7 FIELD REPLACEMENT PROCEDURES

This section describes the field replacement procedures (FRPs) to follow when you perform maintenance on the CRAY EL series system. When you perform maintenance, always observe all safety precautions and electrostatic discharge (ESD) prevention guidelines.

Hazard Statements

When performing maintenance, be alert for hazard statements in the documentation that advise you of hazards you may encounter while servicing Cray Research equipment. The following list describes the hazard statement signal words.

- **Danger** – Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.
- **Warning** – Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.
- **Caution** – Indicates a potentially hazardous situation that, if not, avoided, may result in minor or moderate injury. This signal word is also used to alert personnel against unsafe practices that can result in machine damage and/or data corruption.

Safety Precautions

Observe the following safety precautions when you perform maintenance on the CRAY EL series system.

1. Do not move the cabinets while they are connected to power.
2. Do not wear watches, necklaces, rings, or other jewelry when working inside a CRAY EL series system cabinet.

WARNING

Severe shock and burns as well as short circuits can occur when you wear rings, watches, or other jewelry during this procedure. Remove all jewelry before starting this procedure. Observe the ESD precautions described in this section.

3. Keep fingers and conductive tools away from high-voltage areas, such as the CRAY EL series capacitor bank and bulkhead as well as the high-current areas on the CPU, memory, or VME IOS power supplies or buses.

DANGER

The CRAY EL series capacitor bank and bulk converter contain a potential 380 volts. Keep fingers and conductive tools away from these high-voltage areas. Perform a voltage check on the system before attempting any maintenance. Serious injury or death will occur if these precautions are not followed.

4. All circuit breakers should be in the OFF (0) position before you plug in the power cord.

5. Ensure that all items removed from the system during servicing are replaced (covers, tools, etc.) when finished.

6. Disconnect the main power plug from the system before working on the power system (capacitor bank and bulkhead).

CAUTION

Depressing the emergency power-off button will immediately shut down the system. Customer data may be lost. Follow shut-down procedures whenever possible.

ESD Precautions

Observe electrostatic discharge precautions during the installation process. Required apparel includes an ESD smock, ESD wrist strap, ESD shoes, and an antistatic mat.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment may result if these precautions are not followed.

ESD Smock

Wear a Cray Research-approved static-dissipative smock when servicing or handling an ESD-sensitive device. Completely button the smock and wear it as the outermost layer of clothing. You must have a portion of the smock's sleeves in direct contact with the skin of your arms. Skin contact is essential for a dissipative path-to-earth ground through your wrist strap. Tuck hair exceeding shoulder length inside the back of the smock.

Wrist Strap

Wear a Cray Research-approved wrist strap when servicing or handling an ESD-sensitive device. Connect the wrist strap cord directly to earth ground to reduce ESD damage to equipment.

ESD Shoes

Wear static-dissipative shoes or shoes with heel straps on both shoes when servicing or handling an ESD-sensitive device. When sensitive equipment is exposed to static discharge, ESD shoes provide an effective backup to the wrist straps and grounding cords. Wear ESD shoes in addition to, not as an alternative to, a wrist strap.

FRP1

Powering Up the CRAY EL Series System

Perform the power-up procedure at the circuit breaker panel located at the rear of the CRAY EL series system. After a 3-minute delay, the power light-emitting diodes (LEDs) illuminate on the control panel.

Procedure

1. Ensure that the AC power plug is connected to power.

2. Ensure that the AC POWER LOSS LED is illuminated on the control panel. Refer to Figure 7-1.

NOTE: The LED will not illuminate if the CRAY EL series system has been powered down for 72 hours or more because the batteries for the LED have discharged. The batteries require approximately 36 hours to charge before the LED will illuminate in this situation.

3. Ensure that the emergency power-off (EPO) button, located on the control panel, is extended outward by turning it counterclockwise to the stop. If it is in, it will now pop out. Refer to Figure 7-2.

4. Ensure that all individual components are powered on at this time. The locations of the power-on buttons are as follows:

   a. The CPU and memory (MEM) buttons are located above the CPU and memory boards on the CPU card cage.

   b. The IOS DC ENABLE/INHIBIT button is located above the IOS VME card cage.

   c. The individual peripheral equipment drawers each have a power-supply enable button located on the front of the drawer.

5. Move the circuit breaker on the back of each cabinet to the ON position (1), turning on the highest numbered cabinet first. For example, in a four-cabinet system, cabinet 4 would be powered on first, and the mainframe cabinet would be powered on last. Refer to Figure 7-3.

6. Visually inspect to ensure that there is no smoke or sparks among the components after you have powered up the system.

7. Ensure that the upper fans are operating.

8. Ensure that the Capacitor Bank Ready LED for each cabinet is illuminated on the control panel. Refer again to Figure 7-1. The Capacitor Bank Ready LED for each cabinet takes approximately 1 minute to illuminate.

9. Wait for the System Ready LED to illuminate.

10. Ensure that the maintenance workstation-model EL (MWS-EL) and the system console are powered on.

NOTE: **`Courier bold`** type indicates commands, options, and field inputs that the user should enter.

11. The MWS-EL or system console boot prompt should appear on the IOS screen (window). Type **`load`** ↵ at the boot prompt. The system will go through its initializing program upon receiving the IOS prompt.

12. Type **`boot`** ↵ at the IOS prompt. This boots the UNICOS operating system.

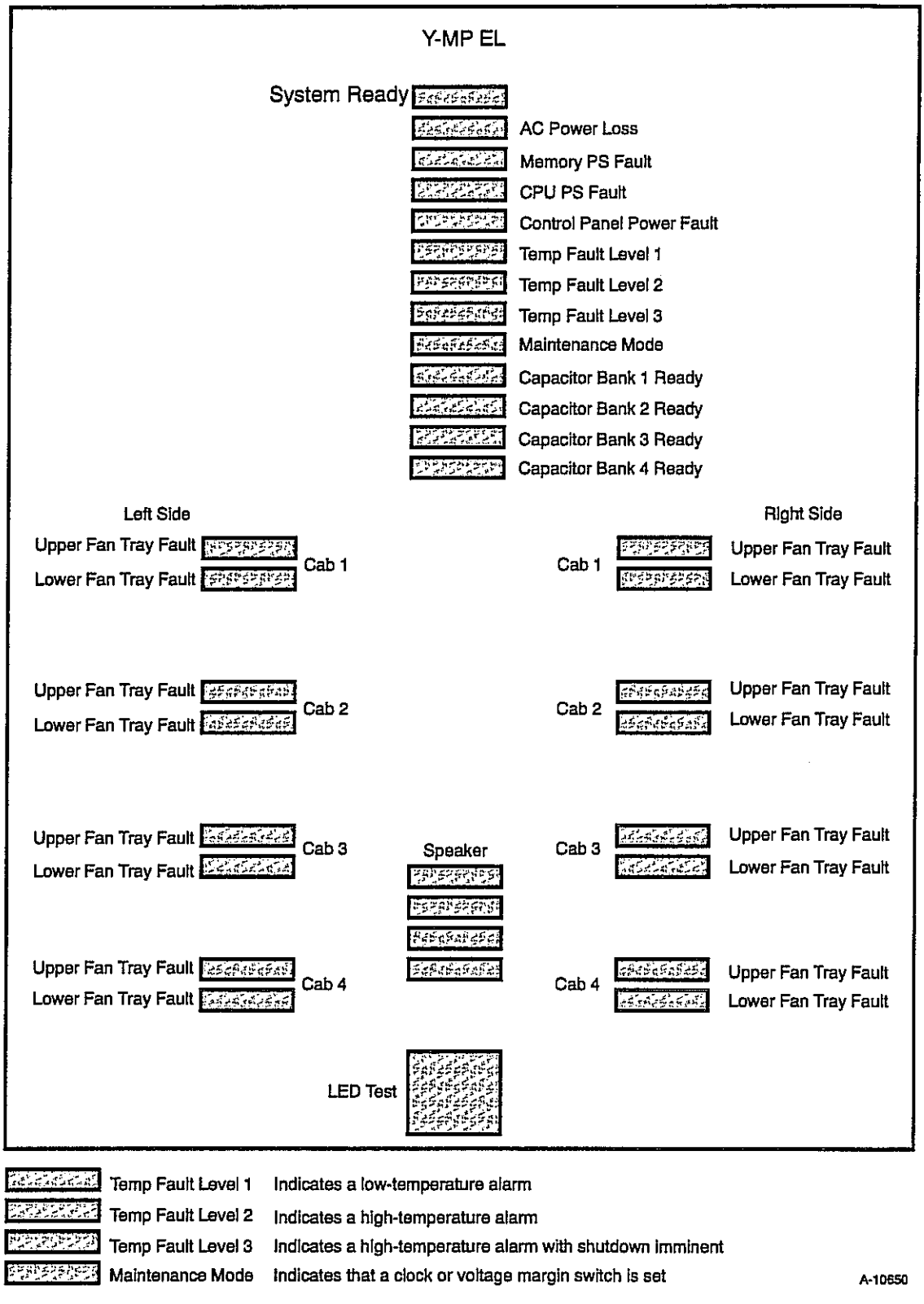

Figure 7-1. CRAY EL Series Control Panel LEDs

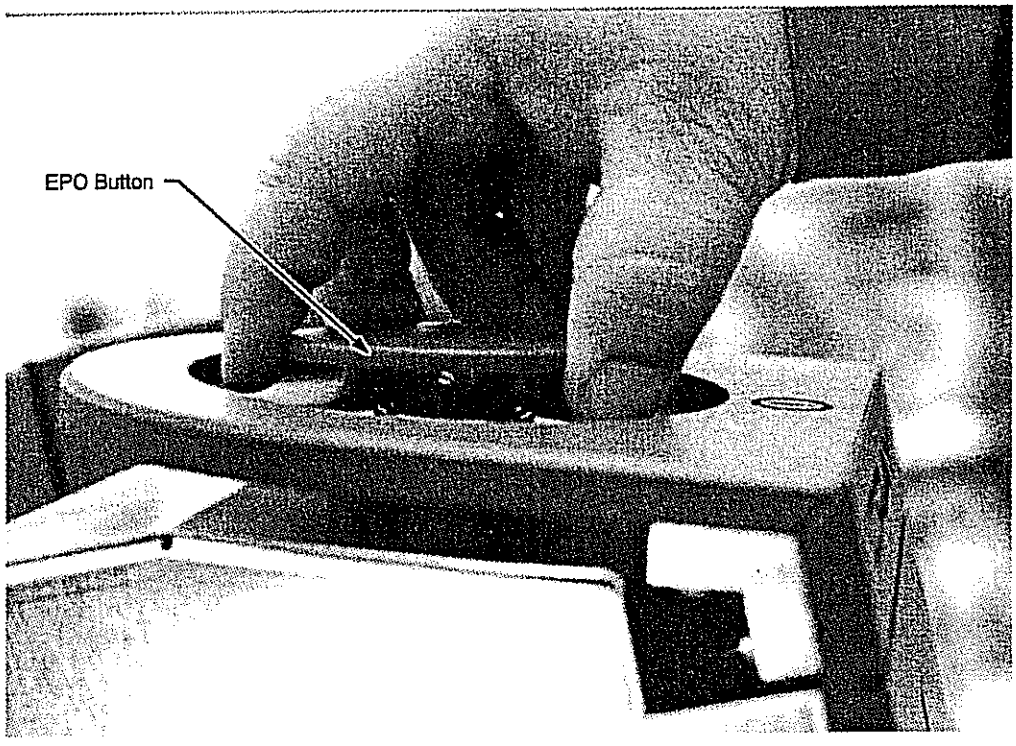

Figure 7-2. EPO Button

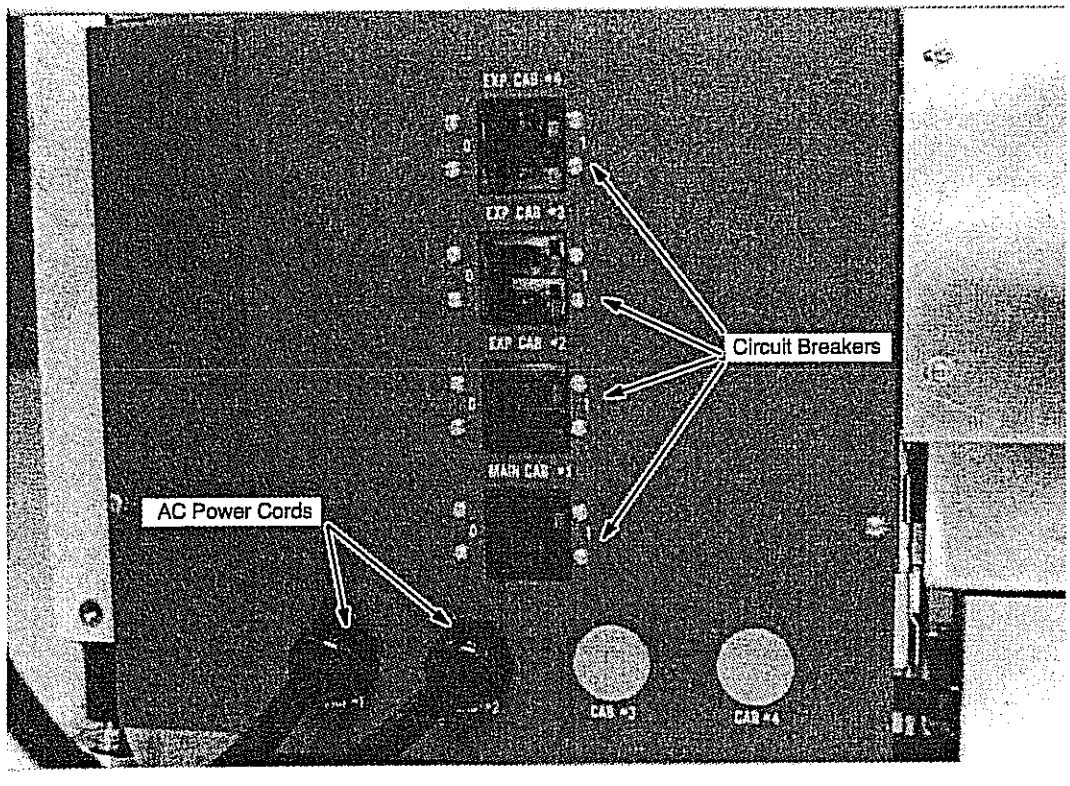

Figure 7-3. CRAY EL Series Circuit Breakers

FRP2

Powering Down the CRAY EL Series System

Use this procedure to power down the system for maintenance.

