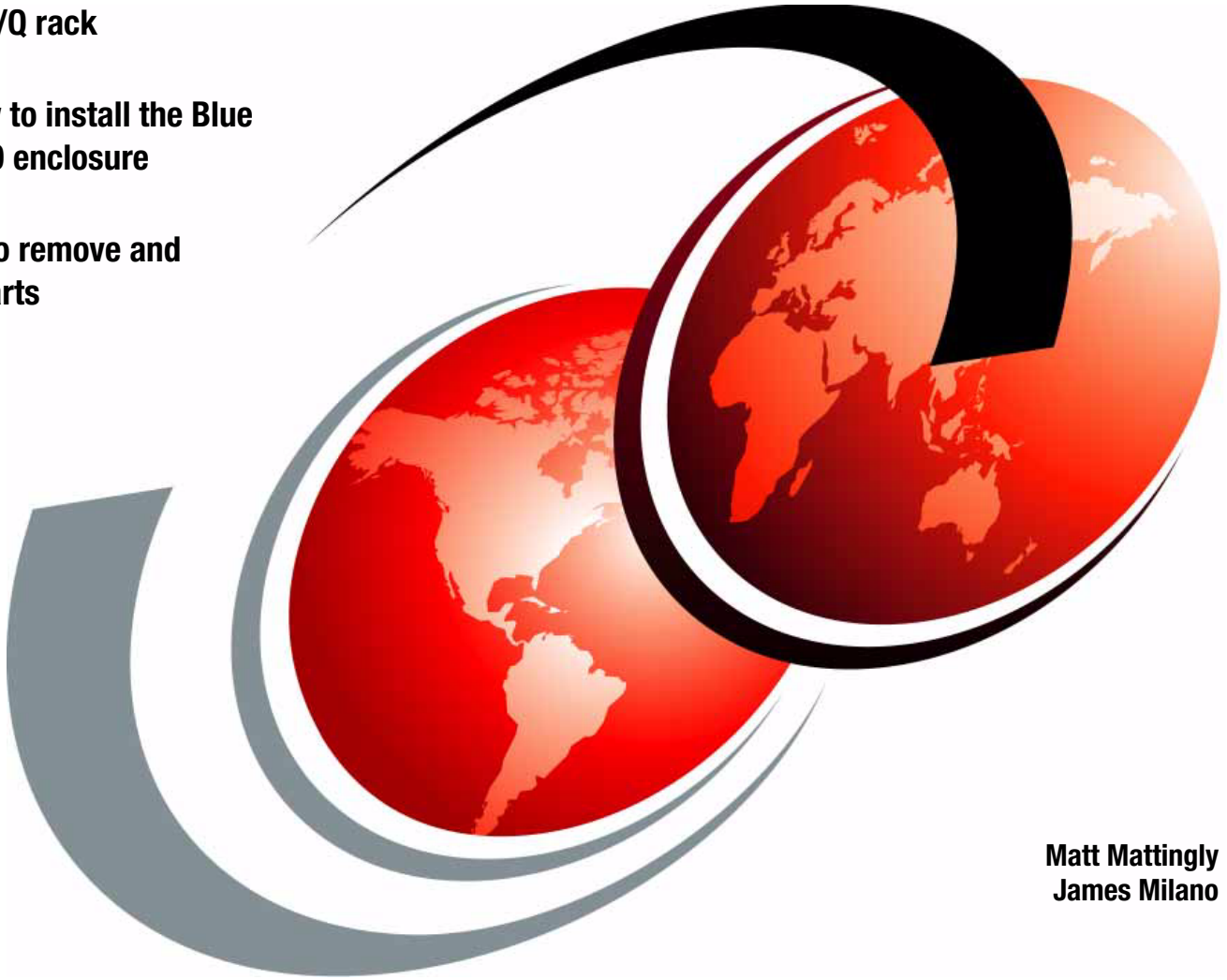
IBM

IBM System Blue Gene Solution: Blue Gene/Q Hardware Installation and Maintenance Guide

- Learn how to install the Blue Gene/Q rack
- Learn how to install the Blue Gene/Q I/O enclosure
- See how to remove and replace parts



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International Technical Support Organization

IBM System Blue Gene Solution: Blue Gene/Q Hardware Installation and Maintenance Guide

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Note: Before using this information and the product it supports, read the information in “Notices” on page xiii.

First Edition (May 2013)

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Preface

This document is one of a series of IBM® Redbooks® written specifically for the IBM Blue Gene/Q® system. The Blue Gene/Q system is the third generation of massively parallel supercomputers from IBM in the Blue Gene® series. This document explains how to install the Blue Gene/Q rack and the Blue Gene/Q I/O enclosure. It shows you how to remove and replace parts.

The team who wrote this book

This book was produced by a team of specialists from around the world working at the International Technical Support Organization, Poughkeepsie Center.

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1

Installing Blue Gene/Q racks

This chapter describes the preparation and installation procedures for Blue Gene/Q racks.

Important: Review the *IBM System Blue Gene Solution: Blue Gene/Q Safety Considerations*, REDP-4656 Redbooks publication before installing or servicing the system.

Whenever a caution or danger notice is displayed, consult *IBM System Blue Gene Solution: Blue Gene/Q Safety Considerations*, REDP-4656 Redbooks publication in the appropriate translated language.

The Blue Gene/Q covers must be closed and locked after service to protect the customer from encountering or accessing hazardous energy inside the covers.

This chapter contains the following sections:

- Unpacking a Blue Gene/Q rack
- Preparing a Blue Gene/Q rack for installation
- Positioning Blue Gene/Q racks
- Installing the BPMs
- Connecting Blue Gene/Q coolant hoses to the facility coolant loop
- Cabling the Blue Gene/Q rack
- Installing the covers
- Updating the coolant monitor firmware
- Saving the coolant monitor calibration data
- Recovering a compute rack from a shutdown caused by the coolant monitor

1.1 Unpacking a Blue Gene/Q rack

To unpack the Blue Gene/Q rack, perform the following procedure:

1. Open the crate.
2. Using the ramp that is provided, roll the Blue Gene/Q rack out of the crate.

> **CAUTION:**
> The Blue Gene/Q rack is heavy. Be careful when moving it.
>
> See the *IBM System Blue Gene Solution: Blue Gene/Q Safety Considerations*, REDP-4656 Redbooks publication.

