LC Repair and Adjustment Procedures

HMM-175-A.1
CRAY T3E Series
Last Modified: March 1998

Wire and Cable Replacement

WACS Boards and Sensors

Coolant

Figures

Tables

Record of Revision

March 1997

Original printing.

January 1998

Revision A. Incorporates changes to FRP 11 (Module Replacement) and FRP 12 (Daughter Card Replacement), and adds a new FRP 13: *Packing a Module in a Shipping Container*. This revision makes all previous versions obsolete.

March 1998

Revision A.1. Incorporates changes to FRP 2 (Module Power Supply Replacement).

LC Cabinet Repair Procedures Overview

This document guides you in removing and replacing the field replaceable units (FRUs) for the CRAY T3E liquid-cooled (LC) cabinet. This document includes a list of FRUs, on-site spares, and tools for the CRAY T3E LC cabinet.

In addition, this document includes lists of the FRUs and site spares for the heat exchanger unit (HEU). FRU procedures for the HEU are detailed in *HEU WC-1 Operation, Maintenance, and Repair,* Cray Research publication HMM-022-A.

Cray Research personnel who perform these replacement procedures must have completed training in CRAY T3E hardware.

Safety Information

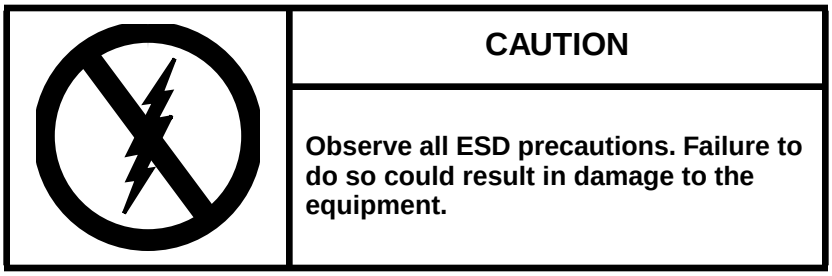
Hazard Statements

During the removal and installation of the computer system parts, be alert for hazard advisory statements. 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 equipment damage and/or data corruption.

ESD Precautions

Observe electrostatic discharge (ESD) precautions during the entire removal and installation process. Required apparel includes an ESD smock, ESD shoes, and an ESD wrist strap. *Safety and ESD Guidelines*, Cray Research publication number HGM-016-A, contains safety information that alerts maintenance and servicing personnel to, and protects them from, potential hazards. **Take the time to read these guidelines**.



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 that exceeds shoulder length inside the back of the smock.

ESD Shoes

Wear approved static-dissipative shoes or approved dissipative heel straps on both shoes when servicing or handling an ESD-sensitive device. When sensitive equipment is exposed to static discharge, ESD shoes provide a backup to the wrist straps and grounding cords and help prevent an excessive charge from building up on you when you are in contact with conductive flooring. Use dissipative footwear in addition to, not as an alternative to, a wrist strap.

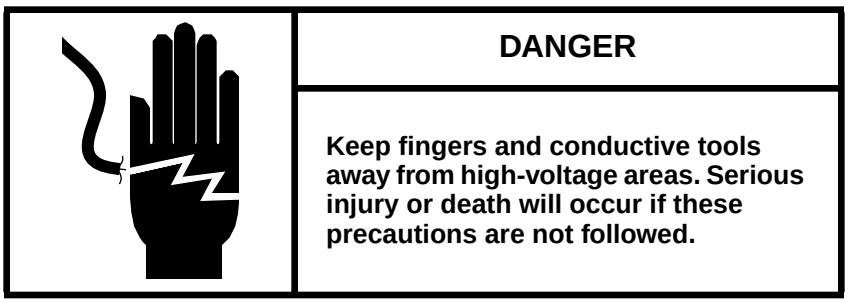
Wrist Strap

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

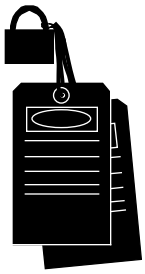
Safety Measures

Observe the following safety measures when you remove, install, repair, or maintain the system.

- Do not wear watches or jewelry when you work on a CRAY T3E system cabinet.
- Keep fingers and conductive tools away from high-voltage areas and from high-current areas.



- Set circuit breakers to the OFF or OPEN position, where indicated, before you start the removal and installation process.



WARNING

Ensure that the electrical circuit breakers for the equipment being serviced are off, locked, and tagged. Failure to do so could result in severe shock and burns.

- Remove all tools from the system cabinets after you service them.
- Several procedures require two people; do not perform the procedure alone.
- Ensure that a qualified electrician has properly installed the power wiring.
- Replace all covers and panels that you removed from the system during servicing.
- Power off the system only after the system software has been shut down in an orderly manner.

CAUTION

If you power off the system before you halt the operating system, you may lose customer data.

Tools Required

The common hand-held tools included with the Customer Service tool kit for a CRAY T3E LC cabinet, P/N 15210200 are the only tools needed. Any special tools are identified in the tools list with that particular procedure.

LC Field-replaceable Units (FRUs), On-site Spares, and Tools

Table 1 lists the field-replaceable units (FRUs) for the CRAY T3E LC cabinet at the time of publication.

Table 1. LC Cabinet Spares

Part Number	Part Name	Cabinet Quantity	Send Back for Repair
Power Supplies			
13264101	Power Supply, 3.3V with thermal pad (kit)	2/Module	Yes
1511820x	Power Supply, 3.3V	2/Module	Yes
15211600	Power Supply, AC - DC 50, WACS	2	Yes
15211700	Power Supply, AC - DC 25, WACS	2	Yes
35185600	Power Supply, AC - DC 50, WACS	2	Yes
57170000	Cordset, IEC320, 20 Amp, 250V	2/Module	No
15214700	Circuit Breaker Assy, 20 Amp (power supply and WACS)	71	No
15214701	Circuit Breaker Assy, 10 Amp (WACS)	2	No
15250500	Filter Assy, Power supply	69	No
15258000	Power supply, Dual output	1	Yes
01158809	Fuse, Ceramic 250V, 15 Amp (power supply)	2/PS	No
01158907	Fuse, GL 250V, 1 Amp		
01158900	Fuse, GL 250V, 1 Amp		No
Rails			
15240100	Rail Assy, LC PEM without GigaRing	1/Module	Yes
15240200	Rail Assy, LC PEM with GigaRing	1/Module	Yes
15215600	Spring, Rail	Variable	No
15133200	Handle, Module	1/Module	No
15130000	Thermistor Assy, module temperature	2/Module	No
Power Distribution Box			
01129701	Alarm, Horn 240V	2	No
01390600	Filter, RFI Line 10 Amp (FL5 and FL6)	2	No
13195200	Filter, RFI Line, 3 Amp (FL7)	1	No
15202000	Filter, 400 Amp	4	No
15225700	Circuit Breaker, 4-pole, 600 Amp (CB1)	1	Yes

Table 1. LC Cabinet Spares (continued)

Part Number	Part Name	Cabinet Quantity	Send Back for Repair
Refrigeration/Cooling			
15130303	Hose Assy, PS blue	1/PS	No
15130404	Hose Assy, PS red	1/PS	No
15145201	Hose Assy, Module grey	2/Module	No
15126900	Coupling, Quick disconnect	2/Module	No
51928809	O-Ring	4/Module	No
WACS			
31481001	Module Assy, CCS	1	Yes
31482003	Module Assy, MMS	1	Yes
31483102	PCB Assy, CCS switch	1	No
31483112	PCB Assy, MMS switch	1	No
13287900	PCB Assy, T3E margin control	1	No
31511100	PCB Assy, T3E interlock	5	No
01492402	Transducer, Pressure	2	No
01665600	Smoke detector	2	No
01766300	Monitor, Dewpoint	2	Yes
15235200	Display, WACS	1	Yes
55003300	Sensor, Temperature	2	No
Cables and Wires			
15112904	Cable Assy, ribbon - 13 in. (33 cm)	4/Rail	No
15112905	Cable Assy, ribbon - 24 in. (61 cm)	8/Rail	No
15112906	Cable Assy, ribbon - 23 in. (58 cm)	2/Rail	No
15128901	Cable Assy, ribbon inverted - 23 in (58 cm)	2/Rail	No
15200501	Cable Assy, GigaRing to bulkhead	4/Module	No
15214200	Cable Assy, PEM to WACS	1/Rail	No
15214300	Cable Assy, PEM to scan	1/Rail	No
15247600	Cable Assy, PEM slot control	2/Module	No
15213601	Cable Assy, Power supply control - 24-in.	Variable	No
15237700	Cable Assy, 4 Position pin	2/Module	No
15223802	Cable Assy, Scan jumper 120”	2	No
15237601	Cable Assy, 2 Position socket to pigtail	2	No
15237801	Cable Assy, 2 Position pin to pigtail	2	No
13315100	Cable Assy, Clock slot control	1	No

Table 1. LC Cabinet Spares (continued)

Part Number	Part Name	Cabinet Quantity	Send Back for Repair
15247800	Cable Assy, HEU interface	1	No
15073300	Cable Assy, HEU RS232 Port H2O	1	No
15256400	Cable Assy, Clock fanout	1	No
15224006	Wire Assy, 34 AWG, 72 in.	1/Module	No
15223701	Wire Assy, Clock	71	No
15244601	Wire Assy, Clock shielded w/drain	1/Module	No
15224008	Wire Assy, 34 AWG, 100 Ohm, 120”	2	No
15224011	Wire Assy, 34 AWG, 100 Ohm, 288'		
WACS Cables			
13303300	Cable Assy, 9 Pin RCPT to RJ45	1	No
15212100	Cable Assy, CS to intcon 20 Pos x 3	1	No
15212200	Cable Assy, CS to intcon 20 Pos x 2	1	No
15212300	Cable Assy, CS to intcon 40 Pos x 2	1	No
15212500	Cable Assy, intcon jumper 6 Pos	4	No
15212600	Cable Assy, CCS/P10	1	No
15212700	Cable Assy,CCS/P9	1	No
15212800	Cable Assy, MS to intcon 40 Pos x 2	1	No
15212900	Cable Assy, MS to intcon 40 Pos x 2	1	No
15213000	Cable Assy, CS to intcon 40 Pos x 2	1	No
15213100	Cable Assy, MMS/P8	1	No
13315000	Cable Assy, CS to intcon 40P x 40P	1	No
15213300	Cable Assy, CS to intcon	1	No
15213400	Cable Assy, CS to intcon 40P x 40P	1	No
15213401	Cable Assy, CS to intcon 40P x 40P	1	No
15213402	Cable Assy, CS to intcon 40P x 40P	1	No
15218200	Cable Assy, CCS/P8	1	No
15249300	Cable Assy, Switch panel to CLK	1	No
15249400	Cable Assy, WACS to CLK soft switch	1	No
15241200	Cable Assy, Clock to WACS	1	No
15247700	Cable Assy, WACS Intcon CCS	1	No
15246200	Cable Assy, TEMP input sensor	1	No
15246300	Cable Assy, Pressure input sensor	1	No
15247300	Cable Assy, WACS Intcon MMS	1	No

Table 1. LC Cabinet Spares (continued)

Part Number	Part Name	Cabinet Quantity	Send Back for Repair
Modules and Daughter Cards			
15105100	Module Subassy, PE LC 5_300 GR2 ICA	Variable	Yes
15106400	Module Subassy, PE LC 5_300 GR1 ICA	Variable	Yes
15147900	Module Subassy, PE LC 56_300 GR2 ICA	Variable	Yes
15148300	Module Subassy, PE LC 56_300 GR1 ICA	Variable	Yes
15152400	Module Subassy, PE LC 5_300 GR1 ICB	Variable	Yes
15152500	Module Subassy, PE LC 5_300 GR2 ICB	Variable	Yes
15155301	Module Subassy, PE LC 56_300 GR2 ICB	Variable	Yes
15155401	Module Subassy, PE LC 56_300 GR1 ICB	Variable	Yes
15168501	Module Subassy, PE LC 56_375 GR1 ICB	Variable	Yes
15168801	Module Subassy, PE LC 56_375 GR2 ICB	Variable	Yes
15172100	Module Subassy, PE LC 56_450 GR1 IDB	Variable	Yes
15174500	Module Subassy, PE LC 56_375 GR1 IDB	Variable	Yes
15175500	Module Subassy, PE LC 56_450 GR1 ICE	Variable	Yes
15176800	Module Subassy, PE LC 56_450 GR1 IDB	Variable	Yes
15177500	Module Subassy, PE LC 56_300 GR1 IDB	Variable	Yes
15181200	Module Subassy, PE LC 56_375 GR1 IDB	Variable	Yes
15182200	Module Subassy, PE LC 56_450 GR1 ICF	Variable	Yes
15185300	Module Subassy, PE LC 56_450 GR1 IFB	Variable	Yes
15164600	Module Assy, T3E Clock	Variable	Yes
15104001	Daughter Board Assy, 128MB	Variable	Yes
15104601	Daughter Board Assy, 64MB	Variable	Yes
15107601	Daughter Board Assy, 256MB	Variable	Yes
15108200	Daughter Board Assy, 512MB	Variable	Yes
15108400	Daughter Board Assy, 1024MB	Variable	Yes
15148500	Daughter Board Assy, 128MB	Variable	Yes
15148700	Daughter Board Assy, 256MB	Variable	Yes
15158100	Daughter Board Assy, 64MB	Variable	Yes
15158300	Daughter Board Assy, 128MB	Variable	Yes
15158500	Daughter Board Assy, 32MB	Variable	Yes

Table 2 lists the on-site spares for the CRAY T3E LC cabinet at the time of publication.

Table 2. LC Cabinet On-site Spares Kit

Part Number	Part Name
01134008	Fuse, Glass 250V 1 Amp
01158809	Fuse, Ceramic 15 Amp 250V
01158900	Fuse, Glass 250V 1/16 Amp
01158907	Fuse, Glass 250V 1 Amp
13345500	Fuse, 250V 5 Amp
01577002	Screw, Cap SCH BTNHD 6-32
01675100	Retainer, Nut 10-32
01775900	Lock, Pin connector
12755600	Spacer, connector
13033501	Screw, SCH WO/Polypatch
13150603	Screw, CAP SCH M6 16mm
13150604	Screw, CAP SCH M6 20mm
15124707	Screw, Cap SCH 4-40 SST
13160505	Washer, Plain M6
13160805	Washer, Lock M6
15129300	Washer, Conical
13264101	Power Supply Assy, T3E FRU
15126900	Coupling, Nipple Assy
15213601	Cable Assy, Power supply control
15223701	Wire Assy, Clock
15224006	Wire Assy, 34 AWG 72-in.
15224008	Wire Assy, 34 AWG 100 Ohm 120-in.
15247600	Cable Assy, PEM slot control
15237700	Cable Assy, 4 POS Pin
51928809	O-ring.351 ID
13249901	IC, Micro power subrack
15130000	Thermistor Assy, Module temperature
15214700	Circuit breaker, 20 Amp
15215600	Spring, rail
Daughter Card - Spare as required to support system memory size.	

Table 3 lists the contents of the tool kit for the CRAY T3E LC cabinet at the time of publication.

Table 3. LC Cabinet Tool Kit

Part Number	Part Name
01015300	Manifold, charging and testing
01140500	Temperature probe
01140800	Kit, solderless terminal
01263600	Multimeter, digital
01523100	Cutter, diagonal
01523700	Pliers, 6-in.
01524502	Wrench, adjustable 12-in.
01524800	Wrench set, combination
01524900	Screwdriver set, Phillips
01524901	Screwdriver set, flat-bladed
01525001	Wrench set, 1/4 in. drive
01525400	Screwdriver set, torque
01529400	Holder, Hemostat
01529401	Holder, Hemostat straight
01531700	Tweezers
01532400	Magnet, parts pick-up
01563600	Screwdriver, PH hard tip
01596700	Probe kit
12277700	Cable assy, test lead ohming
13170700	Wire stripper, variable
13267200	Socket set, metric hex bit 2mm - 6mm
13267300	Socket set, metric 1/4 in. drive 4mm - 12mm
13267400	Wrench set, metric 7 pc. 7mm - 15mm
15102900	Handle assy, module removal
15255200	Case tool, 7.50” deep
51908400	Pliers, needle nose
ME107389	Tool assy, daughter board removal
ME107775	Inner box assembly, Module
15252100	Pencil, Mechanical 0.3mm
15252200	Dental Pick, Curved
15252400	Balldriver Set, Metric Hex 1.5mm - 10mm

Table 3. LC Cabinet Tool Kit (continued)

Part Number	Part Name
01531200	Mirror, Inspection TLSCP
15255800	Flashlight, Flexible Snakelike plus
15255000	Extractor, PLCC 20 - 84 pin
15255100	Lockout device, electrical plug
15255200	Tool case, 7 1/2” deep
90433200	Ratchet, 3/8” drive - reversible
01567500	Adapter, 3/8F - 1/2M
15161700	Hex bit, 14mm
ME104005	Socket, wing-nut
15252600	Handle assy, power supply removal
12804700	Connector, DB25 Loopback
15256900	Flashlight, Nighthawk microlight
90334800	Tape, Cleaner HD 4mm
15258200	Plate Assy, Module protector
35177400	Wrench set, Balldriver hex 0.05 – 5/32

Note: If a YMP cart is available on site, it can be modified for use with both CRAY Y-MP and CRAY T3E modules by ordering and installing two rails, P/N 13267700.

HEU Field-replaceable Units (FRUs) and On-site Spares

Table 4 lists the field-replaceable units for the heat exchanger unit (HEU) at the time of publication.

Table 4. HEU Spares

Part Number	Part Name	Cabinet Quantity	Send back for Repair
01035802	Pump, Centrifugal 60-HZ, 6.25 Imp	1	Yes
01037200	Gasket, Viton 2 in.	38	No
01037201	Gasket, Viton 3 in.	5	No
01037204	Gasket, Viton 1.5 in.	3	No
01039800	Switch, MDL with clamp	1	No
01158924	Fuse, Glass 250V 0.4 Amp	2	No
01386200	Thermistor, Surf temp	2	No
01390600	Filter, RFI Line 10 Amp	1	No
01390900	Strainer, Slot 3.0 in.	1	Yes
01460900	Contactor, 460V 75HP	1	No
01461100	Control, Aux side mount	1	No
01461101	Control, Aux side mount	2	No
01485800	Transformer, 4KVA Control	1	No
01492402	Transducer, Pressure 0 - 200	4	No
01498402	Circuit Breaker, 2 Amp	1	No
01709601	Switch, Control Pressure 180	1	No
55144603	Fuse, 500V 5 Amp	2	No
13193700	Valve Assy, Butterfly 2 in.	1	Yes
13193800	Valve Assy, 3-Way 2 in.	1	Yes
15237100	Relay, Overload heater 3-pole	1	No
15237203	Heater, Overload 37.6 - 41.5 Amp	3	No
15237204	Heater, Overload 79 - 84 Amp	3	No
31470000	Module Assy, Temp regulator	1	Yes
31473000	Module Assy, HEU Control	1	Yes
55003300	Probe, Temp 1.5 in. long	2	No
55144603	Fuse, 500V 5A	2	No

Table 5 lists the on-site spares for the HEU at the time of publication.

Table 5. HEU Spares Kit

Part Number	Part Name
01035802	Pump, Centrifugal 60 Hz 6.25 Imp
01037200	Gasket, Viton 2”
01037201	Gasket, Viton 3”
01037204	Gasket, Viton 1.5”
01039800	Switch, MDL w/clamp
01158924	Fuse, Glass 250V 0.4 Amp
01386200	Thermistor, Surf temp
01390600	Filter, RFI Line 10 Amp
01390900	Strainer, slot 3.0”
01460900	Contactor, 460V 75HP
01461100	Control, Aux side mount
01461101	Control, Aux side mount
01485800	Transformer, 4KVA control
01492402	Transducer, Pressure
01498402	Circuit Breaker, 2 Amp
55144603	Fuse, 500V 5A
15237203	Heater, Overload 37.6 - 41.5 Amp
15237204	Heater, Overload 79 - 84 Amp
55003300	Probe, Temp 1.50” Lg
01709601	Switch, Control Pressure 180
13193700	Valve Assy, Butterfly 2”
13193800	Valve Assy, 3-way 2”
15213700	Relay, Overload Heater 3 Pole
31470000	Module Assy, Temp Regulator
31473000	Module Assy, HEU Control

Repair and Replacement Procedures

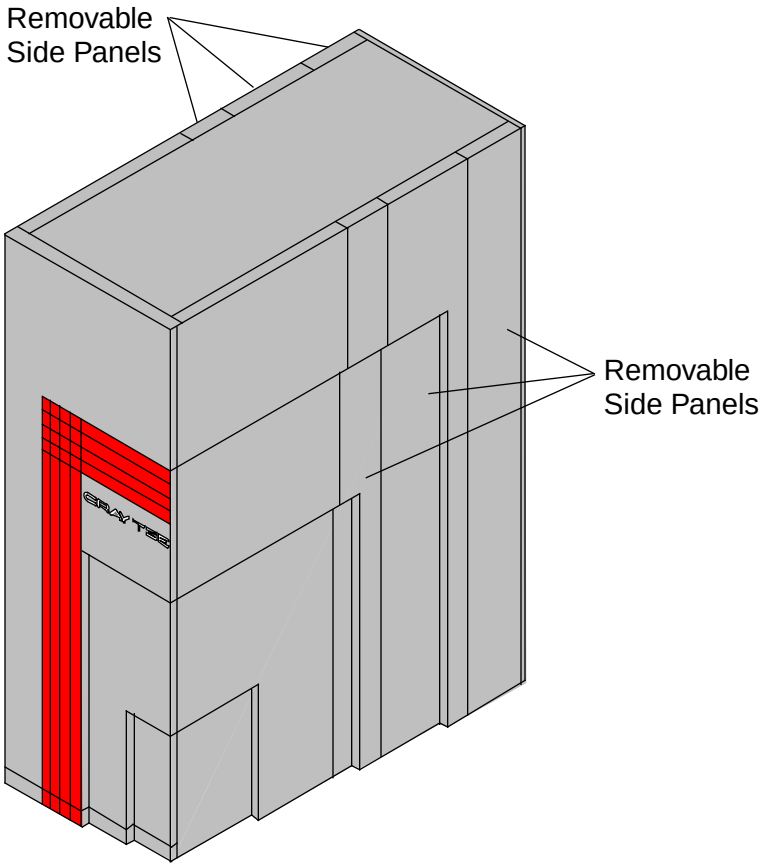
These procedures are grouped in the following order:

- Cabinet panels
- Power
- Modules, daughter cards, and rails
- Wire replacement
- Cable replacement
- WACS boards, switches, and sensors

FRP 1: Removing the Cabinet Side Panels

To access the wiremat, power bus rails, and ground strap connections, remove the 3 side panels on either side of the LC cabinet. Refer to Figure 1.

Figure 1. LC Cabinet Side Panels

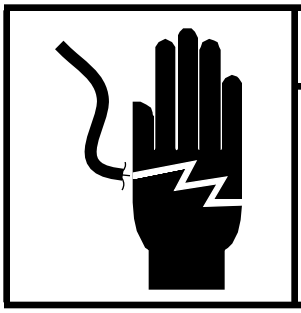


Cabinet Panel Removal

1. The bottom of each side panels is held in place by magnetic fasteners; pull the bottom of the panel away from the frame.
2. Lift the panel straight up.
3. Place the panel away from the cabinet where it will not be damaged.
4. Reverse the process to reinstall the panels.

FRP 2: Module Power Supply Replacement

It is not necessary to remove power from the cabinet when you perform this procedure. (However, it is a good safety practice to do so.)



WARNING

Live voltage is present in the cabinet during this procedure. Failure to avoid live power components could result in severe shock and burns.

During hot-swap operations coolant is flowing under pressure; therefore, when you disconnect the coolant hoses, **always** remove the supply coolant (blue) hose **first**. Refer to Figure 2.

Part Number

- 13264100 (power supply, 3.3 Vac with thermal pad)

Tools Required

- Socket set, Hex bit, 1/4-in. drive metric (P/N 53267200)
  - 2.5-mm hex (allen) bit
- 3-mm hex (allen) wrench
- Screwdriver set, torque (P/N 01525400)
- Power supply removal tool (P/N 15252600)

Power Supply Assembly Removal

1. Identify the failed module power supply.
2. Open both of the defective module’s power supply circuit breakers.
3. Verify that the module is off by checking the WACS page display for that location.

4. Disconnect the power cord from the defective power supply.
5. Remove the coolant hoses; remove the supply hose **first**.
6. Disconnect the WACS 9-pin control cable from the power supply; this may require the use of a flashlight and long slotted screwdriver.
7. Use a 3-mm hex (allen) wrench to unscrew the stop screw about 1/2-in.
8. Use the power supply removal tool to remove the power supply assembly from the chassis. Refer to Figure 3.

