User Manual

Allen-Bradley

PowerFlex® 6000 Medium Voltage Variable Frequency Drive

Publication 6000-UM001B-EN-P

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	**ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Introduction

This document provides procedural information for managing daily or recurring tasks involving PowerFlex 6000 medium voltage variable frequency drives.

Who Should Use This Manual

This manual is intended for use by personnel familiar with operating medium voltage and solid-state variable speed drive equipment. The manual contains material that enables operation and regular maintenance of the drive system.

What Is Not in This Manual

This manual provides information specific to maintaining the PowerFlex 6000 medium voltage variable frequency drive. It does not include topics such as:

- Dimensional and electrical drawings generated for each customer's order
- Spare parts lists compiled for each customer's order

Please refer to the following documents for additional product detail or instruction relating to PowerFlex 6000 drives:

- PowerFlex 6000 Medium Voltage Variable Frequency Drive Shipping, Handling, and Installation Instructions (6000-IN006_-EN-P). This document provides procedural information for physically unloading, moving, and installing PowerFlex 6000 medium voltage drives.
- PowerFlex 6000 Medium Voltage Variable Frequency Drive Commissioning Manual (6000-IN007_-EN-P). This document provides information for commissioning PowerFlex 6000 medium voltage drives.

Rockwell Automation provides the site- and installation-specific electrical and design information for each drive during the order process cycle. If they are not available on site with the drive, contact Rockwell Automation.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http:/www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

General Precautions

ATTENTION: This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference Allen-Bradley publication 8000-4.5.2, "Guarding Against Electrostatic Damage" or any other applicable ESD protection handbook.

ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

ATTENTION: Only personnel familiar with the PowerFlex 6000 Adjustable Speed Drive (ASD) and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

Service and Support

Commissioning Support

After installation, Rockwell Automation is responsible for commissioning activities for the PowerFlex 6000 product line. Contact your local Rockwell Automation sales representative to arrange commissioning.

Rockwell Automation support includes, but is not limited to:

- quoting and managing product on-site start-ups
- quoting and managing field modification projects
- quoting and managing customer in-house and on-site product training

The user or its representatives are responsible for pre-commissioning activities to prepare the drive for commissioning. Failure to complete these activities prior to the commissioning process will delay the start-up of the drive. Please refer to the Pre-commissioning Checklist in the PowerFlex 6000 Medium Voltage Variable Frequency Drive Shipping, Handling, and Installation Instructions (6000-IN006_-EN-P).

Introduction

Around the world, Allen-Bradley® PowerFlex® medium voltage drives from Rockwell Automation have built a reputation for providing efficient and reliable motor control for industry's most demanding applications. From the hardware designed to help optimize production to the power of networked control platforms, users can quickly and easily gain access to valuable information from their systems. Better information leads to higher asset availability, reduced energy and maintenance costs, and asset and personnel protection - all resulting in an increased return on your investment and real bottom-line savings. No matter where your applications are located - and whether your requirements are simple or complex, count on PowerFlex medium voltage drives for the optimal solution.

Safety Considerations

SHOCK HAZARD: Energized industrial control equipment can be dangerous. Severe injury or death can result from electrical shock, burn, or unintended actuation of control equipment. Hazardous voltages may exist in the drive cabinet even with the input circuit breaker in the off position. If it is necessary to work in the vicinity of energized equipment, the safety related work practices outlined in Electrical Safety requirements for Employee Work places must be followed. Before attempting any work, verify the system has been locked out and tested to have no potential.

Lockout and tagout the device feeding power to the input of the drive before performing any drive maintenance or component replacements. After the input device cabinet doors are opened, immediately test the outgoing power cables feeding the drive with a live-line tool (hot stick) while wearing high voltage gloves. Repeat the live-line tool (hot stick) testing at the drive incoming line power cable connections to verify that medium voltage is not present. Pay special attention to any capacitors connected to medium voltage that can retain a charge for a period of time. Only after the drive equipment has been verified as isolated and de-energized can subsequent work be performed. Even though the input to the drive may be open, it is still possible for hazardous voltage to be present.

Refer to national and local safety guidelines for detailed procedures on how to safely isolate the equipment from hazards.

ATTENTION: The national and local electrical codes outline provisions for safely installing and working on electrical equipment. Installation must comply with specifications regarding wire type, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

Environmental Conditions

- Elevation above sea level must be less than 1000 m (3250 ft)(1).
- Ambient air temperature must be between 0...40°C (32...104°F)(2).
- Relative humidity must be less than 90%, non-condensing.
- The drive must be installed indoors; there must be no dripping water or other fluids in the room.
- Cooling air must be clean without significant concentrations of sand, corrosive or conductive dust (defined by IEC 721-1 as being less than 0.2 mg/m^3 of dust), or explosive gas.
- Free from significant vibration.
- The drive must be anchored on a level floor. Please refer to the dimension drawing for the anchor point sizes and locations.

For the equipment to operate in conditions other than those specified, consult the local Rockwell Automation Sales Office.

How it Works

Cascaded "H" Bridge (CHB) Topology

The proven CHB topology combines an integrally mounted phase shifting isolation transformer and series-connected power modules for each phase. In addition to stepping down the input voltage, the isolation transformer also provides two other principal functions:

- Mitigate common mode voltage stress so motors with standard insulation levels can be used.
- Reduce Total Harmonic Distortion (THD), due to the phase shifting of its secondary windings, so input side harmonics don't negatively impact the plant or utility power grid.

(1) Options are available for operation up to 3000 m.a.s.l. However, these must be stated at the time of order and cannot be retrofitted in the field.

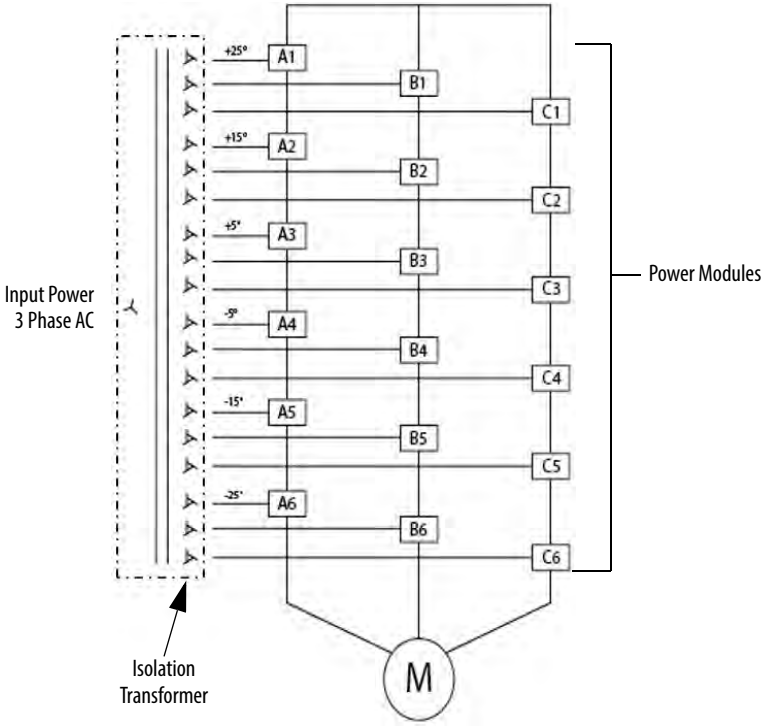
(2) Options are available for ambient temperatures up to 50 °C. However, these must be stated at the time of order and cannot be retrofitted in the field.

A number of identical low voltage power modules are series-connected (cascaded) together to produce the medium voltage levels required to operate the motor.

The voltage step for each module is relatively small and a Pulse Width Modulation (PWM) switching pattern is used so output harmonics and torque pulsations at the motor are minimal, even at lower speeds. This technology is very motor friendly so standard motors can be used for new applications and it also is ideal for retrofitting existing motors. This also allows for the motor cable lengths required for most applications, without the requirement for output filtering.

This power module concept makes maintenance quick and easy. Each module has powerful built in diagnostics to identify and isolate a module needing replacement, in the unlikely event of a failure. This minimizes power module replacement time, so process uptime is maximized.

Figure 1 - 6/6.6 kV Example Power Structure



Simplified Electrical Diagrams

Figure 2 - 3000V / 3300V (18 Pulse - 9 Power Modules)

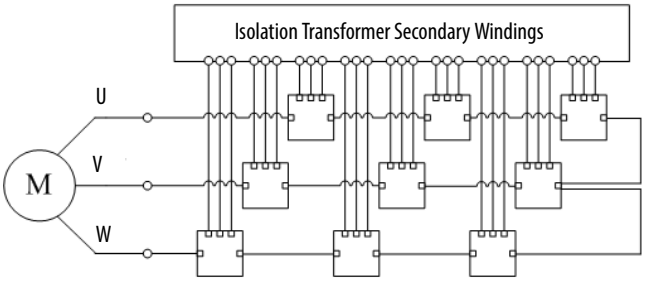


Figure 3 - 6000V /6600V (36 Pulse - 18 Power Modules)

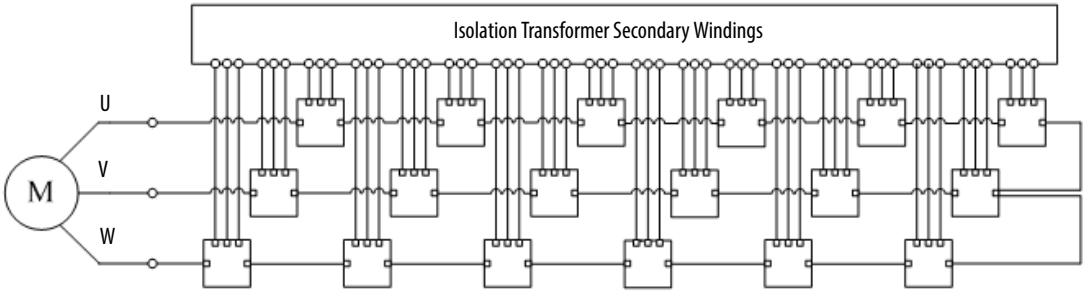


Figure 4 - 10,000V (54 Pulse - 27 Power Modules)

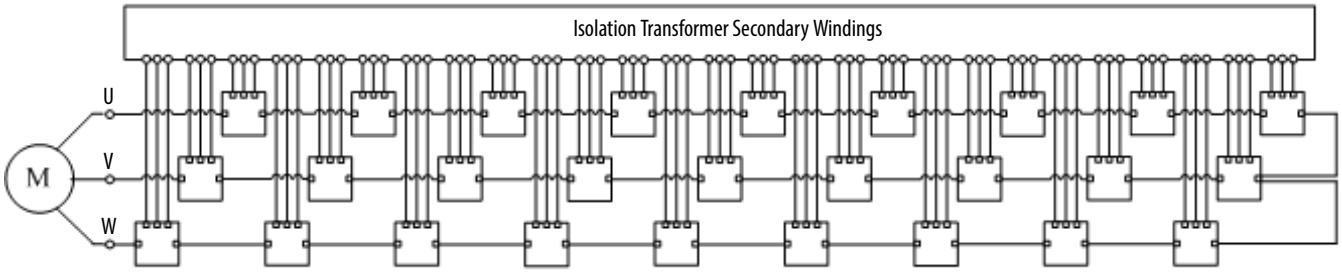


Figure 5 - Connectivity Overview

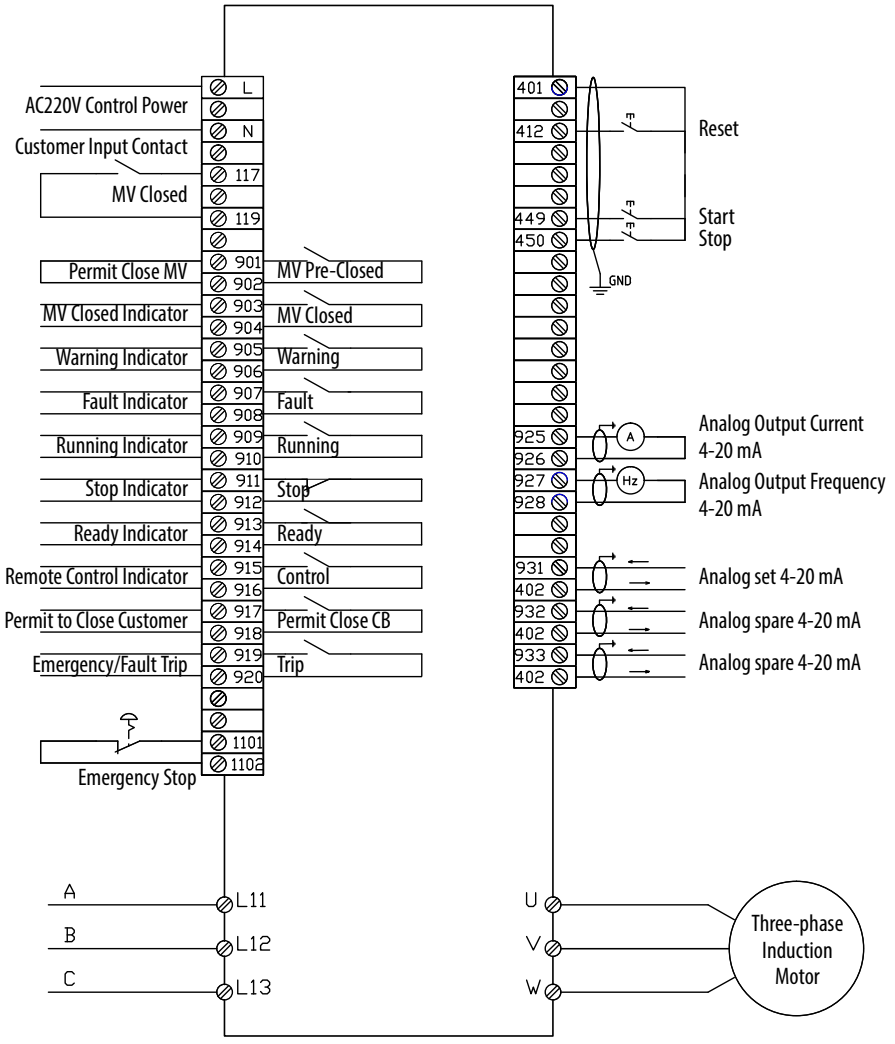
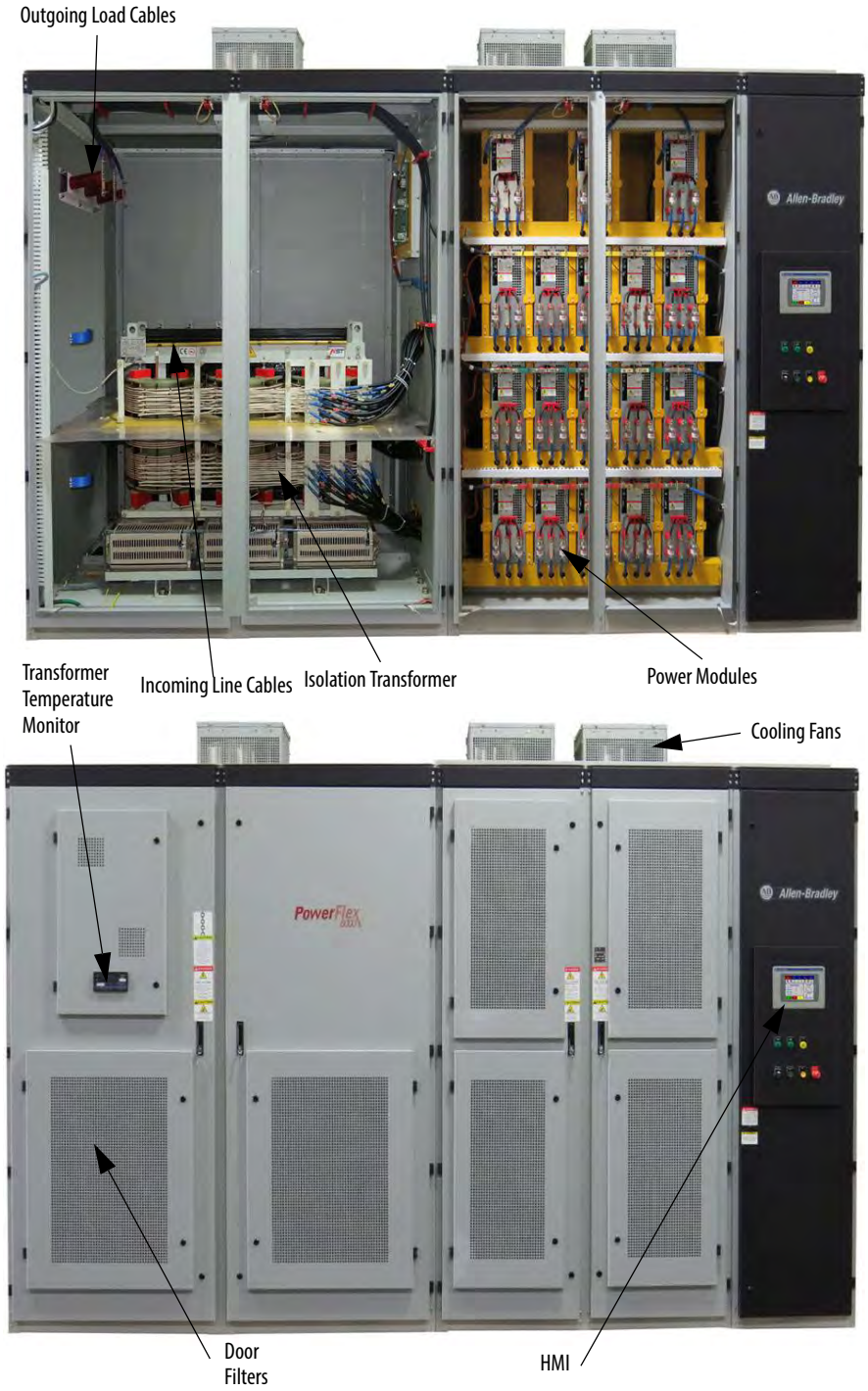


Figure 6 - PowerFlex 6000 Principal Components



Generous space for terminating incoming line cables.
Generous space for terminating outgoing load cables.
Integrally mounted Multi-pulse Isolation Transformer (3 wires in & 3 wires out) ensures low line side harmonics and high input power factor
Cabinet ships in two sections to minimize shipping and handling issues.
All Power Modules are identical to minimize spare parts.
All Power Modules are designed for easy removal and replacement to minimize MTTR.
Power Module has a PWM pattern to reduce output harmonics
All MV doors are electrically interlocked with input switching device

Isolation Transformer Temperature Monitor
All door filters can be changed while the drive is running
All cooling fans are internally powered by a dedicated winding in the Isolation Transformer – no separate fan power supply is needed from customer
All MV doors are lockable
Intuitive, easy-to-use, color touchscreen HMI
Many communication modules are available, such as EtherNet I/P and Profibus DP
Automatic switchover (no trip) to internally supplied control power if customer-supplied single phase control power is lost
On-line UPS supplied as standard

Standards Compliance

Technical specifications and relevant standards in the manufacture, testing, and acceptance of equipment include:

Standard Number	Standard Description
IEEE 519	Electrical and Electronics Engineers Institute Harmonics Control Requirements
IEC 60146	Semiconductor Converters–Specification of Basic Requirements
IEC 60038:1983	IEC Standard Voltages
IEC 60050-151:2001	International Electrotechnical Vocabulary, Chapter 151: Electrical and Magnetic Devices
IEC 60050-551:1999	International Electrotechnical Vocabulary, Chapter 551: Power Electronics
IEC 60076	Electric Power Transformer
IEC 60721-3-1:1997	Classification of Environmental Conditions, Part 3: Classification of Groups of Environmental Parameters and their Severities. Section 1: Storage
IEC 60721-3-2:1997	Classification of Environmental Conditions, Part 3: Classification of Groups of Environmental Parameters and their Severities
IEC 60721-3-3:2008	Classification of Environmental Conditions, Part 3: Classification of Groups of Environmental Parameters and their Severities. Stationary Use at Weather-protected Locations
IEC 61000-2-4:2002	Electromagnetic Compatibility (EMC), Part 2, Environment, Chapter 4: Compatibility Levels in Industrial Plants for Low Frequency Conducted Disturbances
IEC 61000-4-7:2002	Electromagnetic Compatibility (EMC) Part 4: Testing and Measurement Techniques, Chapter 7: General Guide on Harmonics and Inter-harmonics Measurements and Instrumentation, for Power Supply Systems and Equipment Connected Thereto
IEC 61800-3:2004	Adjustable Speed Electrical Power Drive Systems, Part 3: EMC Requirements and Specific Test Methods
IEC 61800-4:2004	Adjustable Speed Electrical Power Drive Systems, Part 4: General Requirement—Rating Specifications for AC Power Drive Systems above 1000V AC and not Exceeding 35 kV
IEC 60757-1983	Code for Designation of Colors
IEC 106:1989	Environment Condition Guides for Specifying Performance Rating of Equipment
IEC 61508.1-7	Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems
GB/T 2900.18-2008	Electrotechnical terminology—Low Voltage Apparatus (IEC60050-441:1984)
GB/T 3859.1-2013	Semiconductor Converters. Specification of Basic Requirements (IEC60146-1-1:1991)
GB/T 3859.2-2013	Semiconductor Converters. Application Guide (IEC60146-1-2:1991)
GB/T 3859.3-2013	Semiconductor Converters. Transformers and Reactors (IEC 60146-1-3,1991)
GB 7678-87	Semiconductor Self-commutated Converters
GB 3797-2005	Electric-driving Control Gear, Part 2: Electric-driving Control Gear Incorporating Electronic Devices
GB/T 14549-93	Quality of Electric Energy Supply Harmonics in Public Supply Network
GB 4208-2008	Degrees of Protection Provided by Enclosures (IP Code) (IEC 60529:1989)
GB/T 16935.1-2008	Insulation Coordination for Equipment within Low Voltage Systems, Part 1: Principles, Requirements, and Tests (IEC 60664-1:1992)
GB 156-2007	Standard Voltages
GB/T 1980-2005	Standard Frequencies
GB/T 2423.10	Electric and Electronic Products—Basic Environmental Test Regulations for Electricians—Guidelines for Vibration (sine)
GB/T 2681	Colors of Insulated Conductors Used in Electrical Assembly Devices
GB 2682	Colors of Indicator Lights and Push Buttons Used in Electrical Assembly Devices
GB/T 4588.1-1996	Specification for Single and Double-sided Printed Boards with Plain Holes
GB/T 4588.2-1996	Sectional Specification: Single and Double-sided Printed Boards with Plated-through Holes

Standard Number	Standard Description
GB 10233.2005	Basic Test Method for Low Voltage Switchgear and Controlgear
GB 12668.4-2006	Adjustable Speed Drive Electrical System, Part 4: General Requirement for Voltage up to 35 kV
GB 12668.3-2006	Adjustable Speed Drive Electrical System, Part 3: EMC Requirement and Testing Method
GB 12668.701-2013	Adjustable Speed Drive Electrical System, Part 701: Communication
GB/T 15139-94	General Technical Standard for Electrical Equipment Structure
GB/ 13422-2013	Semiconductor Converters—Electrical Test Methods
IEEE 519-1992	Practices and Requirements for Harmonic Control in Electrical Power Systems
GB/T 12668.4-2006	Adjustable Speed Electrical Power Drive Systems, Part 4: General Requirements. Rating Specifications for AC Power
GB1094.11-2007	Power Transformer, Part 11: Dry-type Transformer

Drive System Layout

There are two basic power cell configurations offered in the PowerFlex 6000 product line. For a drive amperage rating ≤200 A, a fixed-mounted power module design is supplied. Fixed-mounted modules are shipped installed in the drive. For a drive amperage rating of >200 A, a drawout power module design is supplied.

The PowerFlex 6000 drive is shipped in two sections, the Isolation Transformer Cabinet and the Power Module/LV Control Cabinet. Refer to PowerFlex 6000 Medium Voltage Variable Frequency Drive Shipping, Handling, and Installation Instructions (6000-IN006_-EN-P).

Elevation Drawings

Figure 7 - Fixed-mounted Power Module Drive Configuration

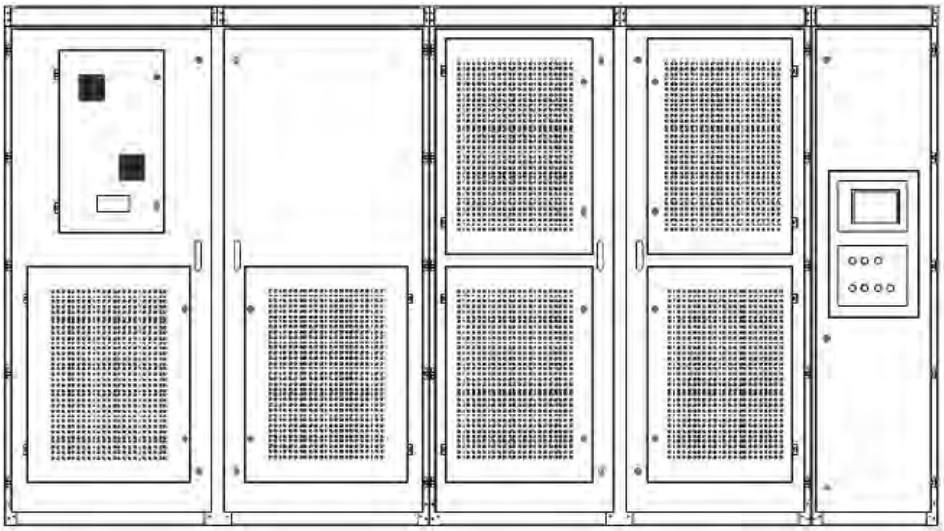
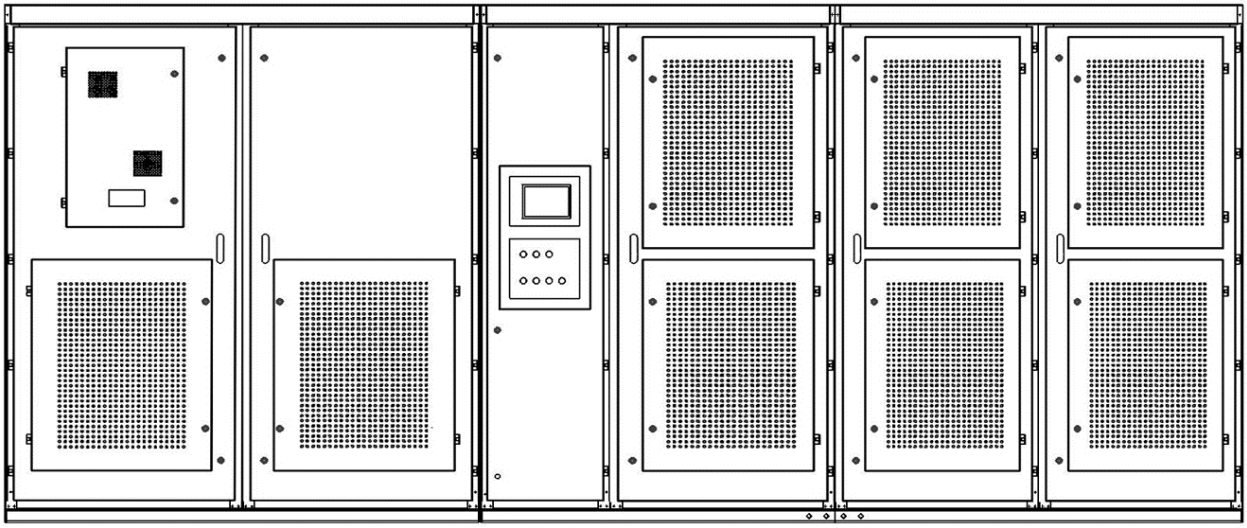


Figure 8 - Drawout Power Module Drive Configuration



Isolation Transformer Cabinet

Figure 9 - Isolation Transformer Cabinet (Fixed-mounted Power Module Drive Configuration)

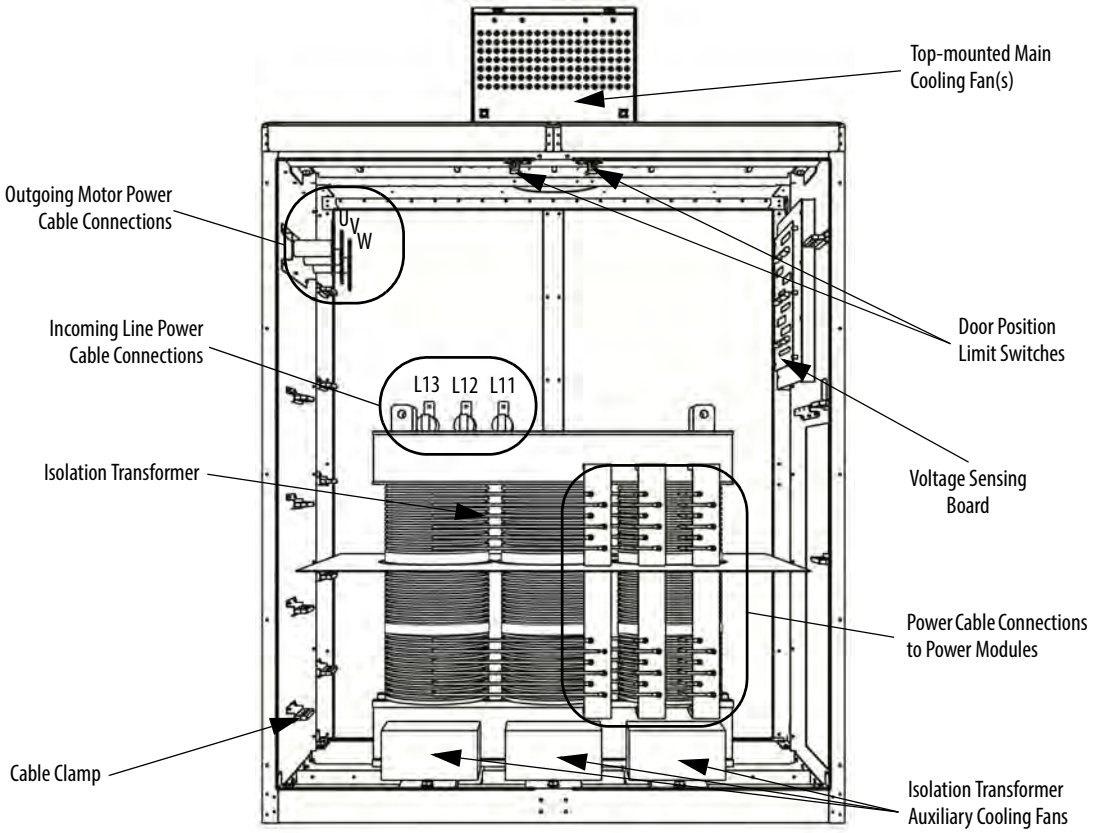
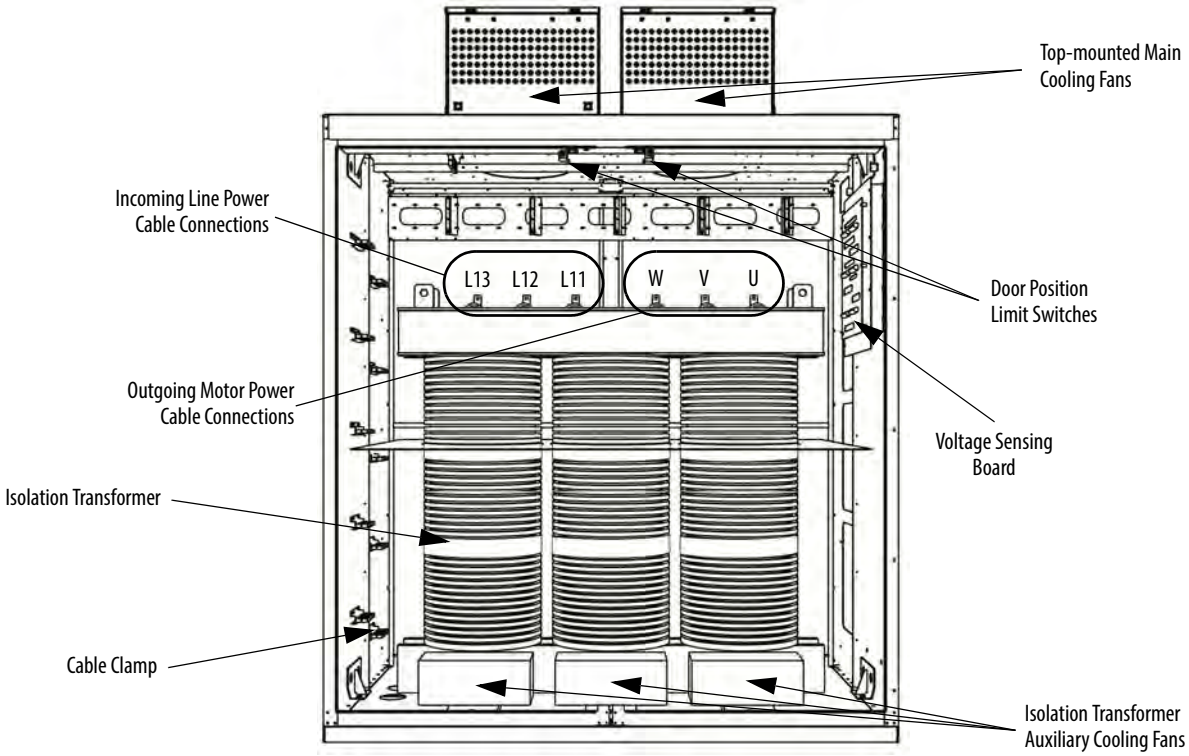


Figure 10 - Isolation Transformer Cabinet (Drawout Power Module Drive Configuration)



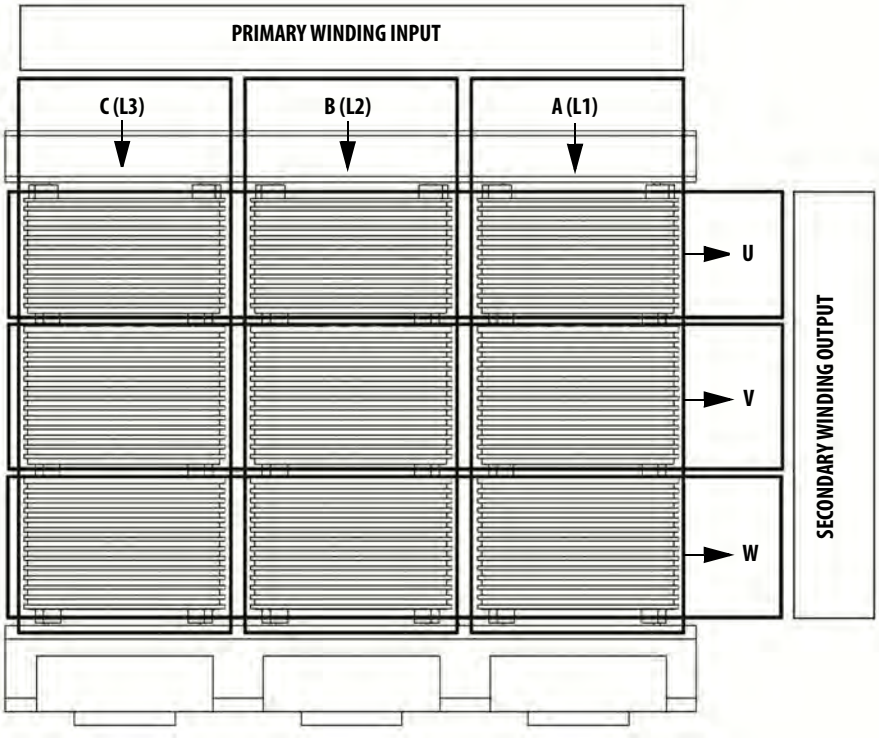
Isolation Transformer

The primary winding of the isolation transformer is rated for the voltage of the distribution system. It is connected to the distribution system by the incoming line power cables. The secondary windings of the isolation transformer are connected to the inputs of the power modules. The secondary winding voltage is typically 690V, to feed the low voltage power modules.

There are between 9 and 27 three-phase secondary side windings, dependent on the motor voltage requirements. The phase relationship between the secondary windings are optimized to provide the highest reduction of line side harmonics.

The isolation transformer's three-phase primary coils are oriented C, B, and A from left to right, as viewed from the front. The secondary windings are also divided into three principal sections from top to bottom. The upper third are to feed the power modules in the U output phase. The middle third are to feed the power modules in the V output phase. The bottom third are to feed the power modules in the W output phase (Figure 11).

Figure 11 - Isolation Transformer Primary and Secondary Winding Orientation



The secondary windings are brought out to corresponding vertical isolated stand-offs on the body of the transformer (orientated C, B, and A from left to right as viewed from the front).

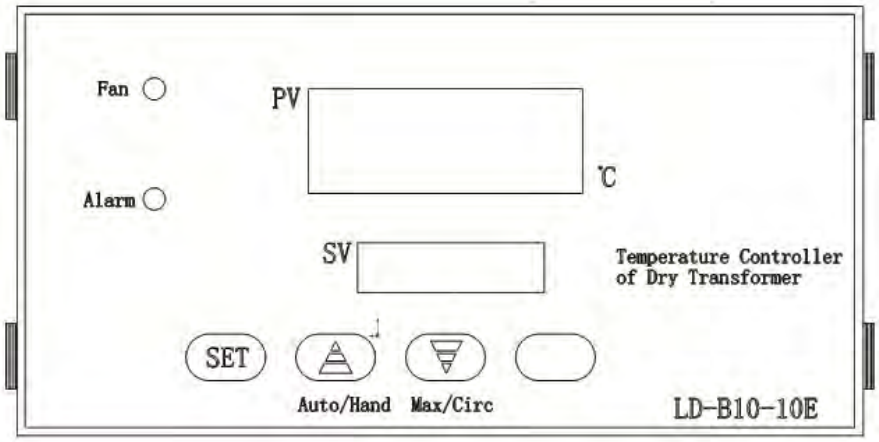
For drives with fixed-mounted power modules, the U and W phase interconnections to the isolation transformer secondary windings are on the front of the isolation transformer and the connections to the V phase are on the rear of the isolation transformer. The power cable connections to the power modules are made at the factory. Therefore, the field power cable connections need to be made at the isolation transformer secondary winding termination points (see 6000-IN006_-EN-P).

For drives with drawout power modules, all of the interconnections between the isolation transformer secondary windings and the power modules are made in the rear of the isolation transformer and the connection to the power modules are also in the rear. The power cable connections to the isolation transformer secondary winding termination point are made at the factory. Therefore, the field power cable connections must be made at the power module input points (see 6000-IN006_-EN-P).

