Days	0 to 65535 day	Days of the motor run time.
Motor-36	2340	N	Motor PF	0 to 1	Power Factor value from motor nameplate
Motor-37	2341	N	PM Trq Comp I/F	0 to 5000	PM Torque Compensation in I/F Mode
Motor-38	2342	N	PM Trq Comp SVC	0 to 5000	PM Torque Compensation in SVC Mode
Motor-39	2343	N	DC-Tun Curr P	0 to 65535	Gain value regulating DC current during DC Alignment of PM motor.
Motor-40	2344	N	DC-Tun Curr I	0 to 65535	Integral gain regulating DC current during DC Alignment of PM motor.

SPECIFICATIONS

Common Specifications

Cooling Method			Forced air cooling by internal fans
Short Circuit Rating			The drive is suitable for use on a circuit capable of delivering not more than 100,000 symmetrical amperes (rms) when protected by suitable Class J fuses.
Agency Approvals			UL and cUL listed, CE, marked.
CONTROL	Control Method		Pulse Width Modulation (PWM) with V/F and SVC (Sensorless Vector Control) for IM and PM motors.
	Frequency Setting Resolution		Digital Reference: 0.01 Hz (Below 100 Hz), 0.1 Hz (Over 100 Hz) Analog Reference: [Max. output frequency] x 0.03/60Hz (±11 bit)
	Frequency Accuracy		Digital: ± 0.01 % of Max. Output Frequency. Analog: ± 0.1 % of Max. Output Frequency.
	V/F Control Curve		12 preset V/F curves and four-point square curve
	Overload Capacity		Variable Torque: 120% of VFD rated current for 1 minute during every 5 minutes of operation. Constant Torque: 150% of VFD rated current for 1 minute during every 5 minutes of operation and 160% for 3 seconds during every 25 seconds of operation.
	Starting Torque		Up to 150% or higher at 0.5Hz (Torque Accuracy ±5%).
	Torque Limit (Stall level)		Variable Torque: Max. 130% torque current; Constant Torque: Max. 160% torque current
OPERATION	Operation Method		Keypad / Terminals / RS-485 BACnet or Modbus Communication / Optional Modbus TCP/IP & Ethernet IP.
	Frequency Setting		Two Analog Inputs 0- 10VDC/ 4- 20mA and One AI 0-10VDC. Digital input: Keypad or Communication
	Inputs	Start Signal	Forward, Reverse and Jog (some features can start and stop VFD based on analog signal).
		Digital Inputs	8 programmable digital inputs can be set to any selection from long list of functions.
		Multi-Step	Up to 17 Speeds can be set including Jog by Programmable Digital Inputs.
		Accel/Decel Time and Presets	0.00- 600.00/0.0- 6000.0 seconds. Three ACC/DEC preset values switched by digital inputs or one by frequency. Additional adjustable Accel/Decel S-Curve pattern.
		Emergency Stop	Ext. Trip and Shutdown immediately interrupt VFD output in any control method.
		Jog	Jog Operation with adjustable Jog frequency
		Fault Reset	Resets VFD via keypad, digital input, or communication. Some critical faults must be reset by recycling power.
		Safety Inputs	SCM and STO terminals for safety circuit wiring.
	Outputs	Three Multi-Function Relays	One relay with Form C: 250VAC 3A/30VDC, 3A (resistive) 1.2A (inductive) contact; Two relays with Form A: 250VAC 1.2A/30VDC 3A (resistive) 1.2A (inductive). Each relay can be programmed to any selection from the functions list.
		Two Analog Outputs	Selections: Output Frequency, Output Current, Output Voltage, Output kW, DC Link Voltage, AVI1, ACI, AVI2 AI signal level. Both outputs are 0-10VDC scalable from 10 to 200%.
	General Operation Functions		DC Braking, Frequency Limit, Jump Frequencies, 2nd ACC/DEC, Auto Restart, Auto-Tuning, PID w/sleep, Flying Start, Speed Search, DC Braking, Slip Compensation, Motor Pre-heat, Temperature Foldback, Damper Control, Fireman's Override, Shutdown, Power-on Delay, Run Delay, Minimum Run Timer, PM Motor and MagForce Control and Auto-Tuning
	Pump Operation Functions		Sleep Mode with Pressure Boost, Pipe Fill, PID, Overpressure, ULD (Underload), HLD (High Load), Broken Pipe, Backspin Timer, MMC, Lubrication, Screen Clean, No-Flow Protection, Pump Prime Time
PROTECTION	VFD Fault Trips		Over Voltage, Low Voltage, Over Current, Overload, Short Circuit, Ground Fault, VFD Overheat, Input Phase Loss, Output Phase Open, CPU Communication Error, Signal Loss, Hardware Fault, etc.
	VFD Alarm		Stall Prevention at ACC and DEC, Overload, Thermal Sensor Fault, Capacitors High Temperature, Signal Loss, Overpressure, Underload, High Load, etc.
	Overcurrent		200/208/230/460VAC Variable Torque: At 200% of VFD rated current 200/208/230/460VAC Constant Torque: At 240% of VFD rated current Current clamp: Variable Torque: 130- 135%, Constant Torque 170- 175% 575VAC models: At 225% VFD rated current Current clamp: Variable Torque: 128- 141%, Constant Torque: 170- 175%
	Overvoltage		230VAC models: At 410VDC DC bus voltage 460VAC models: At 820VDC DC bus voltage 575VAC models: At 1016VDC DC bus voltage
	Fault History		Keypad provides 6 fault records. VFD logs 30 faults.
ENVIRONMENT	Operating Temperature		NEMA 1: 14°F ~ 104°F (-10°C ~ 40°C), Open Type: 14°F ~ 122°F (-10°C ~ 50°C)
	Storage Temperature		-13°F ~ 158°F (-25°C ~ 70°C)
	Ambient Humidity		Up to 95% RH. (Non-Condensing)
	Altitude		Normal up to 3,300ft (1,000m). At altitude up to 2,000 m, de-rate by 1% of rated current or lower 0.5 ºC of temperature for every 100m above 1,000m. Maximum altitude for Corner Grounded TN system is 2,000m. For application over 2,000m, please contact Technical Support.
	Vibration and Impact		1mm peak to peak value from 2Hz to 13.2Hz; 0.7G- 1.0G from 13.2Hz to 55Hz; 1.0G from 55Hz to 512Hz. Comply with IEC 60068-2-6 and IEC/EN60068-2-27.
	Environmental Conditions		Pollution degree 2. No Corrosive Gas, Combustible Gas, Oil Mist or Dust. IEC60721-3-3/ IEC60364-1/ IEC60664-1.