Figure 2. Module Power Supply

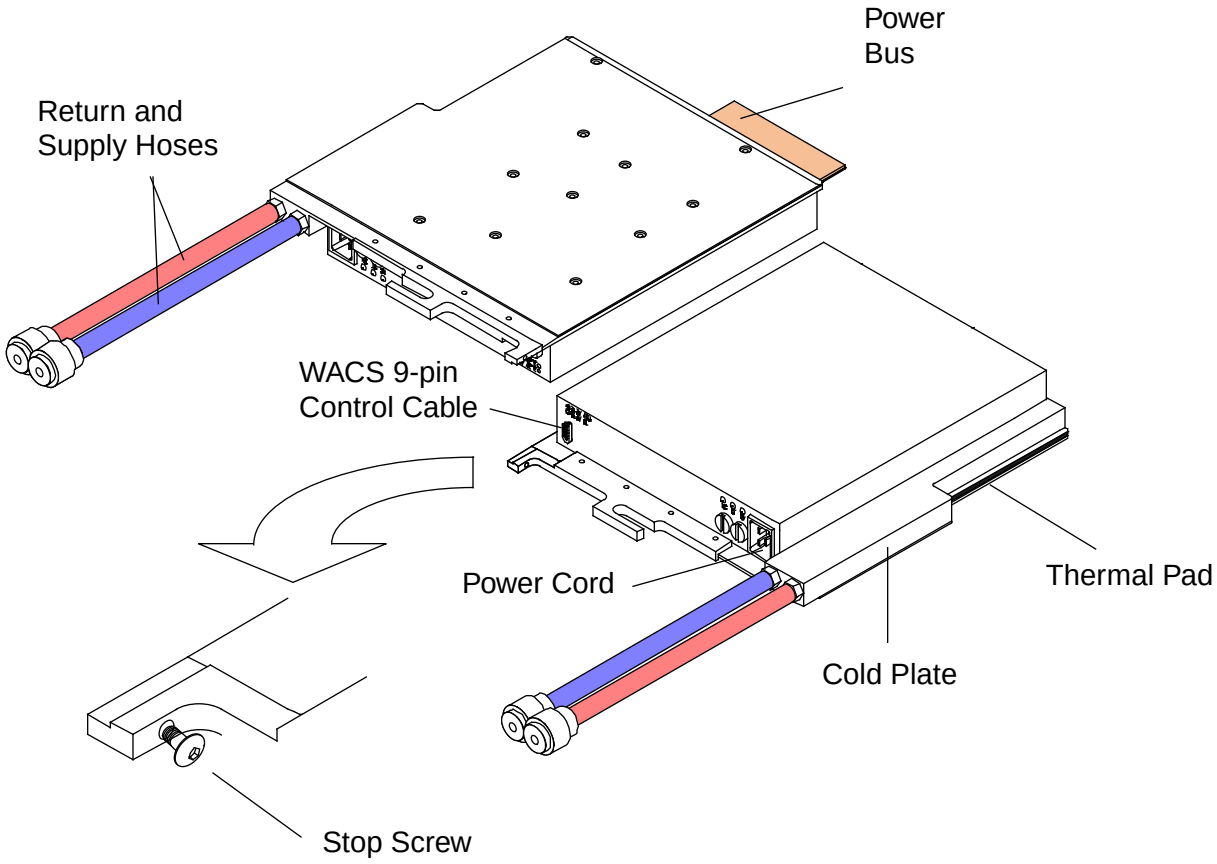
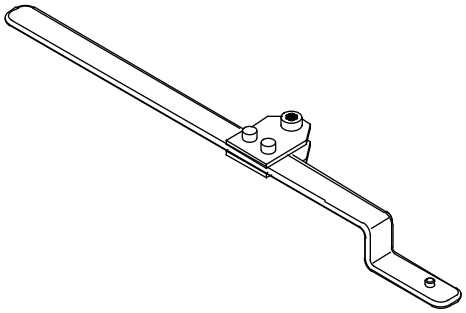


Figure 3. Power Supply Removal Tool

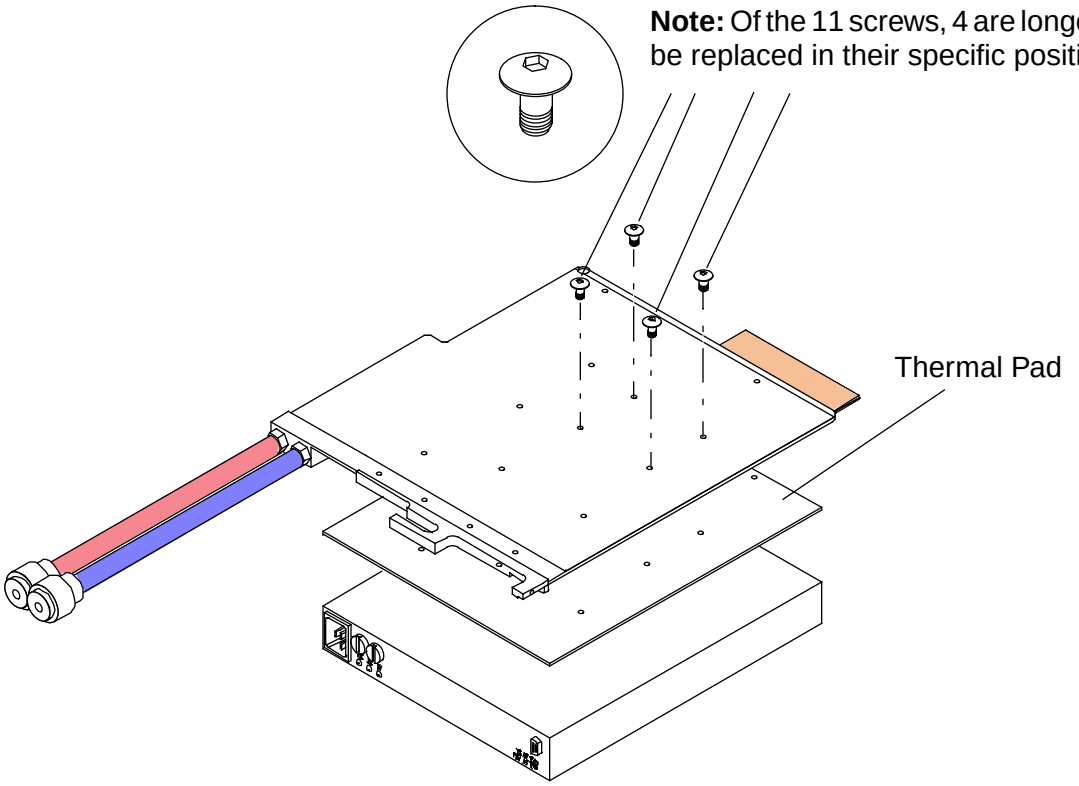


Power Supply and Thermal Pad Replacement

Note: The new power supply consists of 2 pieces: the power supply and the thermal pad.

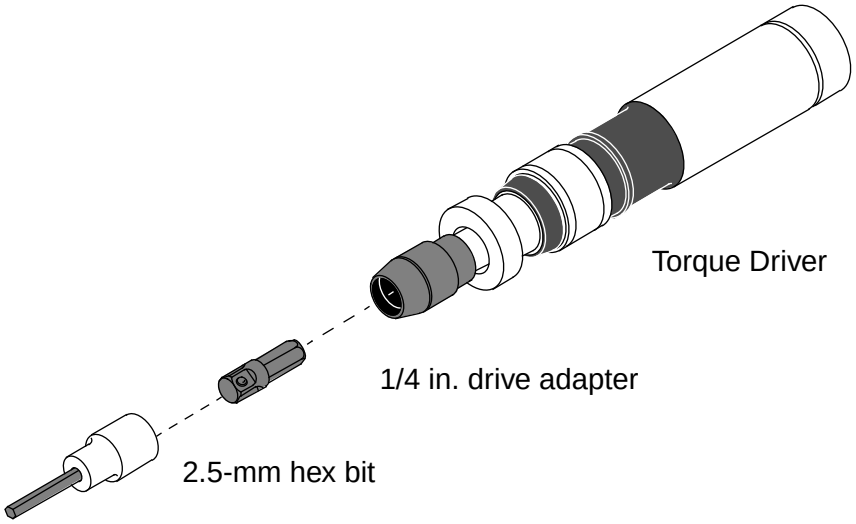
1. Turn over the power supply assembly that you just removed and use a flat-tip, 2.5-mm hex (allen) bit to remove the screws that attach the cold plate to the power supply. Refer to Figure 4.

Figure 4. Long Mounting-screw Locations



Note: Because the mounting screws have shallow heads, you must take care to use the appropriate bits and adapters when removing the screws. Refer to Figure 5. Do not use the ball-tip hex wrenches when removing or inserting these screws.

Figure 5. Torque Driver



2. Remove the cold plate from the power supply.
3. Remove the thermal pad from the cold plate; discard the old thermal pad.
4. Position the new thermal pad on the new power supply.
5. Position the cold plate on the thermal pad and power supply.
6. Use a 2.5-mm hex (allen) bit with 1/4-in. drive adapter and torque driver to screw the cold plate assembly to the power supply. Refer to Figure 5.

   Note: All screws must to torqued to just 21-in. lbs. Excess torque could strip or round out the inner portion of the screw head.

Power Supply Assembly Installation

1. Slide the new power supply assembly into the chassis.
2. Use a 3-mm hex (allen) wrench to screw the power supply stop screw into the center support column.
3. Connect the 9-pin WACS control cable and power supply cord.

4. Connect the coolant hoses; connect the return (red) coolant hose **first**.

5. Close the circuit breakers for the module.

6. Press the START button on the WACS panel to activate the power enable signal.

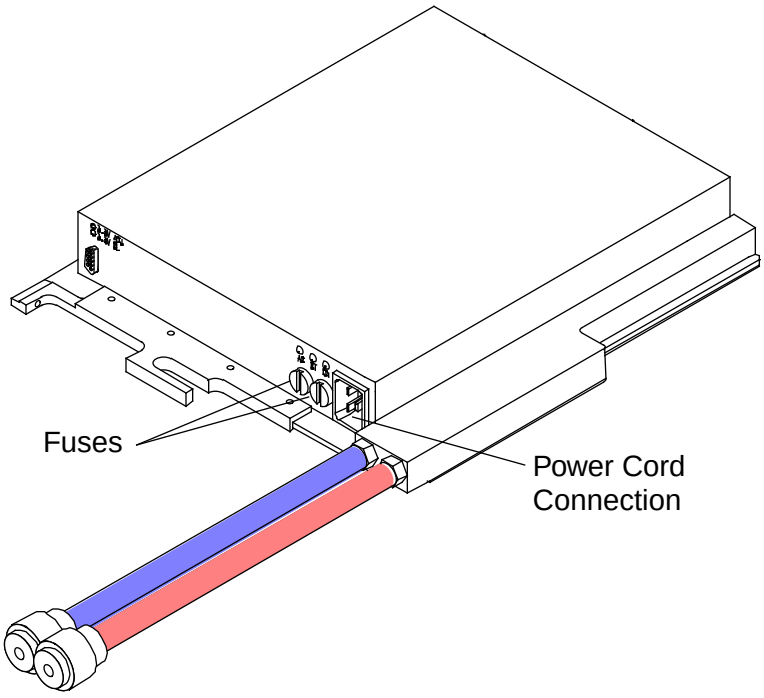
   Note: If the module was not slid after power was removed, when the breakers are closed, the power supplies come up on their own.

7. Monitor the WACS display page of that module to ensure that the new power supply provides the correct voltage.

FRP 3: Module Power Supply Fuse Replacement

Each module power supply contains two 15-amp fuses, as shown in Figure 6. These fuses are field replaceable while the cabinet is powered on.

Figure 6. Module Power Supply - Fuses



Part Number

- 01158809 (fuse, ceramic 250 Vac, 15 Amp)

Tools Required

- Small slotted screwdriver
- Digital voltmeter

Power Supply Fuse Replacement

1. Identify the failed power supply.
2. Open the defective power supply’s circuit breaker.
3. As an added precaution, remove the power cord from the power supply.

4. Remove the 2 fuses, 1 at a time, and check for continuity.
5. Replace any defective fuse.
6. Connect the power cord.
7. Turn on the power supply’s circuit breaker.
8. Press the START button on the WACS panel to activate the power enable signal.
9. Monitor the WACS display page of that module to ensure that the power supply provides the correct voltage.
10. Verify that the PCB LEDs are on.

FRP 4: Module Power Supply Circuit Breaker Replacement

You must power off the cabinet before you replace a power supply circuit breaker.

Part Number

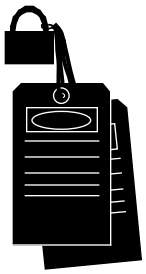
- 15214700 (circuit breaker assembly, 20 Amp)

Tools Required

- Slotted screwdriver
- Phillips screwdriver
- 2.5-mm hex (allen) wrench

Circuit Breaker Removal

1. Power down the cabinet by pressing the STOP button.
2. Open the main circuit breaker (CB1).
3. Open the circuit breakers that feed CB1 from the customer's power panels; lock and tag these breakers.



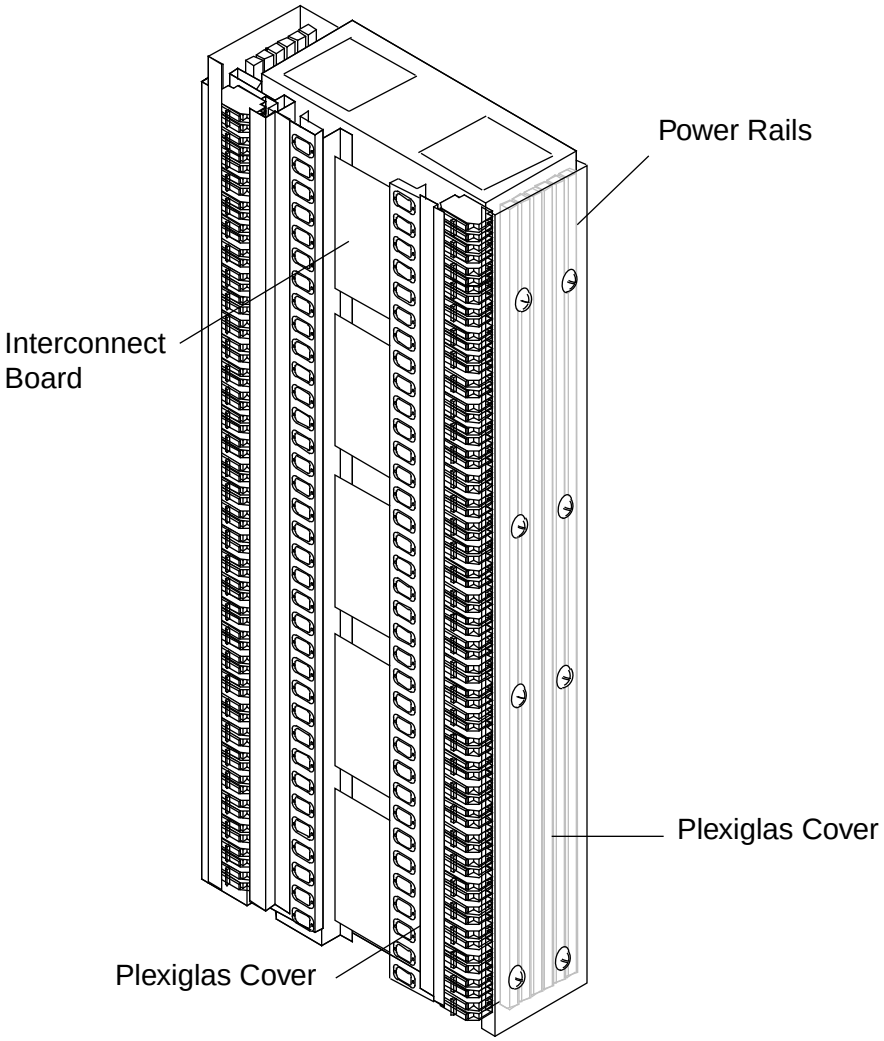
WARNING

Ensure that the electrical circuit breakers for the equipment being serviced are off, locked, and tagged. Failure to do so could result in severe shock and burns.

4. Open the side door to provide access to the defective circuit breaker.
5. Remove the 8 plastic screws that attach the Plexiglas cover over the bus rails; refer to Figure 7. Carefully lay this piece flat on the floor in a protected area.

6. Remove the 7 2.5-mm hex-head screws that attach the Plexiglas cover over the output side of the circuit breakers. Carefully lay this piece flat on the floor.

Figure 7. Power Bus Rail Covers



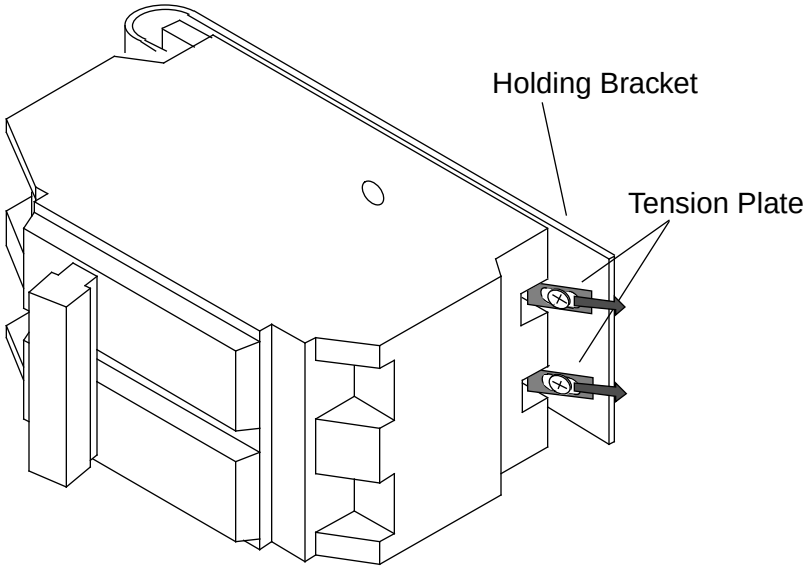
7. Use a slotted screwdriver to disconnect the input-side wires to the defective circuit breaker. If necessary, label each wire for position.

8. Use a slotted screwdriver to disconnect the output-side wires from the circuit breaker. If necessary, label each wire for position.

9. Loosen the 2 screws that hold the tension plates against the circuit breaker and slide the circuit breaker away from the rail. Refer to Figure 8.

Note: Some early cabinets used a snap-in circuit breaker. To remove this type of circuit breaker, pull it away from the rail and slide it out of the holding bracket.

Figure 8. Module Circuit Breaker



Circuit Breaker Installation

1. Slide the new circuit breaker in place and tighten the tension plate screws (or slide the new circuit breaker under the holding bracket and snap it in place).
2. Attach the output-side wires to the breaker.
3. Attach the input-side wires to the breaker.
4. Replace the Plexiglas covers that you removed earlier.
5. Close all circuit breakers and return the cabinet to operation.
6. Verify correct cabinet operation.

FRP 5: Main Circuit Breaker Replacement

If you are not familiar with this task, you may want to ask a qualified electrician for assistance, or the customer may require that their electrician perform this procedure.

Part Number

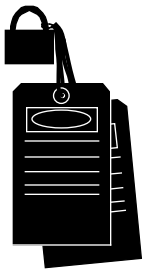
- 15225700 (circuit breaker, 4-pole, 600 Amp)

Tools Required

- Phillips screwdriver
- 8-mm hex (allen) wrench
- Digital voltmeter
- Solderless terminal kit (P/N 01140800)

Main Circuit Breaker Removal

1. Press the STOP button to remove power from the modules.
2. Open the main circuit breaker, CB1.
3. Open the circuit breakers that feed CB1 from the customer's power panels; lock and tag these breakers.



WARNING

Ensure that the electrical circuit breakers for the equipment being serviced are off, locked, and tagged. Failure to do so could result in severe shock and burns.

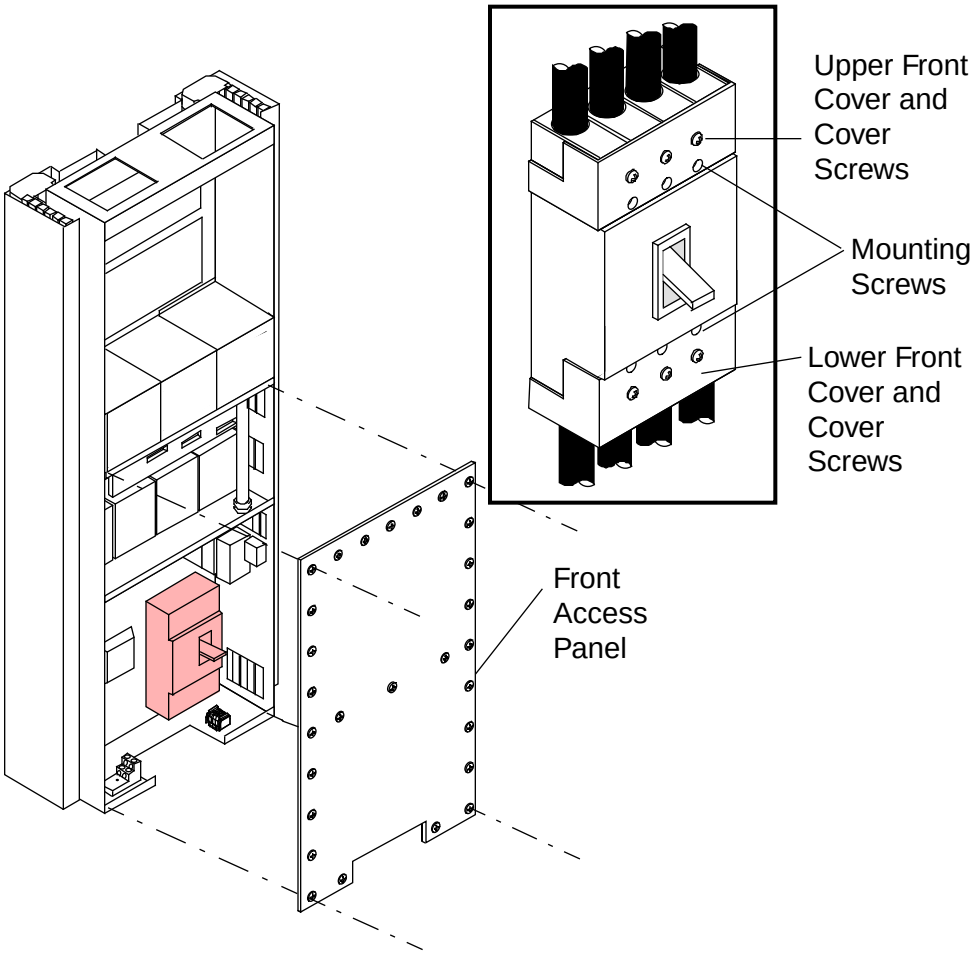
4. Using a Phillips screwdriver, loosen the 28 1/4-turn zeus fasteners and remove the power box access panel. Refer to Figure 9.
5. Remove the 3 Phillips screws that secure the lower front cover to the main circuit breaker and slide the cover toward you.

6. Meter the input to the main circuit breaker to ensure that power is removed.

7. Remove the 3 Phillips screws that secure the top front cover from the main circuit breaker and slide the cover toward you.

8. Record the position of the input and output power lines.

Figure 9. Main Circuit Breaker



9. Use an 8-mm hex (allen) wrench to remove the wires from the input (line) side of the circuit breaker.

10. Use an 8-mm hex (allen) wrench to remove the wires from the output (load) side of the circuit breaker.

11. Trace the shunt trip wires from the circuit breaker to control filter FL6, and remove the wires from the filter.

Note: Due to its weight, try to brace the underside of the circuit breaker.

12. Remove the 4 or 6 long bolts hold the circuit breaker to the power box.

Main Circuit Breaker Installation

1. Before you install the new circuit breaker, route the shunt trip wires around the back and through the channel on the circuit breaker casing.
2. Attach the new circuit breaker to the power box frame using the 4, 4-in. screws. (Do not use the large washers or nuts that come with the new circuit breaker.)
3. Use a Phillips screwdriver to remove the top and bottom power-line covers from the new circuit breaker.
4. Use an 8-mm hex (allen) wrench to reattach the power wires to the output side of the circuit breaker.
5. Use an 8-mm hex (allen) wrench to reattach the power wires to the input side of the circuit breaker.
6. Attach solderless connectors to the shunt trip wires and connect them to the control-line filter, FL6.
7. Close the customer's circuit breakers.

CAUTION
Use extreme caution when performing the following steps.

8. Close the main circuit breaker, CB1.
9. Meter the input of the circuit breaker, CB1. Verify your readings to the values in Table 6.

Table 6. Incoming Power Readings

Circuit Breaker CB1 (Input)		
Voltage (Phase to phase) 3 phase wires and ground DELTA	A to B	180 to 240 Vac
	A to C	180 to 240 Vac
	B to C	180 to 240 Vac
	A to Ground	90 to 125 Vac
	B to Ground	90 to 125 Vac
	C to Ground	90 to 125 Vac
Voltage (phase to neutral) 3 phase wires, neutral and ground WYE	A to B	360 to 440 Vac
	A to C	360 to 440 Vac
	B to C	360 to 440 Vac
	A to Neutral	180 to 240 Vac
	B to Neutral	180 to 240 Vac
	C to Neutral	180 to 240 Vac

10. Meter the output side of the circuit breaker and compare your finding to Table 6.
11. Open circuit breaker CB1.
12. Reattach the top and bottom circuit breaker covers.
13. Replace the power access panel.
14. Close circuit breaker CB1.
15. Press the START button and return the system to operation.
16. Close the front door.

FRP 6: Phase Interchange Assembly Plate (PIAP) Replacement

Part Number

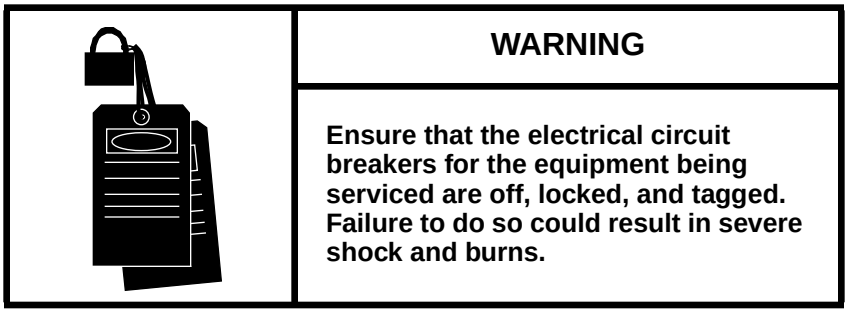
- 15208300 (bus assembly, Y/Delta interchange)

Tools Required

- 5-mm hex (allen) wrench
- Phillips screwdriver

PIAP Removal

1. Open the cabinet front door and press the STOP button.
2. Open circuit breaker CB1.
3. Lock and tag the customer's circuit breakers.



4. Use a Phillips screwdriver and loosen the 28 1/4-turn zeus fasteners and remove the power box access panel.

   Note: The PIAP, shown in Figure 10, can be positioned in either the delta-input or Y-input mode. Read the information on the PIAP before you remove it. When you install the PIAP, ensure that the same information faces you.

5. Use a 5-mm hex (allen) wrench to remove the six 50-mm bolts that secure the PIAP to the power rails (3 on each end).

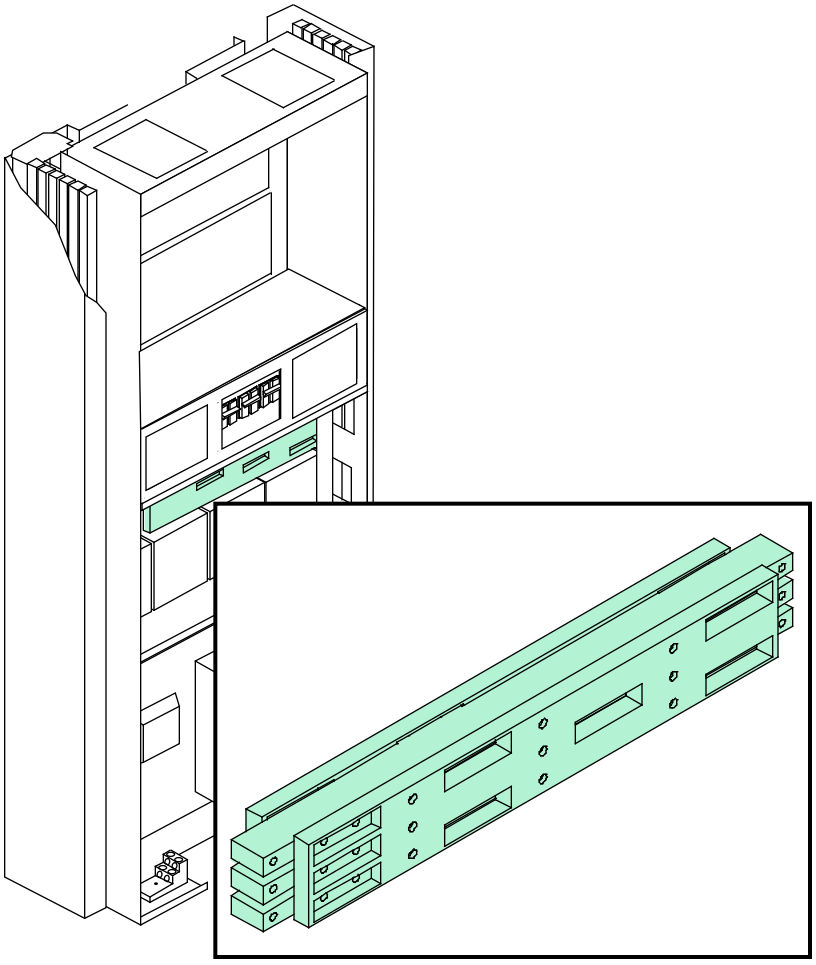
   Note: The position of the ring-terminal power lead is important.

When you reinstall the PIAP, connect the ring terminal to the same power bus.

6. Use a 5-mm hex (allen) wrench to remove the six 60-mm bolts that connect the PIAP to the individual phase rails or the neutral rail.

CAUTION
The PIAP is heavy. Use care when removing the last bolts. Two people are recommended for this portion of the procedure.