Procedure

1. Ensure that all customer jobs have been completed before you start to power down the system.

2. From the UNICOS kernel, shut down UNICOS; refer to the *Software Installation Bulletin for CRAY Y-MP EL Computer Systems*, CRI publication number SG-5201 2.3. This procedure should take approximately 15 minutes.

CAUTION

When you perform maintenance on the CRAY EL series system, press the EPO button to power down the system. This ensures that all safety features are working correctly.

3. Press the EPO button.

4. Ensure that the AC Power Loss LED is illuminated.

FRP3

Removing the Front Panel Assembly

The front panel assembly is split into two pieces, as shown in Figure 7-4.

Procedure

1. Push up on the lower two spring catches at the bottom of the front curved panel piece (one spring catch is located in each corner) and pull the panel out to prevent it from latching again. Refer to Figure 7-5. The bottom of the panel has now been released and is hanging from the panel-mounting screws. Refer to Figure 7-6.

2. Lift the top curved panel piece and ease it upward and outward, while taking care not to damage the control panel trim cover. Be careful not to push the emergency power-off (EPO) button.

3. Push up on the lower two spring catches at the bottom of the back cut-out panel piece (one spring catch is located in each corner) and pull the panel out to prevent it from latching again. Refer to Figure 7-5. The bottom of the panel has now been released and is hanging from the panel-mounting screws. Refer to Figure 7-6. Gently lift this piece off of the mounting screws.

4. Remove the inner front-panel electromagnetic interference (EMI) shield by removing the four screws located near the four corners of the EMI shield as shown in Figure 7-7.

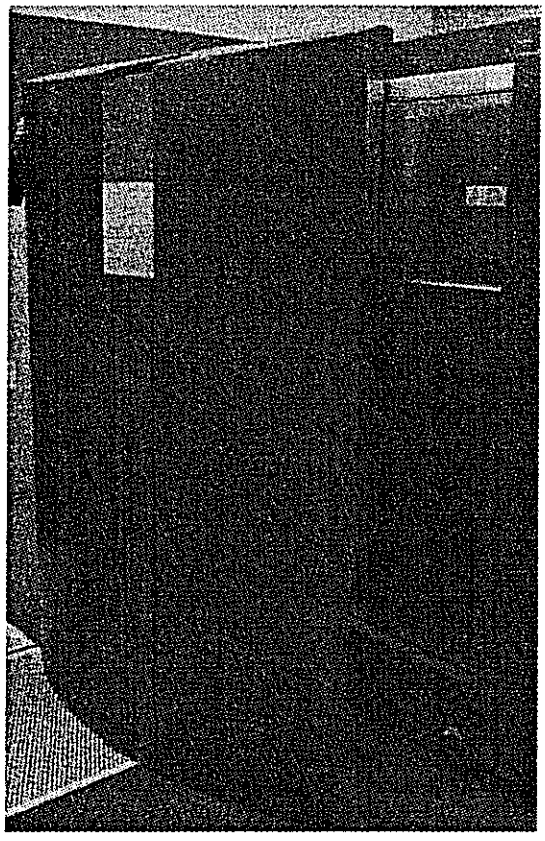

Figure 7-4. Two-piece Front Panel

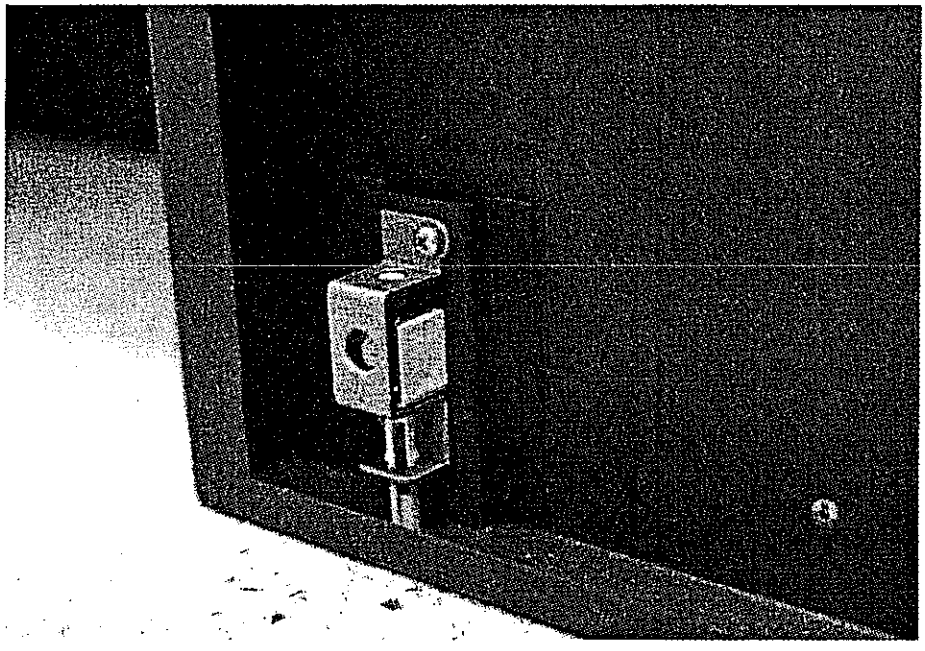

Figure 7-5. Front Panel Spring Catch (1 per Corner)

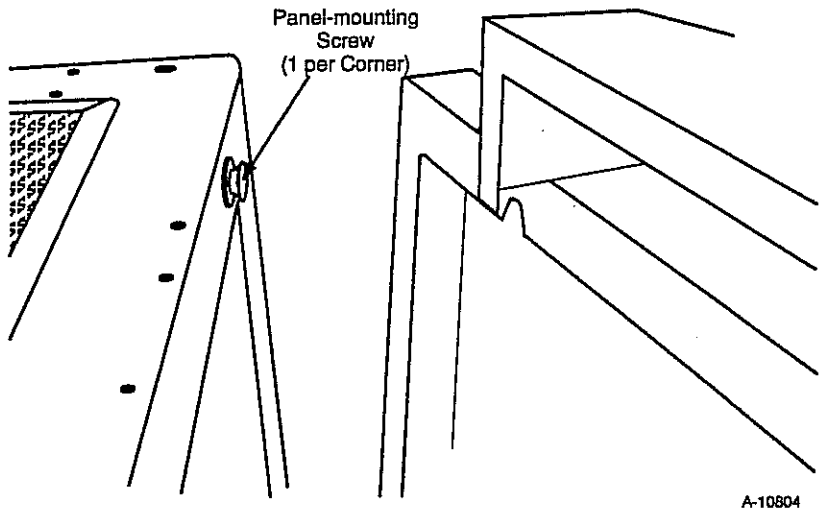

Figure 7-6. Panel-mounting Screw

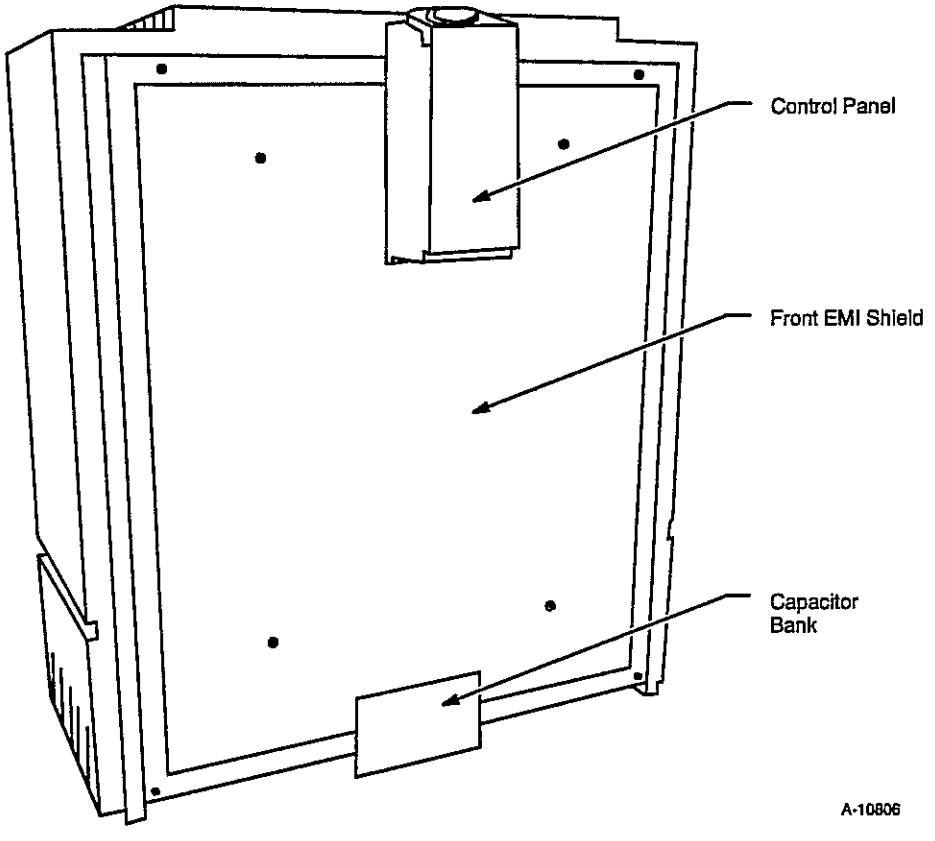

Figure 7-7. Inner Front-panel EMI Shield

FRP4

Replacing the Front Panel Assembly

Procedure

1. Replace the inner front-panel EMI shield (Figure 7-7) by placing the panel correctly back into the frame and securing the four panel screws.

2. Hang the front panel back cut-out piece on the panel-mounting screws carefully. Refer to Figure 7-6. Be careful not to damage the control panel trim cover.

3. Push the bottom of the panel into the frame; you should hear a click as the panel locks into position.

4. Hang the curved center panel piece on the panel-mounting screws. Be careful not to damage the control panel trim cover or accidently bump the EPO button.

CAUTION

Take care not to damage the control panel trim cover or accidently depress the EPO button when replacing the front panel. Damage to the system may occur.

5. Push the bottom of the panel into the frame; you should hear a click as the panel locks into position.

FRP5

Opening or Removing the Side Panels

This procedure applies to both the left and right side panels. Some of the procedures in this manual require you to actually remove the side panel. If you are removing a right side panel, you will have to remove the front panel assembly first. If you are removing a left side panel on a single-cabinet system, you will have to remove the back panel assembly first.

Procedure

1. Turn the latch (Figure 7-8) counterclockwise one half turn to unlatch it and swing the panel open.

NOTE: Proceed to Step 2 only if the procedure you are performing indicates that a side panel should be removed.

2. Lift the panel upward, keeping it as straight as possible, until it clears the hinge pins.

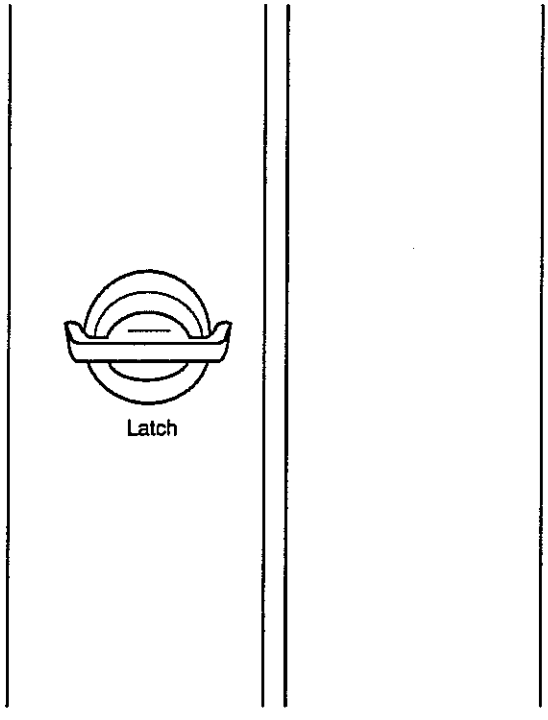

Figure 7-8. Side Panel Latch

FRP6

Closing or Replacing the Side Panels

If you removed a side panel, use Step 1 and Step 2 to replace it; if you opened, but did not remove, a side panel; use Step 2 to close the side panel.

Procedure

1. Carefully lower the panel onto the hinge pins.
2. Push the panel to close it, and turn the latch clockwise until it locks. Refer to Figure 7-8.

FRP7

Removing the Back Panel Assembly

This procedure includes removing the back panel and the inner back-panel EMI shield. Removing the back panel requires two people.

Procedure

1. Release the lower two spring catches (Figure 7-5) located on the bottom of the panel (one spring catch is located in each corner) and push up on the release rod. The bottom of the panel has now been released and the panel is hanging from the panel-mounting screws. Refer to Figure 7-6.

2. Position one person at each end of the panel to lift the panel and ease it outward.

3. Remove the inner back-panel EMI shield (refer to Figure 7-9) by removing the two screws located near the upper corners of the panel.

Figure 7-9. Inner Back-panel EMI Shield

FRP8

Replacing the Back Panel Assembly

Procedure

1. Replace the inner back-panel EMI shield (Figure 7-9) by placing the panel back into the frame and securing the two panel screws.
2. Hang the panel on the panel-mounting screws carefully. Refer to Figure 7-6.
3. Push the bottom of the panel into the frame; you should hear a click as the panel locks into position.

FRP9

Removing the IOS VME Boards

The IOS VME boards act as controllers for the individual peripherals. An MIOP board and an input/output buffer board (IOBB) are also in the VME. If a peripheral seems to be faulty, consider that the controller may be failing. The IOS VME boards are shown in Figure 7-10.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Power down the IOS VME subsystem by depressing the VME INHIBIT/ENABLE button on the small computer system interface (SCSI) assembly.
2. Label the front ribbon cables and then remove them from each IOS board. Refer again to Figure 7-10.
3. Loosen the retaining screws on the top and bottom of the board.
4. Grasp the board by the ejector handles located on the top and bottom of the board; push the top ejector handle up and the bottom ejector handle down at the same time and pull the board outward and away from the backplane.

NOTE: Some VME boards do not have ejector handles. You must pull this type of board out of the card cage.

