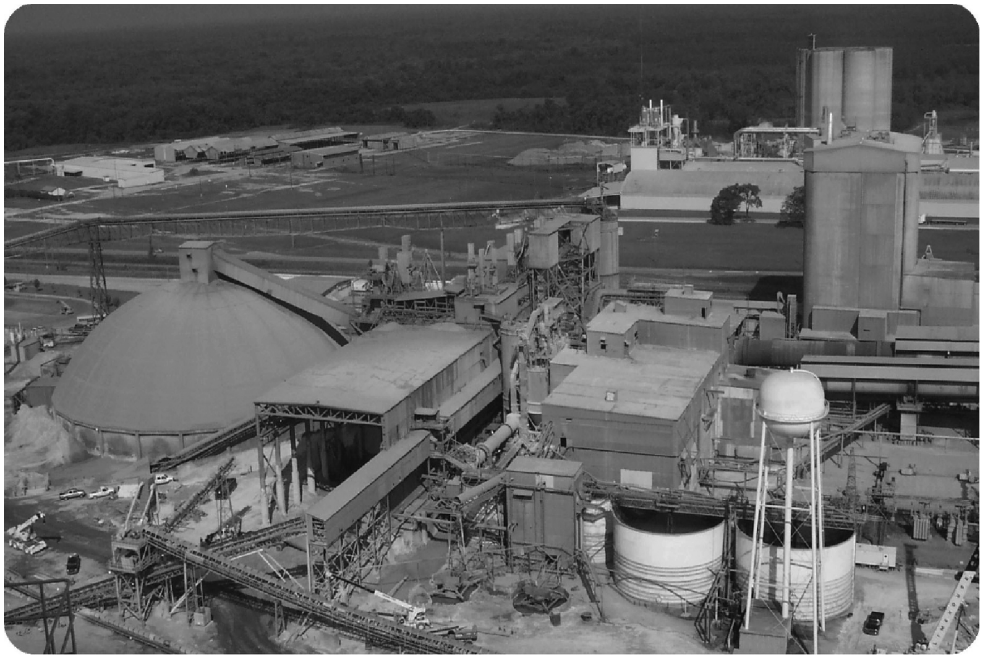
Commissioning Manual

Allen-Bradley

PowerFlex 6000 Medium Voltage Variable Frequency Drive Commissioning Manual

Publication 6000-IN007B-EN-P



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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).

Appendix B

Appendix C

Notes:

Introduction

This document provides procedural information for commissioning PowerFlex® 6000 medium voltage drives with version 4.001 firmware.

Who Should Use This Manual

This manual is intended for Rockwell Automation Field Service Engineers with Medium Voltage Drive factory training and field experience commissioning medium voltage solid-state variable speed drive equipment.

WARNING: This document is for internal use only (for Rockwell CSM/field support Engineers). **DO NOT** disclose this document to customers or any non-Rockwell Automation employee. Disclosure of sensitive information in this document may cause dire consequences to the drive.

What Is Not in This Manual

This manual is generic and does not include project-specific or drive-specific information. Contact the Start-up Project Manager for required project-specific or drive-specific information such as:

- Dimensional Drawings and Electrical Drawings generated for the customer's order.
- Spare parts lists compiled for the customer's order.
- Drive-specific technical specifications.
- Pre-commissioning Checklist
- PLC program for standard, integral PLC

Required Supplemental Information

Dimensional Drawings and Electrical Drawings

Thoroughly review the project-specific Dimensional Drawings (DDs) and Electrical Drawings (EDs) to understand the specific drive system being commissioned, before performing any mechanical or electrical work.

Within these drawings is detailed information which is important to understand for the commissioning and installation of the equipment.

Table 1 - Electrical Drawings

	Contactor Locations (electrically)
	Drive Topology
	General Notes
	Minimum Power Cable Insulation Ratings
	Component Designations
	Customer Power and Control Wiring Locations (electrically)
	Control and Medium Voltage Power Ratings
	Fuse Locations (electrically)

Table 2 - Dimensional Drawings

	Control and Medium Voltage Power Ratings
	Drive Options
	Motor Ratings
	Drive Power Component Selection Ratings

If the drawings require changes to suit the installation and application of the system, fax or e-mail the marked up drawings to the Start-up Project Manager.

Shipping, Handling, and Installation Manual

Review publication 6000-IN006_-EN-P, PowerFlex 6000 Medium Voltage Variable Frequency Drive Shipping, Handling, and Installation manual.

The customer/contractor has the option to perform the electrical interconnection work between cabinet shipping splits, as shown in this manual, or contract Rockwell Automation to perform this work. This will be reflected in the Services Purchase Order and the pre-commissioning checklist. Verify that the documentation matches the actual scope of work done by the customer/contractor. You will be required to either perform this interconnection work immediately prior to the commissioning process or to verify the work was done correctly by the contractor. It is very important to confirm the alignment of the paperwork with the actual scope of work.

It is also extremely important to understand the contractor's basic scope of work, preceding the commissioning process. Part of the overall commissioning process is to ensure this work has been done correctly. If this work has not been done properly, this must be brought to the attention of the customer immediately. Do not proceed with commissioning until this issue is resolved.

Additional required information about the PowerFlex 6000 can be downloaded from http:/www.rockwellautomation.com/literature/.

- 6000-IN006_-EN-P: PowerFlex 6000 Medium Voltage Variable Frequency Drive Shipping, Handling, and Installation Instructions
- 6000-UM002_-EN-P: PowerFlex 6000 Medium Voltage Variable Frequency Drive User Manual (operating the HMI, full parameter listing)

You must review these publications thoroughly before beginning the commissioning process. They contain supplemental information that will aid in the commissioning process.

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.

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.

Notes:

Introduction

Overview

Information contained in this chapter will assist in commissioning a PowerFlex 6000 medium voltage AC drive.

Review the information contained in this chapter prior to commissioning the drive and use it as a reference while the drive commissioning is performed.

WARNING: Perform the commissioning checks illustrated in the sequence that they have been presented. Failure to do so may result in equipment failure, personal injury, or death.

Prior to commissioning, the following work will have been performed by the customer or the customer's electrical contractor:

Connect External Cabling and Wiring
Connect System Ground Cable(1)
Megger Test of Power Cables
Connect Incoming Line and Outgoing Motor Power Cables(1)
Connect Control Power Wiring
Connect External Control Signal Wiring
Connect Electrical Safety Interlock Control Signal Wiring Circuit to Input Circuit Breaker
Connect Internal Cabling and Wiring(2)
Connect Isolation Transformer Secondary Power Cables to Power Modules
Connect Motor Cables and Voltage Sensing Board Cables to U, V, and W Output Phase Buses
Connect LV Control and Fan Wiring Bundles
Connect Ground Bus Splices

(1) If an optional bypass unit is supplied, the system ground cable, incoming line power cables, and outgoing motor power cables are connected to the bypass unit.

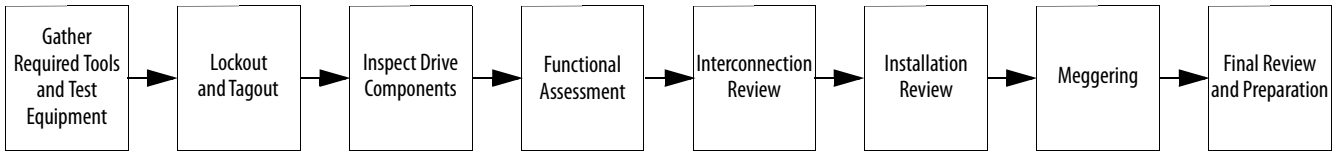
(2) Interconnection of power cables and low voltage control wiring bundles, between separately shipped cabinets, can be done by the contractor or Rockwell Automation. The commissioning quote from Rockwell Automation reflects this and will contain two options:
a) the base quote, reflecting the power cable and control wiring interconnection work being done by the contractor
b) the optional quote adder, reflecting the additional time and cost for Rockwell Automation to perform the power cable and control wiring interconnection work immediately prior to the commissioning process.

This work will be reviewed during the pre-commissioning customer meeting and validated during the commissioning process; see Installaion Review on page 21 or page 37.

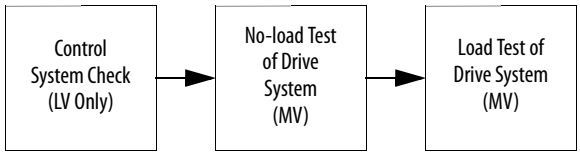
Process Flowcharts

Documentation and Application Review

Preparation and Inspection



Commissioning



Documentation and Application Review

Review all Rockwell Automation Supplied Documentation

Each drive is shipped with the technical publications required to assist in commissioning and troubleshooting the drive. Request copies or revisions of these documents from the Start-up Project Manager. However, you will have received e-copies of this information prior to commissioning by the Start-up Project Manager.

Before commissioning the drive, ensure you have the following resources:

- Project-specific Electrical Drawings and Dimensional Drawings
- PowerFlex 6000 Medium Voltage Variable Frequency Drive Shipping, Handling, and Installation Manual 6000-IN006_-EN-P): provides procedural information for physically unloading, moving, and installing equipment
- PowerFlex 6000 Medium Voltage Variable Frequency Drive Commissioning Manual (6000-IN007_-EN-P): required procedures and checklists for Rockwell Automation Field Service Engineers.
- PowerFlex 6000 Medium Voltage Variable Frequency Drive User Manual (6000-UM002_-EN-P): instructions for daily recurring drive usage, HMI interface, and maintenance tasks

- PLC Program: The PLC I/O processes control signals within the drive and I/O signals to and from the customer's control system and input circuit breaker. The PLC program is standardized. However, it may be customized to address specific customer requirements by Rockwell Automation during the Application Engineering phase of order execution.

Pre-commissioning Customer Meeting

Before commissioning the drive, it is recommended to schedule a meeting with the customer.

1. Discuss the activities and documentation needed to review the drive application
2. Review the start-up activities and timelines
3. Review the Pre-commissioning Checklist (see 6000-IN006_-EN-P)
4. Review the drive application

Review Drive Application

To ensure trouble-free commissioning, it is necessary for all personnel involved in the start-up to familiarize themselves with the drive and actual application. Service on the equipment should not be performed without a clear understanding of how the equipment has been designed to function and how the equipment has been applied.

Before commissioning the drive, inspect the process that the drive is intended to control. This identifies how the equipment is designed to suit the application, and any potential hazards. Determine what measures must be taken to ensure that commissioning the equipment does not expose anyone to hazardous situations or damage to the equipment. Verify that the load is not turning due to the process, as a freewheeling motor can generate voltage that will be back-fed to the equipment being serviced. Take all actions necessary to ensure that motor regeneration into the drive does not occur while the equipment is being started up or being serviced.

Review Electrical System One-line Diagram

Identify all relevant equipment Tag Identification names and numbers. Study the system for sources of power and parallel paths of medium voltage power. Retain a copy of the one-line diagram for commissioning the drive. If applicable, send a copy of the one-line diagram to the Start-up Project Manager to be archived and used for future customer assistance.

On-site Verification of Electrical System One-line Diagram

ATTENTION: Make sure the medium voltage input circuit breaker feeding the drive is locked out and tagged out. Make sure the LV circuit breaker feeding control power to the drive is locked out and tagged out. Make sure the drive is de-energized before conducting the drive inspection process.

Once all documentation has been reviewed, an on-site inspection of the drive is required. Identify the physical locations of the connections to the drive using Tag Identification names or numbers from the one-line diagram and Rockwell Automation Electrical Drawings.

All customer power and control wiring required for the drive line-up installation has been identified on the Rockwell Automation Electrical Drawings by a dashed line.

Installation of all external power cabling and control wiring interfacing with the drive is completed by the customer or their electrical contractor. Verify that this wiring is installed correctly and meets electrical voltage and current capacity requirements. Trace the power cables point-to-point from the input circuit breaker to the drive, and from the drive to the motor using the Electrical Drawings as a reference for proper drive power cable termination locations. Any discrepancy between the physical installation and the Electrical Drawings of the following items should be reviewed prior to commissioning the drive:

- Medium voltage power cabling in from the input circuit breaker to drive
- Medium voltage power cabling out from drive to motor
- Low Voltage control power cables from LV MCC or circuit breaker to drive
- Ground connection from system ground to drive
- Control signal wires and communication cables from remote DCS/PLC or other remote device to drive
- Electrical safety interlock/control wiring from the drive to the input circuit breaker

ATTENTION: Do not change wiring or remove terminal wiring.

Preparation and Inspection (For IEC)

Gather Required Tools and Test Equipment

Hand Tools

- Metric wrenches and sockets
- Torque wrench
- Assortment of screw drivers
- Wire stripper/cutter

Electrical Equipment

- High voltage gloves – 17 kV insulation rating (minimum)
- Anti-static strap
- Live-line tool (Hot stick)
- 5 kV Insulation Tester

Test Equipment

- 600V (1000V rating) digital multimeter with assorted clip leads

Computer Requirements and Software

- Laptop computer
- USB cable
- PLC program
- CCW software

Lockout and Tagout

SHOCK HAZARD: Servicing 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 cabinet even with the input circuit breaker in the off position. Required practice is to disconnect and lock out control equipment from power sources, and confirm discharge of stored energy in capacitors. 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 input circuit breaker before opening the doors to the drive system cabinets. After the cabinet doors are opened, immediately test the incoming and outgoing power cables and any components connected to medium voltage with a live-line tool (hot stick) while wearing high voltage gloves. Pay special attention to any capacitors connected to medium voltage that can retain a charge for a period of time. Only after the 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 local safety guidelines for detailed procedures on how to safely isolate the equipment from hazards.

Safety Test

Complete every point included in this section prior to continuing with the drive commissioning, to ensure that the commissioning continues in an environment safe to all those involved in servicing the drive. Ensure that commissioning of this drive is performed in accordance with local safety standards.

Inspect Drive Components

After performing the lockout and tagout procedure (see page 15), open all of the cabinet doors. Inspect each component for signs of shipping damage (see Table 3 on page 18). An initial inspection would have been done by the customer when the equipment was received. However, this would have been done from the front only and was just looking for obvious signs of damage (see publication 6000-IN006_-EN-P). Record the part number and description of any damaged components and immediately contact the Start-up Project Manager to order replacement components, if required.

ATTENTION: Verify the equipment against any damage. Do not install a damaged drive.

Verify that all components are securely affixed to the cabinet.

Most components will be easily visible on the doors or from the front of the cabinets after the doors are opened. Some components are best viewed from the rear of the cabinet.

For rear inspection, remove top and bottom rear access plates from the drive and bypass cabinet (if supplied). See publication 6000-IN006_-EN-P.

IMPORTANT The Inspect Drive Components Checklist (see page 18) mentions the principal base components supplied in the drive and bypass units. It is not comprehensive, as customer-required options may be supplied and three different bypass configurations are available.

Perform the shipping damage inspection for all components mounted in the drive cabinets and specific bypass unit cabinet (if supplied).

Functional Assessment

After the components are visually inspected to identify any shipping damage, a thorough functional assessment should be performed (see Table 4 on page 19). The main purpose of this assessment is to ensure that all movable parts and assemblies operate properly, connect properly, and components are wired properly and securely.

The Functional Assessment procedure can be combined with the “Inspect Drive Components” checklist on page 18.

Descriptions of the Power Cable Connections to be inspected and torqued to specifications are in the Interconnection Review and Installation Review sections.

Table 3 - Inspect Drive Components Checklist (IEC)

	Bypass Cabinet (if supplied)	Isolation Transformer Cabinet	Power Module Cabinet	Low Voltage Control Cabinet
Front	**Door:** ❑ Pilot Lights ❑ Voltage Indicator Relay **Cabinet:** ❑ Insulators ❑ Switch assemblies ❑ Vacuum contactors ❑ Mechanical linkages	**Door:** ❑ Transformer Temperature monitor ❑ LV Cabinet components – Fan control circuit breakers **Cabinet:** ❑ Transformer Plastic Baffle ❑ Outgoing Motor Power Cable standoffs on Cabinet Sidesheet(1) ❑ Outgoing Motor Power Cable Terminal Insulators on transformer (1) ❑ Voltage Sensing Board ❑ Incoming Line Power Cable Terminal Insulators on transformer ❑ Motor Cable Braces **Fixed Mounted Power Module Configuration:** ❑ Transformer Secondary Windings (2 sets) – Inspect nomex wrap – Verify windings from core are undamaged – Check for debris in top of core	**Fixed Mounted Power Module Configuration:** ❑ Power Module retaining tabs ❑ Check for debris ❑ Output Bus Supports ❑ Fuse Mounting Supports **Drawout Power Module Configuration:** ❑ Support frame ❑ Power Modules	**Door:** ❑ Pilot lights ❑ Push buttons ❑ Selector switches ❑ HMI ❑ Interface board (on the back of the LV door) **Panel:** ❑ DIN rail mounted components ❑ UPS ❑ Fiber optic cables ❑ PLC ❑ Control Unit
Rear		**Fixed Mounted Power Module Configuration:** ❑ Transformer Secondary Windings (1) – Inspect nomex wrap – Verify windings from core are undamaged – Check for debris in top of core **Drawout Power Module Configuration:** ❑ Transformer Secondary Windings (3) – Inspect nomex wrap – Verify windings from core are undamaged – Check for debris in top of core	**Fixed Mounted Power Module:** ❑ Heat sink – Verify orientation relative to barrier plates **Drawout Power Module:** ❑ Power In/Power Out connections	❑ UPS connections

(1) Motor Cable terminations could be on the transformer structure or cabinet sidesheet, depending on the power rating.

Table 4 - Functional Assessment Checklist (IEC)

	Bypass Cabinet (if supplied)	Isolation Transformer Cabinet	Power Module Cabinet	Low Voltage Control Cabinet
Front	❑ Electrical Door Interlock – Verify proper operation of auxiliary contacts with an ohmmeter ❑ Isolation switch auxiliary contacts – Verify proper operation with an ohmmeter ❑ Isolation switches – Verify proper operation – Outer jaws must securely contact the center stab in the closed position ❑ Secondary Wiring and Low Voltage Fuses – Check all connections per Electrical Drawings ❑ Door Grounding Straps	❑ Transformer Secondary Cables – Verify cables are properly fed through the glanding plate and are undamaged ❑ Voltage Sensing Board cables – Verify the primary and secondary connections to the board are secure ❑ Door Interlock Limit Switches – Test auxiliary switch contacts wired back to terminal blocks in LV panel with ohmmeter ❑ Temperature Sensing Wires (3 places) – Verify wires are intact and properly inserted ❑ Bottom-mounted Auxiliary Fan power from Isolation Transformer Auxiliary Winding – Check connections ❑ Door Grounding Straps ❑ Transformer Temperature Protection Relay – Tug test on all cable connections ❑ Auxiliary Cooling Fans (3) – Check electrical connection	❑ HECS (2) – Check plug connectors ❑ Door Interlock Limit Switches (2) – Test switch contacts wired back to terminal blocks in LV panel with ohmmeter ❑ Power Modules fiber optic cables – Check all connections ❑ Power Modules Fuses – Test each fuse with multimeter ❑ Door Grounding Straps	❑ Control Unit – Check connection of all fiber optic cables – Check connection of HMI interface board – HMI ❑ Low Voltage wires – Tug test all wires on door, panel, and relays and terminal blocks ❑ Circuit Breakers and Contactors – Verify operation ❑ Vertical Ground Bus – Check connections from all attached components ❑ Low Voltage Door – Verify operation of all operator interface devices ❑ AC/DC Power Supplies – Check connections ❑ Door Grounding Straps
Rear	❑ Surge Arrestors – Check braided copper connections ❑ Voltage Sensing Relay Cables – Perform tug test ❑ Line and Load side power cables – Verify phasing and torque ❑ Top Ground Bus – Verify braided connections	❑ Transformer Secondary Cables – Verify cables are properly fed through the glanding plate are undamaged ❑ Tap Changer – Verify connection ❑ Top Mounted Cooling Fans – Check electrical connection ❑ Fan Housings – Assembly must be affixed properly to structure ❑ Auxiliary Cooling Fans (3) – Check electrical connection	❑ Top Mounted Cooling Fans – Check electrical connection	❑ UPS – Check connection

Interconnection Review

The interconnection checklist summarizes the required items to review to validate the reconnection of power, ground, and control cables between cabinets within the drive system, that were disconnected for shipment. Power and control cables that pass from one cabinet to another are bundled in the appropriate cabinet. These cables are connected for system test at the factory but disconnected and coiled up for shipment. If this interconnection work was done by the contractor, use this checklist to review and ensure the work was done correctly. If the interconnection work was not done by the contractor, the scope of work required to be performed is described in 6000-IN006_-EN-P.

IMPORTANT Check torque on all power and ground cable connections per specifications listed in Torque Requirements on page 109.

Table 5 - Interconnection Review Checklist (IEC)

	Bypass Cabinet (if supplied)	Isolation Transformer Cabinet	Power Module Cabinet	Low Voltage Control Cabinet
Front Inspection	❑ Verify the braided ground connection to adjacent cabinet(s) is properly installed ❑ Review the braided ground connection to adjacent cabinet ❑ Verify line and load power cables from Isolation Transformer Cabinet are properly connected ❑ Verify all control wires per Electrical Drawing	❑ Verify the braided ground connection to adjacent cabinet(s) is properly installed ❑ Review all isolation transformer secondary wiring from Power Module cabinet (2 sets) ❑ Verify that the shields of all of the system's connecting wires are properly grounded ❑ Verify all control wires per Electrical Drawing – Cables are run in LV cable sections along front and back of cabinet	❑ Verify the braided ground connection to adjacent cabinet(s) is properly installed ❑ Verify that the shields of all of the system's connecting wires are properly grounded ❑ Review load power cable connection from Isolation Transformer Cabinet ❑ Verify Voltage Sensing Board power cables from Isolation Transformer Cabinet are properly installed	❑ Verify control signal wiring bundles from LV Control cabinet to LV panel in Isolation Transformer cabinet and LV panel in the Bypass Cabinet (if supplied) are routed correctly
Rear Inspection		**Fixed Mounted Power Module:** ❑ Verify all isolation transformer secondary windings from Power Module Cabinet are properly connected (1 set) **Drawout Power Module:** ❑ Verify all isolation transformer secondary windings from Power Module Cabinet are properly connected (3 sets) ❑ Verify all power supply cables for main cooling fans for Isolation Transformer Cabinet are properly connected(3 sets)		

Installation Review

Prior to commencing the commissioning of the drive, verify the equipment was properly installed. Identifying errors in the drive installation prior to commencing the commissioning as opposed to mid-way through the commissioning process will greatly reduce the amount of time required to commission the drive. Verify the drive and all associated equipment have the system power grounding cable installed. Refer to 6000-IN006_-EN-P to review the contractor's drive installation responsibilities and understand the scope of the work you will be reviewing.

Mechanical Installation Inspection

Sequence	Task	Reference Document
1	Verify line up positioning	Dimensional Drawings
2	Verify cabinets are bolted together correctly	6000-IN006_-EN-P
3	Verify cabinets are affixed to the floor properly	Dimensional Drawings, 6000-IN006_-EN-P
4	Verify fans are installed correctly	6000-IN006_-EN-P
5	Verify power modules are installed correctly	6000-IN006_-EN-P
6	Review duct installation (if applicable)	6000-IN006_-EN-P
7	Verify the cable trenches meet design requirements	6000-IN006_-EN-P
8	Verify required cabinet clearances	6000-IN006_-EN-P
9	Verify there are no scratches or damage to the cabinet body	N/A
10	Verify the top cover of the isolation transformer cabinet is securely mounted	6000-IN006_-EN-P

Refer to project-specific EDs to review all electrical connections to external input and output devices.

Electrical Installation Inspection

Sequence	Task	Reference Document
1	Verify that medium voltage cables are separated at least 30 cm from the control cables	
2	Verify that all secondary control wiring use shielded cables	
3	Verify that input and output medium voltage cables specifications meet the stated insulation requirements	Electrical Drawings
4	Verify that input and output medium voltage cables have attached nameplates	
5	Verify the diameter of control power cables comply with the drawings	Electrical Drawings
6	Verify that the electrical safety circuit wiring between the input circuit breaker and the drive is shielded and only the end at the drive side is grounded	
7	Verify the wiring between the DCS and the drive is shielded and only the end the drive side is grounded	
8	Verify that the user-provided ground cable is $\geq$50 mm^2	
9	Verify the isolation transformer's primary input voltage matches the system primary voltage	
10	Verify that the customer motor specifications match the drive voltage and current capabilities	
11	Verify that the isolation transformer's input side wiring is correct	Electrical Drawings
12	Verify that the motor output side wiring is correct	Electrical Drawings
13	Verify all external control wiring is terminated correctly and to the proper terminal blocks	Electrical Drawings
14	Verify torque on incoming line power cable and outgoing motor power cable terminations	Electrical Drawings

Power Cabling

Trace the power cabling from termination point to termination point while examining the cable and its routing for mechanical damage, sharp bend radiuses and sources of induced noise and heat. The power cabling must be is sufficiently braced to contain the cabling in the event of a ground fault. Color coding is used to indicate the phase orientation of the drive.

Table 6 - Color Coding

Color	Incoming Line Side	Outgoing Motor Side
Black	L11 (A Phase) Line Cable Terminal	U Phase: • Power Module Bus • VSB Input Cable • Motor Cable Termination • Motor Cable Connection to Power Module Bus
Brown	L12 (B Phase) Line Cable Terminal	V Phase: • Power Module Bus • VSB Input Cable • Motor Cable Termination • Motor Cable Connection to Power Module Bus
Grey	L13 (C Phase) Line Cable Terminal	W Phase: • Power Module Bus • VSB Input Cable • Motor Cable Termination • Motor Cable Connection to Power Module Bus

Incoming Line and Outgoing Motor cables must be routed separately to prevent cable insulation damage.

All cables must be terminated on each end and sufficiently torqued.

All customer power cables must be Hi-Potted or Meggered and read a sufficient insulation value. Review Hi-Pot or megger test report from the customer.

Control Wiring

Identify all customer-required control wiring detailed on the Electrical Drawings and locate it within the terminal blocks. Verify the cable insulation is not tightened in a terminal connection. All connections must have proper continuity.

Inspect the control cable routing to ensure that DC control wiring and AC control wiring are separated from each other. Routing them together in the same bundle or cabling product may result in unwanted noise being induced in the drive control. In the overhead cable tray provided at the front of the drive, the AC control, DC control and fiber optic cables must be separate. These cables may also be from the bottom.

Control wiring must be routed separately from power cabling.

Inspect for additional control not shown on the Electrical Drawings. Determine its purpose, mark the changes on the electrical diagram and send the prints to the Start-up Project Manager for future reference.

Perform a tug test on all control cables to ensure that they are securely fastened, and check each plug and connector to ensure it is properly seated in its socket.

Drive Megger Check

Isolate the Power and Control Circuits

ATTENTION: Verify the grounding cable connection is secure.
Disconnect the low voltage power before the megger test.
Short circuit the 3 input cables and 3 output cables on one point.

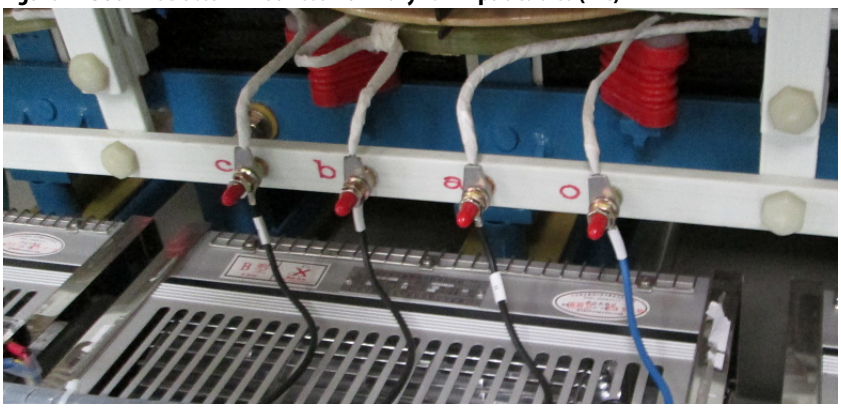
1. Isolate and lock out the drive system from any high voltage source.

   Disconnect any incoming power sources, medium voltage sources should be isolated and locked out and all control power sources should be turned off at their respective circuit breaker(s).

   Verify with a potential indicator that power sources have been disconnected, and that the control power in the drive is de-energized.

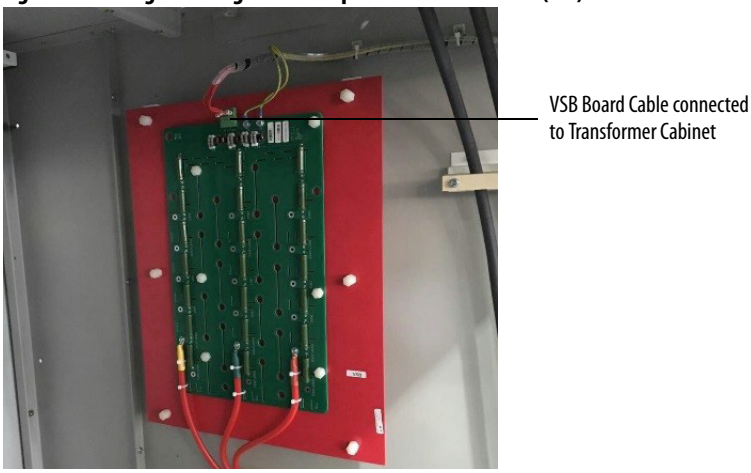
2. Disconnect four 380V AC cables (a, b, c, and o cables) from the bottom of the Isolation Transformer.

Figure 1 - 380V AC Bottom-mounted Auxiliary Fan Input Cables (IEC)



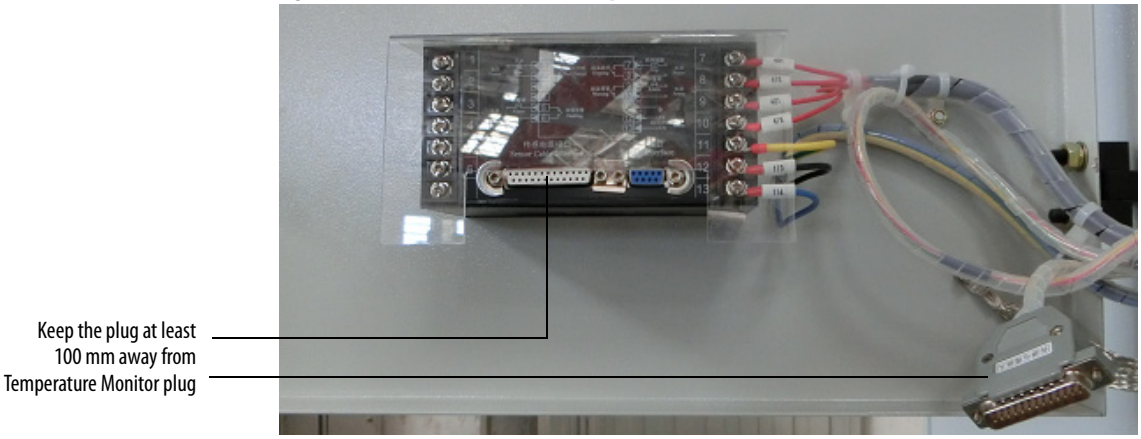
3. Disconnect the Voltage Sensing Board Output Cable. Keep the plug at least 100 mm away from the Voltage Sensing Board.