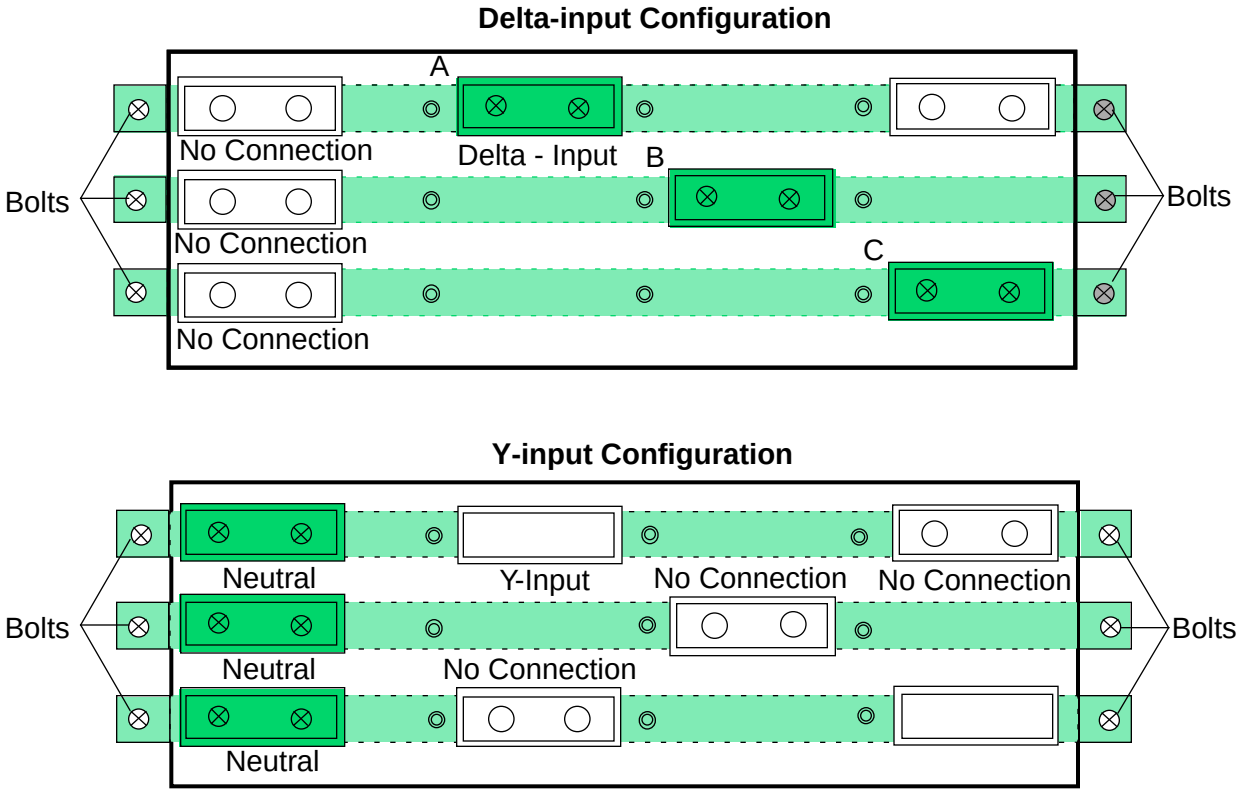
Figure 10. PIAP Location



PIAP Installation

1. Position the new PIAP and secure it to the outside rails with the six 50-mm bolts. Be sure to place the ring terminal on the same power rail. Figure 11 shows the positions for both Y-input and delta configurations.
2. Use the six 60-mm bolts to secure the PIAP to either the phase rails or the neutral rail.
3. Tighten all bolts.
4. Replace the access cover on the power box.
5. Close the customer's circuit breakers and main breaker CB1.
6. Press the START button and return the system to operation.

Figure 11. PIAP Positions



FRP 7: Control Line Filter Replacement

Three control line filters (FL5, FL6, and FL7) are inside the power box. Identify the defective filter. Use this procedure for any of the 3 filters.

Part Number

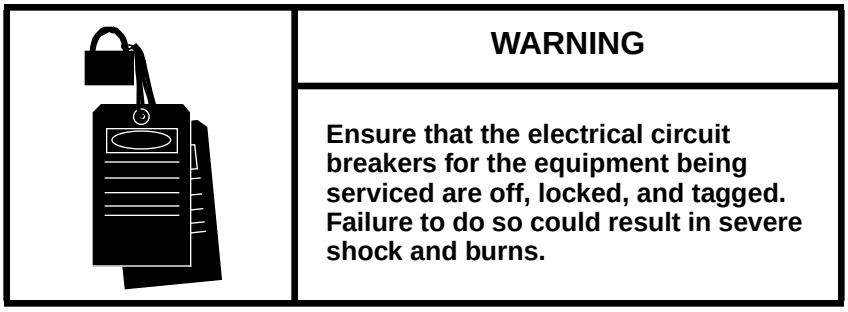
- 01390600 (filter, RFI line 10 Amp - FL5 and FL6)
- 13195200 (filter, RFI line 3 Amp - FL7)

Tools Required

- Phillips screwdriver
- Solderless connector kit
- 2.5-mm hex (allen) wrench
- Needle-nose pliers

Filter Removal

1. Open the cabinet front door and press the STOP button.
2. Open circuit breaker, CB1.
3. Lock and tag the customer's circuit breakers.



WARNING

Ensure that the electrical circuit breakers for the equipment being serviced are off, locked, and tagged. Failure to do so could result in severe shock and burns.

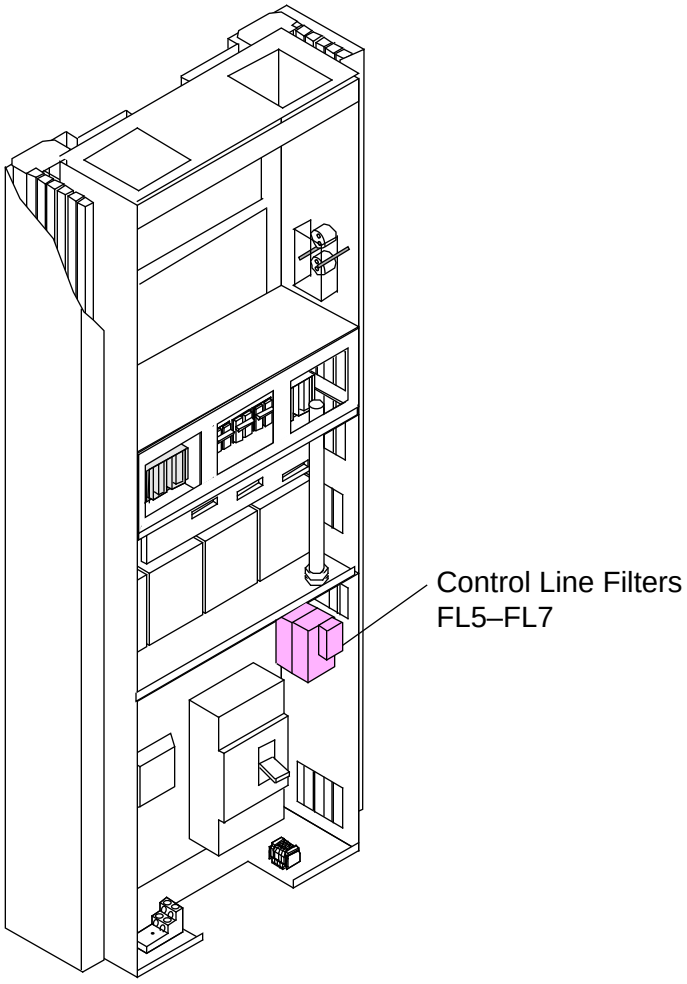
4. Use a Phillips screwdriver and loosen the 28 1/4-turn zeus fasteners and remove the power box access panel.
5. Use a pair of needle-nose pliers to remove the solderless connectors from the defective filter; label the position of each wire. Refer to Figure 12.

6. Use a 2.5-mm (allen) hex ball-driver wrench to remove the mounting screws that hold the filter to the power-box wall.

Filter Installation

1. Position the new filter and secure the filter to the power box.
2. Reattach the power and control wiring.
3. Replace the access panel to the power box.
4. Close the customer's cabinet circuit breakers and CB1.
5. Press the START button and return the system to operation.

Figure 12. Line Filters Location



FRP 8: WACS DC Power Supply Replacement

This procedure applies to both the primary and secondary WACS power supply groups. The WACS display page for power supplies indicates which power supply must be replaced.

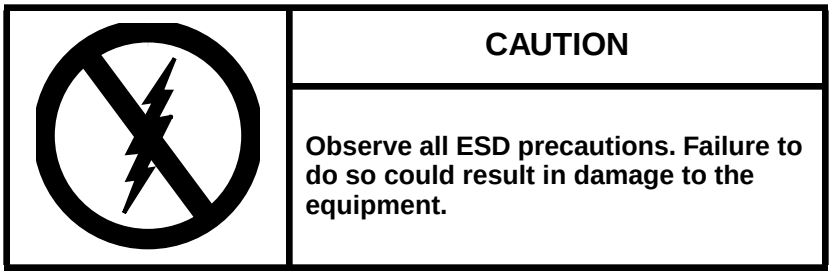
You can perform this procedure while the LC cabinet is powered on; however, it is recommended that you power off the cabinet.

Part Number

- 15211600 (power supply, AC to DC 50)
- 35185600 (power supply, AC to DC 50)
- 15211700 (power supply, AC to DC 25)

Tools Required

- Phillips screwdriver
- Slotted screwdriver
- 2.5-mm hex (allen) wrench



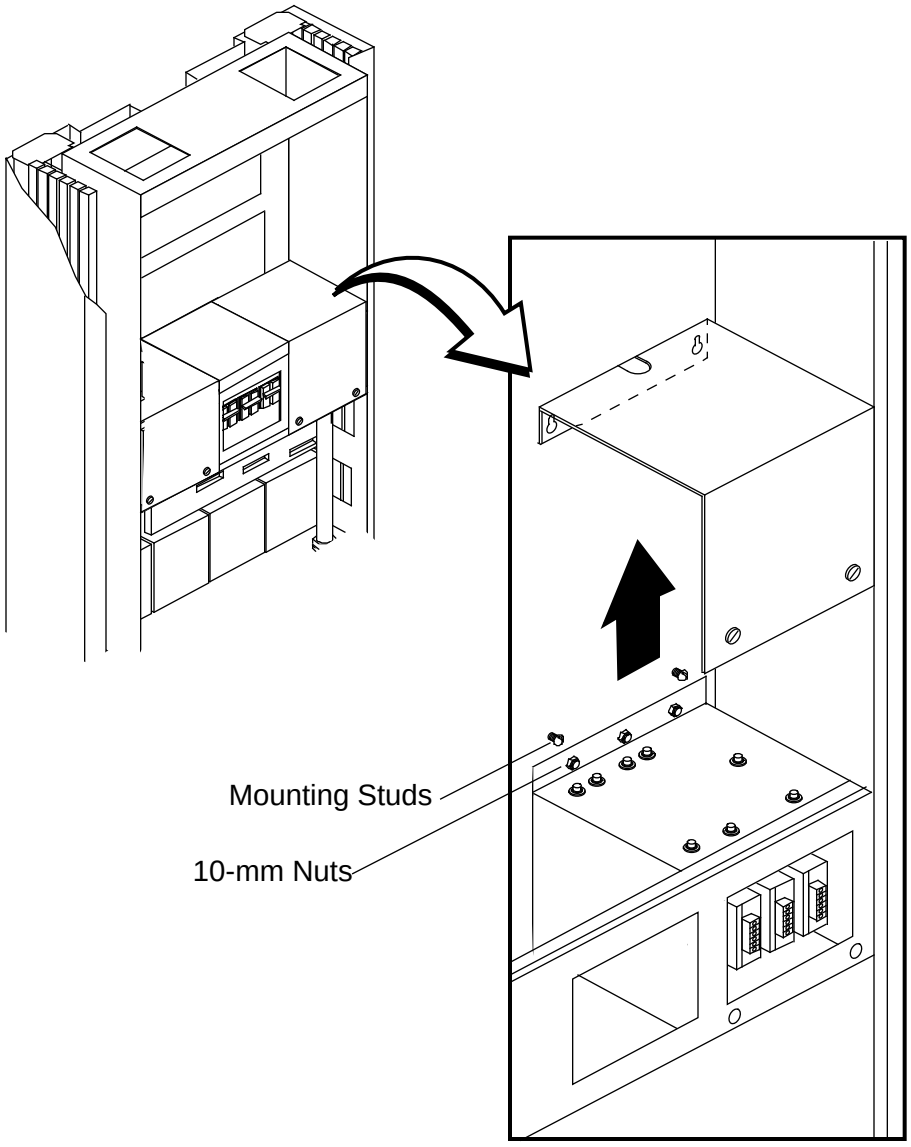
Power Supply Removal

1. Open the cabinet front door.
2. Open the primary (CB3) or secondary (CB4) circuit breaker depending on the failed power supply group.

   Note: Press the STOP button and open circuit breaker CB1 to power off the cabinet.

3. Remove the power supply group access cover by turning the fasteners and lifting the cover plate off. The back of the cover plate slides over 2 mounting studs on the back wall (refer to Figure 13).

Figure 13. WACS DC Power Supply Cover Plate



4. As you remove the cover plate, slide the power wiring away from the cover plate.

5. Disconnect cable connectors J3/P3 and J7/P7 or J4/P4 and J6/P6.

Based upon system availability you can remove the power supply group and perform a bench repair or replace the failed power supply in the system. Both procedures follow.

Bench Replacement

1. Remove the three 10-mm nuts, flat-washers and lock washers that hold the power supply group in place.
2. Carefully lift the entire power supply group from the cabinet.
3. Working in an ESD safe area, replace the failed power supply:
   a. Identify the failed power supply.
   b. Disconnect the input and output power wires from the old power supply and label them for reconnection.
   c. Remove the 2.5-mm hex screws that hold the old power supply in place.
   d. Secure the new power supply to the mounting plate using the 2.5-mm hex screws that you removed previously.
   e. Reconnect the input and output power wires to the new power supply.
4. Lower the power supply group into the cabinet; take care not to pinch any wires.
5. Secure the power supply group by using the flat washers, lock washers, and 10-mm nuts.

In-cabinet Replacement

1. Remove the plastic strip that covers the terminal screws.
2. Remove the power supply wires; be sure to label the power wires as you remove them.
3. Use a 2.5-mm hex wrench to remove the screws that hold the power supply in place.
4. Remove the defective power supply.
5. Insert the new power supply and secure it to the mounting plate with the 2.5-mm screws.
6. Attach all wires to the terminal strip.
7. Replace the plastic terminal strip cover.

After Repair

1. Reconnect cable connectors J3/P3 and J7/P7 or J4/P4 and J6/P6.
2. Install the cover plate; insert the power wiring into the plate as you do so.
3. Secure the cover using the 1/4-turn fasteners.
4. Close circuit breaker CB3 or CB4.

   Note: If you powered off the cabinet, close circuit breaker CB1 and press the START button.

5. Monitor the WACS display page for WACS power.

FRP 9: Circuit Breaker CB2, CB3, or CB4 Replacement

The three circuit breakers are attached to a mounting plate, which is attached to part of the power box frame. You must loosen this mounting plate to remove any of the circuit breakers. This procedure must be performed with the cabinet powered off.

Part Number

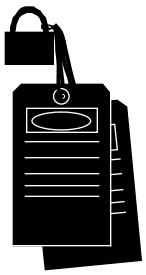
- 15214700 (circuit breaker, 20 Amp - CB2)
- 15214701 (circuit breaker, 10 Amp - CB3 and CB4)

Tools Required

- Slotted screwdriver
- Phillips screwdriver
- 10-mm box-end wrench
- 4-mm hex (allen) wrench

Circuit Breaker Removal

1. Open the cabinet front door and press the STOP button.
2. Open the cabinet main circuit breaker CB1.
3. Lock and tag the customer’s circuit breakers.



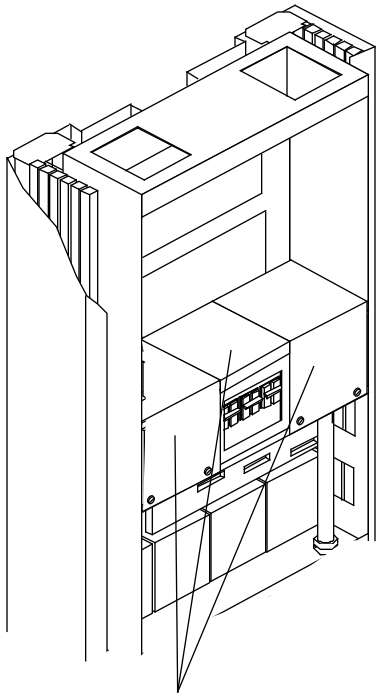
WARNING

Ensure that the electrical circuit breakers for the equipment being serviced are off, locked, and tagged. Failure to do so could result in severe shock and burns.

4. Use a Phillips screwdriver to loosen the two 1/4-turn fasteners that secure each of the access covers over the circuit breakers and both WACS power supply groups. Refer to Figure 14.

5. Carefully remove all 3 of the access covers; ensure that you slide any wire bundles free from the covers.

Figure 14. Access Panel Covers



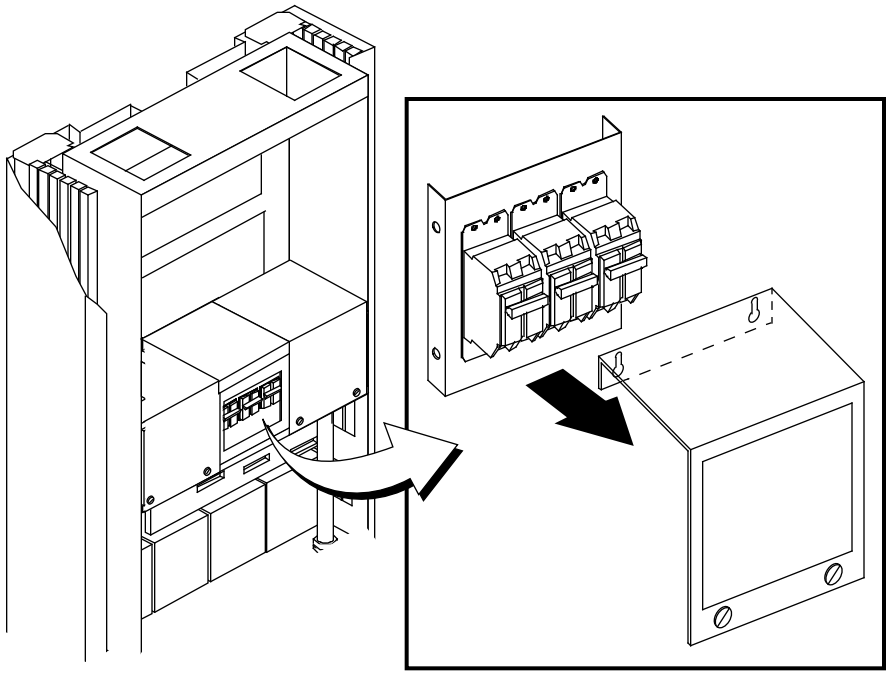
6. Use a 10-mm box-end wrench and a 4-mm hex wrench to remove the 4 bolts, washers, and nuts that secure the circuit breaker mounting plate to the frame.

   Note: Later cabinet designs replaced the bolt-washer-nut combination with a bolt that screws into a fitting on the sides of the mounting plate. Use a 4-mm hex wrench to remove the 4 screws that hold the plate in position.

   Note: Unless you remove the input (line) side wires from the terminal block behind the circuit breakers, you cannot completely remove the mounting plate. However, it is not necessary to remove these wires.

7. A front cutout in the cabinet frame gives you access to the circuit breaker wires. Remove the input wires from the bottom of the defective circuit breaker; label the wires for position.

Figure 15. Circuit Breakers



8. Working over the top of the cutout, remove the output wires from the top of the circuit breaker.

9. Use a slotted screwdriver to loosen the screws that hold the breaker to the mounting plate.

   Note: Some earlier cabinets used a snap-in circuit breaker. To remove this type, pull the circuit breaker away from the mounting plate and slide it out of the holding bracket.

10. Slide the circuit breaker away from the mounting plate.

Circuit Breaker Installation

1. Put the new breaker in place and secure it to the mounting plate.

2. Working through the cutout, reattach the input wires to the bottom of the breaker.

3. Reattach the output wires to the top of the breaker.

4. Position the mounting plate and reattach it to the frame using the 4 screws, washers, and nuts that you removed earlier.

5. Replace all 3 access panel covers; be careful to place the power wires in the panel cutout.

6. Secure the panels with the 1/4-turn fasteners.

7. Close all circuit breakers.

8. Press the START button and return the system to operation.

FRP 10: WACS Ride-through Capacitor Replacement

Part Number

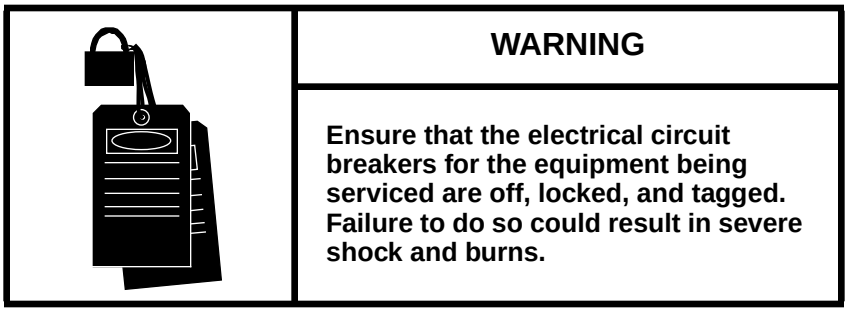
- 13191301 (capacitor, 25V 39000 µFD) Refer to Figure 16.
- 13193102 (capacitor, 50V 18000 µFD)

Tools Required

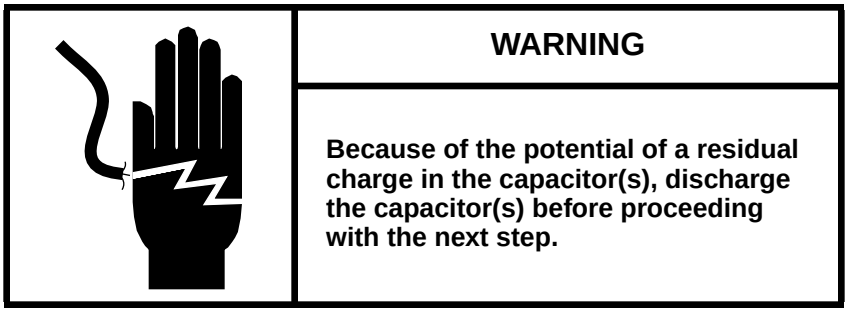
- 2.5-mm hex (allen) wrench
- Slotted screwdriver

Capacitor Removal

1. Open the cabinet front door and press the STOP button.
2. Open the cabinet main circuit breaker, CB1.
3. Lock and tag the customer's circuit breakers.



4. Open the WACS access panel.
5. Use a 2.5-mm hex (allen) wrench to remove the 2 screws that secures the Plexiglas cover over the capacitors.

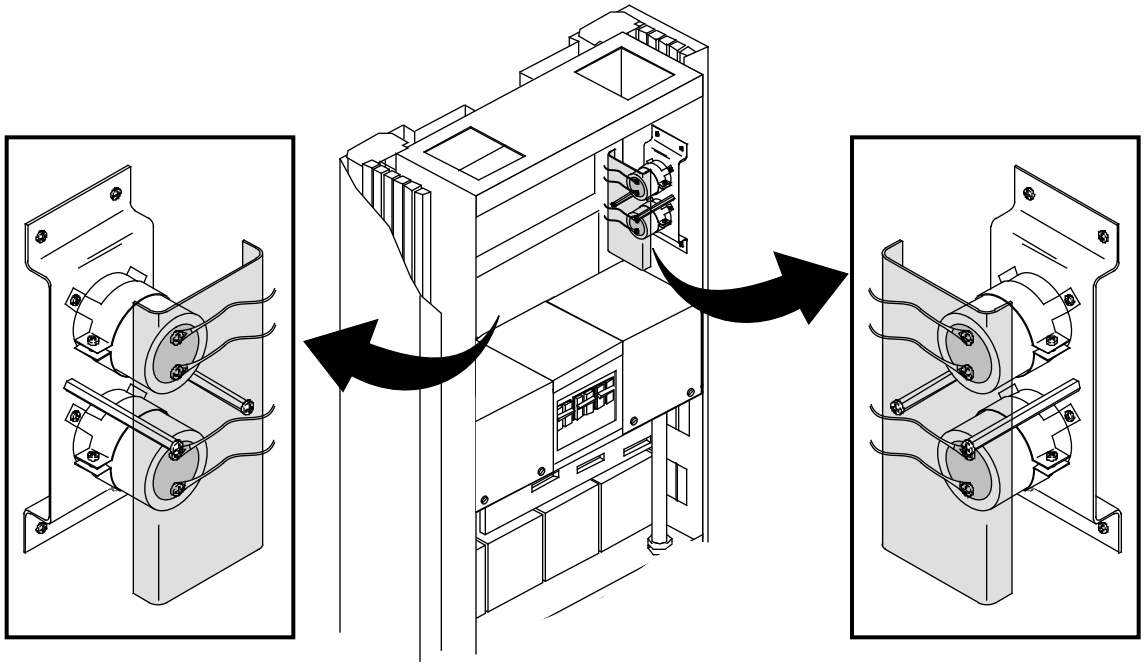


6. Use a slotted screwdriver to remove the wire leads; label the position of each.
7. Use a slotted screwdriver to loosen the capacitor holding clamp. Note the position of the positive and negative terminals.
8. Remove the capacitor.

Capacitor Installation

1. Install the new capacitor in the holding clamp and tighten the holding clamp.
2. Ensure that you reattach the wire leads to the correct terminals on the capacitor.
3. Replace the Plexiglas cover.
4. Close the WACS access panel and close all circuit breakers.
5. Press the START button and return the system to operation.

Figure 16. Ride-through Capacitors



FRP 11: Module Replacement

This procedure applies to PEM and clock module replacement.

Module edge connectors, module slider contacts, and edge connectors in the rails are extremely delicate. Follow this procedure carefully to avoid damaging the module or the rail connectors when you remove and install modules.

NOTE: You can perform this procedure with the module powered off and the rest of the chassis powered on. You can also perform this procedure with the chassis powered off and the HEU supplying coolant to another LC cabinet. In either case, to eliminate loss of coolant, always remove the module supply-coolant (blue manifold) hose **first**.

CAUTION
Observe all ESD precautions. Failure to do so could result in damage to the equipment.

NOTE: Refer to FN 2290, *CRAY T3E Module and Daughter Card Part Number Reference,* for current PEM, clock, and daughter-card part numbers and details on the following rules:

- When you order a new PEM, compare the part number of the PEM you removed to the reference chart in FN 2290 to determine the part number that you should order.
- Never place daughter cards of different memory sizes on the same PEM.
- Never place a PEM with an EV5.6 processor in a system that has been running only EV5 processors unless the module slots have been checked for proper wiring and auxiliary voltage per FCO 3198. If you are not sure whether the slots were checked, contact Technical Support.
- When ordering clock P/N 15108601, you must specify the air-cooled or liquid-cooled type because of fanout differences.
- If you move an I3/GR3 PEM into a slot that previously contained an I4/GR4 PEM that was connected to a GigaRing, poor system performance and system crashes can occur.

Part Number

- ME107844 (box, outer module shipper)
- ME107776 (box, inner module shipper)
- 12919100 (plastic cams - shuttle connector locks)

Tools Required

- Camming tools (P/N 12889800)
- Module removal handle (P/N 15102900)

Module Removal

1. If you perform this procedure with the cabinet power on, identify the failed module and turn off the module circuit breakers for that module (both Y- and Z-side). To remove power to all the modules, press the STOP button on the WACS panel.

2. Verify that the module LEDs are off.

3. Disconnect the module coolant supply hose (blue manifold) first; then disconnect the return coolant hose (red manifold).