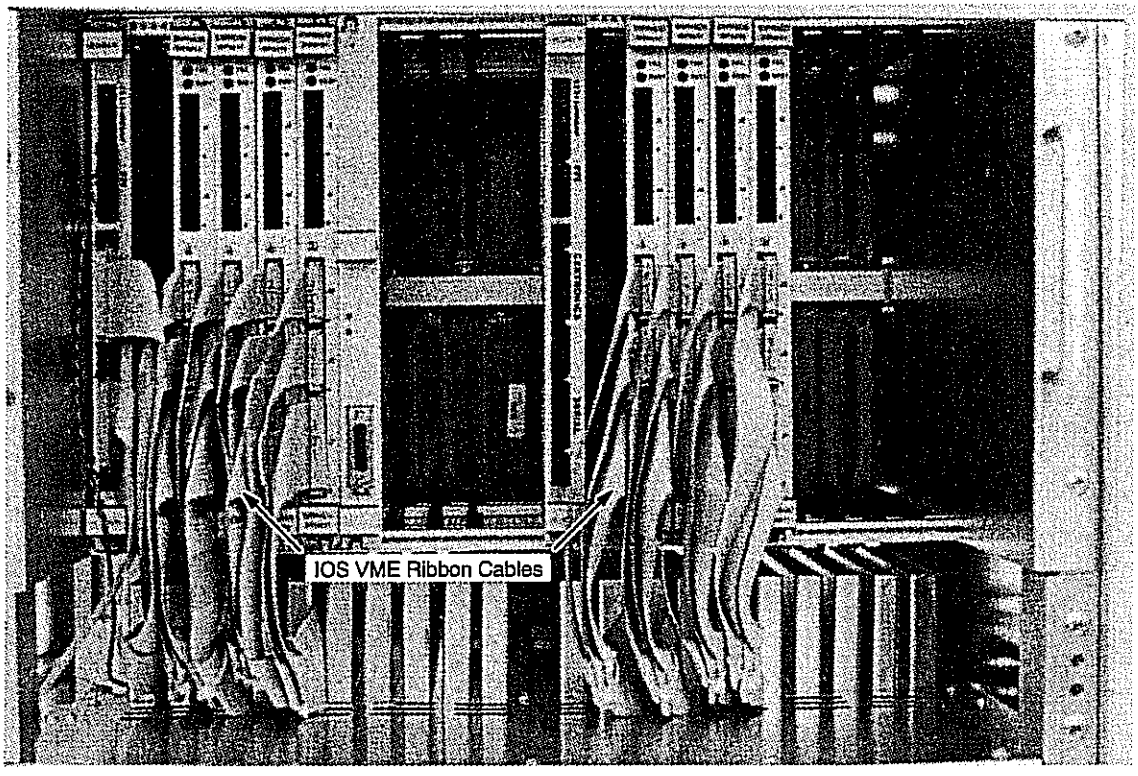

Figure 7-10. IOS VME Boards

FRP10

Replacing the IOS VME Boards

Compare the replacement board with the board you are replacing to ensure that the individual board address jumper and switch configuration on the replacement board are identical to the jumper and switch configuration on the board you are replacing.

If you are adding a new type of IOS VME board to the system configuration, you can compare the jumper and switch configuration of the board with the configurations illustrated in Section 4 of this manual.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Ensure that there are no damaged pins in the VME backplane.
2. Slide the IOS VME board into the correct slot along the glides until it comes in contact with the backplane.
3. Press the top and bottom of the board towards the backplane to set the board into the backplane connector.
4. Tighten the retaining screws.
5. Reconnect the ribbon cables.

FRP11

Removing the IOS VME Card Cage

If you have determined that the backplane is faulty, you will have to replace the IOS VME card cage. None of the IOS VME boards will operate if the backplane is faulty.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Power down the system using FRP2.
2. Open the right side panel using FRP5.
3. Remove the back panel assembly using FRP7.
4. Remove the screws that secure the card cage. Refer to Figure 7-11.
5. Ensure that all of the cables connected to the front of the IOS VME boards are properly labeled.
6. Disconnect the cables connected to the front of the IOS VME boards; do not disconnect the cables connected to the back of the IOS VME.

CAUTION

Lay the cables flat so you will not damage them as you are pulling out the IOS VME card cage.

7. Pull the card cage out as far as it will extend (the drawer has locks as shown in Figure 7-11), and then remove the entire maintenance small computer system interface (SCSI) as directed in the following steps.

8. Remove the VME INHIBIT/ENABLE button cover on the VME card cage to access the inner screws, but leave the switch wires connected. Refer to Figure 7-12 while performing Steps a, b, and c, and place the components you remove in an antistatic workspace.

   a. Remove the two retaining screws on each side of the EXABYTE-2 (EX-2) helical scan cartridge drive.

   b. Remove the two screws on each side that secure the hard disk drive to the SCSI. Retain the data cables.

   c. Remove the two retaining screws on each side to release the streaming tape drive. Retain the data cables.

9. Remove the six retaining screws that cover the voltage buses in the vertical wireway as shown in Figure 7-13. This provides access to the card cage power plugs and the cable carrier.

10. Perform a safety voltage check on the system using FRP50.

DANGER

Wait for the system to completely power down before you touch any components associated with the high-voltage circuits. Verify power loss by performing a voltage check; failure to do so will result in death or serious injury.

11. Disconnect the power plug, power sense cable plug, and cable carrier (two screws). Refer to Figure 7-14.

NOTE: If your system contains tape drives, the interface cables may also be tied to the cable carrier. Disconnect these cables from the back of the card cage, cut the wire wraps on the cable carrier, and retain the cables.

12. Release the card cage locks and pull the card cage completely out.

CAUTION

The card cage has heavy weight concentration towards the back of the card cage. Exercise caution so that it does not drop and damage the card cage or cause injury.

13. Remove the VME boards from the faulty card cage one at a time and insert them into the replacement card cage in the correct locations.

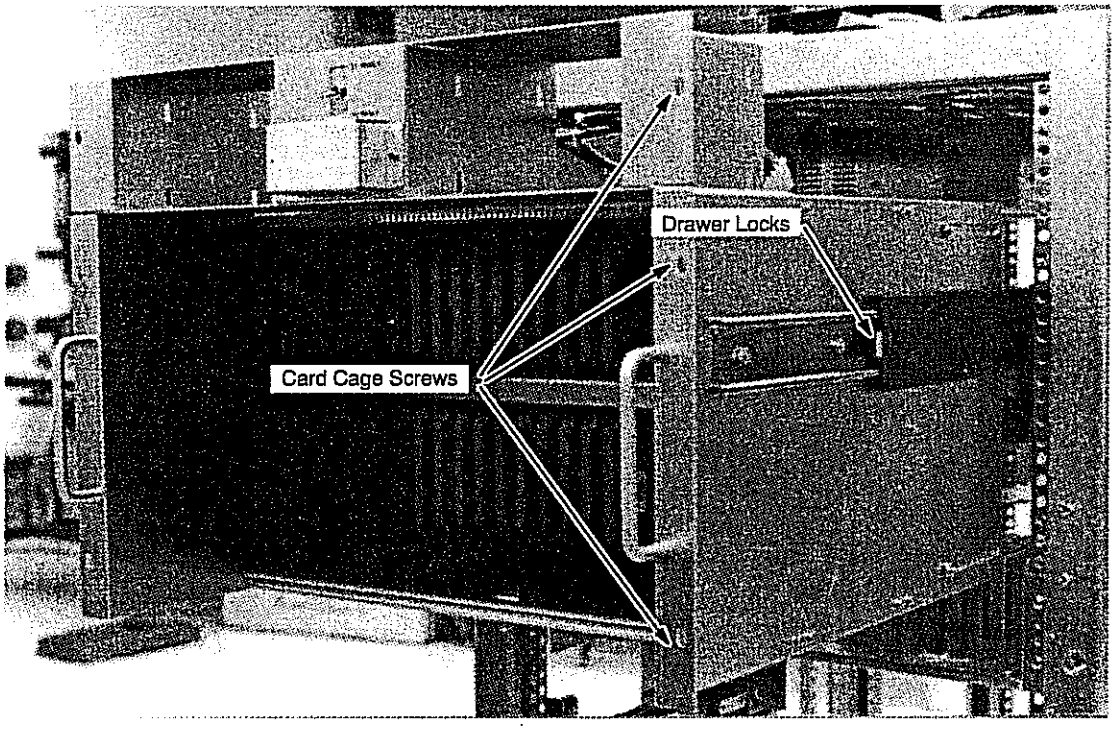

Figure 7-11. IOS VME Card Cage

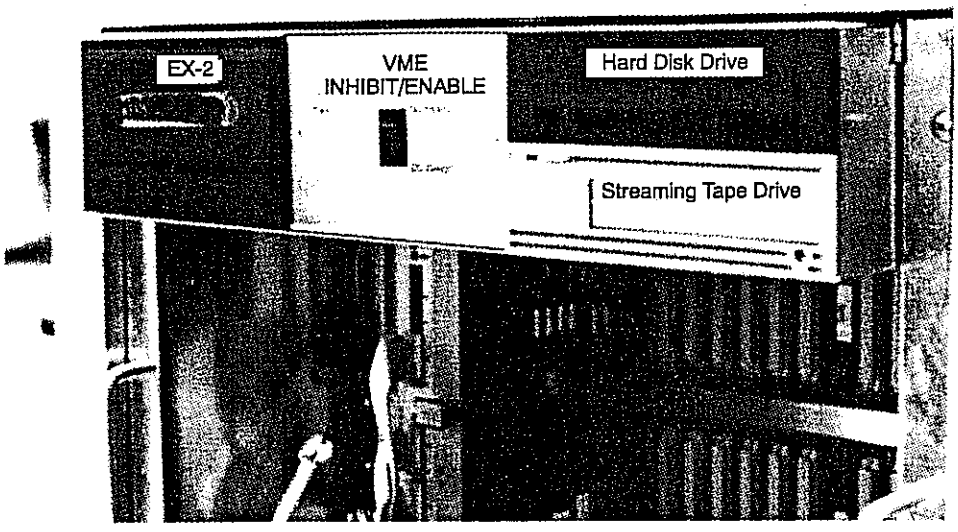

Figure 7-12. SCSI Subassembly

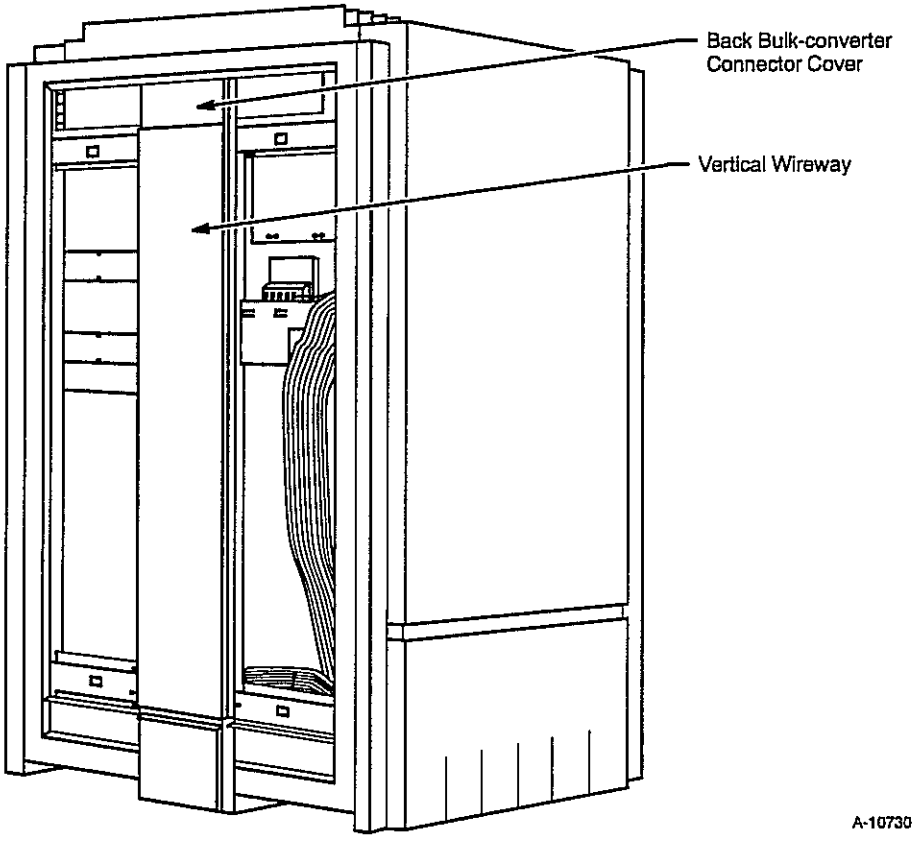

Figure 7-13. Vertical Wireway

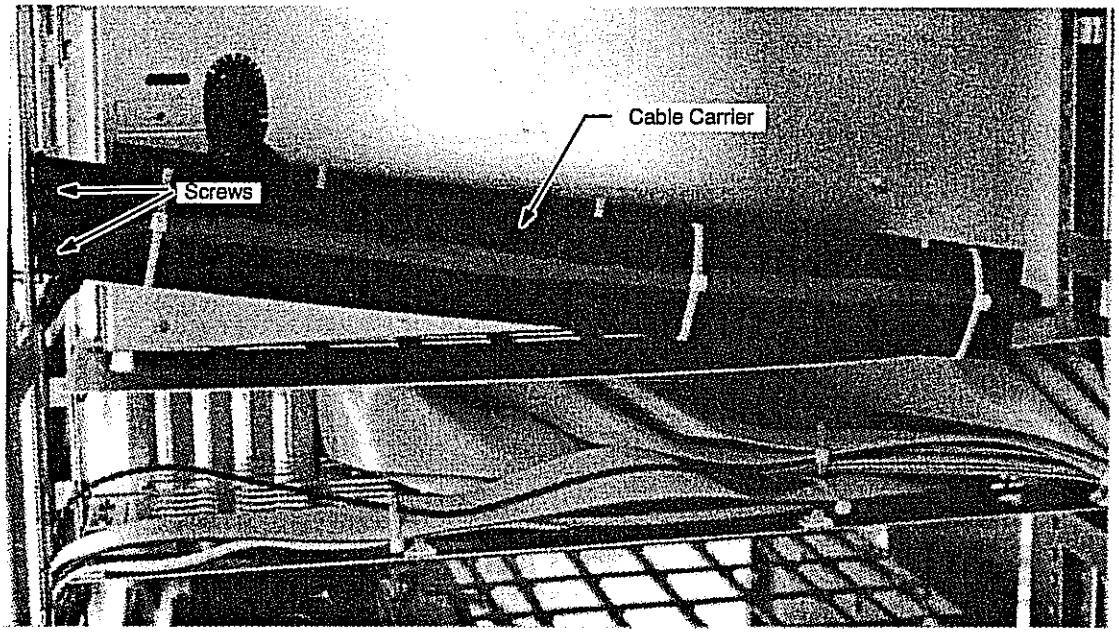

Figure 7-14. Cable Carrier

FRP12

Replacing the IOS VME Card Cage

Exercise caution when you reinstall the IOS VME card cage to ensure that no cables are damaged. Also ensure that the cables, when reinstalled, are seated properly into their connectors.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Push the card cage back on the tracks until it latches; do not push the card cage into the frame after it latches. Leave the card cage extended.
2. If you have not moved each VME board from the faulty card cage to the replacement card cage, do so at this time.
3. Check the jumpers on the back of the replacement VME card cage to ensure the jumper connections are the same as on the old card cage. Move the jumpers from the faulty card cage to the replacement card cage.
4. Reconnect the power plug, sense cable, and cable carrier.
5. Replace the vertical wireway cover by reinstalling all screws.
6. Replace the I/O cables on the back of the VME card cage if applicable.
7. Replace the helical scan cartridge drive, hard disk, and streaming tape drive by reinstalling the screws that were removed in FRP11, Step 8.
8. Push the card cage into the frame.

