# PowerFlex Digital DC Drive – Frame C

Bulletin Number 20P

Allen-Bradley
by ROCKWELL AUTOMATION

## Hardware Service Manual

Original Instructions

# 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).

## Flow Charts

### Appendix C

This manual contains component test and hardware replacement information for PowerFlex® DC frame C drives, 150...500 Hp (112...373 kW).

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

It is highly recommended that you obtain a copy of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001, which contains fault/alarm and programming information to assist you in troubleshooting drive errors and determining if repairs are necessary. See Additional Resources on page 147 for information on related publications and how to obtain manuals.

## Summary of Changes

This manual contains new and updated information.

| Topic | Page |
|---|---|
| Added a note to the procedure Troubleshoot an Armature Bridge Failure. | 21 |
| Changed values in the table Armature Pulse/Snubber Circuit Measurements for Non-Regenerative Drives. | 32 |
| Changed the procedure Check the Field SCR/Dual Diode Module. | 33 |
| Added the Non-regenerative Drive Power Module Diagram. | 123 |
| Added the Regenerative Drive Power Module Diagram. | 124 |

## Notes:

# Before You Begin Testing, Maintenance, or Repairs

## Introduction

This chapter provides information you should know before you begin tests, maintenance or repairs on drive components.

## General Safety Precautions

Read the following precautions before you begin testing components, performing maintenance or repairing the drive.

**ATTENTION:** Only qualified personnel familiar with DC drives and associated machinery should plan or implement the installation, startup, and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

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

**ATTENTION:** Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment. Hazardous voltages may exist in the drive 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 may result from improper usage of an oscilloscope and other test equipment. The oscilloscope chassis may be at a potentially fatal voltage if not properly grounded. If an oscilloscope is used to measure high voltage waveforms, use only a dual channel oscilloscope in the differential mode with X 100 probes. It is recommended that the oscilloscope be used in the A minus B Quasi-differential mode with the oscilloscope chassis correctly grounded to an earth ground.

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

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

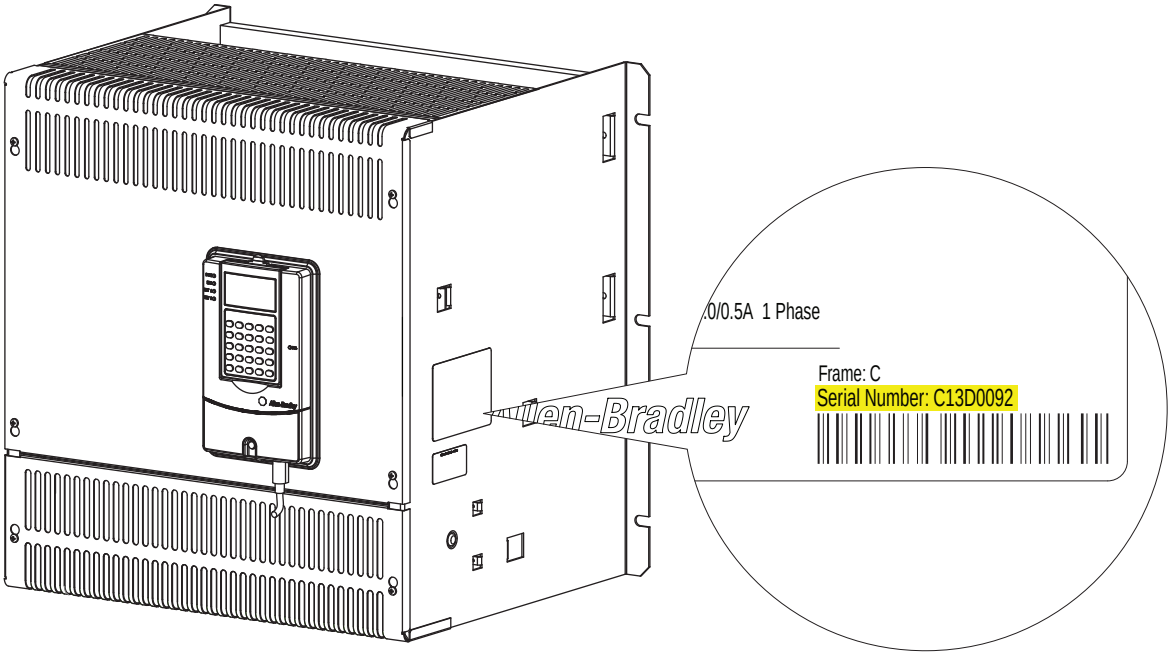
Electrical arcing causes excessive wear to contacts on both the module and its mating connector. Worn contacts may create electrical resistance.

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

## Hardware Description

The PowerFlex DC drive contains a power structure that has an armature and field supply. The armature supply consists of a three–phase, full wave rectified, dual bridge, capable of two or four quadrant output. The field supply consists of single phase, full wave rectified bridge. Also associated with the power structure are incoming line protection devices and contactor and dynamic brake control circuits.

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



# Commonly Used Tools

## Service Tools

This list of basic service tools which will cover needs of tools for repair and maintenance 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 | 3x drive rated armature current output |
| Soldering 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 | |
| Crimping tools | For cable terminals 1.5...240 |
| Angle wrench | |
| Screw drivers: | |
| Flat nose | 7x2 mm |
| Hexalobular | T15, T20, T25 |
| Phillips® | #1, 2, 3 |
| Hexagonal wrench | #4, 5, 6 |
| ESD-protected place of work | Working surface, floor covering, seat and ground connections |
| ESD-protective clothing | Wrist wrap, shoes, overall clothing (coat) |

Phillips® is a registered trademark of Phillips Screw Company.

## Software Tools

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

# Component Test Procedures

## Introduction

This chapter provides general procedures for inspecting and testing the major components of the drive 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** Using the diagnostic tests in this chapter should only be performed by qualified personnel and only when other corrective actions have failed. All tests assume that the control board connections have been properly made.

For common drive symptoms and corrective actions and fault troubleshooting information, see Chapter 4 "Troubleshooting" in the PowerFlex Digital DC Drive User Manual, publication 20P-UM001.

## Save the Parameter Configuration

It is recommended that you save the drive and communication adapter parameter configuration to a HIM Set or by up loading the drive and adapter parameters to an offline node file using DriveExecutive™ before performing any service or testing on the drive. HIM sets are files stored in permanent nonvolatile HIM memory.

### Save to a HIM Set

Complete these steps to save the drive and adapter parameters to a HIM set.

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

The HIM Set will be saved to nonvolatile memory.

### Download Parameters to an Offline Node File

You can save all drive and adapter parameters in the drive to an offline database file on your computer using DriveExecutive. An offline node file (*.dno) contains all information about the node, including the necessary databases.

1. From the **Drive** menu, select **Upload from Drive** or click the upload button  on the toolbar.
2. Click **Yes** to confirm the operation, which cannot be undone.
3. If you are not connected to a drive, the Connect to Drive dialog displays. Select the drive to which you want to connect and click **OK**.
4. A dialog displays the status of the upload operation. Click **Cancel** to cancel the operation.

## Visual Component Inspection

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

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the protective covers and lower the control EMI shield when necessary. See Remove the Protective Covers from the Drive on page 43 and Move the Control EMI Shield on page 58.
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

If a drive Power Failure fault (F3) has occurred and the drive is inoperable via the HIM or other means of control, compete the steps below to determine where the control power failure has occurred.

1. Read the General Safety Precautions on page 10.
2. Remove the protective covers from the drive. See Remove the Protective Covers from the Drive on page 43.
3. Measure the signal voltage at the testpoints on the control board as indicated in the following table.

| 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-10 | +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 |
| 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 |
| 0VEXP | 0VEXP | Figure 2 on page 19 | XP3-7 / XP3-8 / XP3-9 | DPI expansion ground |

Note: For a flow chart version of the steps that follow, see Control Power Supply Failure on page 140.

4. If any of the signals in the table above is incorrect or missing, verify that either 115 VAC or 230 VAC voltage is present at terminals U2 and V2 (control circuit power input).
   - If the voltage is present and correct, continue with step 5 below.
   - 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 drive is still inoperable, continue with step 5 below.
5. Remove AC control power from terminals U2 and V2 and remove and test the fuses (F1 and F2) on the switching power supply board. See Switching Power Supply Circuit Board Fuse Removal and Installation on page 60 for fuse location.
   - If the fuse is blown, continue with step 6 below.
   - If the fuse is not blown, replace the switching power supply board.
6. Replace the fuse on the switching power supply board. See Switching Power Supply Circuit Board Fuse Removal and Installation on page 60.
7. Disconnect the cable at connector XA on the control board. See Figure 29 on page 136 for location of connector XA.
8. Apply AC control power to the drive.
   - If the fuse blows, continue with Testing the Switching Power Supply and Pulse Transformer Boards below.
   - If the fuse does not blow, continue with Testing the Control and Field Board Connections on page 17.

## Testing the Switching Power Supply and Pulse Transformer Boards

1. Remove power from the drive.
2. Replace the fuses on the switching power supply board. See Switching Power Supply Circuit Board Fuse Removal and Installation on page 60.
3. Remove the switching power supply board from the drive. See Switching Power Supply Circuit Board Removal and Installation on page 61.
4. Reapply power to the switching power supply board only.
   - If the power supply fuses do not blow, continue with step 5 below.
   - If the power supply fuses blow, replace the switching power supply board.
5. Remove all incoming AC voltage from the drive.
6. Check all external wiring 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.
7. If no short circuit conditions exist, replace the pulse transformer board.

## Testing the Control and Field Board Connections

1. Using an ohmmeter, check all input and output wiring on terminals 1...40 on terminal blocks TB1 and TB2 on the control board for a possible short circuit condition. Repair any short circuit conditions if found.
2. If an encoder and/or tachometer is used, use an ohmmeter to check all wiring on the respective terminals for a possible short circuit condition. Repair any short circuit conditions if found.
3. Remove the cables from connector XR and XFCD on the control board and use an ohmmeter to check between all voltage test points and common on the control board for possible short circuit conditions. The ohmmeter measurements should be greater than 200 kΩ . If any low resistance measurements are found, replace the control board.
4. Using an ohmmeter, measure between pins 1 and 2 and pins 3 and 2 on the XFCD cable connector. The resistance measurement for both tests should be greater than 200 kΩ . If a lower resistance value is measured, replace field board.

**Figure 1 - Control Board Testpoints - Upper Left**

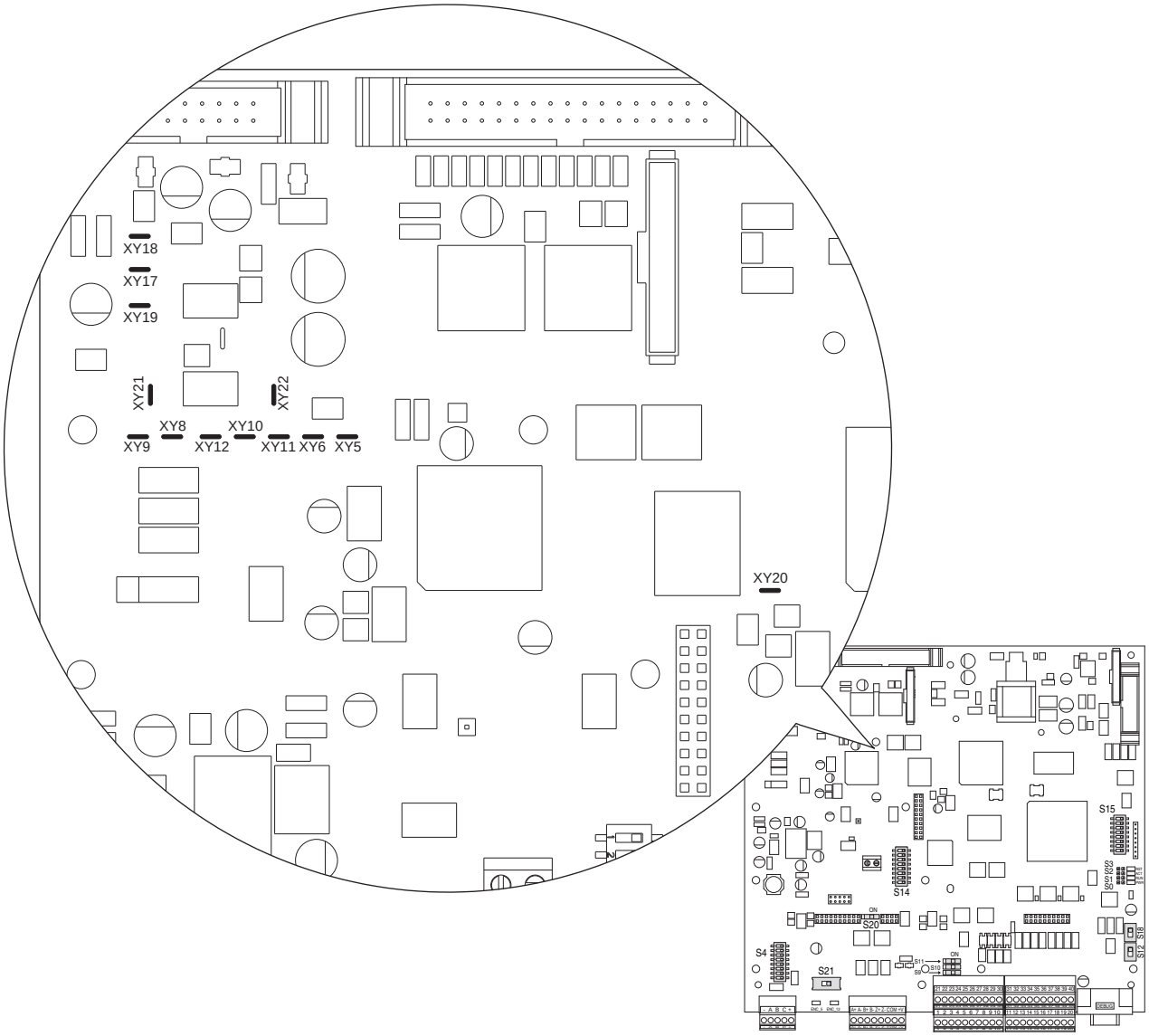
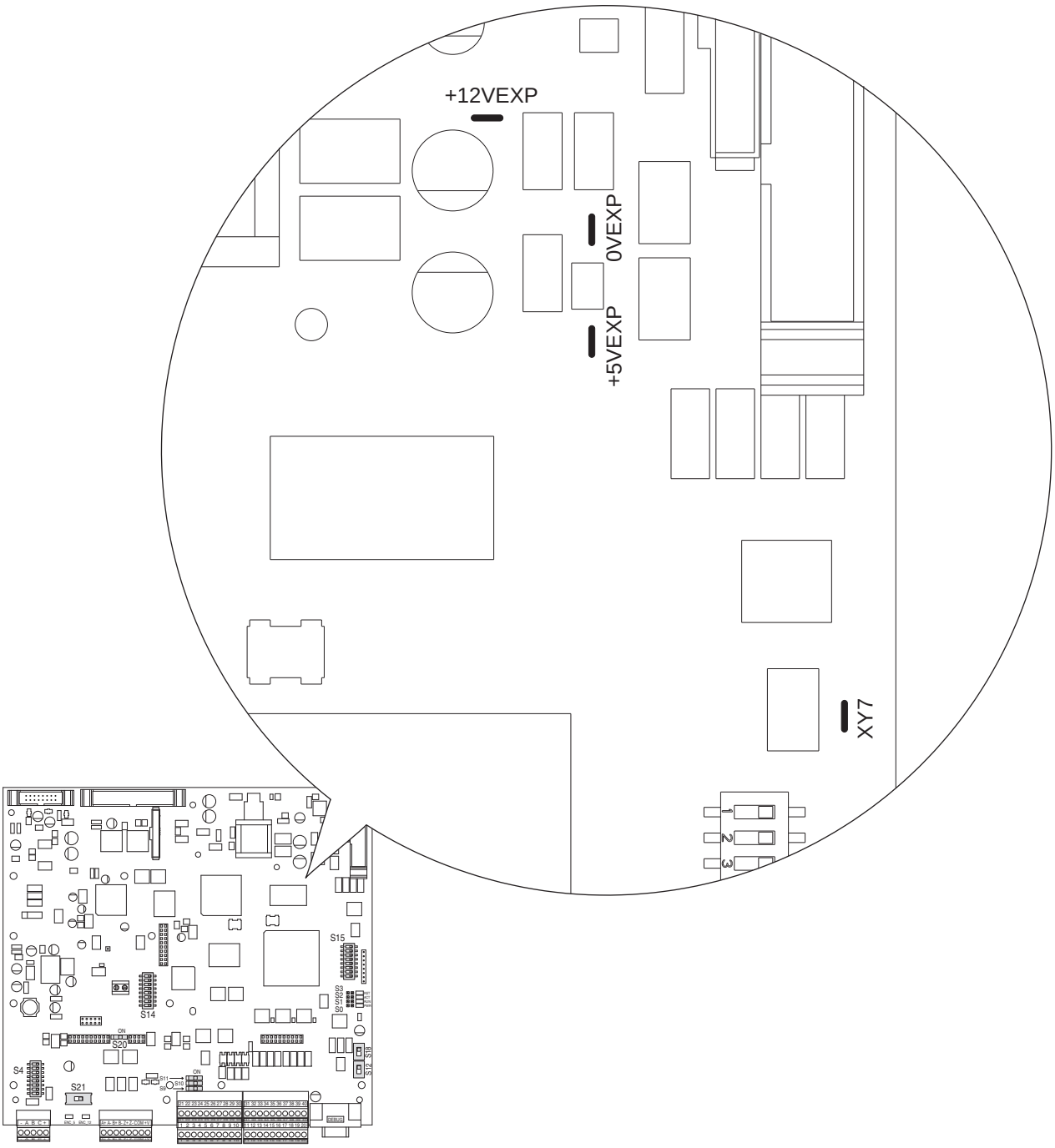


**Figure 2 - Control Board Testpoints - Upper Right**



## Troubleshoot an AC Undervoltage Fault

If the drive faults with an AC Undervoltage Fault (F4), or parameter 466 [AC Line Voltage] does not equal the expected incoming AC line voltage, measure the AC line input signals as directed in the steps below.

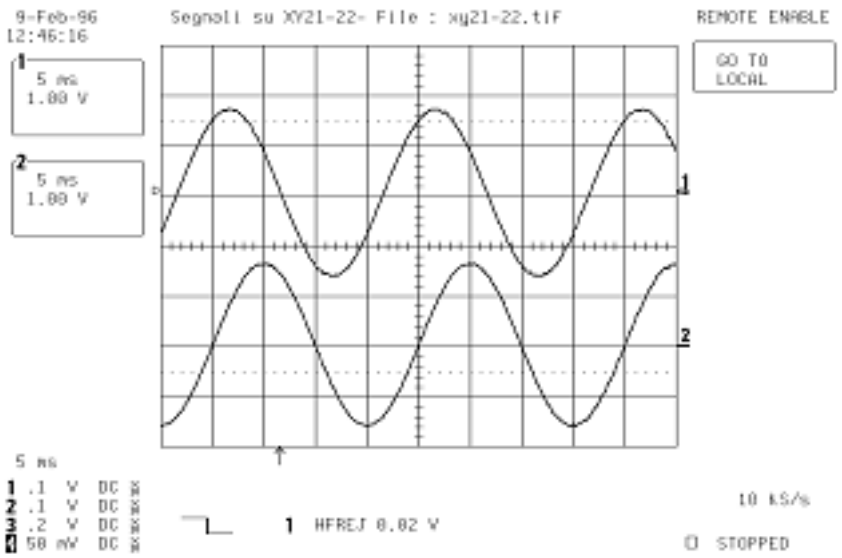
1. Read the General Safety Precautions on page 10.
2. Remove the protective covers from the drive. See Protective Cover Removal and Installation on page 43.
3. Using a voltmeter, measure the voltage at terminals U, V, and W of the drive.

   Note: If an AC input contactor is used, the voltage must be measured on both the input and output sides of the contactor.

   If any of the voltage measurements is incorrect or missing, remove incoming AC power and verify the wiring to the drive and the power supply source and correct any problems.
4. 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. Also, see Figure 16 on page 125 for a schematic diagram.

**Table 1 - Combined AC Line Input Signal Testpoints**

| Incoming AC Line Voltage | Phases | Measure From Testpoint | ... | To Testpoint | Peak to Peak Measurement | RMS Measurement |
|---|---|---|---|---|---|---|
| 240 VAC | V and U | XY22 | ... | XY18 | 1.42 VAC | 0.500 V |
| | V and W | XY21 | ... | XY18 | | |
| 480 VAC | V and U | XY22 | ... | XY18 | 2.95 VAC | 1.040 V |
| | V and W | XY21 | ... | XY18 | | |
| 575 VAC | V and U | XY22 | ... | XY18 | 2.85 VAC | 1.007 V |
| | V and W | XY21 | ... | XY18 | | |
| 690 VAC | V and U | XY22 | ... | XY18 | 3.45 VAC | 1.220 V |
| | V and W | XY21 | ... | XY18 | | |




- If any of the voltage measurements above are incorrect or missing, continue with step 5 below.

- If the voltage measurements above are correct but the value of parameter 466 [AC Line Voltage] is incorrect, replace the control board.

5. Remove the ribbon cable connected to XR on the control board and pulse transformer board and test the continuity of the cable using the measurements in Table 25 on page 134.

   If the measurements on the XR cable are correct, replace the pulse transformer board.

## Troubleshoot an Armature Bridge Failure

If the drive is running unstable or faults with an Overcurrent Fault (F13) an armature bridge failure may have occurred. All of the signals going to and coming from the SCR bridges are transmitted via the ribbon cable connected to XR on the control board and can be measured at these points. See Figure 29 on page 136 for location of the XR connector on the control board.

**IMPORTANT** These checks cannot be completed with an AC contactor in use.

1. Read the General Safety Precautions on page 10.
2. Remove the protective covers from the drive. See Protective Cover Removal and Installation on page 43.
3. If using a DC output contactor, disconnect the cable from XR on the control board and measure the signal for each SCR gate as indicated in the table below:

| Signal Name | XR Cable Pin | Gate | | Note |
|---|---|---|---|---|
| | | MP | MN | |
| IT1 | 27 | G1 | G04 | |
| IT2 | 29 | G2 | G05 | |
| IT3 | 31 | G3 | G06 | |
| IT4 | 21 | G4 | G01 | |
| IT5 | 23 | G5 | G02 | |
| IT6 | 25 | G6 | G03 | |
| MN | 33 | – | – | Negative bridge MN - active when high (+5V) |
| MP | 34 | – | – | Positive bridge MP - active when high (+5V) |

Figure 3, Figure 4, and Figure 5 below are examples representing gate pulse, current and voltage signal measurements taken on an SCR. In the figures below:

- The current signal is taken on the testpoint XY17 (+2.5V offset; +0.6V=Drive size current).
- The voltage signal is taken on the testpoint XY19 (+2.5V offset).
- The ground signal is taken on either testpoint XY10 or XY18.

**Figure 3 - Good SCR Gate Pulse and Armature Current Signals Example**

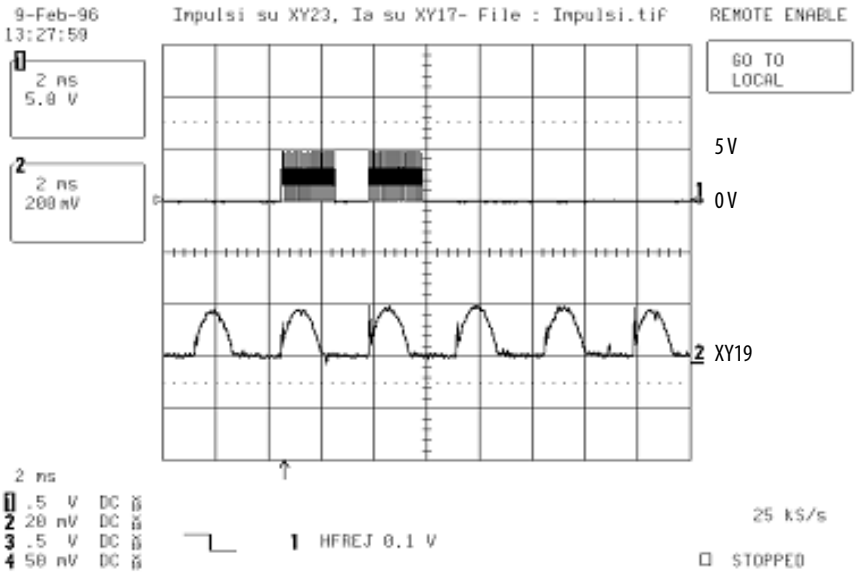
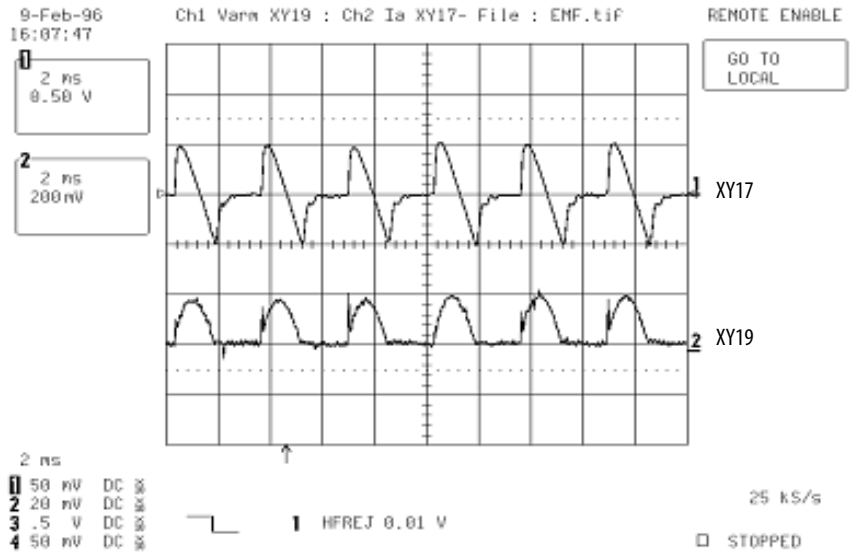
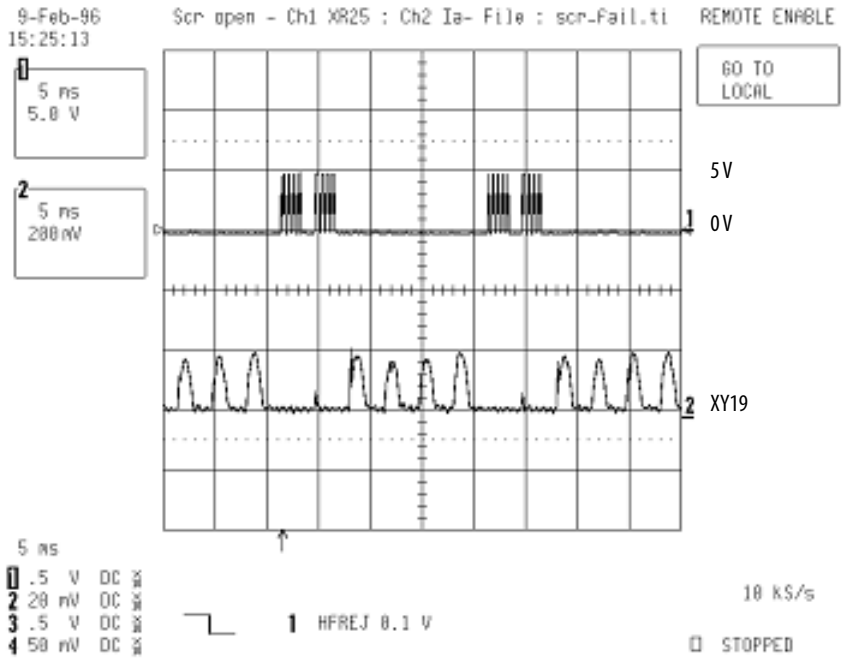



**Figure 4 - Good SCR Armature Voltage and Motor Current Signal Example**



A malfunctioning thyristor is connected to the relative gate. For example, if the tested signal is at XR25 and the positive bridge is active (MP high) from the following figure you can deduce that SCR connected to gate G6 is open.

**Figure 5 - Open Thyristor Example**




## Troubleshoot a Field Current Loss Fault

If the drive faults with a "Field Current Loss" fault (F6) and there is low or incorrect field current present at the motor, as seen in parameter 351 [Field Current], complete the steps in Low or Incorrect Field Current below. If the drive faults with a "Field Current Loss" fault (F6) and there is no field current present at the motor, as seen in parameter 351 [Field Current], complete the steps in No Field Current on page 25.

### Low or Incorrect Field Current

Note: For a flow chart version of these steps, see Low or Incorrect Field Current on page 142.

1. Read the General Safety Precautions on page 10.
2. Verify the actual value of parameter 351 [Field Current] by measuring the DC motor field current using a DC clamp.
3. Verify that the drive rated field bridge current is set correctly in parameter 374 [Drv Fld Brdg Cur] and DIP switch S14 is configured to correctly (according to the instructions in the PowerFlex Digital DC Drive User Manual, publication 20P-UM001) and make any necessary corrections. See Control Board on page 136 for DIP switch location.

4. Verify that the value of parameter 280 [Nom Mtr Fld Amps] matches the rated field current value on motor nameplate and make any necessary corrections.
5. Remove the protective covers from the drive. See Protective Cover Removal and Installation on page 43.
6. Measure the field current signal on the green LA-LB terminal located on the control board: LA is the ground and LB is field current signal. The measured value of the field current at LA-LB should be equal to the value of parameter 374 [Drv Fld Brdg Cur]. If these values are equivalent, the voltage across these terminals should be 1.66 VDC.

   Note: For lower field current values, the voltage will be proportional. For example, if the field is set up for 2 A and the motor is rated for 1.5 A, the measurement at LA-LB will be 1.245 VDC (1.5 / x = 2 / 1.66).

   - If the voltage measurement is incorrect, continue with step 7 below.
   - If the voltage measurement is correct, but the "Field Current Loss" fault still exists, replace the control board.
7. Using an ohmmeter, measure the resistance across terminals LA-LB to verify that the value equals the equivalent resistance as indicated in the table below (set with DIP switch S14 on the control board).

| **Switch ohms:** | | **168.5** | **333.3** | **182** | **36.4** | **845** | **1668** | **3333** | **–** | **Equivalent Resistance** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Field Current Scale** | **Field Supply** | **S14-1** | **S14-2** | **S14-3** | **S14-4** | **S14-5** | **S14-6** | **S14-7** | **S14-8** | **Ohms** |
| 1 A | 10 A | OFF | OFF | OFF | OFF | OFF | ON | Not used (OFF) | | 1668 |
| 2 A | | OFF | OFF | OFF | OFF | ON | OFF | | | 845 |
| 3 A | | OFF | OFF | OFF | OFF | ON | ON | | | 560.9 |
| 5 A | | OFF | ON | OFF | OFF | OFF | OFF | | | 333.3 |
| 10 A | | ON | OFF | OFF | OFF | OFF | OFF | | | 168.5 |
| 13 A | 14 A | ON | OFF | OFF | OFF | ON | ON | | | 129.6 |
| 17 A | 20 A | OFF | ON | ON | OFF | ON | ON | | | 97.3 |
| 20 A | | ON | OFF | ON | OFF | OFF | ON | | | 83.1 |

   - If the resistance measurement is incorrect, replace the field board.

## No Field Current

Note: For a flow chart version of these steps, see No Field Current on page 141.

1. Read the General Safety Precautions on page 10.
2. Remove the protective covers from the drive. See Protective Cover Removal and Installation on page 43.
3. Verify that the correct AC voltage is present at terminals U1 and V1 at the top of the field fuse holder mounted on the control panel. See Figure 18 on page 126 for a schematic diagram.
   - If the voltage is correct, continue with step 4 below.
   - If the voltage is incorrect or missing, remove power from the drive and verify the wiring to the drive and the power supply source and correct any problems. Test the voltage level again to verify that it is correct. If the voltage is correct, but the fault persists or parameter 351 [Field Current] is incorrect, continue with step 4 below.
4. Remove AC power to the drive and check the fuses at FU1 and FV1. See Remove Power from the Drive on page 42.
   - If the fuses are blown, complete the steps in Test Field Wiring and Voltage Signals on page 25.
   - If the fuses are not blown, complete the steps in Test Field Control Signals on page 25.

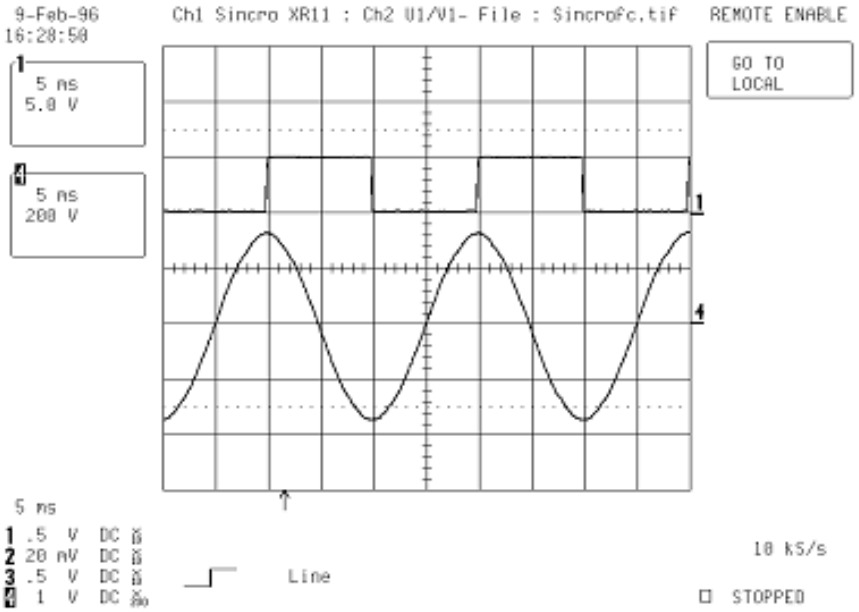
### *Test Field Wiring and Voltage Signals*

1. Test the resistance of the motor field wiring and motor field for possible short circuits.
   - If there are no short circuits, continue with step 2 below.
   - If a short circuit exists, correct any problems.
2. Check the field SCR/dual diode module for a short circuit condition. See Check the Field SCR/Dual Diode Module on page 33.
   - If there are no short circuits, continue with step 3 below.
   - If a short circuit exists, replace the field SCR/dual diode module.
3. Replace the field fuses at FU1 and FV1 and apply power to the drive.
4. If the field fuses blow, replace the field board.

### *Test Field Control Signals*

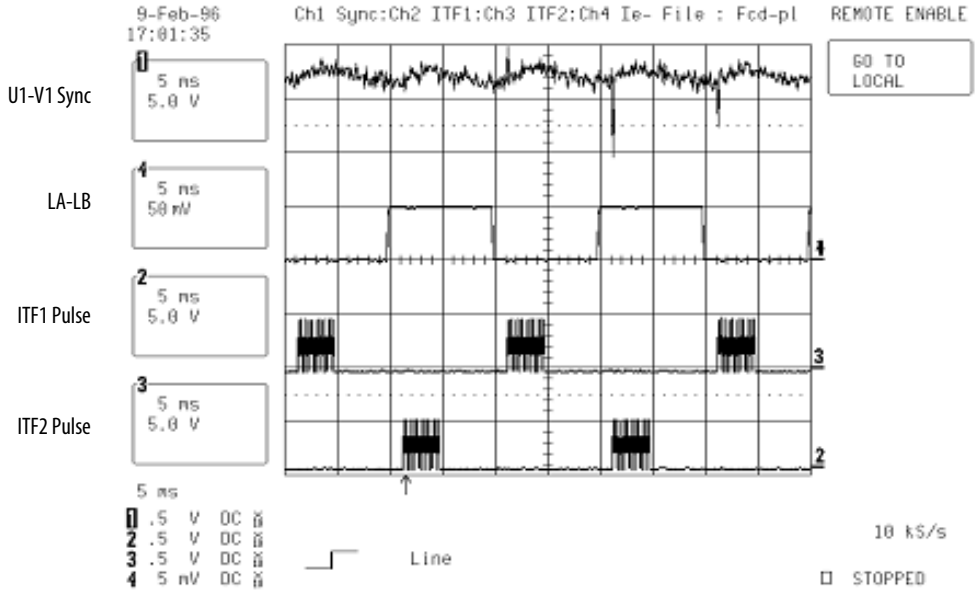
1. Disconnect the cable from connector XR on the control board and measure the U1-V1 voltage synchronization signal at pin 11 on the cable. See Figure 29 on page 136 for location of the XR connector on the control board.

This signal is a square wave signal with a 90° lag phase displacement compared to the AC voltage signal.




2. Measure the gate signals at pins XR-1 and XR-2 on the cable. The figure below displays the following signals from top to bottom:

| Channel | Signal |
|---|---|
| 1 | U1-V1 Sync |
| 4 | Ie - LEM current feedback signal taken on LA-LB terminal |
| 2 | ITF1 pulse |
| 3 | ITF2 pulse |




- If the gate signals are missing, replace the control board.
- If the gate signals are present, replace the field board.

# Power Component Test Procedures

## Check the Armature SCR Modules

The PowerFlex DC drive armature supply consists of three (non-regenerative drives) or six (regenerative drives) SCR modules mounted on heat sinks within the legs assemblies. A malfunction of any of these devices will be indicated by either an Overcurrent fault (F13), blown or tripped incoming protection devices, or erratic motor operation. The following procedure can be used if an armature bridge component malfunction is suspected.

1. Read the General Safety Precautions on page 10.
2. Remove and lock-out all incoming power for the drive. See Remove Power from the Drive on page 42.
3. Verify that contactor power (if used) is removed.
4. Verify that power to an external field supply (if used) is removed.
5. 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 regenerative drives, see Table 2 on page 28 and Figure 6 on page 28.
   - For non-regenerative drives, see Table 3 on page 29 and Figure 7 on page 29.

   If a low resistance is detected, determine which SCR module(s) is/are damaged based on the tables below and replace that module(s). See SCR Modules Removal and Installation on page 93.

**Table 2 - SCR Anode to Cathode Junction Measurements for Regenerative Drives**

| 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 6 - Regenerative Drive SCR Module Layout**

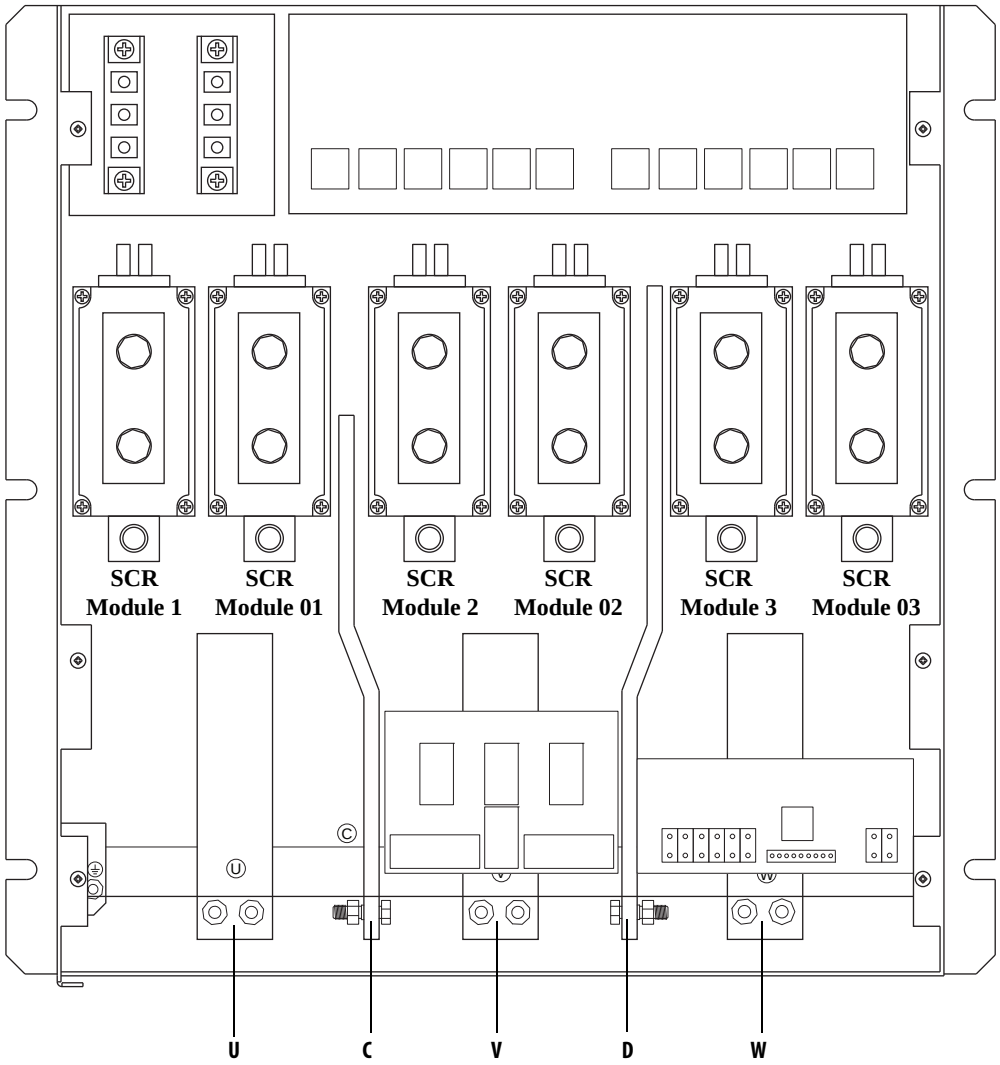
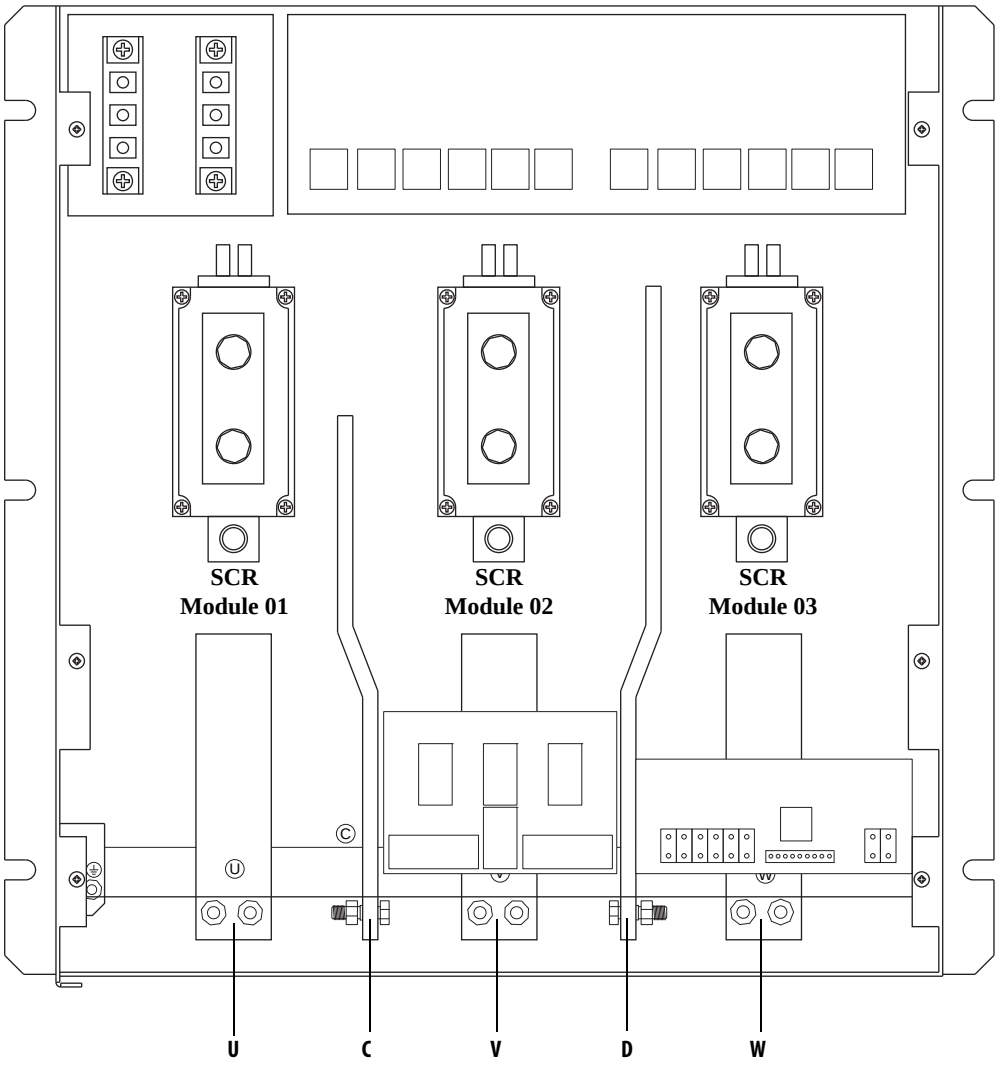


**Table 3 - SCR Anode to Cathode Junction Measurements for Non-Regenerative Drives**

| On SCR Module… | SCR… | Measure from Terminal… | To Terminal… | Nominal meter reading: |
|---|---|---|---|---|
| 01 | 01 | U | C | "open circuit" or "megaohms" range |
| | 04 | U | D | |
| 02 | 02 | V | C | |
| | 05 | V | D | |
| 03 | 03 | W | C | |
| | 06 | W | D | |

**Figure 7 - Non-Regenerative Drive 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 regenerative drives, see Table 4 and Figure 8 below.
   - For non-regenerative drives, see Table 5 on page 31 and Figure 9 on page 31.

