Allen-Bradley

PowerFlex®

700S High Performance AC Drive and 700H Adjustable Frequency AC Drive

Frame 10

200-250KW / 300-450HP 400V / 480V

250-400KW / 250-450HP 600V / 690V

Hardware Service Manual

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. *Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls* (Publication SGI-1.1 available from your local Rockwell Automation sales office or online at **www.rockwellautomation.com/literature**) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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.

Important: Identifies information that is critical for successful application and understanding of the product.

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 the hazard
- recognize the consequences

Shock Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that dangerous voltage may be present.

Burn Hazard labels may be located on or inside the equipment (e.g., drive or motor) to alert people that surfaces may be at dangerous temperatures.

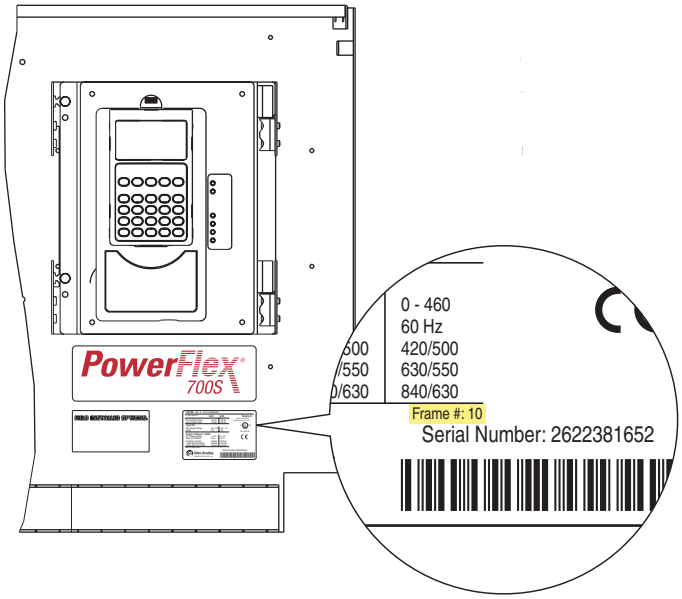
Overview

Who Should Use this Manual?

This manual is intended for qualified service personnel responsible for troubleshooting and repairing high power PowerFlex 700S and 700H AC Drives. You should have previous experience with, and basic understanding of, electrical terminology, procedures, required troubleshooting equipment, equipment protection procedures and methods, and safety precautions.

What is in this Manual

This manual contains hardware service information for Frame 10 PowerFlex 700S and 700H drives only. Verify that you are working on a Frame 10 drive by checking the data nameplate on the Control Frame. The frame number is printed just above the serial number.



What is Not in this Manual

This manual does not contain in depth fault information for troubleshooting. That information is available in publications 20C-PM001, *Programming Manual - PowerFlex 700H Adjustable Frequency AC Drive*, PFLEX-IN006, *Installation Instructions - PowerFlex 700S and 700H Adjustable Frequency AC Drive* and 20D-UM001, *User Manual - PowerFlex 700S High Performance AC Drive*.

Reference Materials

Allen-Bradley publications are available on the internet at *www.rockwellautomation.com/literature*.

The following publications provide general drive information.

Title	Publication
Wiring and Grounding Guide, (PWM) AC Drives	DRIVES-IN001...
Safety Guidelines for the Application, Installation and Maintenance of Solid State Control	SGI-1.1
A Global Reference Guide for Reading Schematic Diagrams	0100-2.10
Guarding Against Electrostatic Damage	8000-4.5.2

The following publications provide specific PowerFlex drive information.

Title	Publication
Programming Manual - PowerFlex 700H AC Drive	20C-PM001...
User Manual - PowerFlex 700S High Performance Drive	20D-UM001...
Installation Instructions - Hi-Resolution Feedback Option Card for PowerFlex 700S Drives	20D-IN001...
Installation Instructions - Multi Device Interface Option for PowerFlex 700S Drives	20D-IN004...
Installation Instructions - Main Control Board PowerFlex 700S Drives	20D-IN005...
Installation Instructions - Control Assembly Cover for PowerFlex 700S Drives	20D-IN006...
Installation Instructions - PowerFlex 700S /700H High Power Maintenance Stand	20D-IN014...
Installation Instructions - PowerFlex 700S and 700H Drives	PFLEX-IN006...
Reference Manual - PowerFlex Adjustable Frequency Drive, (Volume 1 - 70 & 700)	PFLEX-RM001...
Reference Manual - PowerFlex Adjustable Frequency Drive, (Volume 2 - 700S)	PFLEX-RM002...

The following publications provide information that is necessary when applying the DriveLogix Controller.

Title	Publication
User Manual - DriveLogix System	20D-UM002...
Installation Instructions - DriveLogix Controller	20D-IN002...
Installation Instructions - Memory Expansion for DriveLogix Controller	20D-IN007...
ControlNet Daughtercard Installation Instructions	1788-IN002...
ControlNet Daughtercard Installation Instructions	1788-IN005...

Understanding Manual Conventions

Terms

The following words are used throughout the manual to describe an action:

Word	Meaning
Can	Possible, able to do something
Cannot	Not possible, not able to do something
May	Permitted, allowed
Must	Unavoidable, you must do this
Shall	Required and necessary
Should	Recommended
Should Not	Not recommended

Cross References

"Figure 2.2 on page 2-6" is a cross reference to figure 2.2 on page 5 of Chapter 2.

"Figure C.1 on page C-2" is a cross reference to figure C.1 on page 2 of Appendix C.

Additional Support Available on Internet

Additional troubleshooting information and software tools are available on the Allen-Bradley Drives Support Website (*http://www.ab.com/support/abdrives/*).

General Precautions

Class 1 LED Product

ATTENTION: Hazard of permanent eye damage exists when using optical transmission equipment. This product emits intense light and invisible radiation. Do not look into module ports or fiber-optic cable connectors.

ATTENTION: The sheet metal cover and mounting screws on the ASIC Board located on the power structure are energized at (-) DC bus potential high voltage. Risk of electrical shock, injury, or death exists if someone comes into contact with the assembly.

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 A-B 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 **qualified personnel** familiar with high power PowerFlex 700S and 700H Drives 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.

ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the DC+ & DC- terminals. The voltage must be zero.

ATTENTION: Potentially fatal voltages may result from improper usage of an oscilloscope and other test equipment. The oscilloscope chassis may be at a potentially fatal voltage if not properly grounded. If an oscilloscope is used to measure high voltage waveforms, use only a dual channel oscilloscope in the differential mode with X 100 probes. It is recommended that the oscilloscope be used in the A minus B Quasi-differential mode with the oscilloscope chassis correctly grounded to an earth ground.

Troubleshooting and Error Codes

ATTENTION: To avoid an electric shock hazard, ensure that all power to the drive has been removed before performing the following.

ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the DC+ & DC- terminals. The voltage must be zero.

ATTENTION: HOT surfaces can cause severe burns. **Do not** touch the heatsink surface during operation of the drive. After disconnecting power allow time for cooling.

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 A-B publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.

Creating Fault Reports

Clear and complete fault reports are critical for analysis and repair of modules returned to the factory.

At a minimum, perform and record the following:

- Record the contents of the fault queue (faults and times of occurrence)
- Make record of any burn marks on the rectifying module, DC-capacitors, inverter bridge, charging resistors, balancing/precharging resistors, printed circuit boards, bus bars, cabling and fiber-optic cabling
- Make record of any liquid and condensation marks on printed circuit boards, components and mechanical parts
- Make record of the amount of dust and other additional particles on drive and drive components
- Make record of any mechanical damage to the drive and drive components
- Record the size and type of main fuses
- Record any other important marks and damage

Addressing 700S Hardware Faults

Fault	No.	Description	Action *(if appropriate)*
HiHp In PhaseLs	65	AC Input Phase Loss - AC voltage is not present on one or two input phases.	1. Check for voltage on each input phase. 2. Check the status of each external input fuses.
HiHp Bus Com Dly	66	Bus Communication Time Delay - the processor has not received proper periodic feedback information.	Check fiber-optic connections between the Power Interface Circuit Board and Voltage Feedback Circuit Board.
HiHp Bus Link LS	67	Bus Communication Link Loss - bus communication between the Power Interface Circuit Board and Voltage Feedback Circuit Board has halted.	Check fiber-optic connections between the Power Interface Circuit Board and Voltage Feedback Circuit Board.
HiHp Bus CRC Er	68	Bus Communication CRC Error - too many Cycling Ring Checksum (CRC) errors have occurred in the communication bus. A fast power cycle may cause the 700S Main Control Board to attempt to communicate with the ASIC Board before the ASIC Board is energized.	Check fiber-optic connections between the Power Interface Circuit Board and Voltage Feedback Circuit Board. Wait five minutes before re-energizing the drive.
HiHp Bus WtchDog	69	Bus Communication Watchdog Error - communication has halted in the communication bus, causing the watch dog timer to expire.	1. Check fiber-optic connections between the Power Interface Circuit Board and Voltage Feedback Circuit Board. 2. Check connections between the Main Control Board and the Power Interface Circuit Board. 3. Replace the Voltage Feedback Circuit Board. 4. Replace the Power Interface Circuit Board. 5. Replace the Main Control Board.
HiHp Fan Fdbk Ls	70	Fan Feedback Loss - a fan feedback signal has been lost.	1. Check the main cooling fan. 2. Check the Main Control Board cooling fan.

Fault	No.	Description	Action *(if appropriate)*
HiHp Drv OvrLoad	71	Drive Overload - the circuit board on the Power Module has detected an overload.	Measure output current of the drive. If the level is ever greater than the maximum drive rated output current level reduce the load. If the levels are always well below the drive rated levels, then replace the power module.
HiHp PwrBd PrcEr	72	Power Board Processor Error - a microprocessor on the Power Board has detected a communication error.	1. Check fiber-optic connections between the Power Interface Circuit Board and Voltage Feedback Circuit Board. 2. Check connections between the Main Control Board and the Power Interface Circuit Board. 3. Replace the Voltage Feedback Circuit Board 4. Replace the Power Interface Circuit Board. 5. Replace the Main Control Board.
HiHp PrChrg Cntc	73	Precharge Contactor Fault - proper contactor feedback has not occurred. The precharge contactor has probably failed to pick up or the feedback signal has failed. This fault only applies to DC input drives.	• Check precharge circuit wiring. • Check for loose connections on X50 terminal block and/or the X9 and X15 connectors on the ASIC Board.
HiHp PwrEE Error	74	Power EEPROM Error - the rating of the drive and data in the Power EEPROM on the Power Board do not match.	Replace output power module or program a new power board.
HiHP PwrBd OTemp	75	Power Board Over-Temperature - temperature of the Power Board on has exceeded 85° C.	Check the main cooling fan and fan power supply, replace if necessary.

Addressing 700H Hardware Faults

Name	No.	Description	Action *(if appropriate)*
Power Loss	3	DC bus voltage remained below [Power Loss Volts] for longer than [Power Loss Time]. Enable/Disable with [Fault Config 1]. For more information refer to publication 20C-PM001, *Programming Manual - PowerFlex 700H*.	Monitor the incoming AC line for low voltage or line power interruption.
UnderVoltage	4	DC bus voltage fell below the minimum value of 333V for 400/480V drives and 461V for 600/ 690V drives. Enable/Disable with [Fault Config 1]. For more information refer to publication 20C-PM001, *Programming Manual - PowerFlex 700H*.	Monitor the incoming AC line for low voltage or power interruption.
OverVoltage	5	DC bus voltage exceeded maximum value.	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install and external dynamic brake option.

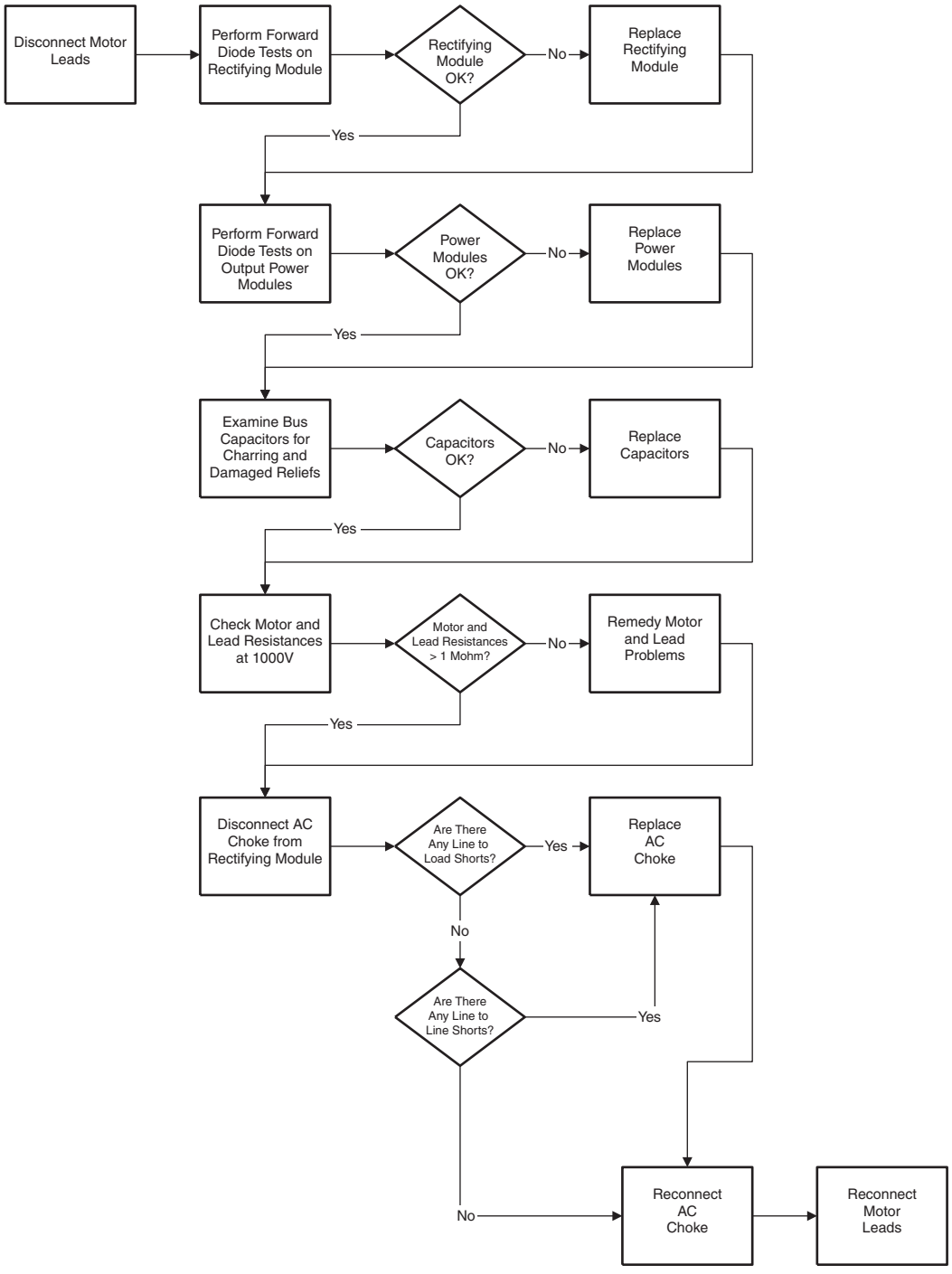
Name	No.	Description	Action *(if appropriate)*
Input Phase	17	One input line phase missing.	Check user-supplied fuses Check AC input line voltage.
OutPhasMissng	21	Zero current in one output motor phase.	Check motor wiring. Check motor for open phase.
Ground Fault	13	A current path to earth ground greater than 25% of drive rating. Ground fault level is 50% of the drive's heavy duty current rating. The current must appear for 800ms before the drive will fault.	Check the motor and external wiring to the drive output terminals for a grounded condition.
InverterFault	14	Hardware problem in the power structure.	Cycle power. Replace drive.
System Fault	10	Hardware problem exists in the power structure.	Cycle power. Replace drive.
Load Loss	15	Do not use this fault in 700H applications	Check that parameter 238 [Fault Config 1] / bit 0 [Power Loss] and parameter 259 [Alarm Config 1] / bit 13 [Load Loss] are set to zero.
Power Unit	70	One or more of the output transistors were operating in the active region instead of desaturation. This can be caused by excessive transistor current or insufficient base drive voltage.	Clear fault.

Diagnostic Procedures by Symptom

The following charts list drive symptoms, symptom descriptions and recommended actions.

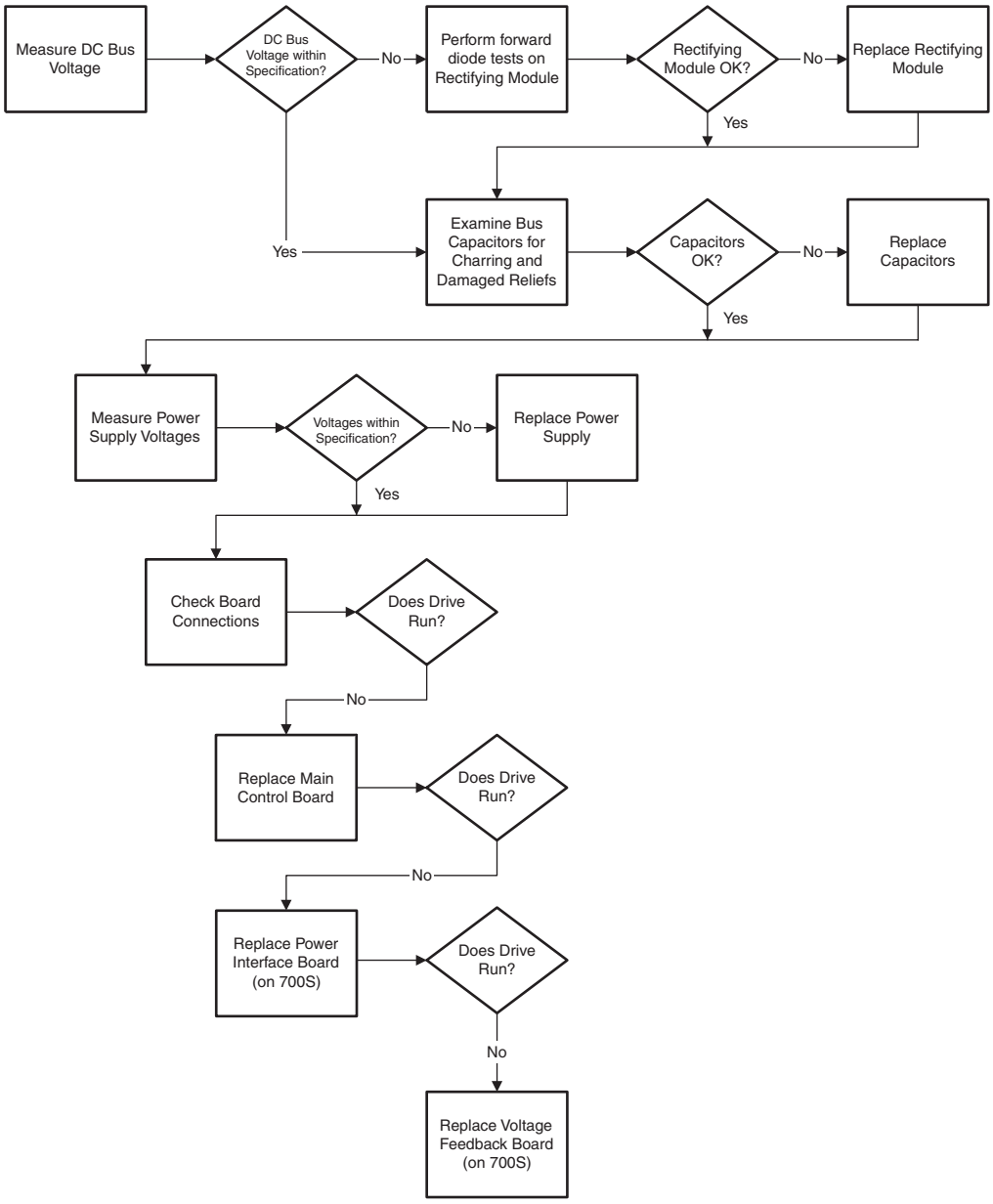
Blown Input Fuses

Use this procedure when a drive clears any of its external circuit breaker or power fuses:



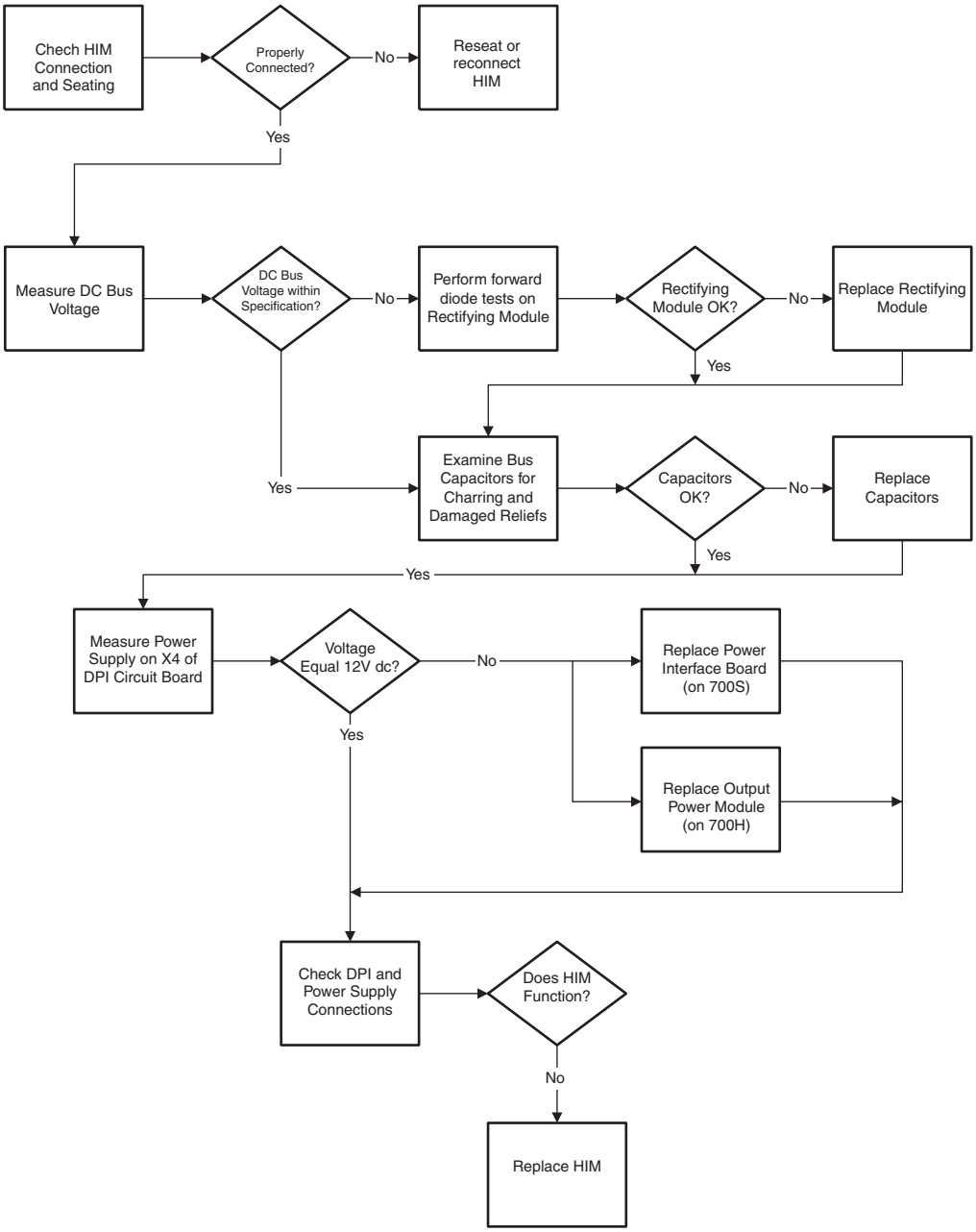
No Output Voltage

Use this procedure when there is no voltage present at the drive output terminals, even though the drive indicates the motor is running:



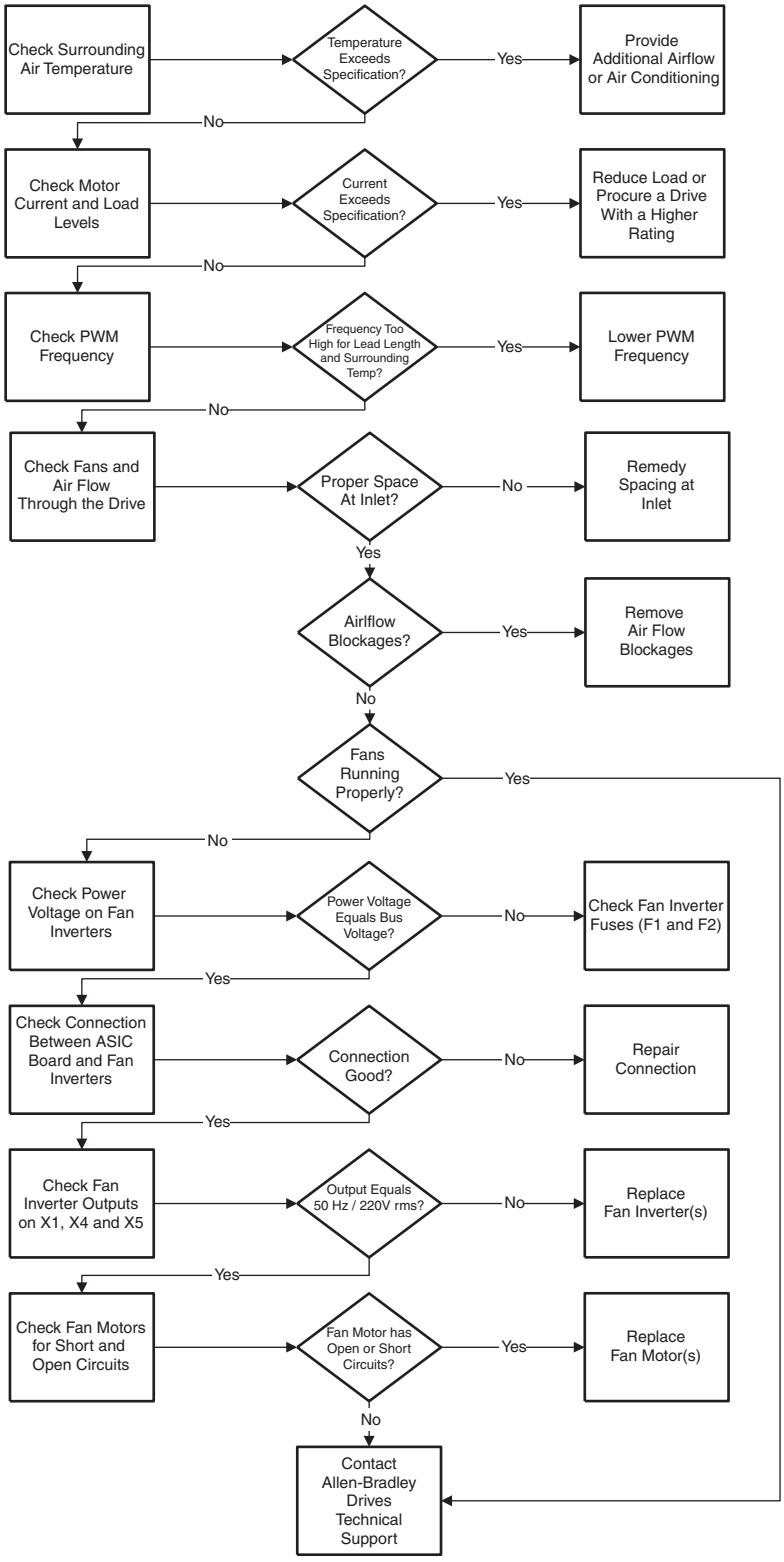
No HIM Display

Use this procedure when the HIM does not function:



Over-Temperature Faults

Use this procedure to troubleshoot drive over-temperature faults (14 - Inv Otemp Pend and 15 - Inv Otemp Trip in 700S or 8 - Heatsink OvrTemp and 9 - Trnsistr OvrTemp in 700H):



Component Test Procedures

ATTENTION: To avoid an electric shock hazard, ensure that all power to the drive has been removed before performing the following.

ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the DC+ & DC- terminals. The voltage must be zero.

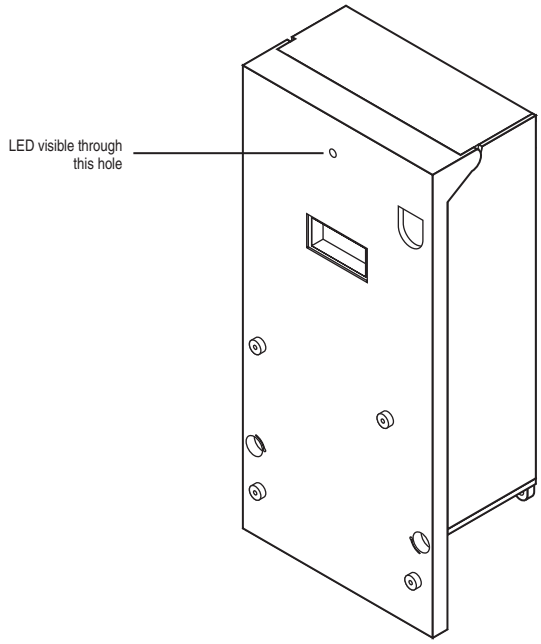
ATTENTION: HOT surfaces can cause severe burns. **Do not** touch the heatsink surface during operation of the drive. After disconnecting power allow time for cooling.

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 A-B publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.

Viewing the 700H Diagnostic LED

The Control Assembly on 700H drives contains a diagnostic LED which is visible through the cover of the Control Assembly.

ATTENTION: The Control Assembly LED is only operational when the drive is energized, and only visible with the door of the drive enclosure is open. Servicing energized equipment can be hazardous. Severe injury or death can result from electrical shock, burn or unintended actuation of controlled equipment. Follow Safety related practices of NFPA 70E, *ELECTRICAL SAFETY FOR EMPLOYEE WORKPLACES*. DO NOT work alone on energized equipment!



LED	Indication
Steady	The drive is operational and has no faults
Flashing Quickly	• Switching power supply overload • Rectifier Board fault • Fan or fan inverter fault • Brake Chopper fault • Fiber Optic Adapter Board Fault
Flashing Slowly	Bad connection between circuit boards, check all connections

Performing Visual Inspections

Visually inspect the cooling tunnels and power structure before energizing the drive.

Inspecting the Cooling Tunnels

1. Remove the main cooling fans from the bottom of the power structure. Refer to Removing Main Fans on page 3-24.
2. Inspect the tunnels. Clean the heatsinks and tunnels if necessary.

Inspecting the Power Structure

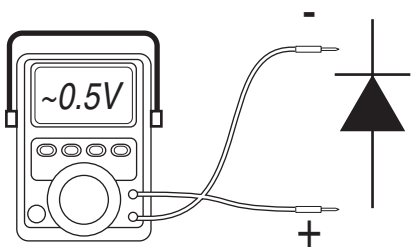
1. Remove the covers from the power structure. Refer to Removing the Covers from the Power Structure on page 3-14.
2. Check components for burn marks, breakage or foil delamination on circuit boards. Check all the boards on the power structure, including those on the Output Power Modules and the Rectifying Module (if present).

   Replace any of these components without further testing if they show evidence of burn marks, breakage or foil delamination.

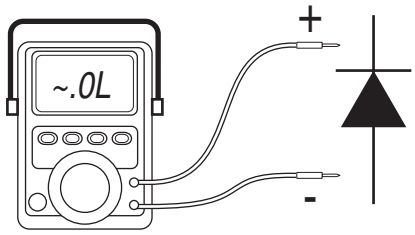
Conducting Forward and Reverse Biased Diode Tests for Major Power Components

A forward biased diode test checks the semiconductor junctions between the terminals and measures the voltage drop across those junctions. To pass each test, the meter must display a voltage near 0.5V. If the test finds a short, the meter will display ".000." If the test finds an open circuit or reversed polarity, the meter will display ".0L" (zero load).

A reverse biased diode test should find an open circuit, and the meter should display ".0L" (zero load).



Forward biased test on PN-junction



Reverse biased test on PN-junction

1. Remove power from the drive. Refer to Removing Power from Drive on page 3-3.
2. Disconnect the motor leads from the drive.
3. Conduct forward and reverse biased diode tests on the Rectifying Module (if present).

Figure 2.1 Measurement Points for Forward and Reverse Diode Tests

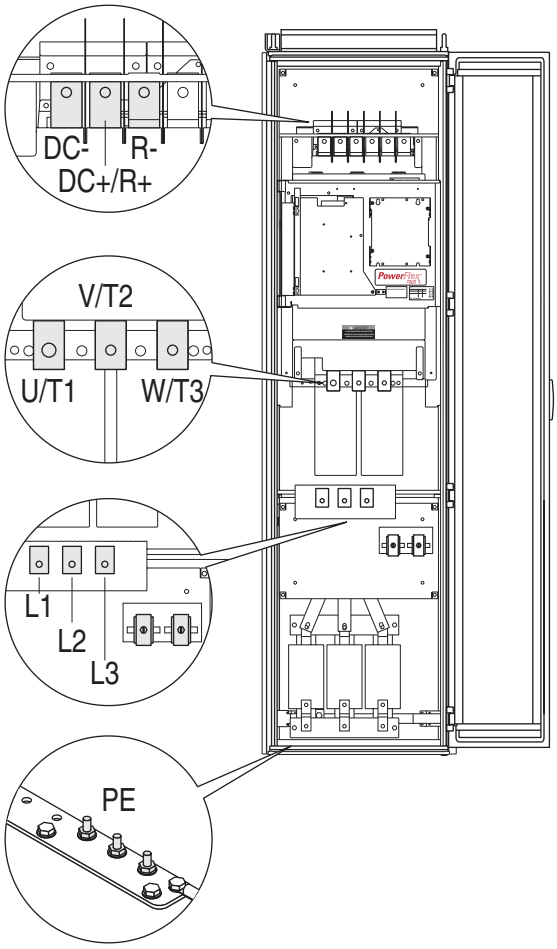


Table 2.A Forward Biased Diode Tests on Rectifying Module

Meter Leads		
-	+	Nominal meter reading
DC+/R+[1]	L1	Meter should beep once and value should gradually rise to about 0.5V
DC+/R+	L2	
DC+/R+	L3	
L1	DC-	
L2	DC-	
L3	DC-	

(1) If the drive does not contain the brake chopper option, the DC+/R+ terminal will be labeled DC+.

Table 2.B Reverse Biased Diode Tests on Rectifying Module

Meter Leads		
+	-	Nominal meter reading
L1	DC-	Meter should display ".0L" (zero load)
L2	DC-	
L3	DC-	
DC+/R+[1]	L1	
DC+/R+	L2	
DC+/R+	L3	

[1] If the drive does not contain the brake chopper option, the DC+/R+ terminal will be labeled DC+.

If the drive fails any of these measurements, replace the Rectifying Module.

4. Conduct forward and reverse biased diode tests on the Output Power Modules.

Table 2.C Forward Biased Diode Tests on Output Power Modules

Meter Leads		
+	-	Nominal meter reading
DC-	T1	Meter should display ".0L" (zero load)
DC-	T2	
DC-	T3	
T1	DC+/R+[1]	
T2	DC+/R+	
T3	DC+/R+	

[1] If the drive does not contain the brake chopper option, the DC+/R+ terminal will be labeled DC+.

Table 2.D Reverse Biased Diode Tests on Output Power Modules

Meter Leads		
+	-	Nominal meter reading
T1	DC-	Meter should beep once and value should gradually rise to about 0.5V
T2	DC-	
T3	DC-	
DC+/R+[1]	T1	
DC+/R+	T2	
DC+/R+	T3	

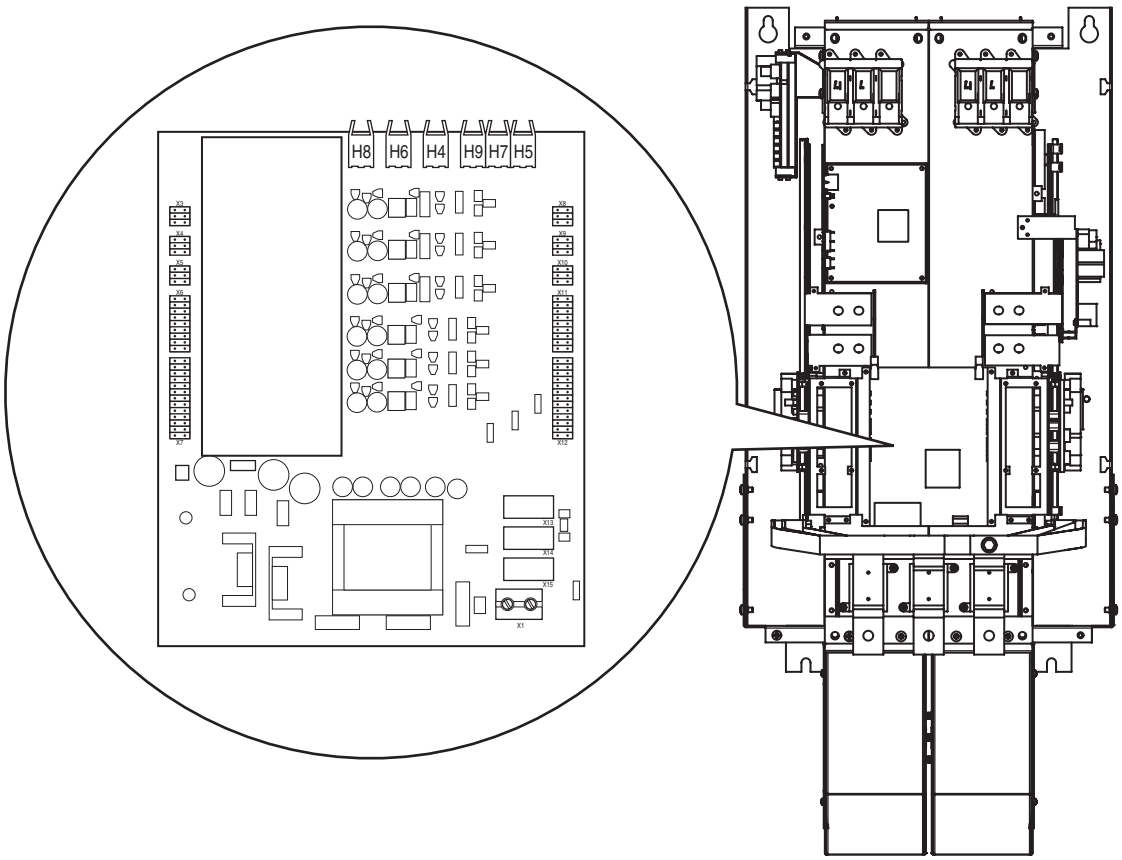
[1] If the drive does not contain the brake chopper option, the DC+/R+ terminal will be labeled DC+.

If the drive fails any of these measurements, replace both Output Power Modules.

Checking Fiber Optic Connections to the Gate Driver Board

Damaged or improperly connected fiber optic cables can cause apparent Gate Driver Board malfunctions.

1. Remove power from the drive. Refer to Removing Power from Drive on page 3-3.
2. Remove the covers from the power structure. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Locate the Gate Driver Board on the front of the power structure.



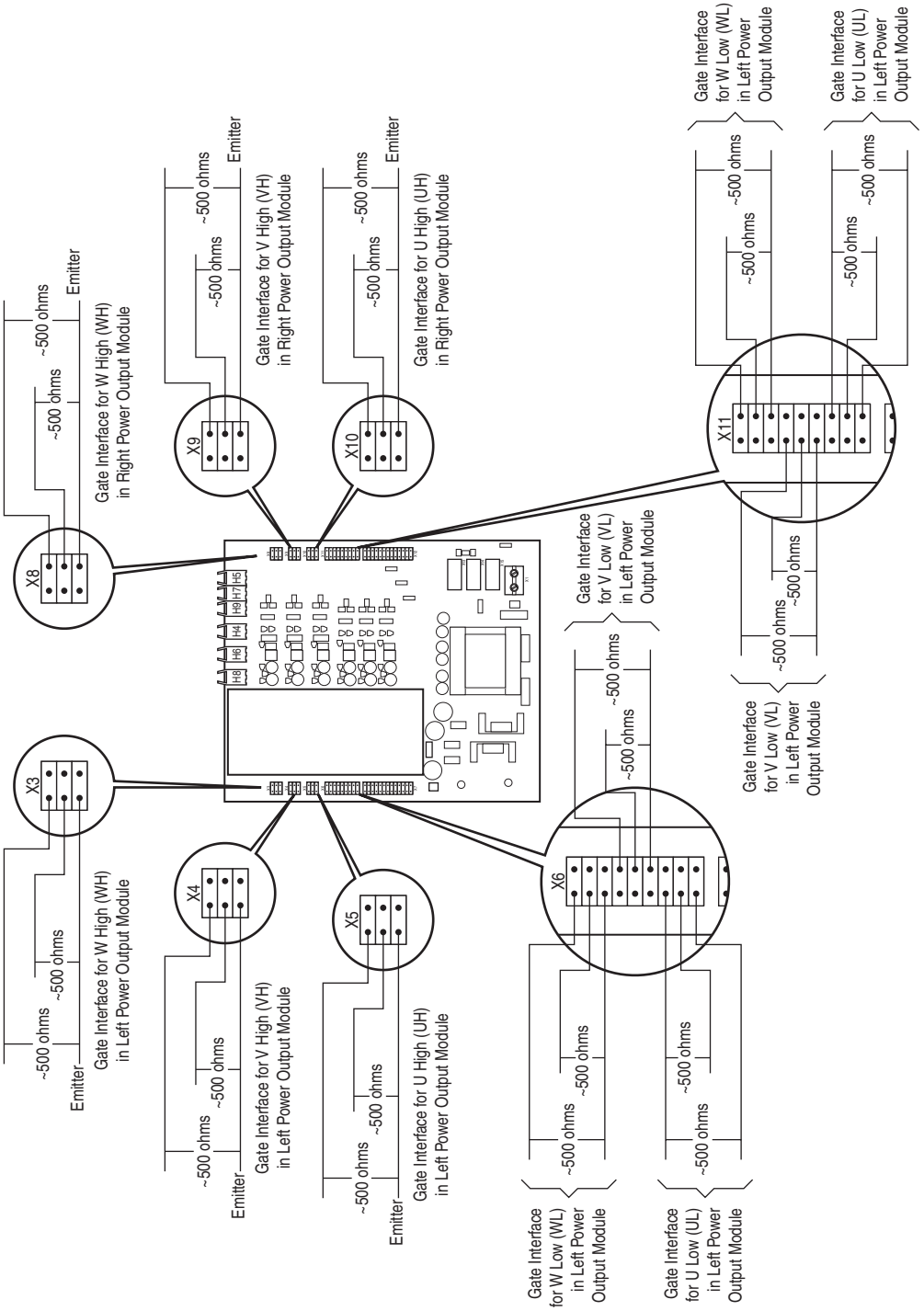
4. Verify the fiber optic cables are properly connected (refer to Figure B.3 on page B-4, Figure B.4 on page B-5 or Figure B.5 on page B-6).
5. Disconnect the cables and inspect them for scratches and cracks.
6. Reconnect the cables, replacing any damaged cables.

Conducting Gate Driver Board Measurements

1. Remove power from the drive. Refer to Removing Power from Drive on page 3-3.
2. Remove the covers from the power structure. Refer to Removing the Covers from the Power Structure on page 3-14.

Gate Interface Resistance

Measure gate interface resistance for each output power transistor. The resistance from each gate and collector pin to the branch emitter pin should be about 500 ohms. If any of the gate interfaces fails this test, replace the appropriate (left or right) Output Power Module.



Preparing the Drive for Active Measurements on the Gate Driver Board

Important: This procedure requires special equipment and training. Only qualified and trained personnel should perform these procedures. *If you do not have the special equipment, replace the Gate Driver Board to determine if the Board is malfunctioning.*

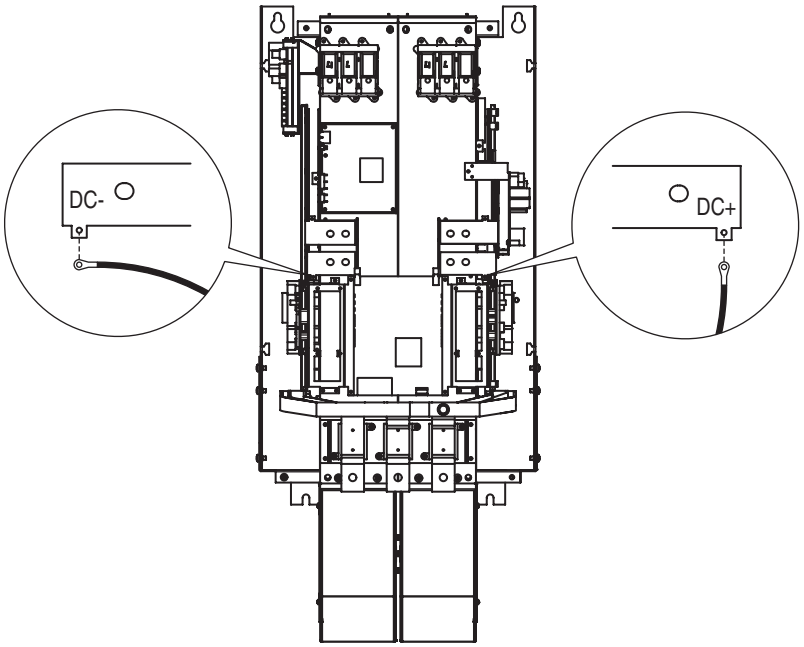
1. Remove power from the drive. Refer to Removing Power from Drive on page 3-3.
2. Remove the covers from the power structure. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Disconnect the fiber optic cables which connect the ASIC Board to the Gate Driver Board at the Gate Driver Board ends.
4. You may want to remove the fuses for the Main Fan Inverters in order to prevent them from running during these tests.

ATTENTION: Running the drive without the Main Fan Inverters could cause the drive to overheat or fault. Possible equipment damage could occur. You must replace the fuses before running the drive.

5. Disconnect the DC+ and DC- wires from the bus bars above the Gate Driver Board. These wires connect the DC bus to the circuit boards in the power structure.

ATTENTION: Running the drive with the DC bus wires disconnected will damage the ASIC Board. You must reconnect these wires before running the drive.

6. Connect the minus (-) probe of the multimeter to the DC- wire. Make sure these DC+ and DC- connections are insulated from all objects.



7. Connect the High Voltage DC Test Power Supply to these wires.

ATTENTION: The sheet metal cover and mounting screws on the ASIC Board located on the power structure are energized at (-) DC bus potential high voltage. Risk of electrical shock, injury, or death exists if someone comes into contact with the assembly. Servicing energized equipment can be hazardous. Severe injury or death can result from electrical shock, burn or unintended actuation of controlled equipment. Follow Safety related practices of NFPA 70E, *ELECTRICAL SAFETY FOR EMPLOYEE WORKPLACES*. DO NOT work alone on energized equipment!

ATTENTION: Certain pins in connectors X7 and X12 on the Gate Driver Board will be energized at DC bus potential high voltage. Risk of electrical shock, personal injury or death, property damage, or economic loss exists if personnel or equipment comes into contact with these pins.

8. Set the current limit on the High Voltage DC Test Power Supply to less than or equal to 1A. Energize the Supply and increase its output to the drive's nominal DC bus voltage (650V dc for drives with 380-500V ac input or 775V dc for drives with 600-690V ac input).

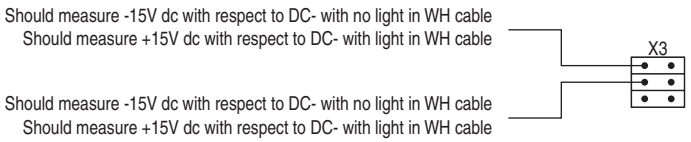
Checking the Opto-Couplers

Class 1 LED Product

ATTENTION: Hazard of permanent eye damage exists when using optical transmission equipment. This product emits intense light and invisible radiation. Do not look into module ports or fiber-optic cable connectors.

1. Locate the fiber optic receiver which transmits the signals for W High (WH) gate interface and connector X3 on the Gate Driver Board. X3 provides the gate interface for the WH output power transistor in the left-hand Output Power Module.

2. Measure the DC voltage at the WH gate and collector pins on X3 with respect to DC-. It should be -15V dc.

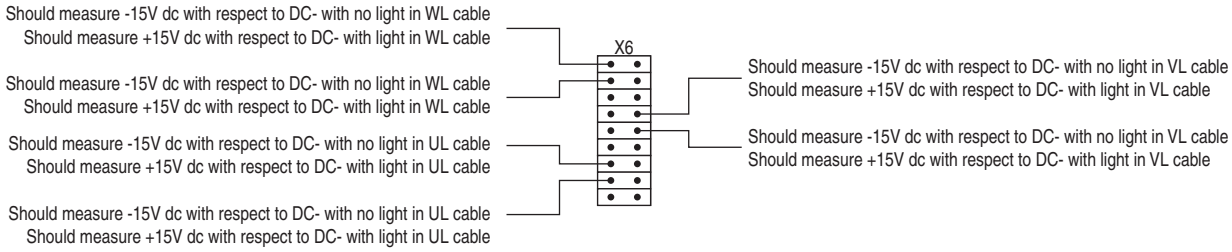


3. While shining an intense light (like a flashlight) into the fiber optic receiver for the WH cable, measure the DC voltage at the WH gate and collector pins on X3 with respect to DC-. It should be +15V dc. If the drive fails any of these tests, replace the fiber optic cable or the Gate Driver Board.