9. Replace the four screws that secure the VME card cage to the 19-inch rack.
10. Replace the I/O cables on the front of the card cage.
11. Replace the vertical wireway cover.
12. Replace the back panel and inner back-panel EMI shield using FRP8.
13. Close the right side panel.
14. Power up the system using FRP1.

Removing the IOS VME Power Supply

If you determine that an IOS VME power supply is faulty, use the following procedure to replace the power supply. The power supply is located behind the VME backplane.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Power down the system using FRP2.
2. Open the right side panel using FRP5.
3. Remove the back panel assembly using FRP7.
4. Remove the six retaining screws from the voltage buses in the vertical wireway. This provides access to the card cage power plugs and the cable carrier.
5. Perform a safety voltage check on the system using FRP50.

DANGER

Wait for the system to completely power down before you touch any components associated with the high-voltage circuits. Verify power loss by performing a voltage check; failure to do so will result in death or serious injury.

6. Remove the six screws that secure the card cage. Refer to Figure 7-11.

7. Ensure that all of the cables connected to the front of the I/O interface boards are properly labeled.

8. Disconnect the cables connected to the front of the I/O interface boards; do not disconnect the cables connected to the back of the I/O interface boards.

CAUTION

Lay the cables flat so you will not damage them as you are pulling out the IOS VME card cage.

9. Pull the card cage out as far as it will extend (the drawer has locks as shown in Figure 7-11).

10. Loosen, but do not remove, the four nuts (two on each side) that secure the power supplies. Refer to Figure 7-15.

11. Slide the power supply assembly out as far as possible from the back of the card cage.

12. Remove the power supply guard by removing the two kep nuts from the top and the two screws from the bottom.

13. Disconnect all wiring and cables from the power supply. This includes removing two plugs, two large nuts on the bus bar, and three wires on the terminal block attached with screws.

14. Disconnect and remove the securing screws on the back of the VME card cage while supporting the power supply, and pull it out.

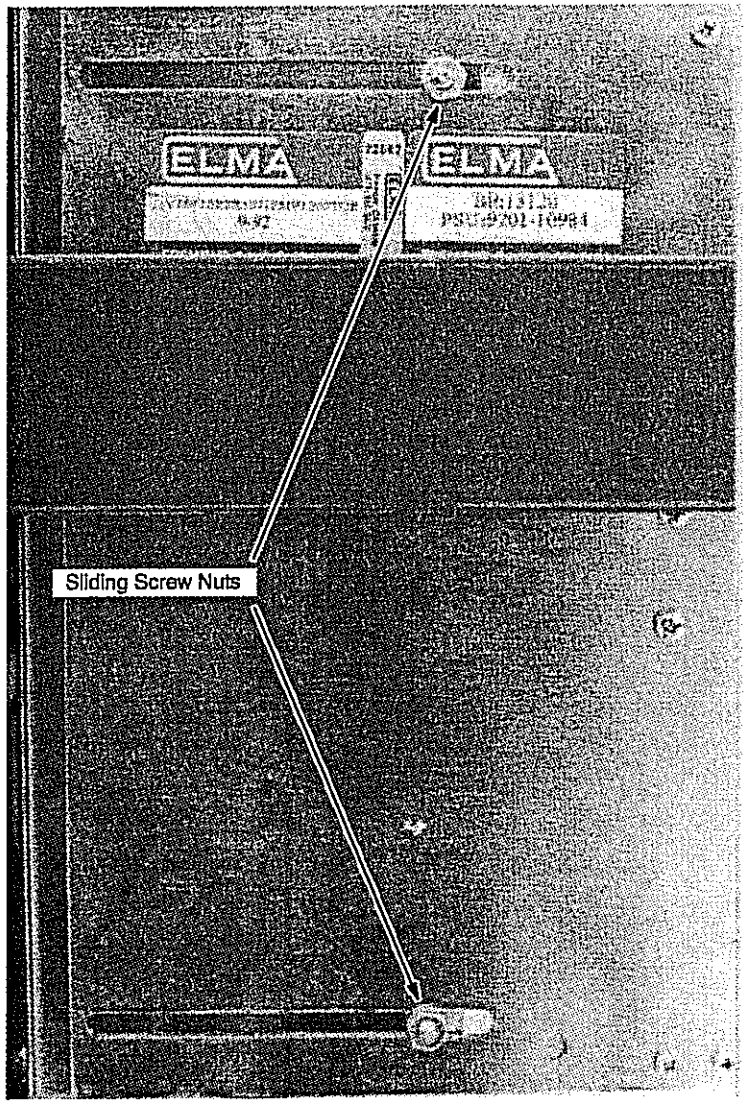

Figure 7-15. VME Power Supply Drawer

FRP14

Replacing the IOS VME Power Supply

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Insert the replacement power supply and replace the six retaining screws.
2. Reconnect all wiring and cables to the power supply.
3. Replace the power supply guard by replacing the two kep nuts and two screws.
4. Gently slide the power supply into place on the card cage.
5. Tighten the four nuts that secure the power supply.

CAUTION

Exercise caution so you do not damage the cables as you are pushing in the IOS VME card cage.

6. Slide the IOS VME card cage back into the frame gently.
7. Replace the four screws on the card cage.
8. Replace the cables on the VME boards.
9. Reseat the IOS VME board cables.
10. Power up the system using FRP1.

FRP15

Removing the CPU and Memory Boards

Use proper ESD procedures when handling the mainframe boards (refer to "ESD Precautions" at the beginning of this section). When it becomes necessary to replace a CPU or memory board, use the following procedure to remove the CRAY Y-MP EL memory or CPU board. This procedure also includes the steps to remove the CRAY EL98 memory and CPU boards.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

NOTE: The procedure for removing the CRAY EL98 CPU and memory boards immediately follows this procedure.

Procedures

1. Power down the system using FRP2.
2. Remove the right side panel using FRP5.
3. Remove the module lock bar by removing its retaining screw.
4. Remove the Y1 bus cables from the CPU boards.
5. Grasp the two extraction levers on the front top and bottom of the appropriate board; push up on the upper lever while pushing down on the lower lever. Refer to Figure 7-16.
6. Slide the board carefully out of the card cage, ensuring that no cables are damaged.
7. Place the defective board in an ESD-safe bag.

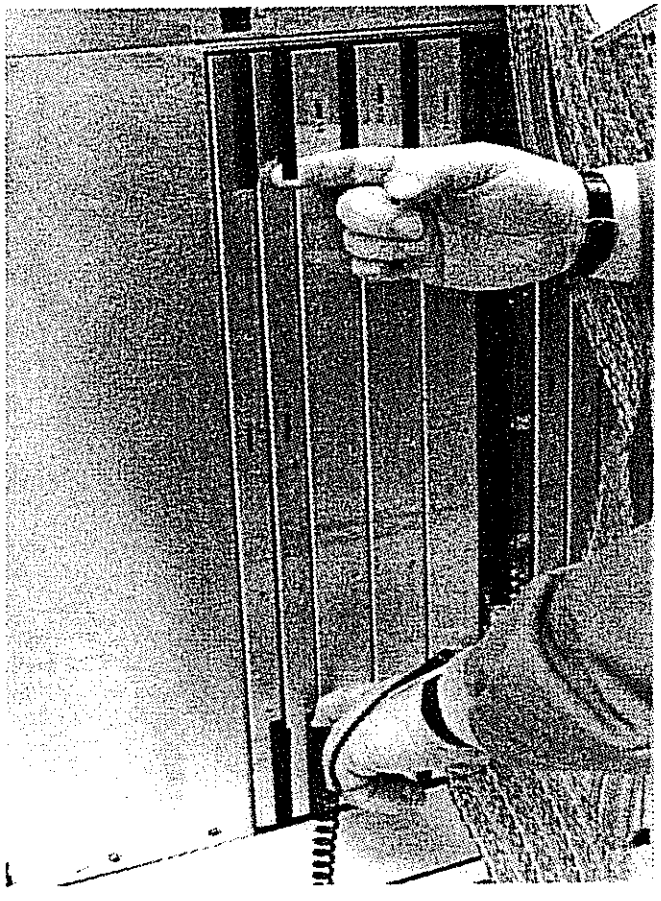

Figure 7-16. Removing the CRAY Y-MP EL CPU Board

Removing the CRAY EL98 CPU and Memory Boards

The procedure for removing the CRAY EL98 boards differs from the procedure for the CRAY Y-MP EL system. You must first remove the memory arbitration bus (MAB) (refer to Figure 7-17) before removing any CPU or memory boards.

1. Perform Steps 1 through 4 on the first page of FRP15.

CAUTION

You must remove the memory arbitration bus before you remove any CPU or memory boards or you may damage the board and bus.

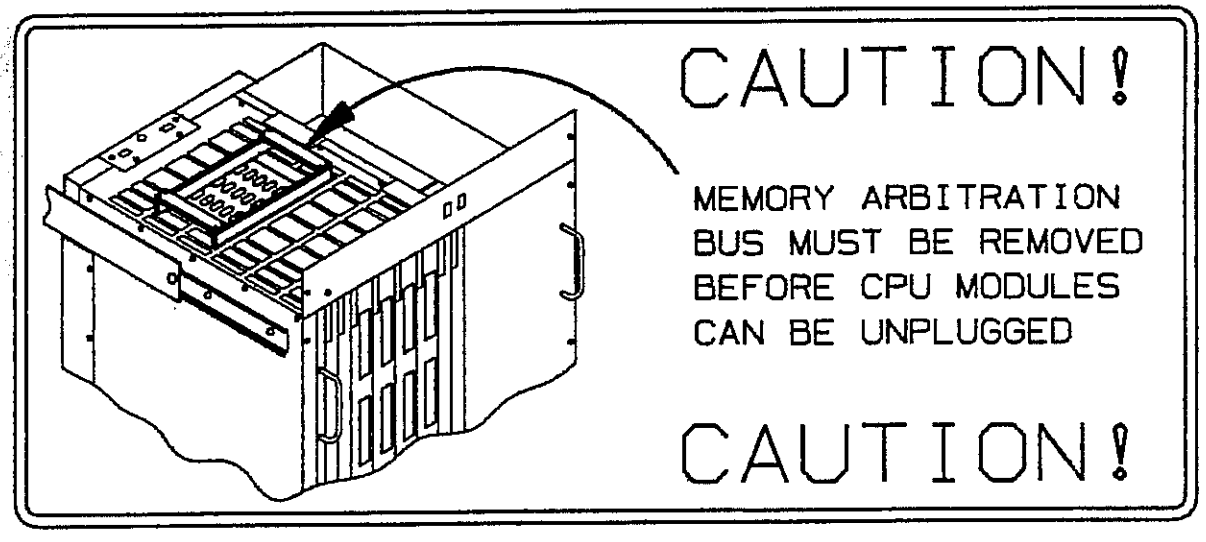

Figure 7-17. MAB Caution Sticker

2. Remove the ten screws from the CPU card cage.
3. Pull out the CPU card cage until it is fully extended.
4. Lift off the MAB. Refer to Figure 7-18.
5. Grasp the two extraction levers on the front top and bottom of the appropriate CPU or memory board; push up on the upper lever while pushing down on the lower lever.

6. Slide the module carefully out of the card cage, ensuring that no cables are damaged.

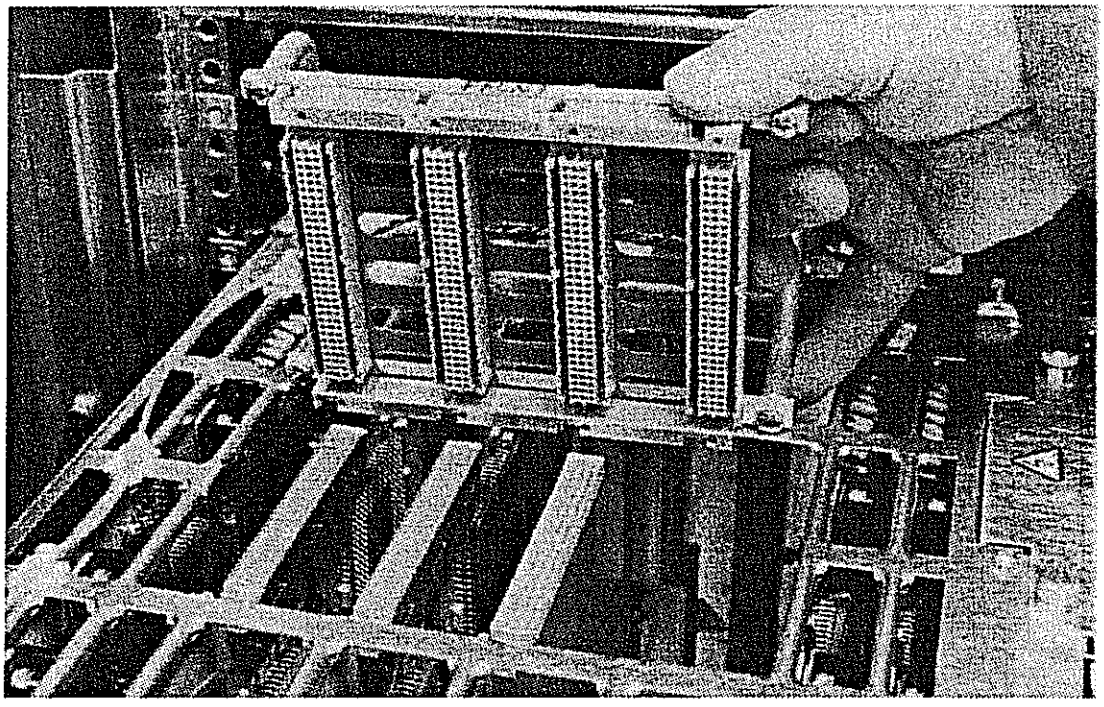

Figure 7-18. CRAY EL98 Memory Arbitration Bus

FRP16

Replacing the CPU and Memory Boards

Ensure that there are no damaged backplane pins before starting this procedure.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Remove the replacement board from the ESD-safe bag or shipping container.
2. Slide the board into the appropriate slot. Note that the logic chips should be on the right side of the board, if it is positioned correctly.
3. Hook the clips on the extractor levers over the lip of the card cage before you seat the board.
4. Push on the extraction levers to seat the board in the backplane connector.
5. Reconnect the Y1 ribbon cables to the CPU boards.
6. Replace the module lock bar.
7. Power on the system using FRP1.