   If a measurement is outside of the range specified in the table, or if one reading deviates significantly from the majority, then module replacement may be necessary. See SCR Modules Removal and Installation on page 93v.

**Table 4 - SCR Gate to Cathode Junction measurements for Regenerative Drives**

| 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 8 - SCR Gate Lead Connection Pinouts for Regenerative Drives**

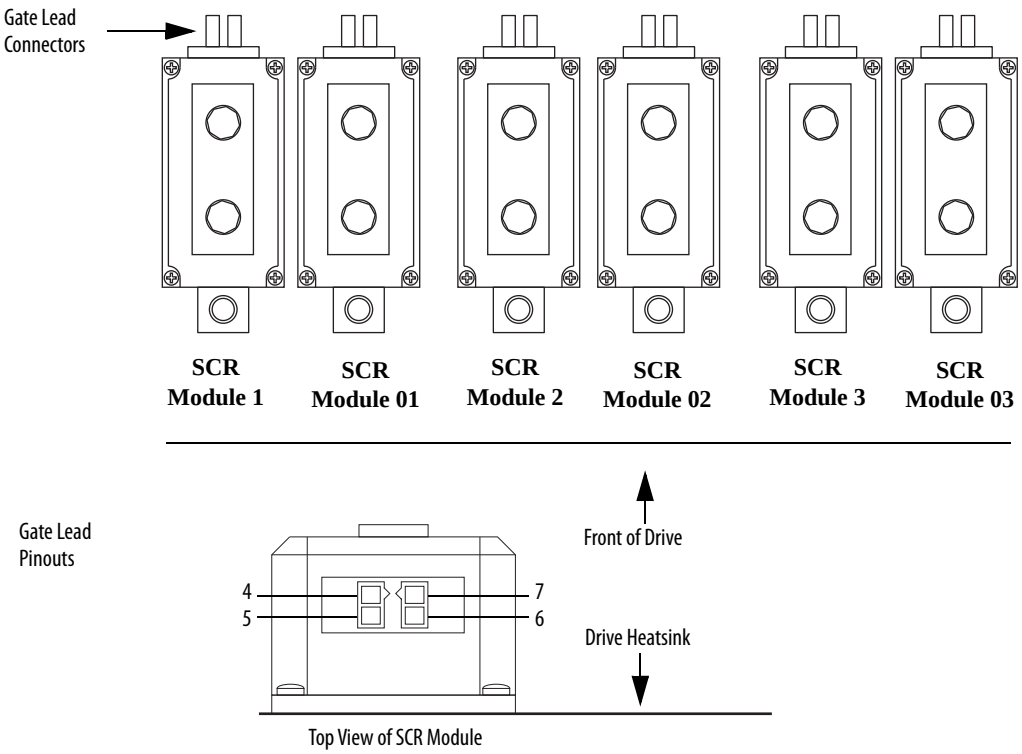
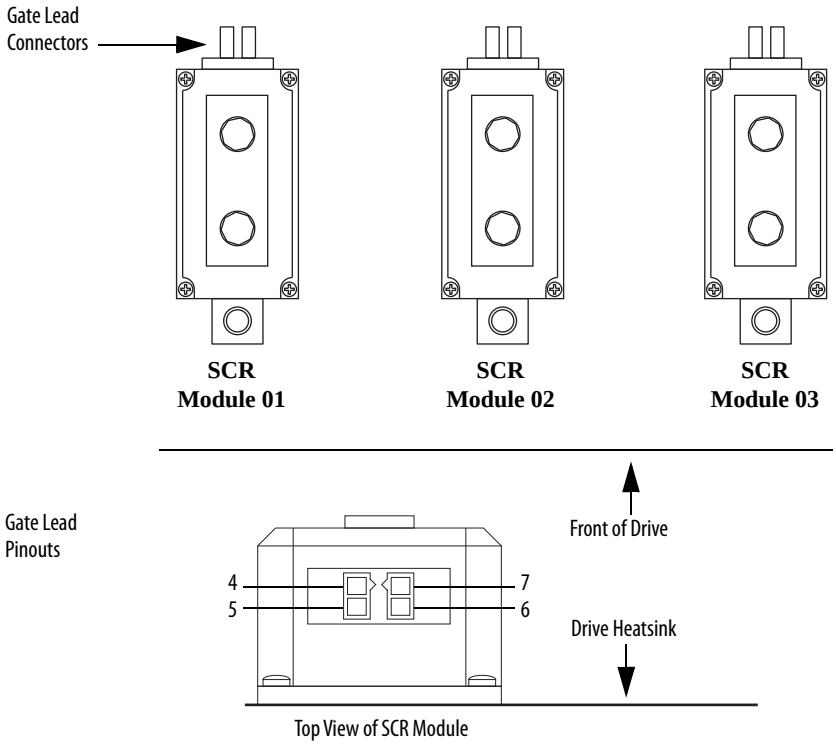


**Table 5 - SCR Gate to Cathode Junction Measurements for Non-Regenerative Drives**

| On SCR Module… | SCR… | Measure from … | To… | Nominal meter reading: |
|---|---|---|---|---|
| 01 | 01 | Pin 6 | Pin 7 | 5…20 Ω (1) |
| | 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 9 - SCR Gate Lead Connection Pinouts for Non-Regenerative Drives**



## Check the Pulse Transformer Board

The armature pulse transformer circuit board contains an isolated gate firing circuit and also provides dv/dt protection for the armature SCR modules. A malfunction of these devices will be indicated by either an Overcurrent fault (F13), blown or tripped incoming protection devices or 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 drive. See Remove Power from the Drive on page 42.
3. Remove the pulse transformer board (see Pulse Transformer Circuit Board Removal and Installation on page 62).
4. With a digital multimeter set for a "continuity check", measure each connection point on the pulse transformer board listed in the tables below. See Figure 27 on page 132 for connector locations.

   If any of the actual measurements are out of tolerance, replace the pulse transformer board.

**Table 6 - Armature Pulse/Snubber Circuit Measurements for Regenerative Drives**

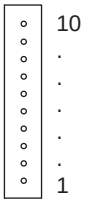
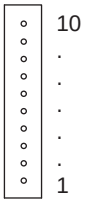
| For SCR | Measure From . . . | To . . . | Meter reading: | Connector XY Pinout |
|---|---|---|---|---|
| 1 | KG1 | XY-4 | "open circuit" |   |
| 4 | KG4 | XY-1 | | |
| 2 | KG2 | XY-5 | | |
| 5 | KG5 | XY-2 | | |
| 3 | KG3 | XY-6 | | |
| 6 | KG6 | XY-3 | | |
| 01 | KG01 | XY-1 | | |
| 04 | KG04 | XY-4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

**Table 7 - Armature Pulse/Snubber Circuit Measurements for Non-Regenerative Drives**

| For SCR | Measure From . . . | To . . . | Meter reading: | Connector XY Pinout |
|---|---|---|---|---|
| 1 | KG1 | XY-1 | "open circuit" |   |
| 4 | KG4 | XY-4 | | |
| 2 | KG2 | XY-2 | | |
| 5 | KG5 | XY-5 | | |
| 3 | KG3 | XY-3 | | |
| 6 | KG6 | XY-6 | | |

5. With the digital multimeter set to “diode test”, measure each connection point on the pulse transformer board listed in the tables below. If any of the actual measurements are out of tolerance, replace the pulse transformer board.

**Table 8 - Armature Pulse Transformer Primary Measurements for Regenerative and Non-Regenerative Drives**

| 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 | | |

**Table 9 - Armature Pulse Transformer Primary Measurements for Regenerative Drives**

| For SCR | (+) Meter Lead | (-) Meter Lead | Meter reading: | Connector XY Pinout |
|---|---|---|---|---|
| 1 | XY-7 | XY-1 | 0.41 Ω |   |
| 4 | XY-7 | XY-4 | | |
| 2 | XY-7 | XY-2 | | |
| 5 | XY-7 | XY-5 | | |
| 3 | XY-7 | XY-3 | | |
| 6 | XY-7 | XY-6 | | |

## Check the Field SCR/Dual Diode Module

The field supply consists of a dual pack SCR/dual diode module arranged in a single–phase full wave rectifier configuration. Malfunction of either of these components may cause various responses including field and velocity related faults, or blown fuses. The following procedures can be used if field bridge malfunctions are suspected.

1. Read the General Safety Precautions on page 10.
2. Remove and lock-out all incoming power to the drive. See Remove Power from the Drive on page 42.
3. Remove the protective covers. See Protective Cover Removal and Installation on page 43.
4. Verify that contactor power (if used) is removed.
5. Verify that power to an external field supply (if used) is removed.
6. Disconnect the field wires from C1 and D1. See Figure 10 on page 34.

7. Check the anode to cathode junction of the field SCR/dual diode module. With the digital multimeter set to "diode test", measure the resistance across the modules. See Table 10 and Figure 10 below.

   If a low resistance is detected, replace the modules. See Field SCR and Dual Diode Module Removal and Installation on page 72.

   If a measurement results in an "infinity" reading, check the fuses at FU1 and FV1 on the control panel to determine if they are open. See Figure 11 on page 35.

**Table 10 - Field SCR/Dual Diode Module Anode to Cathode Junction Measurements**

| (+) Meter Lead Terminal | (-) Meter Lead Terminal | Nominal meter reading: |
|---|---|---|
| U1 | C1 | 0.45V |
| U1 | D1 | open or infinity |
| V1 | C1 | open or infinity |
| V1 | D1 | open or infinity |
| C1 | D1 | open or infinity |
| C1 | U1 | open or infinity |
| C1 | V1 | open or infinity |
| D1 | C1 | 0.9V |
| D1 | U1 | 0.45V |
| D1 | V1 | open or infinity |

**Figure 10 - Field Terminal Block Location**

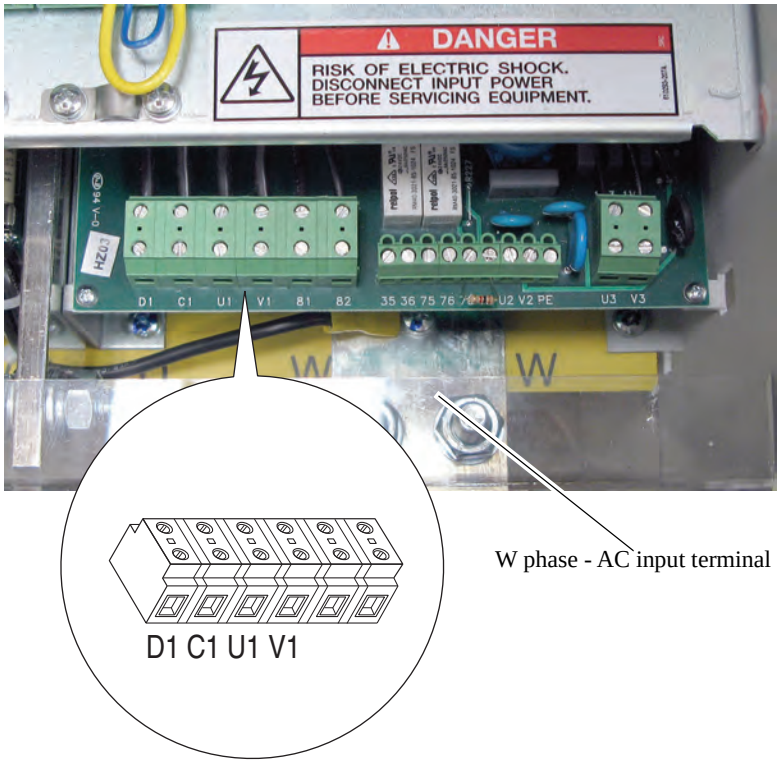
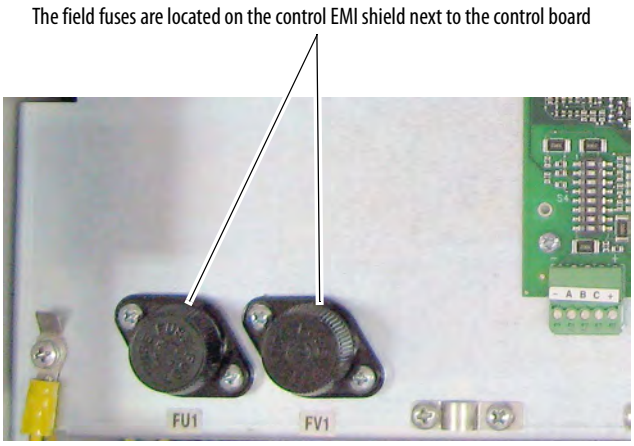


**Figure 11 - Field Fuses Location**




8. Remove the cable from connector XP on the pulse transformer circuit board. See Figure 27 on page 132 for connector location.
9. Check the gate cathode junction of the field SCR/dual diode module. With the digital multimeter set to “diode test” measure the resistance across the modules (lead orientation is not critical). See Table 11 below.

   If a low resistance is detected, replace the SCR/dual diode module. See Field SCR and Dual Diode Module Removal and Installation on page 72.

**Table 11 - SCR/Dual Diode Module Gate Cathode Junction Measurements**

| Measure from… | To… | Nominal meter reading: |
|---|---|---|
| XP1 | XP2 | 10…20 Ω |
| XP3 | XP4 | |

# Speed Feedback Device Tests

## Check the Encoder

The encoder feedback device provides a dual channel quadrature output waveform and requires that the output be differential line drivers at +5 or +12...15V signal levels. The encoder power supply voltage and input selection is controlled by DIP switch S21 on the control board (see "DIP Switch and Jumper Settings" in the PowerFlex Digital DC Drive User Manual, publication 20P-UM001). The encoder power supply from the drive can be measured from +V (+) to COM (-) with a digital multimeter. If S21 is set to ENC_5, the voltage level should be +2.5...5.4V. If S21 is set to ENC_12, the voltage level should be +5.4V...15.2V. For reference, see Figure 21 on page 128 for a schematic diagram.

The Channel A and Channel B are square wave type outputs that are 90 degrees out of phase. When rotating in the counter clockwise direction, as viewed from the commutator end, Channel A leads Channel B. Each differential channel has an inverted and non–inverted signal.

Power for the encoder is provided internally and is capable of 200mA of current with a current foldback feature that protects the power supply should the current draw exceed 200mA. If different power supply requirements exist for the chosen feedback device, the supply must be provided external to the drive.

The frequency is proportional to speed and the pulse rate of the encoder, referred to as the "Pulse/Rev" rating on the nameplate. The speed of the motor can be calculated by: Speed (RPM) = [Frequency (Hz) x 60]/[Pulses/Revolution].

## Check the DC Tachometer

- Verify that DIP switch S4 on the control board is set to the correct input voltage of the DC analog tachometer. See "DIP Switch and Jumper Settings" in the PowerFlex Digital DC Drive User Manual, publication 20P-UM001. Also, see Figure 22 on page 128 for a circuit diagram.
- The analog tach signal is fine scaled using parameter 562 [Anlg Tach Gain].
- See "Drive Reference and Feedback Scaling" in Appendix C of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001, for more information.

## Check the Resolver Interface Board

The resolver feedback option module uses the resolver feedback board for resolver connections, and the resolver interface board for external power, status, feedback board reset, and encoder output connections.

If a "Resolver Error" (F93) fault occurs and the resolver wiring and configuration are correct, the following LED indicators and testpoints on the resolver interface board can be used to verify that the board is not damaged.

- Verify that the following LEDs are functioning as expected. See Figure 12 on page 38 for LED locations and switch settings.

| LED Code | LED Color | On State | Off State |
|---|---|---|---|
| D3 | Red | 24V overload (fuse F1 blown). This fuse is self-resetting when it returns to normal operating temperature. | 24V supply is OK. |
| D10 | Green | 12V supply is OK. | Loss of 12V power. |
| D11 | Green | Resolver feedback board voltage is OK. | Voltage error on resolver feedback board. |
| D12 | Blue | Switch S1 is set to +24V for encoder signal output on TB2. | S1 is not set for +24V. |
| D16 | Yellow | Switch S1 is set to +12V for encoder signal output on TB2. | S1 is not set for +12V. |
| D18 | Green | Switch S1 is set to +5V for encoder signal output on TB2. | S1 is not set for +5V. |
| D26 | Red | Resolver feedback board is in reset mode. | Resolver feedback board not in reset mode. |

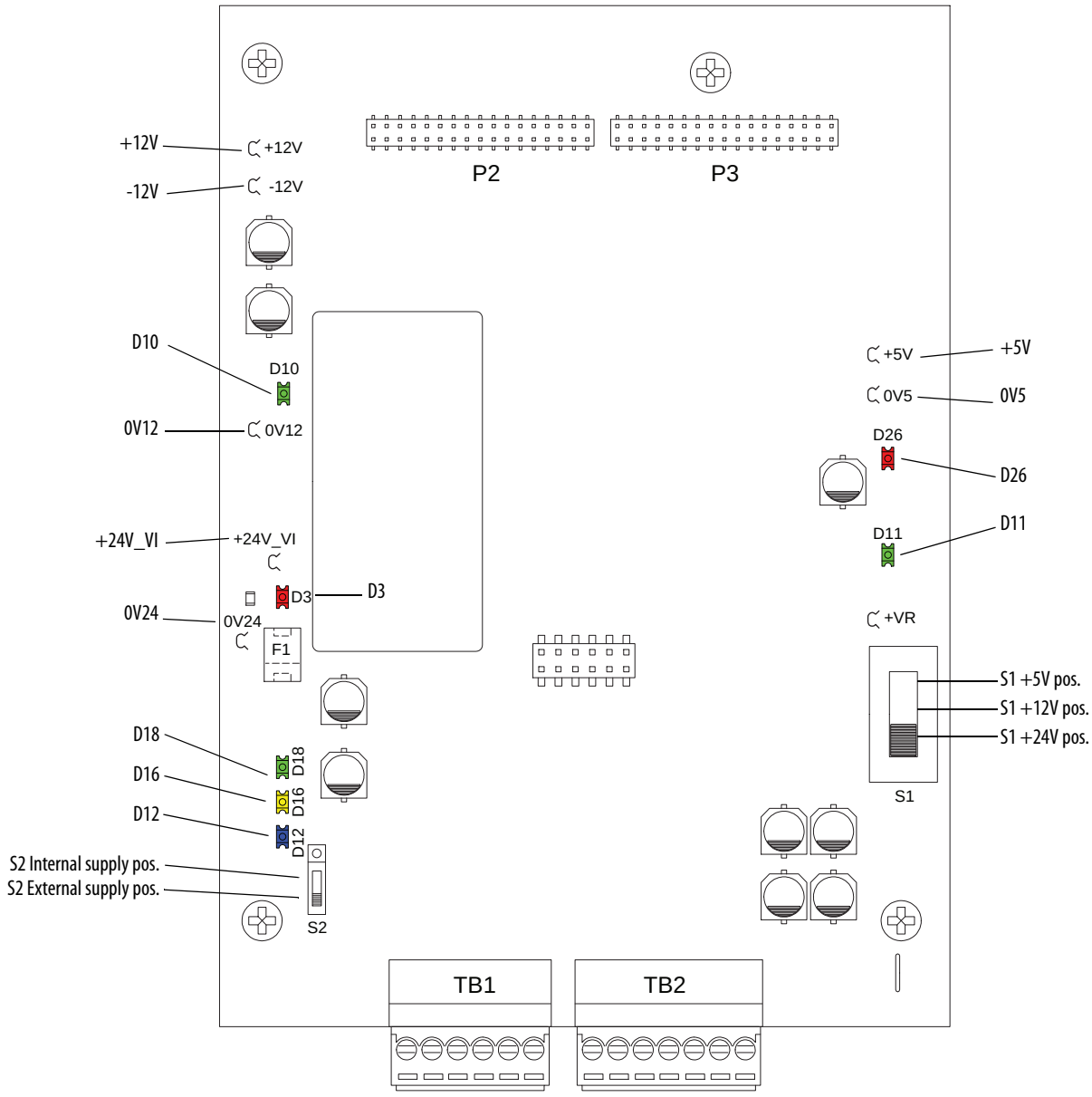
If any of the LEDs that should turn on when control power is applied fail to do so, verify that the resolver interface and resolver feedback boards are properly seated on the appropriate connectors (XRE, P2, P3). If problems persist, replace the resolver interface and/or resolver feedback board.

- Measure the signal voltage at the testpoints as indicated in the following table. See Figure 12 on page 38 for testpoint locations.

| Testpoint | to | Testpoint | Measurement |
|---|---|---|---|
| +12V | … | 0V12 | 12V DC ±5% |
| -12V | … | 0V12 | -12V DC ±5% |
| +24V_VI | … | 0V24 | 24V DC ±5% |
| +5V | … | 0V5 | 5V DC ±5% |

If any of the voltage measurements fails, replace the resolver interface board.

**Figure 12 - Resolver Interface Board Testpoint Locations**



## Thermistors and Thermal Switches

Motor overheating is detected by an external, user-supplied themistor (PTC) or thermal switch connected to terminals 78 and 79 on the control power terminal block on the lower, right corner of the pulse transformer circuit board. See Figure 27 on page 132 for terminal block location.

Motor overheating is typically identified by a "Motor Over Temp" fault (F16). See "Fault Descriptions" in Chapter 4 of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001 for details. See Figure 23 on page 129 for a circuit diagram.

- If a thermal switch is used, a 1 kΩ resistor must be placed in series between the switch and either terminal 78 or 79.
- If neither a thermistor (PTC) or a thermal switch is installed, a 1 kΩ resistor must be connected between terminals 78 and 79.

The drive heatsink temperature is monitored by a bimetal thermostat connected directly to the heatsink. When the heatsink temperature is too high, a "Heatsink OvrTemp" fault (F8) occurs. See "Fault Descriptions" in Chapter 4 of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001 for details. See Figure 24 on page 129 for a circuit diagram.

During normal operation, 1.6V DC is present between terminal 78 and drive common. When an open circuit exists between terminals 78 and 79, 24V DC will be present at terminal 78 to drive common. If the 24V is missing, the pulse transformer board may need 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 "Using Contactors" in Chapter 1 of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001, for more information.

The "Main Contactor" fault (F10) indicates a problems related to a contactor used with the drive. See "Fault Descriptions" in Chapter 4 of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001 for details.

## Create a Fault Report

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

At a minimum, perform and record the following:

- Record the contents of the fault queue (faults and times of occurrence). See the PowerFlex Digital DC Drive User Manual, publication 20P-UM001, for detailed Fault and Alarm codes and descriptions.
- 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 drive and drive components
- Make a record of any mechanical damage to the drive and drive components
- Record the size and type of main fuses
- Record any other important marks and damage

## 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 drives series number (if applicable)
- Product serial number
- Firmware revision level
- Most recent fault code
- Your application

You can use the table below to record the data provided in each PowerFlex DC drive parameter listed.

| Param(s) | Name | Description | Parameter Data |
|---|---|---|---|
| 1349 | Status1 at Fault | Captures and displays Par 381 [Drive Status 1] bit pattern at the time of the last fault. | |
| 1350 | Status2 at Fault | Captures and displays Par 382 [Drive Status 2] bit pattern at the time of the last fault. | |
| 1351-1360 | Fault x Code | A code that represents the fault that tripped the drive. The codes will appear in these parameters in the order they occur (i.e., [Fault 1 Code] = the most recent fault). | |
| 1361-1370 | Fault x Time | The time between initial drive power up and the occurrence of the associated trip fault. | |
| 1371 | Fault Arm Amps | Captures and displays the armature current (as a percentage of rated current) at the time of the last fault. | |
| 1372 | Fault Speed | Captures and displays the output speed (rpm) of the drive at the time of the last fault. | |
| 1373 | Fault Field Amps | Captures and displays the field current (as a percentage of rated current) at the time of the last fault. | |
| 1374 | Fault Voltage | Captures and displays the armature voltage at the time of the last fault. | |

# Access Procedures

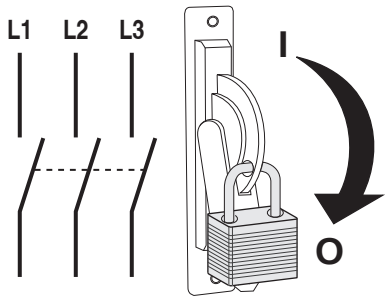
## Remove Power from the Drive

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

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

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

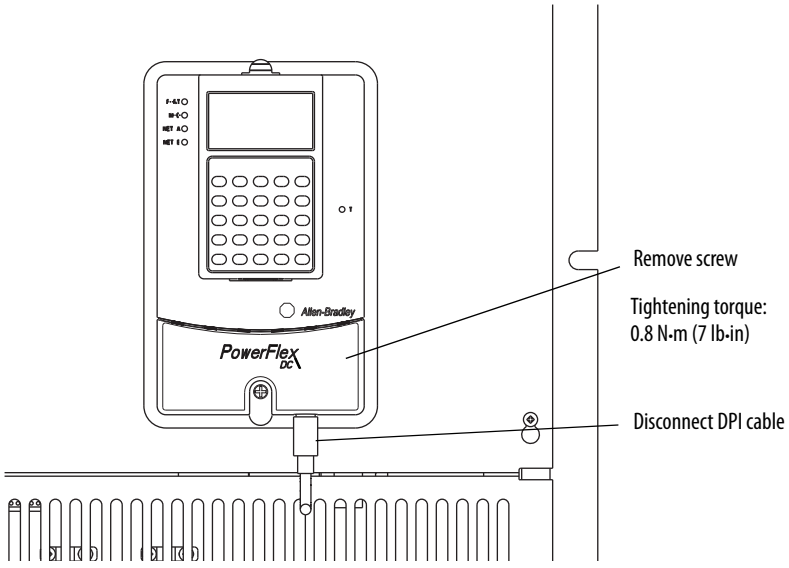
1. Remove and lock-out all incoming power to the drive.




## DPI / HIM Assembly Removal and Installation

### Remove the DPI/HIM Assembly

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Disconnect the DPI cable from the HIM assembly.
4. Remove the screw that secures the DPI / HIM assembly to the drive.
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.



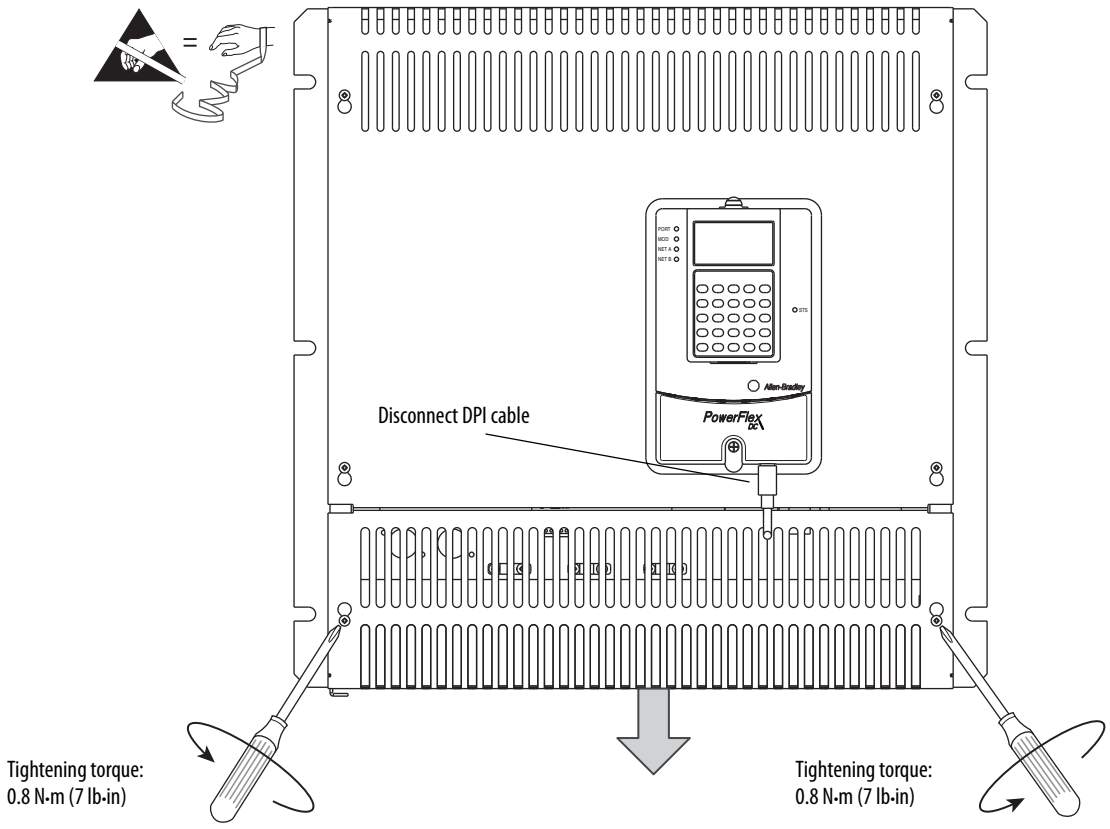
### Install the DPI / HIM Assembly

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

## Protective Cover Removal and Installation

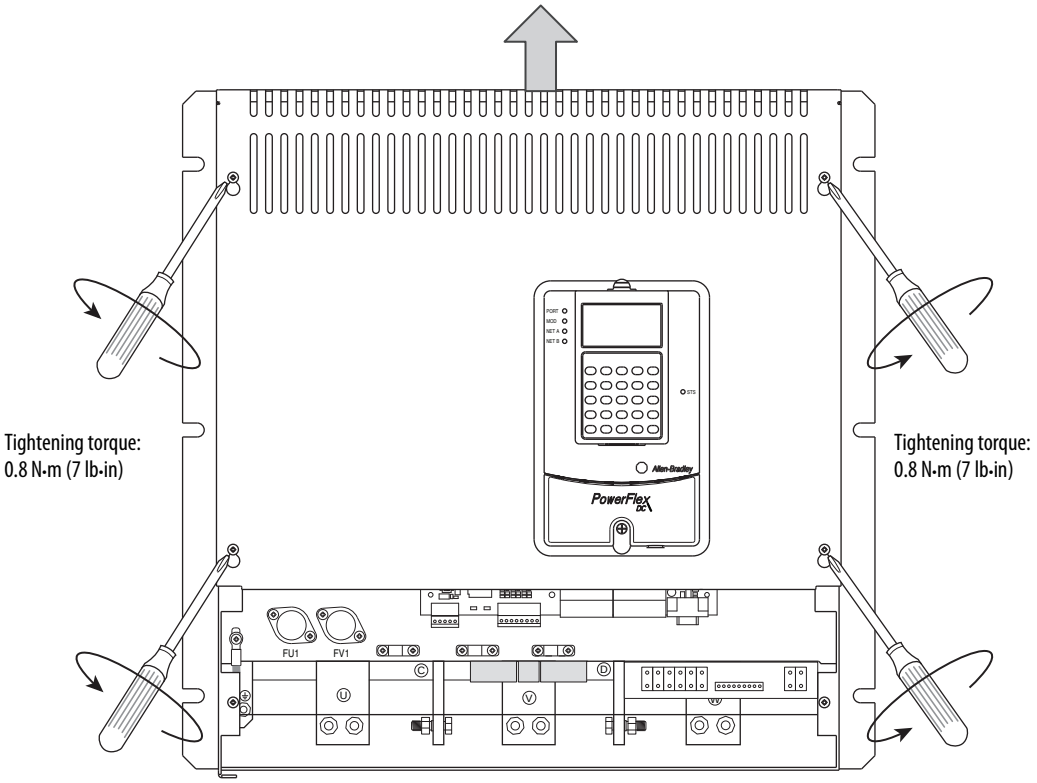
### Remove the Protective Covers from the Drive

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Disconnect the DPI cable from the HIM assembly.
4. Loosen, but do not remove, the screws that secure the bottom cover to the drive, then slide the cover down and off the drive chassis.

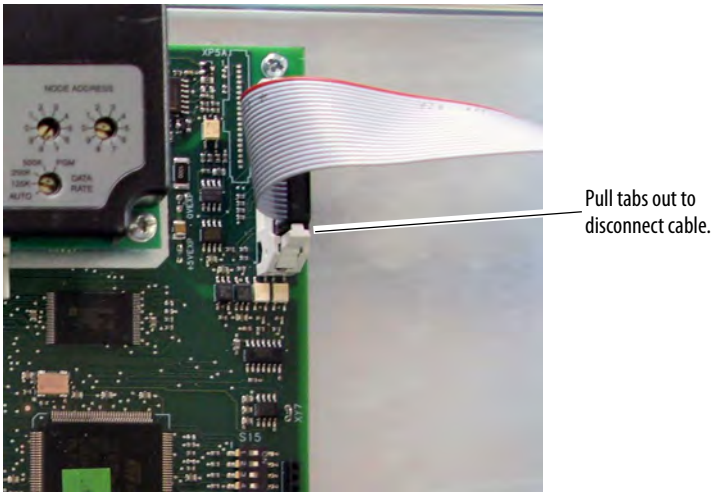


5. Loosen, but do not remove, the screws that secure the top cover to the drive, then slide the cover up and off the drive chassis.

| **IMPORTANT** | The HIM assembly is connected via a cable to the control board and therefore will not pull free from the drive until disconnected. See step 5 below for instructions. |
|---|---|




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



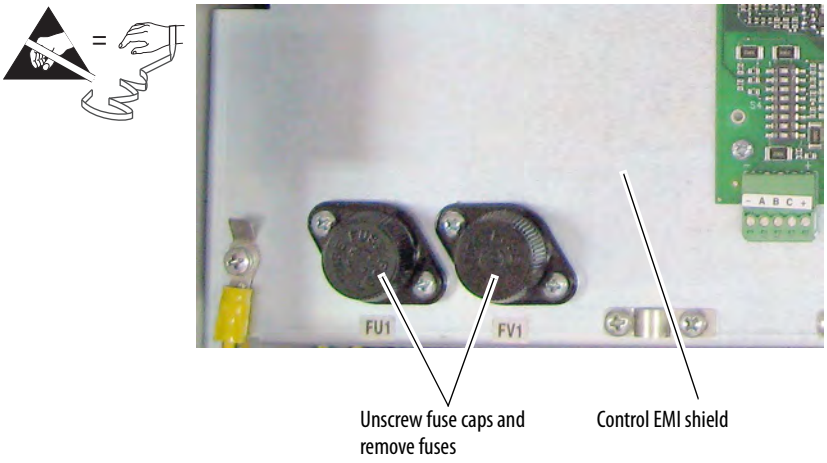
### Install the Protective Covers on the Drive

Install the protective covers in the reverse order of removal.

## Field Circuit Fuses Removal and Installation

### Remove the Field Circuit Fuses

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the lower protective cover only from the drive. See Protective Cover Removal and Installation on page 43.
4. On the control EMI shield, unscrew the fuse holders and remove the existing fuses from the holders.



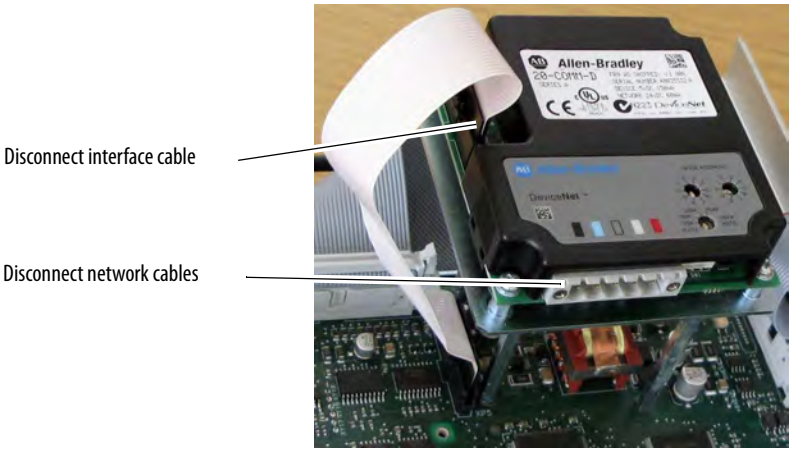

### Install the Field Circuit Fuses

Install the field circuit fuses in the reverse order of removal.

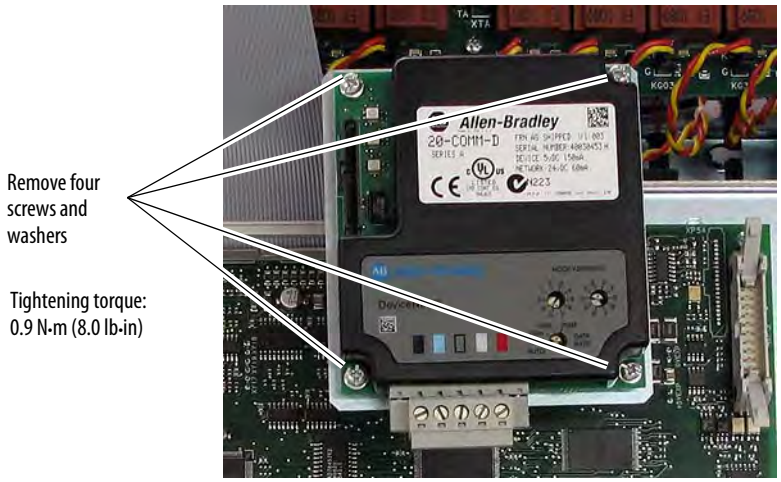
# Communication Adapter and EMI Shield Removal and Installation

## Remove the Communication Adapter and EMI Shield

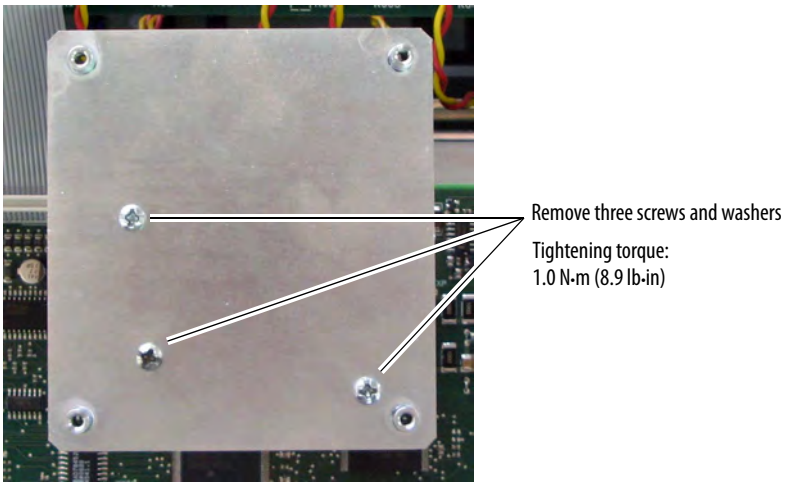
1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the Protective Covers from the drive. See Protective Cover Removal and Installation on page 43.
4. Disconnect the interface cable from the communication adapter and set it aside.
5. Disconnect any network cables from the adapter and set them aside.



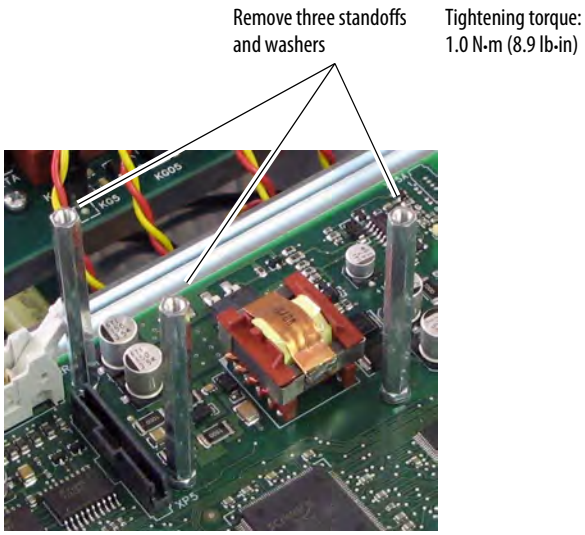

6. Remove the four screws and washers that secure the communication adapter to the EMI shield and remove the adapter.



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




8. Remove the three standoffs and washers from the control board.




## Install the Communication Adapter and EMI Shield

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

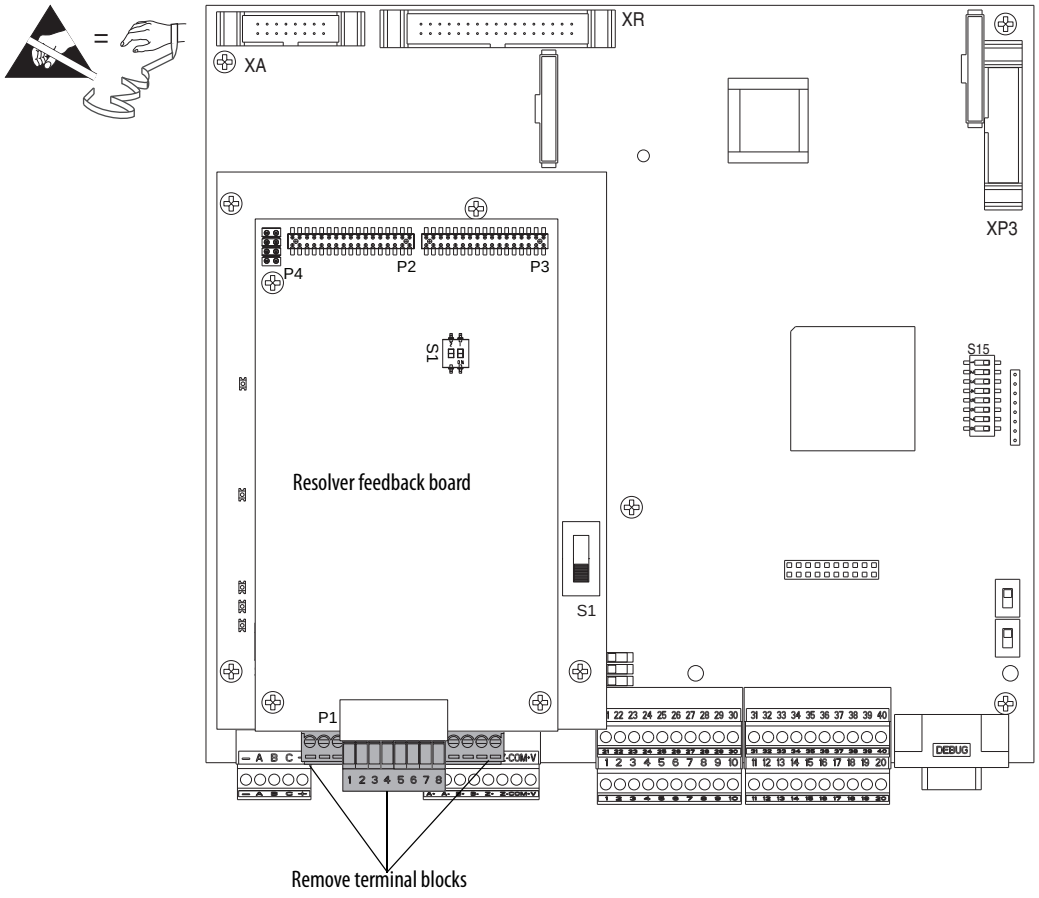
# Resolver Feedback and Interface Circuit Board Removal and Installation

## Remove the Resolver Feedback and Interface Circuit Boards

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the protective covers from the drive. See Remove the Protective Covers from the Drive on page 43.

