

PowerFlex DC Field Controller, Frame A and B

Catalog Number 23PFC



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.

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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).

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This manual contains component test and hardware replacement procedures for the PowerFlex® DC field controller:

- Frame A (17...120 A)
- Frame B (245...570 A)

This manual is intended for qualified service personnel responsible for troubleshooting and repairing PowerFlex DC field controllers. You must have previous experience with, and basic understanding of, electrical terminology, procedures, required troubleshooting equipment, equipment protection procedures and methods, and safety precautions.

It is highly recommended that you obtain a copy of the PowerFlex DC Field Controller Programming Manual, publication [23PFC-PM001](#). The PowerFlex DC Field Controller Programming Manual contains fault/alarm and programming information to assist you in troubleshooting device errors and determine if repairs are necessary. See Additional Resources for information on related publications and how to obtain manuals.

Additional Resources

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

Resource	Description
PowerFlex DC Field Controller Programming Manual, publication 23PFC-PM001	Provides information on how to start up, program, and troubleshoot the PowerFlex DC Field Controller.
PowerFlex DC Field Controller Installation Instructions, publication 23PFC-IN001	Provides installation instructions for the PowerFlex DC Field Controller.
Preventive Maintenance of Industrial Control and Drive System Equipment, publication DRIVES-TD001	Provides a guide to performing preventative maintenance on industrial control and drive system equipment.
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.rockwellautomation.com/global/certification/overview.page	Provides declarations of conformity, certificates, and other certification details.
PowerFlex DC Field Controller Spare Parts List, publication PFLEX-SB003	Provides a current list of spare parts available for the PowerFlex DC field controller.

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

Notes:

Before You Begin Testing, Maintenance or Repairs

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Commonly Used Tools	12

This chapter provides information to help you prepare for tests, maintenance, or repairs on device components.

General Safety Precautions

Read the following precautions before you test components, perform maintenance, or repair the device.



ATTENTION: Only qualified personnel familiar with DC drives, field controllers, and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply can result in personal injury and/or equipment damage.



ATTENTION: This device contains Electrostatic Discharge (ESD) sensitive parts and assemblies. Static control precautions are required when you install, test, service or repair assemblies. Component damage can 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: Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment. Hazardous voltages can exist in the device enclosure even with the circuit breaker in the off position. Recommended practice is to disconnect and lock out control equipment from power sources. If it is necessary to work in the vicinity of energized equipment, the safety-related work practices of NFPA 70E, Electrical Safety Requirements for Employee Workplaces, must be followed. DO NOT work alone on energized equipment.



ATTENTION: Potentially fatal voltages can result from improper usage of an oscilloscope and other test equipment. The oscilloscope chassis can 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 you use the oscilloscope in the A minus B Quasi-differential mode with the oscilloscope chassis that is correctly grounded to an earth ground.



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

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

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



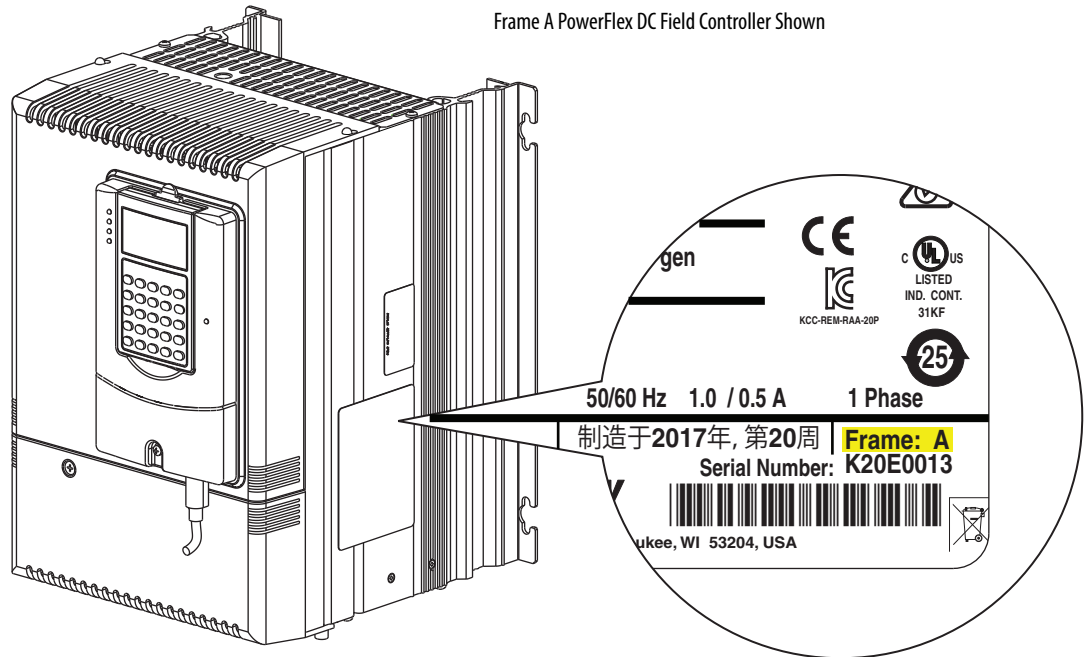
ATTENTION: HOT surfaces can cause severe burns. **Do not** touch the heat sink surface during operation of the device. After you disconnect power, allow time for cooling.

Hardware Description

The PowerFlex® DC field controller provides three-phase, four quadrant (reversing) DC motor or generator field control. The power supply consists of a three-phase, full wave rectified, dual bridge, capable of two or four quadrant output. An AC input contactor can be used to protect the field controller when it is used in standalone mode.

Verify the frame size of the field controller you are working on by checking the data nameplate that is on the side of the device. The frame size is printed just above the serial number in the lower right corner of the label.

Frame A PowerFlex DC Field Controller Shown



Commonly Used Tools

Service Tools

This list includes the tools that are needed for installation and test measurements.

Item	Details
Digital multimeter	Digital multimeter, capable of AC and DC voltage, continuity, resistance and forward diode bias tests. Fluke model 87 III or equivalent (recommended).
Oscilloscope	Portable, digitizing, dual channel scope, with isolation
Current clamp	3 times the device rated current output
Solder station	Soldering / de-soldering
Torque wrench	1...12 N•m
Torque wrench	6...50 N•m
Box wrench	7 mm, 8 mm, 10 mm, 13 mm, 17 mm, 19 mm, 22 mm
Socket extension	230 mm
Wrench	7 mm, 8 mm, 10 mm, 13 mm, 17 mm, 19 mm, 22 mm
Wire cutter	
Nose pliers	
Crimp tools	For cable terminals 1.5...240
Angle wrench	
Screw drivers:	
Flat nose	7 x 2 mm
Phillips	#1, 2, 3
Hexagonal wrench	#4, 5, 6
ESD-protected place of work	Working surface, Floor cover, seat and ground connections
ESD-protective clothing	Wrist wrap, shoes, overall clothing (coat)

Software Tools

You can use Connected Components Workbench® software or DriveExecutive™ software to monitor, upload, or download system parameters. You can also view current alarm and fault information.

Component Test Procedures

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This chapter provides general procedures for inspecting and testing the major components of the field controller and includes recommendations for repairs. Due to the technical nature of this product and the variety of possible applications, not all possible fault conditions and troubleshooting solutions can be described in this manual.

IMPORTANT Only perform the diagnostic tests in this chapter if you are qualified and only when other corrective actions have failed. All tests assume that the control board connections have been properly made.

For common field controller symptoms and corrective actions and fault troubleshooting information, see the Troubleshooting chapter in the PowerFlex® DC Field Controller Programming Manual, publication [23PFC-PM001](#).











Save the Parameter Configuration

It is recommended that you save the field controller and communication adapter parameter configuration before performing any service. You can save the device configuration by using one of these methods:

- HIM Set - see Save to a HIM Set.
- Download the field controller and adapter parameters to an offline database file by using DriveExecutive™. See the on-line help that is provided with DriveExecutive for information on how to save database files.
- Export a configuration file by using Connected Components Workbench® software. See the on-line help that is provided with Connected Components Workbench for information on how to export a device configuration file.

Save to a HIM Set

Follow these steps to save the device and adapter parameters to a HIM set.

1. On the HIM, access the Memory Storage menu.
2. Select the HIM CopyCat menu and press .
3. Select Device -> HIM and press .
4. Do one of the following:
 - If there is no existing HIM Set, enter a name using the  and  buttons to select the desired characters and press .
 - If there is an existing HIM Set, press  to overwrite it, or select No using the  button and use the  and  buttons to select the desired characters. Then press .

The HIM Set will be saved to nonvolatile memory.

Visual Component Inspection

Visually inspect the circuit boards and power components before energizing the field controller for any of the component test procedures.

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device.
 - For frame A devices, see page [33](#)
 - For frame B devices, see page [79](#)
3. Remove the protective covers from the device.
 - For frame A devices, see page [36](#)
 - For frame B devices, see page [80](#)
4. Check components for burn marks, breakage, or foil delamination on all circuit boards.

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

Troubleshoot a Control Power Supply Failure

Complete these steps to determine where a control power failure has occurred. A control power failure can be signaled in these ways:

- A Power Failure fault (F3) has occurred
- The field controller is inoperable by using the HIM or other means of control

1. Read the General Safety Precautions on page [10](#).
2. Remove the protective covers from the device.
 - For frame A devices, see page [36](#)
 - For frame B devices, see page [80](#)
3. If installed, remove the fiber-optic interface option module. See the PowerFlex DC Fiber-optic Interface Option Module Installation Instructions, publication [20P-IN078](#), for instructions.
4. Measure the signal voltage at the control circuit board testpoints as indicated in the following table.

Table 1 - Control Circuit Board Testpoints

Name	Testpoint	For Testpoint Location See	Associated Connector-pin	Description
+ 5V	XY5	Figure 1 on page 18	XA-1 / XA-3 / XA-5	+5V digital supply
GNDD	XY6	Figure 1 on page 18	XA-2 / XA-4 / XA-6	+5V digital supply ground
GNDD	XY7	Figure 2 on page 19	XA-2 / XA-4 / XA-6	+5V digital supply ground
+15V	XY12	Figure 1 on page 18	XA-9 / XA-1Control Circuit Board Testpoints0	+15V analog supply
GNDA	XY10	Figure 1 on page 18	XA-11 / XA-12	15V analog supply ground
-15 V	XY11	Figure 1 on page 18	XA-13 / XA-14	-15V analog supply
+24V	XY8	Figure 1 on page 18	XA-16	+24V terminal block

Table 1 - Control Circuit Board Testpoints

Name	Testpoint	For Testpoint Location See	Associated Connector-pin	Description
GNDV	XY9	Figure 1 on page 18	XA-15	+24V terminal block ground
+5VEXP	+5VEXP	Figure 2 on page 19	XP3-1 / XP3-2 / XP3-3	+5V for DPI expansion
+12VEXP	+12VEXP	Figure 2 on page 19	XP3-4 / XP3-5	+12V for DPI expansion
OVEXP	OVEXP	Figure 2 on page 19	XP3-7 / XP3-8 / XP3-9	DPI expansion ground

For a flow chart version of the remaining steps, see Troubleshooting Flow Chart on page [143](#).

5. If any of the signals in [Table 1](#) is incorrect or missing, verify that either 115V AC or 230V AC voltage is present at terminals U2 and V2 (control circuit power input).
 - If the voltage is present and correct, continue with step [6](#).
 - If the voltage is incorrect or missing, remove control power and verify the wiring and power source to U2, V2, and correct any problems. Test the voltage level again to verify that it is correct. If the voltage is correct, but the device is still inoperable, continue with step [6](#).
6. Remove AC control power from terminals U2 and V2 and remove and test the fuse F1 and F2 (if present) at the top of the device.
 - If a fuse is open, continue with step [7](#).
 - If a fuse is not open, replace the switching power supply board.
7. Replace the fuse/fuses on the switching power supply board.
8. Disconnect the cable at connector XA on the control board. See Control Board Layout on page [141](#) for location of connector XA.
9. Apply AC control power to the device.
 - If a fuse is open, continue with Test the Switching Power Supply and Pulse Transformer Boards on page [17](#).
 - If a fuse does not open, use an ohmmeter to check all input and output wiring on terminals 1...40 on control board terminal blocks TB1 and TB2 for a possible short circuit condition. Repair any short circuit conditions if found.

Test the Switching Power Supply and Pulse Transformer Boards

Complete these steps to test the switching power supply and pulse transformer circuit boards.

1. Replace the fuse/fuses on the switching power supply board.
 - For frame A devices, see page [34](#)
 - For frame B devices, see page [92](#)
2. Remove the switching power supply board from the pulse transformer board.
 - For frame A devices, see page [50](#)
 - For frame B devices, see page [93](#)
3. Reapply power to the switching power supply board only.
 - If a fuse does not open, continue with step [5](#).
 - If a fuse opens, replace the switching power supply board.
4. Remove all incoming AC voltage from the device.
5. Check all external wiring that is connected to the pulse transformer board, including the motor PTC if used, for a possible short circuit condition. Repair any short circuit conditions if found.
6. If no short circuit conditions exist, replace the pulse transformer board.

Figure 1 - Control Board Testpoints - Upper Left

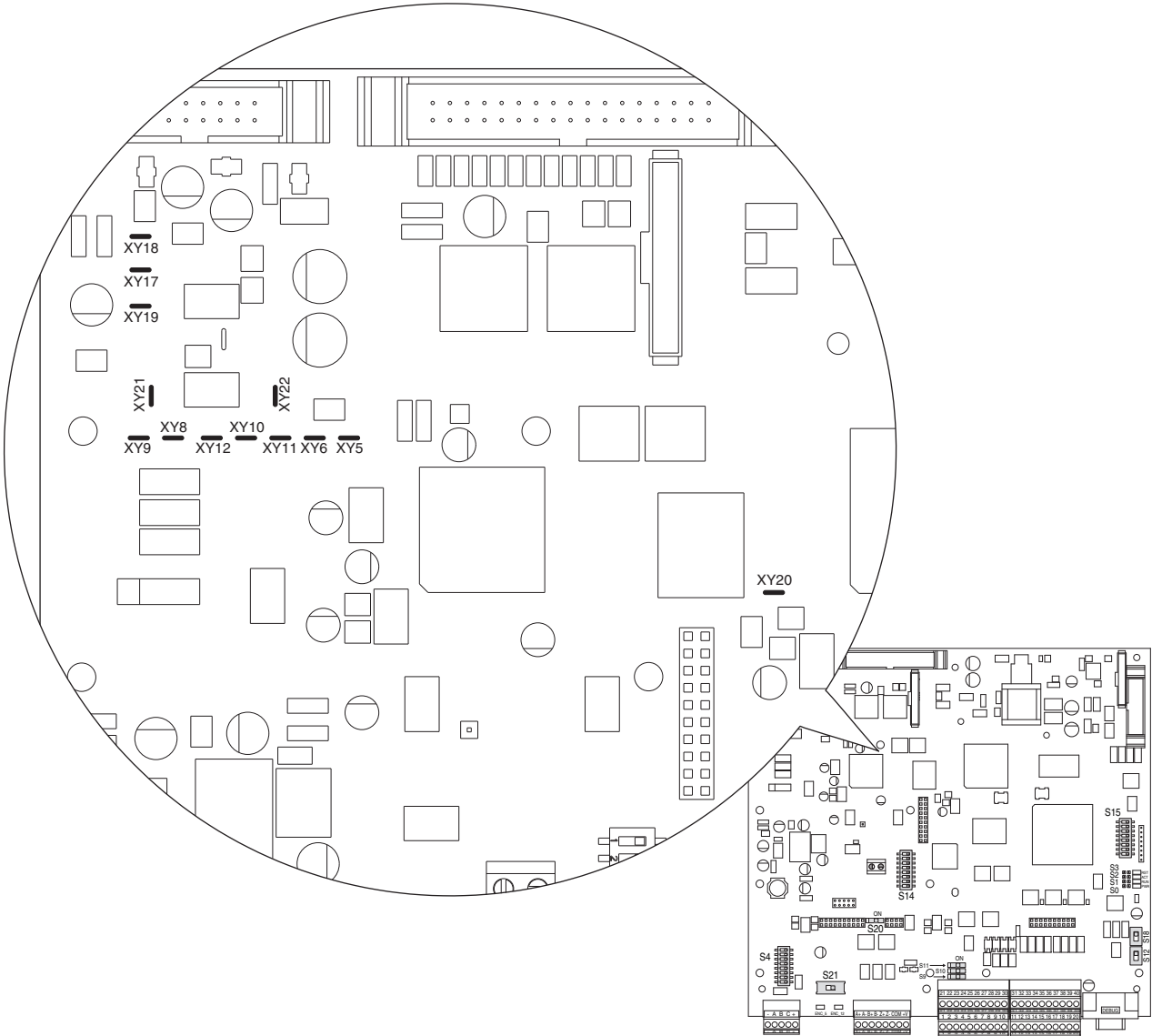
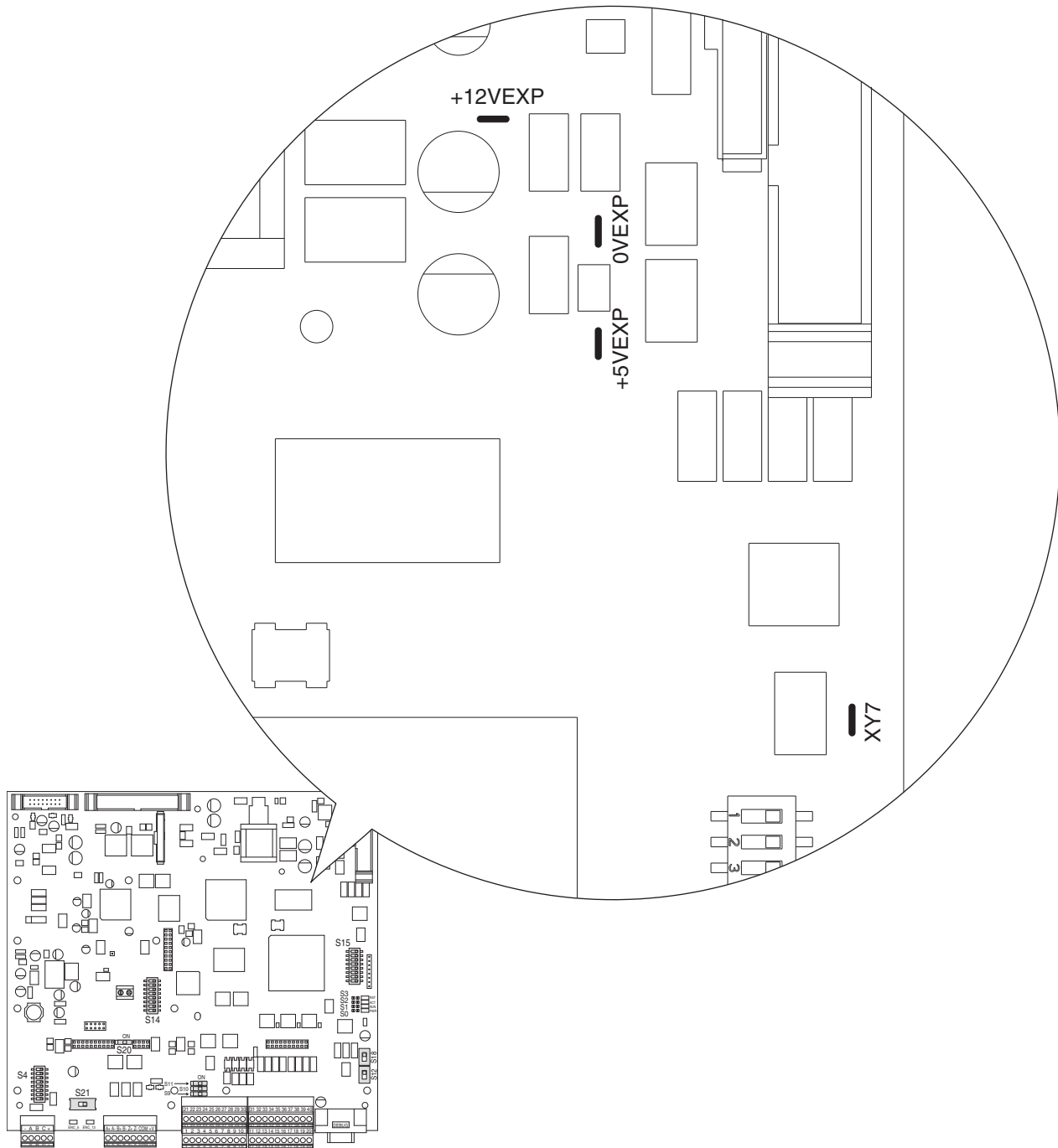


Figure 2 - Control Board Testpoints - Upper Right



Troubleshoot an AC Undervoltage Fault

Measure the AC line input signals, as directed in these steps, when one of these conditions exists:

- The device faults with an AC Undervoltage Fault (F4)
- Parameter 466 [AC Line Voltage] does not equal the expected incoming AC line voltage

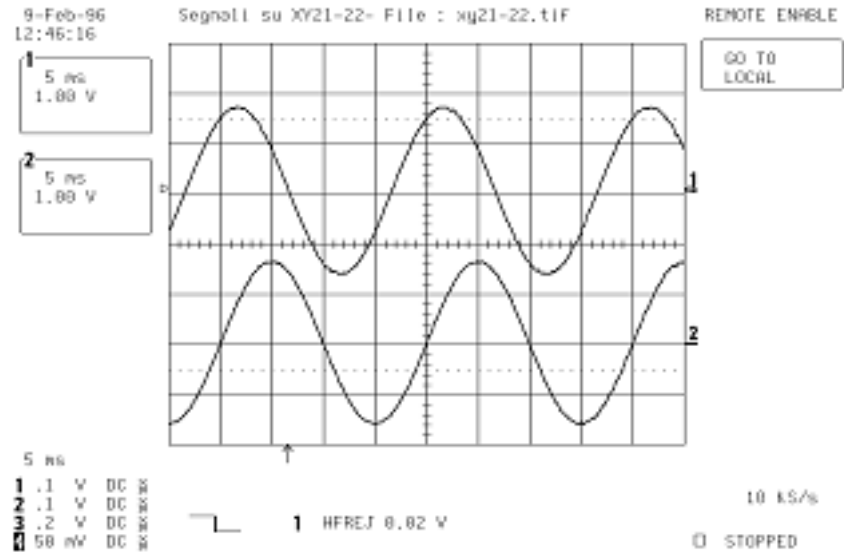


ATTENTION: Servicing energized equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment. Follow Safety related practices of NFPA 70E, ELECTRICAL SAFETY FOR EMPLOYEE WORKPLACES.

1. Read the General Safety Precautions on page [10](#).
2. Remove the protective covers from the device.
 - For frame A devices, see page [36](#)
 - For frame B devices, see page [80](#)
3. Use a voltmeter to measure the voltage at terminals U, V, and W of the device. If an AC input contactor is used, the voltage must be measured on both the input and output sides of the contactor.
4. If any of the voltage measurements is incorrect or missing, remove incoming AC power and verify the wiring to the device and the power supply source and correct any problems.
5. Using a voltmeter, measure the combined voltages of the AC lines on the following testpoints on the control board (all waveforms have a 2.5V offset).
 - See [Figure 1](#) on page [18](#) and [Figure 2](#) on page [19](#) for location of the testpoints.
 - See [Figure 19](#) on page [129](#) for a schematic diagram.

Table 2 - Combined AC Line Input Signal Testpoints

Incoming AC Line Voltage	Phases	Measure from Testpoint	...	To Testpoint	Peak to Peak Measurement	RMS Measurement
115V AC	V and U	XY22	...	XY18	1.93V AC	0.683V
	V and W	XY21	...	XY18		
480V AC	V and U	XY22	...	XY18	2.95V AC	1.040V
	V and W	XY21	...	XY18		



- If any of the voltage measurements are incorrect or missing, continue with step 6.
 - If the voltage measurements are correct but the value of parameter 466 [AC Line Voltage] is incorrect, replace the control board.
6. Remove the ribbon cable that is connected to XR on the control board and pulse transformer board and test the continuity of the cable.
- For frame A devices, use the measurements in [Table 15](#) on page [134](#).
 - For frame B devices, use the measurements in [Table 21](#) on page [139](#).
7. If the measurements on the XR cable are correct, replace the pulse transformer board.

Power Component Test Procedures

Follow the applicable procedure for the affected power components.

Check the SCR Modules

The PowerFlex DC field controller power bridge consists of six SCR modules that are mounted on the main heat sink. One of these conditions can indicate a malfunction of a SCR module:

- An Overcurrent fault (F13)
- Blown or tripped incoming protection devices
- Erratic field operation.

The following procedure can be used if a power bridge component malfunction is suspected.

1. Read the General Safety Precautions on page [10](#).
2. Remove the protective covers from the device.
 - For frame A devices, see page [36](#)
 - For frame B devices, see page [80](#)
3. Verify that contactor power (if used) is removed.
4. Check the anode to cathode junction of each SCR. With a digital multimeter set to Ohms, measure the resistance across the SCRs (lead orientation is not critical).
 - For frame A devices, see [Table 3](#) on page [22](#) and [Figure 3](#) on page [23](#).
 - For frame B devices, see [Table 3](#) on page [22](#) and [Figure 4](#) on page [23](#).
5. If a low resistance is detected, determine which SCR modules are damaged based on [Table 3](#) on page [22](#) and replace that module.
 - For frame A devices, see SCR Module Replacement on page [67](#).
 - For frame B devices, see SCR Modules Replacement on page [103](#).

Table 3 - SCR Anode to Cathode Junction Measurements

On SCR Module	SCR	Measure from Terminal	To Terminal	Nominal meter Reading
1	1	U	C	"open circuit" or "megaOhms" range
	4	U	D	
2	2	V	C	
	5	V	D	
3	3	W	C	
	6	W	D	
01	01	U	C	
	04	U	D	
02	02	V	C	
	05	V	D	
03	03	W	C	
	06	W	D	

Figure 3 - Frame A SCR Module Layout

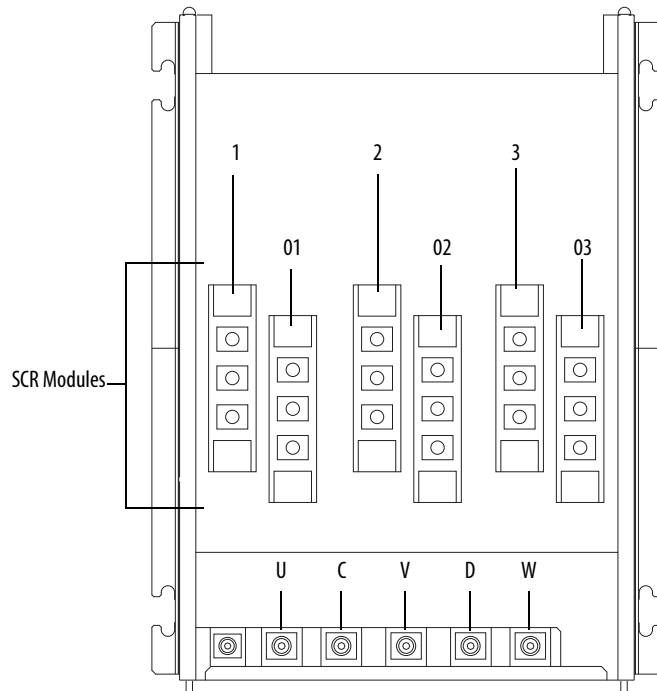
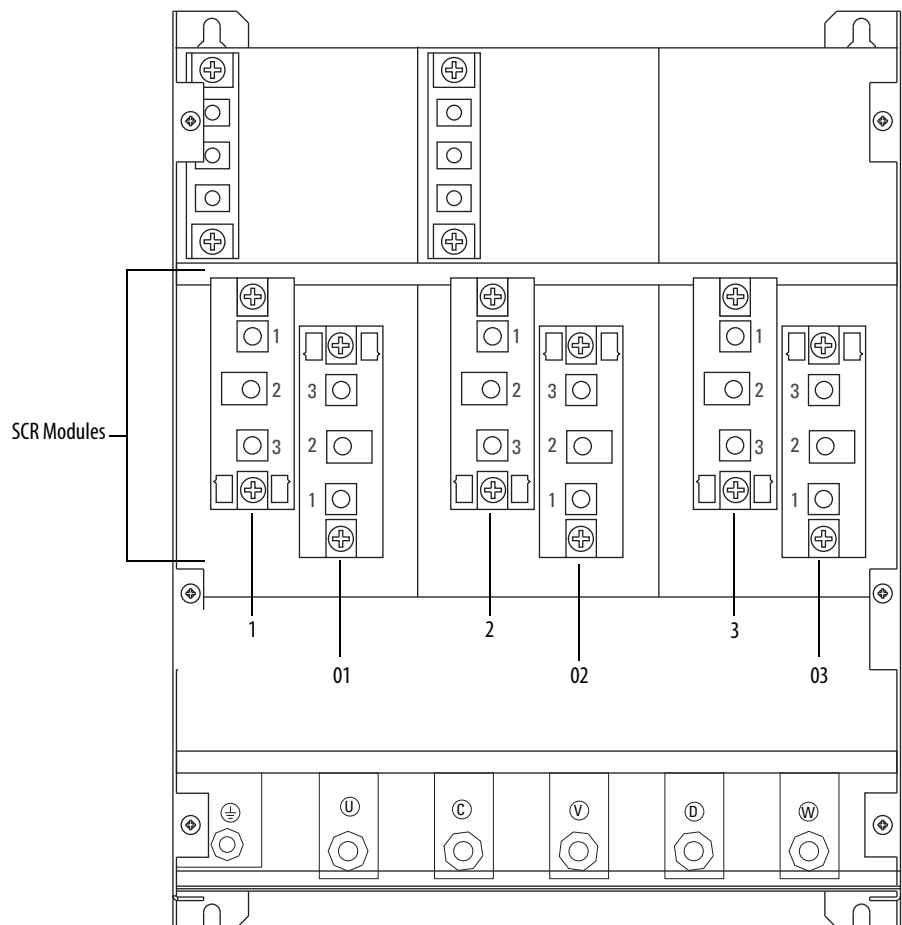


Figure 4 - Frame B SCR Module Layout



- 6. Check the gate to cathode junction of each SCR. With a digital multimeter set to Ohms, measure the resistance of each SCR junction.
 - For frame A devices, see [Table 4](#) and [Figure 5](#).
 - For frame B devices, see [Table 4](#) and [Figure 6](#) on page 25.
- 7. If a measurement is outside of the range that is specified in [Table 4](#) or if one reading deviates significantly from the majority, consider replacing the SCR modules.
 - For frame A devices, see SCR Module Replacement on page 67.
 - For frame B devices, see SCR Modules Replacement on page 103.

Table 4 - SCR Gate to Cathode Junction Measurements

On SCR Module	SCR	Measure from	To	Nominal meter reading
1	1	Pin 5	Pin 4	5...20 Ω ⁽¹⁾
	4	Pin 6	Pin 7	
2	2	Pin 5	Pin 4	
	5	Pin 6	Pin 7	
3	3	Pin 5	Pin 4	
	6	Pin 6	Pin 7	
01	01	Pin 6	Pin 7	
	04	Pin 5	Pin 4	
02	02	Pin 6	Pin 7	
	05	Pin 5	Pin 4	
03	03	Pin 6	Pin 7	
	06	Pin 5	Pin 4	

(1) The actual reading varies depending upon the SCR manufacturer. Verify that the actual measured value is consistent for all SCRs.

Figure 5 - Frame A SCR Module Gate-Lead Connection Pinouts

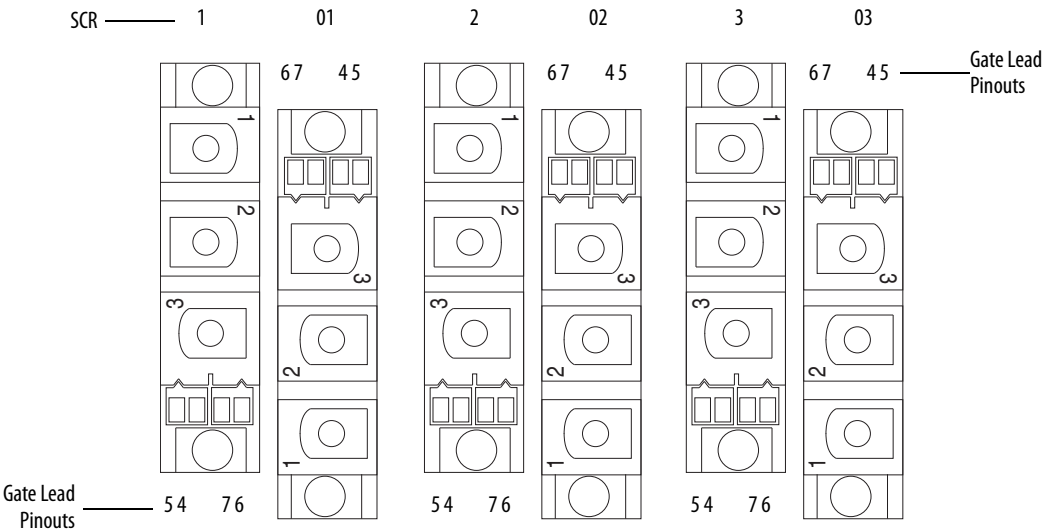
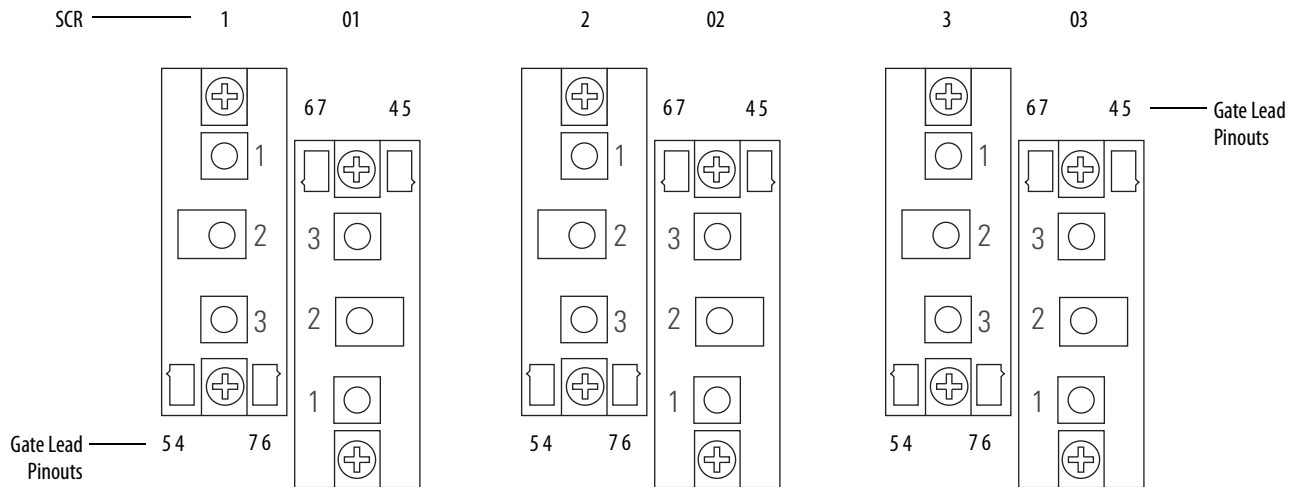


Figure 6 - Frame B SCR Module Gate-Lead Connection Pinouts

Check the Pulse Transformer Board

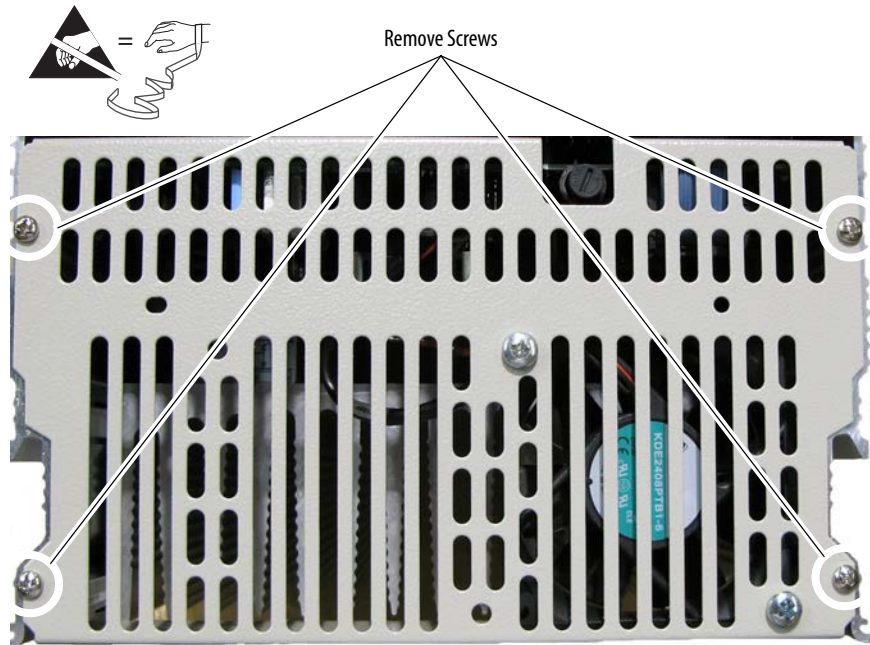
The pulse transformer circuit board contains an isolated gate firing circuit and also provides dv/dt protection for the SCR modules. One of these conditions can indicate a malfunction of these devices:

- An Overcurrent fault (F13)
- A blown or tripped incoming protection device
- Erratic motor operation

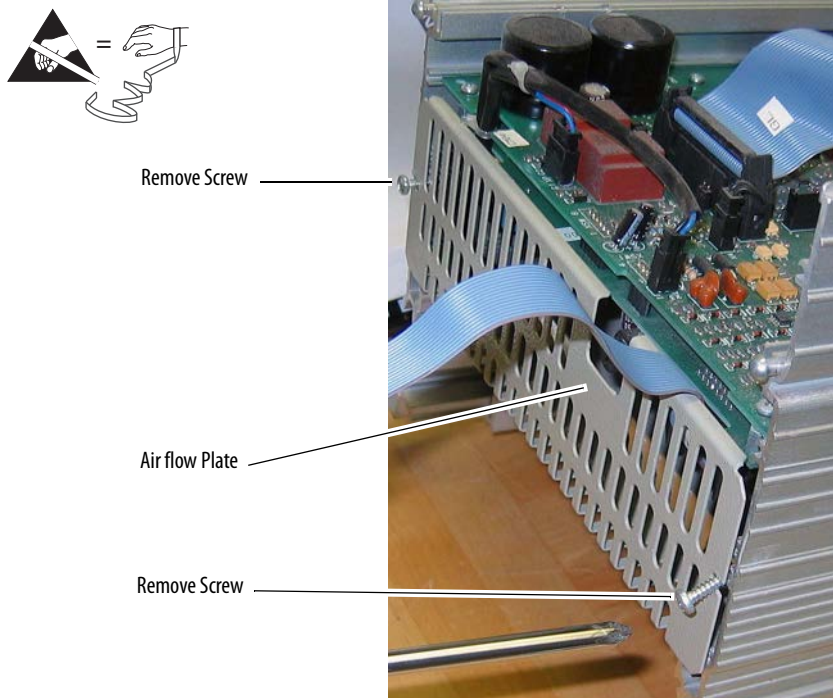
Use the following procedure if a malfunction in this circuitry is suspected.

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device.
 - For frame A devices, see page [33](#)
 - For frame B devices, see page [79](#)
3. Remove the protective covers from the device.
 - For frame A devices, see page [36](#)
 - For frame B devices, see page [80](#)
4. Remove the control electromagnetic interference (EMI) shield and control board.
 - For frame A devices, see Control EMI Shield and Control Circuit Board Replacement page [48](#).
 - For frame B devices, see Remove the Communication Adapter and Electromagnetic Interference Shield page [83](#).

5. For 60 A frame A devices only, complete these steps:
 - a. Remove the four screws that secure the slotted air flow plate to the top of the device.
 - b. Remove the fan cable from connector XV on the switching power supply board and remove the plate.




6. For 120 A frame A devices only, complete this step:
 - Remove the two screws that secure the slotted air flow plate to the top of the device and remove the plate.



IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

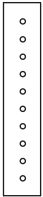
7. Remove the pulse transformer board. The switching power supply board is mounted on the back of the pulse transformer board but does not need to be removed from the pulse transformer board for this test.
 - For frame A devices, see Pulse Transformer and Switching Power Supply Circuit Board Replacement on page [50](#).
 - For frame B devices, see Remove the Pulse Transformer and Switching Power Supply Circuit Boards on page [93](#).
8. With a digital multimeter set for a “continuity check”, measure each connection point on the pulse transformer board that is listed in [Table 5](#).
 - For frame A device, see [Figure 21](#) on page [132](#) for connector locations.
 - For frame B device, see [Figure 23](#) on page [137](#) for connector locations.
9. If any of the actual measurements are out of tolerance, replace the pulse transformer board.

Table 5 - Load Pulse/Snubber Circuit Measurements

For SCR	Measure From	To	Meter reading	Connector XY Pinout
1	KG1	XY-4	“open circuit”	
4	KG4	XY-1		
2	KG2	XY-5		
5	KG5	XY-2		
3	KG3	XY-6		
6	KG6	XY-3		
01	KG01	XY-1		
04	KG04	XY-4		
02	KG02	XY-2		
05	KG05	XY-5		
03	KG03	XY-3		
06	KG06	XY-6		

10. With the digital multimeter set to “diode test”, measure each connection point on the pulse transformer board that is listed in [Table 6](#).
11. If any of the actual measurements are out of tolerance, replace the pulse transformer board.