3. Remove the two orange bulk power module (BPM) shipping brackets and the silver I/O enclosure shipping bracket. See Figure 1-1 on page 3.

> **Important:** The customer must be advised to retain all shipping and packaging materials for the Blue Gene/Q product for use in potential future relocations. Shipping brackets and other material associated with the original shipment must also be retained.
>
> If not retained by the customer for future relocations, the customer might need to purchase replacement shipping and packaging materials, shipping brackets, and other material from IBM (if available). This material might not be available from IBM. Alternatively, the customer might need to have custom shipping and packaging materials constructed on site, at the customer's expense. If the required shipping brackets are not available, components might need to be removed from the rack for shipping. The customer might need to purchase additional custom packaging materials for those components.

Figure 1-1 Blue Gene/Q shipping bracket placement

4. Push all of the BPMs in until they latch.
5. Remove the two orange shipping brackets on the back of each I/O drawer. There is one bracket on each side. See Figure 1-2 on page 4.

Attention: Retain all the shipping brackets and all related hardware (nuts, bolts, washers, and other related parts). These parts might be required to protect the system if the rack is moved.

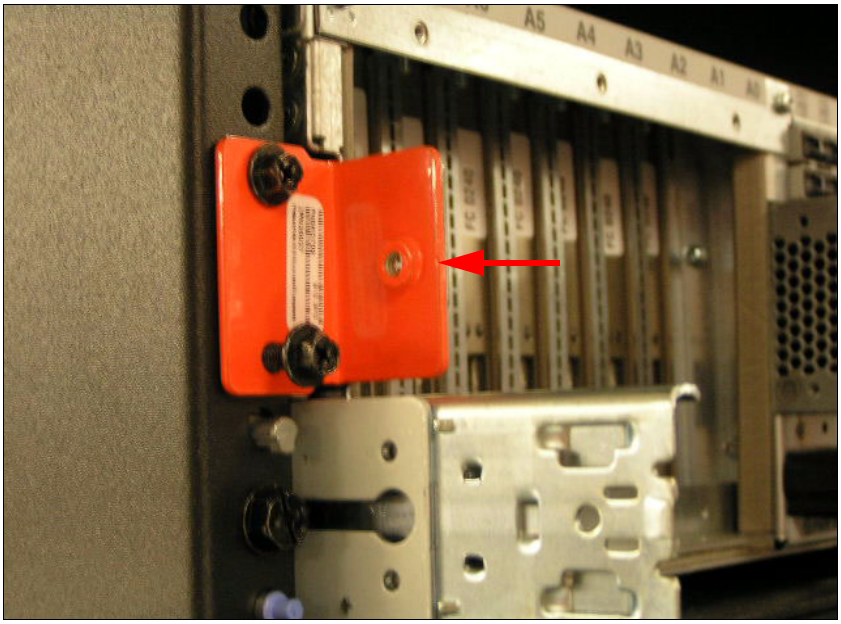


Figure 1-2 I/O drawer shipping bracket placement

6. Install the I/O drawer interlock bracket where one of the orange shipping brackets was on the I/O drawer. See Figure 2-6 on page 50.

1.2 Preparing a Blue Gene/Q rack for installation

When the Blue Gene/Q rack is shipped, the bulk power enclosures (BPEs), clock card, side panels, and some brackets are not installed. These items must be installed at this time.

Perform the following procedures to prepare the Blue Gene/Q rack for installation:

- 1.2.1, “Installing door brackets” on page 5
- 1.2.2, “Inspecting the manifold” on page 6
- 1.2.3, “Installing the bulk power right side brackets” on page 8
- 1.2.4, “Installing the bulk power enclosures” on page 11
- 1.2.5, “Connecting the BPE environmental cables” on page 12
- 1.2.6, “Installing a clock card” on page 14

1.2.1 Installing door brackets

Perform the following procedure to install the door brackets for a Blue Gene/Q rack.

Install the two right side and the two left side door brackets with two screws (part number 97P5047) on each bracket. See Figure 1-3.