Isolation Transformer Temperature Monitor

A discrete transformer temperature monitor is mounted on the LV door in the isolation transformer cabinet. Three temperature sensors are embedded in the isolation transformer. The monitor can be set to indicate an alarm condition or a trip condition, dependent on the temperature detected.

Figure 12 - Isolation Transformer Temperature Monitor



A separate user manual from the manufacturer is included in the documentation package.

Isolation Transformer Auxiliary Cooling Fans

Six fans are mounted directly underneath the isolation transformer to force air directly through the windings - to ensure reliable cooling. A baffle structure surrounds the periphery of the transformer structure to ensure the cooling air does not bypass the interior of the transformer windings. These fans are powered by a tertiary winding in the isolation transformer. Separate fan control power is not required.

Top-mounted Main Cooling Fan(s)

The top mounted cooling fan(s) work with the auxiliary cooling fans to ensure reliable cooling of the isolation transformer. They ensure the air is exhausted from the cabinet by creating an induced draft.

Incoming Line Power Cable Connections

The incoming line cables connect to the line side terminals on the isolation transformer. Incoming line cables can be brought in through the top or bottom of the isolation transformer cabinet. Generous working space is provided, if stress cones are required. See publication 6000-IN006_-EN-P for additional details.

Outgoing Motor Cable Connections

The outgoing motor cables connect to a cable stand-off assembly on the cabinet side sheet (Fixed-mounted Power Module configuration) or to the cable stand-offs mounted on the Isolation Transformer (Drawout Power Module configuration).

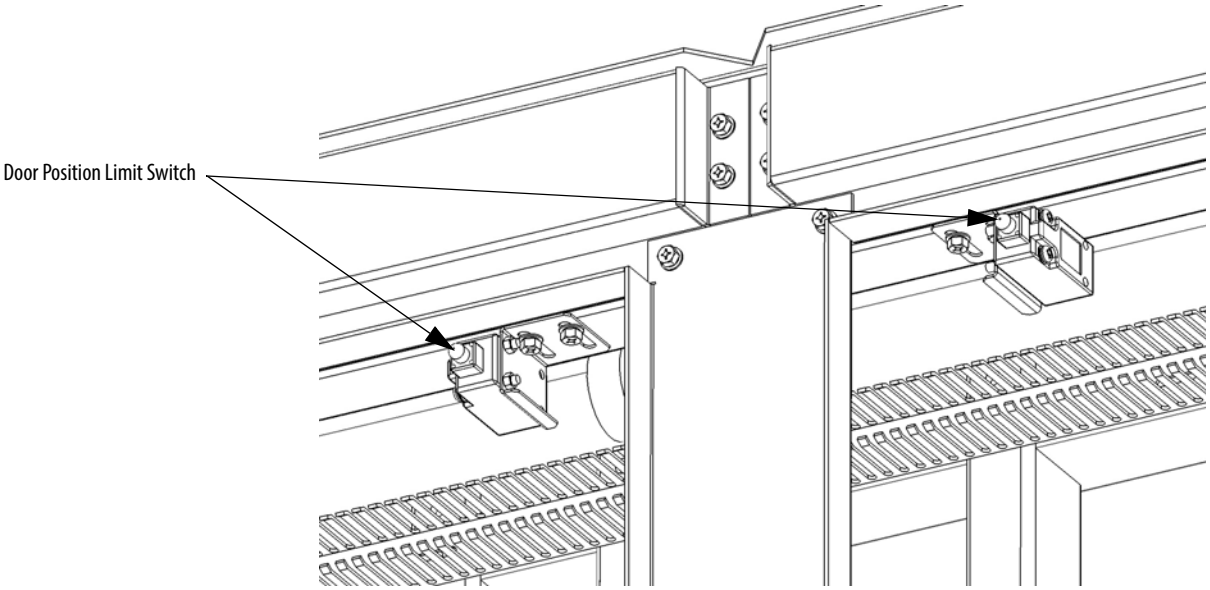
The outgoing motor cables connect to output phase of the power module array. Outgoing motor cables can be brought in through the top or bottom of the isolation transformer cabinet. Generous working space is provided. See publication 6000-IN006_-EN-P for additional details.

Door Position Limit Switch

Each cabinet door that allows access to medium voltage components is lockable and also has a Guardmaster® safety limit switch. If the cabinet door is opened when the input switching device feeding power to the drive is closed, the input device will be tripped off.

ATTENTION: The door position interlock is a safety feature. It must not be used solely as a part of the plant operation process to ensure the drive has been disconnected from input medium voltage. Keep the medium voltage doors locked as standard practice. If access to the medium voltage rated cabinets is required, always go to the input device feeding the drive to verify if it is open. Lock out and tagout the input device before performing any work on the drive or bypass units.

Figure 13 - Door Position Limit Switch Location



Voltage Sensing Board

The Voltage Sensing Board (VSB) is connected to the drive output terminals that connect to the motor. The VSB converts motor voltage to low voltage levels which allows the drive to monitor the output voltage to the motor.

Figure 14 - Voltage Sensing Board

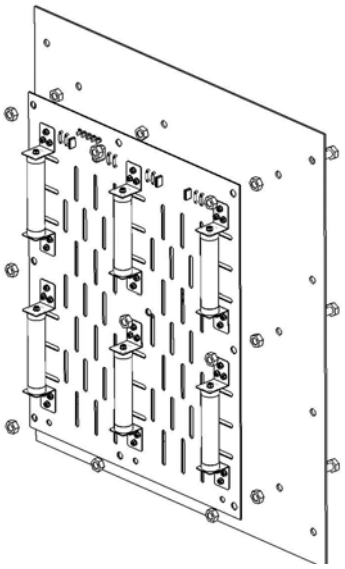
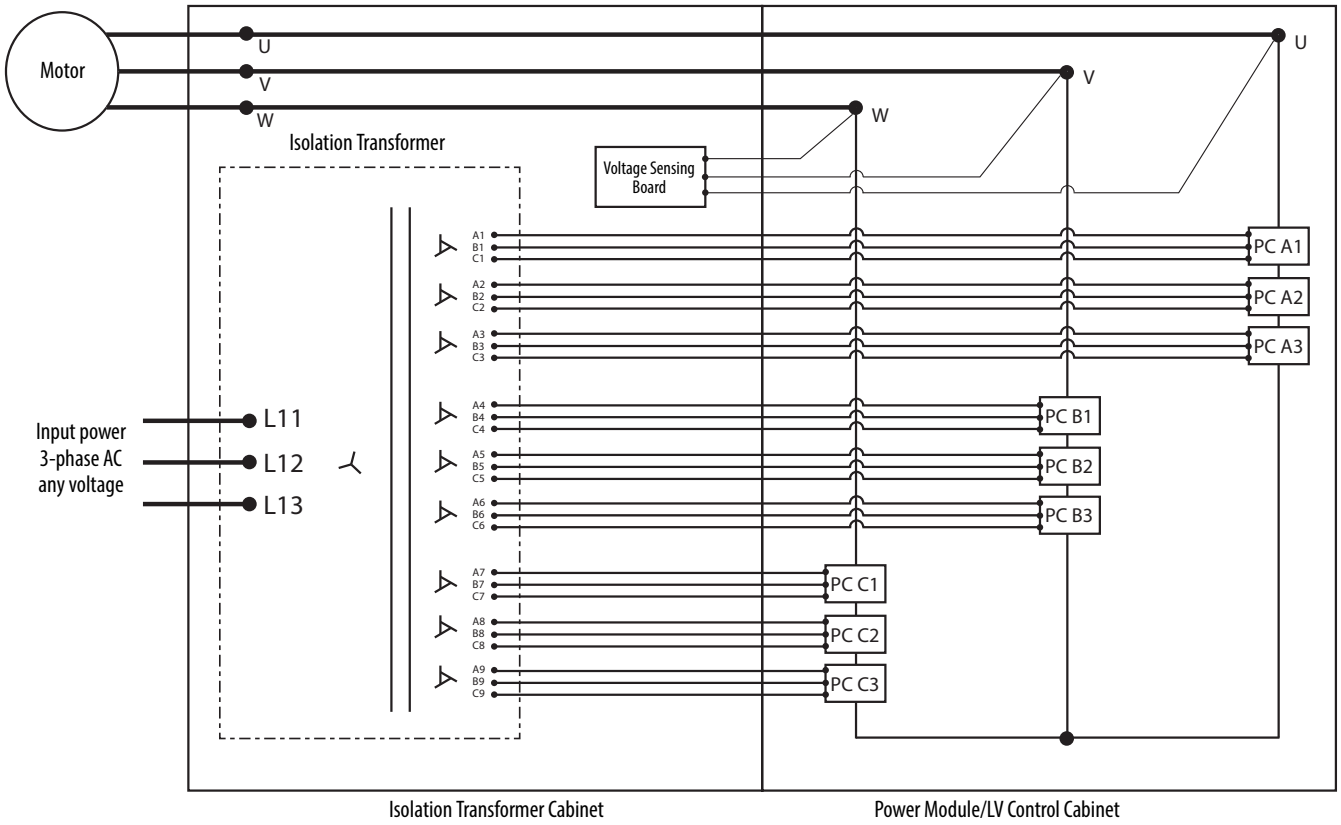


Figure 15 - Power Cabling Overview (3.3 kV Fixed-mounted Power Module Configuration)



Power Module Cabinet

Figure 16 - Fixed-mounted Power Module Configuration

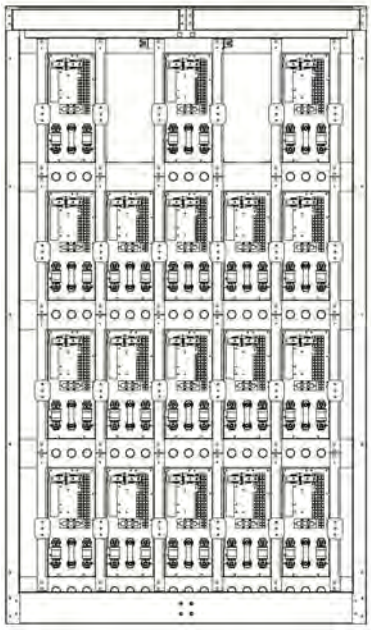
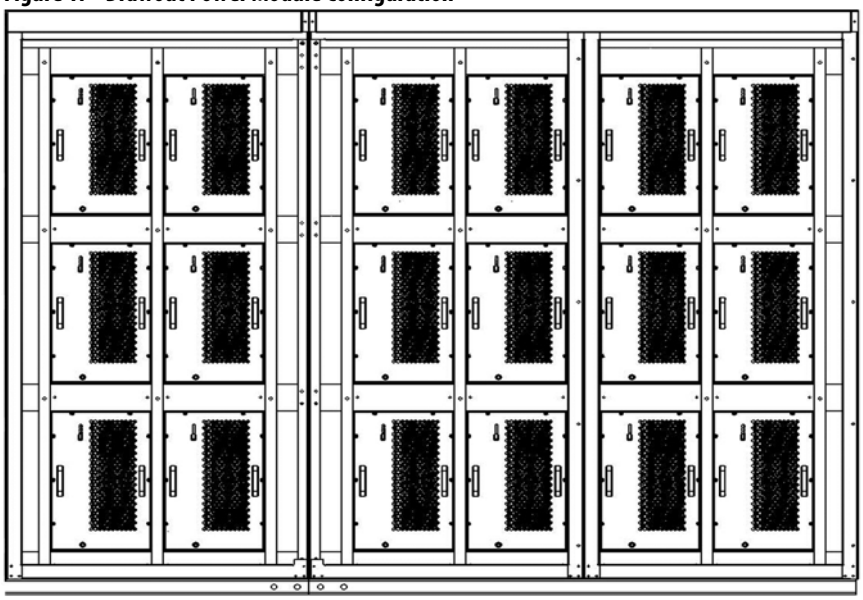


Figure 17 - Drawout Power Module Configuration



Power Modules

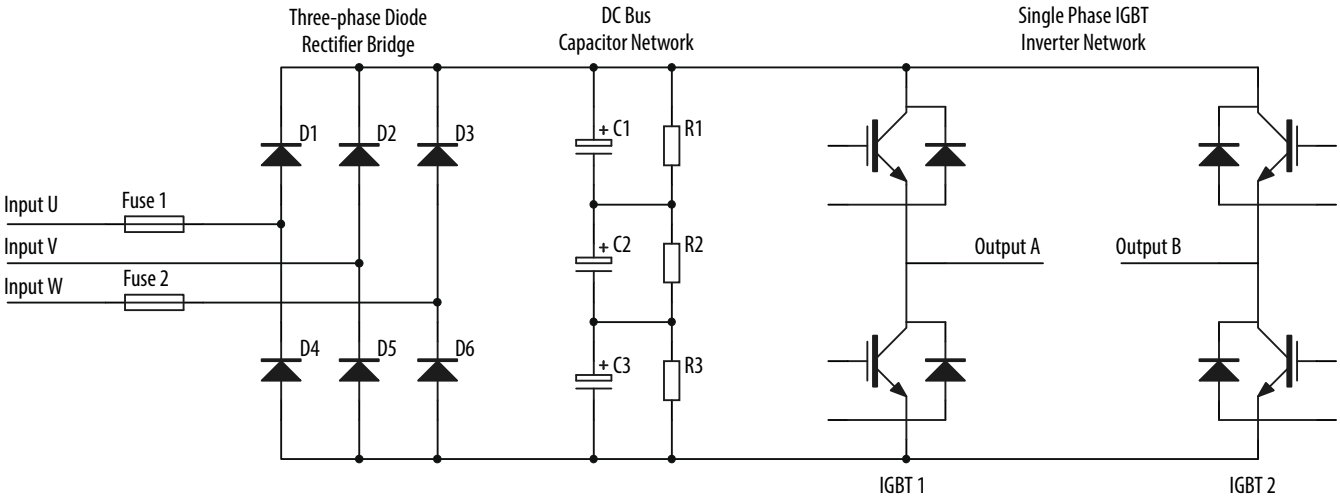
Power Modules are available in a wide variety of amperage ratings relating to the required motor current. Power Modules rated up to and including 200 A are fixed-mounted in the drive and ship already installed.

Drawout power modules are supplied for a drive current rating of >200 A. The power modules are shipped separately and must be installed in the cabinet. A Power Module lift cart is included and shipped together with the other components.

Basic Principle of Power Module

The Power Module combines a three phase rectifier and an "H" bridge inverter, powered from the secondary side windings of the Isolation Transformer. After rectifying and filtering, it outputs AC current with variable frequency and variable voltage under the control of four IGBTs using a PWM switching pattern. Several Power Modules, after being connected in series and superposed, can output three-phase AC current with adjustable frequency and voltage to control an AC motor.

Figure 18 - Low Voltage Power Module



Control signals to the Power Module and the feedback signals from the Power Module are transmitted by fiber optic cables which provide electrical isolation between the medium voltage and low voltage sections of the drive, and protects against electromagnetic interference.

Although the voltage produced by each power unit is typically less than 690V, the voltage-to-ground can reach the VFD rated output voltage, if operating at rated frequency.

The control signals from the main control unit, through the optical-electrical converter, are sent to the Power Module control board for further processing and to the corresponding gate drive circuits to turn the IGBTs on or off.

The status information of the Power Module is transmitted through the electrical-optical converter and sent to the main control unit. When there is a fault, the main control unit sends control signals to lockout or bypass the affected Power Module.

The Power Module cabinet consists of Power Modules, current transformers and high-voltage cable.

The Power Modules are divided evenly into three phases (U, V, and W). The units in each phase are connected end-to-end at the output terminals. Then individual phases are formed, using a star connection. Current transformers are installed into the U phase and W phase.

Different models of Power Modules are used for VFDs of different power ratings (Figure 19).

Figure 19 - Typical Fixed-mounted Power Module

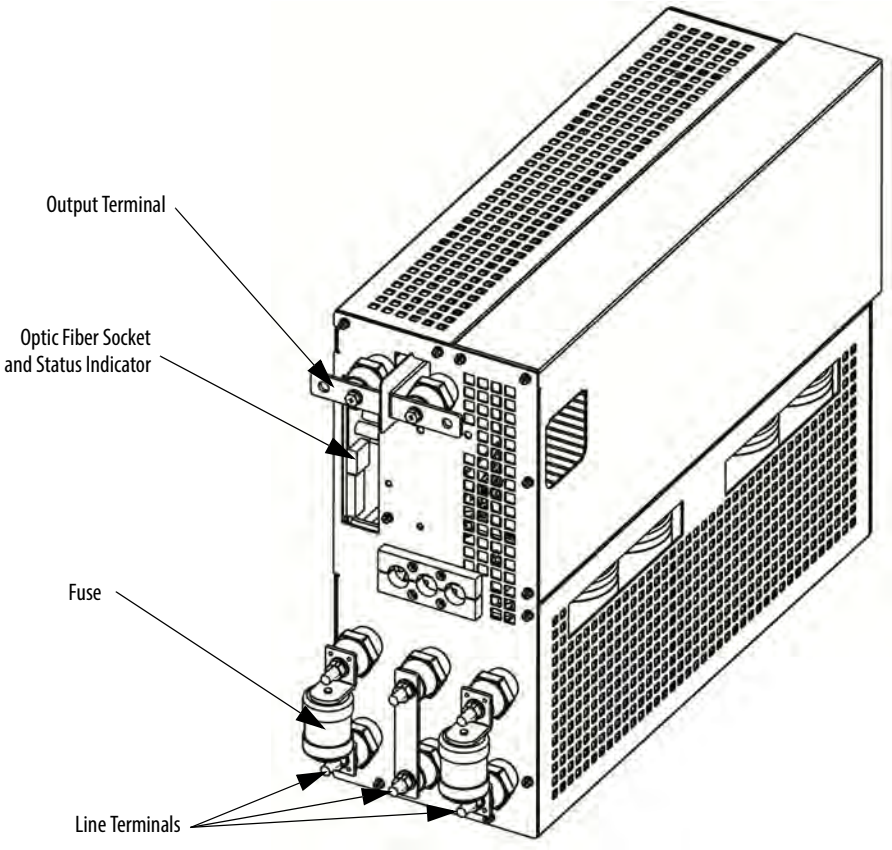


Table 1 - Power Module Ratings

Catalog Number	Spare Part Number	Current Rating (Amps)
TPUxx/030-AC3	HTPUXX/030-AC3-R	30
TPUxx/040-AC3	HTPUXX/040-AC3-R	40
TPUxx/050-AC3	HTPUXX/050-AC3-R	50
TPUxx/060-AC3	HTPUXX/060-AC3-R	60
TPUxx/075-AC3	HTPUXX/075-AC3-R	75
TPUxx/080-AC3	HTPUXX/080-AC3-R	80
TPUxx/100-AC3	HTPUXX/100-AC3-R	100
TPUxx/120-AC3	HTPUXX/120-AC3-R	120
TPUxx/150-AC3	HTPUXX/150-AC3-R	150
TPUxx/180-AC3	HTPUXX/180-AC3-R	180
TPUxx/200-AC3	HTPUXX/200-AC3-R	200
TPUxx/300-AC3	HTPUXX/300-AC3-R	300
TPUxx/380-AC3	HTPUXX/380-AC3-R	380
TPUxx/420-AC3	HTPUXX/420-AC3-R	420

Hall Effect Current Sensors (HECs)

The Hall Effect Current Sensors are current transformers capable of measuring current throughout the output frequency range of the drive. They monitor the current waveform in each of the phases going to the motor and provide feedback to the control system.

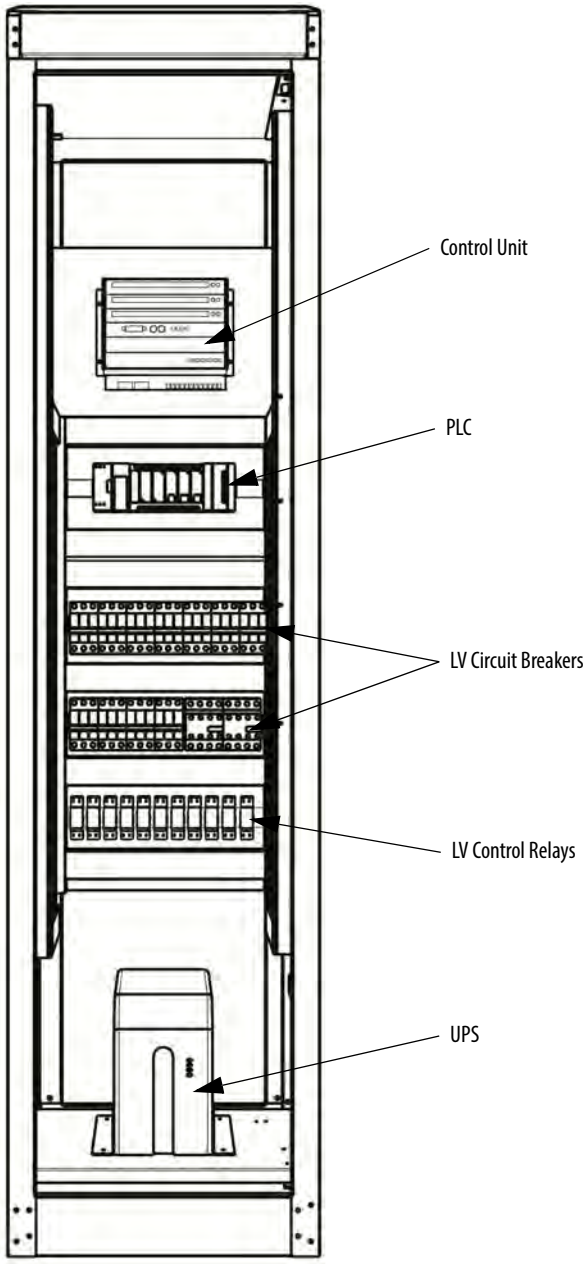
Top-mounted Main Cooling Fan(s)

The Top-mounted Cooling Fans ensure reliable cooling of the Power Modules. They draw cool air in through the vents in the Power Module Cabinet doors, through the Power Modules, and exhaust the heated air out through the top of the cabinet.

LV Control Cabinet

The LV Control Cabinet consists of the Control Unit, the human-machine Interface (HMI), PLC, AC/DC power supplies, contactors and relays.

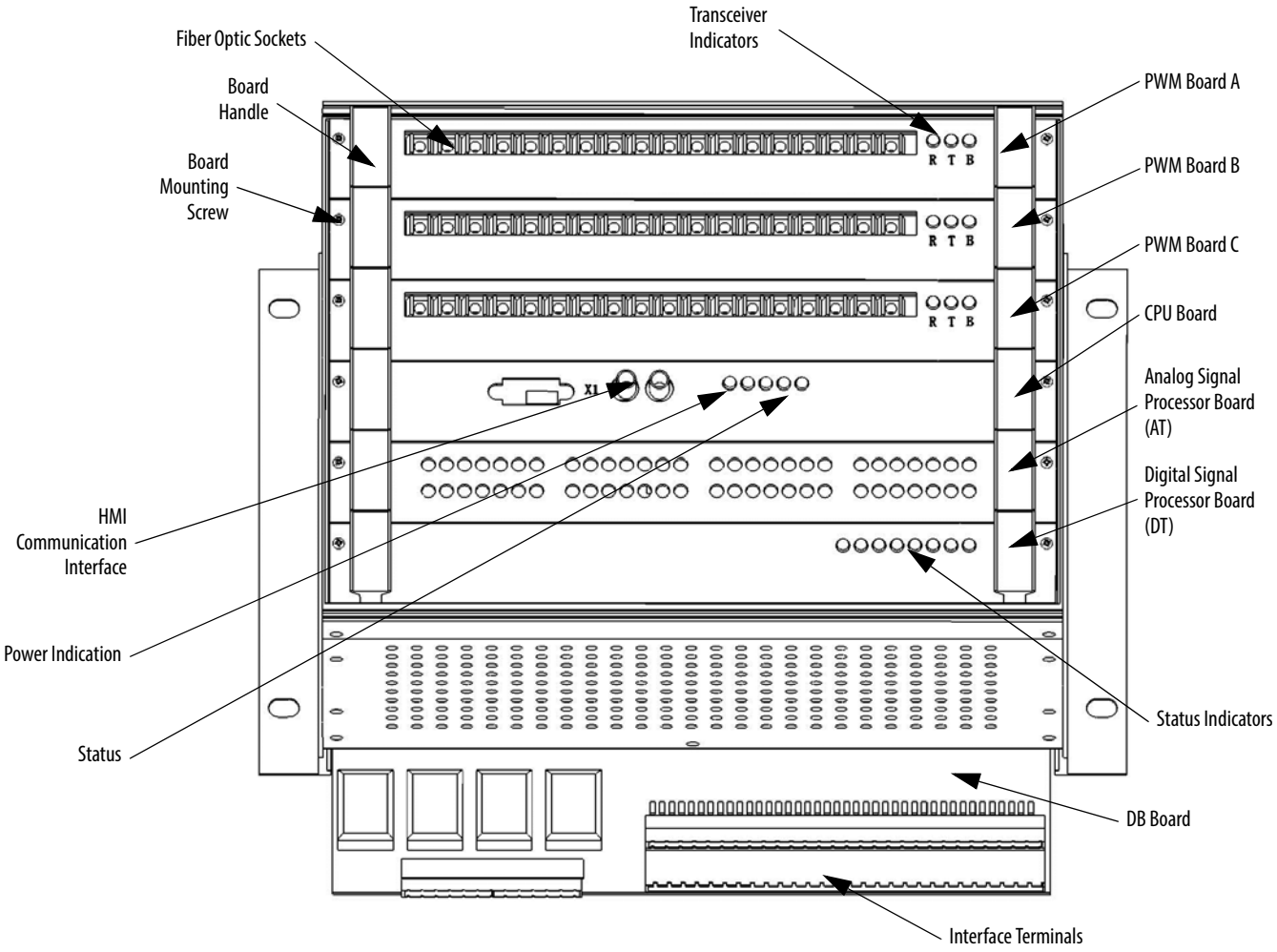
The HMI is located on the front door of the LV Control Cabinet, where an operator can setup, monitor, and control the drive.



Control Unit (all modules)

The control unit provides the core functionality of the variable frequency drive. This includes controlling the power modules to produce the required output voltage and frequency, monitoring the power modules, motor voltage, and motor current to provide alarm and trip signals based on the information.

Figure 20 - PowerFlex 6000 Interface



The CPU Board accepts external inputs through the connected communication network, hard-wired control devices or user interactions via the HMI to determine the actions required of the drive. The CPU Board also monitors motor voltage and current as well as internal inputs from the PLC, analog and digital signal processor boards and Power Modules. It uses these inputs in its motor control and protection algorithms to determine the necessary actions to be taken and outputs to be set. In combination with the PWM Boards, the CPU board sends the necessary optical PWM control signals to the Power Modules to allow the Power Modules to output the required voltage and frequency to the motor

Figure 21 - Control Unit Layout

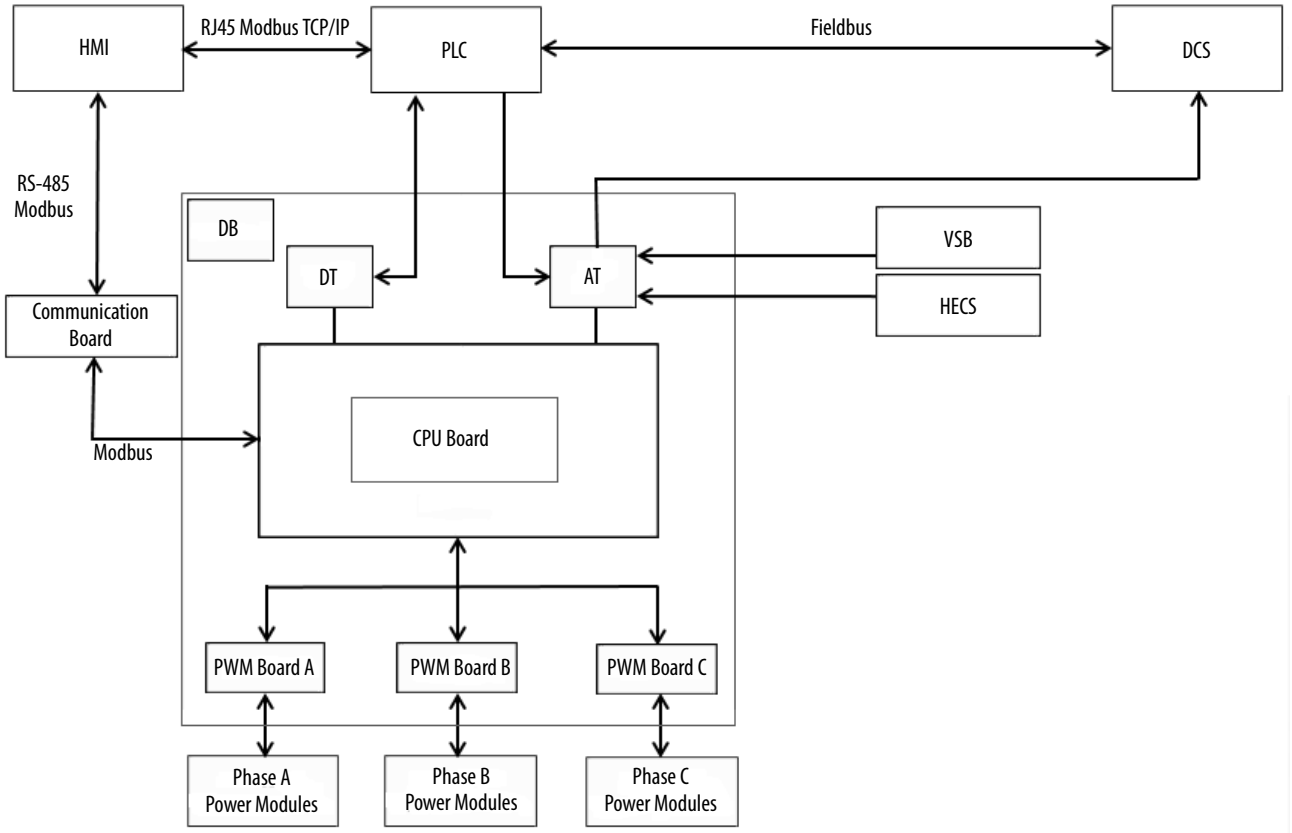


Table 2 - Control Unit description

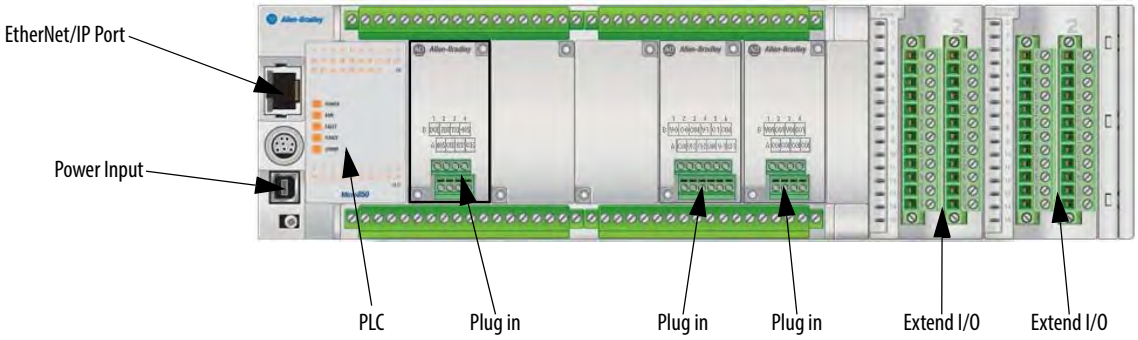
Board Function	
PWM Board A, B, C	Output PWM and control signals to Power Modules Collect and process fault and state information from Power Modules to CPU board Each phase PWM board can control up to nine power cells
CPU Board	Process analog input signals, switch and fault information, control DA and switch signal output, realize V/F algorithm, set and change parameters in communication with HMI
Analog Signal Processor Board (AT)	Collect and process analog input signals to CPU Board, output analog signals processed by DT board
Digital Signal Processor Board (DT)	Collect and output digital signals, digital to analog conversion function
DB Board	Acts as a base board in the Control Unit and interfaces the digital and analog signal cables
Connector	
HMI Communication Interface	Connection between HMI and Control Unit. Provides inputs from the HMI and PLC to the CPU Board
Fiber Optic Socket	Connection between Power Modules and Control Unit (two per module)
Interface Terminals	Connects external inputs, outputs and the CPU Board
Status Indicators	
Phase control board transceiver indicator light	B: board healthy indicator T: transmit data to power module indicator R: receive data from power module indicator
CPU Board Indicator Lights	
5V	5V power supply indicator
3.3V	3.3V power supply indicator
FPGA	FPGA healthy indicator
DSP1	DSP1 healthy indicator
DSP2	DSP2 healthy indicator

Digital Signal Processor Board Indicator Lights	
HVEN	Allow High voltage switching on indicator
RUN	Drive Running indicator
Fault	Drive is in fault state
Trip	Drive is in trip state; any fault can result in trip
Alarm	Drive in alarm state
Reserved	

PLC

The PowerFlex 6000 uses a Micro850 PLC to perform many of its internal control functions. The PLC controls and monitors the cooling fans, input and bypass switching devices, door switch status, etc. The PLC is also responsible for interfacing with the user's automation control system via many optional communication protocols. Standard communication protocols are EtherNet/IP, Modbus/TCP Server and Modbus RTU. Optional communication modules are available to support other communication protocols.

Figure 22 - PLC Location



HMI

The PowerFlex 6000 HMI is a PanelView Plus 700 series, catalog number 2711P-T7C4D9.

The HMI is connected to the Master Control board through a communication interface (standard RJ45 EtherNet/IP connection). The HMI configures operating parameters and input operation commands, and displays the operation status, operation parameters, and fault messages.

UPS

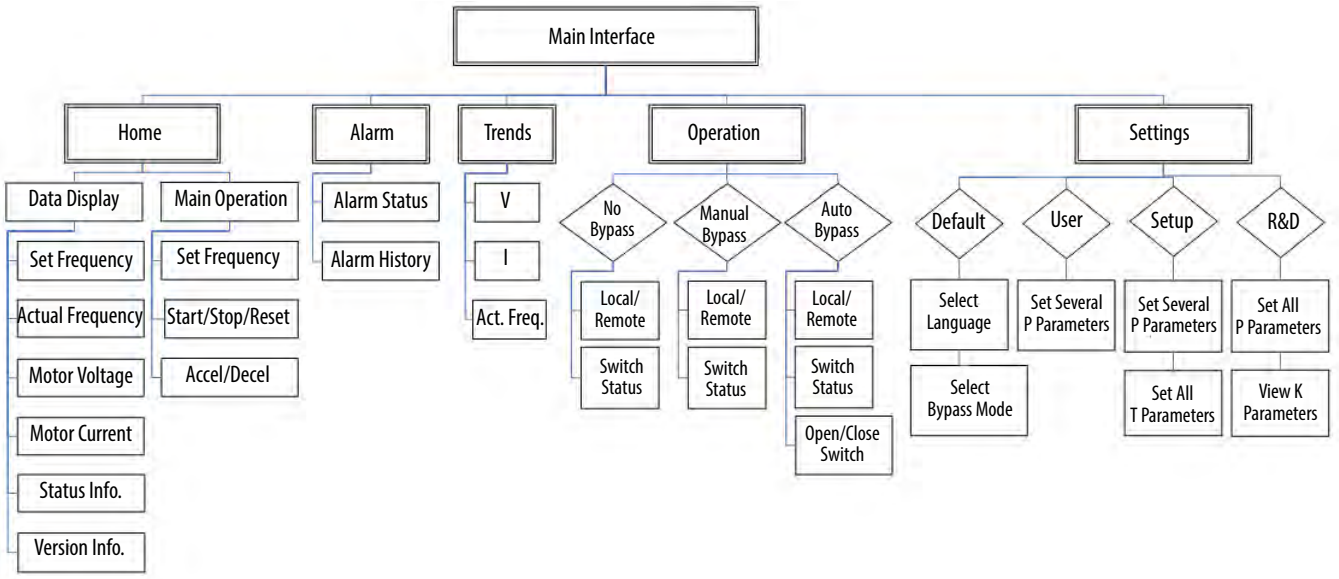
The UPS supplies power to the LV Control cabinet using internal batteries if the customer-supplied control power and isolation transformer control power is off. The UPS provides control power in the event of transient power loss to ensure the drive control can operate without interruption.

Setup and Operation

Overview

The structure of the touchscreen operation is shown in Figure 23.

Figure 23 - HMI Overview

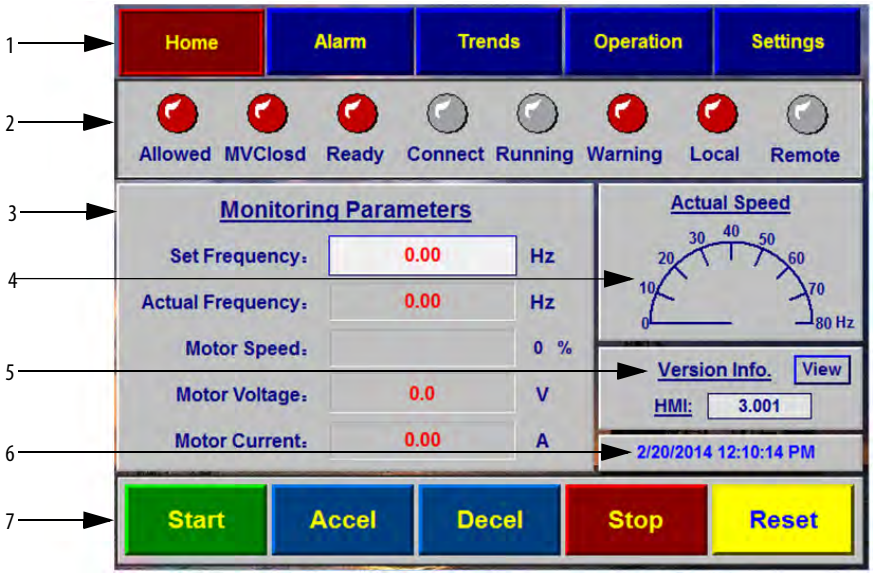


Main Interface

The Main Interface Screen contains configuration and operation controls, monitoring parameters and actual speed.

	Screen Layout
1	Top Menu Bar
2	Status Bar
3	Set and Monitor Box
4	Actual Frequency Display Box
5	Version Information Box
6	Actual Date and Time
7	Operation Bar

Figure 24 - Main Interface Screen



Drive Setup and Configuration Controls

There are five buttons in the Top Menu Bar. A description of the functionality is described in Table 3.