4. Repeat steps 3 and 4 with connector X4 and the VH cable. X4 provides the gate interface for the VH output power transistor in the left-hand Output Power Module. If the drive fails any of these tests, replace the Gate Driver Board.

5. Repeat steps 3 and 4 with connector X5 and the UH cable. X5 provides the gate interface for the UH output power transistor in the left-hand Output Power Module. If the drive fails any of these tests, replace the Gate Driver Board.

6. Repeat steps 3 and 4 with connector X6 and the cables for WL, VL and UL. If the drive fails any of these tests, replace the Gate Driver Board.



7. Repeat steps 3 and 4 with connector X8 and the WH cable. X8 provides the gate interface for the WH output power transistor in the right-hand Output Power Module. If the drive fails any of these tests, replace the Gate Driver Board.

8. Repeat steps 3 and 4 with connector X9 and the VH cable. X9 provides the gate interface for the VH output power transistor in the right-hand Output Power Module. If the drive fails any of these tests, replace the Gate Driver Board.

9. Repeat steps 3 and 4 with connector X10 and the cables for WL, VL and UL. If the drive fails any of these tests, replace the Gate Driver Board.

10. Reconnect the DC+ and DC- wires on the bus bars above the Gate Driver Board (Refer to Step 4 on page 2-9).

ATTENTION: Running the drive with the DC bus wires disconnected will damage the ASIC Board. You must reconnect these wires before running the drive.

Figure 2.2 Opto-Coupler Checks for Left-Hand Output Power Module

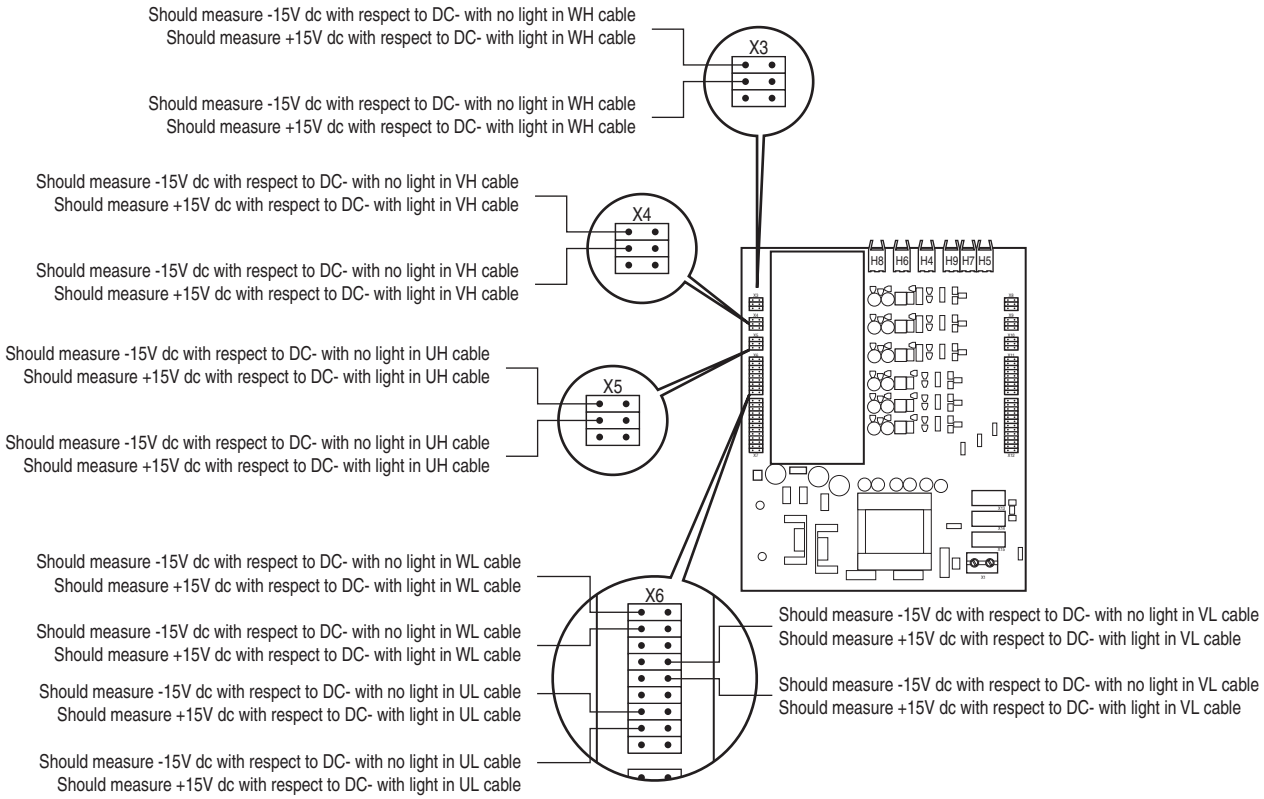
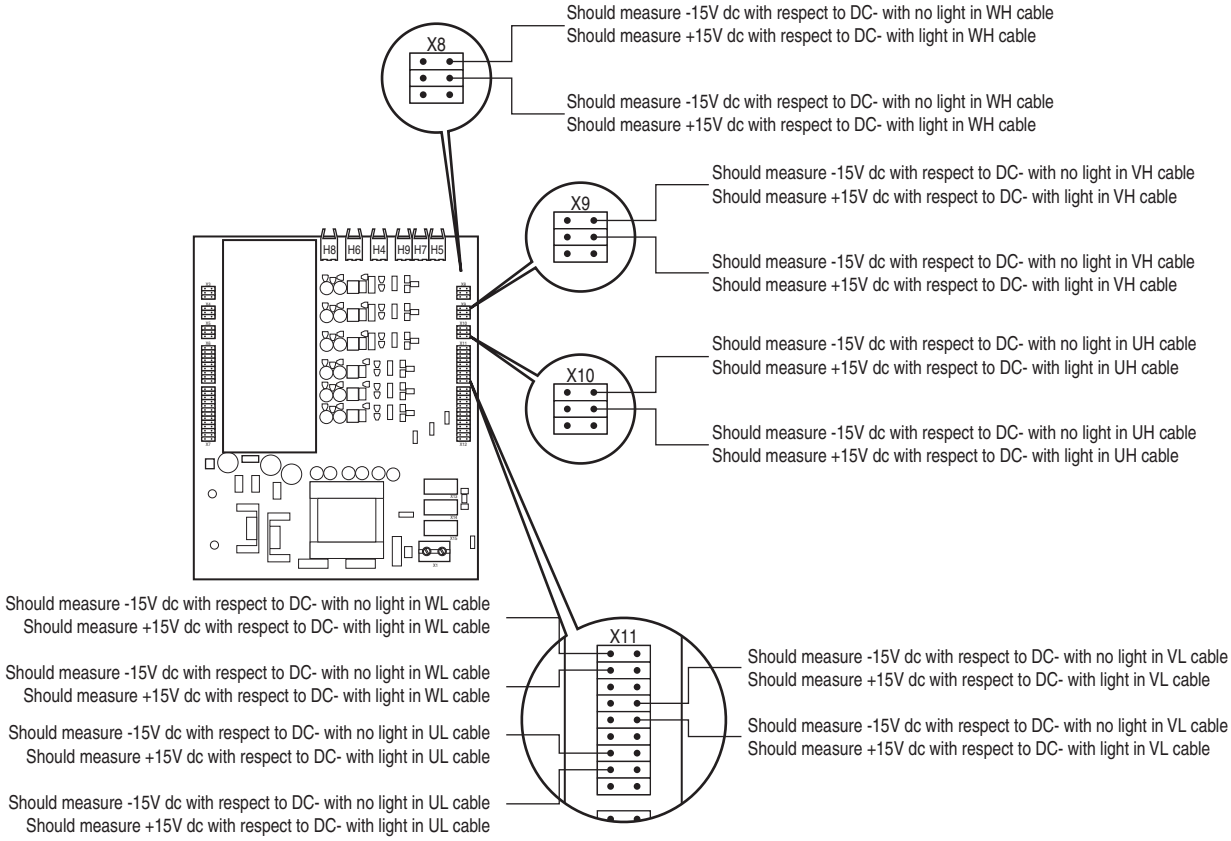


Figure 2.3 Opto-Coupler Checks for Right-Hand Output Power Module



Checking Rectifying Module (on AC Input Drives Only)

Important: This procedure requires special equipment and training. Only qualified and trained personnel should perform these procedures.

1. Remove power from the drive. Refer to Removing Power from Drive on page 3-3.
2. Remove the covers from the power structure. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Visually inspect the pre-charging resistors. If pre-charging resistors are damaged:

   A. Replace the Rectifying Module (See Removing the Right-Side Output Power Module and Rectifying Module on page 3-31).

   B. Check the capacitors, rectifiers and external connections for short-circuits. (See Checking the DC Bus Capacitors on page 2-16)

   C. Check the Output Power Modules (See Conducting Forward and Reverse Biased Diode Tests for Major Power Components on page 2-3).
4. Verify that the plugs on the cable that connects X13 on the Rectifying Board to X2 on the ASIC Board are properly seated.
5. Verify that the jumper at X50 on the Rectifying board is in place.

Taking Measurements on Rectifying Module

6. Disconnect connectors X13, X12, X11 and X10.
7. Perform resistance measurements, using a digital multimeter, on the points listed in Table 2.E on page 2-14 (on AC Three-Phase drives). These points are on the back of the X10, X11 and X12 plugs which you have disconnected from the board. **If the Rectifying Module fails any of these tests, replace it** (See Removing the Right-Side Output Power Module and Rectifying Module on page 3-31)**.**

Table 2.E Rectifying Module Resistance Measurements

Measurement points	Resistance
X10: red to X10: black	18Ω ± 1Ω
X11: red to X11: black	
X12: red to X12: black	

8. Without applying power to X13 verify that there is no resistance between the following points: J3 and X9, J7 and X9, and J11 and X9. Refer to Rectifying Board Charge Relay Test Results on page 2-15. **If the Rectifying Module fails any of these tests, replace it** (See Removing the Right-Side Output Power Module and Rectifying Module on page 3-31)**.**

9. Connect the DC Test Power Supply to X13 (positive to pin 5 and common to pin 1). Raise the output of the DC Test Power Supply to 24V dc.

Important: Power supply polarity is critical during these tests. Reversing the polarity will damage components on the circuit board.

10. Verify that the voltage and resistance between the following points is zero: J3 and X10: Pin 1, J7 and X11: Pin 1, and J11 and X12: Pin 1. Refer to Rectifying Board Charge Relay Test Results on page 2-15. **If the Rectifying Module fails any of these tests, replace it** (See Removing the Right-Side Output Power Module and Rectifying Module on page 3-31)**.**

Figure 2.4 Rectifying board layout and measurement points

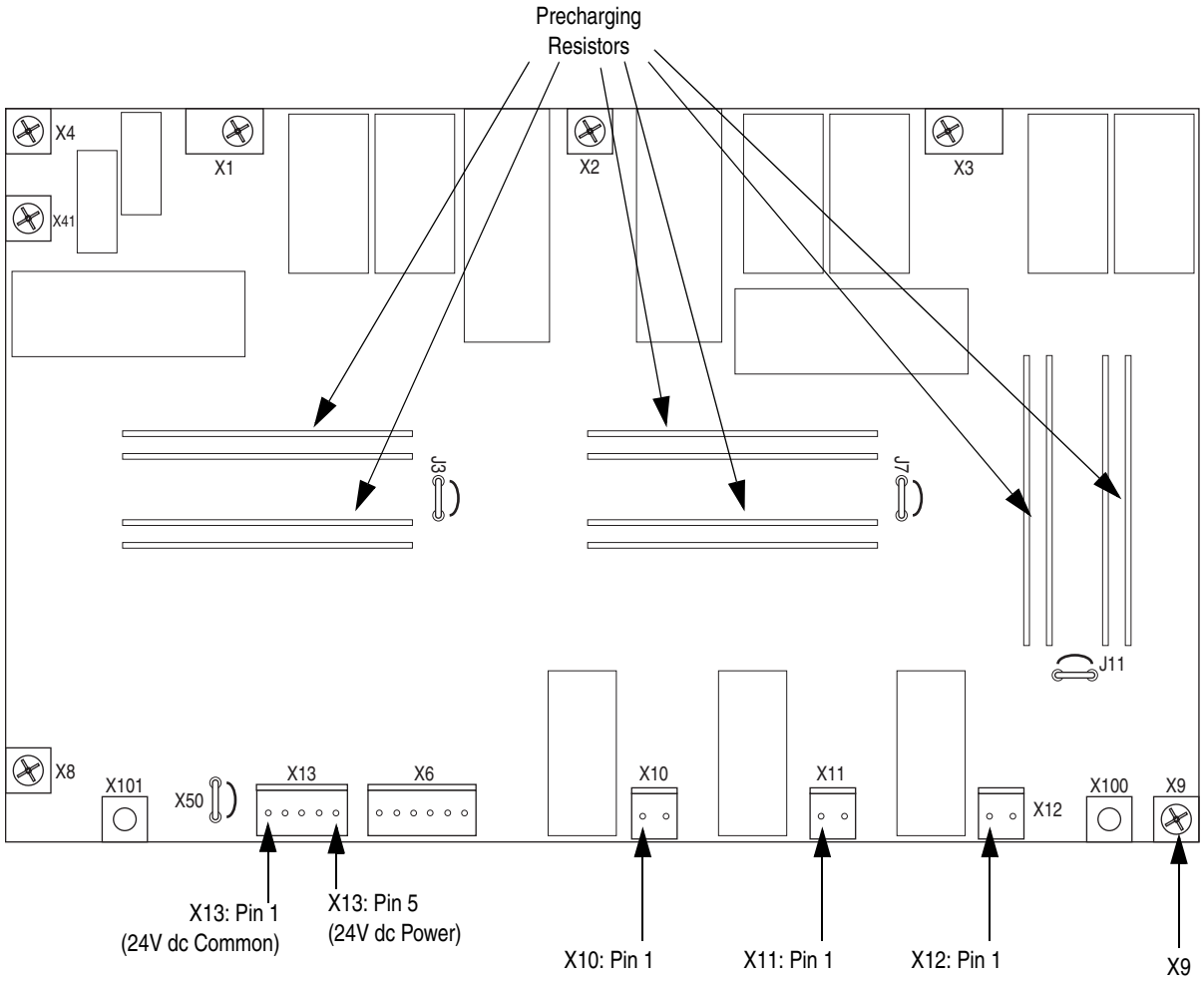


Table 2.F Rectifying Board Charge Relay Test Results

No Power on X13			24V dc Power on X13		
Meter Leads			Meter Leads		
+	-	Results	+	-	Results
J3	X9	0Ω	J3	X10: Pin 1	0Ω / 0V
J7	X9		J7	X11: Pin 1	
J11	X9		J11	X12: Pin 1	

Checking the DC Bus Capacitors

Important: This procedure requires special equipment and training. Only qualified and trained personnel should perform these procedures.

These tests require the recommended high voltage DC-power supply.

1. Remove power from the drive. Refer to Removing Power from Drive on page 3-3.
2. Remove the covers from the power structure. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Set the current limit of the DC power supply to less than 50mA.
4. Connect the power supply's DC+ to the drive's DC+ terminal and the power supply's DC- to the drive's DC- terminal.
5. Set the power supply voltage setting to zero.
6. Switch on the external DC power supply.
7. Slowly increase the external DC power supply output voltage to the drive's nominal DC bus voltage (650V dc for drives with 380-500V ac input or 775V dc for drives with 600-690V ac input).
8. Monitor the current while testing.
9. Leakage current should be less than 3mA when voltage has stabilized.
10. Abort test if current leakage is significantly higher when voltage has stabilized.
11. Decrease the DC power supply output voltage to zero. Wait until DC bus voltage has decreased to zero. Switch off the external DC power supply.
12. As a precaution, use a resistor to discharge each capacitor after testing. Use a resistor with the proper resistance and power handling capability for the discharge current.
13. If any capacitor has failed. Replace all the capacitors in the same series connection (See Removing Capacitors on page 3-38).

Checking the Main Fan Inverters and Fans

Checking Inverter LEDs

A frame 10 drive has two fans and two fan inverters. Each frame inverter has a red and a green diagnostic LED.

ATTENTION: The inverter LEDs are only operational when the drive is energized, and only visible with the covers removed from the power structure. Servicing energized equipment can be hazardous. Severe injury or death can result from electrical shock, burn or unintended actuation of controlled equipment. Follow Safety related practices of NFPA 70E, *ELECTRICAL SAFETY FOR EMPLOYEE WORKPLACES*. DO NOT work alone on energized equipment!

LED		
Red	**Green**	**Indication**
Steady	Steady	Inverter Idle
Off	Flashing	Inverter Running
Flashing	Steady	Inverter Faulted or No Control from ASIC Board

Checking Fan Inverter Fuses

A pair of fuses (F1 and F2) feed DC Bus power to both inverters. Locate these fuses and, using a multi-meter, verify that they are not open.

Isolating a Faulty Fan Inverter

The ASIC Board controls both fan inverters. A cable connects X11 on the ASIC Board to X8 on the left-hand inverter. Another cable connects X3 of the left-hand inverter to X8 on the right-hand inverter. A jumper terminates X3 on the right-hand inverter. Refer to Figure B.6 on page B-7. Use the following procedure to isolate a faulty inverter if the fans are not running:

1. Disconnect the cable from X3 of the left-hand inverter.
2. Remove the jumper from X3 of the right-hand inverter, and connect it to X3 of the left-hand inverter.
3. Energize the drive. If the left-hand fan runs, then the right-hand fan inverter is faulty.

Checking the Main Fan Motors

1. Remove power from the drive. Refer to Removing Power from Drive on page 3-3.
2. Remove the covers from the power structure. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Disconnect the left-hand fan motor from its inverter.
4. Measure the resistance of the fan windings. If the resulting measurements are not similar to those in Table 2.G below, replace the fan (See Removing the Main Fan on page 3-32).

Table 2.G Correct Fan Measurements

Connection Wires	Resistance ± 5%
Black-Brown	60
Brown-Blue	26
Blue-Black	34
Resistance to ground	.0L (Zero Load)

5. Reconnect the left-hand fan motor to its inverter.
6. Repeat steps 3-4 for the right-hand fan motor.

Access Procedures

ATTENTION: To avoid an electric shock hazard, ensure that all power to the drive has been removed before performing the following.

ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the DC+ & DC- terminals. The voltage must be zero.

ATTENTION: The sheet metal cover and mounting screws on the ASIC Board located on the power structure are energized at (-) DC bus potential high voltage. Risk of electrical shock, injury, or death exists if someone comes into contact with the assembly.

ATTENTION: HOT surfaces can cause severe burns. **Do not** touch the heatsink surface during operation of the drive. After disconnecting power allow time for cooling.

ATTENTION: Hazard of permanent eye damage exists when using optical transmission equipment. This product emits intense light and invisible radiation. Do not look into fiber-optic ports or fiber-optic cable connectors.

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 A-B publication 8000-4.5.2, “Guarding Against Electrostatic Damage” or any other applicable ESD protection handbook.

Torque Specifications

The following table lists fastener torque specifications:

Item	Screw	Final Torque
DPI / HIM Assembly Door	M3 x 6 Phillips®	0.9 N-m (8 lb.-in.)
DPI / HIM Assembly (mounting)	M3 x 6 Phillips	0.9 N-m (8 lb.-in.)
700S Power Interface Circuit Board (mounting)	M3 x 6 Phillips	0.9 N-m (8 lb.-in.)
700H I/O and Control Assembly	M4 x 8 self-tapping	0.8 N-m (7 lb.-in.)

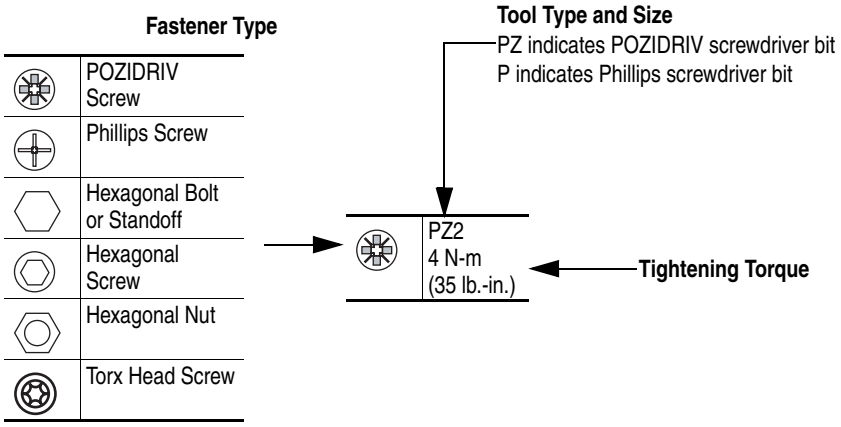
Item	Screw	Final Torque
700H Fiber Optic Adapter Board (mounting)	 M4 x 8 POZIDRIV ®	0.9 N-m (8 lb.-in.)
700S Voltage Feedback Circuit Board (mounting)	 M3 x 6 Phillips	0.9 N-m (8 lb.-in.)
AC Input Terminals on Power Structure	 M10 nut	40 N-m (354 lb.-in.)
Motor Output Terminals on Power Structure	 M8 x 20 hexagonal screw	20 N-m (177 lb.-in.)
Main Fan (Mounting)	 M6 x 20 POZIDRIV	3 N-m (27 lb.-in.)
Main Fan	 M4 x 8 POZIDRIV	1.7 N-m (15 lb.-in.)
Touch Cover (Main Fan)	 M5 x 16	3 N-m (27 lb.-in.)
ASIC Fan	 M4 x 16 POZIDRIV	0.4 N-m (3.5 lb.-in.)
Rectifier board (Mounting)	 M4 x 8 POZIDRIV	1 N-m (9 lb.-in.)
Output Power Module Output Terminals (U,V,W)	 M8 x 20 hexagonal screw	14 N-m (124 lb.-in.)
Rectifying Module Input Terminals (L1,L2,L3)	 M10 x 20 hexagonal screw	12 N-m (106 lb.-in.)
Y-Bus Bar	 M10 nut	40 N-m (354 lb.-in.)
Capacitor	 M4 x 8 self tapping	1 N-m (9 lb.-in.)
Capacitor Bus Bar	 M6 x 16 POZIDRIV	4 N-m (35 lb.-in.)
Capacitor Bus Bar	 M6 x 20 POZIDRIV	4 N-m (35 lb.-in.)
DC- / DC+ Terminals	 M6 x 20 POZIDRIV	5 N-m (44 lb.-in.)
Block (Mounting)	 M10 x 12 hexagonal screw	20 N-m (177 lb.-in.)
700S Voltage Feedback Circuit Board (mounting)	 M3 x 0.5 thread - 37 mm x 37 mm hex standoff	0.9 N-m (8 lb.-in.)

POZIDRIV® is a registered trademark of the Phillips Screw Company

Phillips® is a registered trademark of Phillips Screw Company

Understanding Torque Figures in Assembly Diagrams

Icons and numbers in the assembly diagrams indicate how to tighten hardware:



Removing Power from Drive

ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the DC+ & DC- terminals. The voltage must be zero.

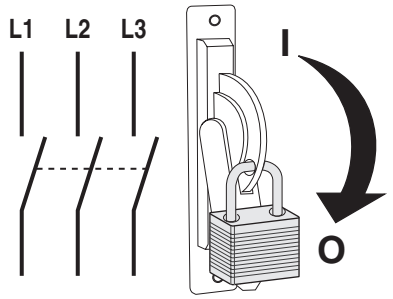
Remove power before making or breaking cable connections. When you remove or insert a cable connector with power applied, an electrical arc may occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system's field devices, causing unintended machine motion
- causing an explosion in a hazardous environment

Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.

Removing Power

1. Turn off and lock out input power. Wait five minutes.
2. Verify that there is no voltage at the drive's input power terminals.
3. Measure the DC bus voltage at the DC+ & DC- terminals on the Power Terminal Block. The voltage must be zero.



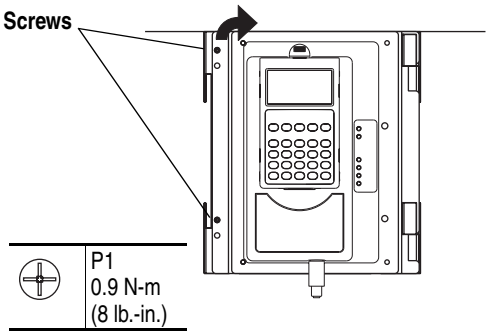
Removing the DPI / HIM Assembly

Removal

1. Remove power from the drive (Removing Power from Drive on page 3-3).

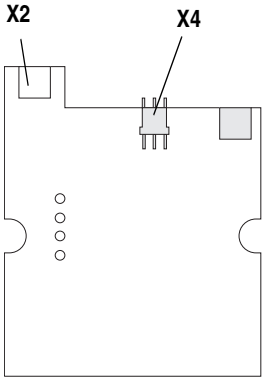
Important: Before removing connections and wires, mark the connections and wires to avoid incorrect wiring during assembly.