4. Remove the plastic cams (shuttle locks) from the module.

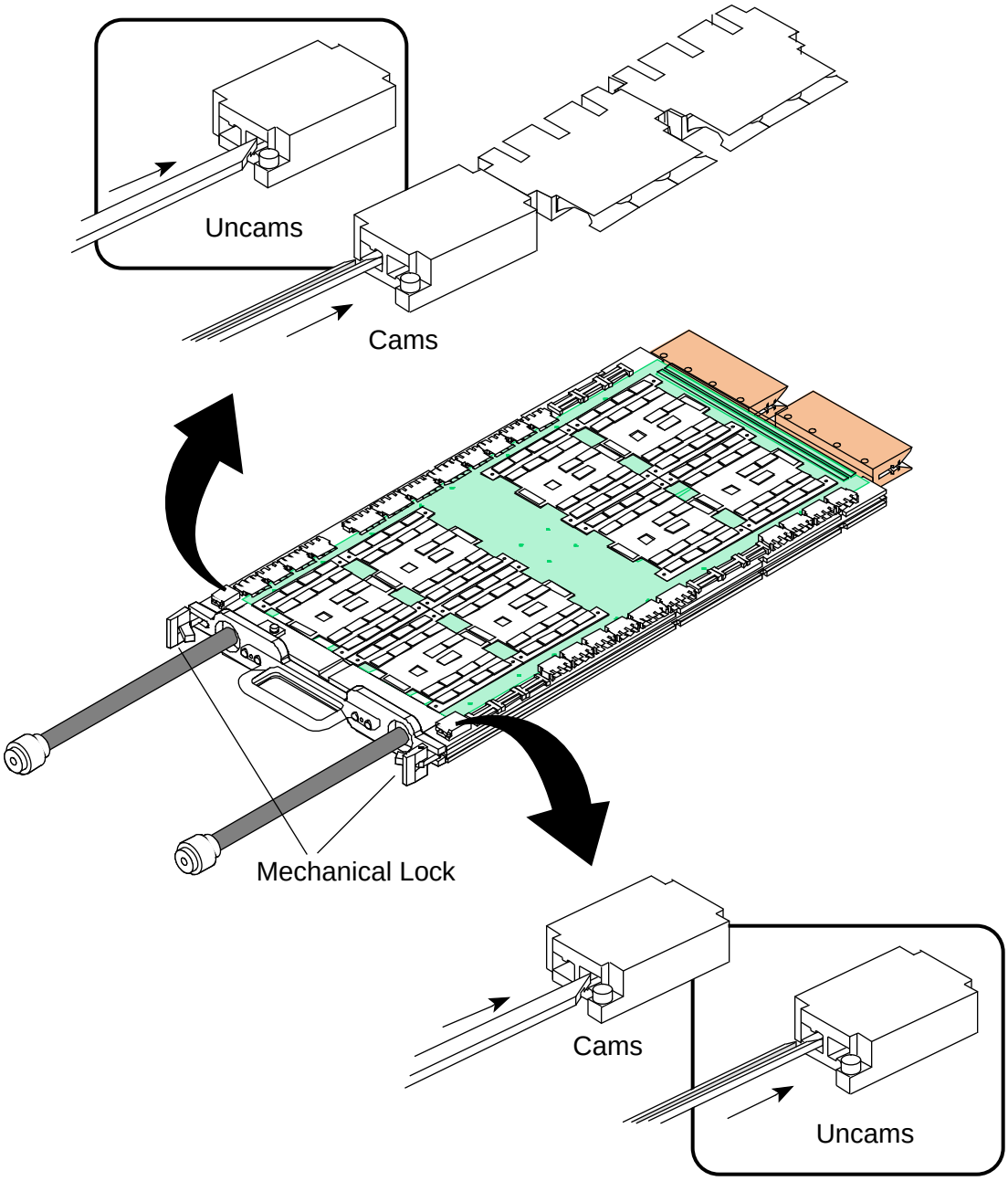
5. Remove the module camming tool(s) from the cam holder.

6. Inspect the module camming tools to determine whether the tools are nicked, bent, or warped. If a camming tool is defective, replace that camming tool.

7. Insert one camming tool into each of the connector slots to retract the module shuttles into the module connectors. The bevelled end of the cam faces toward the module to retract the shuttles. Refer to Figure 17.

   NOTE: Leave the camming tools in the module while you remove the module or a plastic cam may be used in place of the camming tool if desired.

Figure 17. LC PEM Camming



8. Open the mechanical locks on the module.

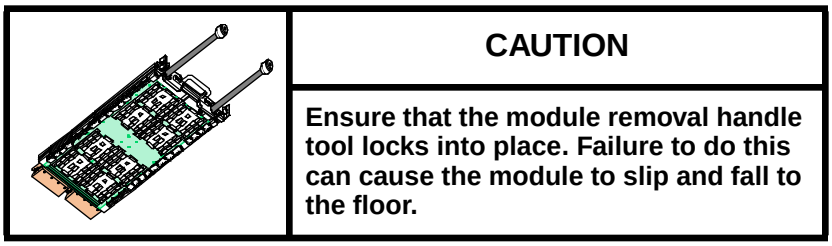
9. Remove the module:

   a. Start removing the module from the slot by holding the module handle and pulling toward you.

   NOTE: It may require some force to pull the module out; use caution.

b. When the module is approximately halfway out, slide the module removal handle assembly, shown in Figure 18, over the cold plate until it locks into the first position. Refer to Figure 19.

NOTE: The module removal handle can lock into any of three positions on the module cold plate. However, due to coolant hoses from the modules above or below the affected module, only the first locking position is usable.



CAUTION

Ensure that the module removal handle tool locks into place. Failure to do this can cause the module to slip and fall to the floor.

Figure 18. Module Removal Handle - P/N 15102900

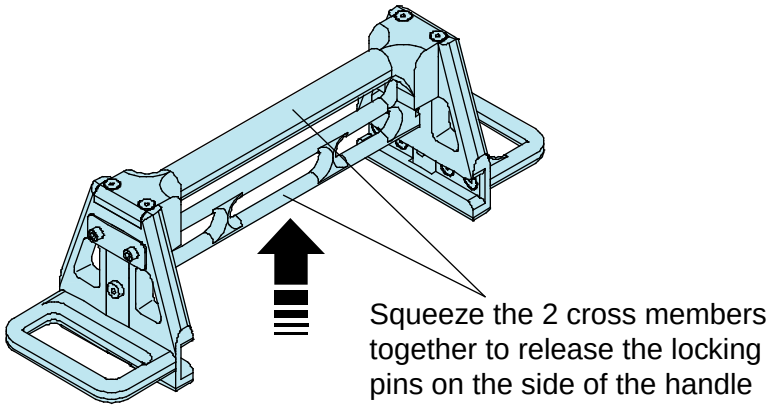
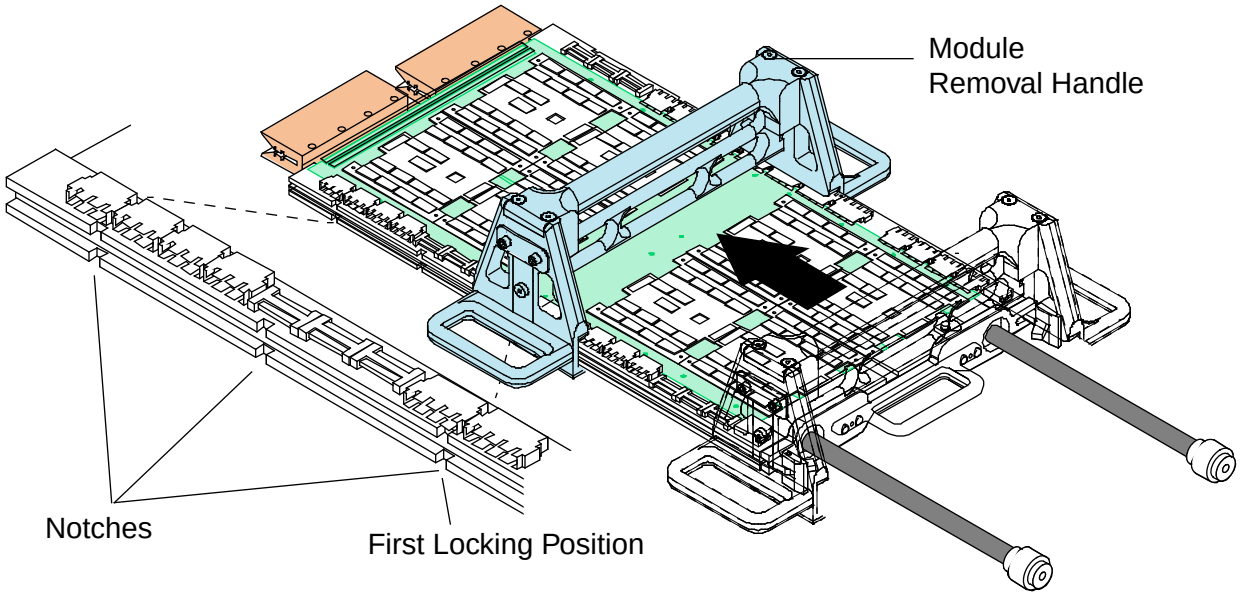


Figure 19. Module Cold Plate Handle Notches



c. Hold both module handles and continue to remove the module from the slot.

10. Place the module in the module cart or use the module shipping container.

NOTE: If you are replacing a daughter card, proceed to FRP 12. If you are shipping a module, proceed to FRP 13.

Module Installation

NOTE: If the PEM jumpers become loose during shipping or handling, refer to FN 2302, *CRAY T3E PEM Jumper Positions and Definitions*, for replacement information.

Prior to insertion, determine whether the module is placed into the cabinet upright or upside down. Match the GigaRing tag on the module to the GigaRing tag on the rail.

1. Use a flashlight to inspect the module slot and connectors. Check for wires that stick out between the connectors on the module rails.

2. Inspect the new module for cracked connectors, debris, and missing or bent slider contacts. If the module has any defects, send it to central repair.

3. Inspect the module-coolant hoses, O-rings, and quick-disconnect (QD) fittings for defects. Replace defective O-rings or coolant hoses as required. For other repairs, return the module to central repair.

4. Slide the module removal handle over the new module until in locks into position.

5. Install 4 cams in the module to ensure that the shuttles are retracted into the module connectors.

6. Lift the module by the handles and carefully slide the module into the rails; do not allow the power buses to contact the module above or below.

7. Slowly insert the module into the rails until the module removal handle contacts the coolant hoses from the modules above or below. Release the pin locks and slide the module removal handle gently toward you as you continue to insert the module.

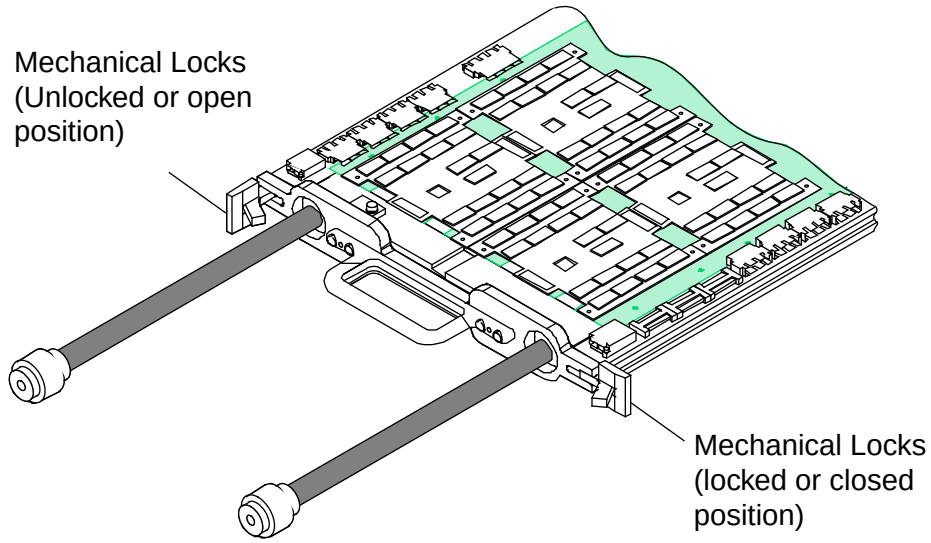
8. Continue to insert the module until the module power buses slide over the power supply power blades.

   NOTE: You might need to use some force to properly seat the module. Be careful not to over-force the module, which can damage it or the connectors.

9. Lock the module's mechanical locks. **Do not continue until the mechanical locks are in the closed position**. Refer to Figure 20.

   NOTE: If the mechanical locks do not close, it may be necessary to pull the module and reseat it again.

Figure 20. Mechanical Locks



10. Cam the new module.

    a. Remove the camming tools.

    b. Engage the module sliders by inserting the camming tool into the module connectors. Hold the camming tool near the connector guides to avoid damaging the tool. Be sure that all module sliders in each row of connectors engage in the proper position.

    c. Remove the camming tools.

    d. Insert the plastic cams (shuttle locks)

11. Connect the module coolant return hose to the return (red) manifold.

12. Connect the module coolant supply hose to the supply (blue) manifold.

13. Check the work area and chassis to be sure that you remove all tools and hardware.

14. Turn on both circuit breakers for the module.

15. Check the local/remote switch on the WACS panel to ensure that it is in the local position.

16. Press the START button on the WACS panel to activate the power enable signal from the CCS board to the module.

17. Return the local/remote switch on the WACS panel to the position it was in before Step 15.
18. Check the WACS display page for the new module and monitor the module's power output and temperature.
19. Check the module coolant hoses for any leaks; correct any problems.
20. Verify that the LEDs on the PCBs are on.
21. Press the WACS memory RESET switch to clear the previous fault and to reflect the current status of the system.
22. Close all access doors.

FRP 12: Daughter Card Replacement

Use the following procedure to remove and install daughter cards, to move daughter cards from one module to another, or to replace faulty ones.

NOTE: Never place daughter cards of different memory size on the same PEM. Refer to FN 2290, *CRAY T3E Module and Daughter Card Part Number Reference*, for more rules and for current PEM, clock, and daughter card part numbers.

Part Number

- Replacement daughter card

15104001	Daughter Card Assy, 128MB
15104601	Daughter Card Assy, 64MB
15107601	Daughter Card Assy, 256MB
15108200	Daughter Card Assy, 512MB
15108400	Daughter Card Assy, 1024MB
15148500	Daughter Card Assy, 128MB
15148700	Daughter Card Assy, 256MB
15158100	Daughter Card Assy, 64MB
15158300	Daughter Card Assy, 128MB
15158500	Daughter Card Assy, 32MB

Tools Required

- Daughter card removal tool (P/N ME107389)
- 3/32-in. hex (allen) wrench with torque driver
- ESD-protective bag
- ESD-safe work surface, such as
  - ESD mat - P/N 01613600
  - Static monitor - P/N 01713901

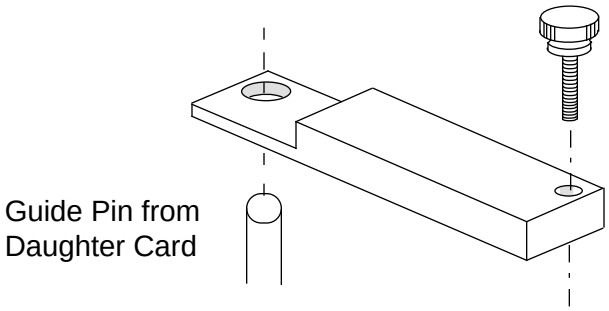
Daughter Card Removal

CAUTION

Observe all ESD precautions. Failure to do so could result in damage to the equipment.

If you plan to store or ship a PEM, ensure that you place pin protectors, P/N 15145700 (refer to Figure 21), on all exposed daughter card pin connectors on the PEM.

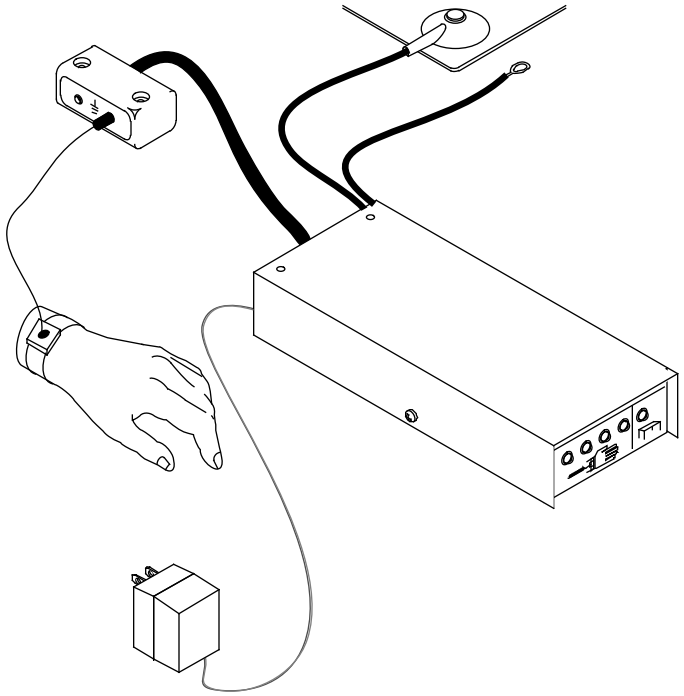
Figure 21. Daughter Card Pin Protector



1. Before you remove the module, prepare an ESD-safe workspace. When you use ESD mat 01613600 and static monitor 01713901, you must connect ground straps as noted in the following list (refer to Figure 22):

   - Attach a ground strap between the static monitor and the ESD mat.
   - Attach a second ground strap between the static monitor and the module.
   - Attach a third ground strap between the static monitor and your wrist strap.

Figure 22. Static Monitor and ESD Ground Mat



2. Remove the module from the cabinet using the module removal procedure, FRP 11.

3. Place the module on an ESD-protected cart or work surface and ensure that all ESD precautions are in place.

NOTE: The spare module inner shipping box contains a piece of antistatic foam that is formed to hold the module. Use this piece of foam as a platform on which to set the module. Place the foam on the antistatic mat.

4. Use a 3/32-in. hex driver to remove the 4 retaining screws that hold the daughter card to the module. (Refer to Figure 23.)

5. Position one leg of the daughter-card removal tool in each of the 4 daughter card notches. (Refer to Figure 24.) Engage the leg hooks with the daughter card cold plate.

   NOTE: You may need to squeeze the top sides of the tool to ensure that the legs pass through the notches.

6. Lift the daughter card removal tool (and daughter card) directly away from the surface of the module.

7. Remove the daughter card from the removal tool and place it in an ESD-protected bag. Ensure that you touch only the sides of the daughter card.

Figure 23. Retaining-screw Locations

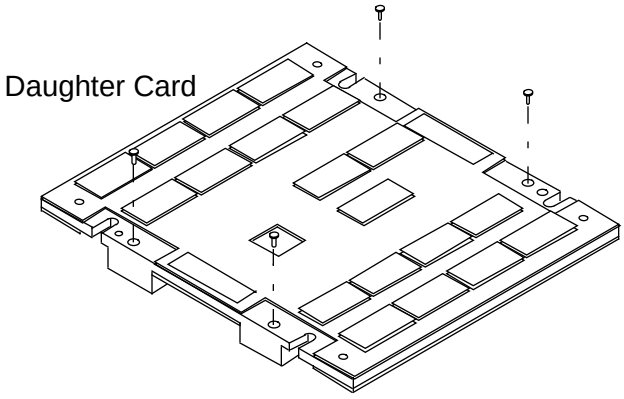
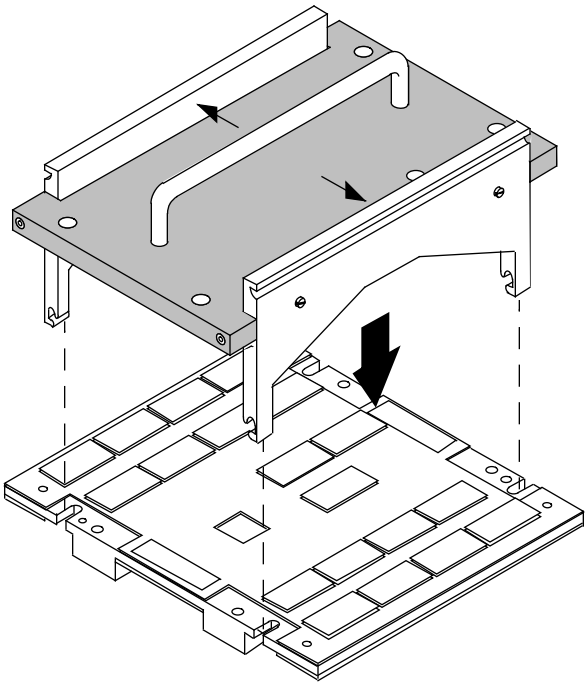


Figure 24. Daughter Card Removal Tool Placement



Daughter Card Installation

Follow all ESD precautions during this procedure. Touch only the sides of the daughter card.

1. Prepare the motherboard for the daughter card. For a new PEM, you must unscrew the pin protector covers so that you can install the daughter card.

2. Visually inspect the daughter card connector pins on the PEM to ensure that no pins are bent or crushed.

3. Carefully place the new daughter card in position on the motherboard. The daughter card is keyed to install in one position only. Align the holes on the daughter card with the guide posts and screw posts (large post, small post) on the motherboard.

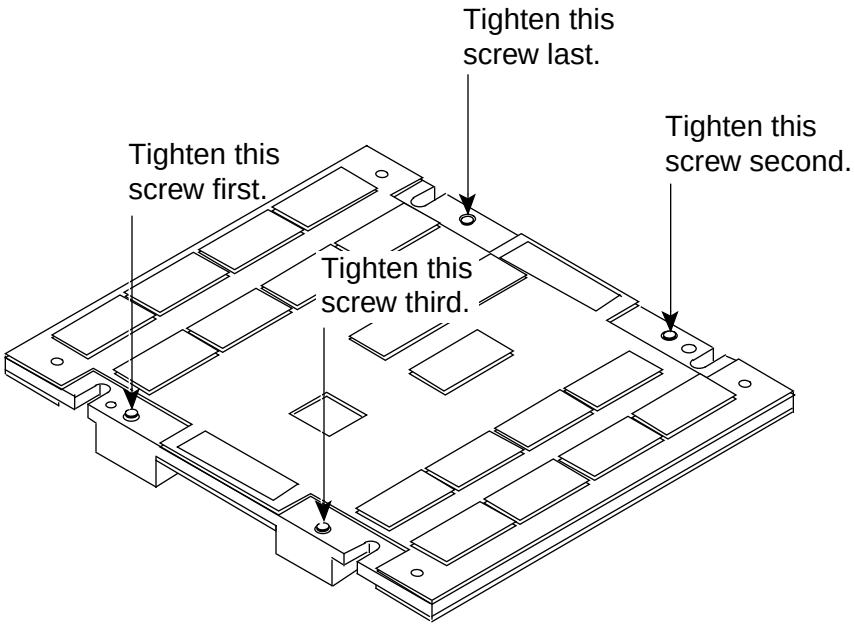
4. When the daughter card is in position, use your fingers to gently seat the daughter card. (The pins should slide gently into place as you press down.)

   - If you feel resistance, stop and determine the cause of the resistance.

   - Be careful not to touch the daughter card in areas that may cause damage.

5. Install the 4 retaining screws that secure the daughter card to the motherboard. Tighten the screws to 50 in-oz each; tighten the screws in the sequence shown in Figure 25.

Figure 25. Tightening the Retaining Screws



6. Check for a voltage-to-ground short on the PEM after you install each daughter card (a voltage-to-ground short can be caused by a bent pin on the daughter card connector):

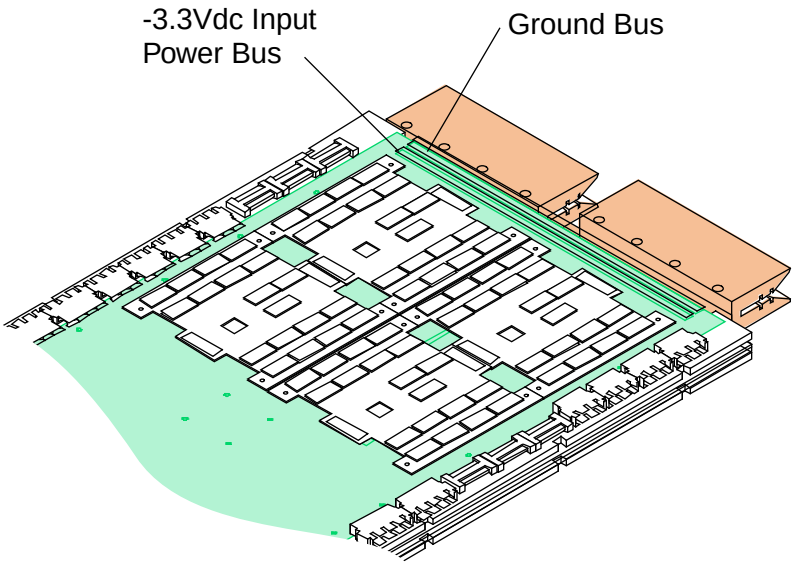
   a. Measure the resistance between the PEM's input power bus and ground to ensure that no voltage-to-ground short exists. Refer to Figure 26.

   NOTE: In most cases, EV5 PEMs indicate less resistance than EV5.6 PEMs.

   b. If the resistance on any PEM is 10 ohms or less, remove the daughter cards one at a time and check for bent pins. Retest after you remove each daughter card. Repair any bent pins if possible. If either the daughter card or motherboard is faulty, replace it immediately.

7. Install the module according to the module replacement procedure. Refer to FRP 11.

Figure 26. Ohming the PEM



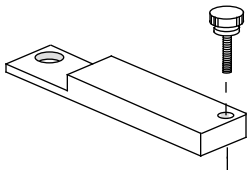
FRP 13: Packing a Module in a Shipping Container

CAUTION

Observe all ESD precautions. Failure to do so can result in damage to the equipment.

1. Before you pack the module for shipment, ensure that you place pin protectors, P/N 15145700 (refer to Figure 27), on all daughter card pin connectors.

Figure 27. Pin Protector



2. Open the module shipping containers:

   - ME107844 (box, outer module shipper [external plastic container])
   - ME107776 (box, inner LC module shipping box [internal cardboard container])

3. Remove the loose foam from the inner box; leave the bottom die-cut foam in place. Refer to Figure 28.

4. Put the module in an ESD-protective plastic bag. Let the hoses extend out of the bag and wrap the bag around the base of the hoses.

5. Close the plastic bag and seal it with static tape.

6. Insert the module in the inner box with the power connectors facing the left and the handle facing the right.

7. Fold, but do not kink, the hose ends into the notch of the foam on the right hand side of the box.

8. Place the top die-cut foam over the module.

9. Roll the piece of filler foam, approximately halfway and place the rolled end over the module handle. Extend the remaining portion of the top over the die-cut foam piece.

NOTE: Do not ship the module without the piece of filler foam.

10. Close the inner box, then pass the retaining strap beneath the box handle and snap the two ends of the strap together.

11. Pack the inner box in the cutout area of the outer box. Refer to Figure 29.

12. Place the cover on the outer box and secure it with the retaining clamps.

13. Complete the module return kit and label the shipping container (outer box) for return to Chippewa Falls. Follow the instructions provided in the module return kit.

NOTE: Remove all previous or old shipping labels from the outer container.