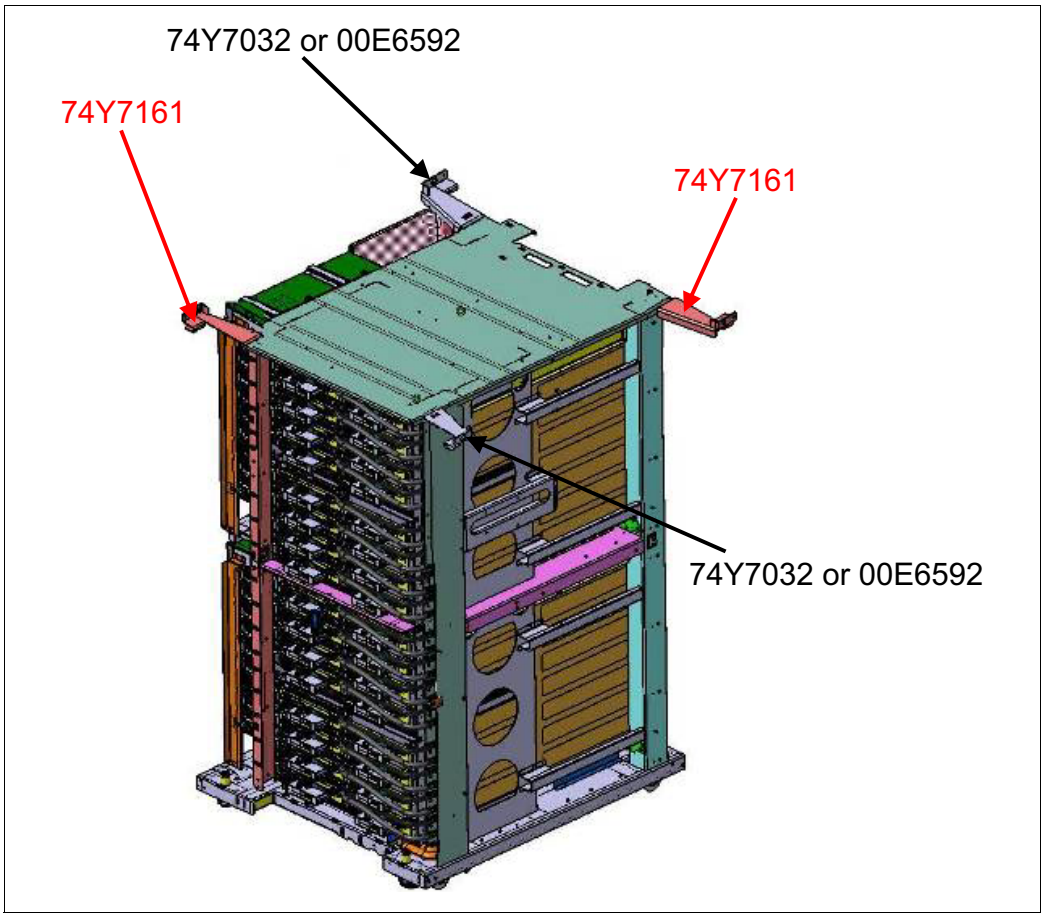


Figure 1-3 Door bracket installation

1.2.2 Inspecting the manifold

Inspect the gray solenoid valve on the manifold (see Figure 1-4) for the correct position. Verify that it is in the “out” position. See Figure 1-5.

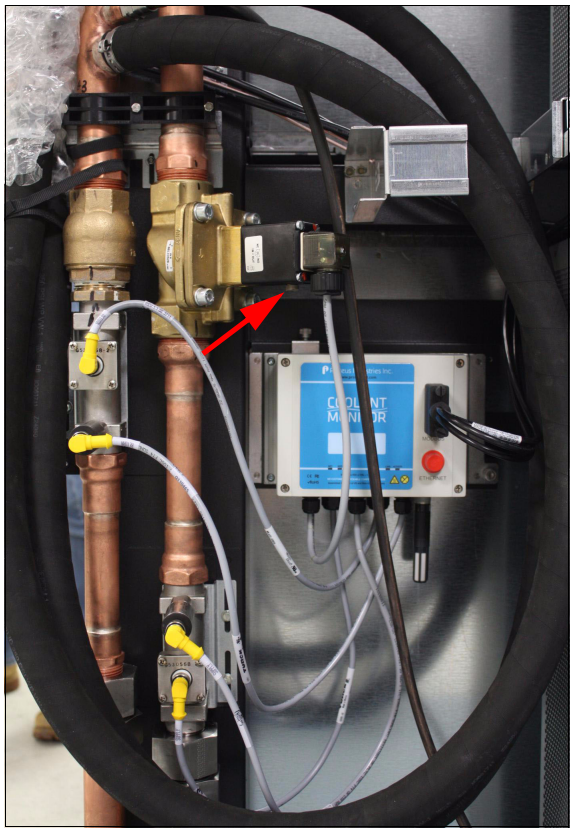


Figure 1-4 Coolant monitor gray solenoid valve location[1]

Figure 1-5 shows the gray solenoid valve in the correct “out” position.

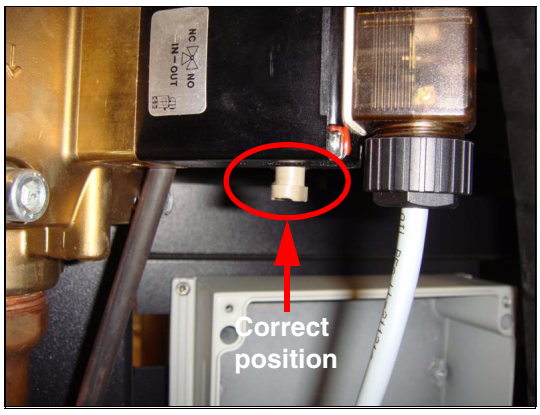


Figure 1-5 Gray solenoid valve in the correct “out” position[2]

[1] Image source: Courtesy of Proteus Industries
[2] Image source: Courtesy of Proteus Industries

Figure 1-6 shows the gray solenoid valve in the incorrect “in” position.

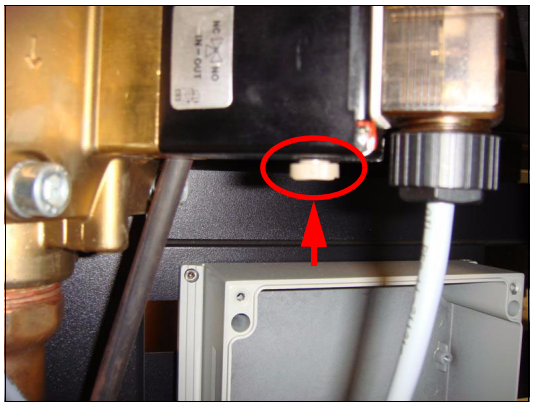


Figure 1-6 Gray solenoid valve in the “in” position[3]

Attention:
The solenoid valve must be in the correct position. If it is closed, the valve prevents the coolant from flowing through the rack. If the valve is left in the closed, or “in”, position, damage to the system occurs. To change the solenoid valve position from the closed to open ("out") position, rotate the valve 1/4 turn. The valve drops into the open position.

Check that the screw collar on the ambient air temperature and humidity sensor is tight. If it is loose, tighten it with your hand.

Check that the pressure sensors and flow sensors are not loose. That is, check that you cannot move them with your hand. If they are loose, tighten them with a 21 mm open-ended wrench (or a crescent wrench) to tighten the sensor and another wrench to secure the reducing fitting to ensure that it does not spin.

Check that the cables to each of the four sensors are tight. Tighten any cables that are loose with your hand. See Figure 4-36 on page 105 for information about the component locations.

[3] Image source: Courtesy of Proteus Industries

1.2.3 Installing the bulk power right side brackets

There are three side brackets that must be installed before installing the BPEs: the lower, middle, and top brackets. Perform the following steps to install them:

1. Starting with the bottom shelf (part number 00E5661), align the 10 screw holes and insert the screws (part number 97P5047) required to secure the shelf to the frame. See Figure 1-7.