Replacing the CRAY EL98 CPU and Memory Boards

1. Remove the replacement module from the ESD-safe bag or shipping container.

2. Slide the module into the appropriate slot. Note that the logic chips should be on the right side of the module, if it is positioned correctly.

3. Push on the extraction levers to seat the module in the backplane connector.

4. Place the MAB as shown in Figure 7-18.

5. Push in the CPU card cage and replace its ten screws.

6. Reconnect the Y1 ribbon cables to the CPU modules.

7. Replace the module lock bar.

8. Power on the system using FRP1.

FRP17

Removing the Clock Module

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Power down the system using FRP2.
2. Open the right side-panel door using FRP5.
3. Disconnect the Y1 cables.
4. Remove the ten screws from the CPU card cage and pull it out.
5. Remove the frequency cable by unscrewing the lower nut on the frequency cable connector. Refer to Figure 7-19.
6. Loosen, but do not remove, the two retaining screws.
7. Pull out the CPU clock module by grasping the retaining screws.

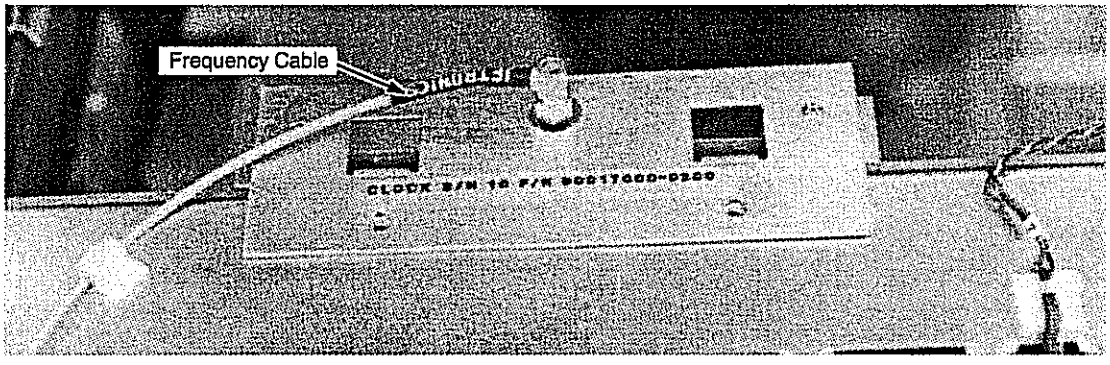

Figure 7-19. Clock Module Frequency Cable

FRP18

Replacing the Clock Module

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Insert the replacement clock module.
2. Replace the frequency cable (refer to Figure 7-19).
3. Ensure that the module is seated properly.
4. Tighten the two retaining screws.
5. Push the CPU card cage in and replace the ten screws.
6. Reconnect the Y1 cables.
7. Power up the system using FRP1.

FRP19

Removing the CPU Card Cage

You must replace the CPU card cage if the CPU backplane is faulty.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Power down the system using FRP2.
2. Open the right side panel and remove the door using FRP5.
3. Disconnect all Y1 bus cables from the front of the CPU boards.
4. Remove all CPU and memory boards using FRP15 and place them in ESD-protected containers.
5. Remove the ten screws on the CPU card cage.
6. Remove the filter from the lower fan tray. Refer to Figure 7-20.
7. Remove the lower fan tray from the bottom of the CPU card cage. Refer to Figure 7-20.
8. Remove the back panel and inner back-panel EMI shield to gain access to the card cage power plugs and the vertical wireway cover. Refer to FRP7.
9. Remove the vertical wireway cover.
10. Extend the card cage out using the grasp handles.
11. Remove the four screws that retain the cable carrier to the wireway. Refer to Figure 7-21.

12. Label and then unplug all power and sense cables.

13. Label and remove both power supplies. Refer to FRP21.

14. Remove the clock module using FRP17.

15. Lay the power and sense cables inside the chassis to prevent damaging the cables when you remove the card cage.

CAUTION

Lay the cables flat so you will not damage them as you are pulling out the IOS VME card cage.

16. Release the card cage locks located on the card cage rails and pull the card cage completely out of the chassis.

NOTE: You must support the card cage when removing it. Use care because the card cage is heavy.

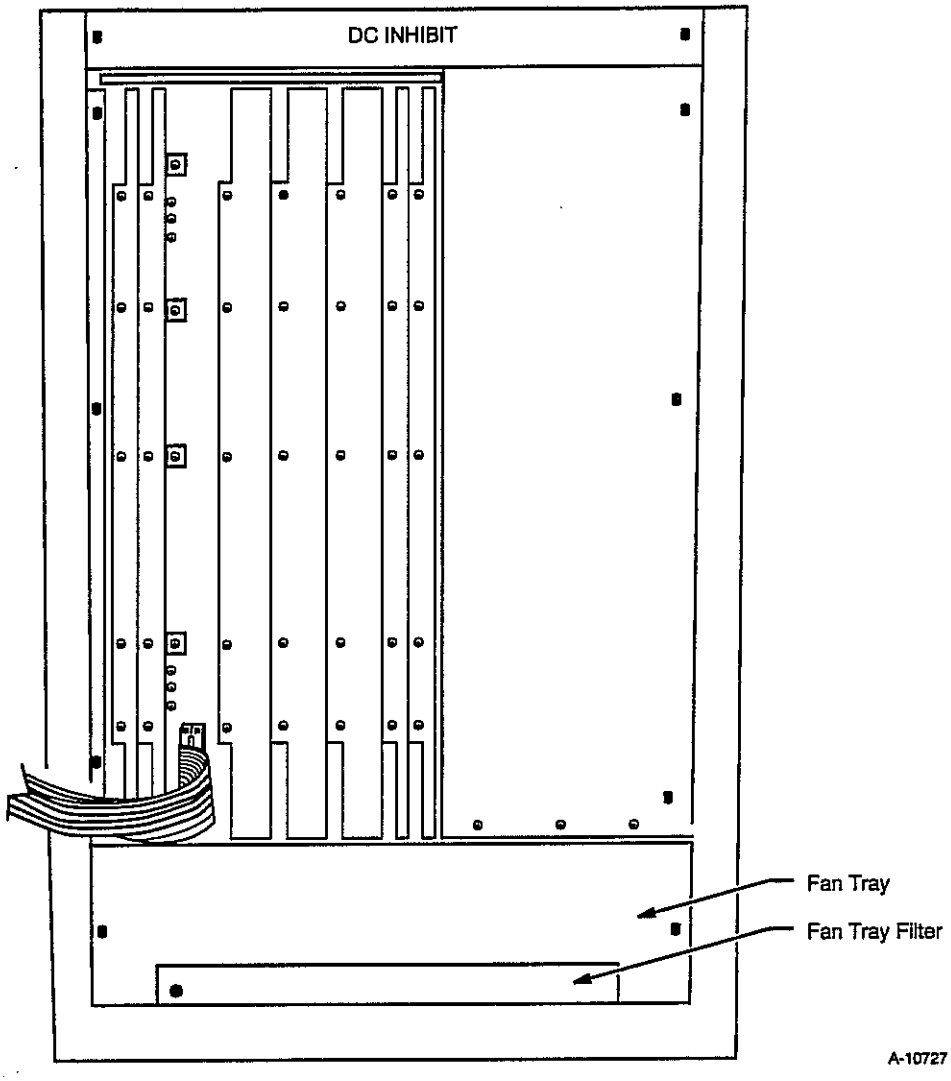

Figure 7-20. CPU Card Cage

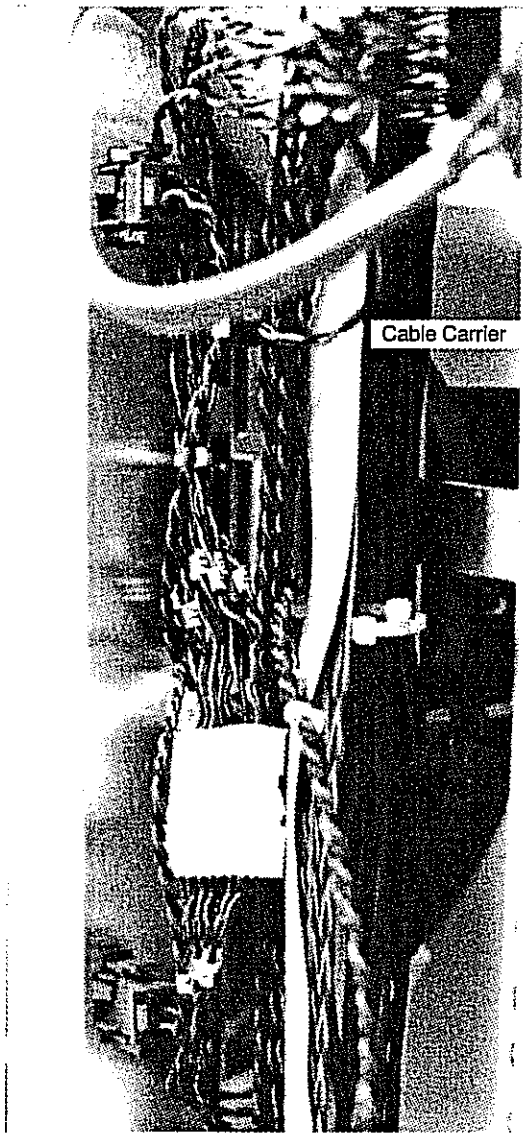

Figure 7-21. CPU Card Cage Power Plugs and Wireway Cable Carrier

FRP20

Replacing the CPU Card Cage

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Push the replacement CPU card cage onto the drawer rails. Leave the card cage extended from the chassis.
2. Reconnect the power plugs and cable carrier.
3. Replace the lower fan tray in the chassis. (Refer to Figure 7-20.)
4. Replace the filter in the lower fan tray. (Refer to Figure 7-20.)
5. Reinstall the clock module using FRP18.
6. Replace the two power supplies. Refer to FRP22.
7. Push the CPU card cage back into the system.
8. Replace the ten screws that secure the CPU card cage.
9. Reinstall the CPU and memory boards using FRP16.
10. Reconnect the Y1 bus cables to the CPU boards.
11. Replace the vertical wireway cover.
12. Replace the inner back-panel EMI shield.
13. Replace the right side panel using FRP6.
14. Power up the system using FRP1.

FRP21

Removing the CPU and Memory Power Supplies

The CPU power supplies are the sole source of power to the CPU. Use the following procedure if you need to replace a power supply.

DANGER

Wait for the system to completely power down before you touch any components associated with the high-voltage circuits. Verify power loss by performing a voltage check; failure to do so will result in death or serious injury.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Power down the system using FRP2.
2. Open the right side panel using FRP5.
3. Remove the ten screws from the CPU card cage.
4. Disconnect the Y1 bus cables from the front of the CPU boards.
5. Pull out the card cage until it is fully extended.
6. Remove the two screws from the output power buses on the bottom of the power supply.

7. Loosen, but do not remove, the two screws that secure the power supply to the frame at the top of the power supply. Refer to Figure 7-22.

8. Grasp the power supply handle and carefully pull up and away from the card cage. Refer to Figure 7-22.

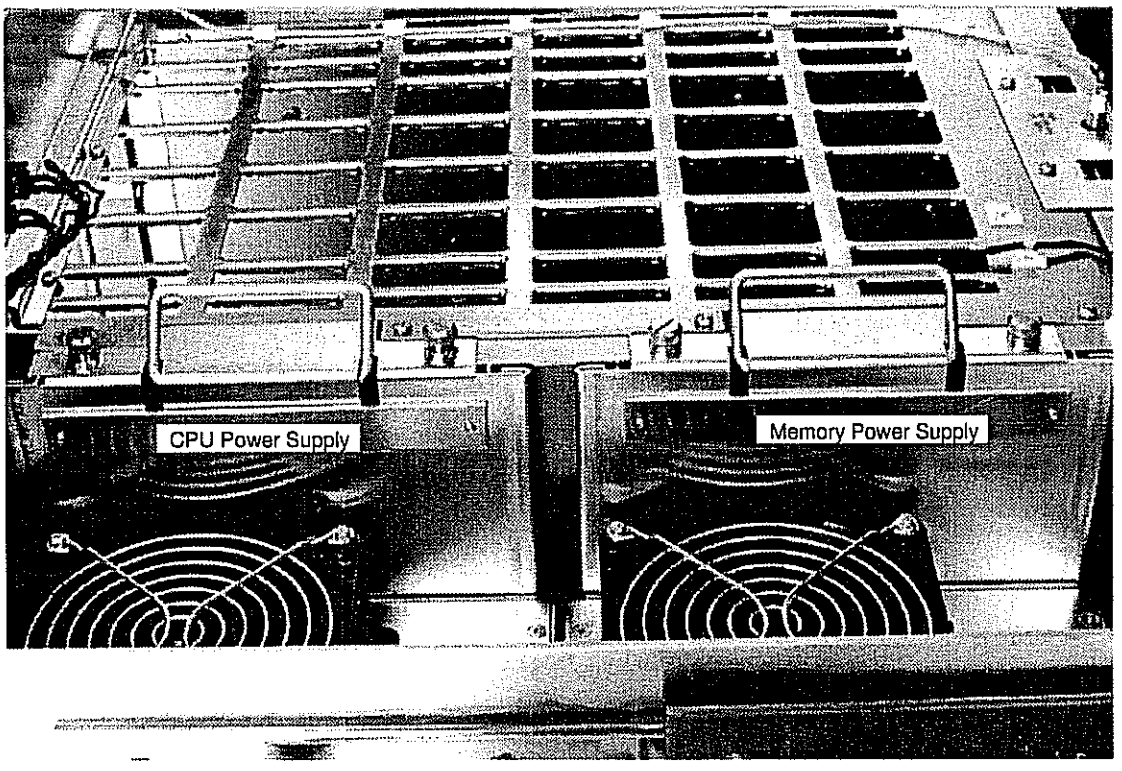

Figure 7-22. CPU and Memory Power Supplies - Top View

FRP22

Replacing the CPU and Memory Power Supplies

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Check the bottom connector and the pins on the replacement power supply for damage.
2. Insert the replacement power supply, taking precautions not to damage the connector. Ensure that the back wires on the power supply are not damaged when you slide the chassis in and out.
3. Tighten the two screws that secure the power supply to the mainframe.
4. Replace the two allen screws that secure the power supply to the buses.
5. Grasp the card cage handles and carefully push the card cage back into the chassis.
6. Replace the ten card cage screws.
7. Reconnect the Y1 bus cables to the front of the CPU boards.
8. Close the right side panel.
9. Power up the system using FRP1.