Figure 2 - Voltage Sensing Board Output Connection Cable (IEC)



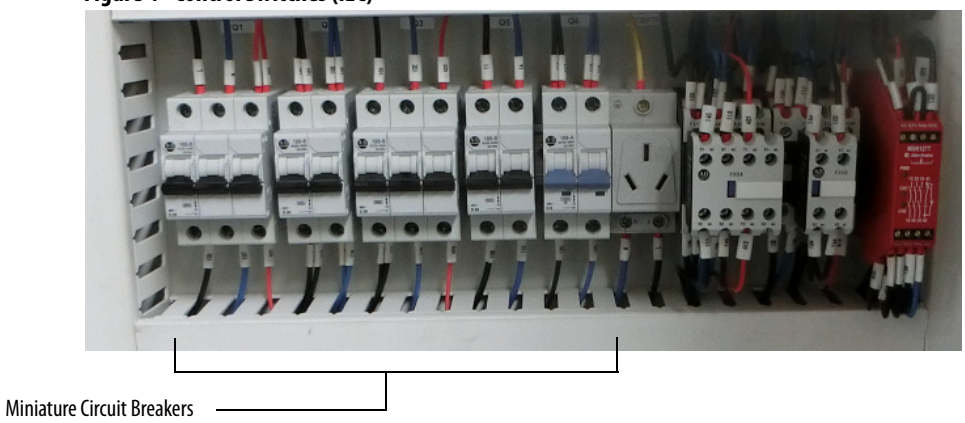
4. Disconnect the Isolation Transformer Temperature Monitor. Keep the plug at least 100 mm away from the connection point on the Monitor.

Figure 3 - Isolation Transformer Temperature Monitor (IEC)



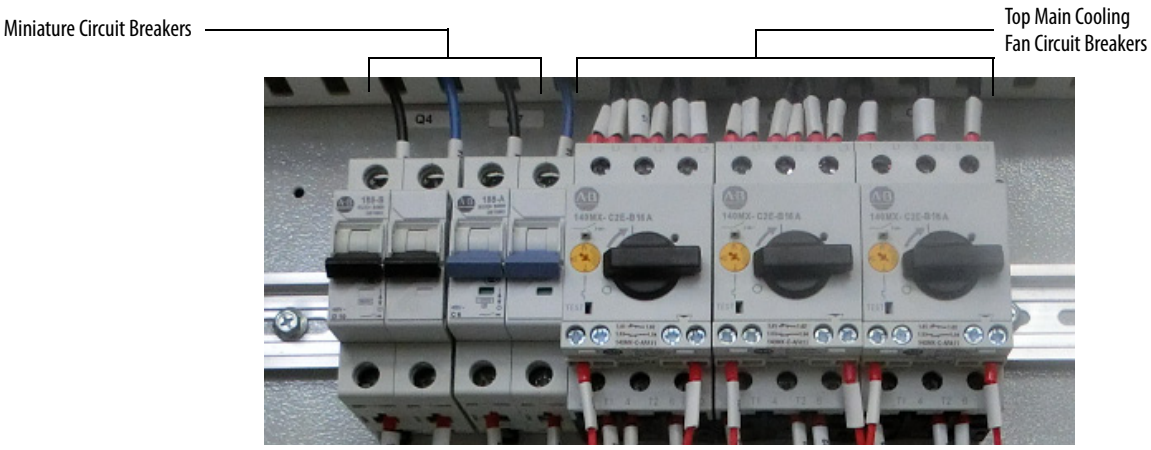
5. Switch the miniature circuit breakers in the LV Cabinet off.

Figure 4 - Control Switches (IEC)



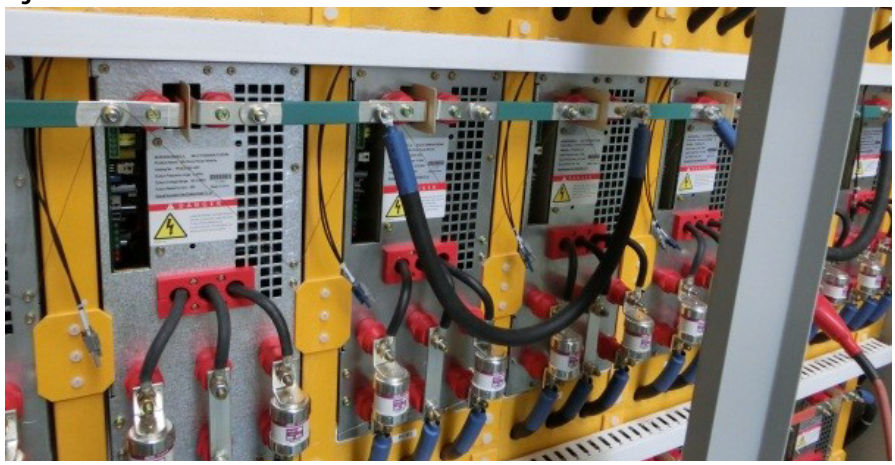
6. Switch the miniature circuit breakers in the Isolation Transformer Cabinet LV Control panel off. Switch the Top Main Cooling Fan circuit breakers off.

Figure 5 - Control Switches (IEC)



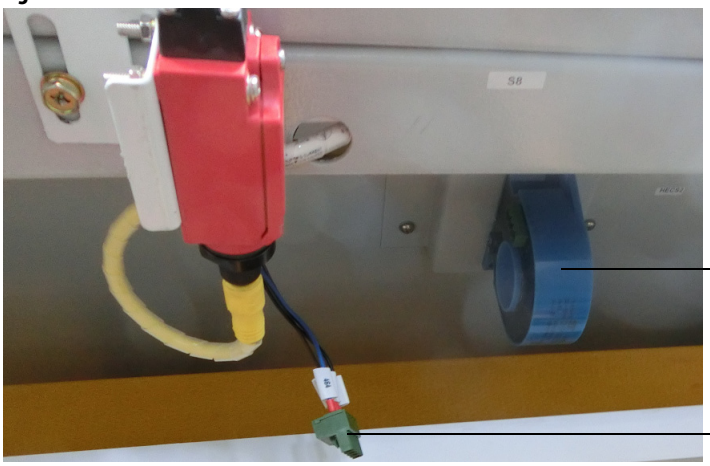
7. Remove two star connection cables (the cabling that goes through the HECS) and connect them to the output connections of any two power modules within a phase.

Figure 6 - Star Connection Cable



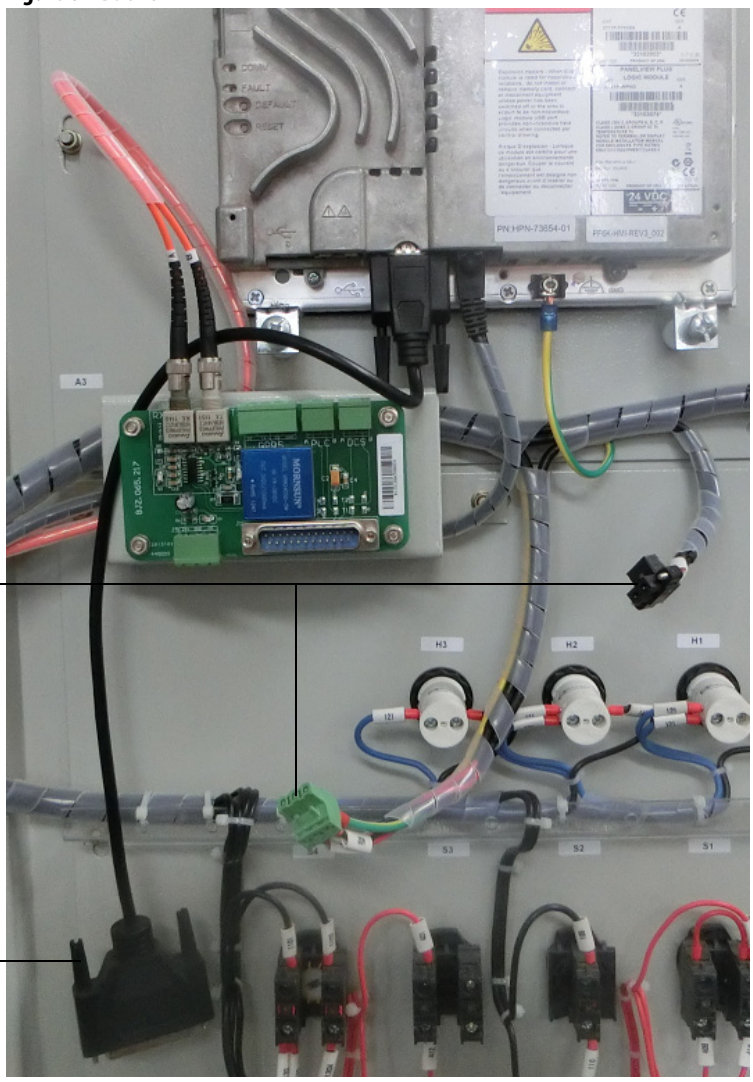
8. Disconnect the control cable of HECS.

Figure 7 - Hall Effect Current Sensor



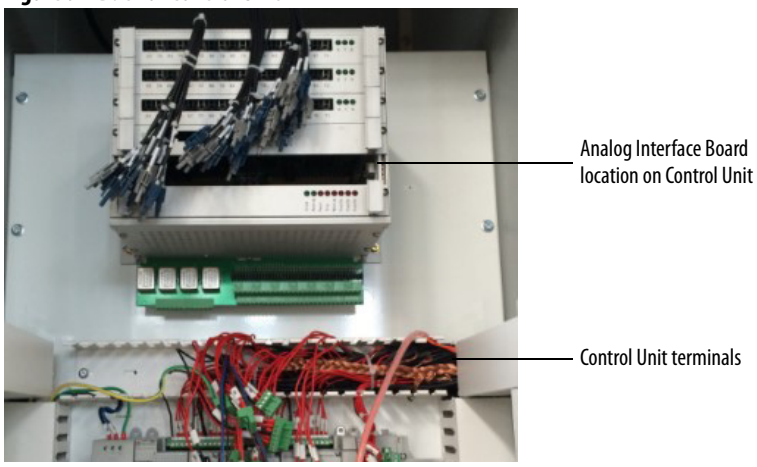
9. Disconnect the HMI and Control Board power cables.

Figure 8 - Back of HMI



10. Remove the Analog Interface board and disconnect all of the terminals from the Control Unit.

Figure 9 - Back of Control Unit



Connect the Insulation Meter

1. Connect the red wire from the insulation meter to the U Phase and the black wire to the grounding bus.

ATTENTION: Verify the drive and any connected equipment is clear of personnel and tools prior to commencing the Megger test. Barricade off any open or exposed conductors. Conduct a walk-around inspection before commencing the test.

2. Use jumper wires to make the connections as shown in Figure 10.

   The jumper wires must be rated for greater than 5 kV or must maintain sufficient clearance to any metal surface.

3. If the Megger has a lower voltage setting (normally 500V or 1000V), apply that voltage for 5 seconds as a precursor for the higher voltage rating. This may limit the damage if there is a problem. If the reading is very high, apply the test voltage per Figure 10.

4. Perform a Megger test with the insulation meter voltage set according to the voltages shown in Table 7 for 1 minute and record the result.

   The test should produce a reading greater than the minimum values listed below. If the test results produced a value lower than these values start segmenting the drive system down into smaller components and repeat the test on each segment to identify the source of the ground fault.

ATTENTION: Discharge the Megger prior to disconnecting it from the equipment.

5. Disconnect the Insulation Meter and jumpers installed in steps 1 and 2.
6. Reconnect all wires, cables, and connections in reverse order of removal.

Figure 10 - Connected Insulation Meter (IEC)

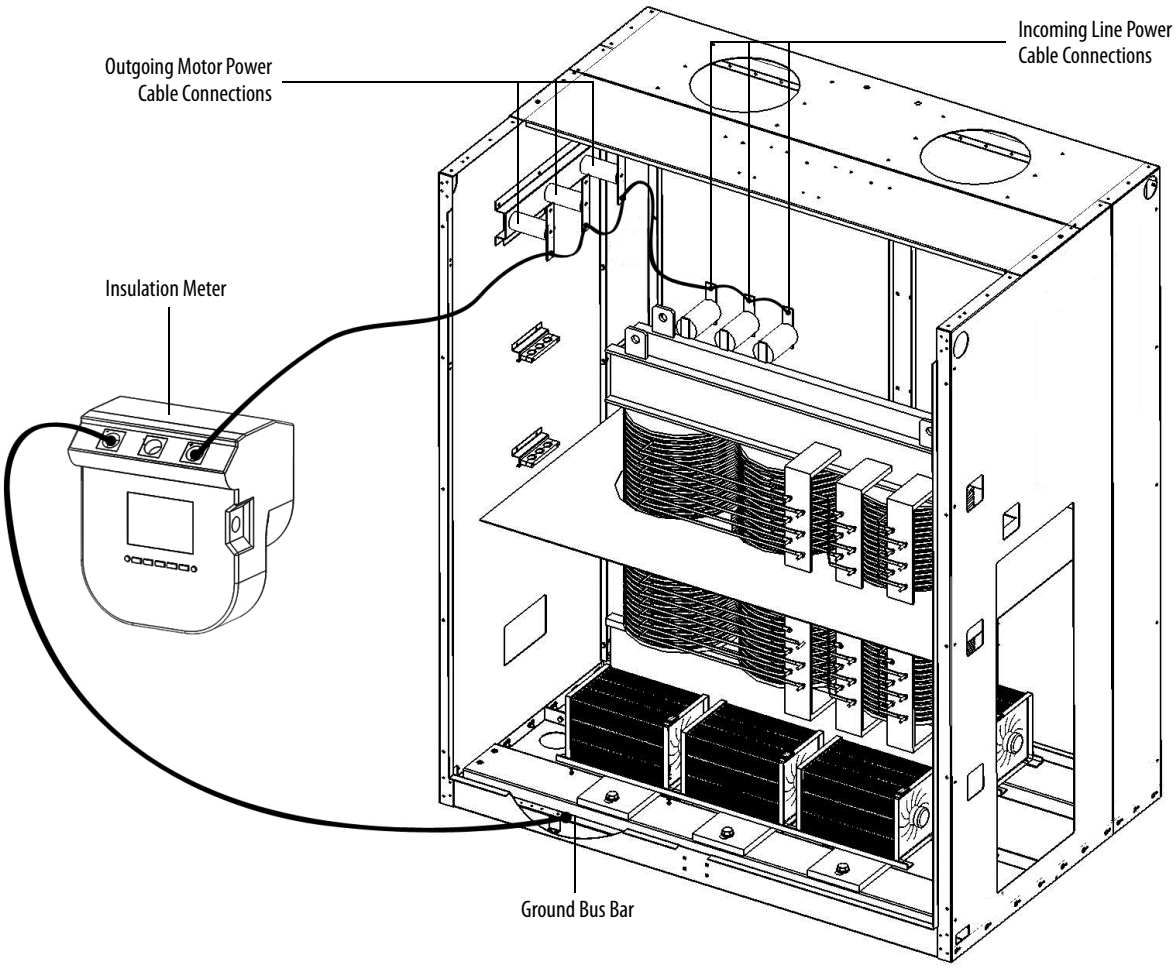


Table 7 - Insulation Test Voltage Values

Drive Rated Voltage U1	Insulation Resistance Test Direct Voltage (V)
1000<U1≤5000	2500
5000<U1	5000

Typical of Drive	Minimum Megger Value
Entire Drive	1 kM Ohm

Final Steps before Equipment is Ready for Energization

1. Review interior of all cabinets for foreign material that might have been left behind during the installation process. Ensure no tools, hardware, or wiring debris remain in the drive system cabinets. Clear any metal shavings that may result from any drilling activities.
2. If any internal barriers were removed during the commissioning process, ensure they are reinstalled.

Seal the Cabinet Plates

Once the back plates have been reattached, the seams along the plates must be sealed with silicone. Where the silicone is applied is dependent on the cabinet configuration (Fixed-mounted or Drawout Power Module).

IMPORTANT Use the approved silicone that is shipped with the drive.

Figure 11 - Silicone Locations on Fixed-mounted Power Module Configuration

Apply silicone as shown by bold lines

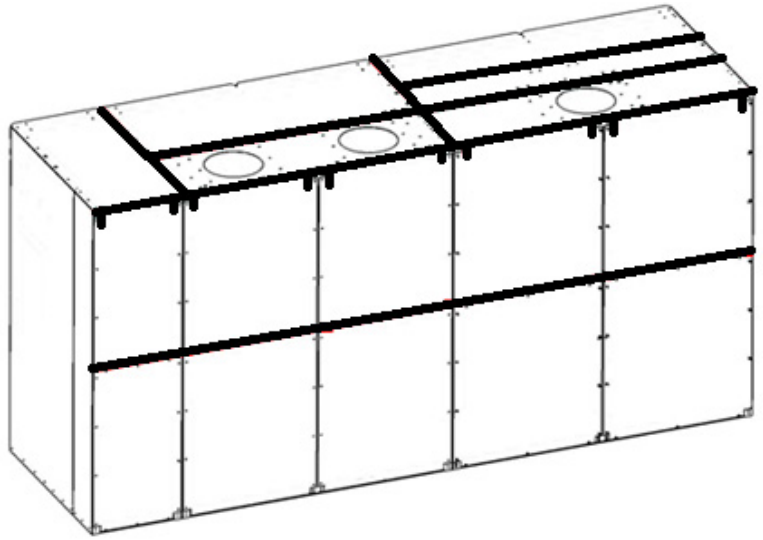
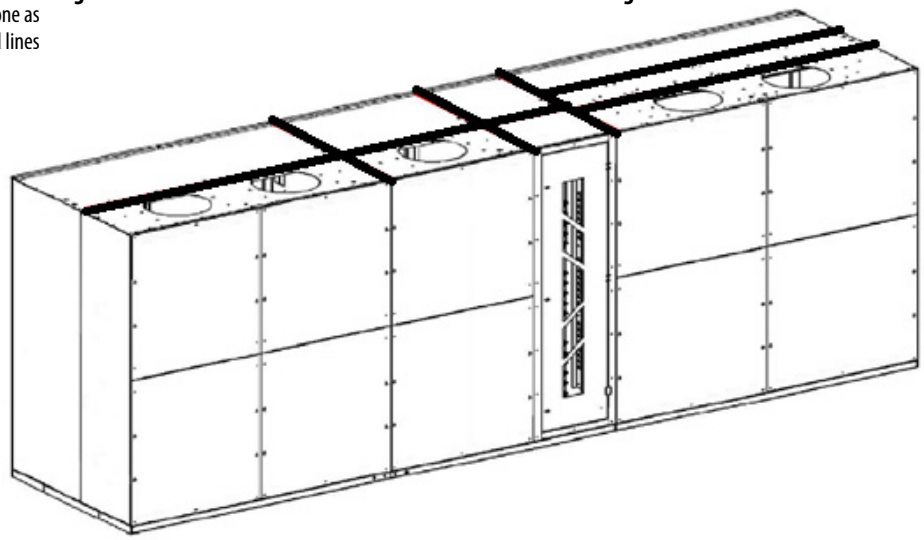


Figure 12 - Silicone Locations on Drawout Power Module Configuration

Apply silicone as shown by bold lines



Notes:

Preparation and Inspection (For UL)

Gather Required Tools and Test Equipment

Hand Tools

- Metric wrenches and sockets
- Torque wrench
- Assortment of screw drivers
- Wire stripper/cutter

Electrical Equipment

- High voltage gloves – 17 kV insulation rating (minimum)
- Anti-static strap
- Live-line tool (Hot stick)
- 5 kV Insulation Tester

Test Equipment

- 600V (1000V rating) digital multimeter with assorted clip leads

Computer Requirements and Software

- Laptop computer
- USB cable
- PLC program
- CCW software

Lockout and Tagout

SHOCK HAZARD: Servicing 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 cabinet even with the input circuit breaker in the off position. Required practice is to disconnect and lock out control equipment from power sources, and confirm discharge of stored energy in capacitors. 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 input circuit breaker before opening the doors to the drive system cabinets. After the cabinet doors are opened, immediately test the incoming and outgoing power cables and any components connected to medium voltage with a live-line tool (hot stick) while wearing high voltage gloves. Pay special attention to any capacitors connected to medium voltage that can retain a charge for a period of time. Only after the 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 local safety guidelines for detailed procedures on how to safely isolate the equipment from hazards.

Safety Test

Complete every point included in this section prior to continuing with the drive commissioning, to ensure that the commissioning continues in an environment safe to all those involved in servicing the drive. Ensure that commissioning of this drive is performed in accordance with local safety standards.

Inspect Drive Components

After performing the lockout and tagout procedure (see page 31), open all of the cabinet doors. Inspect each component for signs of shipping damage (see Table 8 on page 34). An initial inspection would have been done by the customer when the equipment was received. However, this would have been done from the front only and was just looking for obvious signs of damage (see publication 6000-IN006_-EN-P). Record the part number and description of any damaged components and immediately contact the Start-up Project Manager to order replacement components, if required.

ATTENTION: Verify the equipment against any damage. Do not install a damaged drive.

Verify that all components are securely affixed to the cabinet.

Most components will be easily visible on the doors or from the front of the cabinets after the doors are opened. Some components are best viewed from the rear of the cabinet.

For rear inspection, remove top and bottom rear access plates from the drive and bypass cabinet (if supplied). See publication 6000-IN006_-EN-P.

IMPORTANT The Inspect Drive Components Checklist (see page 34) mentions the principal base components supplied in the drive and bypass units. It is not comprehensive, as customer-required options may be supplied and three different bypass configurations are available.

Perform the shipping damage inspection for all components mounted in the drive cabinets and specific bypass unit cabinet (if supplied).

Functional Assessment

After the components are visually inspected to identify any shipping damage, a thorough functional assessment should be performed (see Table 9 on page 35). The main purpose of this assessment is to ensure that all movable parts and assemblies operate properly, connect properly, and components are wired properly and securely.

The Functional Assessment procedure can be combined with the “Inspect Drive Components” checklist on page 34.

Descriptions of the Power Cable Connections to be inspected and torqued to specifications are in the Interconnection Review and Installation Review sections.

Table 8 - Inspect Drive Components Checklist (UL)

	Bypass Cabinet (if supplied)	Isolation Transformer Cabinet	Power Module Cabinet	Low Voltage Control Cabinet
Front	**Door:** ❑ Pilot Lights ❑ Voltage Indicator Relay **Cabinet:** ❑ Insulators ❑ Switch assemblies ❑ Vacuum contactors ❑ Mechanical linkages	**Door:** ❑ Transformer Temperature monitor ❑ LV Cabinet components – Fan control circuit breakers **Cabinet:** ❑ Transformer Plastic Baffle ❑ Outgoing Motor Power Cable standoffs on Cabinet Sidesheet(1) ❑ Outgoing Motor Power Cable Terminal Insulators on transformer (1) ❑ Incoming Line Power Cable Terminal Insulators on transformer ❑ Motor Cable Braces **Fixed Mounted Power Module Configuration:** ❑ Transformer Secondary Windings (2 sets) – Inspect nomex wrap – Verify windings from core are undamaged – Check for debris in top of core	**Fixed Mounted Power Module Configuration:** ❑ Power Module retaining tabs ❑ Check for debris ❑ Output Bus Supports ❑ Fuse Mounting Supports ❑ Voltage Sensing Board **Drawout Power Module Configuration:** ❑ Support frame ❑ Power Modules	**Door:** ❑ Pilot lights ❑ Push buttons ❑ Selector switches ❑ HMI ❑ Interface board (on the back of the LV door) **Panel:** ❑ DIN rail mounted components ❑ UPS ❑ Fiber optic cables ❑ PLC ❑ Control Unit
Rear		**Fixed Mounted Power Module Configuration:** ❑ Transformer Secondary Windings (1) – Inspect nomex wrap – Verify windings from core are undamaged – Check for debris in top of core	**Fixed Mounted Power Module:** ❑ Heat sink – Verify orientation relative to barrier plates	❑ UPS connections

(1) Motor Cable terminations could be on the transformer structure or cabinet sidesheet, depending on the power rating.

Table 9 - Functional Assessment Checklist (UL)

	Bypass Cabinet (if supplied)	Isolation Transformer Cabinet	Power Module Cabinet	Low Voltage Control Cabinet
Front	❑ Electrical Door Interlock – Verify proper operation of auxiliary contacts with an ohmmeter ❑ Isolation switch auxiliary contacts – Verify proper operation with an ohmmeter ❑ Isolation switches – Verify proper operation – Outer jaws must securely contact the center stab in the closed position ❑ Secondary Wiring and Low Voltage Fuses – Check all connections per Electrical Drawings ❑ Door Grounding Straps	❑ Transformer Secondary Cables – Verify cables are properly fed through the glanding plate and are undamaged ❑ Mechanical Interlock – Test auxiliary switch contacts wired back to terminal blocks in LV panel with ohmmeter ❑ Temperature Sensing Wires (3 places) – Verify wires are intact and properly inserted ❑ Door Grounding Straps ❑ Transformer Temperature Protection Relay – Tug test on all cable connections	❑ HECS (2) – Check plug connectors ❑ Mechanical Interlock (2) – Test switch contacts wired back to terminal blocks in LV panel with ohmmeter ❑ Power Modules fiber optic cables – Check all connections ❑ Power Modules Fuses – Test each fuse with multimeter ❑ Door Grounding Straps ❑ Voltage Sensing Board cables – Verify the primary and secondary connections to the board are secure	❑ Control Unit – Check connection of all fiber optic cables – Check connection of HMI interface board – HMI ❑ Low Voltage wires – Tug test all wires on door, panel, and relays and terminal blocks ❑ Circuit Breakers and Contactors – Verify operation ❑ Vertical Ground Bus – Check connections from all attached components ❑ Low Voltage Door – Verify operation of all operator interface devices ❑ AC/DC Power Supplies – Check connections ❑ Door Grounding Straps
Rear	❑ Surge Arrestors – Check braided copper connections ❑ Voltage Sensing Relay Cables – Perform tug test ❑ Line and Load side power cables – Verify phasing and torque ❑ Top Ground Bus – Verify braided connections	❑ Transformer Secondary Cables – Verify cables are properly fed through the glanding plate are undamaged ❑ Tap Changer – Verify connection ❑ Top Mounted Cooling Fans – Check electrical connection ❑ Fan Housings – Assembly must be affixed properly to structure	❑ Top Mounted Cooling Fans – Check electrical connection	❑ UPS – Check connection

Interconnection Review

The interconnection checklist summarizes the required items to review to validate the reconnection of power, ground, and control cables between cabinets within the drive system, that were disconnected for shipment. Power and control cables that pass from one cabinet to another are bundled in the appropriate cabinet. These cables are connected for system test at the factory but disconnected and coiled up for shipment. If this interconnection work was done by the contractor, use this checklist to review and ensure the work was done correctly. If the interconnection work was not done by the contractor, the scope of work required to be performed is described in 6000-IN006_-EN-P.

IMPORTANT Check torque on all power and ground cable connections per specifications listed in Torque Requirements on page 109.

Table 10 - Interconnection Review Checklist (UL)

	Bypass Cabinet (if supplied)	Isolation Transformer Cabinet	Power Module Cabinet	Low Voltage Control Cabinet
Front Inspection	❑ Verify the braided ground connection to adjacent cabinet(s) is properly installed ❑ Review the braided ground connection to adjacent cabinet ❑ Verify line and load power cables from Isolation Transformer Cabinet are properly connected ❑ Verify all control wires per Electrical Drawing	❑ Verify the braided ground connection to adjacent cabinet(s) is properly installed ❑ Review all isolation transformer secondary wiring from Power Module cabinet (2 sets) ❑ Verify that the shields of all of the system's connecting wires are properly grounded ❑ Verify all control wires per Electrical Drawing – Cables are run in LV cable sections along front and back of cabinet	❑ Verify the braided ground connection to adjacent cabinet(s) is properly installed ❑ Verify that the shields of all of the system's connecting wires are properly grounded ❑ Review load power cable connection from Isolation Transformer Cabinet ❑ Verify Voltage Sensing Board power cables from Power Module Cabinet are properly installed ❑ Verify that the two plugs from the LV Control Cabinet and Isolation Transformer Cabinet are properly installed	❑ Verify control signal wiring bundles from LV Control cabinet to LV panel in Isolation Transformer cabinet and LV panel in the Bypass Cabinet (if supplied) are routed correctly

Installation Review

Prior to commencing the commissioning of the drive, verify the equipment was properly installed. Identifying errors in the drive installation prior to commencing the commissioning as opposed to mid-way through the commissioning process will greatly reduce the amount of time required to commission the drive. Verify the drive and all associated equipment have the system power grounding cable installed. Refer to 6000-IN006_-EN-P to review the contractor's drive installation responsibilities and understand the scope of the work you will be reviewing.

Mechanical Installation Inspection

Sequence	Task	Reference Document
1	Verify line up positioning	Dimensional Drawings
2	Verify cabinets are bolted together correctly	6000-IN006_-EN-P
3	Verify cabinets are affixed to the floor properly	Dimensional Drawings, 6000-IN006_-EN-P
4	Verify fans are installed correctly	6000-IN006_-EN-P
5	Verify power modules are installed correctly	6000-IN006_-EN-P
6	Review duct installation (if applicable)	6000-IN006_-EN-P
7	Verify the cable trenches meet design requirements	6000-IN006_-EN-P
8	Verify required cabinet clearances	6000-IN006_-EN-P
9	Verify there are no scratches or damage to the cabinet body	N/A
10	Verify the top cover of the isolation transformer cabinet is securely mounted	6000-IN006_-EN-P

Refer to project-specific EDs to review all electrical connections to external input and output devices.

Electrical Installation Inspection

Sequence	Task	Reference Document
1	Verify that medium voltage cables are separated at least 30 cm from the control cables	
2	Verify that all secondary control wiring use shielded cables	
3	Verify that input and output medium voltage cables specifications meet the stated insulation requirements	Electrical Drawings
4	Verify that input and output medium voltage cables have attached nameplates	
5	Verify the diameter of control power cables comply with the drawings	Electrical Drawings
6	Verify that the electrical safety circuit wiring between the input circuit breaker and the drive is shielded and only the end at the drive side is grounded	
7	Verify the wiring between the DCS and the drive is shielded and only the end the drive side is grounded	
8	Verify that the user-provided ground cable is $\geq$50 mm^2	
9	Verify the isolation transformer's primary input voltage matches the system primary voltage	
10	Verify that the customer motor specifications match the drive voltage and current capabilities	
11	Verify that the isolation transformer's input side wiring is correct	Electrical Drawings
12	Verify that the motor output side wiring is correct	Electrical Drawings
13	Verify all external control wiring is terminated correctly and to the proper terminal blocks	Electrical Drawings
14	Verify torque on incoming line power cable and outgoing motor power cable terminations	Electrical Drawings

Power Cabling

Trace the power cabling from termination point to termination point while examining the cable and its routing for mechanical damage, sharp bend radiuses and sources of induced noise and heat. The power cabling must be is sufficiently braced to contain the cabling in the event of a ground fault. Color coding is used to indicate the phase orientation of the drive.

Table 11 - Color Coding (UL)

Color	Incoming Line Side	Outgoing Motor Side
Black	L1 (A Phase) Line Cable Terminal	U Phase: • Power Module Bus • VSB Input Cable • Motor Cable Termination • Motor Cable Connection to Power Module Bus
Red	L2 (B Phase) Line Cable Terminal	V Phase: • Power Module Bus • VSB Input Cable • Motor Cable Termination • Motor Cable Connection to Power Module Bus
Blue	L3 (C Phase) Line Cable Terminal	W Phase: • Power Module Bus • VSB Input Cable • Motor Cable Termination • Motor Cable Connection to Power Module Bus

Incoming Line and Outgoing Motor cables must be routed separately to prevent cable insulation damage.

All cables must be terminated on each end and sufficiently torqued.

All customer power cables must be Hi-Potted or Meggered and read a sufficient insulation value. Review Hi-Pot or megger test report from the customer.

Control Wiring

Identify all customer-required control wiring detailed on the Electrical Drawings and locate it within the terminal blocks. Verify the cable insulation is not tightened in a terminal connection. All connections must have proper continuity.