2. Remove the two screws from front of DPI / HIM assembly.



3. Open the door, which holds the DPI interface and HIM.

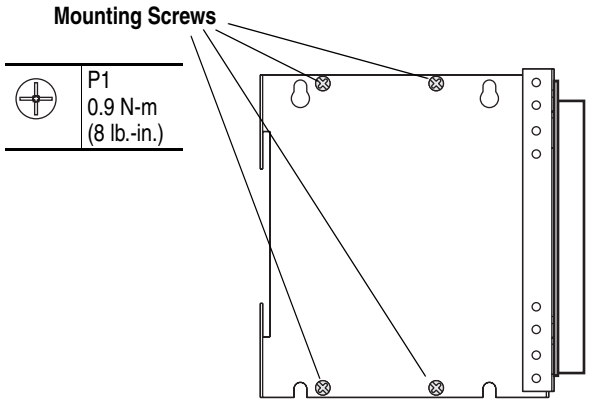
4. Unplug the DPI cable from X2 connector on the DPI Interface Circuit Board.



Back view of DPI Circuit Board which should remain mounted on the back of the assembly

5. On 700S drives only, unplug the cable from X4 connector on the circuit board.

6. Remove the four mounting screws and the assembly from the Control Frame.

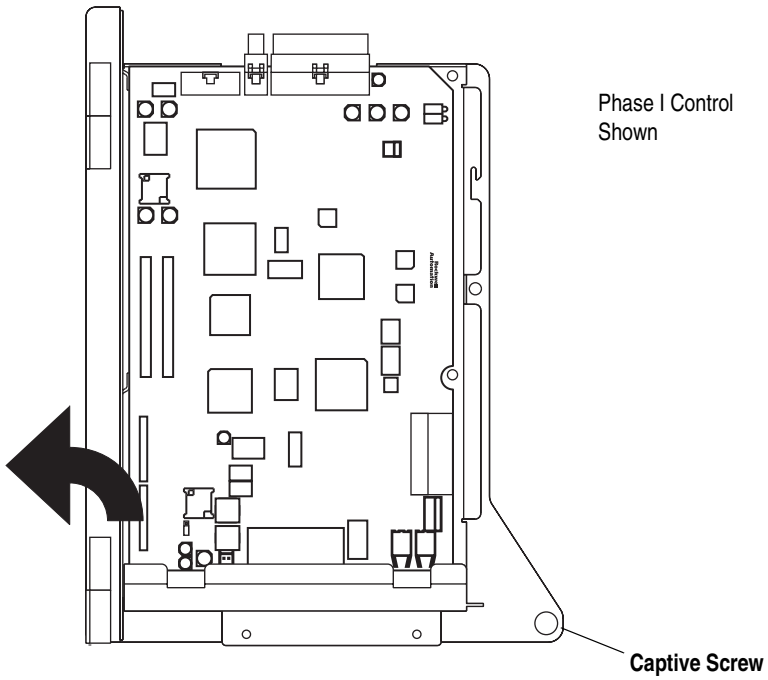


Installation

Install the DPI / HIM Assembly in reverse order of removal, while referring to Torque Specifications on page 3-1.

Removing 700S Control Assembly

Removal



1. Remove power from the drive (Removing Power from Drive on page 3-3).

Important: Before removing connections and wires, mark the connections and wires to avoid incorrect wiring during assembly.

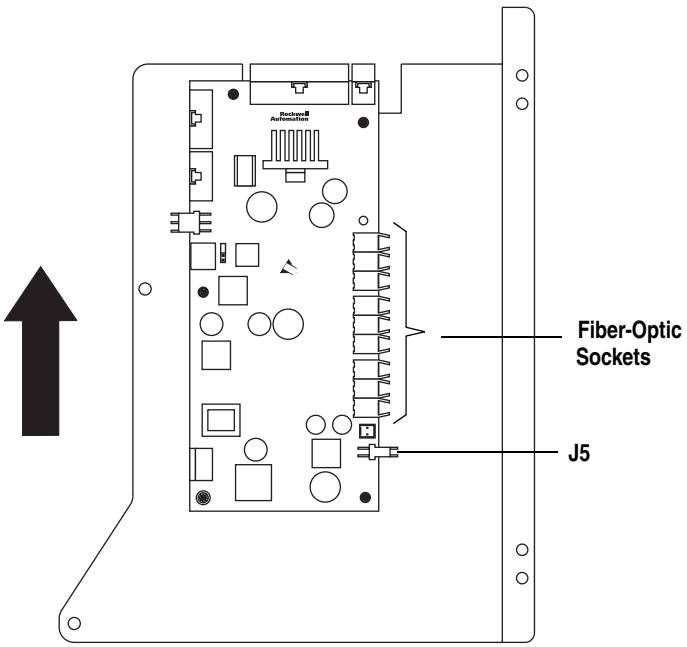
2. Unplug any fiber optic ControlNet and SynchLink cables from the Control Assembly.

ATTENTION: Hazard of permanent eye damage exists when using optical transmission equipment. This product emits intense light and invisible radiation. Do not look into fiber-optic ports or fiber-optic cable connectors.

Important: Minimum inside bend radius for SynchLink and ControlNet fiber-optic cable is 25.4 mm (1 in.). Any bends with a shorter inside radius can permanently damage the fiber-optic cable. Signal attenuation increases with decreased inside bend radii.

3. Unplug any remaining I/O and communications cables from the Control Assembly and set them aside.

4. Loosen the captive screw.
5. Swing the Control Assembly away from drive.



6. Carefully disconnect the fiber-optic cables from sockets along the right side of the Power Interface Circuit Board (on the backside of the Control Assembly), and carefully set them aside.

ATTENTION: Hazard of permanent eye damage exists when using optical transmission equipment. This product emits intense light and invisible radiation. Do not look into fiber-optic ports or fiber-optic cable connectors.

Important: Minimum inside bend radius for fiber-optic cable is 25.4 mm (1 in.). Any bends with a shorter inside radius can permanently damage the fiber-optic cable. Signal attenuation increases with decreased inside bend radii.

7. Disconnect the other cables from sockets of the Power Interface Circuit Board, and set them aside.
8. Lift the Control Assembly up and off of hinge.

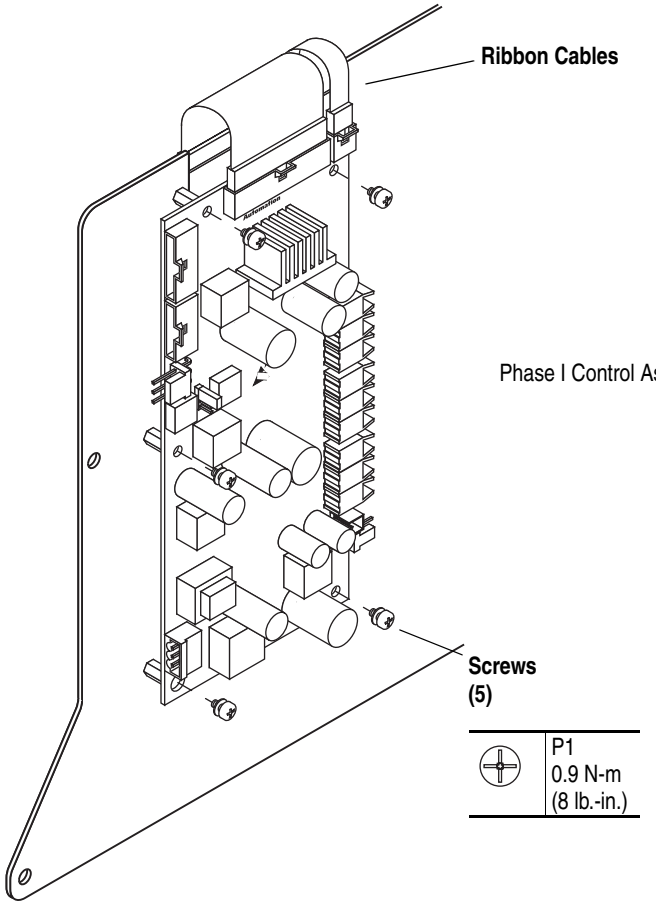
Installation

Install the 700S Control Assembly in reverse order of removal, while referring to Torque Specifications on page 3-1.

Removing 700S Power Interface Circuit Board

Removal

1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Remove the 700S Control Assembly (Removing 700S Control Assembly on page 3-7).



3. Carefully disconnect the ribbon cables from sockets on the Power Interface Circuit Board, and carefully set them aside.
4. Remove the five screws which secure the Power Interface Circuit Board to the Control Frame.
5. Remove the circuit board from the Control Frame.

Installation

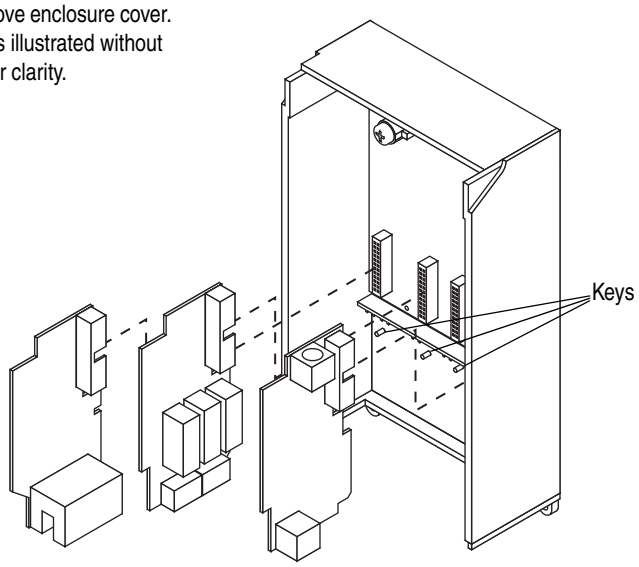
Install the 700S Power Interface Circuit Board in reverse order of removal, while referring to Torque Specifications on page 3-1.

Removing the 700H I/O Boards and Control Assembly

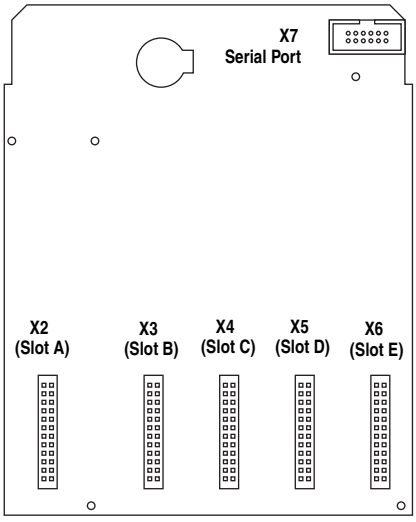
Removal

1. Remove power from the drive. Refer to Removing Power from Drive on page 3-3.
2. Open the enclosure that contains the Control and I/O Boards and carefully unplug the DPI cable and any I/O cables.
3. Remove the I/O Boards from the Control Board and enclosure. Note the order of the boards and the keys which prevent placement of boards in incorrect slots.

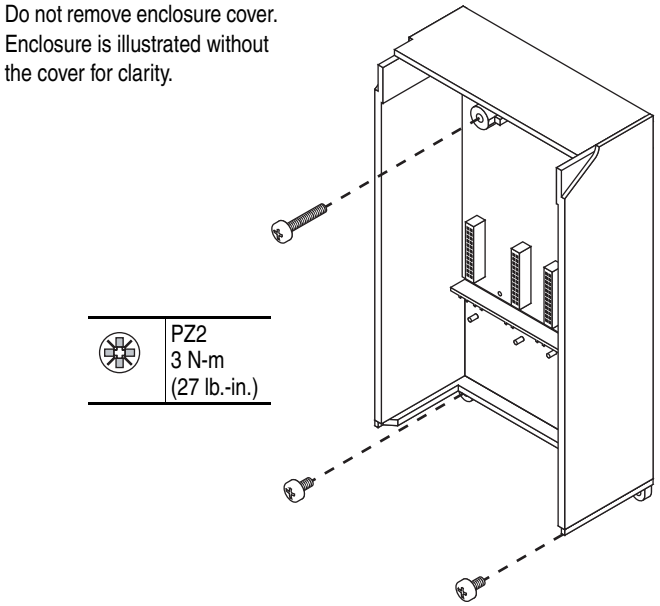
Do not remove enclosure cover. Enclosure is illustrated without the cover for clarity.



4. Unplug the serial connection from X7 of the Control Board.



5. Remove the three screws which secure the Control Assembly to the drive.



6. Remove the Control Assembly.

Installation

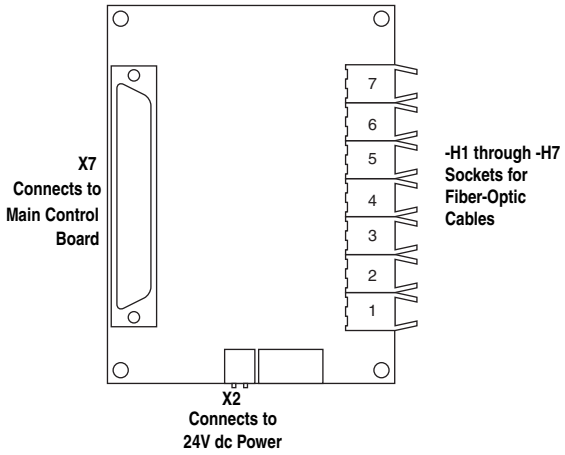
Install the 700H Control and I/O Boards in reverse order of removal, while referring to Torque Specifications on page 3-1.

Removing the 700H Fiber Optic Adapter Board

Removal

1. Remove power from the drive. Refer to Removing Power from Drive on page 3-3.
2. Referring to Removing the 700H I/O Boards and Control Assembly on page 3-10, remove the I/O boards and Control Assembly.
3. Move the Control Frame to expose its back, while referring to Removing the Covers from the Power Structure on page 3-14.

4. Disconnect the control power cable from X2 of the Fiber Optic Adapter Board.

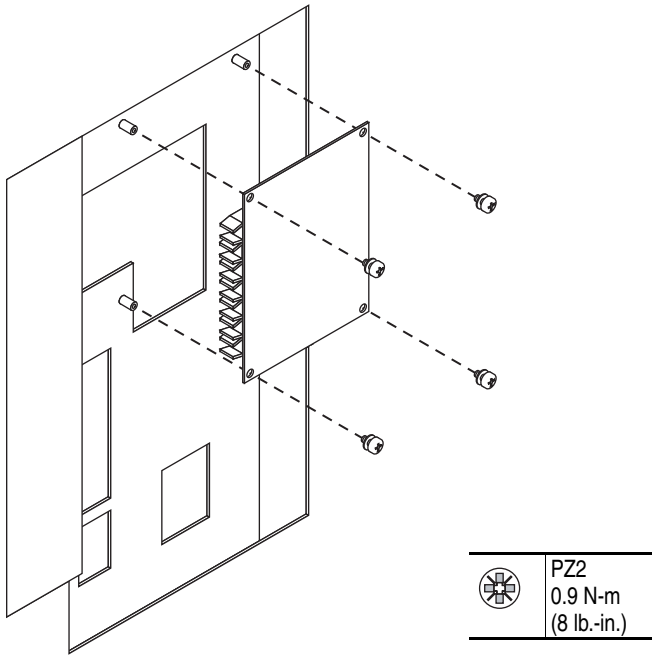


5. Carefully disconnect the fiber-optic cables from right side of the circuit board, and carefully set them aside.

ATTENTION: Hazard of permanent eye damage exists when using optical transmission equipment. This product emits intense light and invisible radiation. Do not look into fiber-optic ports or fiber-optic cable connectors.

Important: Minimum inside bend radius for fiber-optic cable is 25.4 mm (1 in.). Any bends with a shorter inside radius can permanently damage the fiber-optic cable. Signal attenuation increases with decreased inside bend radii.

6. Remove the four screws which secure the Fiber Optic Adapter bracket to the stand-offs on the back of the Control Frame.



	PZ2 0.9 N-m (8 lb.-in.)

7. Remove the Fiber Optic Adapter Board from the Control Frame.

Installation

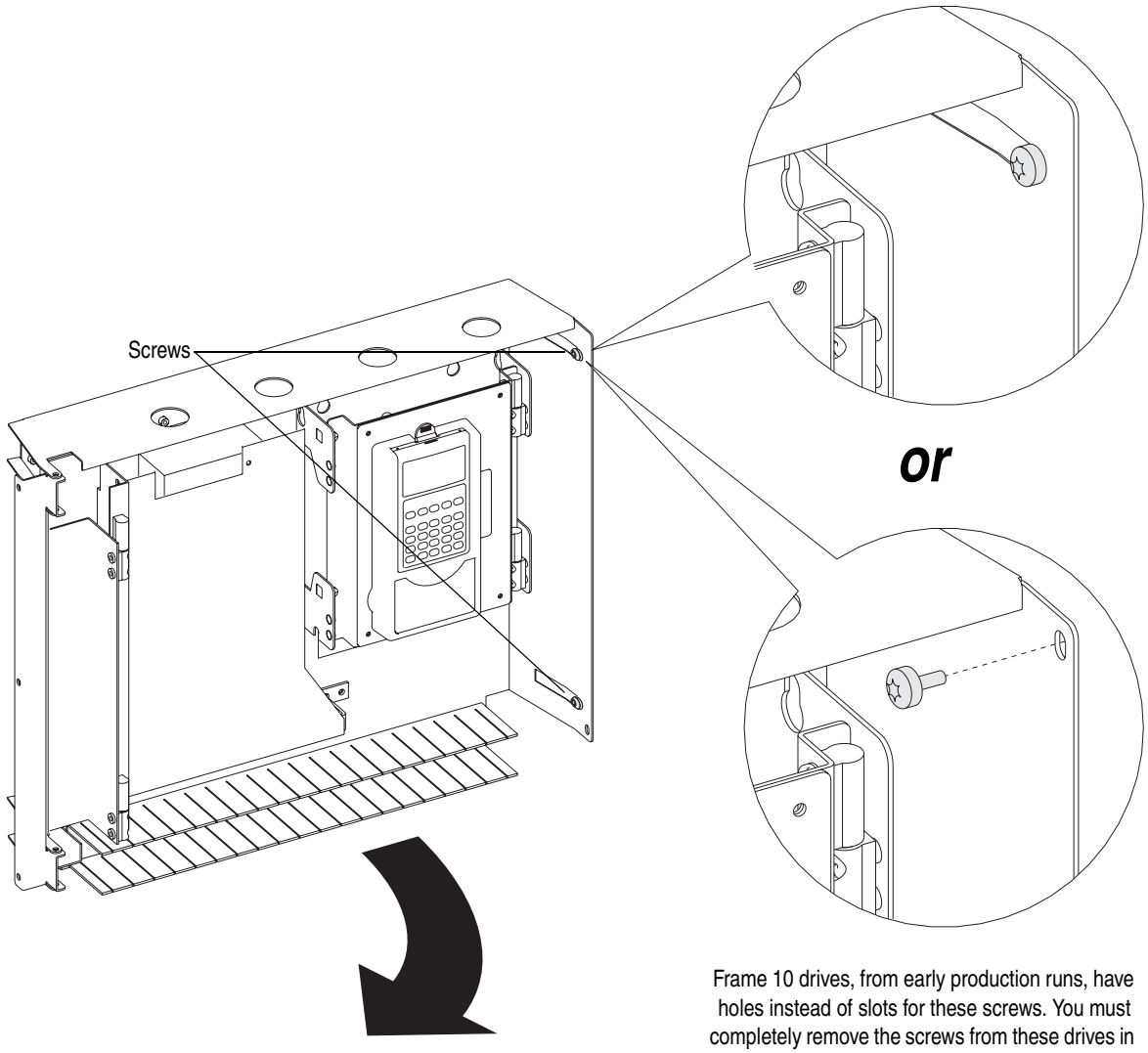
Install the 700H Fiber Optic Adapter Board in reverse order of removal, while referring to Torque Specifications on page 3-1.

Removing the Covers from the Power Structure

Moving Control Frame

Removal

1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Loosen the T8 Torx-head screws, which secure the Control Frame to the drive enclosure (Remove screws on early frame 10 drives).
3. Swing the Control Frame out and away from the power structure.



Frame 10 drives, from early production runs, have holes instead of slots for these screws. You must completely remove the screws from these drives in order to swing-open the control frame.

Installation

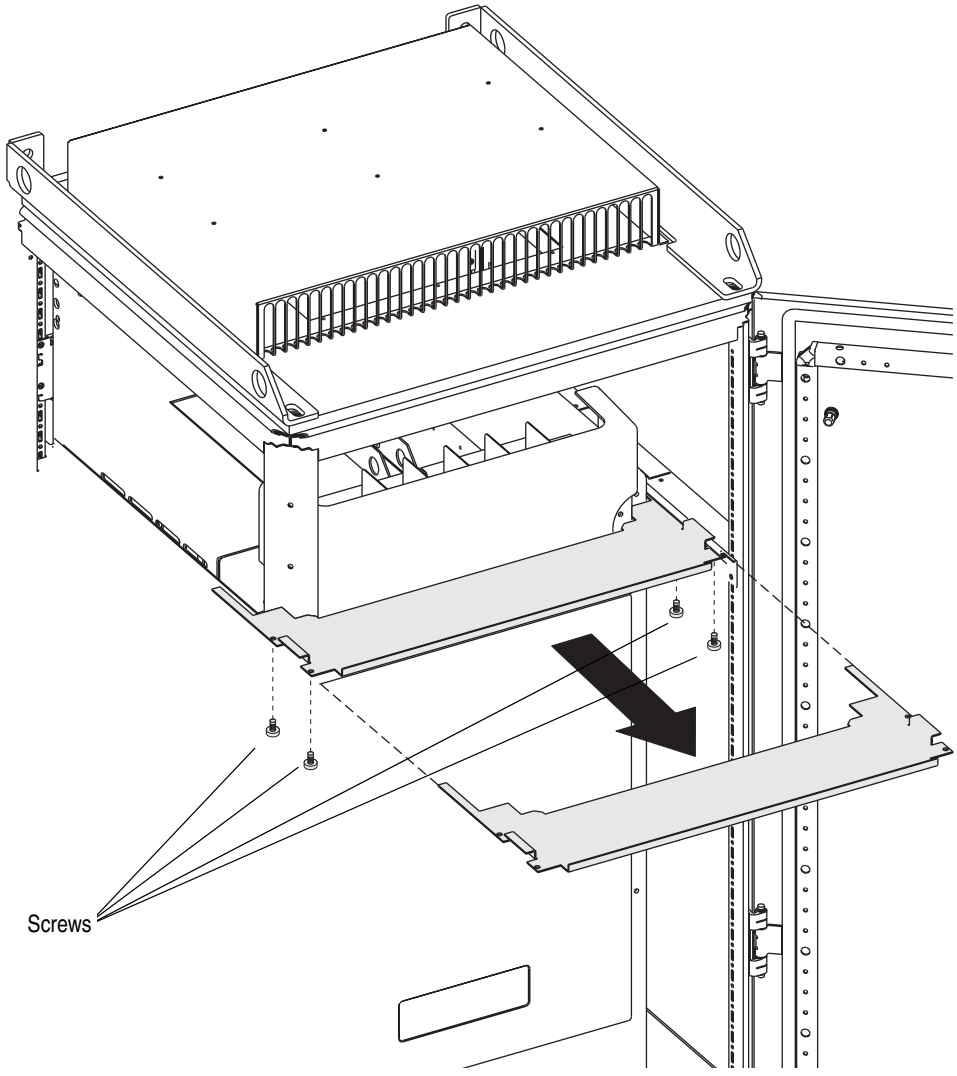
Install the Control Frame in reverse order of removal, while referring to Torque Specifications on page 3-1.

Removing the Airflow Plate

The drive is equipped with a plate, just above the Control Frame, that manages airflow through the drive. You must remove this plate in order to access the protective covers.

Removal

1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Move the Control Frame away from the power structure (Removing the Covers from the Power Structure on page 3-14).



3. Remove the T8 Torx-head screws which secure the airflow plate to the drive.
4. Slide airflow plate off of drive.

Installation

Install the Airflow Plate in reverse order of removal, while referring to Torque Specifications on page 3-1.