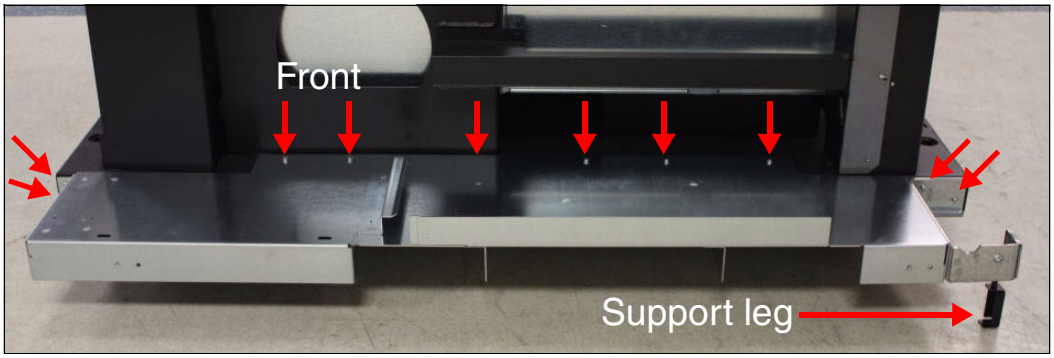


Figure 1-7 Bottom side BPE shelf with screw locations

Attention: Install the support leg (part number 00E5691) and screw (part number 46K4287) after the rack is positioned. See Figure 1-7.

Be careful not to damage the part. The leg must be adjusted for optimal support. The support strengthens the side structure because the door hinge brackets are mounted onto this shelf.

2. Align the middle shelf (part number 00J0429) with the screw holes. Insert the seven screws (part number 97P5047). A socket extension is required to reach the screws. See Figure 1-8 for screw locations.

Figure 1-8 Middle side BPE shelf with screw locations

3. Install the upper shelf (part number 00J0428) and use two screws (part number 97P5047) to secure it. See Figure 1-9.

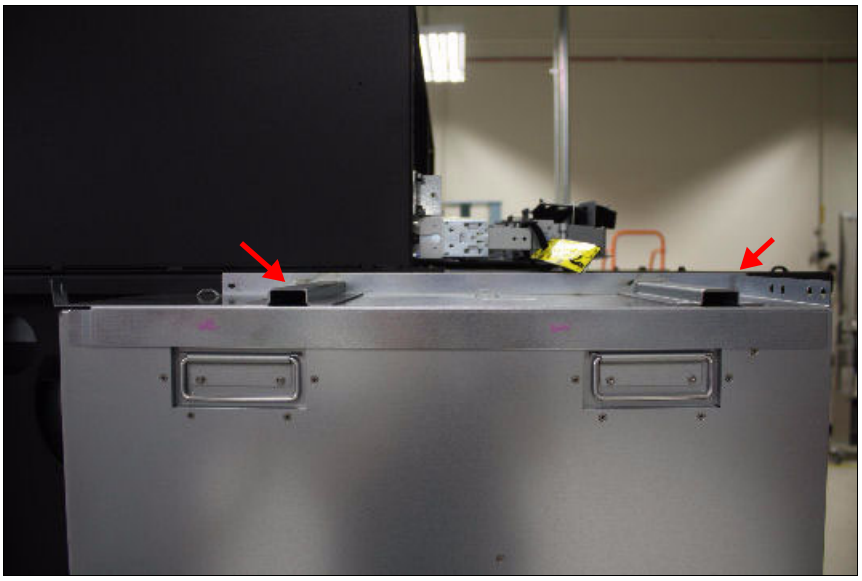


Figure 1-9 Top side BPE shelf with screw locations

4. Align the black frame support (part number 46K5764) with the six screw holes on the upper half of the front edge of the frame. See Figure 1-10 for the screw hole locations.

Attention: Install the two screws at the left side of Figure 1-10 from the inside, front of the frame.

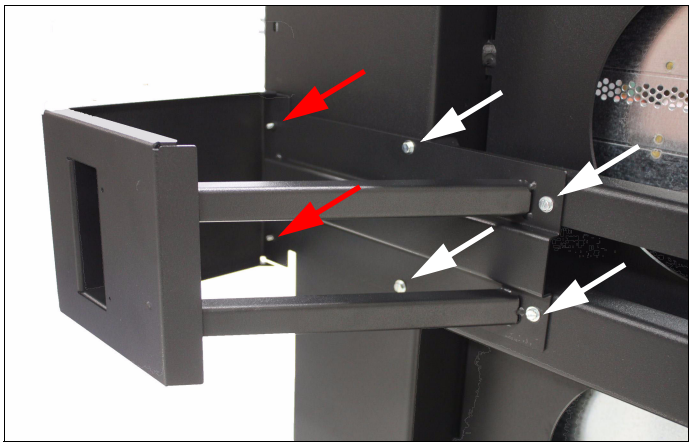


Figure 1-10 Part number 46K5764 with screw locations

5. Install the side panel (part number 00J0427). There are two retaining pins in the bottom of the side panel, which are inserted into slots in the bottom BPE shelf. Five screws secure this panel. Figure 1-11 shows screw and pin locations.

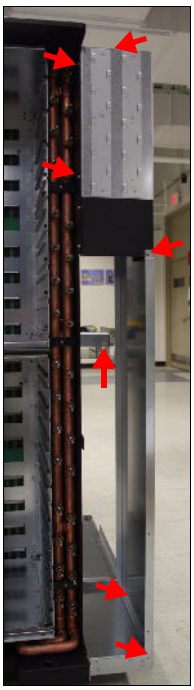


Figure 1-11 Side panel with screw and pin locations

6. Install the cable support cover (part number 46K5472). There are seven screws to secure the cable support cover. See Figure 1-12 for information about where to place the screws.

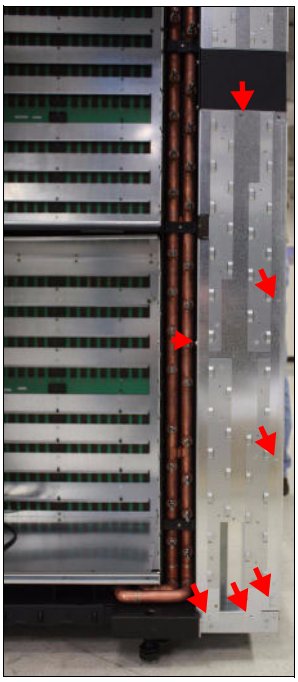


Figure 1-12 Cable support cover with screw locations

1.2.4 Installing the bulk power enclosures

A compute rack bulk power enclosure (BPE) weighs approximately 66 lbs. and can be positioned at a height of 39 inches from the floor. Ensure proper handling methods and or equipment are used when removing or replacing a BPE.

Perform the following procedure to install the bulk power enclosures.