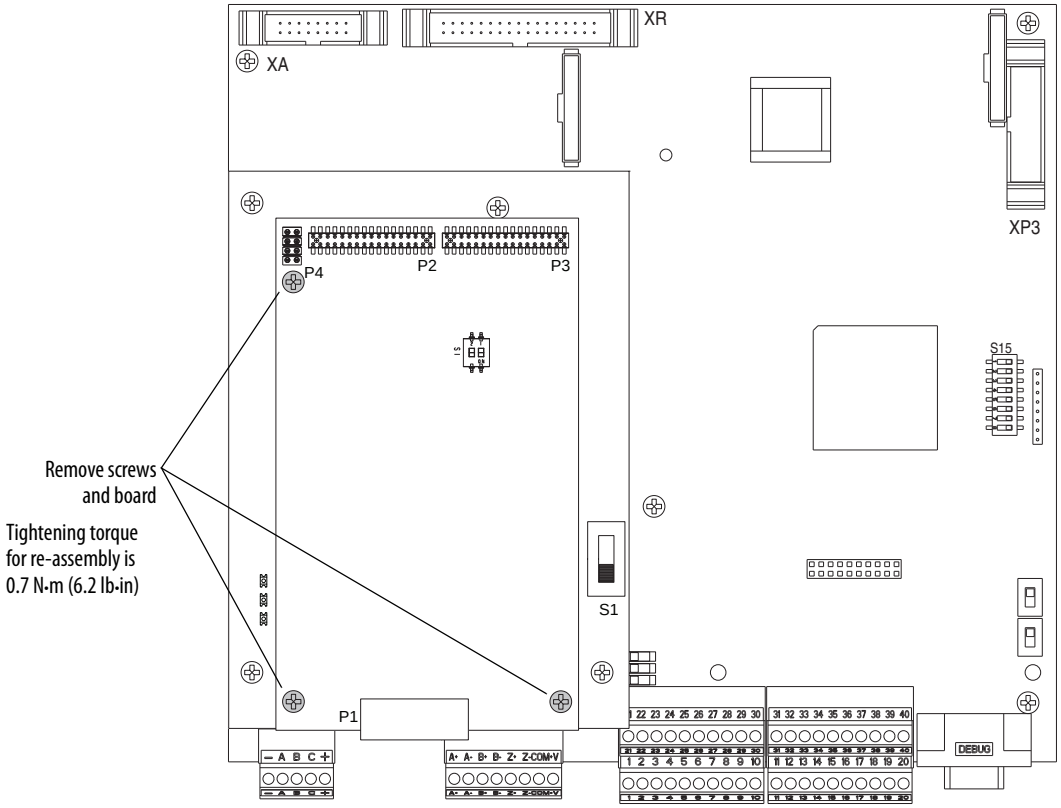
**IMPORTANT** Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

4. Disconnect the plug-in terminal blocks from the resolver feedback and resolver interface boards.

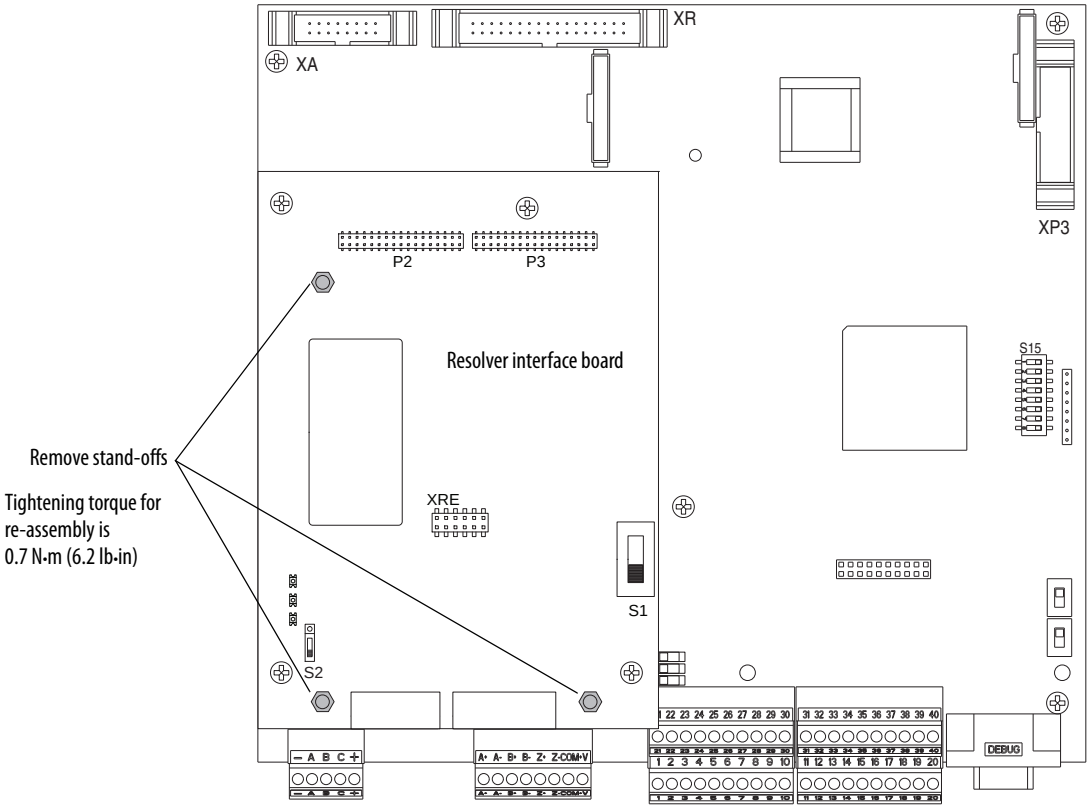


5. Remove the three hexalobular screws that secure the resolver feedback board to the stand-offs on the resolver interface board and carefully remove the resolver feedback board.

**IMPORTANT** The resolver feedback board is connected to the resolver interface board below it via stacker connector pins at connectors P2 and P3. Lift the resolver feedback board straight up during removal to avoid any damage to the connector pins.

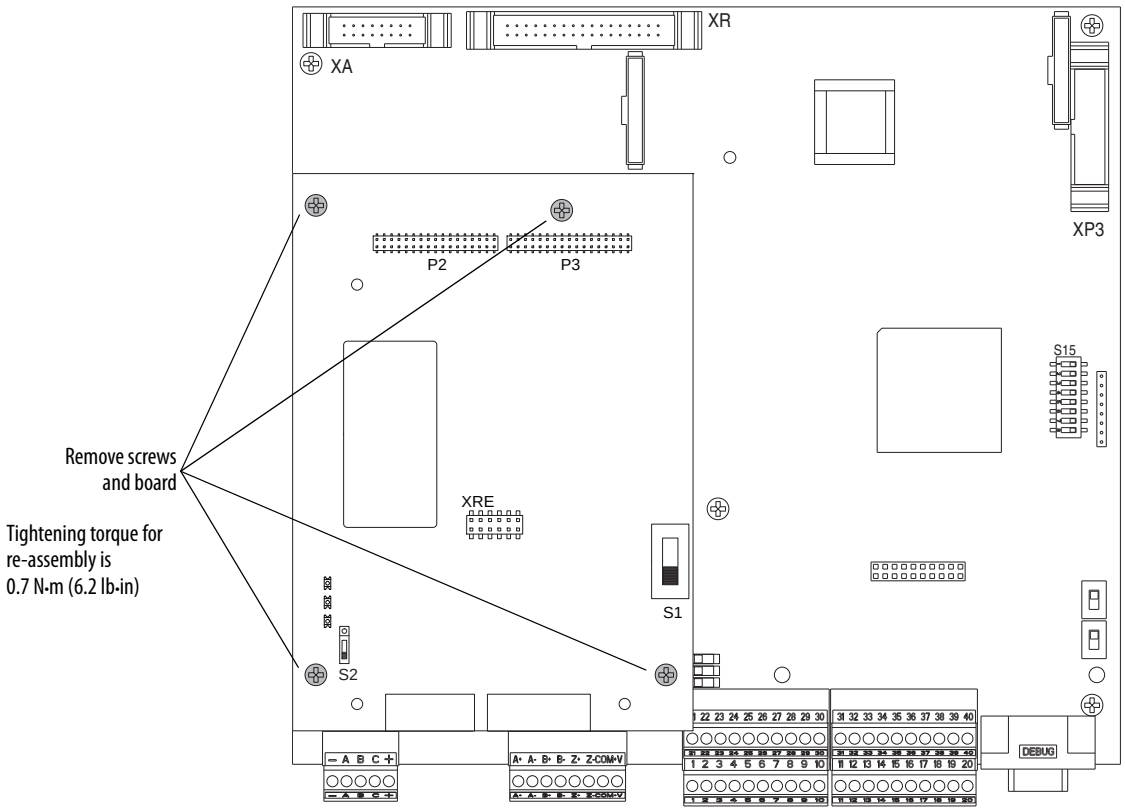


**6.** Remove the three stand-offs from the resolver interface board.



7. Remove the four hexalobular screws that secure the resolver interface board to the control board and remove the resolver interface board.

**IMPORTANT** The resolver interface board is connected to the control board below it via a stacker connector pin at connector XRE. Lift the resolver interface board straight up during removal to avoid any damage to the connector pin.




## Install the Resolver Feedback and Interface Circuit Boards

Install the resolver feedback and interface boards in reverse order of removal.

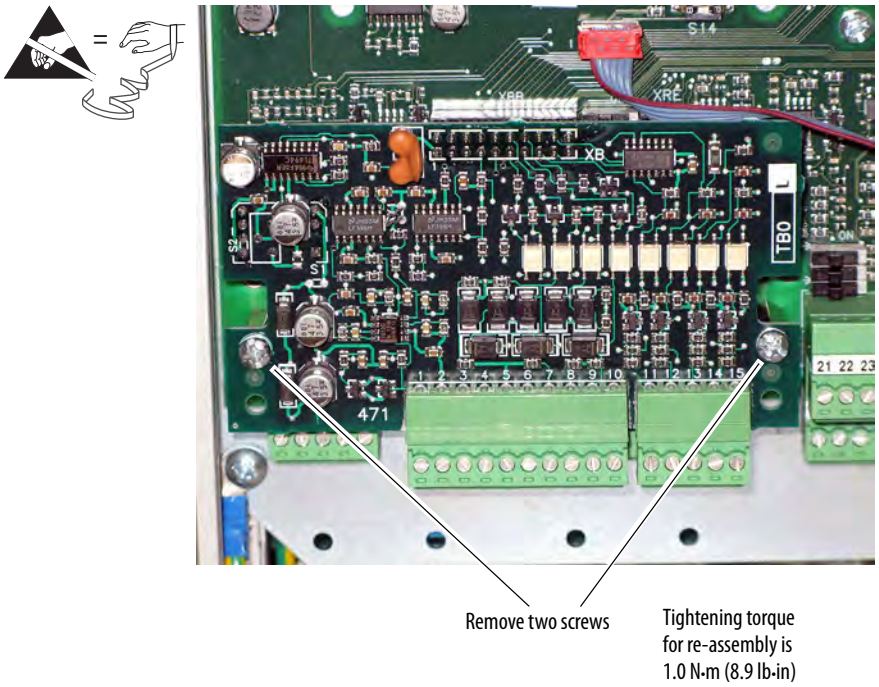
# I/O Expansion Circuit Board Removal and Installation

## Remove the I/O Expansion Circuit Board

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Protective Cover Removal and Installation on page 43.
4. If installed, remove the resolver feedback option board. See Remove the Resolver Feedback and Interface Circuit Boards on page 48.

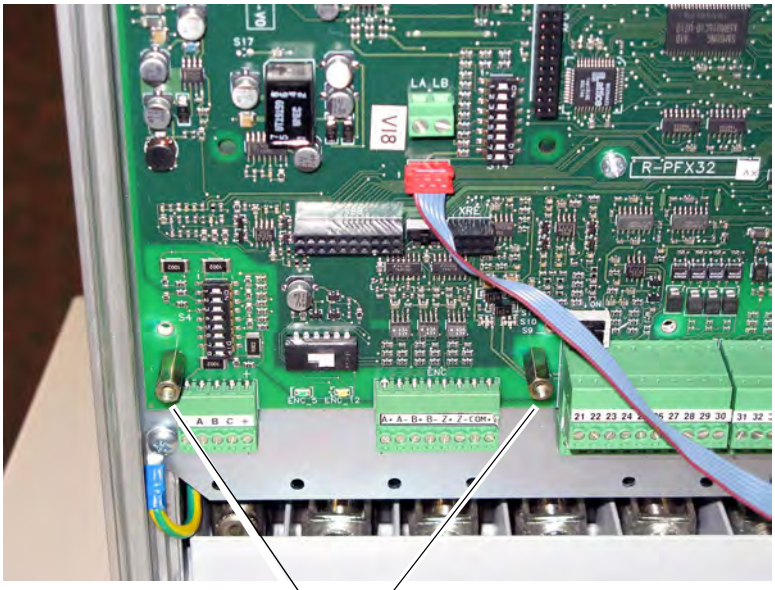
| **IMPORTANT** | Mark all connections and wires before removal to avoid incorrect wiring during reassembly. |
|---|---|

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




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

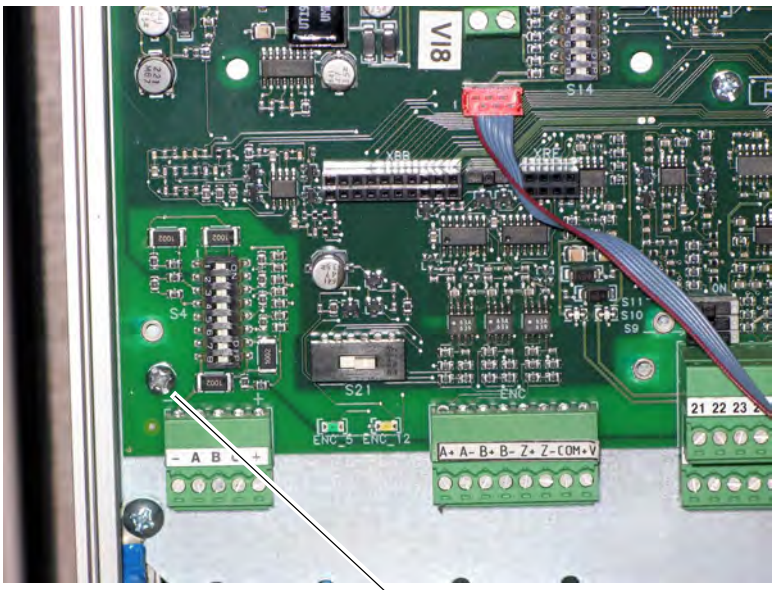
8. Remove the two stand-offs and washers from the control board.




Remove two stand-offs and washers

Tightening torque for re-assembly is 1.0 N•m (8.9 lb•in)

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




Install screw

Tightening torque for re-assembly is 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.

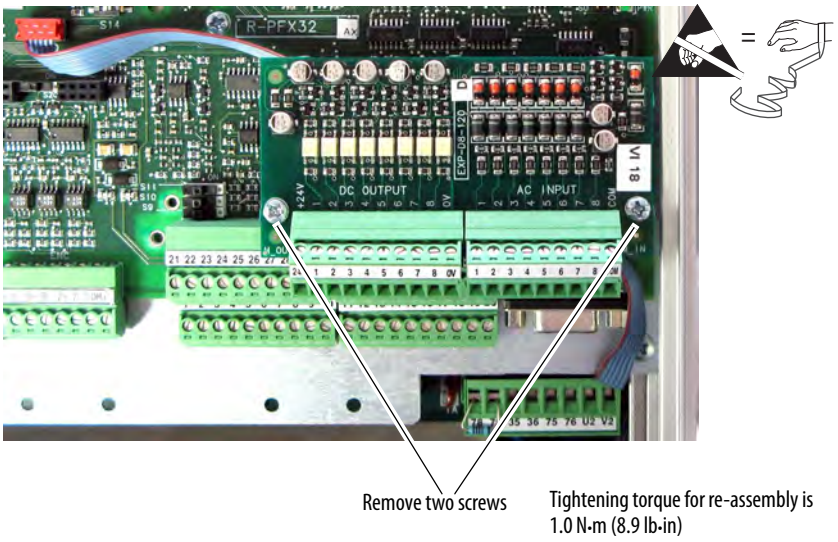
# 115V AC to 24V DC I/O Converter Circuit Board Removal and Installation

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

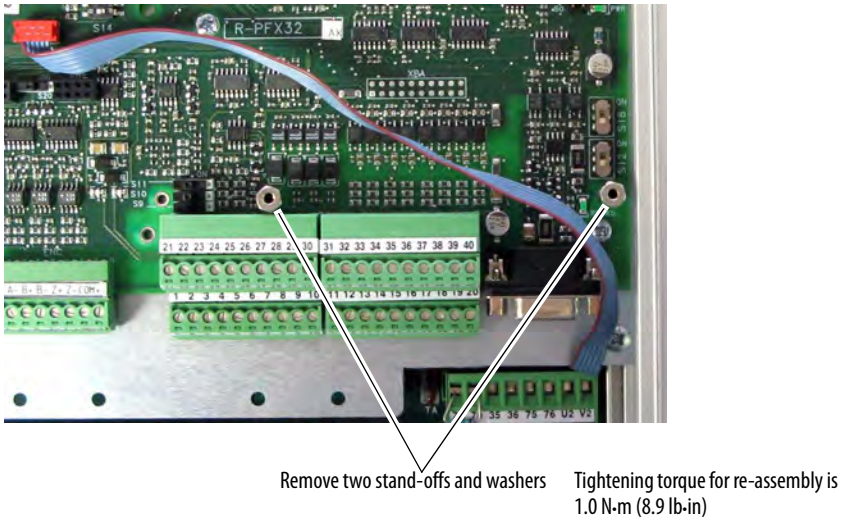
1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.

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

4. Remove the plug-in I/O terminal block with the wiring kept in place.
5. Remove the two screws 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 and washers 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 Removal and Installation

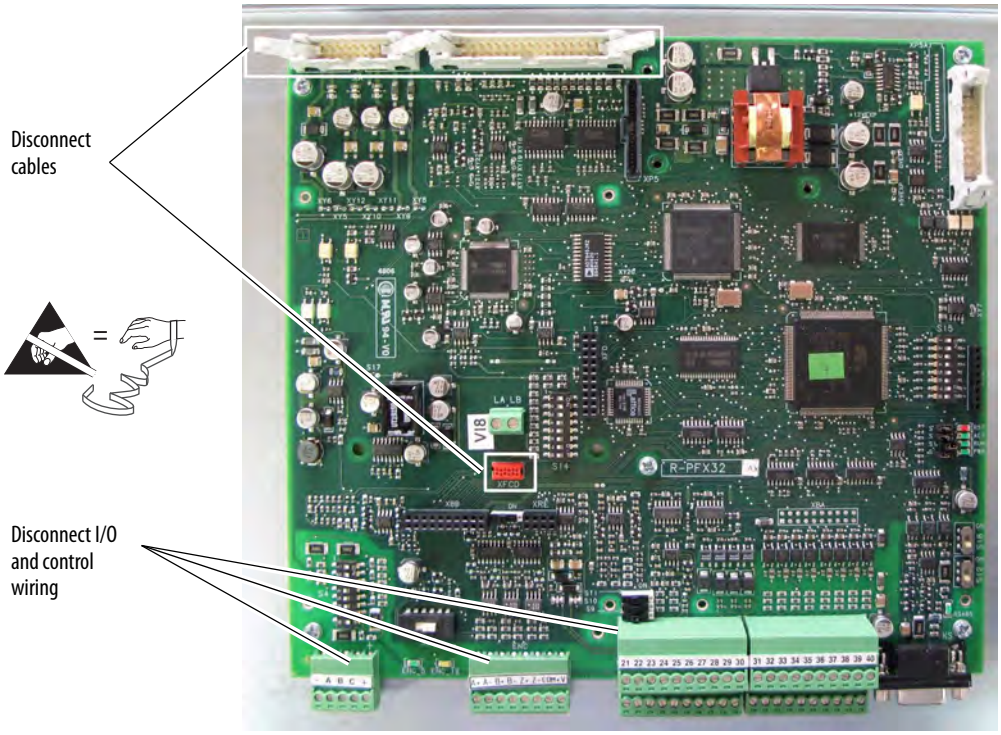
### Remove the Control Circuit Board

1. Save the drive and adapter parameter configuration to a HIM set or by down loading the drive and adapter parameters to an offline database file using DriveExecutive. Refer to the PowerFlex DC Digital Drive User Manual, publication 20P-UM001, for information on using the HIM or the on-line help provided with DriveExecutive for more information on HIM Sets or using the HIM.
2. Read the General Safety Precautions on page 10.
3. Remove power from the drive. See Remove Power from the Drive on page 42.
4. Remove the protective covers from the drive. See Remove the Protective Covers from the Drive on page 43.
5. Remove the communication adapter and EMI shield from the control board. See Remove the Communication Adapter and EMI Shield on page 46.
6. If present, remove the I/O expansion circuit board. See Remove the I/O Expansion Circuit Board on page 52.
7. If present, remove the 115V AC to 24V DC I/O converter circuit board. See Remove the 115V AC to 24V DC I/O Converter Circuit Board on page 54.
8. Record all switch and jumper settings on the control board. Refer to the PowerFlex DC Digital Drive User Manual, publication 20P-UM001, for more information.

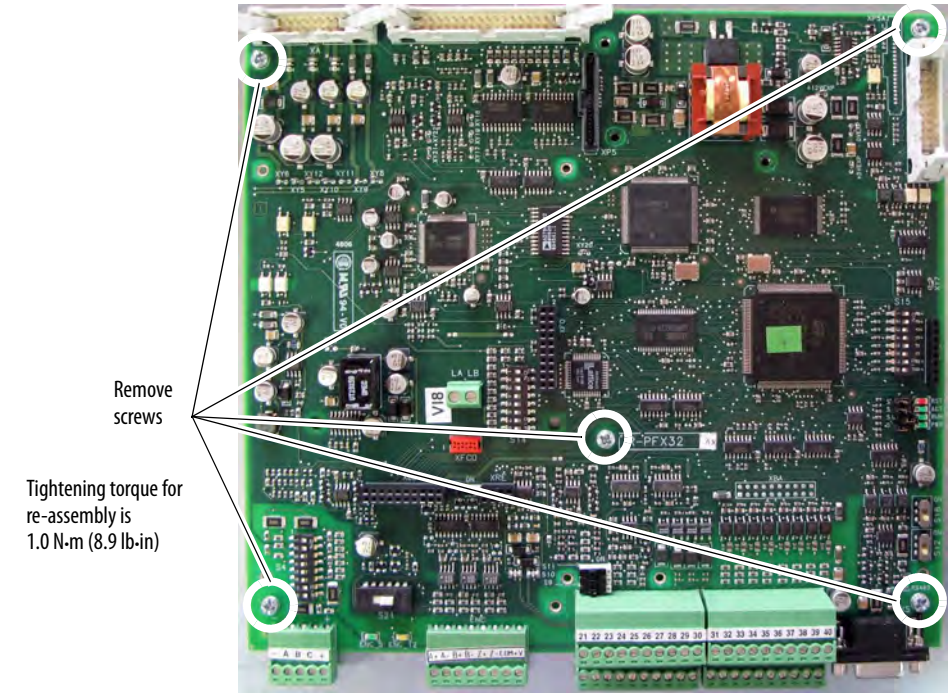
| Jumper/ Switch | Function | | Setting |
|---|---|---|---|
| S4 | Configures the input voltage of the DC analog tachometer. | | |
| S9 | Configures the input signal of Analog Input 1 (terminals 1 and 2): | | |
| | Note: The input signal type must also be programmed accordingly using Par 71 [Anlg In1 Config]. | | |
| S10 | Configures the input signal of Analog Input 2 (terminal 3 and 4): | | |
| | Note: The input signal type must also be programmed accordingly using Par 76 [Anlg In2 Config]. | | |
| S11 | Configures the input signal of Analog Input 3 (terminals 5 and 6): | | |
| | Note: The input signal type must also be programmed accordingly using Par 81 [Anlg In3 Config]. | | |
| S14 | Field current resistors setting.<br>In addition, the value selected with switch S14 must be entered in Par 374 [Rated Field Curr] in the control software when the drive is commissioned. | | S14-1 =<br>S14-2 =<br>S14-3 =<br>S14-4 =<br>S14-5 =<br>S14-6 =<br>S14-7 = (not used)<br>S14-8 = (not used) |
| S15 | Configuration of the control circuit board to the appropriate drive size. This value is set to the appropriate size at the factory. | | S15-1 =<br>S15-2 =<br>S15-3 =<br>S15-4 =<br>S15-5 =<br>S15-6 =<br>S15-7 =<br>S15-8 = |
| S20 | Monitoring of the Z channel of the Digital Encoder on connector XE2: | | |
| | Off Position | Z-channel monitored | |
| | On Position | Z-channel not monitored | |
| | The S20 setting should match the value selected in Par 652 [Encoder Err Chk] (for example, if S20 = "Off", then Par 652 = 1 "Enabled"). | | |
| S21 | Encoder power supply voltage and input adaptation selection:<br>Note: When control power is supplied to the drive, the appropriate LED lights to indicate the selection of the switch. | | |
| | ENC_5 | +5 V encoder (+2.5…5.4V input range) | |
| | ENC_12 | +12…15 V encoder (+5.4V…15.2V input range) | |

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

9. Carefully disconnect the cables from connectors XFCD, 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

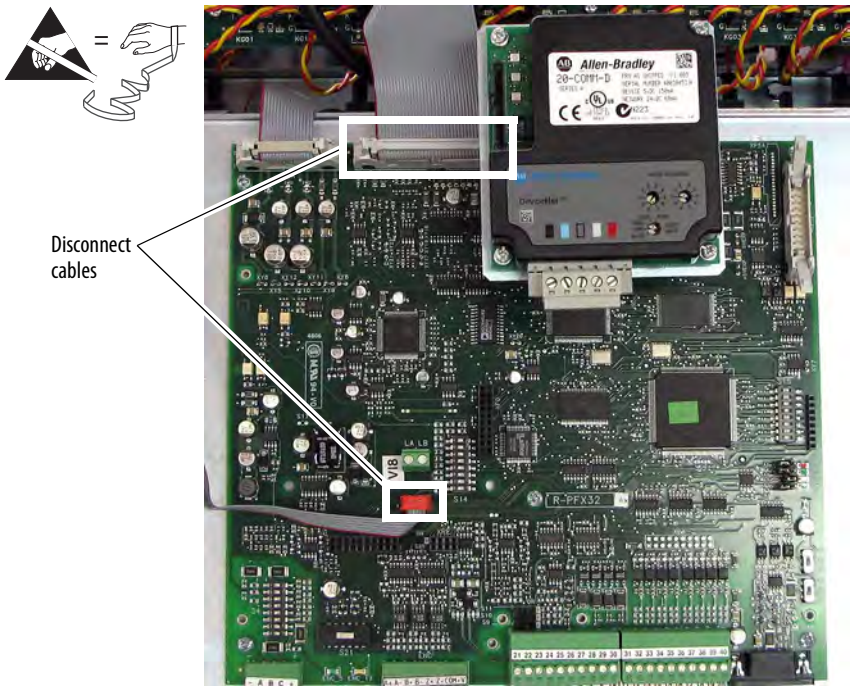
Install the control board in reverse order of removal.

## Control EMI Shield Removal and Closure

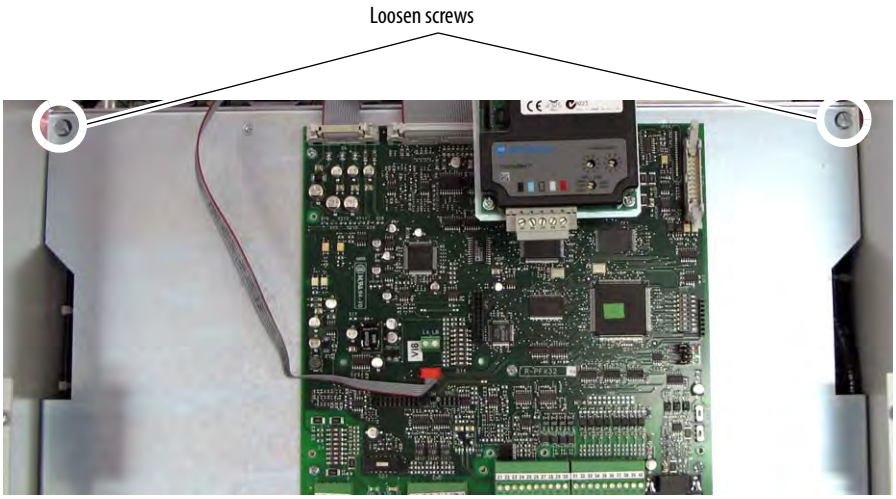
### Move the Control EMI Shield

You must move the control EMI shield that holds the control board in order to access other components within the drive.

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.
4. Carefully disconnect the cables from connectors XFCD and XR on the control board.

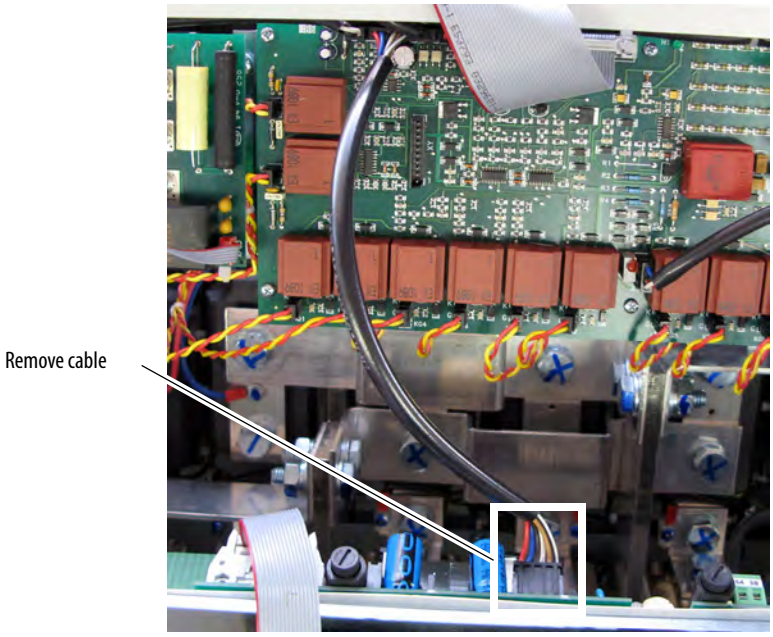


5. Loosen the two captive screws at the top of the control EMI shield and partially lower the shield. The shield will not open to its full extent due to a cable connection between the switching power supply board and the pulse transformer board.




6. Disconnect the cable from connector XSW on the switching power supply board and lower the control EMI shield until it rests on the drive chassis.

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



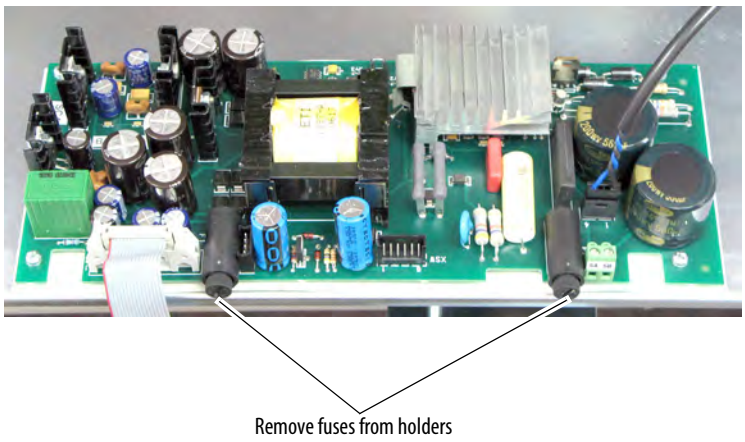

## Install the Control EMI Shield

Install the control EMI shield in reverse order of removal.

## Switching Power Supply Circuit Board Fuse Removal and Installation

### Remove the Fuses on the Switching Power Supply Circuit Board

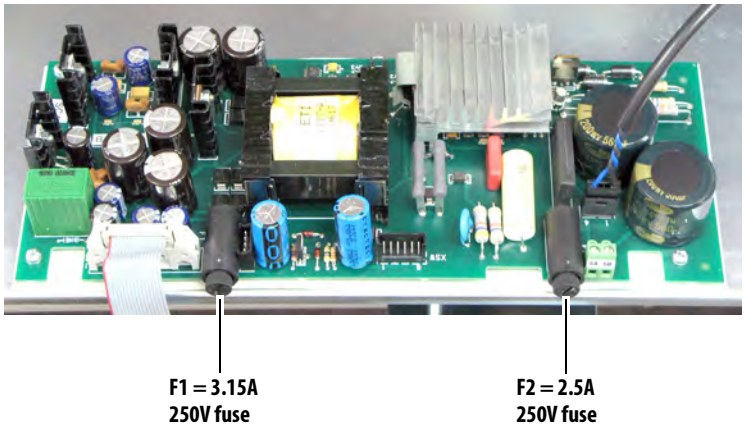
1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.
4. Move the control EMI shield. See Move the Control EMI Shield on page 58.
5. Remove the two fuses on the switching power supply board by inserting a screwdriver in the slot on the top of the fuse, carefully pushing down and turning 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.

**IMPORTANT** Insert the 3.15A 250V fuse in the fuse holder designated F1. Insert the 2.5A 250V fuse in the fuse holder designated F2.



# Switching Power Supply Circuit Board Removal and Installation

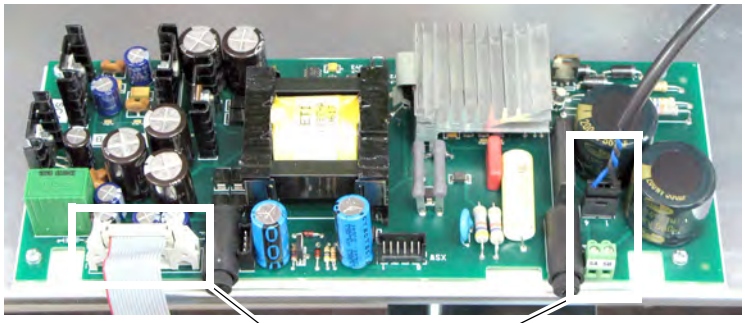
## Remove the Switching Power Supply Circuit Board

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.
4. Move the control EMI shield. See Move the Control EMI Shield on page 58.
5. Disconnect the cables from connector XA and XUV on the switching power supply board.

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

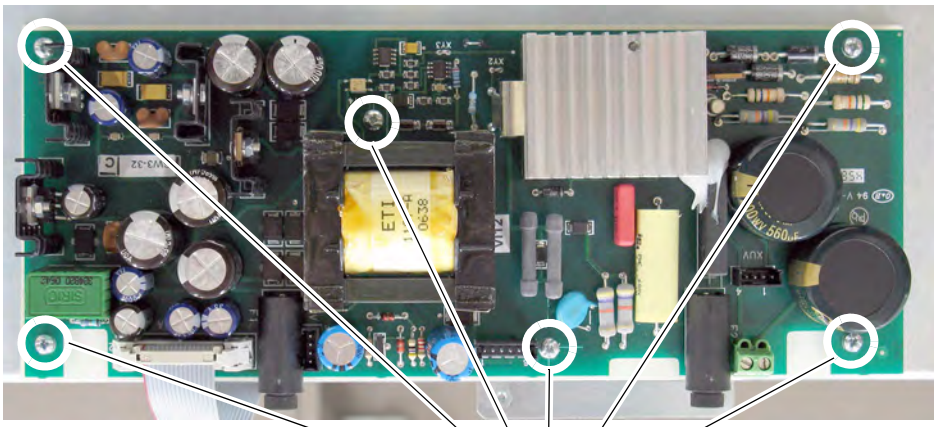
6. If present, disconnect the jumper from terminals SA-SB.

| **IMPORTANT** | Be sure to replace the jumper between terminals SA-SB if using 115V AC control input power when installing a new switching power supply board. |
|---|---|



7. Remove the six screws and washers that secure the board to the control EMI shield and remove the board.

| **IMPORTANT** | DO NOT remove the isolation shield below the board, unless it is damaged and you are replacing it with a new sheet. |
|---|---|




### Install the Switching Power Supply Circuit Board

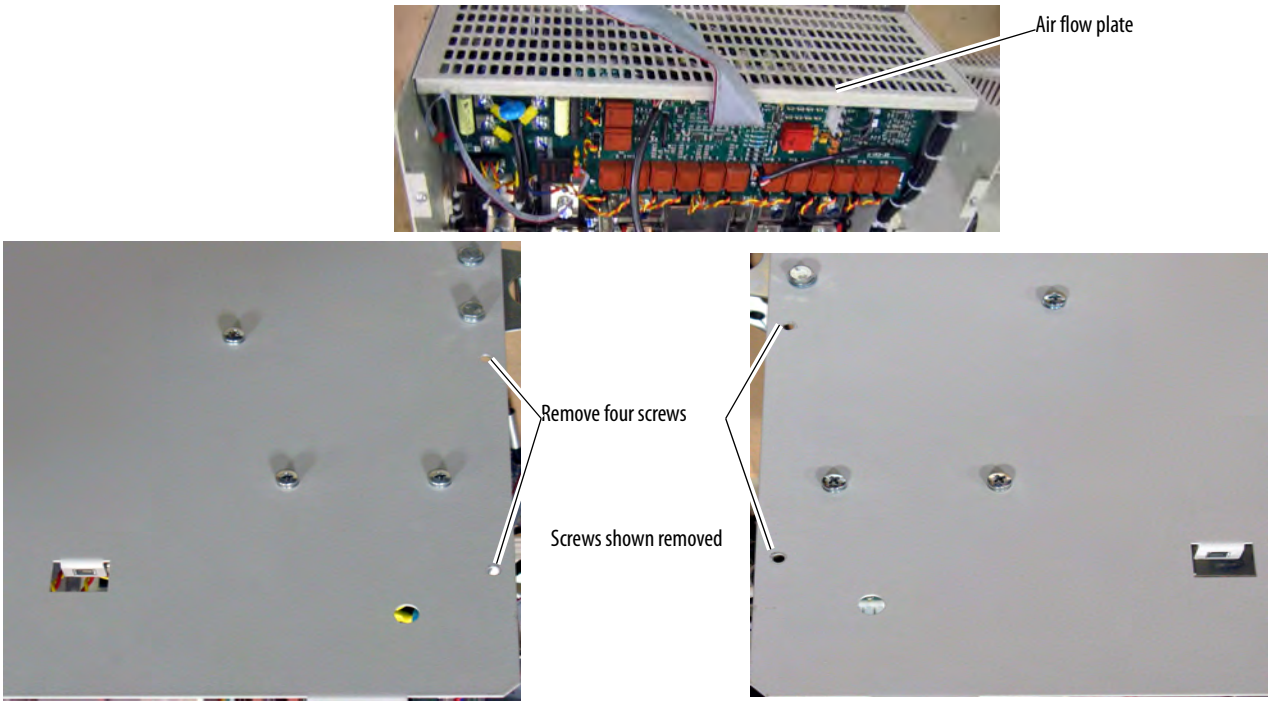
Install the switching power supply board in reverse order of removal.

## Pulse Transformer Circuit Board Removal and Installation

### Remove the Pulse Transformer Circuit Board

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.
4. Move the control EMI shield. See Move the Control EMI Shield on page 58.

5. Remove the four screws (two on either side of the drive frame) that secure the slotted air flow plate to the top of the drive and remove the plate.



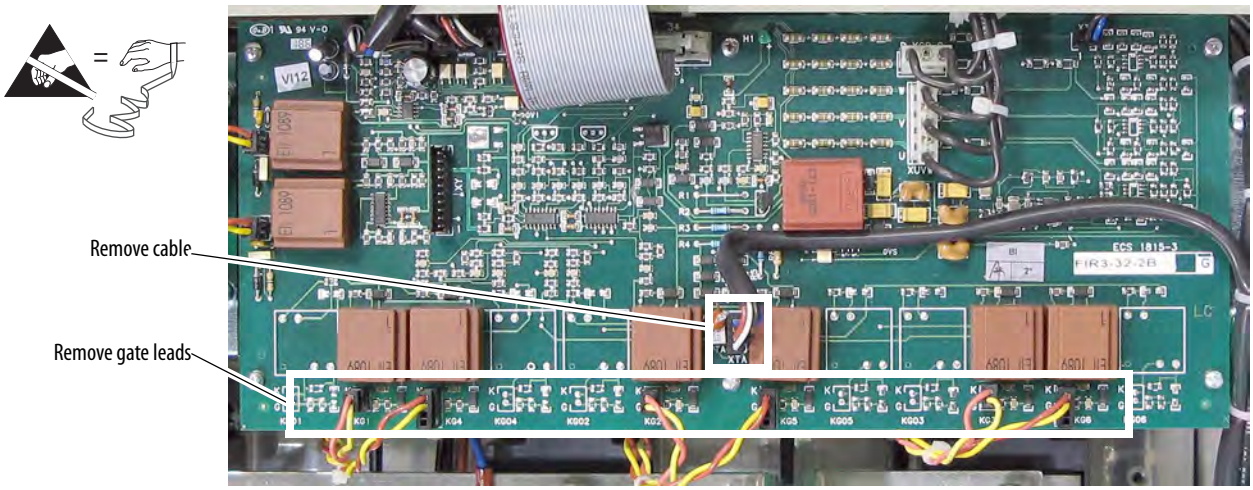

**IMPORTANT** Mark all connections and wires before removal to avoid incorrect wiring during reassembly.

6. Remove the appropriate gate leads:
   - For non-regenerative drives, remove each pair of (orange and yellow) gate lead cables from connectors KG1...KG6 and push each lead through the appropriate opening in the board.
   - For regenerative drive, 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.

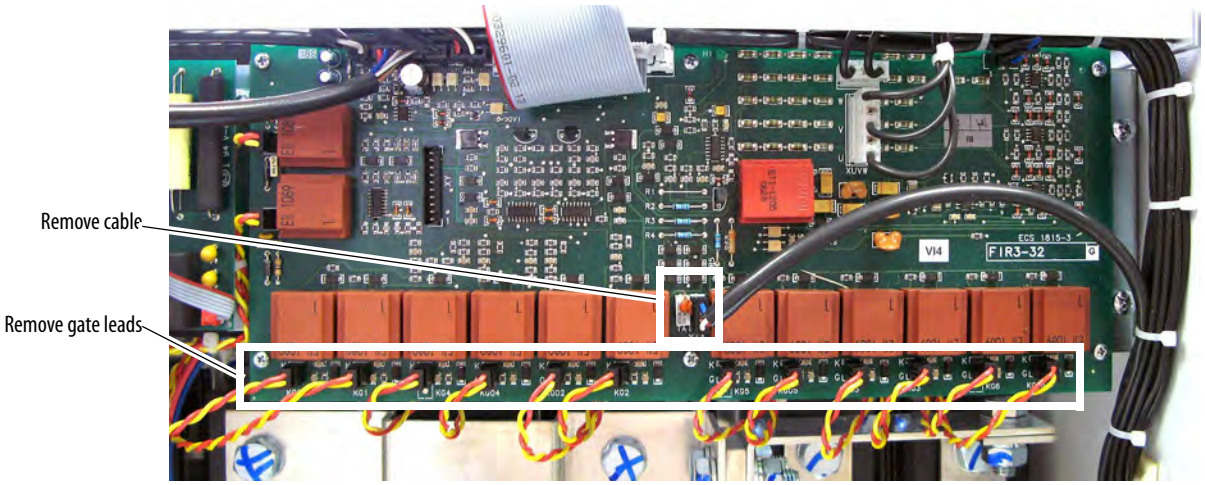
| **IMPORTANT** | Carefully remove the gate leads by grasping the connector. DO NOT pull the gate leads off by pulling on the wires. |
|---|---|

7. Remove the cable from connector XTA at the bottom center of the board.

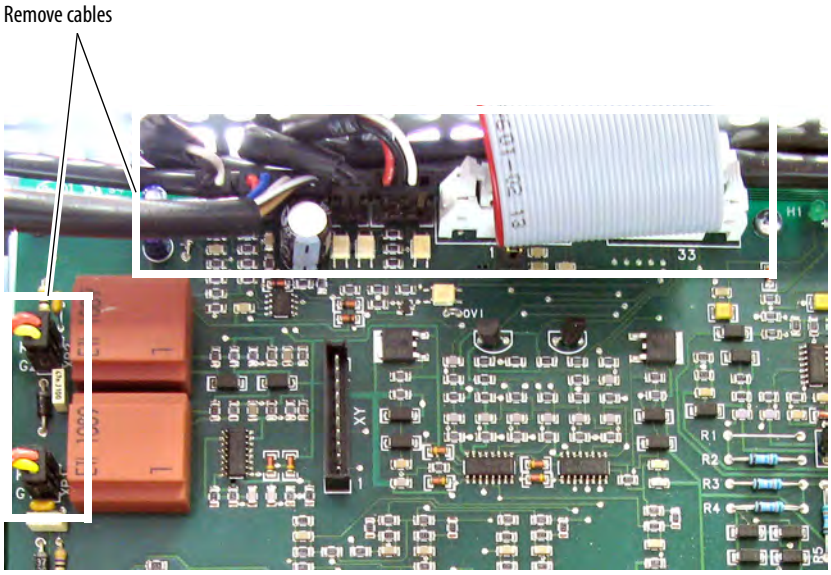
**Non-Regenerative Drive**



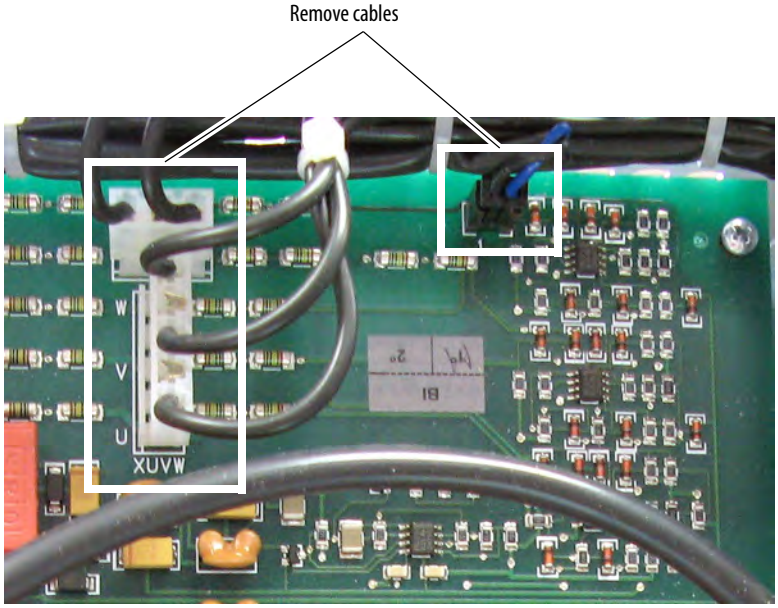

**Regenerative Drive**



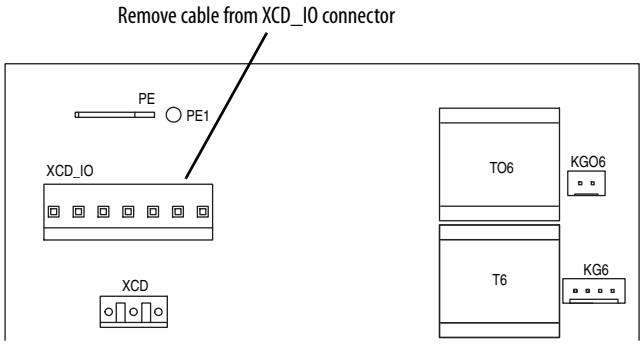
8. Remove the (orange and yellow) cables from connectors K1G1 and K2G2 on the top left side of the board.
9. Remove the cables from connectors X4, X5 and XTM at the top left side of the board.