Removing Protective Covers from Power Structure

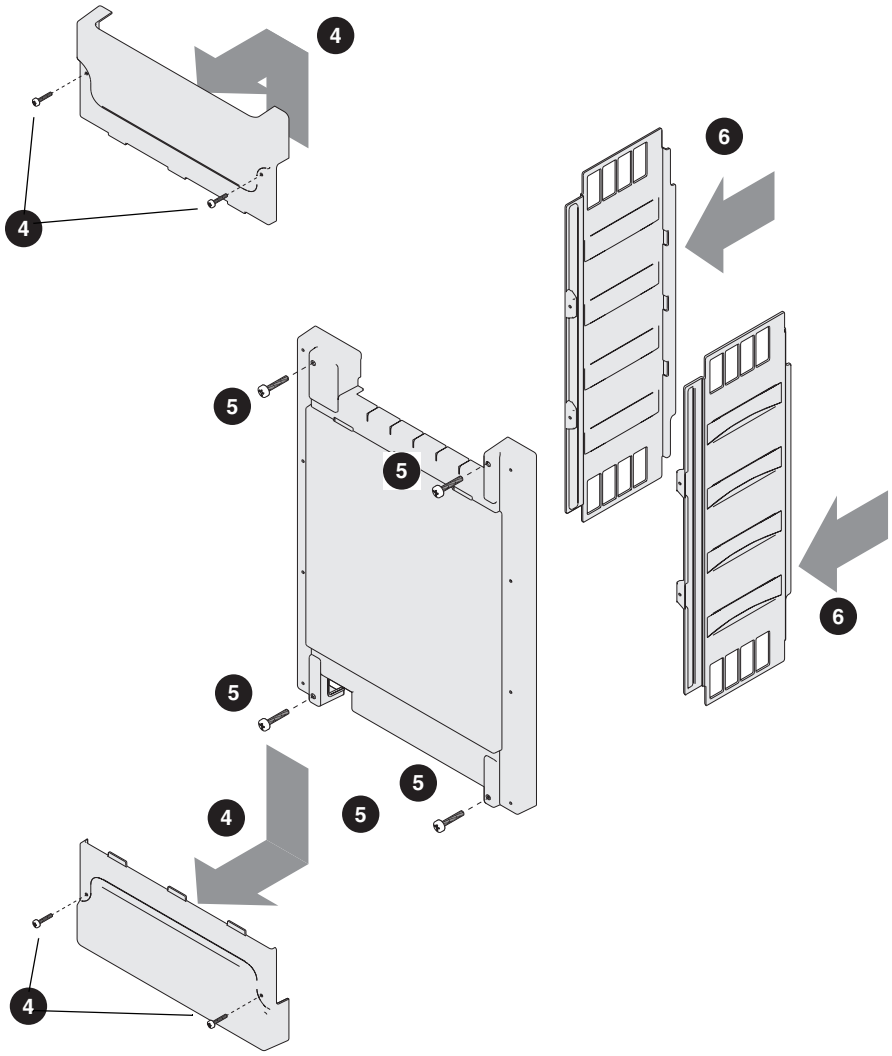
You must remove the protective covers to gain access to the power structure.

Removal

1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Move the Control Frame away from the power structure (Removing the Covers from the Power Structure on page 3-14).
3. Remove the Airflow Plate (Removing the Airflow Plate on page 3-15).
4. Remove the four M5 Pozi-drive screws, which secure the top and bottom protective covers to the main front protective cover, then remove the top and bottom protective covers.

   Note: *you only need to remove the top and bottom covers to gain access to the power terminals. You can remove the other covers without removing the top and bottom ones*
5. Remove the four M5 Pozi-drive screws, which secure the main front protective cover to the drive, then remove the protective cover.

6. Remove the side protective covers.



Installation

Install the Protective Covers in reverse order of removal, while referring to Torque Specifications on page 3-1.

Removing 700S Voltage Feedback Circuit Board

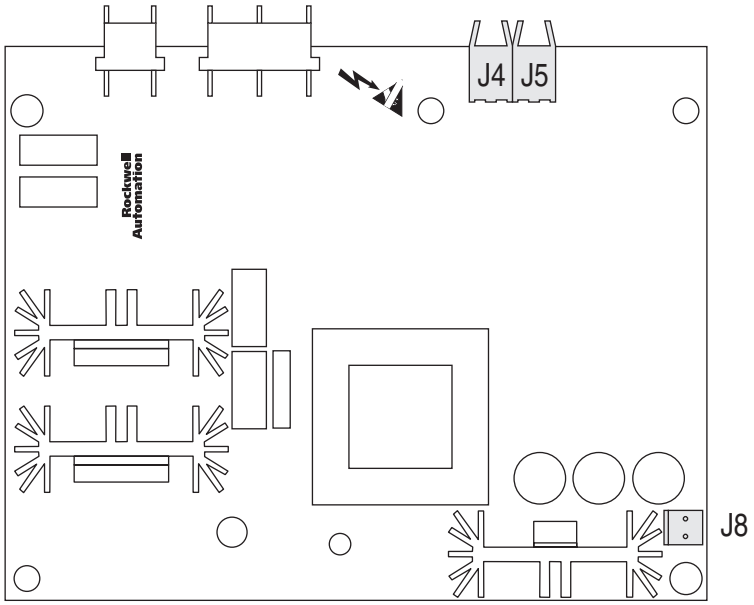
Removal

1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Remove the covers from the power structures. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Carefully disconnect the fiber-optic cables from J4 and J5 sockets along the top of the Voltage Feedback Circuit Board, and carefully set them aside.

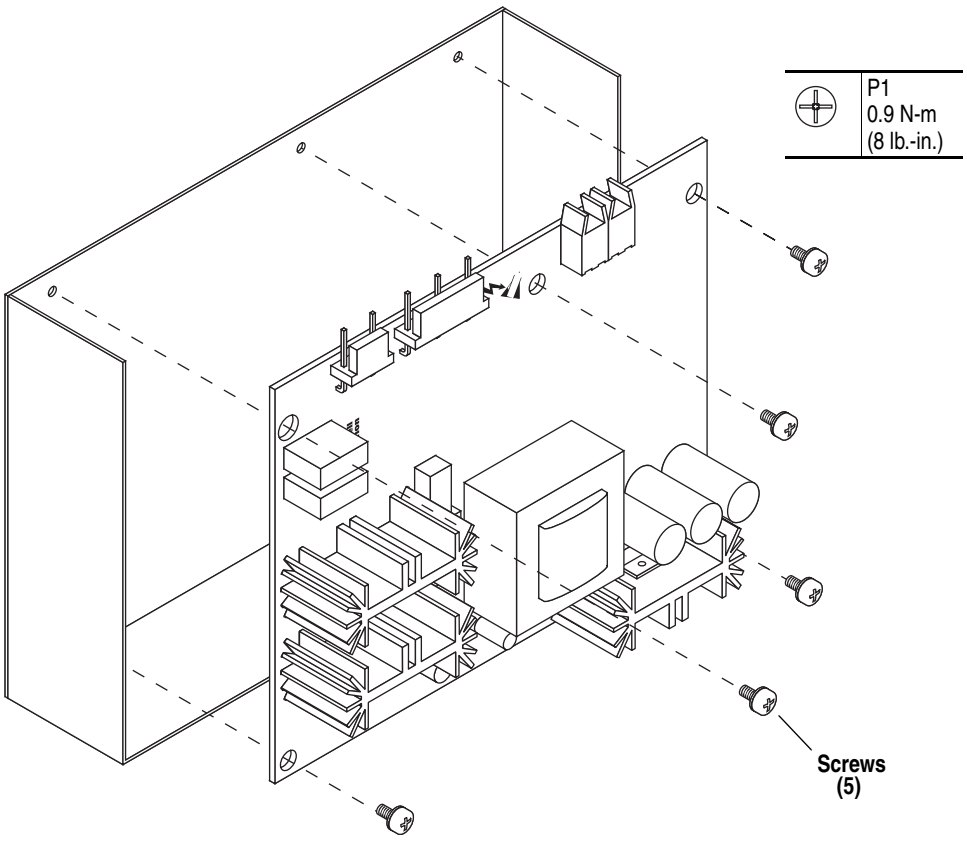
ATTENTION: Hazard of permanent eye damage exists when using optical transmission equipment. This product emits intense light and invisible radiation. Do not look into fiber-optic ports or fiber-optic cable connectors.

Important: Minimum inside bend radius for fiber-optic cable is 25.4 mm (1 in.). Any bends with a shorter inside radius can permanently damage the fiber-optic cable. Signal attenuation increases with decreased inside bend radii.

4. Disconnect the cable from J8 socket of the Voltage Feedback Circuit Board, and set it aside.



5. Remove the five screws which secure the Voltage Feedback Circuit Board to the drive.
6. Remove the circuit board from the drive.



Installation

Install the 700S Voltage Feedback Circuit Board in reverse order of removal, while referring to Torque Specifications on page 3-1.

Removing Gate Driver Board and Adapter Board

Removal

1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Remove the covers from the power structures. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Disconnect the wires from the fuse block, which holds the fuses for the Fan Inverters. Then remove the fuses.
4. Remove the screws, which secure the fuse block to the bracket beneath it, and remove the fuse block.

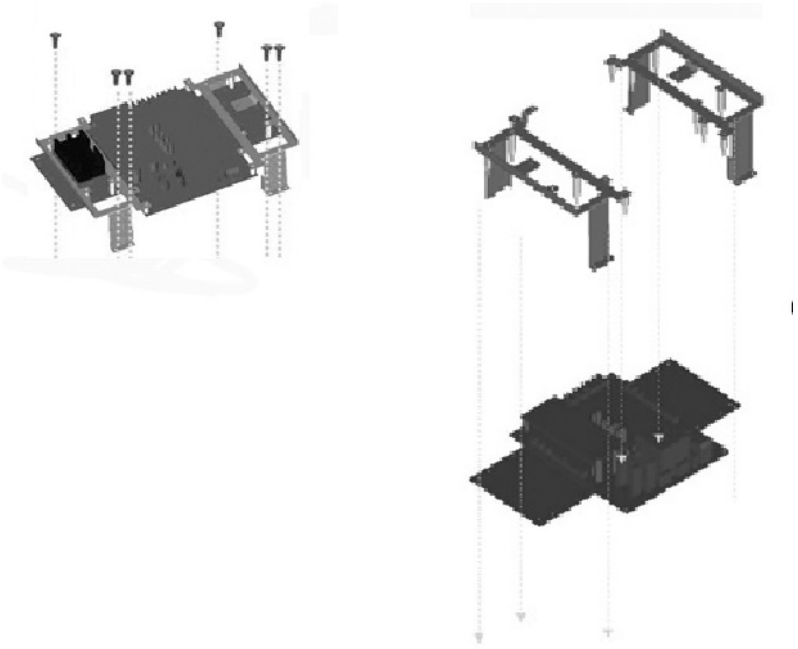
5. Carefully disconnect the fiber-optic cables from sockets along the top of the Gate Driver Board, and carefully set them aside.

ATTENTION: Hazard of permanent eye damage exists when using optical transmission equipment. This product emits intense light and invisible radiation. Do not look into fiber-optic ports or fiber-optic cable connectors.

Important: Minimum inside bend radius for fiber-optic cable is 25.4 mm (1 in.). Any bends with a shorter inside radius can permanently damage the fiber-optic cable. Signal attenuation increases with decreased inside bend radii.

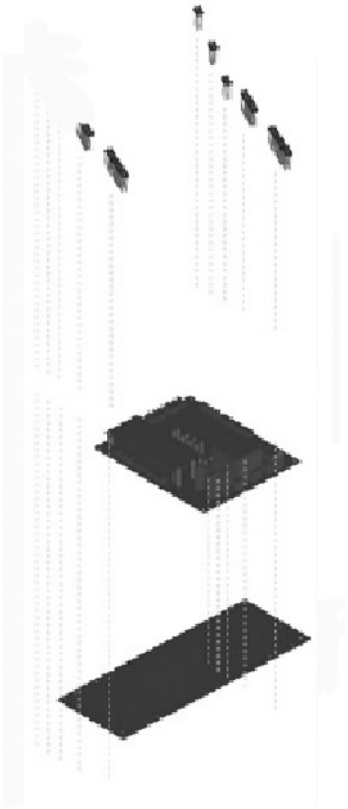
6. Disconnect the other cables from sockets of the Gate Driver Board, and set them aside.

7. Remove the six (6) screws which secure the brackets to the drive. Then remove the brackets.



8. Remove the eight of the stacker connectors from the Gate Driver Board, leaving the two smaller ones which are third from the top.

9. Carefully remove the board and the remaining connectors.



10. Remove the cable ties that secure the Adapter Board to the circuit boards on the Output Power Modules, and remove the Adapter Board.

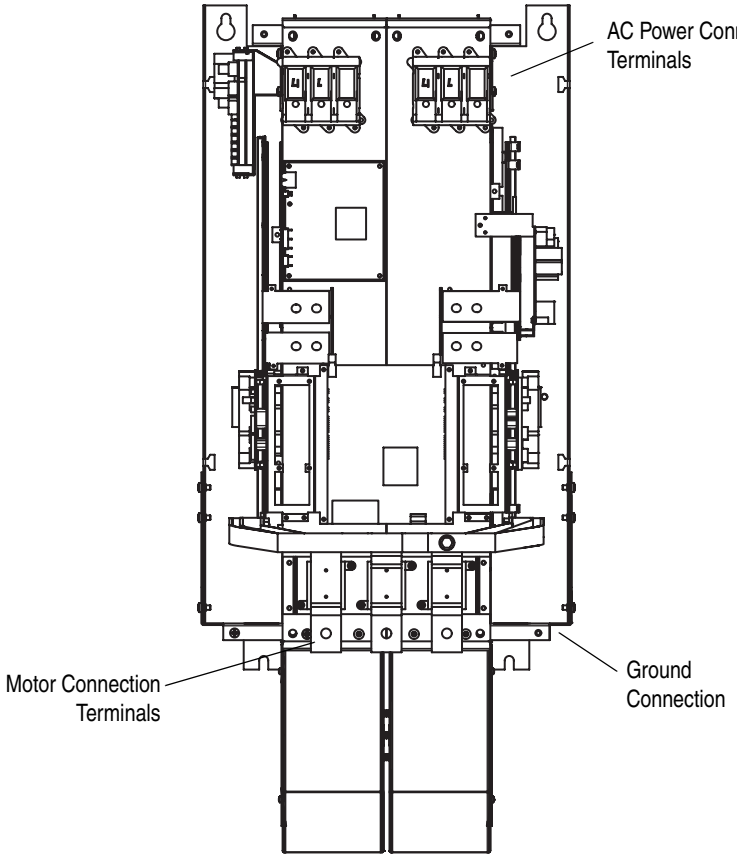
Installation

1. Replace the Adapter Board and install the cable ties, which secure it to the circuit boards on the Output Power Modules.
2. Plug the old stacker connectors into the new Gate Driver Board so the pins do not protrude through the connectors on the back of the board.
3. Align the Gate Driver Board so that its connectors align with the mating connectors on the Adapter Board.
4. While supporting the Adapter Board from behind, press the Gate Driver Board onto it.
5. Verify the proper alignment of the mounting with a mirror. Verify that none of the pins in the stacker connectors have missed the mating connectors.
6. Install the brackets, and install and tighten the mounting screws.
7. Connect all of the cables on the new Gate Driver Board.

Removing the Power Structure from the Drive Cabinet

Removal

1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Remove the covers from the power structures. Refer to Removing the Covers from the Power Structure on page 3-14.



3. Remove the motor wiring from the power structure at the front of the power structure.
4. Remove the ground connection from the lower right rear corner of the power structure.
5. Remove the input (AC or DC) and brake wiring (if equipped) from the incoming terminals at the top of the power structure.
6. Follow the instructions in publication PFLEX-IN014, *Installation Instructions - PowerFlex 700S /700H High Power Maintenance Stand*, to install the Maintenance Stand. Remove the power structure by sliding it onto the rails of the Maintenance Stand.

   Note: *The Maintenance Stand is designed for removing power structures from drives supplied in Rittal TS8 enclosures. Alternate means of removal will be necessary for other types of enclosures.*

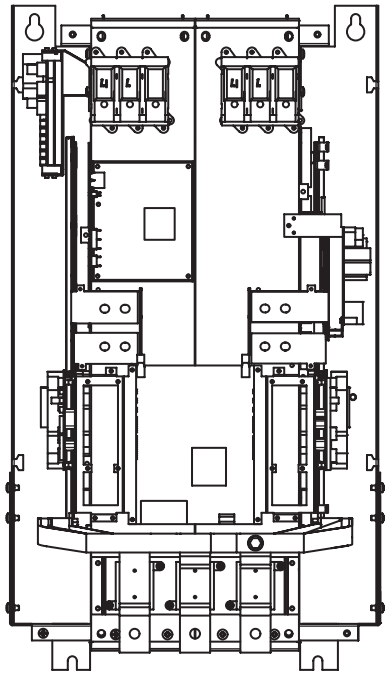
Installation

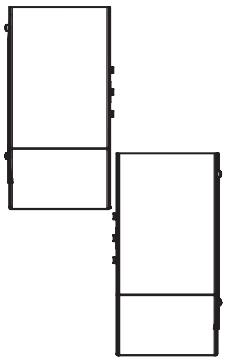
Install the power structure in reverse order of removal, while referring to Torque Specifications on page 3-1. Refer to the publication PFLEX-IN006…, *Installation Instructions - PowerFlex 700S and 700H High Power Drives*, for tightening torques of motor terminations.

Removing Main Fans

Removal

1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Remove the covers from the power structures. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Disconnect the fan cable connectors under the power structure.
4. Remove the two (2) screws which secure each fan to the drive (there are two fans and four screws). Then remove the fans.





Installation

Install the fans in reverse order of removal, while referring to Torque Specifications on page 3-1.

Removing the ASIC Board

Removal

ATTENTION: The sheet metal cover and mounting screws on the ASIC Board located on the power structure are energized at (-) DC bus potential high voltage. Risk of electrical shock, injury, or death exists if someone comes into contact with the assembly.

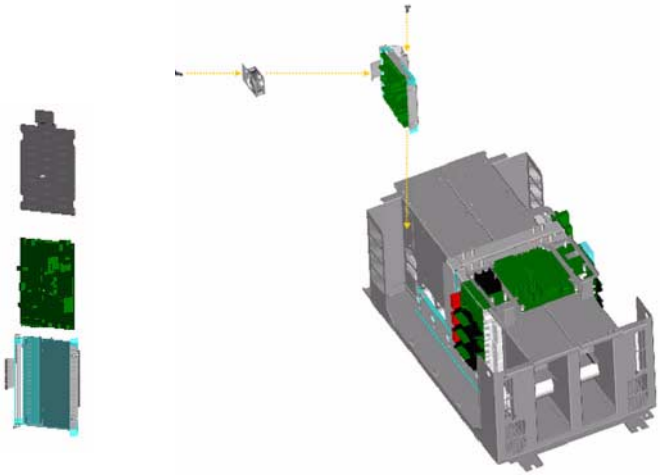
1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Remove the covers from the power structures. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Remove the cover from the ASIC assembly and the -DC bus connection from the cover.
4. Unplug the fan, which mounts on the cover, from connector X1 of the ASIC board.
5. Carefully disconnect the fiber-optic cables from sockets of the ASIC Board, and carefully set them aside.

ATTENTION: Hazard of permanent eye damage exists when using optical transmission equipment. This product emits intense light and invisible radiation. Do not look into fiber-optic ports or fiber-optic cable connectors.

Important: Minimum inside bend radius for fiber-optic cable is 25.4 mm (1 in.). Any bends with a shorter inside radius can permanently damage the fiber-optic cable. Signal attenuation increases with decreased inside bend radii.

6. Disconnect the other cables from sockets on the front of the ASIC Board, and set them aside.

7. Remove the fan from the ASIC Board.



8. Slide the ASIC Board assembly out of its chassis.

9. Remove the plastic board holder.

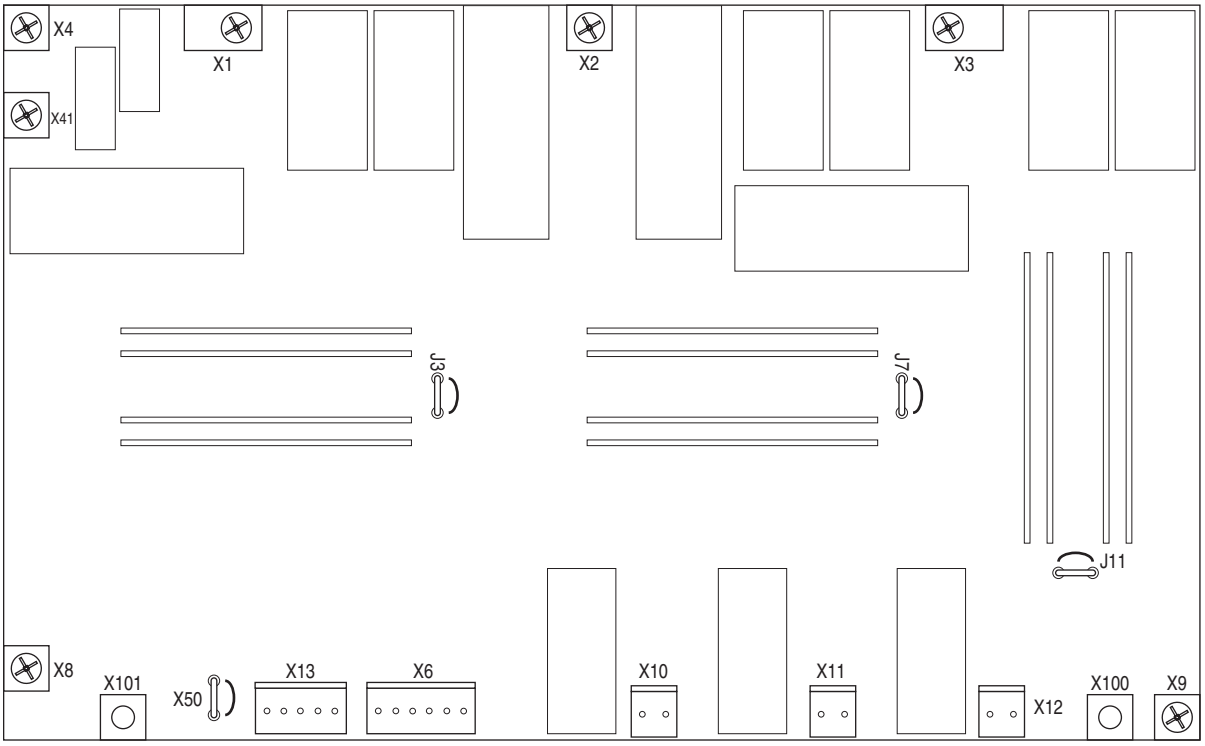
Installation

Install the ASIC Board in reverse order of removal, while referring to Torque Specifications on page 3-1. Reconnect cables to ASIC Board, while referring to (refer to Figure B.3 on page B-4, Figure B.4 on page B-5 or Figure B.5 on page B-6).

Removing the Rectifying Board

Removal

1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Remove the covers from the power structures. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Disconnect all the wiring from the Rectifying Board and carefully set it aside.
4. Remove the screws that secure the circuit board to the Rectifying Module, and remove the board.



Installation

Install the Rectifying Board in reverse order of removal, while referring to Torque Specifications on page 3-1.

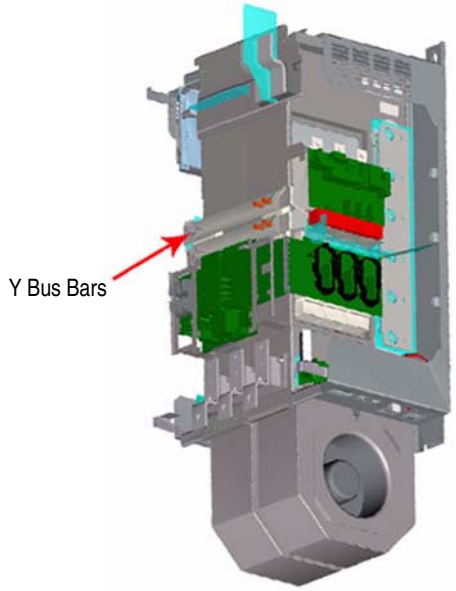
Removing the Left-Side Output Power Module

Removal

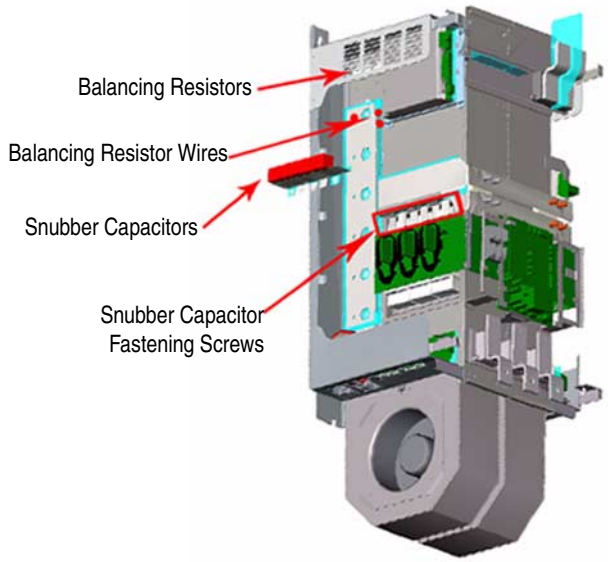
Important: Do not attempt to disassemble the Output Power Module.