Inspect the control cable routing to ensure that DC control wiring and AC control wiring are separated from each other. Routing them together in the same bundle or cabling product may result in unwanted noise being induced in the drive control. In the overhead cable tray provided at the front of the drive, the AC control, DC control and fiber optic cables must be separate. These cables may also be from the bottom.

Control wiring must be routed separately from power cabling.

Inspect for additional control not shown on the Electrical Drawings. Determine its purpose, mark the changes on the electrical diagram and send the prints to the Start-up Project Manager for future reference.

Perform a tug test on all control cables to ensure that they are securely fastened, and check each plug and connector to ensure it is properly seated in its socket.

Drive Megger Check

Isolate the Power and Control Circuits

ATTENTION: Verify the grounding cable connection is secure.
Disconnect the low voltage power before the megger test.
Short circuit the 3 input cables and 3 output cables on one point.

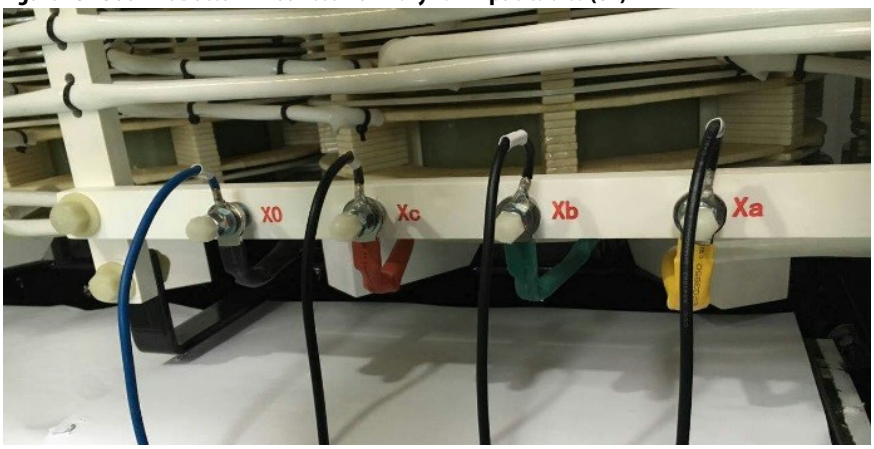
1. Isolate and lock out the drive system from any high voltage source.

   Disconnect any incoming power sources, medium voltage sources should be isolated and locked out and all control power sources should be turned off at their respective circuit breaker(s).

   Verify with a potential indicator that power sources have been disconnected, and that the control power in the drive is de-energized.

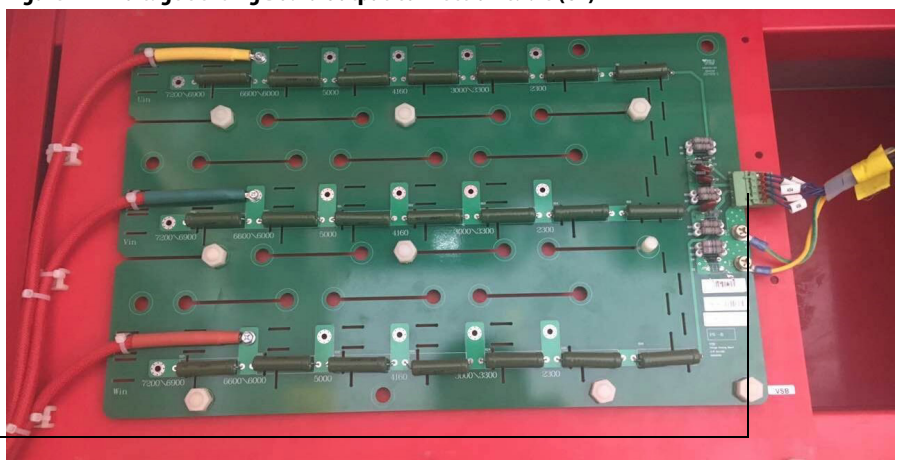
2. Disconnect four 380V AC cables (a, b, c, and o cables) from the bottom of the Isolation Transformer.

Figure 13 - 380V AC Bottom-mounted Auxiliary Fan Input Cables (UL)



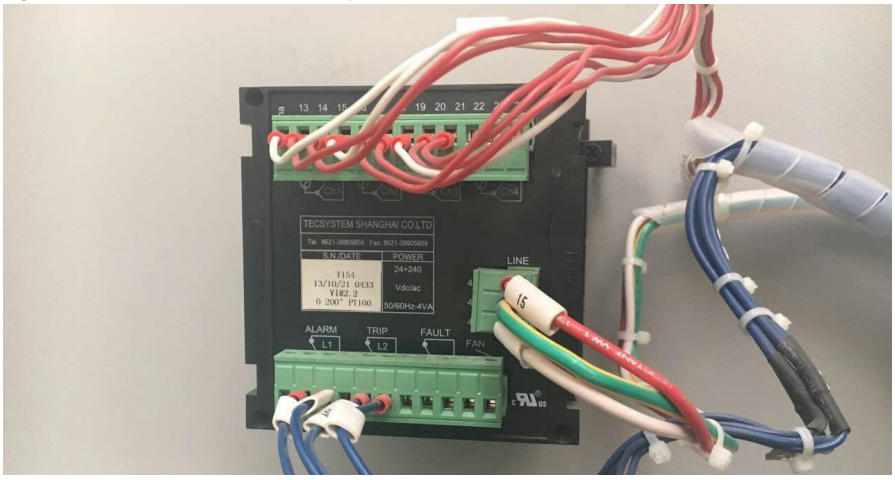
3. Disconnect the Voltage Sensing Board Output Cable. Keep the plug at least 100 mm away from the Voltage Sensing Board.

Figure 14 - Voltage Sensing Board Output Connection Cable (UL)



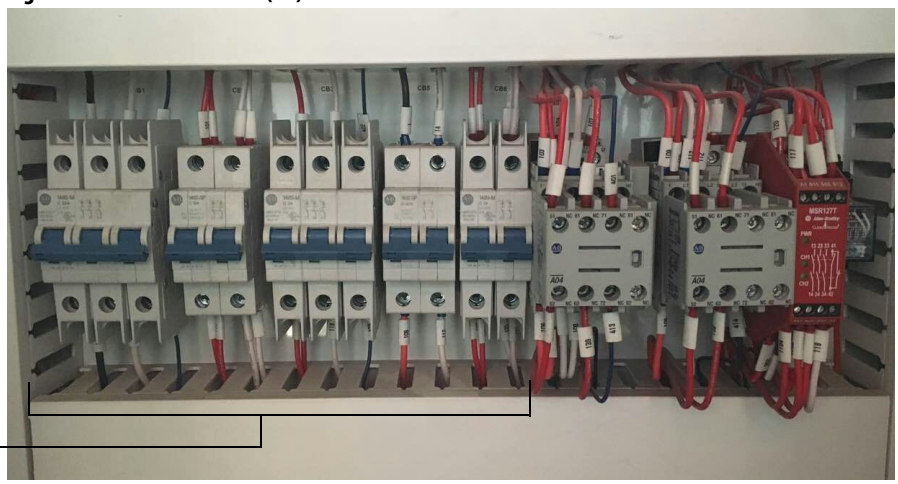
4. Disconnect the Isolation Transformer Temperature Monitor. Keep the plug at least 100 mm away from the connection point on the Monitor.

Figure 15 - Isolation Transformer Temperature Monitor (UL)



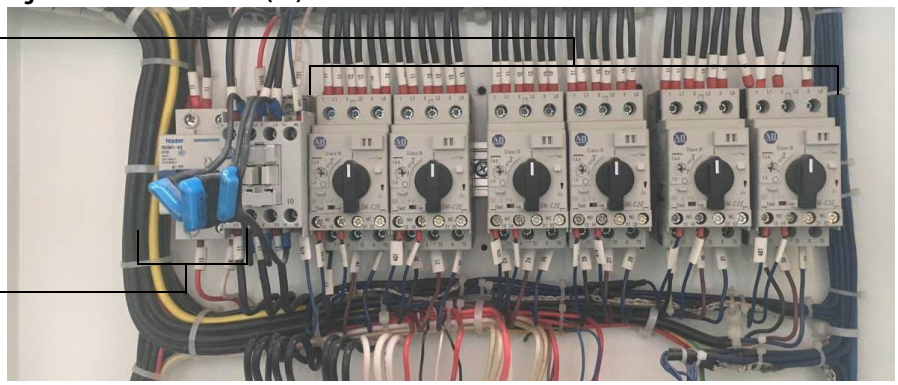
5. Switch the miniature circuit breakers in the LV Cabinet off.

Figure 16 - Control Switches (UL)



6. Switch the miniature circuit breakers in the Isolation Transformer Cabinet LV Control panel off. Switch the Top Main Cooling Fan circuit breakers off.

Figure 17 - Control Switches (UL)

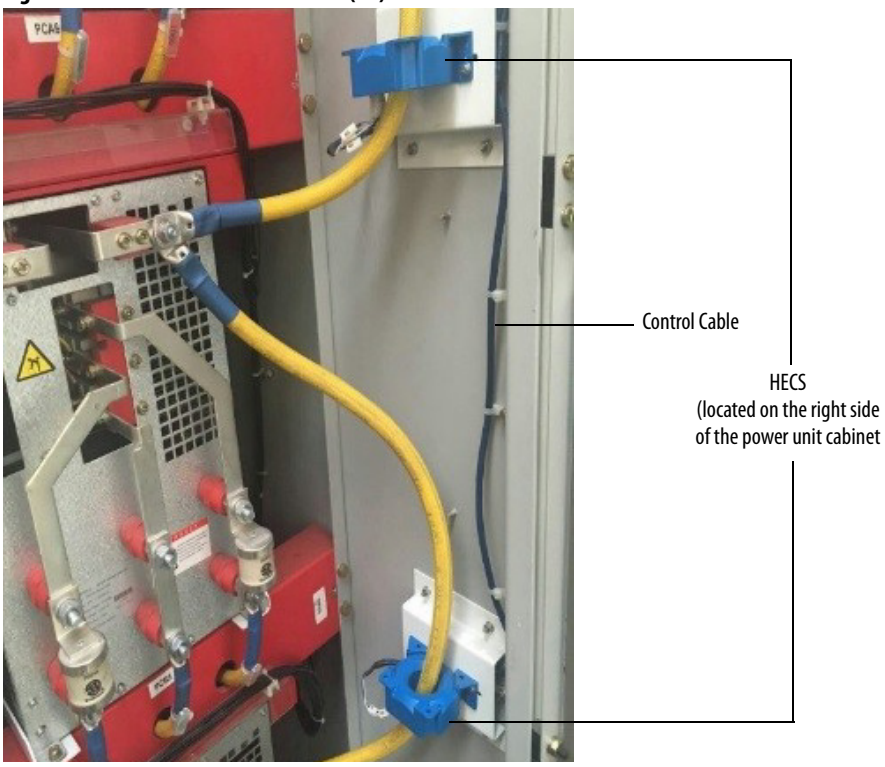


7. Remove two star connection cables (the cabling that goes through the HECS) and connect them to the output connections of any two power modules within a phase.

Figure 18 - Star Connection Cable (UL)

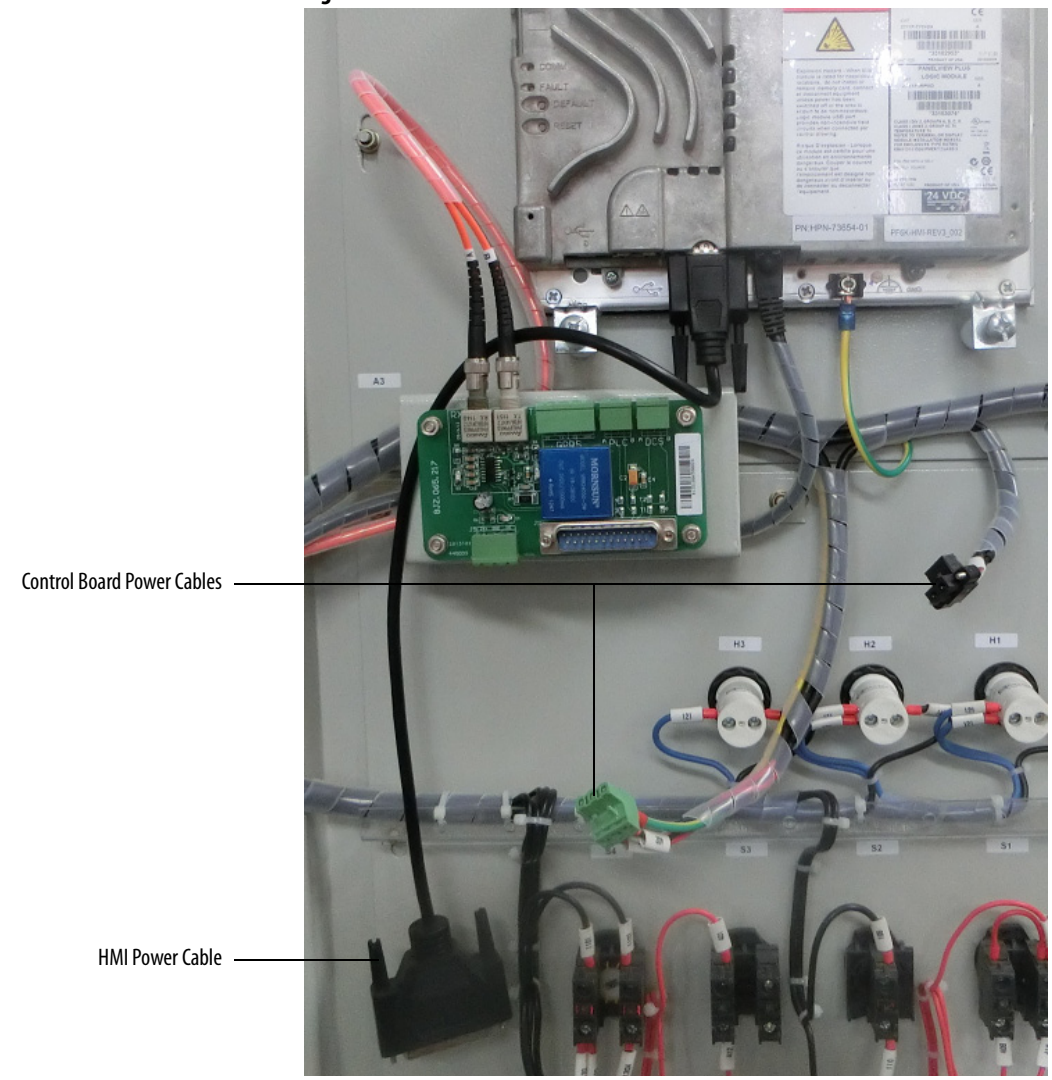
8. Disconnect the control cable of HECS.

Figure 19 - Hall Effect Current Sensor (UL)



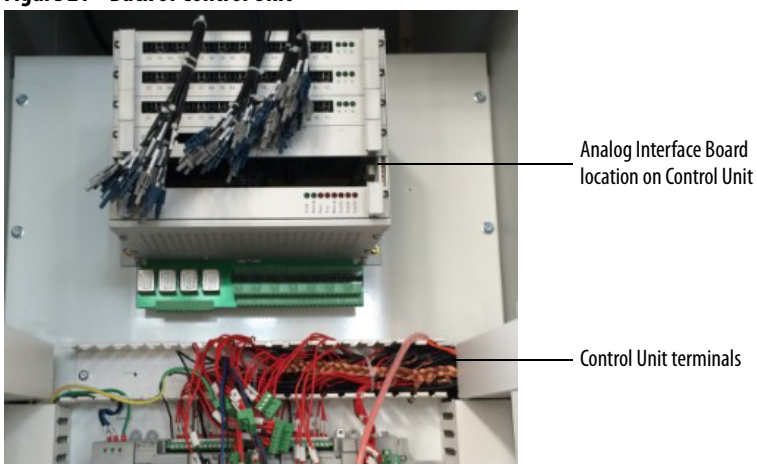
9. Disconnect the HMI and Control Board power cables.

Figure 20 - Back of HMI



10. Remove the Analog Interface board and disconnect all of the terminals from the Control Unit.

Figure 21 - Back of Control Unit



Connect the Insulation Meter

1. Connect the red wire from the insulation meter to the U Phase and the black wire to the grounding bus.

ATTENTION: Verify the drive and any connected equipment is clear of personnel and tools prior to commencing the Megger test. Barricade off any open or exposed conductors. Conduct a walk-around inspection before commencing the test.

2. Use jumper wires to make the connections as shown in Figure 22.

   The jumper wires must be rated for greater than 5 kV or must maintain sufficient clearance to any metal surface.

3. If the Megger has a lower voltage setting (normally 500V or 1000V), apply that voltage for 5 seconds as a precursor for the higher voltage rating. This may limit the damage if there is a problem. If the reading is very high, apply the test voltage per Figure 22.

4. Perform a Megger test with the insulation meter voltage set according to the voltages shown in Table 12 for 1 minute and record the result.

   The test should produce a reading greater than the minimum values listed below. If the test results produced a value lower than these values start segmenting the drive system down into smaller components and repeat the test on each segment to identify the source of the ground fault.

ATTENTION: Discharge the Megger prior to disconnecting it from the equipment.

5. Disconnect the Insulation Meter and jumpers installed in steps 1 and 2.
6. Reconnect all wires, cables, and connections in reverse order of removal.

Figure 22 - Connected Insulation Meter (UL)

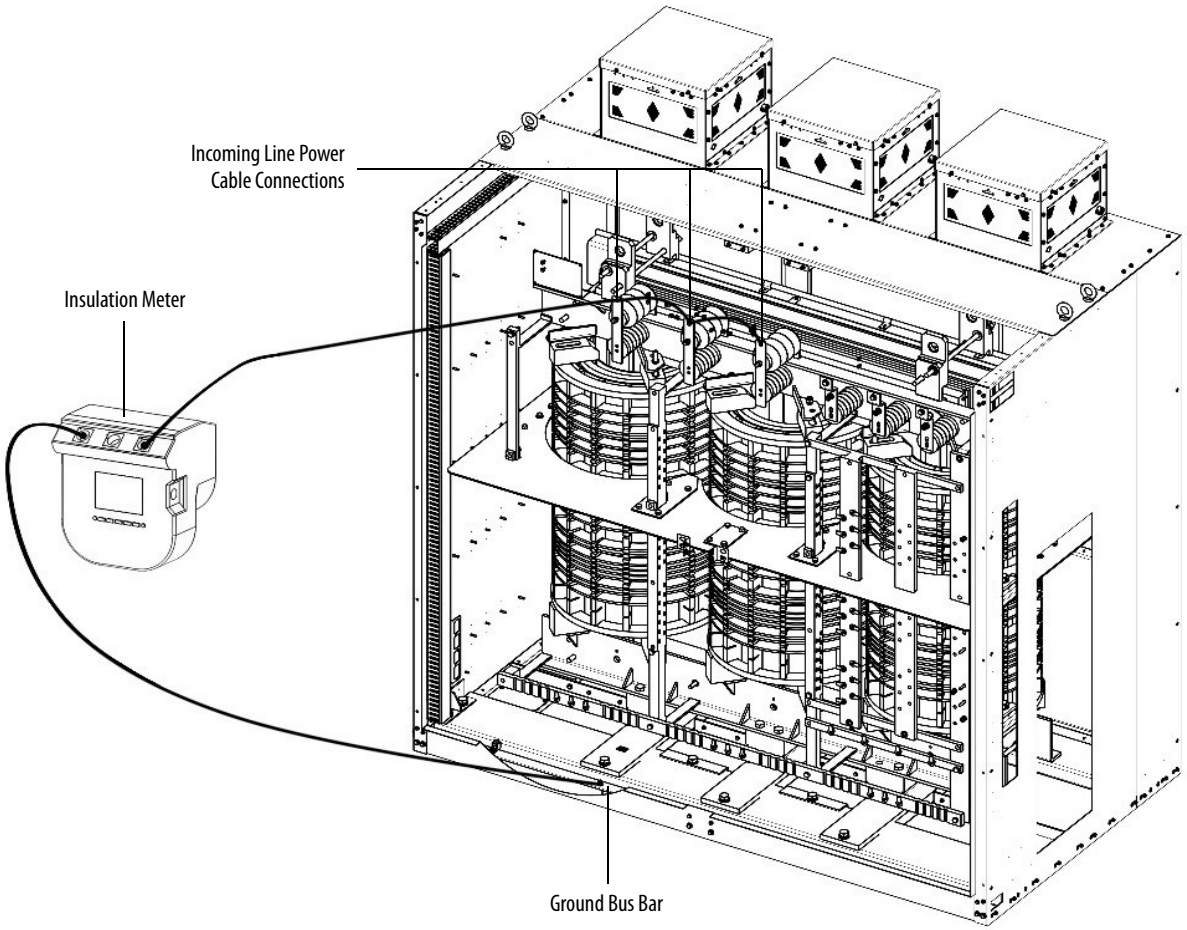


Table 12 - Insulation Test Voltage Values

Drive Rated Voltage U1	Insulation Resistance Test Direct Voltage (V)
1000<U1≤5000	2500
5000<U1	5000

Typical of Drive	Minimum Megger Value
Entire Drive	1 kM Ohm

Final Steps before Equipment is Ready for Energization

1. Review interior of all cabinets for foreign material that might have been left behind during the installation process. Ensure no tools, hardware, or wiring debris remain in the drive system cabinets. Clear any metal shavings that may result from any drilling activities.
2. If any internal barriers were removed during the commissioning process, ensure they are reinstalled.

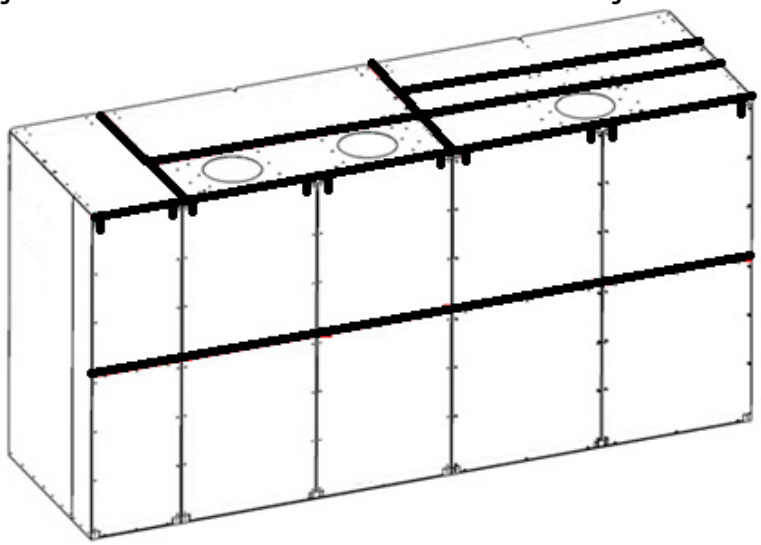
Seal the Cabinet Plates

Once the back plates have been reattached, the seams along the plates must be sealed with silicone. Where the silicone is applied is dependent on the cabinet configuration (Fixed-mounted or Drawout Power Module).

IMPORTANT Use the approved silicone that is shipped with the drive.

Figure 23 - Silicone Locations on Fixed-mounted Power Module Configuration

Apply silicone as shown by bold lines



Commissioning

Introduction

ATTENTION: The Control System Check requires LV Control power only. The Input Circuit Breaker must remain locked out and tagged out for this procedure.

A number of activities are required before the Control System Check can be performed.

The complete Control System Check requires the following procedures to be performed.

(1) Only required if a bypass configuration is supplied.

Control System Check Setup

Simulate Closed Input Circuit Breaker

IMPORTANT	The "normal" operating mode is for the input circuit breaker to be closed. Install a temporary jumper (X1-117, X1-119) in the LV Control Cabinet to simulate operating the system in "normal" mode (input circuit breaker closed) to allow the Control System Check process to proceed. Refer to Electrical Drawings.

Energize Control Circuit

Before beginning this process, ensure that the customer's control power supply breaker is closed and control power is available.

Control power voltage used in the control circuit is nominally 220V and referred to in the example. The control circuit can directly accommodate other widely used voltages of 230V and 240V also. If 110V or 120V is the control power voltage supplied by the customer, a control power transformer is supplied in the LV control cabinet to step up the customer supplied control power to 220V (Figure 24). This must be specified at time of order.

Q1 (CB1), Q2 (CB2), Q3 (CB3), Q5 (CB5), and Q6 (CB6) miniature circuit breaker designations are located in the LV Control Cabinet (Figure 25). The Q4 (CB4) and Q7 (CB7) miniature circuit breaker designations are located in the LV Control panel of the Isolation Transformer Cabinet (Figure 26). Refer to the Electrical Drawings.

Test points indicated in the instructions are at the circuit breaker terminals, not at the terminal blocks.

Circuit breaker device designation labels (Q1 (CB1), Q2 (CB2), etc.) are affixed to the device mounting surfaces.

Figure 24 - UPS and CPT Mounting Plate (Top View)

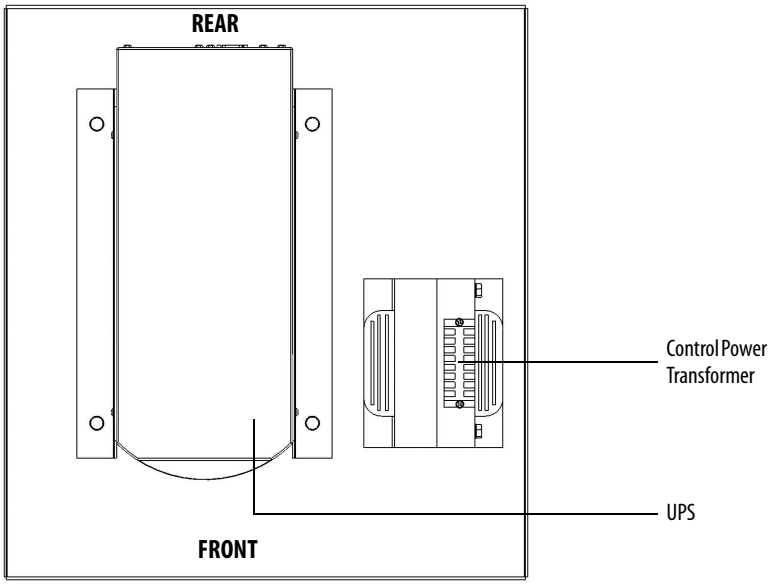


Figure 25 - LV Control Cabinet

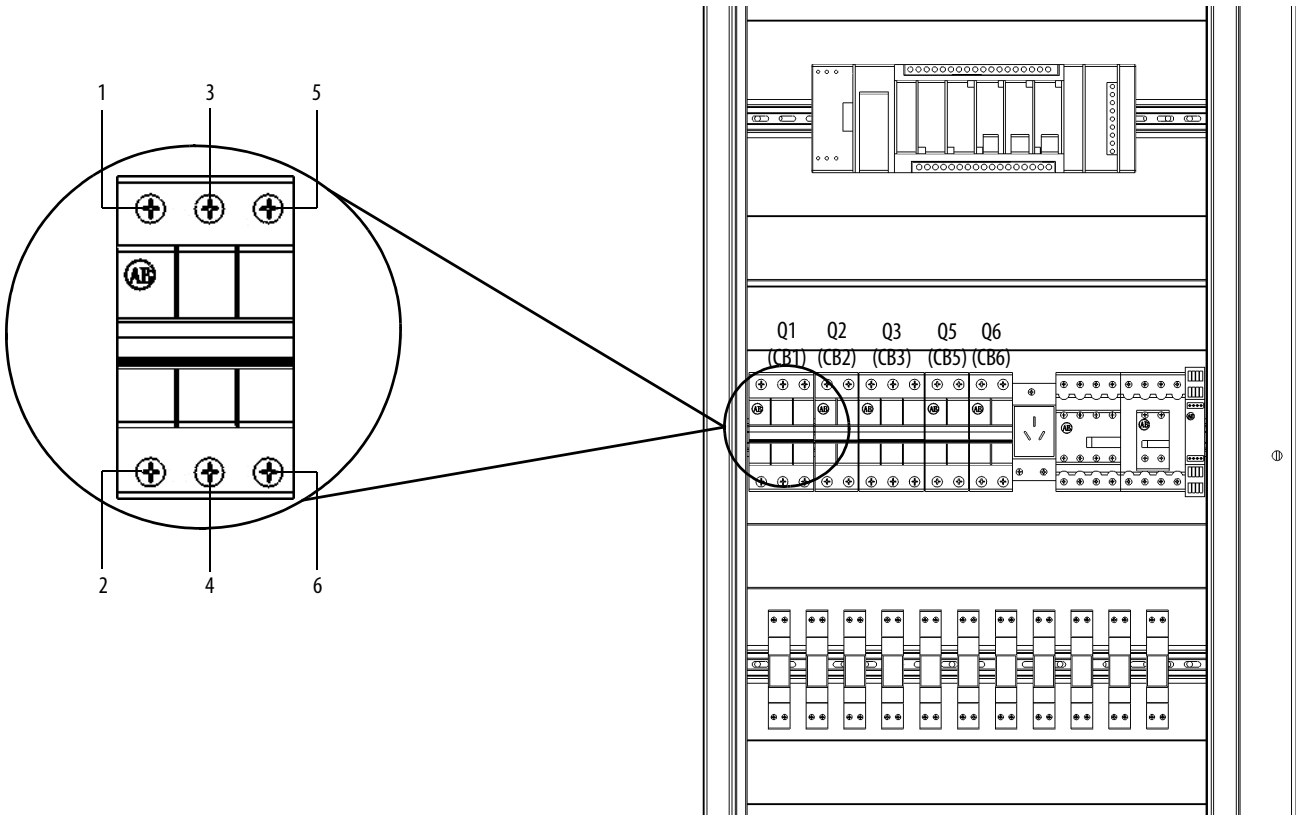
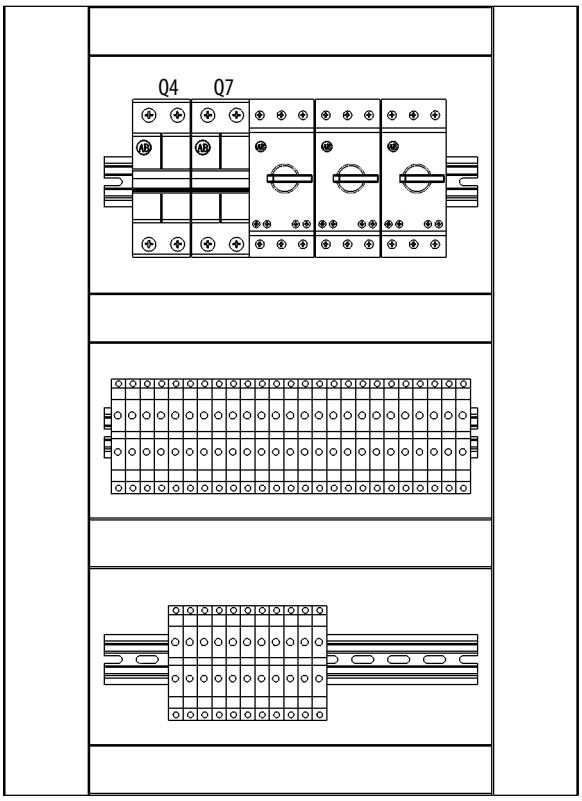