Table 3 - Setup and Configuration Controls

Home	• Return to Main Interface screen
Alarm	• Check warnings • Check faults • Reset alarm status • Show alarm history
Trends	• Check voltage trends • Check current trends • Check frequency trends • Pause trending
Operation	• Confirm/change bypass configuration • Change from local to remote control • Close/open drive contactors (auto bypass)
Settings	• Access System Settings – Change Language – Change Bypass Mode • Access P and T Parameters

Status Indicators

There are eight status indicators on Status Bar.

Table 4 - Status Indicators

Allowed	The drive is in a state that will allow MV to be applied
MVClosd	Indicates that the input switching device feeding MV power to the drive is closed
Ready	Drive is ready to start
Connect	Being connected with medium voltage
Running	The drive is running
Warning	The system has faults or warnings
Local	The system is under Local Control
Remote	The system is under Remote Control

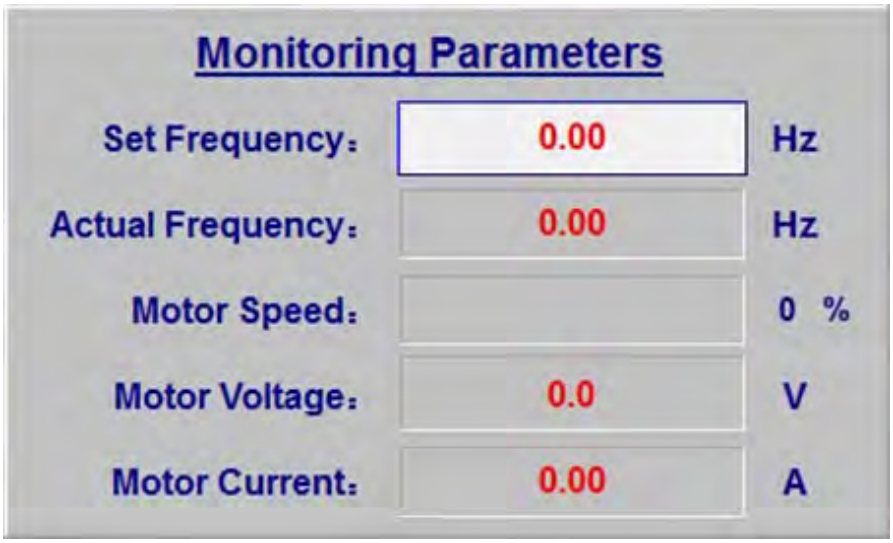
Operation Bar

Table 5 - Operation Bar Buttons

Start	Starts the drive only if no fault is found during self test at startup; otherwise, this button is invalid
Accel	Increases the frequency by the set step
Decel	Decreases the frequency by the set step
Stop	Stop output of the drive
Reset(1)	Resets the drive (under fault conditions) once

(1) The drive must not be running to complete this operation.

Setup and Monitor Box



The set frequency field is the only one which is user-configurable. See Set Frequency (Hz) for instruction on how to set the frequency.

Table 6 - Monitoring Parameters

Set Frequency	Frequency set for the drive (Hz)
Actual Frequency	Actual frequency of the drive (Hz)
Motor Speed	Speed of the motor (%)
Motor Voltage	Voltage of the motor stator (V)
Motor Current	Current of the motor stator (A)

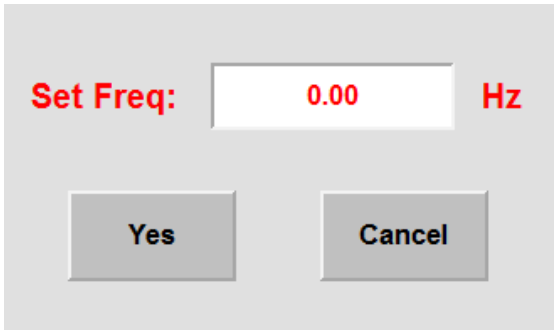
Main Interface Controls

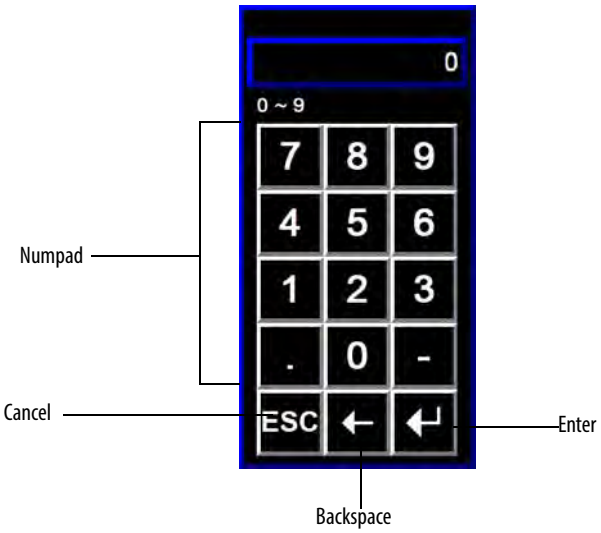
From the Main Interface screen, you can:

Set Frequency (Hz)

1. Press the **Set Frequency:** input field.

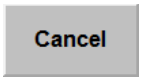
2. Press the Set Freq: input field.



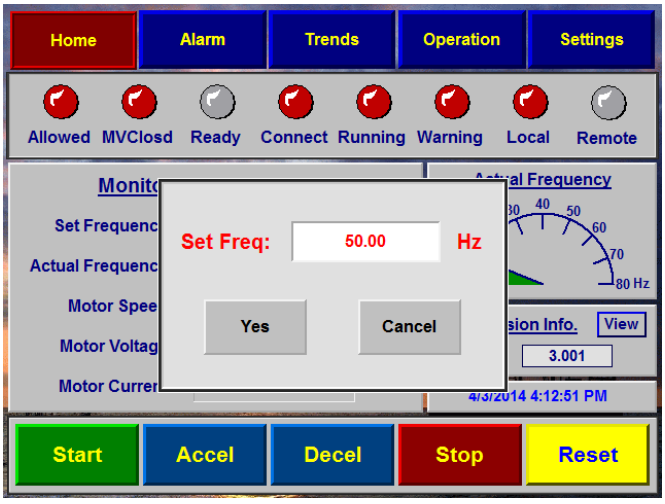


3. Enter desired frequency and press  .

4. Press 

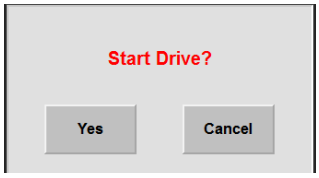
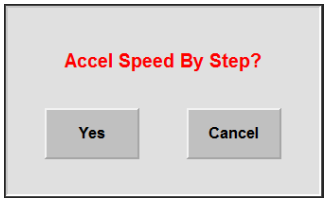
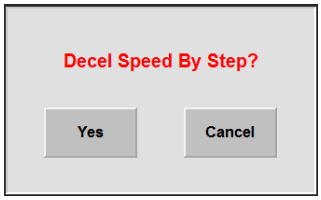
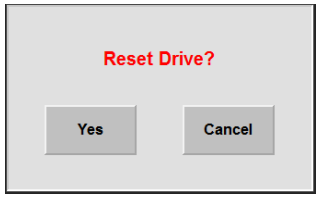
to accept or 

to cancel.



Drive Operation Controls

Press the desired Drive Operation Control button, and Yes to accept or Cancel to cancel.

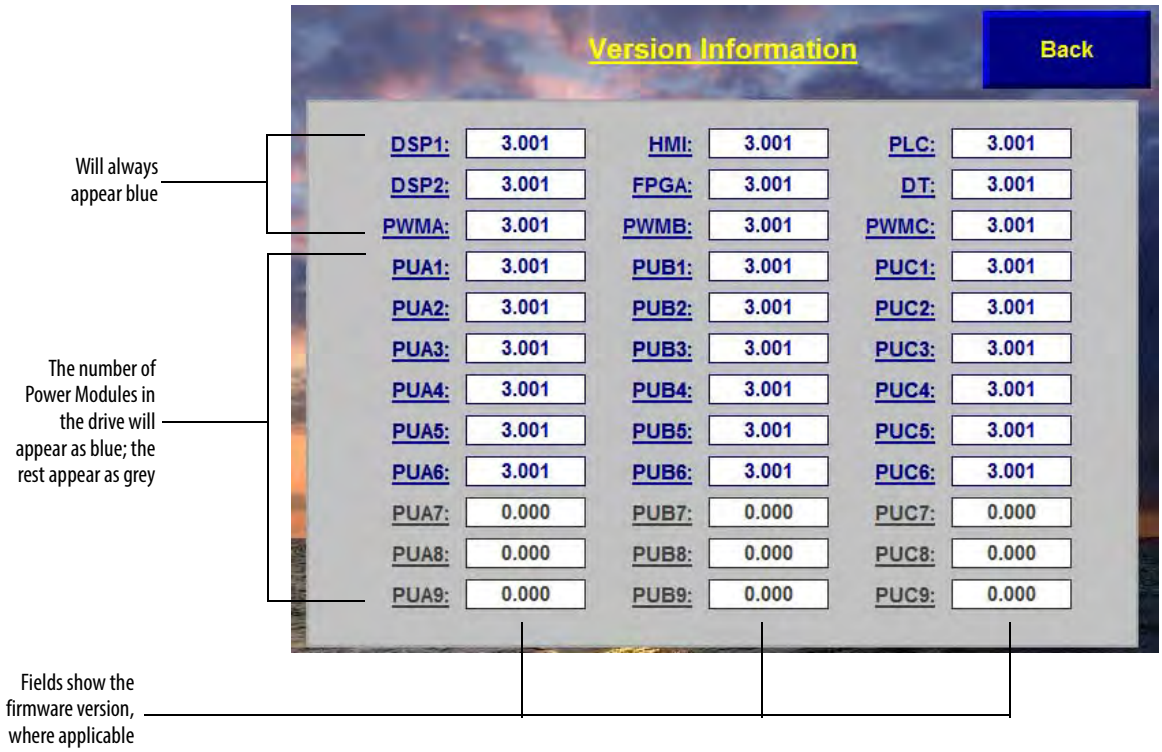
Start	
Accel	
Decel	
Stop	
Reset	

ATTENTION: Drive Operation Controls will only function if using Local Control, otherwise the following dialog appears.

View Version Information

Press View under **Version Info.** to view the currently installed Firmware.

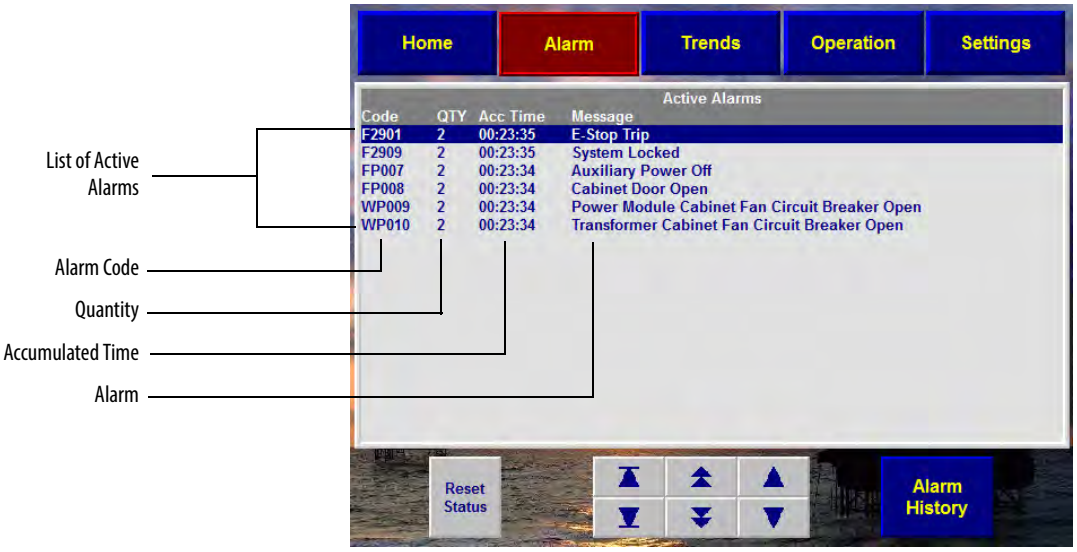
The Version Information screen shows the most current firmware installed for the applicable devices.



Alarm

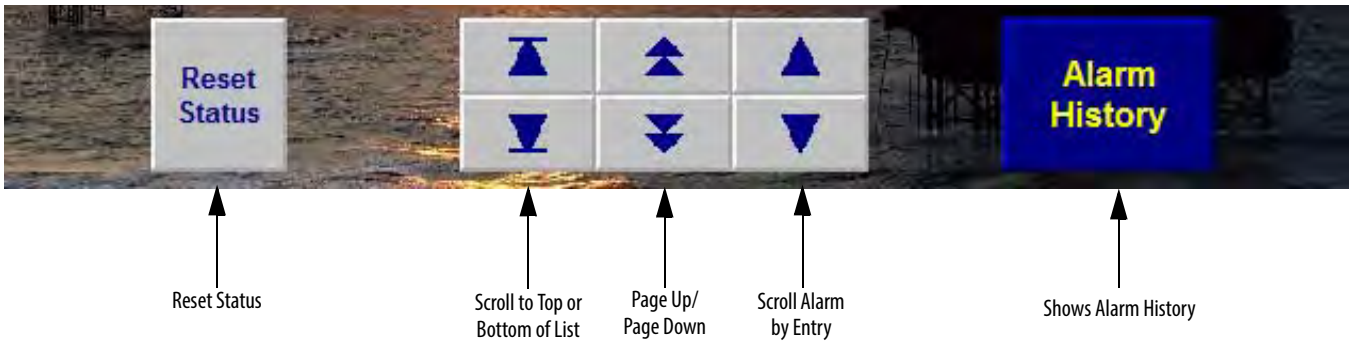
If the drive encounters and alarm or warnings, Alarm will blink, indicating an active alarm.

Press the Alarm button in the Top Menu Bar to see the active alarms.



Code	Alarm code. Codes beginning with W indicates a warning, codes beginning with F indicates a fault.
QTY	How many times the alarm has occurred
Acc Time	Time which has elapsed since the alarm
Message	Description of the warning or fault

Active Alarms Controls

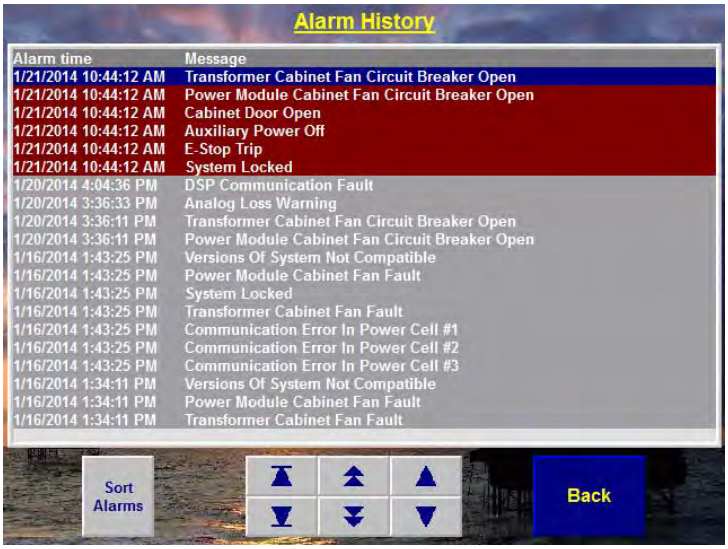


Reset Status

Reset Status will reset just the quantity and accumulated time of the alarms. This function does not reset the drive.

Alarm History

Press Alarm History to see a detailed listed of all warnings and faults on the drive. The controls to scroll through the alarms are the same.



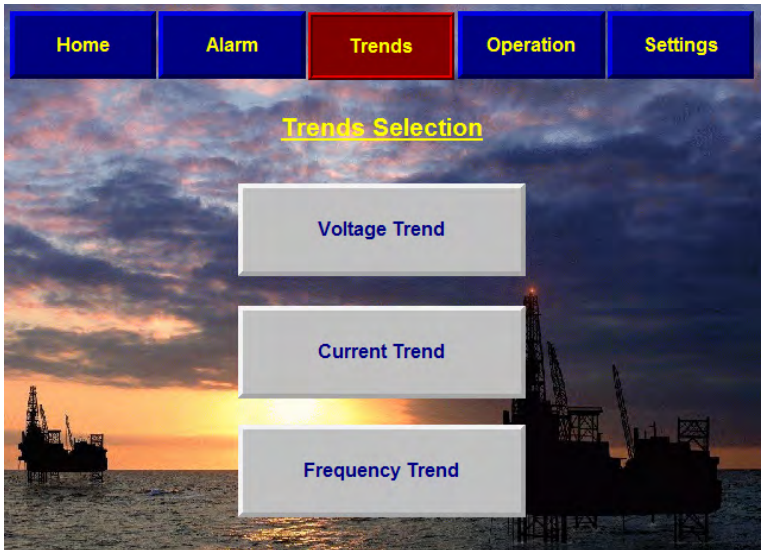
Sort Alarms

Press Sort Alarms once to sort once to sort by time. Press again to sort by message.

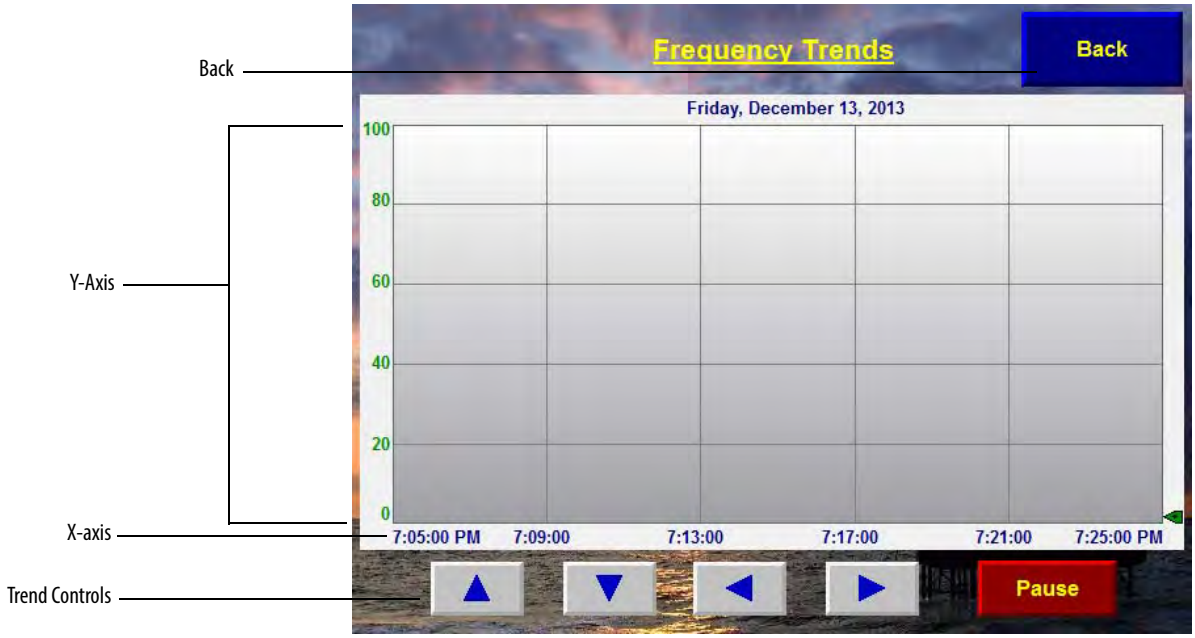
TIP Current alarms appear as red; past alarms appear as gray.

Trends

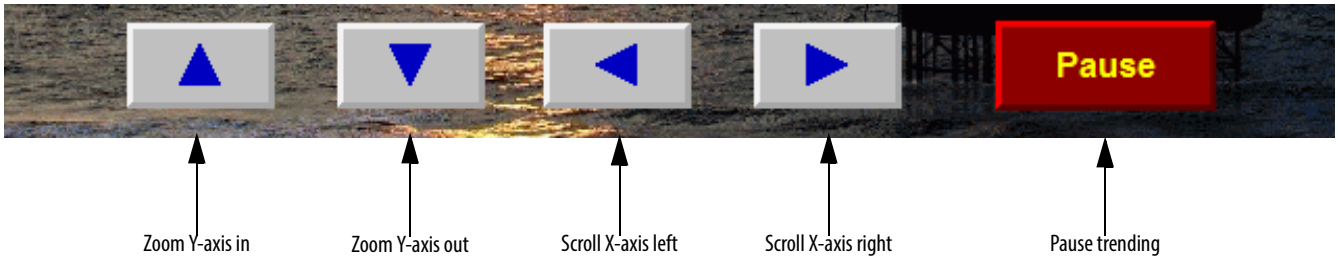
There are three different trending options, Voltage, Current, and Trends. Press any button to view the trends.



You can view Voltage, Current, or Frequency trends. Voltage is measured in volts, Current in amps, and Frequency in Hz.

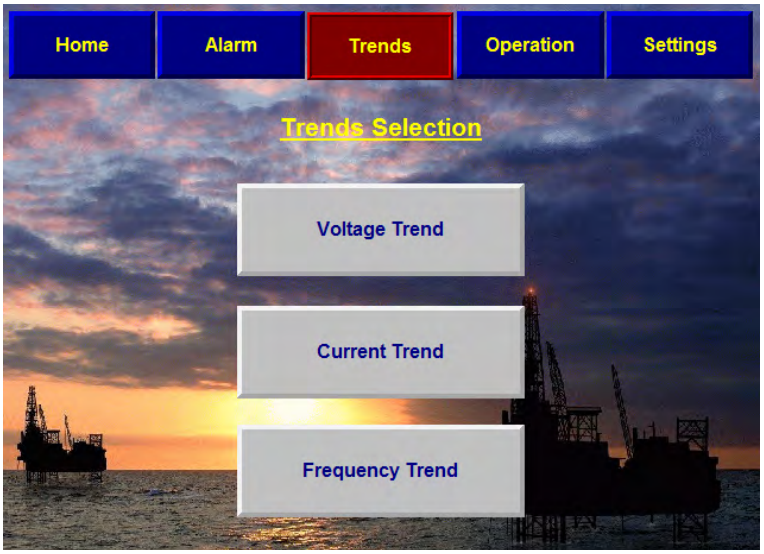


The trend controls are the same for all three screens.



View Voltage, Current or Frequency Trends

1. From the Main Interface screen, press Trends.
2. Press Voltage Trend, Current Trend, or Frequency Trend in the **Trends Selection** screen.



3. Use the ▲ and ▼ buttons to zoom in or out.

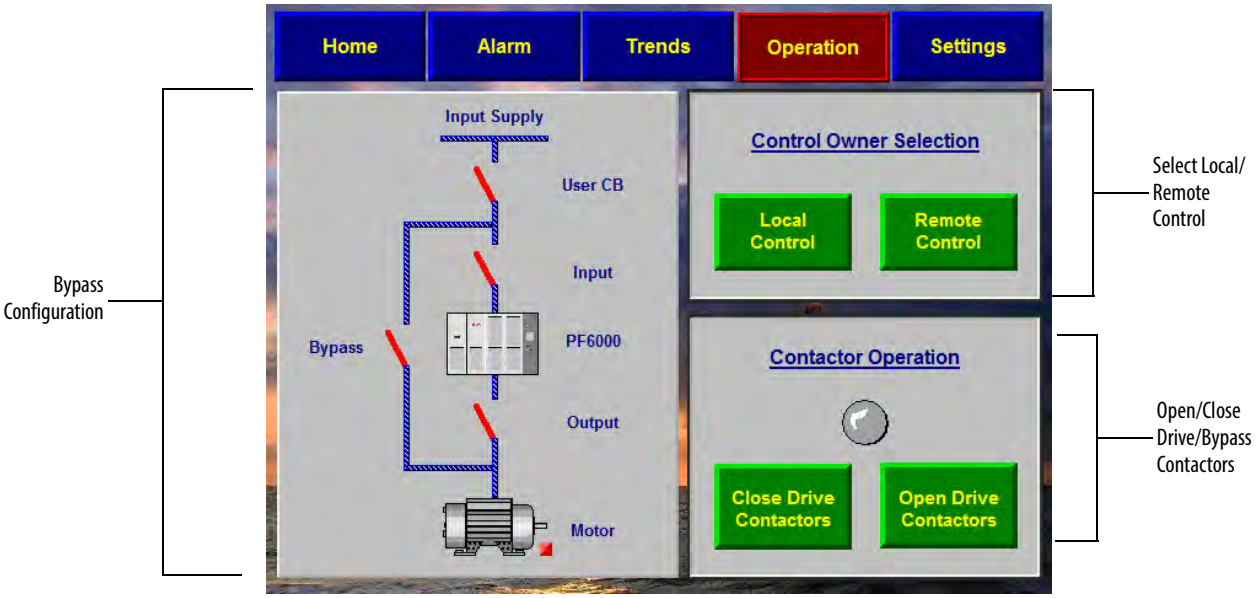
   Press the ◀ and ▶ buttons to scroll.

   TIP The time shown in the X-axis captures 20 minutes. Scrolling left or right will scroll in 10 minute increments.

4. Press Pause to pause the trend capture.
5. Press Back to return to the **Trends Selection** screen.

Operation

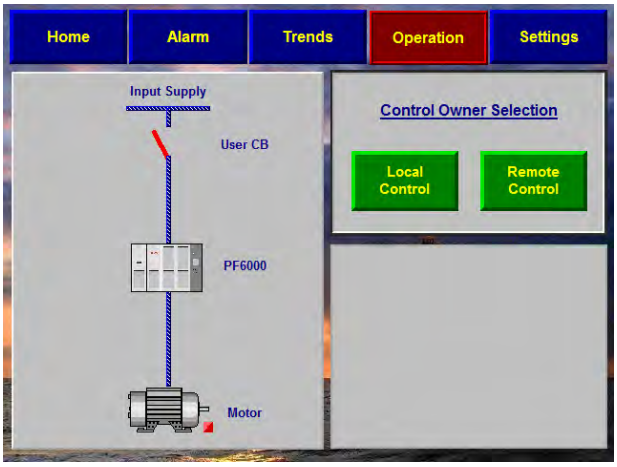
The Operation interface displays the bypass mode, control owner selection, and contactor operation.



In this screen, you can:

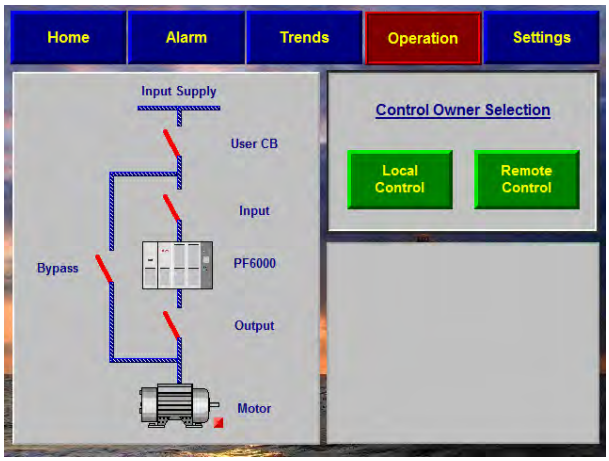
Confirm Bypass Mode

1. Press Operation from the Main Interface screen.
2. Confirm the Bypass Configuration matches one of the three **Input Supply** graphics.

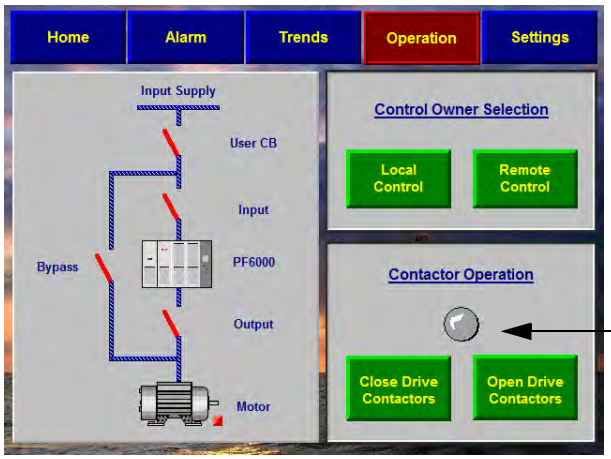


No Bypass Cabinet

Manual Bypass Cabinet



Automatic Bypass Cabinet



Note the Contactor Operation selection appears when Automatic Bypass is selected

3. To change the Bypass Mode:

   a. Press **Settings**.

   b. Press **System Settings**.

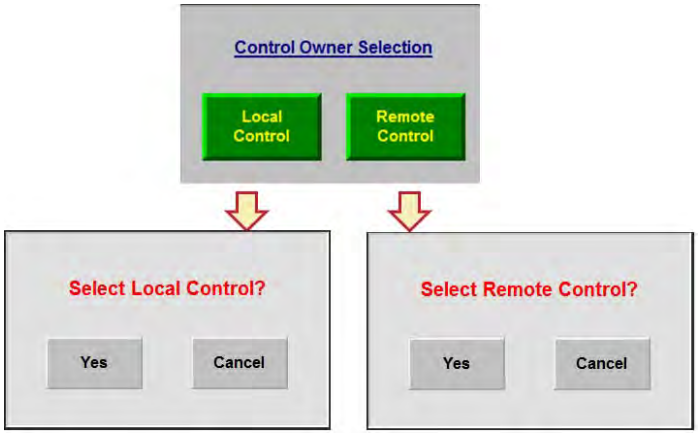
   c. Choose desired Bypass Mode under **Select Bypass Mode**.

   d. Press **RETURN**.

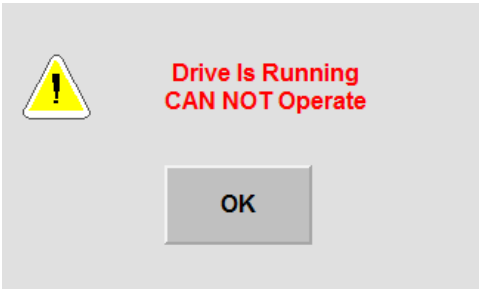
   e. Press **Operation** to confirm operation.

Choose Local/Remote Operation

1. Press Operation from the Main Interface screen.
2. Under **Control Owner Selection**, press either Local Control or Remote Control.
3. Select Yes to confirm in the **Select Local Control?** or **Select Remote Control?** dialog box.



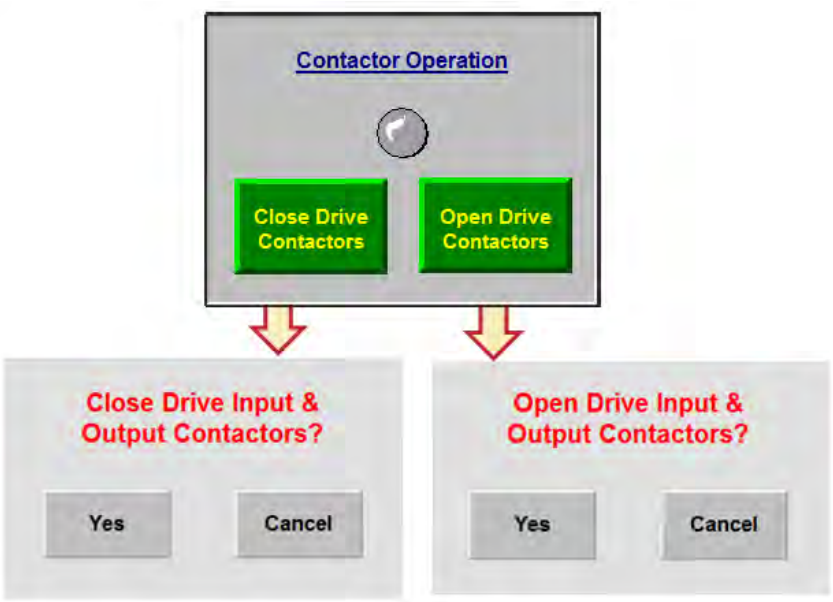
ATTENTION: This operation can only operate while drive is not running.



Open/Close Drive Input and Output Contactors

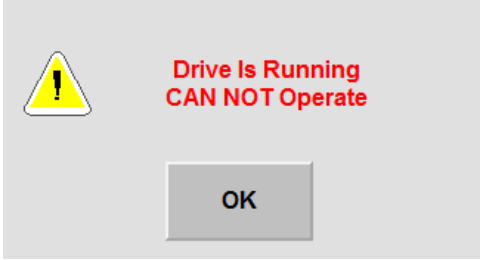
IMPORTANT Turn the 3-position on the selector switch on the front of the LV Cabinet to the Drive position.

1. Under **Contactor Operation**, press either Close Drive Contactors or Open Drive Contactors.
2. Select Yes to confirm in the **Close Drive Input & Output Contactors?** or **Open Drive Input & Output Contactors?** dialog box.



ATTENTION: Operations in this graphic can only operate while on local control.

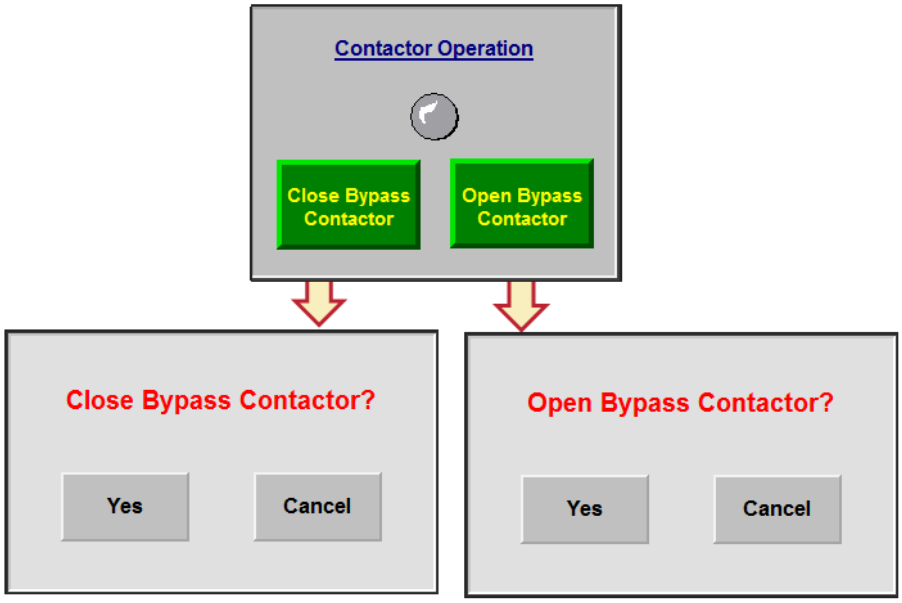
ATTENTION: This operation can only operate while drive is not running.



Open/Close Bypass Contactors

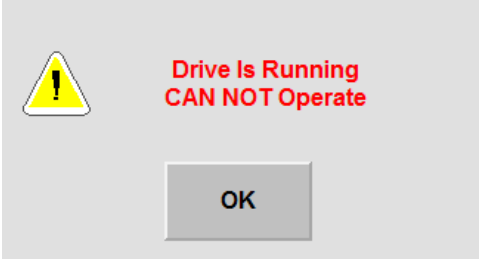
IMPORTANT Turn the 3-position on the selector switch on the front of the LV Cabinet to the Bypass position.

1. Under **Contactor Operation**, press either Close Bypass Contactor or Open Bypass Contactor.
2. Select Yes to confirm in the **Close Bypass Contactors?** or **Open Bypass Contactors?** dialog box.



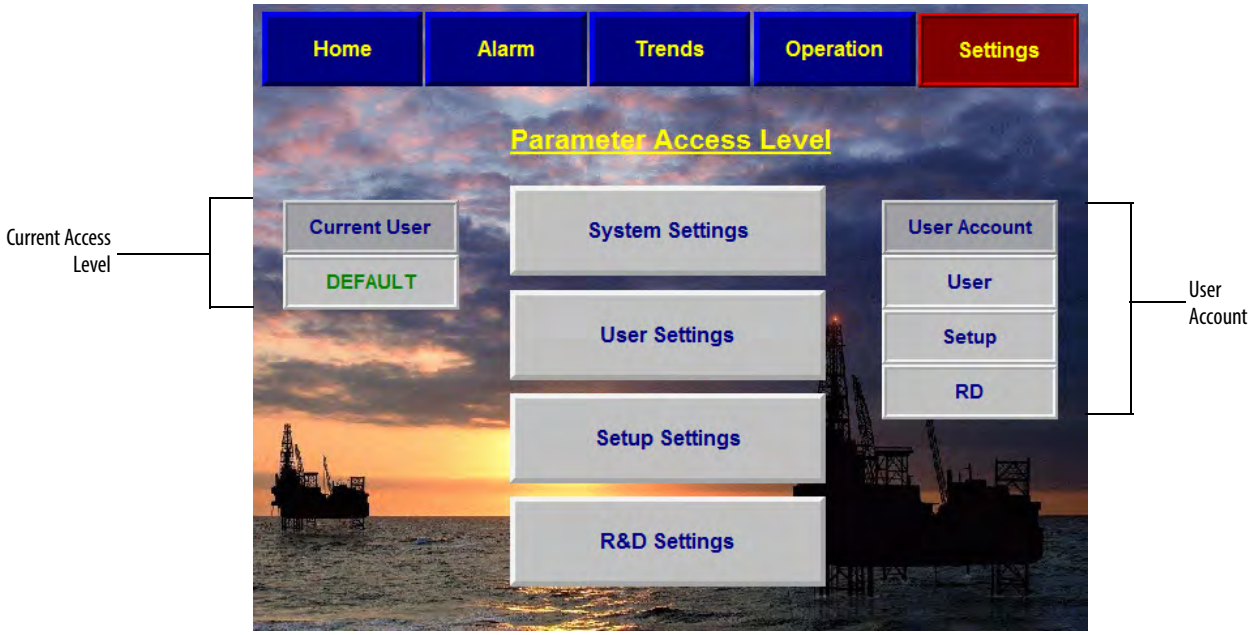
ATTENTION: Operations in this graphic can only operate while on local control.

ATTENTION: This operation can only operate while drive is not running.



Settings

The Settings screen is where you can access and modify parameters, choose or change system language, or change bypass mode.