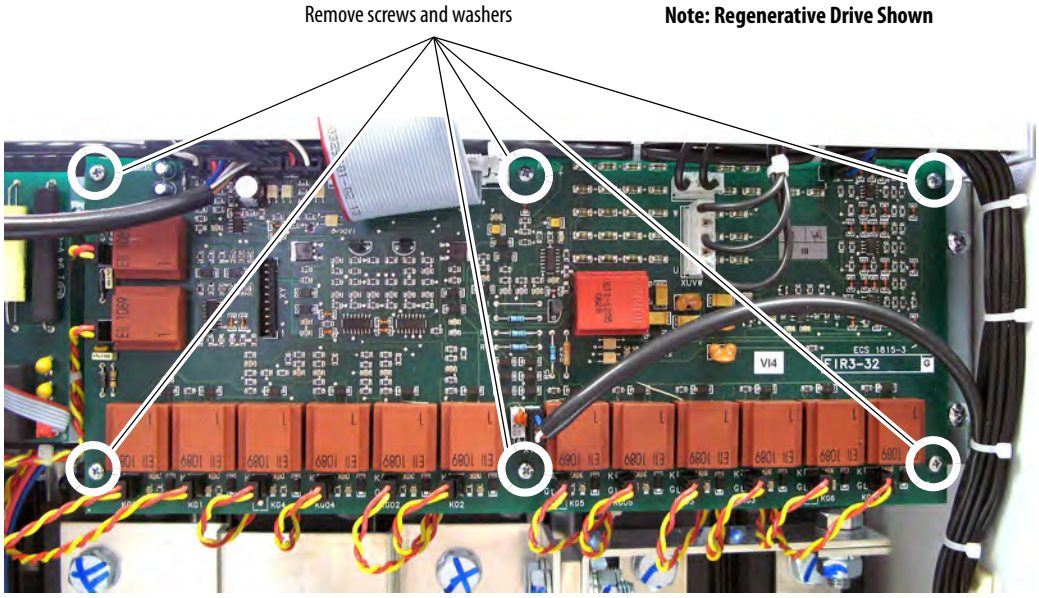

10. Remove the cables from connectors XCD, XUVW and X3 at the top right side of the board.



11. For Pulse Transformer boards with an armature voltage feedback terminal block, FIR3-XX, rev. "M" and higher, remove the cable from connector XCD_I0 on the upper right corner of the board.




12. Remove the six screws and washers that secure the pulse transformer board to the drive and remove the board.



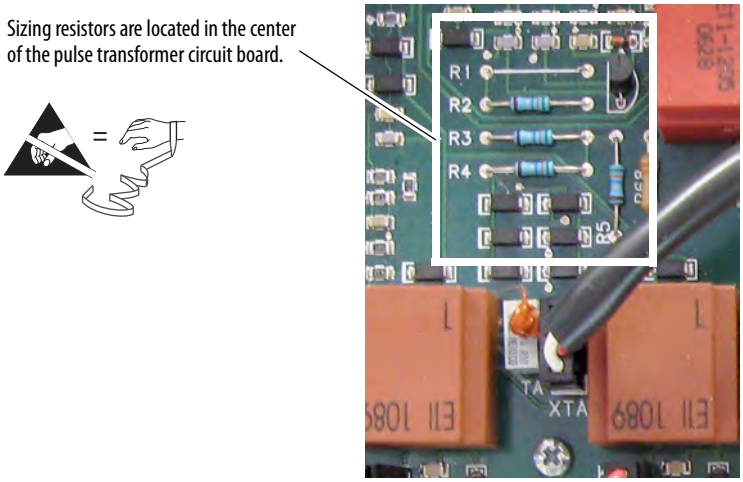

## Configure the Pulse Transformer Circuit Board

The new pulse transformer circuit board must be configured to match the drive size (armature output current and HP rating). The steps required to configure the pulse transformer board are different based on the revision code of the pulse transformer board. See either, Configuring a Pulse Transformer Board FIR3-xx Rev. "L" and Lower on page 67, or Configuring a Pulse Transformer Board FIR3-xx Rev. "M" and Higher on page 69.

*Configuring a Pulse Transformer Board FIR3-xx Rev. "L" and Lower*

**IMPORTANT** This procedure requires a multimeter that measures resistance to thousandths of an ohm.

1. Cut and remove the appropriate sizing resistor(s) (if necessary) from the pulse transformer board based on the drive AC input voltage, armature output current, and HP rating shown in Table 12 and Table 13 in the Sizing Resistors Configuration section below.




## Sizing Resistors Configuration

The tables below indicate the value of the designated resistor (R1...R5) when left in place on the pulse transformer board, or indicate "Remove" when the resistor should be cut off and removed from the board. "–" indicates that this resistor is not contained on the pulse transformer board for the designated drive size.

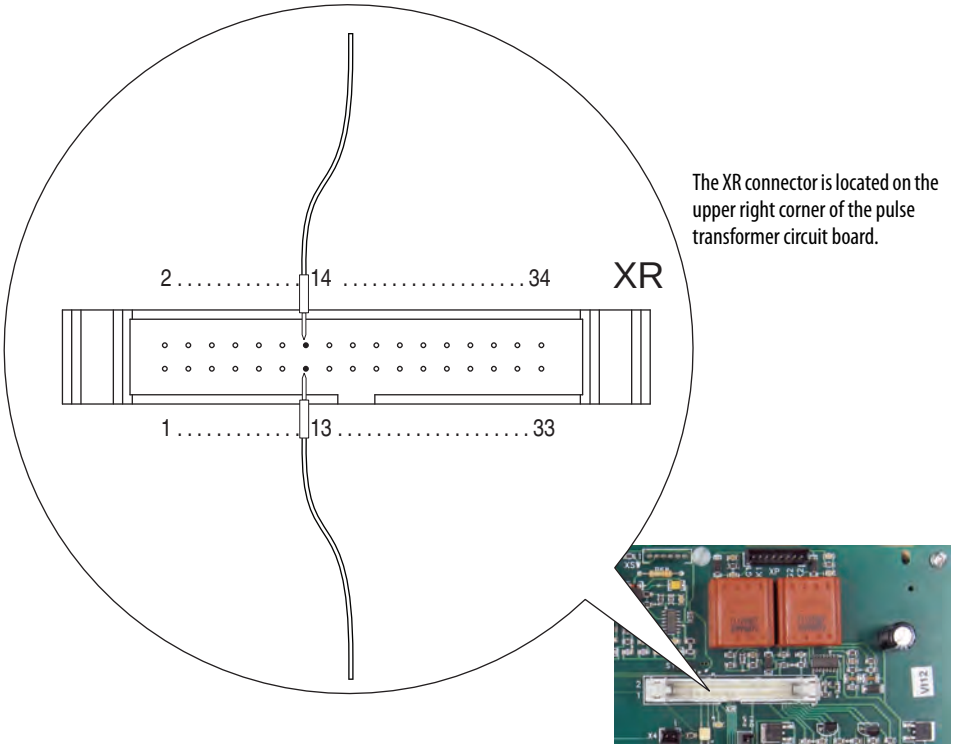
**Table 12 - 230V AC Input Drives**

| Drive Current Rating Code | DC Amps | AC Line Amps | HP | R1 | R2 | R3 | R4 | R5 |
|---|---|---|---|---|---|---|---|---|
| 521 | 521 | 426 | 150 | – | Remove | 5.36Ω | 5.36Ω | 5.36Ω |

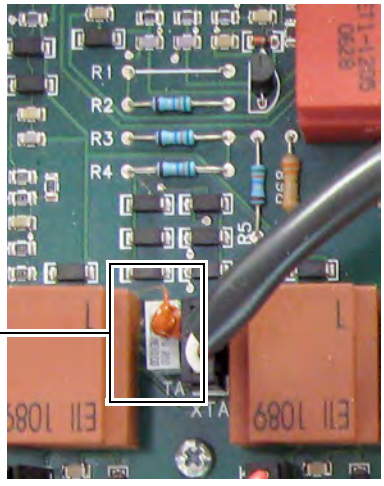
**Table 13 - 460V AC Input Drives**

| Drive Current Rating Code | DC Amps | AC Line Amps | HP | R1 | R2 | R3 | R4 | R5 |
|---|---|---|---|---|---|---|---|---|
| 495 | 495 | 404.4 | 300 | – | Remove | 5.36Ω | 5.36Ω | 5.36Ω |
| 667 | 667 | 544.9 | 400 | – | 5.36Ω | 5.36Ω | 5.36Ω | 5.36Ω |

2. Connect the leads of the multimeter to pins 13 and 14 of connector XR on the pulse transformer board (polarity is not important) and, using the TA potentiometer in the center of the pulse transformer circuit board, set the total resistance (RTA) to the appropriate value as indicated in Table 14 or Table 15 in the Total Resistance Values section on page 69.




The XR connector is located on the upper right corner of the pulse transformer circuit board.




The TA potentiometer is located on the lower right corner of the pulse transformer circuit board next to the control power terminal block.

### Total Resistance Values

**Table 14 - 230V AC Input Drives**

| Drive Current Rating Code | DC Amps | AC Line Amps | HP | Set RTA Value Using TA Potentiometer (Ohms) |
|---|---|---|---|---|
| 521 | 521 | 426 | 150 | 4.699 |

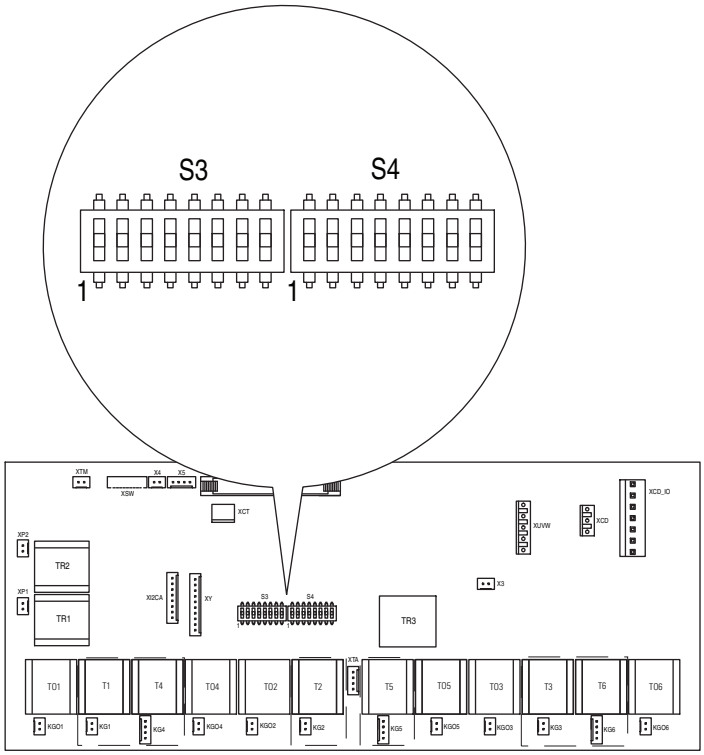
**Table 15 - 460V AC Input Drives**

| Drive Current Rating Code | DC Amps | AC Line Amps | HP | Set RTA Value Using TA Potentiometer (Ohms) |
|---|---|---|---|---|
| 495 | 495 | 404.4 | 300 | 4.945 |
| 667 | 667 | 544.9 | 400 | 3.67 |

3. Seal the TA potentiometer in place using RV (silicon).
4. Continue with Install the Pulse Transformer Circuit Board on page 70.

*Configuring a Pulse Transformer Board FIR3-xx Rev. "M" and Higher*

Set DIP switches S3 and S4 (shown in the illustration below) on the pulse transformer board to the correct settings based on the appropriate AC input voltage, armature output current, and HP rating shown in Table 16 or Table 17 on page 70.



**IMPORTANT** A blank cell below a switch in the tables below indicate that the setting is "OFF".

**Table 16 - 230V AC Input Drives**

| Drive Current Rating Code | DC Amps | AC Line Amps | HP | 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 |
| 521 | 521 | 426 | 150 | ON | | | ON | | | | | | | | ON | | | ON | |
| 70 | 700 | 571 | 200 | | | | | | | | ON | | ON | | | | ON | ON | |

**Table 17 - 460V AC Input Drives**

| Drive Current Rating Code | DC Amps | AC Line Amps | HP | 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 |
| 495 | 495 | 404.4 | 300 | | ON | | ON | | | | | | ON | | | | | ON | |
| 667 | 667 | 544.9 | 400 | | | | | | | | ON | ON | | | | | ON | ON | |

**Table 18 - 575V AC Input Drives**

| Drive Current Rating Code | DC Amps | AC Line Amps | HP | 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 |
| 540 | 540 | 441.2 | 400 | | | | | ON | | | ON | | | | ON | | | ON | |
| 675 | 675 | 551.5 | 500 | ON | | | | | | | | | ON | | | | ON | ON | |

**Table 19 - 690V AC Input Drives**

| Drive Current Rating Code | DC Amps | AC Line Amps | HP | 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 |
| 452 | 452 | 369 | 400 | ON | ON | | | | | ON | | | | | | | | ON | |
| 565 | 565 | 462 | 500 | ON | | | | | | | | | ON | | ON | | | ON | |

## Install the Pulse Transformer Circuit Board

Install the new pulse transformer board in reverse order of removal.

- Inspect the existing connection cables for burn marks, cracks or loose connectors. If necessary, replace the cables connected to connector X3, X4, X5, XCD, XR, XSW, XTA and XUVW on the pulse transformer board with the new cables provided.
- Inspect the existing gate lead cables for burn marks, cracks or loose connectors. If necessary, replace the gate lead cables with the new cables provided.

**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 drive may occur.

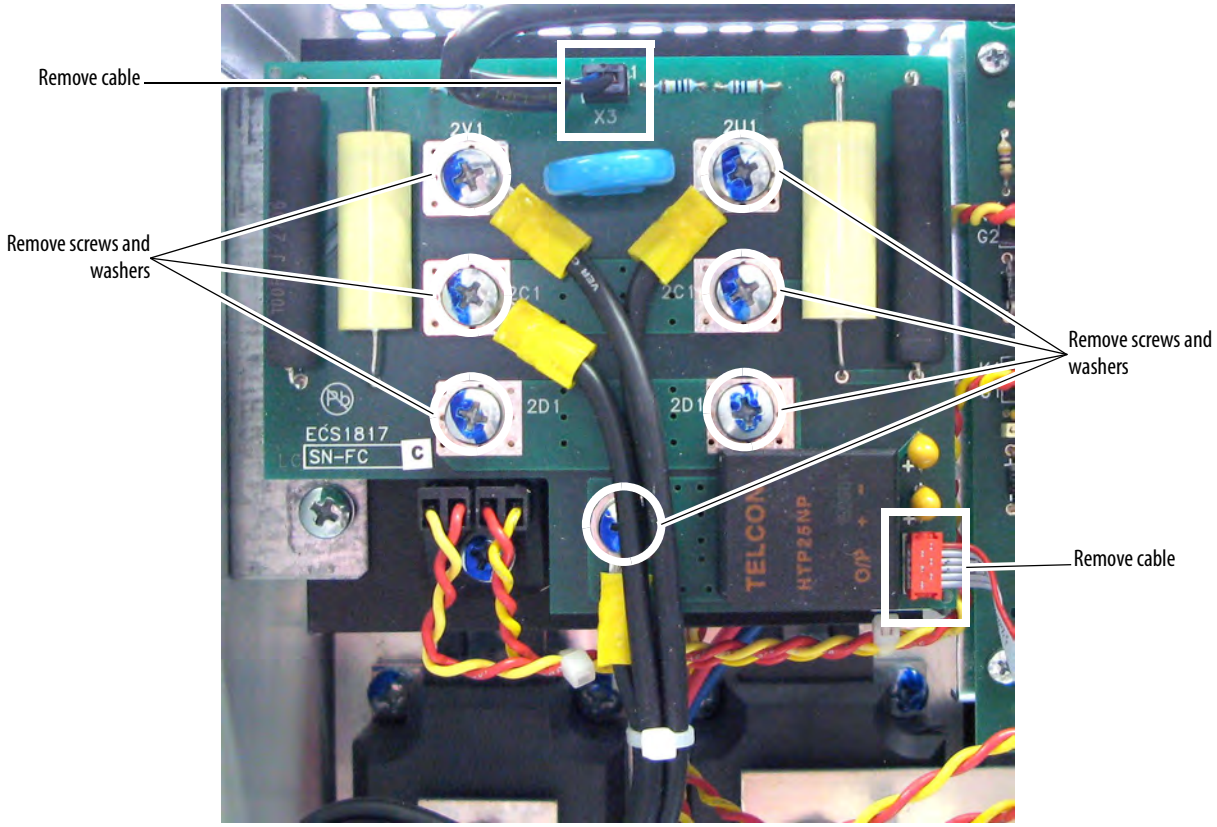
# Field Power Circuit Board Removal and Installation

## Remove the Field Power Circuit Board

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.
4. Move the control EMI shield. See Move the Control EMI Shield on page 58).

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

5. Remove the cables from connectors X3 and XFCD on the board.
6. Remove the seven screws, washers and wire leads (connections 2V1, 2U1 and 2C1 and one unmarked) from the board and remove the board from the drive.



### Install the Field Power Circuit Board

Install the field power board in reverse order of removal.

- Tightening torque for the screws connecting the field power board to the field SCR and dual diode modules is 2.5...4.0 N•m (22...35 lb•in).

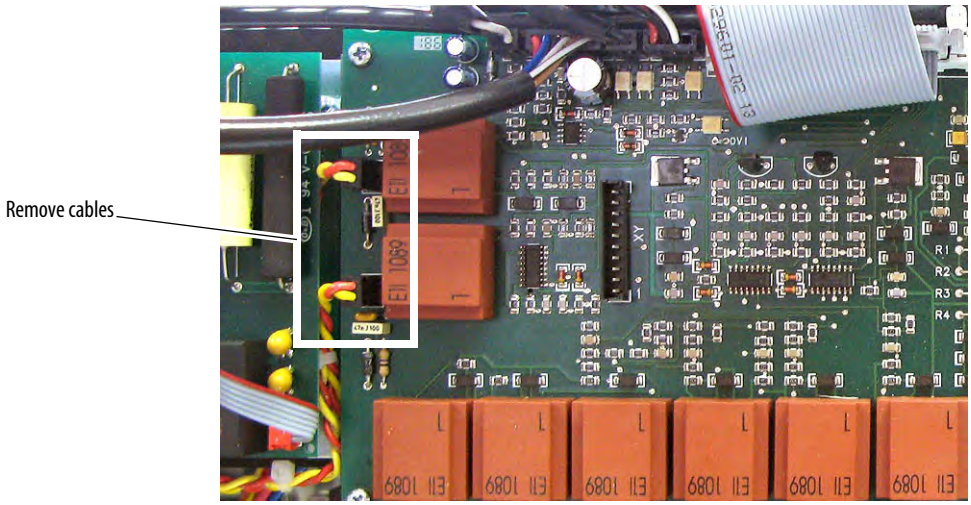
## Field SCR and Dual Diode Module Removal and Installation

### Remove the Field SCR and Dual Diode Module

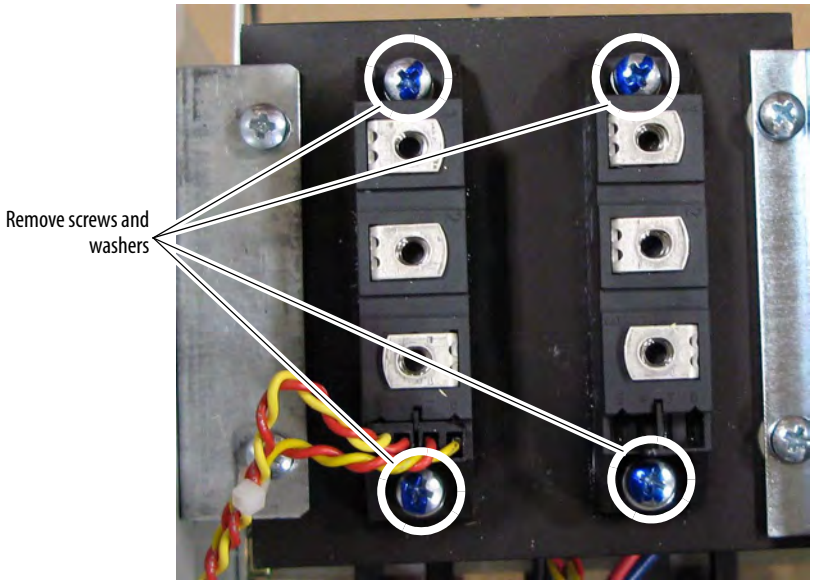
1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.
4. Move the control EMI shield. See Move the Control EMI Shield on page 58.
5. Remove the field power circuit board. See Remove the Field Power Circuit Board on page 71.

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

6. Remove the (orange and yellow) cables from connectors K1G1 and K2G2 on the top left side of the pulse transformer board.



7. Remove the two screws and washers that secure each module to the heatsink and remove the modules from the drive.




## Install the Field SCR and Dual Diode Module

Install the field SCR and dual diode module in reverse order of removal.

- Apply thermal grease to the bottom of the SCR and dual diode modules before securing them to the heatsink.

**ATTENTION:** Thermal grease must be applied to the bottom of the SCR and dual diode modules before securing them to the heatsink or damage to the drive may occur.

- Tightening torque for the screws connecting the field SCR and dual diode modules to the heatsink and the screws connecting the field board to the field SCR and dual diode modules is 2.5...4.0 N•m (22...35 lb•in).

# AC Line Snubber Circuit Board and Resistors Removal and Installation

## Remove the AC Line Snubber Circuit Board and Resistors

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.
4. Move the control EMI shield. See Move the Control EMI Shield on page 58.

*Disconnect and Remove the Pulse Transformer and Field Power Circuit Boards*

You must remove the pulse transformer and field power circuit boards in order to replace the AC line snubber circuit board and resistors.

5. Remove the four screws that secure the slotted air flow plate to the top of the drive and remove the plate.

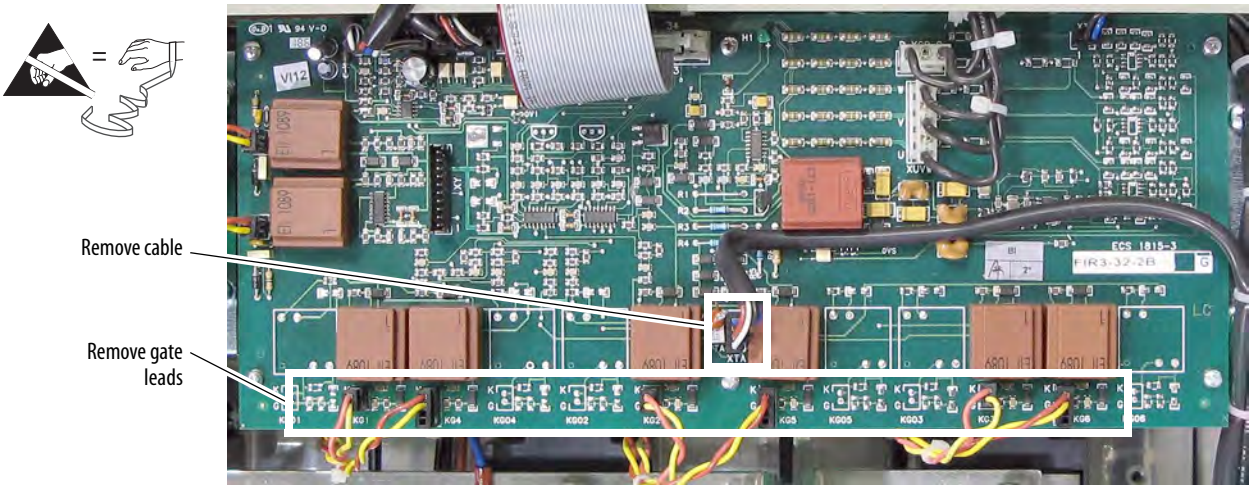
| | |
|---|---|
| **IMPORTANT** | Mark all connections and wires before removal to avoid incorrect wiring during reassembly. |

6. Remove the appropriate gate leads:
   - For non-regenerative drives, remove each pair of (orange and yellow) gate lead cables from connectors KG1...KG6 and push each lead through the appropriate opening in the board.
   - For regenerative drive, 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.

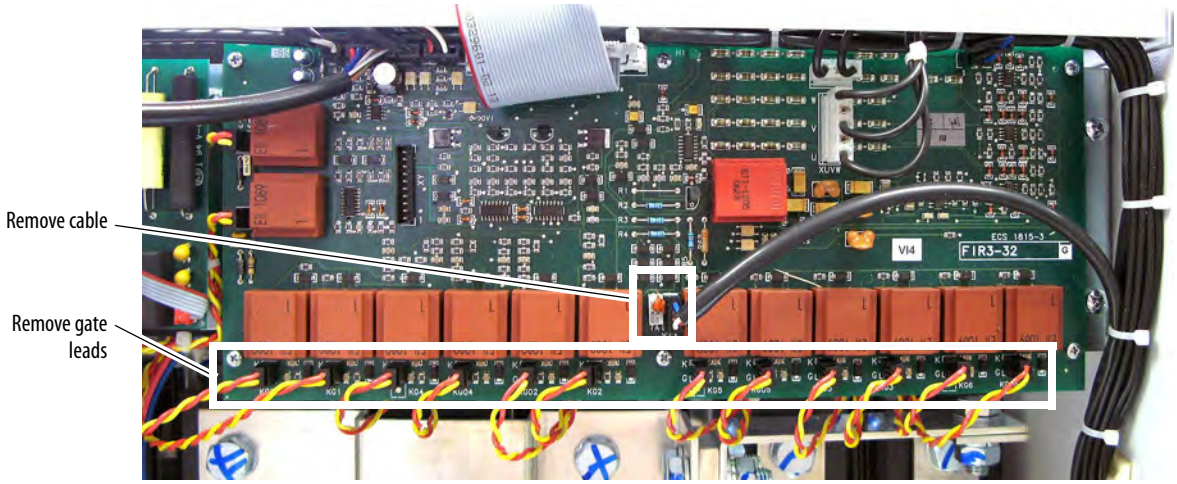
| **IMPORTANT** | Carefully remove the gate leads by grasping the connector. DO NOT pull the gate leads off by pulling on the wires. |
|---|---|

7. Remove the cable from connector XTA at the bottom center of the pulse transformer board.

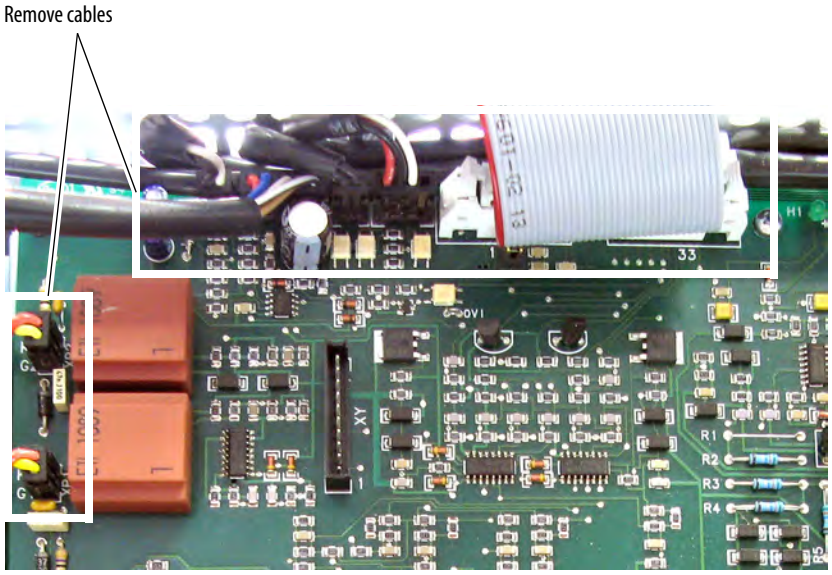
**Non-Regenerative Drive**



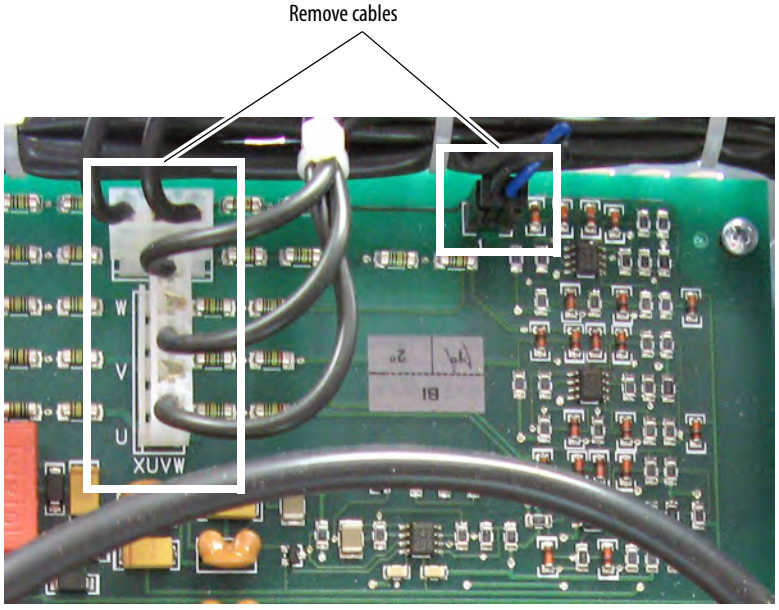

**Regenerative Drive**



8. Remove the (orange and yellow) cables from connectors K1G1 and K2G2 on the top left side of the pulse transformer board.
9. Remove the cables from connectors XTM, X4 and X5 at the top left side of the pulse transformer board.

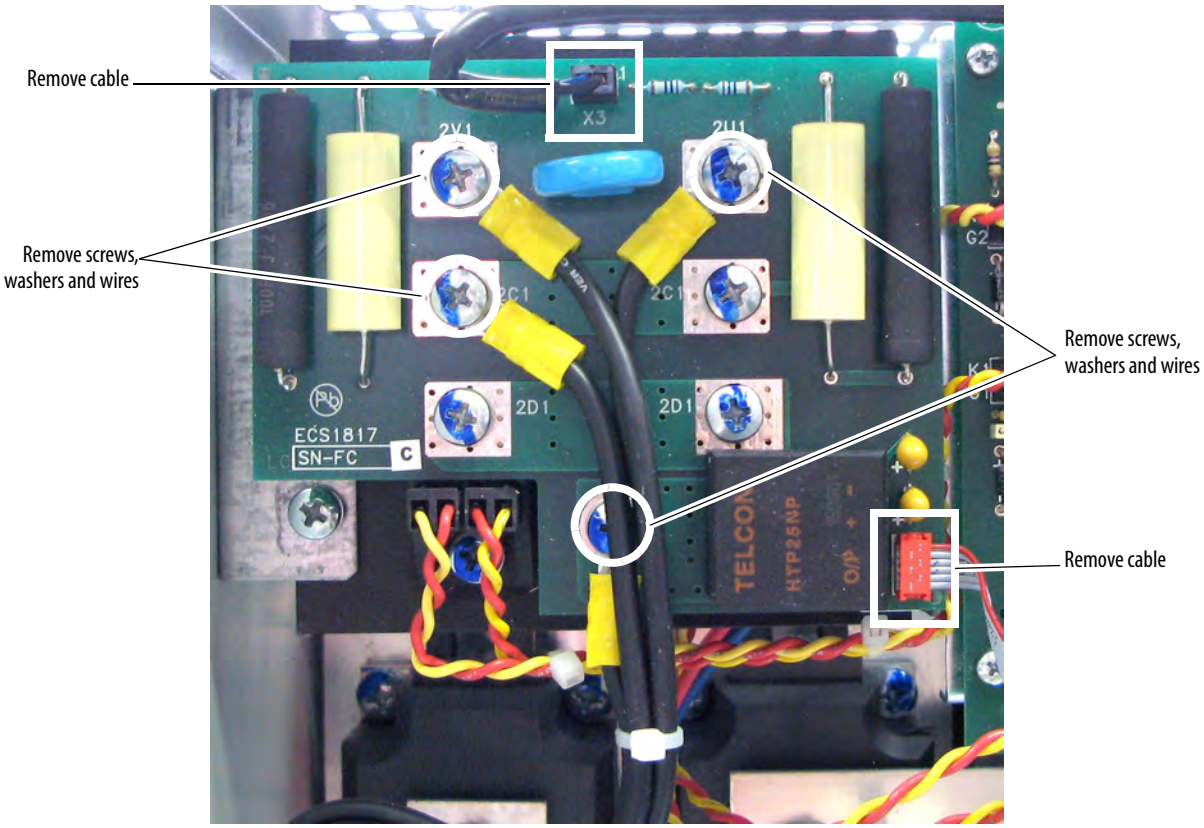



10. Remove the cables from connectors XCD, XUVW and X3 at the top right side of the pulse transformer board.

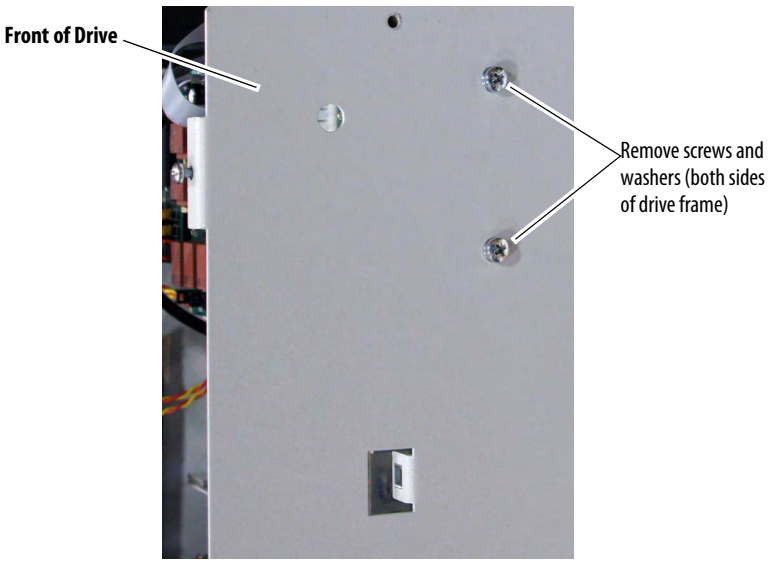



11. Remove the cables from connectors X3 and XFCD on the field power board.

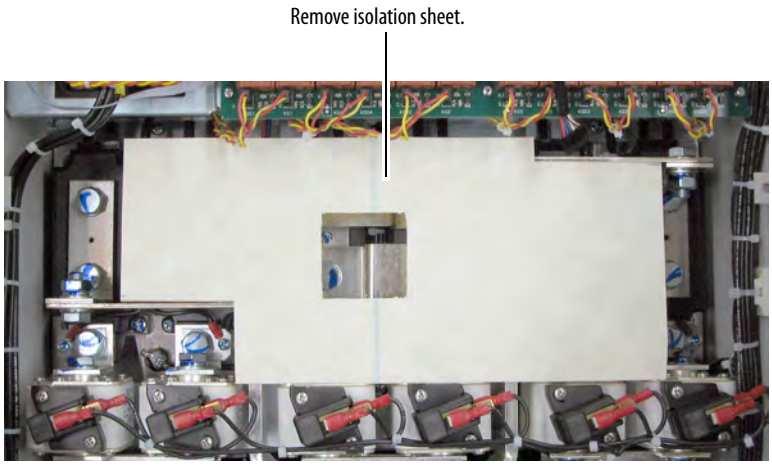
**12.** Remove the four screws and washers that secure the wire leads (connections 2V1, 2U1 and 2C1 and one unmarked) from the field power board and set the wires aside.



**13.** Remove the four screws and washers (two on either side of the drive frame) that secure the support plate for the pulse transformer and field power boards to the drive frame and remove the support plate and boards.

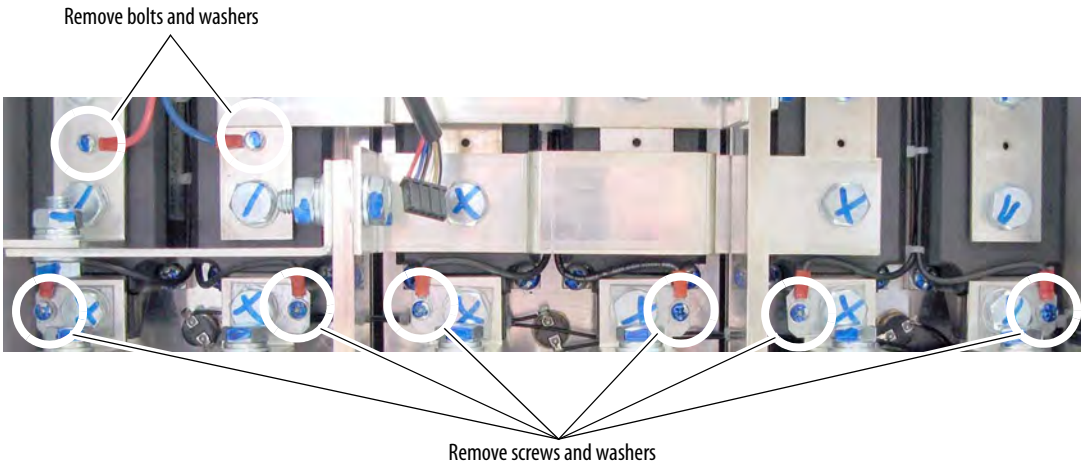



**14.** If present, remove the isolation sheet that is secured to the bus bars.

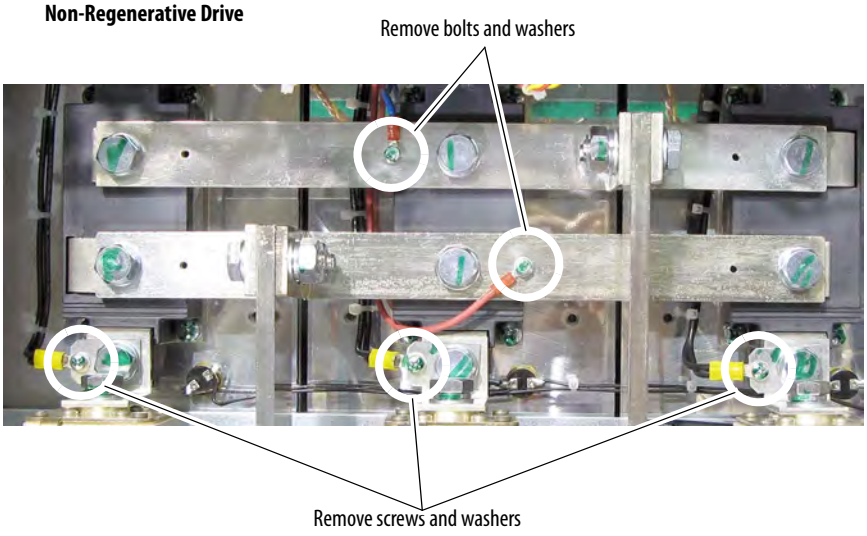


15. Remove the bolts and washers that secure the AC line snubber board (red and blue) leads and screws and washers that secure the resistor (black) leads to the bus bars and remove the leads.

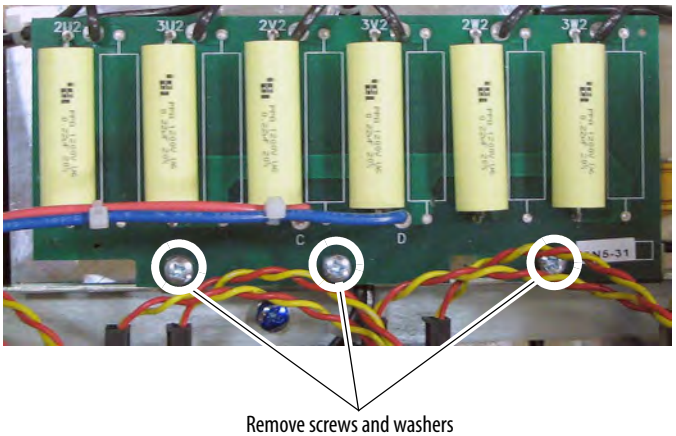
**Regenerative Drive**



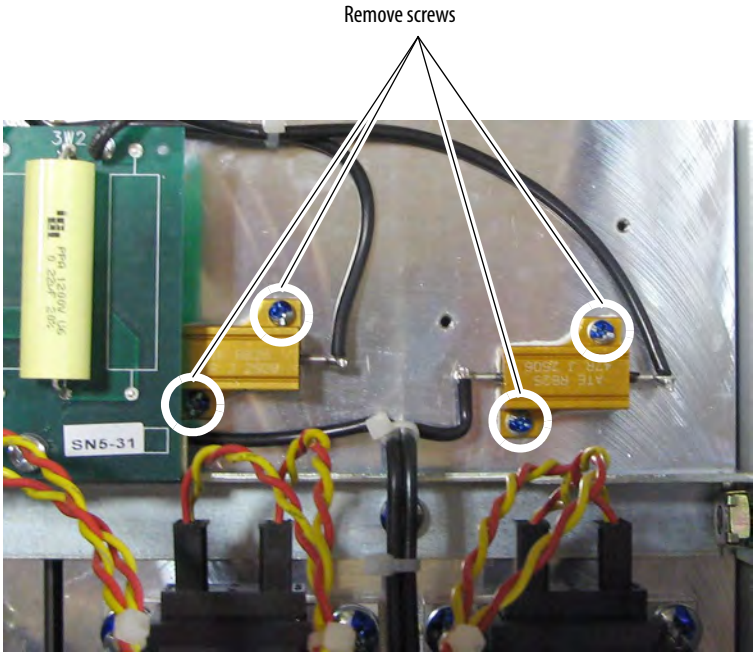

**Non-Regenerative Drive**



16. Remove the three screws and washers that secure the AC line snubber board to the drive frame and remove the board.




17. Remove the two screws that secure each resistor (six total) to the drive frame and remove the resistors from the drive.



### Install the AC Line Snubber Circuit Board and Resistors

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

- Apply thermal grease to the bottom of the resistors before securing them to the heatsink.

**ATTENTION:** Thermal grease must be applied to the bottom of the resistors before securing them to the heatsink or damage to the drive may occur.

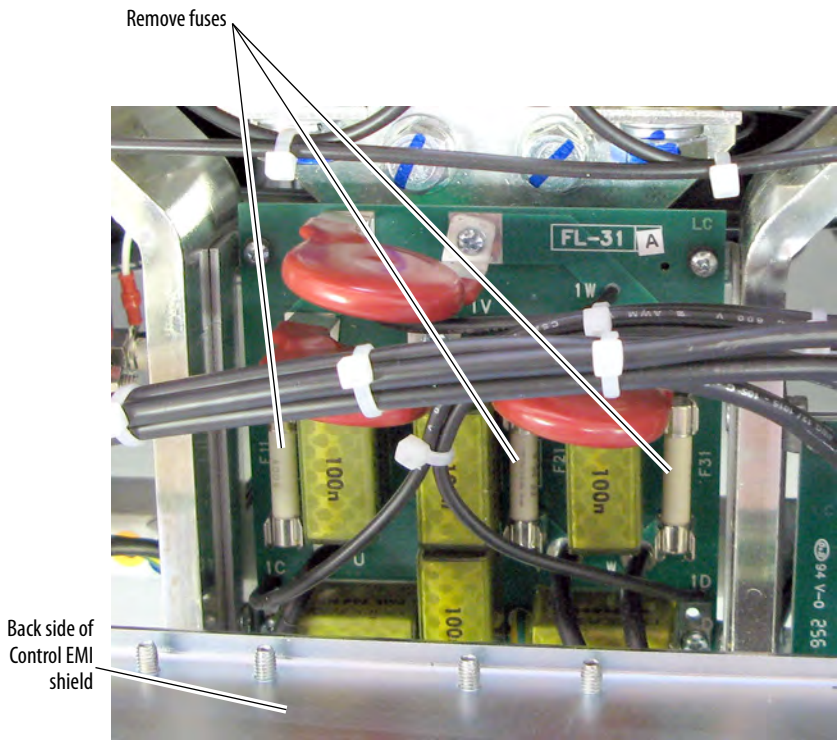
- Tightening torque for the screws connecting the field board to the field SCR and dual diode modules is 2.5...4.0 N•m (22...35 lb•in).