FRP23

Removing the Bulk Converter

The bulk converter is a self-contained unit that houses four power supplies: two 12-V power supplies to operate the fans and two 380-V power supplies to provide primary DC power. If any one of these power supplies becomes defective, you must replace the entire bulk converter.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

The following procedure is written for a single-cabinet system. If you have a multicabinet system, you must separate the cabinets using FRP48 and remove the appropriate front and back panels before removing the bulk converter.

1. Power down the system using FRP2.
2. Remove the front panel and inner front-panel EMI shield using FRP3.
3. Remove the back panel and inner back-panel EMI shield using FRP7.
4. Remove the top grill panels (slotted trim) by removing the two slotted screws located on the top of the chassis next to the side panels. The top grill panel then lifts off by sliding on two guide pins on the bulk converter.

DANGER

Wait for the system to completely power down before you touch any components associated with the high-voltage circuits. Verify power loss by performing a voltage check; failure to do so will result in death or serious injury.

5. If you are changing the bulk converter in a cabinet with the control panel, remove the vertical wireway cover by removing six screws (three on each side) while supporting the weight of the control panel at the same time.

6. Support the control panel as you lower it to the floor and rest it against the cabinet. Take precautions to avoid damaging the cable harnesses and connectors.

7. Perform a safety voltage check on the system using FRP50.

8. Remove the front and back bulk-converter access plates by removing the two screws from each plate.

9. Disconnect the bulkhead connectors (six on the front and five on the back) from the bulk converter. Refer to Figure 7-23.

10. Remove the left and right top fan-tray perforated covers by removing four screws from each assembly. Use caution; these edges may be sharp.

11. Remove the fan tray screws, which are four Phillips screws and four hex screws.

12. Lift the outside edge fan tray and slide the trays about 4 in. away from the bulk converter. Do not strain or damage the fan-tray wire harness.

13. Remove the four bulkhead-retaining screws. Refer to Figure 7-24.

14. If necessary, extend the upper peripheral trays and/or the IOS card cage about 4 in. to enable you to grasp the bulk converter. You do not need to remove the IOS board cables.

CAUTION

To avoid personal injury and machine damage, use two people to lift the bulk converter; it is very heavy. Take care not to damage the connectors.

15. To remove the bulk converter, perform the following steps.

    a. Lift the bulk converter straight up until the connectors contact the frame.

    b. Move the bulk converter forward or backward to allow clearance of the opposite end. (One connector on each end is too long to allow you to lift the bulk converter directly straight up and out.)

    c. Tip the bulk converter up on the end that is clear and lift it from the chassis.

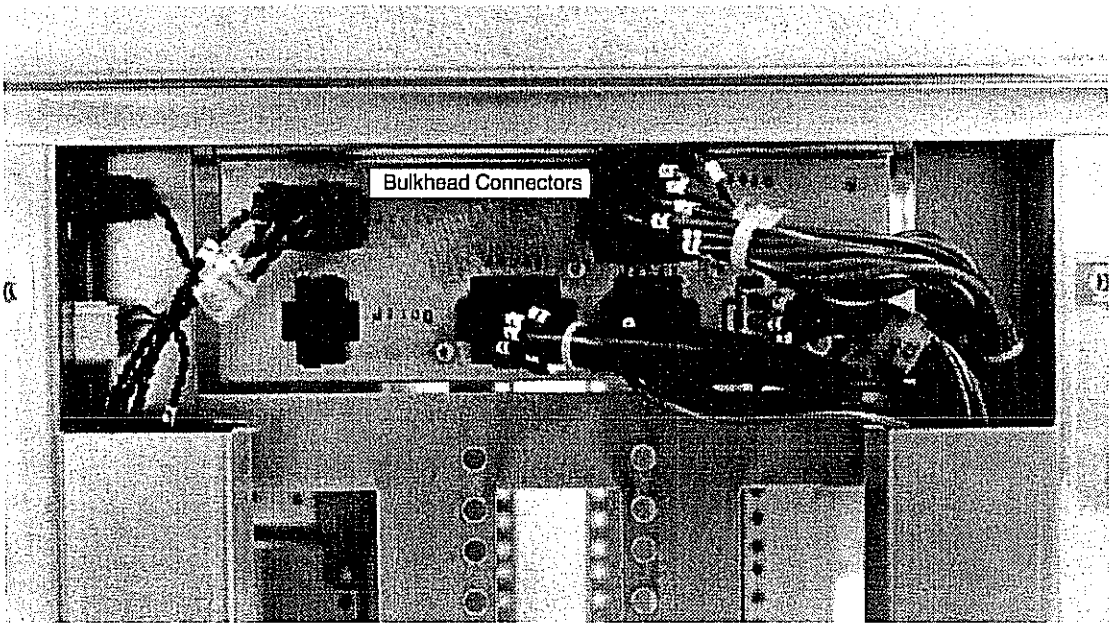

Figure 7-23. Bulkhead Connectors

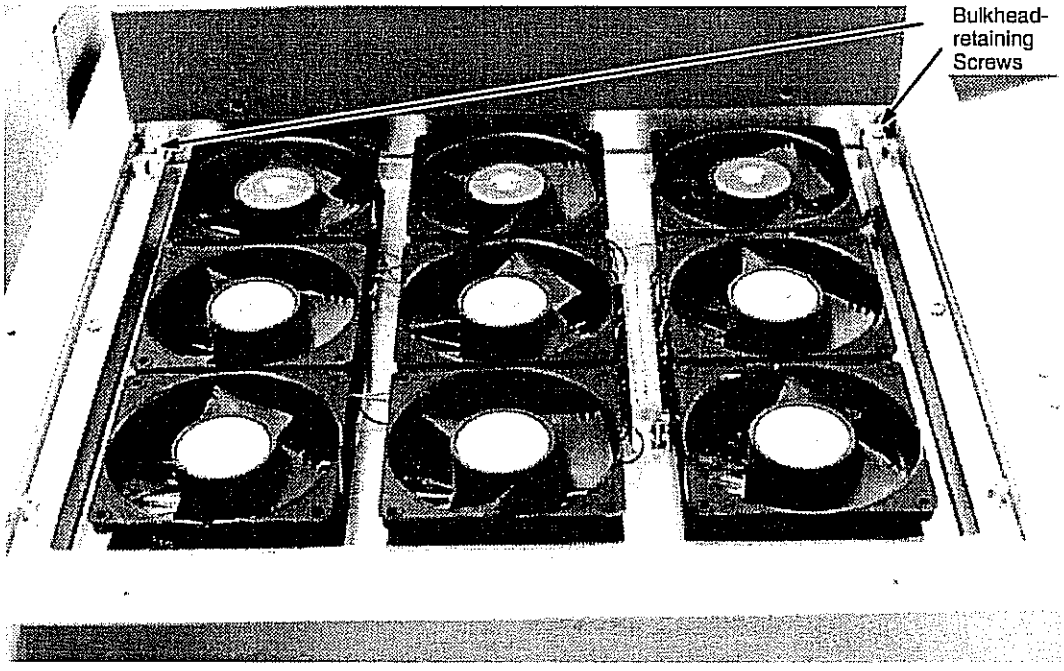

Figure 7-24. Bulkhead-retaining Screws

FRP24

Replacing the Bulk Converter

The following procedure is written for a single-cabinet system. If you have a multicabinet system, you must reconnect the cabinets using FRP49 and replace the appropriate front and back panels after replacing the bulk converter.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

CAUTION

To avoid personal injury and machine damage, use two people to lift the bulk converter; it is very heavy. Take care not to damage the connectors.

1. To install the bulk converter, perform the following steps.

   a. Tip the replacement bulk converter up on one end and lower the end into the chassis.

   b. Move the bulk converter forward or backward to allow clearance of the opposite end. (One connector on each end is too long to allow you to lower the bulk converter straight down initially.)

   c. Lower the bulk converter straight down until the connectors contact the frame. (Be careful as you lower the bulk converter to avoid damaging the connectors.)

2. Place the upper peripheral trays in their original positions.

3. Replace the four bulkhead-retaining screws. Refer to Figure 7-24.

4. Slide the fan trays back into the chassis. Do not strain or damage the fan-tray wire harness.

5. Replace the fan tray screws, which are four Phillips screws and four hex screws.

NOTE: The hex screws are the screws nearest to the corners.

6. Replace the left and right top fan-tray perforated covers and ensure that the holes align with the stand-off screws.

7. Reconnect the bulkhead connectors (six on the front and five on the back) to the bulk converter.

8. Replace the front and back bulk converter access plates by replacing the two screws on each plate.

9. Support the control panel as you lift it off the floor and place it back in location. Take precautions to avoid pinching the cable harnesses and connectors.

10. If you are changing the bulk converter in a cabinet with the control panel, fasten the vertical wireway cover by tightening the three screws on each side of the cover.

11. Replace the back panel and inner back-panel EMI shield using FRP8.

12. Replace the front panel and inner front-panel EMI shield using FRP4.

13. Power up the system using FRP1.

FRP25

Removing the Capacitor Bank

The capacitor bank maintains power to the system during momentary power line failures.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

The following procedure is written for a single-cabinet system; if you have a multicabinet system, you need to separate the cabinets before proceeding and remove the appropriate front and back panels and EMI shields.

DANGER

Wait for the system to completely power down before you touch any components associated with the high-voltage circuits. Verify power loss by performing a voltage check; failure to do so will result in death or serious injury.

1. Power down the system using FRP2.
2. Unplug the system from the power source.
3. Remove the front panel and inner front-panel EMI shield using FRP3.
4. Remove the back panel and inner back-panel EMI shield using FRP7.

5. Remove the front and back vertical wireway panels.

6. Use FRP50 to verify that the high-voltage buses on the front and on the back of the cabinet are discharged to 0 volts.

7. Remove the capacitor-bank access plates. The front plate is a panel with two screws, and the back plate is a box with four screws. Refer to Figure 7-25.

NOTE: Some models have an inner panel secured by two screws that you need to remove.

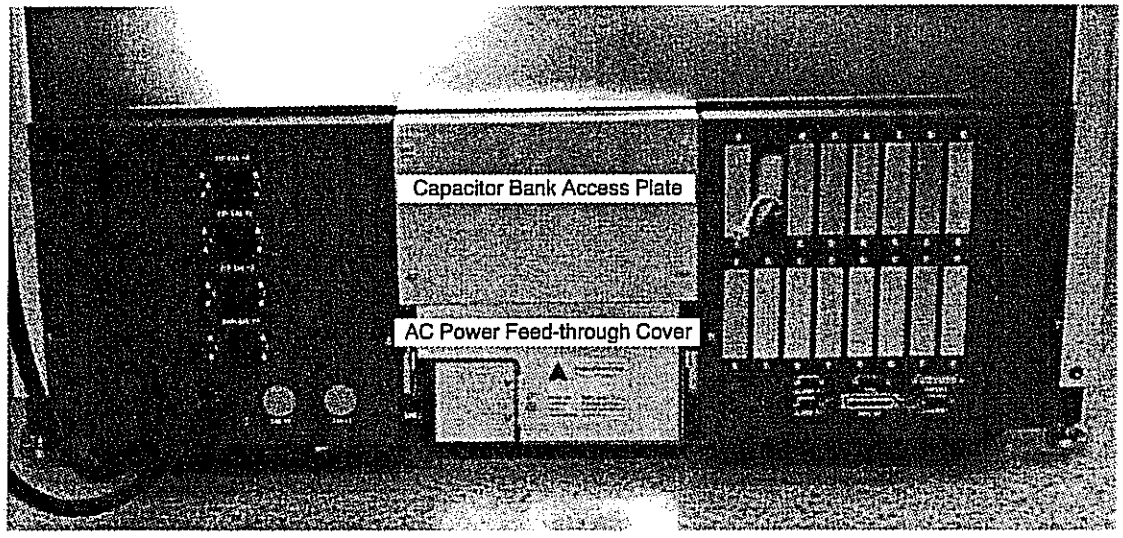

Figure 7-25. Back Capacitor-bank Access Plate

8. Disconnect the connectors from the front and back of the capacitor bank. Refer to Figure 7-26.

9. If you are repairing the mainframe cabinet, remove the incoming power module using FRP27. Set the incoming power module to one side.

   a. If you are repairing the mainframe cabinet, remove the four mounting screws from the incoming data cable module and set it to one side. The cables remain attached.

10. Remove the AC input-cable strain-relief plate (three screws) from the lower left corner of the back of the capacitor bank.

    a. Remove the two outer screws.

    b. Loosen the screw located toward the back of the relief plate.

11. Remove the two screws from the front upper corners of the capacitor bank on the front of the system. Keep these screws separate because they are different sizes. The unit should slide freely to the rear about 5 inches. Use caution because the capacitor bank is very heavy. Refer to Figure 7-25.