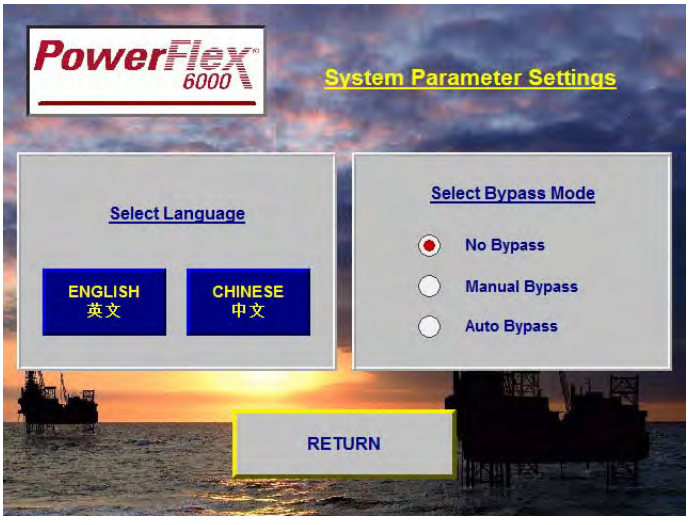
System Settings	Select Language and Bypass Mode
User Settings	View or modify User-level parameter settings
Setup Settings	View or modify “P” or “T” parameters
R&D Settings	For use by authorized Rockwell Automation personnel only.

System Settings

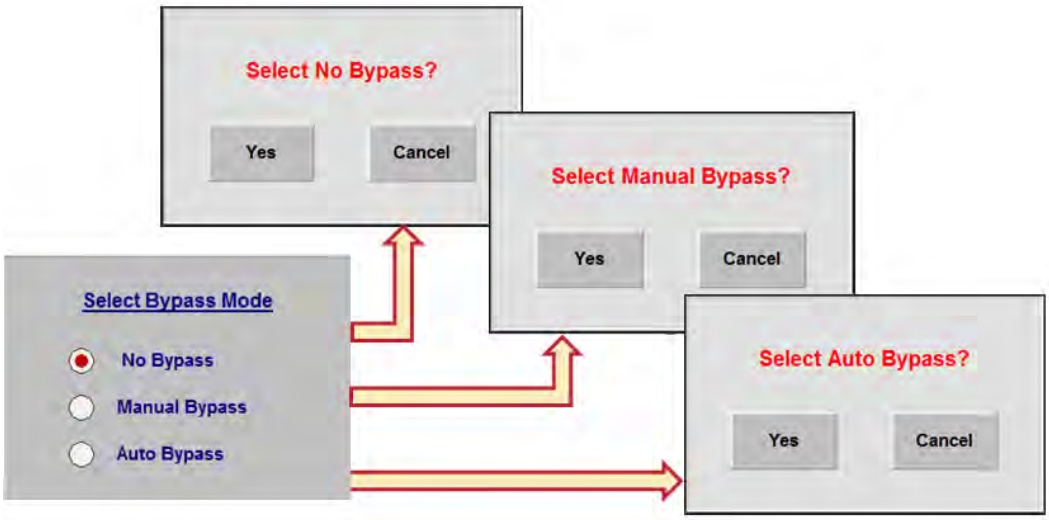
Change the HMI language or bypass mode under System Settings.

1. Press 

.
2. Press desired language to choose that language.



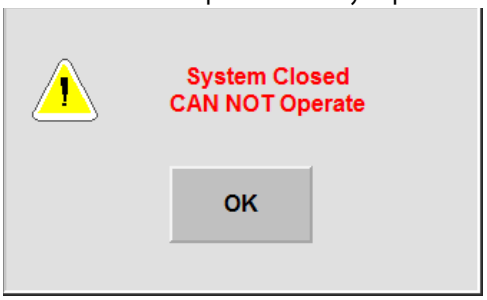
3. Select bypass mode and press Yes to accept or Cancel to cancel.



4. Press RETURN to accept.

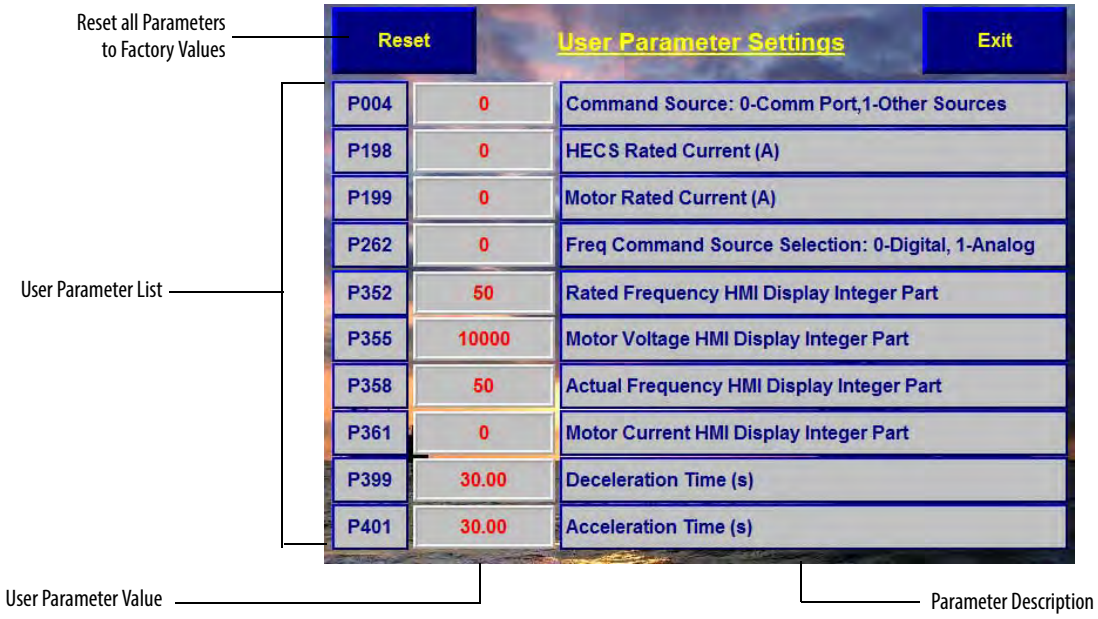
ATTENTION: Operations in this graphic can only operate while on local control.

ATTENTION: This operation can only be performed when any switch is closed.



User Settings

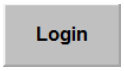
You can access, view, or change the user parameters in User Settings.



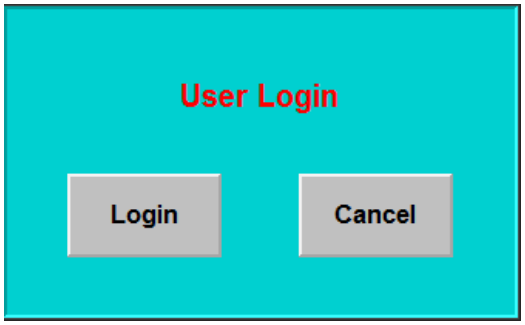
Change User Parameters

1. Press 

.

2. The **User Login** dialog box appears. Press 

.



3. Enter the User and Password details.

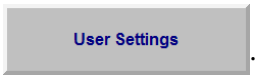
   Press 

to enter user details. Press 
when finished.

   Press 

to enter password details. Press 
when finished.

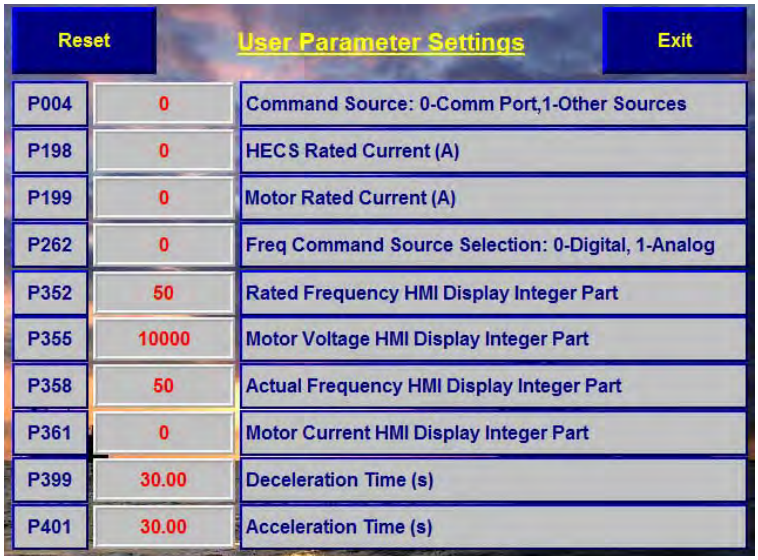
4. Press  to login.
5. If the login was successful, the Current User will show as User.

6. Press 

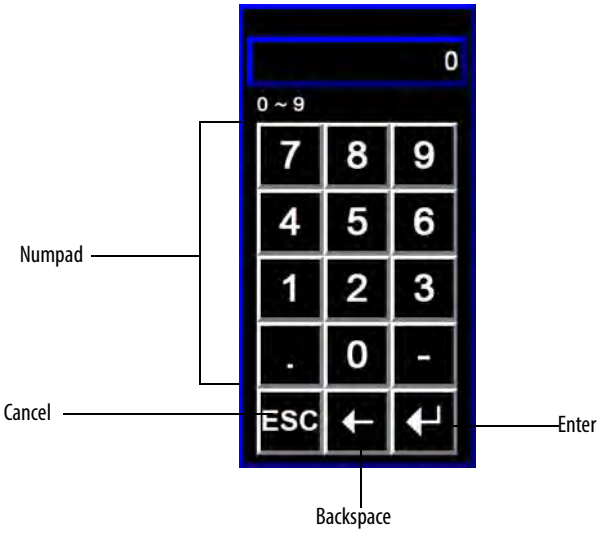
.

IMPORTANT If the login information was incorrect, you will be prompted to login again.

In the **User Parameters Settings** screen, the user parameters automatically refresh.



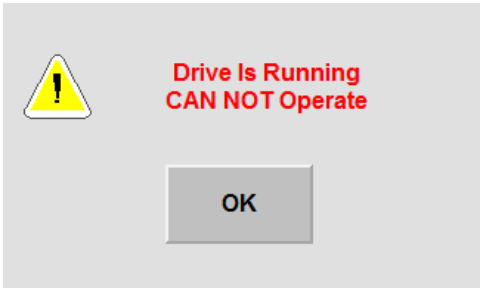
Press the parameter input field to change the parameter value.



Press **Reset** to restore all user parameters to the factory setting.

ATTENTION: Operations in this graphic can only operate while on local control.

ATTENTION: This operation can only operate while drive is not running.

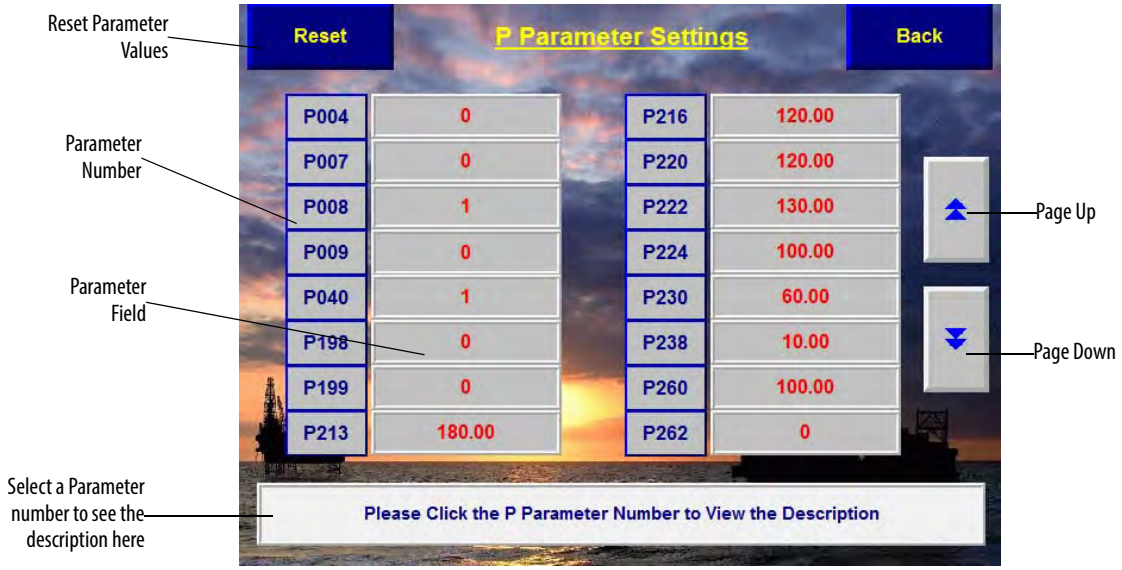


Press **EXIT** to return to the **Parameter Access Level** screen.

TIP User parameter access will logout when you exit User Settings.

Setup Settings

View or modify "P" or "T" Parameters in the Setup Settings interface.

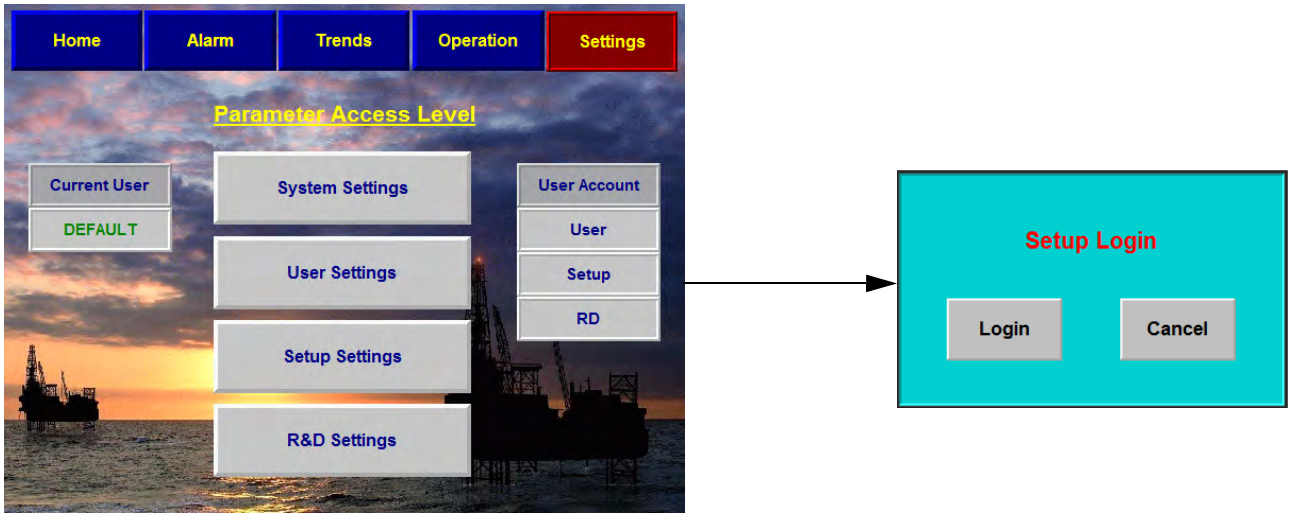


View/Change P or T Parameters

IMPORTANT You must have Setup login access to view or modify "P" or "T" parameters.

1. Press Setup Settings under **Parameter Access Level**.

   The **Setup Login** dialog box appears. Press Login.



2. Enter the User and Password details.

Press 

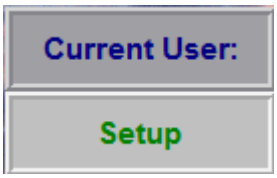
to enter user details. Press  when finished.

Press 

to enter password details. Press  when finished.

3. Press  to login.

   The Current User will now display Setup, indicating appropriate access has been granted.



4. Once logged in, press 

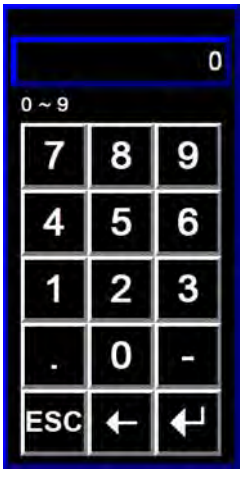
to proceed.

IMPORTANT If the login information was incorrect, you will be prompted to login again.

5. Press 

or 

in the **Setup Parameter Type**.
6. Press the Parameter Field and enter desired value on the keypad dialog and press  .

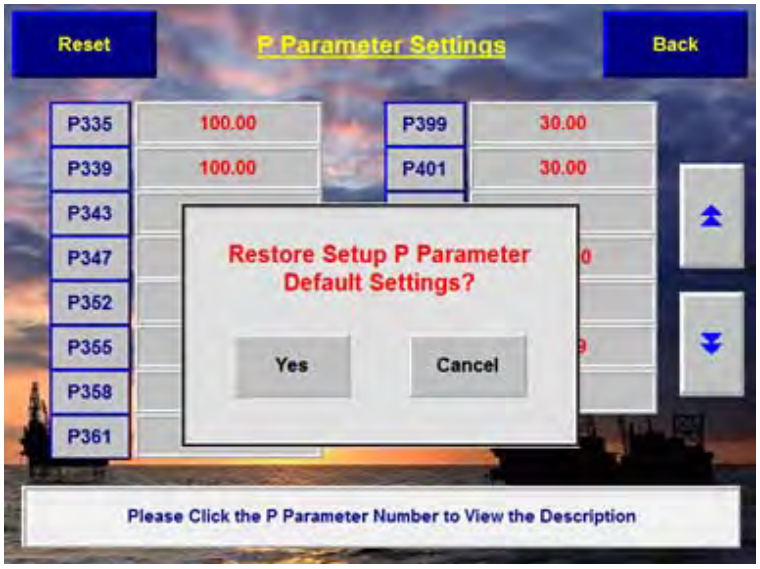


7. Press  or  to Page Up or Page Down through the parameters.

Restore "P" or "T" Parameters

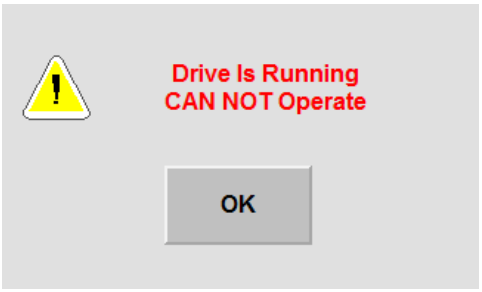
Press **Reset** to restore the parameters to factory settings.

Press **Yes** to accept or **Cancel** to cancel.



ATTENTION: Operations in this graphic can only operate while on local control.

ATTENTION: This operation can only operate while drive is not running.



Notes:

Parameters and Function Codes

P Parameters

Parameter Number	Description	Default Value	Modify Root	Lower Limit	Upper Limit
P004	Command Source 0: Communication Port 1: Other Sources	0	OFF	0	1
P005	Restore Factory Settings 40: User Level 30: Setup Level 50: R&D Level	0	OFF	0	50
P007	Number Of Power Cells Per Phase	9	ON	0	9
P008	Motor Rotation Direction Under Local Control 1: Forward 0: Reverse	1	OFF	0	1
P009	Motor Rotation Direction Command Selection: 0: Local 1: DCS	0	OFF	0	1
P010	Power Cell Fault Mask	32767	ON	0	32767
P017	Number Of Motor Pole Pairs	2	OFF	0	100
P018	Enable Flying Start With Encoder	0	OFF	0	1
P019	Encoder Resolution	1024	OFF	0	4096
P020	Mask Bit For System Fault	32767	ON	0	32767
P021	Mask Bit For System Warning	32767	ON	0	32767
P022	Mask Bit For Logic Fault A	32767	ON	0	32767
P023	Mask Bit For Logic Fault B	32767	ON	0	32767
P024	Stop Method 0: Ramp Down 1: Coast Stop	0	ON	0	1
P025	Flux Reduction Enable	0	ON	0	1
P026	Power Angle Threshold For Flux Reduction	0	ON	0	180
P027	Time For Flux Reducing	5000	ON	0	32767
P028	Flux Reduction Ratio	70	ON	0	100
P029	Power Angle Threshold For Flux Restore	0	ON	0	180
P040	Safe Start Condition 0: Zero Frequency Command Required 1: Frequency Command Allowed	1	OFF	0	1
P089	Skip Frequency Enable 0: Disable 1: Enable	0	ON	0	1

Parameter Number	Description	Default Value	Modify Root	Lower Limit	Upper Limit
P090	Skip Frequency 1 Lower Limit	0	ON	0	75
P091	Skip Frequency 1 Upper Limit	0	ON	0	75
P092	Skip Frequency 2 Lower Limit	0	ON	0	75
P093	Skip Frequency 2 Upper Limit	0	ON	0	75
P113	Flying Start-Initial Output Voltage Percentage (%)	5	ON	0	100
P114	Flying Start-Current Comparison Delay For Motor Speed Search (ms)	1000	ON	0	5000
P115	Flying Start-Current Threshold For Successful Motor Speed Search	5	ON	0	100
P198	HECS Rated Current (A)	0	ON	0	5000
P199	Motor Rated Current (A)	0	ON	0	5000
P200	Ia Motor Current Memory Address	13	ON	0	500
P201	Motor Ia Scaling Correction Factor	100	ON	0	199.99
P202	Ib Motor Current Memory Address	14	ON	0	500
P203	Motor Ib Scaling Correction Factor	100	ON	0	199.99
P204	Motor Uab Voltage Address	11	ON	0	500
P205	Motor Uab Voltage Scaling Factor Correction	199.99	ON	0	199.99
P206	Motor Uac Voltage Scaling Factor Correction	199.99	ON	0	199.99
P211	Filter Time For Abnormal Output Voltage (ms)	1000	ON	0	32767
P212	Filter Time For Output Short-Circuit (ms)	10	ON	0	32767
P213	Output Short-Circuit Fault Threshold	180	ON	0	199.99
P214	Over Current Low/High Speed Region Boundary	5	ON	0	100
P215	Filter Time For Output Over Current (0.1 s)	200	ON	0	32767
P216	High-Frequency Output Over Current Threshold	120	ON	0	199.99
P217	Low-Frequency Output Over Current Threshold	70	ON	0	199.99
P218	Filter Time For Motor Over Temperature (0.1 s)	6000	ON	0	32767
P219	Motor Over Temperature Warning Threshold	110	ON	0	199.99
P220	Motor Over Temperature Fault Threshold	120	ON	0	199.99
P221	Filter Time For Output Over Voltage (ms)	100	ON	0	32767
P222	Output Over Voltage Fault Threshold	130	ON	0	199.99
P223	Output Voltage Deviation Warning Threshold	60	ON	0	199.99
P224	Output Voltage Deviation Fault Threshold	80	ON	0	199.99
P225	Motor Over Temperature Warning Cancellation Temperature	100	ON	0	199.99
P226	Output Voltage Abnormality Warning Cancellation Threshold	50	ON	0	199.99
P227	Ground Fault Detection Scaling Correction Factor	100	ON	0	199.99
P228	Filter Time For Ground Fault (ms)	1000	ON	0	32767
P229	Ground Fault Warning Threshold	20	ON	0	199.99
P230	Ground Fault Trip Threshold	60	ON	0	199.99
P231	Filter Time For Overspeed Fault (Upper Limit)	100	ON	0	32767

Parameter Number	Description	Default Value	Modify Root	Lower Limit	Upper Limit
P232	Filter Time For Overspeed Fault (Lower Limit)	100	ON	0	32767
P233	Threshold Of Over-Speed Fault At Lower Frequency Limit	20	ON	0	199.99
P234	Threshold Of Over-Speed Fault At Upper Frequency Limit	20	ON	0	199.99
P235	Frequency Deviation Warning Cancellation Threshold	0.99	ON	0	199.99
P236	Frequency Deviation Warning Threshold	6	ON	0	199.99
P237	Frequency Deviation Warning Delay (ms)	8	ON	0	32767
P238	Motor Stall Fault Threshold	10	ON	0	199.99
P239	Motor Stall Fault Delay (ms)	6000	ON	0	32767
P240	Transformer Over Temperature Fault Delay (ms)	5000	ON	0	32767
P241	Transformer Over Temperature Warning Delay (ms)	5000	ON	0	32767
P247	Software Interlock: 1-Disable, 0-Enable	1	ON	0	1
P250	Input Contactor/Circuit Breaker Close Delay (ms)	5000	ON	0	10000
P251	Frequency Command-Low Frequency Region Boundary	0.5	ON	0	100
P252	Motor In Stopping Condition Threshold	1	ON	0	100
P253	Motor Coast Stop Time	10	ON	0	10000
P256	Ground Fault Warning Cancellation Threshold	10	ON	0	199.99
P257	Motor Stall Warning Cancellation Threshold	2.98	ON	0	199.99
P259	Frequency Command Analog Offset	0	ON	-100	199.99
P260	Frequency Command Analog Scaling Factor	100	ON	0	199.99
P261	Frequency Command Analog Minimum	0.49	ON	0	199.99
P262	Frequency Command Source Selection: 0-Digital, 1-Analog	0	OFF	0	1
P270	Delayed Lockout Time Of Stop Operation (ms)	2000	ON	0	5000
P271	Flux Delay (ms)	50	ON	0	5000
P300	Digital Output #0 Memory Address	99	ON	0	500
P301	Digital Output #0 Logic: 1-Inverting, 0-Non-Inverting	0	ON	0	1
P302	Digital Output #0 Bit Selection (0...15)	0	ON	0	15
P303	Digital Output #0 Delay (ms)	0	ON	0	32767
P304	Digital Output #1 Memory Address	99	ON	0	500
P305	Digital Output #1 Logic: 1-Inverting, 0-Non-Inverting	0	ON	0	1
P306	Digital Output #1 Bit Selection (0...15)	1	ON	0	15
P307	Digital Output #1 Delay (ms)	0	ON	0	32767
P308	Digital Output #2 Memory Address	99	ON	0	500
P309	Digital Output #2 Logic 1: Inverting 0: Non-Inverting	0	ON	0	1
P310	Digital Output #2 Bit Selection (0...15)	2	ON	0	15
P311	Digital Output #2 Delay (ms)	0	ON	0	32767
P312	Digital Output #3 Memory Address	99	ON	0	500

Parameter Number	Description	Default Value	Modify Root	Lower Limit	Upper Limit
P313	Digital Output #3 Logic 1: Inverting 0: Non-Inverting	0	ON	0	1
P314	Digital Output #3 Bit Selection (0...15)	3	ON	0	15
P315	Digital Output #3 Delay (ms)	0	ON	0	32767
P316	Digital Output #4 Memory Address	99	ON	0	500
P317	Digital Output #4 Logic 1: Inverting 0: Non-Inverting	0	ON	0	1
P318	Digital Output #4 Bit Selection (0...15)	4	ON	0	15
P319	Digital Output #4 Delay (ms)	0	ON	0	32767
P320	Digital Output #5 Memory Address	99	ON	0	500
P321	Digital Output #5 Logic 1: Inverting 0: Non-Inverting	0	ON	0	1
P322	Digital Output #5 Bit Selection (0...15)	5	ON	0	15
P323	Digital Output #5 Delay (ms)	0	ON	0	32767
P324	Digital Output #6 Memory Address	99	ON	0	500
P325	Digital Output #6 Logic 1: Inverting 0: Non-Inverting	0	ON	0	1
P326	Digital Output #6 Bit Selection (0...15)	6	ON	0	15
P327	Digital Output #6 Delay (ms)	0	ON	0	32767
P328	Digital Output #7 Memory Address	99	ON	0	500
P329	Digital Output #7 Logic 1: Inverting 0: Non-Inverting	0	ON	0	1
P330	Digital Output #7 Bit Selection (0...15)	7	ON	0	15
P331	Digital Output #7 Delay (ms)	0	ON	0	32767
P332	Analog Output #1 Memory Address	252	ON	0	500
P333	Analog Output #1 Filter Time (ms)	1000	ON	0	32767
P334	Analog Output #1 Offset	0	ON	-100	100
P335	Analog Output #1 Scaling Factor	100	ON	0	199.99
P336	Analog Output #2 Memory Address	206	ON	0	500
P337	Analog Output #2 Filter Time (ms)	1000	ON	0	32767
P338	Analog Output #2 Offset	0	ON	-100	100
P339	Analog Output #2 Scaling Factor	100	ON	0	199.99
P340	Analog Output #3 Memory Address	0	ON	0	500
P341	Analog Output #3 Filter Time (ms)	1000	ON	0	32767
P342	Analog Output #3 Offset	0	ON	-100	100
P343	Analog Output #3 Scaling Factor	100	ON	0	199.99
P344	Analog Output #4 Memory Address	0	ON	0	500
P345	Analog Output #4 Filter Time (ms)	1000	ON	0	32767

Parameter Number	Description	Default Value	Modify Root	Lower Limit	Upper Limit
P346	Analog Output #4 Offset	0	ON	-100	100
P347	Analog Output #4 Scaling Factor	100	ON	0	199.99
P351	Rated Frequency HMI Display Filter Time (ms)	100	ON	0	32767
P352	Rated Frequency HMI Display Integer Part	50	ON	0	75
P353	Rated Frequency HMI Display Decimal Part	0	ON	0	1000
P354	Motor Voltage HMI Display Filter Time (ms)	2000	ON	0	32767
P355	Motor Voltage HMI Display Integer Part	10000	ON	0	16384
P356	Motor Voltage HMI Display Decimal Part	0	ON	0	1000
P357	Actual Frequency HMI Display Filter Time (ms)	100	ON	0	32767
P358	Actual Frequency HMI Display Integer Part	50	ON	0	75
P359	Actual Frequency HMI Display Decimal Part	0	ON	0	1000
P360	Motor Current HMI Display Filter Time (ms)	2000	ON	0	32767
P361	Motor Current HMI Display Integer Part	0	ON	0	5000
P362	Motor Current HMI Display Decimal Part	0	ON	0	1000
P371	Rated Frequency HMI Display Address	221	ON	0	500
P372	Motor Voltage HMI Display Address	119	ON	0	500
P373	Actual Frequency HMI Display Address	252	ON	0	500
P374	Motor Current HMI Display Address	118	ON	0	500
P399	Deceleration Time (s)	300	ON	0	3276
P400	Deceleration Time During Loss Of Input Supply (s)	200	ON	0	3276
P401	Acceleration Time (s)	200	ON	0	3276
P402	Acceleration Ramp Transition Time (s)	3	ON	0	3276
P403	Acceleration Time Unit 1000 = 0.01 s 10000 = 0.1s	0.1	ON	0	0.1
P405	Deceleration Ramp Transition Time (s)	3	ON	0	3276
P406	Deceleration Time Unit 1000 = 0.01 s 10000 = 0.1s	0.1	ON	0	0.1
P409	Amplification Coefficient Of Error Terms	100	ON	0	199.99
P413	Frequency Command Lower Limit	0	ON	-16384	16384
P414	Frequency Command Deadband Upper Limit	0.49	ON	0	100
P415	Frequency Command Upper Limit	16384	ON	-16384	16384
P416	Flying Start Mode 0: Disable 1: Set Frequency 2: Stop Frequency Plus 5 Hz 3: Rated Frequency	0	ON	0	3
P417	Flying Start Motor Speed Search Timeout (s)	50	ON	0	1000
P438	Flying Start Current Compensation Threshold	100	ON	0	199.99
P439	Current Compensator Output Upper Limit	100	ON	0	100
P442	Current Compensation Threshold	190	ON	0	199.99

Parameter Number	Description	Default Value	Modify Root	Lower Limit	Upper Limit
P443	Upper Limit Of Current Compensation Input Deadband	0	ON	-16384	32767
P444	Lower Limit Of Current Compensation Input Deadband	0	ON	-16384	32767
P445	Proportional Coefficient Of Current Compensation (%)	5	ON	0	199.99
P446	Integral Coefficient Of Current Compensation (ms)	100	ON	0	32767
P447	Lower Limit Of Current Compensation Output	-100	ON	-100	0
P448	Minimum Frequency For Current Compensation	5	ON	0	100
P449	Proportional Coefficient Of Current Compensation Output (%)	0.99	ON	0	199.99
P450	Upper Limit Of Frequency Compensation Output	100	ON	0	100
P451	Low Speed Voltage Compensation (%)	0.99	OFF	0	10
P452	Low Speed Voltage Compensation Frequency Threshold	20	ON	0	100
P453	V/F Curve 0: Linear 1: Parabolic Curve 2: Predefined Curve #1 3: Predefined Curve #2	1	OFF	0	3
P454	Flux Time (s)	0.5	OFF	0	10
P455	Modulation Index	87.99	ON	0	199.99
P456	Motor Voltage Upper Limit	87.99	ON	0	199.99
P457	Flying Start Voltage Recovery Time (s) (Low Speed Region)	5	ON	0	163.84
P458	Coefficient A	40	OFF	0	100
P459	Flying Start Voltage Recovery Time (s) (High Speed Region)	5	ON	0	163.84
P460	Rated Output Frequency	50	OFF	0	75
P461	Restart Enable	0	ON	0	1
P462	Fault Reset Timeout (s)	120	ON	0	120
P463	Flying Start Low/High Speed Regions Boundary (%)	16	ON	0	100
P465	Power Cell Fault Auto Reset Delay (s)	4	ON	0	10
P466	Maximum Output Frequency	50	OFF	0	75
P467	Over Speed Enable	0	OFF	0	1
P470	Version Compatibility Enable	1	OFF	0	1
P497	Major Rev # Of DSP Main Firmware	0	Cannot Modify	——	——
P498	Minor Rev # Of DSP Main Firmware	2	Cannot Modify	——	——
P499	Display Fault Masks Button	0	ON	0	1
P500	Display DSP Variables	0	ON	0	1

T Parameters

Parameter Number	Description	Default Value	Modify Root	Lower Limit	Upper Limit
T01	Fault-To-Bypass 0: Disable 1: Enable	0	ON	0	1
T02	Fault-To-Bypass Delay	3	ON	0	60
T03	Fault-To-Bypass Delay When Starting the Motor (0...60s)	60	ON	0	60
T04	Fault-To-Bypass Minimum Frequency 0...Rated Frequency (Hz)	5	ON	0	Rated Frequency
T05	Auto Restart After Input Supply Power Loss 0: Disable 1: Enable	0	ON	0	1
T06	Input Supply Power Loss Time for Auto Restart (0...20s)	20	ON	0	20
T07	Local Frequency Command Selection 0: Digital 1: Analog	0	ON	0	1
T08	Remote Frequency Command Selection 1: Analog 2: 4-Step Speed 4: Communication Port	1	ON	1	4
T09	Frequency Step For Accel or Decel	1	ON	1	Rated Frequency
T10	Exit Config Environment Password	555	OFF		
T11	Automatic Bypass-To-Drive or Drive-To-Bypass Selection				
T12	PID Parameter Settings				
	P	0.01	ON	0	32767
	I	0.01	ON	0	32767
	D	0	ON	0	32767
	D Gain	0	ON	0	32767
T13	4-Step Variable Speed (available only when T8=2)				
	Speed 1	10	ON	0	Rated Frequency
	Speed 2	20	ON	0	Rated Frequency
	Speed 3	30	ON	0	Rated Frequency
	Speed 4	40	ON	0	Rated Frequency

Alarm List

Code	Alarm
F0000	IGBT Set #1 Over Current In Power Cell #1
F0001	IGBT Set #2 Over Current In Power Cell #1
F0002	Input Over Voltage In Power Cell #1
F0004	Communication Error In Power Cell #1
F0005	No PWM1 Pulse For IGBT Set #1 In Power Cell #1
F0006	No PWM2 Pulse For IGBT Set #2 In Power Cell #1
F0007	IGBT Set #1 Failed To Turn On In Power Cell #1
F0008	IGBT Set #2 Failed To Turn On In Power Cell #1
F0009	Power Cell #1 Bypassed
F0010	Over Temperature In Power Cell #1
F0011	Power Cell #1 Failed To Bypass
F0012	One Phase Lost In Power Cell #1
F0013	Two Phases Lost In Power Cell #1
F0100	IGBT Set #1 Over Current In Power Cell #2
F0101	IGBT Set #2 Over Current In Power Cell #2
F0102	Input Over Voltage In Power Cell #2
F0104	Communication Error In Power Cell #2
F0105	No PWM1 Pulse For IGBT Set #1 In Power Cell #2
F0106	No PWM2 Pulse For IGBT Set #2 In Power Cell #2
F0107	IGBT Set #1 Failed To Turn On In Power Cell #2
F0108	IGBT Set #2 Failed To Turn On In Power Cell #2
F0109	Power Cell #2 Bypassed
F0110	Over Temperature In Power Cell #2
F0111	Power Cell #2 Failed To Bypass
F0112	One Phase Lost In Power Cell #2
F0113	Two Phases Lost In Power Cell #2
F0200	IGBT Set #1 Over Current In Power Cell #3
F0201	IGBT Set #2 Over Current In Power Cell #3
F0202	Input Over Voltage In Power Cell #3
F0204	Communication Error In Power Cell #3
F0205	No PWM1 Pulse For IGBT Set #1 In Power Cell #3
F0206	No PWM2 Pulse For IGBT Set #2 In Power Cell #3
F0207	IGBT Set #1 Failed To Turn On In Power Cell #3
F0208	IGBT Set #2 Failed To Turn On In Power Cell #3
F0209	Power Cell #3 Bypassed
F0210	Over Temperature In Power Cell #3
F0211	Power Cell #3 Failed To Bypass
F0212	One Phase Lost In Power Cell #3
F0213	Two Phases Lost In Power Cell #3

Code	Alarm
F0300	IGBT Set #1 Over Current In Power Cell #4
F0301	IGBT Set #2 Over Current In Power Cell #4
F0302	Input Over Voltage In Power Cell #4
F0304	Communication Error In Power Cell #4
F0305	No PWM1 Pulse For IGBT Set #1 In Power Cell #4
F0306	No PWM2 Pulse For IGBT Set #2 In Power Cell #4
F0307	IGBT Set #1 Failed To Turn On In Power Cell #4
F0308	IGBT Set #2 Failed To Turn On In Power Cell #4
F0309	Power Cell #4 Bypassed
F0310	Over Temperature In Power Cell #4
F0311	Power Cell #4 Failed To Bypass
F0312	One Phase Lost In Power Cell #4
F0313	Two Phases Lost In Power Cell #4
F0400	IGBT Set #1 Over Current In Power Cell #5
F0401	IGBT Set #2 Over Current In Power Cell #5
F0402	Input Over Voltage In Power Cell #5
F0404	Communication Error In Power Cell #5
F0405	No PWM1 Pulse For IGBT Set #1 In Power Cell #5
F0406	No PWM2 Pulse For IGBT Set #2 In Power Cell #5
F0407	IGBT Set #1 Failed To Turn On In Power Cell #5
F0408	IGBT Set #2 Failed To Turn On In Power Cell #5
F0409	Power Cell #5 Bypassed
F0410	Over Temperature In Power Cell #5
F0411	Power Cell #5 Failed To Bypass
F0412	One Phase Lost In Power Cell #5
F0413	Two Phases Lost In Power Cell #5
F0500	IGBT Set #1 Over Current In Power Cell #6
F0501	IGBT Set #2 Over Current In Power Cell #6
F0502	Input Over Voltage In Power Cell #6
F0504	Communication Error In Power Cell #6
F0505	No PWM1 Pulse For IGBT Set #1 In Power Cell #6
F0506	No PWM2 Pulse For IGBT Set #2 In Power Cell #6
F0507	IGBT Set #1 Failed To Turn On In Power Cell #6
F0508	IGBT Set #2 Failed To Turn On In Power Cell #6
F0509	Power Cell #6 Bypassed
F0510	Over Temperature In Power Cell #6
F0511	Power Cell #6 Failed To Bypass
F0512	One Phase Lost In Power Cell #6
F0513	Two Phases Lost In Power Cell #6
F0600	IGBT Set #1 Over Current In Power Cell #7