Figure 28. Module Shipping Container – Inner Box

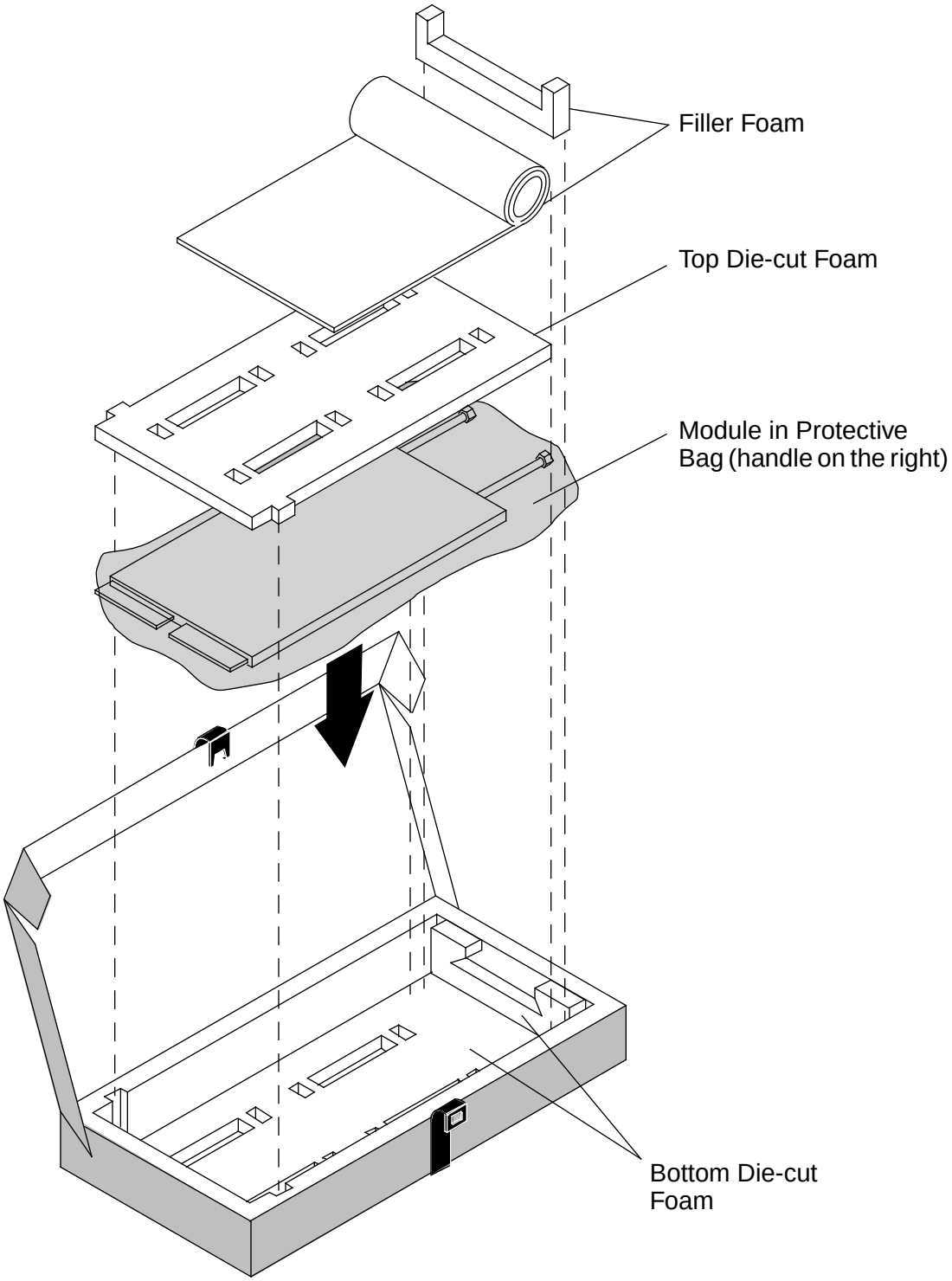
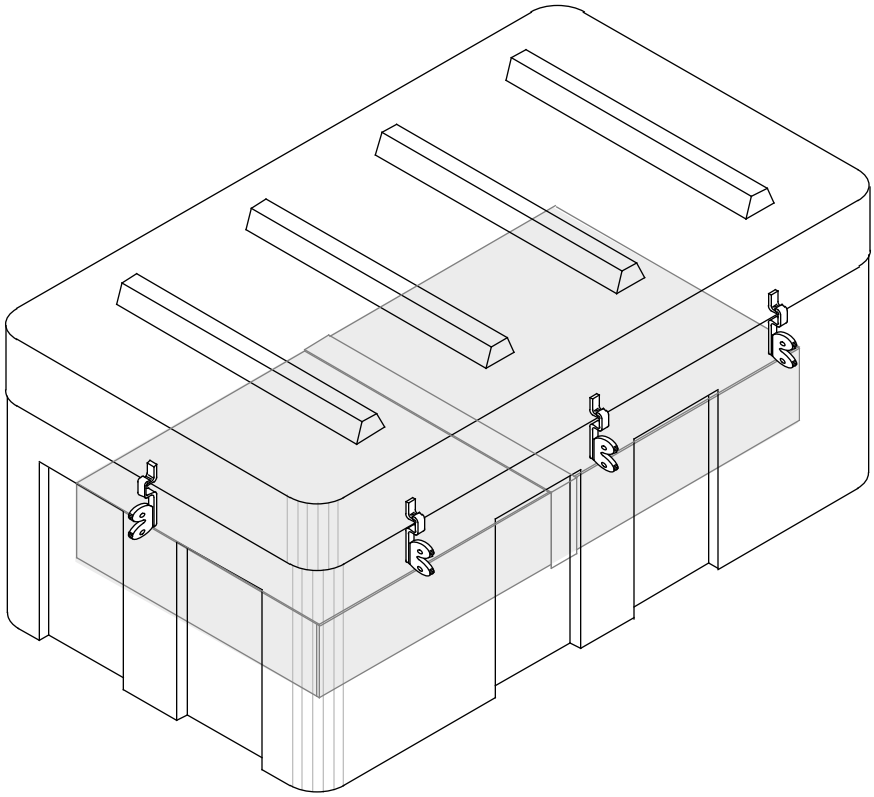


Figure 29. Module Shipping Container – Outer Box



FRP 14: Module Thermistor Replacement

You can replace the top board thermistor without completely removing the module. Depending on the location of the module, the bottom board thermistor can also be replaced without completely removing the module; refer to Figure 30.

Part Number

- 55003300 (temperature sensor)

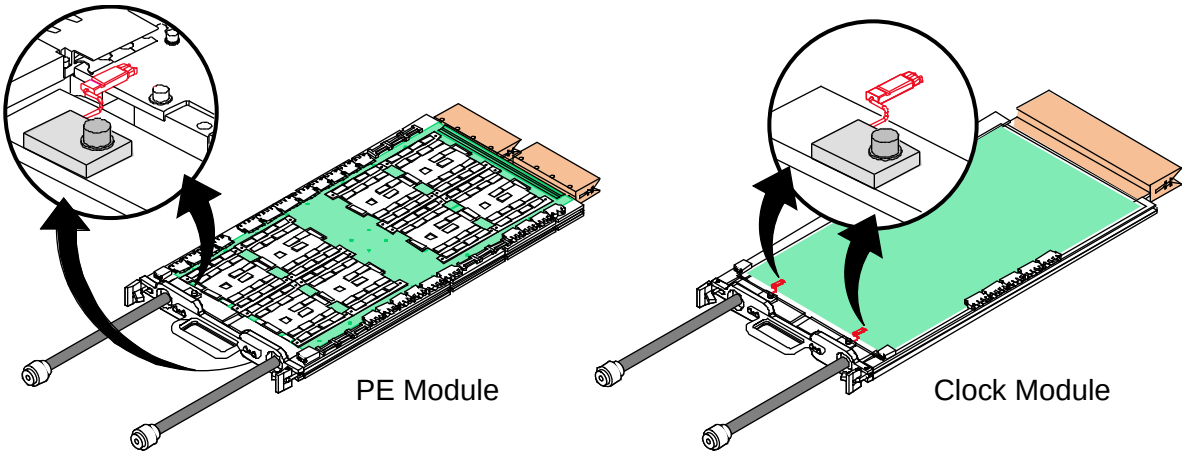
Tools Required

- 4-mm hex (allen) wrench

Thermistor removal

1. Power off the module by opening the correct module power supply circuit breakers.
2. Uncam the module; refer to FRP 11.
3. If you can replace the thermistor without completely removing the module, continue with step 5.
4. If necessary, completely remove the module:
   a. Place the module on a static free work surface.
   b. Continue with step 6.
5. Slide the module partially out.
6. Disconnect the thermistor cable socket from the PCB pins, pulls apart.
7. Use a 4-mm hex (allen) wrench to remove the screw that secures the defective thermistor.
8. Remove the defective thermistor.

Figure 30. Module Thermistor



Thermistor Installation

1. Use the screw that you removed previously to attach the new thermistor to the cold plate.
2. Connect the thermistor cable connection on the PC board.
3. Install the module (refer to FRP 11).
4. Close the module power supply circuit breakers.
5. Press the START button to activate the power enable signal from the CCS board.
6. Monitor the module temperature at the WACS display page for that module.

FRP 15: Module Rail Replacement

Before you install the new rail, carefully remove the cable labels from the torus and GigaRing cables and apply them to the new rail's cable connectors. If necessary, make new labels.

Part Number

- 15240100 (rail assembly without GigaRing)
- 15240200 (rail assembly with GigaRing

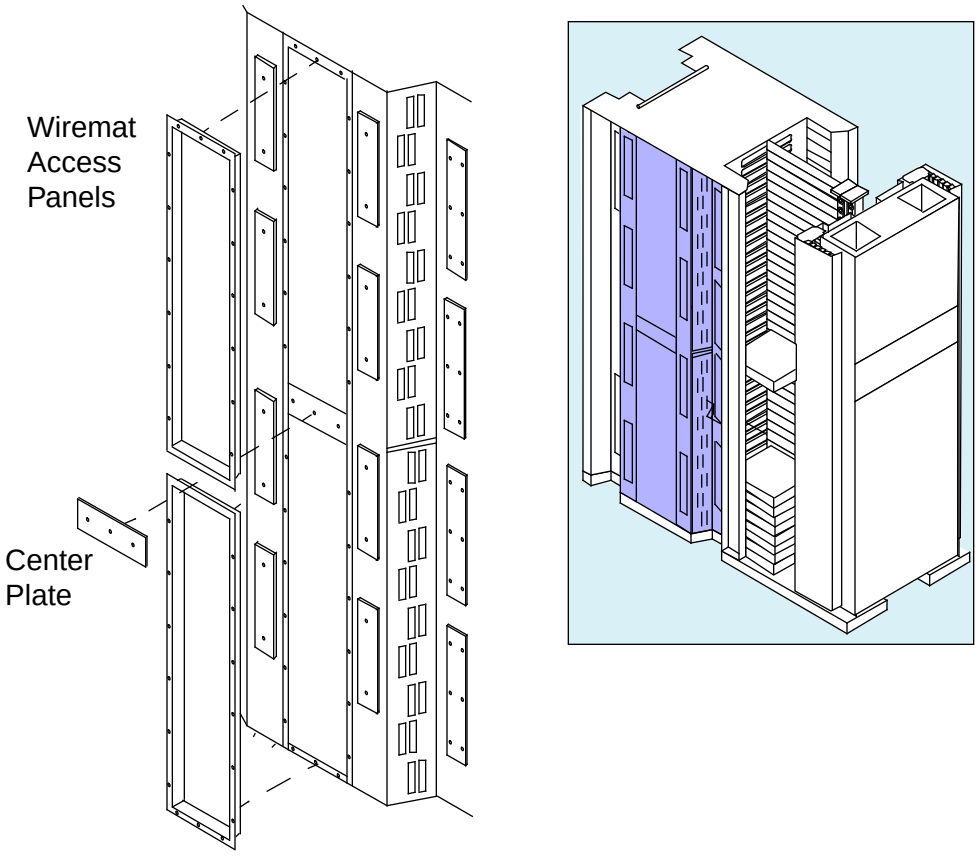
Tools Required

- Phillips screwdriver
- 3/16-in. socket and driver
- 4-mm hex (allen) wrench

Rail Removal

1. Open the cabinet's front door and press the STOP button.
2. Power off the cabinet by opening the cabinet's main circuit breaker CB1.
3. Open the rear cabinet door.
4. Remove the module where the defective rail is and remove as many adjacent modules as necessary to provide access to the rail. Put the modules in a protected location that is ESD safe.
5. Remove the cabinet side panels (refer to FRP 1) to gain access to the wiremat.
6. Remove the wiremat covers for the area where the repair will take place (refer to Figure 31):
   a. Unlock the 1/4-turn screws that hold the center cross plate.
   b. Unlock the 1/4-turn screws that hold the upper and/or lower wiremat cover.

Figure 31. Wiremat Covers



7. If the defective rail has external GigaRing cable connections, disconnect the external cables from the bulkhead. Note the connections for future reference.

8. Disconnect the GigaRing cables that route from the rail to the bulkhead.

9. In the wiremat, disconnect the defective rail's torus and boundary scan cables; note the connections in the wiremat for future reference.

10. Remove the system clock wire and, if required, the GigaRing clock wire from the clock connector; refer to FRP 16.

11. Remove the PEM-to-WACS cable:

    a. Open the side door to access the WACS control cables for the defective rail.

    b. Disconnect the WACS bulkhead-to-interconnect board control cable for the defective rail at the internal bulkhead.

c. Use a 3/16-in. socket to remove the standoffs from the PEM-to-WACS cable connector.

d. Carefully pull the PEM-to-WACS cable back to the wiremat area.

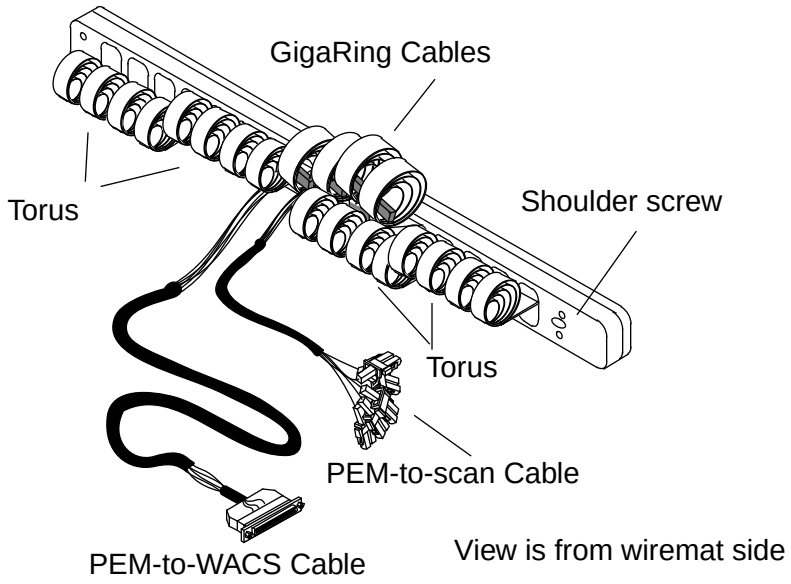
NOTE: At this point all cables should be free.

12. Use a 4-mm hex (allen) wrench to remove the rail shoulder screw for the defective rail.

13. Carefully remove the rail from the chassis; take care with any disconnected cables.

NOTE: For this portion of the procedure, a second person is helpful.

Figure 32. PEM Rail Assembly



Rail Installation

1. Insert the new rail in the chassis:

a. Pass all cables through the opening into the wiremat area.

b. Position the new rail over the dowel pins on the center support column.

c. Attach the new rail to the frame using the shoulder screw that you removed previously.

2. Reconnect the system clock wire and, if necessary, the GigaRing clock wire to the clock connector; refer to FRP 17.
3. Route the PEM-to-WACS cable through the frame to the internal bulkhead and attach the cable connector to the internal bulkhead
4. Reconnect the WACS bulkhead-to-interconnect board control cable.
5. Reconnect the boundary scan connections.
6. Reattach the GigaRing cable connectors to the bulkheads (if necessary).
7. Connect any external GigaRing cables to the bulkhead connectors.
8. Reconnect the torus cables.
9. Install all modules that you removed previously.
10. Close the main circuit breaker CB1.
11. Press the START button and power on the system.
12. Test the cabinet; run boundary scan and offline diagnostics to ensure that the problem was corrected.
13. Install the wiremat covers and side panels.
14. Return the system to operation and ensure proper function.

FRP 16: Wire Replacement or Addition

The following procedure describes the process for removing and installing the pin connector for a shuttle. Use this procedure for:

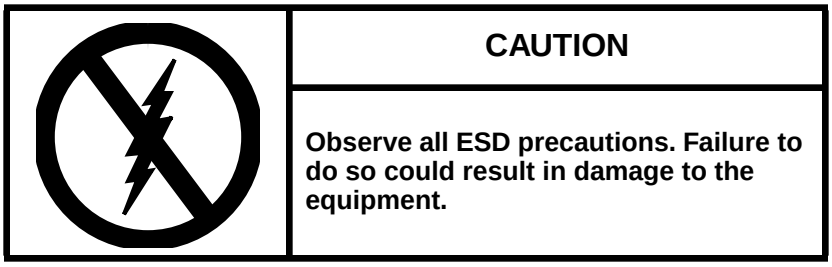
- Clock wire replacement
- GigaRing clock wire replacement
- PEM-to-WACS cable replacement
- Boundary scan cable replacement

Refer to Figure 39 and Figure 40 for detailed diagrams of the 64-pin shuttle connector.

Tools Required

- Dental pick
- 0.3-mm mechanical pencil without lead

Wire Removal



CAUTION

Observe all ESD precautions. Failure to do so could result in damage to the equipment.

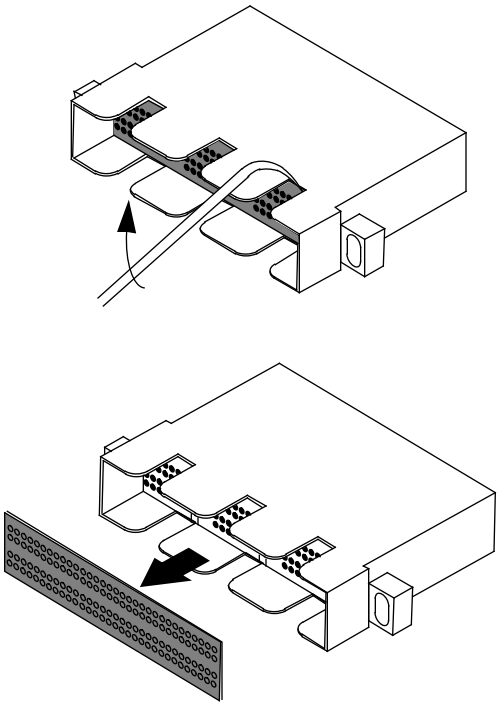
1. Open the cabinet's front door.
2. Power off the cabinet by pressing the STOP button and then opening the cabinet's main circuit breaker, CB1.
3. Remove the side panels to access the wiremat; refer to FRP 1.
4. Remove the wiremat access covers to expose the wiremat:
   a. Unlock the 1/4-turn screws that hold the center cross plate.
   b. Unlock the 1/4-turn screws that hold the upper or lower wiremat cover.

5. Remove the modules where the defective wire connects. In addition, remove as many adjacent modules as needed to provide access to these rails. Refer to FRP 11.

6. Record the location of the defective wire (module slot, connector, and pin); if necessary, refer to the appropriate engineering specification.

7. Use a dental pick (or some other sharp tool) to carefully remove the plastic pin lock from the module side of the connector. If the defective wire passes from one shuttle connector to another, remove the pin lock at both ends of the wire. Refer to Figure 33.

Figure 33. Plastic Pin Lock Removal

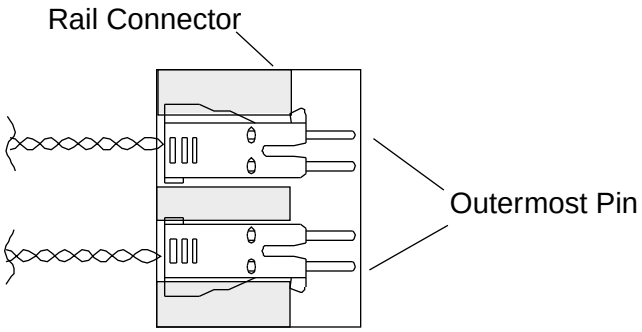


8. Use a 0.3-mm mechanical pencil without lead (or use a wire removal tool) to release the defective wire from each rail connector:

   a. Position yourself so that you can see the wire's pins.

   b. Carefully slide the hollow tip of the pencil over the outermost pin of the pin pair as shown in Figure 34 and Figure 35.

Figure 34. Rail Connector - Side View

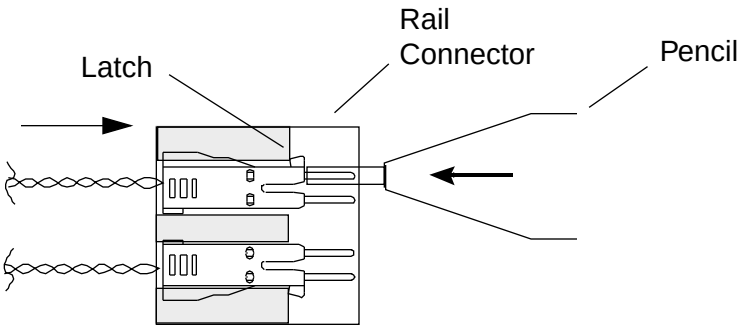


c. Apply a gentle force both toward the other pin and away from the connector edge.

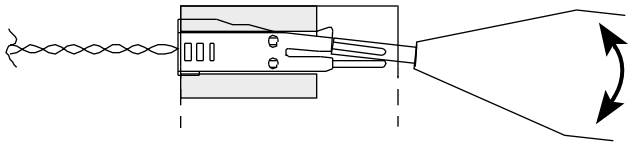
d. Return to the wiremat and pull the defective clock wire from the rail connector.

Figure 35. Pin Connector Removal with a Mechanical Pencil

Slip the hollow point of the pencil over the outer pin.

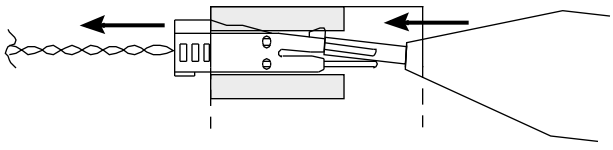


Gently angle the pencil so that the outer pin bends toward the inner pin. This releases the pin lock.



Note: Diagram shown with a cut-away view of the rail connector

Push the 2-pin connector out of the rail connector.



9. If necessary, repeat Step 7and Step 8 for the other end of the wire.

10. Cut the pin connectors off the wire. Leave the wire in the bundle.

Wire Installation

1. Determine the location for the replacement wire.
2. Route the new wire in the wiremat from the origin to the destination.

NOTE: If you are replacing a cable, carefully lay the cable in the wiremat while inserting the pin connectors.

3. Perform the following steps to insert each end of the new wire in the rail connector:

   a. Position the new wire above or below the appropriate pin slot in the rail connector. Refer to Figure 39 and Figure 40 for the wire location within the connector.

   b. Use your fingers or an appropriate tool (such as hemostats or a wire insertion tool) to gently push the pin connector into the pin slot; refer to Figure 36. Ensure that you do not damage the wires.

   c. Carefully press forward (towards the module area) on the top of the pin connector to fully insert the clock pin connector. You should hear it click into place.

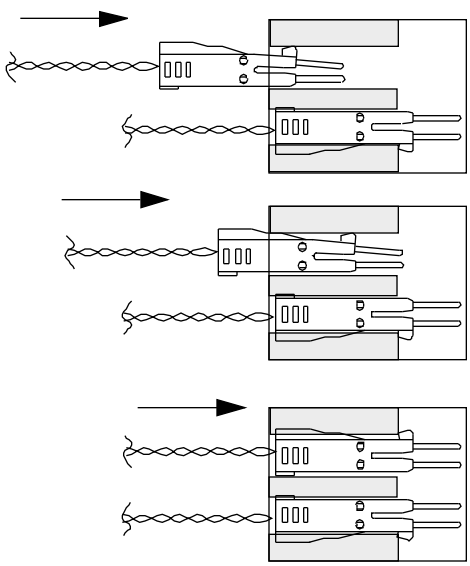
   d. Repeat this procedure for all pins of a replacement cable.

Figure 36. Wire Insertion

Move the wire connector to the appropriate location.

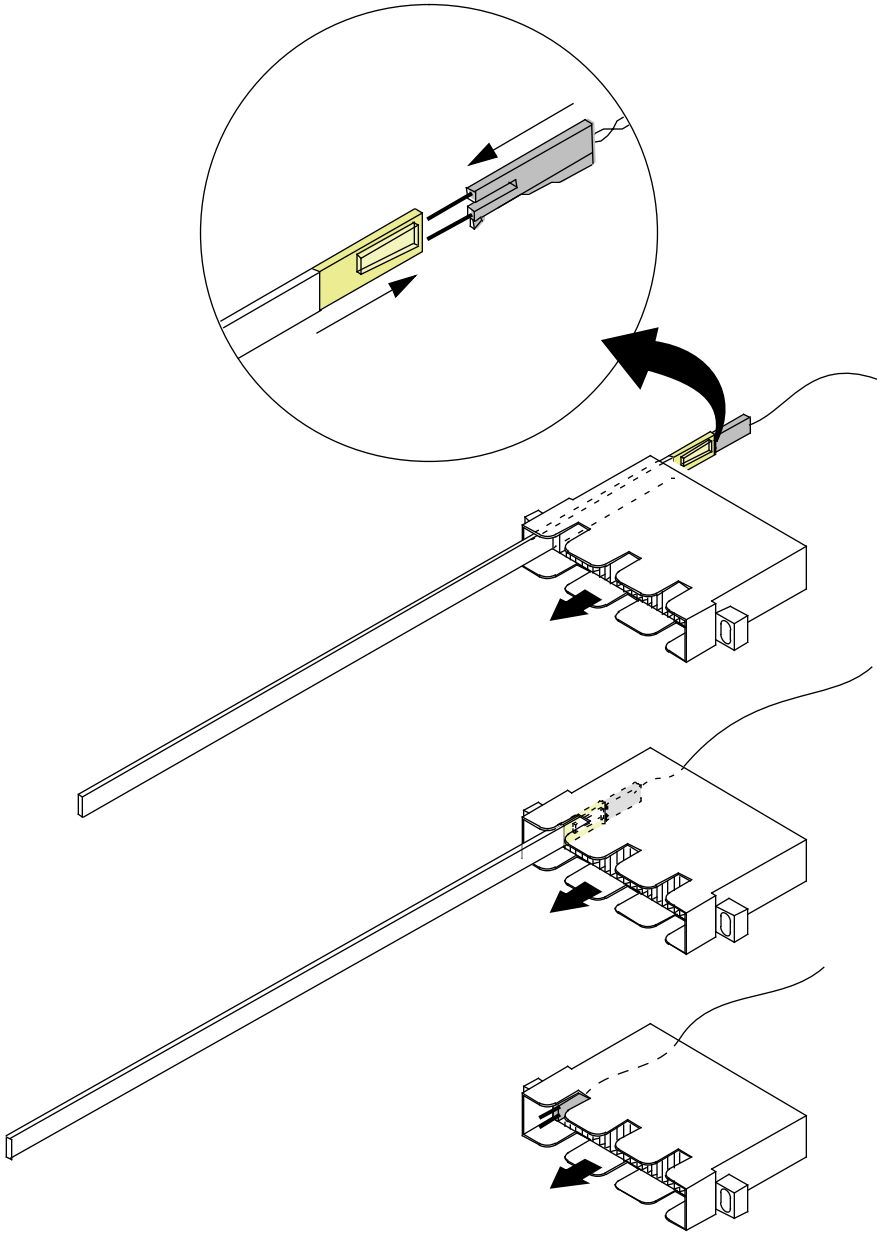
Gently push the wire connector into rail connector.

Press the top of the connector to fully seat it in the rail connector.



Note: Diagram shows cutaway view of the rail connector

Figure 37. Wire Insertion Tool Procedure



Thread the wire rod through the appropriate pin slot in the connector block, as shown. Ensure that the plastic tip on the wire rod is at the wire-insertion end of the connector block, and ensure that the slanted portion of the cavity in the plastic tip faces the outside of the connector block.

Then, insert the 2-pin connector into the cavity, as shown at left. The cavity pinches the pins together as you insert the connector.

Pull the rod through the connector block to insert the 2-pin connector. If necessary, seat the connector with your fingertip.