200~230V Class 1~125HP (0.75~90kW)

Model (CXD-xxx-2V) UL Type 1[1]		005A	007A	010A	015A	021A	031A	046A	061A	075A	090A	105A	146A	180A	215A	276A	322A
Frame Size		A					B			C			D		E		
Input Ratings	Voltage	200 (-15%) to 240 VAC (+10 %)															
	Frequency	50/60 Hz (± 5 %)															
Output Ratings	Max Carrier Freq	2-15kHz													2-9kHz		
	Voltage [2]	200 ~ 240 VAC [2]															
	Frequency	0.01 ~ 599 Hz													0.01 ~ 400 Hz		
Efficiency		98 %															
Power Factor		>0.98															
Weight kg (lbs.)		2.6 ± 0.3 (5.8 ± 0.7)					5.4 ± 1 (11.9 ± 2.2)			9.8 ± 1.5 (21.6 ± 3.3)			38.5 ± 1.5 (84.9 ± 3.3)		64.8 ± 1.5 (142.9 ± 3.3)		
DC Choke		None											Built-in 3%				
VFD Ratings with 3-Phase Input Power																	
Variable Torque Motor[3] Ratings	Max Amps	5	7.5	10	15	21	31	46	61	75	90	105	146	180	215	276	322
	Capacity [kVA]	2	3	4	6	8.4	12	18	24	30	36	42	58	72	86	110	128
	Max HP @ 200 V Surface Motor	1	1.5	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100
	Max HP @ 208 V Surface Motor	1	1.5	2	3	5	7.5	10	20	25	30	30	50	60	75	100	100
	Max HP @ 230 V Surface Motor	1	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100	125
	Max HP @ 200 V 4" Submersible	.75	1.5	2	3	5	7.5	–	–	–	–	–	–	–	–	–	–
	Max HP @ 230 V 4" Submersible	1	1.5	2	3	5	7.5	–	–	–	–	–	–	–	–	–	–
	Max HP @ 200 V 6" Submersible	–	–	–	–	5	7.5	10	15	20	25	30	40	40	60	–	–
	Max HP @ 230 V 6" Submersible	–	–	–	–	5	7.5	10	20	20	25	30	40	50	60	–	–
Constant Torque Motor[3] Ratings	Max Amps	3	5	8	11	17	25	33	49	65	75	90	120	146	180	216	255
	Capacity [kVA]	1.2	2	3.2	4.4	6.8	10	13	20	26	30	36	48	58	72	86	20
	Max HP @ 200 V	.5	1	2	3	3	5	10	15	20	20	25	40	50	60	60	75
	Max HP @ 230 V	.5	1	2	3	5	8	10	15	20	25	30	40	50	60	75	100
VFD Ratings with 1-Phase Input Power																	
Variable Torque Motor Ratings	Max Amps	2.5	3.75	5	7.5	10.5	15.5	23	30.5	37.5	45	52.5	48.1	59.4	70.9	91	106.2
	Max HP @ 200 V Surface Motor	.5	.75	1	1	2	3	5	7.5	10	10	15	10	15	20	25	30
	Max HP @ 208 V Surface Motor	.5	.75	1	2	2	3	5	7.5	10	10	15	15	20	25	30	30
	Max HP @ 230 V Surface Motor	.5	.75	1	2	3	5	7.5	10	10	15	15	10	20	25	30	40
	Max HP @ 200 V 4" Submersible	–	.5	.5	1.5	2	3	5	7.5	–	–	–	–	–	–	–	–
	Max HP @ 230 V 4" Submersible	–	.5	1	1.5	2	3	5	7.5	–	–	–	–	–	–	–	–
	Max HP @ 200 V 6" Submersible	–	–	–	–	–	–	5	7.5	10	10	10	10	15	20	25	30
	Max HP @ 230 V 6" Submersible	–	–	–	–	–	–	5	7.5	10	10	15	15	20	20	25	33
Constant Torque Motor Ratings	Max Amps	2.5	2.5	4	5.5	8.8	12.5	16.5	24.5	32.5	37.5	45	39.6	48.2	59.4	71	84.2
	Max HP @ 200 V	.5	.5	.75	1	2	3	3	5	10	10	10	10	10	15	20	25
	Max HP @ 230 V	.5	.5	.75	1	2	3	5	7.5	10	10	15	10	15	20	25	30

1 UL Open Type VFD with installed UL Type 1 kit.

2 The VFD cannot produce output voltage greater than input voltage.

3 Variable torque (VT) motor rating based on a 120% overload for 1 minute. Constant Torque (CT) motor rating based on 120% overload for 1 minute and 160% overload for 3 seconds.