Code	Alarm
F0601	IGBT Set #2 Over Current In Power Cell #7
F0602	Input Over Voltage In Power Cell #7
F0604	Communication Error In Power Cell #7
F0605	No PWM1 Pulse For IGBT Set #1 In Power Cell #7
F0606	No PWM2 Pulse For IGBT Set #2 In Power Cell #7
F0607	IGBT Set #1 Failed To Turn On In Power Cell #7
F0608	IGBT Set #2 Failed To Turn On In Power Cell #7
F0609	Power Cell #7 Bypassed
F0610	Over Temperature In Power Cell #7
F0611	Power Cell #7 Failed To Bypass
F0612	One Phase Lost In Power Cell #7
F0613	Two Phases Lost In Power Cell #7
F0700	IGBT Set #1 Over Current In Power Cell #8
F0701	IGBT Set #2 Over Current In Power Cell #8
F0702	Input Over Voltage In Power Cell #8
F0704	Communication Error In Power Cell #8
F0705	No PWM1 Pulse For IGBT Set #1 In Power Cell #8
F0706	No PWM2 Pulse For IGBT Set #2 In Power Cell #8
F0707	IGBT Set #1 Failed To Turn On In Power Cell #8
F0708	IGBT Set #2 Failed To Turn On In Power Cell #8
F0709	Power Cell #8 Bypassed
F0710	Over Temperature In Power Cell #8
F0711	Power Cell #8 Failed To Bypass
F0712	One Phase Lost In Power Cell #8
F0713	Two Phases Lost In Power Cell #8
F0800	IGBT Set #1 Over Current In Power Cell #9
F0801	IGBT Set #2 Over Current In Power Cell #9
F0802	Input Over Voltage In Power Cell #9
F0804	Communication Error In Power Cell #9
F0805	No PWM1 Pulse For IGBT Set #1 In Power Cell #9
F0806	No PWM2 Pulse For IGBT Set #2 In Power Cell #9
F0807	IGBT Set #1 Failed To Turn On In Power Cell #9
F0808	IGBT Set #2 Failed To Turn On In Power Cell #9
F0809	Power Cell #9 Bypassed
F0810	Over Temperature In Power Cell #9
F0811	Power Cell #9 Failed To Bypass
F0812	One Phase Lost In Power Cell #9
F0813	Two Phases Lost In Power Cell #9
F0900	IGBT Set #1 Over Current In Power Cell #10
F0901	IGBT Set #2 Over Current In Power Cell #10

Code	Alarm
F0902	Input Over Voltage In Power Cell #10
F0904	Communication Error In Power Cell #10
F0905	No PWM1 Pulse For IGBT Set #1 In Power Cell #10
F0906	No PWM2 Pulse For IGBT Set #2 In Power Cell #10
F0907	IGBT Set #1 Failed To Turn On In Power Cell #10
F0908	IGBT Set #2 Failed To Turn On In Power Cell #10
F0909	Power Cell #10 Bypassed
F0910	Over Temperature In Power Cell #10
F0911	Power Cell #10 Failed To Bypass
F0912	One Phase Lost In Power Cell #10
F0913	Two Phases Lost In Power Cell #10
F1000	IGBT Set #1 Over Current In Power Cell #11
F1001	IGBT Set #2 Over Current In Power Cell #11
F1002	Input Over Voltage In Power Cell #11
F1004	Communication Error In Power Cell #11
F1005	No PWM1 Pulse For IGBT Set #1 In Power Cell #11
F1006	No PWM2 Pulse For IGBT Set #2 In Power Cell #11
F1007	IGBT Set #1 Failed To Turn On In Power Cell #11
F1008	IGBT Set #2 Failed To Turn On In Power Cell #11
F1009	Power Cell #11 Bypassed
F1010	Over Temperature In Power Cell #11
F1011	Power Cell #11 Failed To Bypass
F1012	One Phase Lost In Power Cell #11
F1013	Two Phases Lost In Power Cell #11
F1100	IGBT Set #1 Over Current In Power Cell #12
F1101	IGBT Set #2 Over Current In Power Cell #12
F1102	Input Over Voltage In Power Cell #12
F1104	Communication Error In Power Cell #12
F1105	No PWM1 Pulse For IGBT Set #1 In Power Cell #12
F1106	No PWM2 Pulse For IGBT Set #2 In Power Cell #12
F1107	IGBT Set #1 Failed To Turn On In Power Cell #12
F1108	IGBT Set #2 Failed To Turn On In Power Cell #12
F1109	Power Cell #12 Bypassed
F1110	Over Temperature In Power Cell #12
F1111	Power Cell #12 Failed To Bypass
F1112	One Phase Lost In Power Cell #12
F1113	Two Phases Lost In Power Cell #12
F1200	IGBT Set #1 Over Current In Power Cell #13
F1201	IGBT Set #2 Over Current In Power Cell #13
F1202	Input Over Voltage In Power Cell #13

Code	Alarm
F1204	Communication Error In Power Cell #13
F1205	No PWM1 Pulse For IGBT Set #1 In Power Cell #13
F1206	No PWM2 Pulse For IGBT Set #2 In Power Cell #13
F1207	IGBT Set #1 Failed To Turn On In Power Cell #13
F1208	IGBT Set #2 Failed To Turn On In Power Cell #13
F1209	Power Cell #13 Bypassed
F1210	Over Temperature In Power Cell #13
F1211	Power Cell #13 Failed To Bypass
F1212	One Phase Lost In Power Cell #13
F1213	Two Phases Lost In Power Cell #13
F1300	IGBT Set #1 Over Current In Power Cell #14
F1301	IGBT Set #2 Over Current In Power Cell #14
F1302	Input Over Voltage In Power Cell #14
F1304	Communication Error In Power Cell #14
F1305	No PWM1 Pulse For IGBT Set #1 In Power Cell #14
F1306	No PWM2 Pulse For IGBT Set #2 In Power Cell #14
F1307	IGBT Set #1 Failed To Turn On In Power Cell #14
F1308	IGBT Set #2 Failed To Turn On In Power Cell #14
F1309	Power Cell #14 Bypassed
F1310	Over Temperature In Power Cell #14
F1311	Power Cell #14 Failed To Bypass
F1312	One Phase Lost In Power Cell #14
F1313	Two Phases Lost In Power Cell #14
F1400	IGBT Set #1 Over Current In Power Cell #15
F1401	IGBT Set #2 Over Current In Power Cell #15
F1402	Input Over Voltage In Power Cell #15
F1404	Communication Error In Power Cell #15
F1405	No PWM1 Pulse For IGBT Set #1 In Power Cell #15
F1406	No PWM2 Pulse For IGBT Set #2 In Power Cell #15
F1407	IGBT Set #1 Failed To Turn On In Power Cell #15
F1408	IGBT Set #2 Failed To Turn On In Power Cell #15
F1409	Power Cell #15 Bypassed
F1410	Over Temperature In Power Cell #15
F1411	Power Cell #15 Failed To Bypass
F1412	One Phase Lost In Power Cell #15
F1413	Two Phases Lost In Power Cell #15
F1500	IGBT Set #1 Over Current In Power Cell #16
F1501	IGBT Set #2 Over Current In Power Cell #16
F1502	Input Over Voltage In Power Cell #16
F1504	Communication Error In Power Cell #16

Code	Alarm
F1505	No PWM1 Pulse For IGBT Set #1 In Power Cell #16
F1506	No PWM2 Pulse For IGBT Set #2 In Power Cell #16
F1507	IGBT Set #1 Failed To Turn On In Power Cell #16
F1508	IGBT Set #2 Failed To Turn On In Power Cell #16
F1509	Power Cell #16 Bypassed
F1510	Over Temperature In Power Cell #16
F1511	Power Cell #16 Failed To Bypass
F1512	One Phase Lost In Power Cell #16
F1513	Two Phases Lost In Power Cell #16
F1600	IGBT Set #1 Over Current In Power Cell #17
F1601	IGBT Set #2 Over Current In Power Cell #17
F1602	Input Over Voltage In Power Cell #17
F1604	Communication Error In Power Cell #17
F1605	No PWM1 Pulse For IGBT Set #1 In Power Cell #17
F1606	No PWM2 Pulse For IGBT Set #2 In Power Cell #17
F1607	IGBT Set #1 Failed To Turn On In Power Cell #17
F1608	IGBT Set #2 Failed To Turn On In Power Cell #17
F1609	Power Cell #17 Bypassed
F1610	Over Temperature In Power Cell #17
F1611	Power Cell #17 Failed To Bypass
F1612	One Phase Lost In Power Cell #17
F1613	Two Phases Lost In Power Cell #17
F1700	IGBT Set #1 Over Current In Power Cell #18
F1701	IGBT Set #2 Over Current In Power Cell #18
F1702	Input Over Voltage In Power Cell #18
F1704	Communication Error In Power Cell #18
F1705	No PWM1 Pulse For IGBT Set #1 In Power Cell #18
F1706	No PWM2 Pulse For IGBT Set #2 In Power Cell #18
F1707	IGBT Set #1 Failed To Turn On In Power Cell #18
F1708	IGBT Set #2 Failed To Turn On In Power Cell #18
F1709	Power Cell #18 Bypassed
F1710	Over Temperature In Power Cell #18
F1711	Power Cell #18 Failed To Bypass
F1712	One Phase Lost In Power Cell #18
F1713	Two Phases Lost In Power Cell #18
F1800	IGBT Set #1 Over Current In Power Cell #19
F1801	IGBT Set #2 Over Current In Power Cell #19
F1802	Input Over Voltage In Power Cell #19
F1804	Communication Error In Power Cell #19
F1805	No PWM1 Pulse For IGBT Set #1 In Power Cell #19

Code	Alarm
F1806	No PWM2 Pulse For IGBT Set #2 In Power Cell #19
F1807	IGBT Set #1 Failed To Turn On In Power Cell #19
F1808	IGBT Set #2 Failed To Turn On In Power Cell #19
F1809	Power Cell #19 Bypassed
F1810	Over Temperature In Power Cell #19
F1811	Power Cell #19 Failed To Bypass
F1812	One Phase Lost In Power Cell #19
F1813	Two Phases Lost In Power Cell #19
F1900	IGBT Set #1 Over Current In Power Cell #20
F1901	IGBT Set #2 Over Current In Power Cell #20
F1902	Input Over Voltage In Power Cell #20
F1904	Communication Error In Power Cell #20
F1905	No PWM1 Pulse For IGBT Set #1 In Power Cell #20
F1906	No PWM2 Pulse For IGBT Set #2 In Power Cell #20
F1907	IGBT Set #1 Failed To Turn On In Power Cell #20
F1908	IGBT Set #2 Failed To Turn On In Power Cell #20
F1909	Power Cell #20 Bypassed
F1910	Over Temperature In Power Cell #20
F1911	Power Cell #20 Failed To Bypass
F1912	One Phase Lost In Power Cell #20
F1913	Two Phases Lost In Power Cell #20
F2000	IGBT Set #1 Over Current In Power Cell #21
F2001	IGBT Set #2 Over Current In Power Cell #21
F2002	Input Over Voltage In Power Cell #21
F2004	Communication Error In Power Cell #21
F2005	No PWM1 Pulse For IGBT Set #1 In Power Cell #21
F2006	No PWM2 Pulse For IGBT Set #2 In Power Cell #21
F2007	IGBT Set #1 Failed To Turn On In Power Cell #21
F2008	IGBT Set #2 Failed To Turn On In Power Cell #21
F2009	Power Cell #21 Bypassed
F2010	Over Temperature In Power Cell #21
F2011	Power Cell #21 Failed To Bypass
F2012	One Phase Lost In Power Cell #21
F2013	Two Phases Lost In Power Cell #21
F2100	IGBT Set #1 Over Current In Power Cell #22
F2101	IGBT Set #2 Over Current In Power Cell #22
F2102	Input Over Voltage In Power Cell #22
F2104	Communication Error In Power Cell #22
F2105	No PWM1 Pulse For IGBT Set #1 In Power Cell #22
F2106	No PWM2 Pulse For IGBT Set #2 In Power Cell #22

Code	Alarm
F2107	IGBT Set #1 Failed To Turn On In Power Cell #22
F2108	IGBT Set #2 Failed To Turn On In Power Cell #22
F2109	Power Cell #22 Bypassed
F2110	Over Temperature In Power Cell #22
F2111	Power Cell #22 Failed To Bypass
F2112	One Phase Lost In Power Cell #22
F2113	Two Phases Lost In Power Cell #22
F2200	IGBT Set #1 Over Current In Power Cell #23
F2201	IGBT Set #2 Over Current In Power Cell #23
F2202	Input Over Voltage In Power Cell #23
F2204	Communication Error In Power Cell #23
F2205	No PWM1 Pulse For IGBT Set #1 In Power Cell #23
F2206	No PWM2 Pulse For IGBT Set #2 In Power Cell #23
F2207	IGBT Set #1 Failed To Turn On In Power Cell #23
F2208	IGBT Set #2 Failed To Turn On In Power Cell #23
F2209	Power Cell #23 Bypassed
F2210	Over Temperature In Power Cell #23
F2211	Power Cell #23 Failed To Bypass
F2212	One Phase Lost In Power Cell #23
F2213	Two Phases Lost In Power Cell #23
F2300	IGBT Set #1 Over Current In Power Cell #24
F2301	IGBT Set #2 Over Current In Power Cell #24
F2302	Input Over Voltage In Power Cell #24
F2304	Communication Error In Power Cell #24
F2305	No PWM1 Pulse For IGBT Set #1 In Power Cell #24
F2306	No PWM2 Pulse For IGBT Set #2 In Power Cell #24
F2307	IGBT Set #1 Failed To Turn On In Power Cell #24
F2308	IGBT Set #2 Failed To Turn On In Power Cell #24
F2309	Power Cell #24 Bypassed
F2310	Over Temperature In Power Cell #24
F2311	Power Cell #24 Failed To Bypass
F2312	One Phase Lost In Power Cell #24
F2313	Two Phases Lost In Power Cell #24
F2400	IGBT Set #1 Over Current In Power Cell #25
F2401	IGBT Set #2 Over Current In Power Cell #25
F2402	Input Over Voltage In Power Cell #25
F2404	Communication Error In Power Cell #25
F2405	No PWM1 Pulse For IGBT Set #1 In Power Cell #25
F2406	No PWM2 Pulse For IGBT Set #2 In Power Cell #25
F2407	IGBT Set #1 Failed To Turn On In Power Cell #25

Code	Alarm
F2408	IGBT Set #2 Failed To Turn On In Power Cell #25
F2409	Power Cell #25 Bypassed
F2410	Over Temperature In Power Cell #25
F2411	Power Cell #25 Failed To Bypass
F2412	One Phase Lost In Power Cell #25
F2413	Two Phases Lost In Power Cell #25
F2500	IGBT Set #1 Over Current In Power Cell #26
F2501	IGBT Set #2 Over Current In Power Cell #26
F2502	Input Over Voltage In Power Cell #26
F2504	Communication Error In Power Cell #26
F2505	No PWM1 Pulse For IGBT Set #1 In Power Cell #26
F2506	No PWM2 Pulse For IGBT Set #2 In Power Cell #26
F2507	IGBT Set #1 Failed To Turn On In Power Cell #26
F2508	IGBT Set #2 Failed To Turn On In Power Cell #26
F2509	Power Cell #26 Bypassed
F2510	Over Temperature In Power Cell #26
F2511	Power Cell #26 Failed To Bypass
F2512	One Phase Lost In Power Cell #26
F2513	Two Phases Lost In Power Cell #26
F2600	IGBT Set #1 Over Current In Power Cell #27
F2601	IGBT Set #2 Over Current In Power Cell #27
F2602	Input Over Voltage In Power Cell #27
F2604	Communication Error In Power Cell #27
F2605	No PWM1 Pulse For IGBT Set #1 In Power Cell #27
F2606	No PWM2 Pulse For IGBT Set #2 In Power Cell #27
F2607	IGBT Set #1 Failed To Turn On In Power Cell #27
F2608	IGBT Set #2 Failed To Turn On In Power Cell #27
F2609	Power Cell #27 Bypassed
F2610	Over Temperature In Power Cell #27
F2611	Power Cell #27 Failed To Bypass
F2612	One Phase Lost In Power Cell #27
F2613	Two Phases Lost In Power Cell #27
F2700	Output Short Circuit
F2701	Output Over Current
F2702	Motor Over Temperature
F2703	Output Over Voltage
F2704	Abnormal Output Voltage
F2705	Ground Fault
F2706	Over Speed Fault
F2707	Motor Stalled

Code	Alarm
F2900	Cabinet Door Opened While Drive Energized
F2901	E-Stop Trip
F2902	Input Circuit Breaker Opened (Not Initiated By The Drive)
F2903	Non-Zero Frequency Command Exists Upon Start
F2904	Flying Start Failed
F2905	Input Circuit Breaker Tripped
F2909	System Locked
F2910	CPU Board In Wrong Position
F2911	AT Board In Wrong Position
F2912	5V Power Supply Fault
F2913	15V Power Supply Fault
F2914	24V DCS Power Supply Fault
F2915	24V PLC Power Supply Fault
F3000	PWMA Board In Wrong Position
F3001	PWMB Board In Wrong Position
F3002	PWMC Board In Wrong Position
F3003	DT Board In Wrong Position
F3100	PWMA Board Not Compatible With PUA1 Board
F3101	PWMA Board Not Compatible With PUA2 Board
F3102	PWMA Board Not Compatible With PUA3 Board
F3103	PWMA Board Not Compatible With PUA4 Board
F3104	PWMA Board Not Compatible With PUA5 Board
F3105	PWMA Board Not Compatible With PUA6 Board
F3106	PWMA Board Not Compatible With PUA7 Board
F3107	PWMA Board Not Compatible With PUA8 Board
F3108	PWMA Board Not Compatible With PUA9 Board
F3109	PWMA Board Not Compatible With PUA10 Board
F3110	PWMA Board Not Compatible With PUA11 Board
F3111	PWMA Board Not Compatible With PUA12 Board
F3112	PWMA Board Not Compatible With PUA13 Board
F3113	Primary FPGA Not Compatible With PWMA Board
F3114	Primary FPGA Not Compatible With PWMB Board
F3115	Primary FPGA Not Compatible With PWMC Board
F3200	PWMB Board Not Compatible With PUB1 Board
F3201	PWMB Board Not Compatible With PUB2 Board
F3202	PWMB Board Not Compatible With PUB3 Board
F3203	PWMB Board Not Compatible With PUB4 Board
F3204	PWMB Board Not Compatible With PUB5 Board
F3205	PWMB Board Not Compatible With PUB6 Board
F3206	PWMB Board Not Compatible With PUB7 Board

Code	Alarm
F3207	PWMB Board Not Compatible With PUB8 Board
F3208	PWMB Board Not Compatible With PUB9 Board
F3209	PWMB Board Not Compatible With PUB10 Board
F3210	PWMB Board Not Compatible With PUB11 Board
F3211	PWMB Board Not Compatible With PUB12 Board
F3212	PWMB Board Not Compatible With PUB13 Board
F3213	Primary FPGA Not Compatible With DT Board
F3214	Primary DSP Not Compatible With Primary FPGA
F3215	Primary DSP Not Compatible With Secondary DSP
F3300	PWMC Board Not Compatible With PUC1 Board
F3301	PWMC Board Not Compatible With PUC2 Board
F3302	PWMC Board Not Compatible With PUC3 Board
F3303	PWMC Board Not Compatible With PUC4 Board
F3304	PWMC Board Not Compatible With PUC5 Board
F3305	PWMC Board Not Compatible With PUC6 Board
F3306	PWMC Board Not Compatible With PUC7 Board
F3307	PWMC Board Not Compatible With PUC8 Board
F3308	PWMC Board Not Compatible With PUC9 Board
F3309	PWMC Board Not Compatible With PUC10 Board
F3310	PWMC Board Not Compatible With PUC11 Board
F3311	PWMC Board Not Compatible With PUC12 Board
F3312	PWMC Board Not Compatible With PUC13 Board
F3313	Versions Of System Not Compatible
F3400	Primary DSP Not Compatible With PLC
F3401	HMI Not Compatible With PLC
F3402	Primary DSP Not Compatible With HMI
FCOM1	DSP Communication Fault
FCOM2	PLC Communication Fault
FP006	Transformer Over Temperature Trip
FP007	Auxiliary Power Off
FP008	Cabinet Door Open
W0003	DC Bus Under Voltage In Power Cell #1 Warning
W0014	Input Over Voltage In Power Cell #1 Warning
W0103	DC Bus Under Voltage In Power Cell #2 Warning
W0114	Input Over Voltage In Power Cell #2 Warning
W0203	DC Bus Under Voltage In Power Cell #3 Warning
W0214	Input Over Voltage In Power Cell #3 Warning
W0303	DC Bus Under Voltage In Power Cell #4 Warning
W0314	Input Over Voltage In Power Cell #4 Warning
W0403	DC Bus Under Voltage In Power Cell #5 Warning

Code	Alarm
W0414	Input Over Voltage In Power Cell #5 Warning
W0503	DC Bus Under Voltage In Power Cell #6 Warning
W0514	Input Over Voltage In Power Cell #6 Warning
W0603	DC Bus Under Voltage In Power Cell #7 Warning
W0614	Input Over Voltage In Power Cell #7 Warning
W0703	DC Bus Under Voltage In Power Cell #8 Warning
W0714	Input Over Voltage In Power Cell #8 Warning
W0803	DC Bus Under Voltage In Power Cell #9 Warning
W0814	Input Over Voltage In Power Cell #9 Warning
W0903	DC Bus Under Voltage In Power Cell #10 Warning
W0914	Input Over Voltage In Power Cell #10 Warning
W1003	DC Bus Under Voltage In Power Cell #11 Warning
W1014	Input Over Voltage In Power Cell #11 Warning
W1103	DC Bus Under Voltage In Power Cell #12 Warning
W1114	Input Over Voltage In Power Cell #12 Warning
W1203	DC Bus Under Voltage In Power Cell #13 Warning
W1214	Input Over Voltage In Power Cell #13 Warning
W1303	DC Bus Under Voltage In Power Cell #14 Warning
W1314	Input Over Voltage In Power Cell #14 Warning
W1403	DC Bus Under Voltage In Power Cell #15 Warning
W1414	Input Over Voltage In Power Cell #15 Warning
W1503	DC Bus Under Voltage In Power Cell #16 Warning
W1514	Input Over Voltage In Power Cell #16 Warning
W1603	DC Bus Under Voltage In Power Cell #17 Warning
W1614	Input Over Voltage In Power Cell #17 Warning
W1703	DC Bus Under Voltage In Power Cell #18 Warning
W1714	Input Over Voltage In Power Cell #18 Warning
W1803	DC Bus Under Voltage In Power Cell #19 Warning
W1814	Input Over Voltage In Power Cell #19 Warning
W1903	DC Bus Under Voltage In Power Cell #20 Warning
W1914	Input Over Voltage In Power Cell #20 Warning
W2003	DC Bus Under Voltage In Power Cell #21 Warning
W2014	Input Over Voltage In Power Cell #21 Warning
W2103	DC Bus Under Voltage In Power Cell #22 Warning
W2114	Input Over Voltage In Power Cell #22 Warning
W2203	DC Bus Under Voltage In Power Cell #23 Warning
W2214	Input Over Voltage In Power Cell #23 Warning
W2303	DC Bus Under Voltage In Power Cell #24 Warning
W2314	Input Over Voltage In Power Cell #24 Warning
W2403	DC Bus Under Voltage In Power Cell #25 Warning

Code	Alarm
W2414	Input Over Voltage In Power Cell #25 Warning
W2503	DC Bus Under Voltage In Power Cell #26 Warning
W2514	Input Over Voltage In Power Cell #26 Warning
W2603	DC Bus Under Voltage In Power Cell #27 Warning
W2614	Input Over Voltage In Power Cell #27 Warning
W2800	Motor Over Temperature Warning
W2801	Abnormal Output Voltage Warning
W2802	Ground Fault Warning
W2803	Output Frequency Deviation Warning
W3314	Version Fault Identification Code Error
WP001	Control Power Switch Warning
WP002	Transformer Cabinet Fan Fault
WP003	Power Module Cabinet Fan Fault
WP004	Transformer Over Temperature Warning
WP005	Analog Loss Warning
WP009	Power Module Cabinet Fan Circuit Breaker Open
WP010	Transformer Cabinet Fan Circuit Breaker Open

Preventative Maintenance and Component Replacement

Safety

ATTENTION: Servicing energized Medium Voltage Motor Control Equipment can be hazardous. Severe injury or death can result from electrical shock, bump, or unintended actuation of controlled equipment. Recommended practice is to disconnect and lockout control equipment from power sources, and release stored energy, if present.For countries following NEMA standards, refer to National Fire Protection Association Standard No. NFPA70E, Part II and (as applicable) OSHA rules for Control of Hazardous Energy Sources (Lockout/Tagout) and OSHA Electrical Safety Related Work Practices safety related work practices, including procedural requirements for lockout/tagout, and appropriate work practices, personnel qualifications and training requirements, where it is not feasible to de-energize and lockout or tagout electric circuits and equipment before working on or near exposed circuit parts.For countries following IEC standards, refer to local codes and regulations.

ATTENTION: Use suitable personal protective equipment (PPE) per local codes or regulations. Failure to do so may results in severe burns, injury, or death.

ATTENTION: Always perform Power Lockout procedure before servicing equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury, or death.

ATTENTION: These tasks require person(s) skilled in this type of detailed work. Read and understand this manual thoroughly before commencing. Contact Rockwell Automation with any questions or for clarification.

Introduction

The drive can experience reduced service life if operated outside of its design parameters. Ensure the operating environment is within specifications. Daily inspection and regular maintenance will maximize the service life of the equipment.

Daily Inspection

Check the following items during normal operation of the drive:

- abnormal noise or vibration in the drive or motor
- abnormal temperature in the drive or motor
- ambient temperature in the control room above nominal
- accumulation of dust or particulate on control room floor or surfaces
- abnormal load current above nominal

Regular Maintenance Intervals

The annual maintenance requirements are summarized on page 123 as a guideline. Detailed procedures referred to in the Preventative Maintenance Schedule are described beginning on page 81.

Medium Voltage Motor control equipment should be inspected periodically. Inspection intervals should be based on environmental and operating conditions and adjusted as indicated by experience. An initial comprehensive inspection, within 3 to 4 months after installation, is suggested. Refer to the following standards for general guidelines for setting-up a periodic maintenance program.For countries following NEMA standards, refer to National Electrical Manufacturers Association (NEMA) Standard No. ICS 1.1 (Safety Guidelines for the Application, Installation, and Maintenance of Solid-Sate Control) for MV Drives and ICS 1.3 (Preventive Maintenance of Industrial Control and Systems Equipment) for MV Controllers. For countries following IEC standards, refer to IEC 61800-5-1 Sec. 6.5 for MV Drives and IEC 60470 Sec. 10, IEC 62271-1 Sec. 10.4 for MV Controllers.

If inspection reveals that dust, dirt, moisture or other contamination has reached the control equipment, the cause must be eliminated. This could indicate unsealed enclosure openings (conduit or other) or incorrect operating procedures. Replace any damaged or embrittled seals, and repair or replace any other damaged or malfunctioning parts. Replace dirty, wet, or contaminated control devices unless they can be cleaned effectively by vacuuming or wiping.

IMPORTANT	Compressed air is not recommended for cleaning because it may displace dirt, dust, or debris into other parts or equipment, or damage delicate parts.

Physical Checks (No Medium Voltage or Control Power)

Power Connection Inspection

- Inspect PowerFlex 6000 drive, input/output/bypass sections, and all associated drive components for loose power cable connections and ground cable connections: torque them based on the required torque specifications.
- Inspect the bus bars and check for any signs of overheating / discoloration and tighten the bus connections to the required torque specifications.
- Clean all cables and bus bars that exhibit dust build-up.
- The torques of incoming / outgoing cable screws of the power unit shall be check if they are in the specified range.
- Use torque sealer on all connections. Carry out the integrity checks on the signal ground and safety grounds.

Physical Inspection

- Check for any visual/physical evidence of damage or degradation of components in the low voltage compartments.
  - This includes Relays, Contactors, Timers, Terminal connectors, Circuit breakers, Ribbon cables, Control Wires, UPS, AC/DC Power Supplies etc.; Causes could be corrosion, excessive temperature, or contamination.
- Check for any visual/physical evidence of damage or degradation of components in the medium voltage compartments (cables, contactors, circuit breakers, isolation disconnecting blades, power units, etc.).
  - This includes main cooling fan, power devices, heat sinks, circuit boards, insulators, cables, capacitors, current transformers, potential transformers, fuses, wiring, etc.; Causes could be corrosion, excessive temperature, or contamination.
- Clean all contaminated components using a vacuum cleaner (DO NOT use a blower), and wipe clean components where appropriate.
- Carry out the physical inspection and verification for the proper operation of the contactor/isolator interlocks, and door interlocks.
- Carry out the physical inspection and verification for the proper operation of the key interlocks.
- Carry out the cleaning of the fans and ensure that the ventilation passages are not blocked and the impellers are freely rotating without any obstruction.
- Carry out the insulation megger test on the transformer, motor, and associated cabling.
- Check all bolts for fastening and adjust them as necessary.

Medium Voltage Testing

Medium voltage insulation resistance (IR) or dielectric withstanding voltage (megger) tests should not be used to check solid-state control equipment. When meggering electrical equipment, such as transformers or motors, solid-state devices must be bypassed before performing the test. Even though no damage may be readily apparent after a megger test, the solid-state devices are degraded and repeated application of high voltage can lead to failure.

Maintenance after a Fault Condition

Opening of the short circuit protective device (such as fuses or circuit breakers) in a properly coordinated motor branch circuit is an indication of a fault condition in excess of operating overload. Such conditions can cause damage to medium voltage motor control equipment. Before restoring power, the fault condition must be corrected and any necessary repairs or replacements must be made to restore the medium voltage motor control equipment to good working order. Refer to NEMA Standards Publication No. ICS-2, Part ICS2-302 for procedures. Use only replacement parts and devices recommended by Rockwell Automation to maintain the integrity of the equipment. Ensure the parts are properly matched to the model, series and revision level of the equipment. After maintenance or repair of the equipment, always test the control system for proper functioning under controlled conditions (that avoid hazards in the event of a control malfunction). For additional information, refer to NEMA ICS 1.3, PREVENTIVE MAINTENANCE OF INDUSTRIAL CONTROL AND SYSTEMS EQUIPMENT, published by the National Electrical Manufacturers Association, and NFPA70B, ELECTRICAL EQUIPMENT MAINTENANCE, published by the National Fire Protection Association.

Final Report

A complete, detailed report on all steps in the Preventive Maintenance procedures should be recorded to identify changes.

A detailed description of all adjustments and measurements that were taken during the process must be recorded (Interlock Adjustments, Loose Connections, Voltage Readings, Megger Results, Parameters, etc.).

Isolation Transformer Cabinet

Replace/Clean Door Mounted Air Filters

Periodically remove and clean, or remove and replace, the air filters according to the Preventative Maintenance table on page 124. The frequency with which you renew the filters depends on the cleanliness of the available cooling air.

The cabinet door filters are installed in six locations, including four locations on the Power Module Cabinet, and two locations on the Isolation Transformer Cabinet. However, the method to remove or clean the air filters is the same. The screens may be replaced while the drive is operating, but the procedure is easier to perform while the drive is shut down.

If the drive is running, you must replace the filter as soon as possible to prevent foreign material from entering into the drive.

Recommended Cleaning Method of Filters:

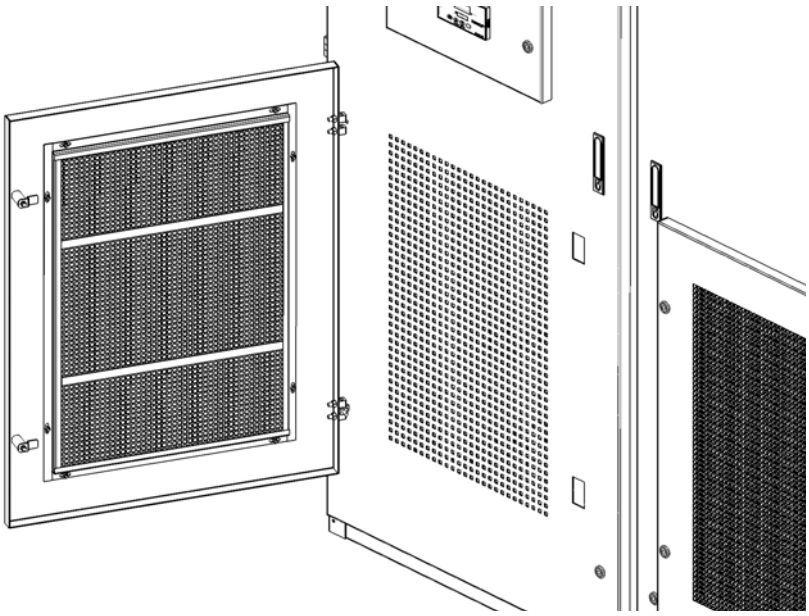
- Vacuum Cleaner – A vacuum cleaner on the inlet side of the filter will remove accumulated dust and dirt.
- Blow with Compressed Air – point compressed air nozzle in opposite direction of operating air flow (Blow from exhaust side toward intake side)
- Cold Water Rinse – Under normal conditions the foam media used in the filters, require no oily adhesives. Collected dirt is washed away quickly and easily using just a standard hose nozzle with plain water.

ATTENTION: The filter must be completely dry before reinstalling.

- Immersion in Warm Soapy Water – Where stubborn air-borne dirt is present, the filter may be dipped in a solution of warm water and mild detergent. Rinse in clear clean water, let stand until completely dry and free of moisture.

Use only Rockwell Automation-supplied or -approved replacement filters (see Spare Parts List on page 127). Replace the filters in the reverse order of its removal. Check that there are no openings to allow foreign matter to enter the drive.

1. Unlatch and open the cabinet filter door more than 90°.



2. Remove the screens by pulling up out of the door.

IMPORTANT When removing the filter, prevent accumulated dirt on the inlet side of the filter from being sucked into the drive. It may be difficult to remove the filter material without tearing due to the suction at the air inlet.

3. Re-install the cleaned or new air filter using reverse order of removal. Ensure the door is fully closed and locked.

Inspect Top Mounted Main Cooling Fans

Inspect fans used for forced air cooling. Replace any that have bent, chipped, or missing blades, or if the shaft does not turn freely. Apply power momentarily to check operation. If unit does not operate, check and replace wiring, fuse, or fan motor as appropriate. Clean or change air filters as recommended in the Users Manual. Ensure the aviation plug has a proper hand-tight connection. Ensure that the ventilation passages are not blocked and the impellers can rotate freely without any obstruction.

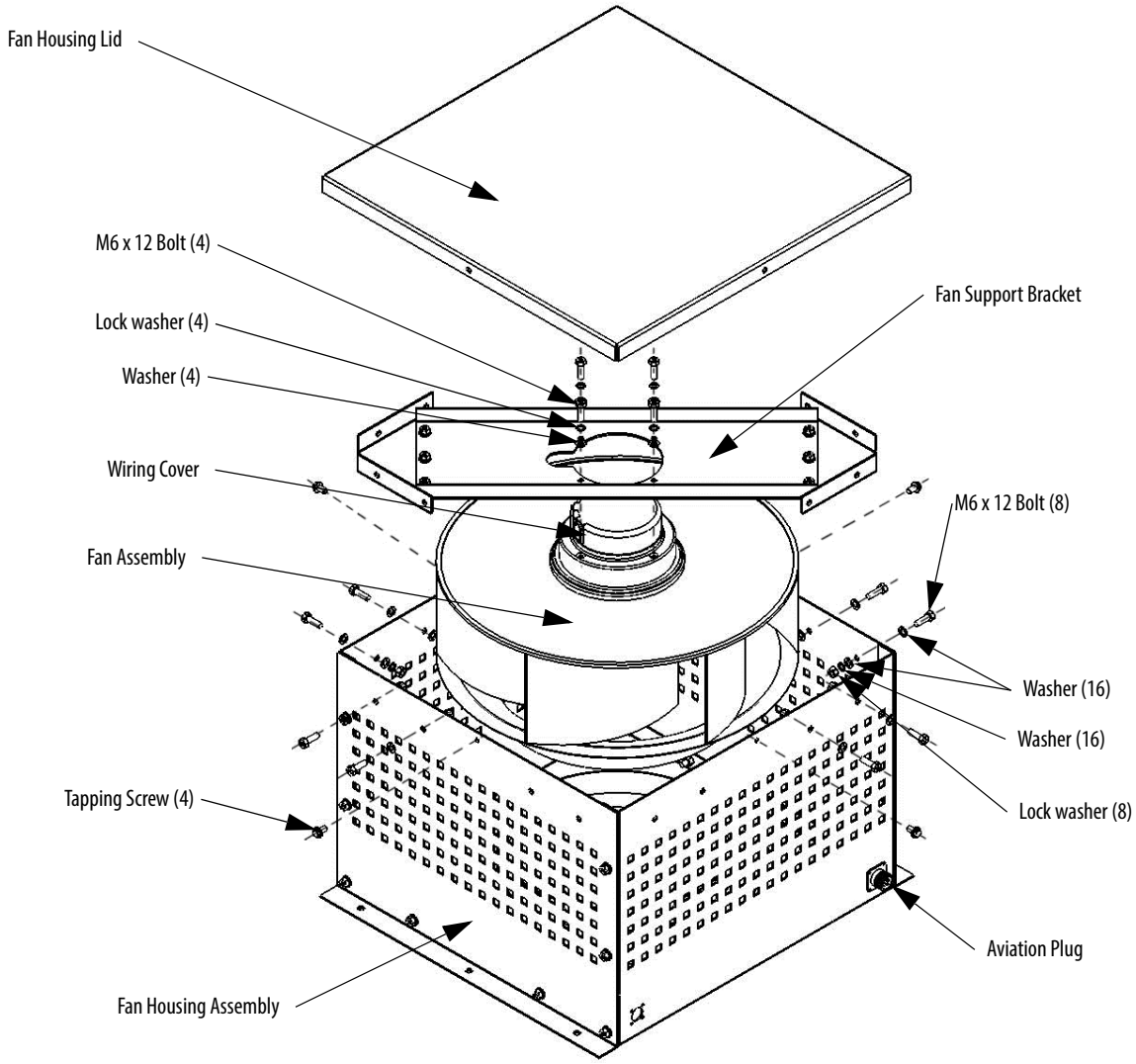
Replace Top Mounted Main Cooling Fans

The top fan housing consists of a motor and impeller assembly. To replace the fan, it is necessary to remove the Fan Housing Lid.