Table 6 - Load Pulse Transformer Primary Measurements

For SCR	(+) Meter Lead	(-) Meter Lead	Meter reading	Connector XY Pinout
1/01	XY-8	XY-1	0.41 Ω	
4/04	XY-8	XY-4		
2/02	XY-8	XY-2		
5/05	XY-8	XY-5		
3/03	XY-8	XY-3		
6/06	XY-8	XY-6		

Thermistors and Thermal Switches

One of these devices, which is connected to terminals 78 and 79 on the control power terminal block, can detect an overheated load:

- An external, user-supplied thermistor (PTC)
- A thermal switch
 - For frame A devices, see [Figure 21](#) on page [132](#) for terminal block location.
 - For frame B devices, see [Figure 23](#) on page [137](#) for terminal block location.

A “PTC Over Temp” fault (F16) or alarm typically signal that the load is overheating.

- See Alarm Descriptions in the PowerFlex DC Field Controller Programming Manual, publication [23PFC-PM001](#), for details.
- For frame A devices, see [Figure 11](#) on page [125](#) for a circuit diagram.
- For frame B devices, see [Figure 16](#) on page [127](#) for a circuit diagram.

Verify that the PTC or thermal switch is correctly configured:

- If a thermal switch is used, a 1 k Ω resistor must be placed in series between the switch and either terminal 78 or 79.
- If a thermistor (PTC) or a thermal switch is installed, a 1 k Ω resistor must be connected between terminals 78 and 79.

A bimetal thermostat monitors the field controller heat-sink temperature. When the heat sink temperature is too high, a “Heatsink OvrTemp” fault (F8) occurs.

- See Fault Descriptions in the PowerFlex DC Field Controller Programming Manual, publication [23PFC-PM001](#), for details.
- For frame A devices, see [Figure 12](#) on page [125](#) for a circuit diagram.
- For frame B devices, see [Figure 17](#) on page [128](#) for a circuit diagram.

During normal operation, 1.6V DC is present between terminal 78 and device common. When an open circuit exists between terminals 78 and 79, 24V DC will be present at terminal 78 to device common. If the 24V is missing, the pulse transformer board can require replacement.

Relay Outputs

Terminals 35 and 36 and 75 and 76 are N.O. relay outputs. The relay output between terminals 35 and 36 is configured with parameter 1392 [Relay Out 1 Sel]. The relay output between terminals 75 and 76 is configured with parameter 629 [Relay Out 2 Sel].

- See AC Input Contactors in the PowerFlex DC Field Controller Installation Instructions, publication [23PFC-PM001](#), for more information.

The “Main Contactor” fault (F10) indicates a problem that is related to a contactor used with the device.

- See Fault Descriptions in the PowerFlex DC Field Controller Programming Manual, publication [23PFC-PM001](#), for details.

Create a Fault Report

A Technical Support wizard is available in the DriveExecutive and Connected Components Workbench software application. The wizard gathers information about the hardware, firmware, non-default parameters, and the fault and alarm queues, including time stamps. The logged data can be saved as a text (.txt) file.

Complete fault reports are critical for analysis and repair of devices that are 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 a record of any burn marks on the printed circuit boards, cabling, bus bars, and SCR modules.
- Make a record of any liquid and condensation marks on the printed circuit boards, components, and mechanical parts.
- Make a record of the amount of dust and other additional particles on the device and device components.
- Make a record of any mechanical damage to the device and device components.
- Record the size and type of main fuses.
- Record any other important marks and damage.

What You Need When You Call Tech Support

When you contact Technical Support, please be prepared to provide the following information:

- Order number
- Product catalog number and device series number (if applicable)
- Product serial number
- Firmware revision level
- Most recent fault code
- Your application

Use [Table 7](#) to record the data that is provided in each PowerFlex DC field controller parameter listed.

Table 7 - PowerFlex DC Field Controller Parameter Data

Parameter	Name	Description	Parameter Data
1349	Status1 at Fault	Captures and displays Par 381 [Device Status 1] bit pattern at the time of the last fault.	
1350	Status2 at Fault	Captures and displays Par 382 [Device Status 2] bit pattern at the time of the last fault.	
1351...1360	Fault <i>x</i> Code	A code that represents the fault that tripped the device. The codes will appear in these parameters in the order they occur (i.e., [Fault 1 Code] = the most recent fault).	
1361...1370	Fault <i>x</i> Time	The time between initial field controller power-up and the occurrence of the associated trip fault.	
1371	Fault Amps	Captures and displays the output current (as a percentage of rated current) at the time of the last fault.	
1374	Fault Voltage	Captures and displays the output voltage at the time of the last fault.	

Frame A Field Controller Part Replacement Procedures

Topic	Page
Replacement Part Kits	32
Remove Power from the Device	33
Switching Power Supply Fuse Replacement	34
DPI / HIM Assembly Replacement	35
Protective Cover Replacement	36
Communication Adapter and Electromagnetic Interference Shield Replacement	38
I/O Expansion Circuit Board Replacement	41
115V AC to 24V DC I/O Converter Circuit Board Replacement	43
Control Circuit Board Replacement	44
Control EMI Shield and Control Circuit Board Replacement	48
Pulse Transformer and Switching Power Supply Circuit Board Replacement	50
AC Current Transducer Replacement	58
Power Traces Circuit Board Replacement	63
Bimetal Thermostat Replacement	66
SCR Module Replacement	67
Cooling Fan Replacement	72

This chapter provides a list of spare part kits and detailed procedures for removing and replacing device components.

Electrostatic Discharge (ESD) sensitive parts and assemblies are identified in this section by this image. Take static control precautions when you install a part or assembly identified as ESD sensitive.



Replacement Part Kits

[Table 8](#) lists the spare parts kits available for PowerFlex® DC frame A field controllers.

Table 8 - Frame A Field Controller Spare Part Kits

Description	Kit Cat. No.	Instructions Page
Fuses		
Switching Power Supply Board Fuses (Qty 2) - Ferrule 5 x 20 mm, 1 A 250V	SK-20P-S8B28	34
Switching Power Supply Board Fuse Holder	SK-20P-S7G84	34
Accessories		
DPI / HIM Assembly	23P-DCFC-CVR1-A1	35
Upper Cover	SK-20P-S75BT	36
Lower Cover	SK-20P-S77BT	36
Control Circuit Boards		
I/O Expansion Board (TBO-32)	20P-S5V62	41
115V AC to 24V DC I/O Converter Board	20P-S520L	43
Control Circuit Board	SK-23P-S5RP1F	44
Power Circuit Boards		
Pulse Transformer Board (FIR1-11-FC) for 200V AC, 17 A Field Controller	SK-23P-S5N461	50
Pulse Transformer Board (FIR1-51-FC) for 500V AC, 17 A Field Controller	SK-23P-S5N43	
Pulse Transformer Board (FIR1-12-FC) for 200V AC, 60 and 120 A Field Controller	SK-23P-S5N462	
Pulse Transformer Board (FIR1-52-FC) for 500V AC, 60 and 120 A Field Controller	SK-23P-S5N46	
Switching Power Supply Board	SK-20P-S5N03	50
Power Traces Board for 200V / 500V AC, 17 A and 60 A Field Controller	SK-20P-S5H95	63
Power Components		
AC Current Transducer (Qty 2), 200 A / 0.1 A	SK-20P-S78H0	58
Bimetal Thermostat 85 °C ±3 °C for 60 A Field Controller	SK-20P-S7G37	66
Bimetal Thermostat 70 °C ±3 °C for 120 A Field Controller	SK-20P-S7GA0	
SCR Module (Qty 6), 1K6V 25 A, for 17 A Field Controller	SK-20P-S7F73	67
SCR Module (Qty 6), 1K6V 40 A for 60 A Field Controller	SK-20P-S7F74	
SCR Module (Qty 6), 1K6V 55 A for 120 A Field Controller	SK-20P-S7F75	
Ventilation Components		
Cooling Fan, 24V DC, 37 CFM, for 60 A Field Controller	SK-20P-S7G76	72
Cooling Fan, 24V DC, 100 CFM, for 120 A Field Controller	SK-20P-S7G71	

Remove Power from the Device

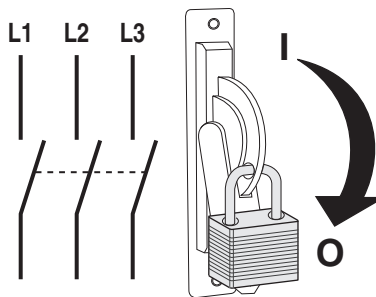


ATTENTION: Remove power before making or breaking cable connections. When you remove or insert a cable connector with power applied, an electrical arc can occur. An electrical arc can cause personal injury or equipment damage by:

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

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

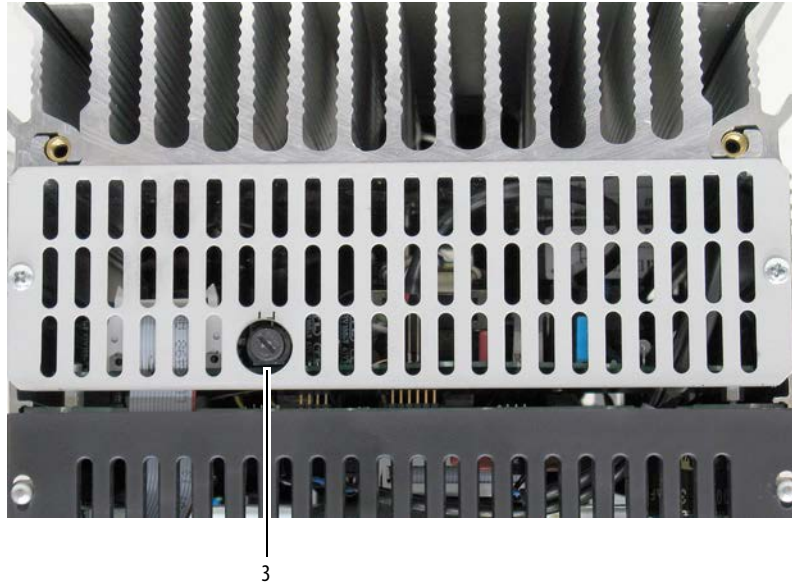
- Remove and lock-out all incoming power to the device.



Switching Power Supply Fuse Replacement Remove the Fuse on the Switching Power Supply Circuit Board

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).
3. On the top of the device, insert a screwdriver in the slot on the top of the fuse holder. Carefully push down and turn the fuse counterclockwise. When the fuse holder releases, remove the holder and fuse.

Top View of Device



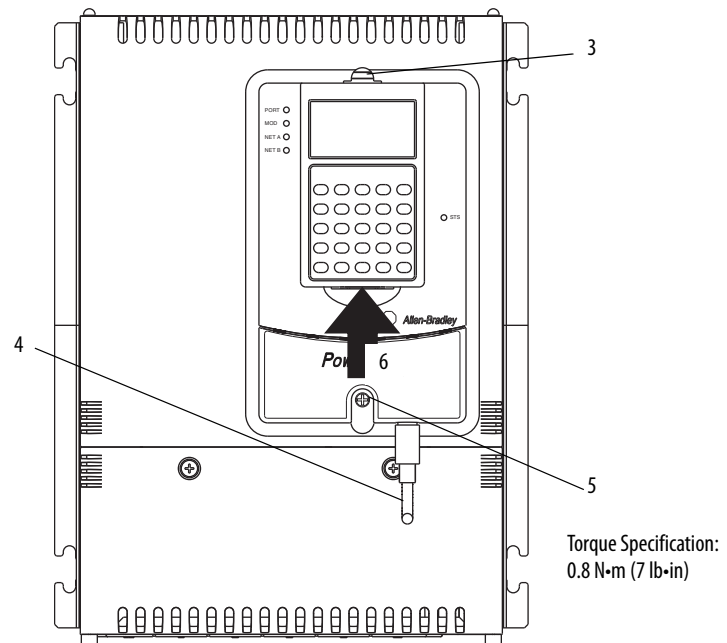
Install the Fuse on the Switching Power Supply Circuit Board

Install the fuse on the switching power supply board in reverse order of removal.

DPI / HIM Assembly Replacement

Remove the DPI / HIM Assembly from the Protective Cover

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).
3. Press downward on the tab at the top of the HIM assembly and, by pressing upward at the bottom, slide the HIM out of the cradle.
4. Disconnect the DPI cable from the HIM assembly.
5. Remove the screw that secures the DPI / HIM assembly to the device.
6. Carefully remove the DPI / HIM assembly from the cover and disconnect the cable from the connector on the back side of the assembly.



Install the DPI / HIM Assembly on the Protective Cover

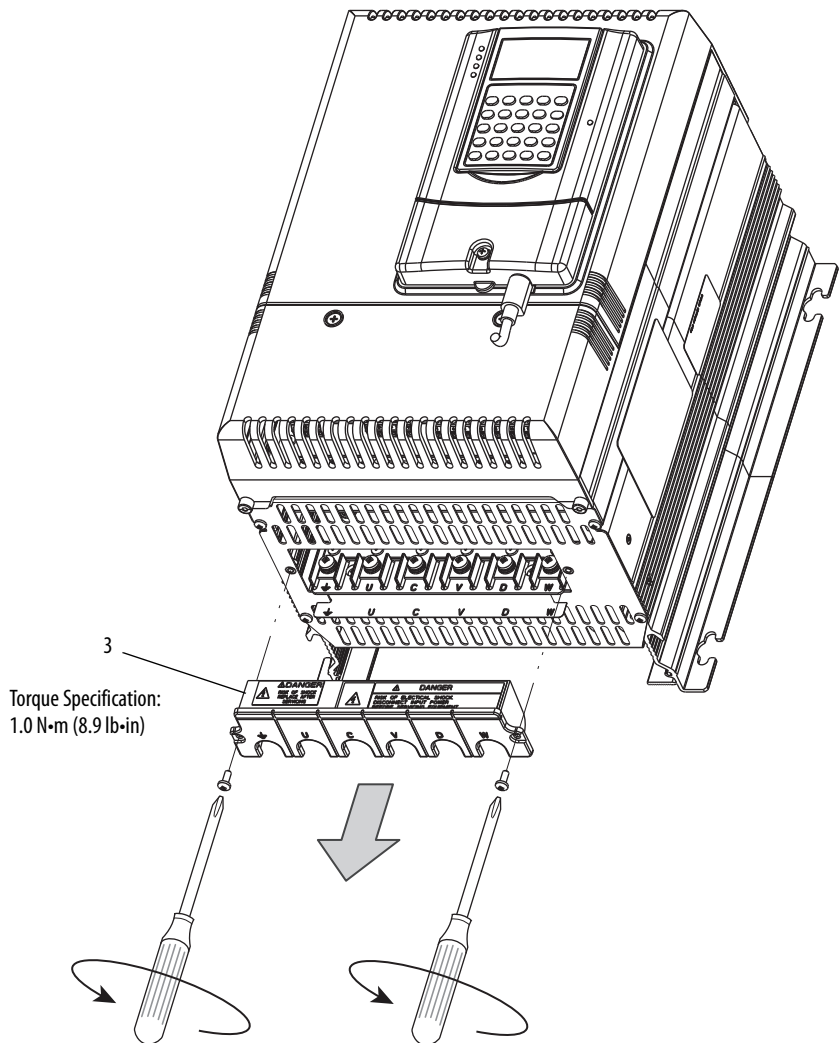
Install the DPI / HIM assembly in reverse order of removal.

Protective Cover Replacement

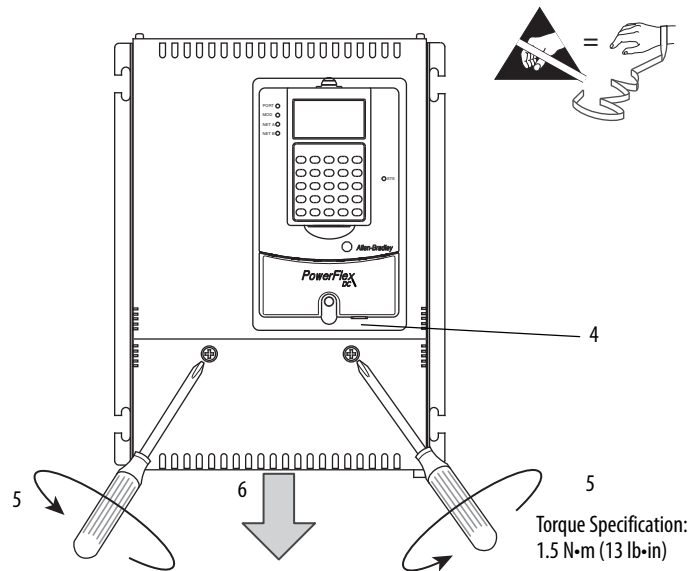
Remove the Protective Covers

You must remove both the lower protective cover and the power terminal cover to access the power terminals.

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).
3. Loosen the two screws that secure the power terminal cover to the device and slide the cover down and off the chassis.

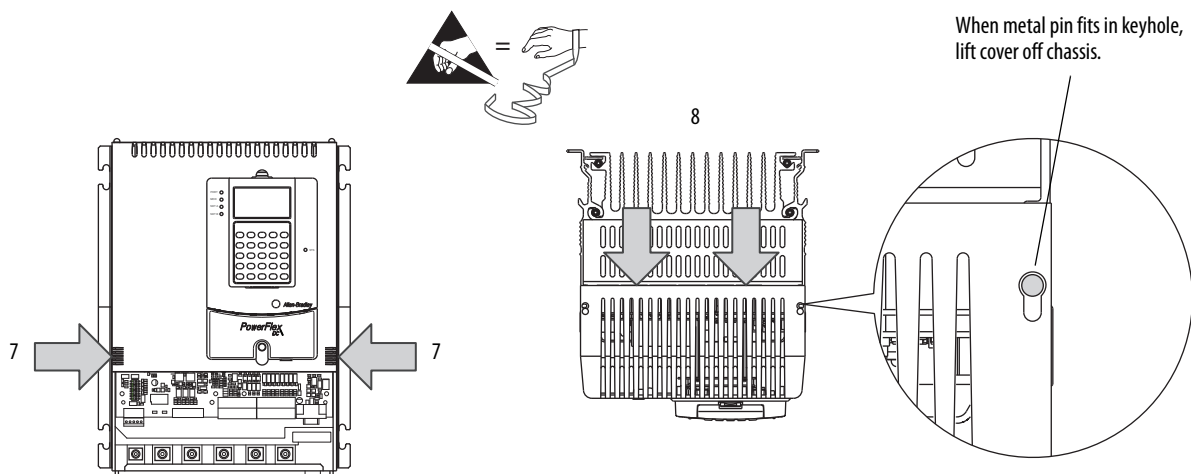


4. Disconnect the DPI cable from the HIM assembly.
5. Loosen the two screws that secure the bottom protective cover to the device.
6. While lifting along the top edge of the cover, slide it down and off the device chassis.



IMPORTANT The backside of the HIM assembly is connected to the control board with a cable. Therefore the cover will not release from the chassis until the cable is disconnected.

7. At the bottom edge of the top cover, press in on the sides and pull the cover away from the chassis to release the cover.
8. At the top edge of the cover, pull the cover away from the device until the pins on the chassis fit in the keyholes of the cover. Then lift the cover off the chassis.



9. Disconnect the HIM communication cable from the connector on the upper right corner of the control board and set the cover aside.



Install the Protective Covers

Install the protective covers in reverse order of removal.



ATTENTION: Risk of electric shock exists when power is applied to the power terminals of the device. The power terminal cover and protective covers must be replaced before you apply power to the device.

Communication Adapter and Electromagnetic Interference Shield Replacement

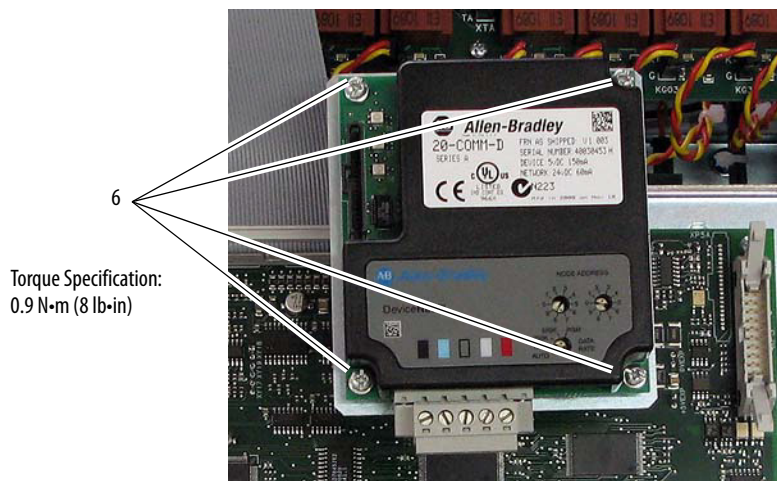
Remove the Communication Adapter and Electromagnetic Interference Shield

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).
3. Remove the protective covers (see page [36](#)).

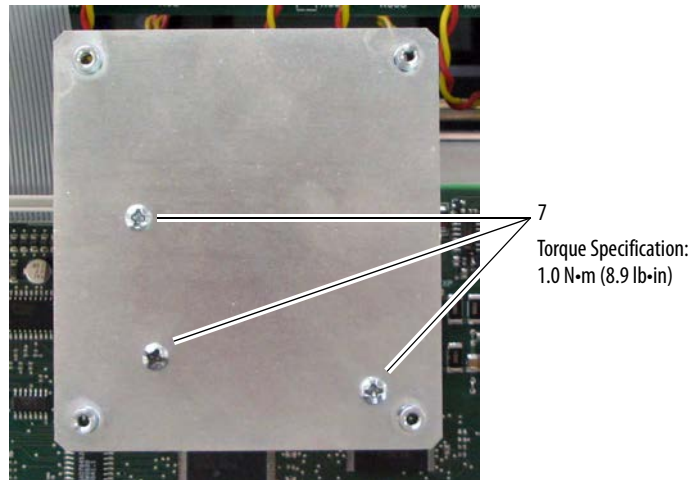
4. Disconnect the interface cable from the communication adapter and set it aside.
5. Disconnect any network cables from the adapter and set them aside.



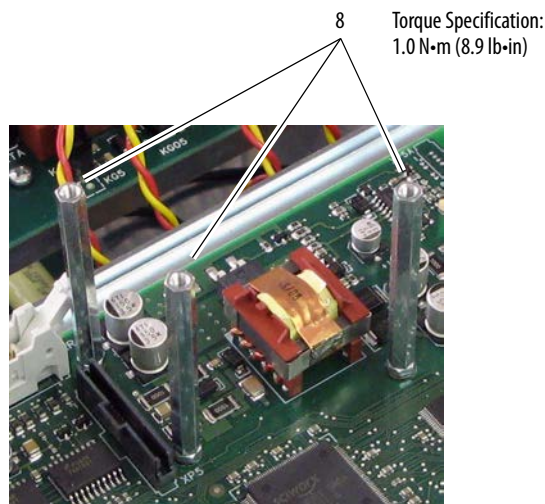
6. Remove the four screws that secure the communication adapter to the Electromagnetic Interference (EMI) shield and remove the adapter.



7. Remove the three screws that secure the EMI shield to the stand-offs on the control board and remove the EMI shield.



8. Remove the three stand-offs from the control board.



Install the Communication Adapter and Electromagnetic Interference Shield

Install the communication adapter and EMI shield in reverse order of removal.

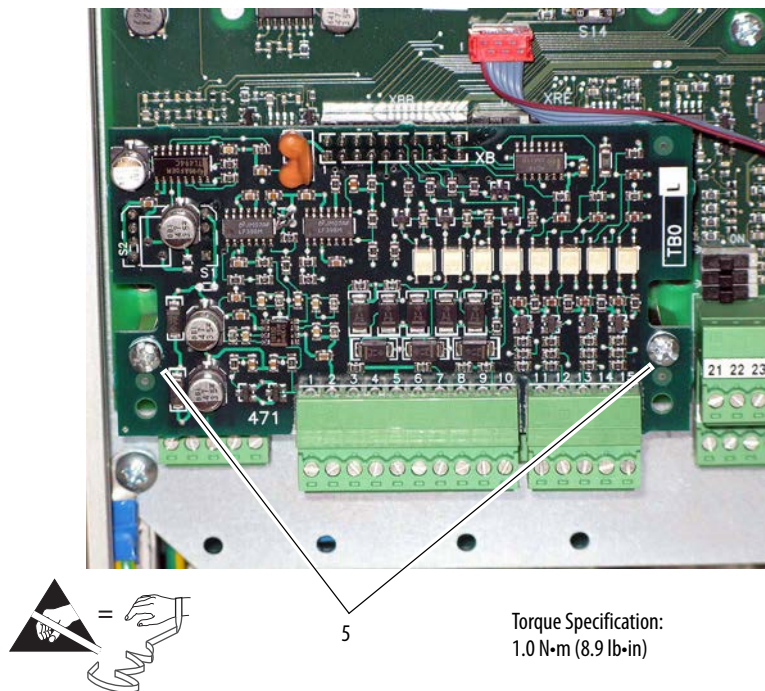
I/O Expansion Circuit Board Replacement

Remove the I/O Expansion Circuit Board

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).
3. Remove the protective covers (see page [36](#)).

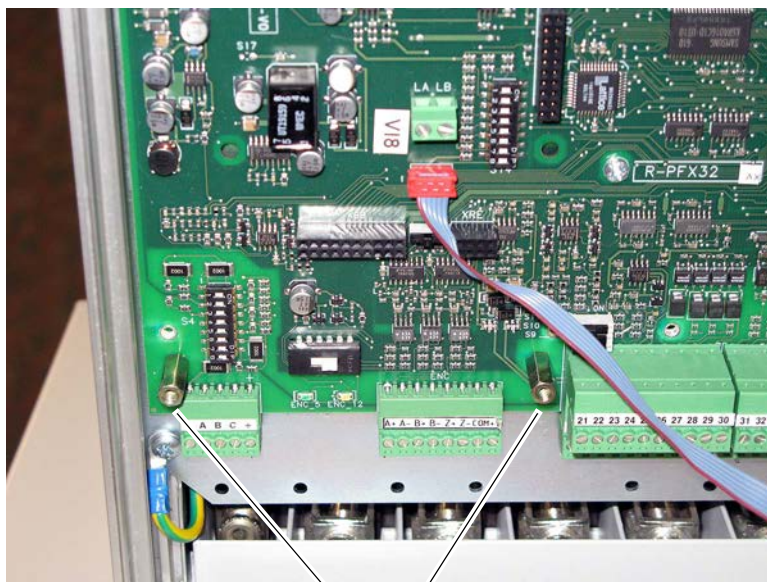
IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

4. Remove the plug-in I/O terminal blocks with the wiring kept in place.
5. Remove the two M3 x 6 mm screws and washers that secure the I/O expansion board to the stand-offs on the control board.



6. Carefully pull the I/O expansion board off connector XBB on the control board.

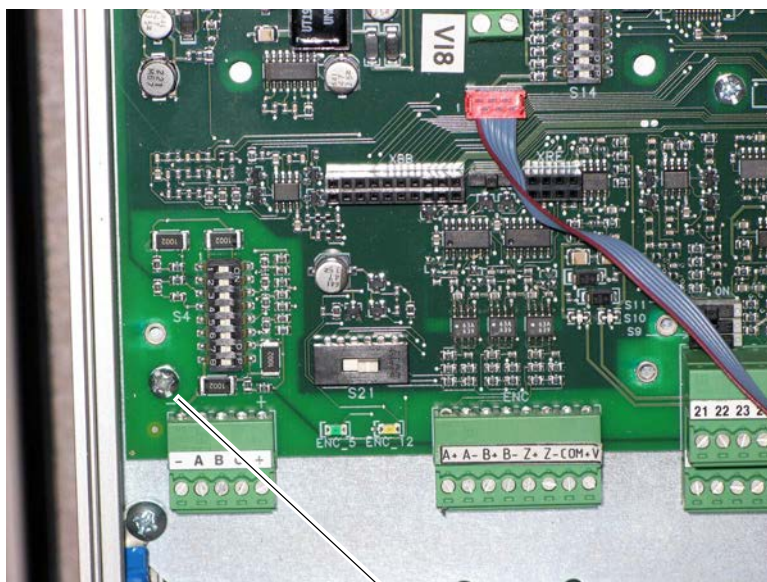
7. Remove the two stand-offs from the control board.



7

Torque Specification:
1.0 N·m (8.9 lb·in)

8. Install one of the existing screws in the lower left corner of the control circuit board.



8

Torque Specification:
1.0 N·m (8.9 lb·in)

Install the I/O Expansion Circuit Board

Install the I/O expansion board in reverse order of removal.

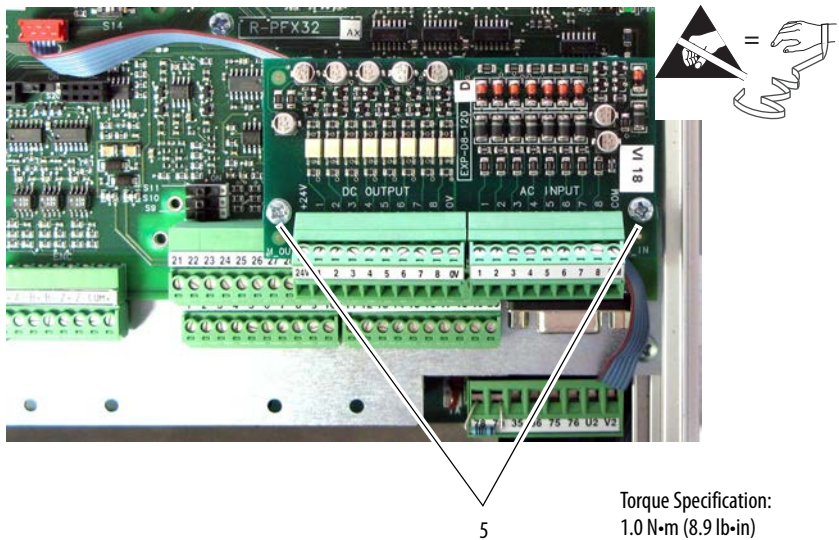
115V AC to 24V DC I/O Converter Circuit Board Replacement

Remove the 115V AC to 24V DC I/O Converter Circuit Board

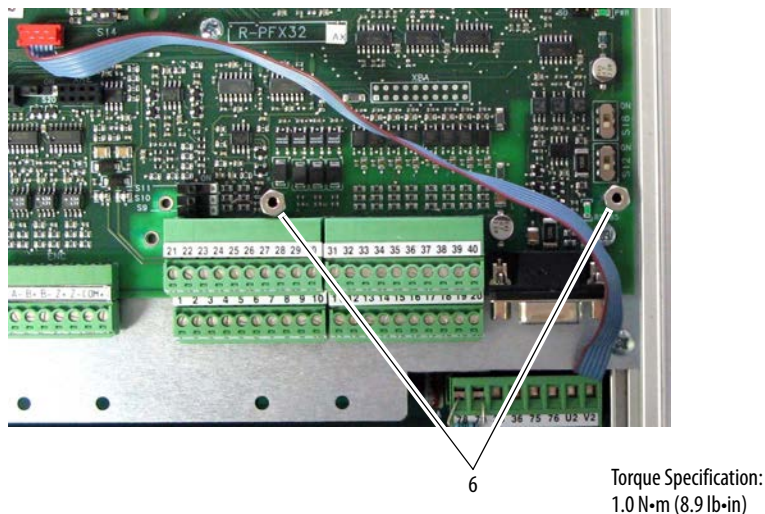
1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).
3. Remove the protective covers (see page [36](#)).

IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

4. Remove the plug-in I/O terminal blocks with the wiring kept in place.
5. Remove the two M3 x 6 mm screws and washers that secure the I/O converter board to the stand-offs on the control board and remove the I/O converter board.



6. Remove the two stand-offs from the control board.



Install the 115V AC to 24V DC I/O Converter Circuit Board

Install the 115V AC to 24V DC I/O converter board in reverse order of removal.

Control Circuit Board Replacement

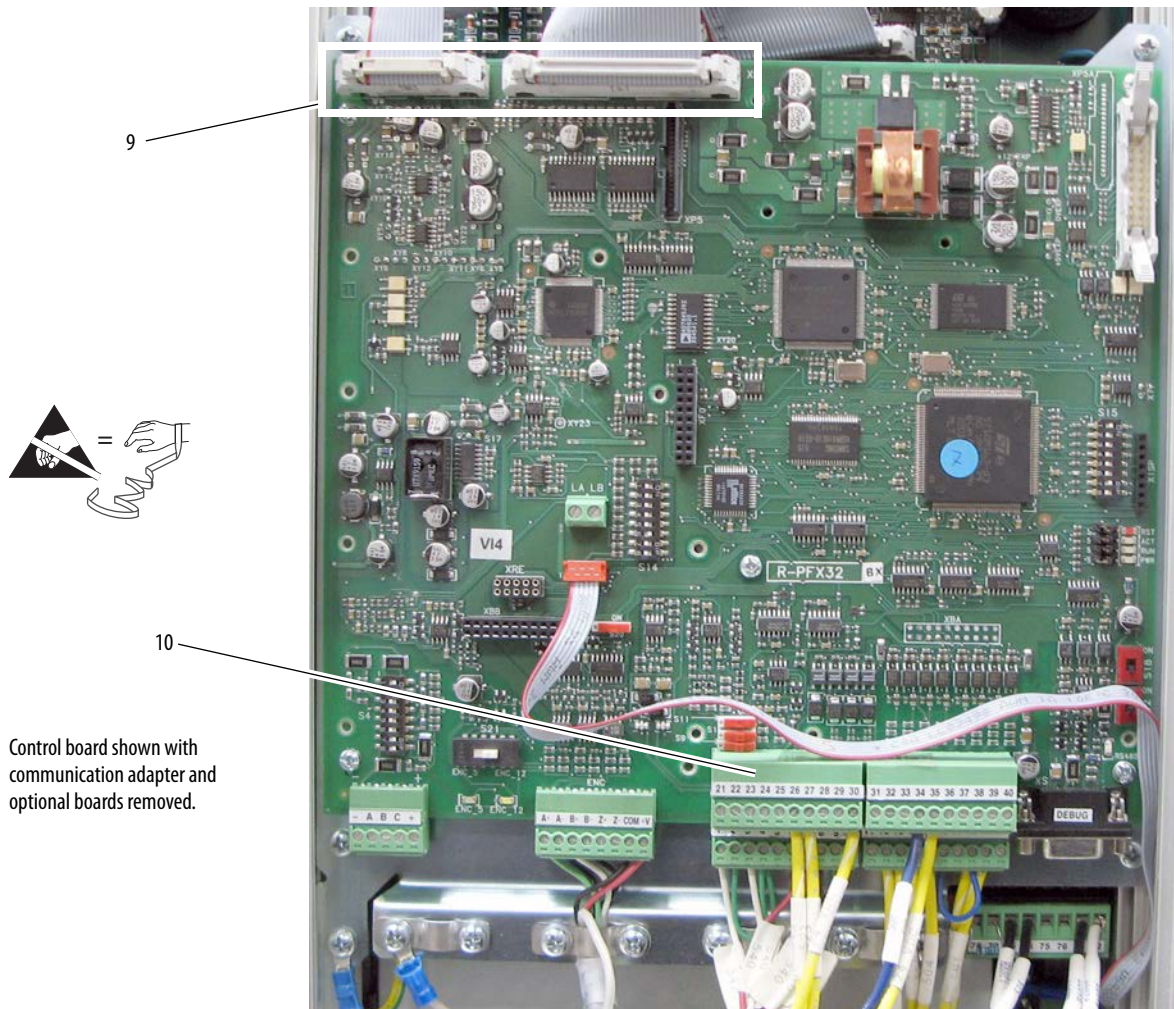
Remove the Control Circuit Board

1. Read the General Safety Precautions on page [10](#).
2. Save the device and adapter parameter configuration by using one of these methods:
 - HIM Set - see Save to a HIM Set on page [14](#).
 - Download the field controller and adapter parameters to an offline database file by using DriveExecutive™. See the on-line help that is provided with DriveExecutive for information on how to save database files.
 - Export a configuration file by using Connected Components Workbench® software. See the on-line help that is provided with Connected Components Workbench for information on how to export a device configuration file.
3. Remove power from the device (see page [33](#)).
4. Remove the protective covers (see page [36](#)).
5. Remove the communication adapter and EMI shield from the control board (see page [38](#)).
6. If installed, remove the I/O expansion circuit board (see page [41](#)).

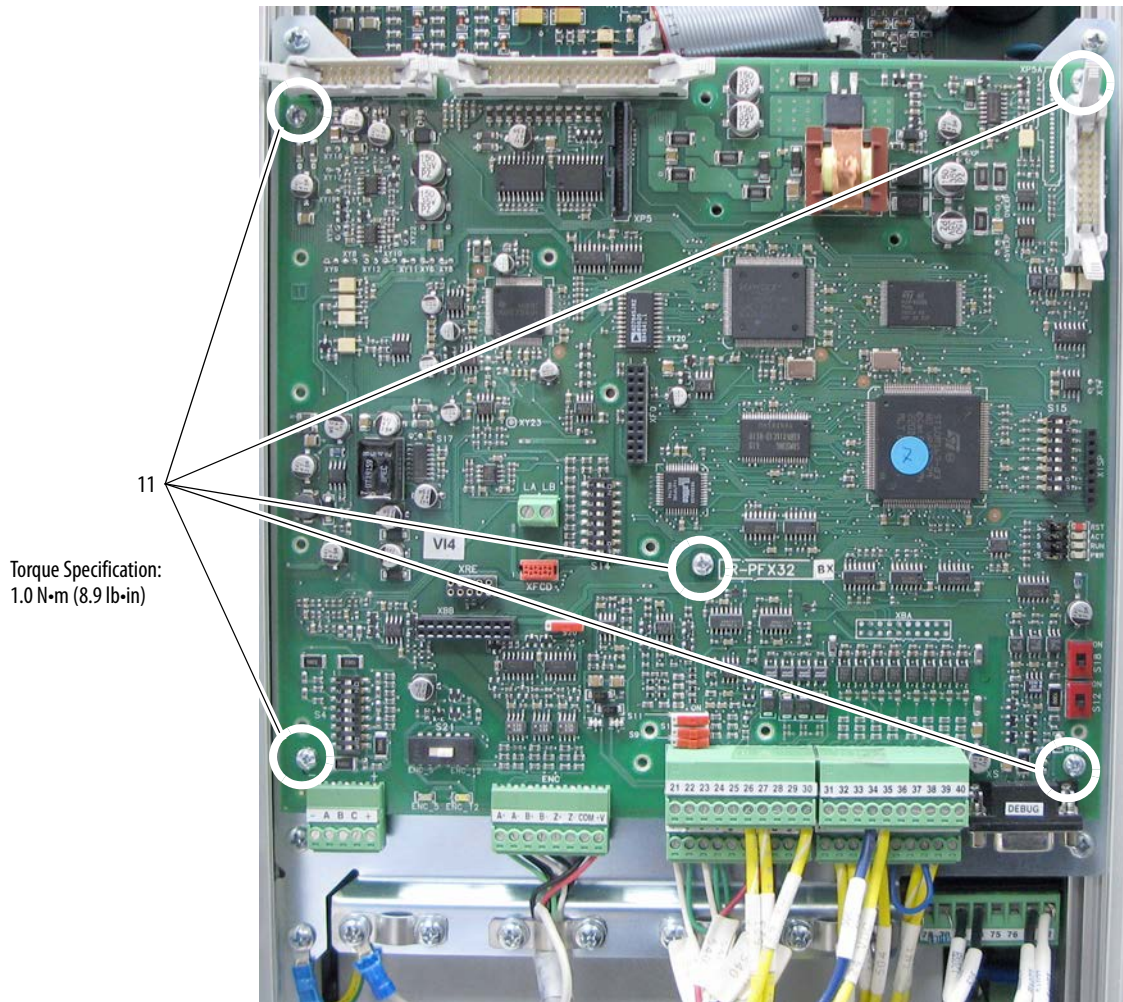
7. If installed, remove the 115V AC to 24V DC I/O converter circuit board (see page [43](#)).
8. Record all switch and jumper settings on the control board. See the PowerFlex DC Field Controller Installation Instructions, publication [23PFC-IN001](#), for more information.

Jumper/ Switch	Function	Setting
S9	Configures the input signal of analog input 1 (terminals 1 and 2):	
	Par 71 [Anlg In1 Config] must be programmed to match the input signal type that is selected with this switch.	
S10	Configures the input signal of analog input 2 (terminal 3 and 4):	
	Par 76 [Anlg In2 Config] must be programmed to match the input signal type that is selected with this switch.	
S11	Configures the input signal of analog input 3 (terminals 5 and 6):	
	Par 81 [Anlg In3 Config] must be programmed to match the input signal type that is selected with this switch.	
S15	Configuration of the control circuit board to the appropriate device size.	S15-1 = S15-2 = S15-3 = S15-4 = S15-5 = S15-6 = S15-7 = S15-8 =

9. Carefully disconnect the cables from connectors XA and XR on the control board.
10. Remove the plug-in I/O and control terminal blocks with the wiring kept in place.



11. Remove the five M3 x 6 mm screws and washers that secure the control board to the control EMI shield and remove the control board.



Install the Control Circuit Board

Install the control board in reverse order of removal.