Figure 26 - LV Panel in the Isolation Transformer Cabinet

For IEC



For UL

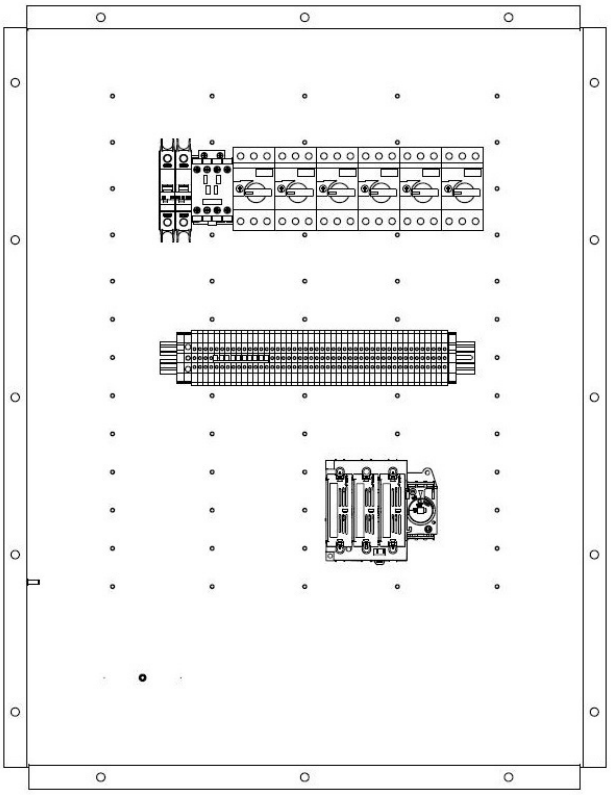


Table 13 - Energize Control Circuit Sequence (For IEC)

Item	Before Closing Breaker	After Closing Breaker	Comments
Close Breaker Q1	Verify that the input voltage at the Q1 circuit breaker is AC220V (1 is L, 3 is N). Verify output is not shorted (2 and 4). Verify OPEN state (5 and 6).	Verify that the output voltage is AC220V (2 is L, 4 is N). Verify CLOSED state (5 and 6).	Q1 connects customer-supplied control power to the control circuit (UPS).
Start UPS (Press ON button)	Before pressing the ON button, withdraw the Type I UPS power plug from the power receptacle (XS2). Verify that the input voltage of the XS2 receptacle is AC220V. Verify that the PE connection of the XS2 receptacle is properly grounded. Plug the UPS into the receptacle. Press and hold the ON button for 3 seconds to turn on the UPS (all status lights on the UPS will be green).	Verify that UPS operates normally and that the UPS output is AC220V. The output of the UPS is connected to the input of Q2 and Q3. The UPS output voltage can be checked at the input of Q2 or Q3 (1 is L, 3 is N).	UPS feeds control power to the circuits supplied by the Q2 and Q3 circuit breakers.
Close Breaker Q2	Verify that the input voltage at the Q2 circuit breaker is AC220V (1 is L, 3 is N). Ignore if done in "Start UPS" step. Verify output is not shorted (2 and 4).	Verify that the input voltage of power supplies is AC220V (L-N). Refer to Figure 27. Verify that the PLC, HMI, and Control Unit power up.	Q2 connects control power directly to AC/DC power supplies (G1, G2, and G3), PLC, HMI, and Control Unit
Close Breaker Q3	Verify that the input voltage at the Q3 circuit breaker is AC220V (1 is L, 3 is N). Ignore if done in "Start UPS" step. Verify output is not shorted (2 and 4). Verify OPEN state (5 and 6).	Verify that the output voltage is AC220V (2 is L, 4 is N). Verify CLOSED state (5 and 6). Verify that the PLC I/O status lights and control relay red indicating lights illuminate.	Q3 connects control power to PLC I/O and control relays.
Close Breaker Q4	Control power is fed from the isolation transformer tertiary winding for the Q4 circuit breaker, therefore not present for this test. A two pole breaker is supplied for lower power drives (220V powered auxiliary fans). A three pole breaker is supplied for higher power drives (380V power auxiliary fans). Verify open status (1 and 2) and output not shorted (2 and 4).	Verify closed status (1 and 2).	Q4 connects control power from isolation transformer tertiary winding to bottom-mounted auxiliary fans (6).
Close Breaker Q5	Control power is fed from the isolation transformer tertiary winding for the Q5 circuit breaker, therefore not present for this test. Verify open status (1 and 2) and output not shorted (2 and 4).	Verify closed status (1 and 2).	Q5 connects back-up control power from isolation transformer tertiary winding to switch to the control circuit (UPS) if the main (customer-supplied) control power is lost.
Close Breaker Q6	Verify that the input voltage at the Q6 circuit breaker is AC220V (1 is L, 3 is N). Verify output is not shorted (2 and 4).	Verify that the output voltage is AC220V (2 is L, 4 is N). Verify that the LV Door pilot lights illuminate.	Q6 connects control power to door mounted pilot lights and spare relays for DCS.
Close Breaker Q7	Verify that the input voltage at the Q7 circuit breaker is AC220V (1 is L, 3 is N). Verify output is not shorted (2 and 4).	Verify that the output voltage is AC220V (2 is L, 4 is N). Verify that the Isolation Transformer temperature monitor powers up.	Q7 connects control power to isolation transformer temperature monitor

ATTENTION: The following should be opened successively when the control power is switched off: Q5, Q4, Q3, Q2 and UPS; opening Q1 is not necessary when the control power is not disconnected.

Table 14 - Energize Control Circuit Sequence (For UL)

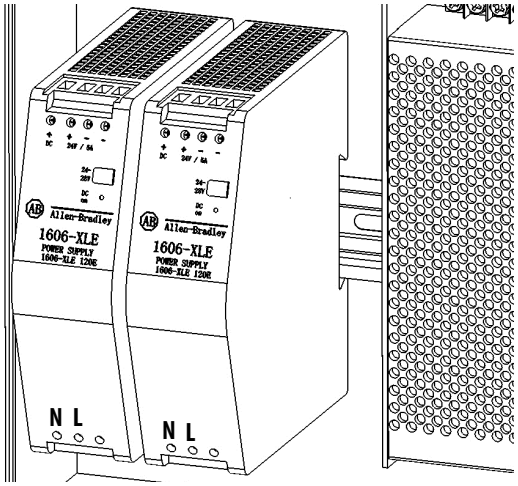
Item	Before Closing Breaker	After Closing Breaker	Comments
Close Breaker CB1	Verify that the input voltage at the CB1 circuit breaker is AC220V (1 is L, 3 is N). Verify output is not shorted (2 and 4). Verify OPEN state (5 and 6).	Verify that the output voltage is AC220V (2 is L, 4 is N). Verify CLOSED state (5 and 6).	CB1 connects customer-supplied control power to the control circuit (UPS).
Start UPS (Press ON button)	Before pressing the ON button, withdraw the Type I UPS power plug from the power receptacle (XS2). Verify that the input voltage of the XS2 receptacle is AC220V. Verify that the PE connection of the XS2 receptacle is properly grounded. Plug the UPS into the receptacle. Press and hold the ON button for 3 seconds to turn on the UPS (all status lights on the UPS will be green).	Verify that UPS operates normally and that the UPS output is AC220V. The output of the UPS is connected to the input of CB2 and CB3. The UPS output voltage can be checked at the input of CB2 or Q3 (1 is L, 3 is N).	UPS feeds control power to the circuits supplied by the CB2 and CB3 circuit breakers.
Close Breaker CB2	Verify that the input voltage at the CB2 circuit breaker is AC220V (1 is L, 3 is N). Ignore if done in "Start UPS" step. Verify output is not shorted (2 and 4).	Verify that the input voltage of power supplies is AC220V (L-N). Refer to Figure 27. Verify that the PLC, HMI, and Control Unit power up.	CB2 connects control power directly to AC/DC power supplies (G1, G2, and G3), PLC, HMI, and Control Unit

Table 14 - Energize Control Circuit Sequence (For UL)

Close Breaker CB3	Verify that the input voltage at the CB3 circuit breaker is AC220V (1 is L, 3 is N). Ignore if done in "Start UPS" step. Verify output is not shorted (2 and 4). Verify OPEN state (5 and 6).	Verify that the output voltage is AC220V (2 is L, 4 is N). Verify CLOSED state (5 and 6). Verify that the PLC I/O status lights and control relay red indicating lights illuminate.	CB3 connects control power to PLC I/O and control relays.
Close Breaker CB5	Control power is fed from the isolation transformer tertiary winding for the CB5 circuit breaker, therefore not present for this test. Verify open status (1 and 2) and output not shorted (2 and 4).	Verify closed status (1 and 2).	CB5 connects back-up control power from isolation transformer tertiary winding to switch to the control circuit (UPS) if the main (customer-supplied) control power is lost.
Close Breaker CB6	Verify that the input voltage at the CB6 circuit breaker is AC220V (1 is L, 3 is N). Verify output is not shorted (2 and 4).	Verify that the output voltage is AC220V (2 is L, 4 is N). Verify that the LV Door pilot lights illuminate.	CB6 connects control power to door mounted pilot lights and spare relays for DCS.
Close Breaker CB7	Verify that the input voltage at the CB7 circuit breaker is AC220V (1 is L, 3 is N). Verify output is not shorted (2 and 4).	Verify that the output voltage is AC220V (2 is L, 4 is N). Verify that the Isolation Transformer temperature monitor powers up.	CB7 connects control power to isolation transformer temperature monitor

ATTENTION: The following should be opened successively when the control power is switched off: CB5, CB3, CB2 and UPS; opening CB1 is not necessary when the control power is not disconnected.

Figure 27 - AC/DC Power Supplies



Control System Check

Verify Factory Default Settings

Confirm Language, Bypass Mode, and Local Operation

The default Language setting and bypass mode are set before shipment.

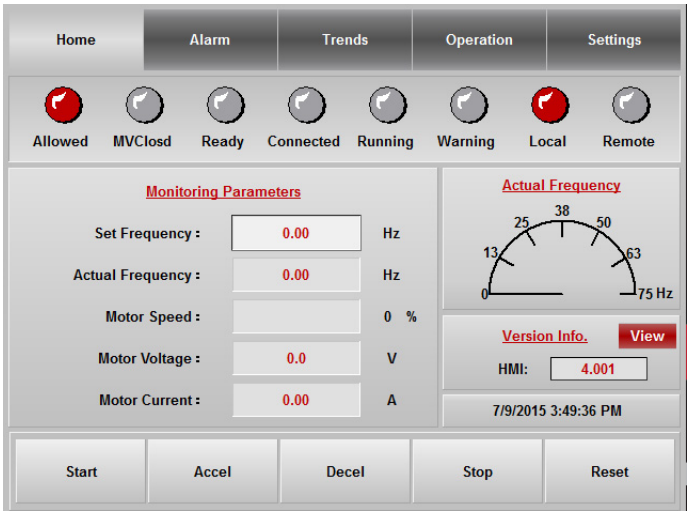
IMPORTANT You can change the language but cannot change the bypass mode, as this is set at the factory to match the shipped drive configuration.

1. Press Others in the **System Parameter Settings** interface screen.

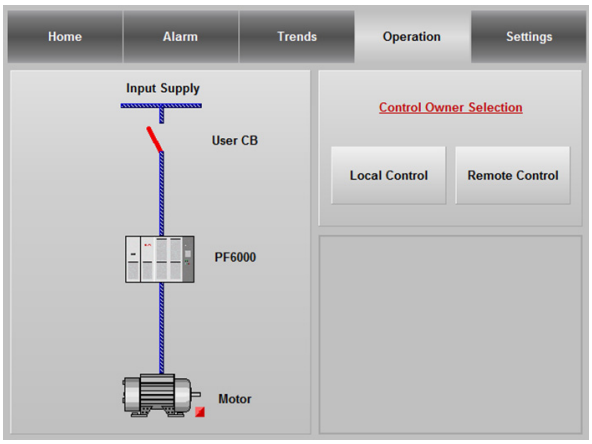
2. In the **Languages** dialog box, select the language you want and press OK.

3. Press ENTER to accept and proceed to the Main Interface Screen.

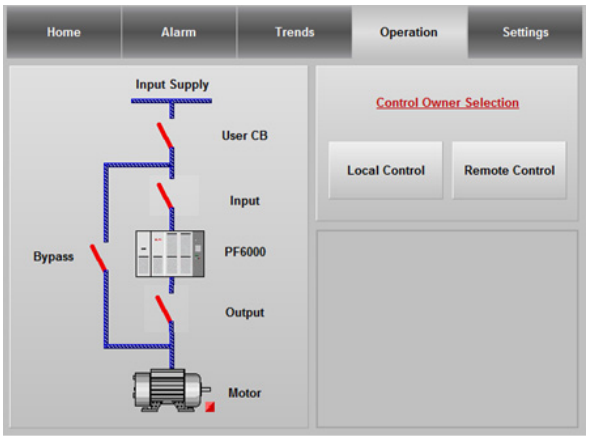
TIP Detailed information about the HMI screens is included in publication 6000-UM002_-EN-P, PowerFlex 6000 Medium Voltage Variable Frequency Drive User Manual.



4. Press Operation and confirm the Bypass Configuration matches one of the five **Input Supply** graphics.

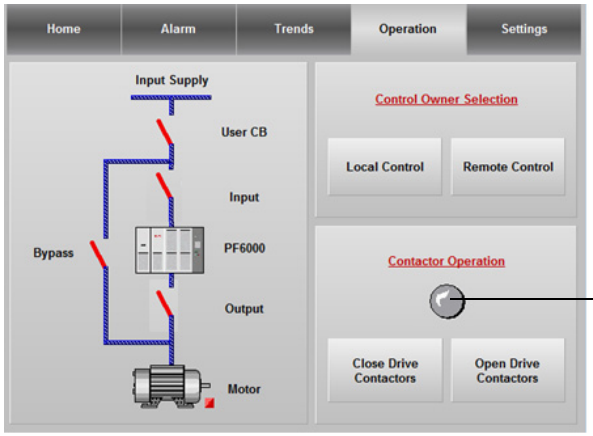


No Bypass Cabinet



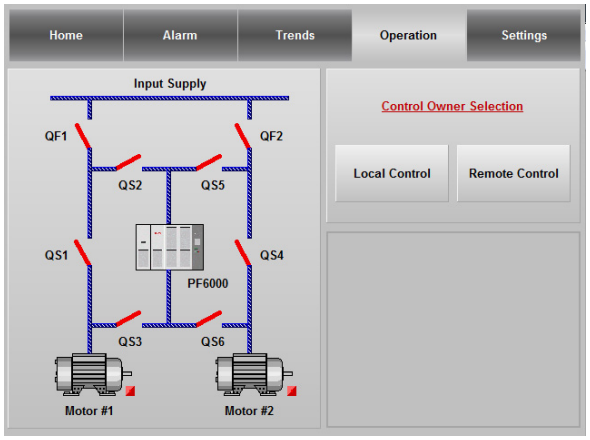
Manual Bypass Cabinet

Automatic Bypass Cabinet

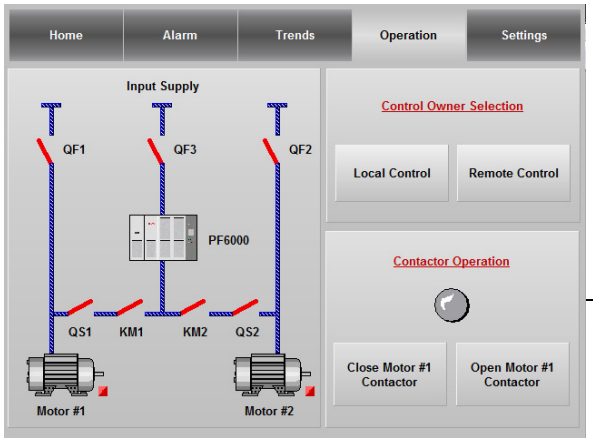


Note the Contactor Operation selection appears when Automatic Bypass is selected

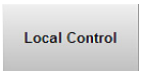
Manual Bypass Two Cabinets



Automatic Bypass Two Cabinets

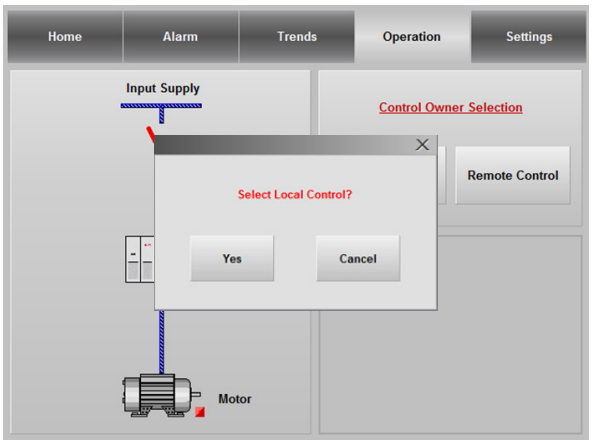


Note the Contactor Operation selection appears when Automatic Bypass is selected

5. Under **Control Owner Selection**, press 

.

The **Select Local Control?** dialog box appears.



6. Select Yes to confirm Local Control, and press Home to return to the Main Interface Screen.

Set P Parameters to Enable Testing

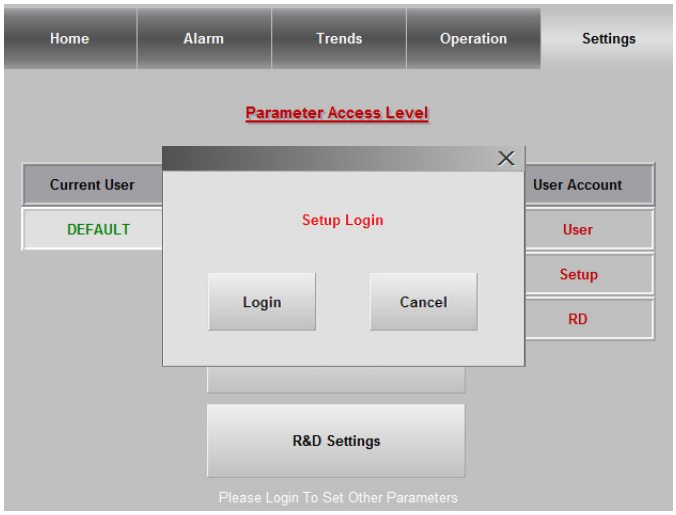
There are two specific "P" parameters that must be changed to allow the Control System Check to proceed.

This section is password protected and the setup login process must be completed before making any changes.

Access Setup Settings

1. Press Settings from the Main Interface Screen.
2. Press Setup Settings under **Parameter Access Level**.

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



3. Enter the User and Password details.

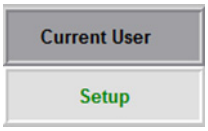
   Press User (F2) and enter "setup". Press ↵ when finished.

   Press Password (F3) to enter the password. Press ↵ when finished.

   TIP The password will be sent by the Project Start-up Manager.

4. Press ↵ to login.

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

5. Once logged in, press Setup Settings to proceed.

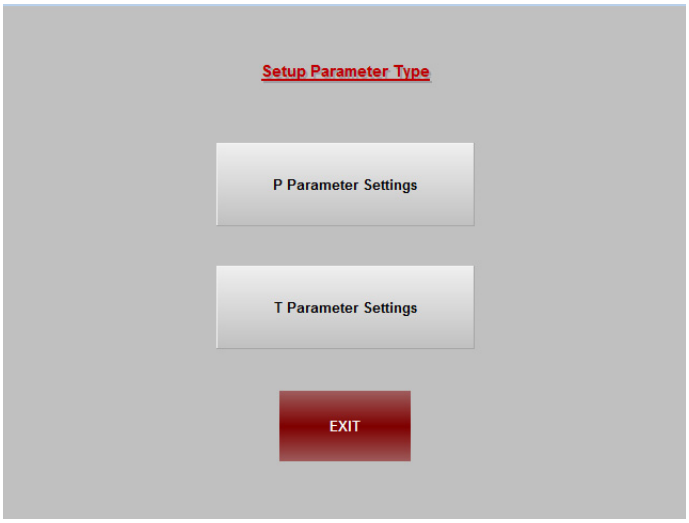
IMPORTANT If the login information was incorrect, you will be prompted to login again.

Set P Parameters

Once the appropriate access has been granted, you can now select and change parameters.

For the simulation tests, you only need to change two parameters: P007 and P224.

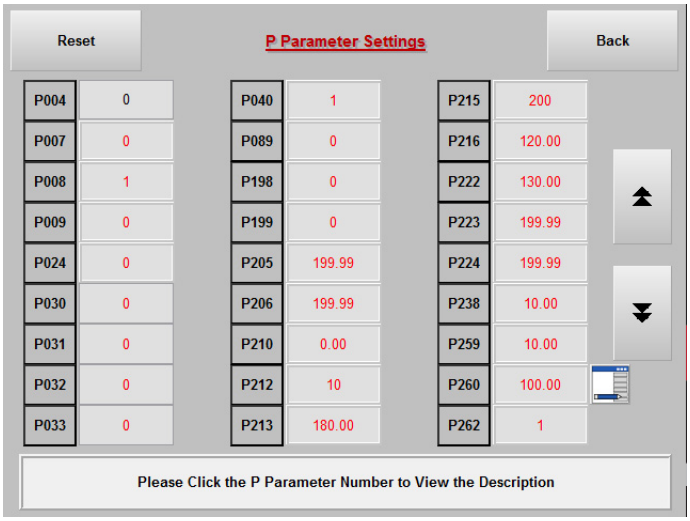
1. Press P Parameter Settings in the **Setup Parameter Type**.



2. Press the P007 parameter input field.

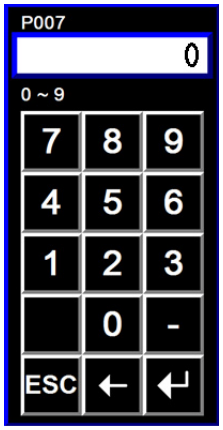
WARNING: Do NOT press Reset. This will reset all factory-set parameters.

TIP When the "P" Parameter number is pressed (e.g. P007), the description appears in the information box at the bottom of the screen.



3. Press "0" on the keypad dialog and press  .

   Parameter 007 will now show a value of "0".

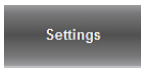


4. Repeat steps 2 and 3 to change Parameter 224 to "120".

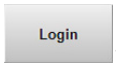
Verify Settings for Low-Voltage Testing

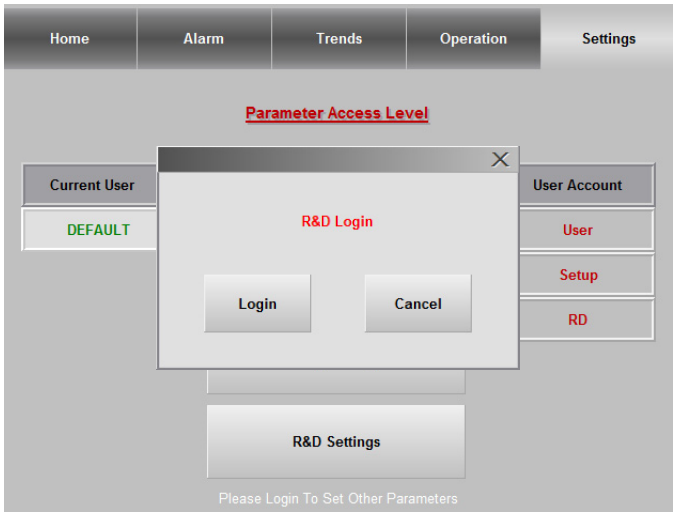
The following settings are for low-voltage testing only.

IMPORTANT Before performing high-voltage testing, the "Power Loss" setting must be restored to the unshielded state.

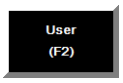
1. Press  from the Main Interface Screen.

2. Press  under **Parameter Access Level**.

   The **R&D Login** dialog box appears. Press  .



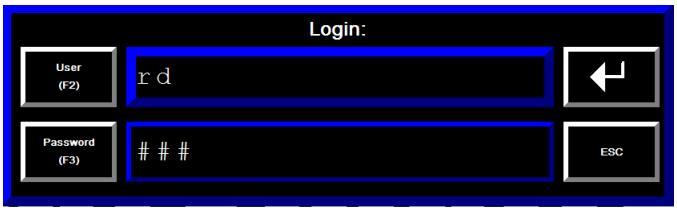
3. Enter the User and Password details.

   Press 

   and enter “RD”. Press  when finished.

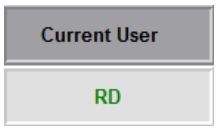
   Press 

   and enter “668”. Press  when finished.



4. Press  to login.

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



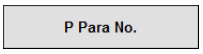
5. Once logged in, press 

   to proceed.

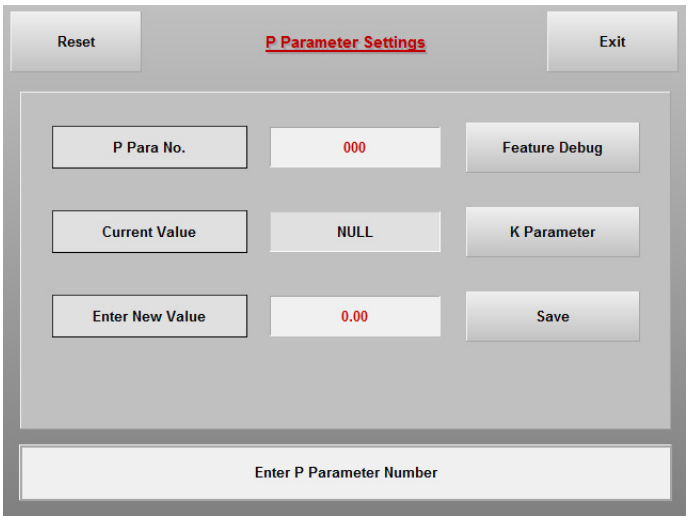
IMPORTANT If the login information was incorrect, you will be prompted to login again.

Set P Parameters

Once the appropriate access has been granted, you can now select and change parameters.

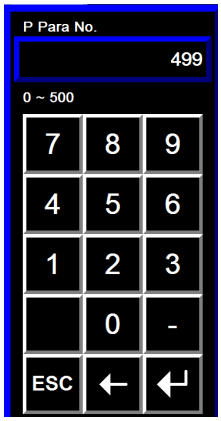
1. Press 

   under **P Parameter Settings**.



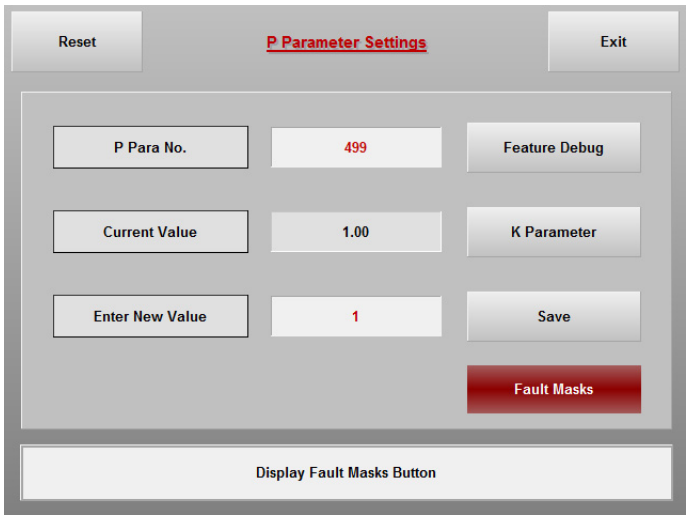
2. Press "499" on the keypad dialog and press ↵.

   P Para No. will now show a value of "499".

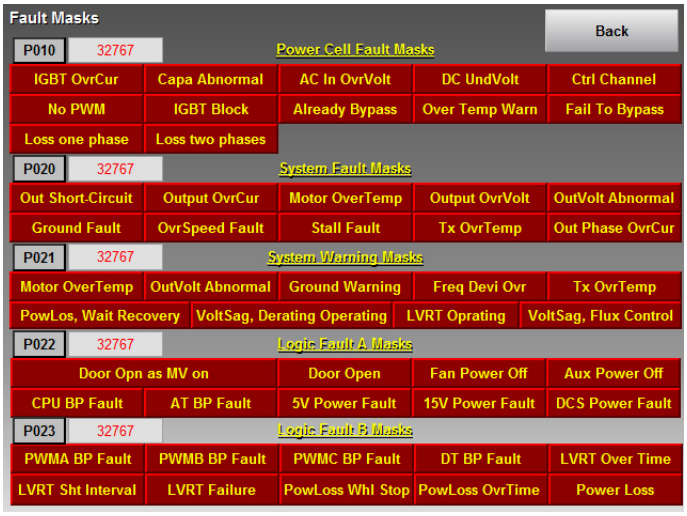


3. Press Enter New Value and enter "1". Press ↵ when finished.

4. Press Save. The Current Value should display "1.00".

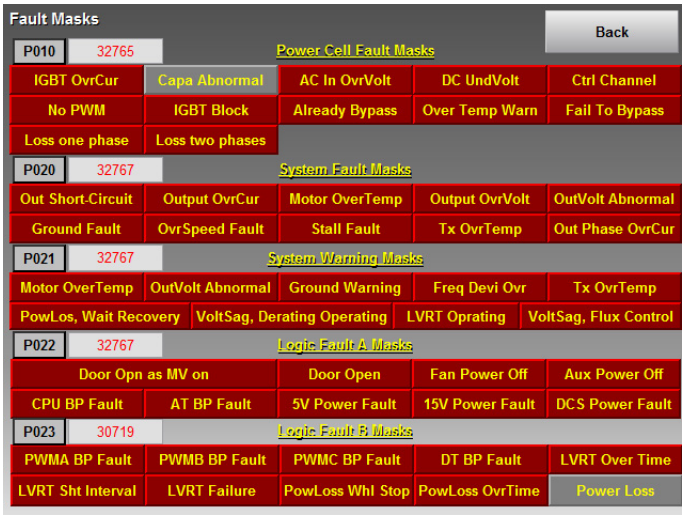


5. Press Fault Masks to view the Fault Masks screen.



For IEC Standard

6. Press **Power Loss** and **Capa Abnormal**. The buttons should change to Power Loss and Capa Abnormal respectively.



WARNING: Before performing the high-voltage test, press Power Loss to change back to **Power Loss** and keep current blocked because there is no hardware detection in IEC)

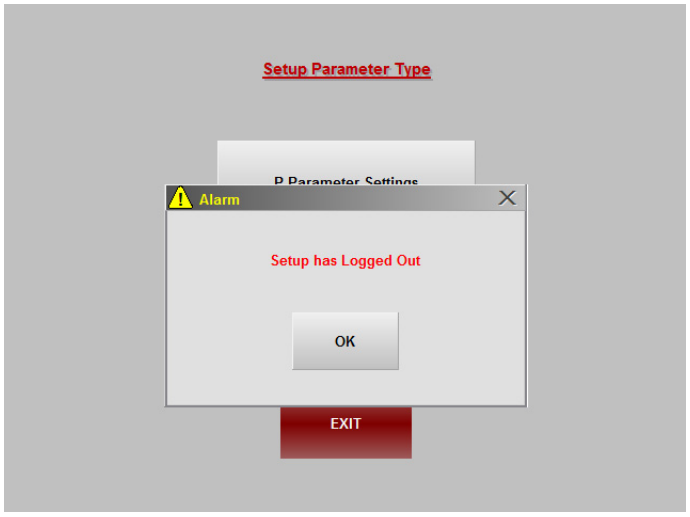
For UL Standard

7. Press **Power Loss** to change the button to **Power Loss**.

8. Press **Back** to return to **P Parameter Settings** and continue with low-voltage testing.

IMPORTANT After the end of the simulation tests, the "Power Loss" setting must be restored to the unshielded state.