Important: Always replace the Output Power Modules in pairs (do not replace just one module).

1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Remove the covers from the power structures. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Remove the power structure from the drive cabinet (Removing the Power Structure from the Drive Cabinet on page 3-23).
4. Remove the cable-tie which secures the Power Module Circuit Board to the Adapter Board.
5. Disconnect the output leads from the bottom of the Output Power Module.
6. Remove the Y Bus Bars.

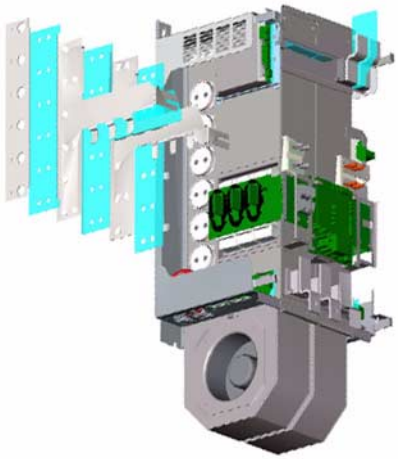


7. Remove the balancing resistor wires from bus bars.



8. Remove the screws that secure the Snubber Capacitors, and remove the Snubber Capacitors.

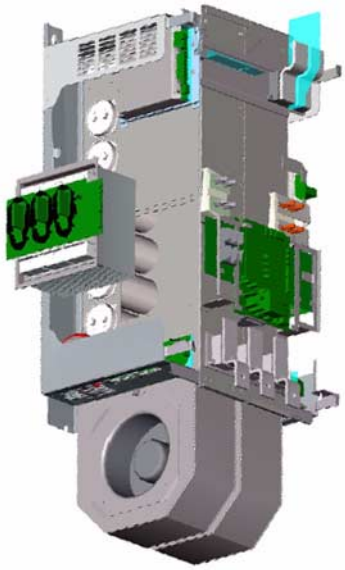
9. Remove the screws that secure the DC Bus Bars to the left side of the power structure, and remove the DC Bus Bars.



10. Remove the screws which secure the Output Power Module to the drive.

11. Disconnect the Power Module Circuit Board from the Adapter Board.

12. Remove the Output Power Module from the drive.



Installation

Install the Output Power Module in reverse order of removal, while referring to Torque Specifications on page 3-1.

Removing the Right-Side Output Power Module and Rectifying Module

Removal

Important: Do not attempt to disassemble the Output Power Module.

Important: Always replace the Output Power Modules in pairs (do not replace just one module).

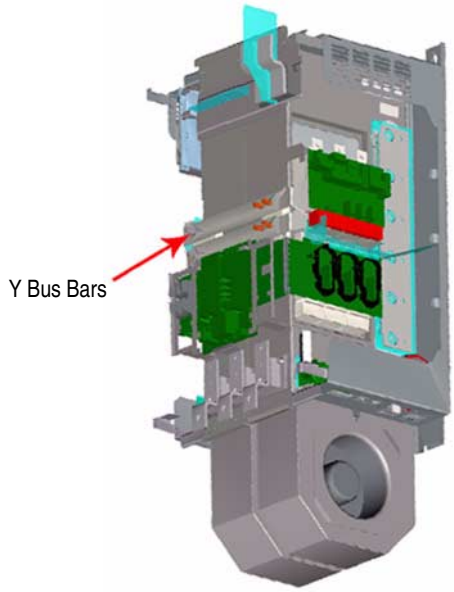
1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Remove the covers from the power structures. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Remove the power structure from the drive cabinet (Removing the Power Structure from the Drive Cabinet on page 3-23).
4. Carefully disconnect the fiber-optic cables from the Gate Driver Board, and carefully set them aside.

ATTENTION: Hazard of permanent eye damage exists when using optical transmission equipment. This product emits intense light and invisible radiation. Do not look into fiber-optic ports or fiber-optic cable connectors.

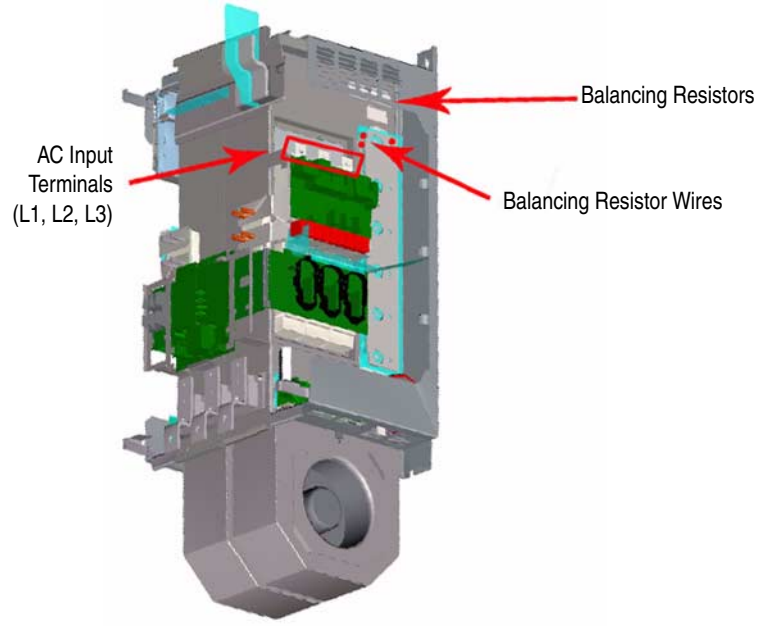
Minimum inside bend radius for fiber-optic cable is 25.4 mm (1 in.). Any bends with a shorter inside radius can permanently

5. Remove the cables from X13, X14 and X15 sockets on the Gate Driver Board, and carefully set them aside. Also, disconnect DC Bus wiring from the Gate Driver Board.
6. Remove the cable-tie which secures the Power Module Circuit Board to the Adapter Board.
7. Disconnect the output leads from the bottom of the Output Power Module.

8. Remove the Y Bus Bars.



9. Remove the balancing resistor wires from bus bars.

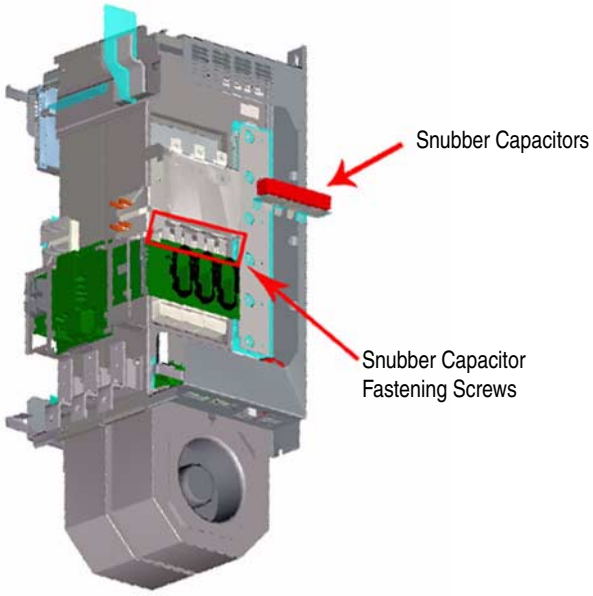


10. Disconnect all wiring from the circuit board on the Rectifying Module.

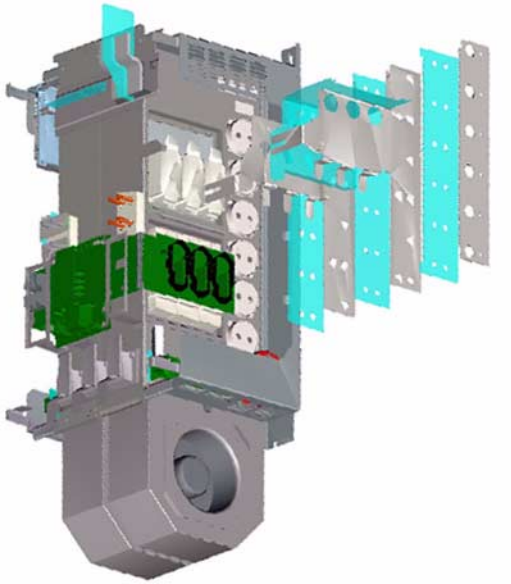
11. Disconnect the cables from the AC input terminals on the Rectifying Module.

12. Remove the circuit board from the Rectifying Module (refer to Removing the Rectifying Board on page 3-27).

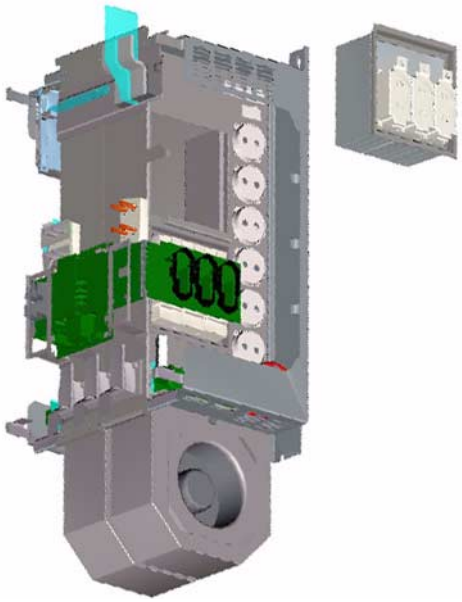
13. Remove the screws that secure the Snubber Capacitors, and remove the Snubber Capacitors.



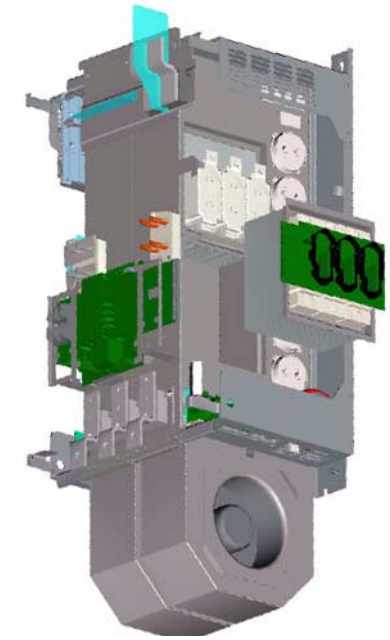
14. Remove the screws that secure DC Bus Bars to right side of power structure, and remove the DC Bus Bars.



15. Remove the screws that secure the Rectifying Module to the power structure, and remove the Rectifying Module.



16. Remove the screws that secure the Output Power Module to the power structure, and remove the Output Power Module.



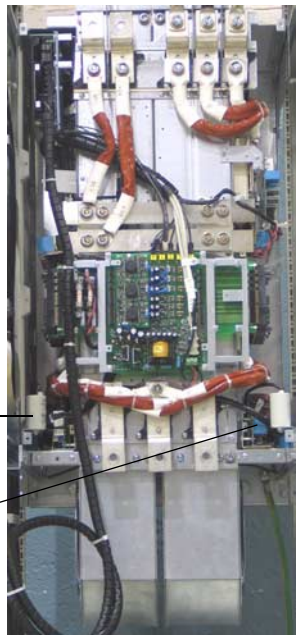
Installation

Install the Output Power Module in reverse order of removal, while referring to Torque Specifications on page 3-1.

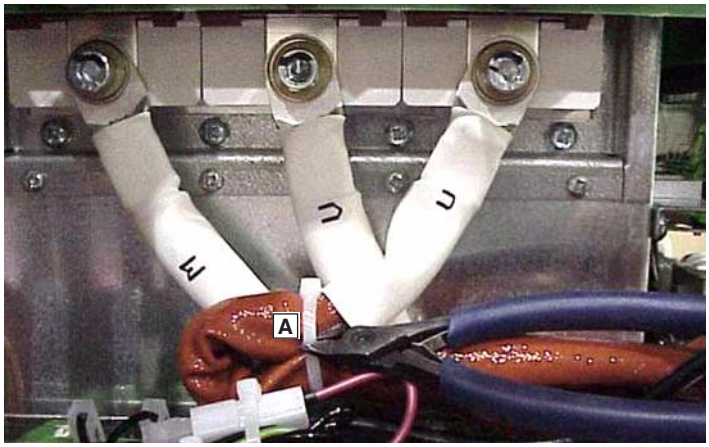
Removing the Fan Inverters

Removal

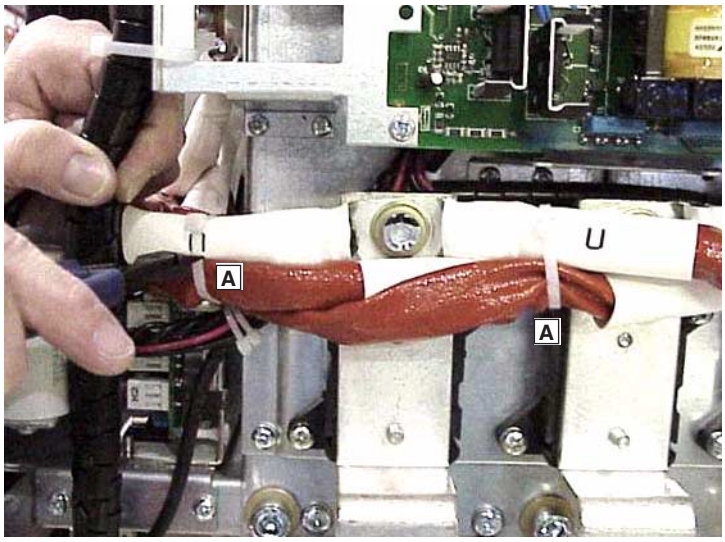
1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Remove the covers from the power structures. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Remove the power structure from the drive cabinet (Removing the Power Structure from the Drive Cabinet on page 3-23).
4. Prepare Power Structure for Inverter Assembly Removal.



Task	Description
A	Remove the cable-ties that secure the cables with orange insulation (on both left-hand and right-hand sides). This will allow you to move the cables while removing the inverter assemblies.



Left-hand Side View



Front View on Left-hand Side

5. Remove the Inverter Assemblies.

Task	Description
A	Remove the two M5 Pozi-drive screws, which secure the front of the fan inverter to the drive. Proper tightening torque for reassembly is 4 N-m (35 lb.-in.).
B	Disconnect the fan motor cable under the inverter.
C	Remove the four M5 Pozi-drive screws, which secure the bottom of the fan inverter to the drive. Proper tightening torque for reassembly is 4 N-m (35 lb.-in.).
D	Disconnect the cables at X2, X8 and X3 (on left-hand and center inverters); and X2 and X8 (on right-hand inverter). ***Note:*** *This step is not shown.*
E	Carefully remove the inverters by sliding them out towards the front of the drive.

Bottom View
of Power Structure

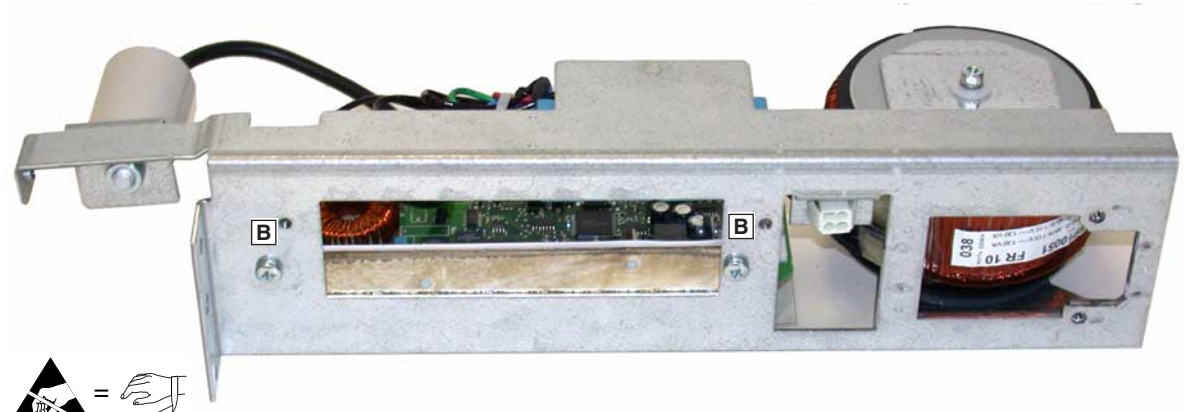
Important: Do not damage the output transformer when removing or installing the inverter.

6. Remove the Inverter from the old Inverter Assembly.

Task	Description
A	Disconnect the cables at connectors X4 (Blue) and X5 (Black).

Right-hand Inverter Shown

Task	Description
B	Remove two M5 Pozi-drive screws, which secure the inverter board and its heatsink to the assembly carriage. Proper tightening torque for reassembly is 4 N-m (35 lb.-in.).
C	Carefully remove the inverter board and its heatsink from the assembly carriage.



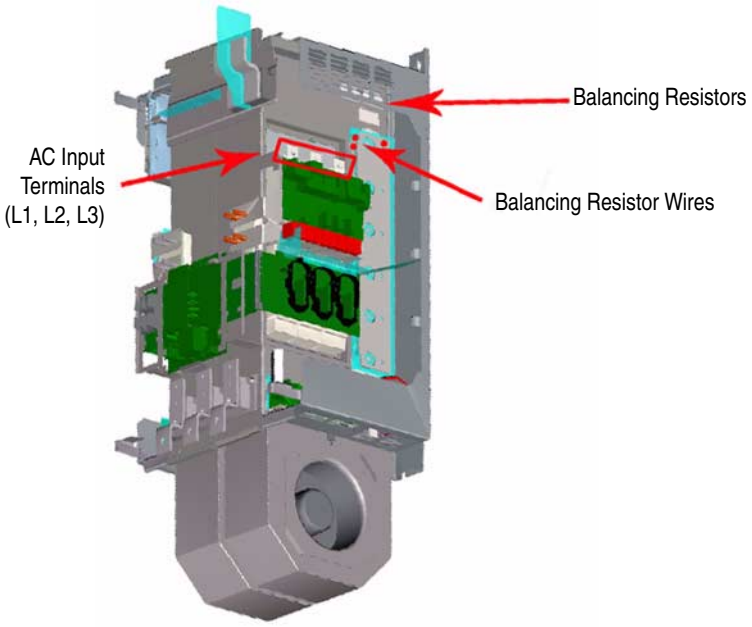
Installation

Install the fan inverters in reverse order of removal, while referring to Torque Specifications on page 3-1.

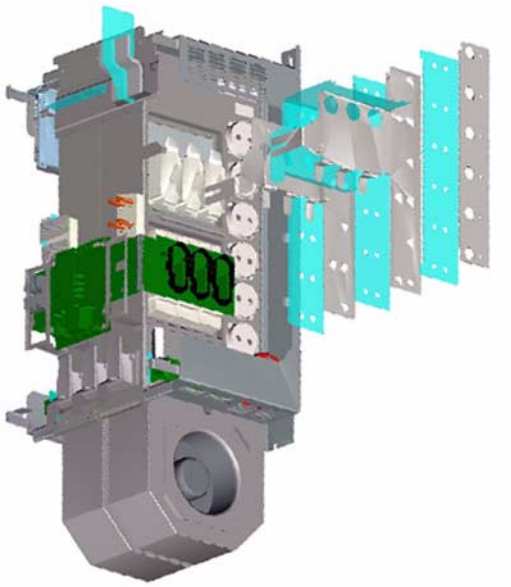
Removing the DC Bus Capacitors

Removal

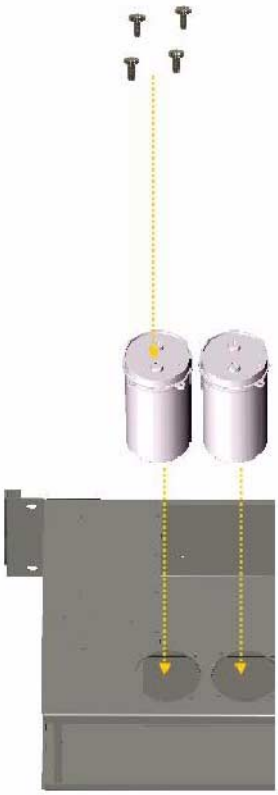
1. Remove power from the drive (Removing Power from Drive on page 3-3).
2. Remove the covers from the power structures. Refer to Removing the Covers from the Power Structure on page 3-14.
3. Remove the power structure from the drive cabinet (Removing the Power Structure from the Drive Cabinet on page 3-23).
4. Remove the balancing resistor wires from bus bars.



5. Remove the screws that secure DC Bus Bars to right side of power structure, and remove the DC Bus Bars.



6. Remove the four (4) screws that secure the capacitor to the power structure, and remove the capacitor.



Installation

Install the capacitors in reverse order of removal, while referring to Torque Specifications on page 3-1.

Start-Up After Repair

ATTENTION: Power must be applied to the drive to perform the following start-up procedure. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning. If an event does not occur while performing this procedure, Do Not Proceed. Remove Power including user supplied control voltages. User supplied voltages may exist even when main AC power is not applied to then drive. Correct the malfunction before continuing.

Phone	United States/ Canada	1.262.512.8176 (7 AM - 6 PM CST) 1.440.646.5800 (24 hour support)
	Outside United States/Canada	You can access the phone number for your country via the Internet: Go to http://www.ab.com Click on *Support* (http://support.rockwellautomation.com/) Under *Contact Customer Support*, click on *Phone Support*
Internet	⇒	Go to http://www.ab.com/support/abdrives/
E-mail	⇒	support@drives.ra.rockwell.com

Be prepared to provide the following information when you contact support:

- Product Catalog Number
- Product Serial Number
- Firmware Revision Level

Before Applying Power to the Drive

1. Check for zero volts between DC+ and DC-.
2. Perform forward and reverse biased diode tests, using a digital multimeter. Refer to Conducting Forward and Reverse Biased Diode Tests for Major Power Components on page 2-3.

Testing with the External DC Power Supply Without Load (Optional)

This is a low current - low risk test for the Output Power Module and drive Control board. It requires the recommended High Voltage DC Test Power Supply.

1. Verify that the DC Test Power Supply is de-energized.
2. Connect the power supply's DC+ to the drive's DC+ terminal and the power supply's DC- to the drive's DC- terminal.
3. Set the power supply voltage setting to zero.
4. Switch on the external DC Test Power Supply.
5. Slowly increase the DC Test Power Supply output voltage to the drive's nominal DC bus voltage (650V dc for drives with 380-500V ac input or 775V dc for drives with 600-690V ac input).
6. Measure the DC bus voltage and verify that the value is reflected in:
   - parameter 306 [DC Bus Voltage] (700S)
   - parameter 012 [DC Bus Voltage] (700H)
7. Make configuration changes which allow the HIM to issue start and speed commands.
8. Make configuration changes which allow operation without an encoder and motor.
9. Start the drive, by pressing  (the start button).
10. Increase the speed command from zero to base speed, by pressing  (the up button).
11. Stop the drive, by pressing  (the stop button).
12. Re-configure the drive to suit the application.
13. Decrease the DC Test Power Supply output voltage to zero. Wait until DC bus voltage has decreased to zero. Switch off the external DC power supply.

Testing Without a Motor

This test allows you to measure several operating parameters and diagnose problems without connecting the motor.

1. Verify that input power wiring and grounding is connected.

1. Verify that the motor cables are disconnected.

2. Energize the drive.

3. Make configuration changes which allow the HIM to issue start and speed commands.

4. Make configuration changes which allow operation without an encoder and motor.

5. Start the drive, by pressing  (the start button).

6. Increase the speed command from zero to base speed, by pressing  (the up button).

7. Measure the output voltage on each phase and verify that it is balanced. If it is unbalanced troubleshoot the drive.

8. Stop the drive, by pressing  (the stop button).

9. Re-configure the drive to suit the application.

Performing the Power Circuit Diagnostic Test on a 700S

The Power Circuit Diagnostic Test, on the 700S, allow you to diagnose problems in the drive's power structure without applying large amounts of power.

1. Verify that input power wiring and grounding is connected.

2. Verify that the motor cables are connected.

3. Energize the drive.

4. From the Monitor menu on the HIM press  (the escape button) to navigate to the Main menu.

5. Use  (the down button) to move the cursor to the Start-Up selection, and  to select Start-Up. Then press  again to verify your intention to continue with the Start-Up menu.

6. Use  (the down button) to move the cursor to Power Circuit Diagnostics (Pwr Circuit Diag), and  to select Power Circuit Diagnostics.

7. Press  to begin the Power Circuit Diagnostic routine. Follow indications and instructions on the HIM.

Testing With the Motor

This test allows you to measure several operating parameters and diagnose problems without connecting the motor to its mechanical load.