460V Class 1~75HP (5.5~55kW)

Model (CXD-xxx-4V) UL Type 1[1]		003A	004A	005A	008A	010A	013A	018A	024A	032A	038A	045A	060A	073A	091A	110A
Frame Size		A							B			C			D0	
Input Ratings	Voltage	380 (-15%) ~ 480 VAC (+10 %)														
	Frequency	50/60 Hz (± 5 %)														
Output Ratings	Max Carrier Freq	2-15kHz										2-10kHz				
	Voltage [2]	3ϕ 380 ~ 480 VAC [3]														
	Frequency	0.01 ~ 599 Hz														
Efficiency		98 %														
Power Factor		>0.98														
Weight kg (lbs.)		2.6 ± 0.3 (5.8 ± 0.7)							5.4 ± 1 (11.9 ± 2.2)			9.8 ± 1.5 (21.6 ± 3.3)			27 ± 1 (59.5 ± 2.2)	
DC Choke		None													Built-in 3%	
VFD Ratings with 3-Phase Input Power																
Variable Torque Motor[3] Ratings	Max Amps	3	4.2	5.5	8.5	10.5	13	18	24	32	38	45	60	73	91	110
	Capacity [kVA]	2.4	3.3	4.4	6.8	8.4	10.4	14.3	19	25	30	36	48	58	73	88
	Max HP @ 460 V Surface Motor	1.5	2	3	5	5	7.5	10	15	20	25	30	40	50	60	75
	Max HP @ 460 V 4" Submersible	1	2	3	5	5	5	10	10	15	–	–	–	–	–	–
	Max HP @ 460 V 6" Submersible	–	–	–	–	5	7.5	10	15	20	20	25	30	40	50	60
	Max HP @ 460 V 8" Submersible	–	–	–	–	–	–	–	–	–	–	–	40	50	60	75
Constant Torque Motor[3] Ratings	Max Amps	1.7	3	4	6	9	10.5	12	18	24	32	38	45	60	73	91
	Capacity [kVA]	2.2	2.4	3.2	4.8	7.2	8.4	10.4	14.3	19	25	30	36	48	58	73
	Max HP @ 460 V	.75	1.5	2	3	5	5	7.5	10	15	20	25	30	40	50	60
VFD Ratings with 1-Phase Input Power																
Variable Torque Motor Ratings	Max Amps	1.5	2.1	2.75	4.25	5.25	6.5	9	12	16	19	22.5	30	36.5	30	36.3
	Max HP @ 460 V Surface Motor	.5	1	1	2	3	3	5	7.5	10	10	15	20	25	20	25
	Max HP @ 460 V 4" Submersible	.5	.5	1	2	2	3	5	5	7.5	10	10	15	–	–	–
	Max HP @ 460 V 6" Submersible	–	–	–	–	–	–	5	5	7.5	10	10	15	20	15	20
	Max HP @ 460 V 8" Submersible	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Constant Torque Motor Ratings	Max Amps	1.5	1.5	2	3	4.5	5.3	6	9	12	16	19	22.5	30	27	33
	Max HP @ 460 V	.5	.5	.75	1.5	2	3	3	5	7.5	10	10	15	20	20	20

1 UL Open Type VFD with installed UL Type 1 kit.

2 The VFD cannot produce output voltage greater than input voltage.

3 Variable torque (VT) motor rating based on a 120% overload for 1 minute. Constant Torque (CT) motor rating based on 120% overload for 1 minute and 160% overload for 3 seconds.

460V Class 100~675HP (75~500kW)

Model (CXD-xxx-4V) UL Type 1[1]		150A	180A	220A	260A	310A	370A	460A	530A	616A	683A	770A	930A
Frame Size		D		E		F		G		H			
Input Ratings	Voltage	380 (-15%) ~ 480 VAC (+10 %)											
	Frequency	50/60 Hz (± 5 %)											
Output Ratings	Max Carrier Freq	2-10kHz	2-9kHz										
	Voltage [2]	380 ~ 480 VAC [3]											
	Frequency	0.01 ~ 599 Hz											
Efficiency		98 %											
Power Factor		>0.98											
Weight kg (lbs.)		38.5 ± 1.5 (84.9 ± 3.3)		64.8 ± 1.5 (142.9 ± 3.3)		86.5 ± 1.5 (190.7 ± 3.3)		134 ± 4 (295.4 ± 8.9)		228 (635)			
DC Choke		Built-in 3%											
VFD Ratings with 3-Phase Input Power													
Variable Torque Motor[3] Ratings	Max Amps	150	180	220	260	310	370	460	530	616	683	770	930
	Capacity [kVA]	120	143	175	207	247	295	367	422	491	544	613	773
	Max HP @ 460 V Surface Motor	100	150	150	200	250	300	350	450	500	550	600	700
	Max HP @ 460 V 4" Submersible	–	–	–	–	–	–	–	–	–	–	–	–
	Max HP @ 460 V 6" Submersible	–	–	–	–	–	–	–	–	–	–	–	–
	Max HP @ 460 V 8" Submersible	100	100	150	175	200	–	–	–	–	–	–	–
Constant Torque Motor[3] Ratings	Max Amps	110	150	180	220	260	310	370	460	550	616	683	866
	Capacity [kVA]	88	120	143	175	207	247	295	367	438	491	544	720
	Max HP @ 460 V	75	100	150	150	200	250	300	350	450	500	550	600
VFD Ratings with 1-Phase Input Power													
Variable Torque Motor Ratings	Max Amps	49.5	59.4	72.6	85.8	102.3	122.1	151.8	174.9	203.28	225.39	254.1	306.9
	Max HP @ 460 V Surface Motor	30	40	50	60	75	75	100	125	150	150	200	250
	Max HP @ 460 V 4" Submersible	–	–	–	–	–	–	–	–	–	–	–	–
	Max HP @ 460 V 6" Submersible	30	40	40	50	60	–	–	–	–	–	–	–
	Max HP @ 460 V 8" Submersible	–	–	40	50	60	75	100	125	125	150	175	200
Constant Torque Motor Ratings	Max Amps	40	55	65	80	91	109	130	161	193	216	240	285.7
	Max HP @ 460 V	30	40	50	60	60	75	100	125	150	150	200	200

1 UL Open Type VFD with installed UL Type 1 kit.

2 The VFD cannot produce output voltage greater than input voltage.

3 Variable torque (VT) motor rating based on a 120% overload for 1 minute. Constant Torque (CT) motor rating based on 120% overload for 1 minute and 160% overload for 3 seconds.