ATTENTION: Fan replacement requires working at a significant height from the floor. Complete this procedure on a safe, stable platform.

ATTENTION: Always perform Power Lockout procedure before servicing equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury, or death.

1. Remove and retain four tapping screws around the Fan Housing Lid, and remove the Lid.
2. Remove and retain eight M6 x 12 bolts from the Fan Housing Assembly which connect to the Fan Support Bracket.



3. Remove and retain four M6 x 12 bolts from the top of the Fan Support Bracket, and remove the bracket from the Fan Assembly.
4. Remove the Wiring Cover and disconnect the wiring.
5. Install the fan in the reverse order of its removal. Rotate the impeller by hand to ensure that there is no contact with the Fan Housing Assembly.

ATTENTION: The fan must be handled with extreme care. Failure to do so can alter the fan balance and will negatively impact performance and life span.

Fan Balance

Fan impellers are statically and dynamically balanced within acceptable tolerances at the factory. Damage in shipping or from incorrect handling or installation may upset the balance. An improperly balanced impeller can lead to excessive vibration causing undue wear on the entire unit.

If vibration is excessive, shut down the fan and determine the cause. Common causes of excessive vibration include:

- Drive support structure not sufficiently rigid or level
- Loose mounting bolts
- Loose impeller or bushing

Inspect Isolation Transformer Auxiliary Cooling Fans

When the drive is running, verify that each of the coil temperatures are the same on the Isolation Transformer Temperature Monitor display. If there is more than a 5 °C difference between the highest and lowest temperature, check the Isolation Transformer Auxiliary Cooling Fans.

Test the Isolation Transformer Auxiliary Cooling Fans:

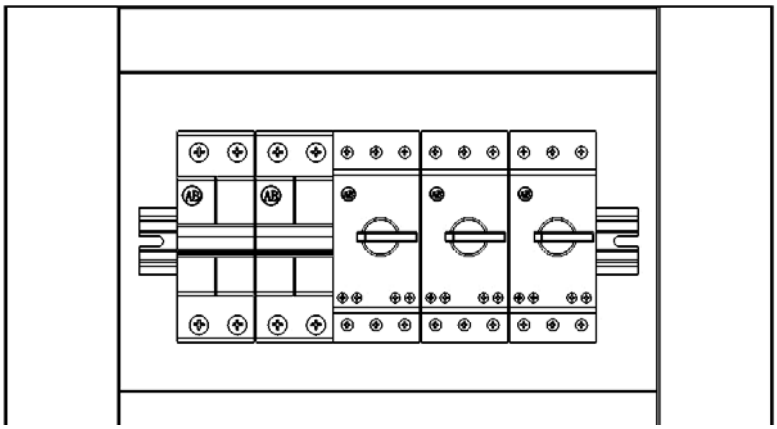
ATTENTION: Verify that all circuits are voltage-free, using a hot stick or appropriate high voltage-measuring device. Failure to do so may result in injury or death.

1. Open the LV Control Door on the Isolation Transformer Cabinet.

   Locate the correct circuit breaker(s).

2. Disconnect the wires from the load side of the Isolation Transformer Auxiliary Cooling Fan circuit breaker. Refer to Electrical Drawings.

Figure 25 - Circuit Breaker Location on LV Control Door



3. Connect 380V power to the wires to verify operation of the fans.

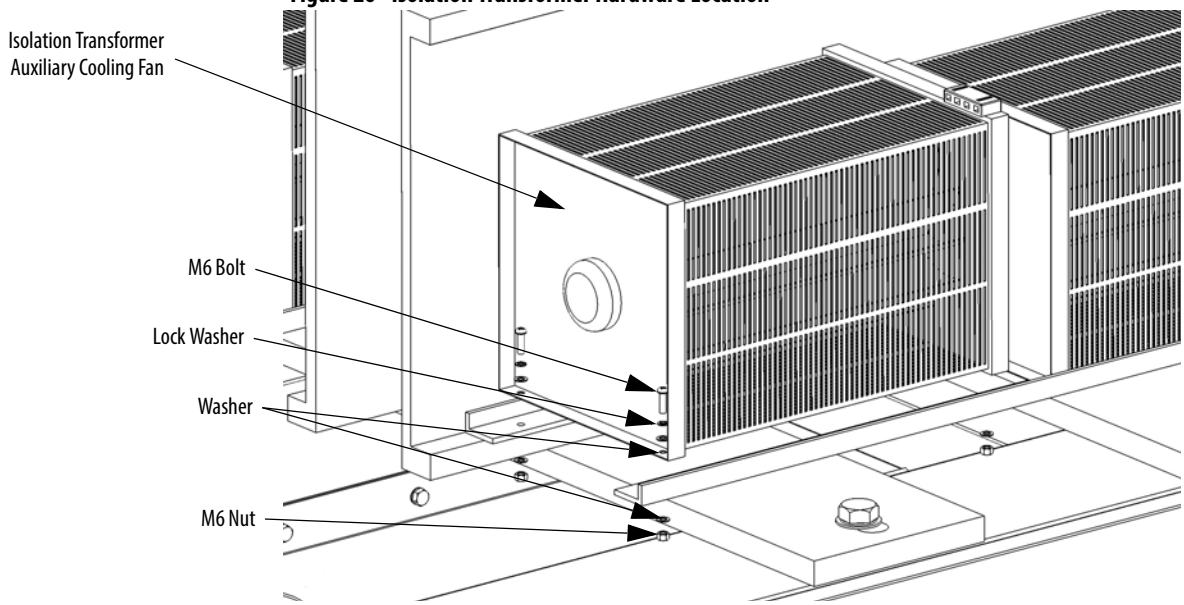
   If a fan is not operational, see Replace Isolation Transformer Auxiliary Cooling Fans on page 86.

4. Remove the power source and reconnect the wires to the circuit breaker.

Replace Isolation Transformer Auxiliary Cooling Fans

1. If the fan is in the front, cut the tie straps to loosen the wire bundle from the top of the fan.
2. Disconnect three wires at the top of the fan.
3. Remove four M6 bolts and hardware and retain.
4. Remove the Auxiliary Cooling Fan.

Figure 26 - Isolation Transformer Hardware Location



5. Install the new fan in reverse order of removal.

   If necessary, install new tie straps around the a, b, c, and o cables through the fan vent.

Inspect Isolation Transformer

1. Verify the fan is rotating in the proper direction.
2. Verify the incoming and outgoing power cable connections are torqued to specifications.

   See Torque Requirements on page 129.
3. Check the cabinet interior and Isolation Transformer windings and remove any foreign material. Vacuum dust or debris from the Isolation Transformer cabinet.
4. Check for any physical evidence of damage or degradation of components.

Inspect Voltage Sensing Board

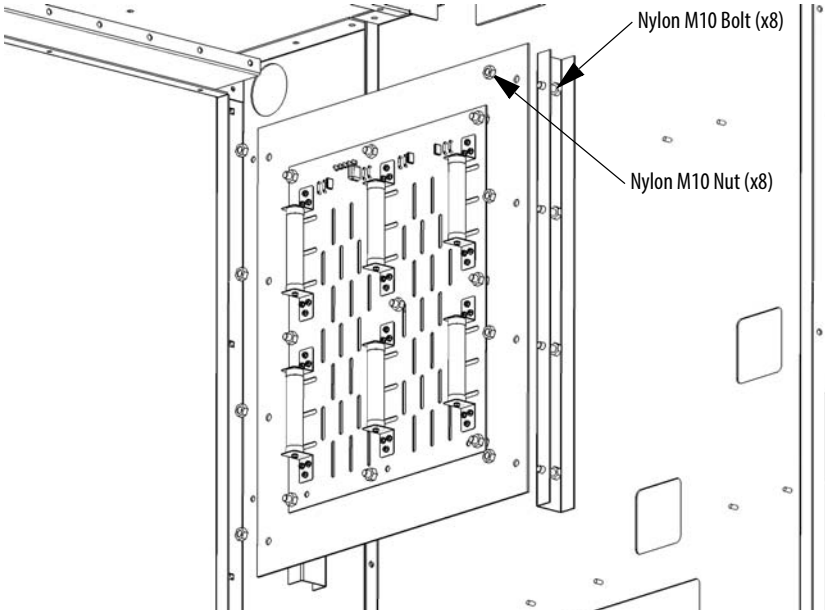
The input VSB cable connections and output VSB wire connectors must be firmly fastened and show no signs of damage or accumulation of dirt, dust, or debris.

Replace Voltage Sensing Board

ATTENTION: To prevent electrical shock, disconnect the main power before working on the Voltage Sensing Board. Verify that all circuits are voltage-free, using a hot stick or appropriate high voltage-measuring device. Failure to do so may result in injury or death.

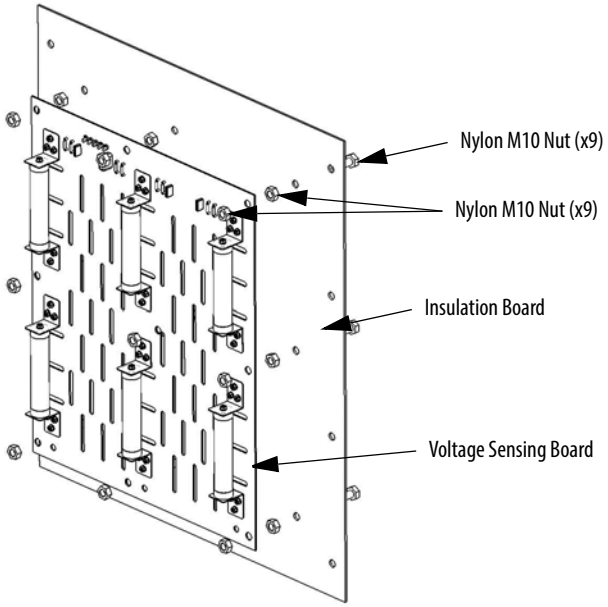
1. Remove the Voltage Sensing Board input and output cables.
2. Remove the eight nylon nuts to remove the Insulation Board from the cabinet side sheet.

Figure 27 - Remove the Insulation Board



3. Remove the nylon nuts which connect the Voltage Sensing Board to the Insulation Board.

Figure 28 - Remove the Voltage Sensing Board from the Insulation Board



4. Install the new Voltage Sensing Board to the Insulation Board in reverse order of removal.
5. Reinstall the Insulation Board to the cabinet side sheet in reverse order of removal.
6. Reconnect the input and output cables according to the Electrical Drawings.

Inspect Door Position Limit Switch

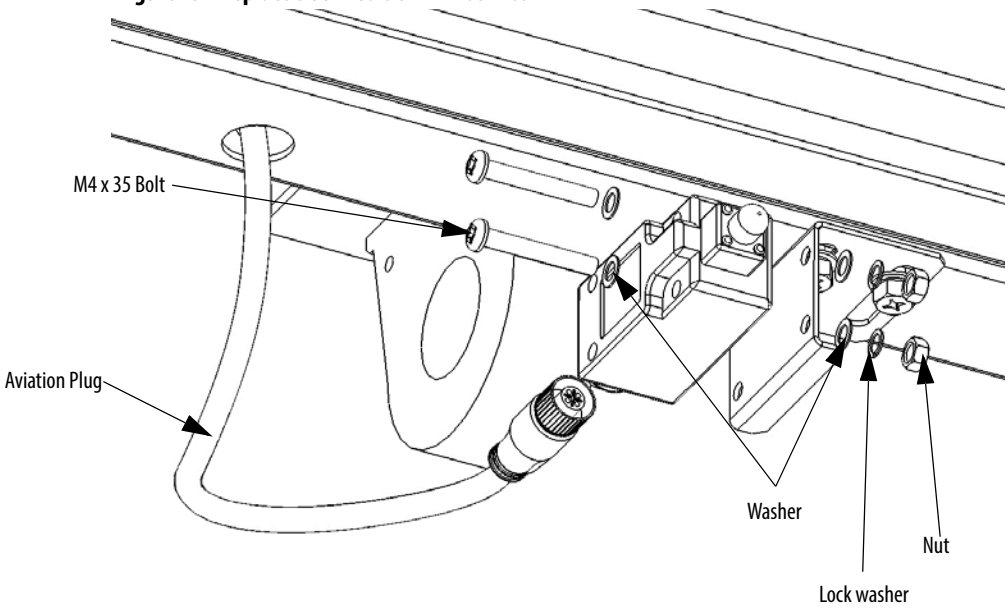
Check for obvious signs of damage, dust, or foreign material. Remove any dirt or foreign material. Wipe components with an anti-static cloth, where applicable. Check the aviation plug has a hand-tight connection.

Replace Door Position Limit Switch

ATTENTION: Ensure the input circuit breaker feeding the drive is open. Lock out and tagout the input circuit breaker before performing any work on the drive or bypass units.

1. Open the drive cabinet door.
2. Disconnect the aviation plug from the back of the Limit Switch.
3. Remove two M4 x 35 bolts and hardware from the mounting bracket.
4. Install the new Limit Switch in reverse order of removal.

Figure 29 - Replace Door Position Limit Switch



Power Module Cabinet

Inspect, Clean, or Replace Door Mounted Air Filters

See Replace/Clean Door Mounted Air Filters on page 81.

Inspect or Replace Top Mounted Main Cooling Fans

See Inspect Top Mounted Main Cooling Fans on page 82.

Inspect Power Modules

1. Check for damage or degradation of the Power Modules
   a. Inspect the power connections for loose connections or any evidence of discoloration of connections from heating
   b. For Drawout Power Module configurations, remove the back plates from the Power Module Cabinet and inspect the plug-in connectors on the back of each Power Module. Look for evidence of discoloration from overheating.
2. Remove dust or debris from all ventilation openings on the Power Module
3. Inspect the electrolytic capacitors, located in the ventilation openings of the Power Module.
   a. Inspect for signs of discoloration, odor, or leakage.
   b. Replace Power Modules if the capacitors have discoloration, odor, or leakage.

Replace Power Module

Table 7 - Power Module Specifications

Type	Output Rating (Amps)	Dimensions (HxWxD), approx.	Weight, approx.
Fixed-mounted	≤150 A	420 x 180 x 615 mm (16.5 x 7.1 x 24.2 in.)	20 kg (44.1 lb)
	151...200 A	420 x 260 x 615 mm (16.5 x 10.2 x 24.2 in.)	25 kg (55.1 lb)
Drawout	201...380 A	575 x 342 x 691 mm (22.6 x 13.5 x 27.2 in.)	40 kg (88.2 lb)
	381...420 A	575 x 342 x 910 mm (22.6 x 13.5 x 35.8 in.)	50 kg (110.2 lb)

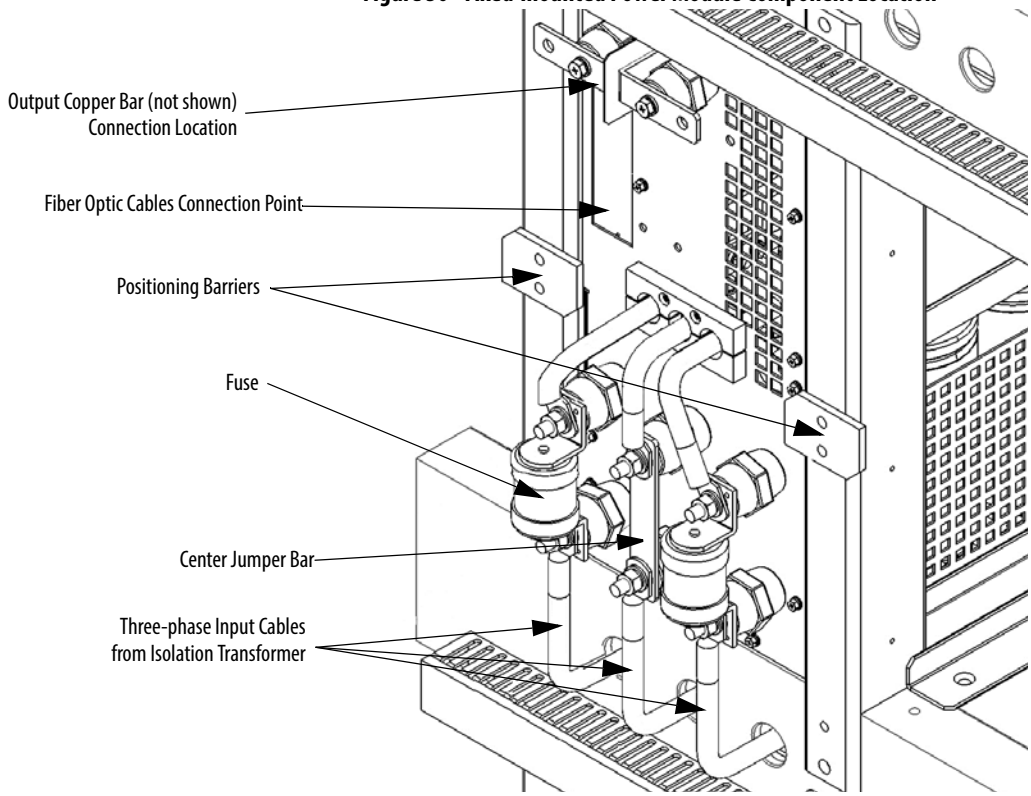
ATTENTION: Two people are required to handle the Power Modules. Always handle the drawout Power Modules using the two recessed lifting handles on both mounting rails (Figure 33).

Fixed-mounted Power Module

ATTENTION: The high-voltage power source must be switched off before replacing a Fixed-mounted Power Module. Wait for 20 minutes before opening the cabinet doors. Verify that all circuits are voltage-free, using a hot stick or appropriate high voltage-measuring device. Failure to do so may result in injury or death.

1. Remove the positioning barriers from both sides of the Power Module.
2. Disconnect the Three-phase Input Power Cables.

Figure 30 - Fixed-mounted Power Module Component Location



3. Remove the Output Copper Bars that connect adjacent Power Modules (Figure 31).

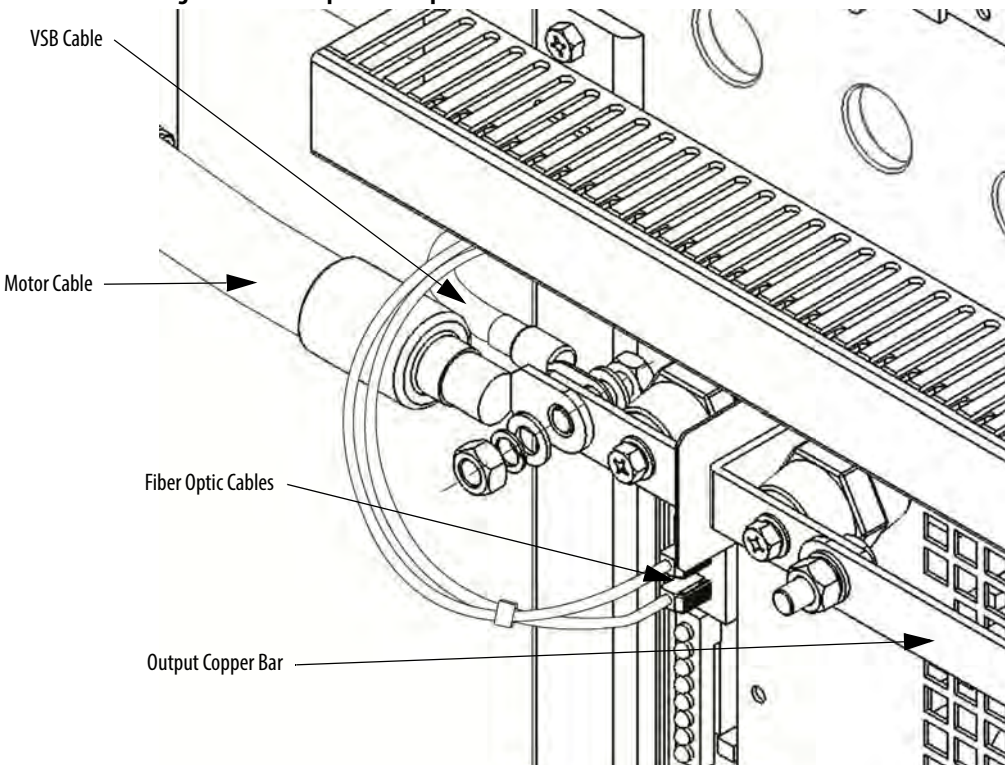
   If the Power Module is at the end of a row, remove the VSB and Motor cable instead of an output copper bus.

4. Disconnect the fiber optic cables.

ATTENTION: When removing the fiber optic cables, be careful to prevent the cables from straining or crimping as the resulting loss in light transmission will impact performance.

ATTENTION: Minimum bend radius permitted for the fiber optic cables is 50 mm (2.0 in.). Any bends with a shorter inside radius can permanently damage the fiber-optic cable.

Figure 31 - Close up of Fiber Optic Location and Power Cables



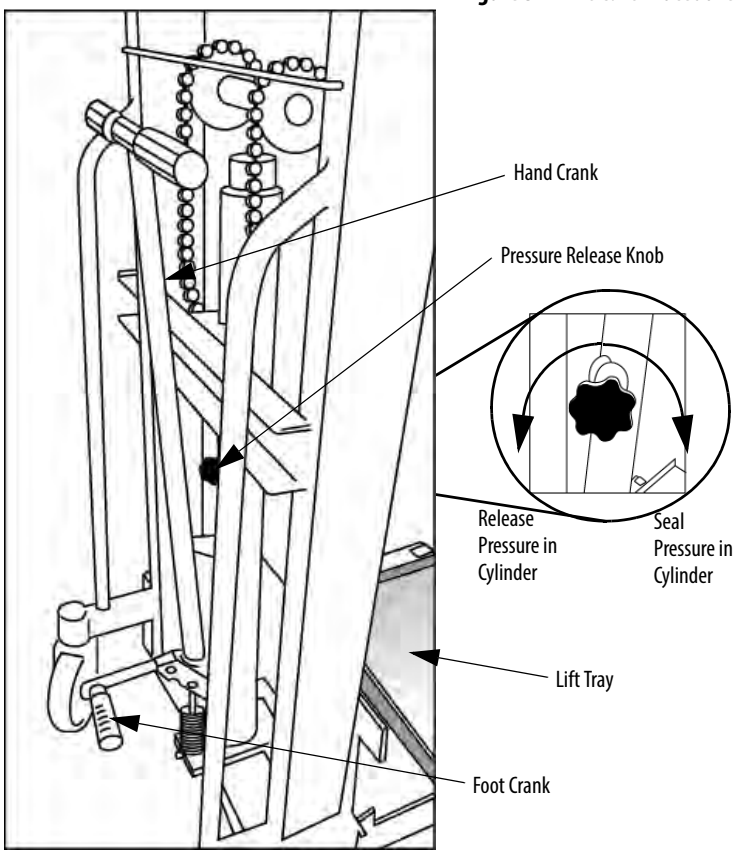
5. Carefully withdraw the Power Module.
6. Install the new Power Module in reverse order of removal.

Replace Drawout Power Module

ATTENTION: Only authorized personnel should operate the lift cart. Keep hands and feet away from the lifting mechanism. Do not stand under the lift tray when in use. Store the lift cart with the tray fully lowered.

Lift Carts are supplied and shipped separately with drawout power module configurations. The unit's hydraulic cylinder can be operated by either a hand or foot crank. The lifting capacity is 1000 kg (2206 lb).

Figure 32 - Lift Cart Procedure

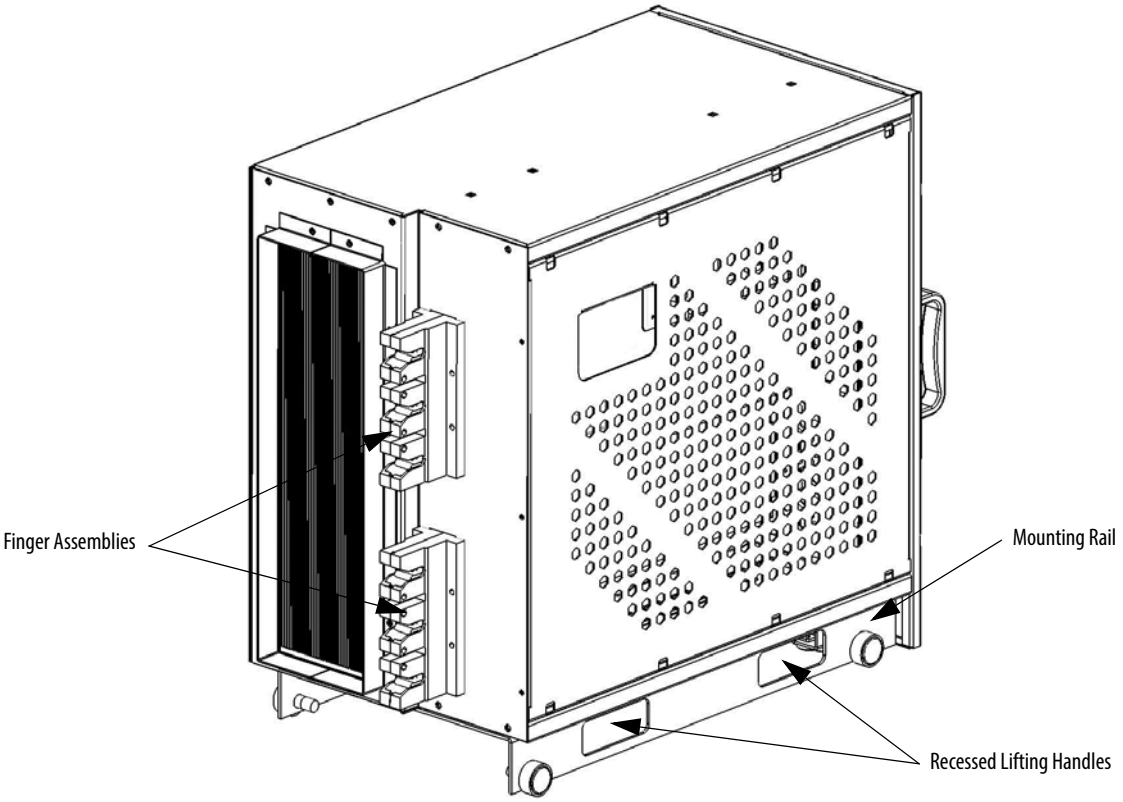


1. Visually inspect the lift cart to ensure it is fully operational.
2. Turn the Pressure Release Knob clockwise until tight.
3. Raise the lift tray using the Hand Crank or the Foot Crank.

   TIP The Foot Crank raises the lift tray faster than the Hand Crank. Use this to raise the Power Module to just below the tray assembly in the drive. Use the Hand Crank for final precise positioning.

4. Lower the lift tray by turning the Pressure Release Knob counter-clockwise.

Figure 33 - Drawout Power Module Lifting Handles



ATTENTION: Do not use the front mounted positioning handles for lifting the Power Modules. They are designed to position or withdraw the Power Module when on the tray assembly.

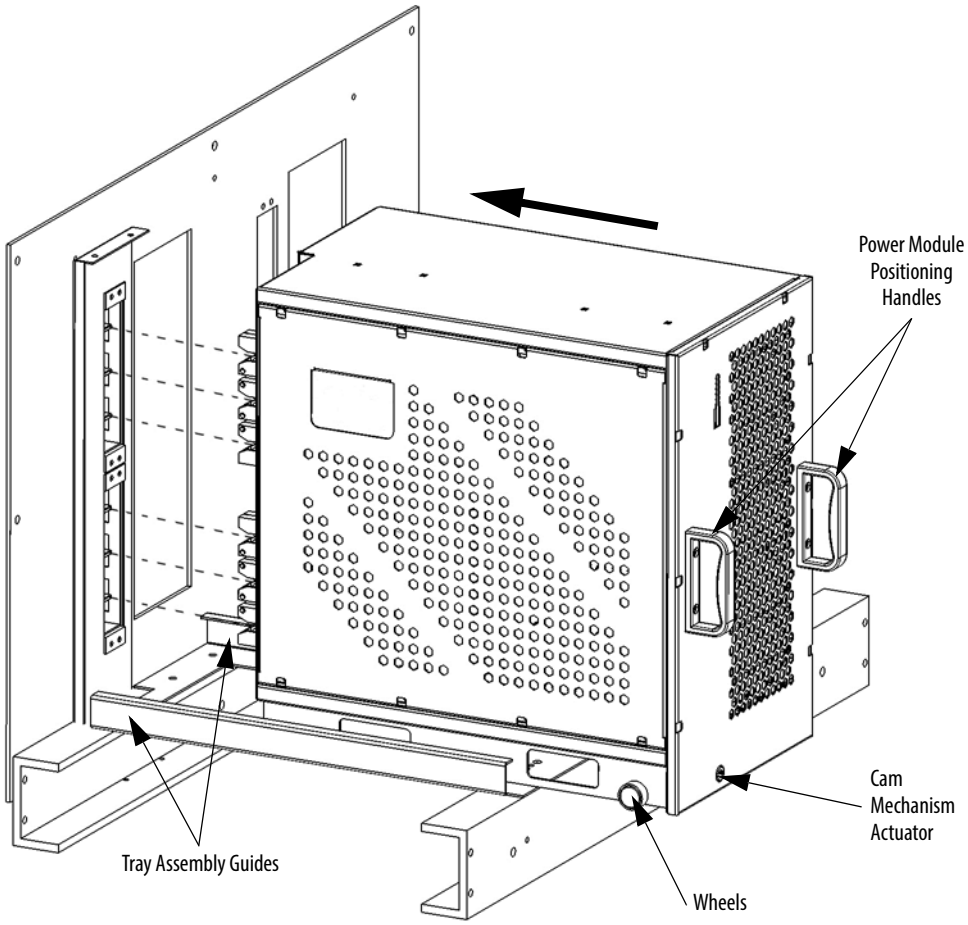
Install Drawout Power Modules

1. Place the Power Module module on the lift cart.

   Ensure the Power Module is properly oriented; the finger assemblies must face towards the drive.

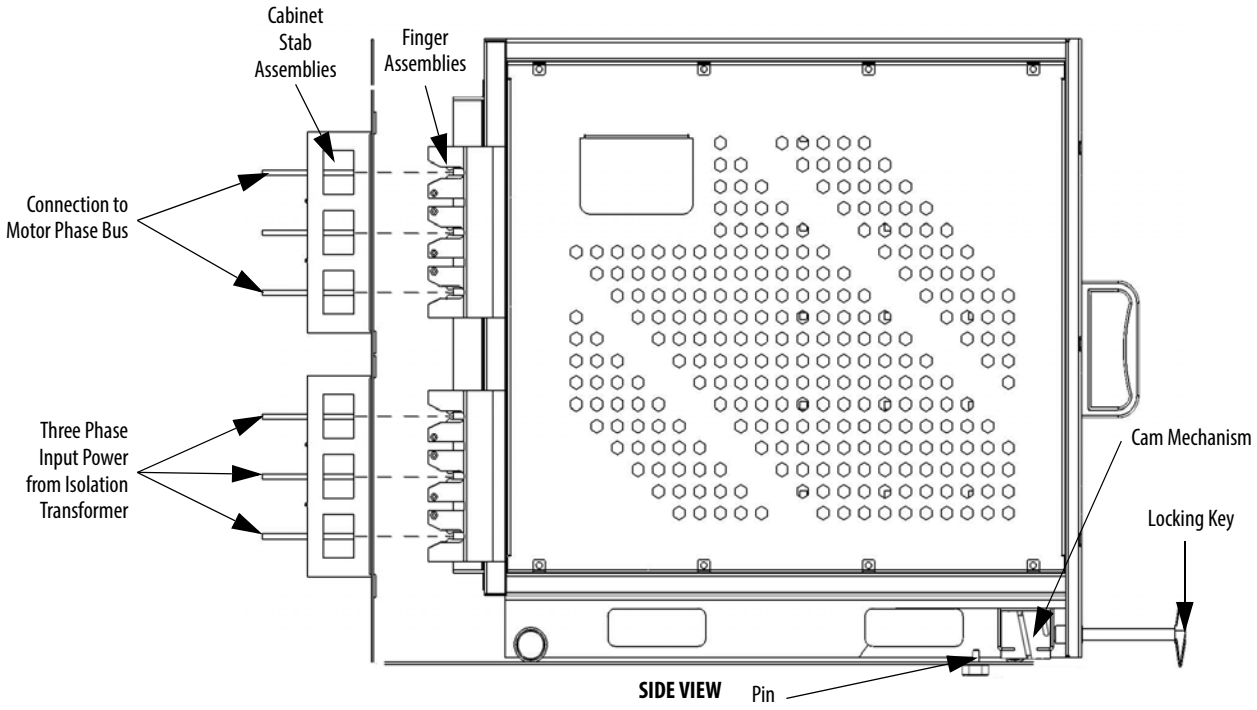
2. Position the lift cart in front of the cabinet and raise the Power Module to the proper height.

3. Align the wheels on the Power Module with the tray assembly guides on each side of the Power Module tray assembly.



4. Push the Power Module slowly backwards into the cabinet until the cam mechanism contacts the pin mounted on the tray assembly.

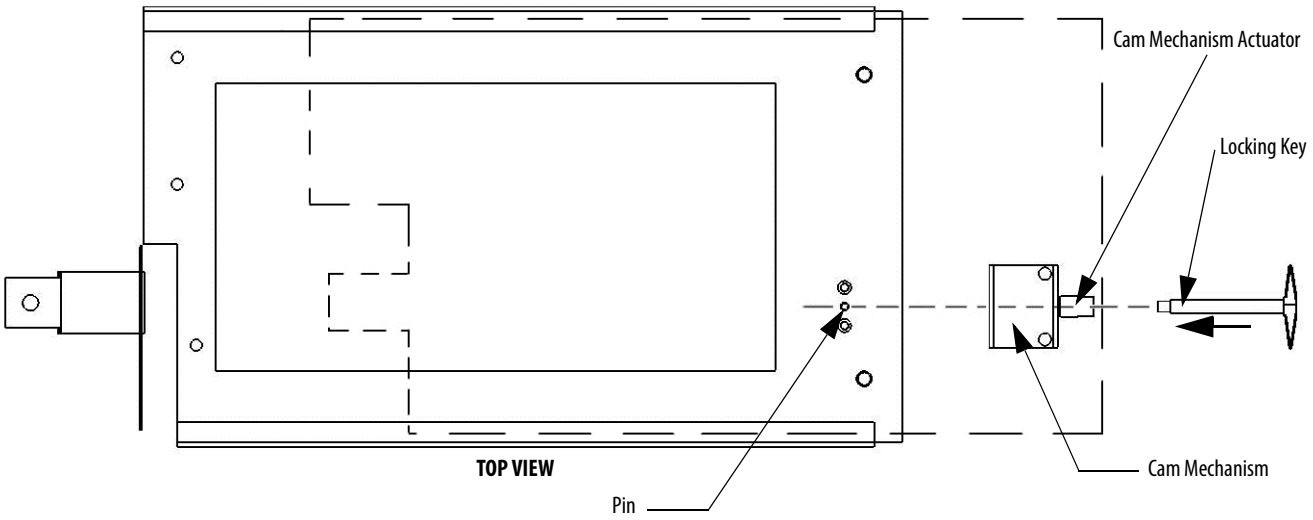
5. Insert the locking key into the cam mechanism actuator and rotate clockwise while gently pushing on the face of the Power Module.



The cam mechanism will catch the pin on the tray assembly.

6. Continue rotating the locking key until the Power Module is fully seated.

This ensures the finger assemblies at the back of the Power Module are fully connected to the stab assemblies at the back of the Power Module compartment.



ATTENTION: The Power Module finger assemblies must be fully seated on the cabinet stab assemblies.

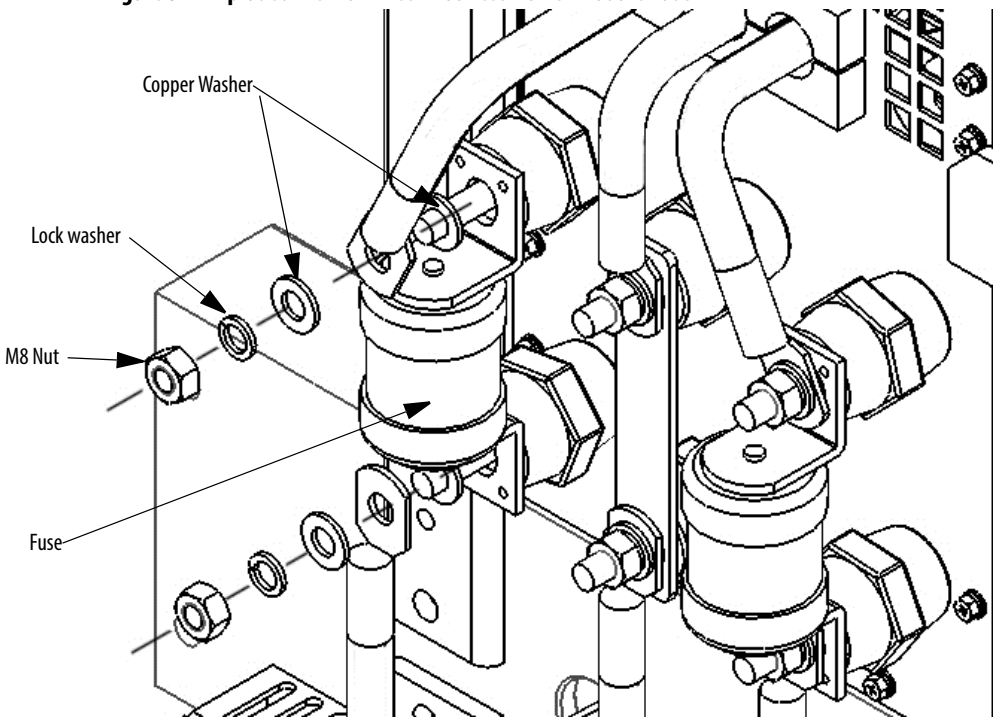
Replace Power Module Fuses

Fixed-mounted Power Module

ATTENTION: Ensure the input circuit breaker feeding the drive is open. Lock out and tagout the input circuit breaker before performing any work on the drive or bypass units.