CAUTION:
The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)

1. Slide the BPEs into place in the shelves. Be sure that the connector for the power cable is at the bottom of the unit. See Figure 1-13.

Figure 1-13 Power lead connector on a BPE

2. Secure each BPE in place with four screws (part number 97P5047). The screw locations are shown in Figure 1-14.

Figure 1-14 BPE screw locations

1.2.5 Connecting the BPE environmental cables

Perform the following steps to connect the environmental cables:

1. Ensure that you have the correct cables. There are two 9-way D-type and two coaxial F-type connector cables coiled together in the middle of the frame. See Figure 1-15. One D-type connector and one coaxial F-type connector cable make an upper and lower BPE bundle.

   The coaxial F-type connector is used for BPE-to-BPE communications for each midplane for controlling the power ON/OFF function. The coaxial cables are thin, brown cables that are seated by using a threaded locking collar. Figure 1-15 shows the environmental cable bundle.

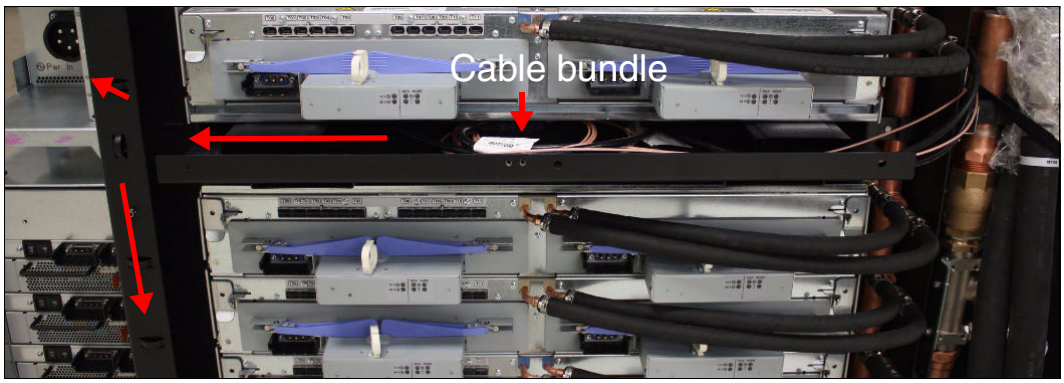


Figure 1-15 BPE environmental cable bundle

2. Route each bundle to the correct locations in the respective BPEs using the cable bundle tie-down areas. The cables are labeled TOP and BOTTOM to identify the BPE to which they must be connected.
3. Connect the F-type cable to the coaxial port, labeled PWR 0-PWR 17, and connect the D-type cable to the BPE CTRL port. The other ports (CLK/SERVICE PWR and COOLANT MON PWR) are not used at this time. Figure 1-16 shows the environmental cable connections.

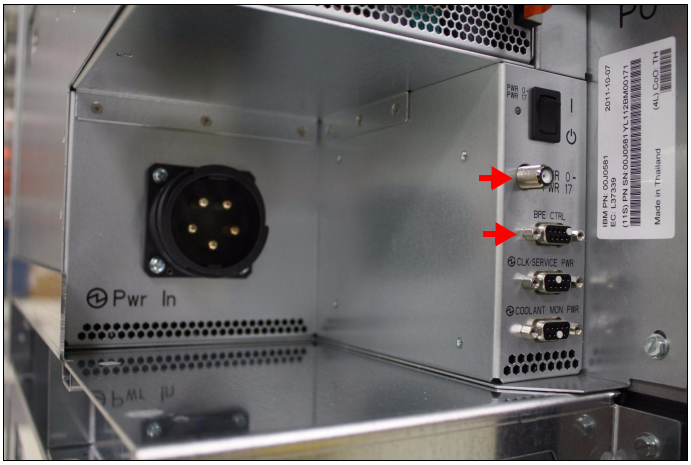


Figure 1-16 BPE environmental cable connections

Attention: The connectors on the BPE are keyed with a white plug. This keying ensures that the cable can be plugged only into the correct location.

1.2.6 Installing a clock card

To install a clock card:

1. Install the clock card in the bottom position when the cables are routed below the floor. Install it in the top position when the cables are routed overhead. See Figure 1-17.