575~690V Class 1~150HP (1.5~175kW)

Model (CXD-xxx-6V) UL Type 1[1]		003A	004A	006A	009A	012A	018A	024A	030A	036A	045A	054A	067A	086A	104A	125A	150A
Frame Size		A			B				C			D		E			
Input Ratings	Voltage	525 (-15%) ~ 600 VAC (+10 %)															
	Frequency	50/60 Hz (± 5 %)															
Output Ratings	Max Carrier Freq	2-15kHz							2-9kHz								
	Voltage [2]	525 ~ 600 VAC [2]															
	Frequency	0.01 ~ 599 Hz															
Efficiency		97 %			98 %				97 %								
Power Factor		>0.98															
Weight kg (lbs.)		3 ± 0.3 (6.6 ± 0.7)			4.8 ± 1 (10.6 ± 2.2)				10 ± 1.5 (22 ± 3.3)			39 ± 1.5 (86 ± 3.3)		61 ± 1.5 (134.5 ± 3.3)			
DC Choke		None										Built-in 3%					
VFD Ratings with 3-Phase Input Power																	
Variable Torque Motor[3] Ratings	Max Amps	3	4.3	6.7	9.9	12.1	18.7	24.2	30	36	45	54	67	86	104	125	150
	Capacity [kVA]	3	4.3	6.7	9.9	12.1	18.6	24.1	36	43	54	65	80	103	124	149	179
	Max HP @ 575V Surface Motor	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100	125	150
	Max HP @ 575 V 4" Submersible	1.5	2	3	5	7.5	10	15	–	–	–	–	–	–	–	–	–
	Max HP @ 575 V 6" Submersible	–	–	–	7.5	7.5	10	20	25	25	30	40	50	60	–	–	–
	Max HP @ 575 V 8" Submersible	–	–	–	–	–	–	–	–	–	–	40	50	75	75	100	100
Constant Torque Motor[3] Ratings	Max Amps	2.5	3.6	5.5	8.2	10	15.5	20	24	30	36	45	54	67	86	104	125
	Capacity [kVA]	2.5	3.6	5.5	8.2	10	15.4	19.9	29	36	43	54	65	80	103	124	149
	Max HP @ 575 V	1.5	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100	125
VFD Ratings with 1-Phase Input Power																	
Variable Torque Motor Ratings	Max Amps	1.5	2.15	3.35	4.95	6.05	9.35	12.1	15	18	22.5	17.82	22.11	28.3	–	–	–
	Max HP @ 575V Surface Motor	.75	1	2	3	3	7.5	10	10	15	20	15	20	25	–	–	–
	Max HP @ 575 V 4" Submersible	.5	1	2	3	3	5	7.5	10	10	15	–	–	–	–	–	–
	Max HP @ 575 V 6" Submersible	–	–	–	–	–	5	7.5	10	10	15	10	15	20	–	–	–
	Max HP @ 575 V 8" Submersible	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Constant Torque Motor Ratings	Max Amps	1.25	1.8	2.75	4.1	5	7.7	9.95	10	12	15	18	14.8	17.8	22.1	–	–
	Max HP @ 575 V	.5	1	2	3	3	5	7.7	7.5	10	10	15	10	15	20	–	–

1 UL Open Type VFD with installed UL Type 1 kit.

2 The VFD cannot produce output voltage greater than input voltage.

3 Variable torque (VT) motor rating based on a 120% overload for 1 minute. Constant Torque (CT) motor rating based on 120% overload for 1 minute and 160% overload for 3 seconds.

575~690V Class 150~700HP (160~522kW)

Model (CXD-xxx-6V) UL Type 1[1]		180A	220A	290A	350A	430A	465A	590A	675A
Frame Size		**F**		**G**		**H**			
Input Ratings	Voltage	525 (-15%) ~ 690 VAC (+10 %)							
	Frequency	50/60 Hz (± 5 %)							
Output Ratings	Max Carrier Freq	2-9kHz							
	Voltage [2]	525 ~ 690 VAC [2]							
	Frequency	0.01 ~ 599 Hz							
Efficiency		97 %	98 %						
Power Factor		>0.98							
Weight kg (lbs.)		88± 1.5 (194± 3.3)		135 ± 4 (297.6 ± 8.8)		243 ± 5 (535.7 ± 11)			
DC Choke		Built-in 3%							
VFD Ratings with 3-Phase Input Power									
Variable Torque Motor[3] Ratings	Max Amps	180	220	290	350	430	465	590	675
	Capacity [kVA]	215	263	347	418	494.5	534.7	678.5	776
	Max HP @ 575V Surface Motor	150	200	300	350	450	450	600	700
	Max HP @ 575 V 8" Submersible	125	175	200	–	–	–	–	–
Constant Torque Motor[3] Ratings	Max Amps	150	180	220	290	350	430	465	590
	Capacity [kVA]	179	215	239	347	402.5	442.7	534.7	776
	Max HP @ 575 V	150	150	200	300	350	450	450	600