1. Remove the M8 nut, lock washer, and copper washer from the top and bottom of the fuse.
2. Remove the cables from the top and bottom of the fuse, and remove another copper washer.
3. Install the new fuse, and replace cables and hardware in reverse order of removal.
4. Torque all hardware to specifications (see Torque Requirements on page 129).

Figure 34 - Exploded View of Fixed-mounted Power Module Fuse



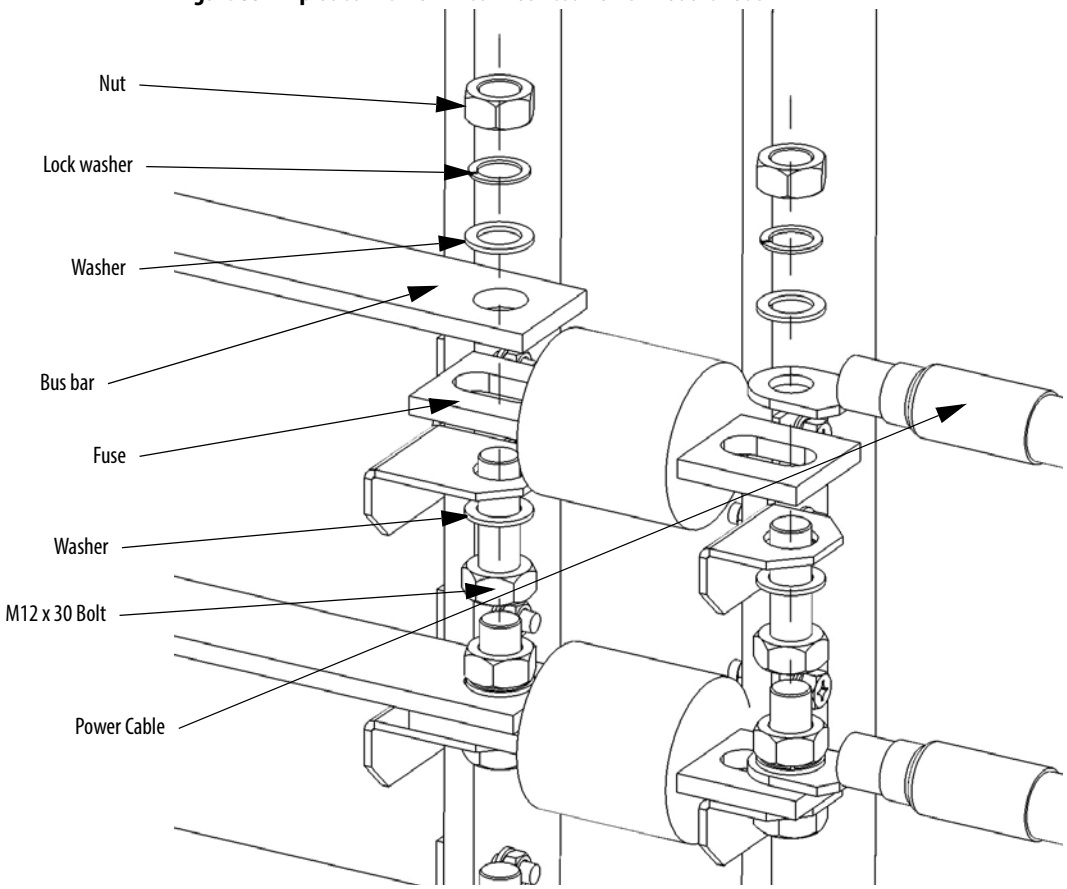
Drawout Power Module

ATTENTION: Ensure the input circuit breaker feeding the drive is open. Lock out and tagout the input circuit breaker before performing any work on the drive or bypass units.

1. Remove and retain the M12 bolt, washer, lock washer, and nut from the top and bottom of the fuse.
2. Remove the fuse from between the fixed bracket and the power cable and bus bar.
3. Install the new fuse, and the hardware in reverse order of removal.
4. Torque all hardware to specifications (see Torque Requirements on page 129).

ATTENTION: The hardware connecting the Drawout Power Modules MUST be reinstalled facing up, as shown in Figure 35. Failure to install the hardware in this manner will affect clearance distance between bolts and can cause an arc.

Figure 35 - Exploded View of Fixed-mounted Power Module Fuse

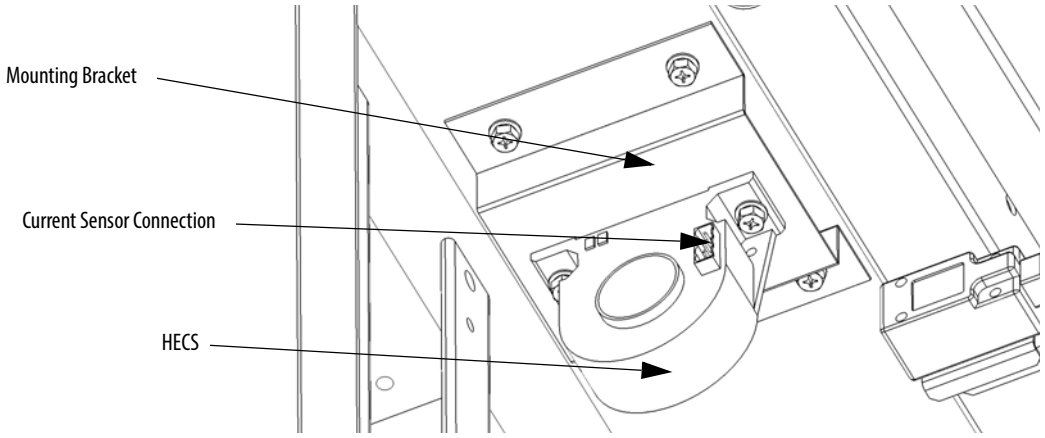


Inspect or Replace HECS

ATTENTION: To prevent electrical shock, disconnect the main power before working on the drive. Verify that all circuits are voltage-free, using a hot stick or appropriate high voltage-measuring device. Failure to do so may result in injury or death.

Two current sensors are located at the top inside the Power Module Cabinet. Verify that the current sensor wire connector is properly seated. Check for obvious signs of damage.

1. Unplug the Current Sensor Connector from the HECS.

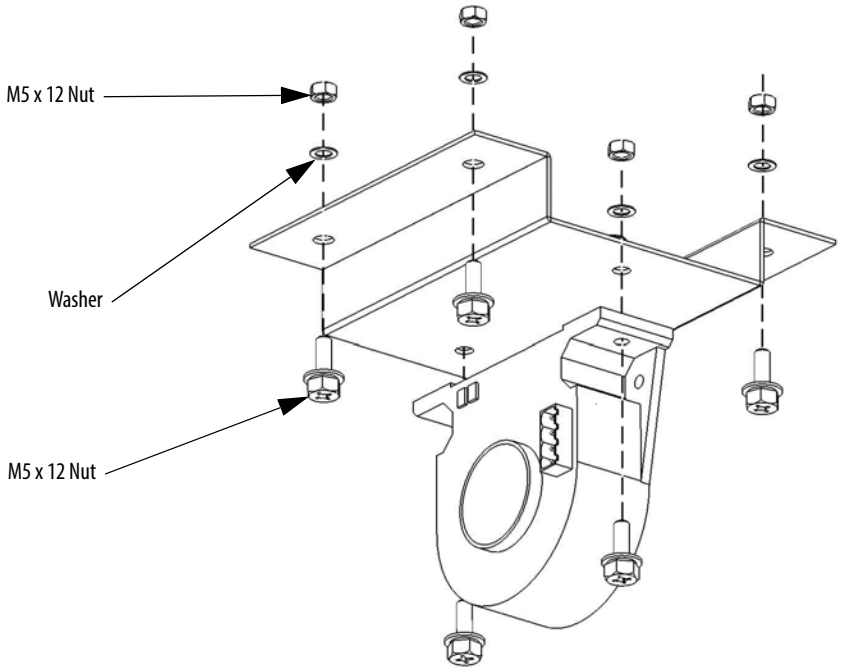


2. Disconnect one end of the power cable that goes through the HECS from the Power Module.
3. Remove the Mounting Bracket with the HECS still attached.

4. Remove and retain M5 x 12 hardware connecting the HECS to the Mounting Bracket.

IMPORTANT Note the orientation of the HECS on the bracket. The new HECS must be installed facing the same direction.

Figure 36 - Exploded view of the HECS and Mounting Bracket



5. Install the HECS on the Mounting Bracket using the existing hardware.

ATTENTION: Verify that the current sampling direction is correct. This is indicated by an arrow symbol on the top of the HECS.

6. Install the Mounting Bracket to the cabinet using existing hardware.
7. Reroute the power cable through the HECS and reattach to the Power Module.

Inspect or Replace Door Position Limit Switch

See Replace Door Position Limit Switch on page 89.

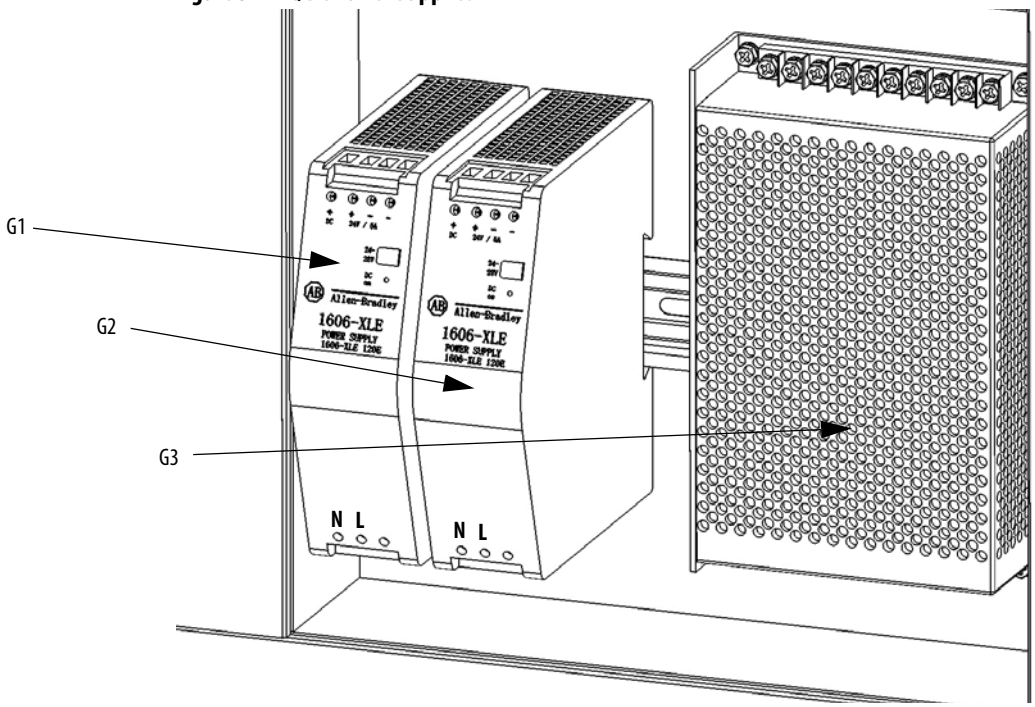
LV Control Cabinet

Inspect AC/DC Power Supplies

Ensure the input and output terminal connections are tight.

Use a voltmeter to check the output voltage. A green LED indicates normal operation.

Figure 37 - AC/DC Power Supplies



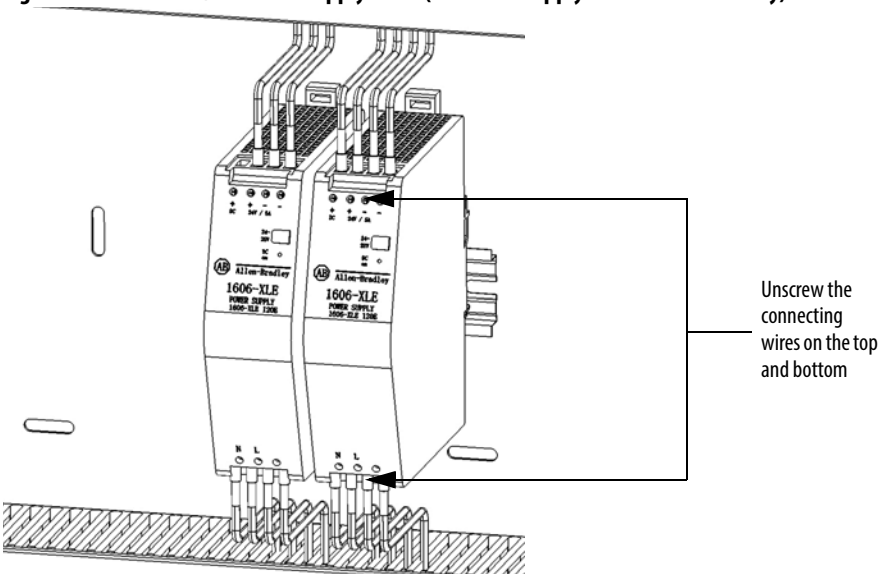
Replace AC/DC Power Supplies

ATTENTION: Always perform Power Lockout procedure before servicing equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury, or death.

G1 or G2 Power Supplies

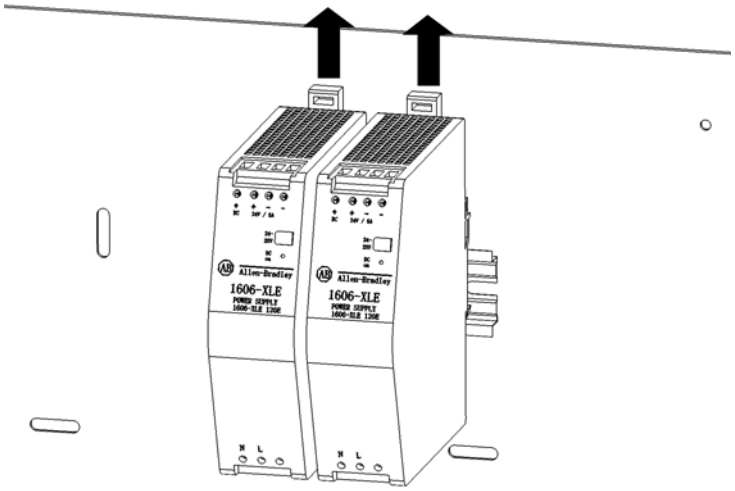
1. Open the LV Control cabinet door.
2. Loosen the top and bottom terminal screws and remove the wires on the G1 or G2 power supplies.

Figure 38 - Remove AC/DC Power Supply wires (G3 Power Supply not shown for clarity)



3. Release the spring-loaded latches at the bottom of the power supply and lift the control relay off the DIN rail.

Figure 39 - Release the latches on the Power Supplies (G3 Power Supply not shown for clarity)

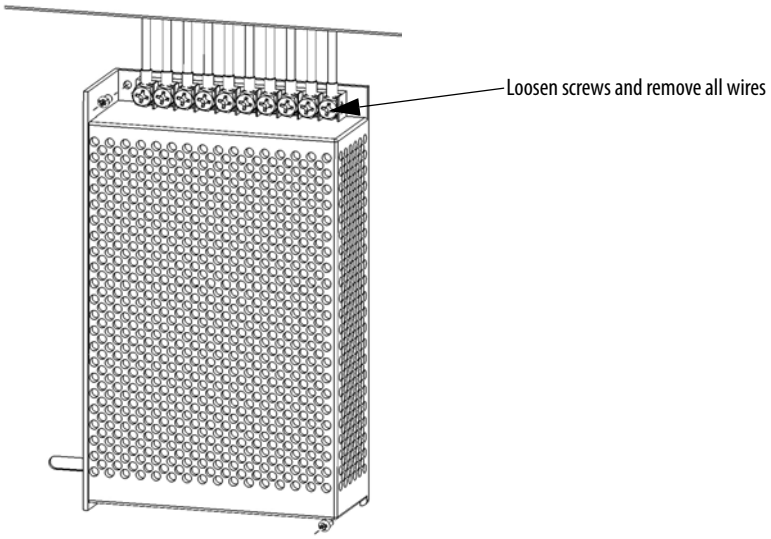


4. Install the new power supply in reverse order of removal.

G3 Power Supply

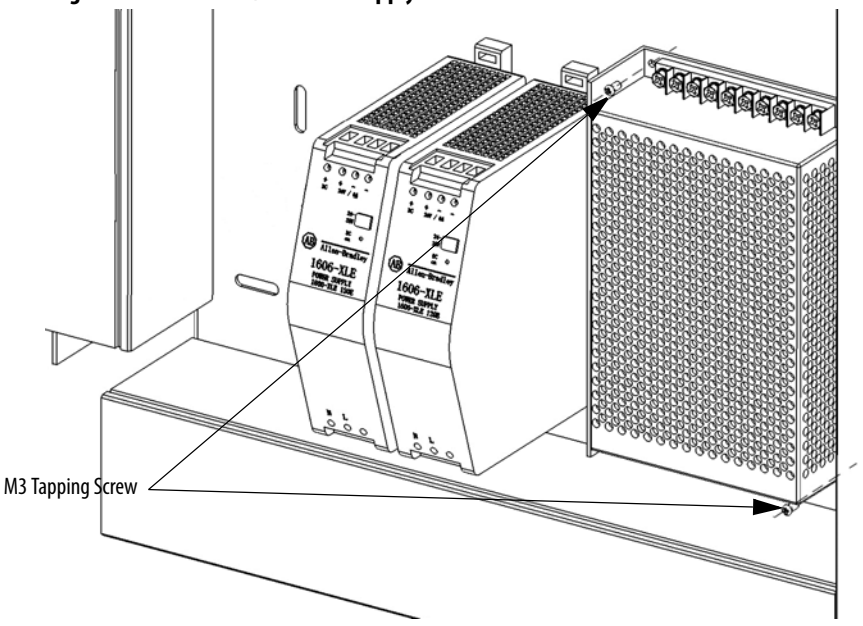
1. Loosen, but do not remove, the screws on the top of the G3 Power Supply.
2. Remove the wires.

Figure 40 - Remove G3 Power Supply wires (G1 and G2 Power Supply not shown for clarity)



3. Remove two M3 Tapping screws to remove the unit.

Figure 41 - Remove AC/DC Power Supply



4. Install the new power supply in reverse order of removal.

Inspect UPS

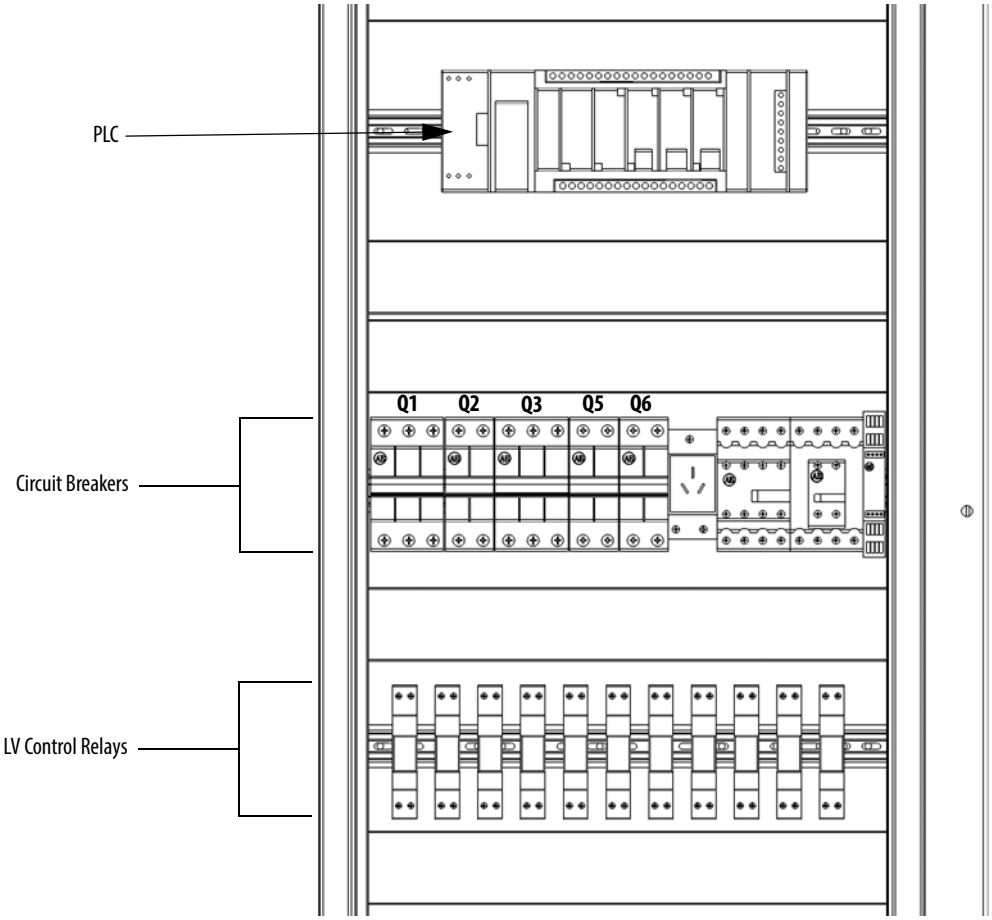
1. Check there are no obstructions or dirt/debris in the exhaust heat fan.
2. Ensure there are no visible signs of damage.

IMPORTANT	If the drive has not been turned on for more than 3 months, the UPS batteries must be charged for at least 10 hours. Apply either MV to the drive or customer-supplied control power.

Check UPS Output Voltage

1. Open the LV Control cabinet door.
2. Turn off the back-up control power circuit breaker (Q5) and the customer-supplied power supply circuit breaker (Q1).

Figure 42 - Circuit Breaker Location in LV Control Cabinet



3. Press ON on the front of the UPS.
4. Using a voltmeter, check the output voltage of the UPS by checking the input voltage on the line side of the Q2 circuit breaker (equivalent electrical point).

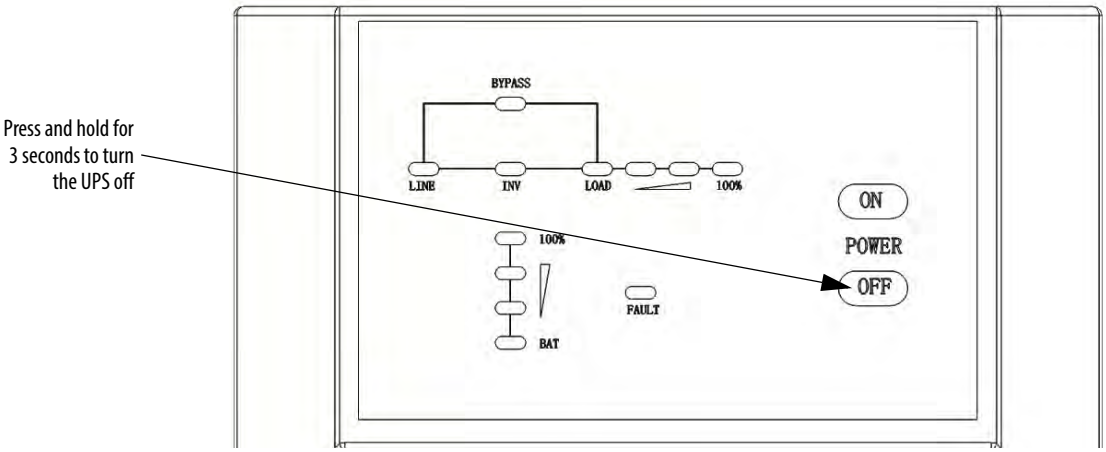
   The input voltage must be 220V AC.

Replace UPS

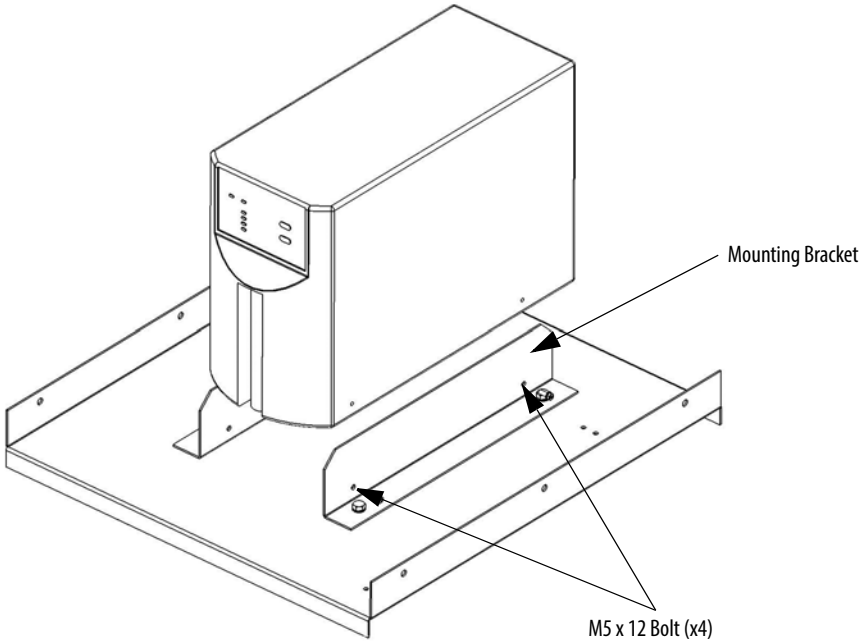
ATTENTION: Always perform Power Lockout procedure before servicing equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury, or death.

1. Turn off the Q2, Q3, and Q6 circuit breakers in the LV Control Cabinet (Figure 42).
2. Press and hold OFF on the front of the UPS.

Figure 43 - Front Display of UPS



3. Turn off the Q1 and Q5 circuit breakers in the LV Control Cabinet.
4. Unplug the UPS input and output power cables and disconnect the ground wire.
5. Remove and retain four screws from the mounting bracket.



6. Install the replacement UPS, and reconnect input and output cables.
7. Turn the Q1 circuit break and press the ON button on the UPS.

   Wait for 2...3 seconds.
8. Using a voltmeter, check the input voltage on the line side of the Q2 circuit breaker.

   The input voltage must be 220V AC.
9. Turn on Q2, Q3, Q5, and Q6 circuit breakers to complete the procedure.

ATTENTION: During removal and installation of the UPS, do not omit the UPS ground wire.

Replace UPS Batteries

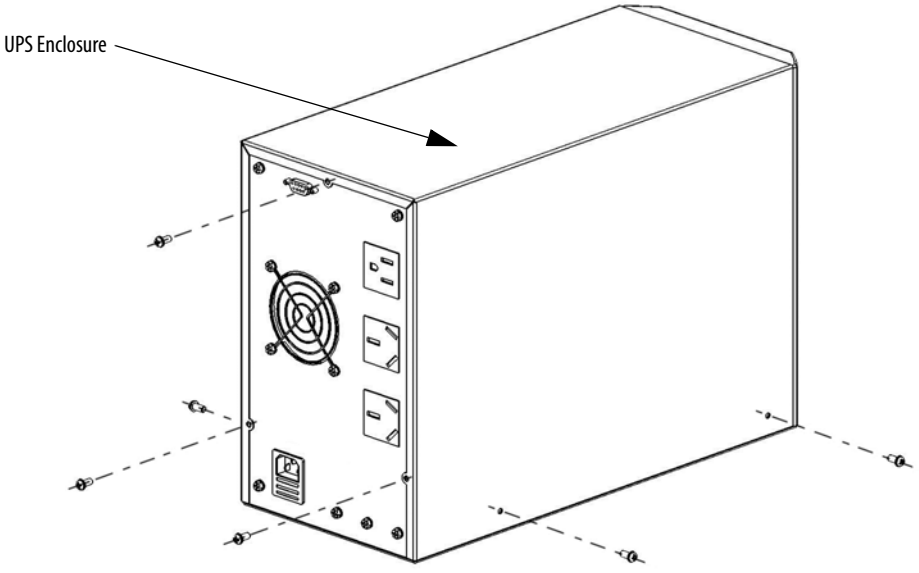
ATTENTION: Do not handle batteries that have leaked electrolytes, as they are corrosive and can cause burns.

The UPS must be removed from the LV Control Cabinet in order to access and replace the batteries. See steps 1...5 of Replace UPS on page 105 for instruction on safely removing the UPS.

Remove the UPS Batteries

1. Remove and retain seven screws from the outside of the UPS enclosure (two screws on either side and three screws on the back).
2. Remove the outer UPS cover and set aside.

Figure 44 - Remove the UPS enclosure hardware



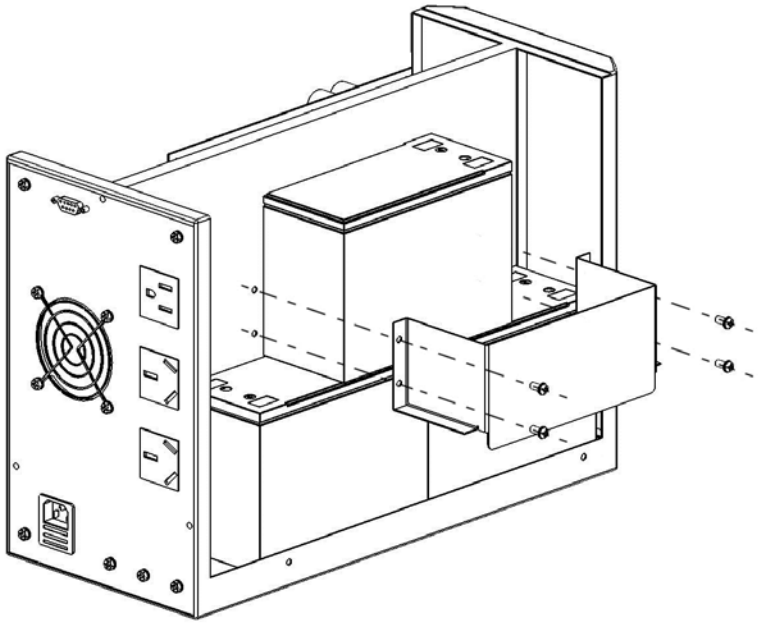
3. Remove the cables from the top battery one at a time, and immediately wrap insulating tape around end of each cable.

   Indicate on the tape the positive or negative terminal, as appropriate.

ATTENTION: Do not touch the positive and negative battery wires to each other or the UPS enclosure.

4. Repeat step 2 for the two remaining batteries.
5. Remove and retain two screws on either side of the mounting bracket, and remove the bracket.

Figure 45 - Remove the mounting bracket



6. Remove the batteries from the UPS.

Do NOT throw batteries in the garbage. Dispose of the batteries according to local regulations.

7. Place the new batteries in the enclosure, and reinstall the mounting bracket using the hardware removed in step 5.
8. Reconnect the cables to the correct terminals on each battery.
9. Use a voltmeter to check the output of the batteries. The total voltage must be 37...40V DC.
10. Install the UPS enclosure using the hardware removed in step 1.

See step 6...9 of Replace UPS on page 105 to reinstall the UPS.

Inspect PLC

1. Verify all input and output terminal connections are secure.
2. Verify all LEDs are working and indicate normal status.

See publication 2080-UM002_-EN-P for further information for the PLC, or publication 2080-WD002_-EN-P for further information regarding the Isolated Serial Port Plug-in Modules.

Inspect/Replace Control Unit or Control Boards

ATTENTION: Always perform Power Lockout procedure before servicing equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury, or death.

- Verify that the terminal connections on the bottom of the Control Unit are secure and are free of dirt, dust, or foreign material. Clean with an anti-static cloth.
- Verify the fiber optic cables are properly connected to the A/B/C PWM boards. Verify an appropriate bend radius (if applicable).
- Check all boards for damage and properly working LEDs.

Replace a Control Unit

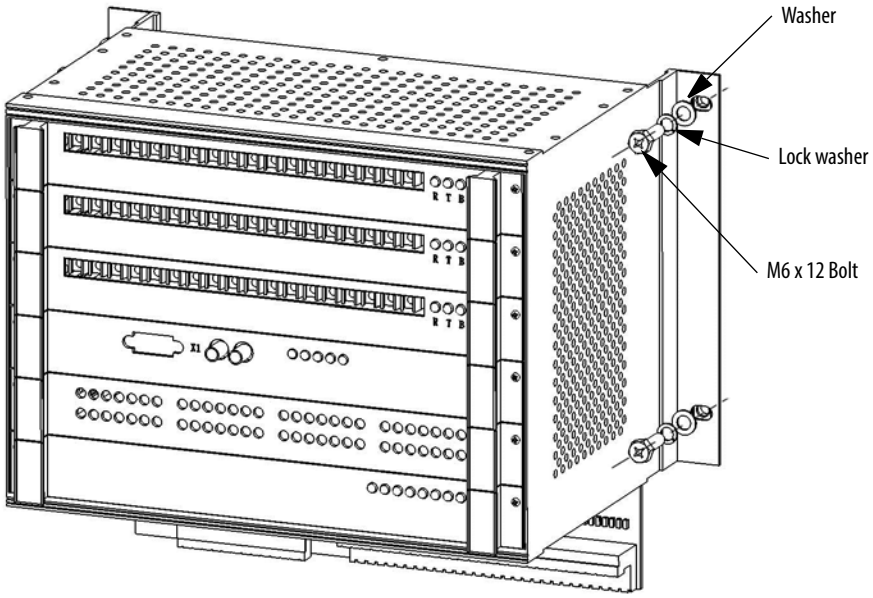
IMPORTANT The Control Unit does not have to be removed to replace Control Boards.

1. Turn off all the control power, turn off the UPS, and confirm the LV Control Cabinet is unenergized before operation.
2. Disconnect all of the bottom terminals.
3. Disconnect the fiber optic wires from A/B/C Phase board.

ATTENTION: When removing the fiber optic cables, be careful to prevent the cables from straining or crimping as a resulting loss in light transmission will impact performance.

4. Disconnect the HMI communication cable from the CPU board.
5. Remove four M6 x 12 bolts, and remove the Control Unit.

Figure 46 - Remove Retaining Screws of Control Unit



6. Install the new Control Unit in reverse order of removal. Refer to Electrical Drawings for exact placement of all wires and connections.

Replace a Control Board

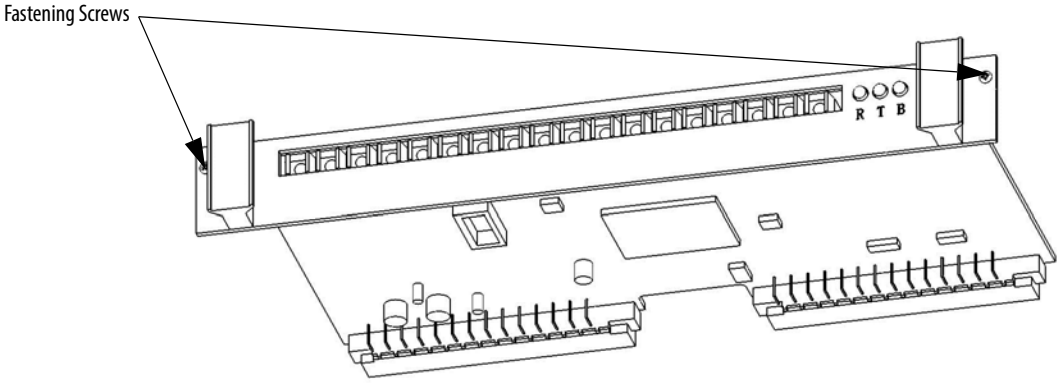
ATTENTION: Some circuit boards can be destroyed by static charges. Use of damaged circuit boards may also damage related components. Use a grounding wrist strap when handling sensitive circuit boards.

1. Turn off all the control power, turn off the UPS, and confirm the LV Control Cabinet is unenergized before operation.

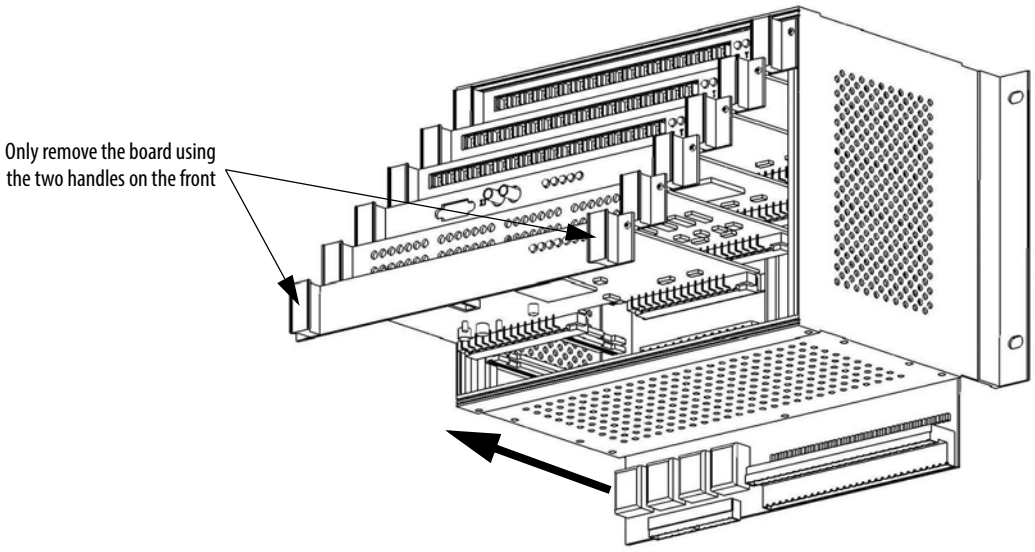
   If applicable, remove the fiber optic wires.

ATTENTION: When removing the fiber optic cables, be careful to prevent the cables from straining or crimping as a resulting loss in light transmission will impact performance.

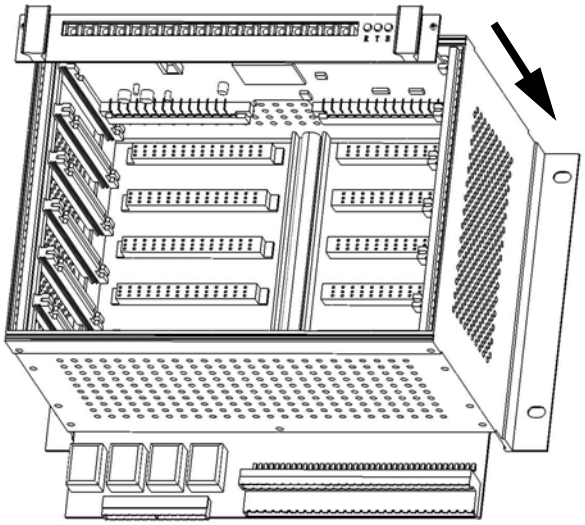
2. Remove the fastening screws on the both sides of the board.