1. Verify that input power wiring and grounding is connected.
2. Verify that the motor cables are connected.
3. Verify that the motor load is disconnected.
4. Energize the drive.
5. Start the drive and increase the speed from zero to base speed.
6. Measure drive output current and verify that the value is reflected in:
   - parameter 308 [Output Current] (700S)
   - parameter 003 [Output Current] (700H)
7. Stop the drive.

Service Tools and Equipment

Software Tools

DriveTools™ SP, DriveExecutive, DriveExplorer™ and DriveObserver™ are software tools for uploading, downloading and monitoring system parameters.

Service tools

This list of basic service tools which will cover needs of tools for repair and maintenance measurements.

Item	Description	Details
1	Oscilloscope	Portable, digitizing, dual channel scope, with isolation
2	Current clamp	1000A(ac, rms), signal output
3	Soldering station	Soldering / de soldering
4	Adjustable power supply	0...1300Vdc, 1A, adjustable current limit. Efore LPS 750-HV or equivalent.
5	Adjustable power supply	0...690Vac (+10%), 10A, three phase, galvanic isolation
6	Multi meter	Digital multi meter, capable of ac and dc voltage, continuity, resistance, capacitance measurements, and forward diode bias tests. Fluke model 87 III or equivalent.
7	Insulation tester	1000Vdc
8	Torque wrench	1...12Nm
9	Torque wrench	6...50Nm
10	box wrench	7mm, 8mm, 10mm, 13mm, 17mm, 19mm, 22mm
11	socket extension	230mm
12	Wrench	7mm, 8mm, 10mm, 13mm, 17mm, 19mm, 22mm
13	Wire cutter	
14	Nose pliers	
15	Crimping tools	For cable terminals 1,5...240
16	Angle wrench	
17	Screw driver	
18	*Flat nose	7*2(mm)
19	*POZIDRIV	1, 2, 3
20	*Phillips	1, 2, 3
21	*Torx	25
22	Hexagonal wrench	4, 5, 6
23	ESD-protected place of work	Working surface, Floor covering, seat and ground connections
24	ESD-protective clothing	Wrist wrap, shoes, overall clothing (coat)
25	Power supply (service)	Capacity of three phase service 400/500/690Vac, 30A
26	20-MAINSTD maintenance stand	Maintenance stand for removing power structure from drive cabinet
27	Fiber-optic repair kit	Agilent HFBR-4593 Polishing Kit, consisting of a Polishing Fixture, 600 grit abrasive paper and 3 mm pink lapping film (3M Company, OC3-14). For Agilent HFBR-4532 latching connectors and HFBR-RL cable. Refer to Agilent publications 5988-9777EN and 5988-3625EN.

Schematics

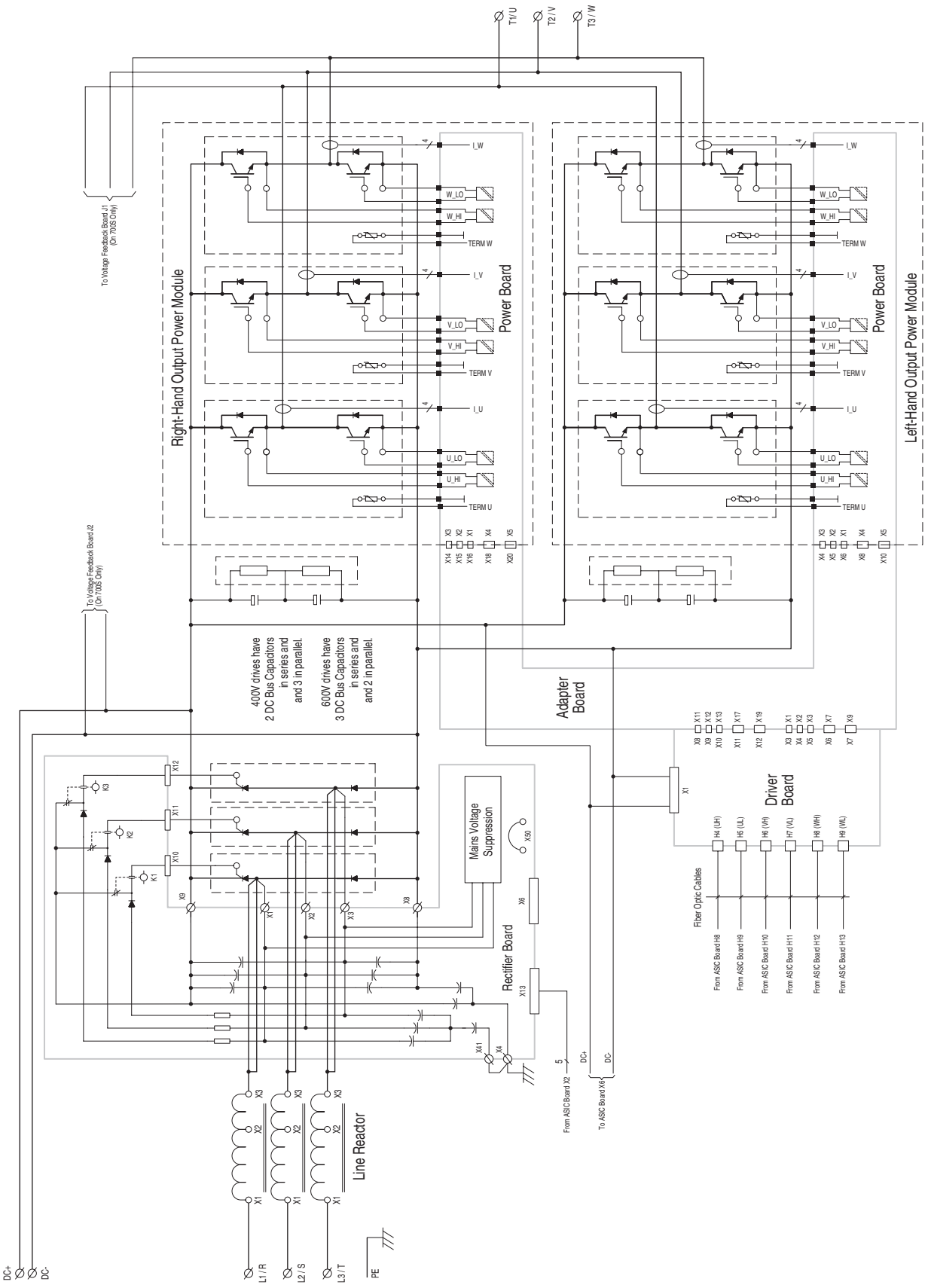


Figure B.1 Power Circuitry for Drives with AC Input

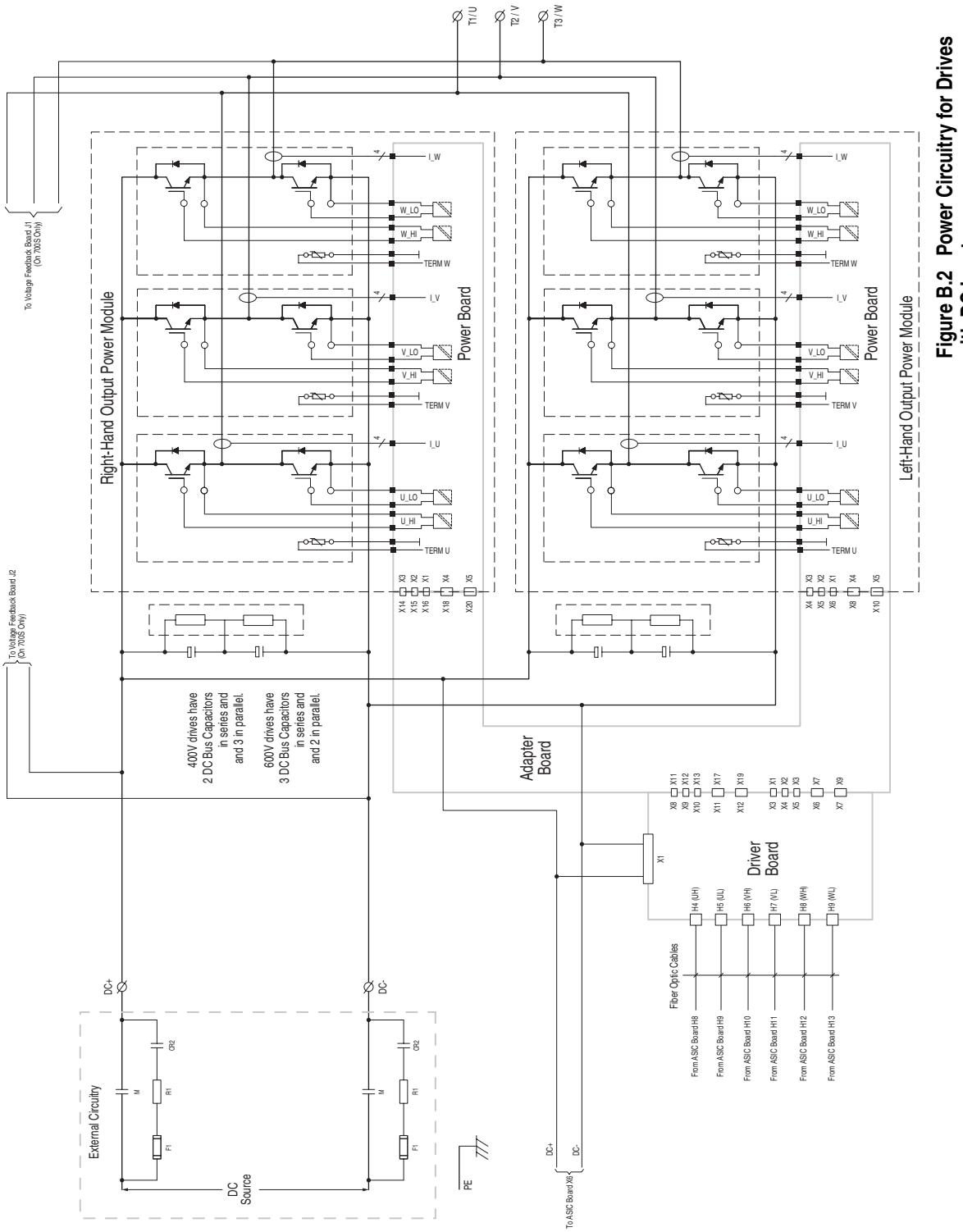


Figure B.2 Power Circuitry for Drives with DC Input

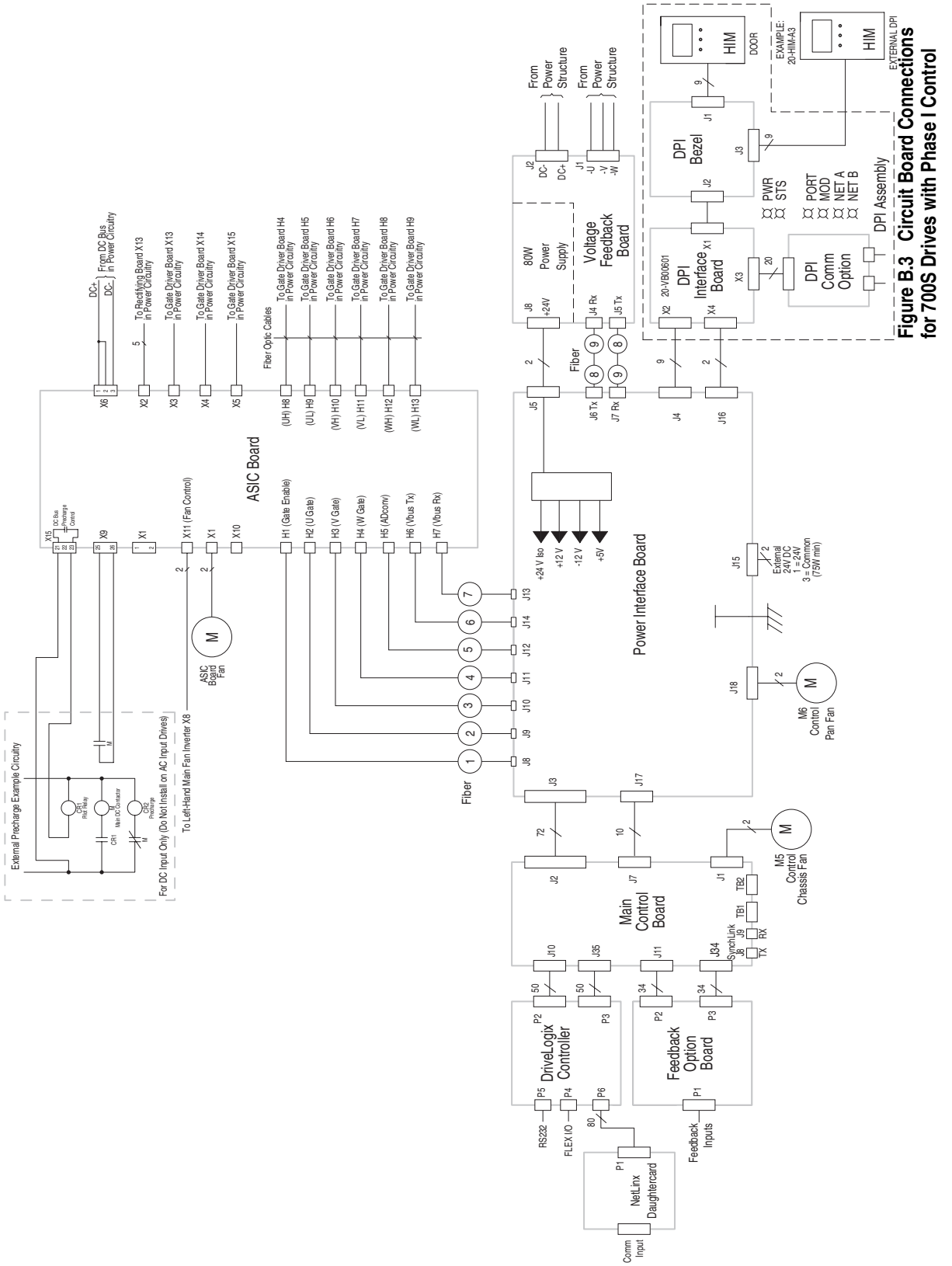


Figure B.3 Circuit Board Connections for 700S Drives with Phase I Control

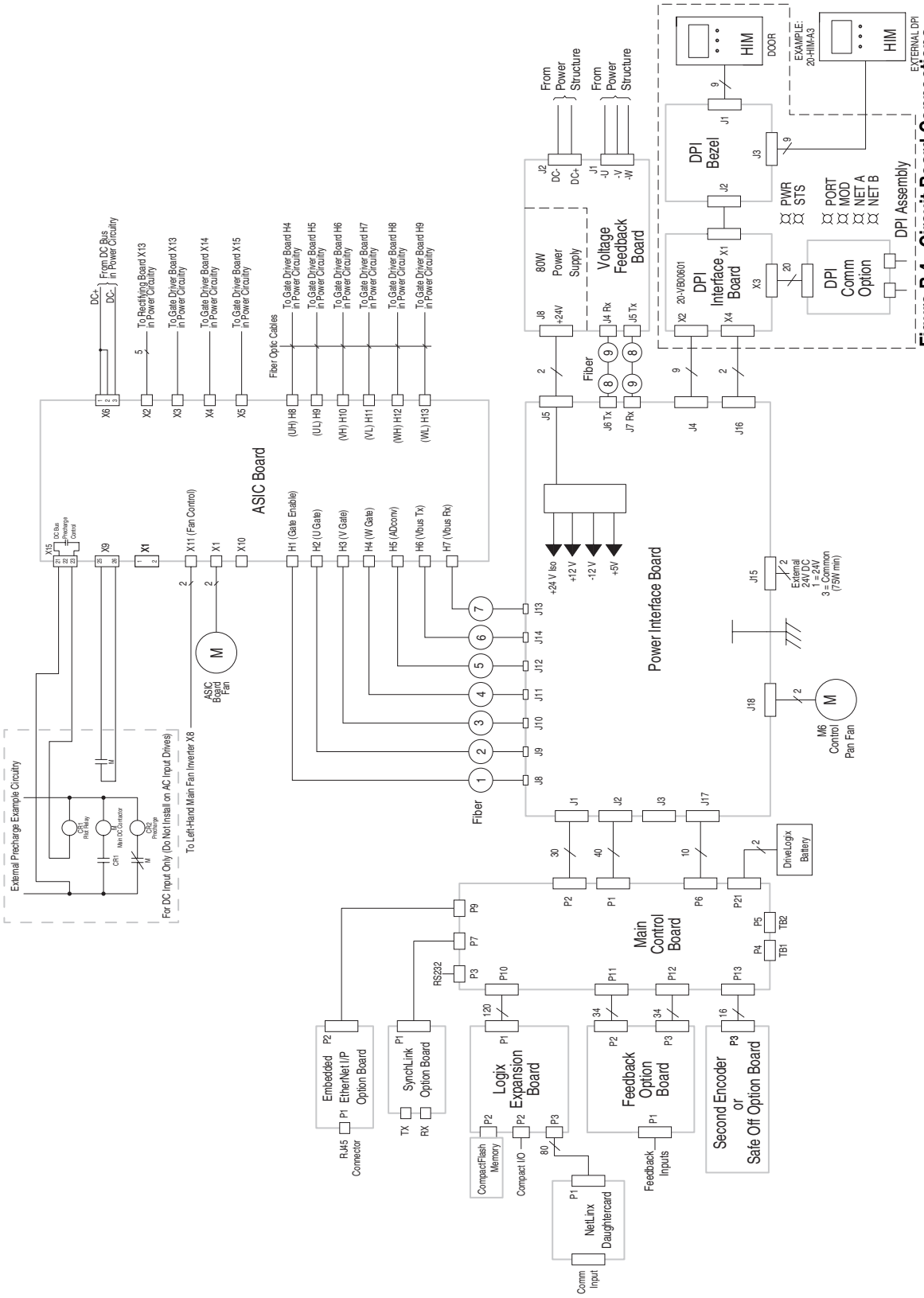


Figure B.4 Circuit Board Connections for 700S Drives with Phase II Control

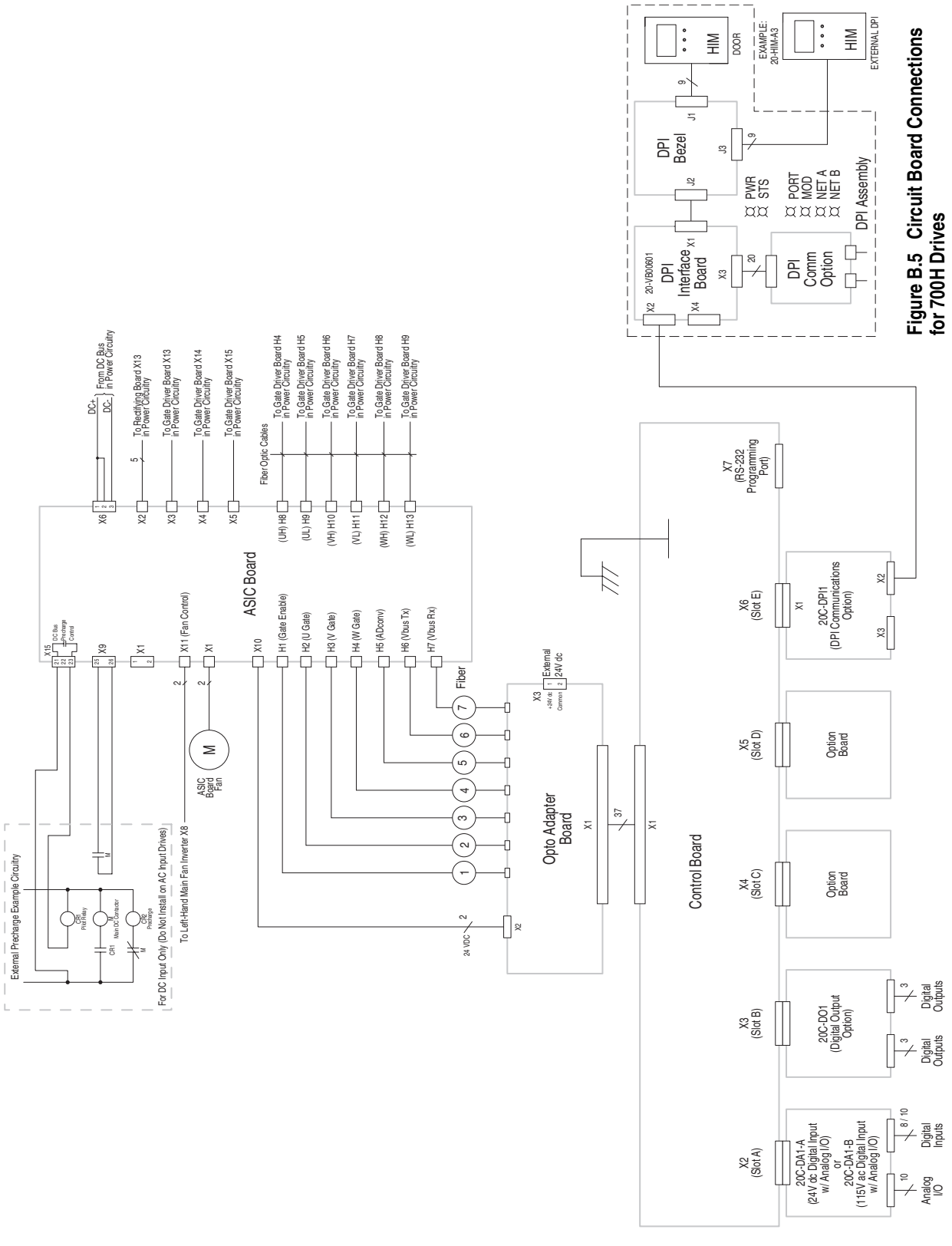


Figure B.5 Circuit Board Connections for 700H Drives

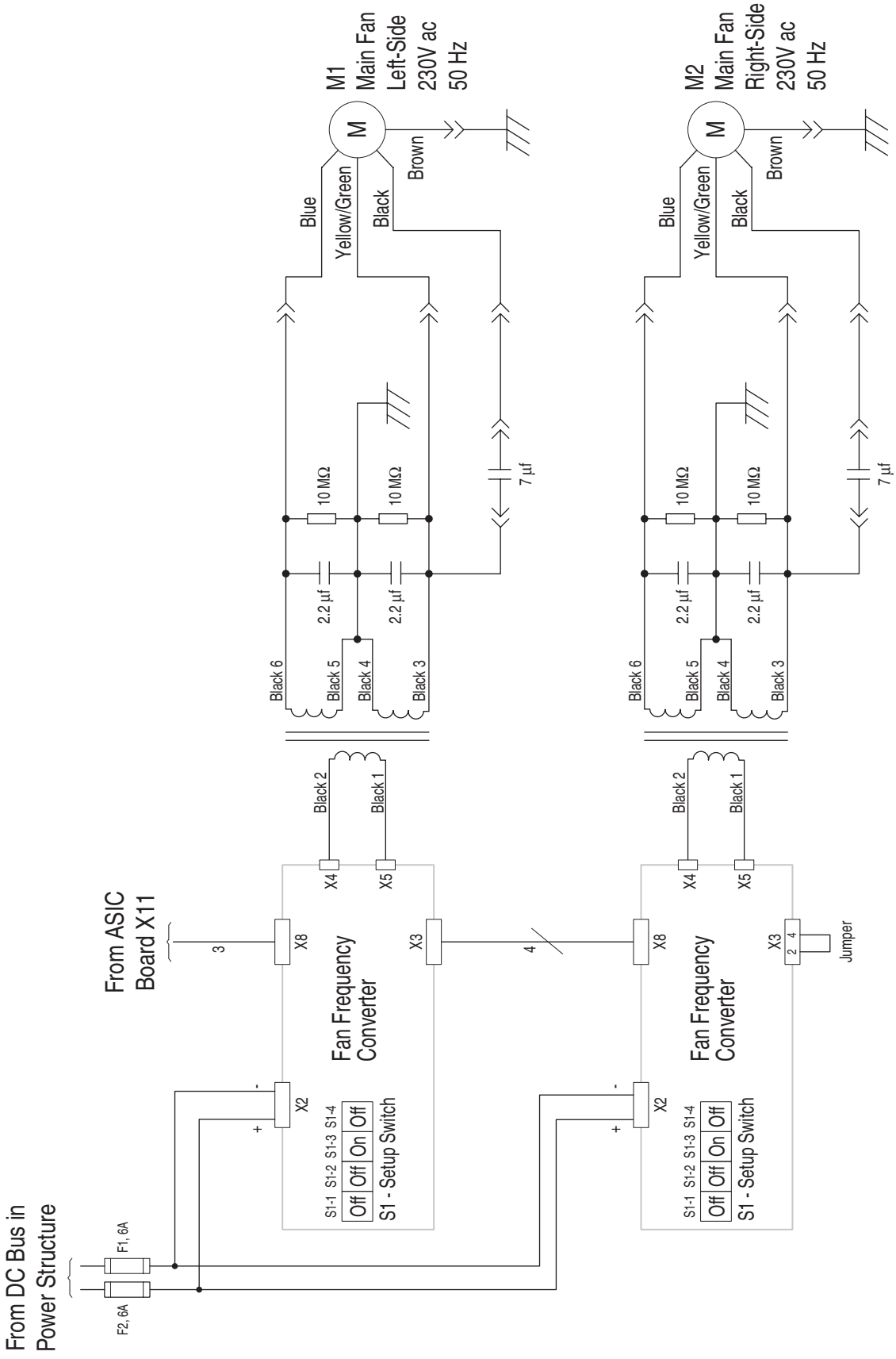


Figure B.6 Fan Inverter Connections

Notes:

Disassembly / Assembly Diagrams

Diagrams on the following pages illustrate disassembly and assembly of the drive and its sub-systems.