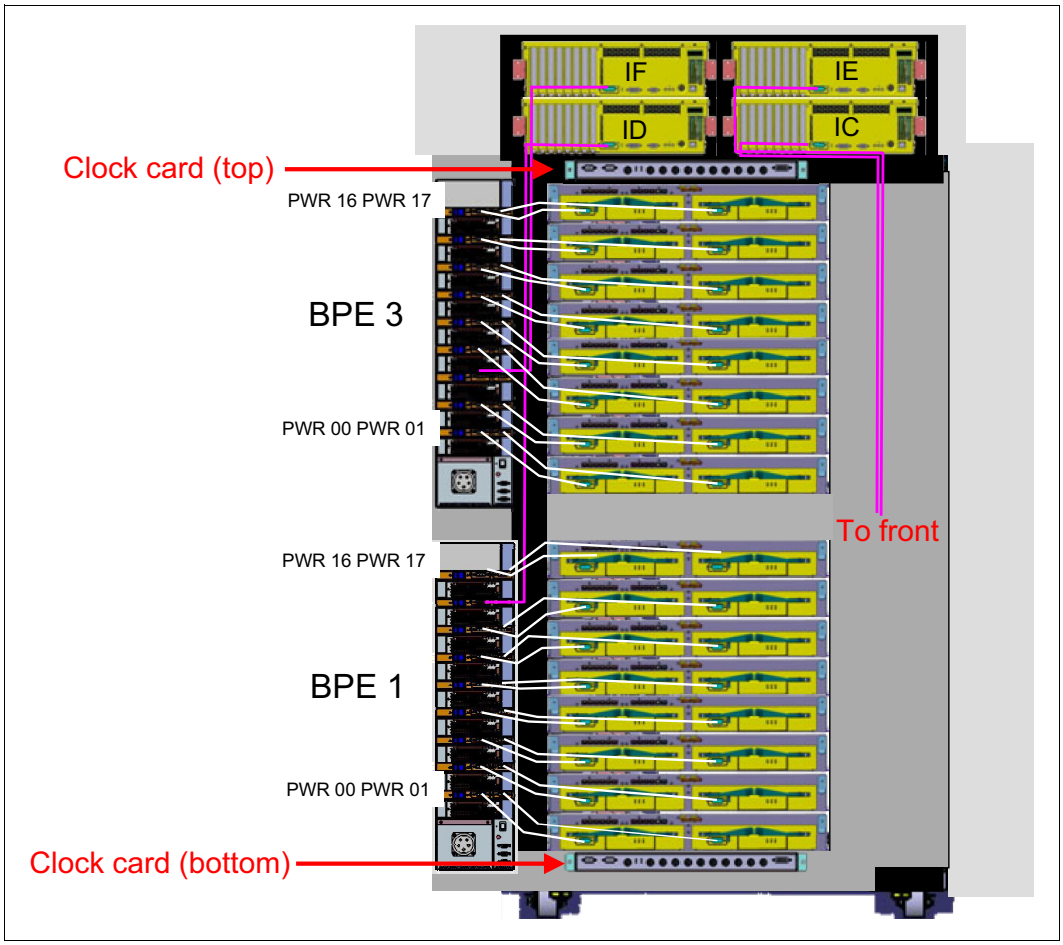


Figure 1-17 Clock card placement

2. Secure the clock card with one screw (PN 46C6380) on each side of the enclosure.

Do not connect the clock cables now. This task is explained in 1.6.4, “Connecting clock cables” on page 29.

1.3 Positioning Blue Gene/Q racks

Perform the following procedure to position a Blue Gene/Q rack:

CAUTION:

- Exercise caution when moving or rolling the compute rack or the I/O rack around raised floor cutouts and other obstructions.
- Ensure all four leveling feet for the compute and I/O rack are lowered after final positioning to prevent system from rolling on its casters.
- A compute rack can weigh up to 4757 pounds (lbs.). Exercise caution when transporting or moving the system, when repositioning the system, or when working on or around the system.
- The compute rack has four full swivel casters for mobility. Exercise caution when moving or repositioning the system, or when rolling up or down ramps.

1. Roll the rack into position on the room floor.

Attention: Push only on the black painted rack, which is structural. Do not push, step on, or use the BPE shelves as levers. These shelves are not structural and can bend.

Carefully feed the coolant hoses through the floor tile hole after positioning the rack.

2. Extend and tighten the rack leveler feet.

1.4 Installing the BPMs

Install nine BPMs into each BPE by sliding the BPM into the slot until the orange latch is latched. See Figure 1-18.

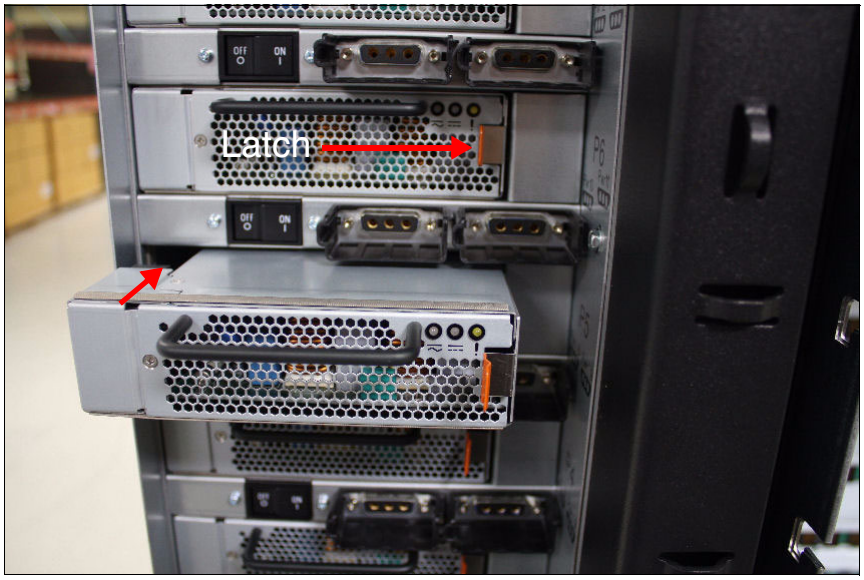


Figure 1-18 BPM installations and latch

1.5 Connecting Blue Gene/Q coolant hoses to the facility coolant loop

Perform the following steps to connect the coolant hoses to the facility coolant loop.

1. Remove the plastic cover and inspect the two o-rings (see the red arrows in Figure 1-19) on the supply and return coolant connectors. The outer o-ring is for protection only, and the inner o-ring is for the seal. Also perform this step for the facility coolant connectors.
2. Purge the 25 PSI of nitrogen from the supply and return rack coolant hose connectors by performing the following steps:

   Attention: Point the coolant hose connector away from you.

   a. Depress the pin on the connector and rotate the lever on the coolant hose connector slowly to release the pressure.
   b. Press the interlock pin and return the lever to the original position. The valves must be closed to connect the hoses.
   c. Repeat these steps on other coolant connector on the rack. Figure 1-19 shows the coolant hose connector.

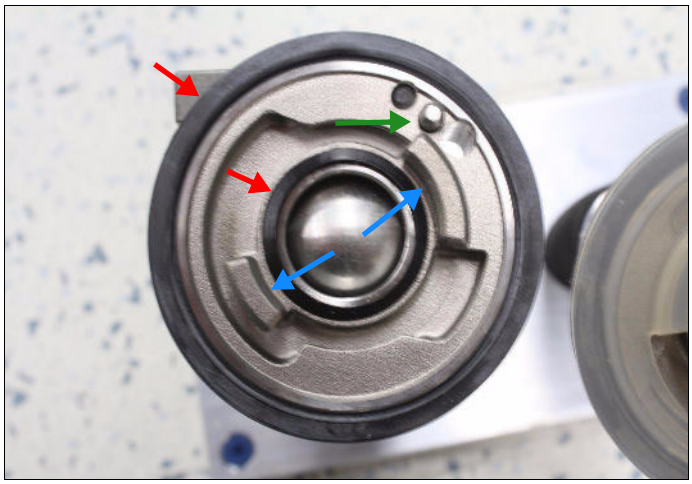


Figure 1-19 Coolant hose connector

3. To connect the rack hoses to the facility coolant hoses, align the hex head screws (see Figure 1-20 on page 17), and turn the connectors clockwise (as viewed from the

perspective of the hose). Aligning the hex screws ensures that you have correctly aligned the interlocking tabs (see the blue arrows that are shown in Figure 1-19 on page 16).