## Transient Noise Filter Circuit Board Fuses Removal and Installation

### Remove the Fuses on the Transient Noise Filter Circuit Board

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.
4. Move the control EMI shield. See Move the Control EMI Shield on page 58.

5. Carefully remove the three fuses from the fuse holders on the transient noise filter board.




### Install the Fuses on the Transient Noise Filter Circuit Board

Install the fuses on the transient noise filter board in reverse order of removal.

## Transient Noise Filter Circuit Board Removal and Installation

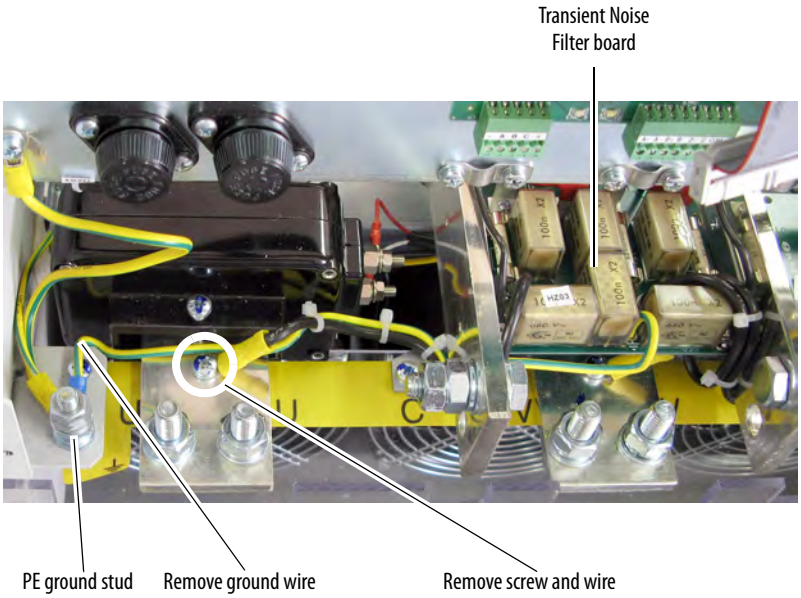
### Remove the Transient Noise Filter Circuit Board

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.

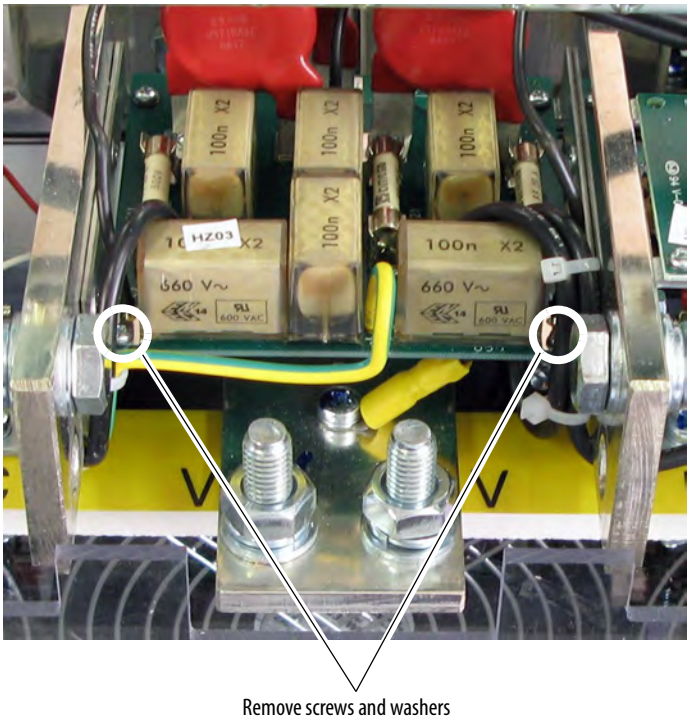
| **IMPORTANT** | Mark all connections and wires before removal to avoid incorrect wiring during reassembly. |
|---|---|

4. Remove the ground wire from the PE ground stud on the drive frame.

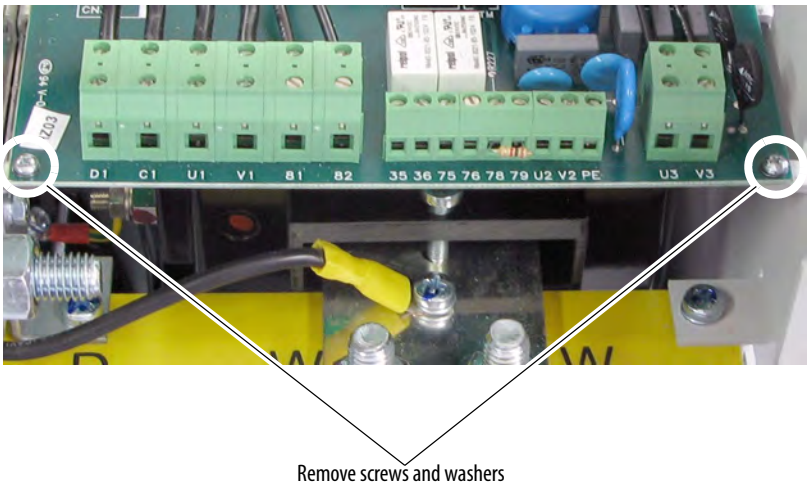
5. Remove the screw that secures the black lead from connection U on the transient noise filter board to the U phase power terminal, and remove the lead.



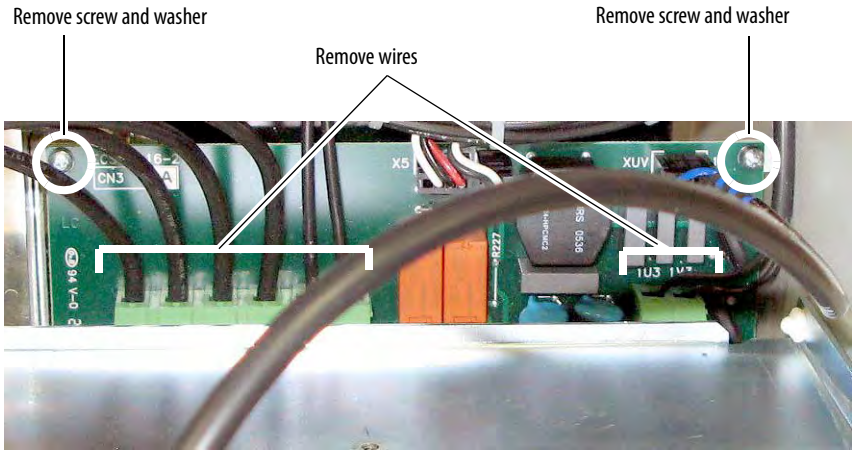

6. Remove the two screws and washers that secure the bottom of the transient noise filter board to the drive



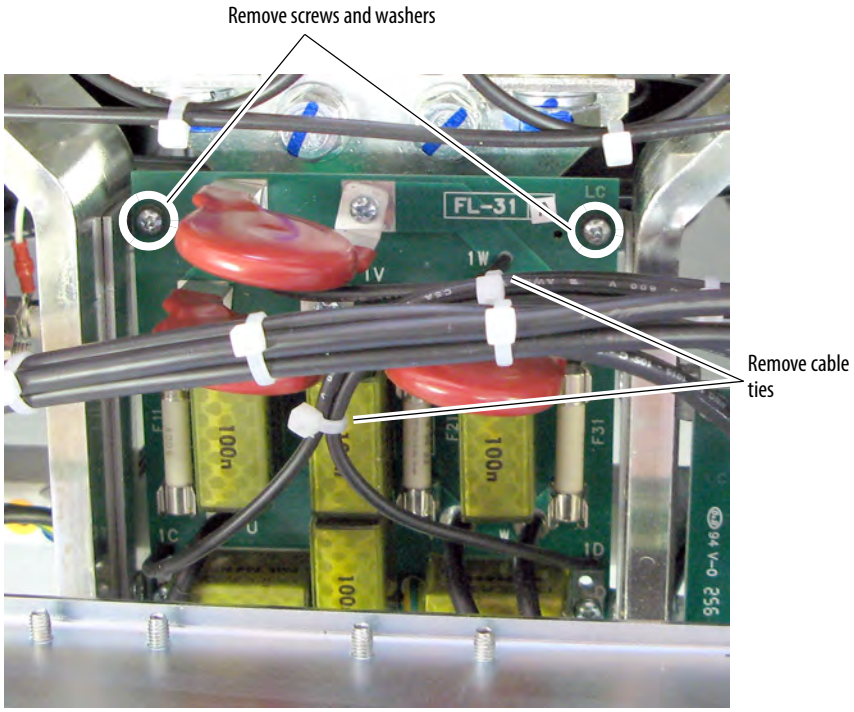
7. Remove the two screws and washers that secure the bottom of the power supply filter circuit board to the drive.



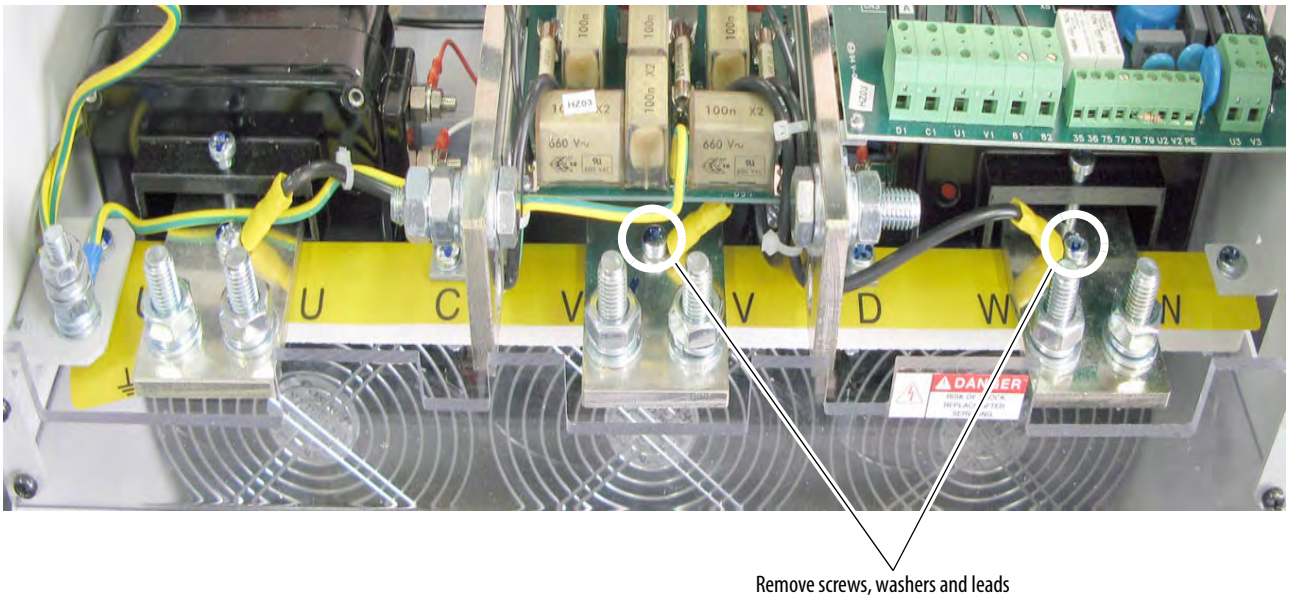

8. Move the control EMI shield. See Move the Control EMI Shield on page 58.
9. Remove the wires that connect to the back of the control terminals on the power supply filter board.
10. Remove the two screws and washers that secure the top of the power supply filter board to the drive and carefully lift the board.



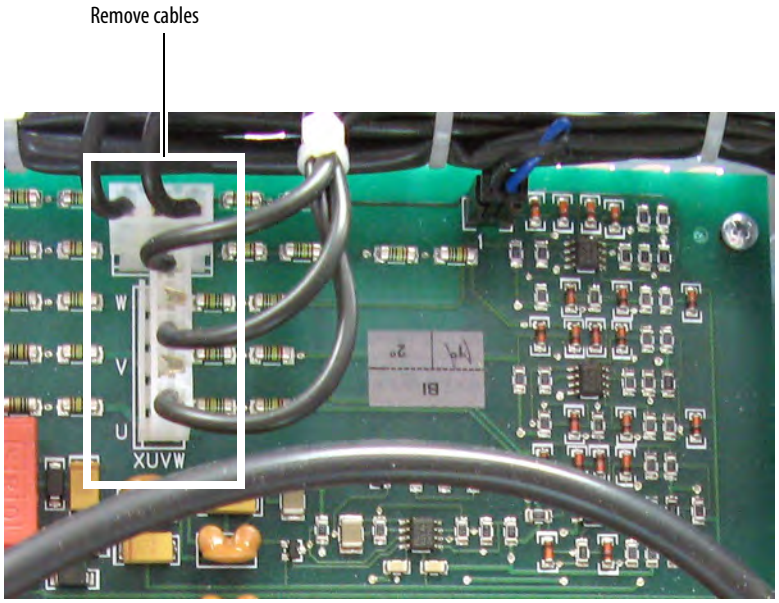
**11.** Remove the two screws and washers that secure the top of the transient noise filter board to the drive and carefully lift the board off the drive.




**12.** Remove the screws and washers that secure the black leads from connections V and W on the transient noise filter board to power terminals V and W, respectively, and remove the leads.



13. Disconnect the cables from connector XCD and XUVW on the pulse transformer circuit board.




14. Cut the cable ties that secure all cables and remove the transient noise filter board and cables from the drive.

### Install the Transient Noise Filter Circuit Board

Install the transient noise filter board and power supply filter board in reverse order of removal.

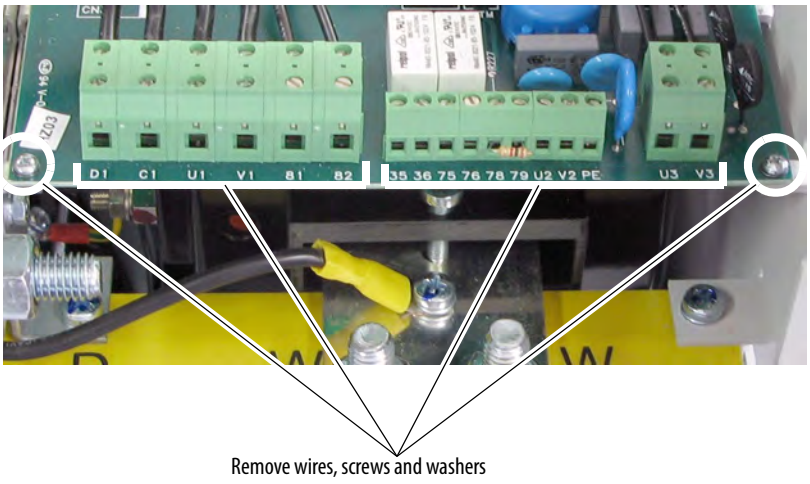
## Power Supply Filter Circuit Board Removal and Installation

### Remove the Power Supply Filter Circuit Board

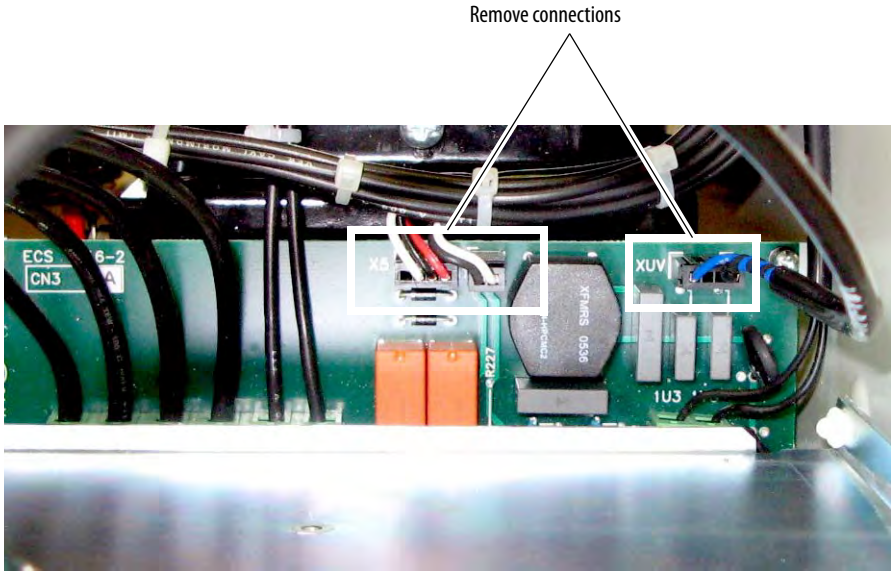
1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.

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

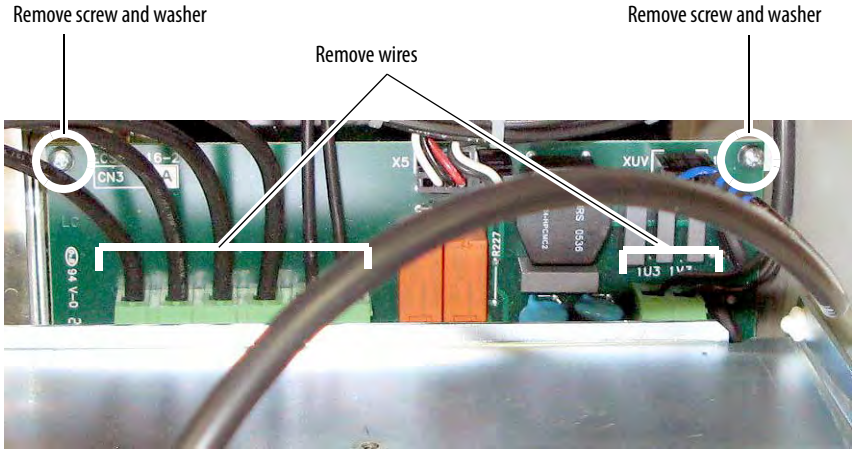
4. Remove all wires from the bottom of the terminal blocks on the power supply filter board.
5. Remove the two screws and washers that secure the bottom of the power supply filter board to the drive.




6. Move the control EMI shield. See Move the Control EMI Shield on page 58.
7. Disconnect the wires from connectors X5, XTM, and XUV on the power supply filter board.



8. Remove all connections from the top of the terminal blocks on the power supply filter board.
9. Remove the two screws and washers that secure the top of the power supply filter board to the drive and remove the board from the drive.




## Install the Power Supply Filter Circuit Board

Install the power supply filter board in reverse order of removal.

# Armature Leg Fuses Removal and Installation

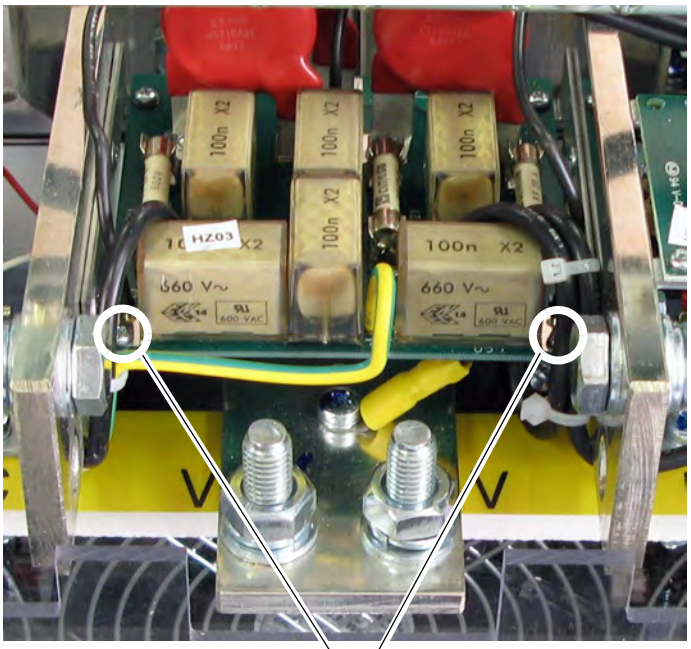
## Remove the Armature Leg Fuses

**Note:** This procedure requires the use of a 17mm open ended wrench.

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.

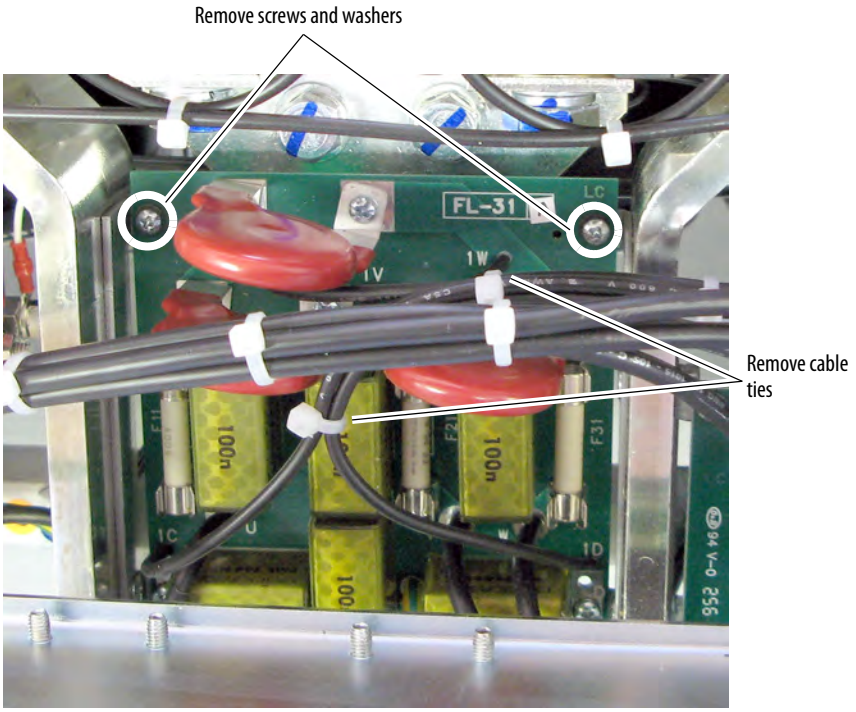
**IMPORTANT** It is necessary to remove the transient noise filter circuit board in order to remove the fuses from the V phase input bus bars.

4. Remove the two screws and washers that secure the bottom of the transient noise filter board to the drive.

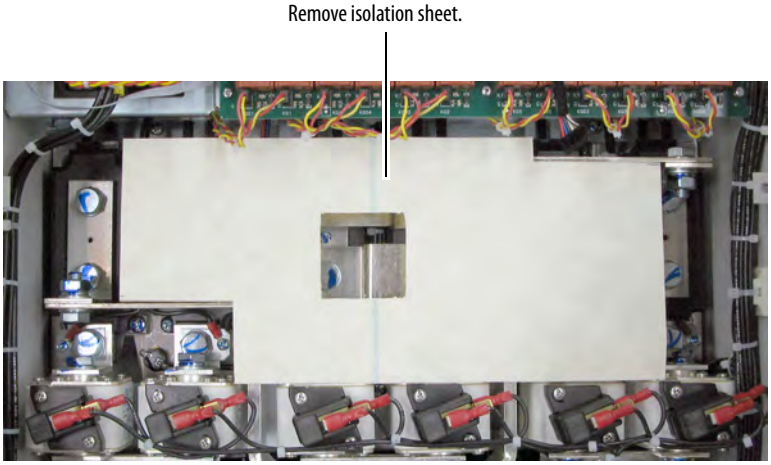



5. Move the control EMI shield. See Move the Control EMI Shield on page 58.

6. Remove the two screws and washers that secure the top of the transient noise filter board to the drive and carefully lift the board off the drive.



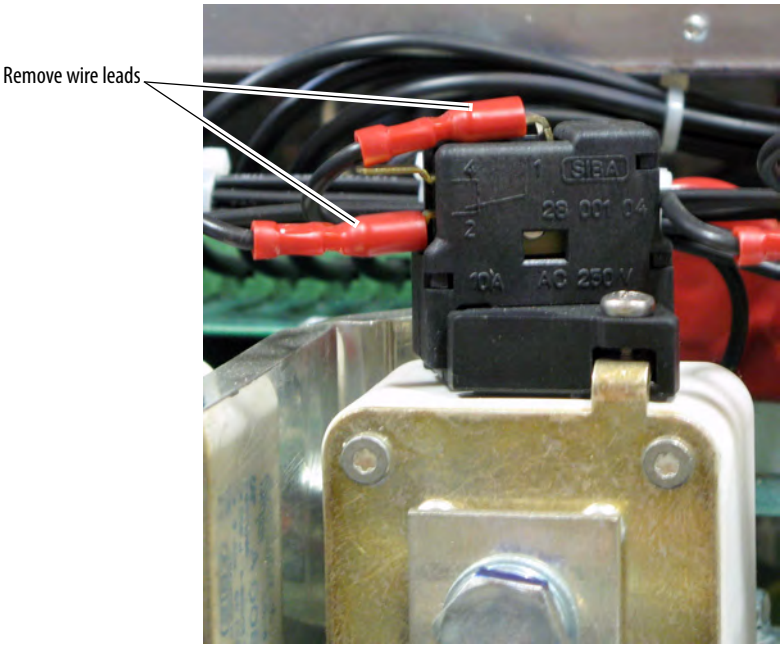

7. If present, remove the isolation sheet that is secured to the bus bars.



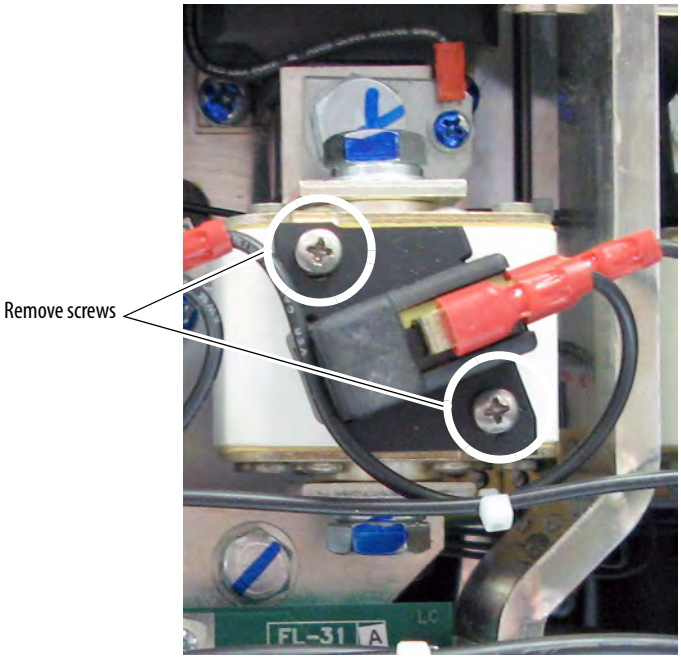

**Note: Regenerative Drive Shown**

8. If necessary, disconnect the wire leads from the switches mounted on the top of the Armature circuit fuses (two each fuse).

| **IMPORTANT** | Note the numbered position of each wire on the fuse for proper installation of the new fuses. |
|---|---|

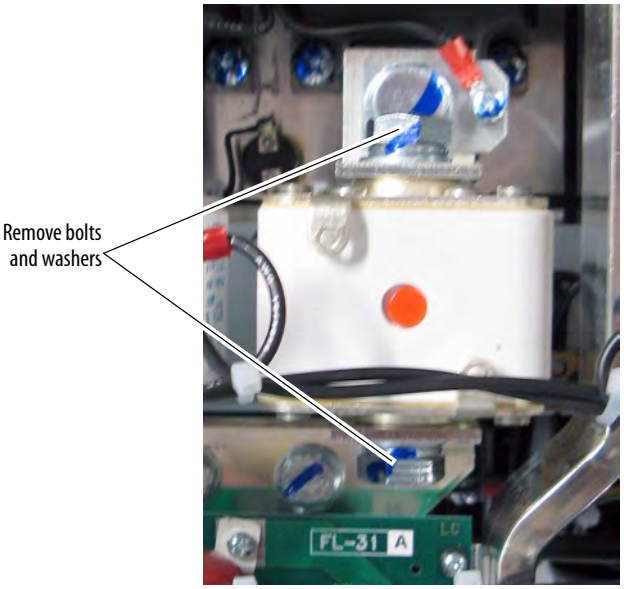



9. Remove the two screws that secure each switch to the fuse and remove the switch. Retain the switch for reuse.



10. Remove the bolts and washers (top and bottom) that secure the fuse to the bus bars and remove the fuse.

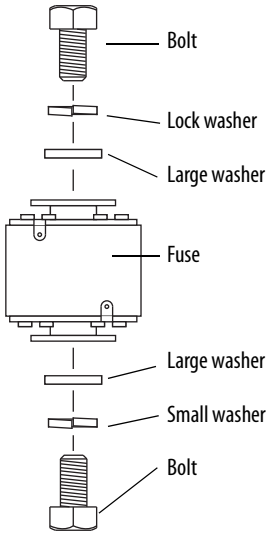
| **IMPORTANT** | Note the order of the washers as you remove them in order to install in the proper order. |
|---|---|




## Install the Armature Leg Fuses

Install the armature leg fuses in reverse order of removal.

| **IMPORTANT** | Verify that the washers are installed in the proper order and that the switches are installed on the correct fuse. |
|---|---|



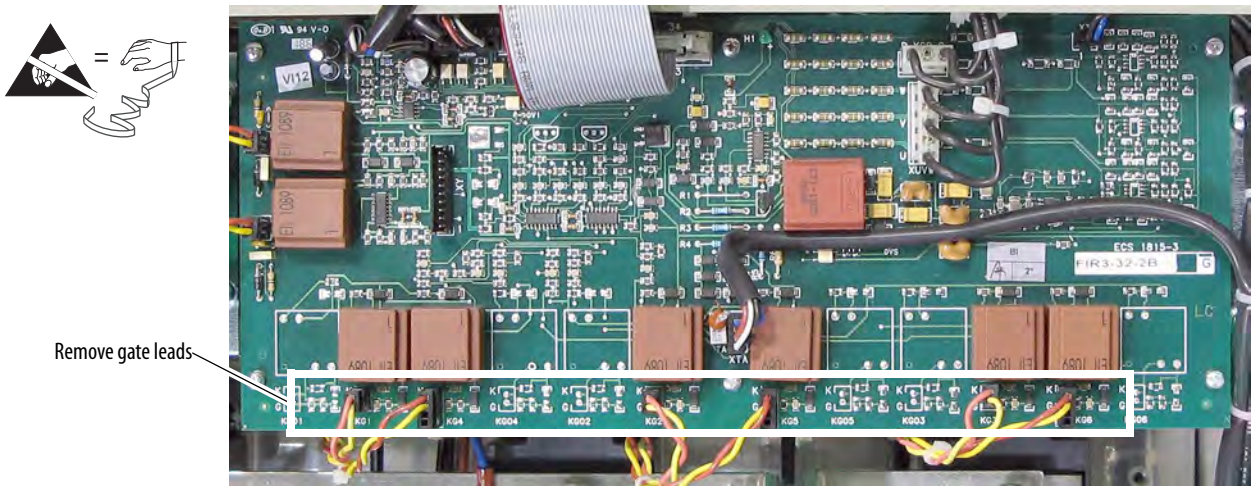
## SCR Modules Removal and Installation

### Remove the SCR Modules

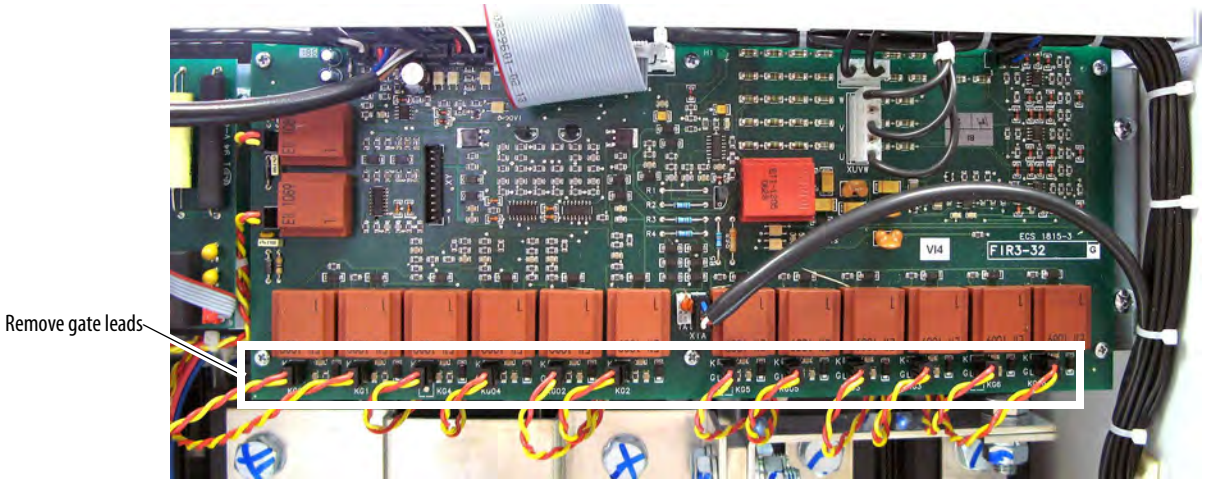
**IMPORTANT** It is recommended that you replace the armature leg fuses for each pair of SCR modules that you replace in the drive. See Remove the Armature Leg Fuses on page 89.

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.
4. Move the control EMI shield. See Move the Control EMI Shield on page 58.
5. Remove the gate leads from the pulse transformer board.

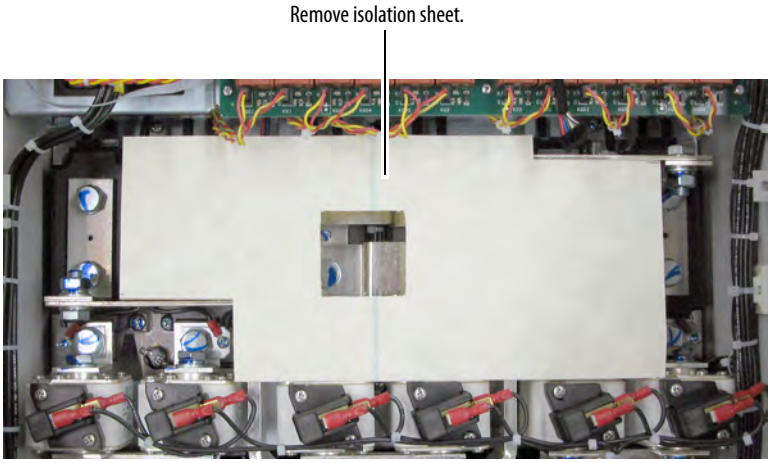
**Non-Regenerative Drive**




**Regenerative Drive**



6. If present, remove the isolation sheet that is secured to the bus bars.

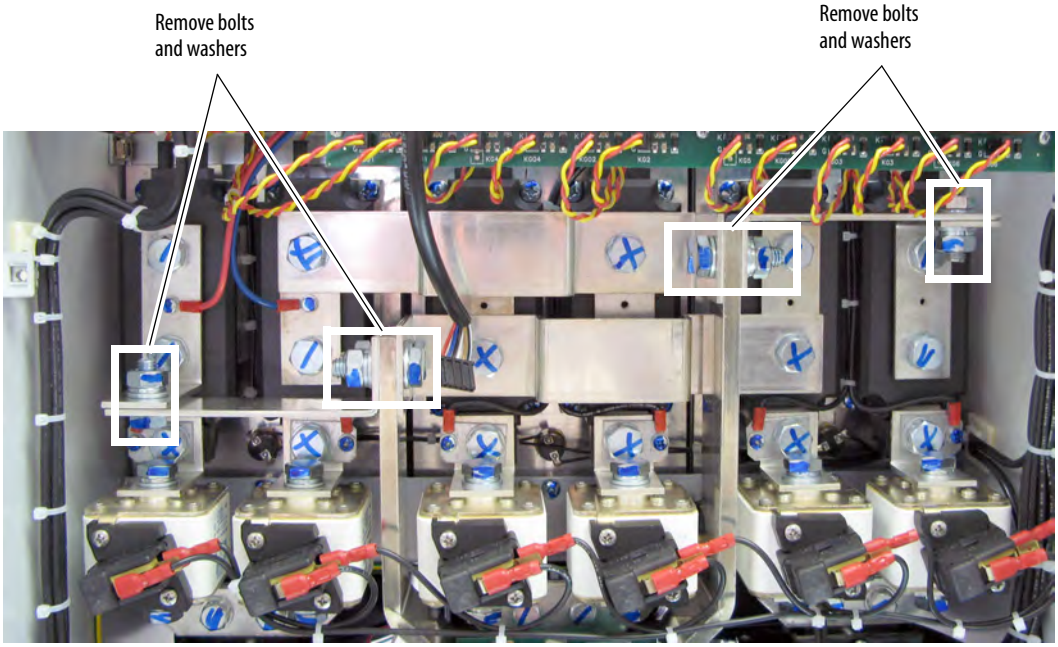



**Note**: Regenerative Drive Shown

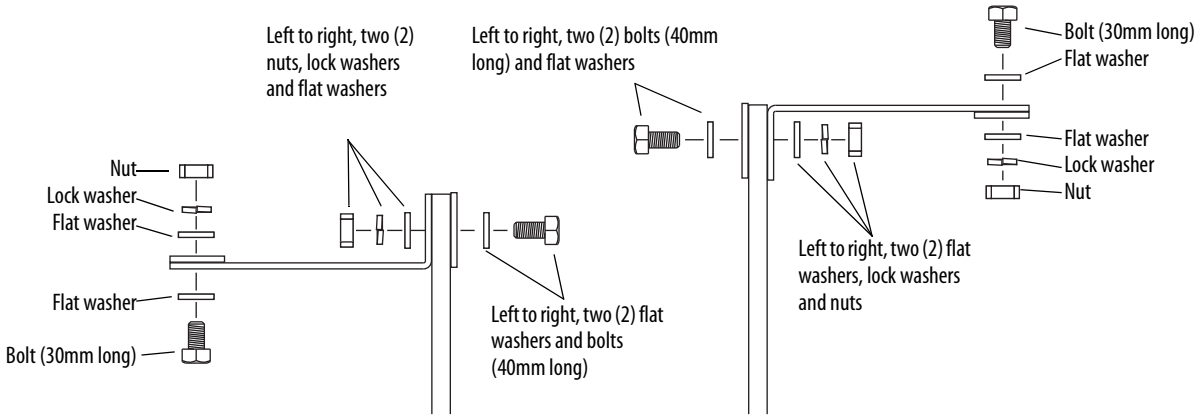
7. Remove the bus bars in order to access the SCR modules in the drive:
   - For regenerative drives, see Remove the Bus Bars from a Regenerative Drive on page 95.
   - For non-regenerative drives, see Remove the Bus Bars from a Non-Regenerative Drive on page 97.

*Remove the Bus Bars from a Regenerative Drive*

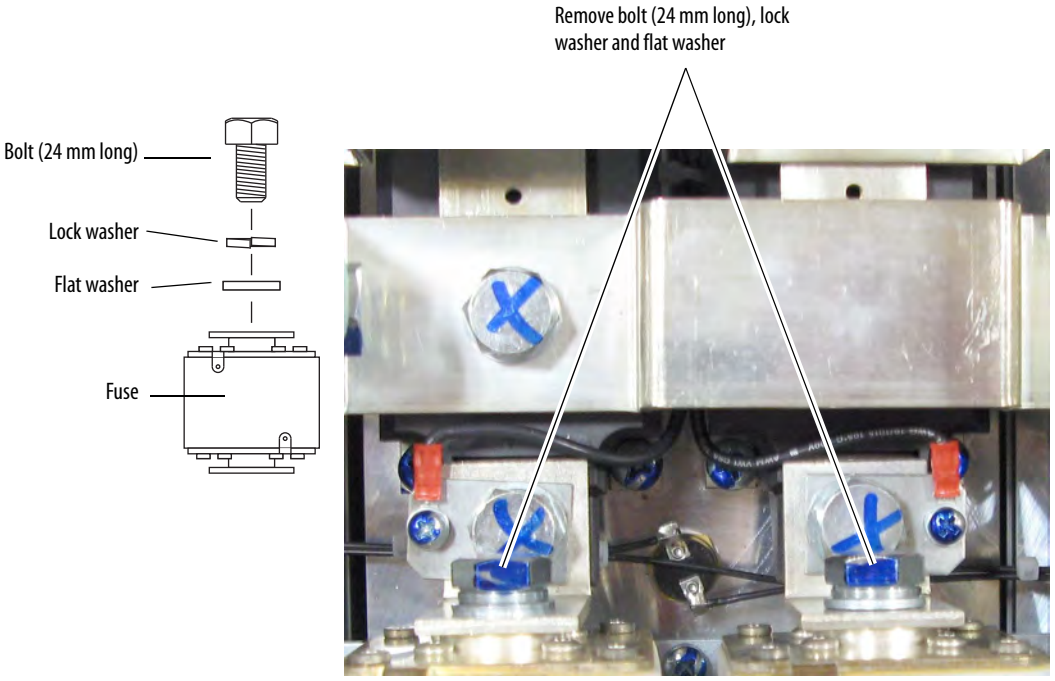
8. Remove the six bolts and washers that secure the intermediate bus bars to the U and W phase AC input and DC output (terminals C and D) bus bars. Note the size and location of the bolts and the order in which the washers are placed on the bolts.



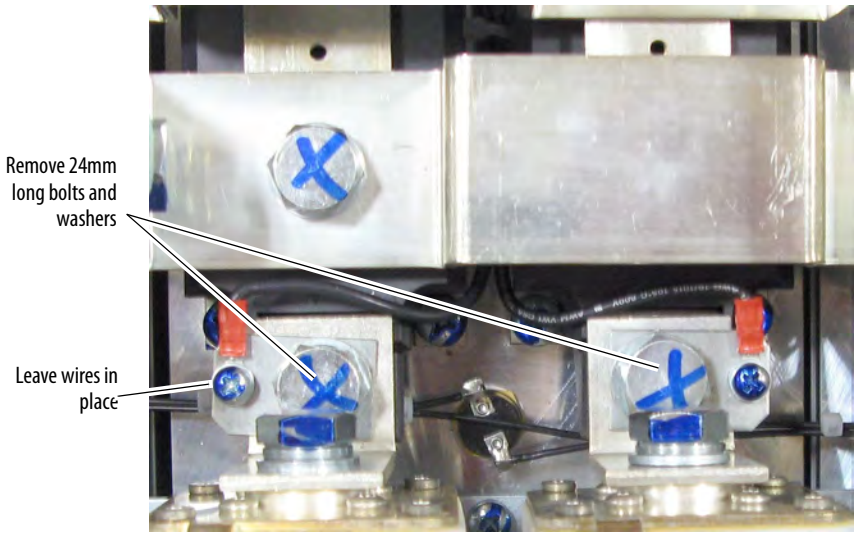

**Bolt Size and Washer Order**



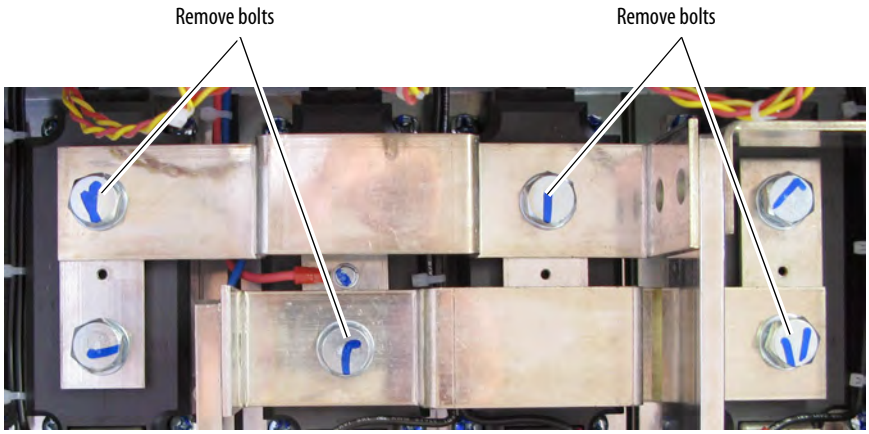
**9.** Remove the bolt (24 mm long) and washers that secure the L-shaped bus bars to the top of each of the six armature leg fuses. Note the order of the washers on the bolt.




**10.** Remove the bolts (24mm long) and washers that secure the L-shaped bus bars to each of the SCR modules and remove the bus bars. Note: You do not need to remove the wires connected to the metal plate secured with the L-shaped bus bar.