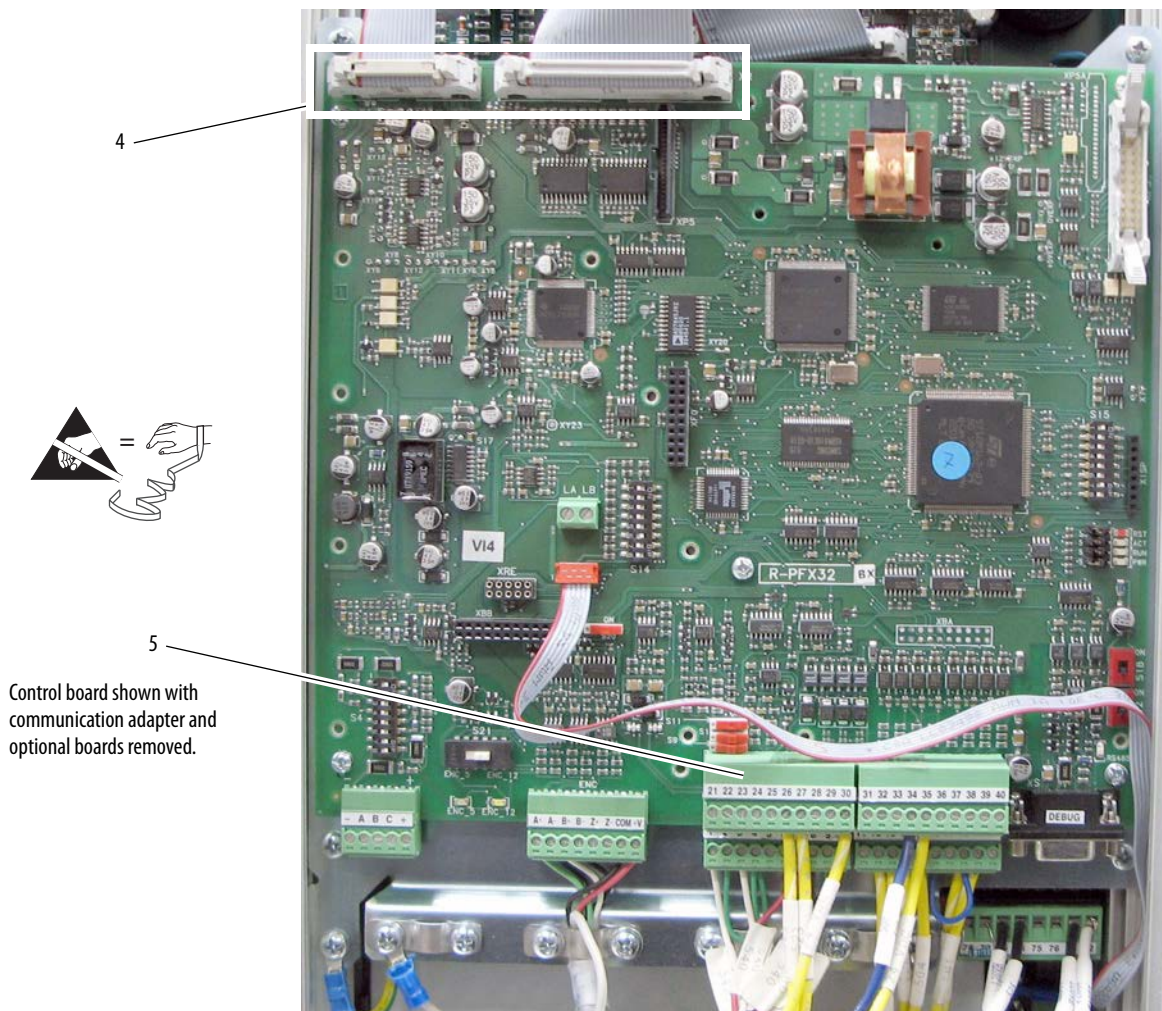
- Verify that all DIP switches are set to the correct configuration based on your recorded settings (see page [45](#)).

Control EMI Shield and Control Circuit Board Replacement

Remove the Control EMI Shield and Control Circuit Board

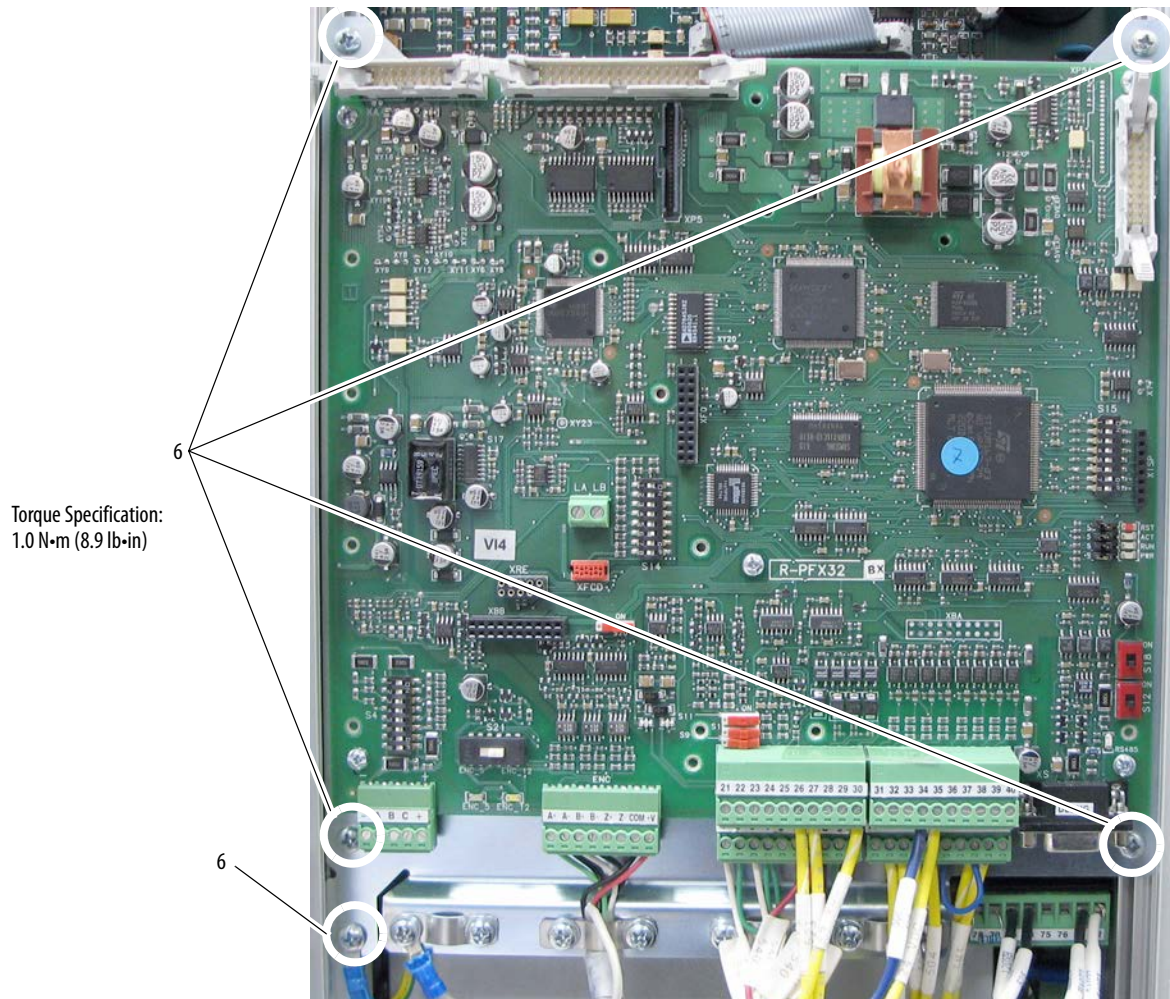
You must remove the control EMI shield that holds the control board to access other components within the device.

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).
3. Remove the protective covers (see page [36](#)).
4. Carefully disconnect the cables from connectors XA and XR on the control board.
5. Remove the plug-in I/O terminal blocks with the wiring kept in place (if used).



6. Remove the five M4 x 9.5 mm screws that secure the control EMI shield and ground wire (in the lower left corner) to the chassis. Slide the control EMI shield and control board up and out of the device.

IMPORTANT Be careful when removing the EMI shield not to pull free any of the gate leads or other cables on the pulse transformer circuit board below the EMI shield.



Install the Control EMI Shield and Control Circuit Board

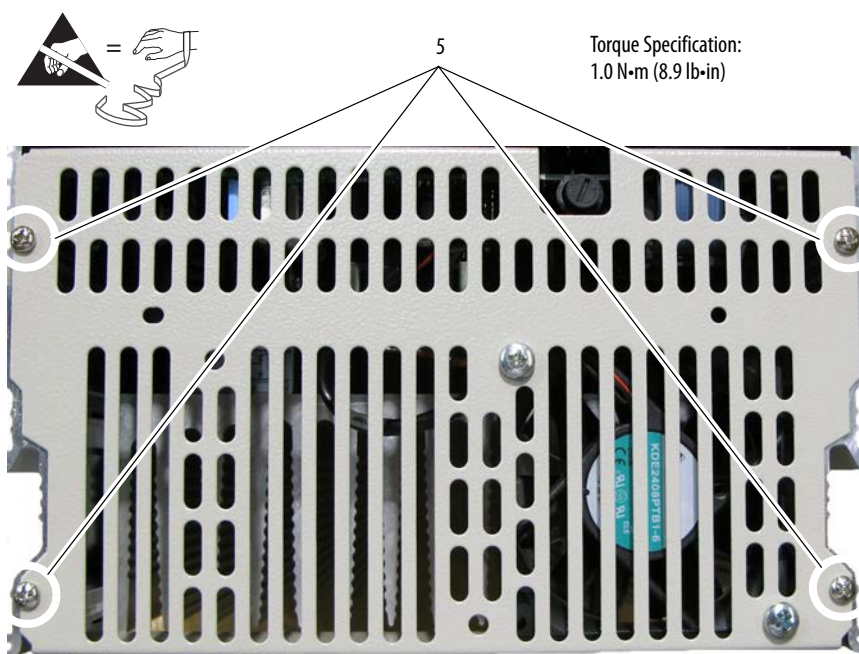
Install the control EMI shield and control board in reverse order of removal.

Pulse Transformer and Switching Power Supply Circuit Board Replacement

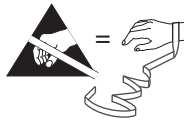
Remove the Pulse Transformer and Switching Power Supply Circuit Board

The switching power supply circuit board is on the back of the pulse transformer circuit board. You must remove both boards to replace either board.

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).
3. Remove the protective covers (see page [36](#)).
4. Remove the control EMI shield and control board (see page [48](#)).
5. For 60 A and 120 A field controllers, complete these steps:
 - a. Remove the four screws that secure the slotted air flow plate to the top of the device.
 - b. Remove the fan cable from connector XV on the switching power supply board and remove the plate.



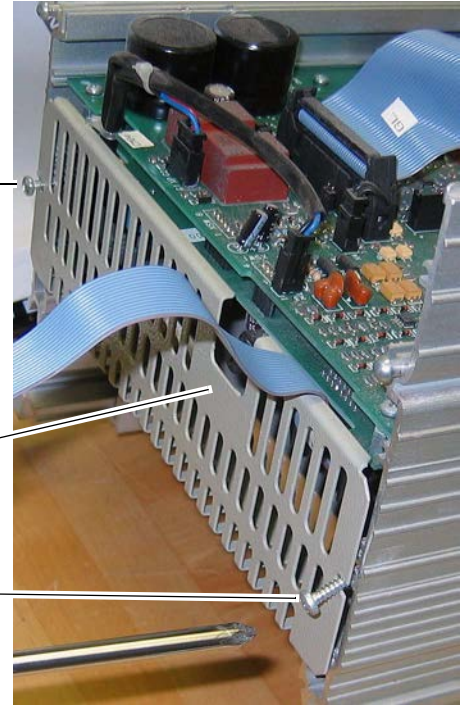
6. For 17 A field controllers, remove the two screws that secure the slotted air flow plate to the top of the device and remove the plate.



Torque Specification:
1.0 N•m (8.9 lb•in)

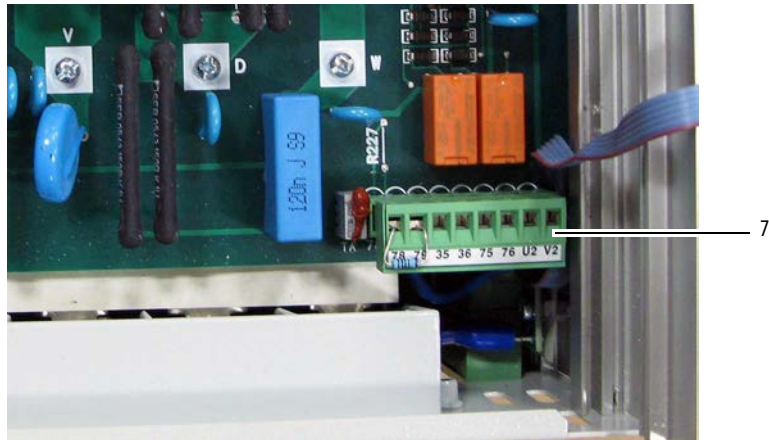
Air flow plate

Torque Specification:
1.0 N•m (8.9 lb•in)

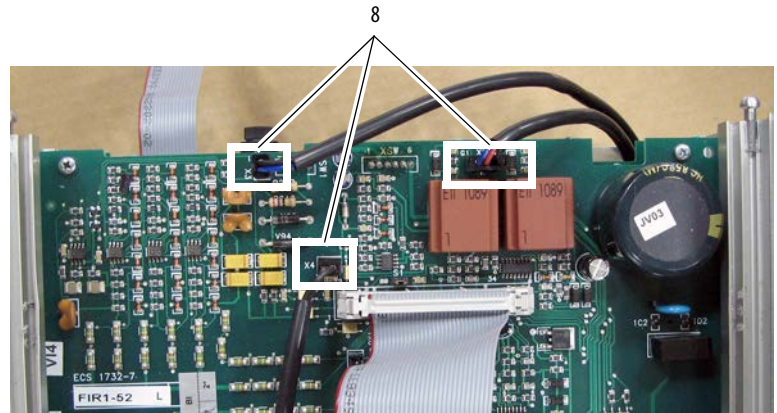


IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

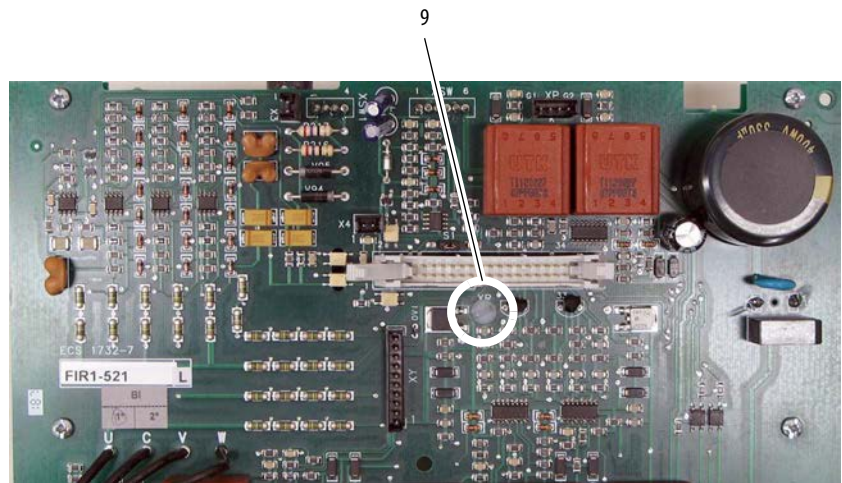
7. Remove the plug-in control power terminal block from the lower right corner of the pulse transformer circuit board.



8. Remove the cables from connectors X3 and X4 at the top of the pulse transformer board. For devices without a fan, do not remove the jumper in connector X4.



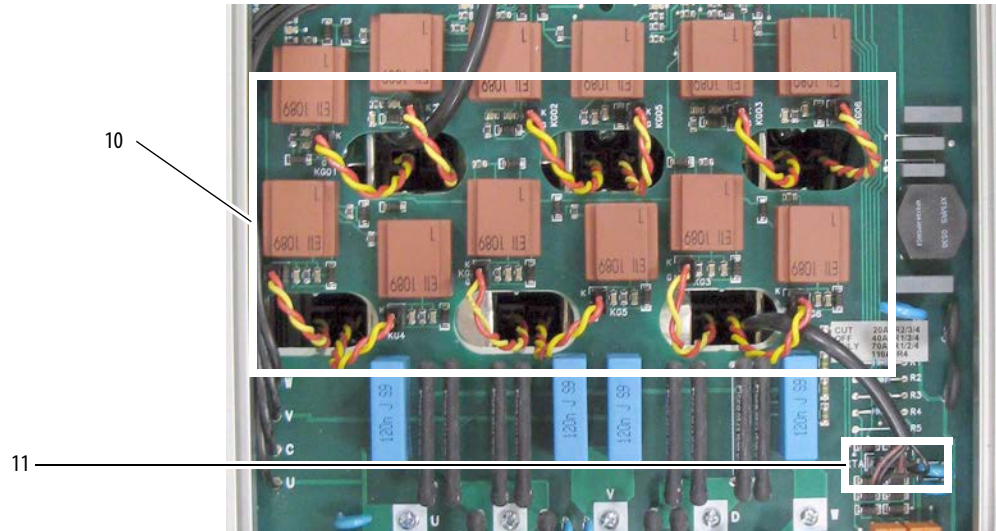
9. Remove the plastic screw near the top of the pulse transformer board and retain for reuse.



10. Remove each pair of (orange and yellow) gate lead cables from connectors KG01...KG06 and KG1...KG6 and push each lead through the appropriate opening in the board.

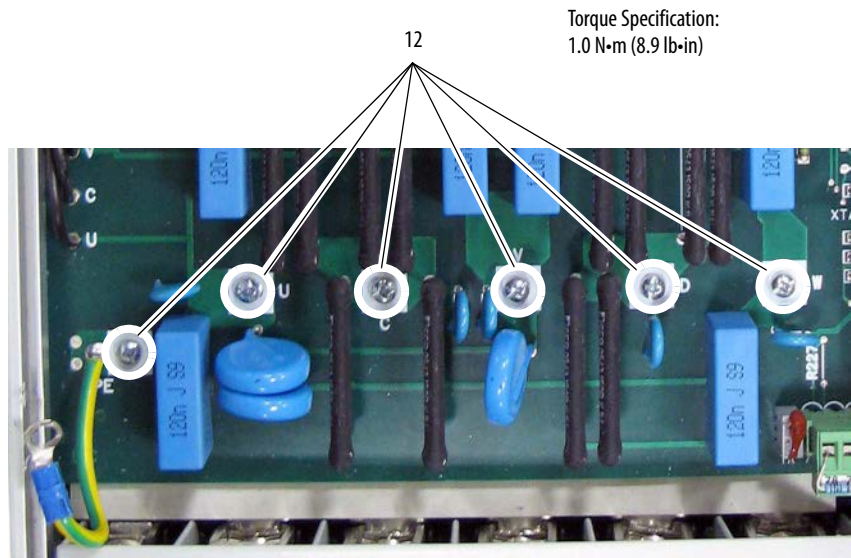
IMPORTANT Carefully remove the gate leads by grasping the connector. DO NOT pull the gate leads off by pulling on the wires.

11. Remove the cable from connectors XTA on the lower right side of the board.

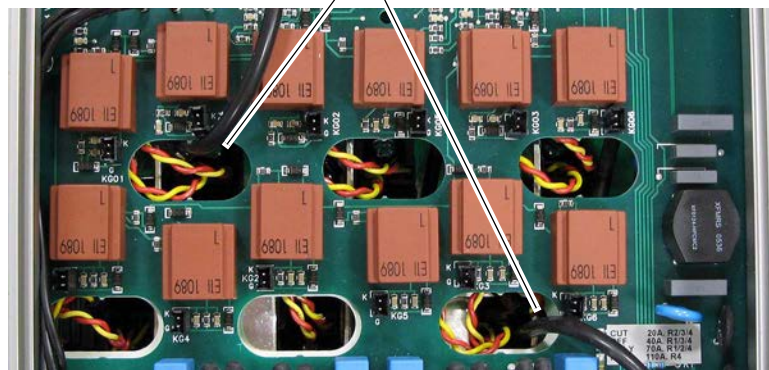


12. Remove the six M3 x 6 mm screws and washers that secure the bottom of the pulse transformer board to the chassis. While lifting slightly on the board, slide it toward the top of the device and out of the chassis. There is an isolation sheet below the board; do not remove this sheet unless it is damaged.

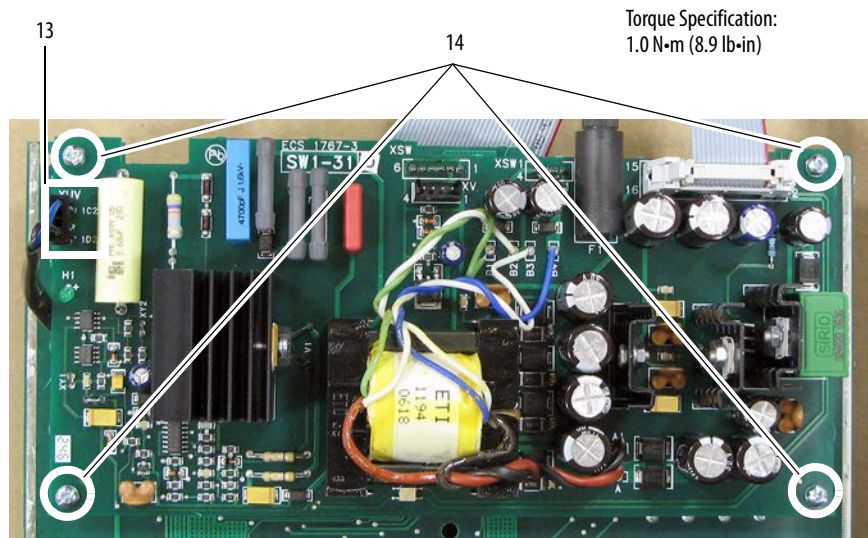
IMPORTANT The cables from connectors X4 and XTA must slide through the openings in the board as it is lifted out of the device chassis. Take care not to damage these cables and connectors.



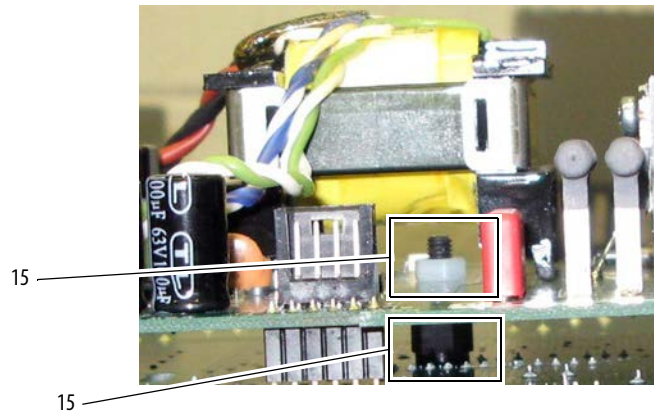
Carefully route cables through openings as the board is removed.



13. Remove the cable from connector XUV on the left side of the switching power supply board.
14. Remove the four M3 x 6 mm screws and washers that secure the switching power supply board to the stand-offs on the back of the pulse transformer board. Remove the switching power supply board.



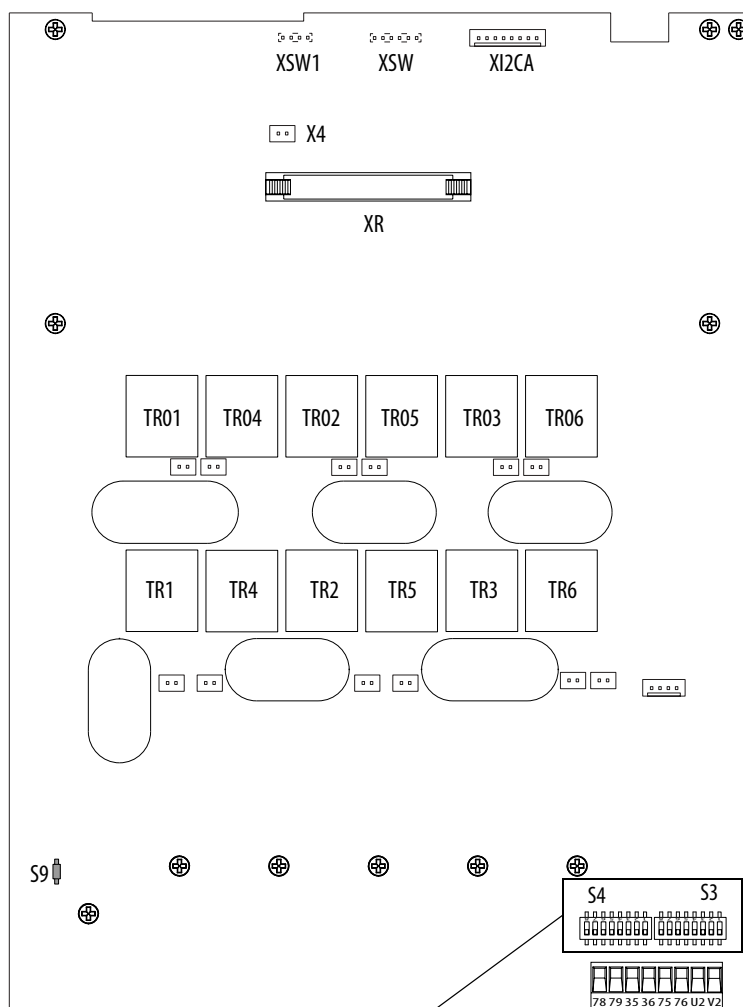
15. Remove the plastic stand-off and nut that secures the switching power supply board to the back of the pulse transformer board.



Install the Pulse Transformer and Switching Power Supply Circuit Boards

Before you install a new pulse transformer circuit board, you must configure the DIP switches on the circuit board to match the field controller size (output current rating).

1. Set DIP switches S3 and S4, on the pulse transformer board, to the correct settings based on the field controller output current rating. See DIP Switch S3 and S4 Settings - FIR1-xx-FC on page [57](#).



IMPORTANT A blank cell below a switch in [Table 9](#) indicates that the setting is “OFF”.

Table 9 - DIP Switch S3 and S4 Settings - FIR1-xx-FC

Device Output Current (Amps)	DIP Switch S3								DIP Switch S4							
	S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	S3-7	S3-8	S4-1	S4-2	S4-3	S4-4	S4-5	S4-6	S4-7	S4-8
17		ON			ON											
60	ON	ON			ON	ON	ON	ON								
120		ON				ON	ON	ON		ON		ON				

2. Install the isolation sheet (if present) before installing the pulse transformer and switching power supply boards.



ATTENTION: Failure to install the Isolation sheet below the pulse transformer and switching power supply boards can result in damage to the field controller.

3. Install the configured pulse transformer board and switching power supply board in reverse order of removal.



ATTENTION: Each gate lead cable must be connected to the exact connector from which it was removed on the pulse transformer circuit board or damage to the device can occur. See [Figure 9](#) on page [124](#) for gate lead pinouts.

AC Current Transducer Replacement

Remove the AC Current Transducers

IMPORTANT AC current transducers must be replaced in pairs.

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).
3. Remove the protective covers (see page [36](#)).
4. Remove the control EMI shield and control circuit board (see page [48](#)).
5. Remove the pulse transformer and switching power supply circuit boards (see page [50](#)).

The device rating determines the power bridge configuration and where the AC current transducers are in the device. Complete the applicable procedures for your field controller:

- 17 A and 60 A frame A field controllers have AC current transducers that are installed on the power traces board. See AC Current Transducers on Devices with a Power Traces Board.
- 120 A frame A field controllers have AC current transducers that are installed on the bus bars inside the field controller. See Remove the AC Current Transducers from 120 A Field Controllers on page [60](#).

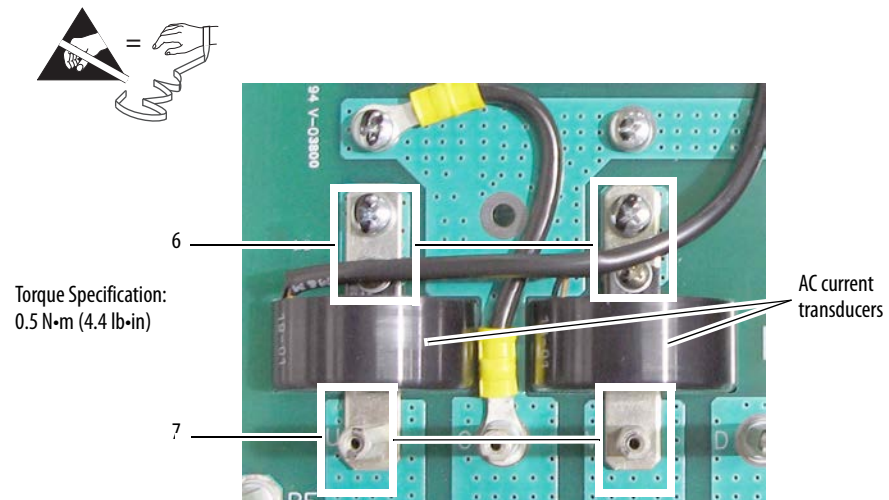
AC Current Transducers on Devices with a Power Traces Board

The field controller amp rating determines how the AC current transducers are secured to the power traces board. Complete the applicable procedures for your field controller:

- See Remove the Current Transducers with Connection Bars on page [59](#) for devices with one metal bar and no windings on the AC current transducers.
- See Remove the Current Transducers with No Connection Bars on page [59](#) for devices no metal bar and windings on the AC current transducers.

Remove the Current Transducers with Connection Bars

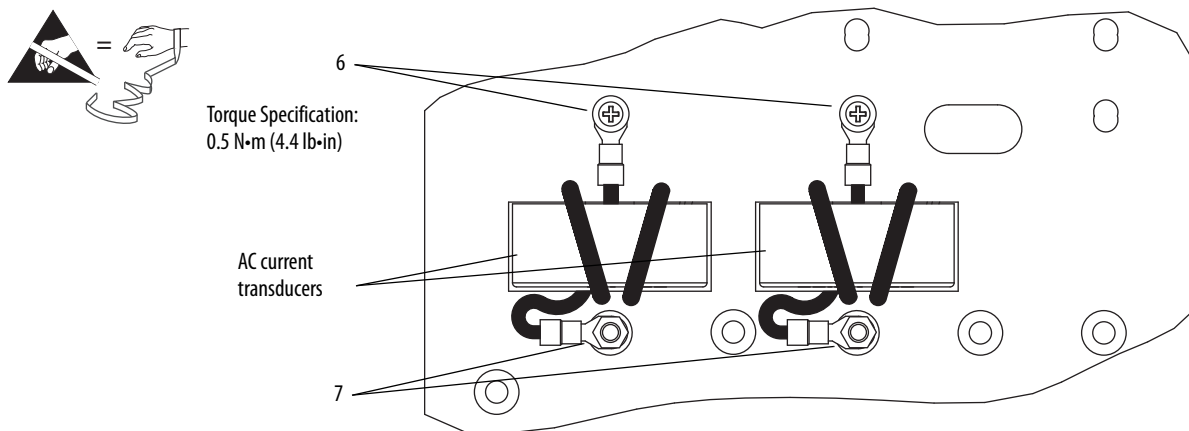
6. Remove the four M3 x 6 mm screws and washers that secure the top of the AC current transducers to the power traces board.
7. Remove the two stand-offs that secure the bottom of the AC current transducers to the power traces circuit board and remove the AC current transducers from the device.



8. Continue with Install the AC Current Transducers on page [62](#).

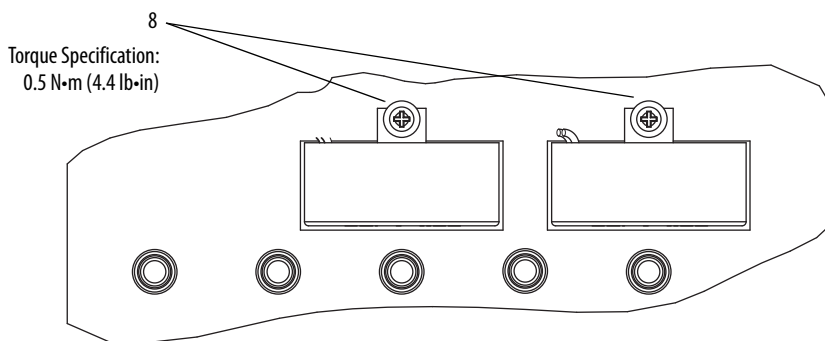
Remove the Current Transducers with No Connection Bars

6. Remove the four M3 x 6 mm screws and washers that secure the top of the AC current transducers to the power traces board.
7. Remove the two screws and washers that secure the top of the wire leads to the power traces board.



8. Turn the board over and remove the two M3 x 6 mm screws and washers that secure the AC current transducers to the board. Remove the AC current transducers and windings (if present) from the device.

IMPORTANT You do not need to remove the windings from the AC current transducers. However, note the number of times the wire lead is wound around the AC current transducers for proper installation of the new AC current transducers.

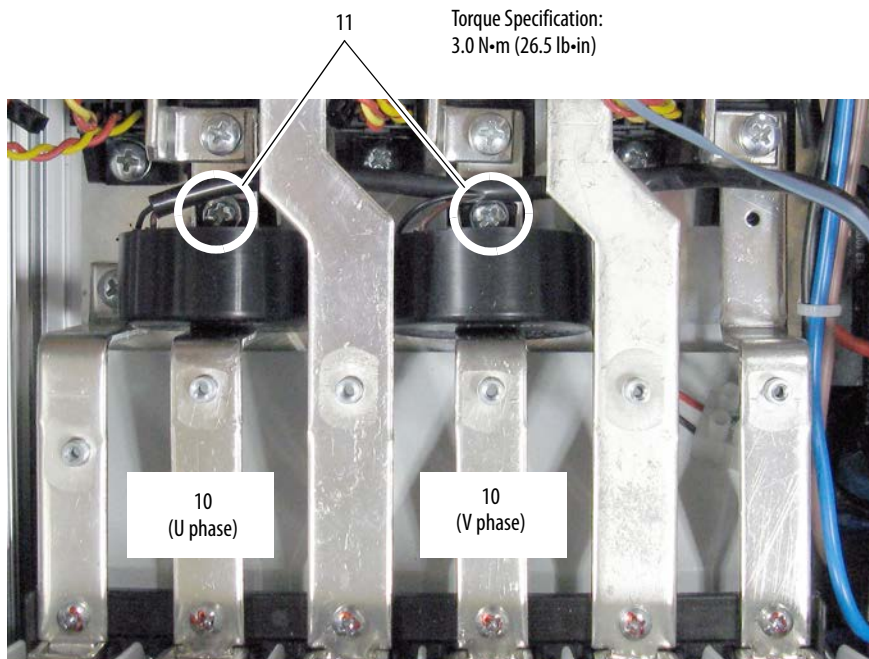


9. Continue with Install the AC Current Transducers on page [62](#).

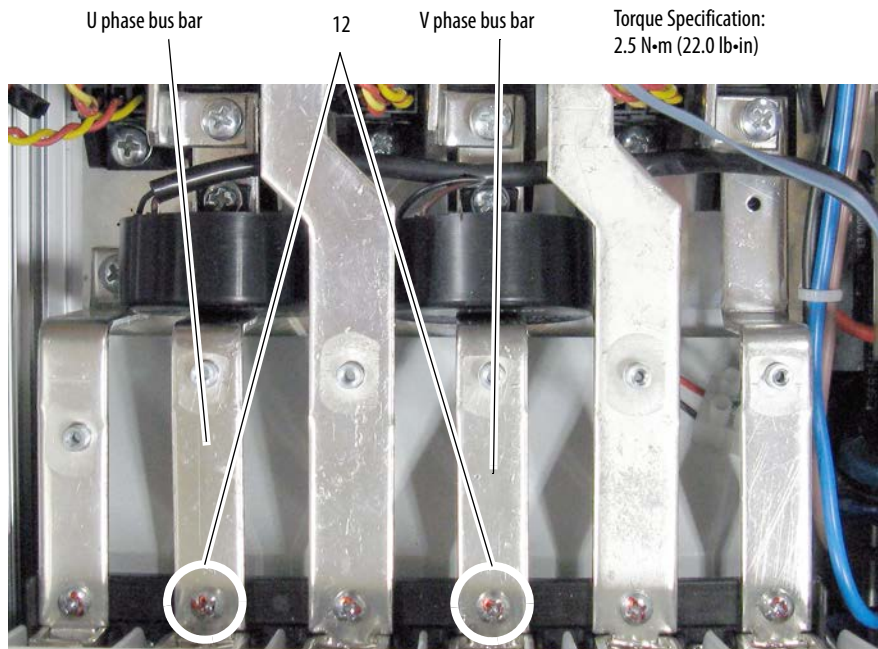
Remove the AC Current Transducers from 120 A Field Controllers

IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

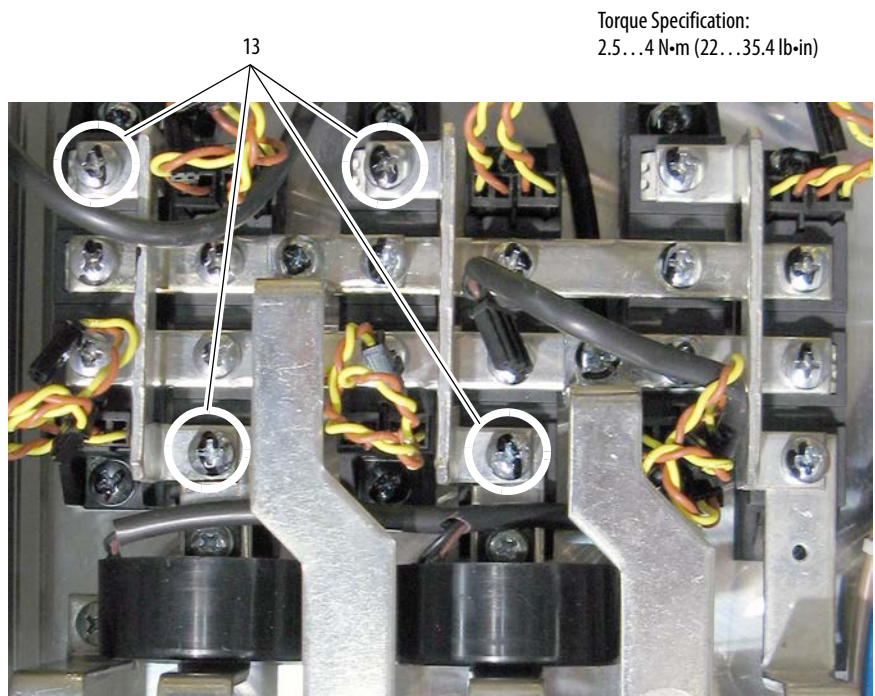
10. Remove the power connections from terminals U and V at the bottom of the device.
11. Remove the M4 x12.5 mm screws and washers that secure each of the AC current transducers to the U and V phase terminal bus bars.



12. Remove the two 5 x 10 mm screws and washers that secure each of the U and V phase terminal bus bars to the terminal isolation strip at the bottom of the device.



13. Remove the top and bottom screws and washers that secure the connecting bus bars and U and V phase terminal bus bars to the SCR modules. Remove the connecting bus bars.



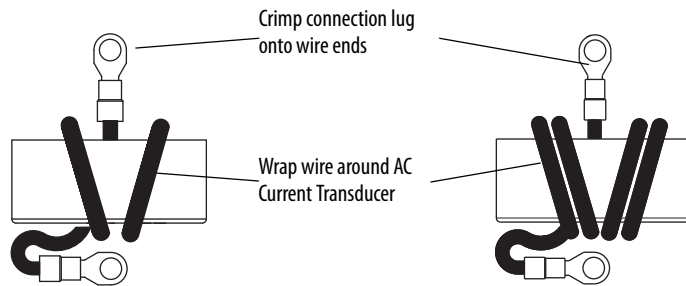
14. While lifting the terminal bus bars out of the device, slide the AC current transducers off the bus bars.

Install the AC Current Transducers

Install the AC current transducers in reverse order of removal.

For AC current transducers that must be wound with wire leads:

- Wind the wire leads around the new AC current transducers the exact number of times and in the same position as the wires on the AC current transducers that were removed from the power traces board.
- Crimp the connection lugs onto the wire leads before they are secured to the power traces board.

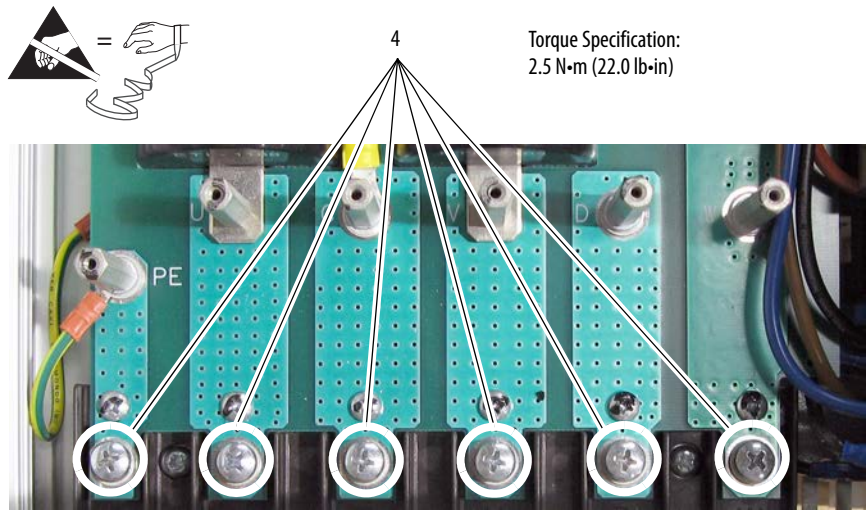


Power Traces Circuit Board Replacement

Remove the Power Traces Circuit Board

The power traces circuit board is only contained in 17 A and 60 A frame A field controllers.

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).
3. Remove the protective covers (see page [36](#)).
4. Remove the M5 x 10 mm screws and washers that secure the terminal lugs (if present) and power and ground wiring to terminals U, V, W, C, D, and PE at the bottom of the device.