1 UL Open Type VFD with installed UL Type 1 kit.

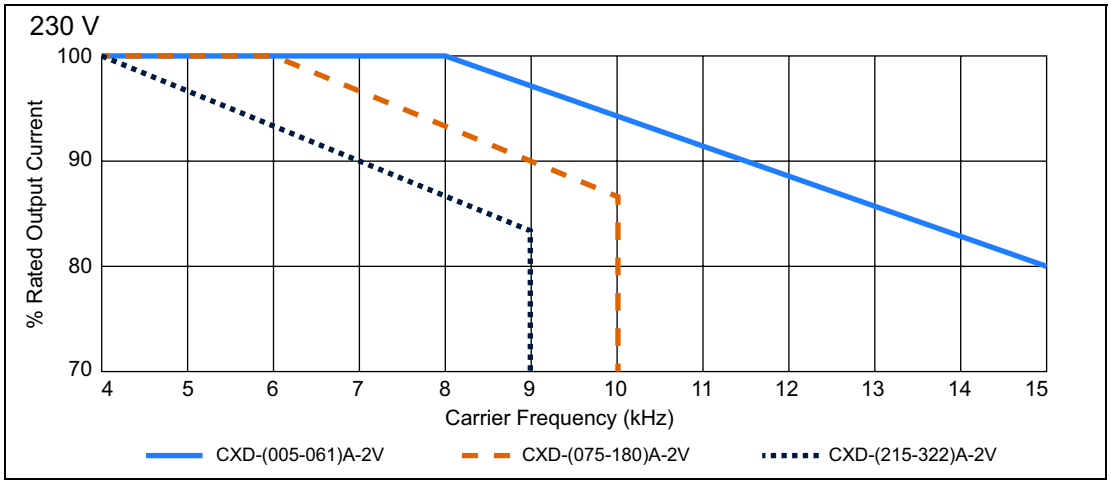
2 The VFD cannot produce output voltage greater than input voltage.

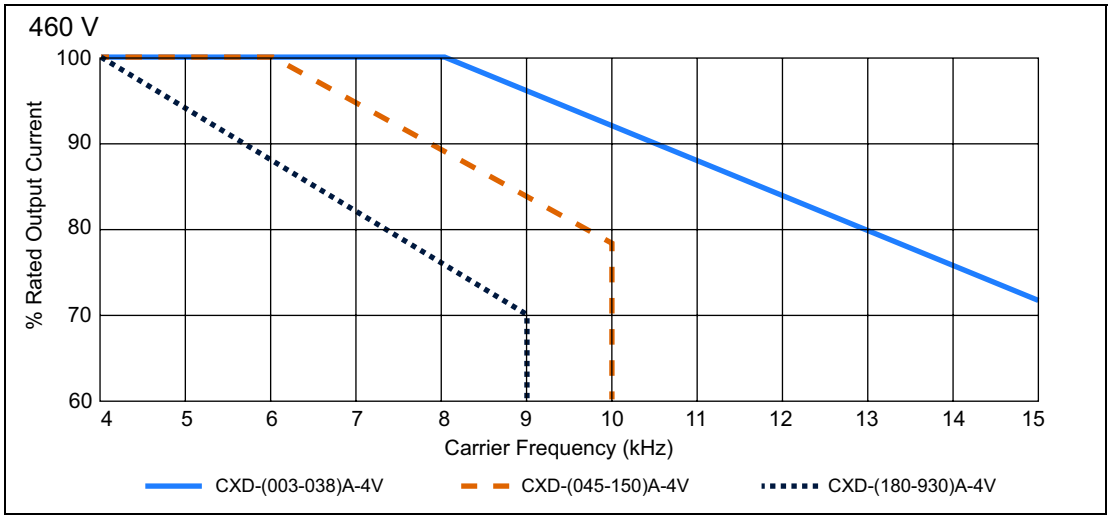
3 Variable torque (VT) motor rating based on a 120% overload for 1 minute. Constant Torque (CT) motor rating based on 120% overload for 1 minute and 160% overload for 3 seconds.