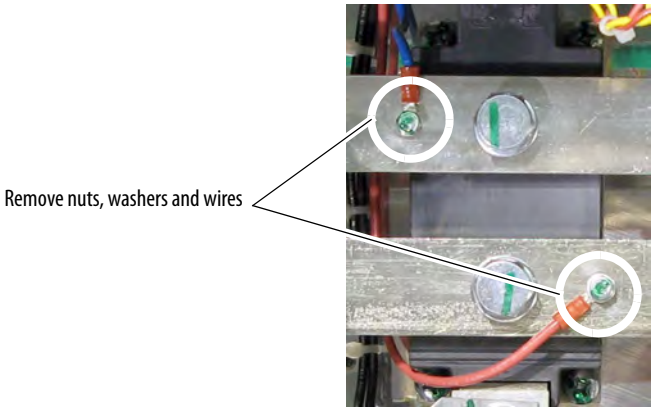
**11.** Remove the four bolts and washers that secure the horizontal bus bars to the SCR modules and remove the bus bars. Note the order of the washers on the bolts and the position of he bus bars.



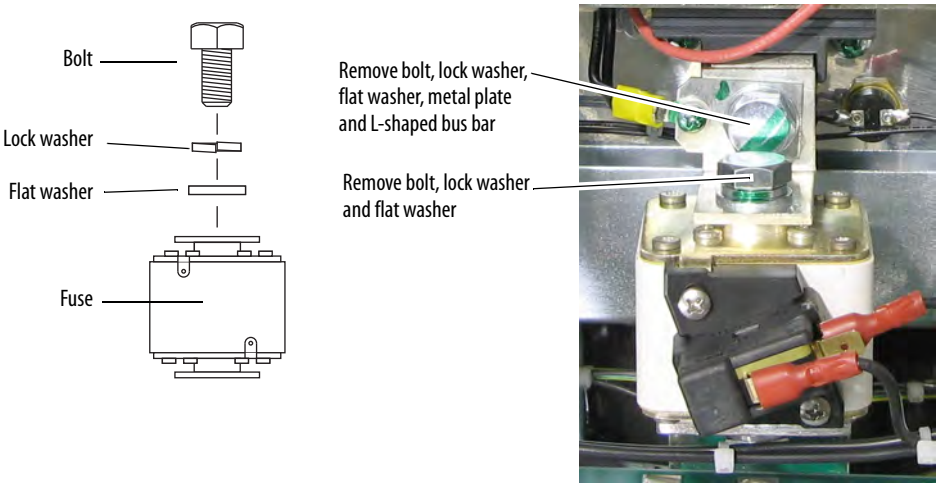

Continue with Remove the SCR Modules on page 99.

*Remove the Bus Bars from a Non-Regenerative Drive*

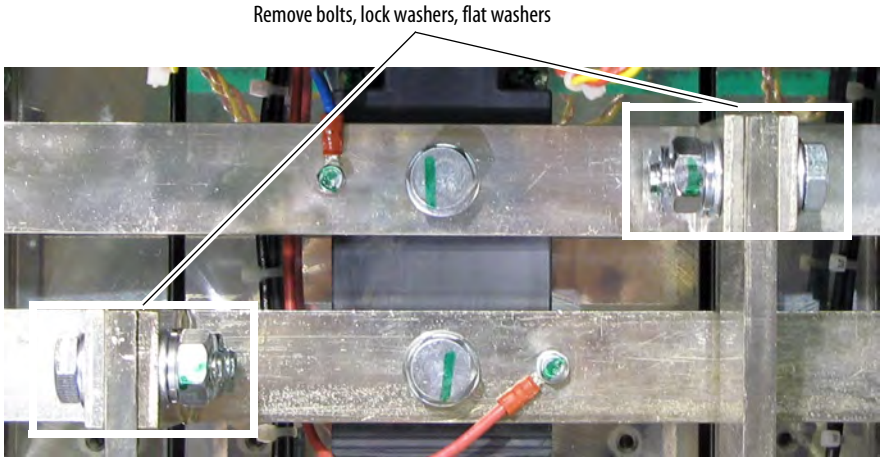
**8.** Remove the nuts and washers that secure the wires (red and blue) from the AC line snubber board to the bus bars and remove the wires.



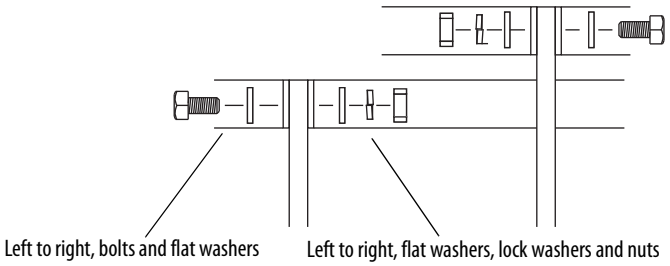
9. Remove the bolts and washers that secure the L-shaped bus bars to the top of each of the three armature leg fuses. Note the order of the washers on the bolt.
10. Remove the bolts and washers that secure the metal plate and L-shaped bus bars to each of the SCR modules and remove the bus bars. Note: You do not need to remove the wires connected to the metal plate secured with the L-shaped bus bar.



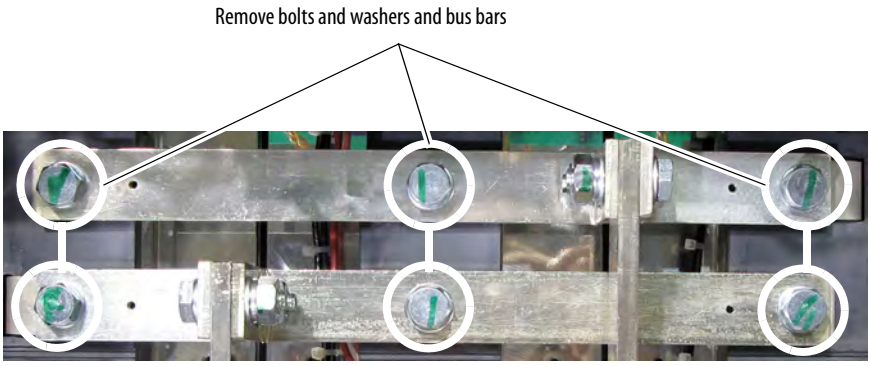

11. Remove the bolts and washers that secure the horizontal bus bars to the C and D (vertical) power terminal bus bars. Note the size and location of the bolts and the order in which the washers are placed on the bolts.




**Bolt and Washer Order**



12. Remove the bolts and washers that secure the horizontal bus bars to the SCR modules and remove the bus bars.

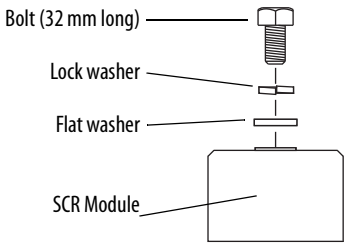


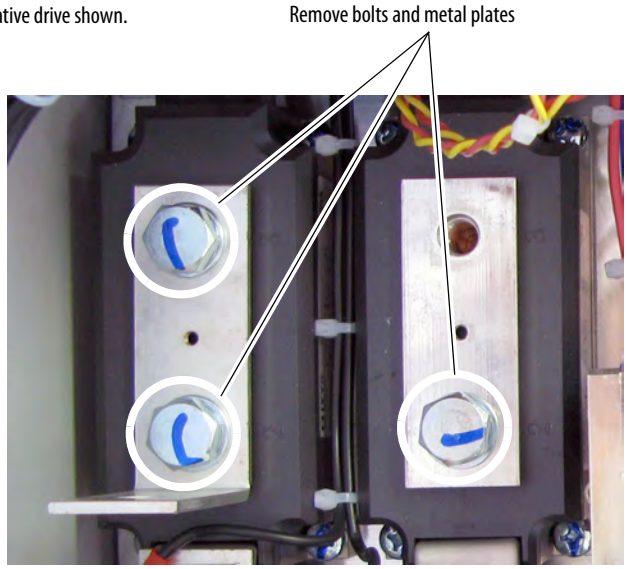

Continue with Remove the SCR Modules below.

*Remove the SCR Modules*

1. Remove the remaining bolts, washers, and metal plates (for regenerative drives only) from the tops of the SCR modules. Note the order of the washers on the bolts.

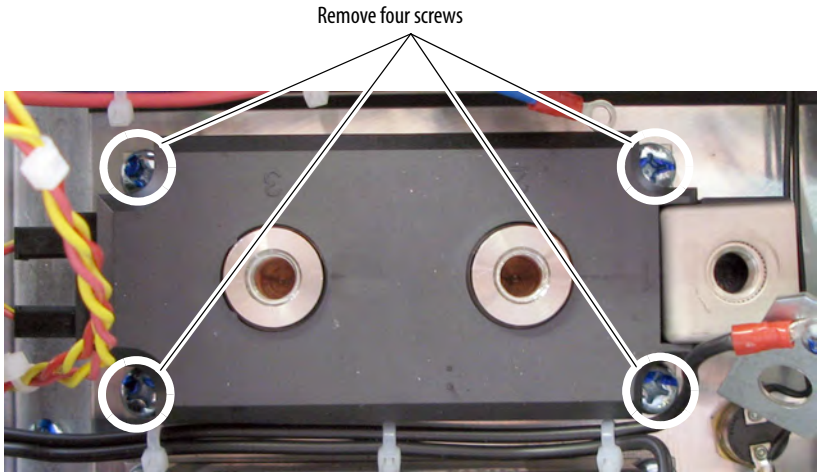
**Note**: Regenerative drive shown.




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

2. Remove the gate leads that connect the SCR modules to the pulse transformer circuit board from the pulse transformer circuit board end.
3. Remove the four screws that secure each SCR module to the heatsink and remove the SCR modules. Note the order of the washers on the bolt.




## Install the SCR Modules

Install the SCR modules in reverse order of removal.

- Verify that each gate lead from the SCR modules is connected to the proper connector on the pulse transformer board.
- Apply thermal grease to the bottom of the SCR modules before securing them to the heatsink.

**ATTENTION:** Thermal grease must be applied to the bottom of the SCR modules before securing them to the heatsink or damage to the drive may occur.

- Use the following table to determine the proper tightening torque for the SCR modules installed on the heatsink:

| 230V AC Input | |
|---|---|
| **Part Number** | **Final Torque** |
| SK-20P-S727F | 4.5…5.5 N•m (40…48.7 lb•in) |
| SK-20P-S770F | 6 Nm (53 lb•in) |

| 460V AC Input | |
|---|---|
| **Part Number** | **Final Torque** |
| SK-20P-S737F | 4.5…5.5 N•m (40…48.7 lb•in) |
| SK-20P-S771F | 6 N•m (53 lb•in) |

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

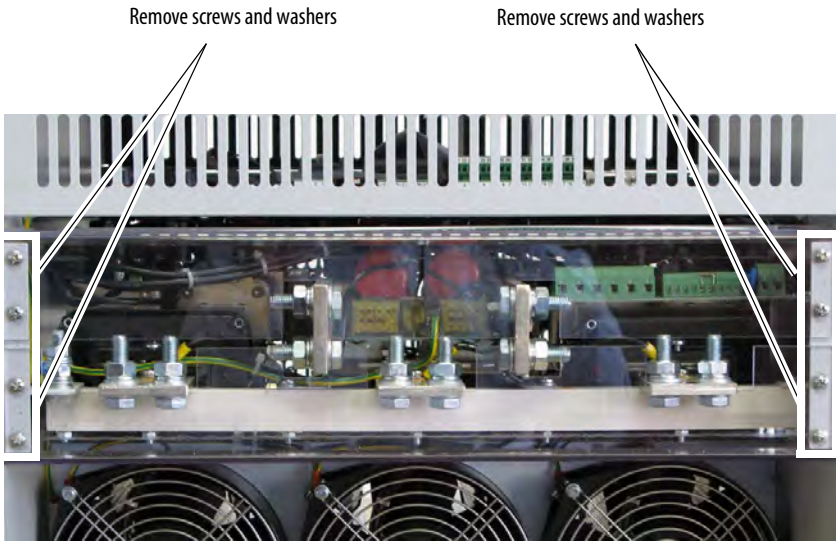
| 230V AC Input | |
|---|---|
| **Part Number** | **Final Torque** |
| SK-20P-S727F | 11…13 N•m (97.4…115 lb•in) |
| SK-20P-S770F | 11…13 N•m (97.4…115 lb•in) |

| 460V AC Input | |
|---|---|
| **Part Number** | **Final Torque** |
| SK-20P-S737F | 11…13 N•m (97.4…115 lb•in) |
| SK-20P-S771F | 11…13 N•m (97.4…115 lb•in) |

# AC Current Transducers Removal and Installation

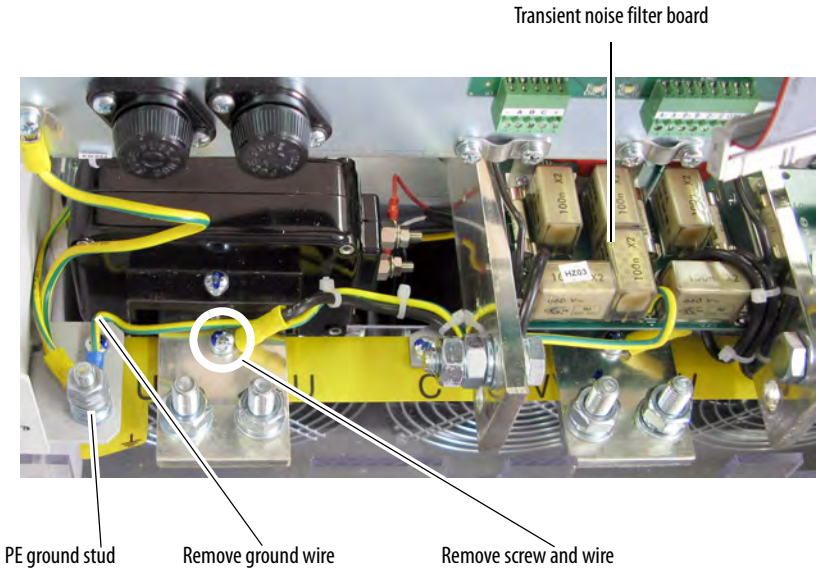
## Remove the AC Current Transducers

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.
4. Remove the eight screws and washers that secure the Lexan shields to the bottom of the drive and remove the shields.

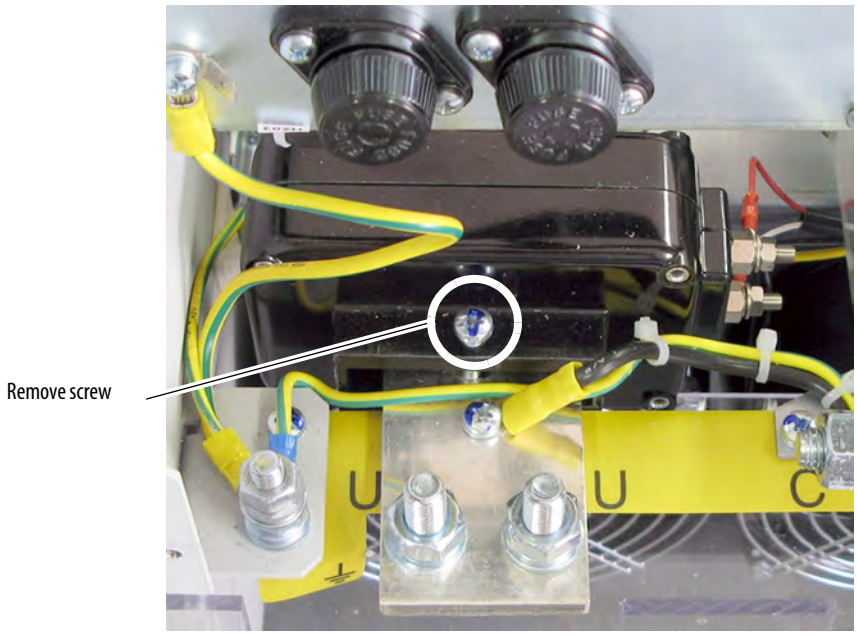



5. Remove the power wiring from the U and W phase AC input power terminals.

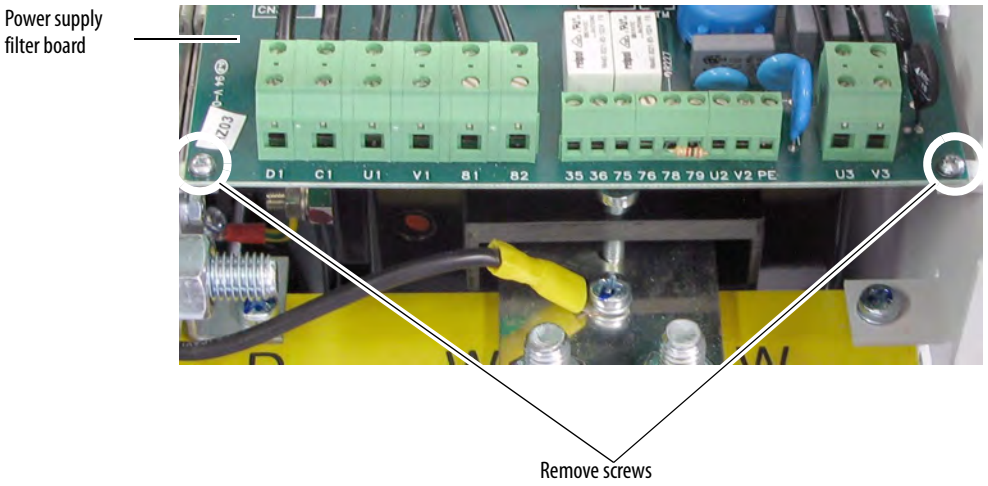
6. Remove the screws that secure the ground wires to the PE terminal (from the transient noise filter board) and U phase power terminal (from the pulse transformer board) and remove the wires.




7. Remove the lower screw that secures the left side AC current transducer to the U phase terminal.

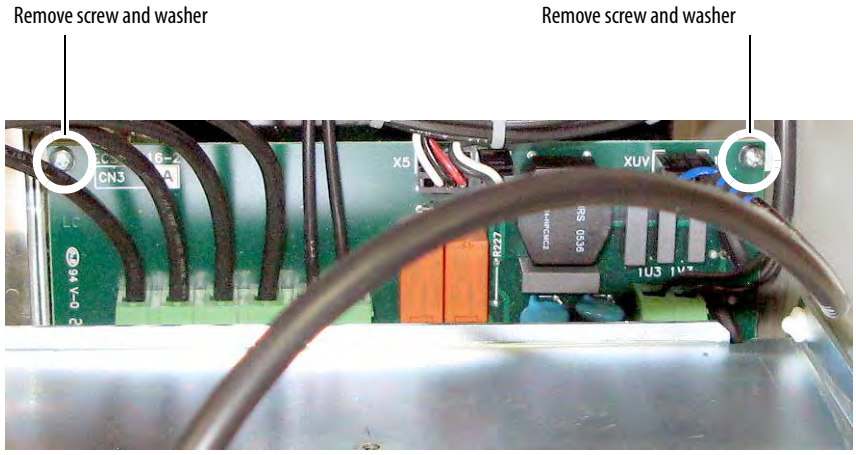


8. Remove the two screws that secure the bottom of the power supply filter circuit board to the drive.

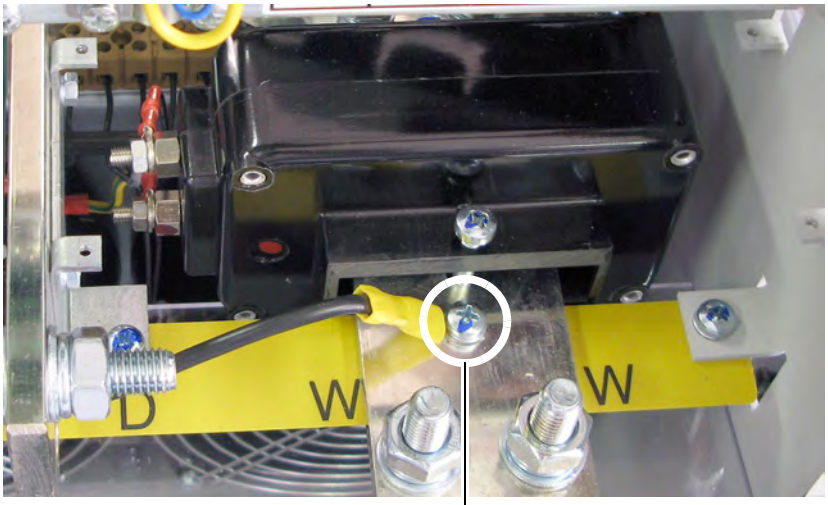



9. Move the control EMI shield. See Move the Control EMI Shield on page 58.

10. Remove the two screws and washers that secure the top of the power supply filter board to the drive and carefully lift the board to gain access to the ground wire connected to the W phase power terminal (see next step).

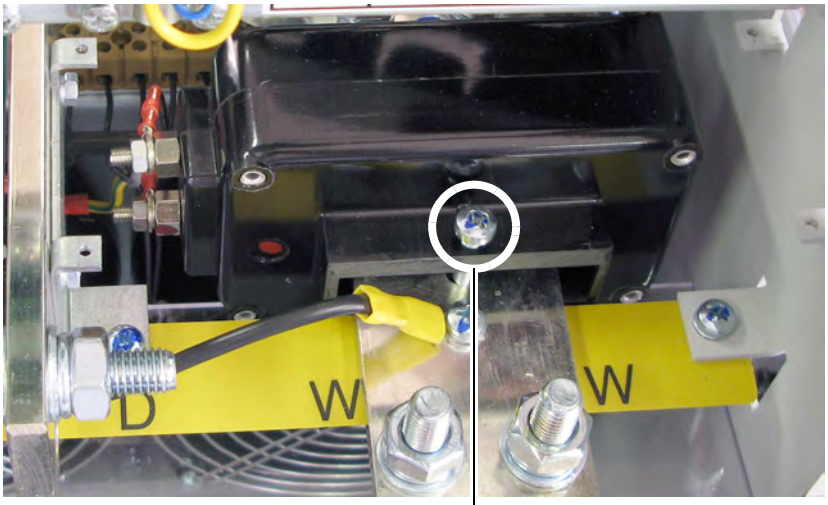


**11.** Temporarily lift the EMI shield and remove the screw that secures the ground wire (from the pulse transformer board) to W phase power terminal and remove the wire.




Remove screw and wire

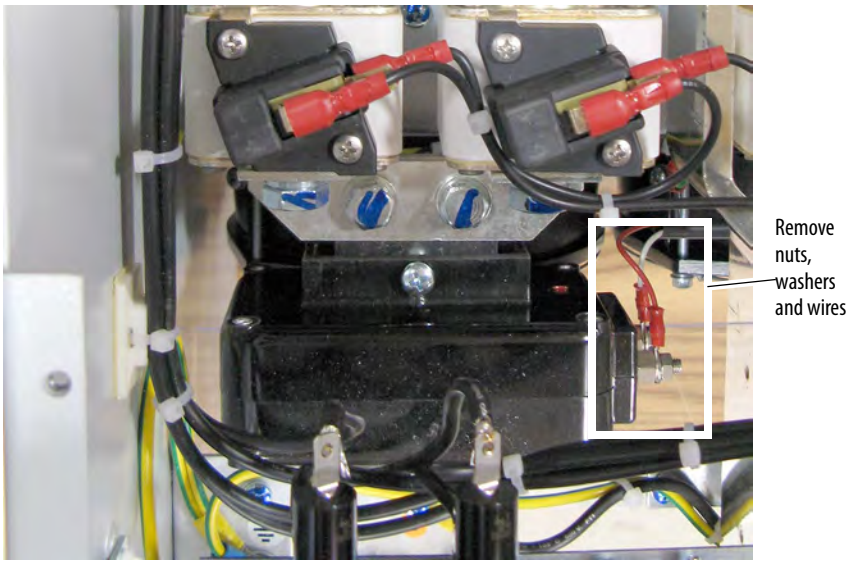
**12.** Remove the lower screw that secures the right side AC current transducer to the W phase power terminal.




Remove screw and wire

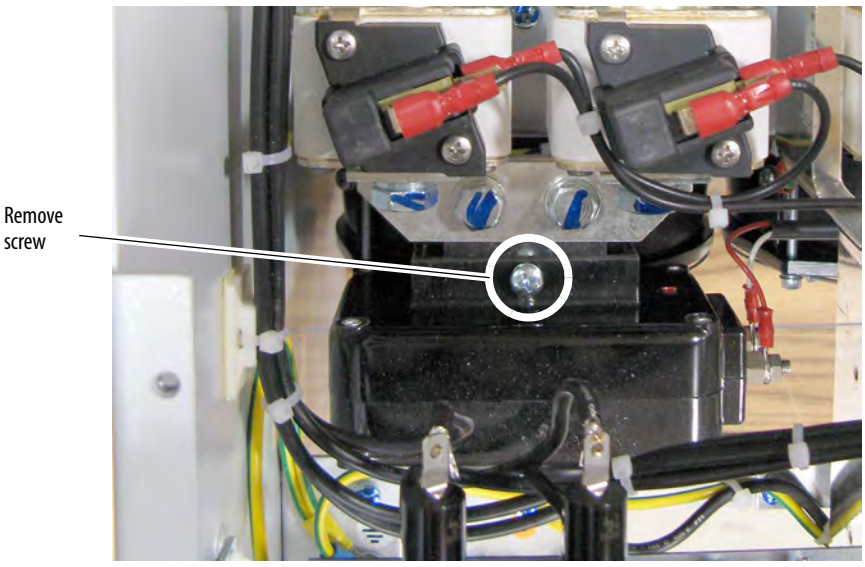
13. Move the EMI shield to the lowered position and remove the nuts and washers that secure the wires (red and white) to each of the AC current transducers and remove the wires.

| **IMPORTANT** | Note the color and location of each lead to ensure that each wire is properly connected during installation. |
|---|---|




**Note**: Left AC current transducer of regenerative drive shown.

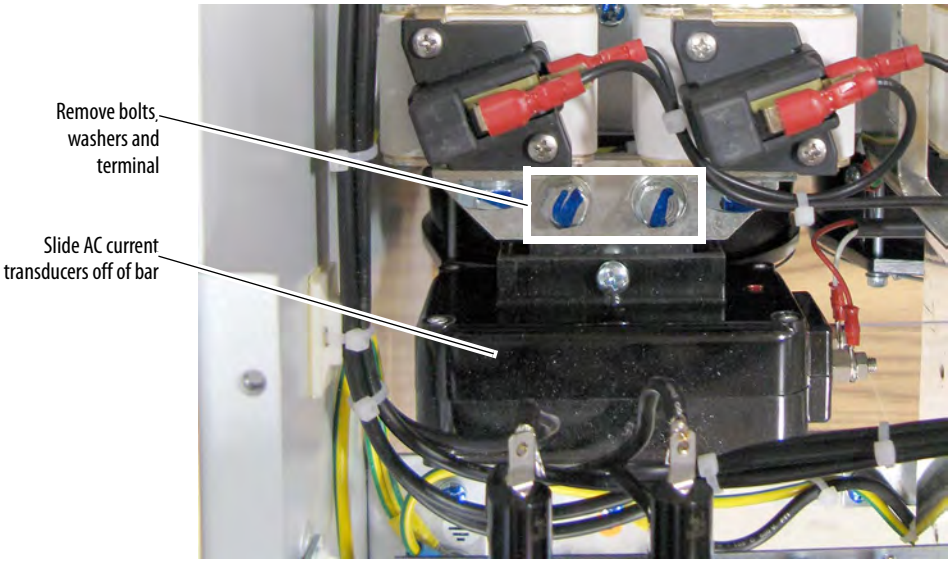
14. Remove the upper screw that secures each of the AC current transducer to the U phase power terminal.




**Note**: Left AC current transducer of regenerative drive shown.

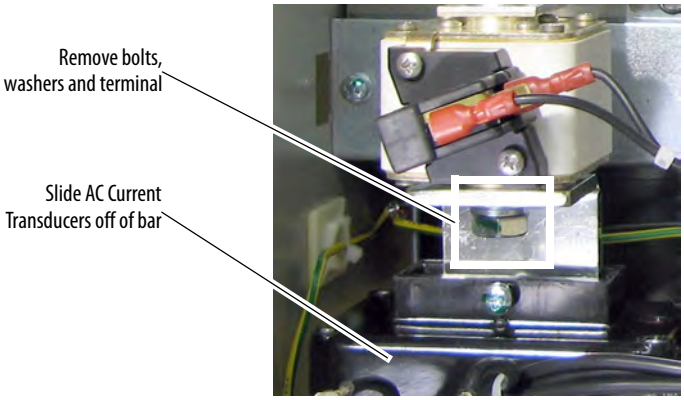
15. Remove the bolt(s) and washer(s) that secure the U and W phase power terminals to the L-shaped bus bar/fuse.
    - For regenerative drives only, remove the two bolts and washers that secure the U and W phase power terminals to the L-shaped bus bars connected to the fuses and while pulling the U and W phase power terminals down toward the bottom of the drive, slide the AC current transducers off of the terminal bus bars and out of the drive.

**Regenerative drive**




- For Non-Regenerative drives only, remove the bolt and washers that secure the U and W phase power terminals to the internal armature fuse and while pulling the U and W phase power terminals up and into the drive, slide the AC current transducers off of the terminal bus bars and out of the drive.

**Non-Regenerative drive**

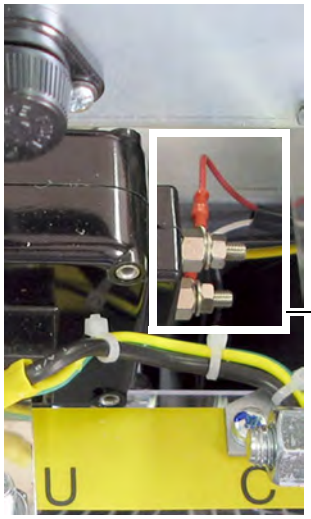


### Install the AC Current Transducers

Install the AC current transducers in reverse order of removal.

**IMPORTANT** Note the color and location of the signal wires to ensure that each wire is properly connected during installation. The wires connected to the left CT are red and white and the wires connected to the right CT are blue and black.

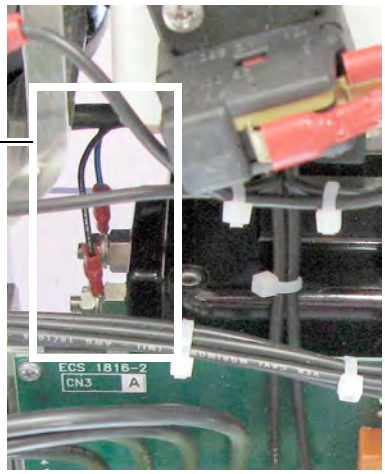
**Left AC Current Transducer**




Left CT - red and white wires

Right CT - blue and black wires

**Right AC Current Transducer**

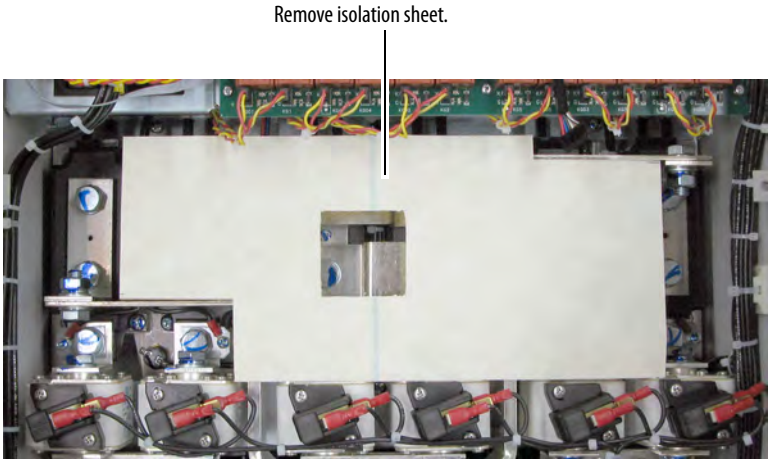



## Bimetal Thermostats Removal and Installation

### Remove the Bimetal Thermostats

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.
4. Move the control EMI shield. See Move the Control EMI Shield on page 58.

5. If present, remove the isolation sheet that is secured to the bus bars.

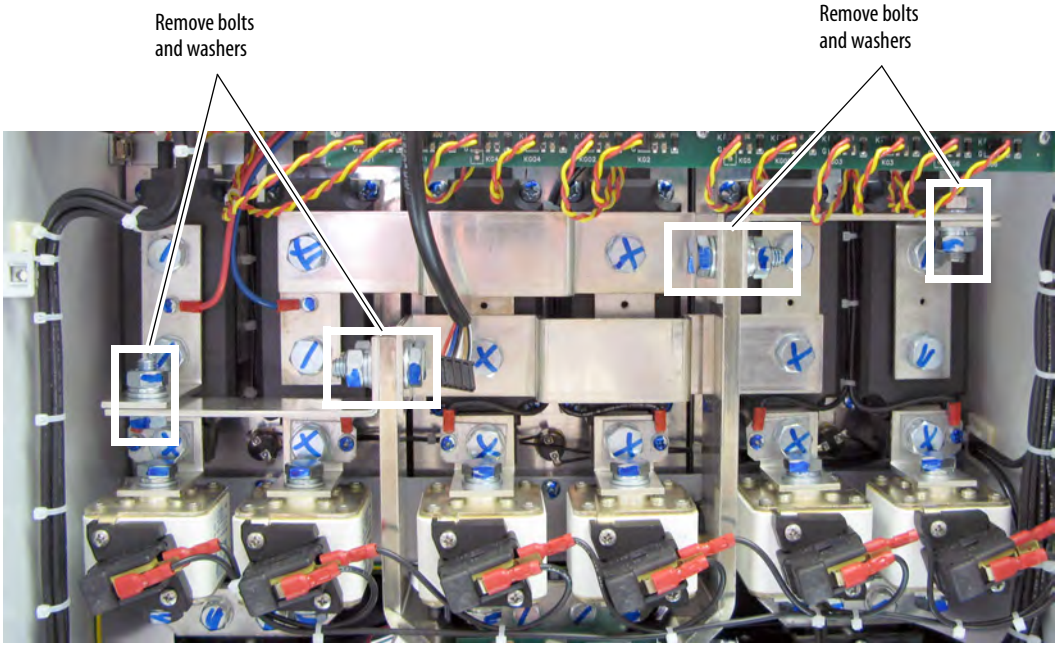



| | |
|---|---|
| **IMPORTANT** | You must remove the bus bars and, for regenerative drives, one SCR module from each pair, for non-regenerative drives, all SCR modules, in order to easily access and remove the bimetal thermostats. |

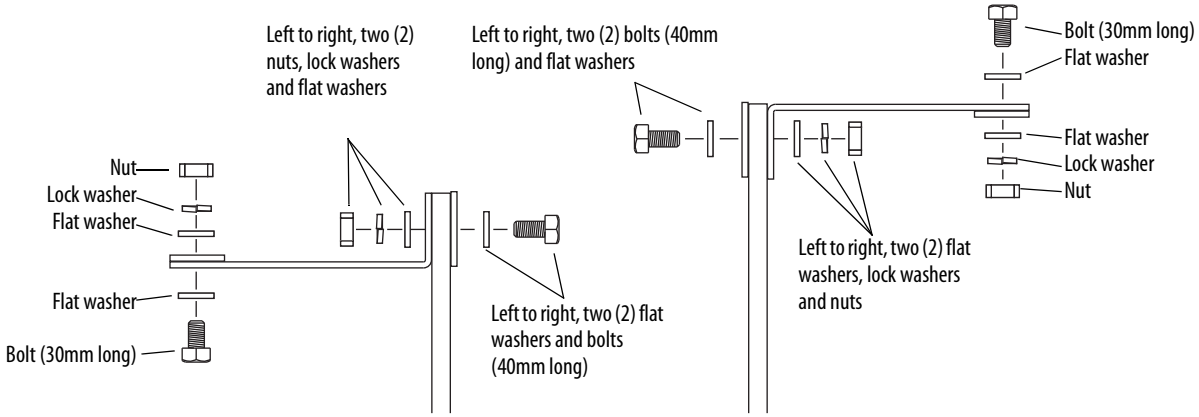
6. Remove the bus bars in order to access the bimetal thermostats in the drive:
   - For regenerative drives, refer to Remove the Bus Bars from a Regenerative Drive on page 3-109.
   - For non-regenerative drives, refer to Remove the Bus Bars from a Non-Regenerative Drive on page 3-111.

*Remove the Bus Bars from a Regenerative Drive*

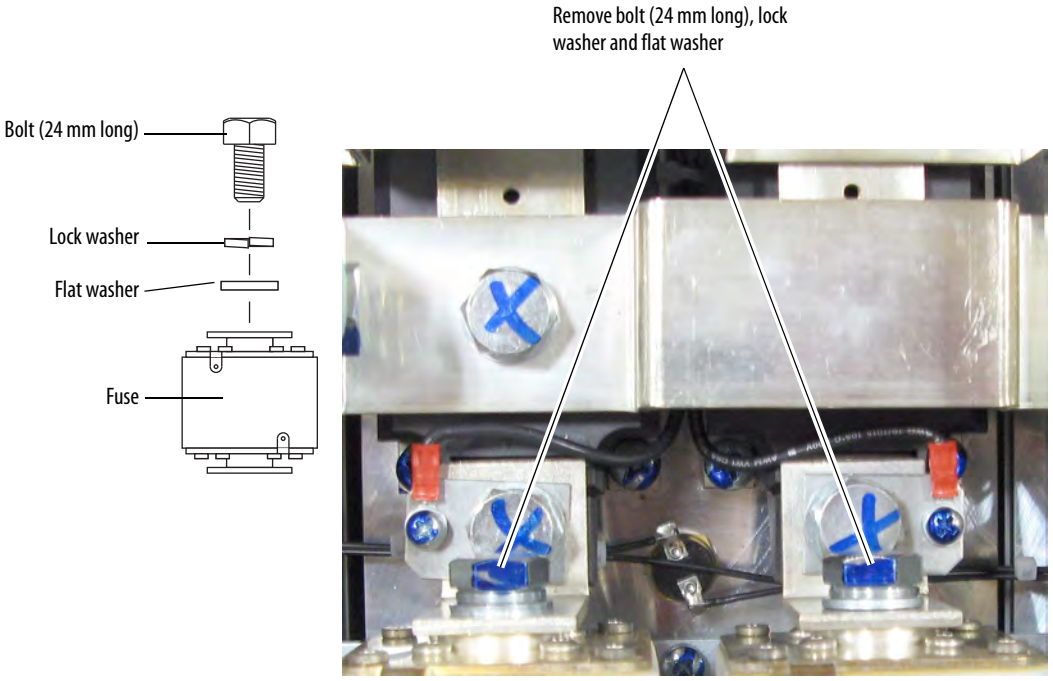
7. Remove the six bolts and corresponding washers that secure the intermediate bus bars to the U and W phase AC input and DC output (terminals C and D) bus bars. Note the size and location of the bolts and the order in which the washers are placed on the bolts.



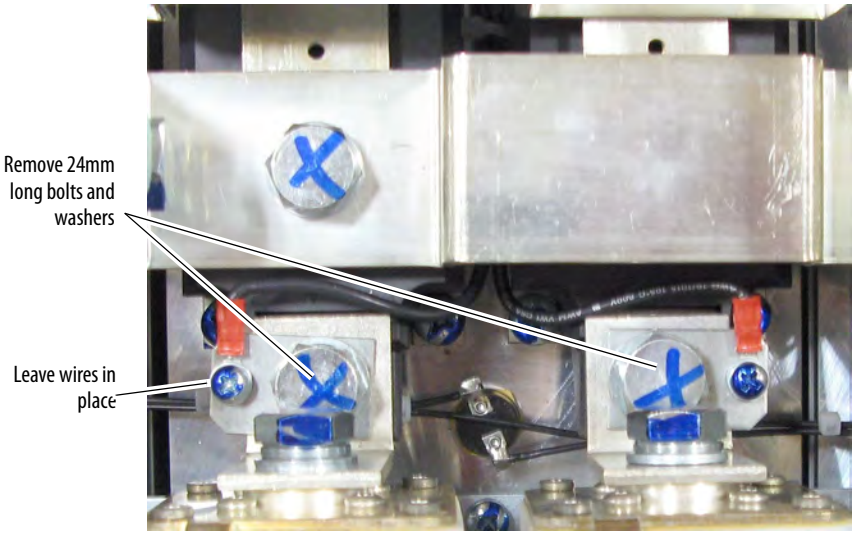

**Bolt Size and Washer Order**



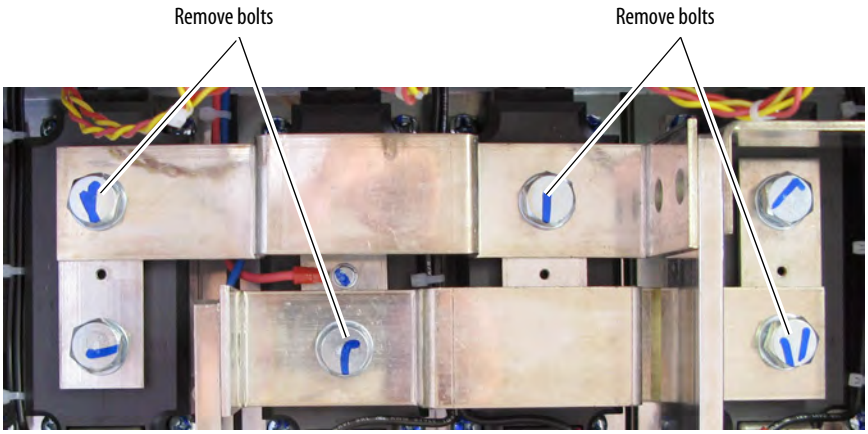
8. Remove the bolt (24 mm long) and washers that secure the L-shaped bus bars to the top of each of the six internal armature leg fuses. Note the order of the washers on the bolt.




9. Remove the bolts (24mm long) and washers that secure the L-shaped bus bars to each of the SCR modules and remove the bus bars. Note: You do not need to remove the wires connected to the metal plate secured with the L-shaped bus bar.



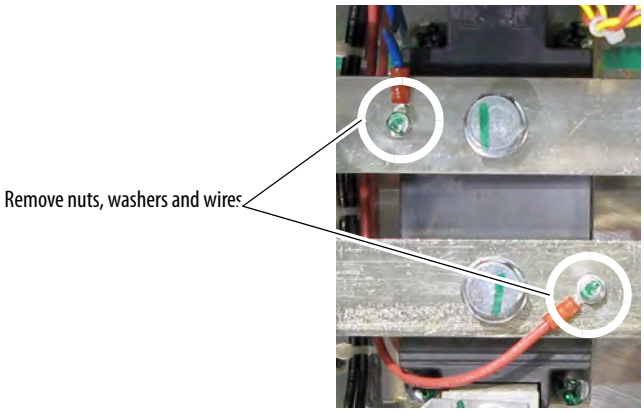
10. Remove the four bolts and washers that secure the horizontal bus bars to the SCR modules and remove the bus bars. Note the order of the washers on the bolts and the position of the bus bars.



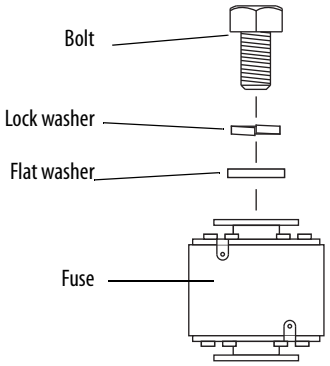

Continue with Remove the SCR Modules and Bimetal Thermostats on page 3-113.

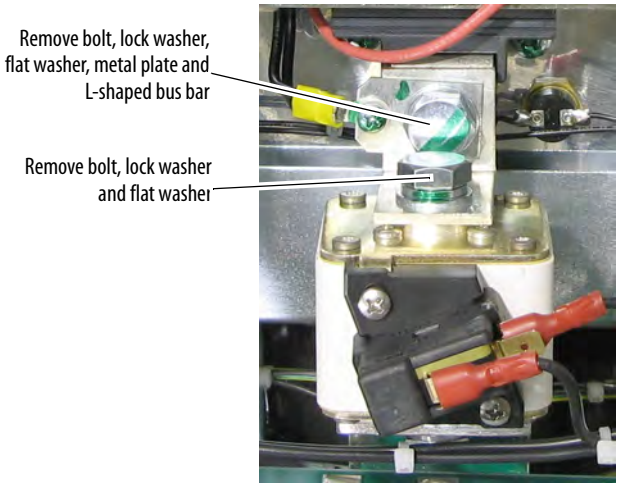
*Remove the Bus Bars from a Non-Regenerative Drive*

7. Remove the nuts and washers that secure the wires (red and blue) from the AC line snubber board to the bus bars and remove the wires.