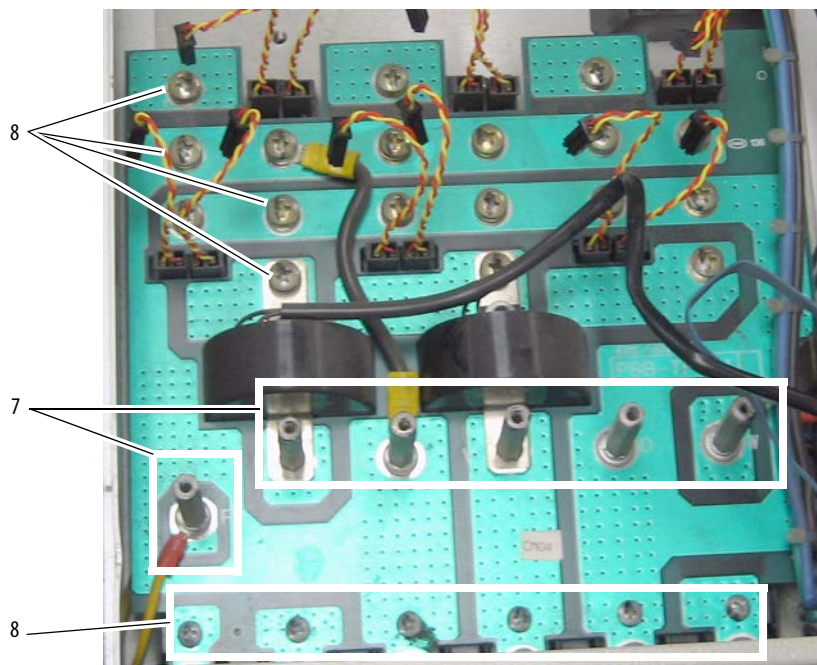


5. Remove the control EMI shield and control board (see page [48](#)).
6. Remove the pulse transformer and switching power supply circuit boards (see page [50](#)).

7. Remove the six stand-offs (and the ground wire) from the power traces circuit board.
8. Remove all M5 x 10 mm screws and washers that secure the board to the SCR modules and power terminal isolation strip. Remove the power traces board from the device.

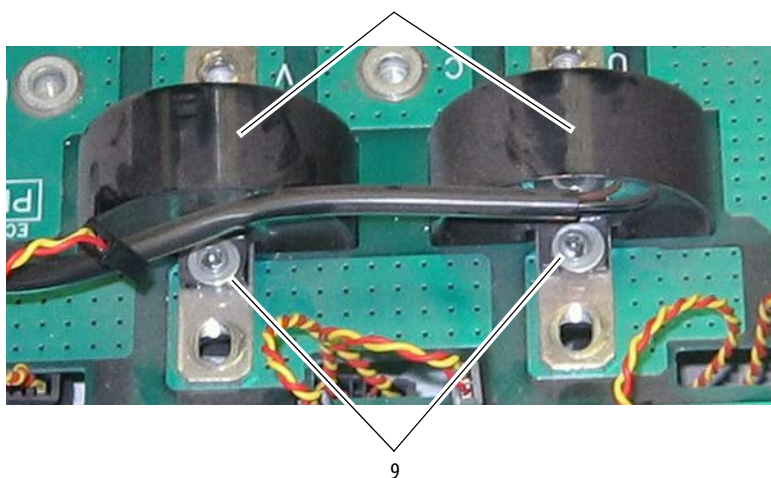


Torque Specification:
2.5 N·m (22.0 lb·in)



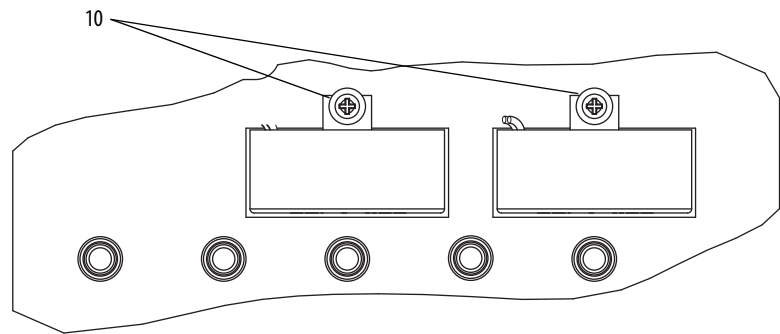
9. Remove the screw and washer that secures the top of each of the AC current transducers to the power traces board and remove the current transducers.

AC current transducers with connections bars



10. For devices with AC current transducers with no connection bars, turn the board over and remove the two screws and washers that secure the AC current transducers to the board. Remove the AC current transducers and windings (if present) from the device.

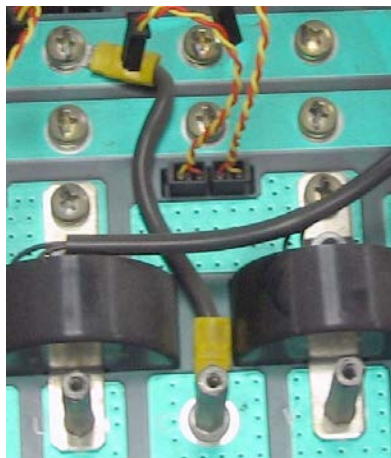
IMPORTANT You do not need to remove the windings from the AC current transducers.



Install the Power Traces Circuit Board

Install the power traces circuit board in reverse order of removal.

- Verify that the connecting wire on the board is placed in the exact location as previously installed.
- Verify that the wire leads wound around the current transducers (if present) are in the same location as when previously installed.



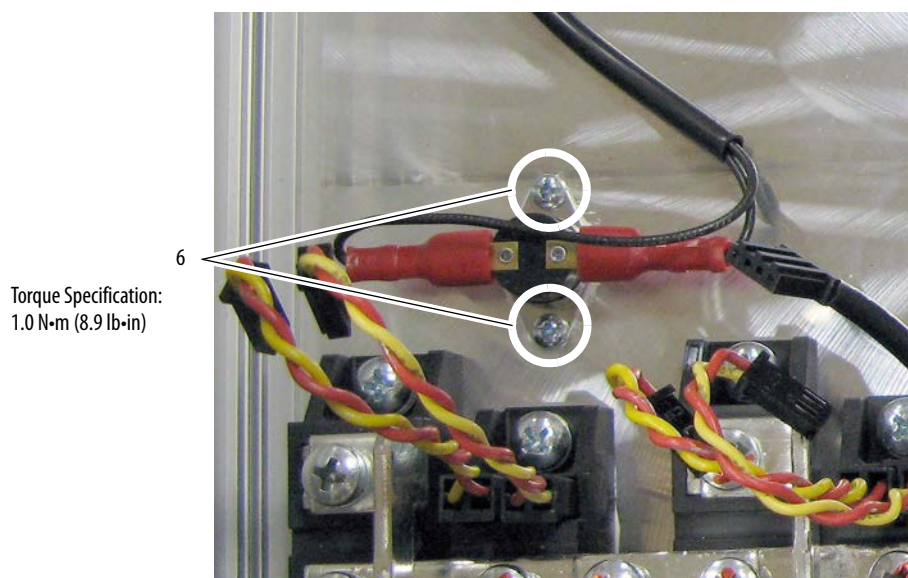
Bimetal Thermostat Replacement

Remove the Bimetal Thermostat

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).
3. Remove the protective covers (see page [36](#)).
4. Remove the control EMI shield and control circuit board (see page [48](#)).
5. Remove the pulse transformer and switching power supply circuit boards (see page [50](#)).

IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

6. Remove the two M3 x 6 mm screws that secure the thermostat to the heat sink and remove the thermostat and connected wires from the device.



Install the Bimetal Thermostat

Install the thermostat in reverse order of removal.

IMPORTANT Thermal grease must be applied to the bottom of the thermostat before securing it to the heat sink.

SCR Module Replacement

Remove the SCR Modules

IMPORTANT The SCR modules must be replaced in pairs for each input phase in order that the gating resistance of each pair of modules is the same.

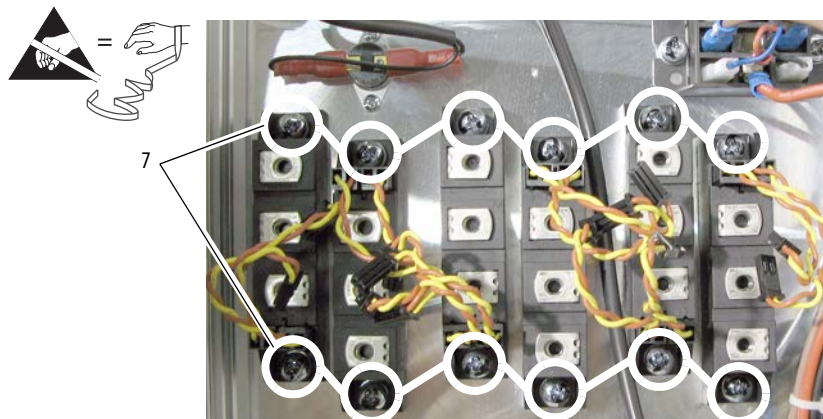
1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).
3. Remove the protective covers (see page [36](#)).
4. Remove the control EMI shield and control circuit board (see page [48](#)).
5. Remove the pulse transformer and switching power supply circuit boards (see page [50](#)).

The device rating determines how the power bridge is configured and the steps that are required to remove the SCR modules:

- See SCR Modules on 17 A and 60 A Field Controllers on page [67](#).
- See SCR Modules on 120 A Field Controllers on page [68](#).

SCR Modules on 17 A and 60 A Field Controllers

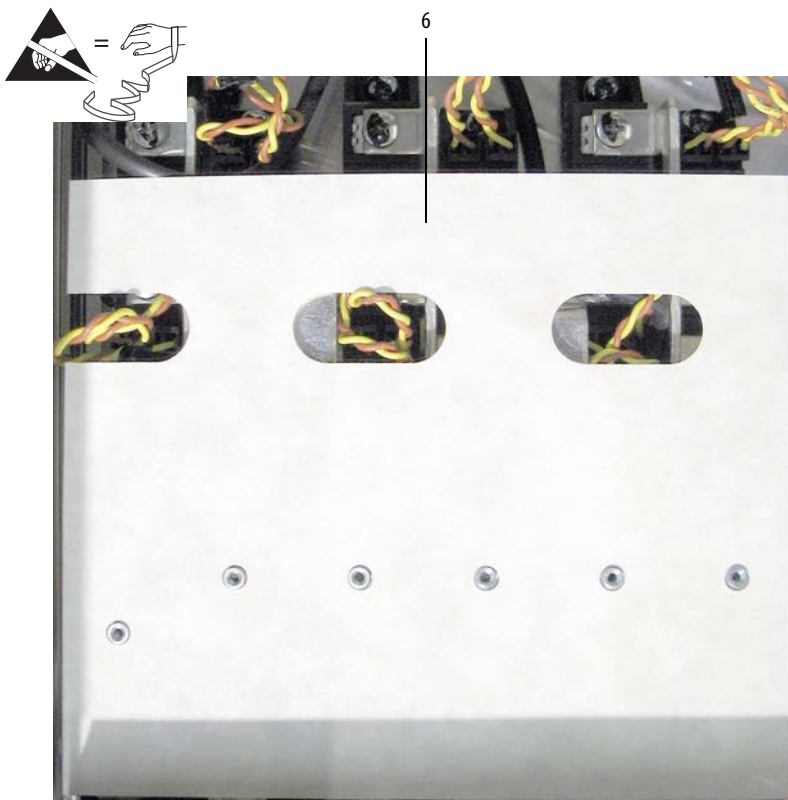
6. Remove the power traces circuit board. See Power Traces Circuit Board Replacement on page [63](#). The AC current transducers can remain on the power traces board.
7. Remove the two screws and washers that secure each SCR module to the heat sink and remove the SCR modules.



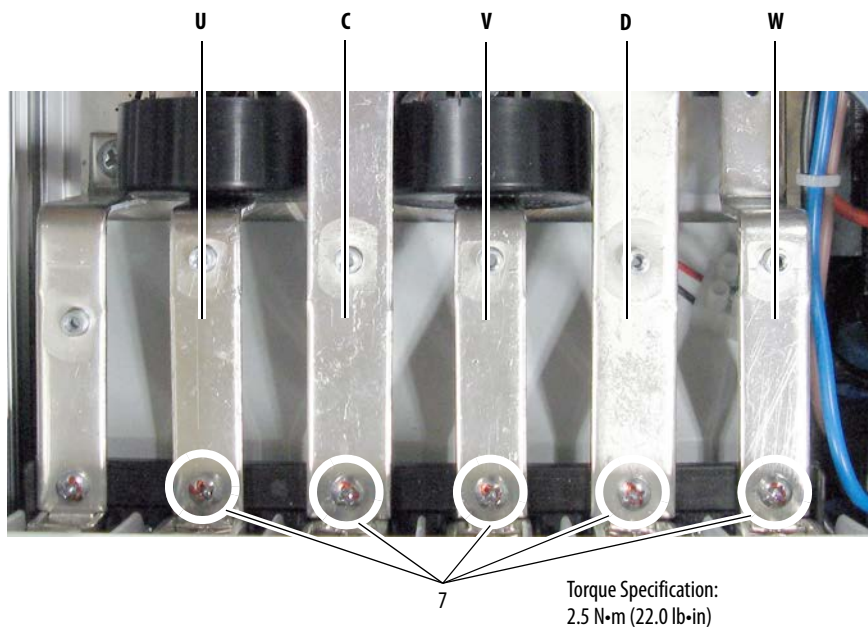
Continue with Install the SCR Modules on page [71](#).

SCR Modules on 120 A Field Controllers

6. Remove the isolation sheet.

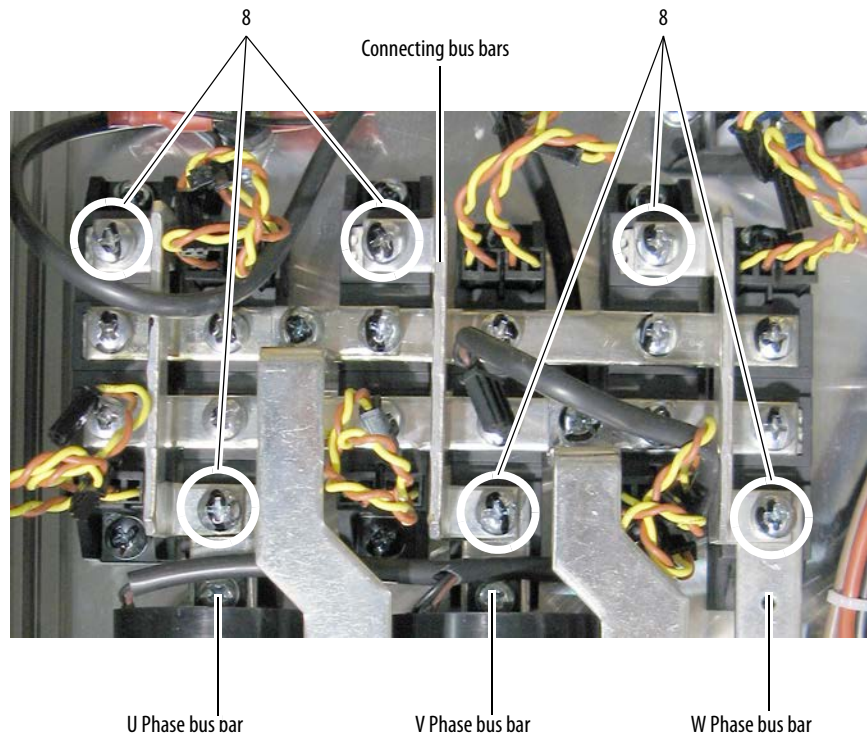


7. Remove the M5 x 10 mm screws that secure the U, V, W, C, and D terminal bus bars to the power terminal isolation strip at the bottom of the device.

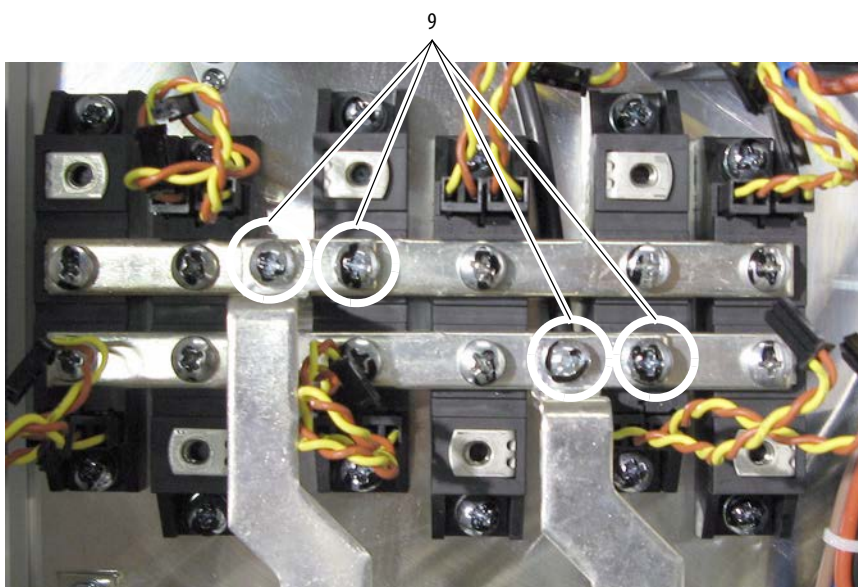


8. Remove the screws and washers that secure the connecting bus bars to the anodes of the corresponding SCR modules and remove the bus bars. In addition, remove the U, V, and W phase terminal bus bars from the device.

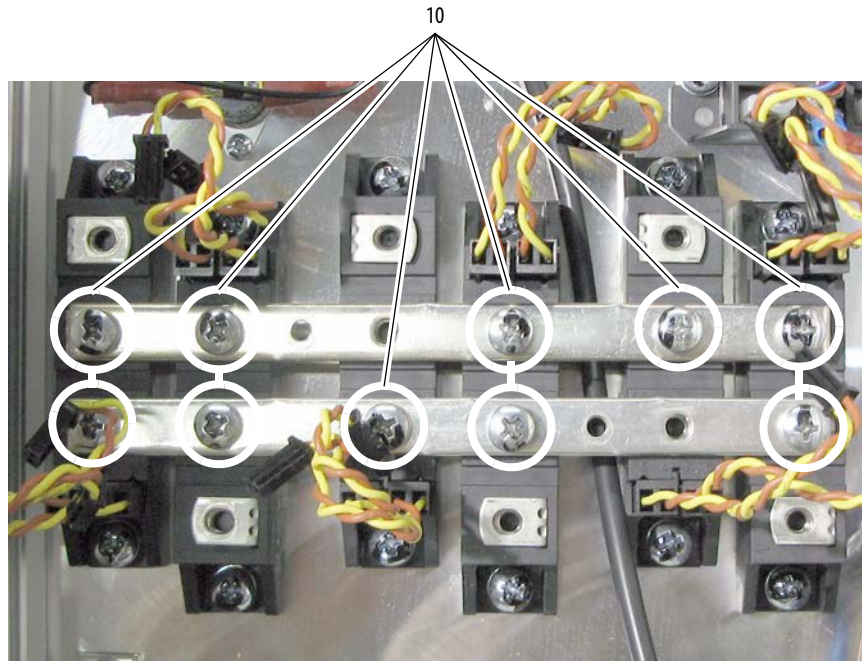
IMPORTANT The screws that secure these bus bars to the SCR modules are M5 x 16. Retain for reuse with these bus bars only.



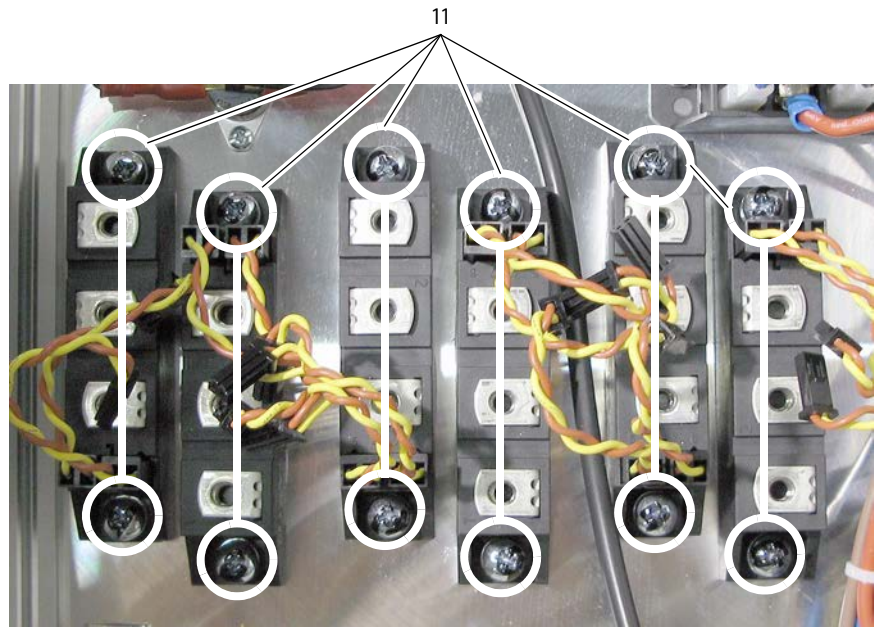
9. Remove the four M5 x 16 screws and washers that secure the C and D terminal bus bars to the horizontal bus bars. Remove the C and D terminal bus bars.



10. Remove the screws and washers that secure the connecting bus bars to the SCR modules and remove the bus bars.



11. Remove the screws and washers that secure each SCR module to the heat sink and remove the SCR modules.



Install the SCR Modules

IMPORTANT Thermal grease must be applied to the bottom of each SCR module before securing it to the heat sink.

Install the SCR modules in the reverse order of removal using these tables for proper hardware torque specifications:

- Use the following table to determine the proper tightening torque for the SCR modules that are installed on the heat sink.

Device Output Current (Amps)	Rockwell Automation Cat. No.	Vendor	Vendor Part Number	Final Torque
17	SK-20P-S7F73	Semikron	SKKT27/16E	5 ±15% N•m (44.25 ±15% lb•in)
		IXYS	MCC26-16io1B	2.5...4 N•m (22...35.4 lb•in)
60	SK-20P-S7F74	Semikron	SKKT42/16E	5 ±15% N•m (44.25 ±15% lb•in)
		ABB-IXYS	MCC44-16io1B	2.5...4 N•m (22...35.4 lb•in)
		ABB-IXYS	MCC60-16io1B	2.5...4 N•m (22...35.4 lb•in)
'20	SK-20P-S7F75	IXYS	MCC56-16io1B	2.5...4 N•m (22...35.4 lb•in)
		Semikron	SKKT57/16E	5 ±15% N•m (44.25 ±15% lb•in)

- Use the following table to determine the proper tightening torque for the bus bars to SCR modules connections.

Device Output Current (Amps)	Rockwell Automation Cat. No.	Vendor	Vendor Part Number	Final Torque
17	SK-20P-S7F73	Semikron	SKKT27/16E	3 ±15% N•m (26.5 ±15% lb•in)
		IXYS	MCC26-16io1B	2.5...4 N•m (22...35.4 lb•in)
60	SK-20P-S7F74	Semikron	SKKT42/16E	3 ±15% N•m (26.5 ±15% lb•in)
		ABB-IXYS	MCC44-16io1B	2.5...4 N•m (22...35.4 lb•in)
		ABB-IXYS	MCC60-16io1B	2.5...4 N•m (22...35.4 lb•in)
120	SK-20P-S7F75	IXYS	MCC56-16io1B	2.5...4 N•m (22...35.4 lb•in)
		Semikron	SKKT57/16E	3 ±15% N•m (26.5 ±15% lb•in)

IMPORTANT Verify that the SCR modules are installed with the gate leads in the proper position. See [Figure 9](#) on page [124](#) for SCR gate lead pinouts.

Cooling Fan Replacement

Remove the Cooling Fan

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [33](#)).

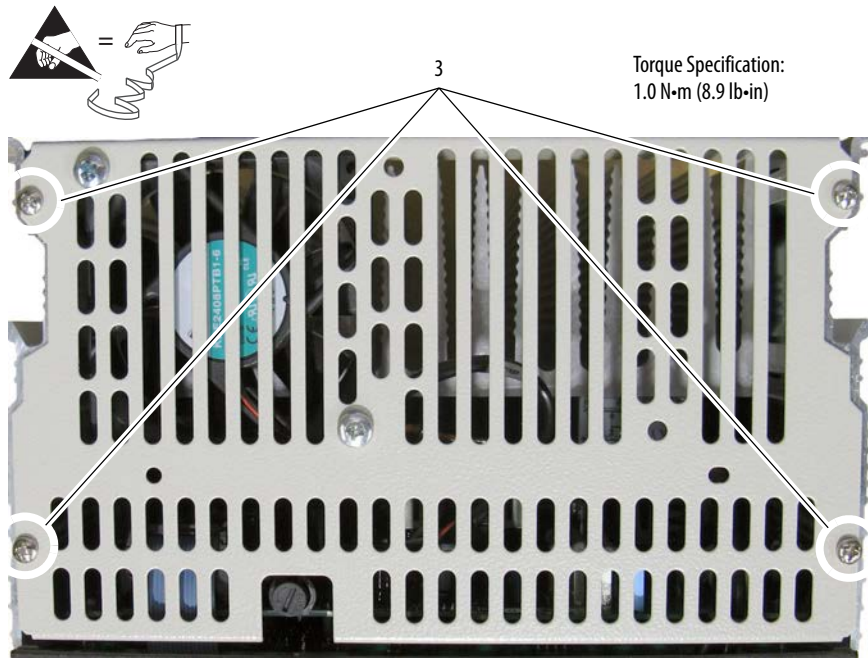
The field controller rating determines where the cooling fan (if any) is located in/on the device:

- See Cooling Fan on 60 Amp Field Controllers on page [73](#).
- See Cooling Fan on 120 Amp Field Controllers on page [74](#).

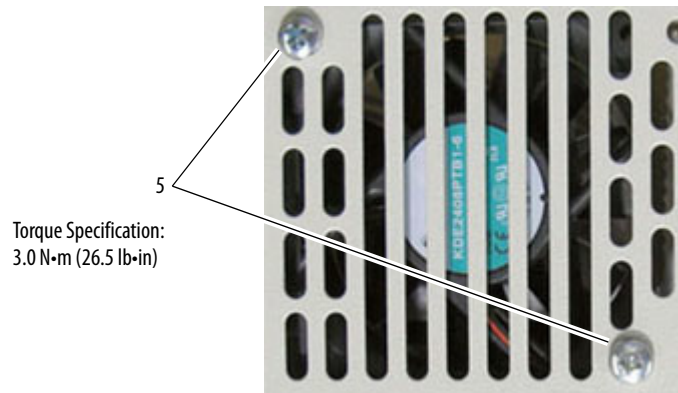
Cooling Fan on 60 Amp Field Controllers

60 Amp frame A field controllers have a cooling fan that is installed at the top of the device.

3. Remove the four screws that secure the slotted air flow plate and fan to the top of the chassis. The fan is connected via a cable to the switching power supply board and therefore will not pull free from the device until the cable is disconnected.
4. Disconnect the fan cable from connector XV on the switching power supply board and remove the fan and air flow plate.



5. Remove the two M4 x 12.5 mm screws that secure the fan and spacers to the air flow plate and remove the fan.

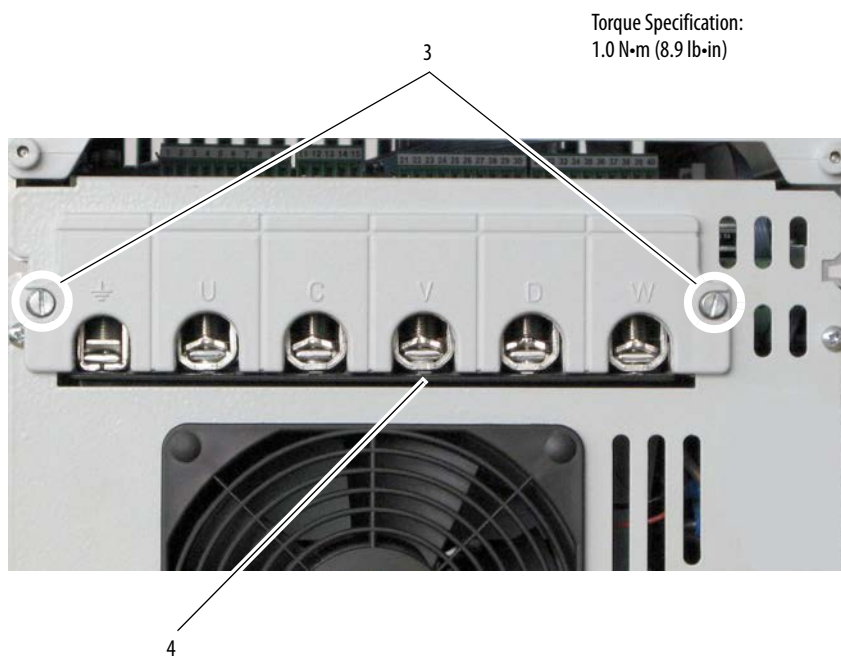


Continue with Install the Cooling Fan on page [76](#).

Cooling Fan on 120 Amp Field Controllers

120 Amp Frame A field controllers have a cooling fan that is installed on the bottom of the device.

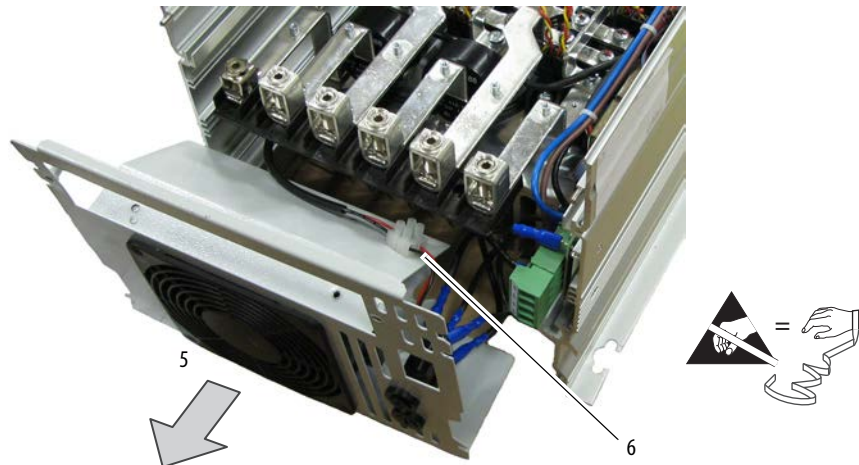
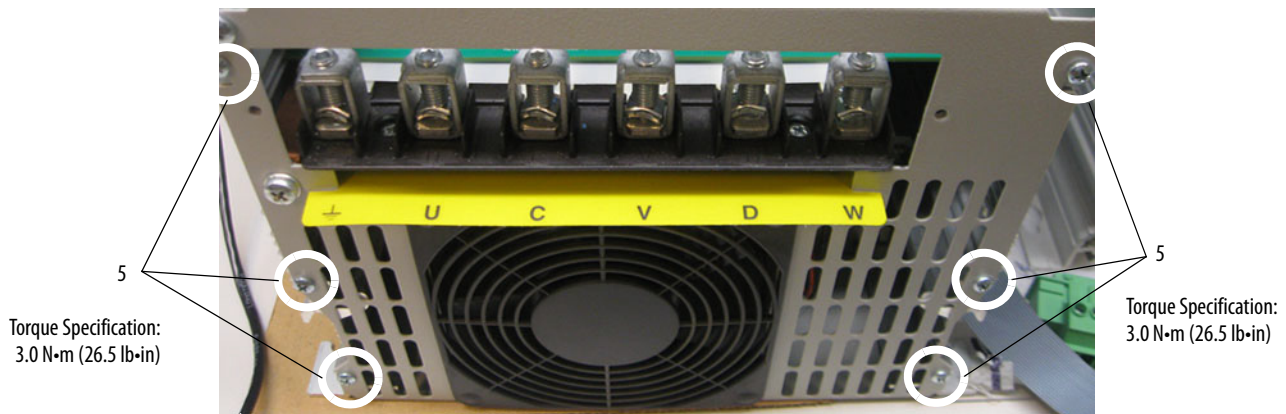
3. Loosen the two screws that secure the power terminal cover to the device and slide the cover down and off the chassis.
4. If necessary, remove the power wiring from the device terminals.



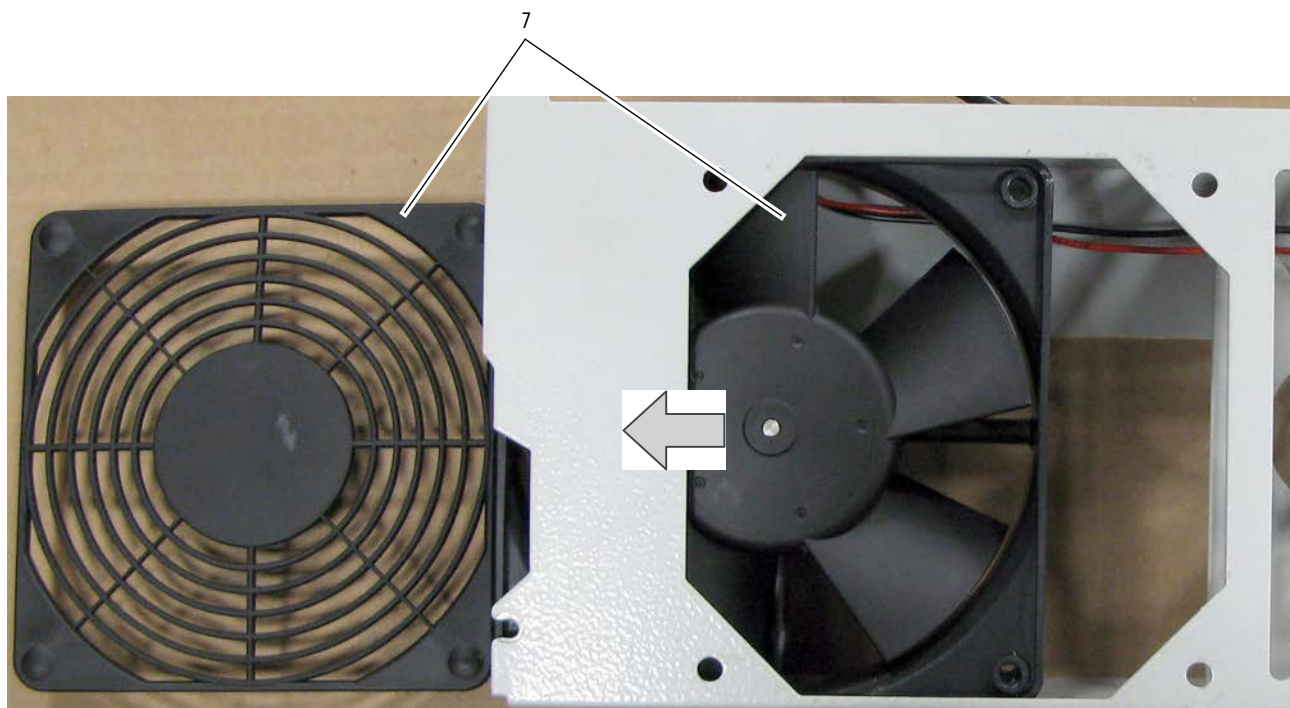
5. Remove the six M4 x 12.5 mm screws that secure the air flow plate to the bottom of the device chassis. Carefully pull the air flow plate and fan assembly down and off the device.

IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

6. Disconnect the (black and red) wires from the fan terminal block that is on the air flow plate.



7. Using a flathead screwdriver, pry the fan cover plate off the air flow plate and slide the fan out of the air flow housing.

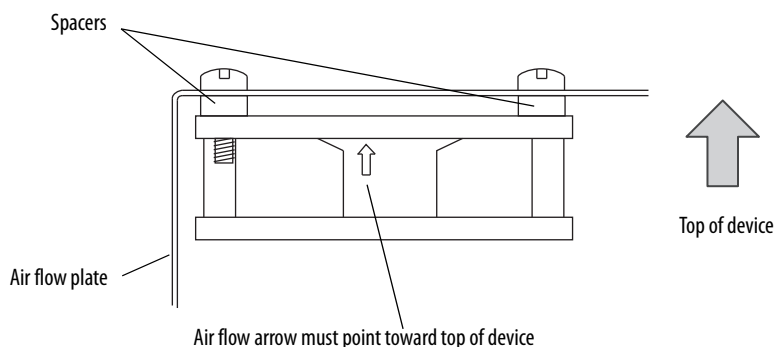


Install the Cooling Fan

Install the cooling fan in reverse order of removal.

IMPORTANT For both fan configurations, verify that the air flow arrow on the fan is pointed toward the top of the device.

IMPORTANT For devices with a fan that is connected to the top air flow plate, verify that the two spacers are properly placed during installation.



Frame B Field Controller Part Replacement Procedures

Topic	Page
Remove Power from the Device	79
DPI / HIM Assembly Replacement	79
Protective Cover Replacement	80
Communication Adapter and Electromagnetic Interference Shield Replacement	83
I/O Expansion Circuit Board Replacement	85
115V AC to 24V DC I/O Converter Circuit Board Replacement	87
Control Circuit Board Replacement	88
Control Electromagnetic Interference Shield Removal and Closure	90
Switching Power Supply Board Fuse Replacement	92
Pulse Transformer Circuit Board Fuse Replacement	92
Pulse Transformer and Switching Power Supply Circuit Boards Replacement	93
AC Line Snubber Circuit Board and Resistors Replacement	101
SCR Modules Replacement	103
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Bimetal Thermostats Replacement	113
Cooling Fan Replacement	117

This chapter provides a list of spare parts and detailed procedures for removing and replacing device components.

Electrostatic Discharge (ESD) sensitive parts and assemblies are identified in this section by this image. Take static control precautions when you install a part or assembly identified as ESD sensitive.



Replacement Parts Kits

[Table 10](#) lists the spare parts kits available for PowerFlex® DC frame B field controllers.

Table 10 - Frame B Field Controller Spare Part Kits

Description	Kit Cat. No.	Instructions Page
Fuses/Fuse Holders		
Switching Power Supply Board Fuse - Ferrule 5 x 20 mm, 2.5 A 250V (1)	SK-20P-S8B29	92
Switching Power Supply Board Fuse Holder	SK-20P-S7G84	92
Pulse Transformer Board Fuses (Qty 3) - Ferrule 6 x 32 mm, 16 A 500V	SK-20P-S824B	92
Accessories		
DPI / HIM Assembly	SK-DC1-CVR1-A1	79
Control Circuit Boards		
I/O Expansion Board (TBO-32)	20P-S5V62	85
115V AC to 24V DC I/O Converter Board	20P-S520L	87
Control Circuit Board (R-PFX32-FC)	SK-20P-S5RP1	88
Power Circuit Boards		
Pulse Transformer Board for 200V AC Field Controller, 245...570 A (FIR2-11-FC)	SK-23P-S5N465	93
Pulse Transformer Board for 500V AC Field Controller, 245...570 A (FIR2-51-FC)	SK-23P-S5N19	
Switching Power Supply Board (SW2-32)	SK-20P-S5N10	93
AC Line Snubber Board (SN5-31)	SK-20P-S5N14	101
Power Components		
AC Current Transducers (Qty 2), 600 A / 0.2 A	SK-20P-S777H	110
Bimetal Thermostat, 85 °C ±3 (Qty 2)	SK-20P-S7G33	113
SCR Modules (Qty 6) 1K6V 160 A, 200V or 500V Field Controller, 245 A	SK-20P-S7F79	103
SCR Modules (Qty 6) 1K6V 210 A, 200V or 500V Field Controller, 365 A	SK-20P-S7F41	
SCR Modules (Qty 6) 1K6V 320 A, 200V or 500V Field Controller, 570 A	SK-20P-S737F	
Ventilation Components		
Cooling Fans (Qty 2), 24V DC, 100 CFM, 200V or 500V Field Controller, 245 A and 365 A	SK-20P-S7G71	117
Cooling Fans (Qty 2), 150x55 mm, 24V DC, 212 CFM, 200V or 500V Field Controller, 570 A	SK-20P-S7G78	

(1) This kit contains one fuse only. You must order two kits to replace both fuses on the switching power supply circuit board for a field controller.

Remove Power from the Device

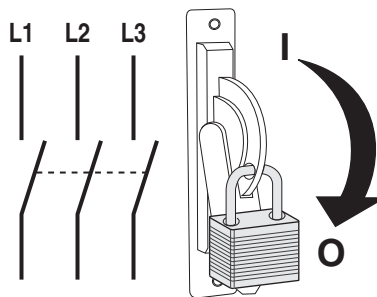


ATTENTION: Remove power before you make or break cable connections. When you remove or insert a cable connector with power applied, an electrical arc can occur. An electrical arc can cause personal injury or property damage by:

- sending an erroneous signal to your system 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 can create electrical resistance.

Remove and lock-out all incoming power to the device.

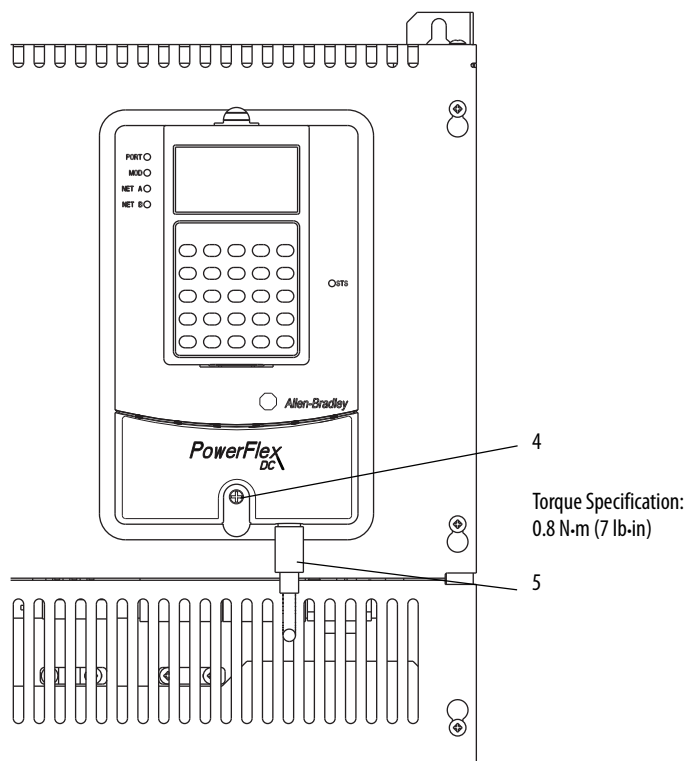


DPI / HIM Assembly Replacement

Remove the DPI / HIM Assembly

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).
3. Disconnect the DPI cable from the HIM assembly.