De-Rating Charts

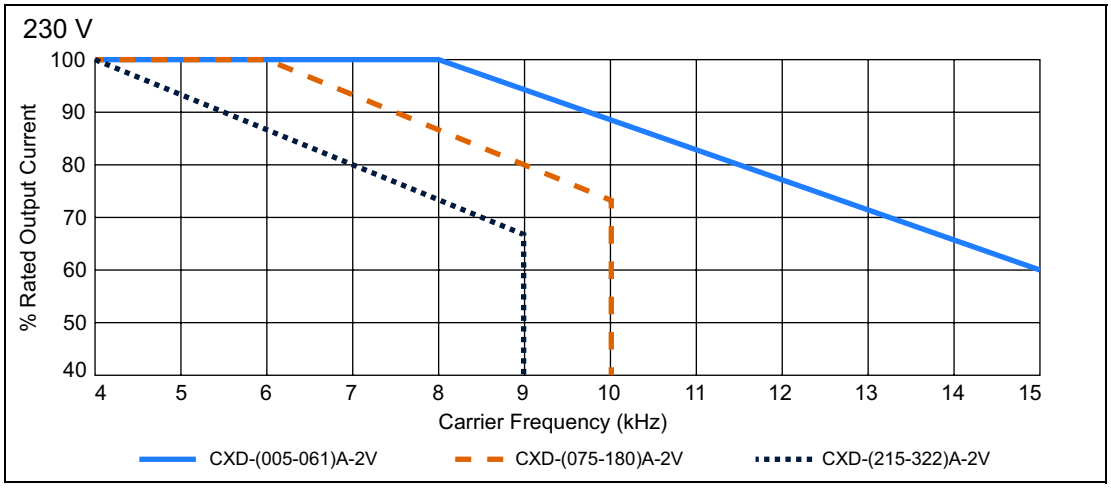
Carrier Frequency De-Rating

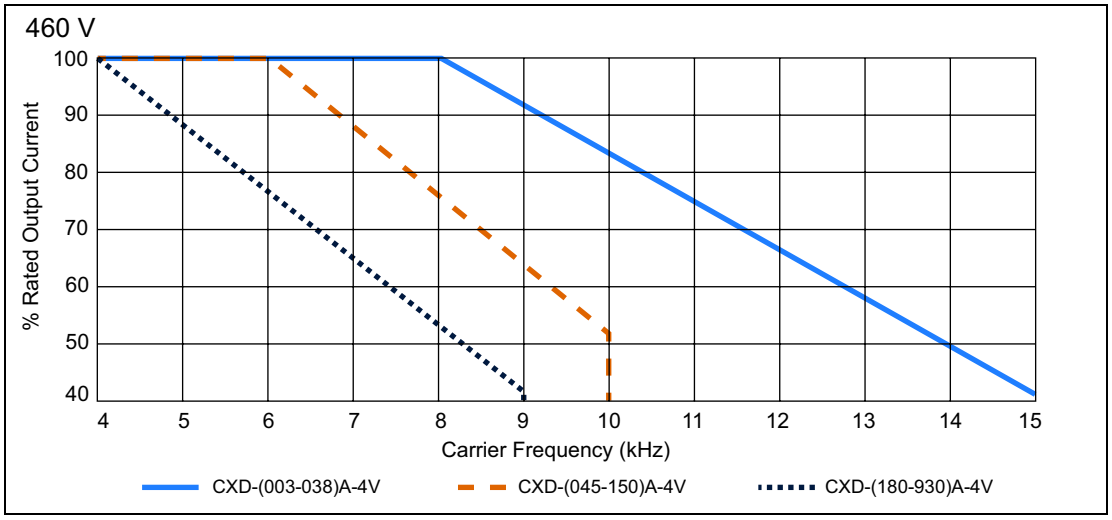
230 V / 460 V Induction Motor with VF or SVC Control



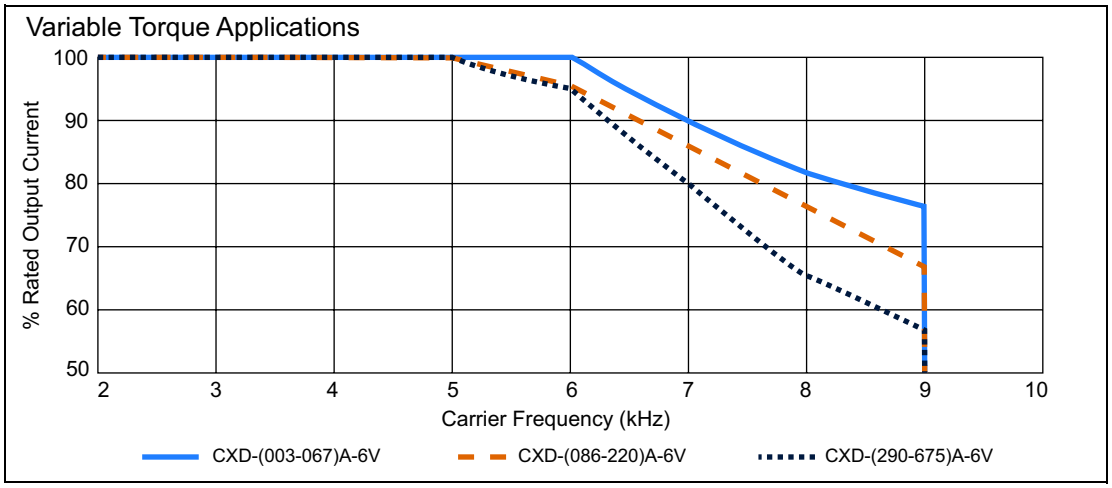


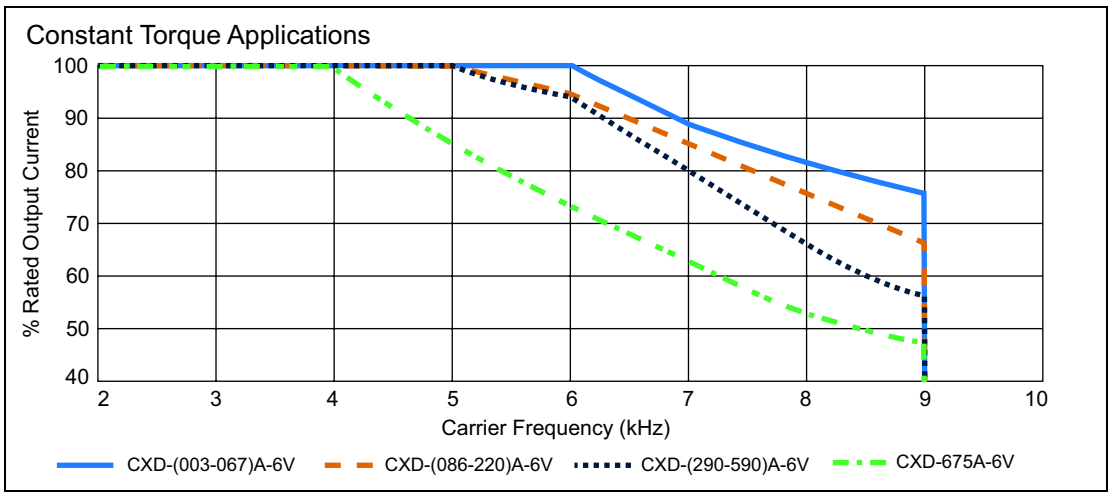
230 V / 460 V Permanent Magnet Motor with SVC Control