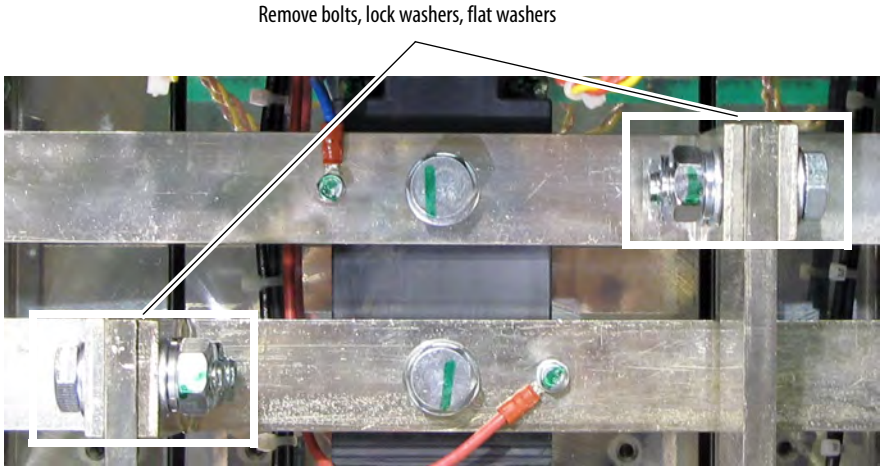


8. Remove the bolts and washers that secure the L-shaped bus bars to the top of each of the three internal armature leg fuses. Note the order of the washers on the bolt.
9. Remove the bolts and washers that secure the metal plate and L-shaped bus bars to each of the SCR modules and remove the bus bars. Note: You do not need to remove the wires connected to the metal plate secured with the L-shaped bus bar.

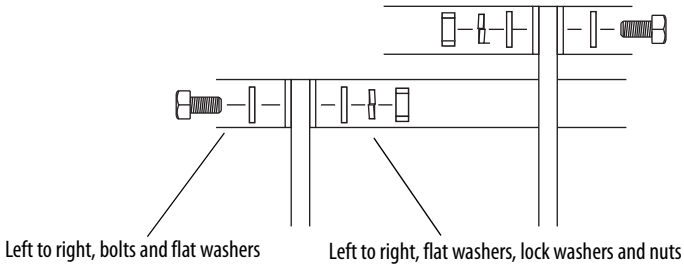


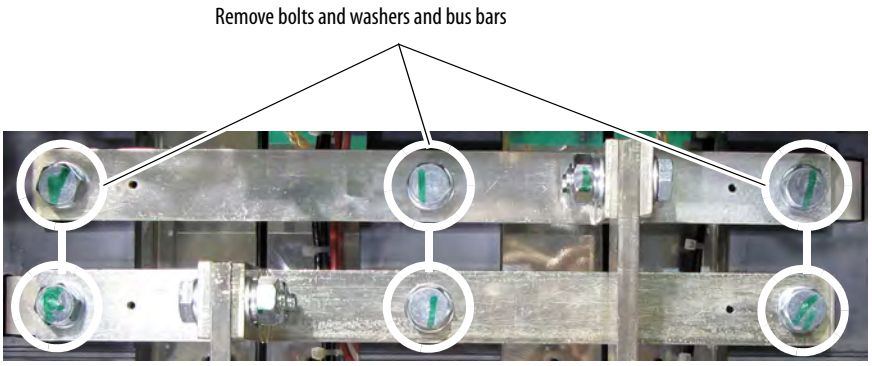

10. Remove the bolts and washers that secure the horizontal bus bars to the C and D (vertical) power terminal bus bars. Note the size and location of the bolts and the order in which the washers are placed on the bolts.




**Bolt and Washer Order**



**11.** Remove the bolts and washers that secure the horizontal bus bars to the SCR modules and remove the bus bars.

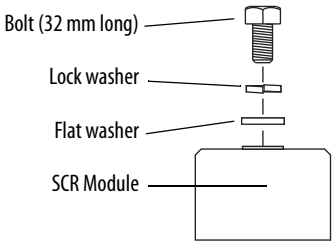


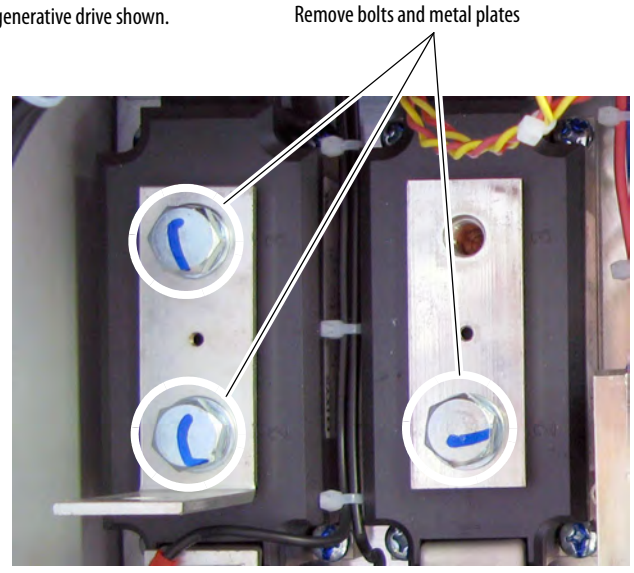

Continue with Remove the SCR Modules and Bimetal Thermostats below.

*Remove the SCR Modules and Bimetal Thermostats*

**1.** Remove the remaining bolts, washers and metal plates (for regenerative drives only) from the tops of the SCR modules. Note the order of the washers on the bolts.

**Note**: Regenerative drive shown.

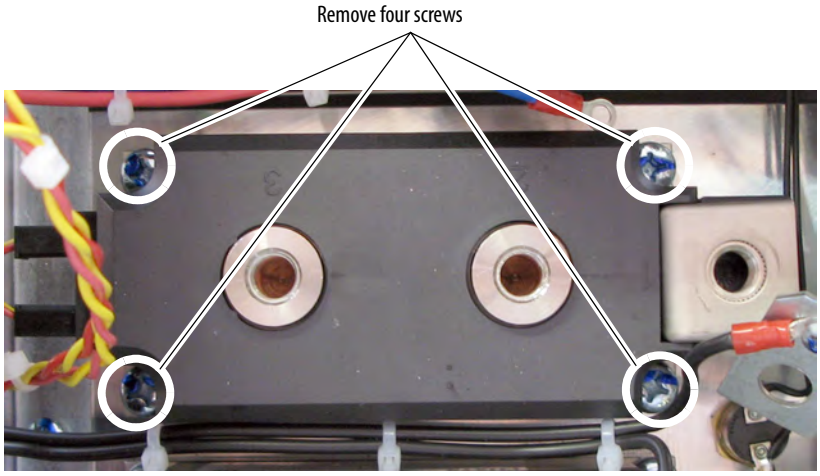


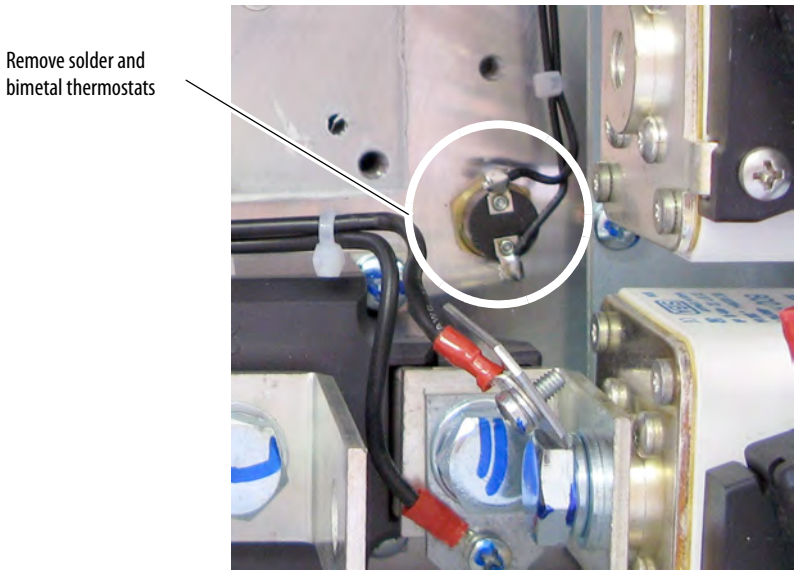

| **IMPORTANT** | Mark all connections and wires before removal to avoid incorrect wiring during reassembly. |
|---|---|

**2.** Remove the gate leads that connect the SCR modules to the pulse transformer circuit board from the pulse transformer circuit board end.

3. Remove the four screws that secure each SCR module to the heatsink and remove the SCR modules. Note the order of the washers on the bolt.




4. Remove the wires connected to the bimetal thermostats from connector X4 on the pulse transformer circuit board.
5. Remove the solder from the connections on the two leads of the bimetal thermostats.
6. Remove the bimetal thermostats from the heatsinks by unscrewing them at the base.



### Install the Bimetal Thermostats

Install the bimetal thermostats in reverse order of removal.

- Apply thermal grease to the bottom of the bimetal thermostats before securing them to the heatsink.

**ATTENTION:** Thermal grease must be applied to the bottom of the bimetal thermostats before securing them to the heatsink or damage to the drive may occur.

- Use the following table to determine the proper tightening torque for the screws that secure the SCR modules to the heatsink:

| 230V AC Input | | | | |
|---|---|---|---|---|
| **Drive Current Rating Code** | **DC Amps** | **AC Line Amps** | **HP** | **Final Torque** |
| 521 | 521 | 426 | 150 | 6 N•m (53 lb•in) |

| 460V AC Input | | | | |
|---|---|---|---|---|
| **Drive Current Rating Code** | **DC Amps** | **AC Line Amps** | **HP** | **Final Torque** |
| 495 | 495 | 404.4 | 300 | 4.5…5.5 N•m (40…48.7 lb•in) |
| 667 | 667 | 544.9 | 400 | 6 N•m (53 lb•in) |

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

| 230V AC Input | | | | |
|---|---|---|---|---|
| **Drive Current Rating Code** | **DC Amps** | **AC Line Amps** | **HP** | **Final Torque** |
| 521 | 521 | 426 | 150 | 11…13 N•m (97.4…115 lb•in) |

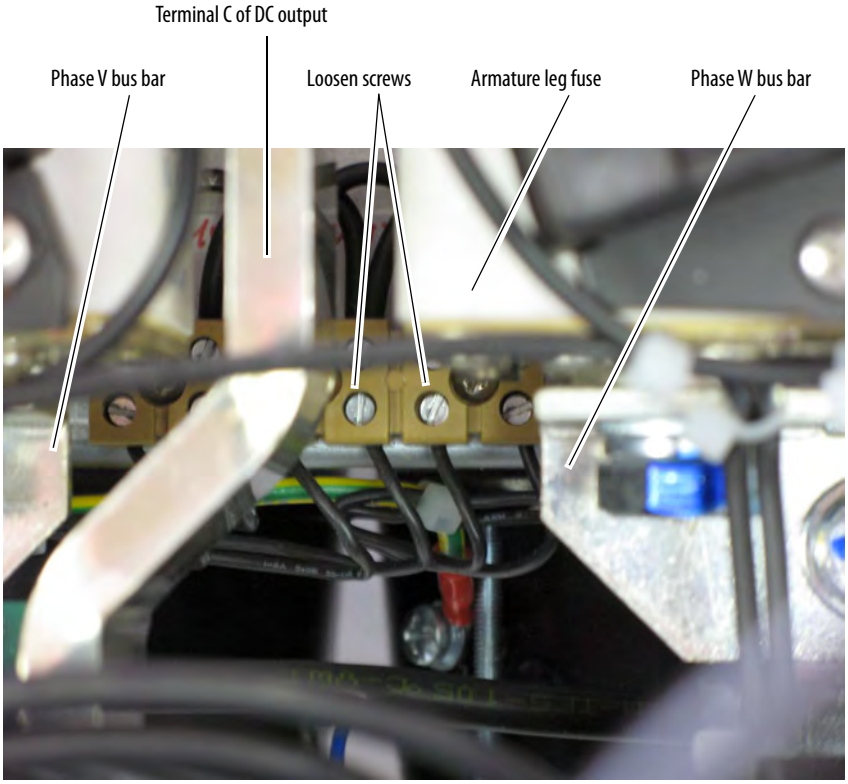
| 460V AC Input | | | | |
|---|---|---|---|---|
| **Drive Current Rating Code** | **DC Amps** | **AC Line Amps** | **HP** | **Final Torque** |
| 495 | 495 | 404.4 | 300 | 11…13 N•m (97.4…115 lb•in) |
| 667 | 667 | 544.9 | 400 | |

## Cooling Fans Removal and Installation

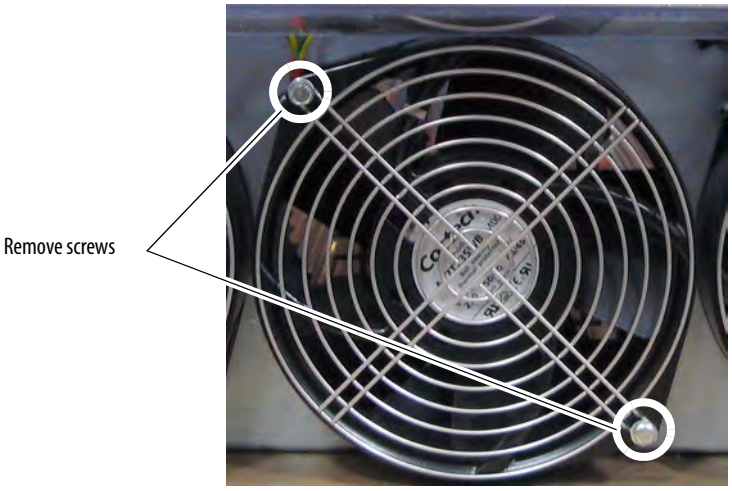
### Remove the Cooling Fans

1. Read the General Safety Precautions on page 10.
2. Remove power from the drive. See Remove Power from the Drive on page 42.
3. Remove the covers from the drive. See Remove the Protective Covers from the Drive on page 43.
4. Move the control EMI shield. See Move the Control EMI Shield on page 58.

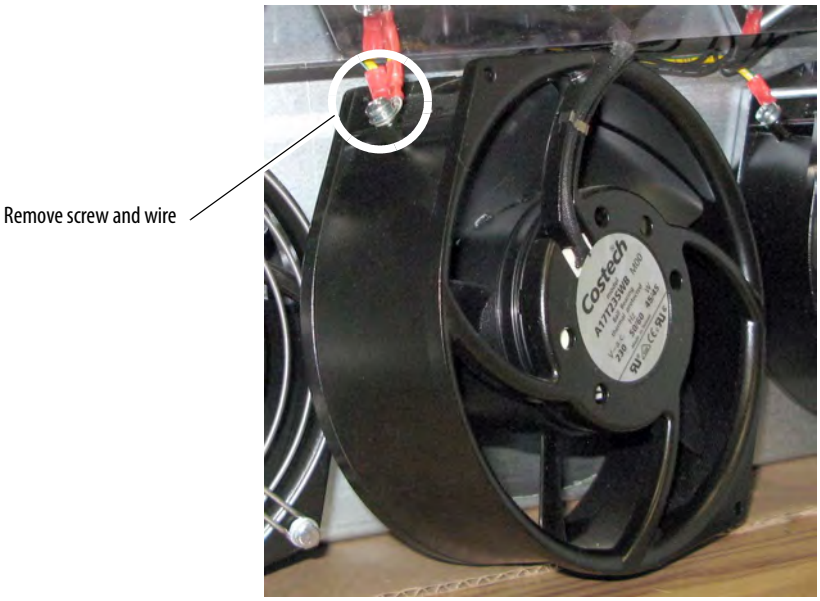
5. Locate the cooling fan terminal block and loosen the screws that secure the fan power supply wires to the terminal block. The cooling fan terminal block is located below the internal armature leg fuses and between the phase V and W AC input bus bars.



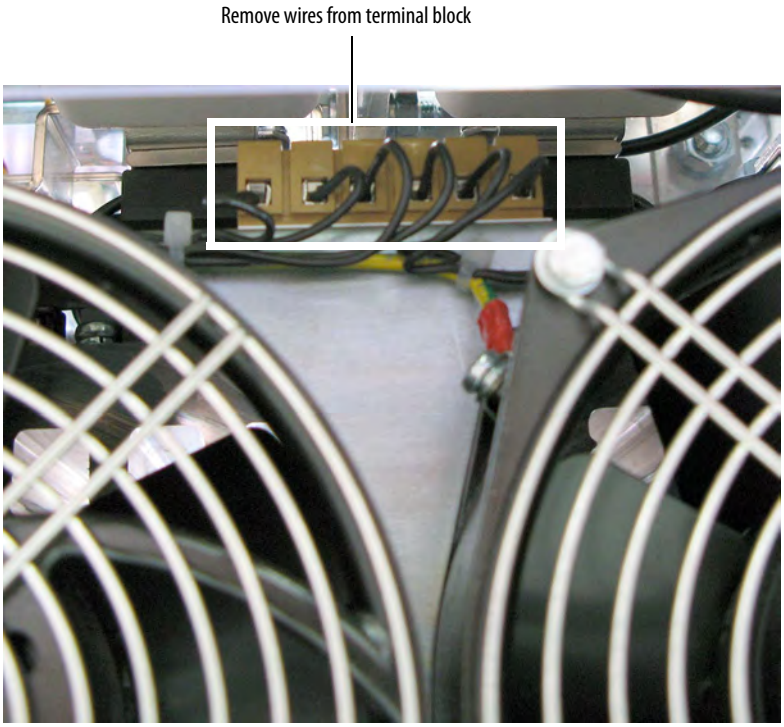

6. At the bottom of the drive, remove the two screws that secure the fan to the drive frame and pull the fan away from the drive.



7. Remove the screw that secures the ground wire to the fan chassis and remove the ground wire.




8. Remove the loosened fan power supply wires from the terminal block and remove the fan.



## Install the Cooling Fans

Install the cooling fans in reverse order of removal.

# Start Up After Repair

Before applying power to a repaired drive, perform the following tests:

- Check the Armature SCR Modules on page 27
- Check the Field SCR/Dual Diode Module on page 33
- Complete the Test With the Motor, Without a Mechanical Load below.

## Test With the Motor, Without a Mechanical Load

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

This procedure requires a HIM to configure and autotune the drive. If you prefer, you can use the DriveExplorer™ or DriveExecutive™ software.

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

1. Verify that the input power wiring and grounding is connected.
2. Verify that the motor cables are connected.
3. Verify that the motor load is disconnected.
4. Verify that the control board DIP switches are set correctly. See Install the Control Circuit Board on page 58 for more information.
5. Apply power to the control circuits (terminals U2 and V2) of the drive.
6. Verify that the following parameter values are set correctly:
   - 45 [Max Ref Speed] is set to the motor nameplate base speed.
   - 162 [Max Feedback Spd] is set to the motor nameplate base speed.
   - 175 [Rated Motor Volt] is set to the motor rated nameplate armature voltage.
   - 179 [Nom Mtr Arm Amps] is set to the rated motor nameplate armature current.
   - 280 [Nom Mtr Fld Amps] is set to the rated motor nameplate field current.

- 374 [Drv Fld Brdg Amps] is set to the rated current of the field bridge regulator

7. Energize the drive.
8. Measure the field current and verify that the value is reflected in parameter 234 [Fld Current Pct].
9. Run the following applicable Autotune procedures detailed in Chapter 2 of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001.
   - Tune the Current Regulator
   - Verify Motor Rotation Direction and Run Feedback Polarity Checks. If parameter 414 [Fdbk Device Type] is set to 3 "Armature", set parameter 107 [Speed Zero Level] to a minimum value of 10% of base motor speed.
   - Configure the Speed Feedback Parameters
   - Tune the Speed Regulator
10. Make configuration changes that allow the HIM to issue start and speed commands.
11. Start the drive, by pressing  (the start button).

    If the drive will not start, verify that you have correctly installed any replacement components.

    If any faults are displayed on the HIM, refer to Chapter 4 - Troubleshooting in the PowerFlex Digital DC Drive User Manual, publication 20P-UM001.
12. Increase the speed command from zero to base speed, by pressing  (the up button).
13. Measure the output voltage and verify that it is reflected in parameter 233 [Output Voltage].
14. Measure the armature current and verify that the value is reflected in parameter 199 [Arm Current Pct].
15. Stop the drive, by pressing  (the stop button).
16. If these measurements are correct, re-configure the drive to suit the application. Refer to Chapters 1 and 2 of the PowerFlex Digital DC Drive User Manual, publication 20P-UM001 for assistance.

    If any of these measurements are incorrect, repeat steps 8...15. If the measurements are still incorrect, repeat the appropriate procedures in Chapter 2 - Component Test Procedures beginning on page 13.