4. Remove the screw that secures the DPI / HIM assembly to the device.
5. Carefully remove the DPI / HIM assembly from the cover and disconnect the cable from the DPI connector on the back side of the assembly.



Install the DPI / HIM Assembly

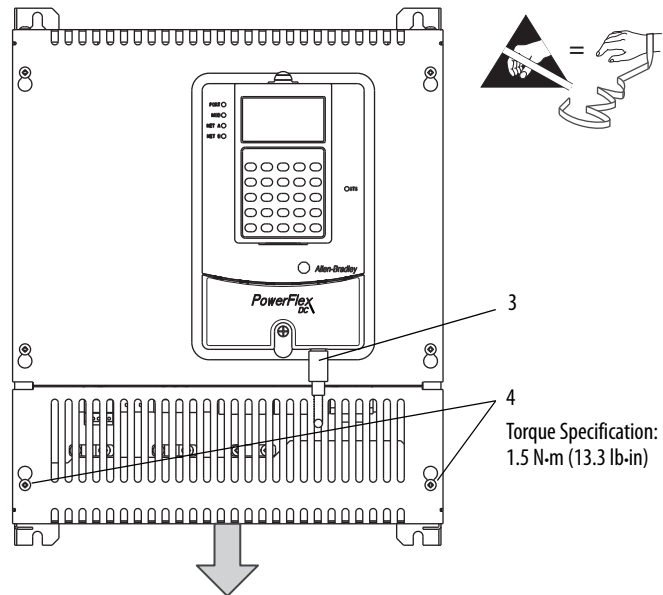
Install the DPI / HIM assembly in reverse order of removal.

Protective Cover Replacement

Remove the Protective Covers

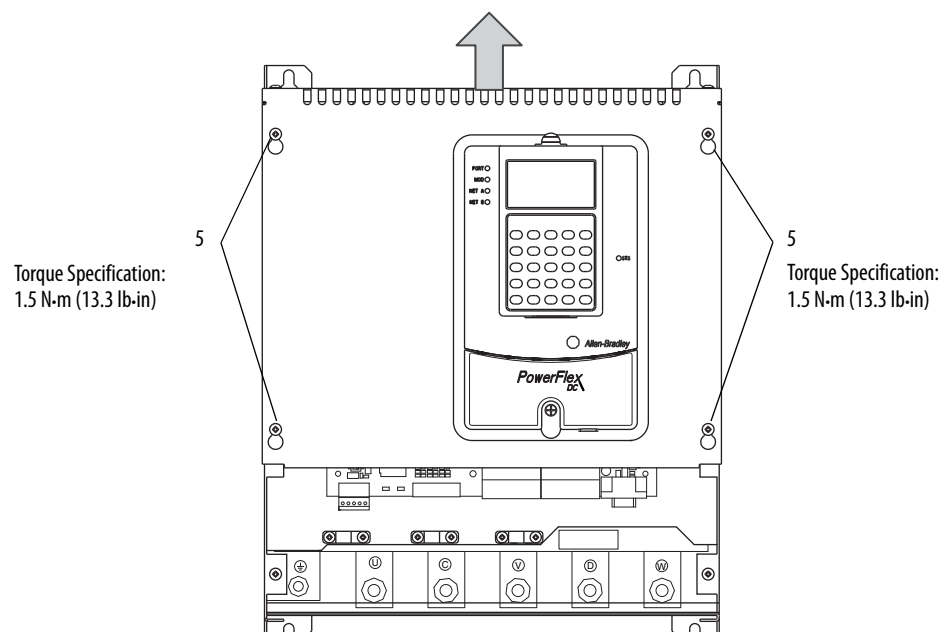
1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).

3. Disconnect the DPI cable from the HIM assembly.
4. Loosen, but do not remove, the screws that secure the bottom cover to the device, then slide the cover down and off the device chassis.

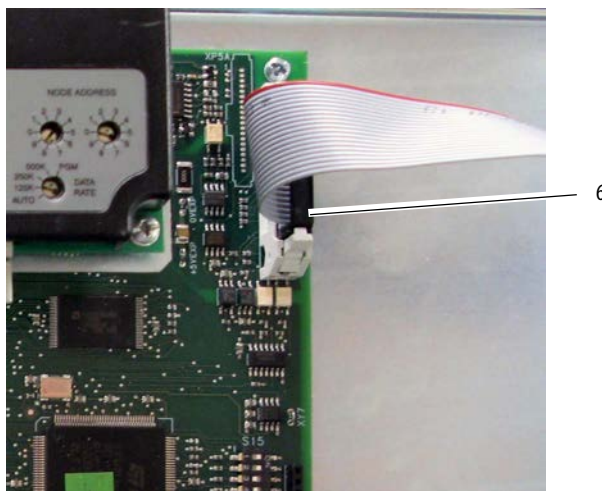


5. Loosen, but do not remove, the screws that secure the top cover to the device, then slide the cover up and off the device chassis.

IMPORTANT The backside of the HIM assembly is connected to the control board with a cable. Therefore the cover will not release from the chassis until the cable is disconnected.



6. Disconnect the HIM communication cable from the connector on the upper right corner of the control board and set the cover aside.



Install the Protective Covers

Install the protective covers in the reverse order of removal.

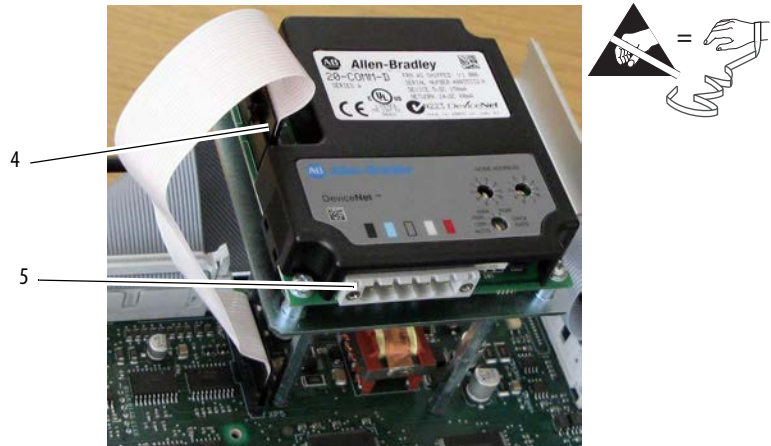


ATTENTION: Risk of electric shock exists when power is applied to the power terminals of the device. The power terminal cover and protective covers must be replaced before you apply power to the device.

Communication Adapter and Electromagnetic Interference Shield Replacement

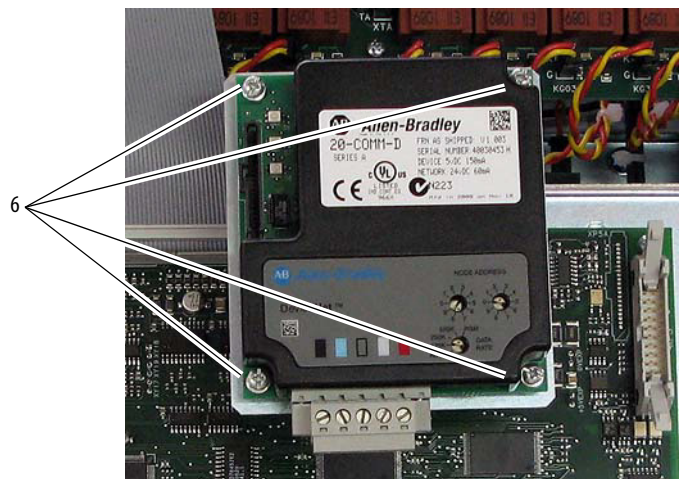
Remove the Communication Adapter and Electromagnetic Interference Shield

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).
3. Remove the protective covers from the device (see page [80](#)).
4. Disconnect the interface cable from the communication adapter and set it aside.
5. Disconnect any network cables from the adapter and set them aside.

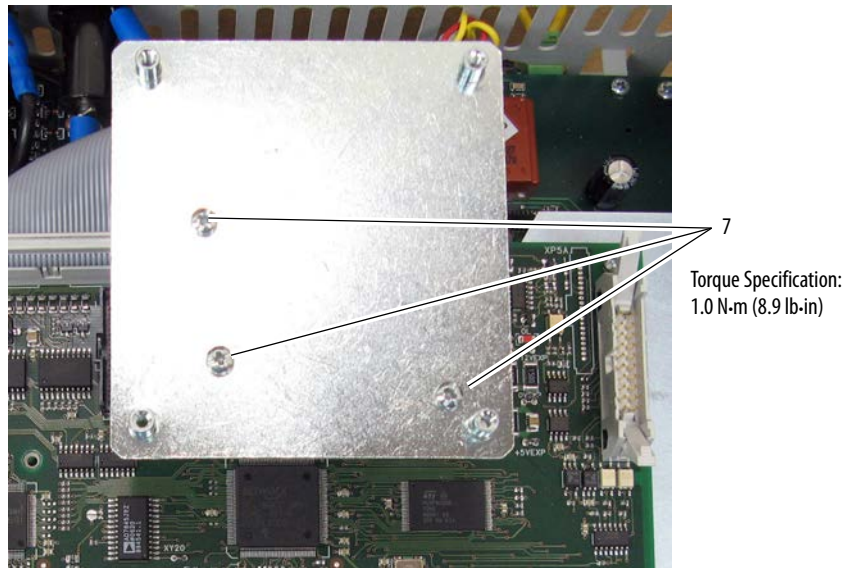


6. Remove the four screws that secure the communication adapter to the electromagnetic interference (EMI) shield and remove the adapter.

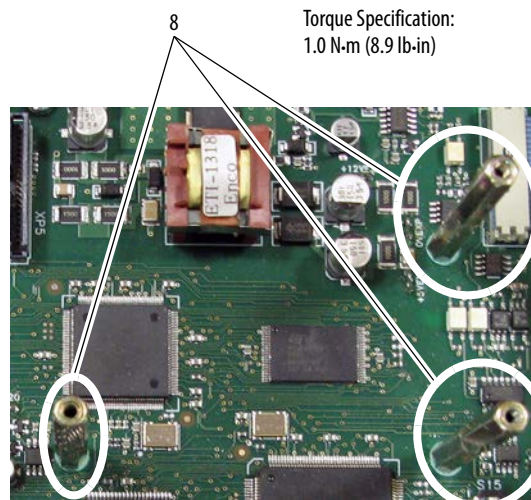
Torque Specification:
0.9 N-m (8.0 lb-in)



7. Remove the three screws that secure the EMI shield to the standoffs on the control board and remove the EMI shield.



8. Remove the three standoffs from the control board.



Install the Communication Adapter and Electromagnetic Interference Shield

Install the communication adapter and EMI shield in reverse order of removal.

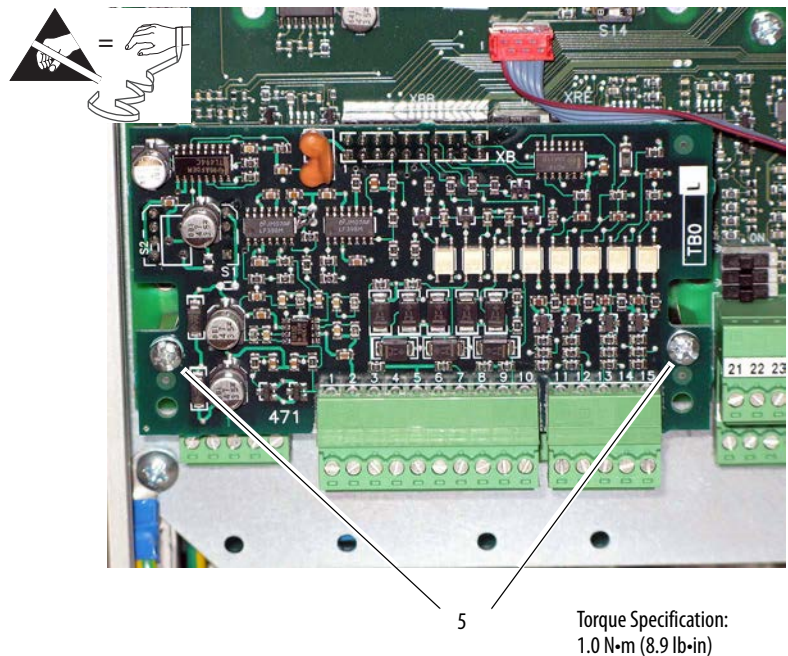
I/O Expansion Circuit Board Replacement

Remove the I/O Expansion Circuit Board

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).
3. Remove the protective covers from the device (see page [80](#)).

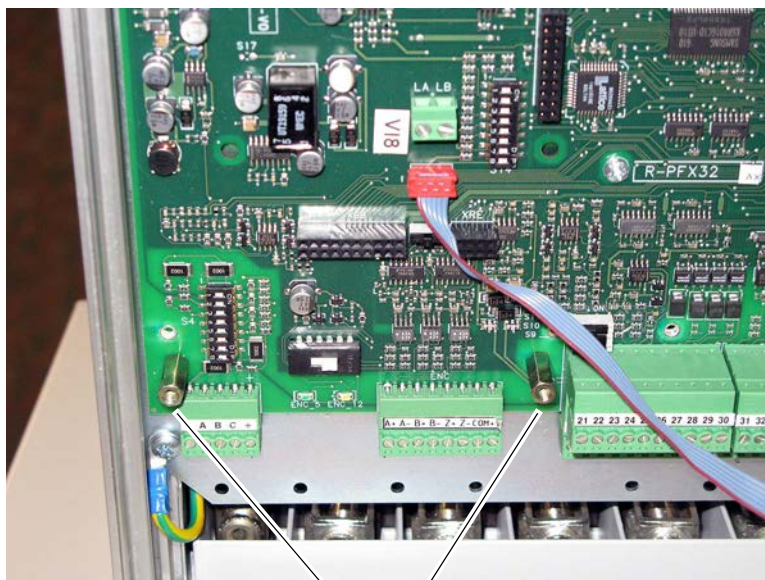
IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

4. Remove the plug-in I/O terminal blocks with the wiring kept in place.
5. Remove the two M3 x 6 mm screws and washers that secure the I/O expansion board to the stand-offs on the control board.



6. Carefully pull the I/O expansion board off connector XBB on the control board.

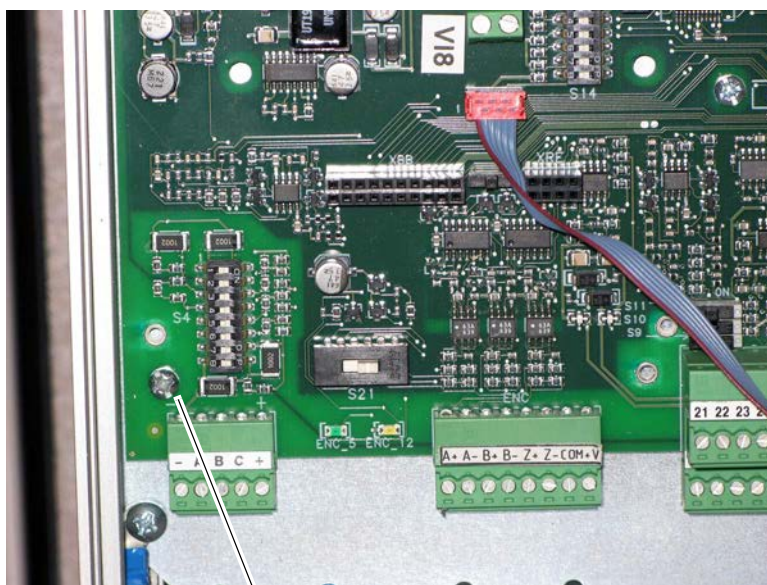
7. Remove the two stand-offs from the control board.



7

Torque Specification:
1.0 N•m (8.9 lb•in)

8. Install one screw in the lower left corner of the control board.



8

Torque Specification:
1.0 N•m (8.9 lb•in)

Install the I/O Expansion Circuit Board

Install the I/O expansion board in reverse order of removal.

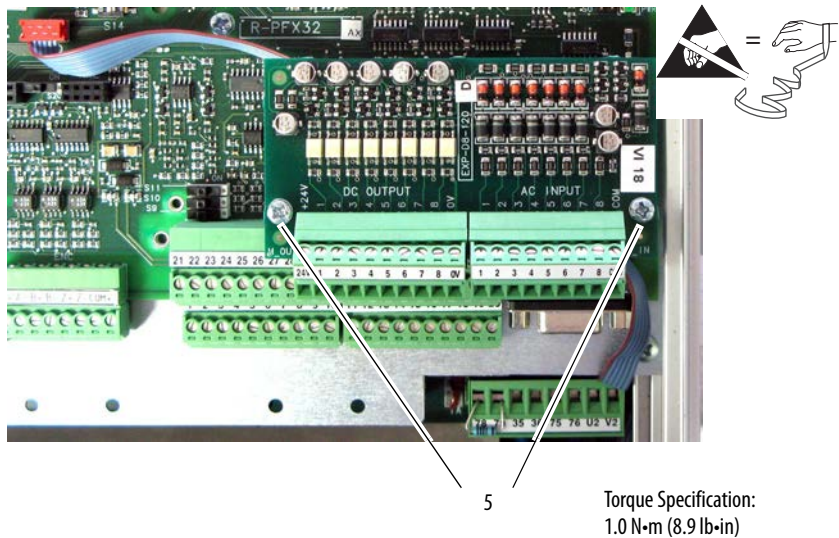
115V AC to 24V DC I/O Converter Circuit Board Replacement

Remove the 115V AC to 24V DC I/O Converter Circuit Board

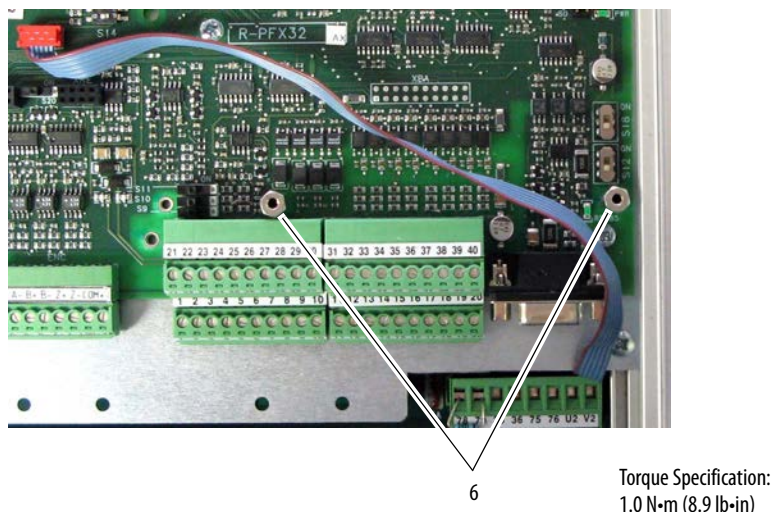
1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).
3. Remove the protective covers from the device (see page [80](#)).

IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

4. Remove the plug-in I/O terminal blocks with the wiring kept in place.
5. Remove the two M3 x 6 mm screws and washers that secure the I/O converter board to the stand-offs on the control board and remove the I/O converter board.



6. Remove the two stand-offs from the control board.



Install the 115V AC to 24V DC I/O Converter Circuit Board

Install the 115V AC to 24V DC I/O converter board in reverse order of removal.

Control Circuit Board Replacement

Remove the Control Circuit Board

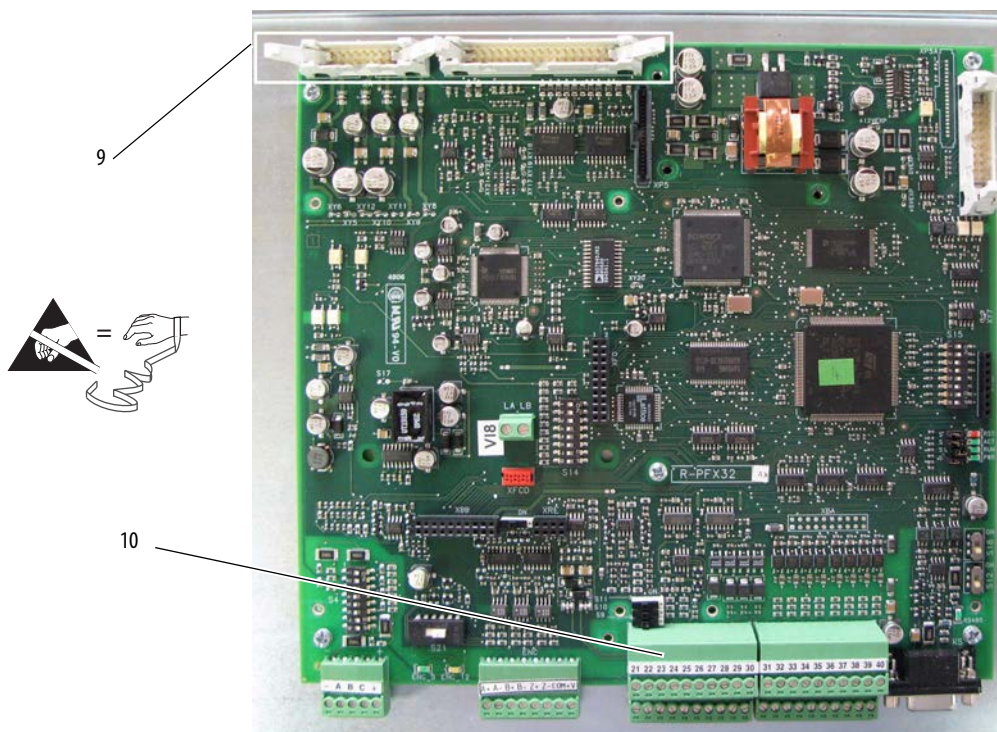
1. Read the General Safety Precautions on page [10](#).
2. Save the device and adapter parameter configuration by using one of these methods:
 - HIM Set - see Save to a HIM Set on page [14](#).
 - Download the field controller and adapter parameters to an offline database file by using DriveExecutive™. See the on-line help that is provided with DriveExecutive for information on how to save database files.
 - Export a configuration file by using Connected Components Workbench® software. See the on-line help that is provided with Connected Components Workbench for information on how to export a device configuration file.
3. Remove power from the device (see page [79](#)).
4. Remove the protective covers from the device (see page [80](#)).
5. Remove the communication adapter and EMI shield from the control board (see page [83](#)).
6. If installed, remove the I/O expansion circuit board (see page [85](#)).
7. If installed, remove the 115V AC to 24V DC I/O converter circuit board (see page [87](#)).

8. Record all switch and jumper settings on the control board. See the PowerFlex DC Field Controller Installation Instructions, publication [23PFC-IN001](#), for more information.

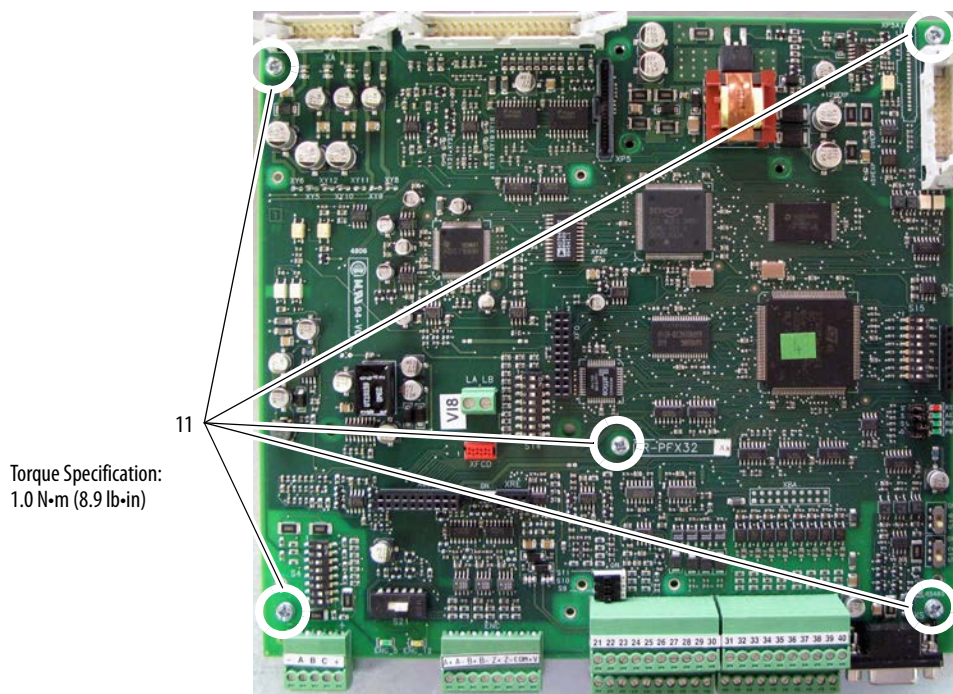
Jumper /Switch	Function	Setting
S9	Configures the input signal of analog input 1 (terminals 1 and 2): Par 71 [Anlg In1 Config] must be programmed to match the input signal type that is selected with this switch.	
S10	Configures the input signal of analog input 2 (terminal 3 and 4): Par 76 [Anlg In2 Config] must be programmed to match the input signal type that is selected with this switch.	
S11	Configures the input signal of analog input 3 (terminals 5 and 6): Par 81 [Anlg In3 Config] must be programmed to match the input signal type that is selected with this switch.	
S15	Configures the control circuit board to the appropriate device size.	S15-1 = S15-2 = S15-3 = S15-4 = S15-5 = S15-6 = S15-7 = S15-8 =

IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

9. Carefully disconnect the cables from connectors XA and XR on the control board.
10. Remove the plug-in I/O and control terminal blocks with the wiring kept in place.



11. Remove the five screws that secure the control board to the control EMI shield and remove the board.



Install the Control Circuit Board

Install the control board in reverse order of removal.

- Verify that all DIP switches are set to the correct configuration based on your recorded settings.

Control Electromagnetic Interference Shield Removal and Closure

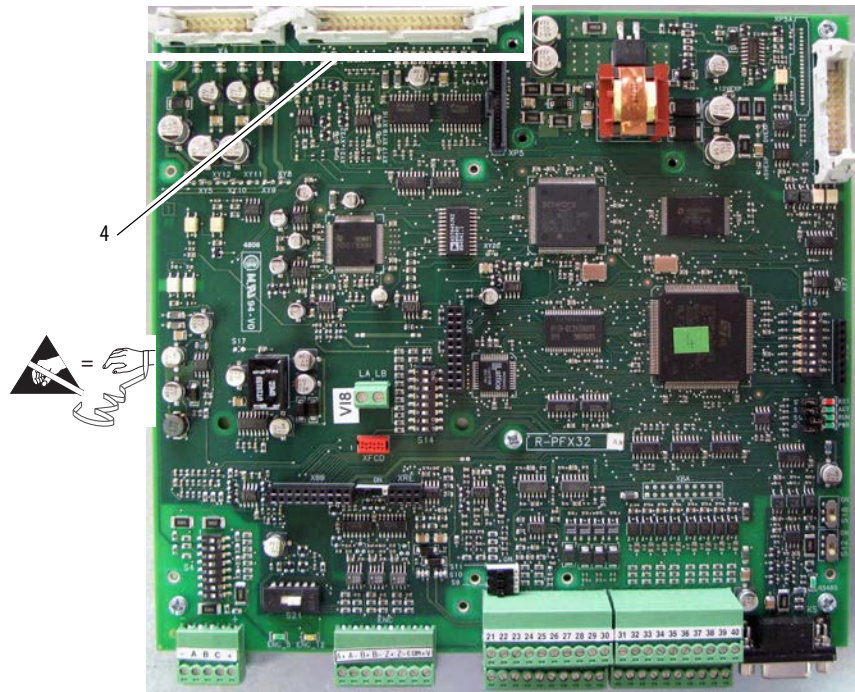
Move the Control Electromagnetic Interference Shield

You must move (lower) the control electromagnetic interference (EMI) shield that holds the control board to access other components within the device.

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).
3. Remove the protective covers from the device (see page [80](#)).

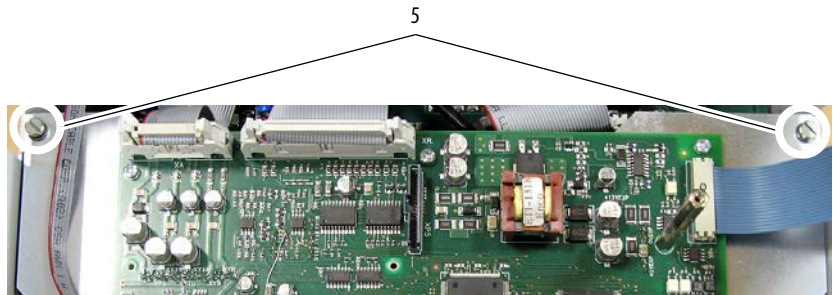
IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

4. Carefully disconnect the cables from connectors XA and XR on the control board.



5. Loosen the two captive screws at the top of the control EMI shield and lower shield.

IMPORTANT If the device is not in a vertical position, the control EMI shield will not remain open without a means of restraint.



Close the Control EMI Shield in the Service Position

Close the control EMI shield in reverse order.

Switching Power Supply Board Fuse Replacement

Remove the Fuses on the Switching Power Supply Circuit Board

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).
3. At the top of the device, insert a screwdriver in the slot on the top of the fuse holder. Carefully push down and turn the fuse counterclockwise. When the fuse holder releases, remove the holder and fuse.



Install the Fuses on the Switching Power Supply Circuit Board

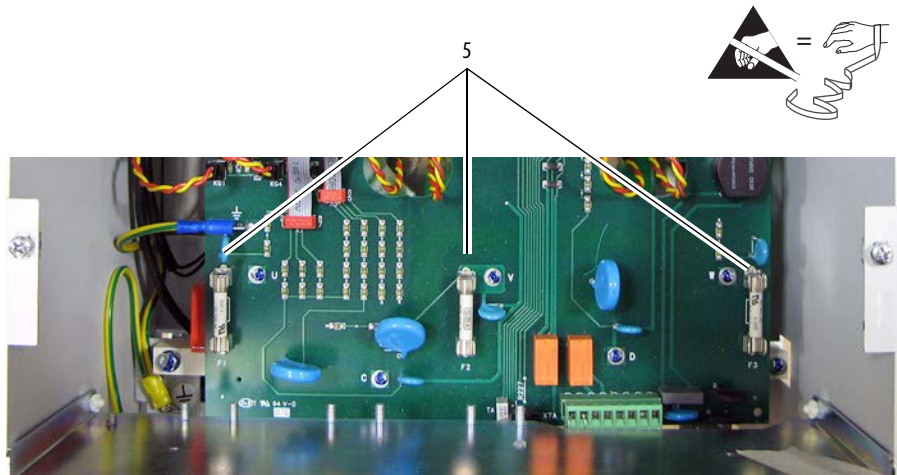
Install the fuses on the switching power supply board in reverse order of removal.

Pulse Transformer Circuit Board Fuse Replacement

Remove the Fuses on the Pulse Transformer Circuit Board

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).
3. Remove the protective covers from the device (see page [80](#)).
4. Move the control EMI shield (see page [90](#)).

5. Using a fuse puller, carefully remove the three fuses from the fuse holders on the pulse transformer board.



Install the Fuses on the Pulse Transformer Circuit Board

Install the fuses on the pulse transformer circuit board in reverse order of removal.

Pulse Transformer and Switching Power Supply Circuit Boards Replacement

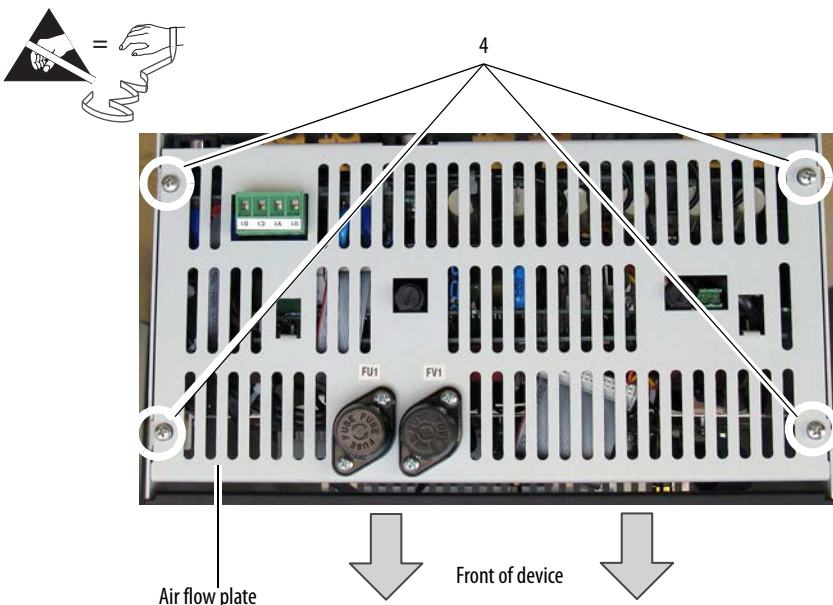
Remove the Pulse Transformer and Switching Power Supply Circuit Boards

The switching power supply circuit board is on the back of the pulse transformer circuit board. You must remove both boards to replace either board.

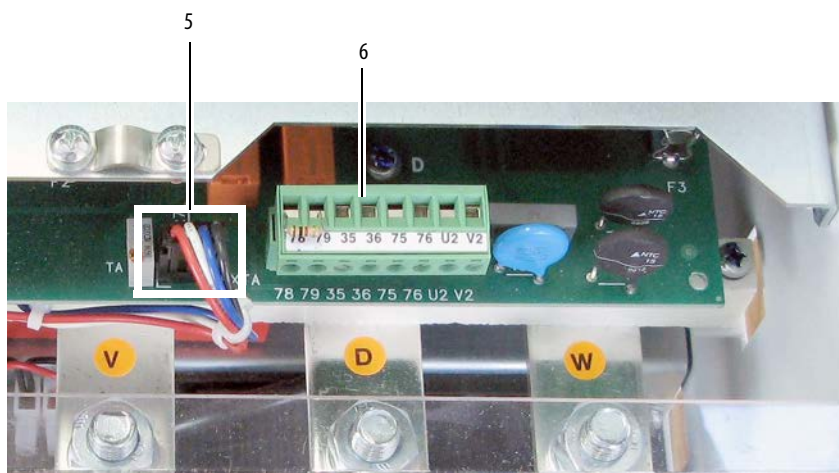
1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).
3. Remove the protective covers from the device (see page [80](#)).

4. Remove the four screws that secure the slotted air flow plate to the top of the device chassis.

IMPORTANT The air flow plate is also secured to the pulse transformer circuit board and therefore cannot yet be removed. Instructions for doing so are included later in this procedure.

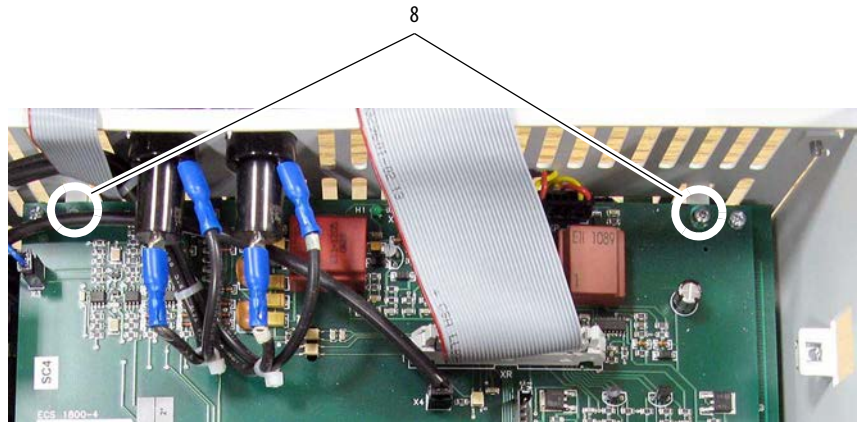


5. Remove the cable from connector XTA at the bottom of the pulse transformer board.
6. Remove the plug-in terminals from the control power block at the bottom of the pulse transformer board.

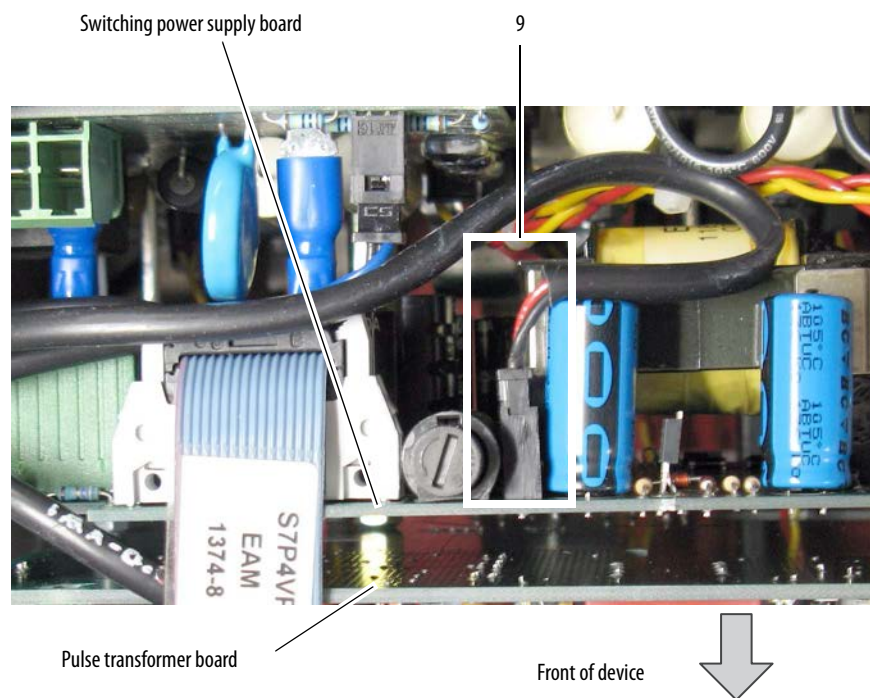


7. Move the control EMI shield (see page [20](#)).

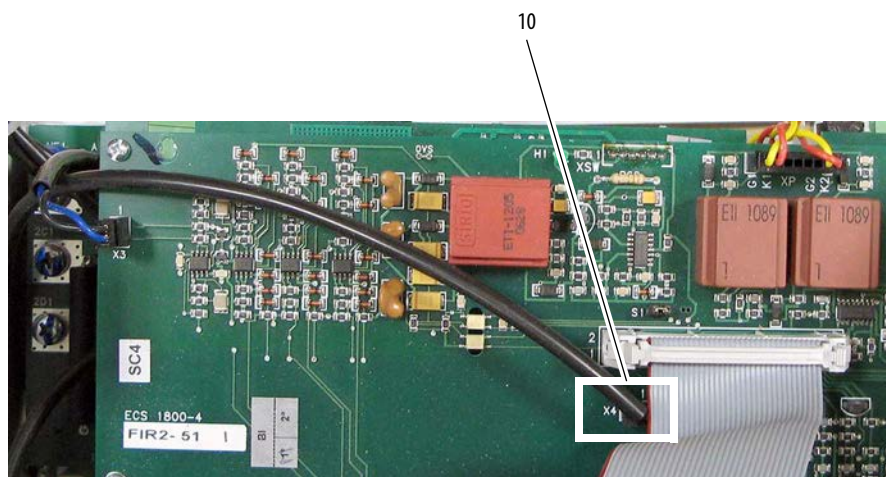
8. Remove the two screws that secure the air flow plate to the top of the pulse transformer board and lift the plate off the device chassis.



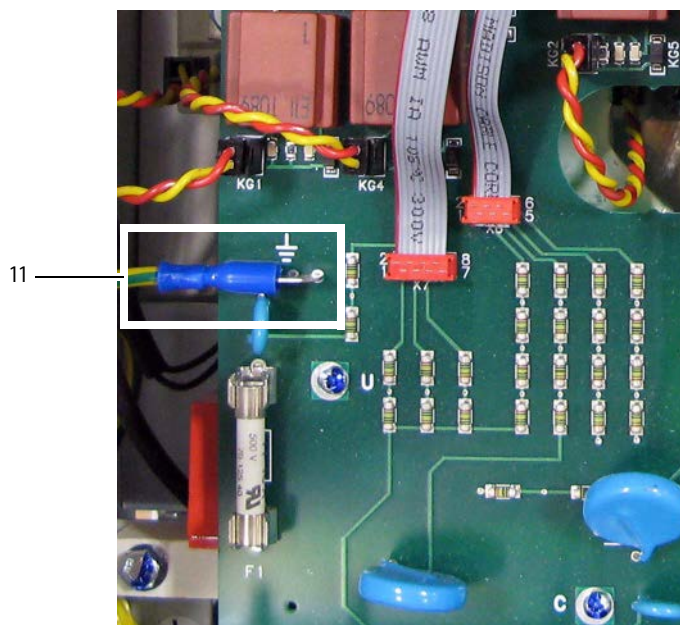
9. Remove the cable from connector XV on the switching power supply board.