Replacing the Plastic Pin Lock

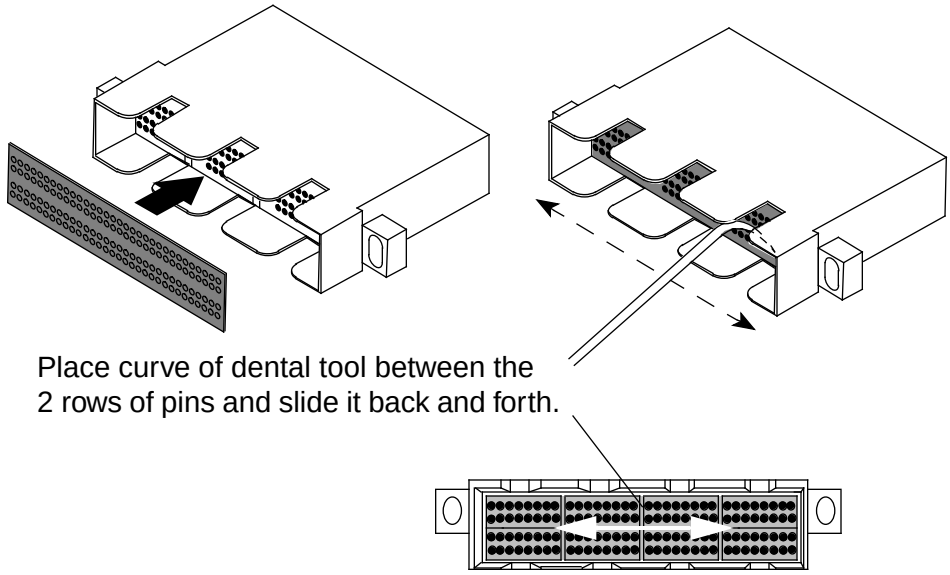
1. From the module side of the connector, insert a plastic pin lock into the clock rail connectors and ensure that the pins are straight (refer to Figure 38).

   a. Position the pin lock on the connector. Place the rough side toward the pins and the smooth side toward the module.

b. Use a dental tool to fully insert the pin lock in the connector. Press the curve of the dental tool against the center of the pin lock, between the 2 sets of pins. Then gently slide the dental tool back and forth as you push the pin lock into position. Refer to Figure 38.

c. Ensure that the pins are straight. (If necessary, use a 0.3-mm mechanical pencil to straighten a misaligned pin. Slip the tip of the pencil over the pin and gently bend the pin into the proper position.

Figure 38. Inserting and Seating a Plastic Connector-pin Lock



2. Using tie wraps, secure the new wire in the wiremat.
3. Replace and cam all modules that were removed; refer to FRP 11.
4. Turn on the cabinet circuit breaker, CB1.
5. Press the START button on the WACS panel to power on the cabinet.
6. Test the cabinet; run boundary scan and offline diagnostics to ensure that the problem was corrected.
7. Reinstall the wiremat access panels that you removed earlier.
8. Reinstall the cabinet panels.
9. Return the system to operation and ensure proper function.

Figure 39. 64-pin PEM Clock and Scan Connector

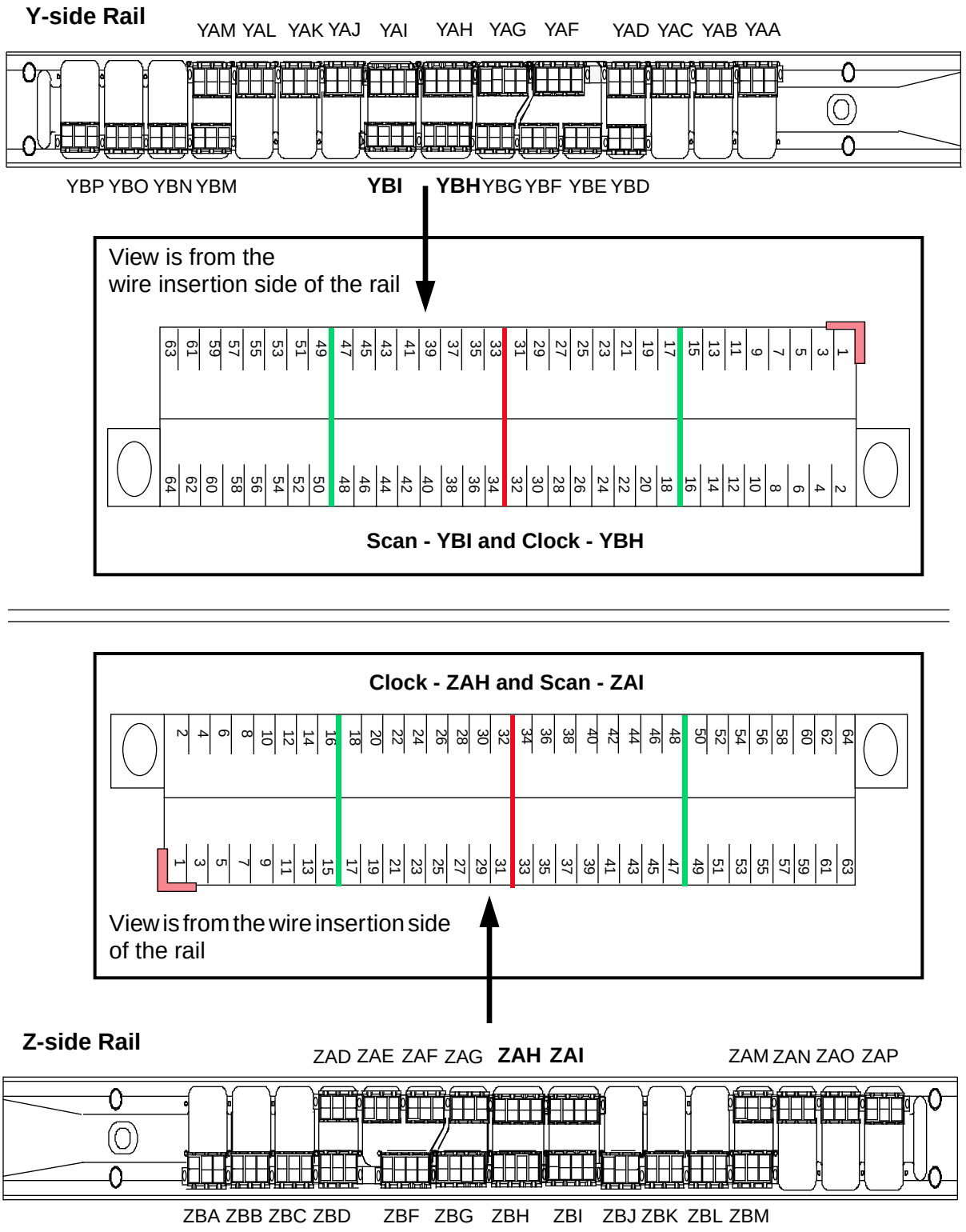
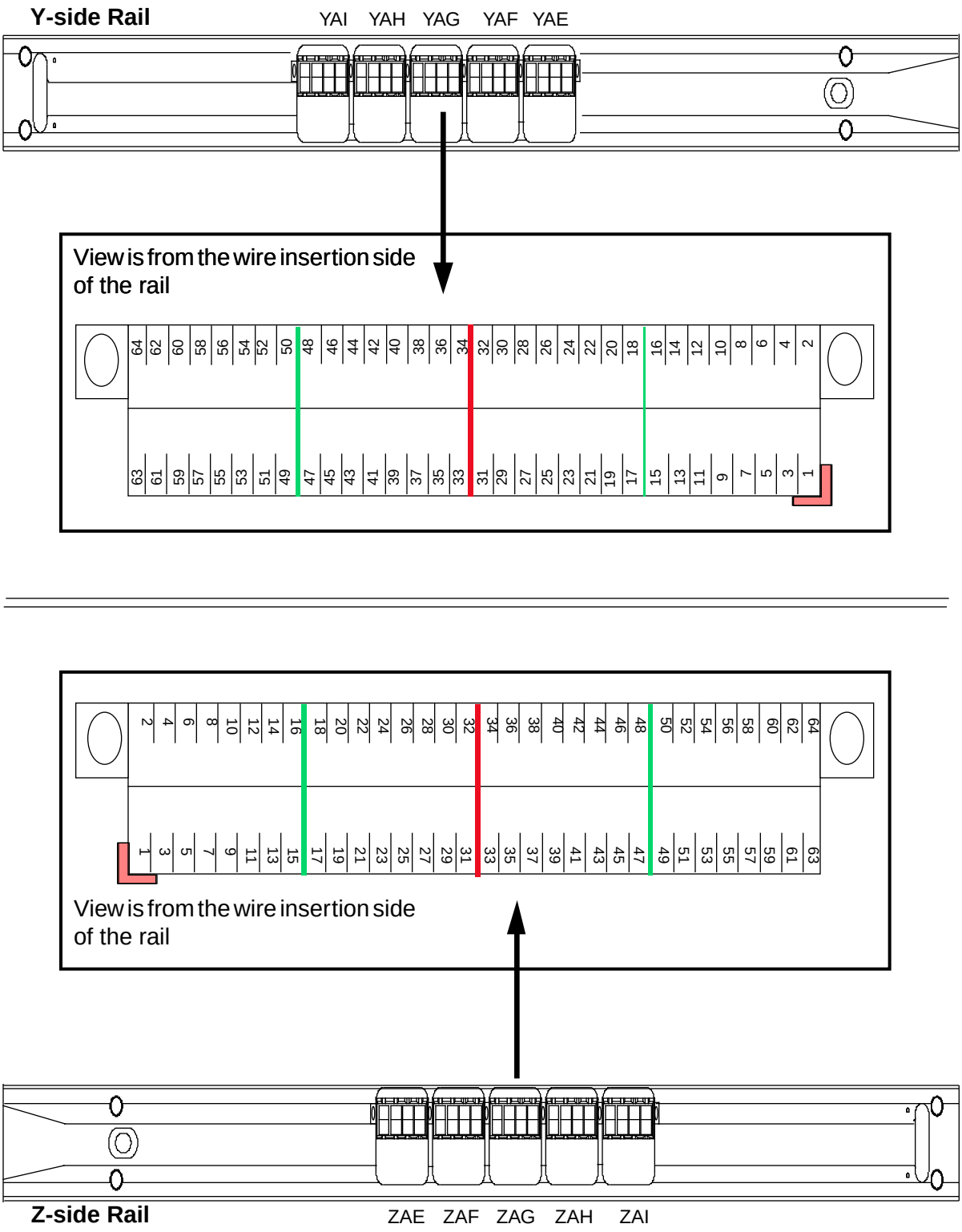


Figure 40. 64-pin Clock Rail Connector



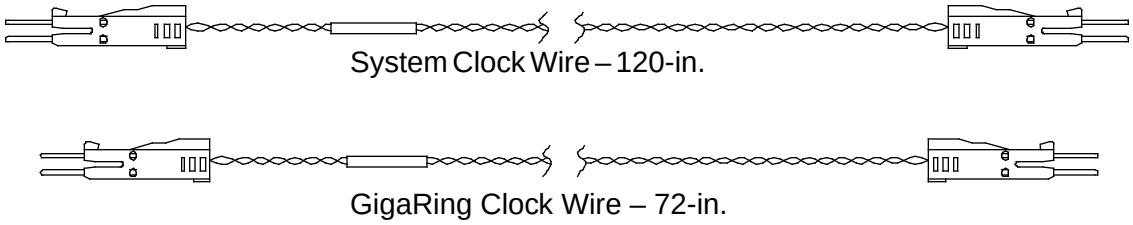
FRP 17: Clock or GigaRing Clock Wire Replacement

This procedure applies to both the system clock wire and the GigaRing clock wire (refer to Figure 41). The defective wire is left in the wire bundle with both ends cut off. Use the wire replacement or addition procedure, FRP 16.

Part Numbers

- 15223701 (system clock replacement wire)
- 15224006 (GigaRing clock replacement wire)

Figure 41. System Clock and GigaRing Clock Replacement Wires



FRP 18: Torus or GigaRing Cable Replacement

This procedure provides three methods for replacing a defective cable:

- Method One - Remove and replace the entire rail
- Method Two - Remove the defective cable without removing the rail
- Method Three - Remove the defective cable by removing two shuttle connectors (clock and scan) and sliding the rail out of position

Choose a method based on your experience and comfort level with working in the wiremat area and removing/installing wire. If you do not feel comfortable with any of the three procedures, contact SWAT for assistance.

Method one requires the most time. With this method you must also unpin the clock and GigaRing clock wires.

Method two is used when the defective cable is located close to the open area in the module cage.

Method three is used when the defective cable is closest to the rear of the rail. With this method, you remove the rail from its position but do not remove it from the cabinet. You then slide the rail towards the module open area for easier access to the defective cable.

CAUTION
Observe all ESD precautions. Failure to do so could result in damage to the equipment.

Part Number

- 15112904 (cable assy, ribbon - 13 in.)
- 15112905 (cable assy, ribbon - 24 in.)
- 15112906 (cable assy, ribbon - 23 in.)
- 15128901 (cable assy, ribbon inverted - 23 in.)
- 15200501 (cable assy, GigaRing to bulkhead)

Tools Required

- 1/4-in. deep-well socket
- Jeweler’s screwdriver set
- 0.05-in. hex (allen) wrench
- Torque screwdriver set
- 4-mm hex (allen) wrench

Method One

Method one uses FRP 15.

Method Two - GigaRing or Torus Cable Replacement

1. Open the cabinet front door and press the STOP button.
2. Remove power from the cabinet by opening the main circuit breaker, CB1.
3. Remove the side panels (refer to FRP 1).
4. Remove the wiremat access panel covers.

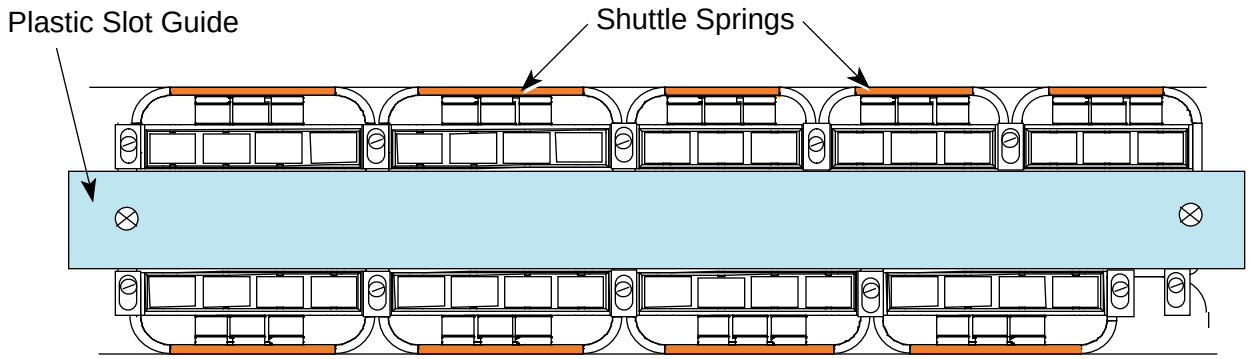
Preparing the Rail

1. To remove a GigaRing cable:
   a. Remove any loopback or external GigaRing cables that connect to the defective cable(s) and label the position of each.
   b. Using a 1/4-in. deep-well socket, remove the jackscrews that secure the GigaRing connector to the bulkhead.
2. To remove a torus cable:
   a. Disconnect the defective cable in the wiremat.
   b. Remove the cable label and attach it to the replacement cable.
3. Remove the module where the defective rail is mounted and remove as many adjacent modules as necessary to provide access to the rail. Put the modules in a protected location that is ESD safe.

4. Use a screwdriver to remove the 4 screws that hold the plastic slot guide to the rail, then remove the slot guide.

   NOTE: Based on the location of the defective cable, you may only have to remove 2 or 3 of the slot guide screws. There should be enough flexibility in the slot guide to move it around. If you put a crimp or bend in the slot guide, replace it.

Figure 42. Module Rail Guide



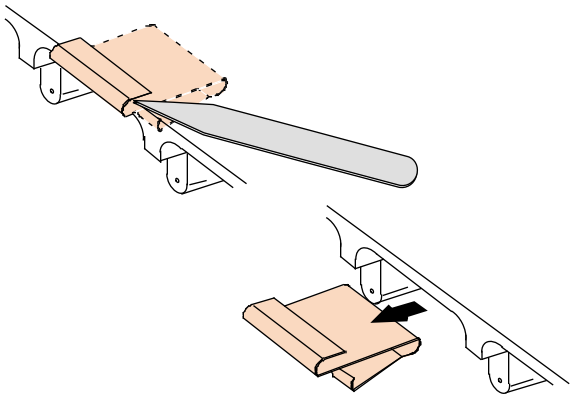
Removing the Defective Cable

Remove the defective cable:

1. Remove the copper-colored connector spring clip before loosening the connector. In addition, remove the spring clips to the connectors on the right and left. Refer to Figure 43.

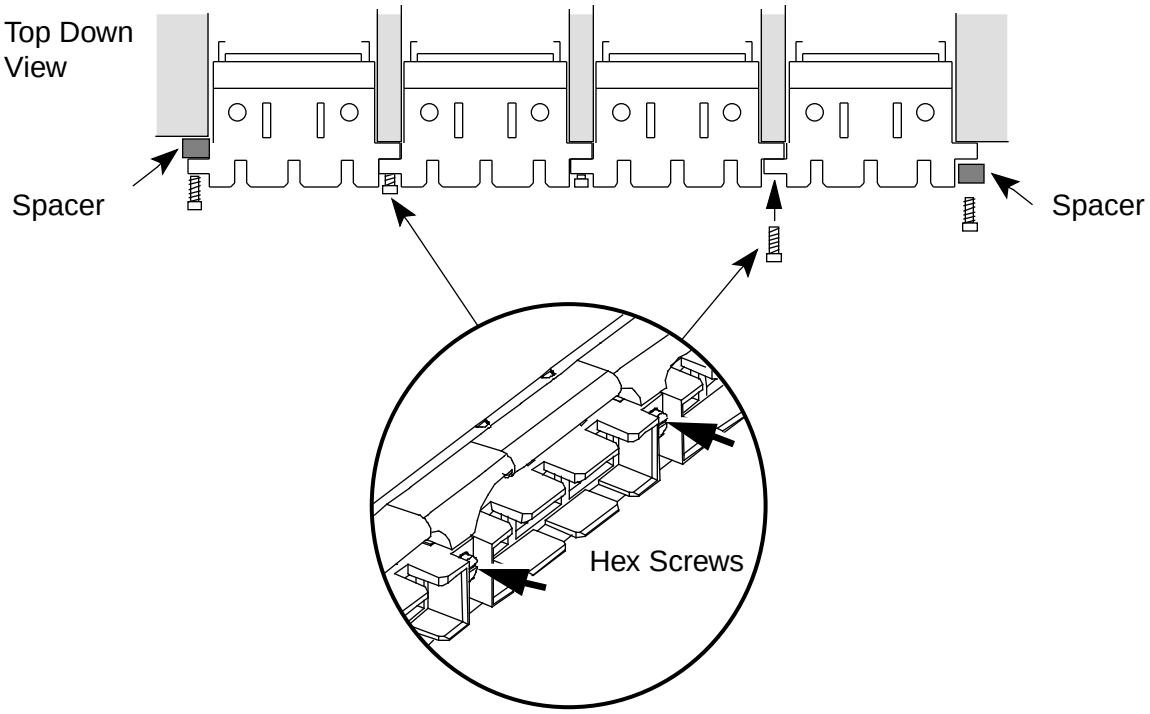
   TIP: To remove a spring, insert the tip of a pair of tweezers between the spring and the edge of the rail, then pry the spring loose.

Figure 43. Connector Spring Removal



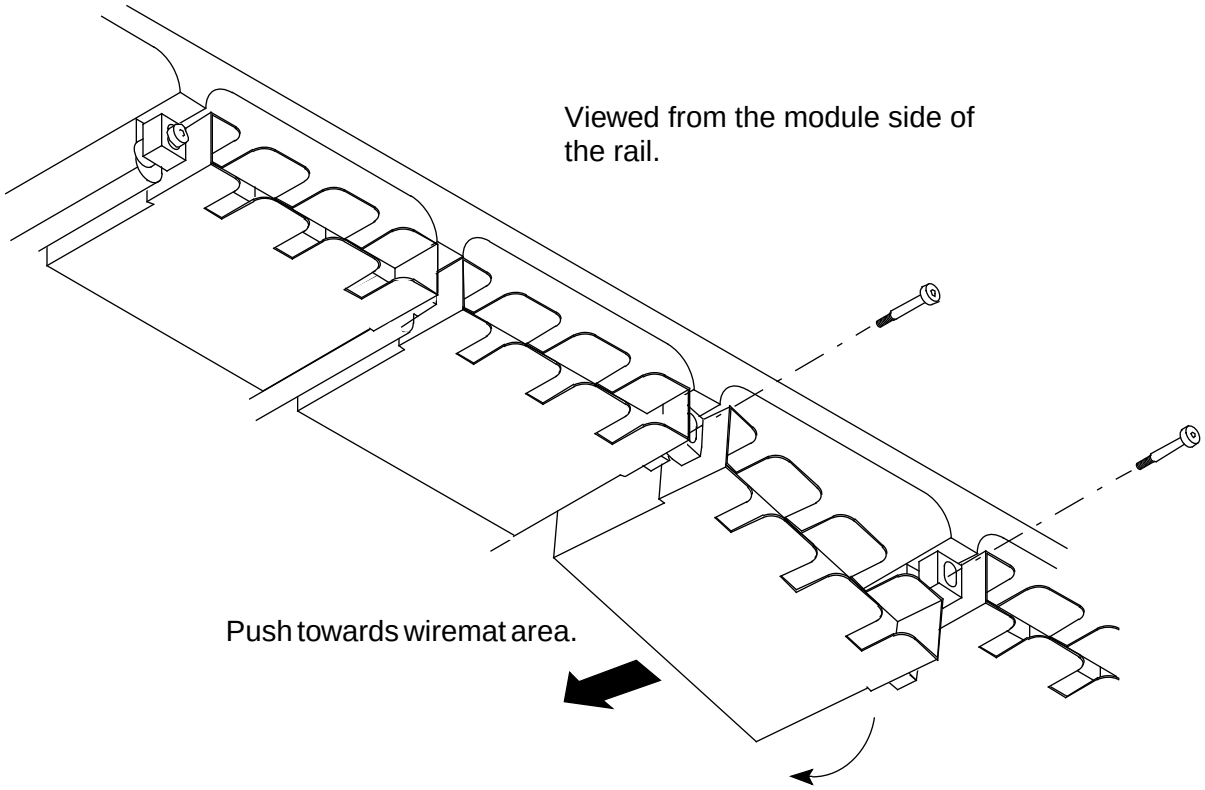
2. Use the 0.05-in. hex wrench to remove the 2 hex screws that secure the connector to the rail; refer to Figure 44. If you remove an end connector, note the location of the spacer.

Figure 44. Rail Connectors



3. Slide the connector up or down and twist it diagonally to the opening and push it toward the wiremat area until it clears the other connectors; then, working from the wiremat side, pull the connector out through the connector slot. Refer to Figure 45.

Figure 45. Remove Connector



Installing the New Cable

1. Install the new cable:

   a. Working from the wiremat side, slide the new cable through the connector slot diagonally.

   b. From the module side of the rail, position the new cable connector. The connector will only fit correctly one way.

   c. Insert the hex screws and (if removed) the spacer. Check the connector alignment, and tighten the screws to 15 in-oz.

2. Replace the connector springs if you removed them; center the spring over the connector.

3. Replace the plastic slot guide that you removed earlier. Do not overtighten the screws.

4. Close all circuit breakers and press the START button on the WACS panel.

5. Replace the wiremat access panels.
6. Replace the side panels that you removed earlier.
7. Return the system to operation, ensure proper function, and close the cabinet doors.

Method Three - Torus or GigaRing Cable Replacement

1. Open the cabinet front door and press the STOP button.
2. Remove power from the cabinet by opening the main circuit breaker, CB1.
3. Remove the side panels (refer to FRP 1).
4. Remove the wiremat access panel covers.

Preparing the Rail

1. To remove a GigaRing cable:
   a. Remove any loopback or external GigaRing cables that connect to the defective cable(s) and label the position of each.
   b. Use a 1/4-in. deep-well socket to remove the jackscrews that secure the GigaRing connector to the bulkhead.
2. To remove a torus cable:
   a. Disconnect the defective cable in the wiremat.
   b. Remove the cable label and attach it to the new cable.
3. Remove the module where the defective rail is mounted and remove as many adjacent modules as necessary to provide access to the rail. Put the modules in a protected location that is ESD safe.
4. Use a screwdriver to remove the 4 screws that hold the plastic slot guide to the rail, then remove the slot guide; refer to Figure 42.

   NOTE: Based on the location of the defective cable, you may only have to remove 2 or 3 of the slot guide screws. There should be enough flexibility in the slot guide to move it around. If you put a crimp or bend in the slot guide, replace it.

Removing the Clock and Scan Connectors

1. Locate the clock and scan connectors on the rail.
2. Remove the clock and scan connectors:
   a. Remove the copper-colored connector spring clips before loosening the connectors. Also remove the spring clips to the right and left of the clock and scan connectors.

      NOTE: To remove a spring, insert the tip of a pair of tweezers between the spring and the edge of the rail, then pry the spring loose. Refer to Figure 43.

   b. Use the 0.05-in. hex wrench to remove the 2 hex screws that secure each connector to the rail; refer to Figure 44. If you remove an end connector, note the location of the spacer.

   c. Slide the connector up or down and twist it diagonally until it clears the other connectors, then push the connector out through the connector slot into the wiremat. Refer to Figure 45.
3. Working from the wiremat area, pull the 2 connectors into the wiremat area; be careful not to damage the pins in the connector.
4. Use a 4-mm hex wrench to remove the shoulder screw holding the rail in place.

   TIP: Prior to loosening the shoulder screw, loosen the tie wraps holding the torus and GigaRing cables in bundles. This may give you more flexibility.
5. Carefully move the rail towards the module area opening to gain access to the defective cable.
6. Set the rail on the protective plate assembly, P/N 15258200.

Removing the Defective Cable

1. Remove the copper-colored connector spring clip before loosening the connectors. Also remove the spring clips to the right and left of the defective cable’s connector.

   NOTE: To remove a spring, insert the tip of a pair of tweezers between the spring and the edge of the rail, then pry the spring loose. Refer to Figure 43.

2. Use the 0.05-in. hex wrench to remove the 2 hex screws that secure each connector to the rail; refer to Figure 44. If you remove an end connector, note the location of the spacer.

3. Slide the connector up or down and twist it diagonally until it clears the other connectors, then push the connector out through the connector slot into the wiremat area. Refer to Figure 45.

Installing the New Cable

1. Install the replacement cable:

   a. Working from the wiremat side, slide the new cable diagonally through the connector slot and position the replacement cable.

   b. From the rail side, pull the new cable connector through the rail and place it into position.

   c. Insert the hex screws and (if removed) the spacer.

   d. Check the connector alignment and tighten the screws to 15 in-oz.

2. Replace the connector spring(s) if you removed them; center the spring over the connector.

3. Slide the rail back into place and secure it with the 4-mm shoulder screw that you removed earlier.

Installing the Clock and Scan Connectors

1. Install the clock and scan connectors:

   a. Working from the wiremat side, slide the 2 connectors diagonally through the connector slot and position them in the rail.

   b. Insert the hex screws and (if removed) the spacer.

   c. Check the connector alignment and tighten the screws to 15 in-oz.

2. Replace the connector spring clips; center the spring clips over the connector.

3. Replace the module slot guide using the screws that you removed earlier.

Connecting the GigaRing and Torus Cables

1. Reconnect any torus cables.
2. Reconnect any GigaRing cables at the bulkhead if necessary.
3. Reconnect any loopback or external GigaRing cables.
4. Close all circuit breakers and press the START button on the WACS panel.
5. Test the cabinet; run boundary scan and offline diagnostics to ensure that the problem was corrected.
6. Replace the wiremat access panels.
7. Replace the side panels that you removed earlier.
8. Return the system to operation, ensure proper function, and close the cabinet doors.