9. Press **Back** to exit P Parameter Settings, and **EXIT**. Press **OK** to confirm Setup has logged out.



10. Press **Home** to return to the Main Interface Screen.

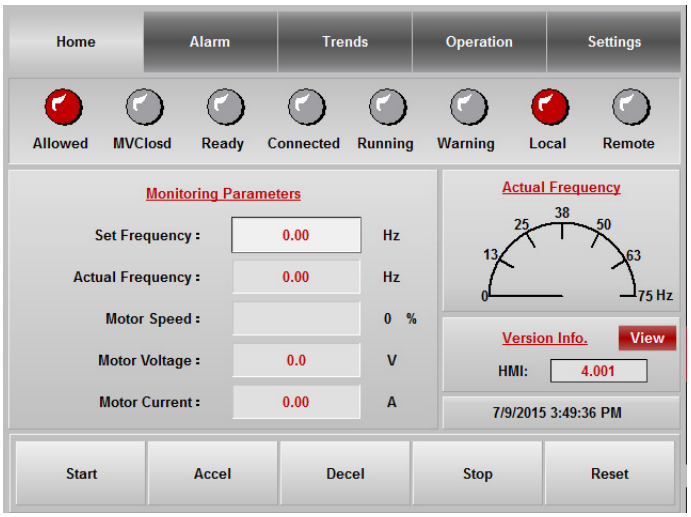
Verify Operation of Frequency Steps

There are two parts to this procedure, increasing the frequency in set increments and increasing the frequency to a specific rated frequency.

TIP During the Control System Check procedure, an "Abnormal Output Voltage Warning" will appear, as the procedure is done without MV and the Control System is expecting an output voltage. Ignore this warning for this procedure.

Increase Frequency by Step

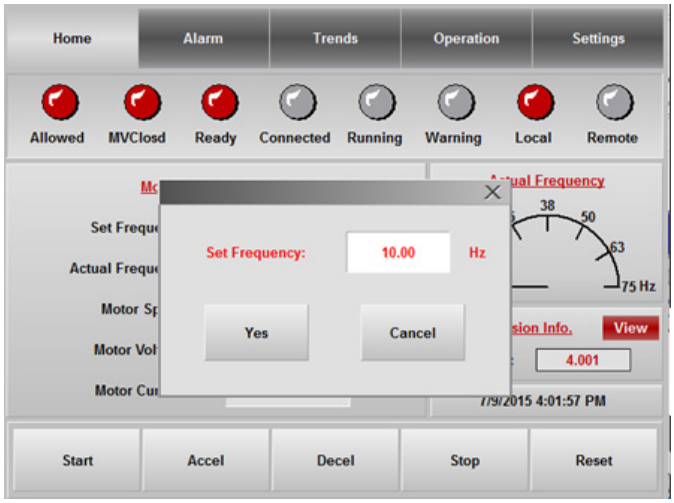
1. From the Main Interface Screen, press the **Set Frequency:** input field.



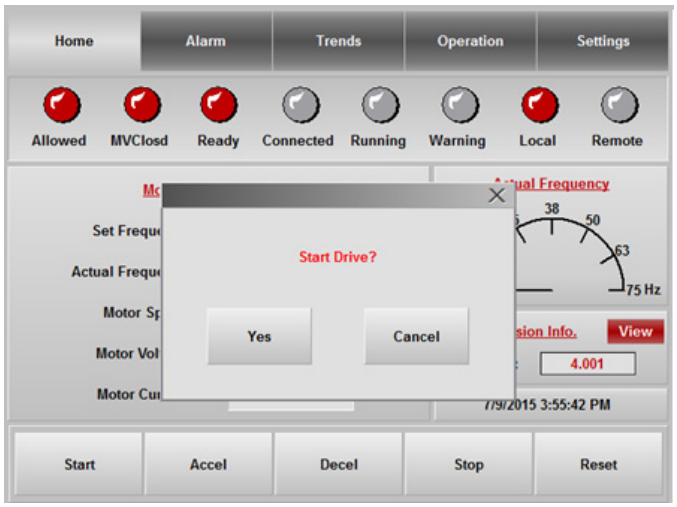
2. In the **Set Freq:** dialog box, enter a value of "10" and press ↵.

   Press Yes to confirm.

TIP The Set Frequency and Actual Frequency occasionally will not show the exact integral value selected, due to internal data conversion in the HMI program.



3. Press Start, and press Yes in the **Start Drive?** dialog box to confirm operation.

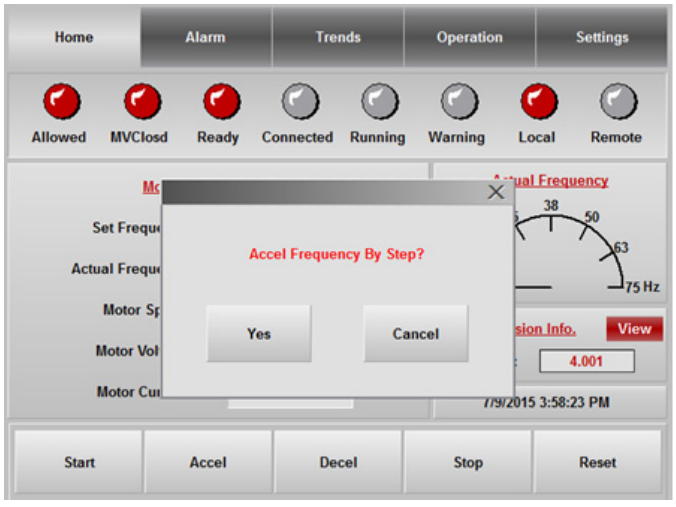


IMPORTANT When the drive is ≥0.5 Hz, the "Connect" light will be illuminated. When the speed of the drive surpasses 0.5 Hz, the "Connect" and "Running" lights will be red. The "Warning" light will illuminate when the Actual Frequency increases above 10.00 Hz. This is an internal function for testing purposes only.

4. When the Actual Frequency reaches 10 Hz, press Accel.

   Press Yes in the **Accel Speed by Step?** dialog box.

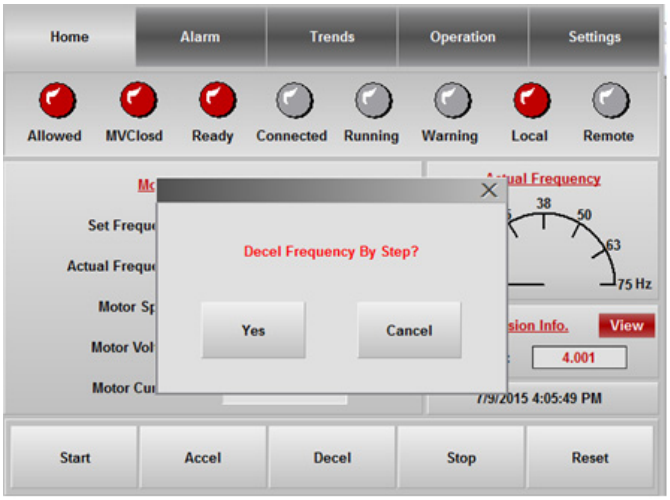
TIP T Parameter T09 determines the value of the frequency step change. The default is 1. Refer to Access T Parameters on page 86.



The Set Frequency and Actual Frequency are now 11 Hz.

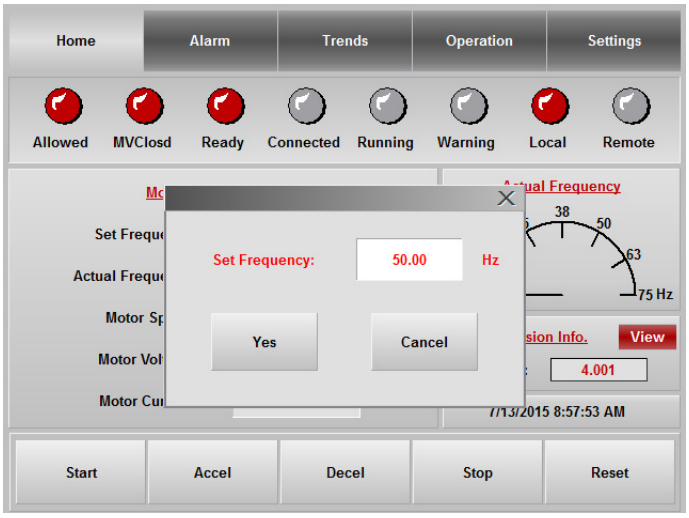
5. Press Decel and press Yes in the **Decel Speed by Step?** dialog box.

   The actual frequency will decrease by 1 Hz.



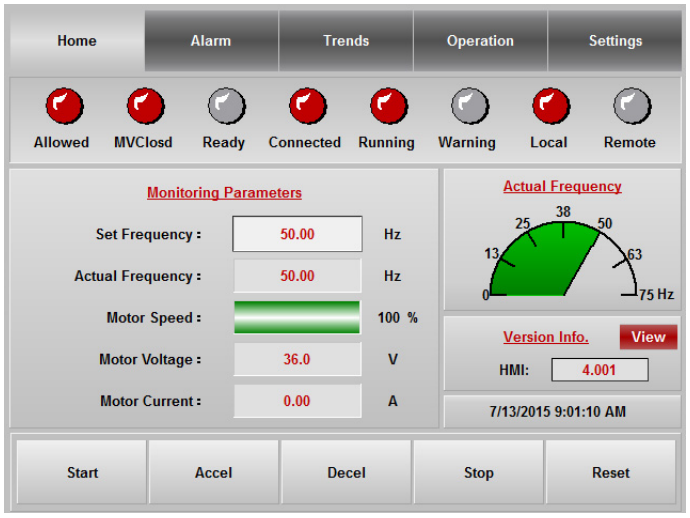
Verify Operation to Set Frequency

1. Press the **Set Frequency:** input field and enter “50” in the **Set Freq:** dialog box and press ↵.

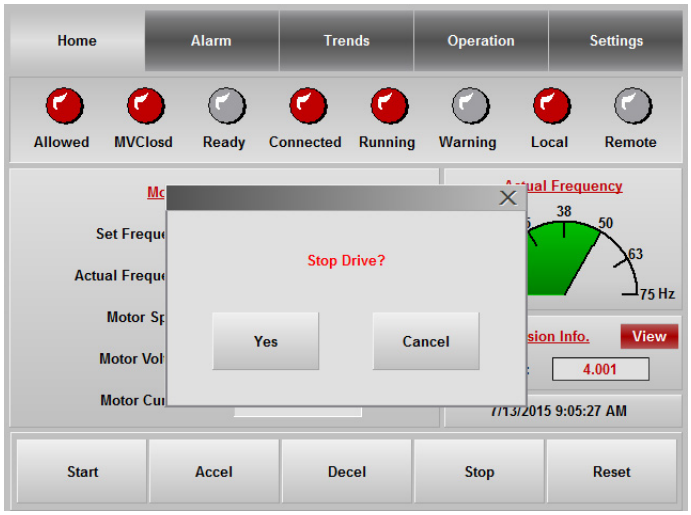


2. Press Yes to accept and begin the simulation.

   Actual Frequency: will show the frequency increasing to 50 Hz.



3. Once the actual frequency has reached the set frequency, press Stop and press Yes in the **Stop Drive?** dialog to confirm action.



   The actual frequency will decrease to 0 Hz.

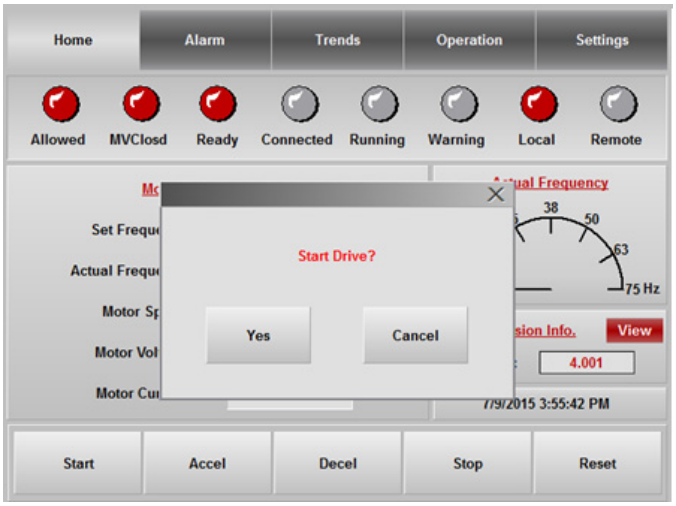
Simulate Warnings and Faults

This section describes how to simulate warnings and faults, and how to clear or reset the alarm. Warning codes begin with a W prefix, and fault codes begin with a F prefix.

Alarm	Self-clearing	Requires Reset
Transformer Overtemperature Warning	YES	
Transformer Overtemperature Trip		YES
Transformer Cabinet Main Cooling Fan Fault	YES	
Power Module Cabinet Main Cooling Fan Fault	YES	
Cabinet Door Open Warning – Left Isolation Transformer Cabinet Door – Right Isolation Transformer Cabinet Door – Left Power Module/LV Cabinet Door – Right Power Module/LV Cabinet Door – Bypass Cabinet Door (if applicable)		YES

The **Set Frequency:** field will already have 50 Hz shown from the previous exercise in the **Set Freq:** dialog box.

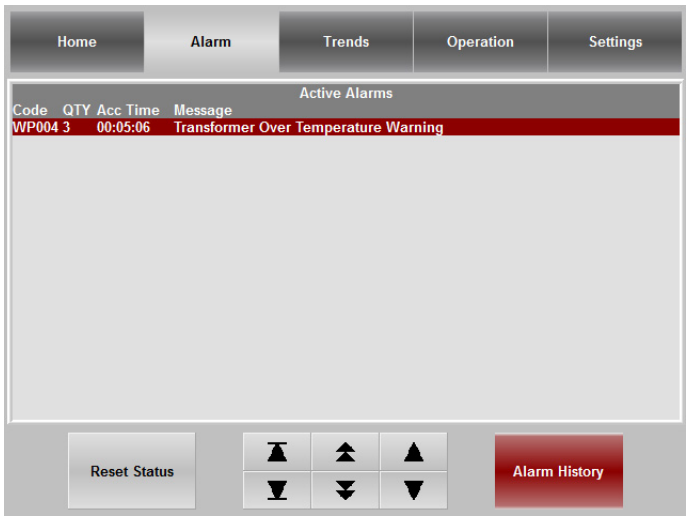
1. Press Start, and press Yes in the **Start Drive?** dialog box.



Simulate the Transformer Overtemperature Warning

1. Start the drive, then open the door of the Control cabinet.
2. In the control cabinet, remove the wire from terminal block 419. This triggers the transformer overtemperature warning alarm.

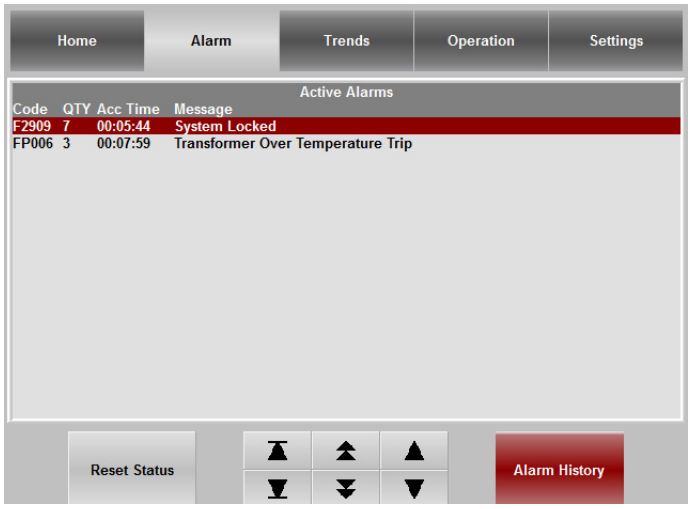
3. Press Alarm to view alarm record.



4. Replace the wire for terminal block 419 and tighten properly to remove the warning.

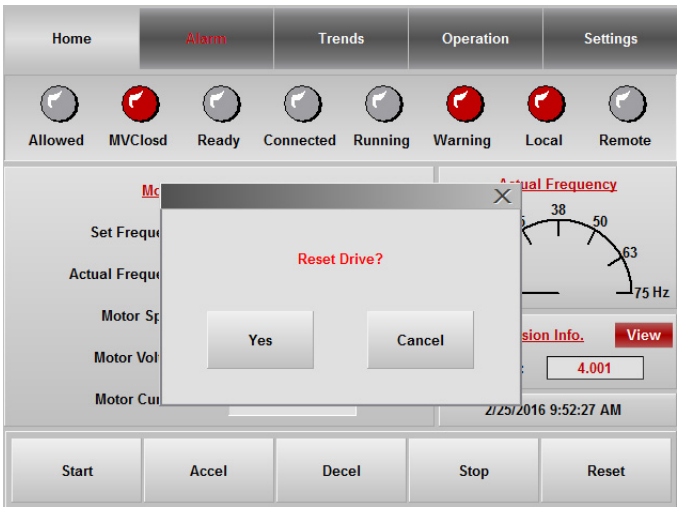
Simulate Transformer Overtemperature Trip

1. Start the drive, then open the door of the Control cabinet.
2. In the Control cabinet, remove the wire from terminal block 418. This triggers the transformer overtemperature trip alarm.
3. Press Alarm to view the alarm record.



4. Replace the wire for terminal block 418 and tighten properly to remove the trip message.
5. Press Home to return to the Main Interface Screen.

6. Press Reset, and press Yes to confirm the operation in the **Reset Drive?** dialog box.



Wait until the Ready status indicator is red before starting another simulation.

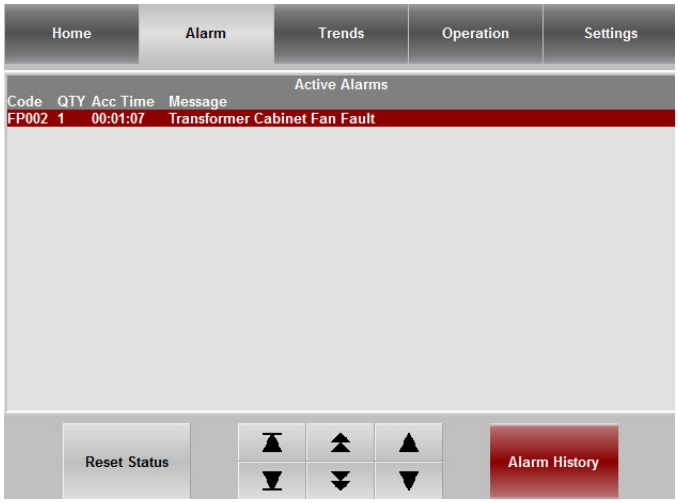
Simulate a Transformer Cabinet Main Cooling Fan Fault

1. Set the frequency to 10 Hz and start the drive.
2. Open the LV door of the Isolation Transformer cabinet.

TIP The circuit breakers for the main cooling fans for the entire drive are located here.

3. Turn the first motor control circuit breaker (Q10 for IEC and CB10 for UL), controlling the Isolation Transformer Cabinet Main Cooling Fans (one per fan), to the OFF position.

4. Press Alarm to confirm the Transformer Cabinet Main Cooling Fan Fault.



5. After the fault is reported, the drive is in a fault stop state.
6. Turn the first (Q10 for IEC and CB10 for UL) circuit breaker to the ON position, to remove the fault.
7. Press Home to return to the Main Interface Screen.

Simulate a Power Module Cabinet Main Cooling Fan Fault

1. Set the frequency to 10 Hz and start the drive.
2. Open the LV door of the Isolation Transformer cabinet.

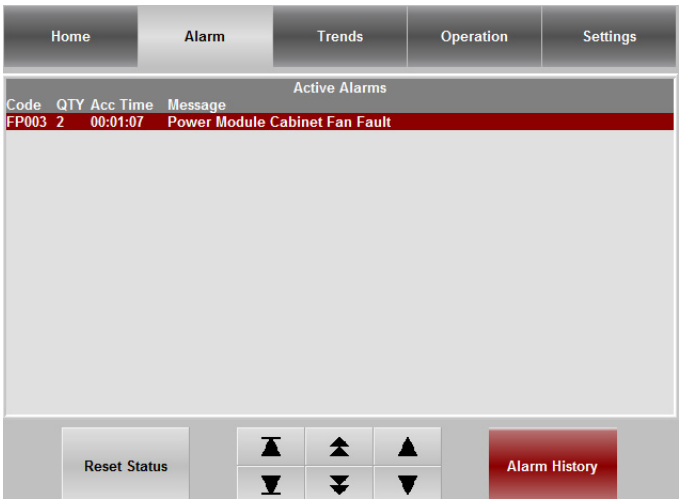
TIP From left to right on the DIN rail in the LV cabinet, the main cooling fan circuit breakers are located first for the Isolation Transformer cabinet then the Power Module cabinet.

Almost all drive configurations will have a maximum of three main cooling fans for the Isolation Transformer Cabinet. Therefore, the main cooling fan circuit breaker designations of Q10, Q11, and Q12 are reserved for the Isolation Transformer Main Cooling Fans. Power Module Cabinet Main Cooling Fan circuit breaker designations begin at Q13.

Refer to the appendix in 6000-IN006 -EN-P to determine the number of main cooling fans in each cabinet location, or look at the fans on the top plate of the drive.

3. Turn the applicable motor control circuit breaker (Q13 for IEC and CB13 for UL), controlling the Power Module Main Cooling Fans (one per fan), to the OFF position.

4. Press Alarm and confirm the Power Module Cabinet Fan Fault.

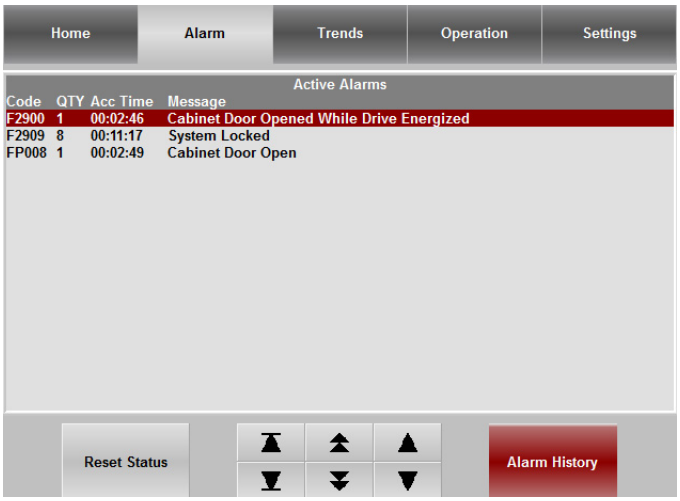


5. After the fault is reported, the drive is in a fault stop state.
6. Turn the (Q13 for IEC and CB13 for UL) circuit breaker to the ON position, to remove the fault.
7. Press Home to return to the Main Interface Screen.

Simulate Cabinet Door Open Warning

1. Open the left Isolation Transformer Cabinet door.
2. Press Alarm to confirm the Cabinet Door Open Warning.

   The drive will shut off.

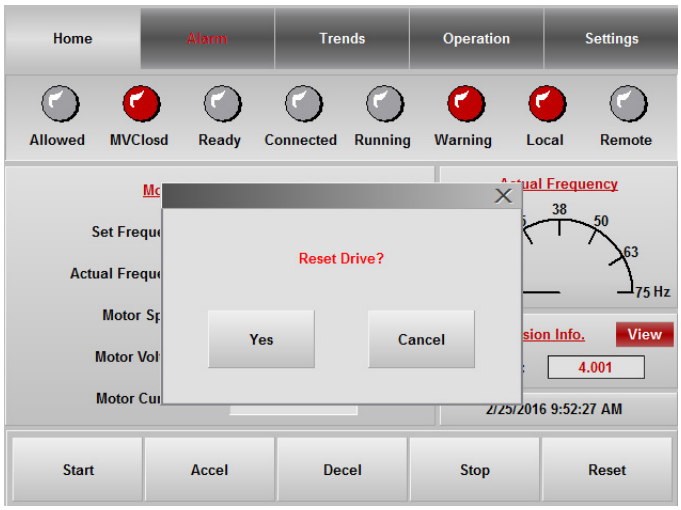


3. Close the left Isolation Transformer Cabinet to remove the warning.
4. Repeat this procedure using the:
   - Right Isolation Transformer Cabinet door
   - Left Power Module/LV Cabinet door

- Right Power Module/LV Cabinet door
- Bypass Cabinet door (if applicable)

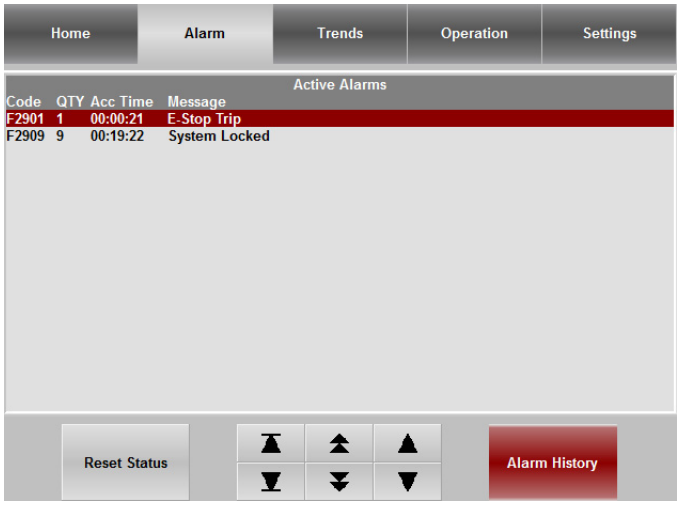
5. Press Home to return to the Main Interface Screen.

6. Press Reset to remove the fault. Press Yes to confirm operation in the **Reset Drive?** dialog.



Verify E-Stop Functionality

1. Press Start on the Main Interface Screen to start the drive.
2. Push the E-stop button on the front of the LV Control cabinet.
3. Press Alarm and confirm the E-stop Trip fault.



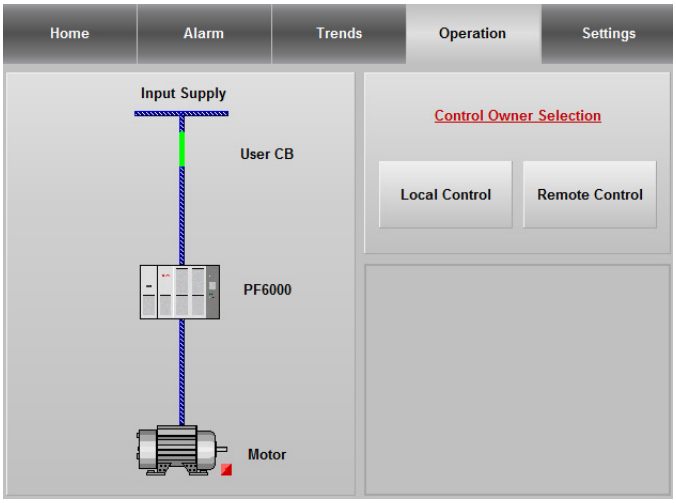
4. Twist to pull out the E-stop button on the front of the LV Control cabinet.

5. Press Home to return to the Main Interface Screen.
6. Press Reset to remove the fault. Press Yes to confirm operation in the **Reset Drive?** dialog.

Verify Switching from Local Control to Remote Control

Depending on whether the drive has an automatic or manual Bypass or no Bypass configuration, the Operation Interface screen will be different.

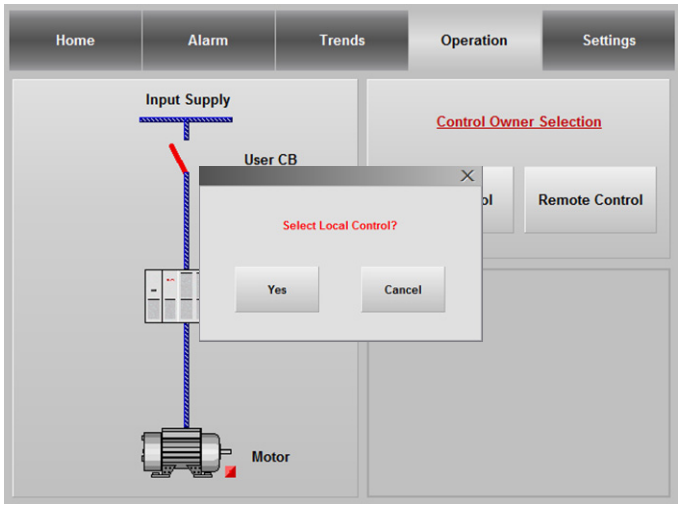
1. Press Operation from the Main Interface Screen.
2. Press Remote Control in the **Control Owner Selection**.
3. Press Yes in the **Select Remote Control?** dialog.



4. Press Home to return to the Main Interface Screen and confirm **Remote** status indicator light is on.

5. Press Operation from the Main Interface Screen.

6. Under **Control Owner Selection**, press Local Control.

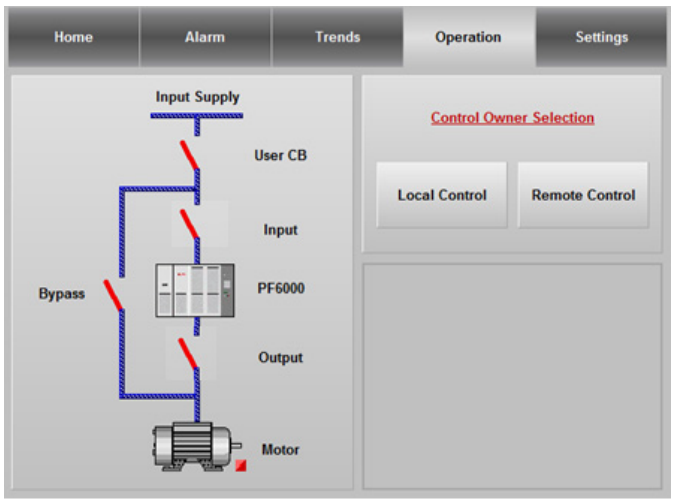


7. Select Yes to confirm selection in the **Select Local Control?** dialog, and press Home to return to the Main Interface Screen and confirm the **Local** status indicator is on.

Verify Operation of Input/Output and Bypass Isolation Switches (Manual Bypass)

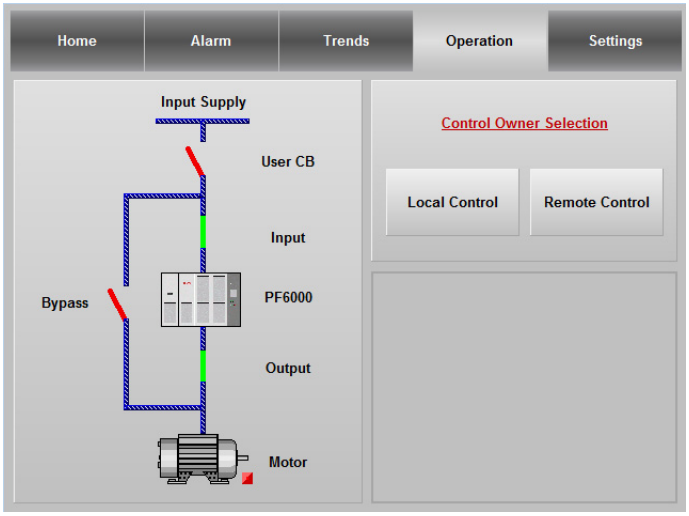
Input/Output Isolation Switches

1. Press Operation from the Main Interface screen.



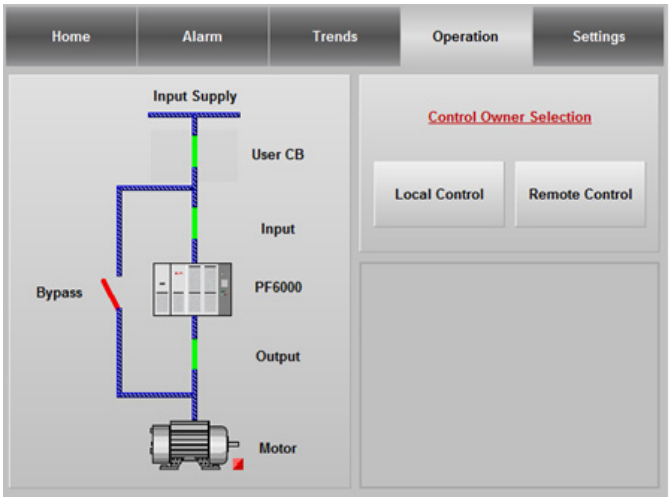
2. Open the Bypass cabinet door, and close QS2 and QS3.