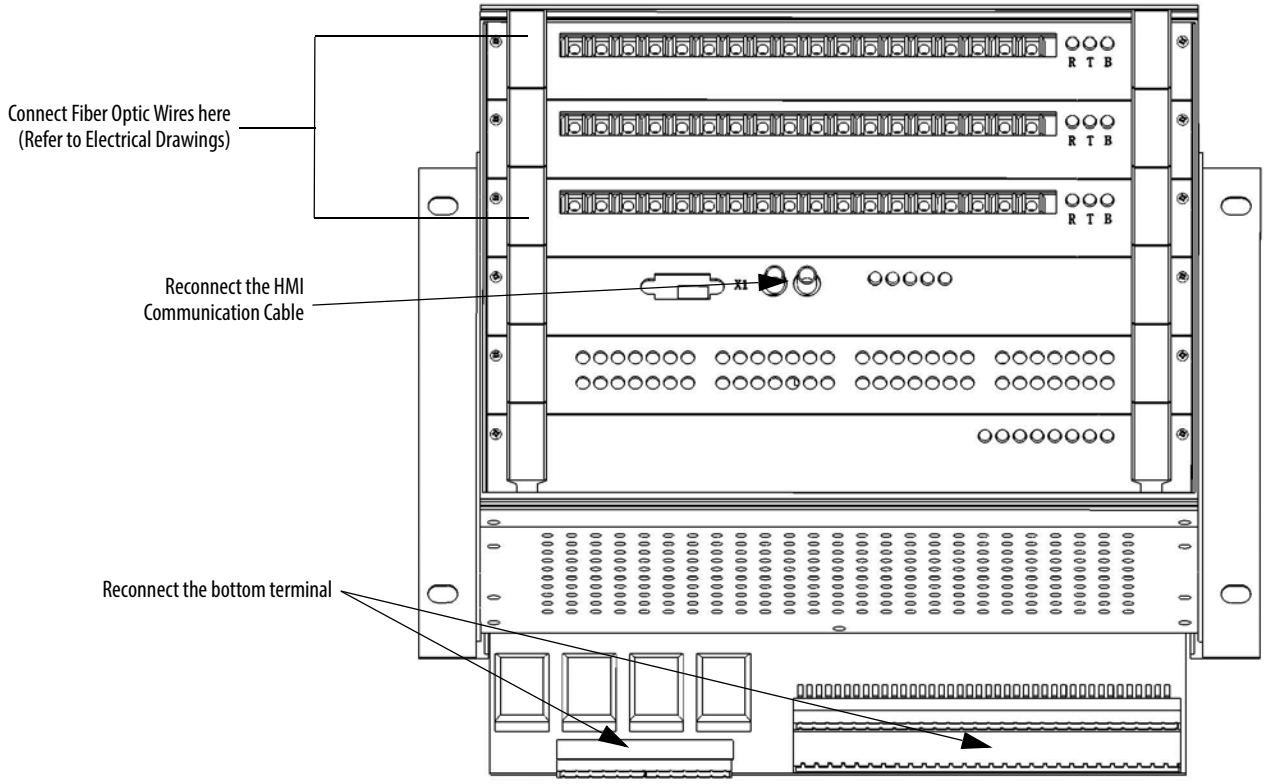
3. Use both hands and carefully remove the board by using the handles on either side on the front of the board.



4. Install the new boards in the reverse order of removal.



5. Refer to the Electrical Drawings for reconnecting the fiber optic wires.



Inspect the HMI

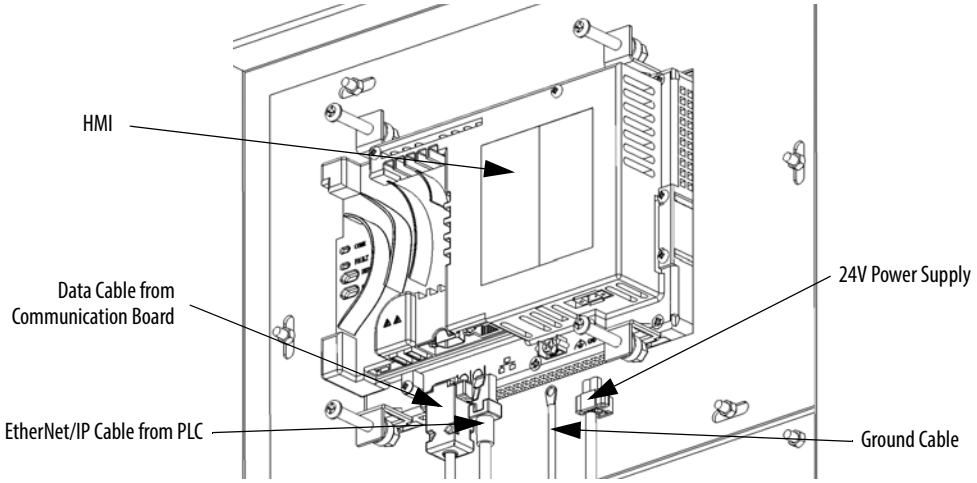
1. Verify the input and output cables and communication cables are hand-tight.
2. Power up the HMI.
3. Verify the HMI display is operating normally.

Replace the HMI

ATTENTION: Always perform Power Lockout procedure before servicing equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury, or death.

The touch screen is located on the LV Control Cabinet door.

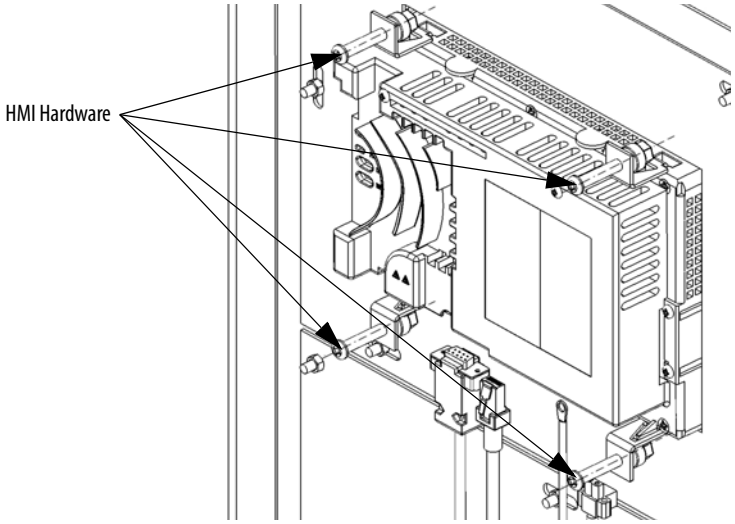
1. Disconnect the data cable from communication board, the EtherNet/IP cable from PLC, the ground cable, and the 24V power supply cable.



2. Remove and retain four screws from HMI.

IMPORTANT Support the HMI from the outside of the door to prevent it from falling through the front of the door.

3. Install the new HMI from the inside of the LV Control Cabinet door.



4. Reconnect all cables in reverse order of removal.

TIP The following HMI components can be replaced:

- Logic Module
- Display Module
- Bezel
- Backlight
- Battery

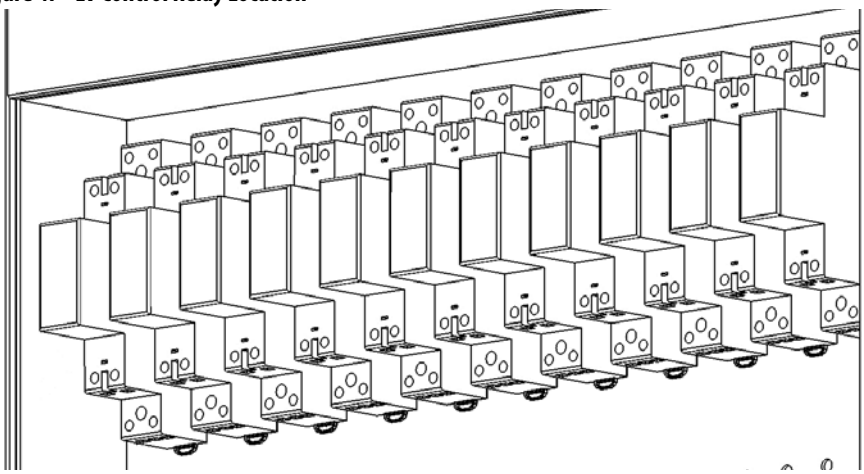
See publication 2711P-UM006_-EN-P for further information.

Replace LV Control Relays

ATTENTION: Always perform Power Lockout procedure before servicing equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury, or death.

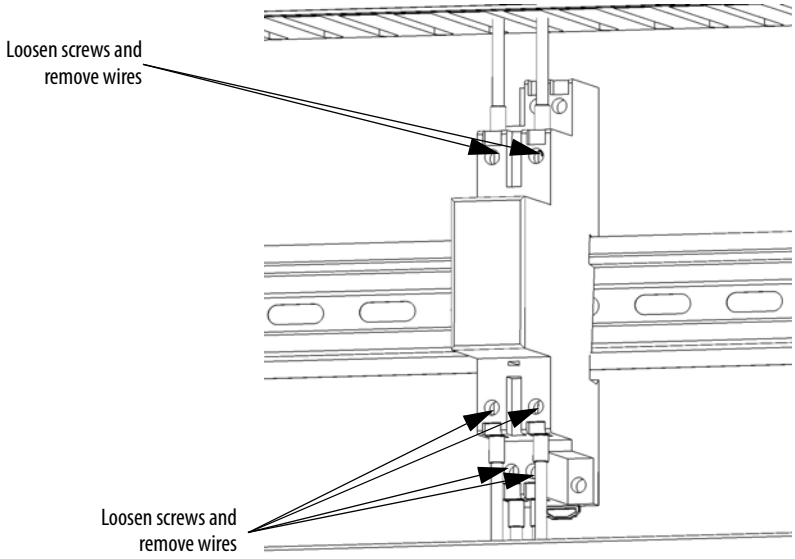
1. Open the LV Control cabinet door.

Figure 47 - LV Control Relay Location



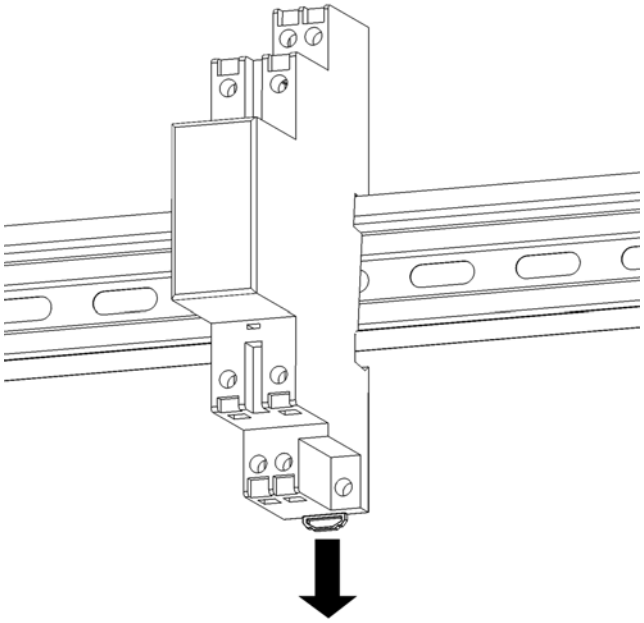
2. Loosen the top and bottom screws and remove the wires on the control relay.

Figure 48 - Loosen screws on the LV Control Relay



3. Release the spring-loaded latches at the bottom of the control relay and lift the control relay off the DIN rail.

Figure 49 - Release the spring-loaded latch on the LV Control Relay



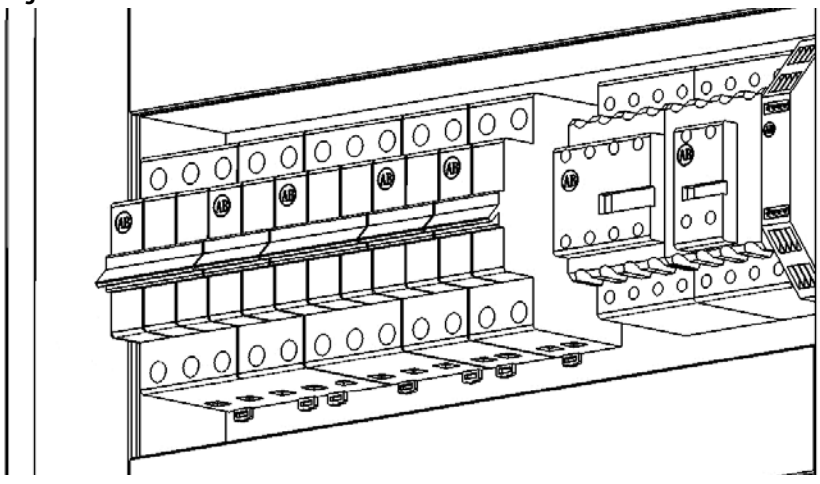
4. Install the new control relay in reverse order of removal.

Replace LV Control Circuit Breakers

ATTENTION: Always perform Power Lockout procedure before servicing equipment. Verify with a hot stick or appropriate voltage measuring device that all circuits are voltage free. Failure to do so may result in severe burns, injury, or death.

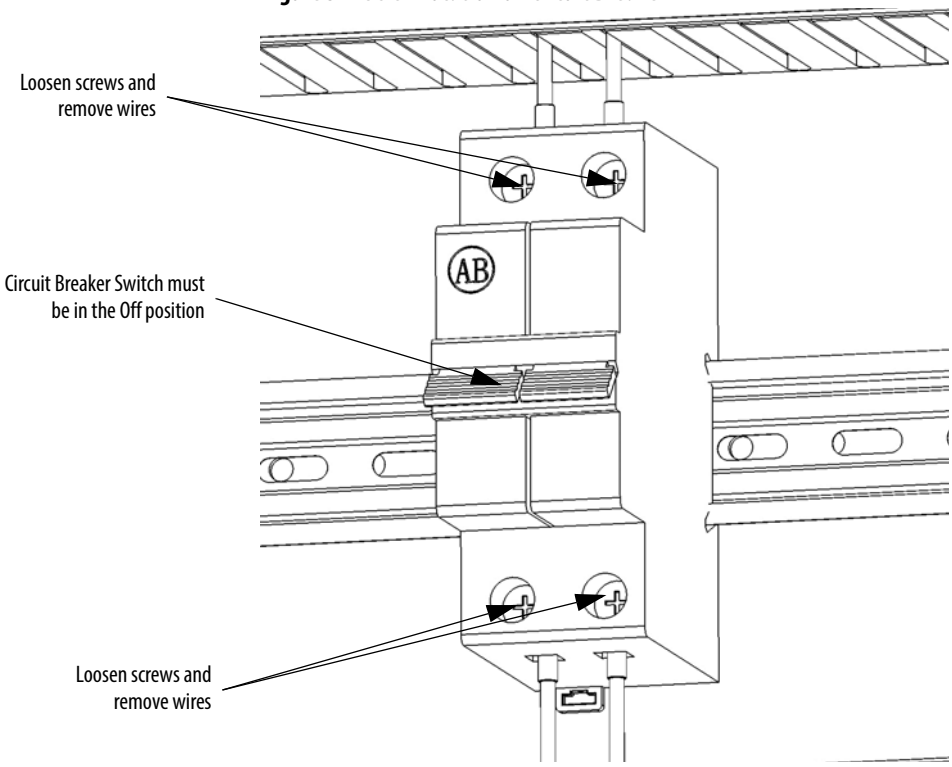
1. Open the LV Control cabinet door.
2. Switch the circuit breaker to the off position.

Figure 50 - Circuit Breaker Location in LV Control Cabinet



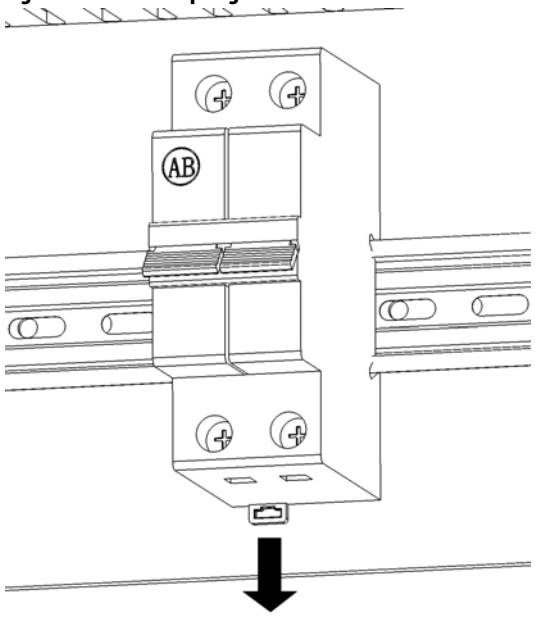
3. Loosen the top and bottom screws and remove the wires on the circuit breaker.

Figure 51 - Screw location on Circuit Breaker



4. Release the spring-loaded latches at the bottom of the circuit breaker and lift the circuit breaker off the DIN rail.

Figure 52 - Release spring-loaded latch on LV Circuit Breakers



5. Install the new circuit breaker in reverse order of removal.

Inspect Coils

If a coil exhibits evidence of overheating (cracked, melted or burned insulation), it must be replaced. In that event, check for and correct overvoltage or undervoltage conditions, which can cause coil failure. Be sure to clean any residue of melted coil insulation from other parts of the device or replace such parts.

Inspect Contacts

Check contacts for excessive wear and dirt accumulations. Vacuum or wipe contacts with a soft cloth if necessary to remove dirt. Contacts are not harmed by discoloration and slight pitting. Do not file contacts. Do not use contact spray cleaners as residues on magnet pole faces or in operating mechanisms can cause sticking and can interfere with electrical continuity. Replace contacts only after the contact face material is badly worn. Replace contacts in complete sets to avoid misalignment and uneven contact pressure.

Inspect Pilot Lights

Replace any burned out lamps or damaged lenses. Do not use solvents or cleaning agents on the lenses.

Do not use test equipment for solid-state controls which is not factory recommended. Doing so can result in damage to the control or test equipment, or unintended actuation of the controlled equipment.

Solid-state devices require little more than a periodic visual inspection. Replace discolored, charred, or burned components. Necessary replacements should be made only at the PC board or plug-in component level. Verify the printed circuit boards are seated in the edge board connectors. Board locking tabs should also be in place. Protect solid-state devices from contamination, and maintain appropriate cooling provisions. Do not use solvents on printed circuit boards.

Inspect Locking and Interlocking Devices

Check these devices to verify proper working condition. Make any necessary replacements only with Allen-Bradley renewal parts or kits. Adjust or repair only in accordance with Allen-Bradley instructions found in the product User Manuals.

Connections

Inspect LV Component Terminal and Plug-in Connections

All LV control connections must be secure. Check for dirt, debris, or foreign material, and clean with anti-static cloth if necessary.

Check relays, contactors, timers, terminal connectors, circuit breakers, ribbon cables, control wires, etc. Check for corrosion, excessive temperature, or contamination. Clean all components using a vacuum cleaner.

Inspect Medium Voltage Cable Connections

Verify that all MV power cable connections and grounding cables are torqued to specification. Apply torque sealer where necessary. Check for corrosion, excessive temperature, or contamination.

Inspect Power Cable and Control Wire Terminals

Loose connections in power circuits can cause overheating that can lead to equipment malfunction or failure. Loose connections in control circuits can cause control malfunctions. Loose bonding or grounding connections can increase hazards of electrical shock and contribute to electromagnetic interference (EMI). Check the tightness of all terminals and bus bar connections and tighten securely any loose connections. Replace any parts or wiring damaged by overheating, and any broken wires or bonding straps. Refer to the User Manual for torque values required for power cable and bus hardware connections.

Inspect Transformer Secondary Windings

Check the Incoming Line Power Cable connections (L1, L2, and L3), the Outgoing Motor Power Cable connections (U, V, W), and the Isolation Transformer Power Cable Connections are torqued to specifications. See Figure 9 on page 19 and Figure 10 on page 19.

Inspect the bus bars and cable connections. Check for any signs of overheating / discoloration and tighten the bus connections to the required torque specifications. Clean all cables and bus bars that exhibit dust build-up. Check for corrosion, excessive temperature, or contamination.

Inspect Power Module Input and Output Power Connections

Verify that all Power Module input line cables and output bus connections are properly torqued. Verify the output cables, VSB Cables and star connection cables are properly torqued. Apply torque sealer if required. Check for corrosion, excessive temperature, or contamination.

General

Review Firmware and Hardware

Verify the firmware version on the HMI. Contact Rockwell Automation to determine whether there are any enhancements or changes made to the Drive Hardware and Control that would be valuable to the application.

Verify that the HMI is operational. Check the status indicators on the Control Unit in the LV Control Cabinet register as normal.

ATTENTION: Ensure there is no power to the drive and wear an anti-static wristband.

Remove any dirt or foreign material. Wipe components with an anti-static cloth, where applicable.

Inspect/Review Spare Parts

Check for signs of damage, dirt, or foreign material. See Spare Parts on page 127.

ATTENTION: Some circuit boards can be destroyed by static charges. Use of damaged circuit boards may also damage related components. Use a grounding wrist strap when handling sensitive circuit boards.

Technical Specifications

Description	
Power Rating Range @ 3 kV motor voltage	320…1600 kW
Power Rating Range @ 3.3 kV motor voltage	360…1720 kW
Power Rating Range @ 6 kV motor voltage	200…3360 kW
Power Rating Range @ 6.6 kV motor voltage	220…3720 kW
Power Rating Range @ 10 kV motor voltage	200…5600 kW
Motor Type	Induction (asynchronous) motors
Input Voltage Rating	3 kV, 3.3 kV, 6 kV, 6.6 kV, 10 kV, 11 kV
Input Voltage Tolerance	±10% of Nominal
Input Voltage Sag	-20% of Nominal, duration – 60 seconds
Input Frequency	50/60 Hz, ±5%
Input Impedance Device	Multiphase Isolation Transformer
Output Voltage	0…3000V, 0…3300V, 0…6000V, 0…6600V, 0…10,000V
Rectifier Configurations	18 pulse (3 kV, 3.3 kV), 36 pulse (6 kV, 6.6 kV), 54 pulse (10 kV, 11 kV)
Inverter Configuration	Pulse Width Modulated (PWM) power modules
Power Semiconductors	Diodes (rectifier), IGBTs (inverter)
Output Current THD (1st…49th)	< 5%
Output Waveform to Motor	Near Sinusoidal Current / Voltage
Medium Voltage Isolation	Fiber Optic
Control Method	Volts per hertz
Output Frequency Range	0.5…75 Hz
Acceleration/Deceleration time	0...3276 seconds
Flying Start Capability	Yes
Service Duty Rating	120% Overload for 1 min every 10 min
Input Power Factor	>.95
VFD Efficiency(1)	>96.5%
VFD Noise Level	< 80 dB
Operator Interface	7 in. WinCE Color Touchscreen
Languages	English, Chinese
Control Power	120V 60 Hz, 240V 60 Hz, 110V 50 Hz, or 220V 50 Hz (3 kVA)
External Input Ratings	24V DC
External Output Ratings	240V AC/2 A
Analog Inputs (Optional)	Four non-isolated, 4…20 mA or 0…10V DC (two spare)
Analog Outputs (Optional)	Two isolated: 4…20 mA, two isolated: 0…5V DC (spare)
Communications Protocols (Optional)	RS232/422/485, Modbus, Modbus Plus, Profibus DP, EtherNet I/P
Enclosure	IP31 (standard), IP42 (optional)
Structure Finish	Epoxy Powder - Paint Exterior Sandtex Light Grey (RAL 7038) - Black (RAL 8022) Internal - Control Sub Plates - High Gloss White (RAL 9003)
Corrosion Protection	Unpainted Parts (Zinc Plated / Bronze Chromate)
Ambient Temperature (Operating)	0…40 °C (standard), 0…50 °C (optional with derating)
Ambient Temperature (Storage)	-25…55 °C
Relative Humidity	Max. 95% non-condensing
Altitude	0…1000 m (standard) 1001…3000 m (optional)

(1) Average for Product Portfolio.

Notes:

Catalog Number Explanation

Position	1	2	3	4	5	6	7	8	9
	6000	— A A A	41	M	R	5	AL	R	— 1...etc.
	a	b	c	d	e	f	g	h	i

a

Bulletin Number	
Code	**Description**
6000	All Drive Products

b

Service Duty/Altitude/Ambient Temperature Code	
Code	**Type**
_ • •	**Service Duty (First Position)** A: Normal Duty Z: Custom (Contact Factory)
• _ •	**Altitude (Second Position)** A: 0...1000 m(1) B: 1001...2000 m(2) C: 2001...3000 m(2) Z: Custom (Contact Factory)
• • _	**Ambient Temperature (Third Position)** A: 0...40 °C B: 0...50 °C (1)(3) Z: Custom (Contact Factory)

(1) 0...1000 m (• A B) is the only valid altitude for 50 °C, as a standard supported option.

(2) Derating for altitude is 10% of the stated A A A Drive Current Rating for 1001...2000 m, and 20% of the stated A A A Drive Current Rating for 2001...3000 m.

(3) Derating for ambient temperature is 2.5% of the stated A A A Drive Current Rating per degree over 40 °C.

c

A A A Drive Current Rating(4)			
Code	**Description**	**Code**	**Description**
15	15 Amp	25	25 Amp
16	16 Amp	26	26 Amp
18	18 Amp	28	28 Amp
20	20 Amp	30	30 Amp
24	24 Amp	32	32 Amp

c (continued)

A A A Drive Current Rating(4)			
Code	**Description**	**Code**	**Description**
33	33 Amp	112	112 Amp
36	36 Amp	120	120 Amp
40	40 Amp	125	125 Amp
41	41 Amp	138	138 Amp
45	45 Amp	140	140 Amp
48	48 Amp	150	150 Amp
50	50 Amp	160	160 Amp
54	54 Amp	168	168 Amp
56	56 Amp	180	180 Amp
60	60 Amp	192	192 Amp
63	63 Amp	200	200 Amp
66	66 Amp	225	225 Amp
71	71 Amp	250	250 Amp
75	75 Amp	280	280 Amp
80	80 Amp	300	300 Amp
84	84 Amp	315	315 Amp
90	90 Amp	350	350 Amp
96	96 Amp	380	380 Amp
100	100 Amp	420	420 Amp
108	108 Amp		

(4) A A A Drive Current Ratings shown are only for Normal Duty, 0...1000 m altitude, and 0...40 °C ambient temperature.
Not all drive current ratings are available in all voltages. Refer to the PowerFlex 6000 Selection Guide.

Position

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
6000	**– AAA**	**41**	**M**	**R**	**5**	**AL**	**R**	**– 1...etc**
a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*

d

Enclosure Type	
Code	**Description**
M	IP31
W	IP42

e

Nominal Line Voltage	
Code	**Description**
B	3.0 kV
C	3.3 kV
F	6.0 kV
J	6.6 kV
R	10 kV
S	11 kV

f

Line Frequency	
Code	**Description**
5	50 Hz
6	60 Hz

g

Control Voltage(5)	
Code	**Description**
AG	110V
AJ	120V
AL	220V
AP	240V

(5) The only control voltage/frequency combinations available as a standard supported option are 110V/50 Hz, 220V/50 Hz, 120V/60 Hz, and 240V/60 Hz.

h

Nominal Load (Motor) Voltage(6)	
Code	**Description**
B	3.0 kV
C	3.3 kV
F	6.0 kV
J	6.6 kV
R	10 kV

(6) Nominal line voltage equals nominal load voltage except for 11 kV line voltage, where 11 kV is NOT available as a load voltage. For 11 kV line voltage, the only valid load voltage options are 3.3 kV and 6.6 kV.

i

Options
Refer to PowerFlex 6000 Medium Voltage Drives Options List.

Preventative Maintenance Schedule

PowerFlex 6000 Maintenance Schedule

This Annual Preventative Maintenance Program includes a visual inspection of all drive components visible from the front of the unit, power supply voltage level checks, general cleaning and maintenance, checking of all accessible power connections for tightness, and other tasks.

I – Inspection

This indicates that the component should be inspected for signs of excessive accumulation of dust/dirt/etc. or external damage.

M – Maintenance

This indicates a maintenance task that is outside the normal preventative maintenance tasks.

R – Replacement

This indicates that the component has reached its mean operational life, and should be replaced to decrease the chance of component failure. It is very likely that components will exceed the design life in the drive, and that is dependent on many factors such as usage, heating, etc.

C – Cleaning

This indicates the cleaning of a part that can be reused, and refers specifically to the door-mounted air filters.

Rv – Review

This refers to a discussion with Rockwell Automation to determine whether any of the enhancements/changes made to the Drive Hardware and Control would be valuable to the application.

RFB/R – Refurbishment/Replacement

The parts can be refurbished at lower cost OR the parts can be replaced with new ones.

Table 8 - Preventative Maintenance Schedule (0...10 yrs.)

			Interval Period (in years from commissioning date)										
Component Location	Component Category	Component/Item	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Isolation Transformer Cabinet	Air-cooling system	Door Mounted Air Filters	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R
		Top-Mounted Main Cooling Fans		I	I	I	I	RFB/R	I	I	I	I	RFB/R
		Auxiliary Cooling Fans		I	I	I	R	I	I	I	R	I	I
	Integral Magnetics	Isolation Transformer		I	I	I	I	I	I	I	I	I	I
	LV Control	Isolation Transformer Temperature Monitor		I	I	I	I	I	R	I	I	I	I
		Voltage Sensing Board		I	I	I	I	I	I	I	I	I	I
Power Module Cabinet	Air-cooling system	Door Mounted Air Filters	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R
		Top Mounted Main Cooling Fans		I	I	I	I	RFB/R	I	I	I	I	RFB/R
	Power Module	Electrolytic Capacitors(1)		I	I	I	I	R	I	I	I	I	I
	Misc.	HECS		I	I	I	I	I	I	I	I	I	I
LV Control Cabinet	Misc.	AC/DC Power Supplies		I	I	I	I	R	I	I	I	I	I
	UPS	UPS		I	I	I	I	I	I	I	I	I	I
		Batteries (UPS)(2)		M	M	R	M	M	R	M	M	R	M
	LV Control	PLC		I	I	I	I	I	I	I	I	I	I
		Control Unit		I	I	I	I	I	I	I	I	I	I
		HMI		I	I	I	I	I	I	I	I	I	I
		LV Control Relays		I	I	I	I	I	I	I	I	I	I
		LV Control Circuit Breakers		I	I	I	I	I	I	I	I	I	I
All	Connections	LV Component Terminal & Plug-in Connections		I	I	I	I	I	I	I	I	I	I
		Medium Voltage Cable Connections		I	I	I	I	I	I	I	I	I	I
		Transformer Secondary Winding Connections		I	I	I	I	I	I	I	I	I	I
		Power Module Input and Output Power Connections		I	I	I	I	I	I	I	I	I	I
General	Enhancements	Firmware		Rv	Rv	Rv	Rv	Rv	Rv	Rv	Rv	Rv	Rv
		Hardware		—	—	Rv	—	—	Rv	—	—	Rv	—
	Operational Conditions	Parameters / Variables		I	I	Rv	I	I	Rv	I	I	Rv	I
	Spare Parts	Inventory Needs		I	I	Rv	I	I	Rv	I	I	Rv	I

(1) Power Modules are refurbished at factory as part of an exchange program.

(2) Fully discharge and recharge the UPS batteries every 6 months, to extend battery life.

Table 9 - Preventative Maintenance Schedule (11...20 yrs.)

			Interval Period (in years from commissioning date)									
Component Location	Component Category	Component/Item	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Isolation Transformer Cabinet	Air-cooling system	Door Mounted Air Filters	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R
		Top Mounted Main Cooling Fans	I	I	I	I	RFB/R	I	I	I	I	I
		Auxiliary Cooling Fans	I	R	I	I	I	R	I	I	I	R
	Integral Magnetics	Isolation Transformer	I	I	I	I	I	I	I	I	I	I
	LV Control	Isolation Transformer Temperature Monitor	I	R	I	I	I	I	I	R	I	I
		Voltage Sensing Board	I	I	I	I	I	I	I	I	I	I
Power Module Cabinet	Air-cooling system	Door Mounted Air Filters	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R	C / R
		Top Mounted Main Cooling Fans	I	I	I	I	RFB/R	I	I	I	I	I
	Power Module	Electrolytic Capacitors(1)	R	I	I	I	I	I	R	I	I	I
	Misc.	HECS	I	I	I	I	I	I	I	I	I	I
LV Control Cabinet	Misc.	AC/DC Power Supplies	R	I	I	I	I	I	R	I	I	I
	UPS	UPS	I	I	I	I	I	I	I	I	I	I
		Batteries (UPS)(2)	M	R	M	M	R	M	M	R	M	M
	LV Control	PLC	I	I	I	I	I	I	I	I	I	I
		Control Unit	I	I	I	I	I	I	I	I	I	I
		HMI	I	I	I	I	I	I	I	I	I	I
		LV Control Relays	I	I	I	I	I	I	I	I	I	I
		LV Control Circuit Breakers	I	I	I	I	I	I	I	I	I	I
All	Connections	LV Component Terminal & Plug-in Connections	I	I	I	I	I	I	I	I	I	I
		Medium Voltage Cable Connections	I	I	I	I	I	I	I	I	I	I
		Transformer Secondary Winding Connections	I	I	I	I	I	I	I	I	I	I
		Power Module Input and Output Power Connections	I	I	I	I	I	I	I	I	I	I
General	Enhancements	Firmware	Rv	Rv	Rv	Rv	Rv	Rv	Rv	Rv	Rv	Rv
		Hardware	—	Rv	—	—	Rv	—	—	Rv	—	—
	Operational Conditions	Parameters / Variables	I	Rv	I	I	Rv	I	I	Rv	I	I
	Spare Parts	Inventory Needs	I	Rv	I	I	Rv	I	I	Rv	I	I

(1) Power Modules are refurbished at factory as part of an exchange program.

(2) Fully discharge and recharge the UPS batteries every 6 months, to extend battery life.

Notes:

Spare Parts

Spare Parts List

Part Number	Part Description	Repair	Replace
H5JZ-065-276-R	Power Module Control Board 315		●
H5JZ-065-269-R	DB Board, Ver. 1.0.0		●
H5JZ-065-271-01-R	Control Unit Digital Signal Processor Board (H5JZ-065-271-01)		●
H5JZ-065-270-R	Control Unit Analog Signal Processor Board (Version 1.0.0)		●
H5JZ-065-272-01-R	CPU Board (H5JZ-065-272-01)		●
H5JZ-065-277-01-R	PWM Board (H5JZ-065-277-01)		●
H5JZ.065.152-R	1200V HV DC-DC BAR-TYPE Board Assembly		●
H5JZ.065.065-R	HMI Communication Board Assembly		●
H5JZ-065-032-R	Power Module Balance Board Assembly		●
H3M45014-3.0KV-R	3 kV Voltage Sensing Board Assembly		●
H3M45014-R	6 kV Voltage Sensing Board Assembly		●
H3M45048-R	10 kV Voltage Sensing Board Assembly		●
H02040199-01-R	Control Unit (H02040199-01), (including all boards)		●
H01012343-R	Control Unit Enclosure		●
HTPUXX/030-AC3-R	30 Amp Power Module	●	
HTPUXX/040-AC3-R	40 Amp Power Module	●	
HTPUXX/050-AC3-R	50 Amp Power Module	●	
HTPUXX/060-AC3-R	60 Amp Power Module	●	
HTPUXX/075-AC3-R	75 Amp Power Module	●	
HTPUXX/080-AC3-R	80 Amp Power Module	●	
HTPUXX/100-AC3-R	100 Amp Power Module	●	
HTPUXX/120-AC3-R	120 Amp Power Module	●	
HTPUXX/150-AC3-R	150 Amp Power Module	●	
HTPUXX/180-AC3-R	180 Amp Power Module	●	
HTPUXX/200-AC3-R	200 Amp Power Module	●	
HTPUXX/300-AC3-R	300 Amp Power Module	●	
HTPUXX/380-AC3-R	380 Amp Power Module	●	
HTPUXX/420-AC3-R	420 Amp Power Module	●	
2711-T7C4D9	PanelView Plus 6 HMI	●	
HRH40M-50-60-R	50/60HZ Centrifugal Fan RH40M		●
HRH45M-50-60-R	50/60HZ Centrifugal Fan RH45M		●
H01020062-R	Door Filter (005 BK 25P P2 1700*1000*10)		●
HFL-000090-R	Standby Fiber (Plug) T -R 5 Meters		●

Part Number	Part Description	Repair	Replace
H01220097-R	UPS KR1000 1000VAH-AC220V I/O		●
H01200077-R	Hall Effect Current Sensor CHF (100G 100A-15V-5V-D35)		●
H01200078-R	Hall Effect Current Sensor CHF (200G 200A-15V-5V-D35)		●
H01200079-R	Hall Effect Current Sensor CHF (300G 300A-15V-5V-D35)		●
HDQ-000015-R	Hall Effect Current Sensor CHF (400G 400A-15V-5V-D35)		●
H01200112-R	Hall Effect Current Sensor CHF (500G 500A-15V-5V-D35)		●
H0109010169-R	Fuse RGS7-700V-63A		●
H0109010163-R	Fuse RGS7-700V-80A		●
H0109010164-R	Fuse RGS7-700V-100A		●
H0109010170-R	Fuse RGS7-700V-125A		●
H0109010165-R	Fuse RGS7-700V-160A		●
H01340697-R	Fuse RGS7-700V-200A		●
H01340698-R	Fuse RGS7-700V-250A		●
H0109020029-R	Fuse RS98E-700V-350A		●
H0109020099-R	Fuse RS98G-700V-500A		●
H5JZ-065-234-R	IGBT FF450R17ME3 drive board assembly		●
H5JZ-065-235-R	IGBT module FS450R17KE3 drive interface board		●

Torque Requirements

Torque Requirements

Proper tightening torque must be used for installation and wiring.

Table 10 - Torque Requirements

Thread Size	Torque	
	N•m	lb•ft
M4	1.4	1.0
M5	2.8	2.1
M6	4.6	3.4
M8	11	8.1
M10	22	16.2
M12	39	28.8
M14	62	45.7
M16	95	70.1
M20	184	135.7

Notes:

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Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support, you can find technical manuals, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools. You can also visit our Knowledgebase at http://www.rockwellautomation.com/knowledgebase for FAQs, technical information, support chat and forums, software updates, and to sign up for product notification updates.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect^{SM} support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/rockwellautomation/support/overview.page, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

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