FRP 19: PEM-to-WACS Cable Replacement

This procedure describes how to remove the PEM-to-WACS cable by unpinning each wire from the clock connector.

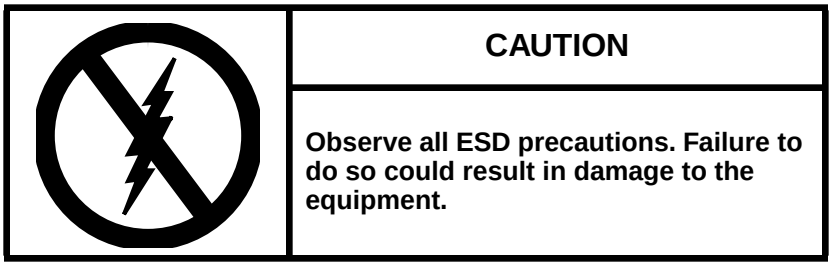
Part Number

- 15214200 (PEM-to-WACS cable)

Tools Required

- 3/16-in. socket and driver
- Phillips screwdriver

Cable Removal



CAUTION

Observe all ESD precautions. Failure to do so could result in damage to the equipment.

1. Open the cabinet's front door and press the STOP button.
2. Open the cabinet's main disconnect circuit breaker, CB1.
3. Open the side cabinet door for the defective cable.
4. Disconnect the bulkhead-to-interconnect board control cable for the failing location at the bulkhead.
5. Use a 3/16-in. socket to remove the standoffs, washers, and nuts for the PEM-to-WACS cable connector from the bulkhead.
6. Remove the outside panel covers from the cabinet (refer to FRP 1) and place them in a safe area.
7. Remove the appropriate WACS access panel cover to access the defective cable by loosening the 1/4-turn screws.

8. Carefully route the defective PEM-to-WACS cable back toward the wiremat area.

9. Remove the wires for the defective cable from the clock connector; use the wire replacement or addition procedure, FRP 16.

Cable Installation

1. Determine the connector pin locations for the new PEM-to-WACS cable pins. Refer to Figure 39.

   NOTE: Each wire of the cable has a connector pin number.

2. Route the new cable wires in and through the wiremat area toward the rail connector.

3. Route the connector end of the cable through the cabinet frame to the internal bulkhead.

4. Using a 3/16-in. socket, attach the connector to the bulkhead.

5. Reconnect the bulkhead-to-interconnect board control cable.

6. Insert each replacement PEM-to-WACS wire into the rail connector; refer to FRP 16.

7. Replace and cam any modules that you removed; refer to FRP 11.

8. Reinstall any panels that you removed earlier.

9. Return the system to operation, ensure proper function, and close the cabinet doors.

FRP 20: PEM-to-Scan Cable Replacement

This procedure describes how to remove the PEM-to-scan cable by unpinning each wire from the clock connector.

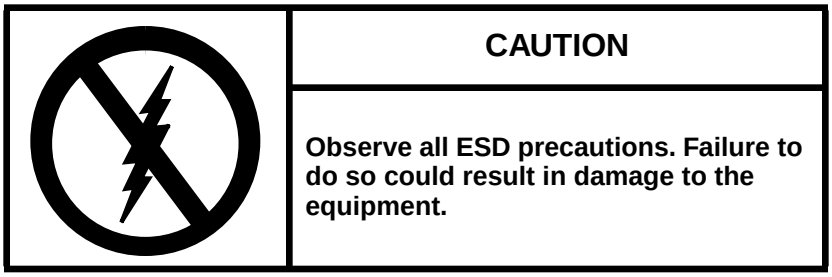
Part Number

- 15214300 (PEM-to-SCAN cable)

Tools Required

- Dental pick
- 0.3-mm mechanical pencil without lead

Cable Removal



CAUTION

Observe all ESD precautions. Failure to do so could result in damage to the equipment.

1. Open the cabinet's front door and press the STOP button.
2. Open the cabinet's main disconnect circuit breaker, CB1.
3. Remove the outside panels from the cabinet to access the wiremat area; refer to FRP 1.
4. Remove the wiremat access panel covers to access the defective module slot.
5. Remove the clock module or the PEM where the defective cable connects. In addition, remove as many adjacent modules as necessary to provide access to the module side of the rail; refer to FRP 11.
6. Locate the defective cable and record the location.
7. Disconnect any boundary scan connections in the wiremat.

8. Remove the wires from the clock connector for the defective cable; use the wire replacement or addition procedure, FRP 16.

Cable Installation

1. Determine the connector pin locations for the new boundary scan cable pins; refer to Figure 39.

   NOTE: Each wire of the cable has a connector pin number.

2. Route the new cable wires in and through the wiremat.

3. Insert each new boundary scan cable wire into the rail connector; refer to FRP 16.

CAUTION
Ensure that you do not damage the wires when you insert the connector.

4. Reconnect the boundary scan cable connectors in the wiremat.

5. Replace and cam any modules that you removed; refer to FRP 11.

6. Close circuit breaker CB1 and press the START button.

7. Test the cabinet; run boundary scan and offline diagnostics to ensure that the problem was corrected.

8. Reinstall any panels and wiremat covers that you removed earlier.

9. Return the system to operation, ensure proper function, and close the cabinet doors.

FRP 21: PEM-to-WACS Control Cable Replacement

You can perform this procedure with the system running and the defective module slot turned off. However, this procedure begins by removing power to all the modules in the cabinet.

Part Number

- 15247600 (PEM slot control cable)

Tools Required

- Slotted screwdriver

Cable Removal

1. Open the cabinet front door and press the STOP button.

   NOTE: If you perform this procedure with the remainder of the cabinet powered on, open the circuit breakers for the affected module.

2. Open the side door for access to the defective cable.
3. Using a small slotted screwdriver, unscrew the cable connector where it attaches to the internal bulkhead.
4. Trace the cable to the interconnect board.
5. Open the cable locks on the opposite end of the cable and remove the cable from the interconnect board.

Cable Installation

1. Position the new cable and slide the flat connector end into the appropriate connector on the interconnect board.
2. Snap the two cable locks in place.
3. Route the cable to the internal bulkhead.
4. Attach the cable to the internal bulkhead using a small slotted screwdriver. **Do not overtighten.**

5. Press the START button and return the system to operation.

   NOTE: If you perform this procedure with the remainder of the cabinet powered on, close the circuit breakers for the affected module, then press the START button.

6. Close all cabinet doors.

FRP 22: Power Supply Control Cable Replacement

You can perform this procedure with the system running and the defective module slot turned off. However, this procedure begins by removing power to all the modules in the cabinet.

Part Number

- 15213601 (power supply control cable)

Tools Required

- Slotted screwdriver

Cable Removal

1. Open the cabinet front door and press the STOP button.

   NOTE: If you perform this procedure with the remainder of the cabinet powered on, open the circuit breakers for the affected module.

2. Open the side door for access to the defective cable.

3. Use a small slotted screwdriver to unscrew the cable connector where it attaches to the power supply.

   NOTE: Newer cables have finger-twist screws instead of flat-blade screws at both ends of the cable.

4. Trace the cable to the interconnect board.

5. Use a small slotted screwdriver or the thumb screws to unscrew the cable connector where it attaches to the interconnect board.

Cable Installation

1. Position the new cable onto the interconnect board connector and if necessary, use a small screwdriver to attach the cable to the board connector.

   NOTE: Do not overtighten the screws.

2. Route the cable to the power supply.
3. Attach the cable to the power supply using a small slotted screwdriver.
4. Close all circuit breakers and press the START button to return the system to operation.
5. Close all cabinet doors.

FRP 23: WACS CCS Board Replacement

The replacement CCS board may not have scanner chips installed. This procedure includes replacing the original chips on the new spare board.

Part Number

- 31481001 (WACS CCS board)

Tools Required

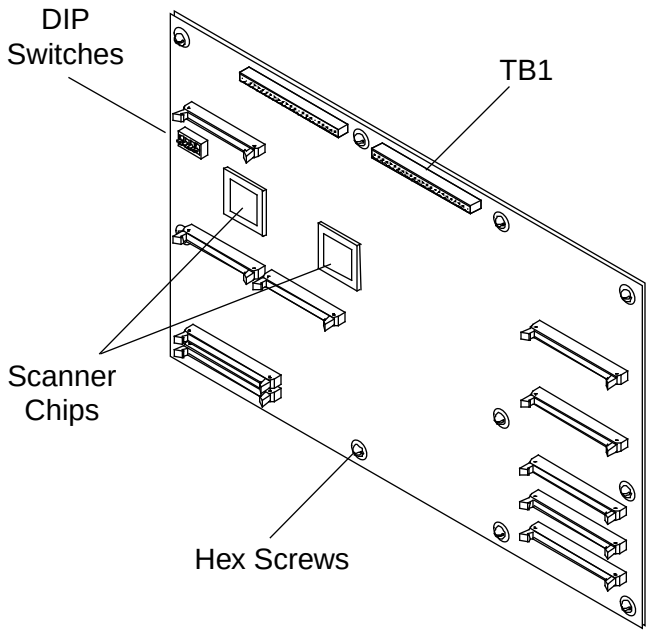
- 3/32-in. hex (allen) wrench
- Chip extractor (if necessary)

CAUTION
Observe all ESD precautions. Failure to do so could result in damage to the equipment.

Board Removal

1. Open the cabinet front door and press the STOP button.
2. Remove all power to the WACS boards by opening circuit breaker CB2.
3. Open the WACS board access panel.

Figure 46. WACS CCS Board



4. Remove the power connector at TB1 of the CCS board. Refer to Figure 46.
5. Remove the remaining cable connections on the board.
6. Use a 3/32-in. hex (allen) wrench to remove the hex screws and washers that secure the board to the power box.
7. Remove the CCS board and place it on an ESD-protected work surface.
8. If necessary, carefully remove the scanner chips from the old board and insert them into the new board.
9. Set the switches on DIP switch S1 of the new CCS board to match the old board.

Board installation

1. Position the new board and secure it to the power box using the hex screws and washers that you removed previously.
2. Reconnect all cables to the CCS board.
3. Reconnect the power connector at TB1.

4. Close circuit breaker CB2.
5. Press the START button and return the cabinet to operation.
6. Close all access panels and doors.

FRP 24: WACS MMS Board Replacement

Part Number

- 31482002 (module assembly, MMS)

Tools Required

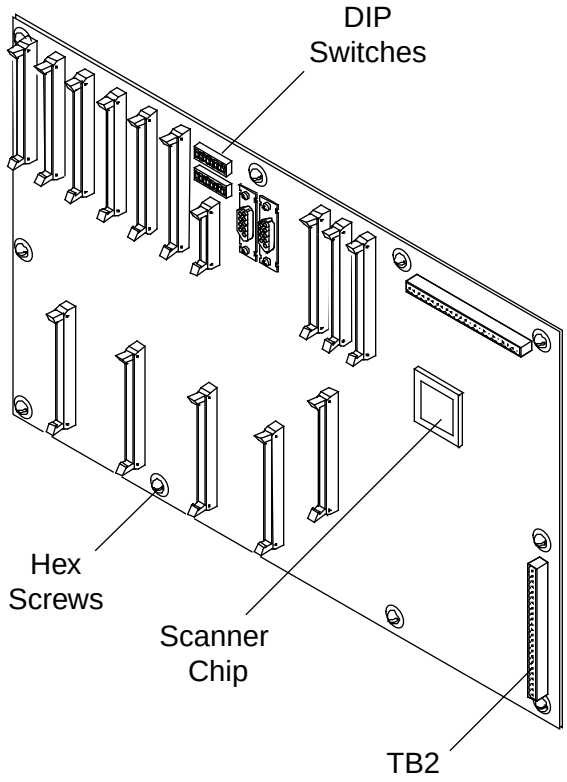
- 3/32-in. hex (allen) wrench
- Chip extractor (if necessary)

CAUTION
Observe all ESD precautions. Failure to do so could result in damage to the equipment.

MMS Board Removal:

1. Open the front door and press the STOP button.
2. Open the main circuit breaker, CB1.
3. Open the WACS access panel.

Figure 47. WACS MMS Board



4. Remove the power connector at TB2 of the MMS board. Refer to Figure 47.

5. Remove the remaining cable connectors on the board.

6. Use a 3/32-in. hex (allen) wrench to remove the hex screws and washers that secure the board to the power box.

7. Remove the MMS board and place it on an ESD-protected work surface.

8. If necessary, carefully remove the scanner chips from the defective board and insert them into the replacement board.

9. Set the positions of the DIP switches on S1 and S2 of the replacement MMS board to match the positions on the defective board.

MMS Board Installation

1. Position the new board and secure it to the power box using the hex screws and washers that you removed previously.

2. Reconnect all cables to the MMS board.
3. Reconnect the power connector at TB2.
4. Close circuit breaker CB1.
5. Verify the operation of the replacement MMS board.
6. Close the WACS access panel and front door.

FRP 25: WACS Switch or Display Board Replacement

The MMS switch board and the WACS display board can be performed with cabinet power on. If you replace the CCS switch board, power off the cabinet.

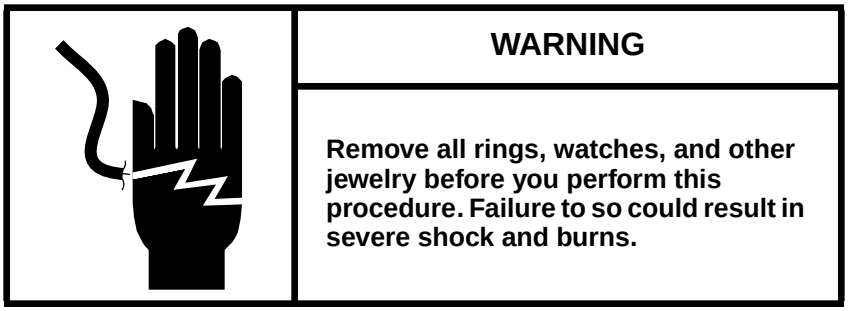
Part Number

- 15235200 (WACS display)
- 31483102 (CCS switch board printed circuit board)
- 31483112 (MMS switch board printed circuit board)

Tools Required

- Metric socket set

CAUTION
Observe all ESD precautions. Failure to do so could result in damage to the equipment.



WARNING

Remove all rings, watches, and other jewelry before you perform this procedure. Failure to so could result in severe shock and burns.

Board Removal

1. Open the front door of the LC cabinet.
2. Open the WACS access panel for access to the circuit board and cable connector.
3. Use a 7-mm socket to remove the 8 nuts and washers that secure the switch and display board cover.

Figure 48. WACS Access Panel - Rear View

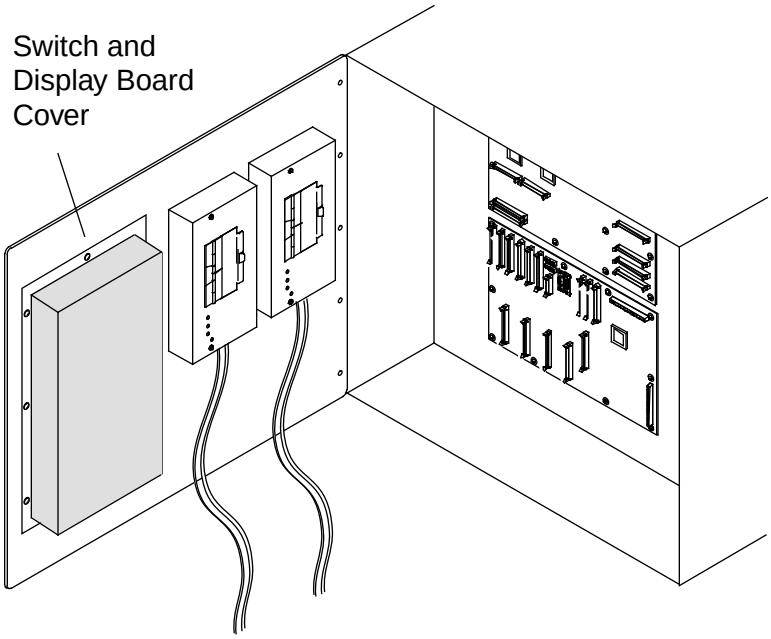
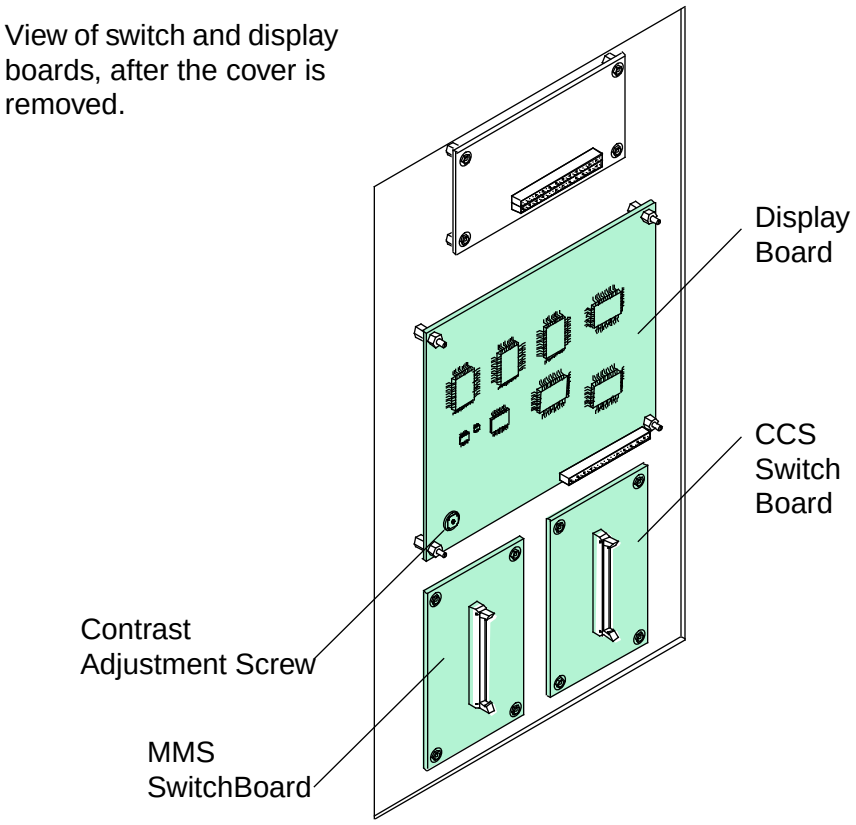


Figure 49. WACS Display and Switch Boards



4. Remove the cable from the defective circuit board.

5. Using a 6-mm socket, remove the 4 or 6 washers and nuts that hold the circuit board in place.

Board Installation

1. Position the new board and secure it with the same hardware that you removed in Step 5.

2. Reattach the cable to the circuit board.

NOTE: If you replaced the display board, before you replace the cover on the WACS access panel, power on the cabinet to verify the contrast of the WACS display. The contrast adjustment screw is shown in Figure 49.

3. Replace the cover using the washers and nuts that you removed previously.

4. If you replaced the CCS switch board, power on the cabinet and press the START switch.

5. Close the access panel and front door.

6. Return the system to operation.

FRP 26: Margin Switch Board Replacement

Perform this procedure with cabinet power off.

Part Number

- 13287900 (margin control printed circuit board assembly)

Tools Required

- Metric socket set

CAUTION

Observe all ESD precautions. Failure to do so could result in damage to the equipment.

WARNING

Remove all rings, watches, and other jewelry before you perform this procedure. Failure to so could result in severe shock and burns.

Board Removal

1. Open the front door of the LC cabinet.
2. Press the STOP button and open circuit breaker CB1.
3. Open the WACS access panel for access to the circuit board and cable connector.
4. Use a 7-mm socket to remove the 8 nuts and washers that secure the switch and display board cover.
5. Remove the cable from the circuit board; refer to Figure 50.

6. From the front side of the access panel, use an 8-mm deep-well socket and remove the nuts and washers from the margin/clock/boundary scan switches.

7. Remove the margin switch board.

Board Installation

1. Position the new margin switch board.

2. Use an 8-mm deep-well socket and replace the hardware on the switch board.

3. Reconnect the cable to the circuit board.

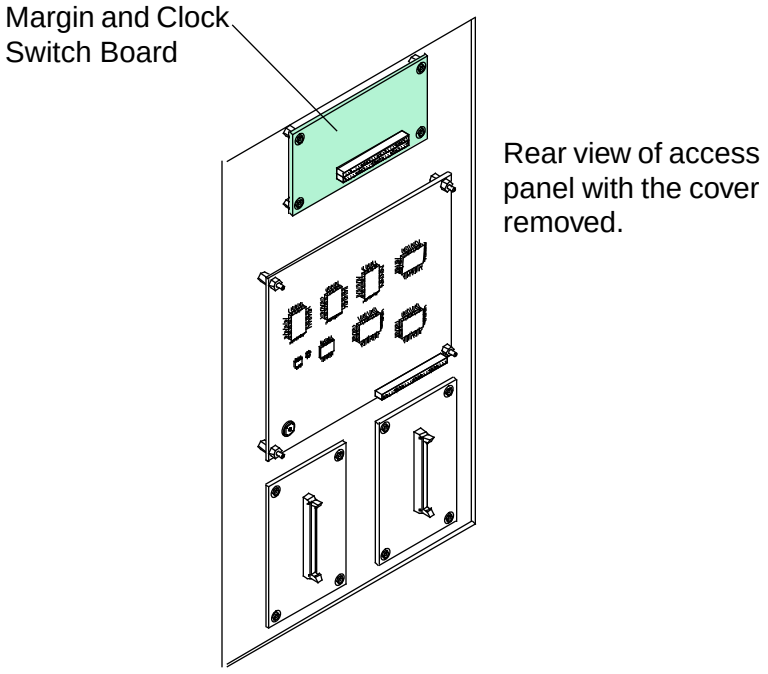
4. Replace the cover using the washers and nuts that you removed previously.

5. Close circuit breaker CB1 and press the START switch.

6. Close all panels and doors.

7. Return the system to operation.

Figure 50. Margin Switch Board



FRP 27: Interconnect Board Replacement

This procedure is performed with cabinet power off.

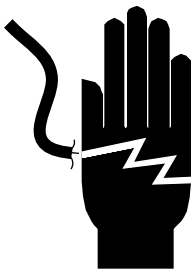
Part Number

- 31511100 (interlock printed circuit board)

Tools Required

- 3/32-in. hex (allen) wrench
- Slotted screwdriver

CAUTION
Observe all ESD precautions. Failure to do so could result in damage to the equipment.



WARNING
Remove all rings, watches, and other jewelry before you perform this procedure. Failure to so could result in severe shock and burns.

Board Removal

1. Open the front door of the LC cabinet.
2. Press the STOP button and open circuit breaker CB1 to remove all power from the cabinet.
3. Open the side doors to provide access to the defective interconnect board.

   NOTE: This procedure requires that you work from both sides of the cabinet.

NOTE: It may be easier to remove enough power supplies on one side of the cabinet to provide comfortable access to the interconnect board.

4. Working from one side of the cabinet, disconnect the WACS control cables from the internal bulkhead and power supplies at the defective interconnect board. Refer to Figure 51.

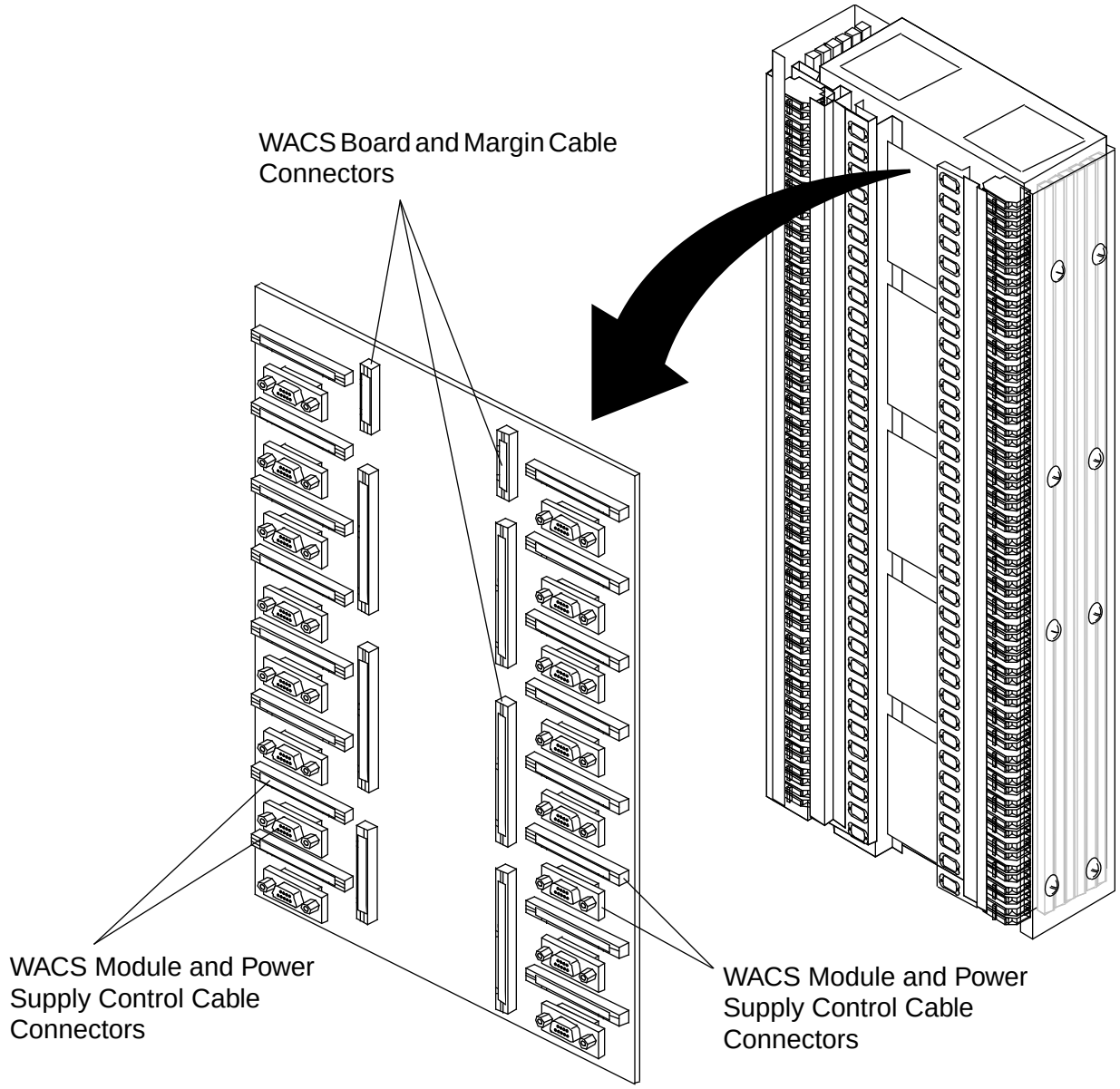
5. Repeat this step for the opposite side of the cabinet.

6. Remove the WACS board cable connectors that attach to the center portion of the interconnect board.

7. Remove the margin cables from the interconnect board.

8. Remove the ten 3/32-in. hex screws that secure the board to the power box.

Figure 51. Interconnect Board



Board Installation

1. Position the new board on the power box and secure it using the ten 3/32-in. screws.
2. Reconnect the margin cables and the WACS board cables.
3. Reconnect the module and power supply control cables.

4. Table 7 shows the cable connection locations.

Table 7. Interconnect Board Locator

					Y-Side		Z Side	
A36	A37	A38	A39	A40	Power Supply Control Cable	WACS Control Cable	Power Supply Control Cable	WACS Control Cable
Module Slot								
1	9	17	25	33	J1	J2	J3	J4
2	10	18	26	34	J5	J6	J7	J8
3	11	19	27	35	J9	J10	J11	J12
4	12	20	28		J13	J14	J15	J16
5	13	21	29		J17	J18	J19	J20
6	14	22	30		J21	J22	J23	J24
7	15	23	31		J25	J26	J27	J28
8	16	24	32		J29	J30	J31	J23

NOTE: Module slot 18, the clock module, only uses one power supply, which is located on the Z side of the cabinet.