   Verify the Input and Output contactors are closed on the HMI.



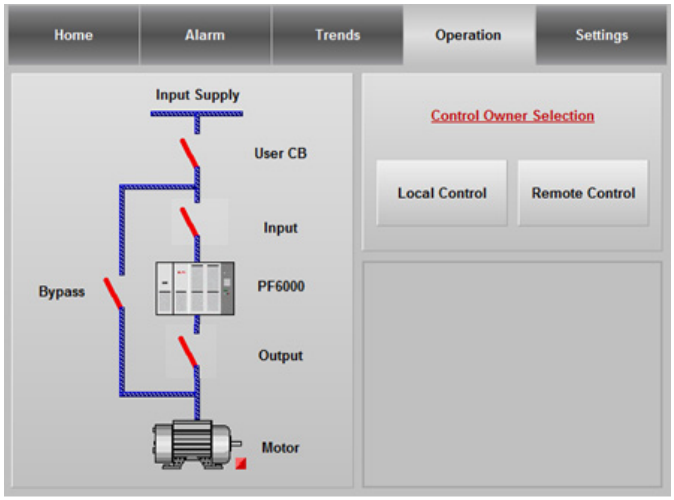
3. Close the customer-supplied input circuit breaker by installing a temporary jumper wire (X-117, X-119).

   Verify the input circuit breaker is closed.



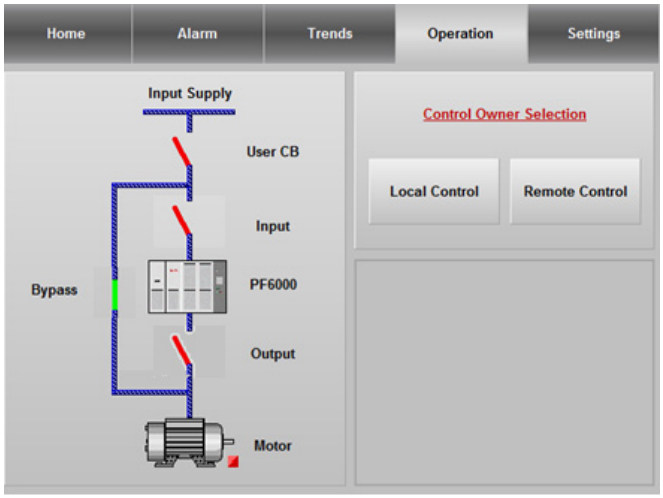
Bypass Isolation Switches

1. Press Operation from the Main Interface screen.



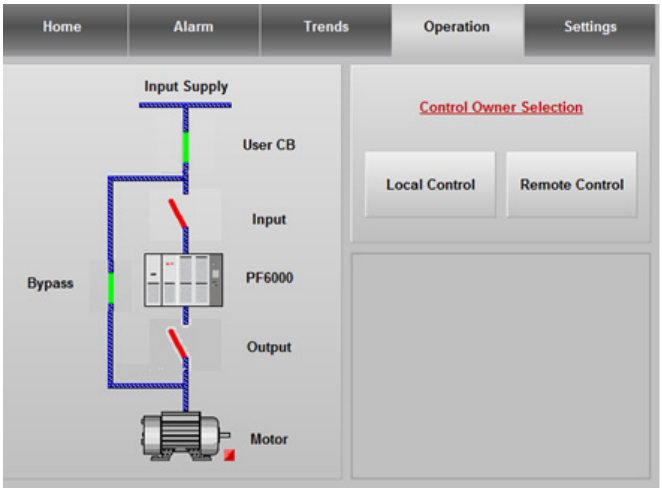
2. Open the Bypass cabinet door, and close QS1.

   Verify the bypass isolation switch is closed on the HMI.



3. Close the customer-supplied input circuit breaker by installing a temporary jumper wire (X-117, X-119).

   Verify the input circuit breaker is closed.

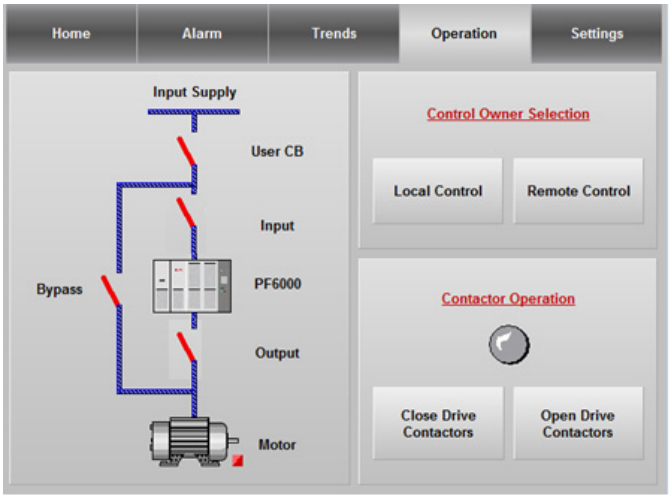


Verify Operation of Input/Output and Bypass Contactors (Automatic Bypass)

Input/Output Drive Contactors

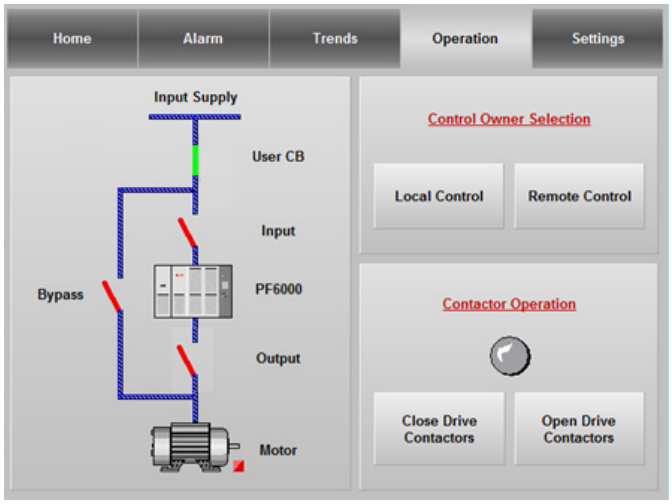
IMPORTANT Turn the 3-position on the selector switch on the front of the LV Cabinet to the Drive position.

1. Press Operation from the Main Interface screen.

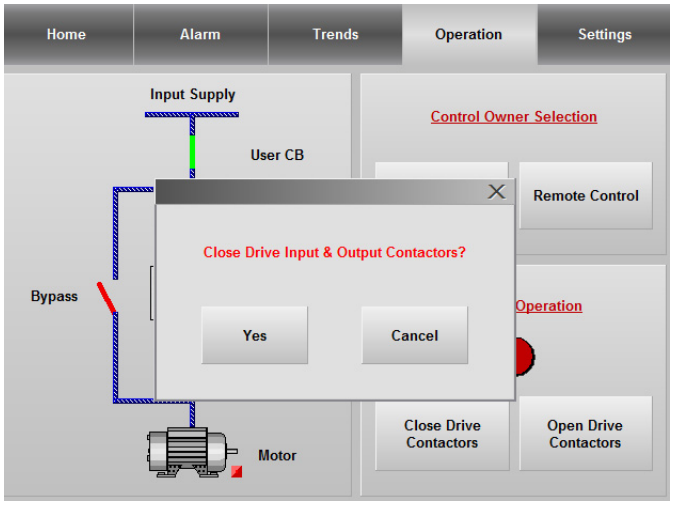


2. Close the customer-supplied input circuit breaker by installing a temporary jumper wire (X-117, X-119).

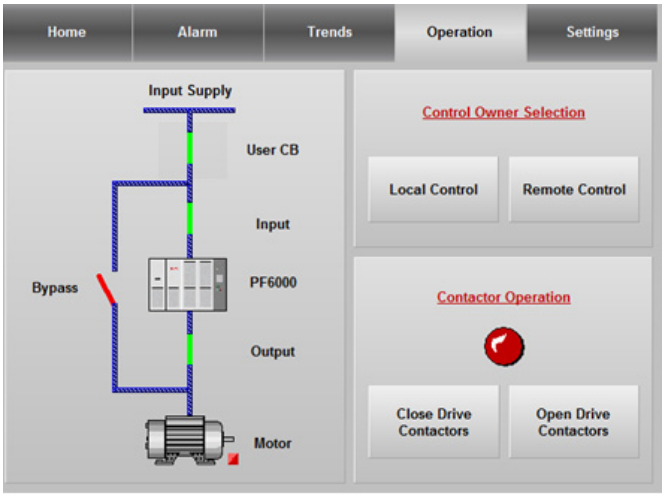
   Verify the input circuit breaker is closed.



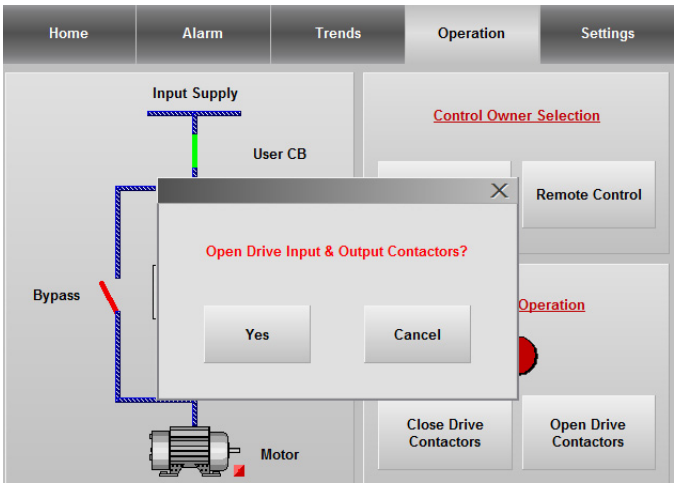
3. Press Close Drive Contactors under **Contactor Operation**, and press Yes to confirm.



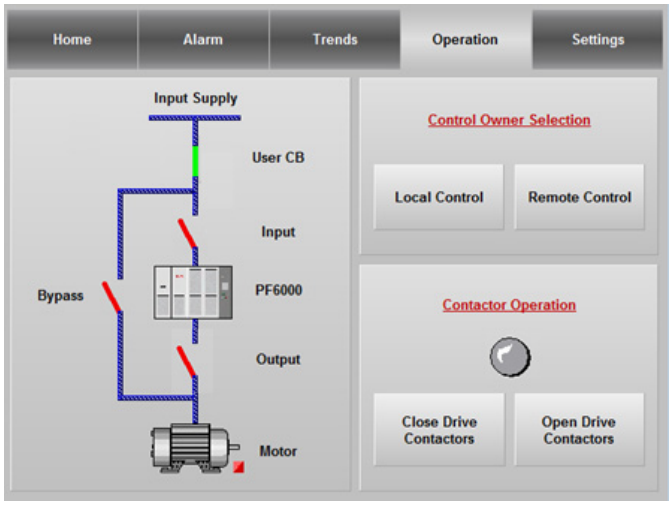
Verify the input and output drive contactors are closed.



4. Press Open Drive Contactors under **Contactor Operation**, and press Yes to confirm.



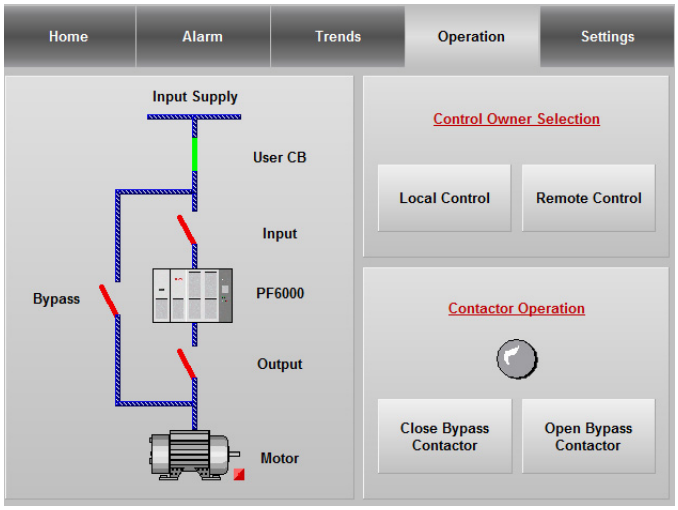
5. Verify the input and output drive contactors are open.



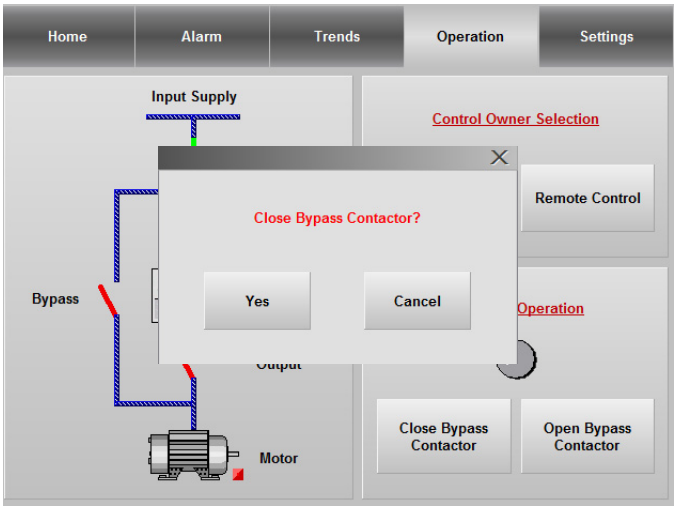
Bypass Contactors

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

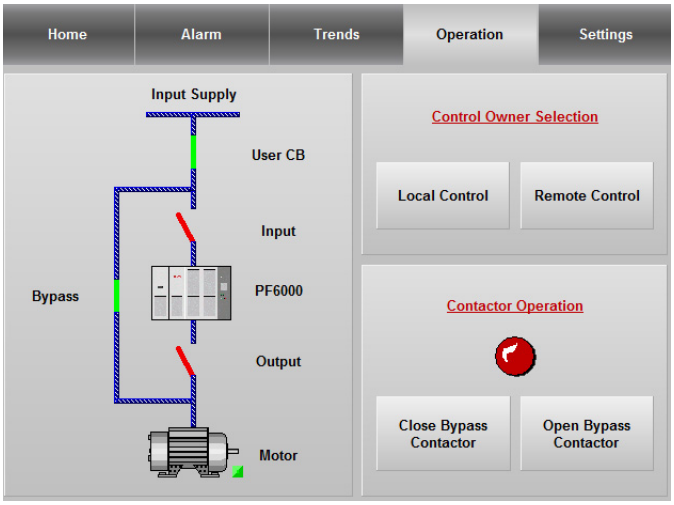
1. Press Operation from the Main Interface screen.



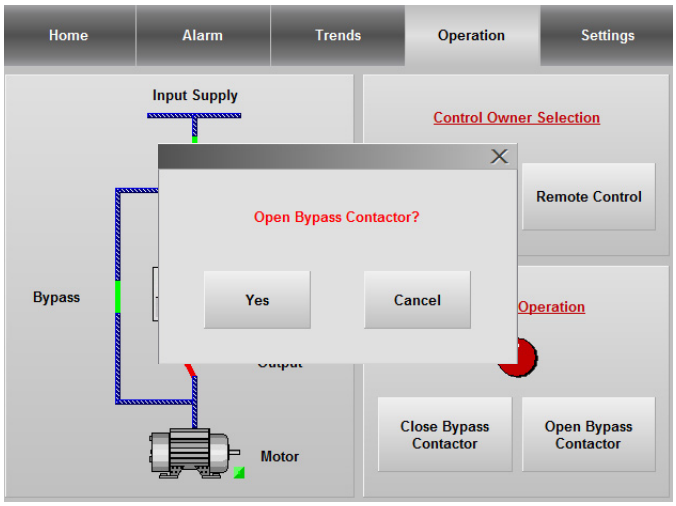
2. Press Close Bypass Contactor under **Contactor Operation**, and press Yes to confirm.



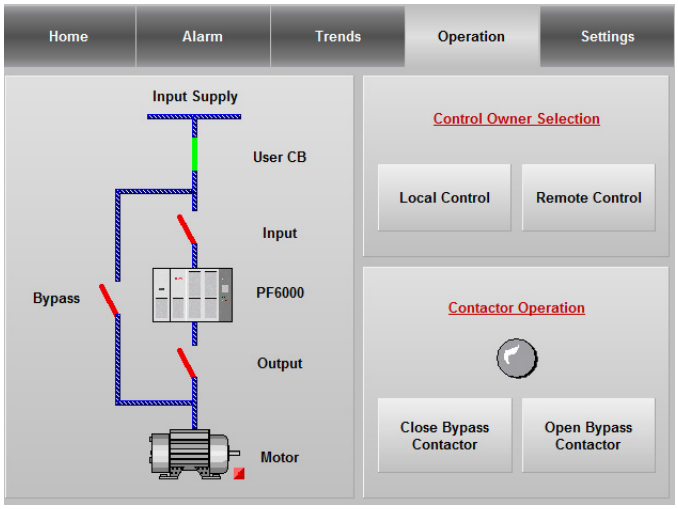
Verify the bypass contactor is closed.



3. Press Open Bypass Contactor under **Contactor Operation**, and press Yes to confirm.



Verify the bypass contactor is open.



Verify Operation of DCS Input and Output Signals

Figure 28 - Status Indicators

Table 15 - Drive to DCS

Signal Name	Terminal Number	HMI Status	Terminal Open	Terminal Closed
MVPRE-Closed CB	901-902	Allowed	Red	Grey
MV CLOSING	903-904	MVClosd	Red	Grey
Warning	905-906	Warning	Red	Grey
Fault	907-908	Warning	Red	Grey
Drive running	909-910	Running/Connect	Red	Grey
Drive STOP	911-912	Running/Connect	Red	Grey
READY	913-914	Ready	Red	Grey
DCS control	915-916	Remote	Red	Grey
		Local	Grey	Red

Table 16 - 4-20 mA

Output Current	925-926	Motor Current	0-Rated Current
Output Frequency	927-928	Actual Frequency	0-Rated Frequency

When the two terminals specified are shorted, verify the result shown in the third column occurs.

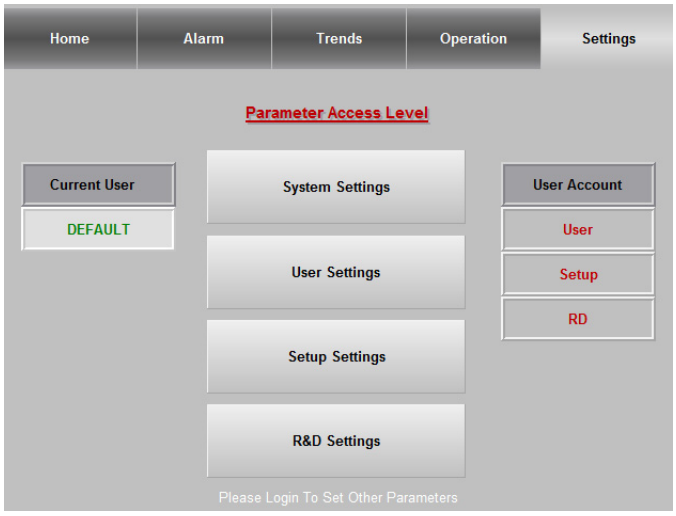
Table 17 - DCS to Drive

Signal Name	Terminal Number	Function
Fault Reset	412-401	Reset System
DCS Start	449-401	Start Drive
DCS Stop	450-401	Stop Drive
E-stop	1101-1101	E-stop Drive
Frequency Set	931-402	Set Drive Frequency

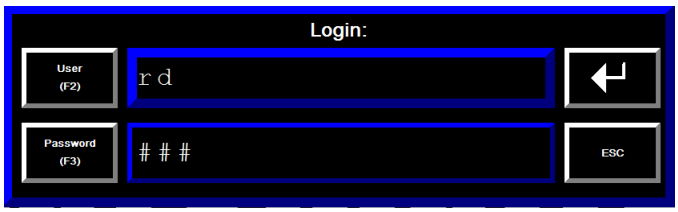
Restore P Parameter Settings

1. Press Settings, and press Setup Settings under **Parameter Access Level**.

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



2. Enter the User and Password details.



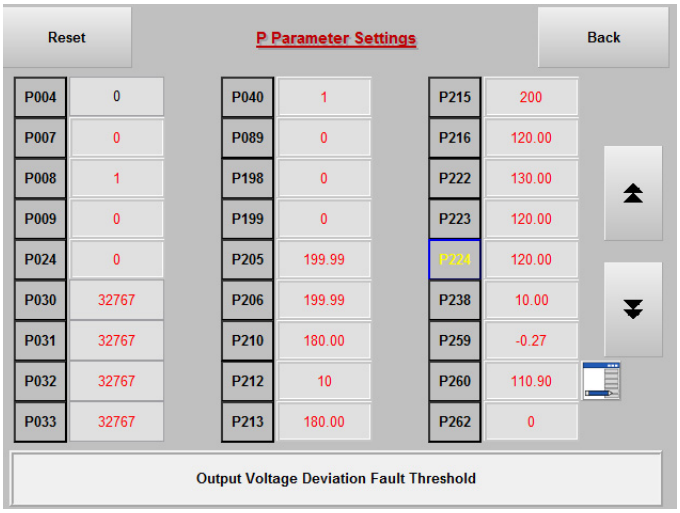
   Press User (F2) to enter user details. Press ↵ when finished.

   Press User (F2) to enter password details. Press ↵ when finished.

3. Press ↵ to login.
4. Press Setup Settings, and press P Parameter Settings.

WARNING: Do NOT press Reset. This will reset all factory-set parameters.

5. Press the P007 parameter field to enter the number of power cells per phase, and press OK.
6. Press the P224 parameter field.
7. Change the value from 120 to 80. Press ↵, and press Back.



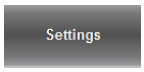
8. Press EXIT to exit **P Parameter Settings**, OK to confirm Setup has logged out, and Home to return to the Main Interface Screen.

WARNING: Remove the temporary jumper (X1-117, X1-119) in the LV Control Cabinet, which was installed to enable the Control System Test.

Set Date and Time Zone

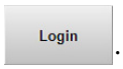
To access the Date and Time Zone settings, you must exit the PowerFlex 6000 HMI to Windows CE.

Access T Parameters

1. Press 

from the Main Interface Screen.
2. Press 

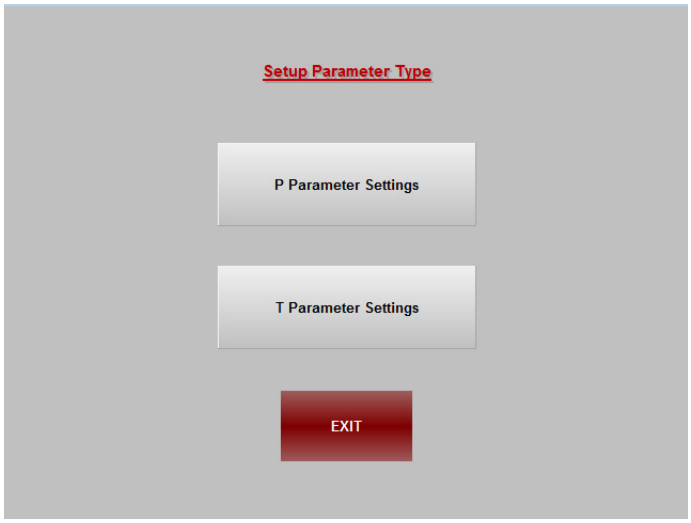
under **Parameter Access Level.**

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

.
3. Enter the User and Password details.
4. Press 
to login.
5. Once logged in, press 

.
6. Press 

in the **Setup Parameter Type**.



7. Press the T10 parameter input field. Enter “555” and press 
.
8. Press 

and 

to confirm.

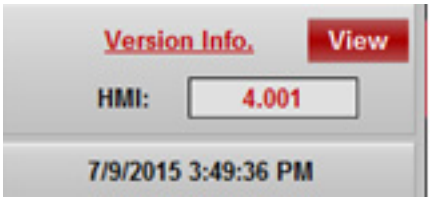
TIP It will take 3...5 minutes to shutdown.

Change Time/Date/Regional Settings

IMPORTANT Enter the Time Zone settings before changing the date and time.

1. In Windows ME, press **Terminal Settings [F4]**.
2. Press the **Down Arrow** to choose *Time/Date/Regional Settings*, and press **Enter**.
3. Choose *Time zone* and press **Enter**.
4. Scroll up or down and select the desired time zone.
   a. Press **Daylight Savings [F1]**
   b. Select the **Yes** radio button, and press **Close [F8].**
5. Press **OK [F7]**.
6. Choose *Date* and press **Enter**.
   a. Press **Year [F1]**, **Month [F2]**, and **Day [F3]** to set the correct date.
   b. Press **OK [F7]**.
7. Choose *Time* and press **Enter**.
   a. Press **Hour [F1]**, **Minute [F2]**, and **Seconds [F3]** to set the correct time.
   b. Press **OK [F7]**.
8. Press **Close [F8]** twice, **Reset [F7]**, and **Yes [F7]** to restart the HMI.
9. Select language and bypass mode in the **System Parameters Settings** interface.
10. Press ENTER to accept and proceed to the Main Interface Screen.

    Verify the date and time is updated under Version Info.



Notes:

No-load Test

Introduction

ATTENTION: Medium Voltage is required for parts of this test. Close and lock all medium voltage doors on the PowerFlex 6000 and Bypass Cabinet (if supplied) prior to removing Lockout and Tagout provisions and closing the input circuit breaker. All safety related work practices outlined in Electrical Safety requirements for Employee Work places must be followed when removing the input circuit breaker from the locked out, tagged out state.

No-load Test

The No-load Test consists of the following procedures and must be performed in the sequence shown.

Sequence		Procedure	Page
LV Only	1	Energize Drive Control Circuit	90
	2	Configure P and T Parameters	90
	3	Close Isolation Switches in Bypass Cabinet(1)	102
MV	4	Close Input Circuit Breaker	103
	5	Check Cooling Fan Operation	103
	6	Operate Motor by HMI	104

(1) This procedure is performed only if an optional bypass configuration is supplied.

WARNING: These procedures must be performed in the order they are listed here. Failure to do so may result in personal injury or death, property damage, or economic loss.

ATTENTION: Isolation switches in bypass cabinets can only be opened or closed when the Input Circuit Breaker is in the open position. Isolation Switches must not be operated when the Input Circuit Breaker is closed.

Energize Drive Control Circuit

The “Energize Control Circuit” process is already described on page 48. For the “Energize Drive Control Circuit” procedure, repeat the process in the same sequence, without the requirements of taking voltage measurements.

1. Close circuit breaker Q1 (CB1).
2. Start UPS. Press and hold the ON button for approximately 3 seconds.
3. Close circuit breakers Q2 (CB2), Q3 (CB3), Q5 (CB5), and Q6 (CB6) in the LV Control Panel.
4. Close circuit breakers Q4 (CB4) and Q7 (CB7) in the Isolation Transformer Cabinet LV Panel.

Configure P and T Parameters

TIP See Set P Parameters to Enable Testing on page 55 for information on how to access and change parameters.

Set the P parameters as shown in Table 18, and T parameters as shown in Table 19.

This table outlines the specific parameters that must be checked and/or modified. Parameters that must be modified are outlined in the Instruction column. All other parameters listed must be verified. For special functions or actions which are not listed here, but are commonly performed while commissioning a drive, see Special Function Parameter Settings on page 117.