Figure 1-20 shows the alignment for the hex head screws.

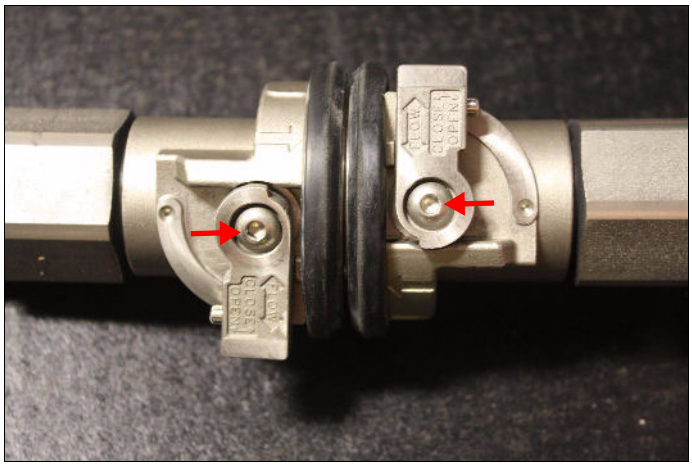


Figure 1-20 Coolant hose hex head alignment

4. Rotate the hose connector clockwise until the arrows on the connectors are aligned. See Figure 1-21.

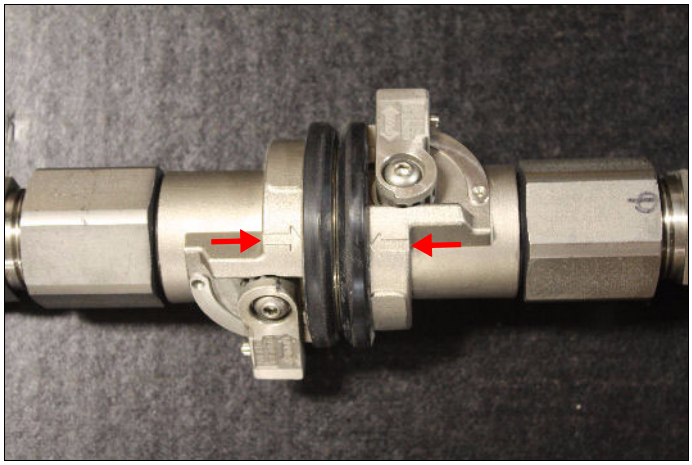


Figure 1-21 Aligned coolant hose connection

Attention: The arrows in the connectors do not need to be in perfect alignment. However, if the connectors have not been rotated sufficiently, the valve levers cannot be operated.

When the arrows are aligned, you can operate the valve levers on both connectors. When the levers are operated, a locking pin is pushed out of each connector into the other. These locking pins prevent the connectors from being rotated (disconnected) with the valve open.

5. Follow the steps in 1.5.1, “Purging the nitrogen from the coolant manifold” on page 18 and 1.5.2, “Opening the coolant hose valves” on page 20.

1.5.1 Purging the nitrogen from the coolant manifold

There will be some remaining nitrogen in the rack manifold and node boards. This nitrogen must be purged before operation. Use the coolant and air purge kit to perform the procedure. All components are available per MFI 66Y4607 in the US, and 66Y4608 for world trade.

Figure 1-22 shows the coolant and air purge kit.

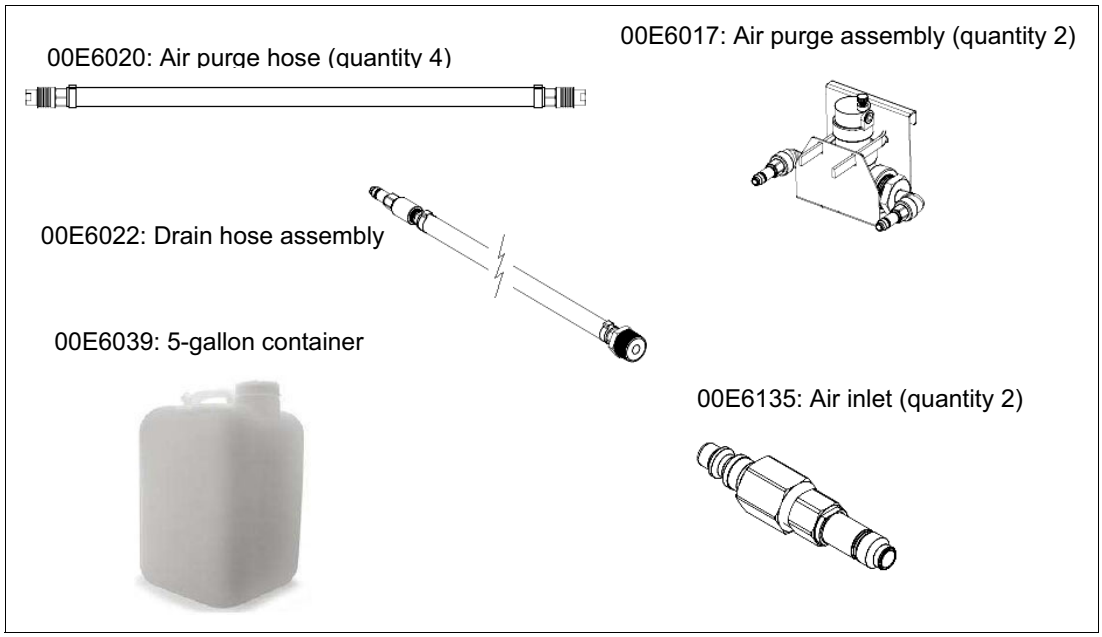


Figure 1-22 Coolant and air purge kit

To purge the air from the coolant manifold:

1. After the rack is properly connected to the facility cooling liquid supply, have the facility coordinator open the facility flow valves. Do NOT open the rack supply and return hose ball valves. See Figure 1-21 on page 17.
2. Locate the four air purge hoses and the two air purge assemblies. See Figure 1-23.