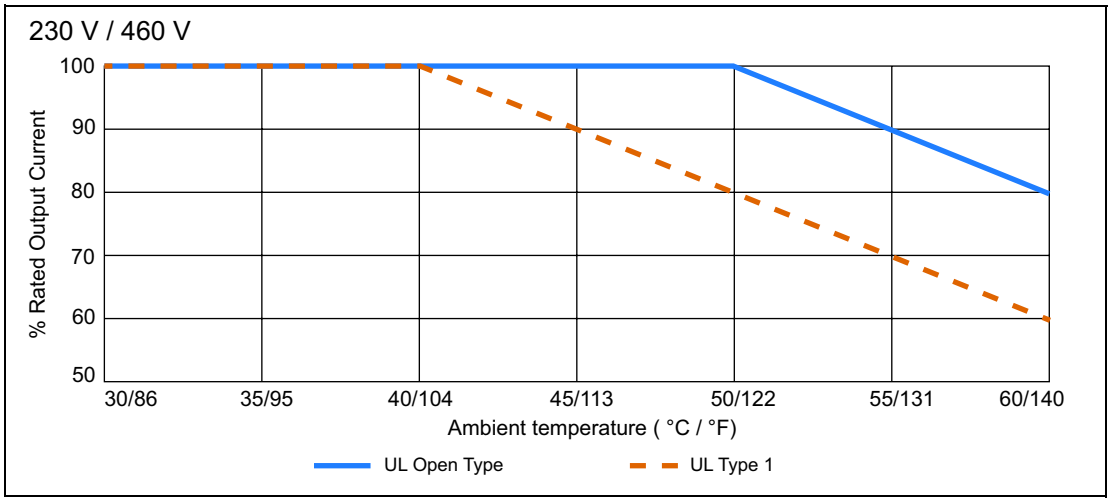


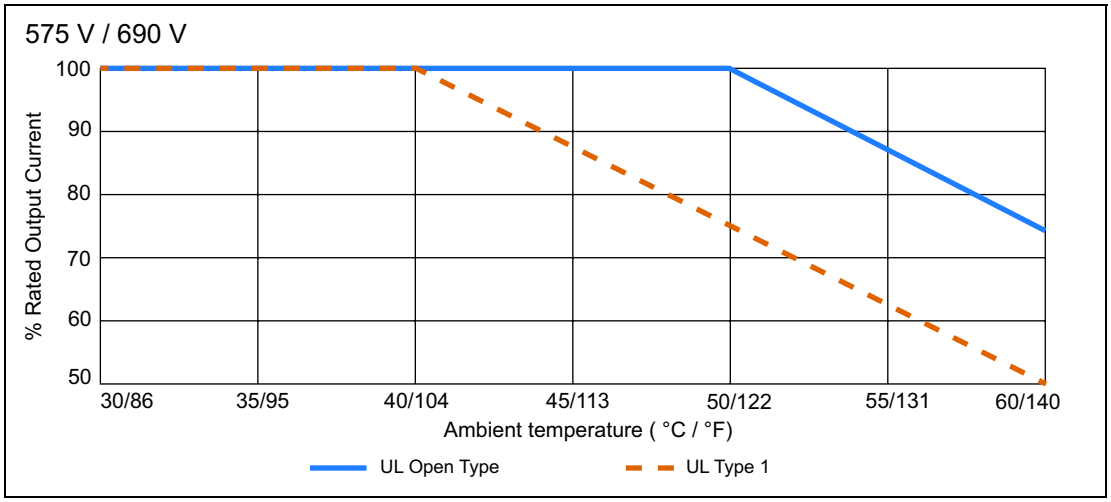
575 V / 690 V Induction Motor with VF or SVC Control