# Schematics

## List of Schematic Diagrams

**Figure 13 - Circuit Board Interconnection Diagram**

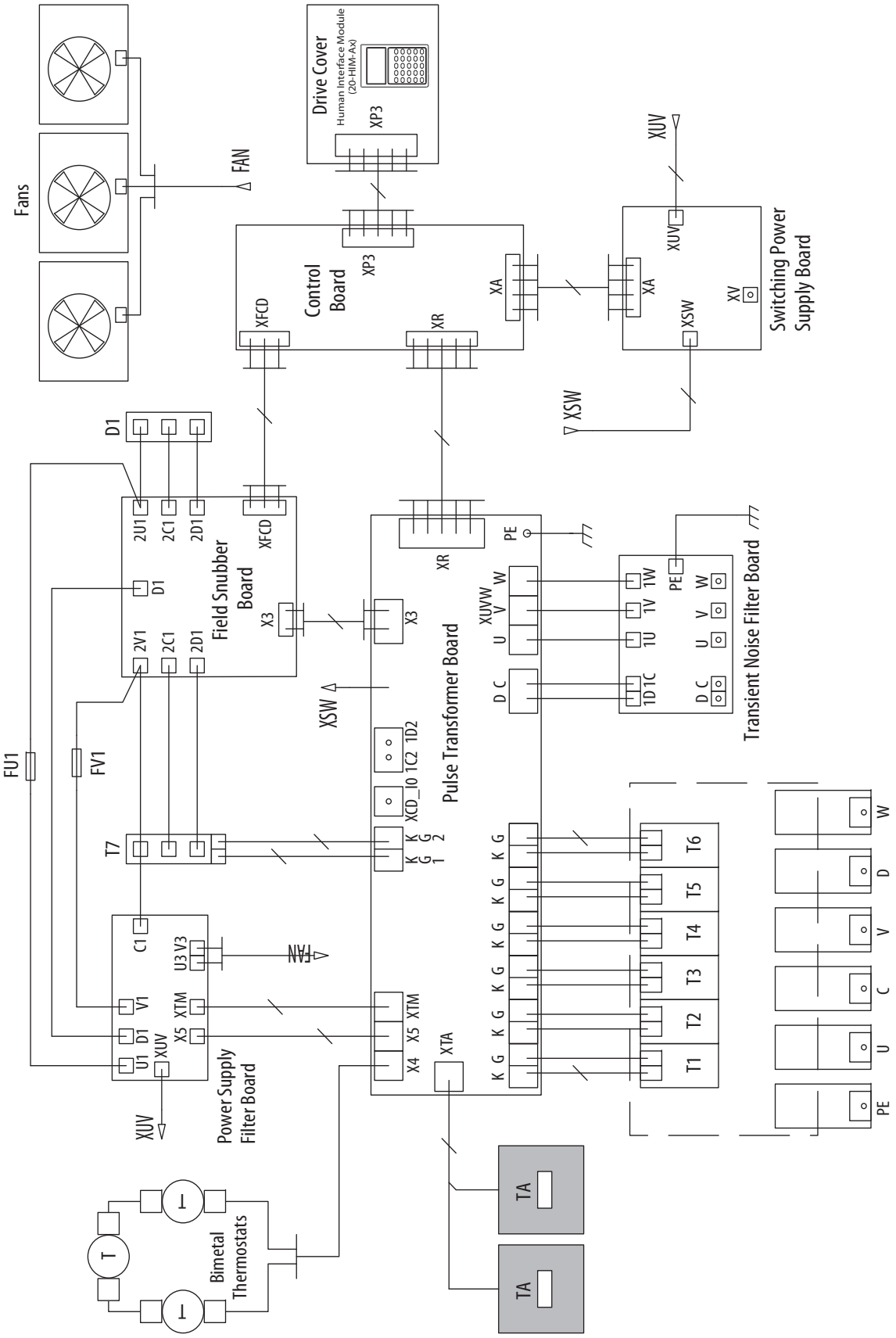


**Figure 14 - Non-regenerative Drive Power Module Diagram**

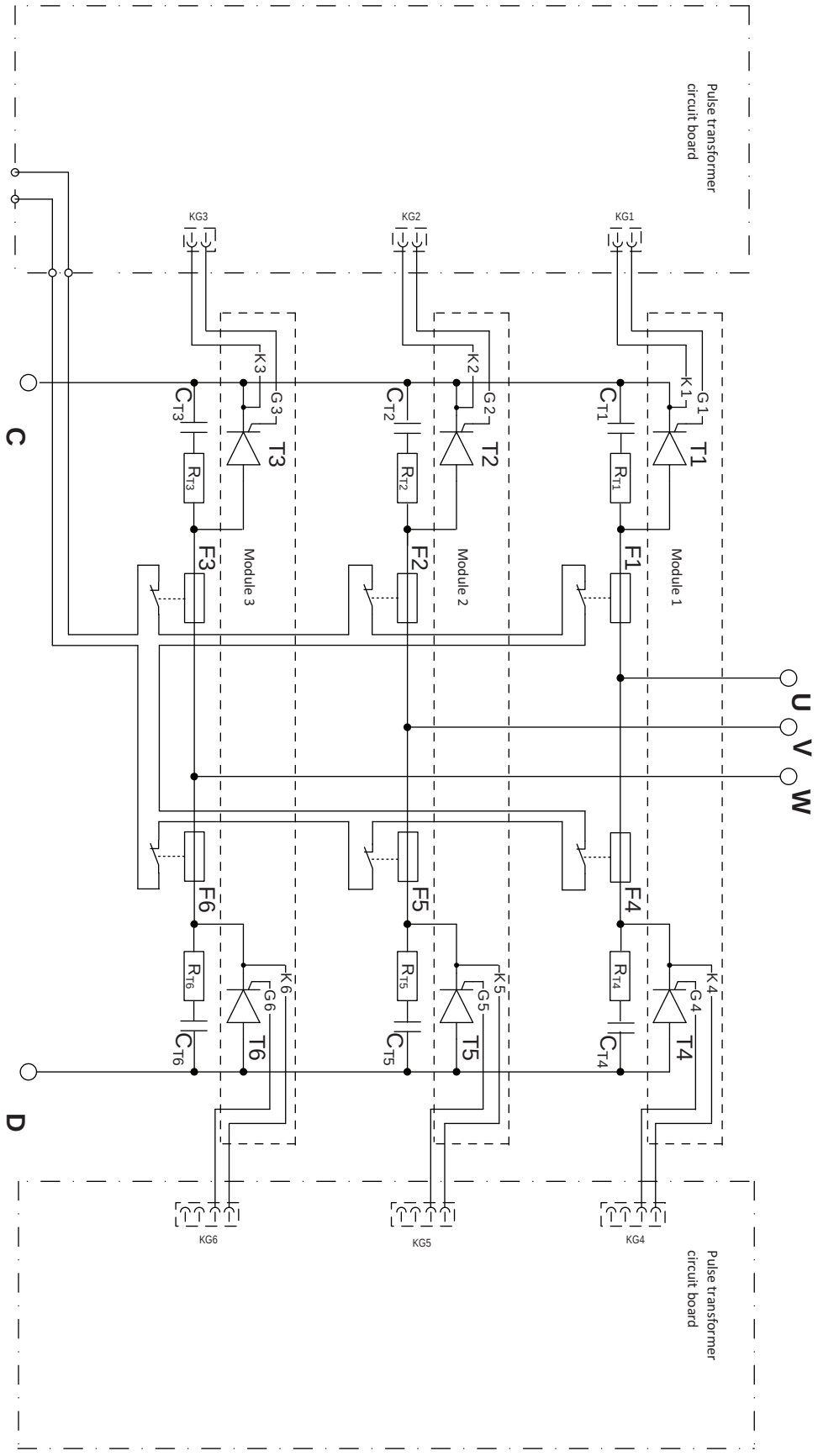


**Figure 15 - Regenerative Drive Power Module Diagram**

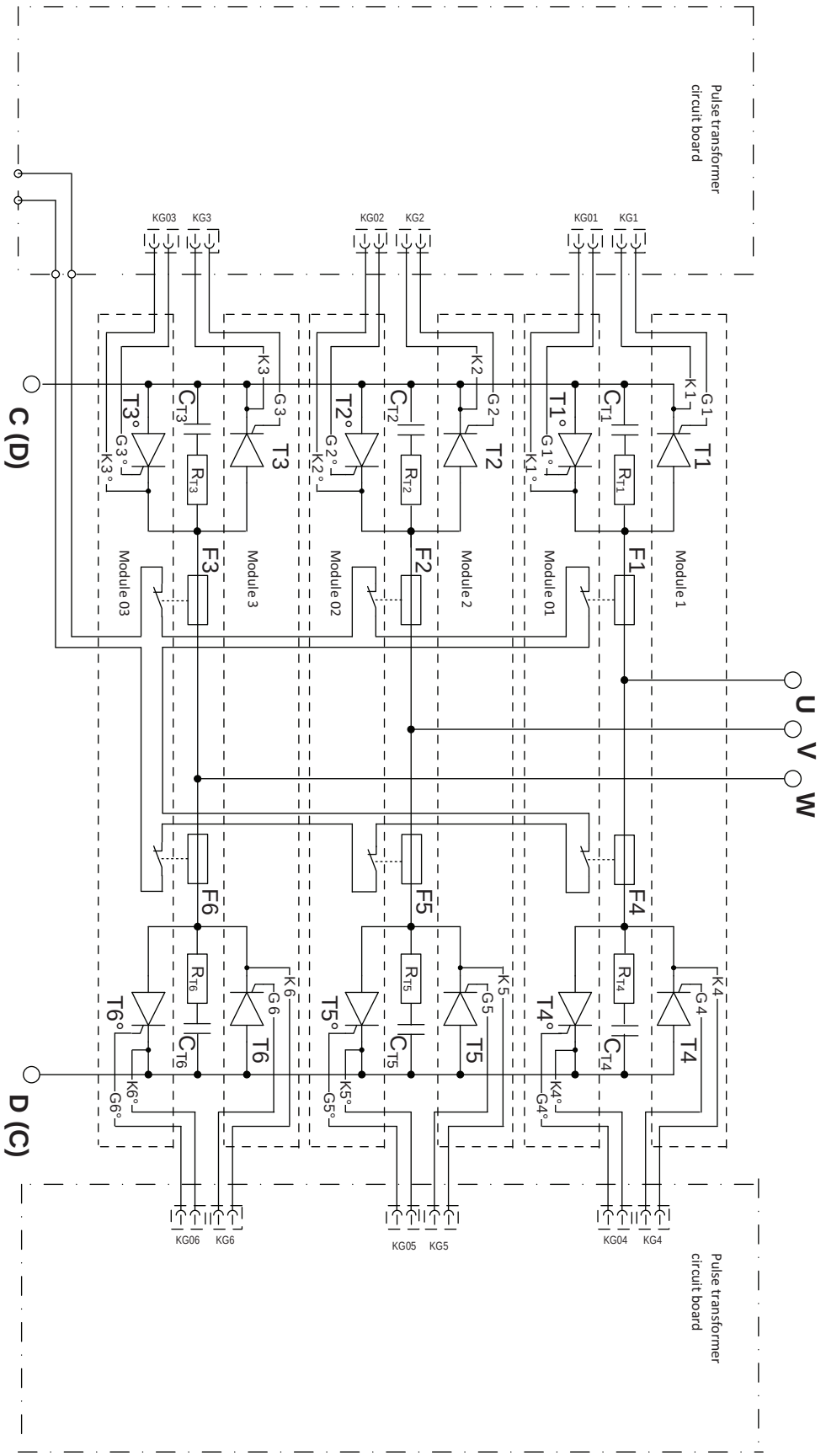


**Figure 16 - AC Line Measurement Points Diagram**

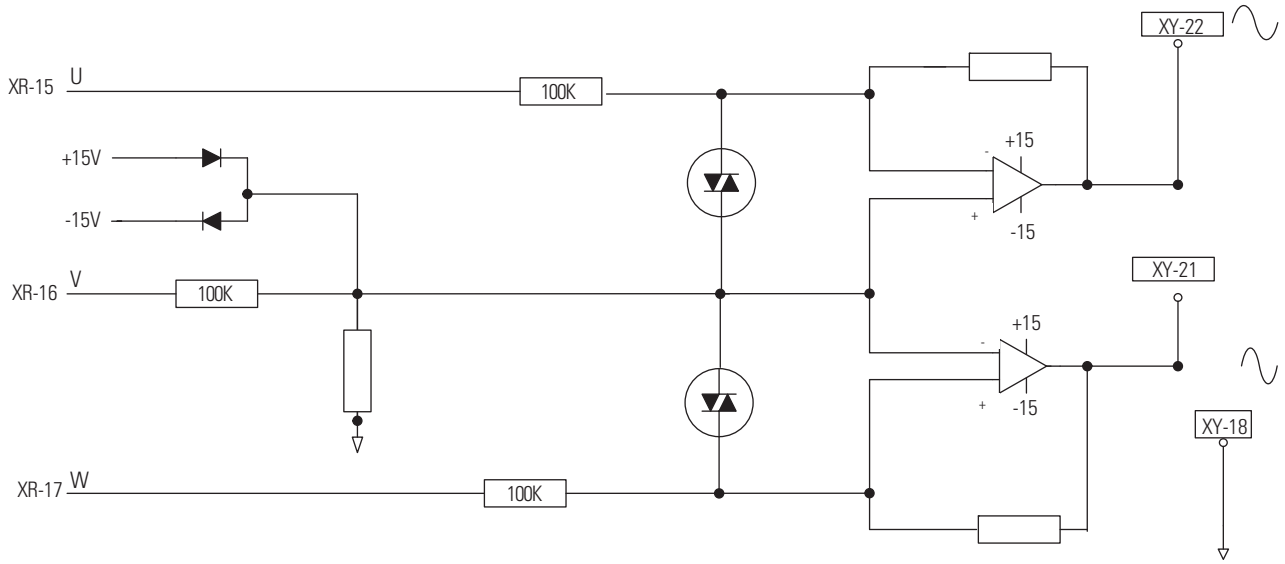



**Figure 17 - Power Feedback Connections Diagram**

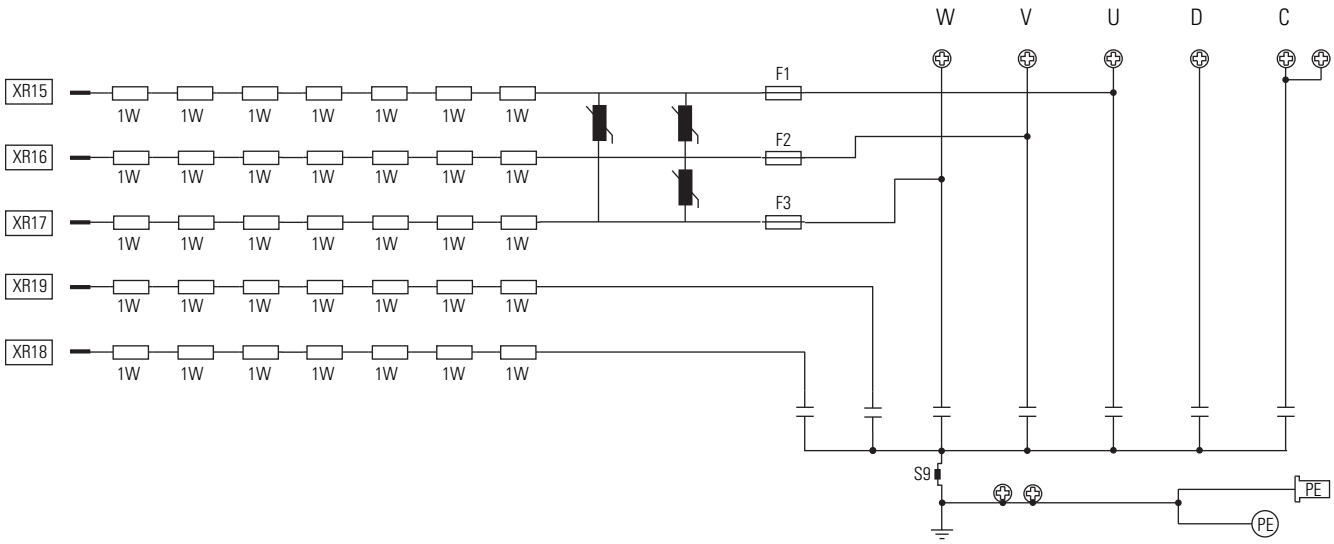


**Figure 18 - Field Board and SCR/Dual Diode Module Connections Diagram**

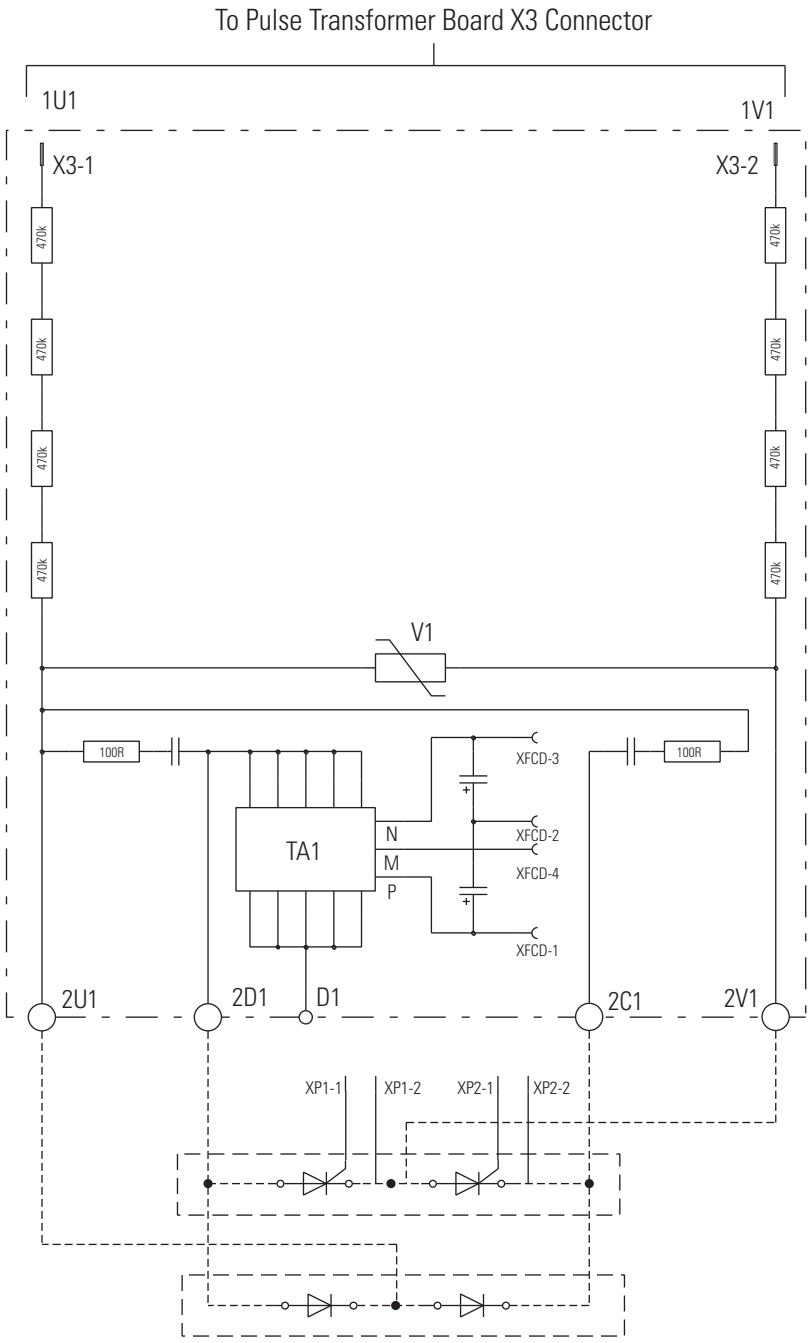


**Figure 19 - Field Control Circuit Diagram**

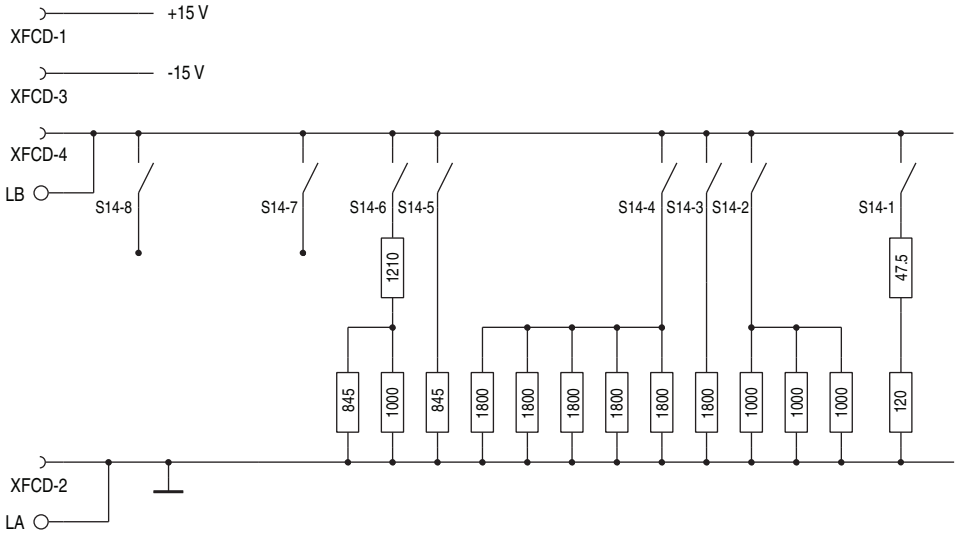



**Figure 20 - Control Circuit Input Power Diagram**

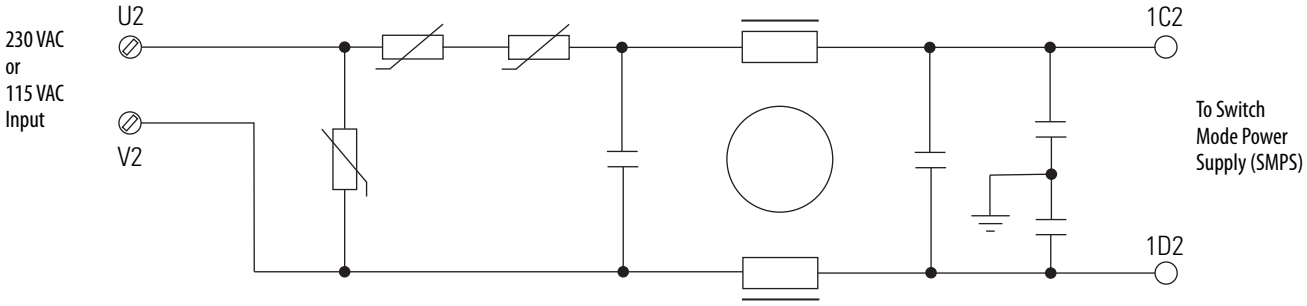


**Figure 21 - Encoder Control Circuit Diagram**

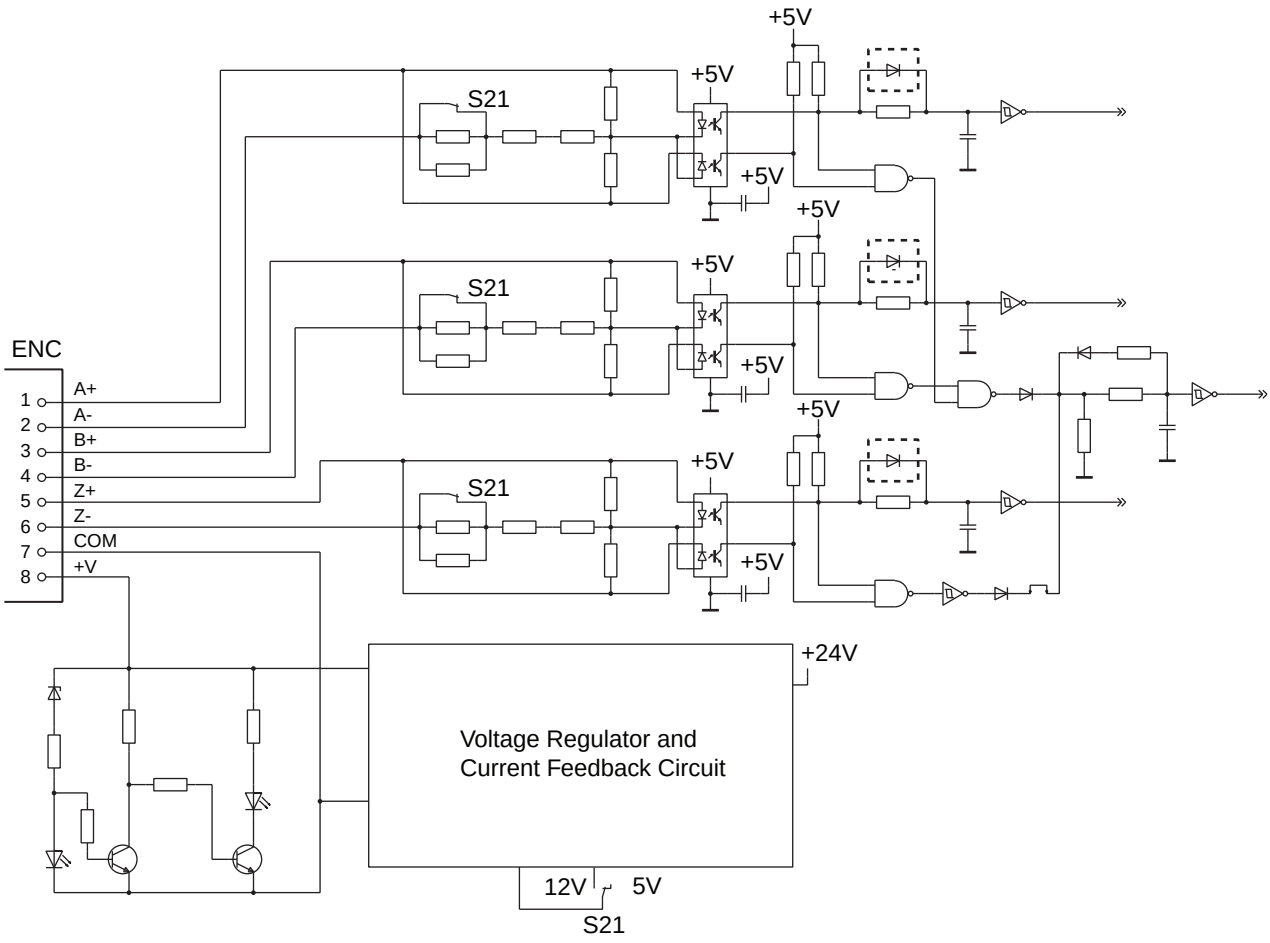



**Figure 22 - DC Tachometer Control Circuit Diagram**

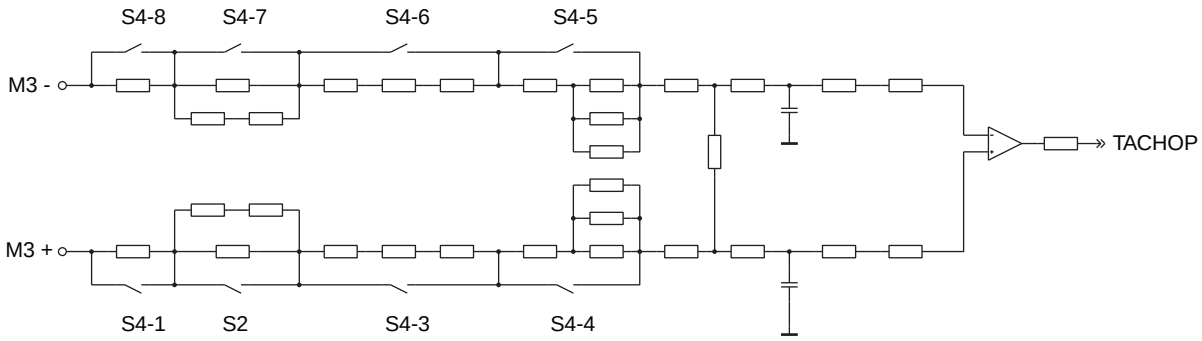


**Figure 23 - Motor Thermal Protection Control Circuit Diagram**

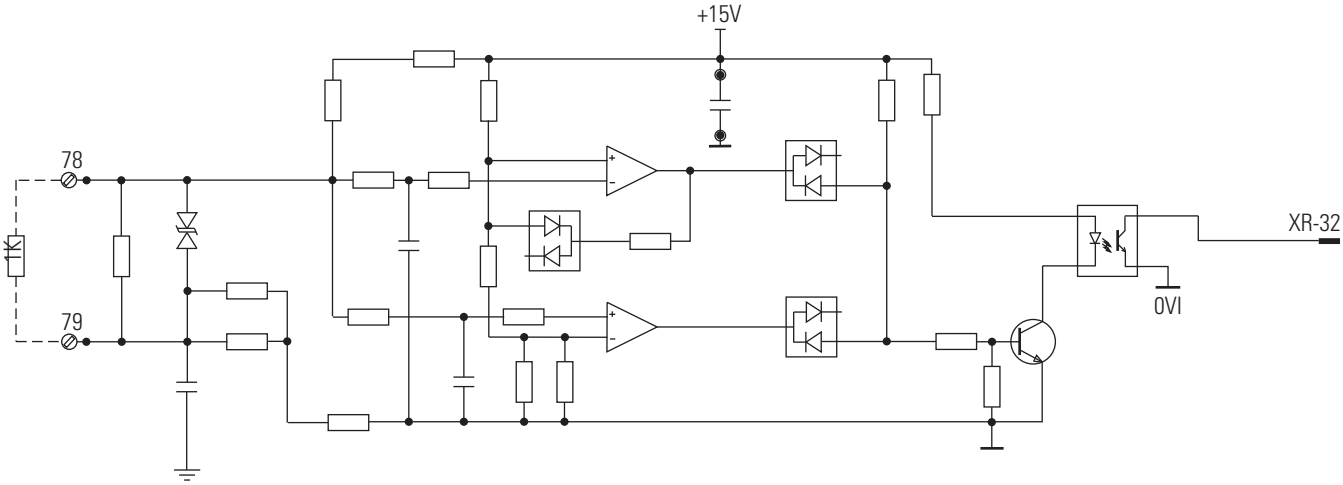



**Figure 24 - Drive Heatsink Monitoring Control Circuit Diagram**

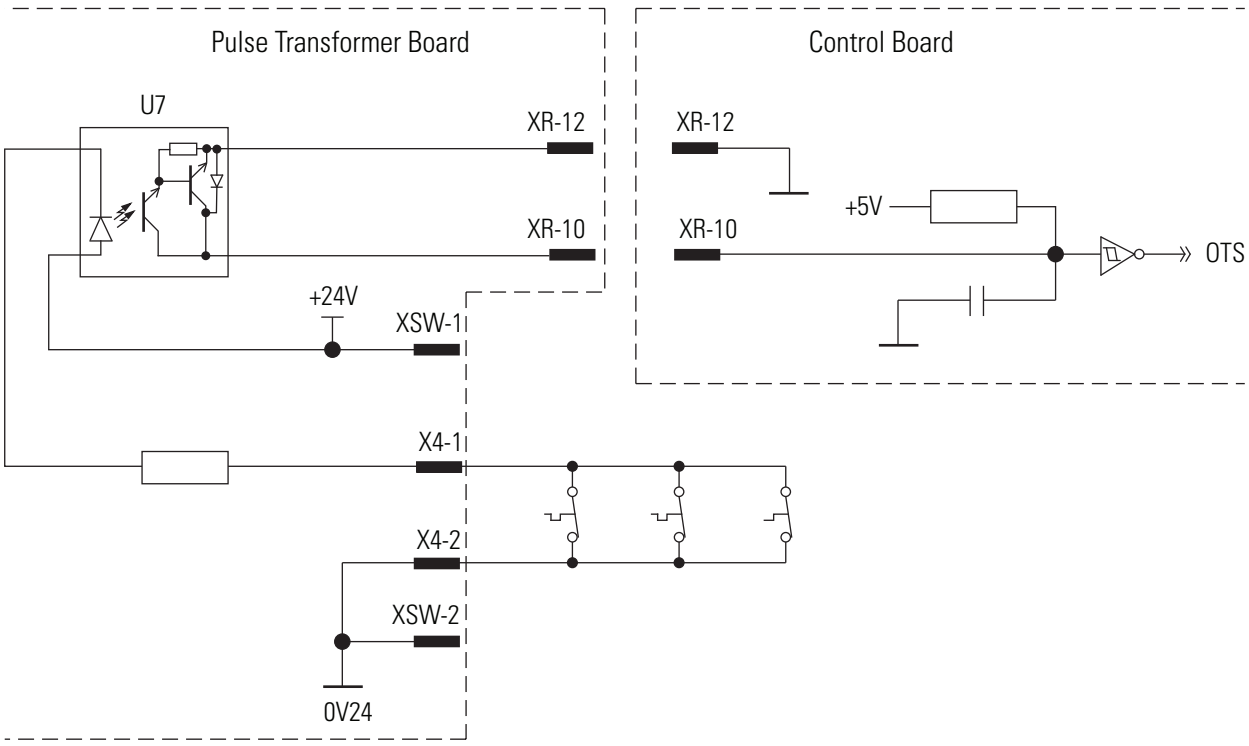


**Figure 25 - Contactor Control Relays Control Circuit Diagram**

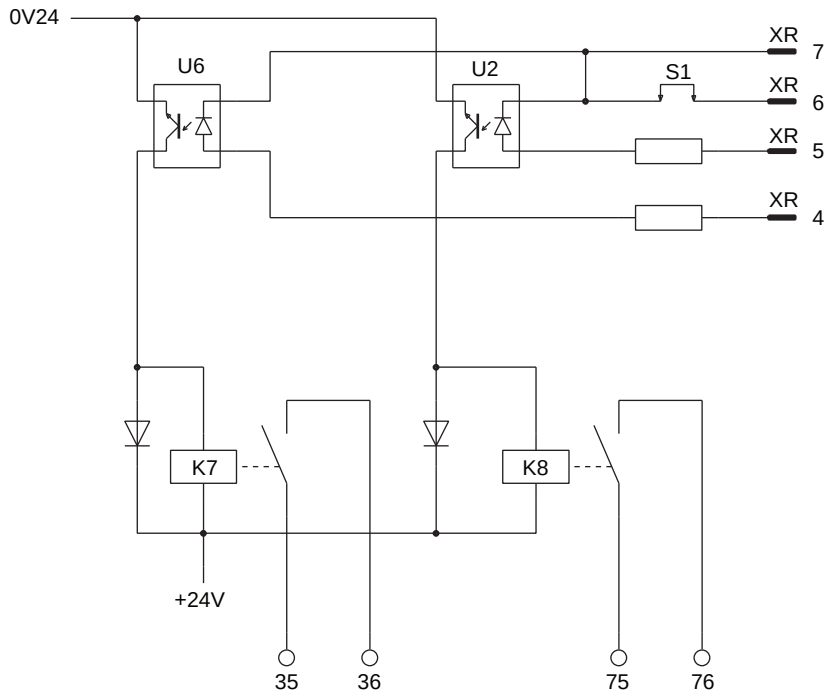
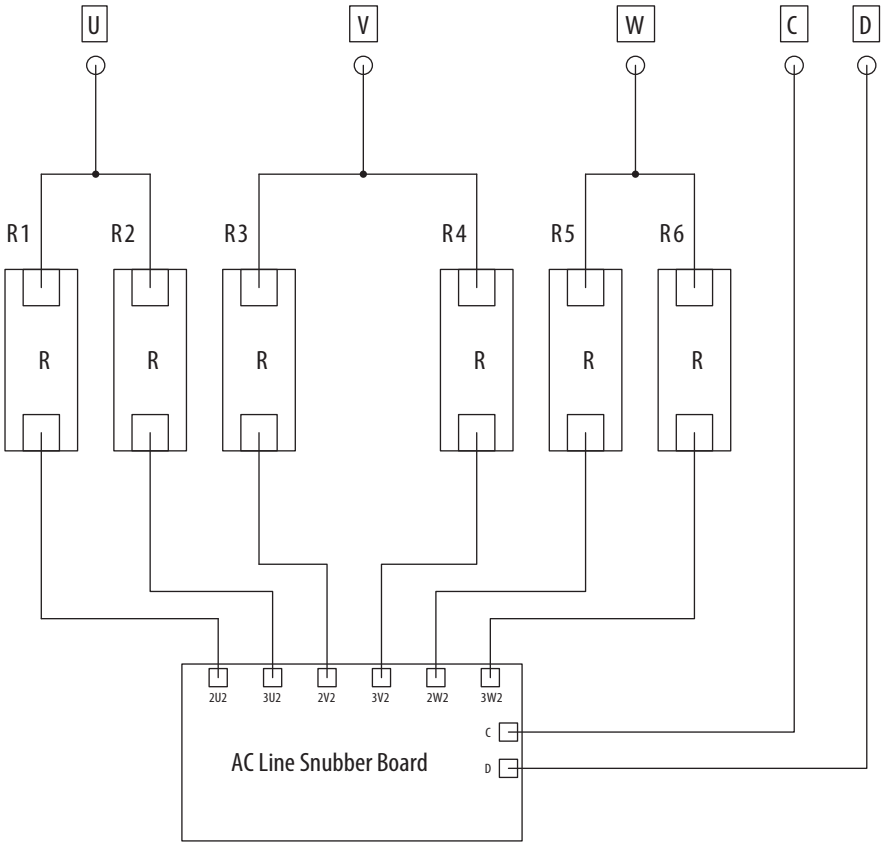



**Figure 26 - AC Line Snubber Circuit**



# Board Layouts and Connections

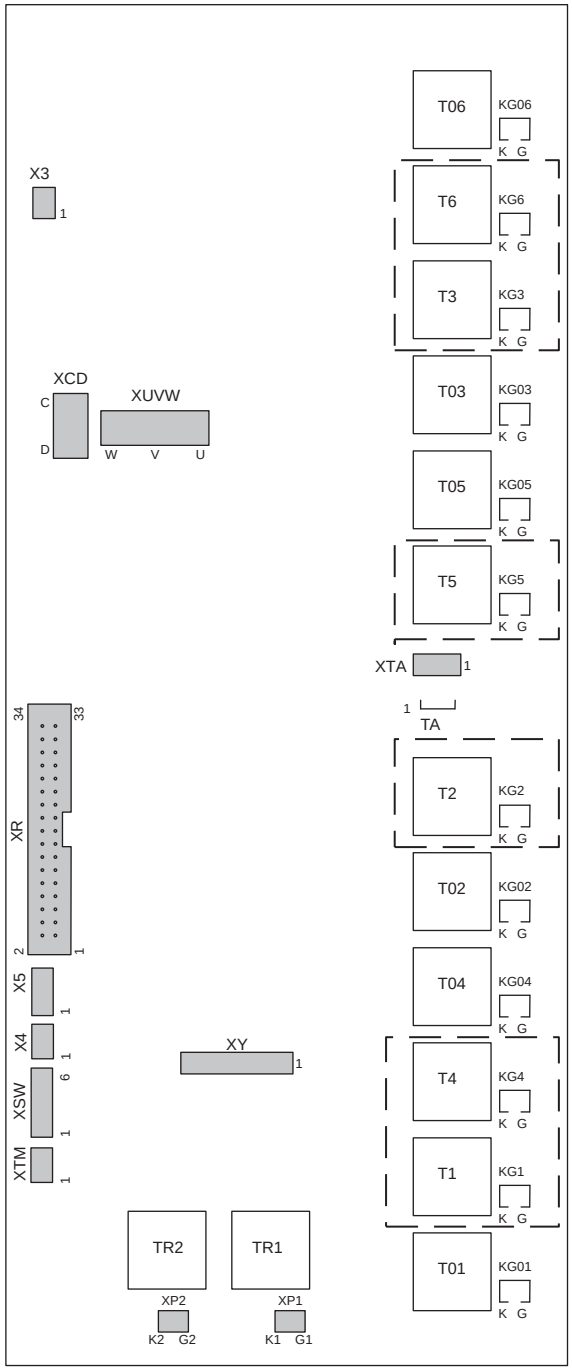
## List of Board Layouts

The following images and tables detail the connection points for the frame C PowerFlex DC drive circuit boards and components.

# Pulse Transformer Board

**Figure 27 - Pulse Transformer Board Layout**

**FIR3-*xx* Rev. "L" and Lower**




**FIR3-*xx* Rev. "M" and Higher**

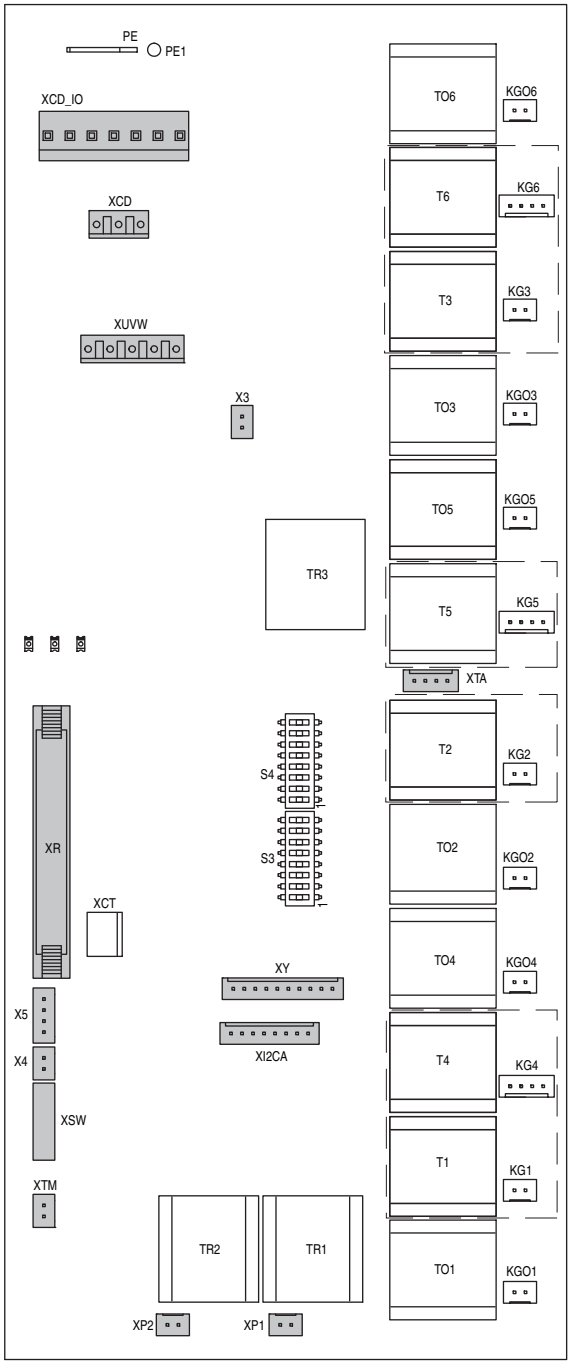


**Table 20 - Pulse Transformer Board to Field Power Board Connections**

| Pulse Transformer Board Connector | Pin Number | to | Pin Number | Field Power Board Connector | Description |
|---|---|---|---|---|---|
| X3 | 1 | … | 1 | X3 | 1U1 field sync signal (from U1) |
| | 2 | … | 2 | | 1V1field sync signal (from V1) |

**Table 21 - Pulse Transformer Board to Bimetal Thermostats Connections**

| Pulse Transformer Board Connector | Pin Number | to | Bimetal Thermostat Terminals | Description |
|---|---|---|---|---|
| X4 | 1 | … | e1, e2, e3 | +24V supply |
| | 2 | … | | 24V common |

**Table 22 - Pulse Transformer Board to Field SCR/Dual Diode Module Connections**

| Pulse Transformer Board Connector | Pin Number | to | Field SCR/Dual Diode Module Connector | Description |
|---|---|---|---|---|
| XP1 | 1 | … | G1 | Gate signal G1 |
| | 2 | … | K1 | Common cathode |
| XP2 | 1 | … | G2 | Gate signal G2 |
| | 2 | … | K2 | Common cathode |

**Table 23 - Pulse Transformer Board to Switching Power Supply Board Connections**

| Pulse Transformer Board Point | Pin Number | to | Pin Number | Switching Power Supply Board Connector | Description |
|---|---|---|---|---|---|
| XSW | 1 | … | 1 | XSW | +24V supply |
| | 2 | … | 2 | | 24V common |
| | 3 | … | 3 | | Internal 18V common |
| | 4 | … | 4 | | |
| | 5 | … | 5 | | Internal +18V supply |
| | 6 | … | 6 | | |

**Table 24 - Pulse Transformer Board to Current Transducers Connections**

| Pulse Transformer Board Connector | Pin Number | Lead | to | Current Transducer Terminals | Description |
|---|---|---|---|---|---|
| XTA | 1 | Red | … | TA-U | Secondary side CT phase U |
| | 2 | White | … | | |
| | 3 | Black | … | TA-V | Secondary side CT phase W |
| | 4 | Blue | … | | |

**Table 25 - Pulse Transformer Board to Control Board Connections**

| 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 | | Heatsink overtemperature |
| | 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 |

For connector X5 and XTM signals, see Table 28 - Power Supply Filter Board to Pulse Transformer Board Connections on page 137.

For connector XCD and XUVW signals, see Table 31 - Transient Noise Board to Pulse Transformer Board Connections on page 138.

# Switching Power Supply Board

**Figure 28 - Switching Power Supply Board Layout**

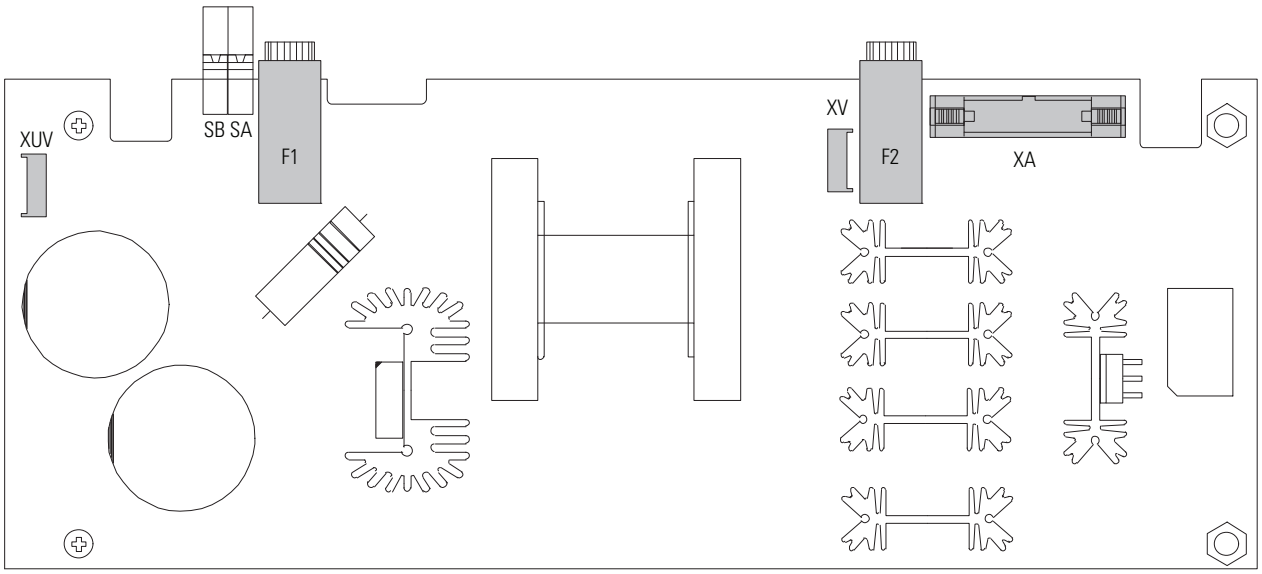



**Table 26 - Switching Power Supply Board to Control Board Connections**

| 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 | | – |
| | 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 |

# Control Board

**Figure 29 - Control Board Layout**

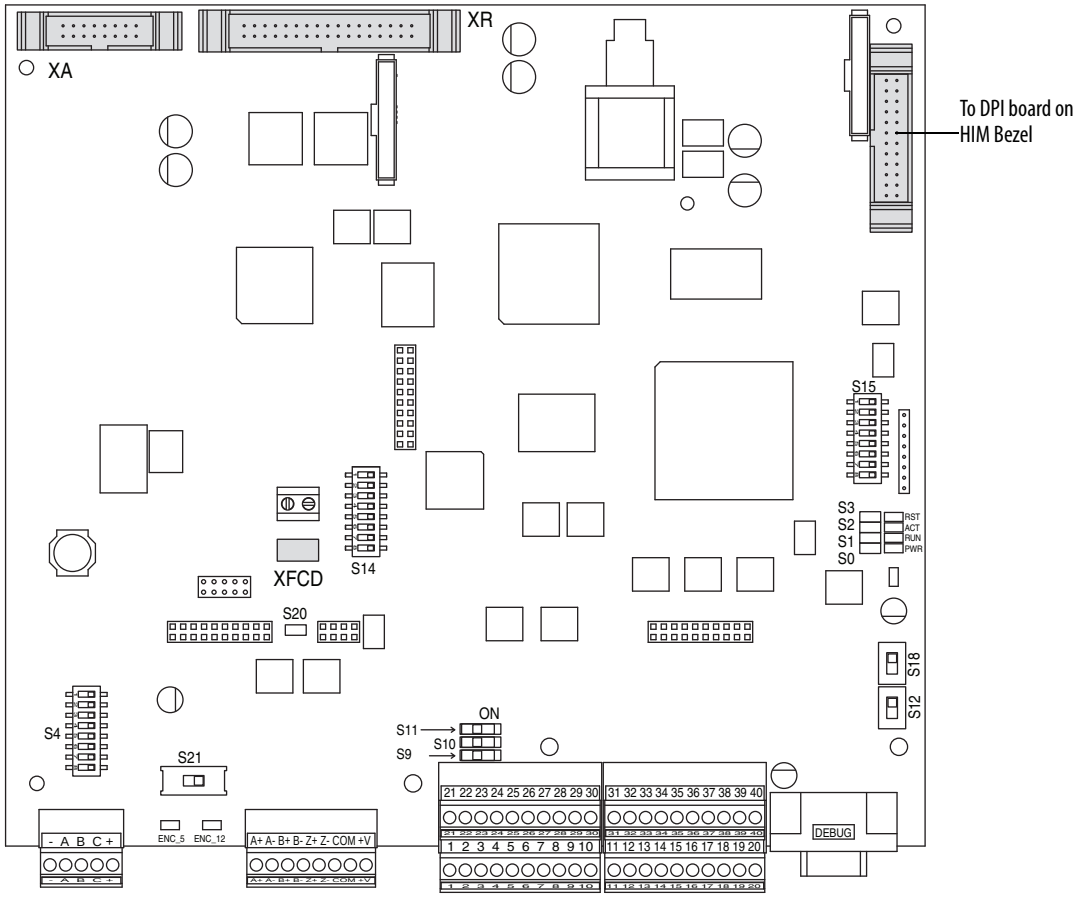


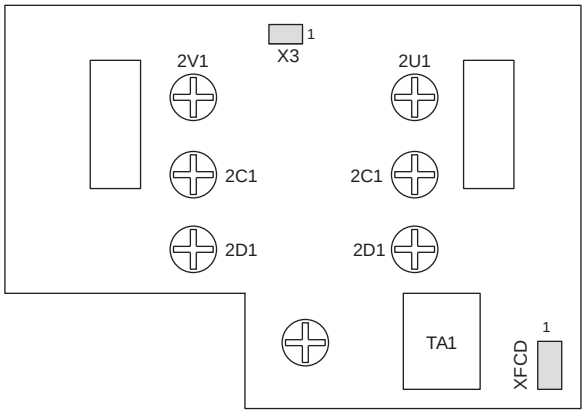

**Table 27 - Control Board to Field Board Connections**

| Control Board Connector | Pin Number | to | Pin Number | Field Board Connector | Description |
|---|---|---|---|---|---|
| XFCD | 1 | … | 1 | XFCD | +15V |
| | 2 | … | 2 | | 15V Common |
| | 3 | … | 3 | | -15V |
| | 4 | … | 4 | | Field CT burden resistors |

For connector XA signals, see Table 26 - Switching Power Supply Board to Control Board Connections on page 135.

# Field Power Board

**Figure 30 - Field Power Board Layout**




For connector X3 signal, see Table 20 - Pulse Transformer Board to Field Power Board Connections on page 133. For connector XFCD signal, see Table 27 - Control Board to Field Board Connections on page 136.

**Figure 31 - Power Supply Filter Board Layout**

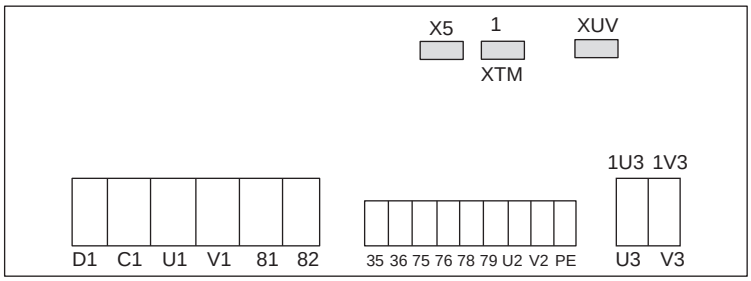



**Table 28 - Power Supply Filter Board to Pulse Transformer Board Connections**

| Power Supply Filter Board Connector | Pin Number | to | Pin Number | Pulse Transformer Board Connector | Description |
|---|---|---|---|---|---|
| X5 | 1 | ... | 1 | X5 | 24V common |
| | 2 | ... | 2 | | |
| | 3 | ... | 3 | | +24V supply |
| | 4 | ... | 4 | | (not used) |
| XTM | 1 | ... | 1 | XTM | 250V AC maximum (from motor PTC) |
| | 2 | ... | 2 | | |

**Table 29 - Power Supply Filter Board to Switching Power Supply Board Connections**

| Power Supply Filter Board Connector | Pin Number | to | Pin Number | Switching Power Supply Board Connector | Description |
|---|---|---|---|---|---|
| XUV | 1 | ... | 1 | XUV | Single phase 115V / 230V AC |
| | 2 | ... | 2 | | (Not used) |
| | 3 | ... | 3 | | |
| | 4 | ... | 4 | | Single phase 115V / 230V AC |

**Table 30 - Power Supply Filter Board to Fan Connections**

| Power Supply Filter Board Connector | to | Fan Terminal Block | Description |
|---|---|---|---|
| 1V3, 1U3 | … | – | Single phase 115V / 230V AC |

**Figure 32 - Transient Noise Filter Board Layout**

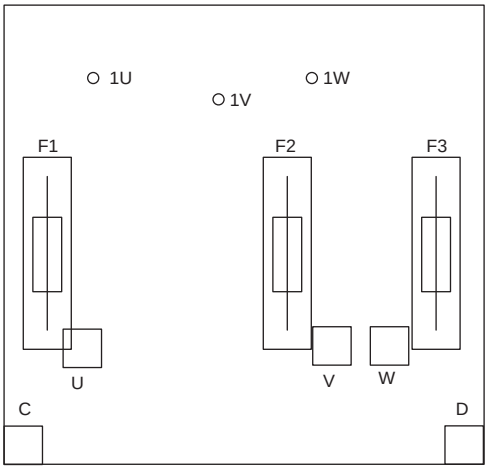



**Table 31 - Transient Noise Board to Pulse Transformer Board Connections**

| Transient Noise Filter Board Connector | to | Pin Number | Pulse Transformer Board Connector | Description |
|---|---|---|---|---|
| 1U | … | 1 | XUVW | Phase U signal |
| 1V | … | 2 | | Phase V signal |
| 1W | … | 3 | | Phase W signal |
| C | … | 1 | XCD | Armature C signal |
| D | … | 2 | | Armature D signal |

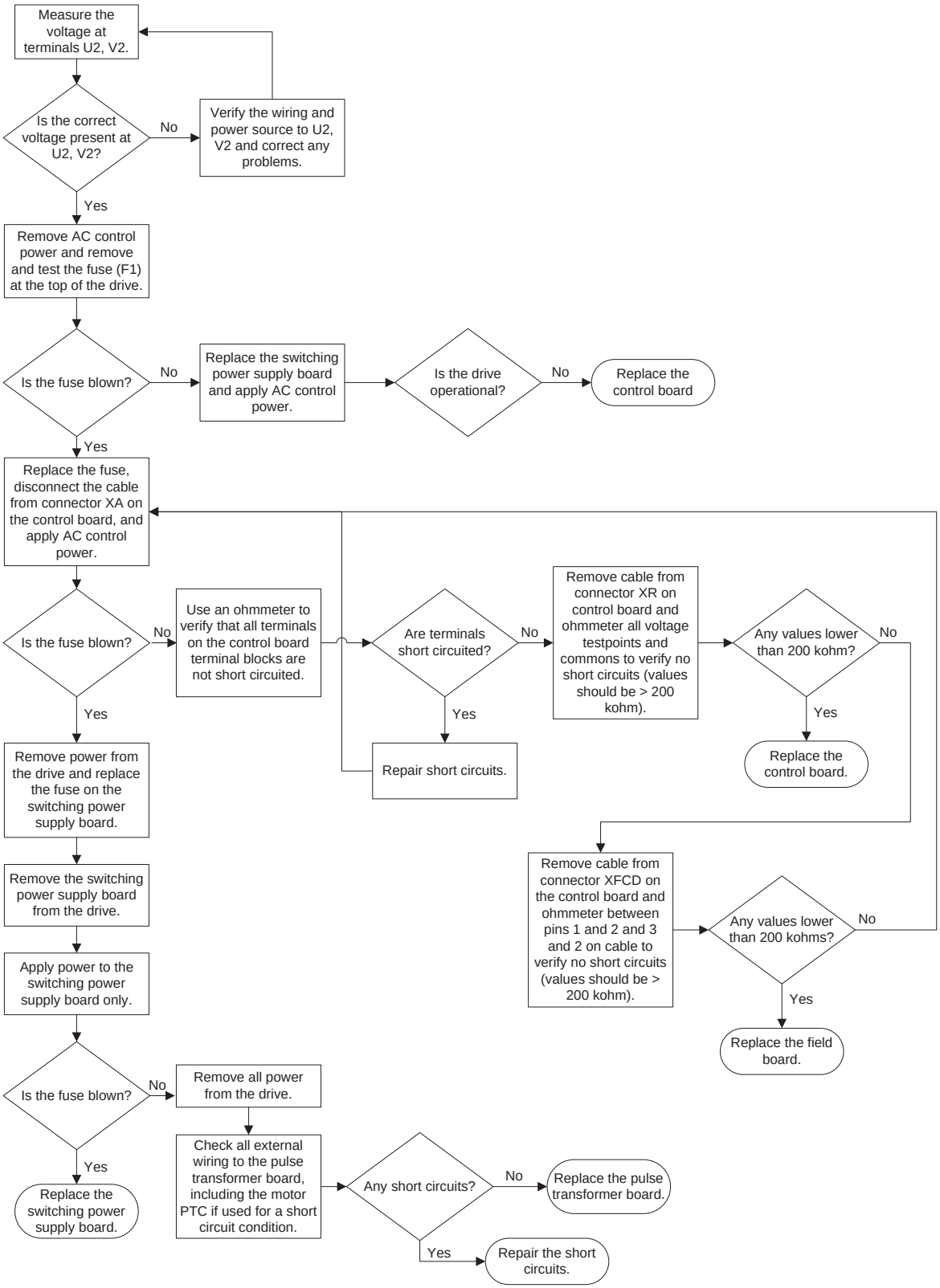
# Flow Charts

## List of Flow Charts

The following pages contain flow chart versions of troubleshooting procedures contained in Chapter 2 - Component Test Procedures.

## Control Power Supply Failure

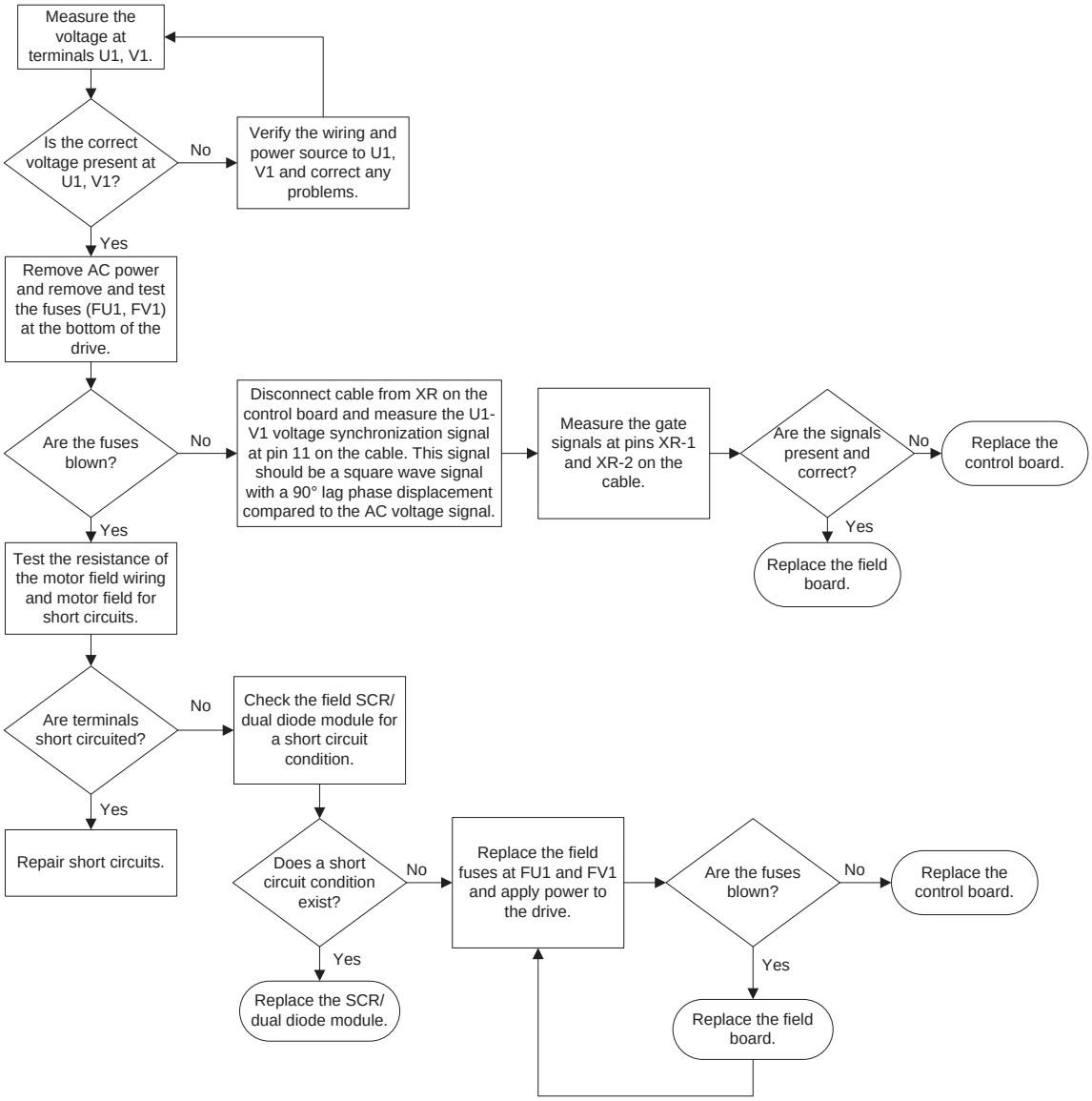
This chart presents the steps for troubleshooting a Power Failure fault (F3).



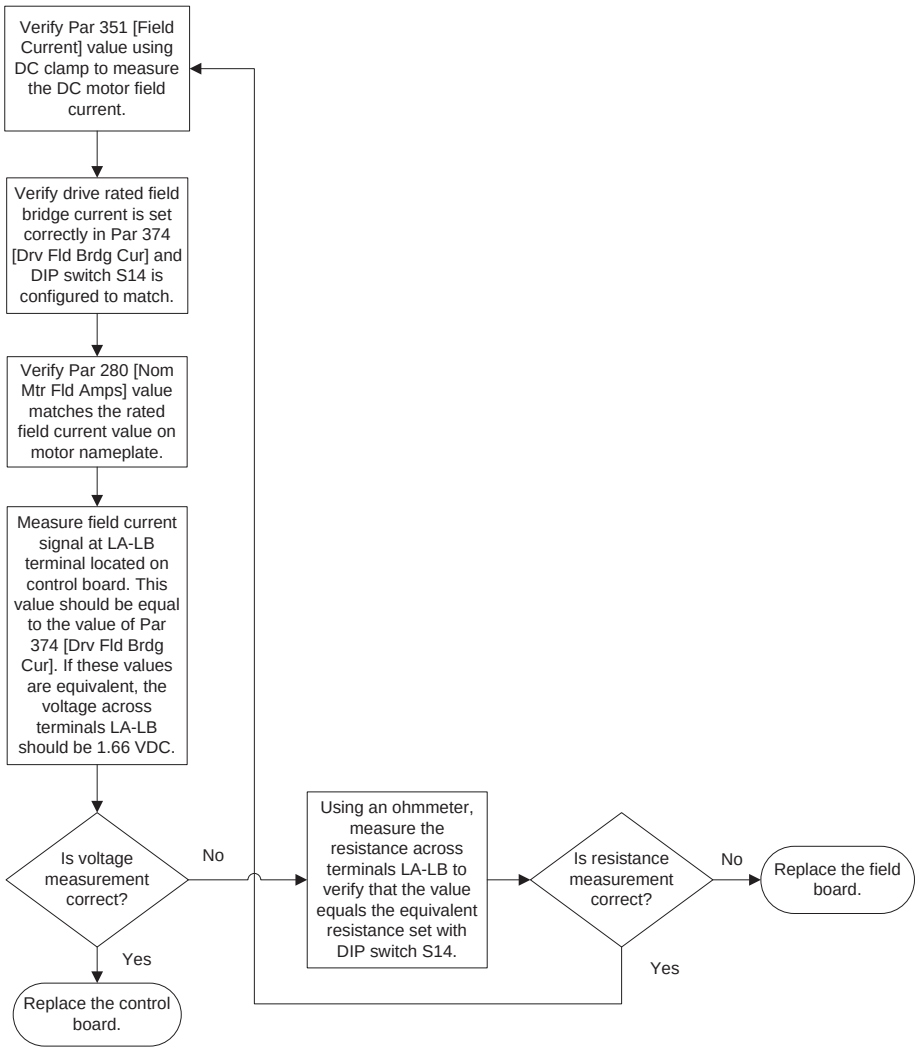
## Field Current Loss Failure

The charts below presents the steps in flow chart form for troubleshooting a Field Current Loss fault (F6).

### No Field Current



# Low or Incorrect Field Current



## M



## O



## P



## R



## S



## T

## V

## Notes:

# Additional Resources

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

| Resource | Description |
|---|---|
| PowerFlex Digital DC Drive User Manual, publication 20P-UM001 | Provides basic information that is required to install, start up, and troubleshoot the PowerFlex DC drive. |
| PowerFlex DC Drive Spare Parts List, publication PFLEX-SB003 | Provides a current list of spare parts available for the PowerFlex DC field controller. |
| Guarding Against Electrostatic Damage, publication 8000-4.5.2 | Explains the causes of ESD, and how you can guard against its effects. |
| EtherNet/IP Network Devices User Manual, ENET-UM006 | Describes how to configure and use EtherNet/IP devices to communicate on the EtherNet/IP network. |
| Ethernet Reference Manual, ENET-RM002 | Describes basic Ethernet concepts, infrastructure components, and infrastructure features. |
| System Security Design Guidelines Reference Manual, SECURE-RM001 | Provides guidance on how to conduct security assessments, implement Rockwell Automation products in a secure system, harden the control system, manage user access, and dispose of equipment. |
| Industrial Components Preventive Maintenance, Enclosures, and Contact Ratings Specifications, publication IC-TD002 | Provides a quick reference tool for Allen-Bradley industrial automation controls and assemblies. |
| Safety Guidelines for the Application, Installation, and Maintenance of Solid-State Control, publication SGI-1.1 | Designed to harmonize with NEMA Standards Publication No. ICS 1.1-1987 and provides general guidelines for the application, installation, and maintenance of solid-state control in the form of individual devices or packaged assemblies incorporating solid-state components. |
| Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1 | Provides general guidelines for installing a Rockwell Automation industrial system. |
| Product Certifications website, rok.auto/certifications. | Provides declarations of conformity, certificates, and other certification details. |

You can view or download publications at rok.auto/literature.

## Rockwell Automation Support

Use these resources to access support information.

| | | |
|---|---|---|
| **Technical Support Center** | Find help with how-to videos, FAQs, chat, user forums, and product notification updates. | rok.auto/support |
| **Knowledgebase** | Access Knowledgebase articles. | rok.auto/knowledgebase |
| **Local Technical Support Phone Numbers** | Locate the telephone number for your country. | rok.auto/phonesupport |
| **Literature Library** | Find installation instructions, manuals, brochures, and technical data publications. | rok.auto/literature |
| **Product Compatibility and Download Center (PCDC)** | Get help determining how products interact, check features and capabilities, and find associated firmware. | rok.auto/pcdc |

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## Waste Electrical and Electronic Equipment (WEEE)

At the end of life, this equipment should be collected separately from any unsorted municipal waste.

Rockwell Automation maintains current product environmental information on its website at rok.auto/pec.



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