12. Label, then disconnect, the incoming power from the capacitor bank.

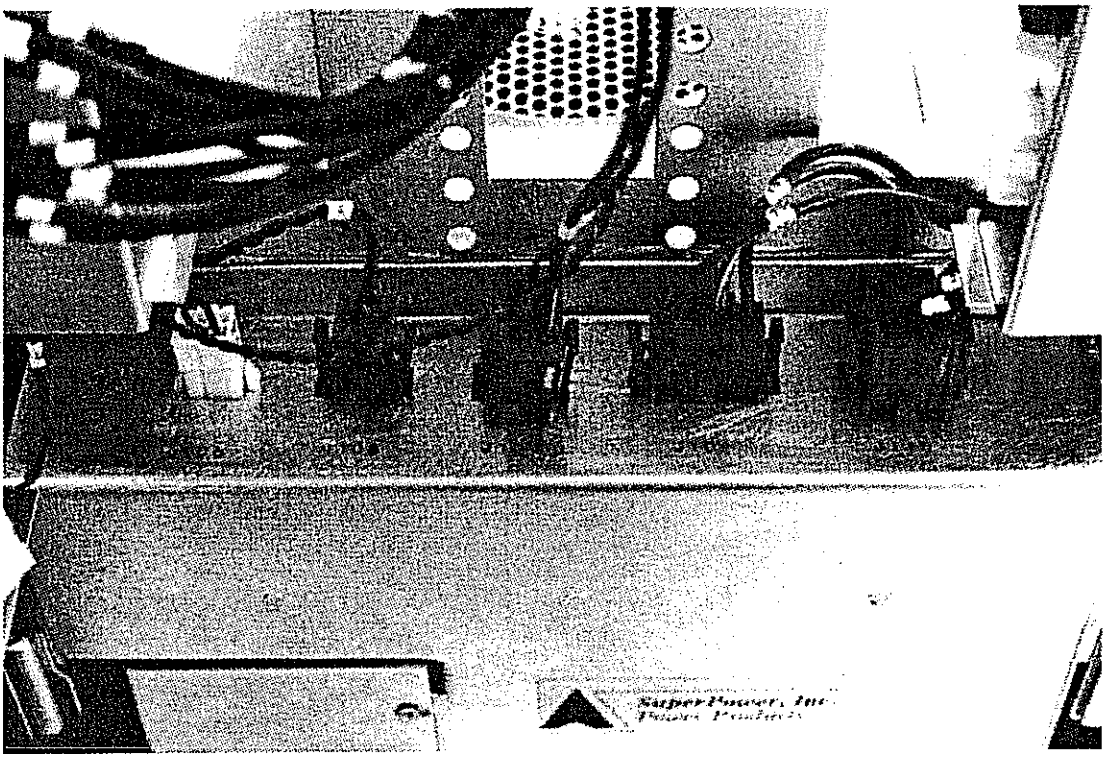

Figure 7-26. Capacitor Bank Connectors

FRP26

Replacing the Capacitor Bank

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

DANGER

Wait for the system to completely power down before you touch any components associated with the high-voltage circuits. Verify power loss by performing a voltage check; failure to do so will result in death or serious injury.

1. Check the incoming air filter to determine whether it needs cleaning or replacement.
2. Slide the replacement capacitor bank in from the back until it is almost all the way in, leaving the AC connectors exposed.
3. Reconnect the AC input cable and reinstall the AC input-cable strain-relief plate.
4. Finish sliding the replacement unit in and secure it with two screws in the front.
5. Reconnect the connectors on the front and back of the capacitor bank.
6. Replace the capacitor-bank access plates.

7. Verify that the capacitor bank is operational by using the following procedure.

   a. Place the DVM leads into the high-voltage socket.

   b. Power the system on, and then power it off by depressing the emergency power-off (EPO) button.

   c. Observe the voltage rapidly decline to around 16 V. The voltage drop will then progress slowly to 0 V.

8. Replace the front and back panels and the EMI shields using FRP4 and FRP8.

9. Power up the system using FRP1.

FRP27

Removing the Incoming Power Module

The incoming power module may need to be replaced if the circuit breaker is faulty or if the ON/OFF switches are inoperable.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

DANGER

Wait for the system to completely power down before you touch any components associated with the high-voltage circuits. Verify power loss by performing a voltage check; failure to do so will result in death or serious injury.

1. Power down the system using FRP2.
2. Unplug all AC cables from their power sources.
3. Remove the back panel and inner back-panel EMI shield using FRP7. Use FRP50 to ensure that the system has completely powered off.
4. Remove the capacitor-bank access plate (shown in Figure 7-25) near the incoming power module (four screws).
5. Unplug the J2, J3, and J4 connectors from the incoming data cable module. Refer to Figure 7-27. Connector J3 is attached with two screws.

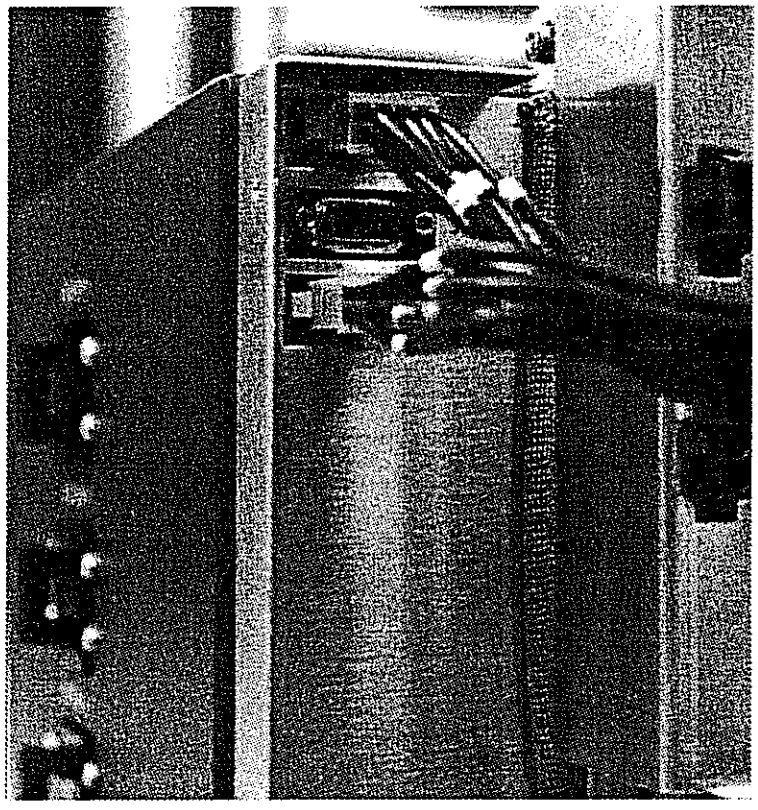

Figure 7-27. Incoming Power Module Connectors and Data Cable

6. Remove the two long and two short screws from the incoming power module.

7. Carefully lay the incoming power module beside the system with the breaker side down.

8. Disconnect the three outgoing AC cables from the capacitor box using an 11/32-inch socket.

9. Remove the back cover of the incoming power module by removing the ten countersunk Phillips screws from the cover. Refer to Figure 7-28.

10. To disconnect the incoming power cable (part number 90086600), first press down firmly with a flat-bladed screwdriver and pull the line (black) and neutral (white) wires from the incoming power module terminal block. Refer to Figure 7-29.

11. After disconnecting the line and neutral wires, disconnect the incoming power cable ground (green) wire from the incoming power module using a 3/8-inch nut driver or a 3/8-inch socket. Refer to Figure 7-29.

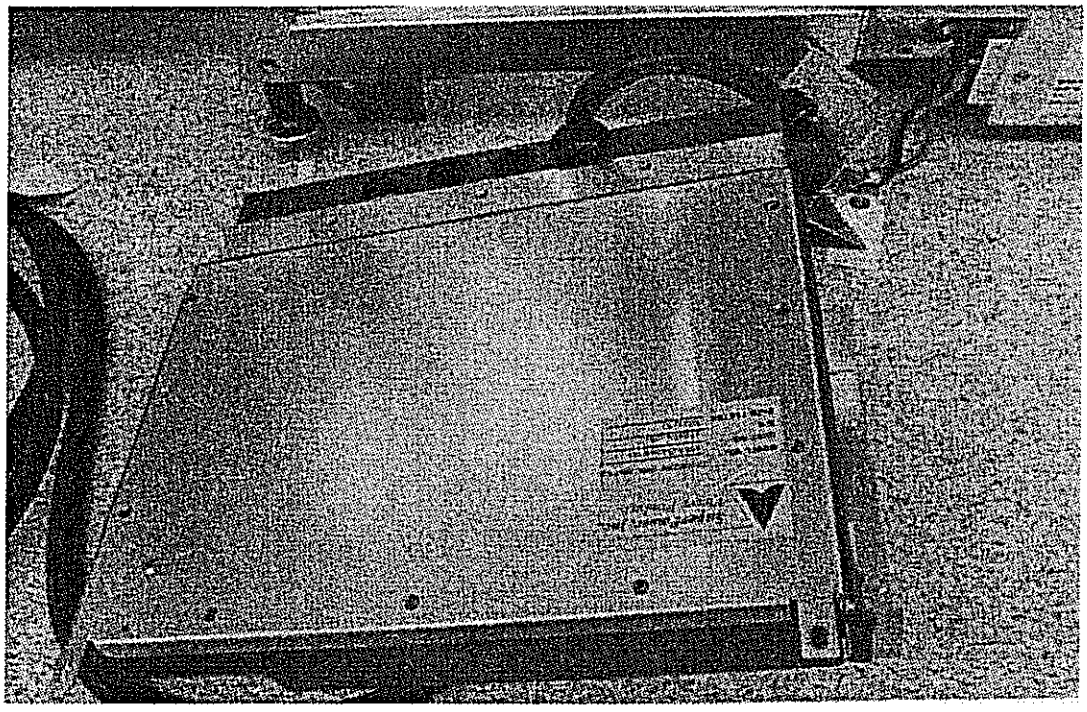

Figure 7-28. Incoming Power Module Back Cover

12. Loosen the lock nut that retains the incoming power cable, using a hammer and flat-bladed screwdriver.

13. Remove the lock nut and slide the cable assembly out of the incoming power module.

14. To disconnect the outgoing power cable (part number 90086301), press down firmly with a flat-blade screwdriver and pull the line (black), neutral (white) and ground (green) wires from the incoming power module terminal block. Refer to Figure 7-29.

15. Remove each AC cable strain-relief using a strain-relief pliers (part number 90232800), and remove the cables. The procedure for removing a strain-relief is located inside the incoming power module. Refer to Figure 7-30.

16. Slide the outgoing power cable out of the incoming power module.

17. Save the incoming and outgoing power cable assemblies for reuse with the replacement incoming power module.

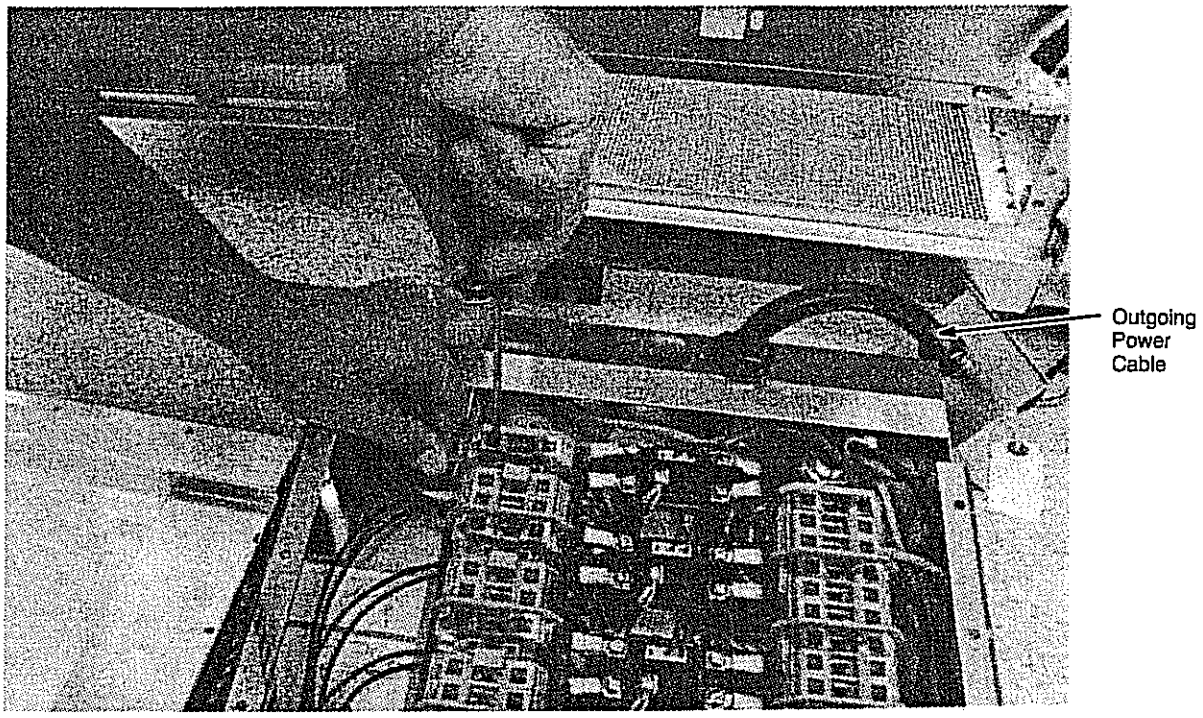

Figure 7-29. Incoming Power Module Terminal Block

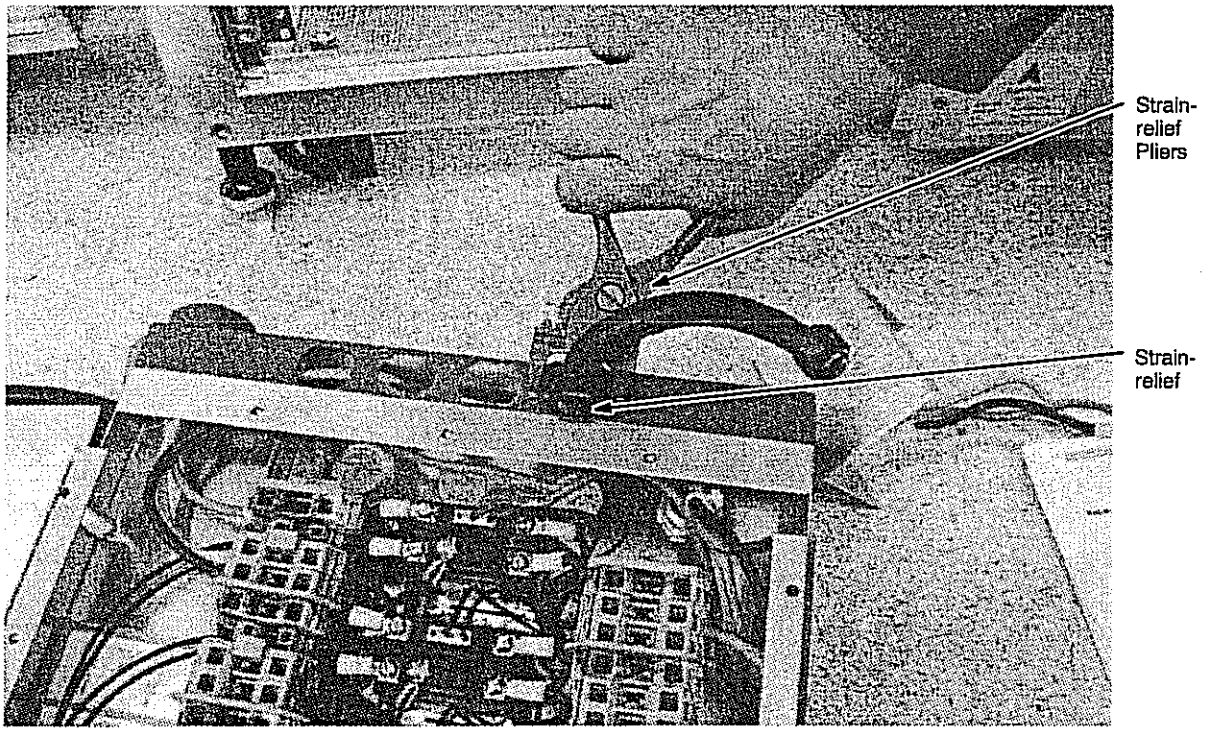

Figure 7-30. Cable Strain-relief Device

FRP28

Replacing the Incoming Power Module

The field repair policy regarding a faulty incoming power module requires you to replace the entire incoming power module.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

DANGER

Wait for the system to completely power down before you touch any components associated with the high-voltage circuits. Verify power loss by performing a voltage check; failure to do so will result in death or serious injury.