Table 18 - Setup and R&D P Parameters

Parameter Number	Description	Min.	Max.	Default	Modify Root
P004	Command Source 0 = Communication Port 1 = Digital Input 2 = EtherNet/IP	0	2	0	OFF
P005	Restore Factory Settings 30 = Restore Setup Level 40 = Restore User Level 50 = Restore R&D Level	0	50	0	OFF
P007	Number of Power Cells Per Phase	0	9	9	ON
P008	Motor Rotation Direction Under Local Control 0 = Reverse 1 = Forward	0	1	1	OFF
P009	Motor Rotation Direction Command Selection: 0 = Local Control 1 = DCS	0	1	0	OFF
P010	Power Cell Fault Mask	0	32767	32767	ON
P017	Number Of Motor Pole Pairs	0	100	2	OFF
P019	Encoder Resolution	0	4096	1024	OFF

Table 18 - Setup and R&D P Parameters (Continued)

Parameter Number	Description	Min.	Max.	Default	Modify Root
P020	Mask Bit For System Fault	0	32767	32767	ON
P021	Mask Bit For System Warning	0	32767	32767	ON
P022	Mask Bit For Logic Fault A	0	32767	32767	ON
P023	Mask Bit For Logic Fault B	0	32767	32767	ON
P024	Stop Method 0 = Ramp Dow 1 = Coast Stop	0	1	0	ON
P025	Flux Reduction Enable 0 = Disable 1 = Enable	0	1	0	ON
P026	Power Angle Threshold For Flux Reduction	0	180	0	ON
P027	Time For Flux Reducing	0	32767	5000	ON
P028	Flux Reduction Ratio	0	100	70	ON
P029	Power Angle Threshold For Flux Restore	0	180	0	ON
P030	Powercell Fault Trip Signal Mask Register	0	32767	32767	OFF
P031	System Fault Trip Signal Mask Register	0	32767	32767	OFF
P032	Logic Fault A Trip Signal Mask Register	0	32767	32767	OFF
P033	Logic Fault B Trip Signal Mask Register	0	32767	32767	OFF
P034	Current Stability Loop Filter Time	0	32767	63	ON
P035	Current Stability Loop Output Scaling Factor	0	100	20	ON
P036	Current Stability Loop Output Upper Limit	0	100	10	ON
P037	Current Stability Loop Output Lower Limit	-100	100	-10	ON
P038	Current Stability Loop Enable 0 = Disable 1 = Enable	0	1	1	ON
P039	Current Stability Loop Enable Frequency Range Upper Limit	0	100	40	ON
P040	Safe Start Condition 0 = Zero Frequency Command Required 1 = Frequency Command Allowed	0	1	1	OFF
P087	Switch Frequency Setting Enable Code 0 = Disable 1 = Enable	0	1	0	OFF
P088	Switch Frequency Setting 0 = 600 Hz 1 = 1200 Hz	0	1	0	OFF
P089	Skip Frequency Enable 0 = Disable 1 = Enable	0	1	0	ON
P090	Skip Frequency 1 Lower Limit	0	75	0	ON
P091	Skip Frequency 1 Upper Limit	0	75	0	ON
P092	Skip Frequency 2 Lower Limit	0	75	0	ON
P093	Skip Frequency 2 Upper Limit	0	75	0	ON
P113	Flying Start-Initial Output Voltage	0	100	5	ON

Table 18 - Setup and R&D P Parameters (Continued)

Parameter Number	Description	Min.	Max.	Default	Modify Root
P114	Flying Start-Current Comparison Delay For Motor Speed Search	0	5000	1000	ON
P115	Flying Start-Current Threshold For Successful Motor Speed Search	0	100	5	ON
P198	HECS Rated Current	0	5000	0	ON
P199	Motor Rated Current	0	5000	0	ON
P200	Ia Motor Current Memory Address	0	500	13	ON
P201	Motor Ia Scaling Correction Factor	0.00	199.99	100.00	ON
P202	Ib Motor Current Memory Address	0	500	14	ON
P203	Motor Ib Scaling Correction Factor	0.00	199.99	100.00	ON
P204	Motor Uab Voltage Address	0	500	11	ON
P205	Motor Uab Voltage Scaling Factor Correction	0.00	199.99	199.99	ON
P206	Motor Uac Voltage Scaling Factor Correction	0.00	199.99	199.99	ON
P208	Phase Over Current Enable Frequency Range Upper Limit	0	100	10	ON
P209	Phase Over Current Filter Time	0	32767	5	ON
P210	Phase Over Current Threshold	0	199.99	180	ON
P211	Filter Time For Abnormal Output Voltage	0	32767	1000	ON
P212	Filter Time For Output Short-Circuit	0	32767	10	ON
P213	Output Short-Circuit Fault Threshold	0	199.99	180	ON
P214	Over Current Low/High Speed Region Boundary	0	100	5	ON
P215	Filter Time For Output Over Current	0.0	3276.7	20.0	ON
P216	High-Frequency Output Over Current Threshold	0.00	199.99	120.00	ON
P217	Low-Frequency Output Over Current Threshold	0.00	199.99	70.00	ON
P218	Filter Time For Motor Over Temperature	0.0	3276.7	600.0	ON
P219	Motor Over Temperature Warning Threshold	0.00	199.99	110.00	ON
P220	Motor Over Temperature Fault Threshold	0.00	199.99	120.00	ON
P221	Filter Time For Output Over Voltage	0	32767	100	ON
P222	Output Over Voltage Fault Threshold	0.00	199.99	130.00	ON
P223	Output Voltage Deviation Warning Threshold	0.00	199.99	60.00	ON
P224	Output Voltage Deviation Fault Threshold	0.00	199.99	80.00	ON
P225	Motor Over Temperature Warning Cancellation Temperature	0.00	199.99	100.00	ON
P226	Output Voltage Abnormality Warning Cancellation Threshold	0.00	199.99	50.00	ON
P227	Ground Fault Detection Scaling Correction Factor	0.00	199.99	100.00	ON
P228	Filter Time For Ground Fault	0	32767	1000	ON
P229	Ground Fault Warning Threshold	0.00	199.99	20.00	ON
P230	Ground Fault Trip Threshold	0.00	199.99	60.00	ON
P231	Filter Time For Overspeed Fault (Upper Limit)	0	32767	100	ON
P232	Filter Time For Overspeed Fault (Lower Limit)	0	32767	100	ON

Table 18 - Setup and R&D P Parameters (Continued)

Parameter Number	Description	Min.	Max.	Default	Modify Root
P233	Threshold Of Over-Speed Fault At Lower Frequency Limit	0.00	199.99	20.00	ON
P234	Threshold Of Over-Speed Fault At Upper Frequency Limit	0.00	199.99	20.00	ON
P235	Frequency Deviation Warning Cancellation Threshold	0.00	199.99	0.99	ON
P236	Frequency Deviation Warning Threshold	0.00	199.99	6.00	ON
P237	Frequency Deviation Warning Delay	0	32767	8	ON
P238	Motor Stall Fault Threshold	0.00	199.99	10.00	ON
P239	Motor Stall Fault Delay	0	32767	6000	ON
P240	Transformer Over Temperature Fault Delay	0	32767	5000	ON
P241	Transformer Over Temperature Warning Delay	0	32767	5000	ON
P247	Software Interlock 0 = Enable 1 = Disable	0	1	1	ON
P250	Input Contactor/Circuit Breaker Close Delay	0	10000	5000	ON
P251	Frequency Command-Low Frequency Region Boundary	0.0	100.0	0.5	ON
P252	Motor In Stopping Condition Threshold	0	100	1	ON
P253	Motor Coast Stop Time	0	10000	10	ON
P256	Ground Fault Warning Cancellation Threshold	0.00	199.99	10.00	ON
P257	Motor Stall Warning Cancellation Threshold	0.00	199.99	2.98	ON
P259	Frequency Command Analog Offset	-100.00	199.99	0.00	ON
P260	Frequency Command Analog Scaling Factor	0.00	199.99	100.00	ON
P261	Frequency Command Analog Minimum	0.00	199.99	0.49	ON
P262	Frequency Command Source Selection 0 = Digital 1 = Analog	0	1	0	OFF
P263	Power Loss Restart Enable 0 = Disable 1 = Enable	0	1	0	OFF
P264	Power Loss Allowable Time	0.00	3599.96	59.63	OFF
P265	Power Loss Time Max Limit	0.00	3599.96	299.82	OFF
P268	Flux Control Signal Filter Time	0.00	13499.96	999.97	ON
P269	System Derating Control Signal Filter Time	0.00	13499.96	999.97	ON
P270	Delayed Lockout Time Of Stop Operation	0	5000	2000	ON
P271	Flux Delay	0	5000	50	ON
P272	Flux Control Regulation Time	0.96	999.97	0.96	ON
P273	Flux Control Regulation Control Enable 0 = Disable 1 = Enable	0	1	1	ON
P275	Flux Control Regulation Acceleration Threshold	100.00	199.99	100.00	ON
P276	Derating Control No-Load Modulation Index	50	100	80	ON
P277	Derating Control Full-Load Modulation Index	50.00	199.99	81.99	ON

Table 18 - Setup and R&D P Parameters (Continued)

Parameter Number	Description	Min.	Max.	Default	Modify Root
P278	Derating Control Enable Threshold	50.00	199.99	100.00	ON
P279	Derating Control Output Filter Time	9.95	1999.94	9.95	ON
P280	Low Voltage Ride Through Recovery Voltage Boost Coefficient	0	100	10	ON
P281	Low Voltage Ride Through Min Time Interval	0.00	1000.00	9.97	ON
P282	Low Voltage Ride Through Min Frequency Limit	5	100	20	OFF
P283	Low Voltage Ride Through Enable 0 = Disable 1 = Enable	0	1	0	ON
P284	Low Voltage Ride Through Min Time Limit	20.02	13663.01	39.62	OFF
P285	Low Voltage Ride Through Max Time Limit	20.02	13663.01	99.66	OFF
P286	Low Voltage Ride Through Recovery Frequency Compensation Factor	-200.00	199.99	0.00	OFF
P287	Low Voltage Ride Through Recovery Time	145.95	13663.01	1499.95	OFF
P288	Low Voltage Ride Through System Delay Correction Factor	0.00	10000.00	2199.97	ON
P289	Low Voltage Ride Through Motor Speed Estimation Filter Time	0.98	1000.00	9.95	OFF
P290	Voltage Loop Enable 0 = Disable 1 = Enable	0	1	0	OFF
P291	Voltage Loop Enable Min Frequency	0	100	20	OFF
P292	Voltage Loop Proportional Coefficient	99.98	1999.94	899.96	ON
P293	Voltage Loop Integral Coefficient	0.00	99.98	19.96	ON
P294	Voltage Loop Positive Incremental Error Limit	20.02	1000.00	49.99	ON
P295	Voltage Loop Negative Incremental Error Limit	20.02	1000.00	99.98	ON
P296	Reserved	49.99	1000.00	0.00	ON
P297	Voltage Loop Voltage Reference	125.00	1200.12	1000.00	ON
P298	Voltage Loop Current Filter Time	0.00	1999.94	9.95	ON
P299	Voltage Loop Voltage Filter Time	0.00	1999.94	2.99	ON
P300	Digital Output #0 Memory Address	0	500	99	ON
P301	Digital Output #0 Logic 0 = Non-Inverting 1 = Inverting	0	1	0	ON
P302	Digital Output #0 Bit Selection	0	15	0	ON
P303	Digital Output #0 Delay	0	32767	0	ON
P304	Digital Output #1 Memory Address	0	500	99	ON
P305	Digital Output #1 Logic 0 = Non-Inverting 1 = Inverting	0	1	0	ON
P306	Digital Output #1 Bit Selection	0	15	1	ON
P307	Digital Output #1 Delay	0	32767	0	ON

Table 18 - Setup and R&D P Parameters (Continued)

Parameter Number	Description	Min.	Max.	Default	Modify Root
P308	Digital Output #2 Memory Address	0	500	99	ON
P309	Digital Output #2 Logic 0 = Non-Inverting 1 = Inverting	0	1	0	ON
P310	Digital Output #2 Bit Selection	0	15	2	ON
P311	Digital Output #2 Delay	0	32767	0	ON
P312	Digital Output #3 Memory Address	0	500	99	ON
P313	Digital Output #3 Logic 0 = Non-Inverting 1 = Inverting\	0	1	0	ON
P314	Digital Output #3 Bit Selection	0	15	3	ON
P315	Digital Output #3 Delay	0	32767	0	ON
P316	Digital Output #4 Memory Address	0	500	99	ON
P317	Digital Output #4 Logic 0 = Non-Inverting 1 = Inverting	0	1	0	ON
P318	Digital Output #4 Bit Selection	0	15	4	ON
P319	Digital Output #4 Delay	0	32767	0	ON
P320	Digital Output #5 Memory Address	0	500	99	ON
P321	Digital Output #5 Logic 0 = Non-Inverting 1 = Inverting	0	1	0	ON
P322	Digital Output #5 Bit Selection	0	15	5	ON
P323	Digital Output #5 Delay	0	32767	0	ON
P324	Digital Output #6 Memory Address	0	500	99	ON
P325	Digital Output #6 Logic 0 = Non-Inverting 1 = Inverting	0	1	0	ON
P326	Digital Output #6 Bit Selection	0	15	6	ON
P327	Digital Output #6 Delay	0	32767	0	ON
P328	Digital Output #7 Memory Address	0	500	99	ON
P329	Digital Output #7 Logic 0 = Non-Inverting 1 = Inverting	0	1	0	ON
P330	Digital Output #7 Bit Selection	0	15	7	ON
P331	Digital Output #7 Delay	0	32767	0	ON
P332	Analog Output #1 Memory Address	0	500	252	ON
P333	Analog Output #1 Filter Time	0	32767	1000	ON
P334	Analog Output #1 Offset	-100	100	0	ON
P335	Analog Output #1 Scaling Factor	0.00	199.99	100.00	ON
P336	Analog Output #2 Memory Address	0	500	206	ON
P337	Analog Output #2 Filter Time	0	32767	1000	ON
P338	Analog Output #2 Offset	-100	100	0	ON

Table 18 - Setup and R&D P Parameters (Continued)

Parameter Number	Description	Min.	Max.	Default	Modify Root
P339	Analog Output #2 Scaling Factor	0.00	199.99	100.00	ON
P340	Analog Output #3 Memory Address	0	500	0	ON
P341	Analog Output #3 Filter Time	0	32767	1000	ON
P342	Analog Output #3 Offset	-100	100	0	ON
P343	Analog Output #3 Scaling Factor	0.00	199.99	100.00	ON
P344	Analog Output #4 Memory Address	0	500	0	ON
P345	Analog Output #4 Filter Time	0	32767	1000	ON
P346	Analog Output #4 Offset	-100	100	0	ON
P347	Analog Output #4 Scaling Factor	0.00	199.99	100.00	ON
P351	Rated Frequency HMI Display Filter Time	0	32767	100	ON
P352	Rated Frequency HMI Display Integer Part	0	75	50	ON
P353	Rated Frequency HMI Display Decimal Part	0	1000	0	ON
P354	Motor Voltage HMI Display Filter Time	0	32767	2000	ON
P355	Motor Voltage HMI Display Integer Part	0	16384	10000	ON
P356	Motor Voltage HMI Display Decimal Part	0	1000	0	ON
P357	Actual Frequency HMI Display Filter Time	0	32767	100	ON
P358	Actual Frequency HMI Display Integer Part	0	75	50	ON
P359	Actual Frequency HMI Display Decimal Part	0	1000	0	ON
P360	Motor Current HMI Display Filter Time	0	32767	2000	ON
P361	Motor Current HMI Display Integer Part	0	5000	0	ON
P362	Motor Current HMI Display Decimal Part	0	1000	0	ON
P371	Rated Frequency HMI Display Address	0	500	221	ON
P372	Motor Voltage HMI Display Address	0	500	119	ON
P373	Actual Frequency HMI Display Address	0	500	252	ON
P374	Motor Current HMI Display Address	0	500	118	ON
P375	Frequency At First Point for 5 Point VF	0	10	1	OFF
P376	Amplitude At First Point for 5 Point VF	0	3	1	OFF
P377	Frequency At Second Point for 5 Point VF	0	100	20	OFF
P378	Amplitude At Second Point for 5 Point VF	0	100	10	OFF
P379	Frequency At Third Point for 5 Point VF	0	100	40	OFF
P380	Amplitude At Third Point for 5 Point VF	0	100	27	OFF
P381	Frequency At Fourth Point for 5 Point VF	0	100	60	OFF
P382	Amplitude At Fourth Point for 5 Point VF	0	100	45	OFF
P383	Frequency At Fifth Point for 5 Point VF	0	100	80	OFF
P384	Amplitude At Fifth Point for 5 Point VF	0	100	70	OFF
P385	Deceleration Process Enable 0 = Disable 1 = Enable	0	1	0	OFF
P386	Deceleration Time 1	0	3276	150	ON

Table 18 - Setup and R&D P Parameters (Continued)

Parameter Number	Description	Min.	Max.	Default	Modify Root
P387	Deceleration Frequency 1	0	75	30	ON
P388	Deceleration Time 2	0	3276	80	ON
P389	Deceleration Frequency 2	0	75	20	ON
P390	Deceleration Time 3	0	3276	80	ON
P391	Deceleration Frequency 3	0	75	10	ON
P392	Deceleration Time 4	0	3276	100	ON
P399	Deceleration Time	0	3276	400	ON
P401	Acceleration Time	0	3276	200	ON
P402	Acceleration Ramp Transition Time	0	3276	3	ON
P403	Acceleration Time Unit 1000 = 0.01 s 10000 = 0.1s	0	0.1	0.1	ON
P405	Deceleration Ramp Transition Time	0	3276	3	ON
P406	Deceleration Time Unit 1000 = 0.01 s 10000 = 0.1s	0	0.1	0.1	ON
P409	Amplification Coefficient Of Error Terms	0.00	199.99	100.00	ON
P411	Over Speed Upper Limit Reference	0	100	100	ON
P412	Over Speed Lower Limit Reference	0	100	0	ON
P413	Frequency Command Lower Limit	-16384	16384	0	ON
P414	Frequency Command Deadband Upper Limit	0.00	100.00	0.49	ON
P415	Frequency Command Upper Limit	-16384	16384	16384	ON
P416	Flying Start Mode 0 = Disable 1 = Set Frequency 2 = Stop Frequency Plus 5 Hz 3 = Rated Frequency	0	3	0	ON
P417	Flying Start Motor Speed Search Timeout	0	1000	50	ON
P438	Current Limitation Enable Frequency Range Lower Limit	0	100	10	ON
P439	Current Limitation Upper Offset	0	10	3	ON
P440	Current Limitation Lower Offset	0	10	3	ON
P441	Current Limitation Threshold	0	130	100	ON
P451	Low Speed Voltage Compensation	0.00	3.00	0.99	OFF
P452	Low Speed Voltage Compensation Frequency Threshold	0	100	20	ON
P453	V/F Curve 0 = Linear 1 = Parabolic Curve 2 = Predefined Curve #1 3 = Predefined Curve #2 4 = 5 Point VF	0	4 (R&D) 3 (Setup)	1	OFF
P454	Flux Time (s)	0.0	10.0	0.5	OFF
P455	Modulation Index	0.00	110.00	87.99	ON
P456	Motor Voltage Upper Limit	0.00	110.00	87.99	ON
P457	Flying Start Voltage Recovery Time (Low Speed Region)	0.00	163.84	5.00	ON

Table 18 - Setup and R&D P Parameters (Continued)

Parameter Number	Description	Min.	Max.	Default	Modify Root
P458	Coefficient A	0	100	40	OFF
P459	Flying Start Voltage Recovery Time (High Speed Region)	0	163.84	5	ON
P460	Rated Output Frequency	0	75	50	OFF
P461	Restart Enable 0 = Disable 1 = Enable	0	1	0	ON
P462	Fault Reset Timeout	0	120	120	ON
P463	Flying Start Low/High Speed Regions Boundary	0	100	16	ON
P465	Power Cell Fault Auto Reset Delay	0	10	4	ON
P466	Maximum Output Frequency	0	75	50	OFF
P467	Over Speed Enable 0 = Disable 1 = Enable	0	1	0	OFF
P470	Version Compatibility Enable 0 = Disable 1 = Enable	0	1	1	OFF
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 = Disable 1 = Enable	0	1	0	ON
P500	Display DSP Variables	0	1	0	ON

There are no specific T parameters to modify when commissioning a drive. Verify the values and only modify per customer specifications.

Table 19 - Setup and R&D T Parameters

Parameter Number	Description	Default Value	Modify Root	Data Type
T01	Fault-To-Bypass 0 = Disable 1 = Enable	0	Yes	Boolean
T02	Fault-To-Bypass Delay (0...5s)	3	Yes	16-bit Unsigned Integer
T03	Fault-To-Bypass Delay When Starting the Motor (0...60s)	60	Yes	16-bit Unsigned Integer
T04	Fault-To-Bypass Minimum Frequency 0...Rated Frequency (Hz)	5	Yes	32-bit Float
T07	Local Frequency Command Selection 0 = Digital 1 = Analog	0	Yes	Boolean
T08	Remote Frequency Command Selection 1 = Analog 2 = 4-Step Speed 4 = Communication Port	1	Yes	16-bit Unsigned Integer
T09	Frequency Step For Accel or Decel	1	Yes	16-bit Unsigned Integer

Table 19 - Setup and R&D T Parameters (Continued)

Parameter Number	Description	Default Value	Modify Root	Data Type
T10	Exit To Configuration Mode Password	555	No	16-bit Unsigned Integer
T11	Automatic Bypass-To-Drive or Drive-To-Bypass Selection	0		Operation Button
	Bypass-To-Drive		Yes	
	Drive-To-Bypass		Yes	
T12	PID Parameter Settings			
	P	0.01	Yes	32-bit Float
	I	0.01	Yes	32-bit Float
	D	0	Yes	32-bit Float
	D Gain	0	Yes	32-bit Float
T13	4-Step Variable Speed (available only when T8 = 2)			
	Speed 1	10	Yes	32-bit Float
	Speed 2	20	Yes	32-bit Float
	Speed 3	30	Yes	32-bit Float
	Speed 4	40	Yes	32-bit Float
T14	One-Drive-Two-Motor Mode, QS Enable 0 = No 1 = Yes	1	Yes	Boolean
T15	Bypass Mode Selection (0...4)	0		Operation Button
	No Bypass		Yes	
	Manual Bypass, One-Drive-One-Motor		Yes	
	Auto Bypass, One-Drive-One-Motor		Yes	
	Manual Bypass, One-Drive-Two-Motor		Yes	
	Auto Bypass, One-Drive-Two-Motor		Yes	
T16	When Disconnected between 0 = Stop 1 = Keep Current Frequency 2 = Keep T13, Speed 1 3 = Keep T13, Speed 2 4 = Keep T13, Speed 3 5 = Keep T13, Speed 4	1	Yes	16-bit Unsigned Integer

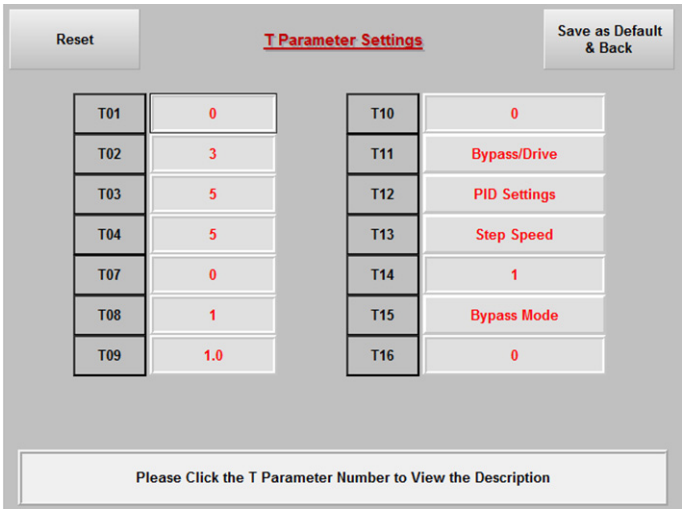
ATTENTION: If you enter a value that is greater than the allowed range for the parameter, the input field will turn red.

Change Parameters T11...T13

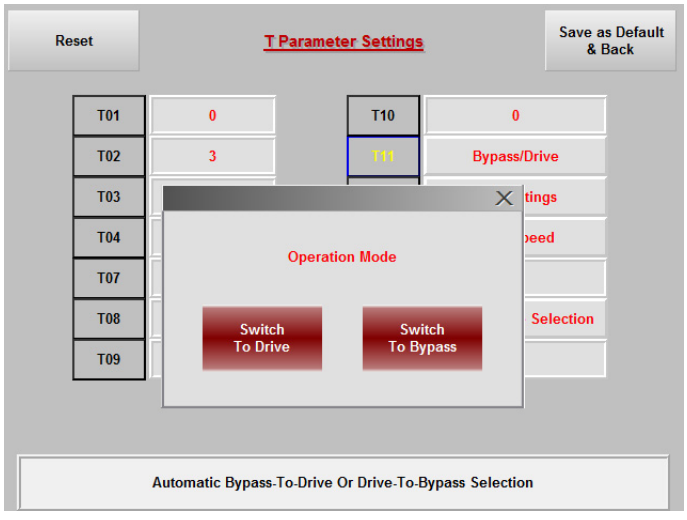
Parameter T11

To change Parameter T11:

1. Press the T11 Parameter input field.



2. In the **Operation Mode** dialog, press Switch To Drive or Switch To Bypass.



3. If you select Switch To Drive, the:
   - drive must be set to Local Control
   - position switch must be set to Drive
   - bypass contactor must be ON
   - drive must not be running.

4. If you select Switch To Bypass, the:
   - drive must be set to Local Control

- position switch must be set to Drive
- drive must be running.

5. Press Yes to confirm selection.

ATTENTION: If the conditions are incorrect, the following dialog appears.

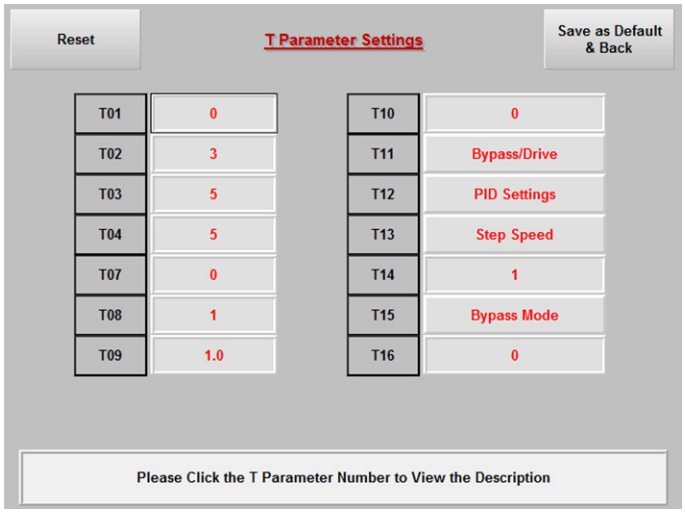
Parameter T12

Parameter T12 is a reserved parameter for R&D and hand-off operation.

Parameter T13

To change Parameter T13:

1. Press the T13 Parameter input field.



2. Enter desired speed values in the **Enter Four Steps** dialog box.

Press the input field to enter a value.

IMPORTANT Parameter T08 must be set to 2.

3. Press Save to accept.

IMPORTANT Refer to publication 6012-UM001_-EN-P, PowerFlex 6000 Drive Bypass Units User Manual or detailed information about operating the switches in bypass cabinets.

Close Isolation Switches in Bypass Cabinet

1. Manual bypass (see Figure 32)
   a. Open QS1 (direct line operation) isolation switch
   b. Close QS2 and QS3 (drive operation) isolation switches
2. Automatic Bypass (with isolating switches) (see Figure 31)
   a. Close QS1 and QS2 (drive operation) isolation switches

Close Input Circuit Breaker

ATTENTION: Medium Voltage is required for this test. Close and lock all medium voltage doors on the PowerFlex 6000 and Bypass Cabinet (if supplied) prior to closing the input circuit breaker. All safety related work practices outlined in Electrical Safety requirements for Employee Work places must be followed when removing the input circuit breaker from the locked out, tagged out state.

1. Remove tags and locks on the input circuit breaker.
2. Close input circuit breaker.
3. Verify that there are no faults or warnings on the HMI screen.

Check Cooling Fan Operation

1. Open the Low Voltage panel door on the Isolation Transformer Cabinet door.
2. Close all of the Drive Main Cooling Fan circuit breakers (Q10, ...) in the Isolation Transformer Cabinet LV Panel.
3. Verify that all cooling fans are operating.
4. Turn off the first Main Cooling Fan Circuit Breaker (Q10) and record the direction of the fan.

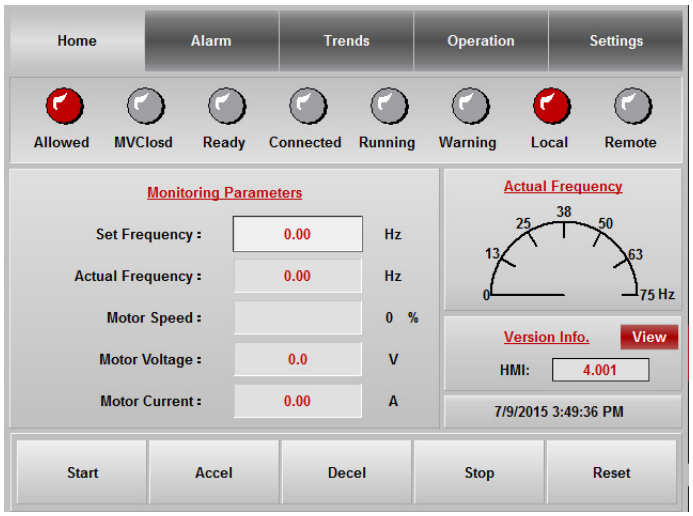
   Viewed from the rear, the blades will rotate left to right (counter-clockwise when viewed from the top). If the fan is rotating in the wrong direction, turn off the specific Main Cooling Fan breaker. Verify the output voltage is 0. Switch two wires on the output of the circuit breaker.
5. Turn the circuit breaker back on, and repeat for the remaining Main Cooling Fan circuit breakers.
6. Verify that there are no faults or warnings on the HMI screen.

IMPORTANT All fans must turn in the same direction.

Operate Motor by HMI

IMPORTANT Before completing this procedure, verify there are no warnings or failure messages on the HMI. The "Ready" status indicator must be red.

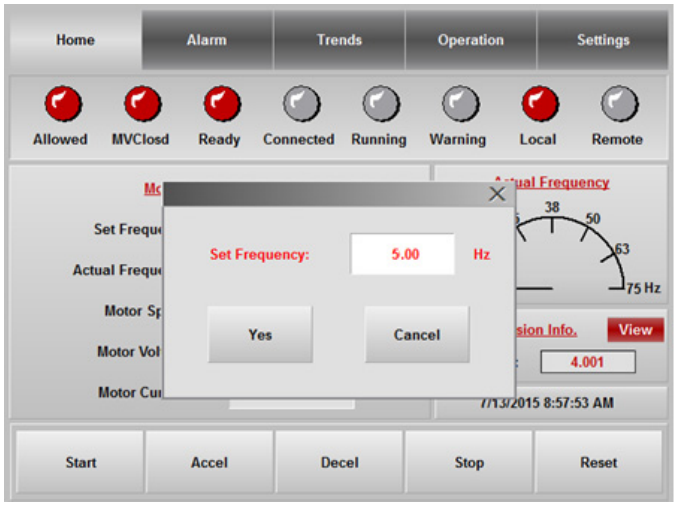
1. From the Main Interface Screen, press the **Set Frequency:** input field.



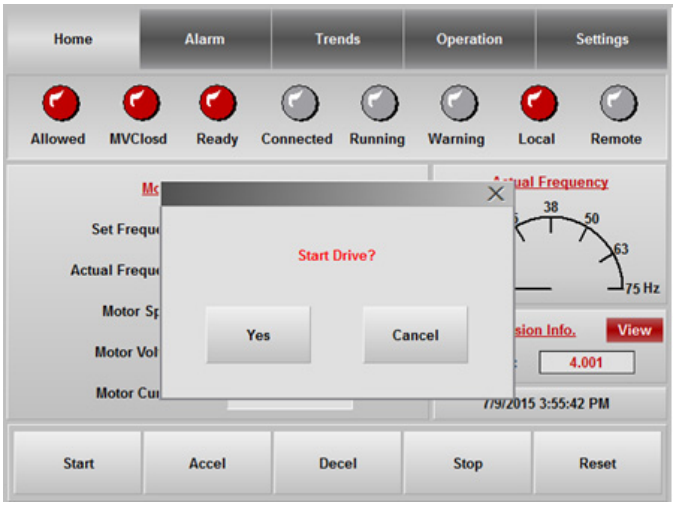
2. In the **Set Freq:** dialog box, enter a value of "5" and press ↵.

   Press Yes to confirm.

TIP The Set Frequency and Actual Frequency occasionally will not show the exact integral value selected, due to internal data conversion in the HMI program.



3. Press Start, and press Yes in the **Start Drive?** dialog box to confirm operation.



IMPORTANT When the drive is ≤0.5 Hz, the "Connect" light will be illuminated. When the speed of the drive surpasses 0.5 Hz, the "Connect" and "Running" lights will be red.

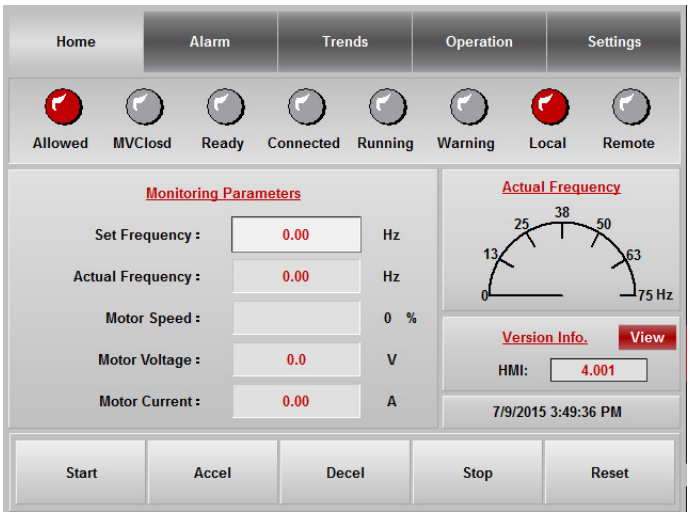
4. Observe the direction of motor rotation.

   If motor rotating direction is incorrect:

   a. Press Stop.
   b. Open the Input Circuit Breaker.
   c. Perform the Lockout and Tagout procedures.
   d. Verify that medium voltage is not present in the drive and in the motor's cable connection box by using a hot stick.
   e. Swap any two cables in the motor's cable connection box.
   f. Repeat Close Input Circuit Breaker on page 103.

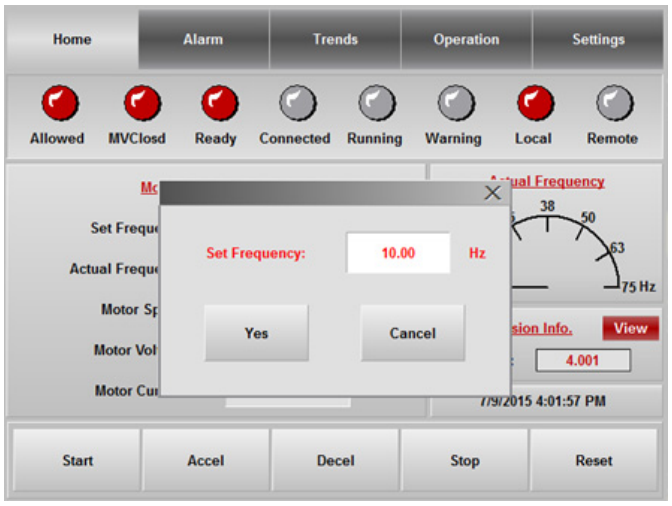
   If the motor rotating direction is correct, continue to step 5.