10. Remove the cables from connector X4 on the pulse transformer board.

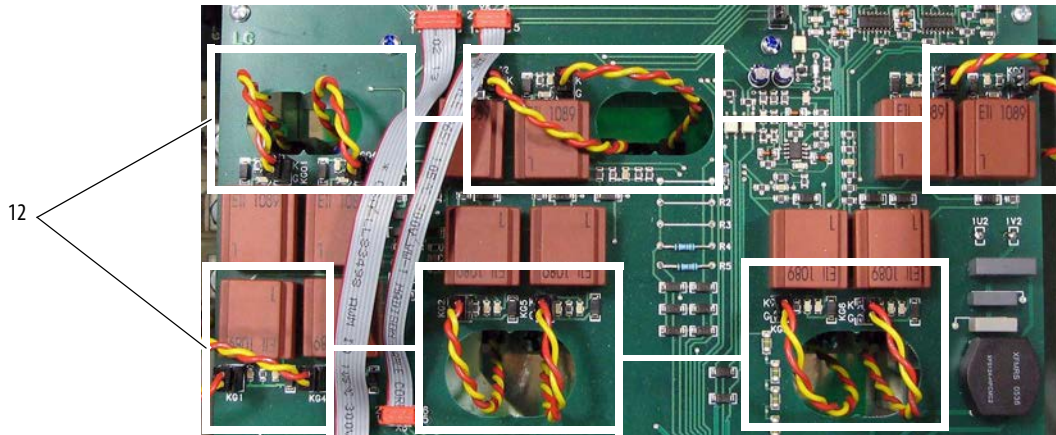


11. Remove the ground connection at the left side of the pulse transformer board.

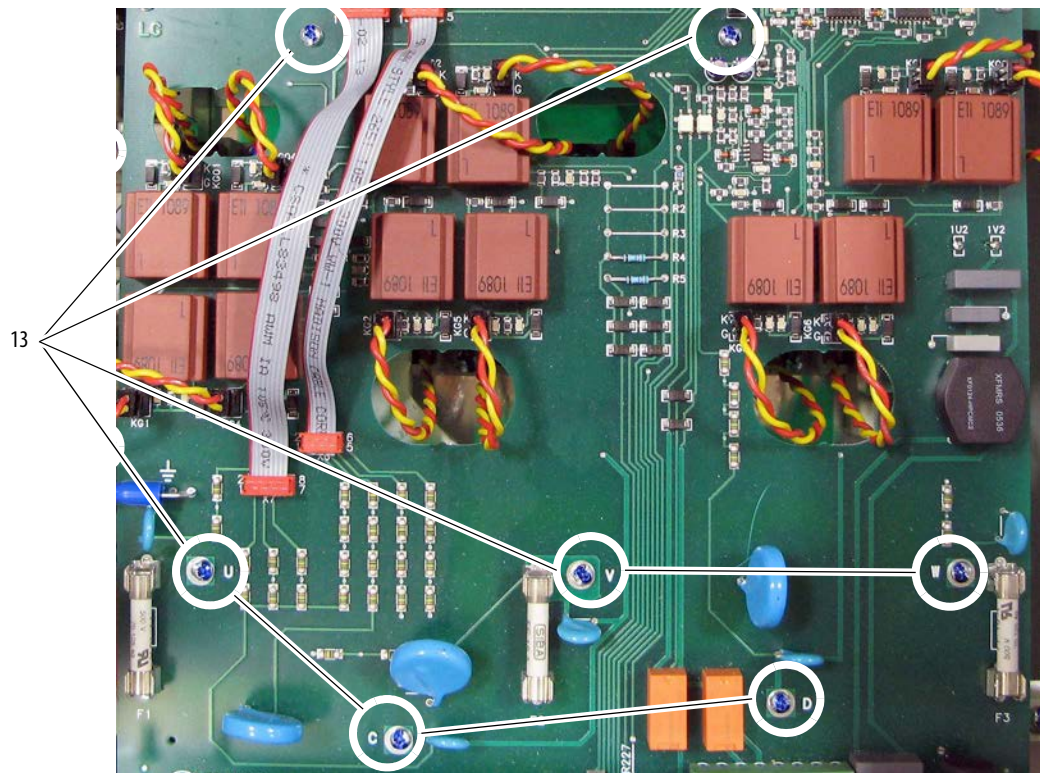


12. Remove each pair of (orange and yellow) gate lead cables from connectors KG01...KG06 and KG1...KG6 and push each lead through the appropriate opening in the board.

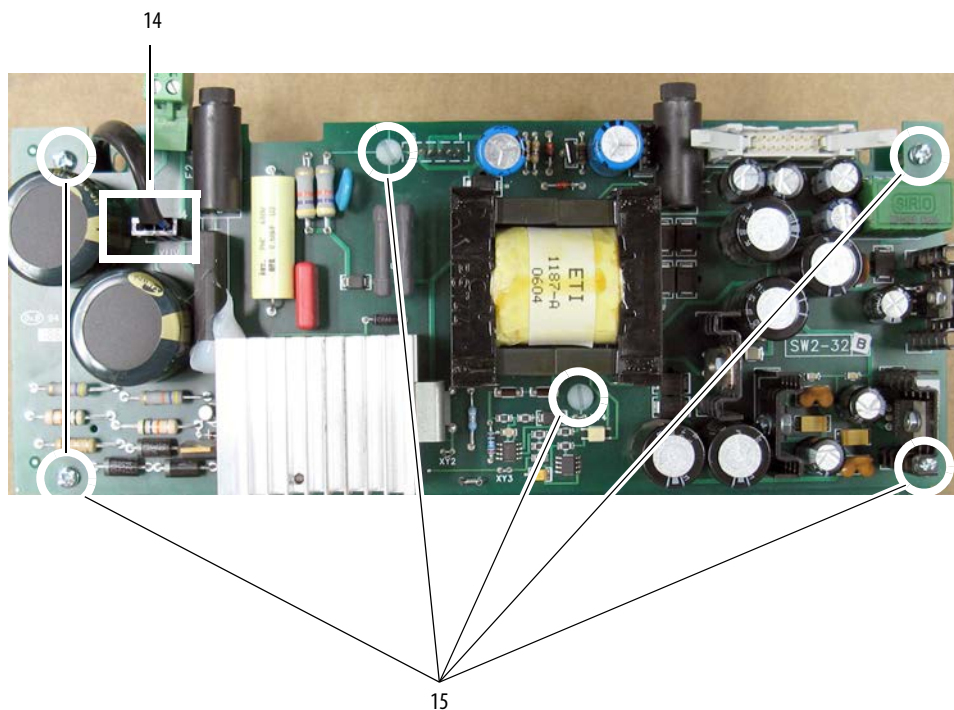
IMPORTANT Carefully remove the gate leads by grasping the connector. DO NOT pull the gate leads off by pulling on the wires.



13. Remove the seven screws that secure the board to the stand-offs on the device chassis and remove the boards from the device.



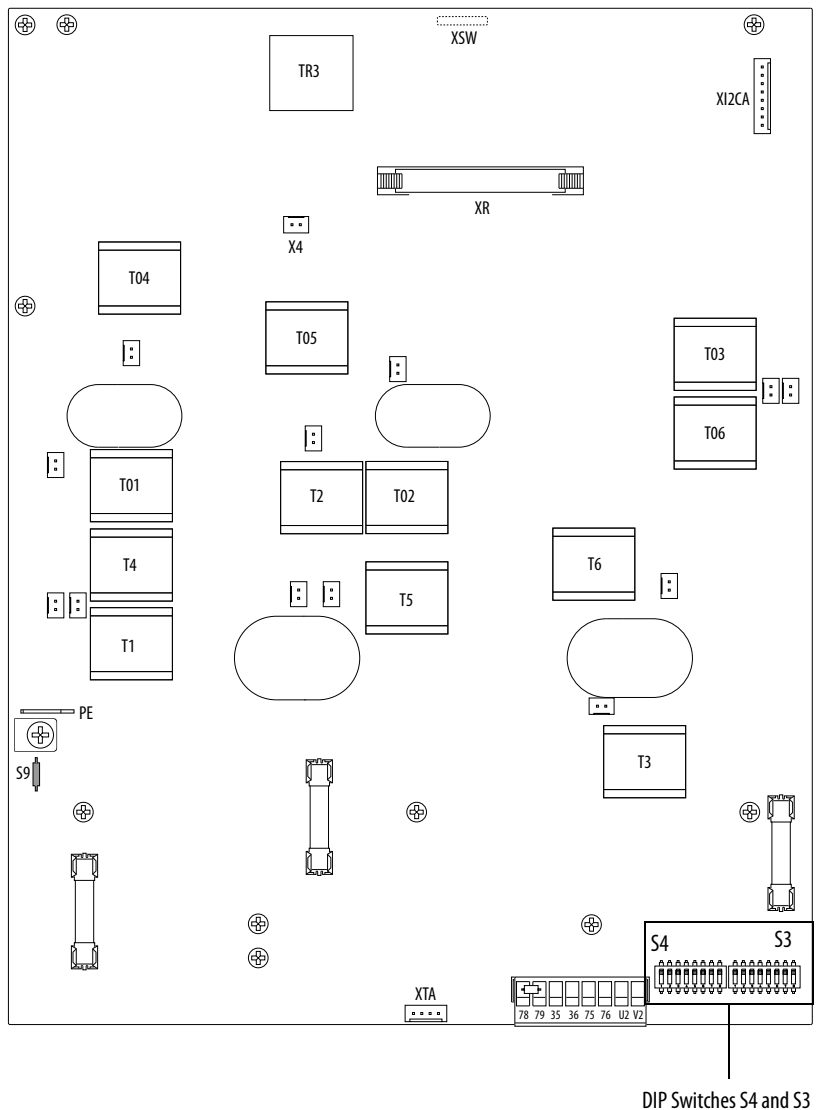
14. Remove the cable from connector XUV on the switching power supply board.
15. Remove the six screws and washers that secure the switching power supply board to the stand-offs on the back of the pulse transformer board. Remove the switching power supply board.



Install the Pulse Transformer and Switching Power Supply Circuit Boards

Before you install a new pulse transformer circuit board, you must configure the DIP switches on the circuit board to match the field controller size (output current rating).

1. Set DIP switches S3 and S4, on the pulse transformer board, to the correct settings based on the field controller output current rating. See DIP Switch S3 and S4 Settings - FIR2-xx-FC on page [100](#).



IMPORTANT A blank cell below a switch in [Table 11](#) indicates that the setting is “OFF”.

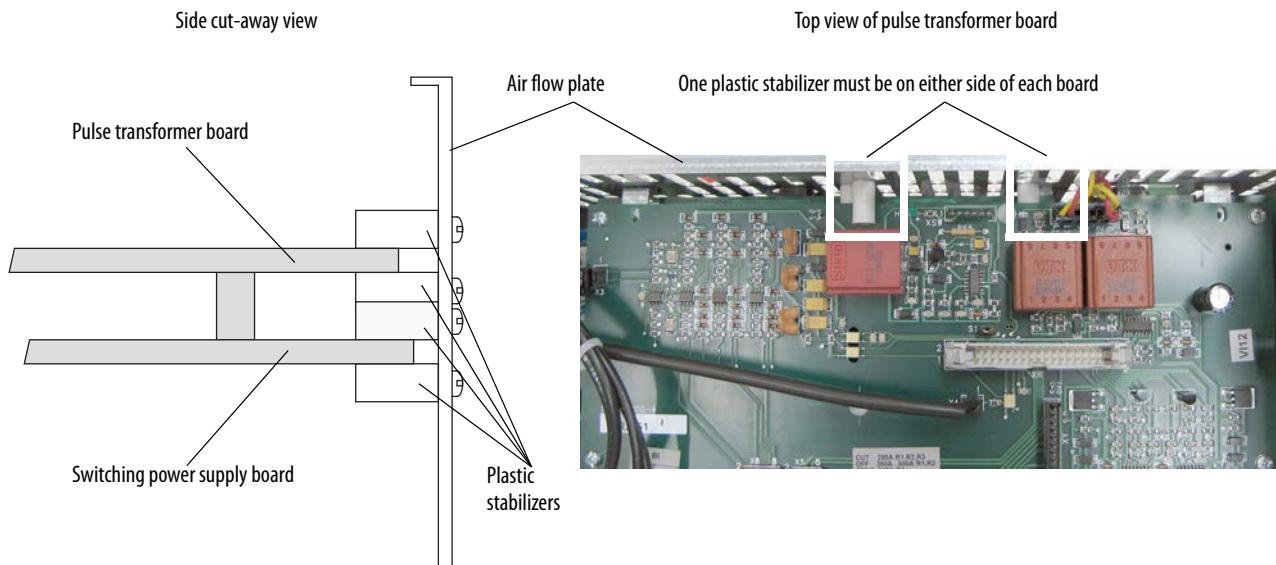
Table 11 - DIP Switch S3 and S4 Settings - FIR2-xx-FC

Output Current (Amps)	DIP Switch S3								DIP Switch S4							
	S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	S3-7	S3-8	S4-1	S4-2	S4-3	S4-4	S4-5	S4-6	S4-7	S4-8
245	ON	ON	ON	ON	ON	ON		ON						ON		
365		ON	ON	ON							ON	ON	ON	ON		
570	ON	ON		ON		ON		ON		ON				ON	ON	



ATTENTION: Each gate lead cable must be connected to the exact connector from which it was removed on the pulse transformer circuit board or damage to the device can occur.

2. Install the pulse transformer board and switching power supply board in the reverse order of removal.
3. Verify that the four plastic board stabilizers that are mounted on the top air flow plate are placed one on either side of each board.

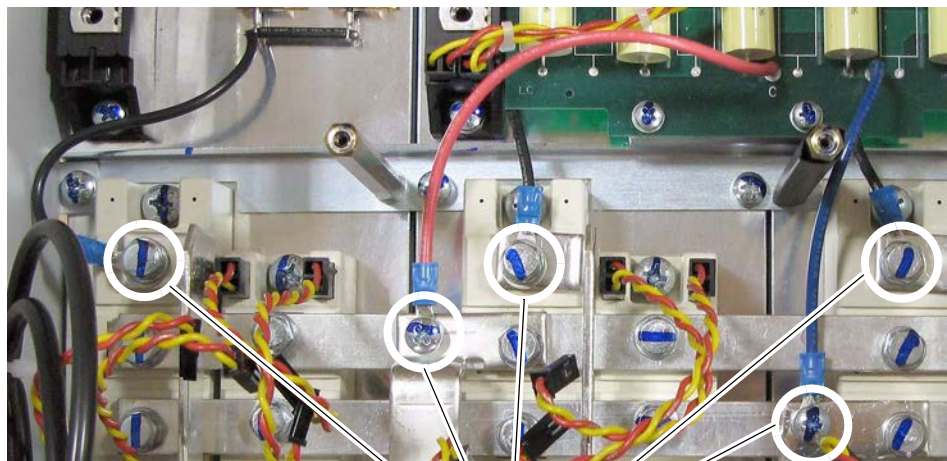


AC Line Snubber Circuit Board and Resistors Replacement

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).
3. Remove the protective covers from the device (see page [80](#)).

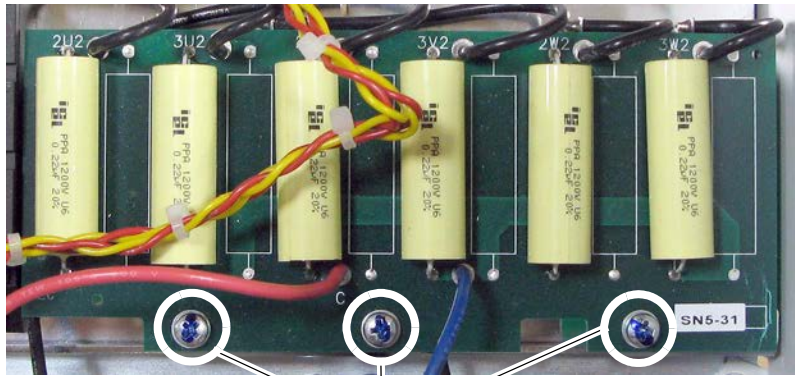
IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

4. Remove the pulse transformer and switching power supply boards from the device (see page [93](#)). You do not need to remove the switching power supply board from the back of the pulse transformer board for this procedure.
5. Remove the two screws and washers that secure the (red and blue) wires from the AC line snubber board to the bus bars and remove the wires.
6. Remove the three screws and washers that secure the (black) wires from the resistors to the bus bars and remove the wires.

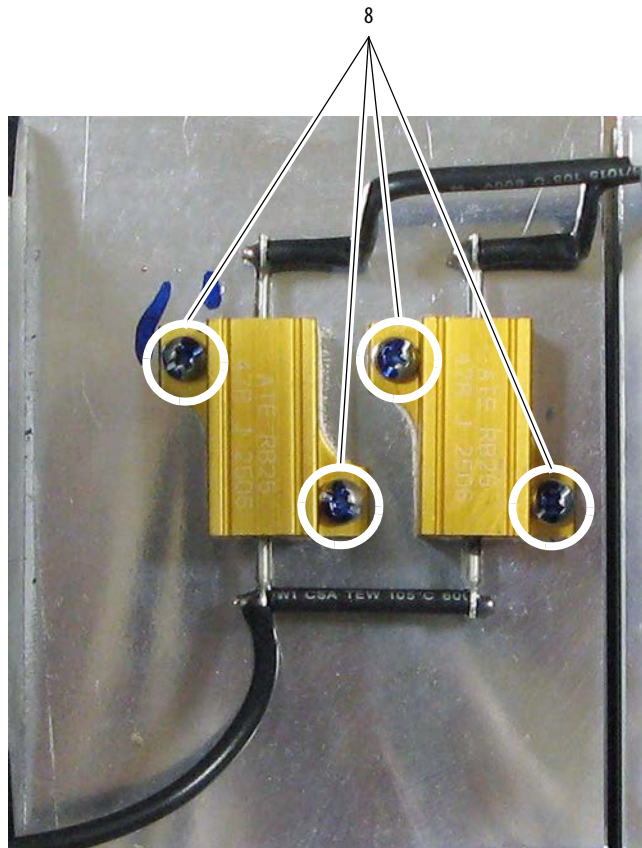


5 and 6

7. Remove the three screws and washers that secure the AC line snubber board to the device frame and lift the board. Note: The wires from the resistors are connected to the board. Therefore, the board cannot be removed until the resistors are removed.



8. Remove the two screws that secure each resistor (six total) to the device heat sink and remove the resistors and AC line snubber board from the device.



Install the AC Line Snubber Circuit Board and Resistors

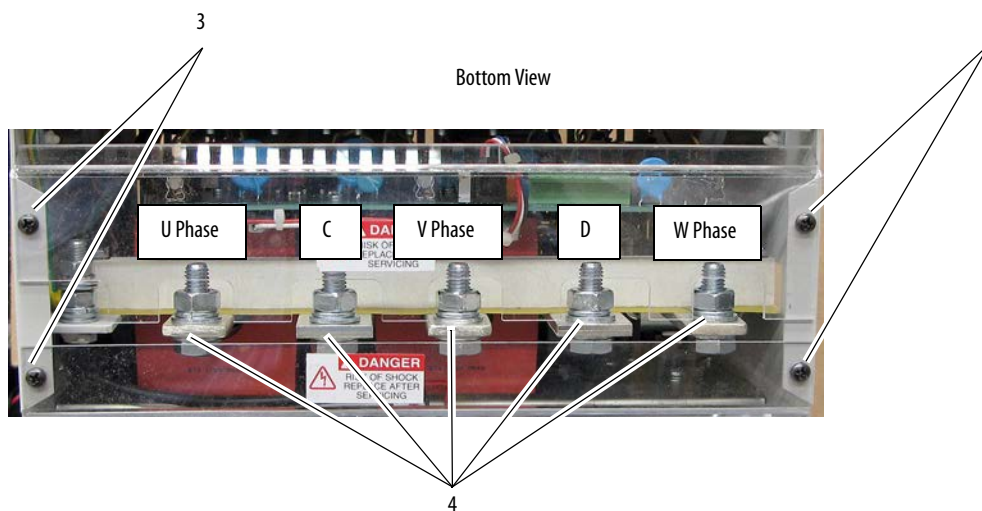
Install the AC line snubber board and resistors in reverse order of removal.

IMPORTANT Thermal grease must be applied to the bottom of the resistors before securing them to the heat sink.

SCR Modules Replacement

Remove the SCR Modules

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).
3. Remove the screws and washers that secure the plastic shields to the bottom of the device and remove the shields.
4. Remove the bolts, washers and wiring from the power terminals (U, V, W, C, and D).



5. Remove the protective covers from the device (see page [80](#)).

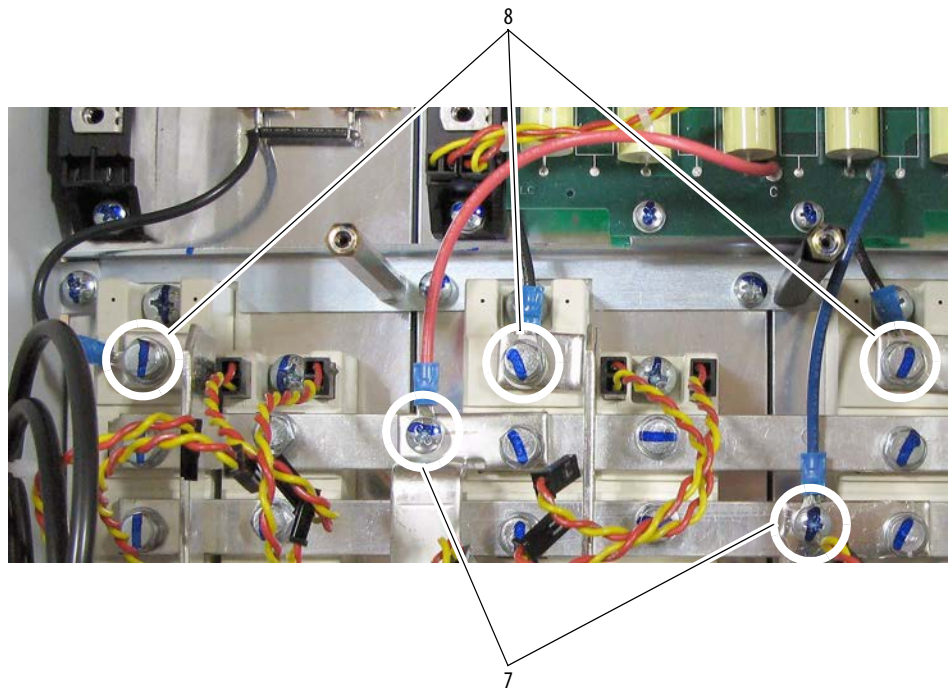
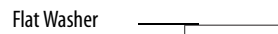
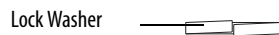
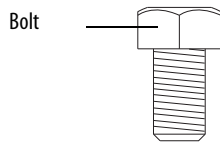
IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

6. Remove the pulse transformer and switching power supply boards from the device (see page [93](#)). You do not need to remove the switching power supply board from the back of the pulse transformer board for this procedure.

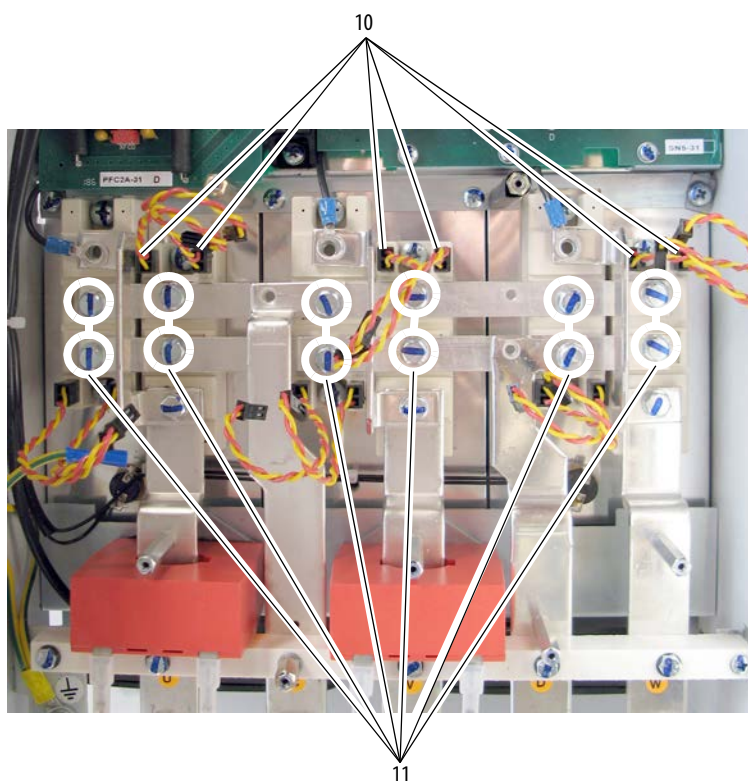
7. Remove the two screws or bolts and washers that secure the (red and blue) wires from the AC line snubber board to the terminal bus bars (C and D) and remove the wires.
8. Remove the three bolts and washers that secure the (black) wires from the resistors to the terminal bus bars (U, V, and W) and remove the wires.



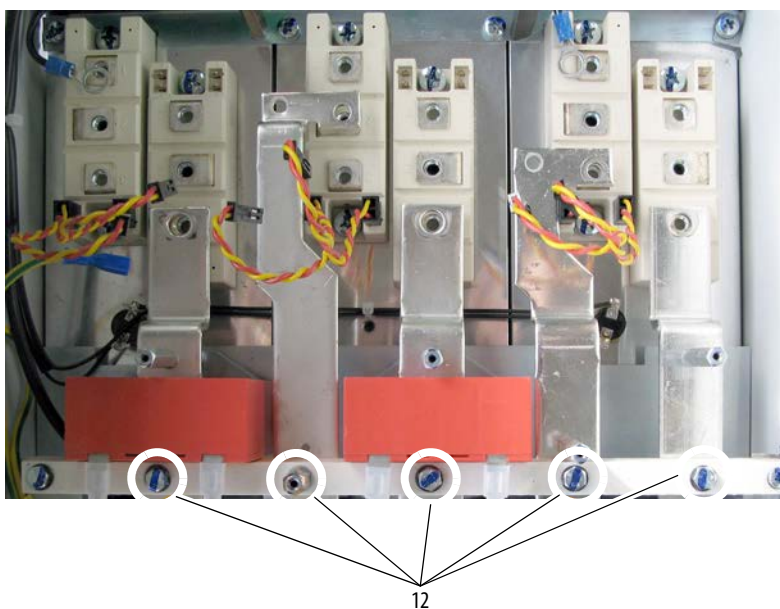
Note the proper order of washers for re-installation.



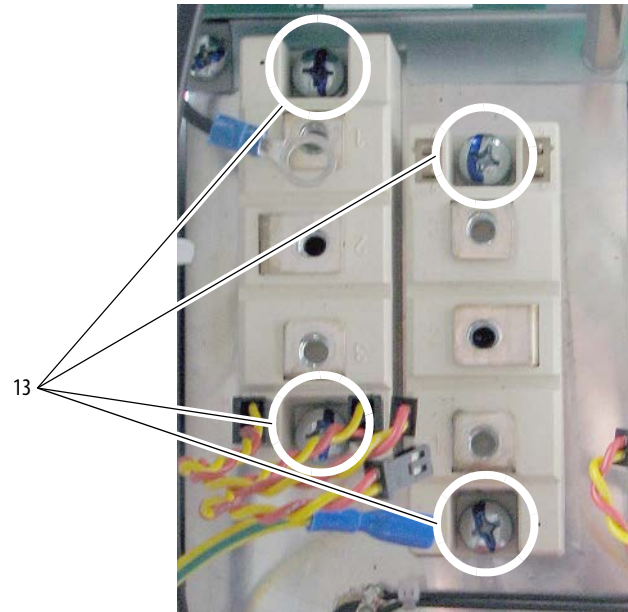
10. Remove the three pairs of upper gate leads from the SCR modules.
11. Remove the bolts and washers that secure the DC bus bars to the SCRs and remove the bus bars.



12. Remove the four bolts and washers and stand-off that secure the power terminal bus bars to the isolation bar and slide the bus bars up and out of the device.



13. Remove the two screws and washers that secure each SCR module to the heat sink and remove the SCR module.

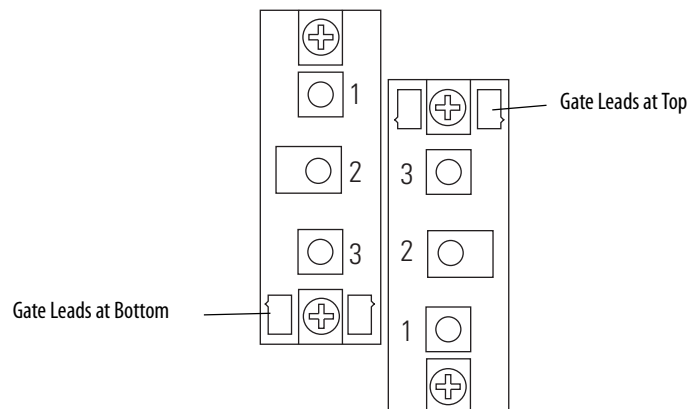


Install the SCR Modules

Install the SCR modules in reverse order of removal.

IMPORTANT Thermal grease must be applied to the bottom of each SCR module before securing it to the heat sink.

- Use the following orientation for installing the SCR modules:



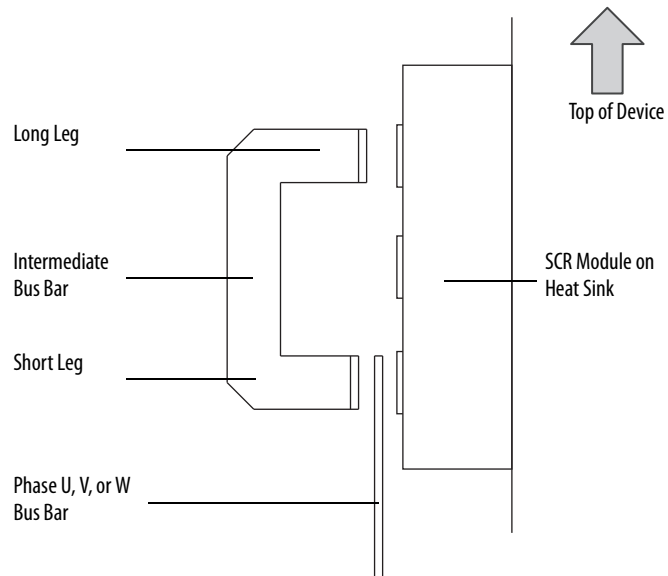
- Use the following table to determine the proper tightening torque for the SCR modules that are installed on the heat sink.

Device Output Current (Amps)	Rockwell Automation Cat. No.	Vendor	Vendor Part Number	Final Torque
245	SK-20P-S7F79	Semikron	SKKT162/16E	5 N•m ±15% (44.25 lb•in ±15%)
		IXYS	MCC162-16io1	2.25...2.75 N•m (20...24.3 lb•in)
365	SK-20P-S7F41	Semikron	SKKT273/16E	5 N•m ±15% (44.25 lb•in ±15%)
		Vishay	VSKT230-16PbF	4...6 N•m ±10% (35.4...53 lb•in ±10%)
		IXYS	MCC225-16io1	4.5...7 N•m (39.8...62 lb•in)
		Infineon	TT210N16K0F	5 N•m ±15% (44.25 lb•in ±15%)
570	SK-20P-S737F	IXYS	MCC312-16io1	4.5...7 N•m (39.8...62 lb•in)
		Semikron	SKKT330/16E	5 ±15% N•m (44.25 ±15% lb•in)
		Infineon	TT285N16K0F	5 N•m ±15% (44.25 lb•in ±15%)

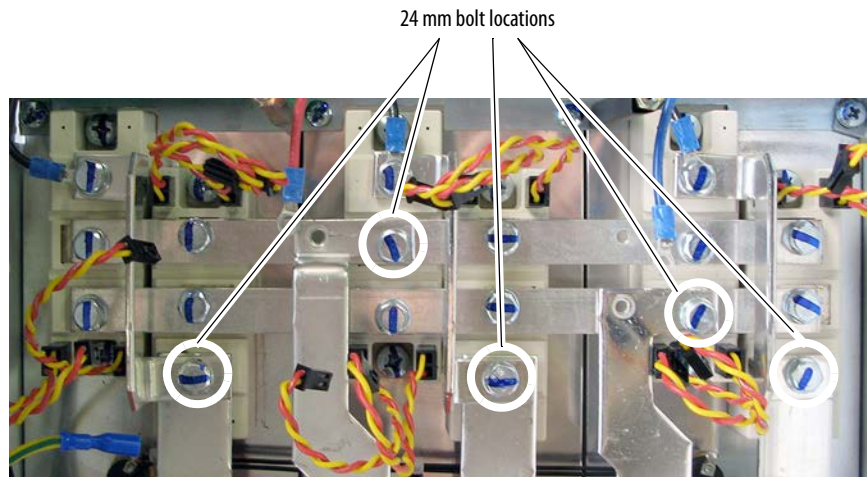
- Use the following table to determine the proper tightening torque for the bus bars connected to the SCR modules:

Device Output Current (Amps)	Rockwell Automation Cat. No.	Vendor	Vendor Part Number	Final Torque
245	SK-20P-S7F79	Semikron	SKKT162/16E	5 N•m ±15% (44.25 lb•in ±15%)
		IXYS	MCC162-16io1	4.5...5.5 N•m (39.8...48.7 lb•in)
365	SK-20P-S7F41	Semikron	SKKT273/16E	9 N•m ±15% (79.6 lb•in ±15%)
		Vishay	VSKT230-16PbF	4...6 N•m ±10% (35.4...53 lb•in ±10%)
		IXYS	MCC225-16io1	11...13 N•m (97.3...115 lb•in)
		Infineon	TT210N16K0F	12 N•m ±10% (106.2 lb•in ±10%)
570	SK-20P-S737F	IXYS	MCC312-16io1	11...13 N•m (97.3...115 lb•in)
		Semikron	SKKT330/16E	9 N•m ±15% (79.6 lb•in ±15%)
		Infineon	TT285N16K0F	12 N•m ±10% (106.2 lb•in ±10%)

- The longer legs of the intermediate AC input bus bars connect to the top of the SCR modules:



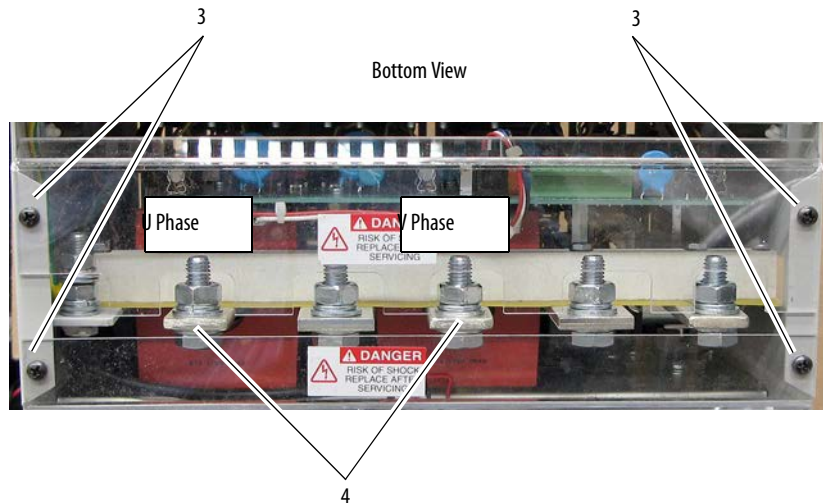
- Five of the bolts are 24 mm long and the rest are 20 mm long. Install the 24 mm bolts in the following locations:



AC Current Transducers Replacement

Remove the AC Current Transducers

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).
3. Remove the screws and washers that secure the plastic shields to the bottom of the device and remove the shields.
4. Remove the bolts, washers, and wiring from the U and V phase AC input power terminals.

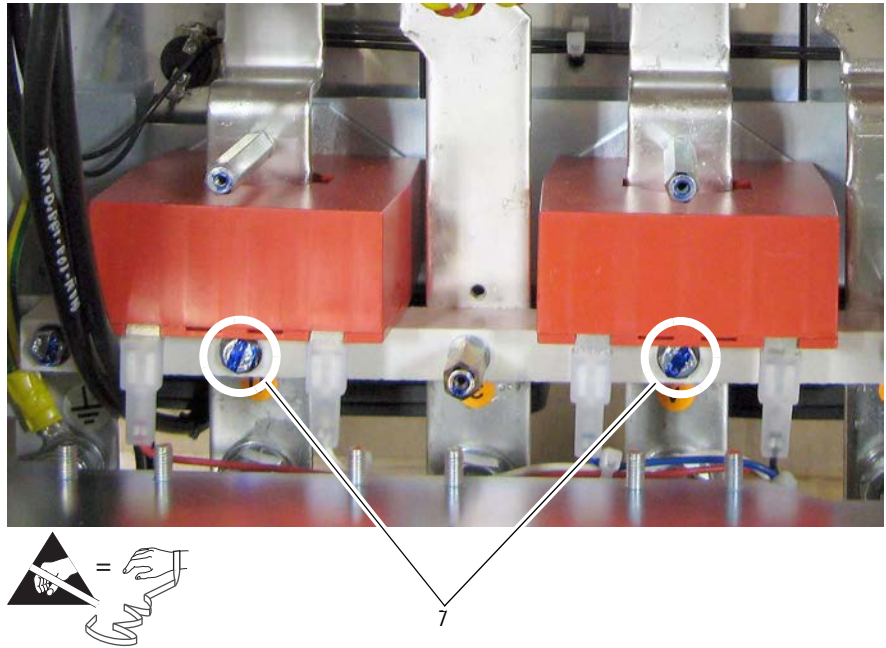


5. Remove the protective covers from the device (see page [80](#)).

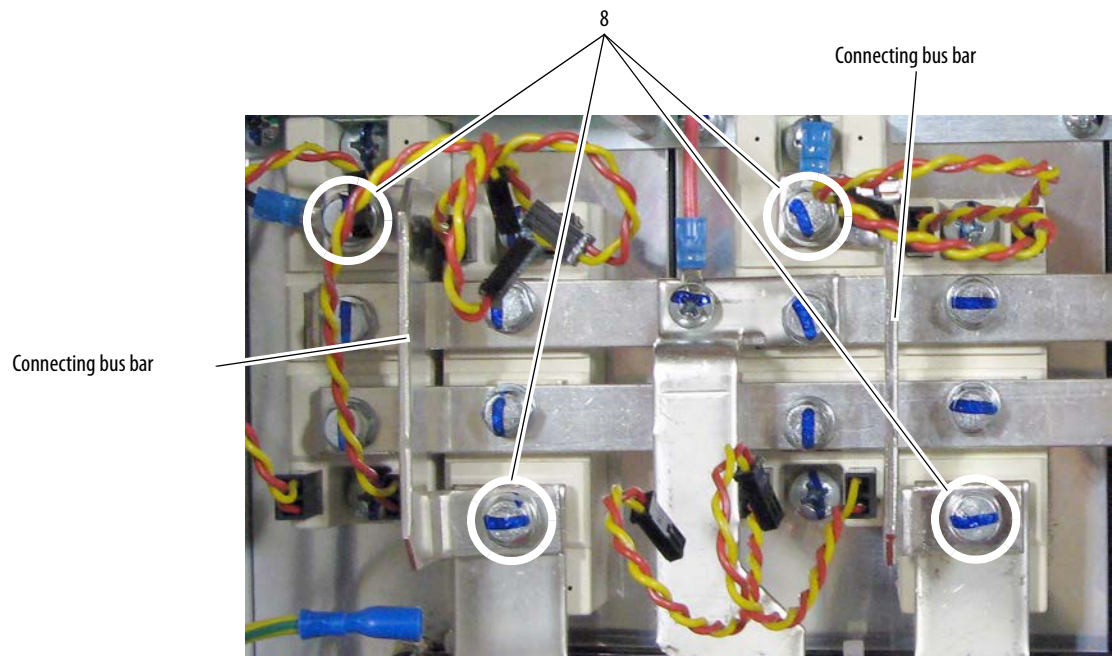
IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

6. Remove the pulse transformer and switching power supply boards from the device (see page [93](#)). You do not need to remove the switching power supply board from the back of the pulse transformer board for this procedure.

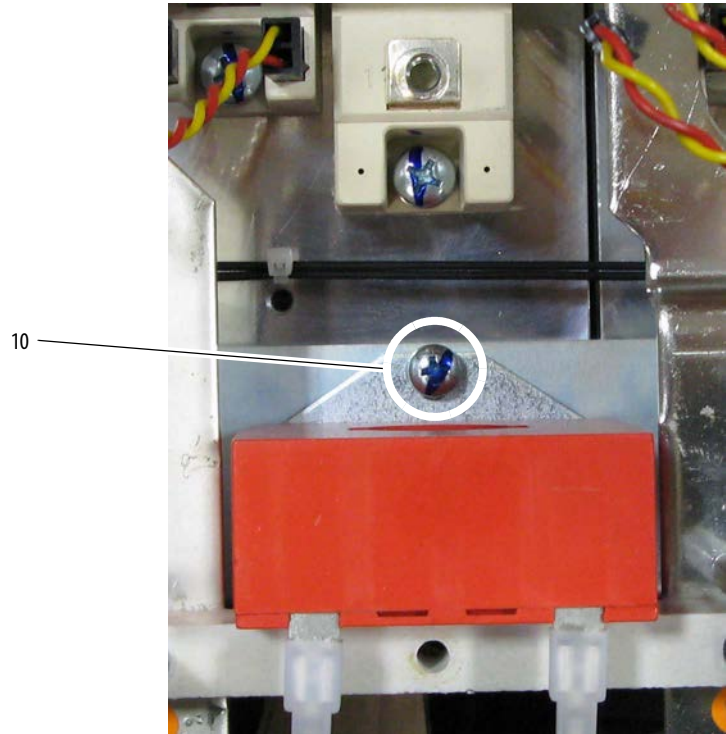
7. Remove the bolts and washers that secure the U and V phase AC input bus bars to the isolation bar.



8. Remove the bolts and washers that secure the resistor wires and the connecting bus bars to the U and V Phase SCR modules and remove the wires and bus bars.