Before you install the replacement incoming power module, you must attach the incoming and outgoing power cable assemblies.

1. Slide the outgoing AC power cable assembly (part number 90086301) through the cable-access hole in the incoming power module.

2. Insert each AC cable strain-relief into the access hole using a strain-relief pliers (part number 90232800).

3. Connect the line (black), neutral (white), and ground (green) wires to the outgoing terminal block by pressing down firmly with a flat-bladed screwdriver and pushing the wires into the terminal block.

4. Slide the incoming AC power cable assembly (part number 90086600) through the cable-access hole in the incoming power module.

5. Connect the line (black) and neutral (white) wires to the incoming terminal block by pressing down firmly with a flat-blade screwdriver and pushing the wires into the terminal block.

6. Connect the ground (green) wire to the incoming power module using a 3/8-inch nut driver.

7. Secure the AC cable assembly to the incoming power module with the connector and lock nut.

8. Tighten the lock nut by lightly tapping on the lock nut using a hammer and flat-bladed screwdriver.

9. Replace the back cover of the incoming power module assembly and secure it with ten countersunk Phillips screws.

10. Replace the two long and two short screws on the incoming power module that secure the module to the chassis.

11. Reconnect the J2, J3, and J4 connectors to the incoming power module. Refer to Figure 7-27.

12. Reconnect the outgoing power cable wires (black, white, and green) to the capacitor-bank connectors using an 11/32-inch socket.

13. Replace the capacitor-bank access plate (four screws).

14. Replace the back panel and inner back-panel EMI shield using FRP8.

15. Replug all AC power cables to their power sources.

16. Power up the system using FRP1.

FRP29

Removing the Control Panel

The control panel (Figure 7-31) displays the status of the system. The entire control panel assembly including cables must be replaced when the control panel requires replacement.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Power down the system using FRP2.
2. Remove the front panel and inner front-panel EMI shields using FRP3.
3. Remove the screws from the vertical wireway cover and set this cover aside.
4. Remove the two screws that connect the control panel to the front bulk-converter connector cover.
5. Remove the two front bulk-converter connector-cover screws.
6. Remove the eight screws that secure the control panel to the mounting plate. Support the control panel as you remove the last screws, because it may fall. Refer to Figure 7-32.
7. Disconnect the two ribbon cables inside the control panel.
8. Disconnect the small connector inside the control panel.
9. Cut the wire wraps on the black wires that come from the mainframe chassis and plug into the EPO button and then disconnect the wires.
10. Remove the six mounting screws and set the control panel aside.

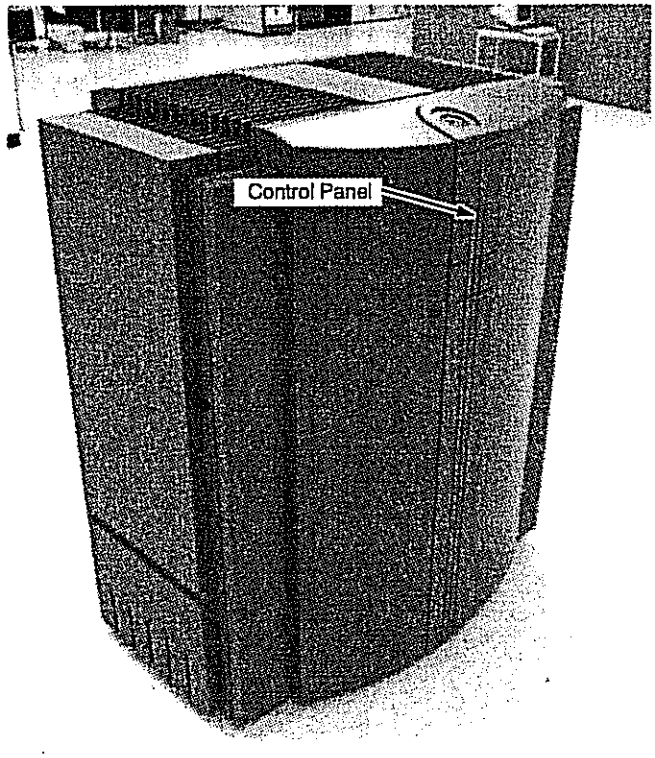

Figure 7-31. Control Panel

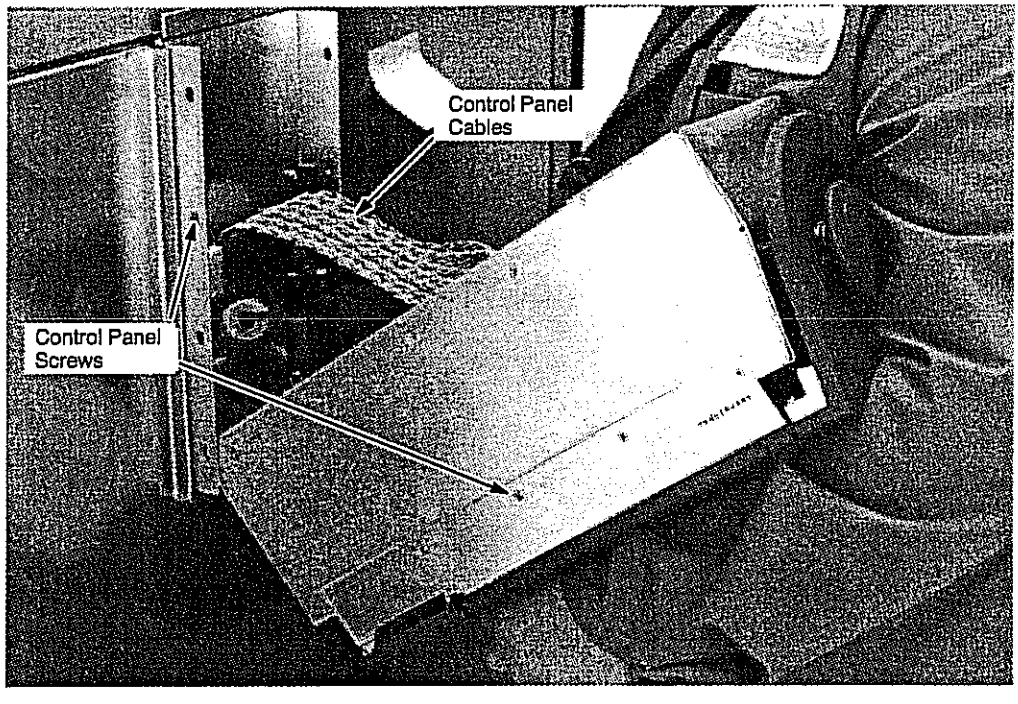

Figure 7-32. Control Panel Cables and Connectors

FRP30

Replacing the Control Panel

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Insert the new control panel and secure the six mounting screws that attach it to the chassis.
2. Insert the new black wires and bundle them with wire wraps.
3. Install the new connector inside the control panel.
4. Install the new ribbon cables into the control panel and their appropriate connectors inside the cabinet. Use cable ties to secure the cables to the nearby support bracket.
5. Replace the eight screws that secure the control panel to the mounting plate.
6. Replace the two front bulk-converter connector-cover screws.
7. Replace the two screws that connect the control panel to the front bulk-converter connector cover.
8. Replace the vertical wireway cover.
9. Replace the front panel and inner front-panel EMI shields using FRP4.
10. Power up the system using FRP1.

FRP31

Removing the Lower Fan Tray

The status lights on the control panel illuminate to indicate that a fan is not operating and should be replaced. Refer to Figure 7-20 for the location of the lower CPU fan tray. Figure 7-33 is a photograph of the left lower fan tray.

CAUTION

Observe ESD precautions when handling static-sensitive devices. Damage to the computer equipment will result if these precautions are not followed.

Procedure

1. Power down the system using FRP2.
2. Open the side panel using FRP5.
3. Remove the two securing screws from the fan tray. Refer to Figure 7-33.
4. Pull out the filter. Refer to Figure 7-33.

NOTE: Only the right side of the CPU cabinet has a tray that is mounted under the CPU card cage. It has a different cable-routing system with no cable carrier. Lift up slightly as you pull the tray completely out of the CPU card cage.

5. If you are not removing the CPU fan tray, pull the fan tray out while supporting it, because it is not fastened to the sliders.
6. When the left lower fan tray is just clear of the frame rest, support the tray while you disconnect the power and sense plugs. Refer to Figure 7-34.
7. Remove the screw for the cable carrier from the fan tray. Refer to Figure 7-34. The cable ties may have to be clipped to allow cable removal. The tray should now be clear of the frame.

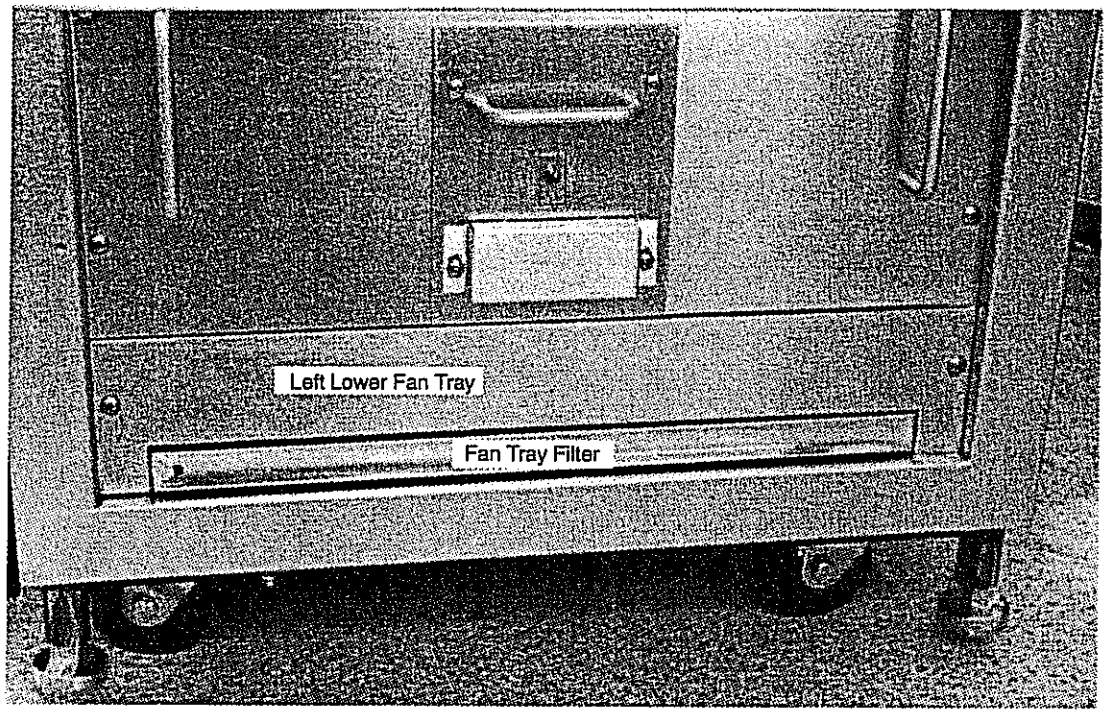

Figure 7-33. Left Lower Fan Tray

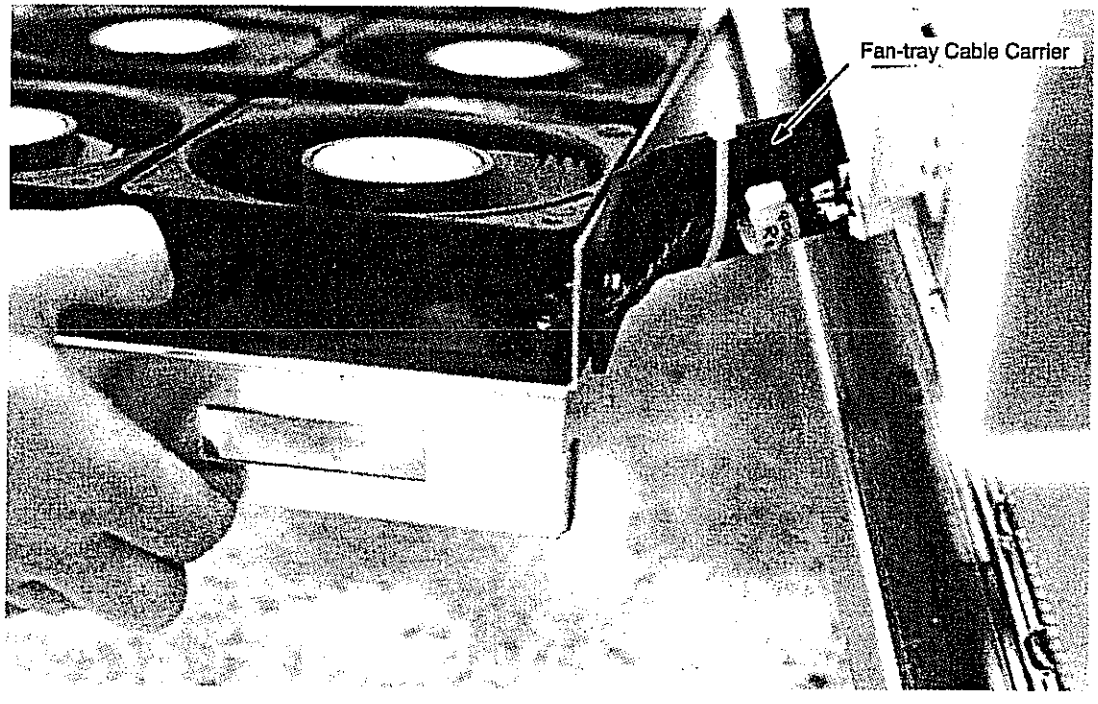

Figure 7-34. Lower Fan-tray Cable Carrier