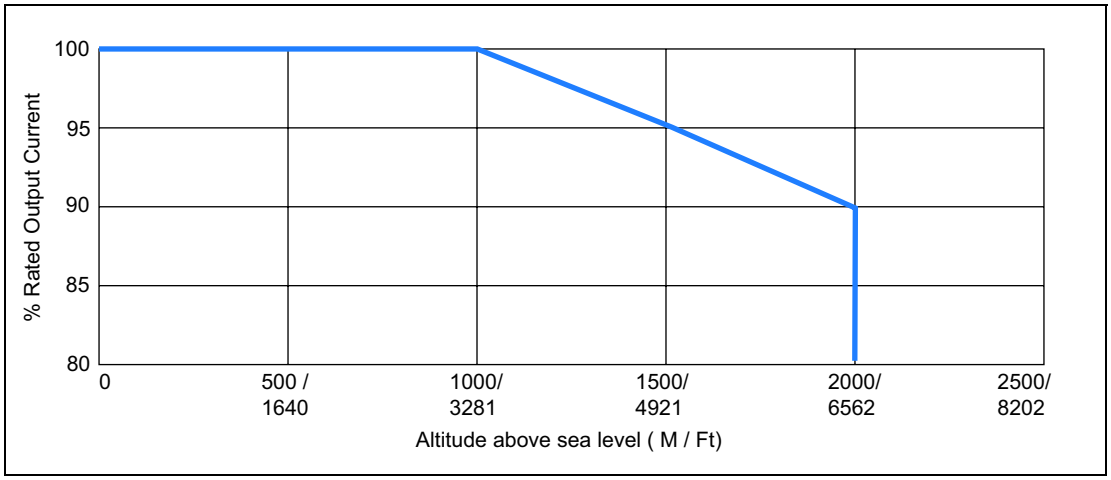


Ambient Temperature De-Rating





Altitude De-Rating



Replacement Components List

X-Drive Replacement Components and Accessories					
Description	**Part Number**	**Applicable Models**			**Quantity Needed**
VFD Keypad *	CXD-KPD	All			1
Remote Keypad Mounting Bracket	MKC-KPPK	All			1
Heat Sink Cooling Fan	MKC-AFKM	CXD-005A-2V	CXD-003A-4V	CXD-003A-6V	1
		CXD-007A-2V	CXD-004A-4V	CXD-004A-6V	
		CXD-010A-2V	CXD-005A-4V	CXD-006A-6V	
		CXD-015A-2V	CXD-008A-4V		
		CXD-021A-2V	CXD-010A-4V		
			CXD-013A-4V		
			CXD-018A-4V		
	MKC-BFKM1	CXD-031A-2V	CXD-024A-4V	CXD-009A-6V	1
				CXD-012A-6V	
				CXD-018A-6V	
				CXD-024A-6V	
	MKC-BFKM2	CXD-046A-2V	CXD-032A-4V		1
			CXD-038A-4V		
	MKC-BFKM3	CXD-061A-2V			1
	MKC-CFKM		CXD-045A-4V		1
			CXD-060A-4V		
			CXD-073A-4V		
	MKC-CFKM	CXD-075A-2V		CXD-030A-6V	2
		CXD-090A-2V		CXD-036A-6V	
		CXD-105A-2V		CXD-045A-6V	
	MKC-D0FKM		CXD-091A-4V		1
			CXD-110A-4V		
	MKC-DFKM	CXD-146A-2V	CXD-150A-4V	CXD-054A-6V	1
		CXD-180A-2V	CXD-180A-4V	CXD-067A-6V	
	MKC-EFKM3			CXD-086A-6V	1
				CXD-104A-6V	
				CXD-125A-6V	
				CXD-150A-6V	
	MKC-EFKM1	CXD-215A-2V			1
		CXD-276A-2V			
	MKC-EFKM2	CXD-322A-2V	CXD-220A-4V		1
			CXD-260A-4V		
	MKC-FFKM		CXD-310A-4V	CXD-180A-6V	1
			CXD-370A-4V	CXD-220A-6V	
	MKC-GFKM		CXD-460A-4V	CXD-290A-6V	1
			CXD-530A-4V	CXD-350A-6V	
	MKC-HFKM		CXD-616A-4V		2
			CXD-683A-4V		
			CXD-770A-4V		
	MKC-HFKM		CXD-930A-4V		3
	MKC-HFKM1			CXD-430A-6V	2
	MKC-HFKM1			CXD-465A-6V	3
				CXD-590A-6V	
				CXD-675A-6V	

X-Drive Replacement Components and Accessories			
Control Board *	5503005502	All	1
I/O Board	5503005701	All	1
FE Connect Communication Card	10000004840	All	1
Ethernet Communication Card	CMC-EIP01	All	1
Extension DC I/O Card	EMC-D42A	All	1
Extension AC Input Card	EMC-611A	All	1
Extension Relay Card	EMC-R6AA	All	1

* **IMPORTANT:** If replacing a keypad or control board for an X-Drive with firmware version 1.0, both the keypad and the control board must be replaced together.

Applicable Standards

1. UL508C – UL/cUL
2. CE
   a. Low Voltage
      - EN61800-5-1
   b. EMC
      - EN61000-3-12
      - IEC61000-6-2
      - IEC61000-4-2
      - IEC61000-4-4
      - IEC61000-4-6
      - EN61800-3
      - IEC61000-6-4
      - IEC61000-4-3
      - IEC61000-4-5
      - IEC61000-4-8
   3. C-Tick
   4. ROHS

GLOSSARY

Acronym/ Term	Definition	Description
AWG	American Wire Gauge	A standardized measurement of wire diameters important for determining current-carrying capacity.
BAS	Building Automation System	A computer-based control system that controls and monitors a building's mechanical and electrical equipment.
BMS	Building Management System	A computer-based control system that controls and monitors a building's mechanical and electrical equipment.
BPC	Bypass Controller	
EMI	Electromagnetic Interference	See RFI.
FLA	Full Load Amperes	The nameplate amperage rating of the motor when it is running at its designed horsepower and on the motors designed voltage.
GFCI	Ground Fault Circuit Interrupter	A fast-acting circuit breaker designed to shut off electric power in the event of a ground-fault within as little as 1/40 of a second.
GPM	Gallons per Minute	A unit of volumetric flow rate in the United States.
HMI	Human Machine Interface	An interface that permits interaction between a human and a machine, such as a display and keyboard.
HOA	Hand/Off/Auto switching	
IGBT	Insulated Gate Bipolar Transistor	A three-terminal power semiconductor device used as an electronic switch to synthesize complex waveforms with pulse-width modulation in a variable-frequency drive (VFD).
IP	International Protection rating	Used as protection measures for motors, electrical devices and motors.
LDT	Load Detection Trip	
MCCB	Molded Case Circuit Breaker	An MCCB provides protection by combining a temperature sensitive device with a current sensitive electromagnetic device.
MMS	Manual Motor Starter	An electromechanical protection device used to switch motors ON/OFF manually and to provide fuseless protection against short-circuit, overload and phase failures.
MOL	Motor Overload	
NEC	National Electrical Code	A regionally adoptable standard for the safe installation of electrical wiring and equipment in the United States.
NEMA	National Electrical Manufacturer Association	The largest trade association of electrical equipment manufacturers in the United States. NEMA publishes more than 700 standards for electrical enclosures, motors and magnet wire, AC plugs and receptacles, etc.
PFC	Power Factor Correction	
PID	Proportional Integral Derivative	A control loop feedback mechanism used in applications requiring continuously modulated control.
PLC	Programmable Logic Controller	A digital computer used for automation of typically industrial electromechanical processes.
PMA	Pump and Motor Assembly	
PWM	Pulse Width Modulation	A modulation technique used to control the power supplied to electrical devices, especially for motor speed control.
RFI	Radio Frequency Interference	A disturbance generated by an external source that affects an electrical circuit by electromagnetic induction, electrostatic coupling, or conduction.

Acronym/ Term	Definition	Description
RMS	Root Mean Square	Refers to the most common mathematical method of defining the effective voltage or current of an AC wave.
RTU	Remote Terminal Unit	A Modbus RS-485 connection following a simple client-server model.
SFA	Service Factor Amperes	The amount of a periodic overload at which a motor can operate without overload or damage.
TDH	Total Dynamic Head	The total equivalent height that a fluid is to be pumped, taking into account friction losses in the pipe.
VAC	Voltage Alternating Current	
VDC	Voltage Direct Current	
VFD	Variable Frequency Drive	A type of adjustable-speed drive used in electro-mechanical drive systems to control AC motor speed and torque by varying motor input frequency and voltage.

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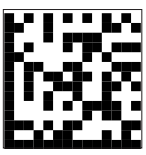

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