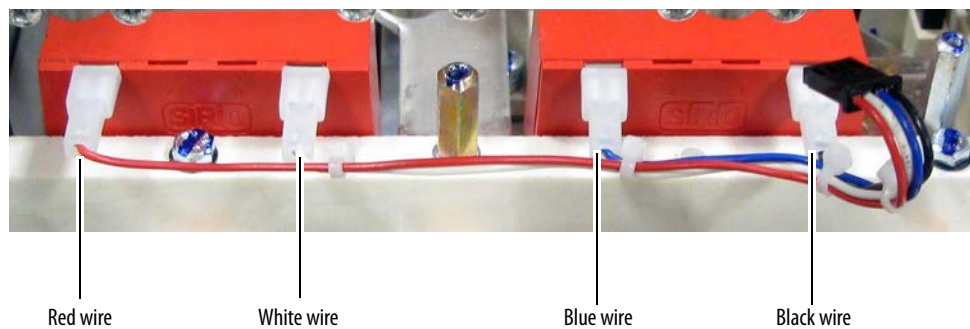
9. Slide the U and V phase bus bars that pass through the AC current transducers up and out of the device.
10. Remove the screw and washer that secures each of the AC current transducers to the device frame and remove the AC current transducers.



Install the AC Current Transducers

Install the AC current transducers in reverse order of removal.

- Note the color and location of each of the four wires that are connected to the AC current transducers to ensure that each wire is properly connected during installation. Use cable ties to bundle wires as shown here.



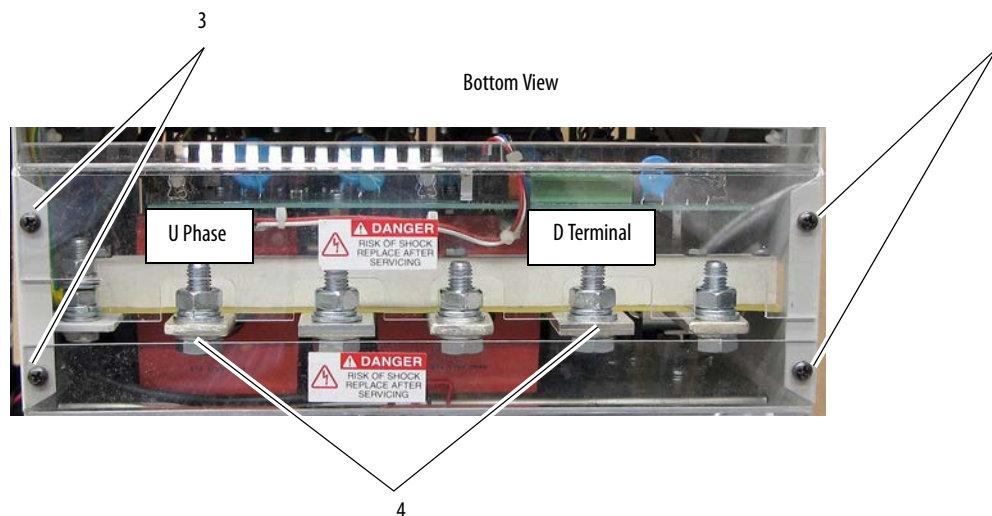
- Use the following table to determine the proper tightening torque for the bus bars connected to the SCR modules:

Device Output Current (Amps)	Rockwell Automation Cat. No.	Vendor	Vendor Part Number	Final Torque
245	SK-20P-S7F79	Semikron	SKKT162/16E	5 N•m \pm 15% (44.25 lb•in \pm 15%)
		IXYS	MCC162-16io1	4.5...5.5 N•m (39.8...48.7 lb•in)
365	SK-20P-S7F41	Semikron	SKKT273/16E	9 N•m \pm 15% (79.6 lb•in \pm 15%)
		Vishay	VSKT230-16PbF	4...6 N•m \pm 10% (35.4...53 lb•in \pm 10%)
		IXYS	MCC225-16io1	11...13 N•m (97.3...115 lb•in)
		Infineon	TT210N16K0F	12 N•m \pm 10% (106.2 lb•in \pm 10%)
570	SK-20P-S737F	IXYS	MCC312-16io1	11...13 N•m (97.3...115 lb•in)
		Semikron	SKKT330/16E	9 N•m \pm 15% (79.6 lb•in \pm 15%)
		Infineon	TT285N16K0F	12 N•m \pm 10% (106.2 lb•in \pm 10%)

Bimetal Thermostats Replacement

Remove the Bimetal Thermostats

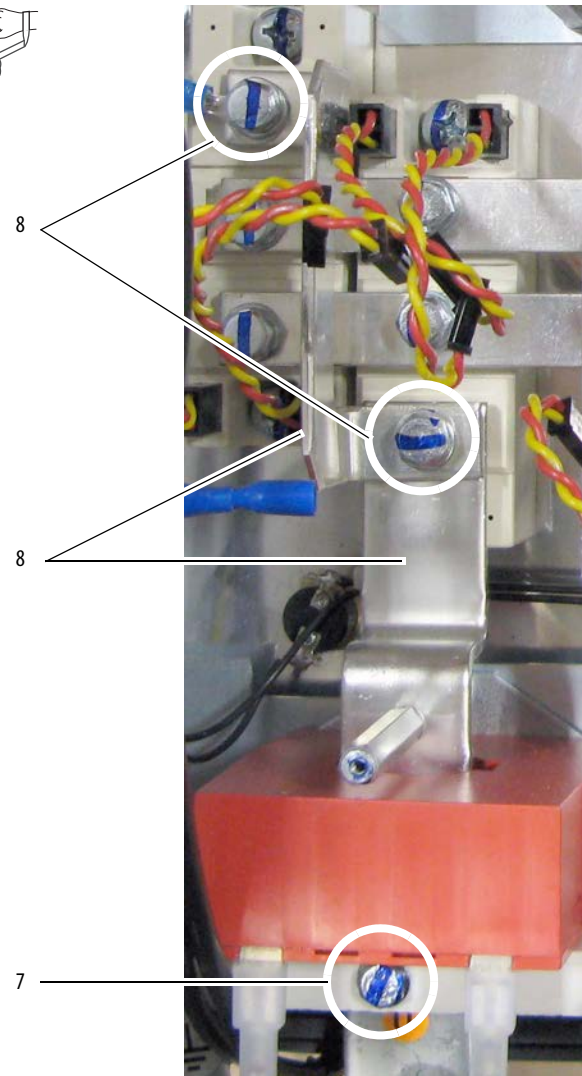
- Read the General Safety Precautions on page [10](#).
- Remove power from the device (see page [79](#)).
- Remove the screws and washers that secure the plastic shields to the bottom of the device and remove the shields.
- Remove the bolts, washers, and wiring from the U phase AC input power terminal and the D power terminal.



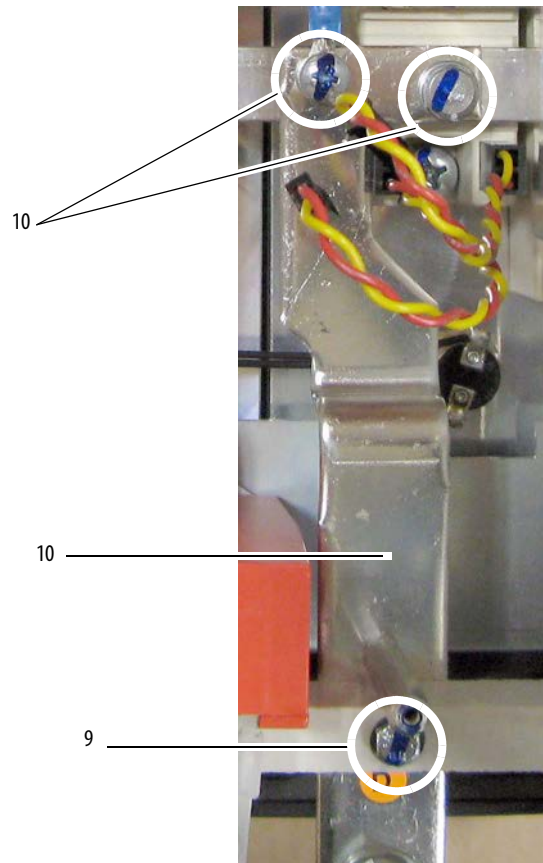
- Remove the protective covers from the device (see page [80](#)).

IMPORTANT Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

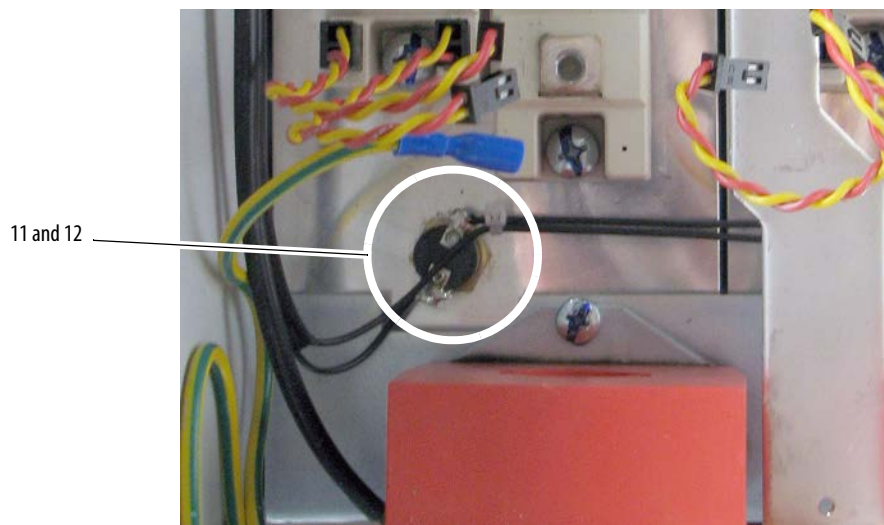
6. Remove the pulse transformer and switching power supply boards from the device (see page 23). You do not need to remove the switching power supply board from the back of the pulse transformer board for this procedure.
7. Remove the bolt and washer that secures the U phase terminal bus bar to the terminal isolation bar.
8. Remove the bolts and washers that secure the connecting bus bar to the U phase SCR modules and remove the bus bars.



9. Remove the bolt and washers that secure the D terminal bus bar to the terminal isolation bar.
10. Remove the screw and washer that secures the wire to the bus bar and the bolt and washer that secures the U phase bus bar to the SCR module and remove the bus bar.



11. Remove the solder from the connections on the two leads of the bimetal thermostats.
12. Remove the bimetal thermostats from the heat sinks by unscrewing them at the base.



Install the Bimetal Thermostats

Install the bimetal thermostats in reverse order of removal.

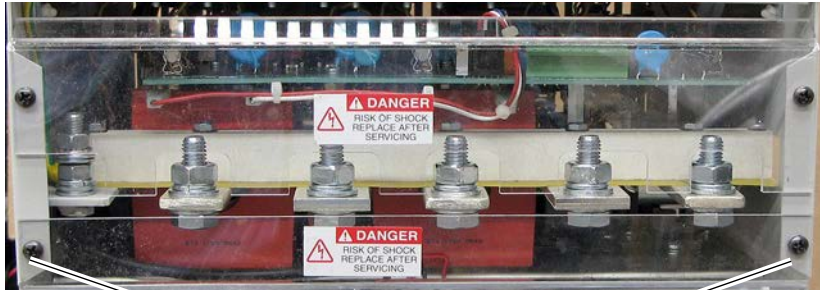
IMPORTANT Thermal grease must be applied to the bottom of the bimetal thermostats before securing them to the heat sink.

Cooling Fan Replacement

Remove the Cooling Fans

1. Read the General Safety Precautions on page [10](#).
2. Remove power from the device (see page [79](#)).
3. Remove the two screws that secure the rear plastic shield to the bottom of the device and remove the shield.

Bottom View

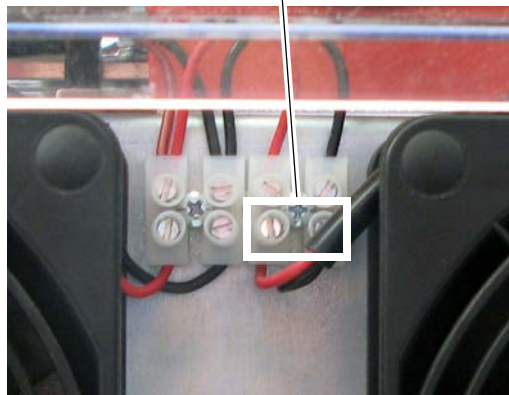


3

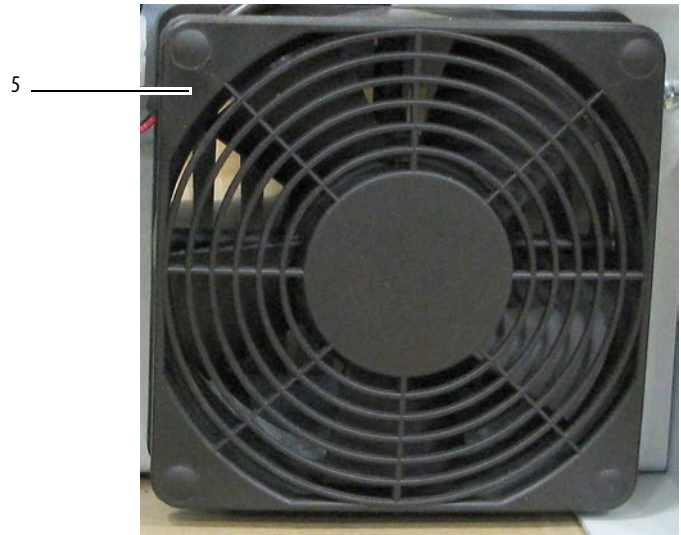
4. Locate the cooling fan terminal block on the bottom of the device and loosen the screws that secure the fan power supply wires (red and black) to the terminal block and remove the wires.

IMPORTANT Note the color and location of each of the wires that are connected to the cooling fan to ensure that each wire is properly connected during installation.

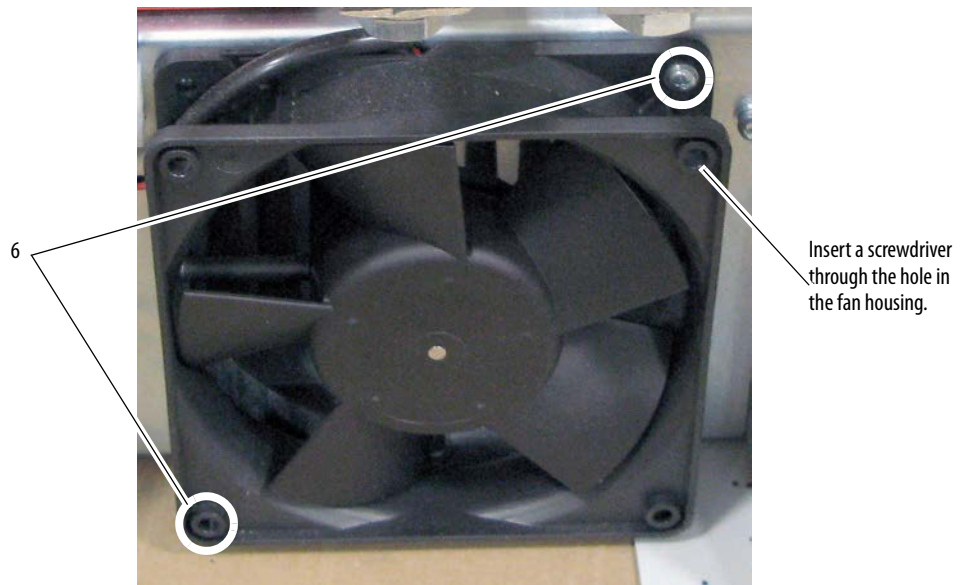
4



5. Using a flathead screwdriver, carefully pry the fan cover plate off the fan housing.



6. Remove the two screws that secure the fan to the device frame. You must insert a Phillips head screwdriver through the hole in the front of the fan housing to reach and remove the screws. Remove the fan from the device.



Install the Cooling Fans

Install the cooling fans in reverse order of removal.

- Verify that the air flow direction arrow on the fans is pointing toward the heat sink on the device.

Start-up after Repair

Before you apply power to a repaired device, perform the following tests:

- Check the SCR Modules on page [22](#)
- Complete the Verify Field Controller Operation Connected to a Load as detailed here.

Verify Field Controller Operation Connected to a Load

This procedure requires a HIM to configure and tune the device. If you prefer, you can use the DriveExecutive™ software or Connected Components Workbench® software.



ATTENTION: Power must be applied to the field controller 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 must perform this 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. Correct the malfunction before continuing.

1. Verify that the input power wiring and grounding is connected.
2. Verify that the power cables are connected to the load.
3. Verify that the control and I/O wiring is correct.
4. Verify that the control board DIP switches are set correctly. See Install the Control Circuit Board on page [47](#) for more information.
5. Verify that the protective covers are installed on the field controller.
6. Apply power to the control circuits (terminals U2 and V2) of the device.
7. Restore the field controller and communication adapter parameter configuration using one of these methods:
 - Restore a saved HIM Set to the field controller.
 - Upload the field controller and adapter configuration from an offline database file to the field controller by using DriveExecutive.
 - Import a device configuration file to the field controller by using Connected Components Workbench software.

8. Verify that the following parameter values are set correctly:
 - 175 [Load Rated Volt] is set to the load nominal (rated) voltage for the field controller.
 - 179 [Load Rated Curr] is set to the load nominal (rated) current.
 - 481 [UnderVolt Thresh] is set to an appropriate value - typically 85% of the nominal AC line voltage.
9. Complete the Verify Field Controller Operation section of Chapter 1 Startup in the PowerFlex® DC Field Controller Programming Manual, publication [23PFC-PM001](#).

Schematics

List of Schematic Diagrams

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Frame A and B Field Controllers	
Frame A and B AC Line Measurement Points Diagram	129
Frame A and B Contactor Control Relays Control Circuit Diagram	129

Frame A Field Controllers

Figure 7 - Frame A Field Controller Interconnection Diagram

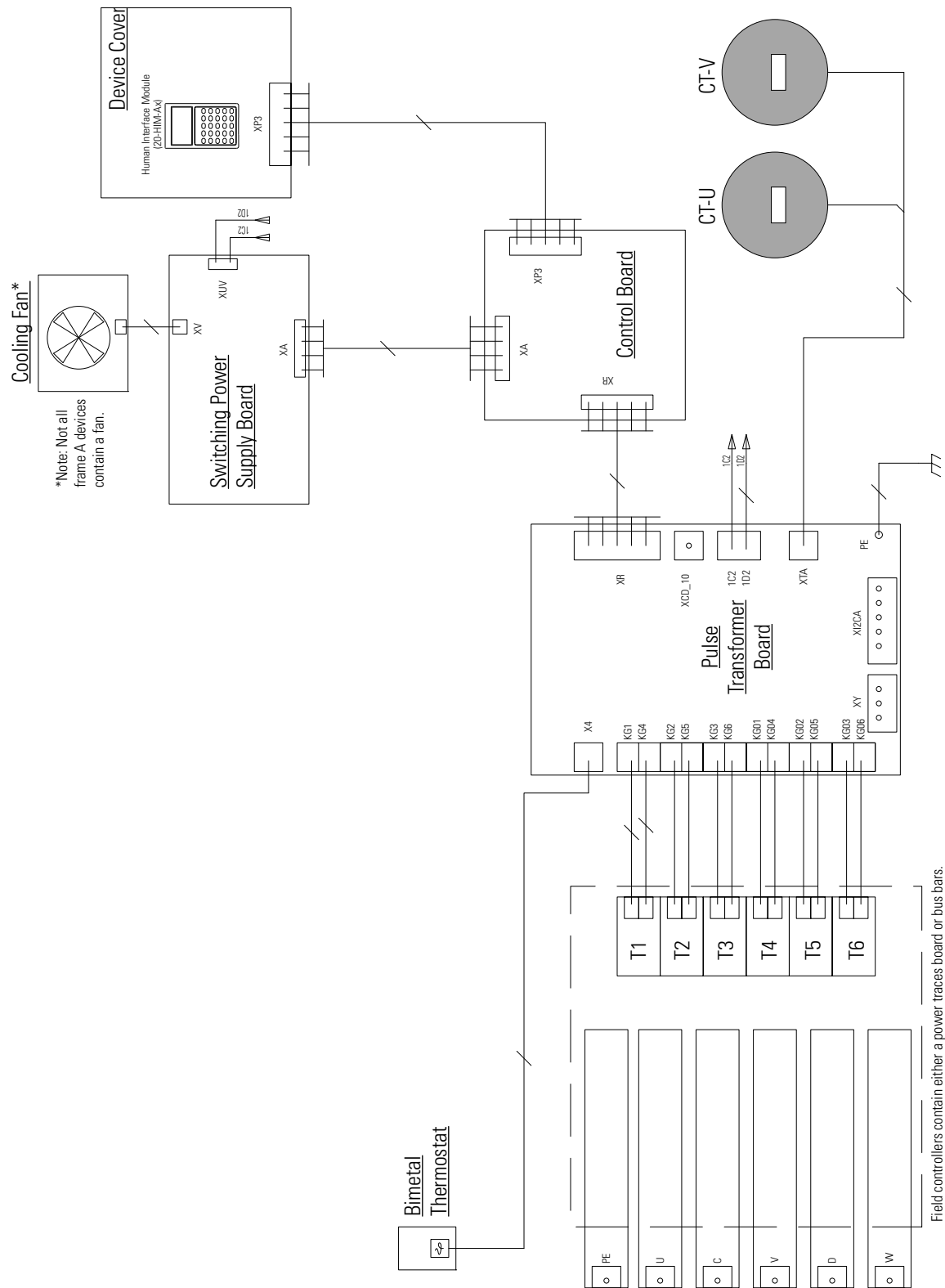


Figure 8 - Frame A Power Feedback Connections Diagram

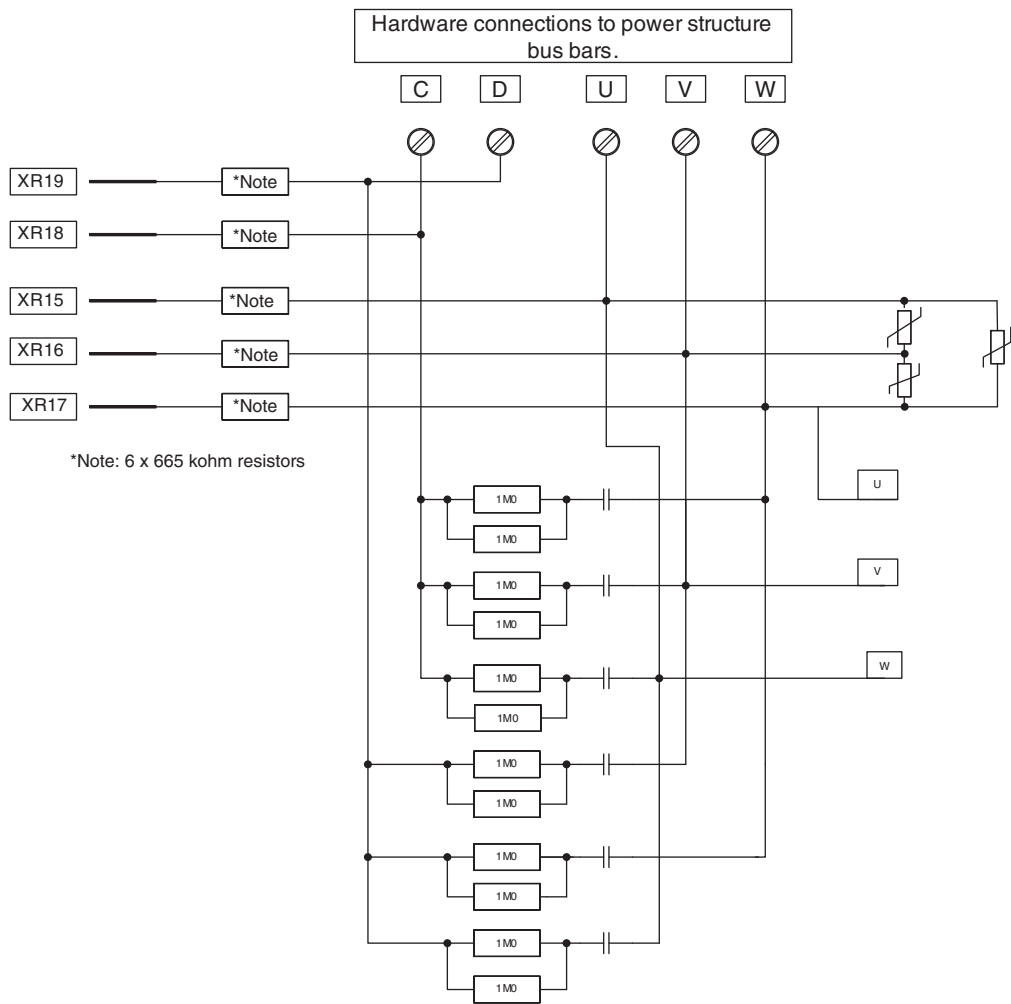


Figure 9 - Frame A SCR to Pulse Transformer Board Gate Lead Pinout Diagram

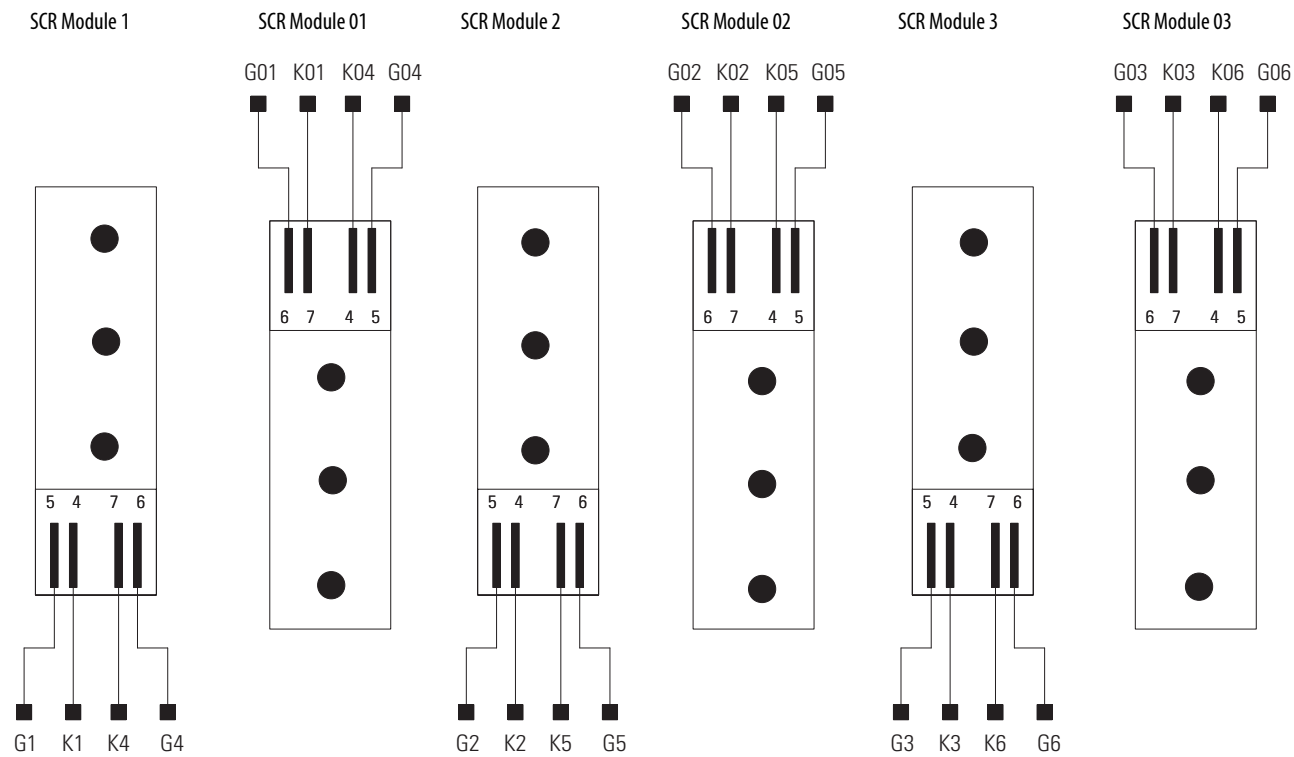


Figure 10 - Frame A Control Circuit Input Power Diagram

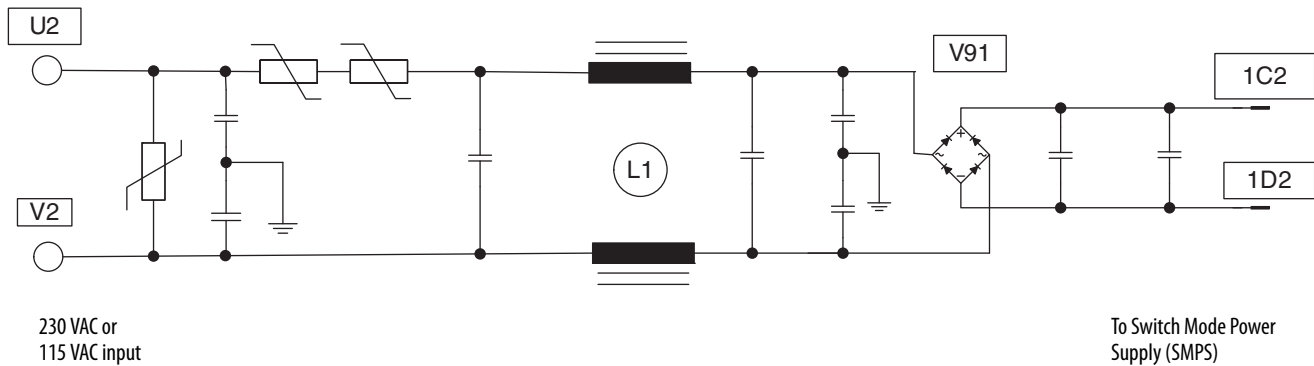
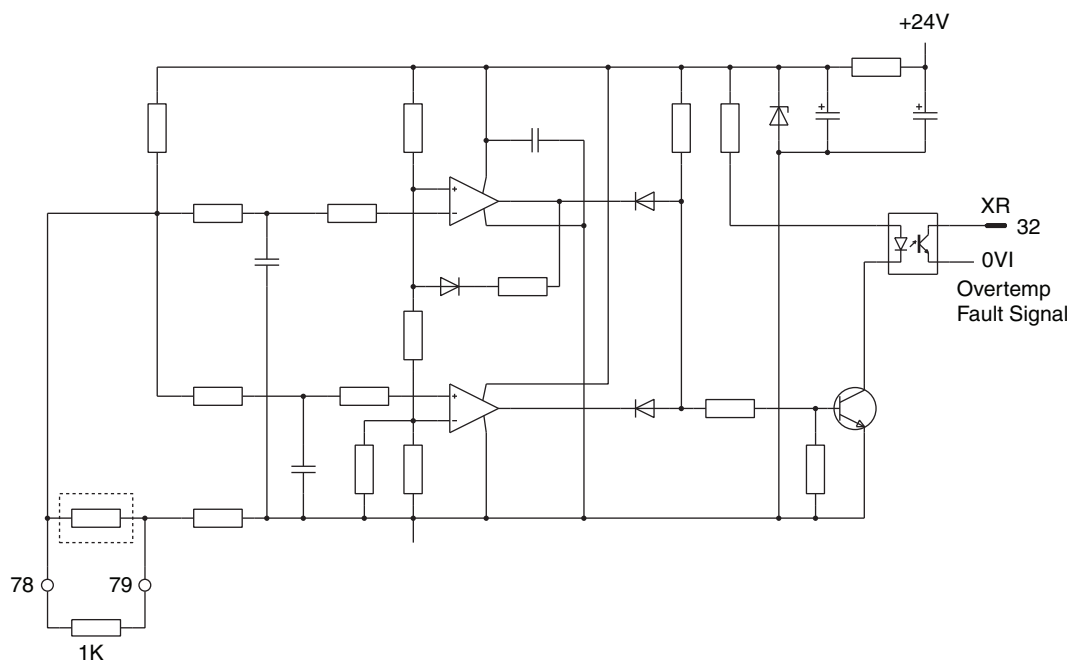
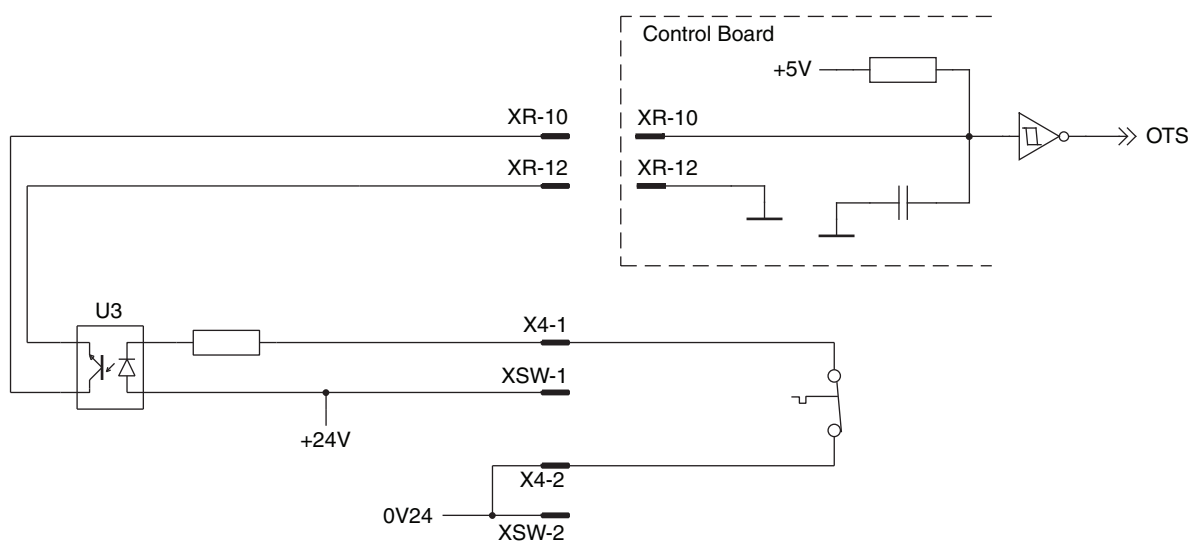


Figure 11 - Frame A Motor Thermal Protection Control Circuit Diagram**Figure 12 - Frame A Heat Sink Monitoring Control Circuit Diagram**

Frame B Field Controllers

Figure 13 - Frame B Field Controller Interconnection Diagram

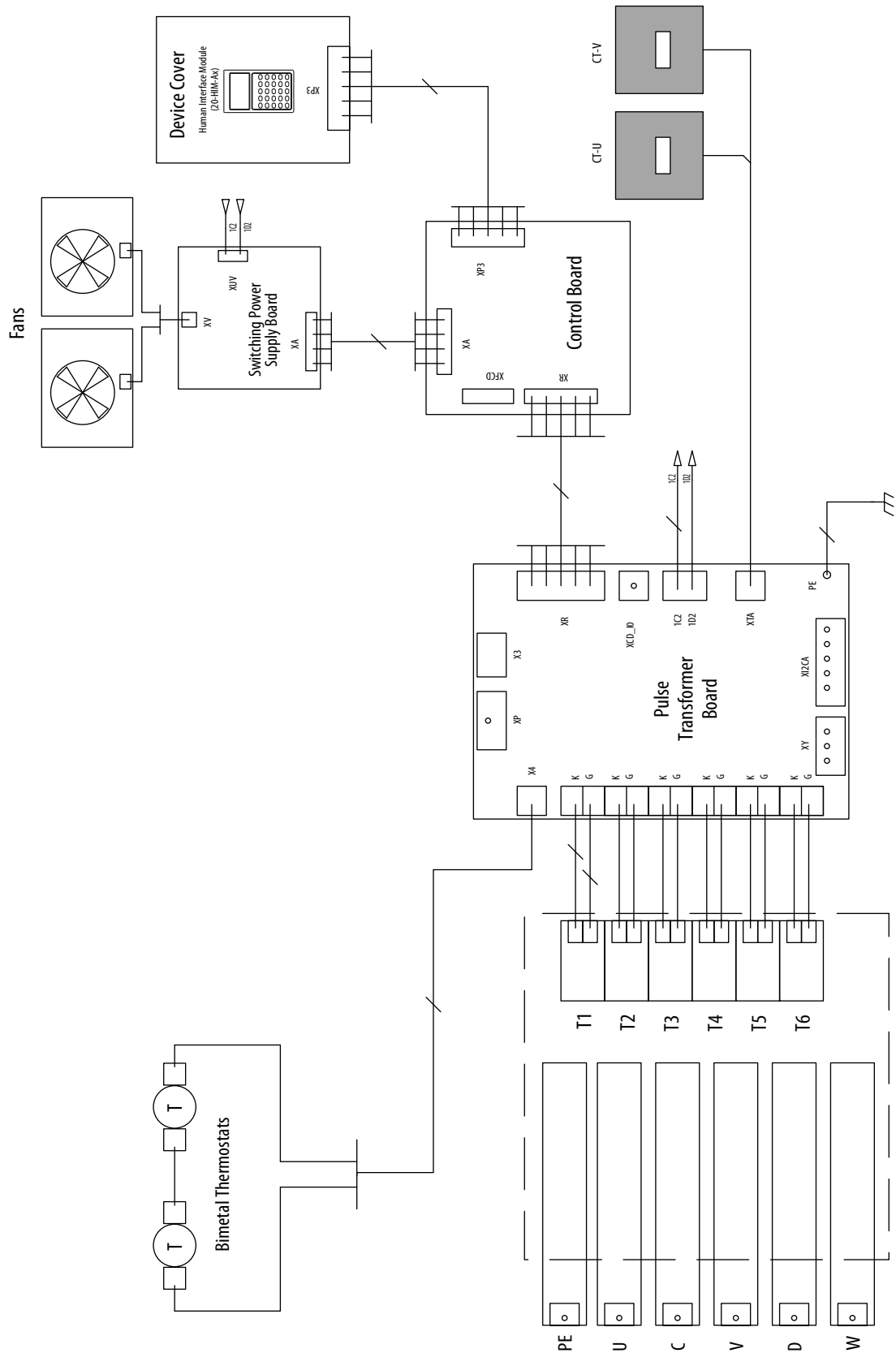


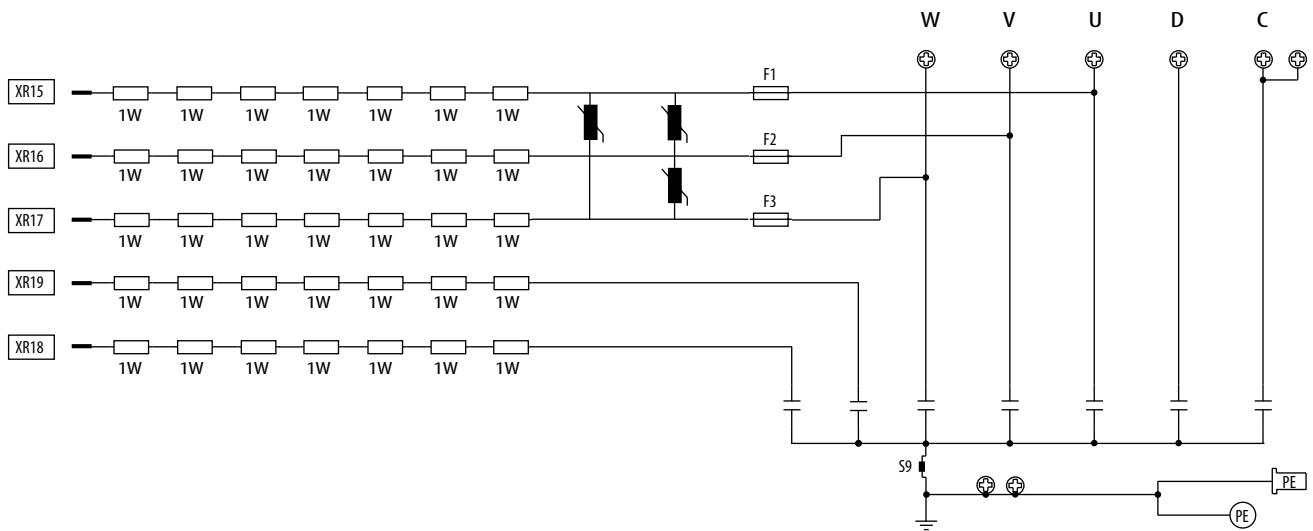
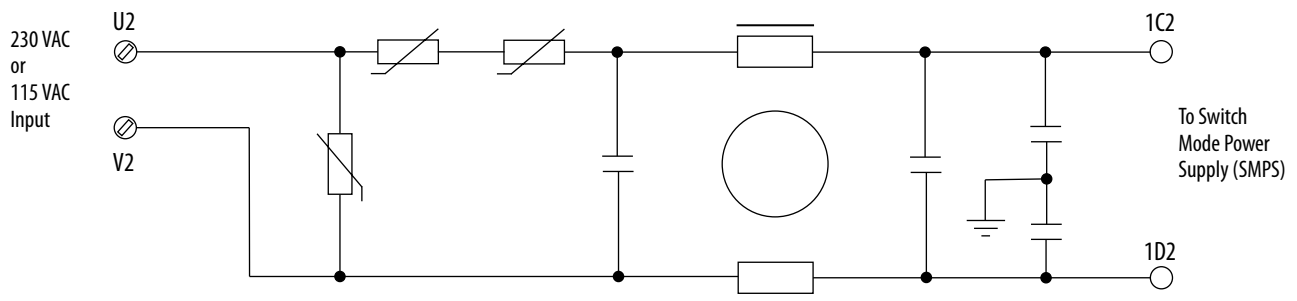
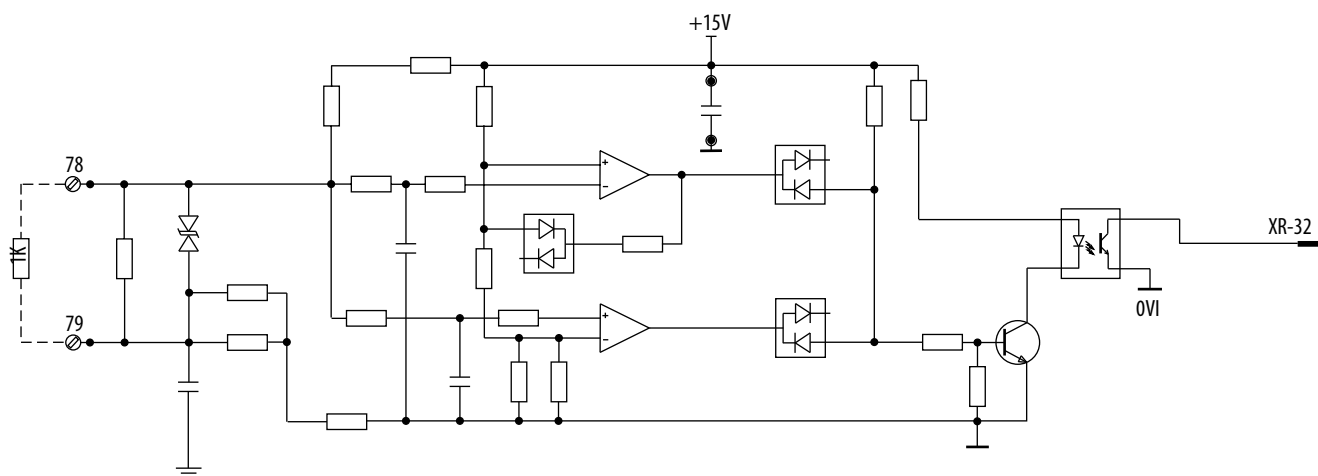
Figure 14 - Frame B Power Feedback Connections Diagram**Figure 15 - Frame B Control Circuit Input Power Diagram****Figure 16 - Frame B Motor Thermal Protection Control Circuit Diagram**