Figure C.1 Main Power Structure Assembly

ATTENTION: The sheet metal cover and mounting screws on the ASIC Board located on the power structure are energized at (-) DC bus potential high voltage. Risk of electrical shock, injury, or death exists if someone comes into contact with the assembly.

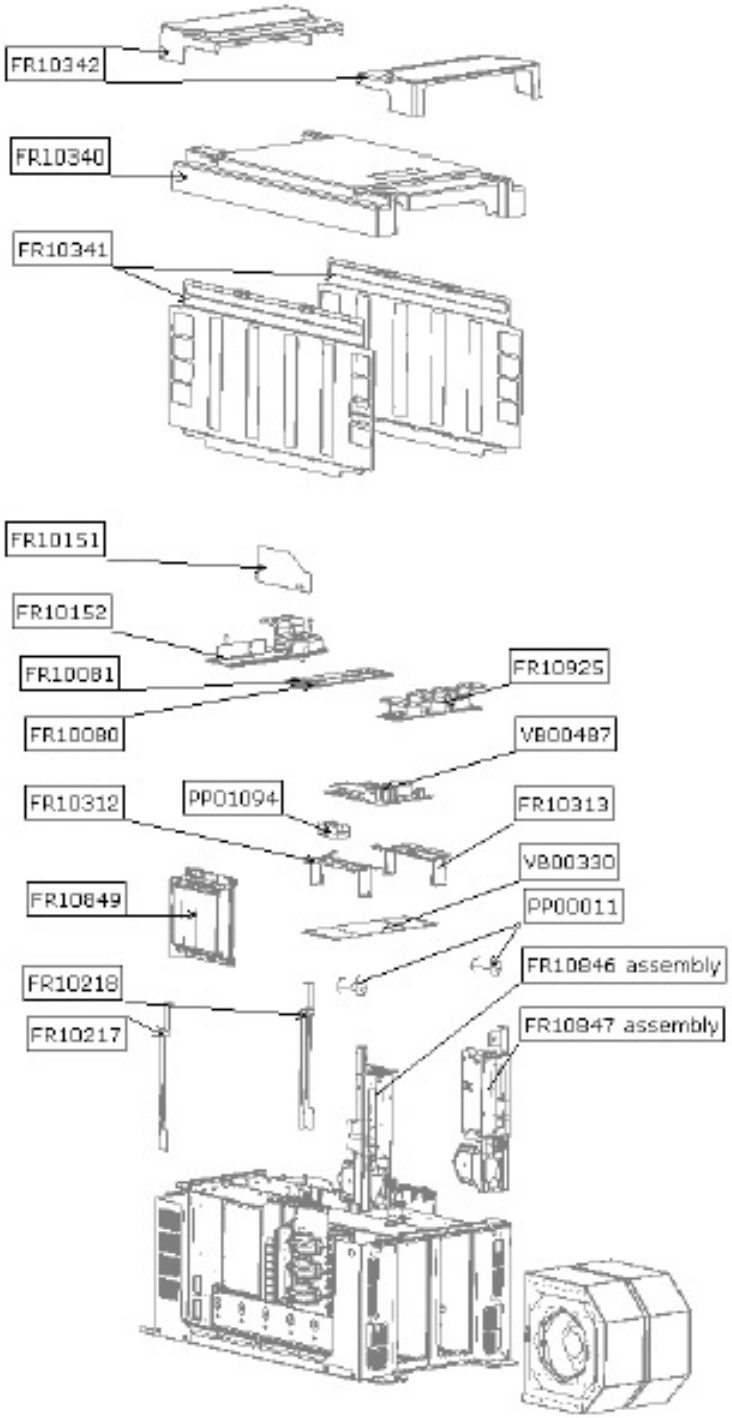


Figure C.2 Right-Hand Side of Power Structure

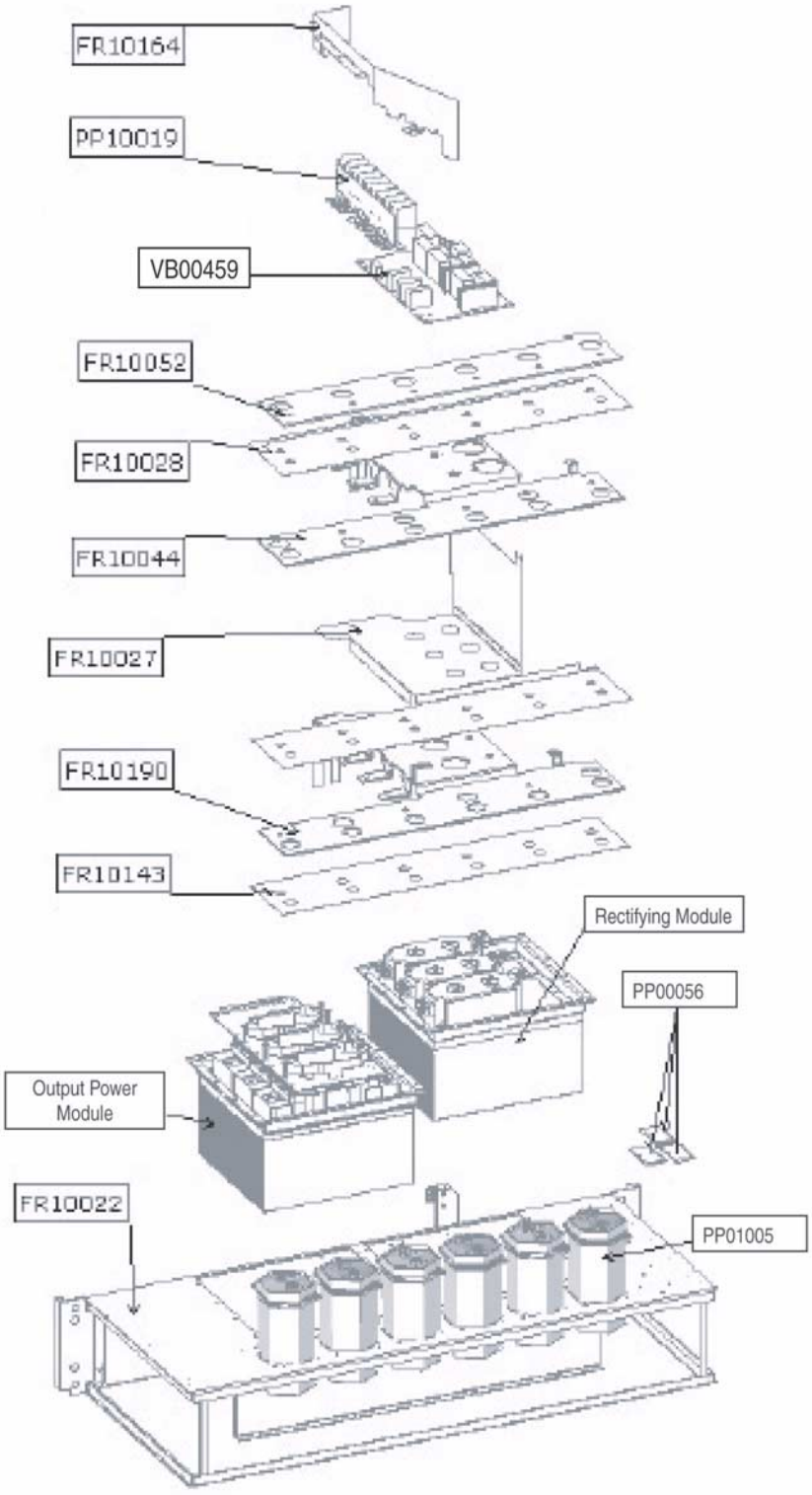


Figure C.3 Left-Hand Side of Power Structure

ATTENTION: The sheet metal cover and mounting screws on the ASIC Board located on the power structure are energized at (-) DC bus potential high voltage. Risk of electrical shock, injury, or death exists if someone comes into contact with the assembly.

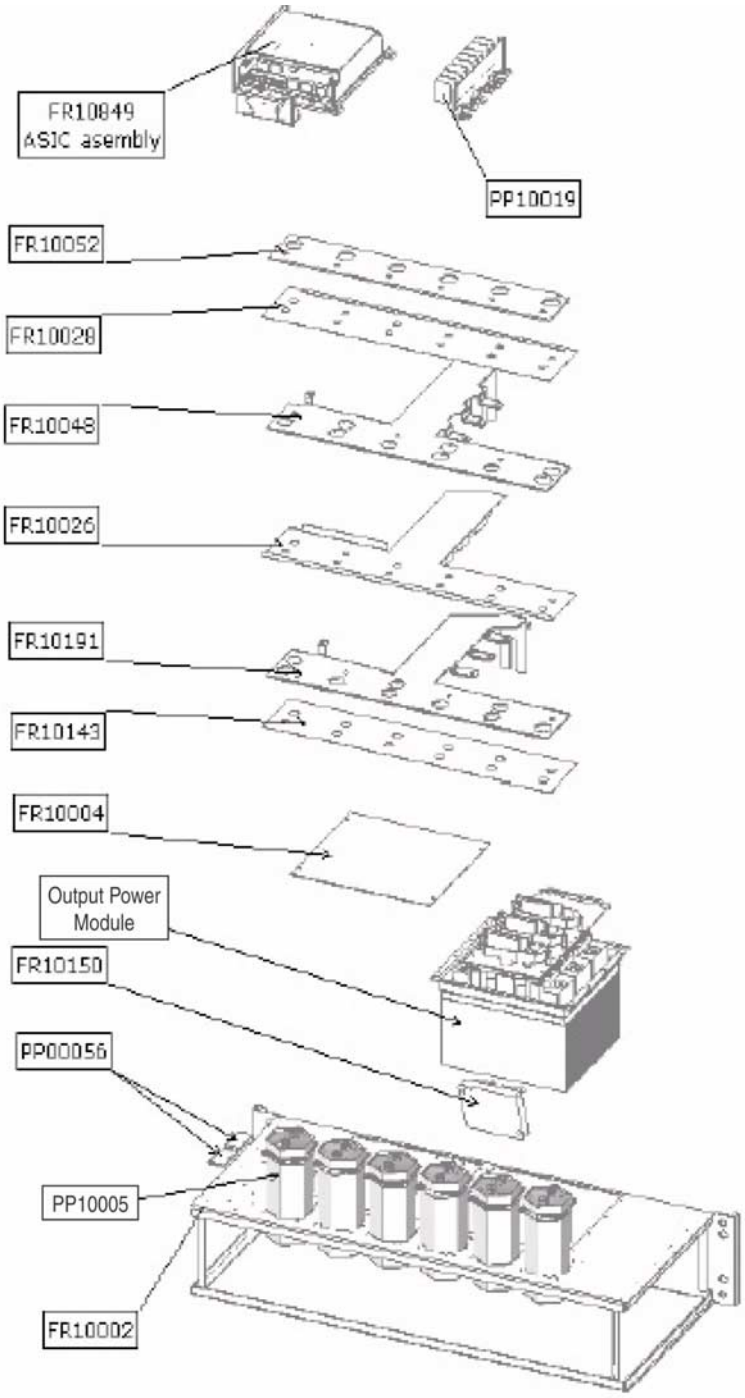


Figure C.4 Fan Inverter Assembly

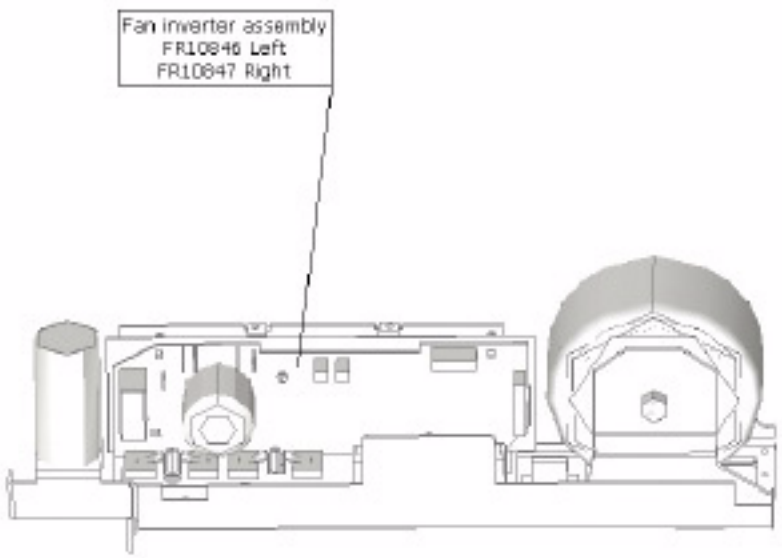


Figure C.5 ASIC Assembly

ATTENTION: The sheet metal cover and mounting screws on the ASIC Board located on the power structure are energized at (-) DC bus potential high voltage. Risk of electrical shock, injury, or death exists if someone comes into contact with the assembly.

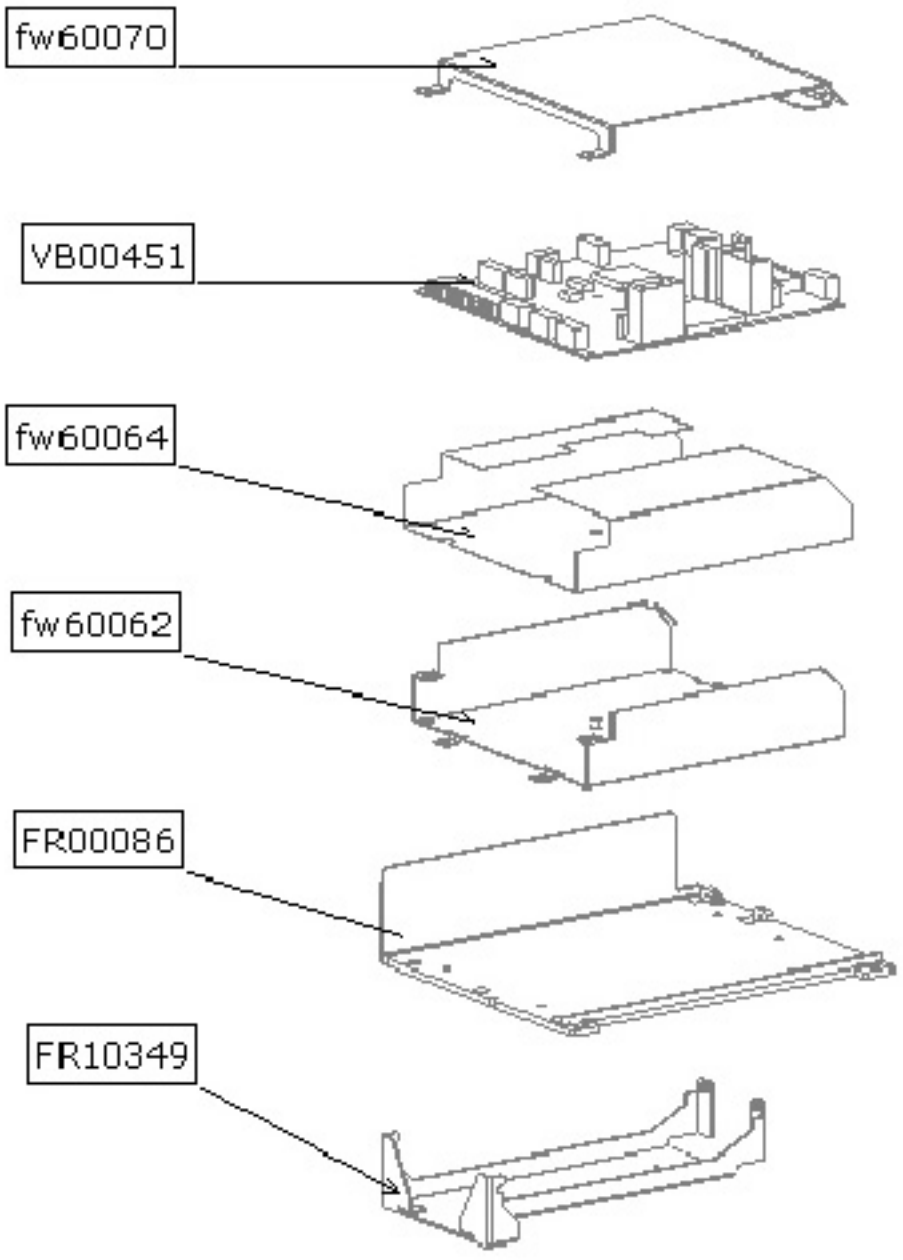
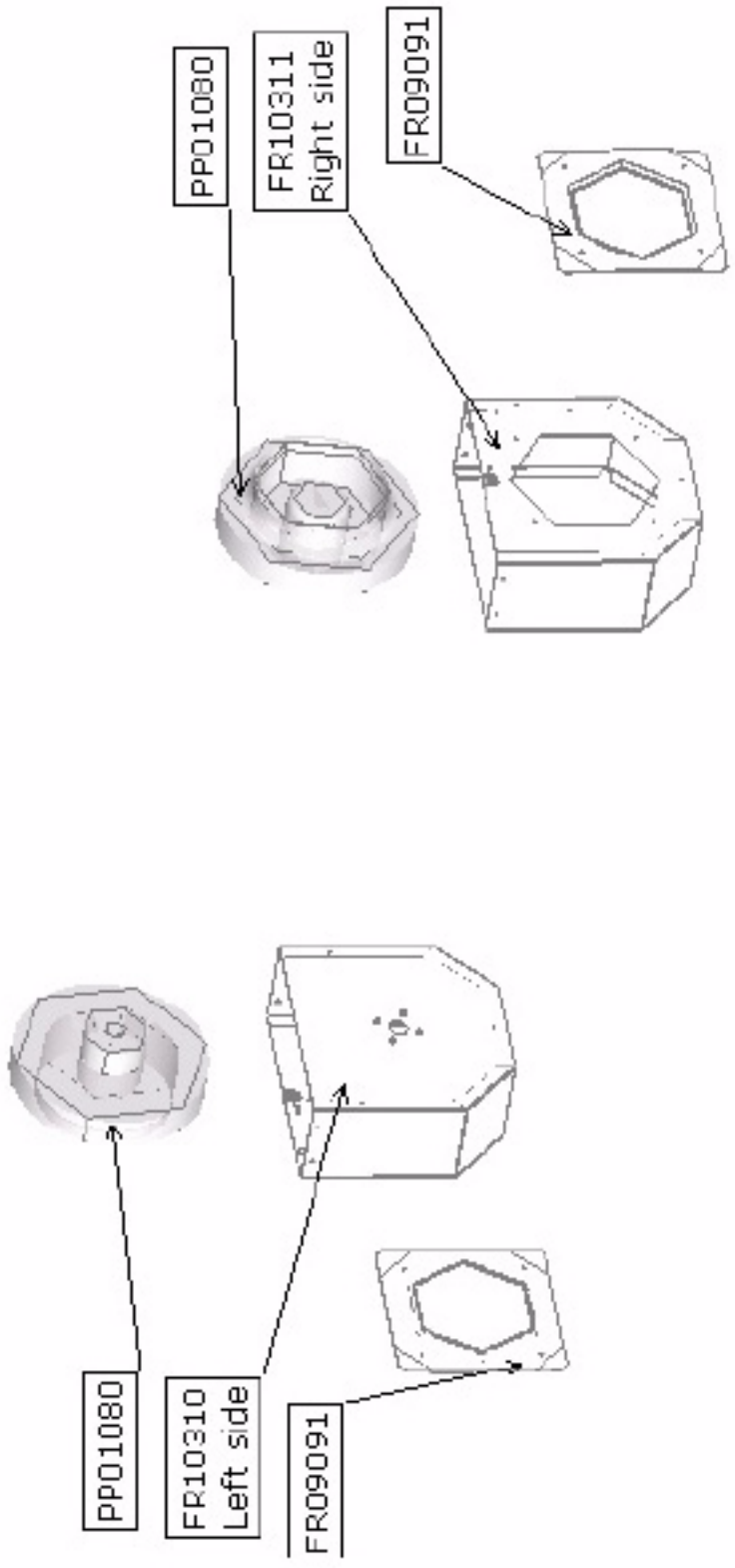


Figure C.6 Main Fan Assembly



Key to ID Numbers

The following table describes the parts identified by balloons in the mechanical drawings:

No.	Description	Rockwell Spare Part No.	Shown in...
FR09091	Intake Cone	NA	Figure C.6
FR10004	Cover Plate	NA	Figure C.3
FR10022	Frame	NA	Figure C.2, Figure C.3
FR10026	DC Bus Bar Insulator	20-FR10026	Figure C.3
FR10027	DC Bus Bar Insulator	20-FR10027	Figure C.2
FR10028	DC Bus Bar Insulator	20-FR10028	Figure C.2, Figure C.3
FR10044	DC Bus Bar	20-FR100044	Figure C.2
FR10048	DC Bus Bar	20-FR10048	Figure C.3
FR10052	DC Bus Bar	20-FR10052	Figure C.2
FR10080	Bus Bar	NA	Figure C.1
FR10081	Insulator For Bus Bar	NA	
FR10143	DC Bus Bar Insulator	20-FR100143	Figure C.3
FR10144	DC Bus Bar	20-FR100144	Figure C.3
FR10150	Insulation Support	NA	Figure C.3
FR10151	Input Terminal Cable Insulator	NA	Figure C.1
FR10152	Input Terminal Assembly	NA	
FR10164	Air Flow Guide Right	NA	Figure C.2
FR10190	DC Bus Bar	20-FR10190	Figure C.2
FR10191	DC Bus Bar	20-FR10191	Figure C.3
FR10217	Plastic Cover Base Top Left	NA	Figure C.1, Figure C.6
FR10218	Plastic Cover Base Top Right	NA	
FR100310	Main Fan Housing	NA	Figure C.6
FR100311	Main Fan Housing	NA	
FR10312	Left Side Board Bracket	NA	Figure C.1
FR10313	Right Side Board Bracket	NA	
FR10340	Touch Cover Front	NA	
FR10341	Touch Cover Side Plate	NA	
FR10342	Main Terminal Cover	NA	
FR10846	Fan Inverter Assembly, Left	20-FR10844	
FR10847	Fan Inverter Assembly, Right	20-FR10845	
FR10849	ASIC Board	SK-H1-ASICBD-D385, SK-H1-ASICBD-D460, SK-H1-ASICBD-D500,	Figure C.3
FR10850	ASIC Assembly Upgrade Kit without the ASIC Board	20-FR10850	Figure C.3
FR10925	Motor Connector Assembly	NA	Figure C.1
FR60086	ASIC Assembly Bracket	Included in 20-FR10850	Figure C.3
FR60349	ASIC Assembly Bracket		Figure C.3
FW60062	ASIC Assembly Bracket		Figure C.3
FW60064	ASIC Assembly Bracket		Figure C.3
FW60070	ASIC Assembly Cover		Figure C.3
PP00011	Capacitor 7µf 450V ac	20-PP00011	Figure C.1, Figure C.6
PP00056	Discharging Resistor 2x16k	20-PP00056	Figure C.2, Figure C.3
PP01005	Electrolytic Capacitor ELKO 3300µf 420V	NA	
PP01080	Main Fan 230W	20-PP01080	Figure C.6
PP01094	Fuse Base DC	20-PP01094	Figure C.1
PP01095	Fuse Base DC	20-PP01095	

No.	Description	Rockwell Spare Part No.	Shown in…
PP10019	Snubber Capacitor Assembly	20-PP10019	Figure C.2, Figure C.3
VB00330	Adapter Board	20-VB00330	Figure C.1
VB00451	ASIC Board	NA	Figure C.1, Figure C.5
VB00459	Rectifying Board	20-VB00459	Figure C.2
VB00487	Gate Driver Board	SK-H1-GDB1-F10D	Figure C.1
Output Power Module	Output Power Module	20-FR1010822, 20-FR1010823, 20-FR1010824	Figure C.1, Figure C.2, Figure C.3
Rectifying Module	Rectifying Module	20-FR1010820	Figure C.1, Figure C.2,

Complete spare parts lists are available on the Allen-Bradley Drives Support Website (*http://www.ab.com/support/abdrives/*).

Notes:

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Publication PFLEX-TG002A-EN-P – July 2005