5. From the Main Interface Screen, press the **Set Frequency:** input field.

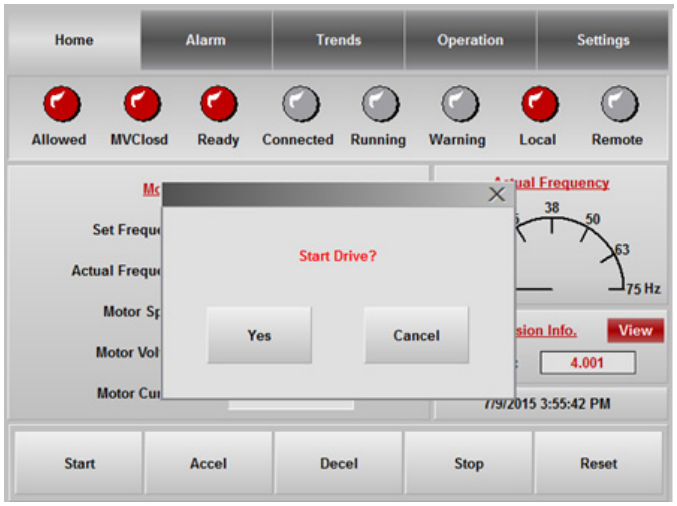


6. In the **Set Freq:** dialog box, enter a value of "10" and press ↵.

   Press Yes to confirm.



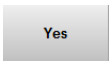
7. Press Start, and press Yes in the **Start Drive?** dialog box to confirm operation.



8. Record the output voltage in the HMI screen.

   The value must not by more than ±10% of output voltage based on the drive configuration.

Drive Voltage	10 Hz	20 Hz	30 Hz	40 Hz	50 Hz
3 kV	310	770	1370	2110	3000
3.3 kV	340	850	1500	2320	3300
4.16 kV	430	1060	1900	2930	4160
6 kV	620	1540	2740	4220	6000
6.6 kV	690	1690	3010	4650	6600
10 kV (Not applicable for UL)	1040	2560	4560	7040	10,000

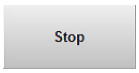
9. Press the **Set Frequency:** input field. In the **Set Freq:** dialog box, enter a value of "20" and press  . Press 

to confirm.
10. Record the output voltage in the HMI screen.

    Repeat this process for 30, 40, and 50 Hz (or 60 Hz).
11. Run the drive for 30 minutes at 50 Hz or 60 Hz (dependent on system frequency).
12. Switch off customer-supplied control power.

    The Control Power Supply Loss warning appears in the HMI.

    The K8 relay will automatically switch-off and the K9 relay will switch on to supply control power from the isolation transformer tertiary winding.
13. Switch on the customer-supplied control power, and push the Power Reset button in control cabinet panel.

    This clears the Control Power Supply Loss warning.
14. Press 

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ATTENTION: The following should be opened successively when the control power is switched off: Q5, Q4, Q3, Q2 and UPS; opening Q1 is not necessary when the control power is not disconnected.

Load Test of Drive System

This process is essentially a repeat of the No Load test procedure.

The Input Circuit Breaker should be off and locked out and tagged out to prevent any possibility of energization of the motor circuit while the application is reconfigured to apply load.

Repeat steps 1, 4, and 6 listed in the Table on page 89.

Notes:

Torque Requirements

Torque Requirements

Proper tightening torque must be used for installation and wiring.

Table 20 - 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:

Single Line Diagrams

Figure 29 - PowerFlex 6000 without Bypass

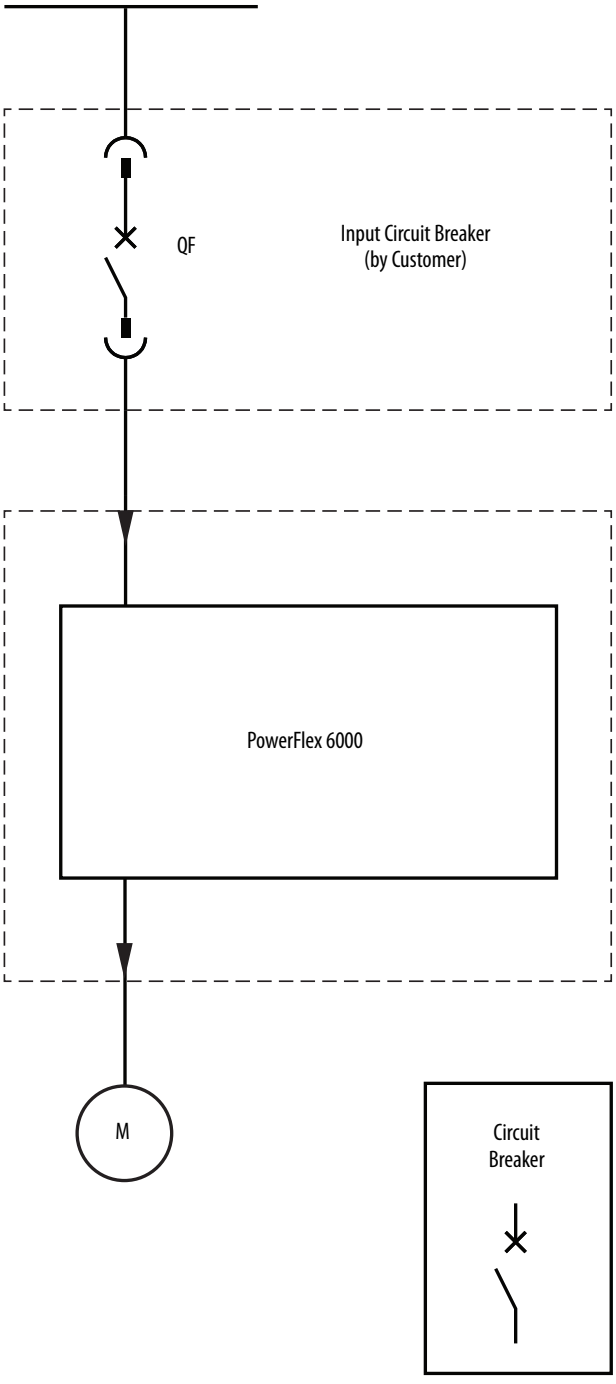


Figure 30 - 6012M Automatic Bypass Version 1 (without Isolation Switches)

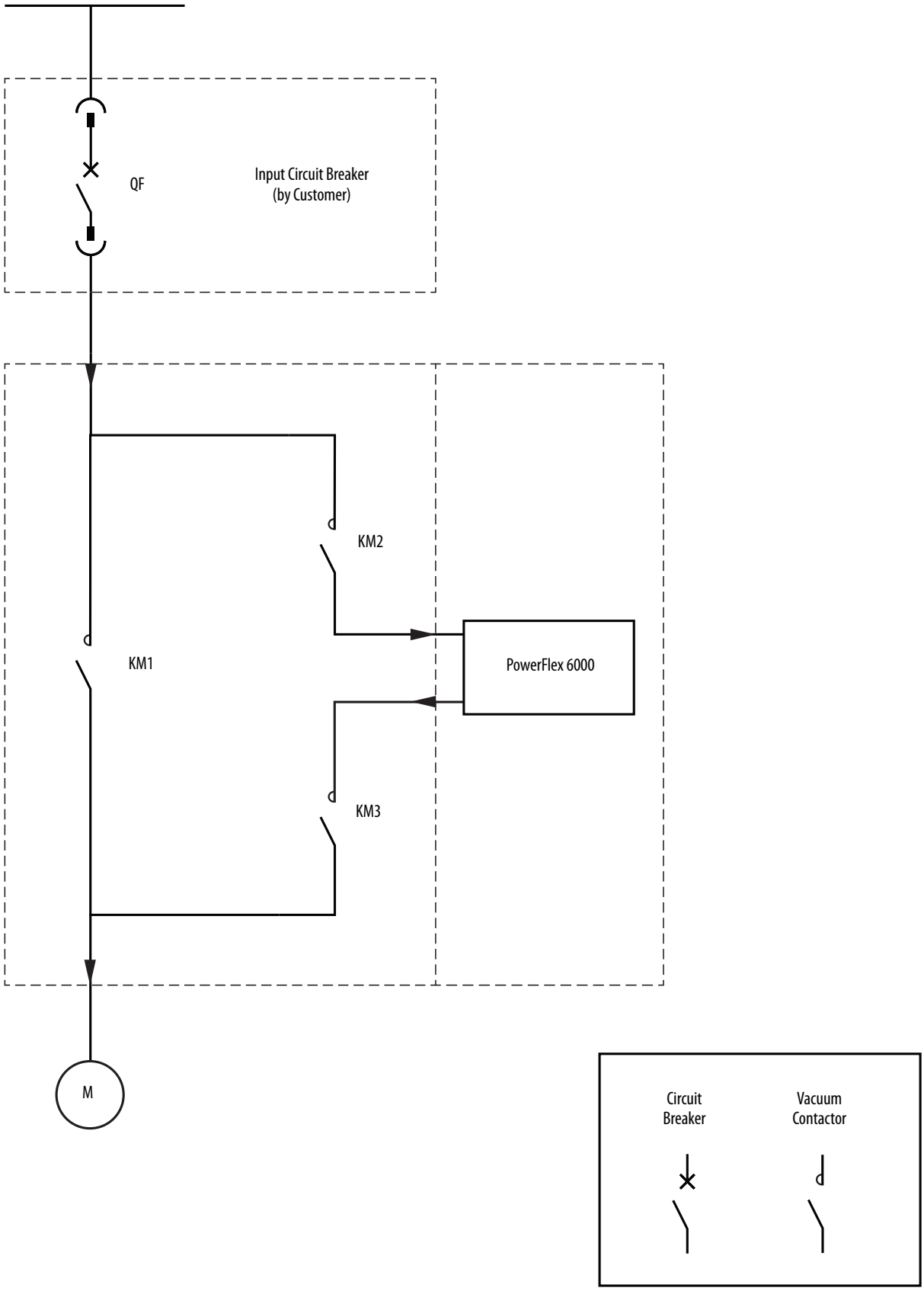


Figure 31 - 6012M Automatic Bypass Version 2 (with Isolation Switches)

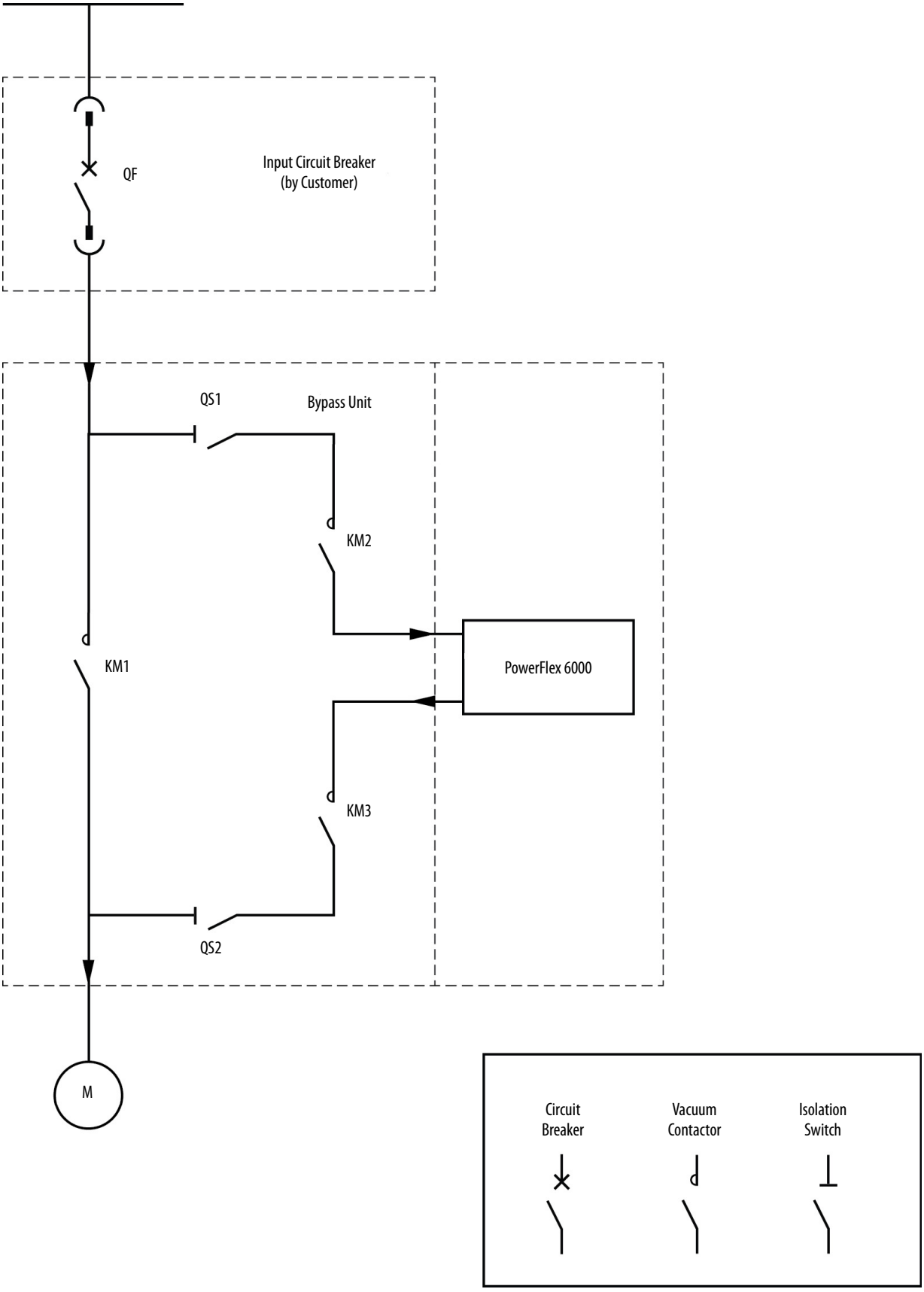


Figure 32 - 6012M Manual Bypass

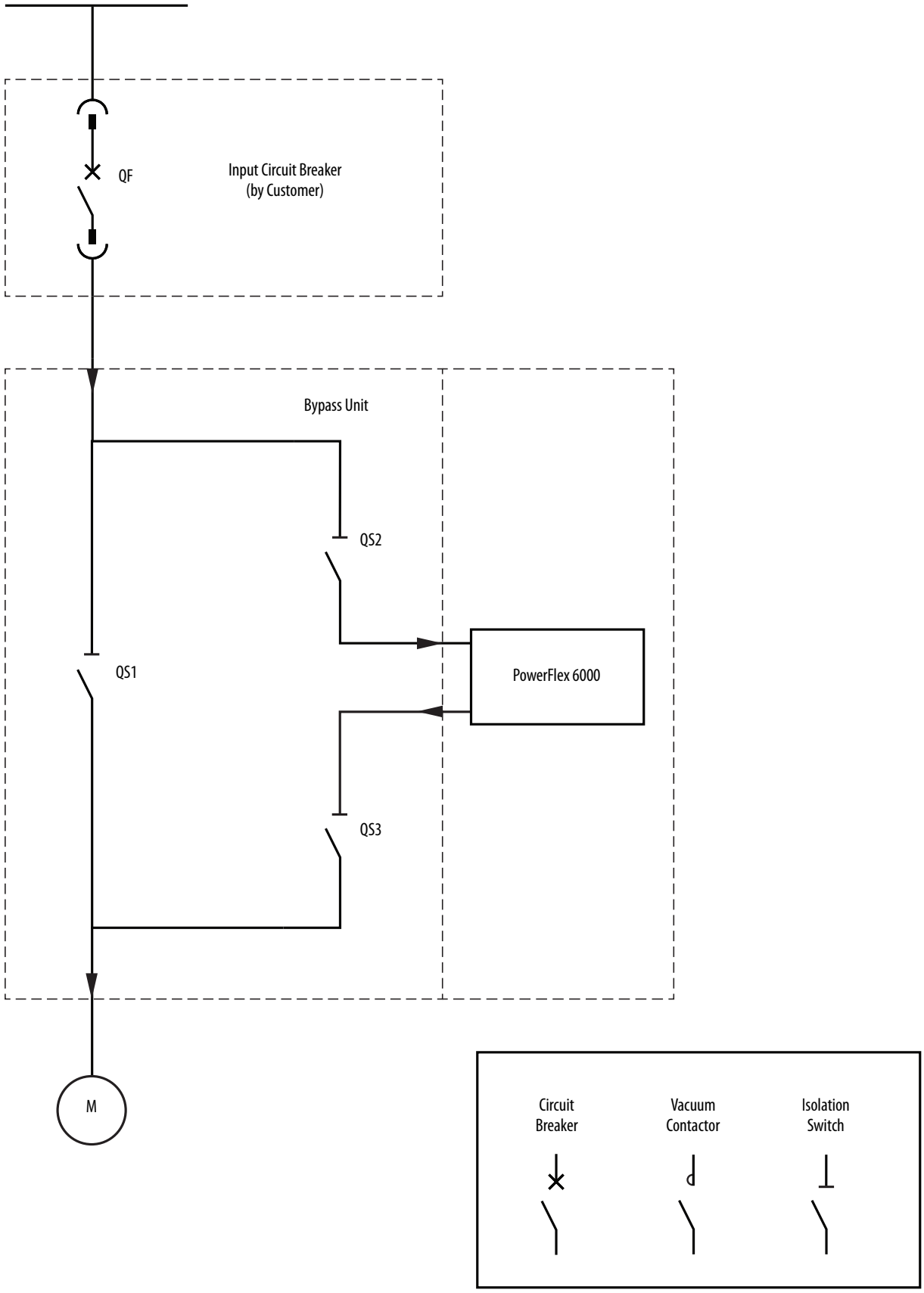


Figure 33 - PowerFlex 6000 Manual Bypass for Two Cabinets

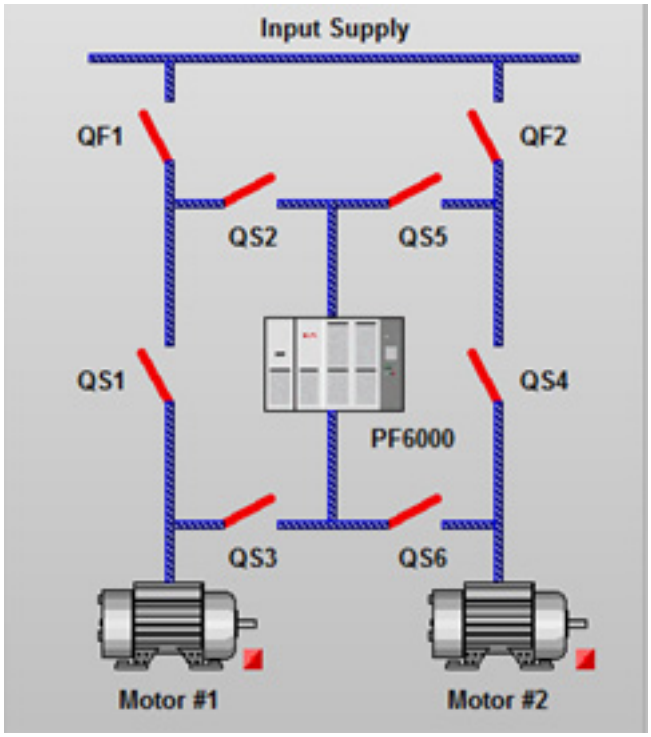
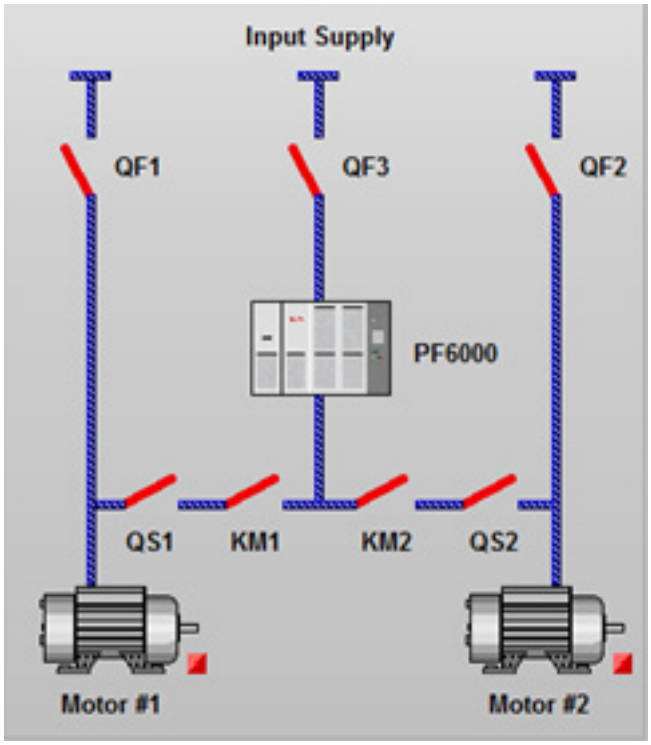


Figure 34 - PowerFlex 6000 Automatic Bypass for Two Cabinets (with Isolation Switches)



Notes:

Special Function Parameter Settings

Overview

Table 18 on page 90 and Table 19 on page 98 outlines specific parameters that must be checked and/or modified when commissioning a drive. Listed below are specific parameters, a brief description and their function to execute optional special functions which, while not essential to commissioning a drive and will not be done every time, are frequently performed.

System Setting Functions

The system setting includes the amount of power modules in one phase, the command source, the drive rated parameter setting, the motor parameter setting, the sensor parameter setting, the restoring of factory default parameter setting, analog output parameter setting.

Number of Power Modules Per Phase

Relevant parameter: P007

Description: sets the amount of power modules per phase.

IMPORTANT This number MUST match the actual amount of power cells in one phase.

P7 is equal to the amount of power modules in one phase; for example, if the amount of power cells in one phase is 6, P007=6. Power Module fault and warning information is based on P007. If P007=0, this is ignored and the user can run the drive using low voltage.

Use this parameter to check low voltage components and the control box.

See Set P Parameters on page 56.

Switch Control Sources

Relevant parameter: P004

Description: P004 selects the control source to start, stop, or reset the drive.

There are two Control Sources, the HMI and the hard-wired I/O interface (DCS). They cannot be enabled at the same time.

Rated/Maximum Output Frequency

Relevant parameter: P460, P466

Description: sets the rated output frequency.

Instruction: P460 is drive's rated output frequency, which should be the same as the motor's rated frequency (0...75 Hz). P466 is the drive's Maximum Output Frequency; P460 cannot exceed P466.

Motor Parameter Setting

Relevant parameter: P017, P199

Description: set basic motor parameters, such as rated current and the number of pole pairs.

Instruction: P199 is motor rated current, which is used to determine faults. P017 sets the number of motor pole pairs.

Hall Effect Current Sensor Setting

Relevant parameter: P198

Instruction: Set the HECS rated current (A) used for the drive current sampling.

Analog Output Display Parameter Setting

Relevant parameters:

Analog Output Display	Parameter
Set Frequency	P351, P352, P353, P371
Motor Voltage	P354, P355, P356, P372
Output Frequency	P357, P358, P359, P373
Motor Current	P360, P361, P362, P374

Description: sets the display parameters for the following analog output signals: Set Frequency, Actual Frequency, Motor Voltage and Motor Current.

Instruction: each signal has four display parameters: memory address, filter parameter, HMI display integer part and HMI display decimal part.

EXAMPLE To output the "given frequency" when the memory address is 221, the filter time is 100 ms, the maximum integer part is 60, the maximum decimal part is 0, set P351=100, P352=60, P353=0, P371=221.

The value of P371, P372, P373, P374 are default values and do not generally need to be changed. Field Support Engineers can change them according to the specific configuration.

Restore Factory Setting

Relevant parameter: P005

Description: restore factory setting parameters.

Instruction: this function includes the three different access levels: User Level, Setup Level, and R&D Level. The amount of parameters restored is dependent on the access level. Press Reset to restore parameters.

The following table shows the parameters which can be restored in the different access levels.

Setup (P005 = 30)	P004, P007, P008, P009, P024, P030, P031, P032, P033, P040, P087, P088, P089, P090, P091, P092, P093, P113, P114, P115, P198, P199, P205, P206, P210, P212, P213, P215, P216, P222, P223, P224, P238, P252, P253, P259, P260, P262, P263, P264, P278, P281, P282, P283, P285, P335, P339, P352, P355, P358, P361, P385, P386, P387, P388, P389, P390, P391, P392, P399, P401, P416, P417, P438, P441, P442, P451, P452, P453, P455, P456, P457, P459, P460, P463, P466, P467
User (P005 = 40)	P004, P198, P199, P262, P352, P355, P358, P361, P399, P401
R&D (P005 = 50)	All P parameters

Speed Command Functions

Set Frequency Command Source

Relevant parameter: P262

Description: this function selects the frequency command source (analog or digital).

Instruction: If P262=0, digital setting is selected, if P262=1, analog setting is selected. Digital mode is setting the frequency from HMI, analog mode is setting the frequency from hard-wired analog I/O. These two modes cannot be enabled at the same time.

Set Frequency Correction

Relevant parameters: P259, P260

Description: this improves the sampling accuracy.

IMPORTANT It can only be enabled when the setting frequency source is set to analog.

Instruction: Set Frequency=P260*Original Set Frequency+P259.

Frequency Command Deadband Upper Limit

Relevant parameter: P414

Description: this function limits the low frequency starting range, reduce the low frequency output error for analog input mode. This parameter avoids the drive's output fluctuation when the frequency is around 0 Hz.

Instruction: if the original set frequency is lower than P414, the set frequency will be changed to P414.

Frequency Amplitude Limit

Relevant parameter: P413, P415

Description: this function limits the amplitude of the Set Frequency. The Set Frequency must not exceed the maximum output frequency of the drive.

Instruction: this function can limit the Set Frequency between P413 and P415, P415>P413>0.

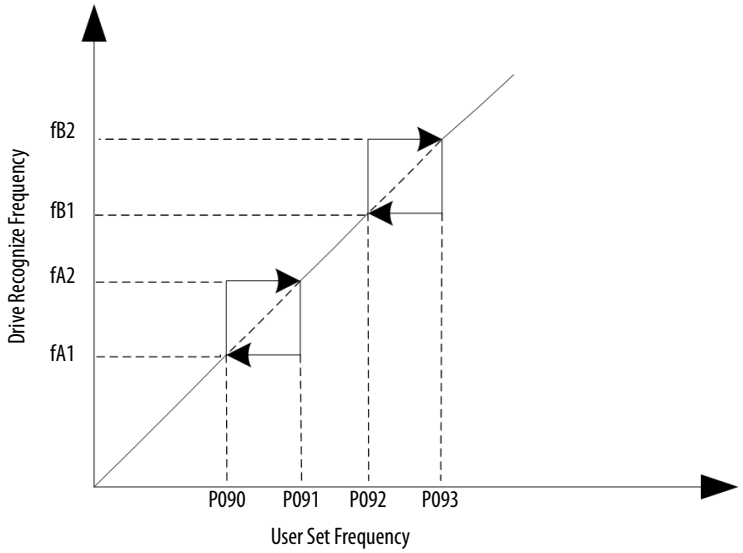
Frequency Skip

Relevant parameter: P089, P090, P091, P092, P093

Description: this function is designed to avoid a trip at certain output frequencies.

Instruction: this function is enabled by P089. There are two bands, one is between P090 and P091, the other is between P092 and P093. The Set Frequency can skip out from these two bands if it is within them. The Set Frequency will be changed automatically into the upper limit of the bands while the speed increases, or changed into the lower limit of the band while the speed decreases (Figure 35). The recommended width of these intervals is 1 Hz.

Figure 35 - Principle diagram of Frequency Skip Function



Speed Reference Functions

V/F Curve Setting

Relevant parameters: P451, P452, P453

Description: calculates the drive's output voltage according to set frequency. There are four available V/F curves: linear, curve, straight-curve and parabolic-curve. Set the compensation voltage to improve the lower frequency start torque.

Instruction: P451 is low speed voltage compensation (%), P452 is low speed voltage compensation frequency threshold. If the output frequency is lower than P452, the output voltage will be improved per P451 (Low Speed Voltage Compensation).

Set Maximum Modulation Index and Limit Output Voltage Amplitude

Relevant parameters: P455, P456

Description: this function sets the maximum modulation index and limit the output voltage amplitude, so the drive can run above rated frequency.

Instruction: change the output voltage without changing the output frequency by adjusting P455. Adjust this value according to the field conditions to ensure the output voltage/frequency is consistent with standard V/F curve.

P456 is the output voltage amplitude limit; the amplitude of output voltage cannot exceed this value.

Set Flux Time

Relevant parameters: P454

Description: this function is designed to build a steady rotating magnetic field before the rotor operates.

Instruction: P454 is the time to build the rotating magnetic field. This value will not generally be changed.

Analog Input

Relevant parameter: P205, P206

3/3.3 kV and 6/6.6 kV drives use the same VSB board.

Set P205 and P206 according to the following table

Voltage Level (kV)	VSB Output Line-to-Line Voltage (RMS V)	P205, P206
3	3.62	195.20
3.3	3.98	177.46
4.16	3.77	187.64
6	3.63	195.09
6.6	3.98	177.35
10 (Not applicable for UL)	4.02	175.54

Stop Mode

Relevant parameter: P024, P252, P253

Description: the drive has two ways to stop the drive, ramp down or coast stop.

Instruction: P024=1 to select coast stop, P024=0 to select ramp down.

If P024=1, the output will stop immediately, so the motor will stop by inertance. If P024=0, the output will stop the from the set frequency to 0 Hz. When the frequency=P252*rated frequency (P252 is a percentage value), the system will be locked.

To restart the drive if coast stop was selected, wait until it stops before restarting. The time needed is:

$$P253 \times \frac{FrequencyBeforeStop}{MaximumFrequency}$$

Flying Start Function

Relevant parameter: P113, P114, P115, P416, P417, P438, P457, P459, P463, K5

Description: The PowerFlex 6000 has three flying start modes:

- search the frequency from set frequency
- search the frequency from the last stop frequency added 5 Hz
- search from the maximum frequency.

Instruction: the flying start feature identifies the motor speed based on the output current.

Some parameters must be changed based on the field application.

- P113: Flying Start - Initial Output Voltage Percentage (%)
- P114: Flying Start - Current Comparison Delay For Motor Speed Search
- P115: Flying Start - Current Threshold For Successful Motor Speed Search
- P416: Enable Flying Start mode
- P417: Flying Start Motor Speed Search Timeout (s)
- P438: Flying Start Current Compensation Threshold
- P457: Flying Start Voltage Recovery Time (s) (Low Speed Region)
- P459: Flying Start Voltage Recovery Time (s) (High Speed Region)
- P463: Flying Start Low/High Speed Regions Boundary (%)

IMPORTANT P416 enables Flying Start Selection. If the Flying Start is not successful, change the other parameters listed accordingly. Otherwise, these parameters do not normally need to be changed.

If the drive cannot search the speed in the field, increase P417 to decrease the search step and improve the accuracy; or increase P113 and decrease P115 to improve the accuracy. If there was any noise during the restore stage, increase P457 or P459. P463 does not need to be changed.

Search from Maximum Frequency to implement AC mode to VF mode.

Restart the Drive

Relevant parameter: P461, P462, P465

Description: these parameters use the auto-restart feature after a system fault.

Instruction: if P461 is enabled (P461=1), the drive will restart at once when system fault occurs.

If there is something wrong with a Power Module, it will wait for P465 before restarting. If a fault happens twice during the Fault Reset Timeout (P462), the drive will trip.

IMPORTANT If restart feature was enabled, the second mode of flying start feature must be enabled.

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In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/services/online-phone.

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.

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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.
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