Figure 17 - Frame B Heat Sink Monitoring Control Circuit Diagram

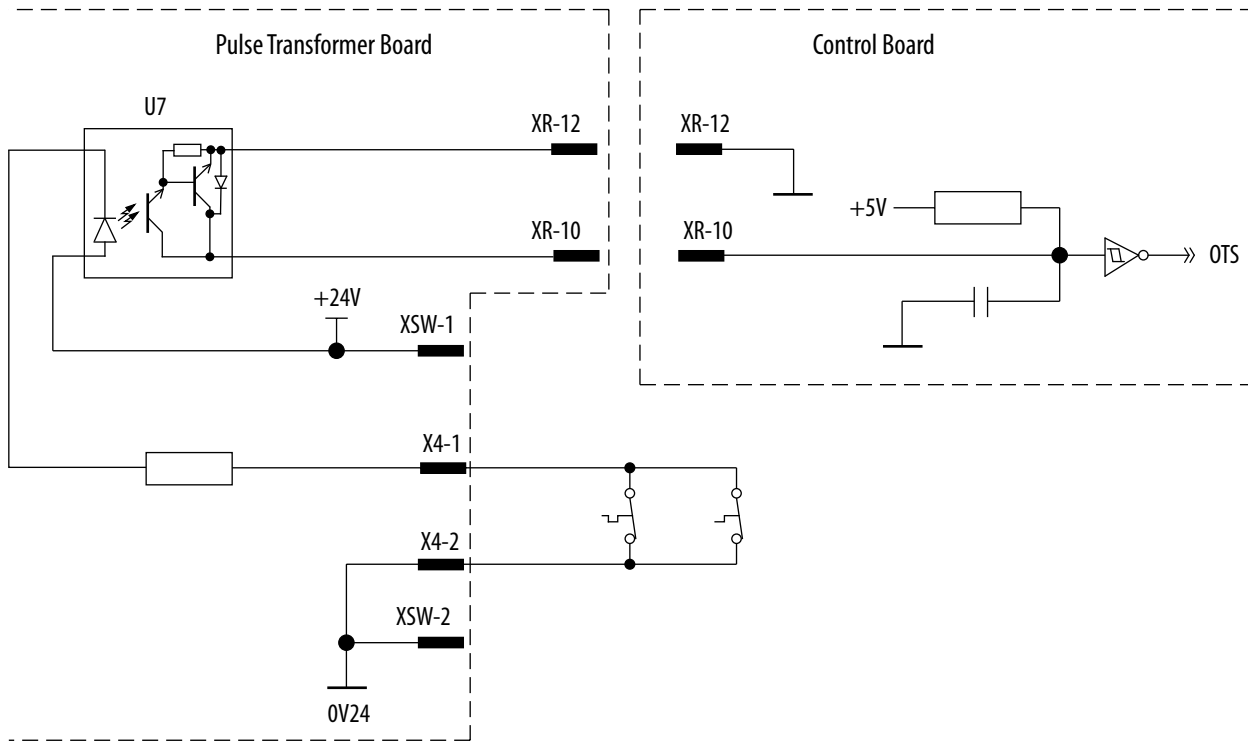
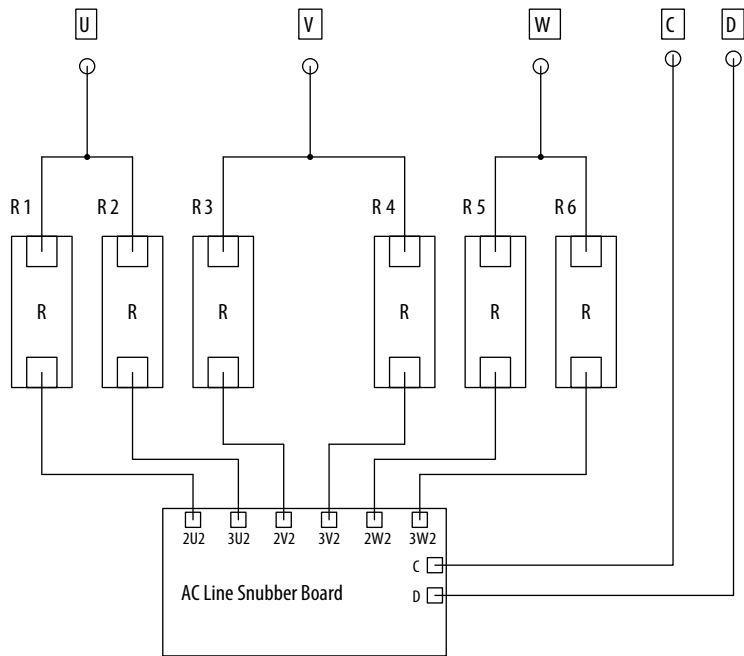


Figure 18 - Frame B AC Line Snubber Circuit Diagram



Frame A and B Field Controllers

Figure 19 - Frame A and B AC Line Measurement Points Diagram

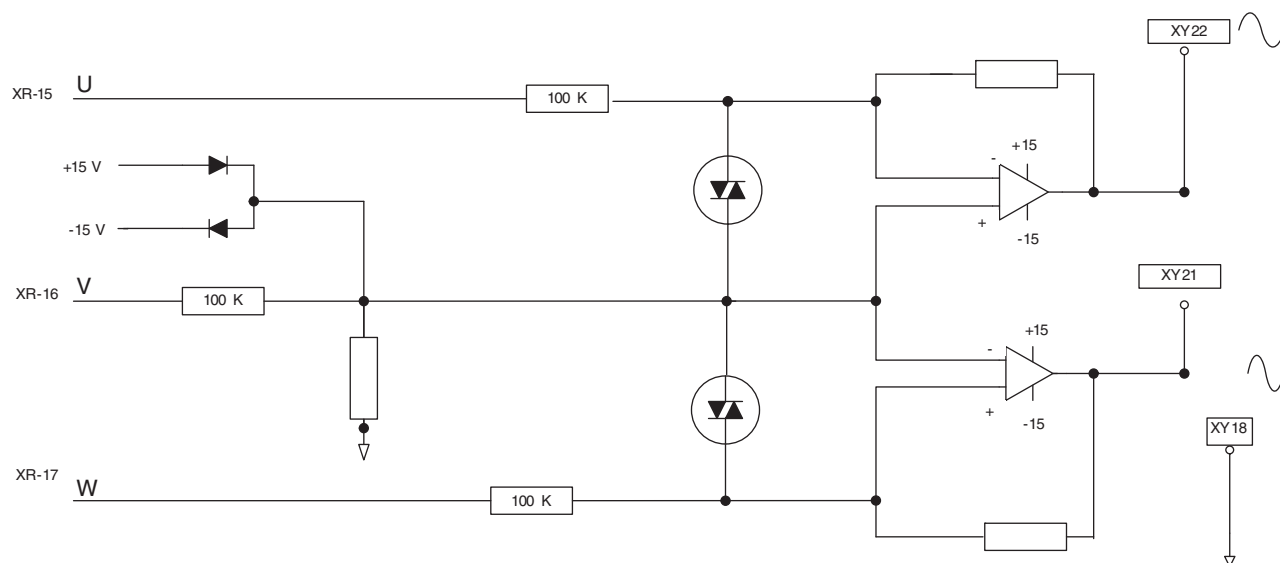
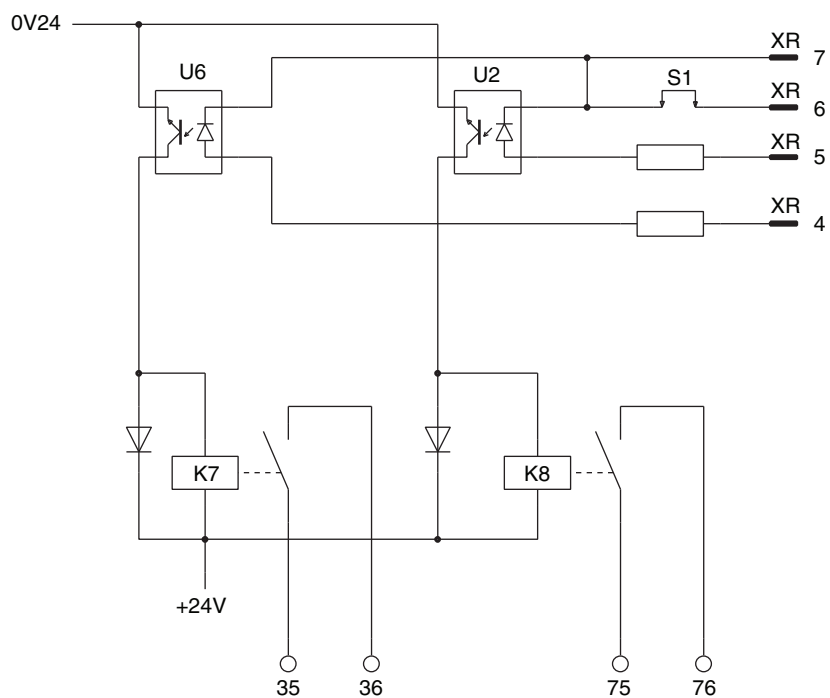


Figure 20 - Frame A and B Contactor Control Relays Control Circuit Diagram



Notes:

Circuit Board Layouts and Connections

List of Circuit Board Layouts

The following images and tables detail the connection points for the frame A PowerFlex® DC field controller circuit boards and components.

Topic	Page
Frame A Pulse Transformer Board Layout	132
Pulse Transformer Board to Switching Power Supply Connections - Frame A	133
Pulse Transformer Board to Bimetal Thermostat Connections - Frame A	133
Pulse Transformer Board to Current Transducer Connections - Frame A	133
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Frame A Switching Power Supply Board Layout	135
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Frame B Switching Power Supply Board Layout	140
Switching Power Supply Board to Control Board Connections - Frame B	140
Control Board Layout	141

Frame A Pulse Transformer Board

Figure 21 - Frame A Pulse Transformer Board Layout

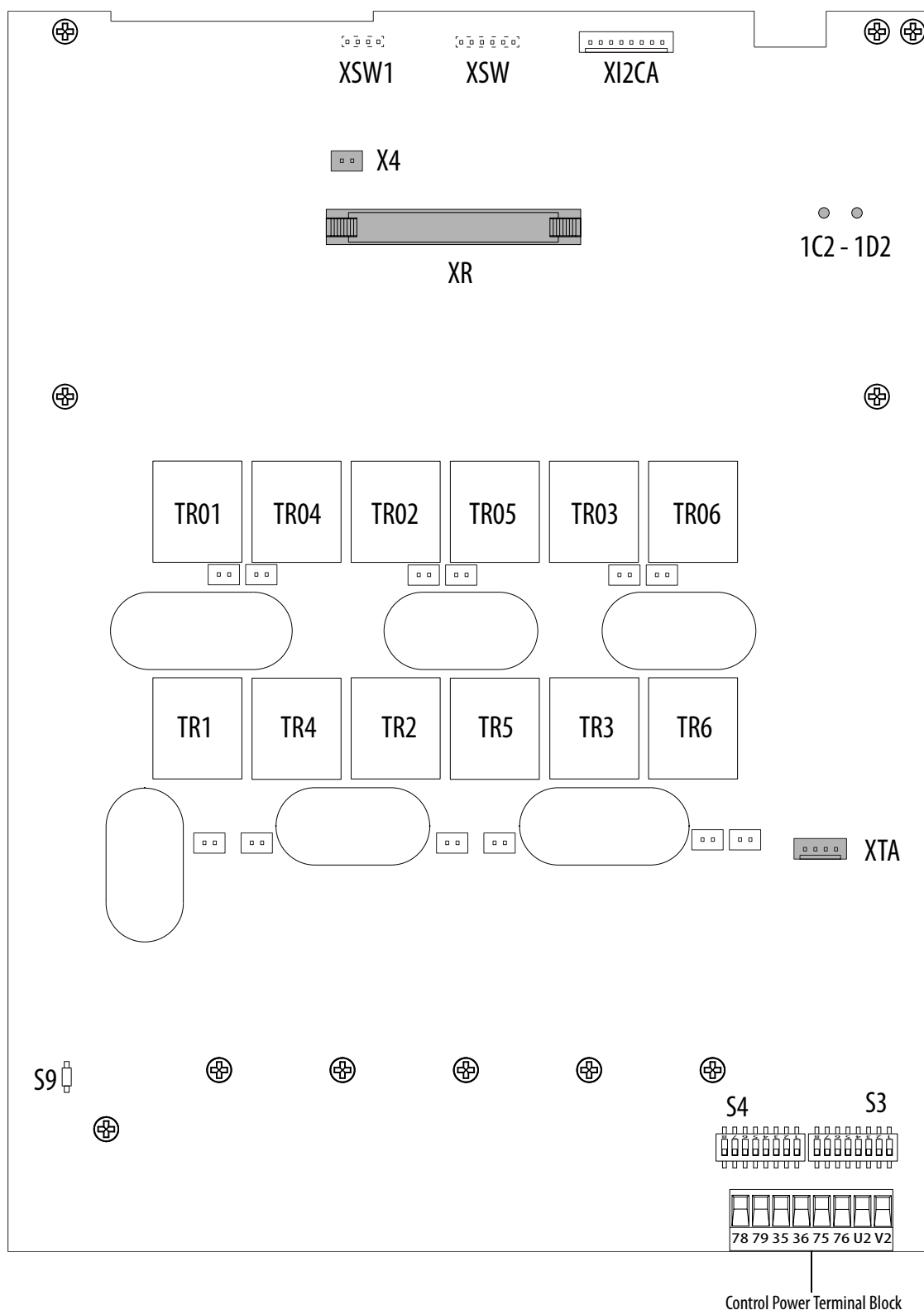


Table 12 - Pulse Transformer Board to Switching Power Supply Connections - Frame A

Pulse Transformer Board Point ⁽¹⁾	to	Pin Number	Switching Power Supply Board Connector	Description
1C2	...	4	XUV	Rectified U2, V2 voltage (approx. 150/300V DC)
	...	3		not used
1D2	...	2		not used
	...	1		Common

(1) Connection on back side of circuit board.

Table 13 - Pulse Transformer Board to Bimetal Thermostat Connections - Frame A

Pulse Transformer Board Connector	Pin Number	to	Pin Number	Bimetal Thermostat Connector	Description
X4	1	...	1	X4	+24V supply through resistor
	2	...	2		24V common

Table 14 - Pulse Transformer Board to Current Transducer Connections - Frame A

Pulse Transformer Board Connector	Pin Number	to	Pin Number	Current Transducer	Description
XTA	1	...	Black	CT on Phase U	Secondary side CT phase U
	2	...	Brown		
	3	...	Black	CT on Phase V	Secondary side CT phase V
	4	...	Brown		

Table 15 - Pulse Transformer Board to Control Board Connections - Frame A

Pulse Transformer Board Connector	Pin Number	to	Pin Number	Control Board Connector	Description
XR	1	...	1	XR	Gate signal G1 field SCR1
	2	...	2		Gate signal G2 field SCR2
	3	...	3		0V (GNDP)
	4	...	4		Relay output terminals 35 and 36 command
	5	...	5		Relay output terminals 75 and 76 command
	6	...	6		2Q/4Q selection signal
	7	...	7		0V (GNDP)
	8	...	8		I armature = 0 signal
	9	...	9		0V (GNDP)
	10	...	10		Heat sink over temperature
	11	...	11		Digital U1, V1 sync signal
	12	...	12		0V (GNDP)
	13	...	13		CT burden signal
	14	...	14		0V (GND)
	15	...	15		Reduced U sync signal
	16	...	16		Reduced V sync signal
	17	...	17		Reduced W sync signal
	18	...	18		Reduced C (armature) signal
	19	...	19		Reduced D (armature) signal
	20	...	20		0V (GNDP)
	21	...	21		Gate signal SCR 4/01
	22	...	22		0V (GNDP)
	23	...	23		Gate signal SCR 5/02
	24	...	24		0V (GNDP)
	25	...	25		Gate signal SCR 6/03
	26	...	26		WH1 (not used, grounded)
	27	...	27		Gate signal SCR 1/04
	28	...	28		WL1 (not used, grounded)
	29	...	29		Gate signal SCR 2/05
	30	...	30		0V (GNDP)
	31	...	31		Gate signal SCR 3/06
	32	...	32		Motor over temperature
	33	...	33		Enable reverse (MN) power bridge
	34	...	34		Enable forward (MP) power bridge

Frame A Switching Power Supply Board

Figure 22 - Frame A Switching Power Supply Board Layout

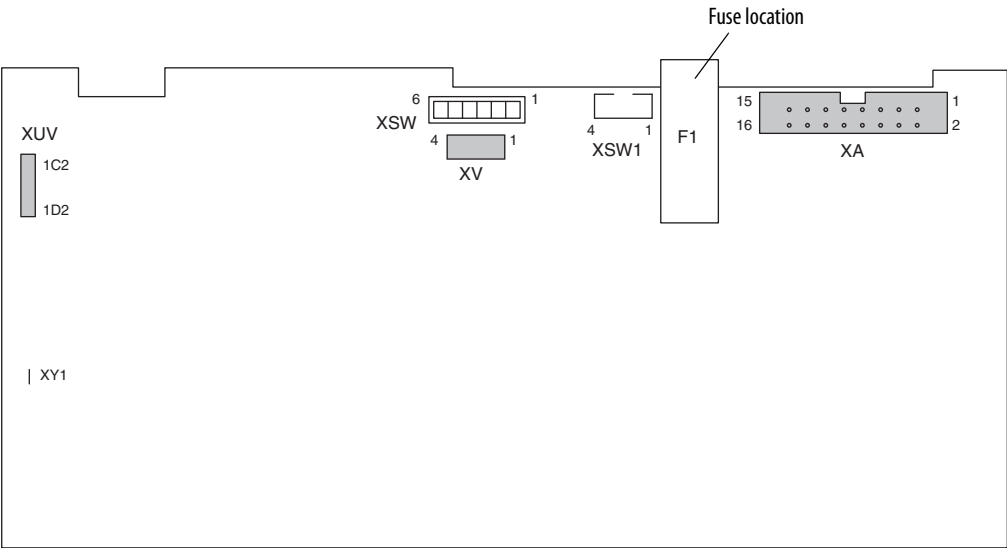


Table 16 - Switching Power Supply to Fan Connections - Frame A

Control Board Connector	Pin Number	to	Pin Number	Fan Connector	Description
XV	1	...	1	XV	+24V
	2	...	2		
	3	...	3		24V supply common
	4	...	4		

Table 17 - Switching Power Supply Board to Control Board Connections - Frame A

Switching Power Supply Board Connector	Pin Number	to	Pin Number	Control Board Connector	Description
XA	1	...	1	XA	+5V
	2	...	2		5V common
	3	...	3		+5V
	4	...	4		5V common
	5	...	5		+5V
	6	...	6		5V common
	7	...	7		SMPS supply input under voltage
	8	...	8		
	9	...	9		+15V
	10	...	10		
	11	...	11		15V common
	12	...	12		
	13	...	13		-15V
	14	...	14		
	15	...	15		24V common
	16	...	16		+24V

See Pulse Transformer Board to Switching Power Supply Connections - Frame A on page [133](#).

Frame B Pulse Transformer Board

Figure 23 - Frame B Pulse Transformer Board Layout

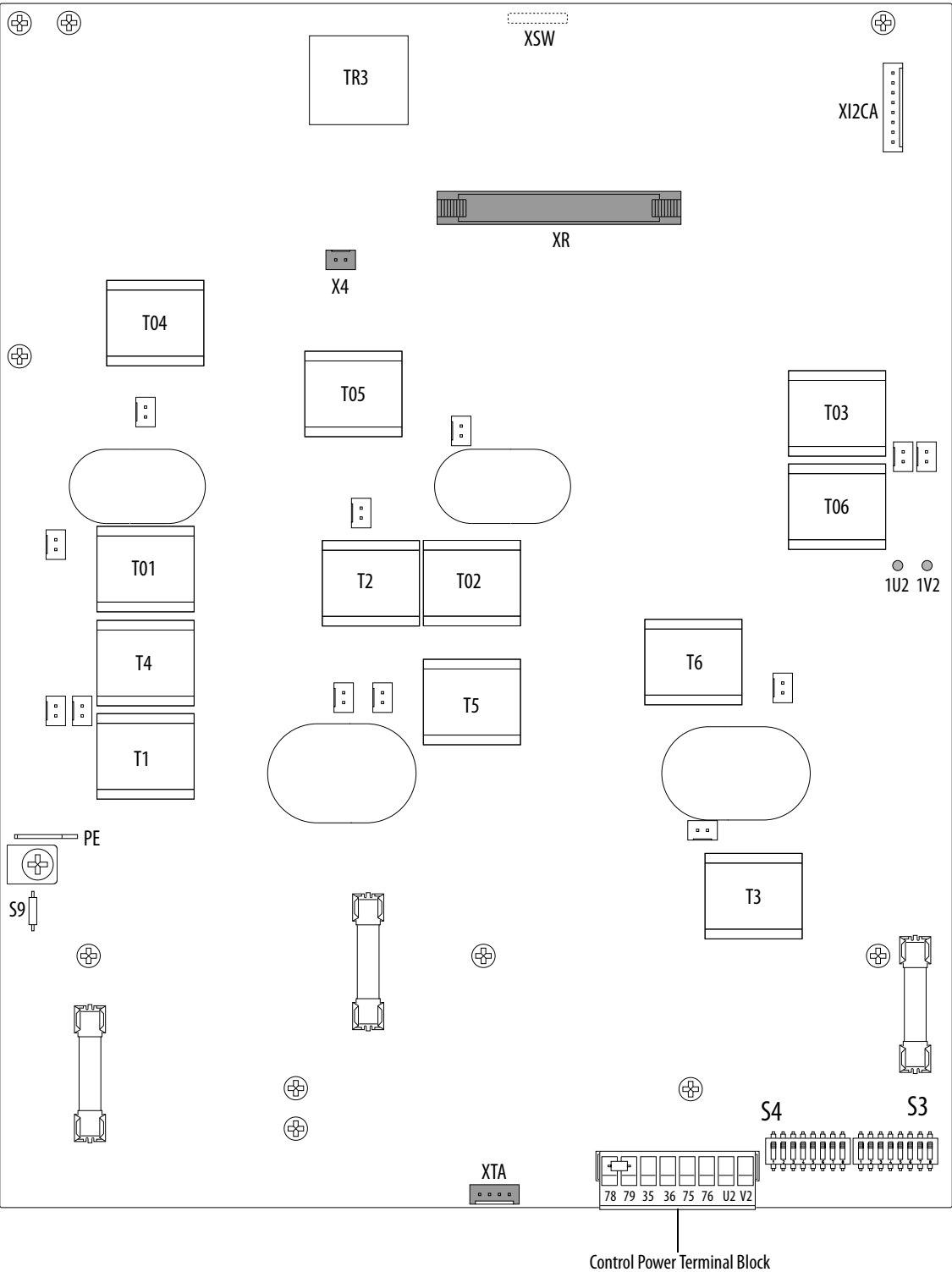


Table 18 - Pulse Transformer Board to Switching Power Supply Connections - Frame B

Pulse Transformer Board Point	to	Pin Number	Switching Power Supply Board Connector	Description
1U2	...	4	XUV	Rectified U2-V2 voltage (approx. 150/300V DC)
	...	3		not used
1V2	...	2		not used
	...	1		Common

Table 19 - Pulse Transformer Board to Bimetal Thermostat Connections - Frame B

Pulse Transformer Board Connector	Pin Number	to	Pin Number	Bimetal Thermostat Connector	Description
X4	1	...	1	X4	+24V supply through resistor
	2	...	2		24V common

Table 20 - Pulse Transformer Board to Current Transducer Connections - Frame B

Pulse Transformer Board Connector	Pin Number	to	Pin Number	Current Transducer	Description
XTA	1	...	Black	CT on Phase U	Secondary side CT phase U
	2	...	Brown		
	3	...	Black	CT on Phase V	Secondary side CT phase V
	4	...	Brown		

Table 21 - Pulse Transformer Board to Control Board Connections - Frame B

Pulse Transformer Board Connector	Pin Number	to	Pin Number	Control Board Connector	Description
XR	1	...	1	XR	Gate signal G1 field SCR1
	2	...	2		Gate signal G2 field SCR2
	3	...	3		0V (GNDP)
	4	...	4		Relay output 35-36 command
	5	...	5		Relay output 75-76 command
	6	...	6		2Q/4Q selection signal
	7	...	7		0V (GNDP)
	8	...	8		I armature = 0 signal
	9	...	9		0V (GNDP)
	10	...	10		Heat Sink over temperature
	11	...	11		Digital U1-V1 sync signal
	12	...	12		0V (GNDP)
	13	...	13		CT burden signal
	14	...	14		0V (GND)
	15	...	15		Reduced U sync signal
	16	...	16		Reduced V sync signal
	17	...	17		Reduced W sync signal
	18	...	18		Reduced C (armature) signal
	19	...	19		Reduced D (armature) signal
	20	...	20		0V (GNDP)
	21	...	21		Gate signal SCR 4/01
	22	...	22		0V (GNDP)
	23	...	23		Gate signal SCR 5/02
	24	...	24		0V (GNDP)
	25	...	25		Gate signal SCR 6/03
	26	...	26		WH1 (not used, grounded)
	27	...	27		Gate signal SCR 1/04
	28	...	28		WL1 (not used, grounded)
	29	...	29		Gate signal SCR 2/05
	30	...	30		0V (GNDP)
	31	...	31		Gate signal SCR 3/06
	32	...	32		Motor overtemperature
	33	...	33		Enable reverse (MN) power bridge
	34	...	34		Enable forward (MP) power bridge

Frame B Switching Power Supply Board

Figure 24 - Frame B Switching Power Supply Board Layout

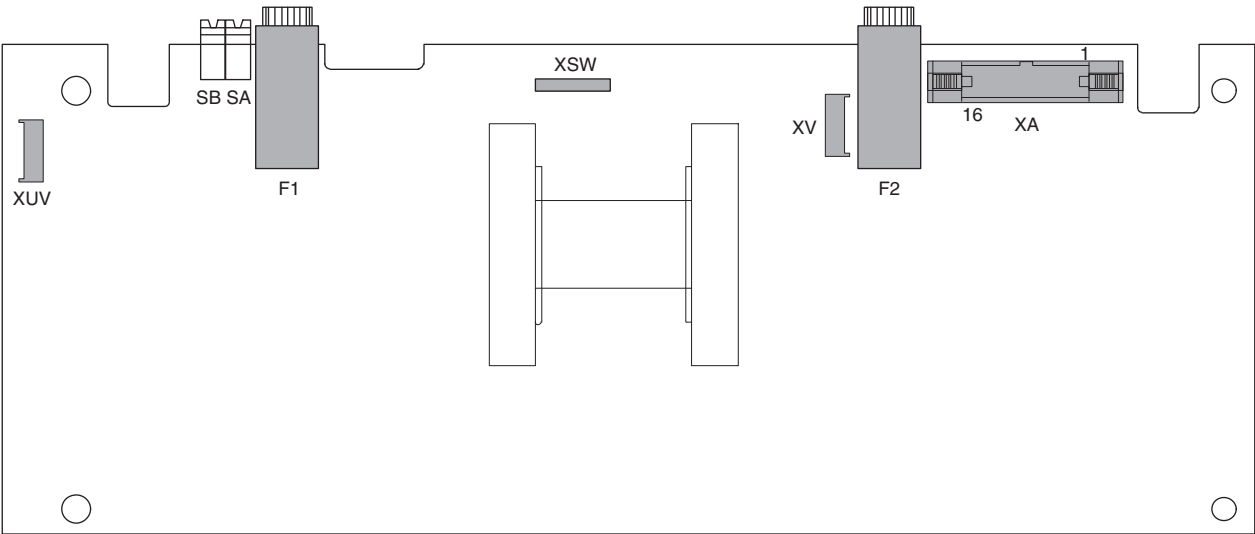
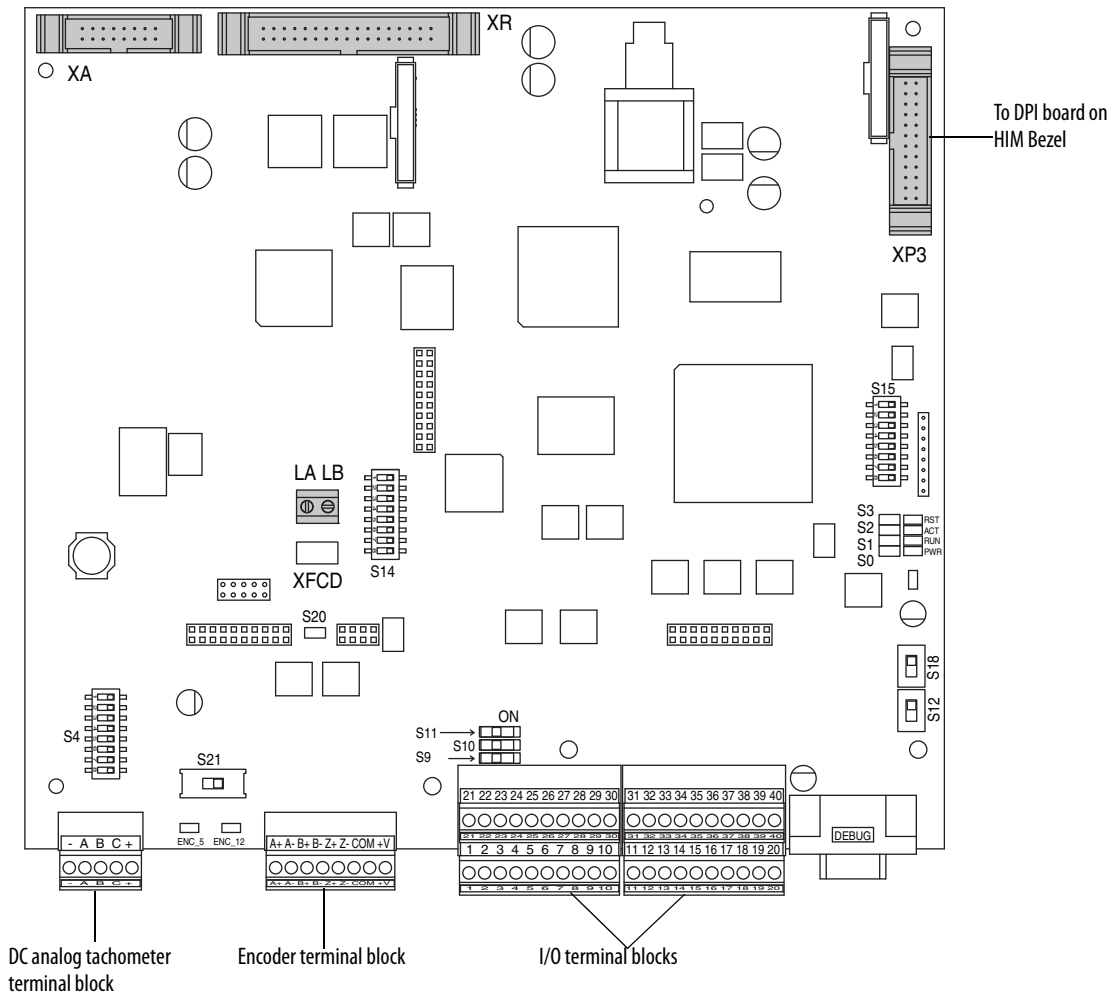


Table 22 - Switching Power Supply Board to Control Board Connections - Frame B

Switching Power Supply Board Connector	Pin Number	to	Pin Number	Control Board Connector	Description
XA	1	...	1	XA	+5V
	2	...	2		5V common
	3	...	3		+5V
	4	...	4		5V common
	5	...	5		+5V
	6	...	6		5V common
	7	...	7		SMPS supply input undervoltage
	8	...	8		
	9	...	9		+15V
	10	...	10		
	11	...	11		15V common
	12	...	12		
	13	...	13		-15V
	14	...	14		
	15	...	15		24V common
	16	...	16		+24V

See Pulse Transformer Board to Switching Power Supply Connections - Frame B on page [138](#).

Control Board**Figure 25 - Control Board Layout**

For Frame A devices, see Pulse Transformer Board to Control Board Connections - Frame A on page [134](#) and Switching Power Supply Board to Control Board Connections - Frame A on page [136](#).

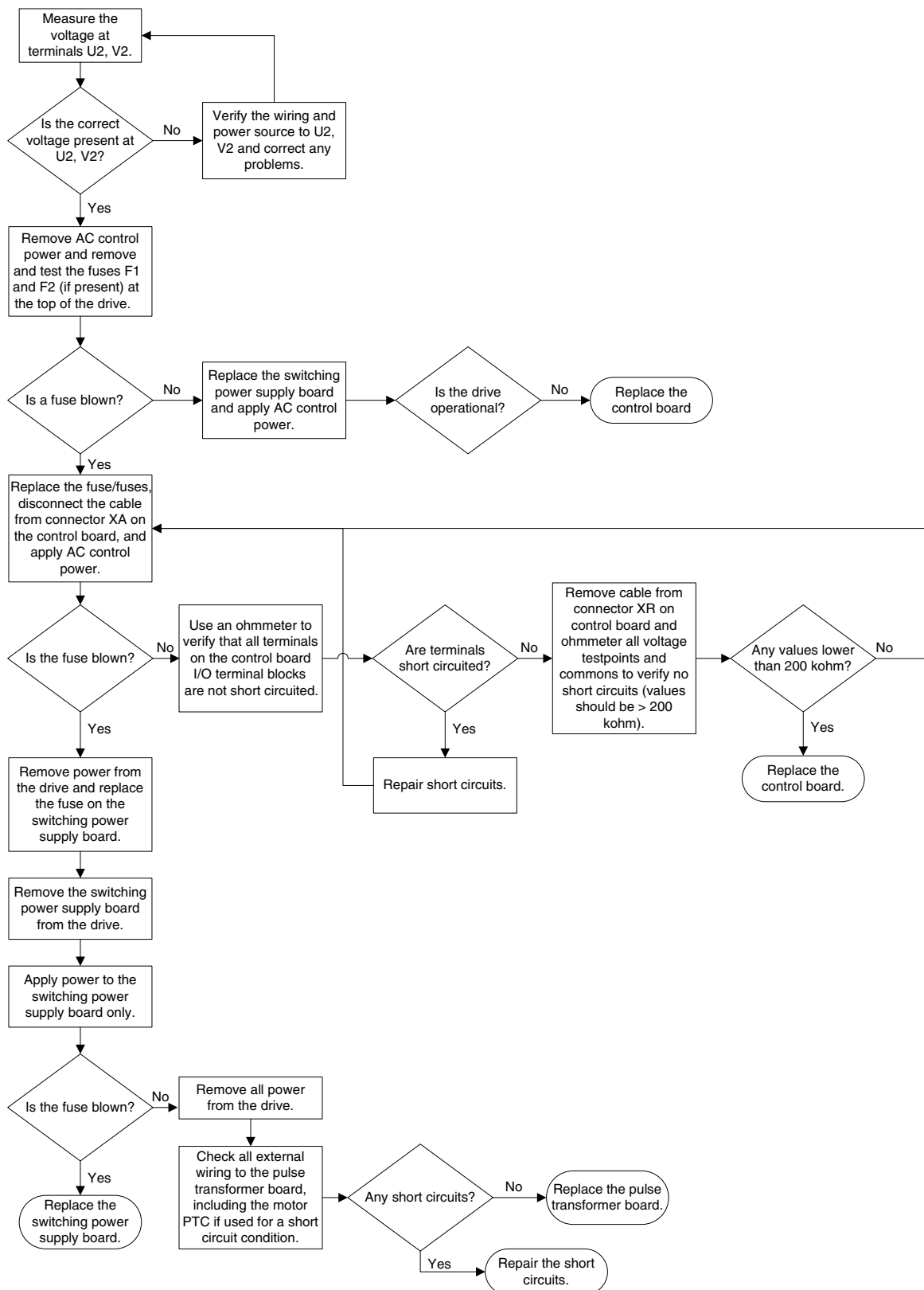
For Frame B devices, see Pulse Transformer Board to Control Board Connections - Frame A on page [134](#) and Switching Power Supply Board to Control Board Connections - Frame A on page [136](#).

Notes:

Troubleshooting Flow Chart

This chart presents the steps for troubleshooting a Power Failure fault (F3). See Troubleshoot a Control Power Supply Failure on page [15](#) for the step-by-step instructions.

Control Power Supply Failure Flow Chart



Numerics

115V AC to 24V DC I/O converter board (frame A)

install 44
remove 43

A

AC current transducer (frame A)

install 62
remove 58

AC current transducer (frame B)

install 112
remove 110

AC line snubber board and resistor (frame B)

install 103
remove 101

B

bimetal thermostat (frame A)

install 66
remove 66

bimetal thermostat (frame B)

install 116
remove 113

C

circuit board

connection 131
layout drawing 131

close

control EMI shield (frame B) 91

communication adapter (frame A)

install 40
remove 38

communication adapter and EMI shield (frame B)

install 84
remove 83

component

inspection 15

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contactor fault 29

control board (frame A)

install 47
remove 44

control board (frame B)

install 90
remove 88

control EMI shield (frame B)

close 91
move 90

control power supply

failure 15

cooling fan (frame A)

install 76
remove 72

cooling fan (frame B)

install 118
remove 117

D

DPI/HIM assembly (frame A)

install 35
remove 35

DPI/HIM assembly (frame B)

install 80
remove 79

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EMI shield and control board (frame A)

install 49
remove 48

F

fault

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create 29

frame size 11

fuse

switching power supply board (frame A) 34

H

heatsink overtemperature

fault 28

I

I/O converter board (frame B)

install 88
remove 87

I/O expansion board (frame A)

install 43
remove 41

I/O expansion board (frame B)

install 86
remove 85

inspection

visual 15

install

- 115V AC to 24V DC I/O converter board (frame A) 44
- AC current transducer (frame A) 62
- AC current transducer (frame B) 112
- AC line snubber board and resistor (frame B) 103
- bimetal thermostat (frame A) 66
- bimetal thermostat (frame B) 116
- communication adapter (frame A) 40
- communication adapter and EMI shield (frame B) 84
- control board (frame A) 47
- control board (frame B) 90
- cooling fan (frame A) 76
- cooling fan (frame B) 118
- DPI/HIM assembly (frame A) 35
- DPI/HIM assembly (frame B) 80
- EMI shield and control board (frame A) 49
- I/O converter board (frame B) 88
- I/O expansion board (frame A) 43
- I/O expansion board (frame B) 86
- power traces board (frame A) 65
- protective cover (frame A) 38
- protective cover (frame B) 82
- pulse transformer board (frame A) 56
- pulse transformer board (frame B) 99
- pulse transformer board fuse (frame B) 93
- SCR module (frame A) 71
- SCR module (frame B) 107
- switching power supply board (frame A) 56
- switching power supply board (frame B) 99
- switching power supply board fuse (frame A) 34
- switching power supply board fuse (frame B) 92

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- circuit board 131

M**motor overheating 28****move**

- control EMI shield (frame B) 90

O**output**

- relay 29

overtemperature

- heatsink 28

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- save 14

power

- removing 33

power failure fault 15**power traces board (frame A)**

- install 65
- remove 63

protective cover (frame A)

- install 38
- remove 36

protective cover (frame B)

- install 82
- remove 80

PTC 28**pulse transformer board**

- test 25

pulse transformer board (frame A)

- install 56
- remove 50

pulse transformer board (frame B)

- install 99
- remove 93

pulse transformer board fuse (frame B)

- install 93
- remove 92

R**relay output 29****remove**

- 115V AC to 24V DC I/O converter board (frame A) 43
- AC current transducer (frame A) 58
- AC current transducer (frame B) 110
- AC line snubber board and resistor (frame B) 101
- bimetal thermostat (frame A) 66
- bimetal thermostat (frame B) 113
- communication adapter (frame A) 38
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- I/O expansion board (frame A) 41
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Use the following resources to access support information.

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Local Technical Support Phone Numbers	Locate the phone number for your country.	http://www.rockwellautomation.com/global/support/get-support-now.page
Direct Dial Codes	Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer.	http://www.rockwellautomation.com/global/support/direct-dial.page
Literature Library	Installation Instructions, Manuals, Brochures, and Technical Data.	http://www.rockwellautomation.com/global/literature-library/overview.page
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	http://www.rockwellautomation.com/global/support/pcdc.page

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