5. Replace any power supplies that you removed.
6. Reconnect any coolant hoses and power cords that you disconnected earlier.
7. Close circuit breaker CB1 and press the START button.
8. Check the WACS display for proper WACS page information.
9. Return the cabinet to operation.
10. Close all cabinet doors.

FRP 28: Smoke Detector Replacement

Part Number

- 01665600 (smoke detector)

Tools Required

- Phillips screwdriver
- Slotted screwdriver

Smoke Detector Removal

1. Open the front door and press the STOP button.
2. Open circuit breaker CB2.
3. Remove the cabinet panels to expose the wiremat area; refer to FRP 1.
4. Remove the center and top wiremat access panels.

   NOTE: Depending upon the number of PEMs installed, the smoke detector can be reached from the module cage area.

5. Remove the defective smoke detector from its mounting bracket by turning the smoke detector counterclockwise and pulling straight down, refer to Figure 52.
6. Disconnect the 4 wires and record the wire locations to ensure proper connection during replacement.

Smoke Detector Installation

1. Reconnect the smoke detector wires to the correct locations.
2. Install the smoke detector on the mounting bracket by lining up the arrows on the smoke detector with the arrows on the mounting bracket and turning the smoke detector clockwise until it clicks in place.
3. Close circuit breaker CB2.

4. Verify that the smoke detector is functioning properly; check the WACS display:

   a. Use a thin tool similar to a toothpick and insert the tool into the test hole on the smoke detector.

   b. Monitor the WACS display for an alarm, fault, and power-off of the cabinet.

   c. Reset circuit breaker CB1.

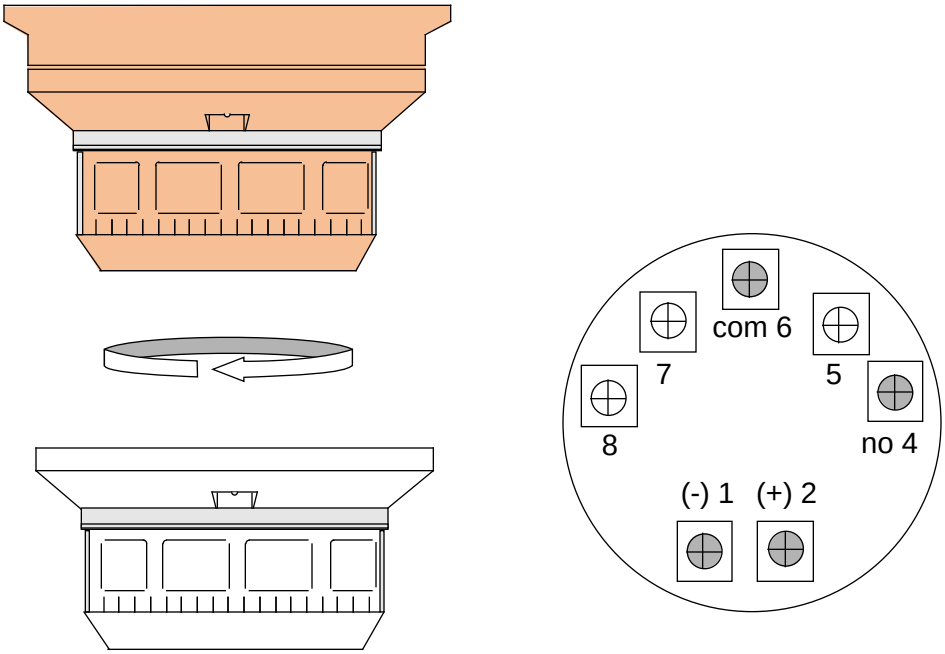
5. Replace all access wiremat panels.

6. Replace all cabinet panels.

7. Press the START button and return the system to operation.

8. Close all cabinet doors.

Figure 52. Smoke Detector



FRP 29: Dewpoint Monitor Replacement

Part Number

- 01766300 (dewpoint monitor)

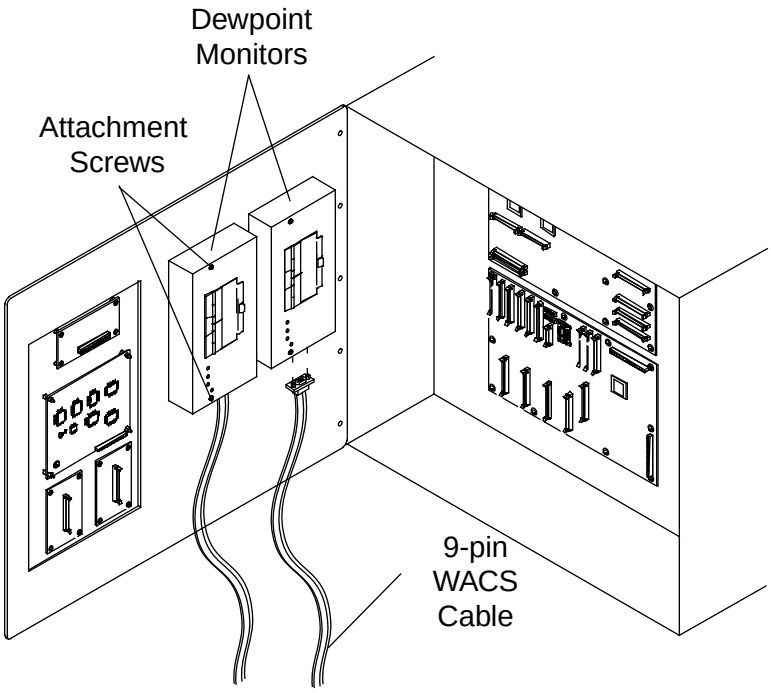
Tools Required

- Slotted screwdriver
- Phillips screwdriver

Dewpoint Monitor Removal

1. Open the cabinet front door and press the STOP button.
2. Open circuit breaker CB2.
3. Open the WACS access panel to expose the failed dewpoint monitor.

Figure 53. Dewpoint Monitors



4. Remove the 9-pin WACS cable from the defective dewpoint monitor.

5. Remove the 2 screws and lock washers that attach the defective dewpoint monitor to the WACS access panel. The screws are located on the front of the access panel.

Dewpoint Monitor Installation

1. Attach the new dewpoint monitor to the WACS access panel using the 2 screws and lock washers.
2. Connect the 9-pin WACS cable.
3. Close circuit breaker CB2.
4. If the Valid Data LED is on, no maintenance is required; proceed to Step 6.
5. If the Clean Mirror LED is on, perform the dewpoint cleaning procedure.
6. Press the START button.
7. Close the WACS access panel and the cabinet front door.

FRP 30: Alarm Horn Replacement

Part Number

- 01129701 (alarm horn)

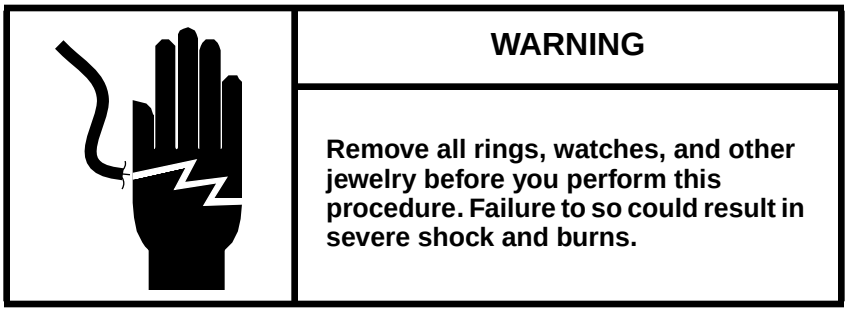
Tools Required

- Phillips screwdriver

Horn Removal

1. Open the front door and press the STOP button.
2. Open circuit breaker CB1.

CAUTION
Observe all ESD precautions. Failure to do so could result in damage to the equipment.



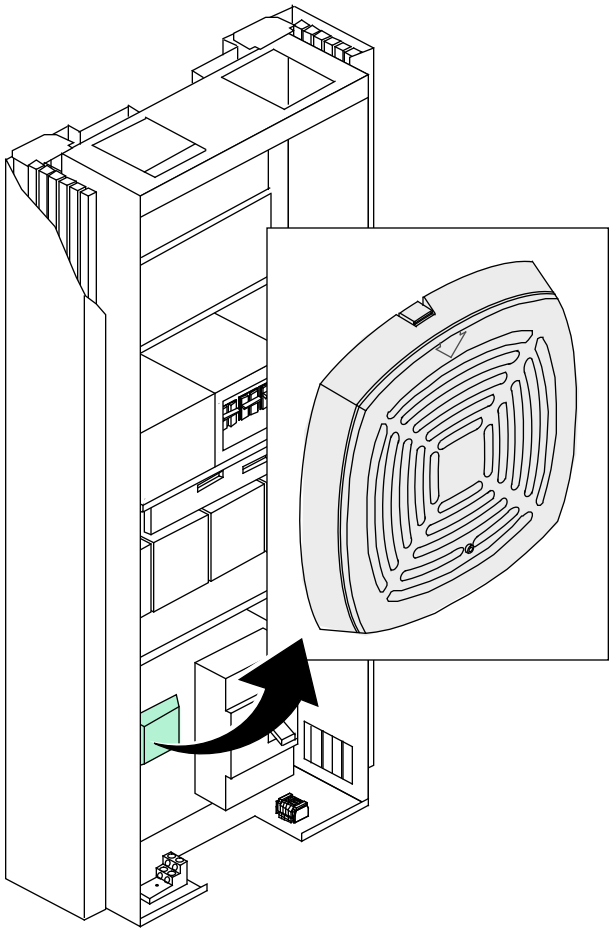
WARNING
Remove all rings, watches, and other jewelry before you perform this procedure. Failure to so could result in severe shock and burns.

3. Remove the power box access cover (28 1/4-turn zeus fasteners).
4. Use a Phillips screwdriver to remove the screw that holds the horn on the mounting bracket (the screw is located on the bottom side of the horn).
5. Remove the defective horn by holding it on both sides and pulling it toward you.

Horn Installation

1. Position the new horn and slide it in place.
2. Secure the horn in place with the Phillips screw.
3. Replace the power box access panel.
4. Close all circuit breakers.
5. Press the START button and return the system to operation.

Figure 54. LC Cabinet Alarm Horn



FRP 31: Manifold Quick-disconnect (QD) Fitting Replacement

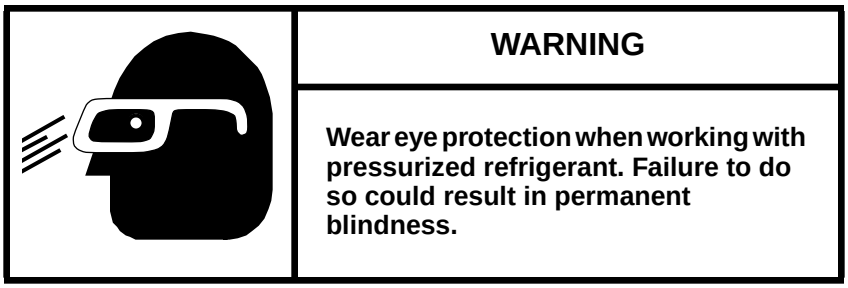
A high module temperature or module power supply temperature could indicate poor dielectric-coolant flow, which may be caused by a defective QD fitting on the manifold.

Part Number

- 15126900 (coupling, quick disconnect)

Tools Required

- Adjustable wrench
- Coolant pump (if necessary)
- Empty coolant barrel (if necessary)



Draining the Manifold and Removing a Defective QD Fitting

1. Open the front door and press the STOP button. If a second module cabinet connects to the HEU, power down the second cabinet.

NOTE: Because one HEU can supply coolant to two LC cabinets, it is necessary to power down the second LC cabinet.

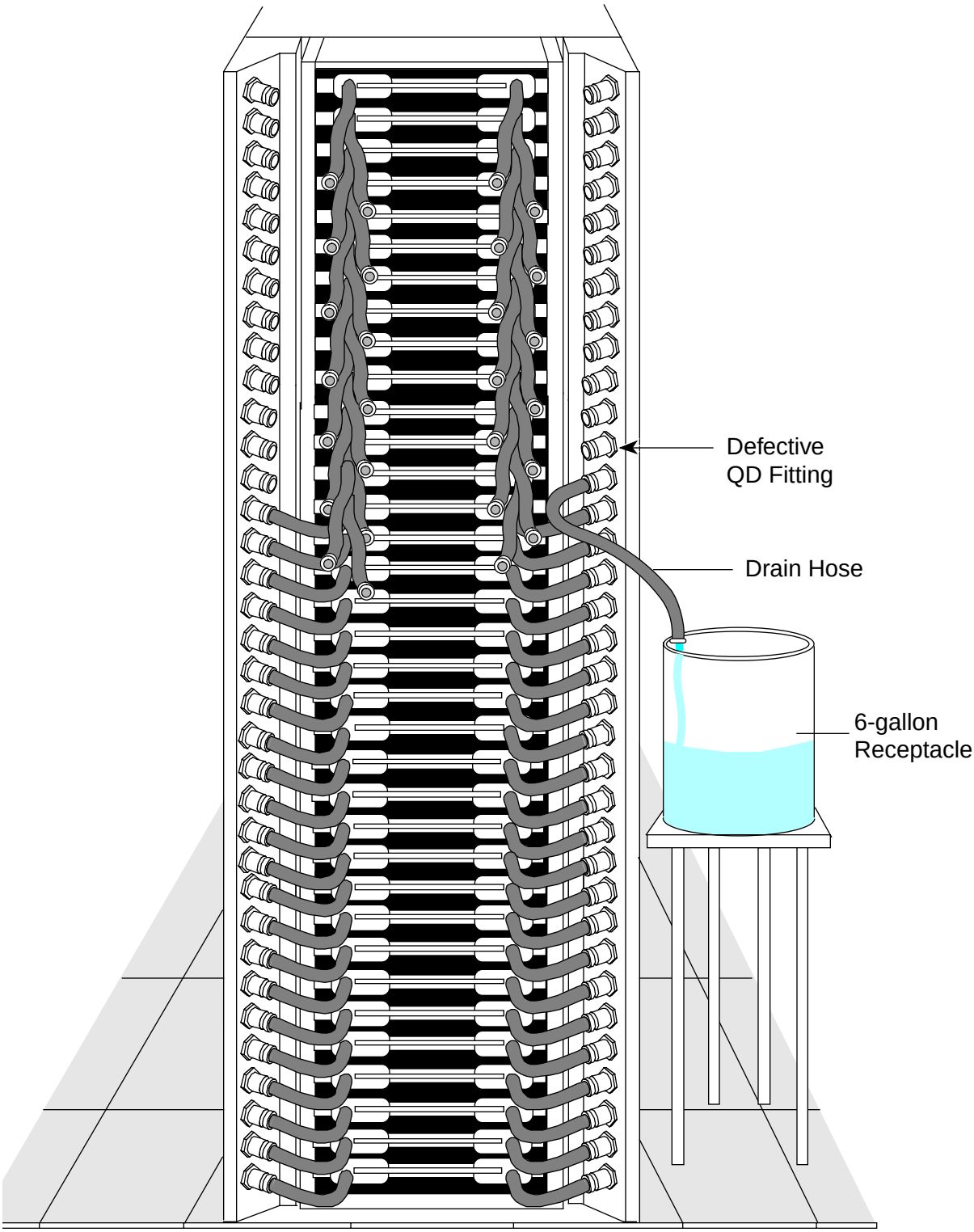
2. Open the main circuit breaker CB 1 on the LC cabinet(s).

3. Disconnect all module hose couplings and module power supply hose couplings on all 4 manifolds above the defective QD fitting.

4. Disconnect the coolant hoses for the effected module or power supply.

5. In addition, disconnect the first module and module power supply hoses below the defective QD fitting. Refer to Figure 55.

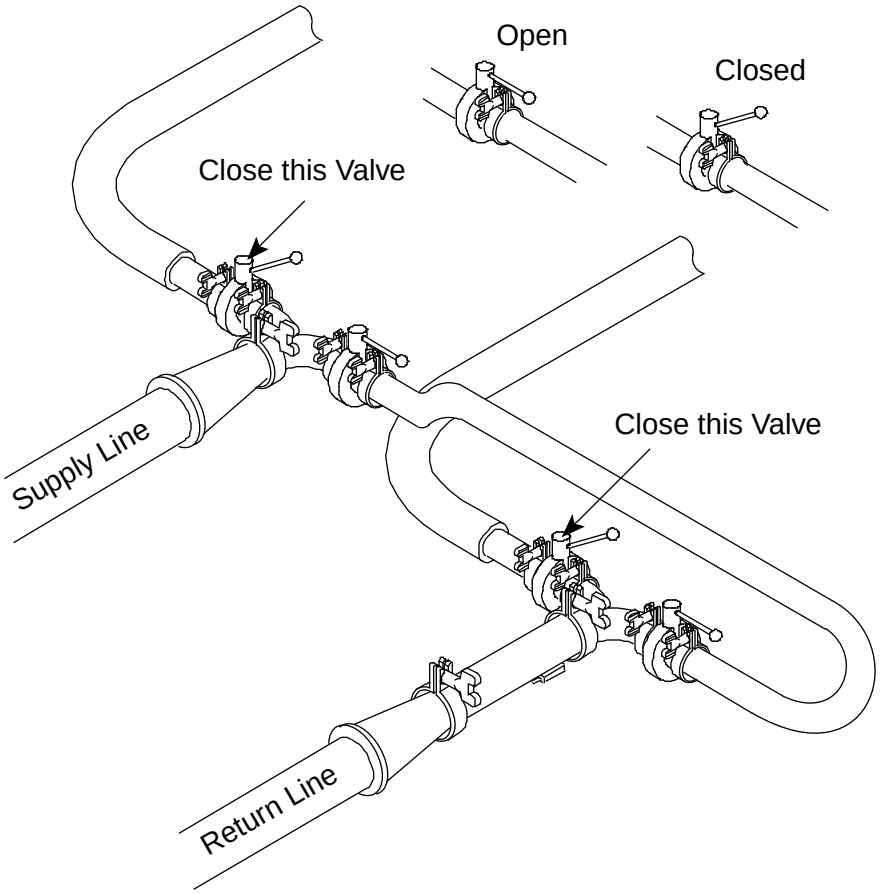
Figure 55. Module Hose Couplings



6. Close the inlet and outlet dielectric coolant shutoff valves for the chassis by turning the valve handle perpendicular to the line run. Refer to Figure 56.

NOTE: The shutoff valves are located under the computer room floor in front of the HEU cabinet.

Figure 56. Inlet and Outlet Valve Locations



Use a clean receptacle for draining and saving the dielectric coolant from the manifolds.

NOTE: Based on the location of the defective QD fitting, you may need a coolant pump and empty coolant barrel.

7. Drain the manifolds using the following steps while referring to Figure 55:

   a. Place the open end of a spare module drain hose into the clean receptacle.

b. Attach the female coupling of the hose assembly to the QD coupling immediately below the coupling you are replacing on the manifold.

c. Control the flow of dielectric coolant into the clean receptacle by removing and reattaching the spare module drain hose.

d. Drain the cabinet until coolant stops flowing out of the attached drain hose.

e. Disconnect the spare module hose.

8. Use an adjustable wrench to remove the defective QD fitting from the manifold.

Installing a QD Fitting and Filling the Manifold

NOTE: Two people are required to perform this procedure.

1. Ensure that the replacement fitting has an O-ring on the threaded end.
2. Screw the replacement fitting into the manifold.
3. Use an adjustable wrench to tighten the fitting.
4. Open the dielectric coolant valves that you closed in the removal process.
5. Fill the HEU storage reservoir tank with the dielectric coolant that you drained from the manifolds.

NOTE: During the following steps, add dielectric coolant to the reservoir tank as required.

6. Turn on the main circuit breaker CB 1.

NOTE: One person starts the HEU coolant pump by pressing the cooling bypass switch on the WACS panel. The second person controls the flow of coolant into the HEU reservoir.

7. Use the spare module hose to bleed off excess air at the top QD fitting for the manifold. Be ready to remove the bleeder hose when dielectric coolant starts to run from the hose.

NOTE: During this operation, keep the HEU reservoir at least half full.

8. When coolant flows from the bleeder hose, release the cooling bypass switch.

9. Reattach all the coolant hoses for the modules and power supplies.
10. Press the START button on the WACS panel.
11. Check the reservoir to ensure that the coolant is at the normal operating level.
12. Add dielectric coolant to the reservoir as necessary.
13. Monitor the module and module power supply temperatures for 10 minutes.

FRP 32: Coolant Hose Replacement

This procedure consists of two parts:

- Module coolant hose replacement
- Power supply coolant hose replacement

Part Number

- 15130303 (hose assembly, blue)
- 15130404 (hose assembly, red)
- 15145201 (hose assembly, grey)

Tools Required

- Open-end wrench set

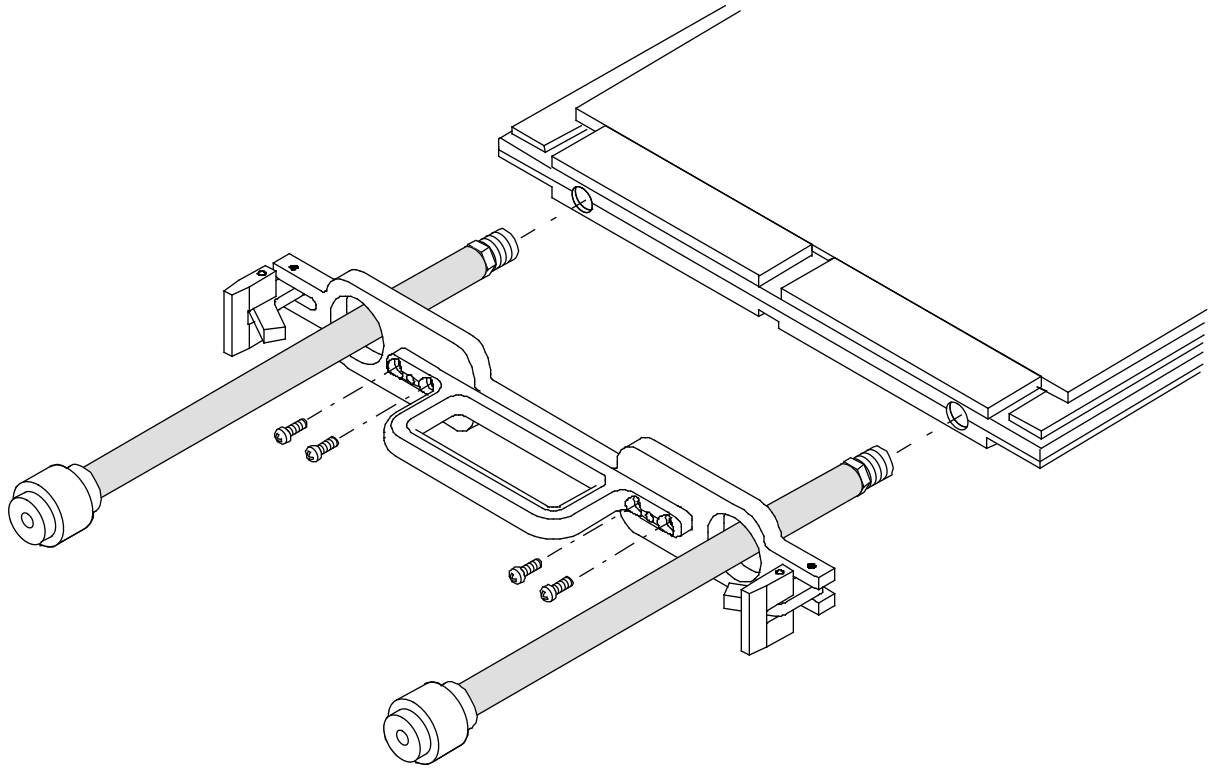
Module Hose Replacement

You can perform this procedure with the system running.

1. Power off the defective module by opening the module power supply circuit breakers.
2. Remove the module coolant hoses from the manifold; remove the **supply** hose first from the blue manifold.
3. Uncam the module.
4. Remove the module and place it on an ESD protected work surface.
5. Use a hex (allen) wrench to remove the 4 screws that secure the module handle to the module. Refer to Figure 57.
6. Slide the module handle away from the cold plate.
7. Use an open-end wrench to remove the defective coolant hose from the cold plate.
8. Remove the coolant hose by sliding it through the handle opening.
9. Slide the replacement hose through the handle opening and screw it into the cold plate. Tighten the nut using the open-end wrench.

10. Replace the module handle that you removed earlier.
11. Install the module in the cabinet.
12. Attach the coolant hoses to the manifolds; attach the **return** hose first to the red manifold.
13. Check for leaks.
14. Close the module power supply circuit breakers.
15. Press the START button on the WACS panel.

Figure 57. Coolant Hose Removal



Power Supply Coolant Hose

1. Power off the defective power supply by opening the module power supply circuit breakers.
2. Remove the power supply power cord.

3. Remove the coolant hoses from the manifolds; remove the **supply** hose first from the blue manifold.

4. Use an open-end wrench to loosen the coupling assembly that holds the hose to the cold plate. Refer to Figure 58.

   NOTE: It may be necessary to remove the power supply to access the hose fitting.

5. Position the new hose and thread the nut into the cold plate.

6. Use an open-end wrench to tighten the coolant hose to the cold plate.

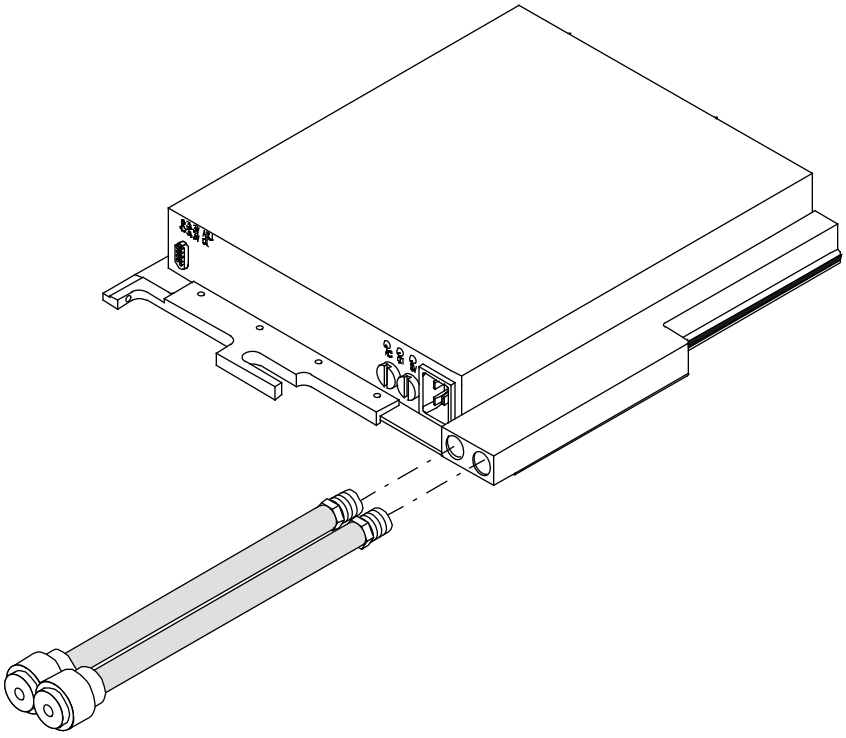
7. Attach the coolant hoses to the manifolds; attach the **return** line first to the red manifold.

8. Check for leaks.

9. Replace the power cord and close the power supply circuit breakers.

10. Press the START button on the WACS panel.

Figure 58. Power Supply Hose Replacement



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