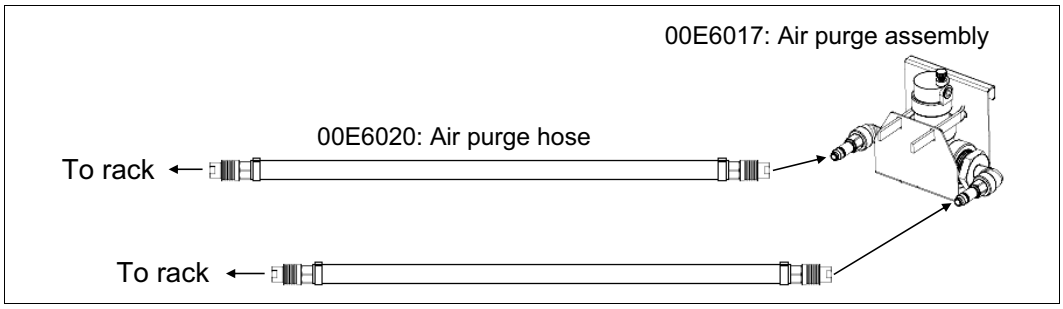


Figure 1-23 Air purge kit

3. Attach two air purge hoses to each air purge assembly, as indicated in Figure 1-24 on page 19.
4. Loosen the small vent cap on the air purge assembly two turns for correct venting.
5. Hang each assembly, as indicated in Figure 1-24 on page 19. There is one assembly for the front of the rack and one assembly for the back of the rack.

6. Attach the two air purging hoses, from each of the assemblies, to the rack coolant manifold. See Figure 1-24.

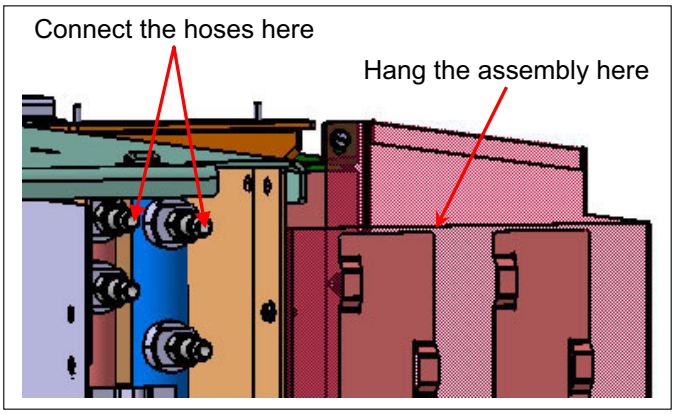


Figure 1-24 Air purging connections

7. Listen for air release and check for coolant leaks during the next steps.

Attention: You might not hear any of the air being vented, but ensure that the vent cap was loosened.

Important: Always open and close the rack supply and return hose ball valves slowly.

8. *Slowly* open the supply ball valve over a period of 2-3 minutes. When the supply valve is completely open, the return valve can be opened. Open the valves on both the supply and return hoses to the rack. See 1.5.2, “Opening the coolant hose valves” on page 20.
9. Inspect the rack plumbing for leaks after both ball valves are open. If leaks are observed, immediately shut off the water supply and remedy the cause of the leak.
10. After the purge assemblies are in place for at least 15 minutes, but not longer than 24 hours, disconnect them from the rack.
11. Repeat this procedure for all other Blue Gene/Q racks that must be purged.

1.5.2 Opening the coolant hose valves

Perform the following steps to open the coolant hose valves:

1. To open or close the valve, press the interlock pin on the valve lever. See Figure 1-25.

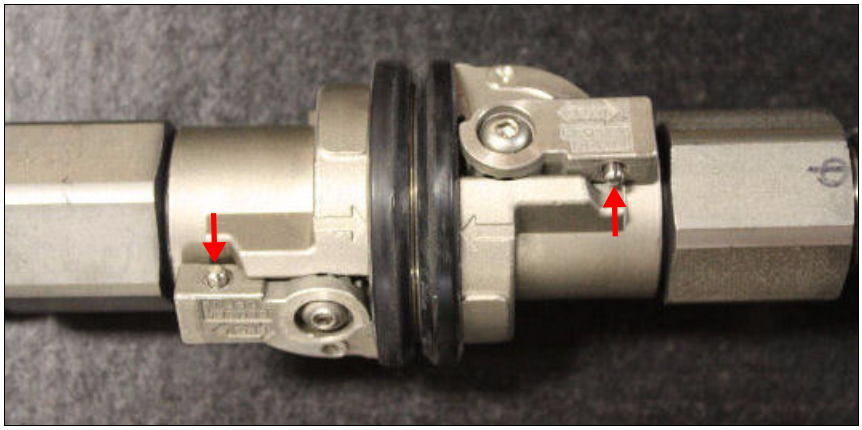


Figure 1-25 Coolant hose connection locking pin and fully open

Open the valves on both the Blue Gene/Q and the facility return hose ends.

Important: Always open and close the rack supply and return hose ball valves slowly.

Attention: If you have difficulty rotating the hose connector valve lever, ensure that the following steps are complete:

1. Make sure that you are pressing in on the interlock pin.
2. Ensure that the hose connectors are fully rotated and the arrows are aligned.

Make sure that you do not open the valves on the hoses that are attached to the site plumbing until the hose connectors are correctly connected.

1.6 Cabling the Blue Gene/Q rack

There are five cable types that must be attached after the rack is placed: the ac power cords, 51 V dc cables, clock, torus, and I/O cables.

Attention: The fiber-optical cable end covers must be retained. They might be required to protect the cable ends if cables are removed for repairs or equipment relocation.

1.6.1 Installing power cables

To install power cables:

1. Identify the BPE to DCA cables. There are two lengths: short (part number 00E6362) and long (part number 00E6363). The short DCA power cable attaches the left DCA to the left connector on the BPE, and the long DCA power cable attaches the right DCA to the right connector on the BPE.

2. Attach the BPE to the DCA power cables. Start at the bottom and work up. Attach the short cables first and then attach the long cables on each node board. Attach the cables to the black rack post with hook-and-loop fasteners.

   Figure 1-26 shows BPE to DCA cabling.

Figure 1-26 Completed BPE to DCA cabling

3. Attach the power cables for I/O drawers to P4 on the top BPEs and P14 on the bottom BPEs.

   The cables run to the center of the rack, on the left side and then to the rear of the rack, where they are routed up to their respective connections at the rear of the drawers. See Figure 2-7 on page 50.

   See Figure 1-27 on page 22 through Figure 1-29 on page 24 for power connection locations for the I/O drawers.

Figure 1-27 shows the power cabling for the front of a system with two midplanes.

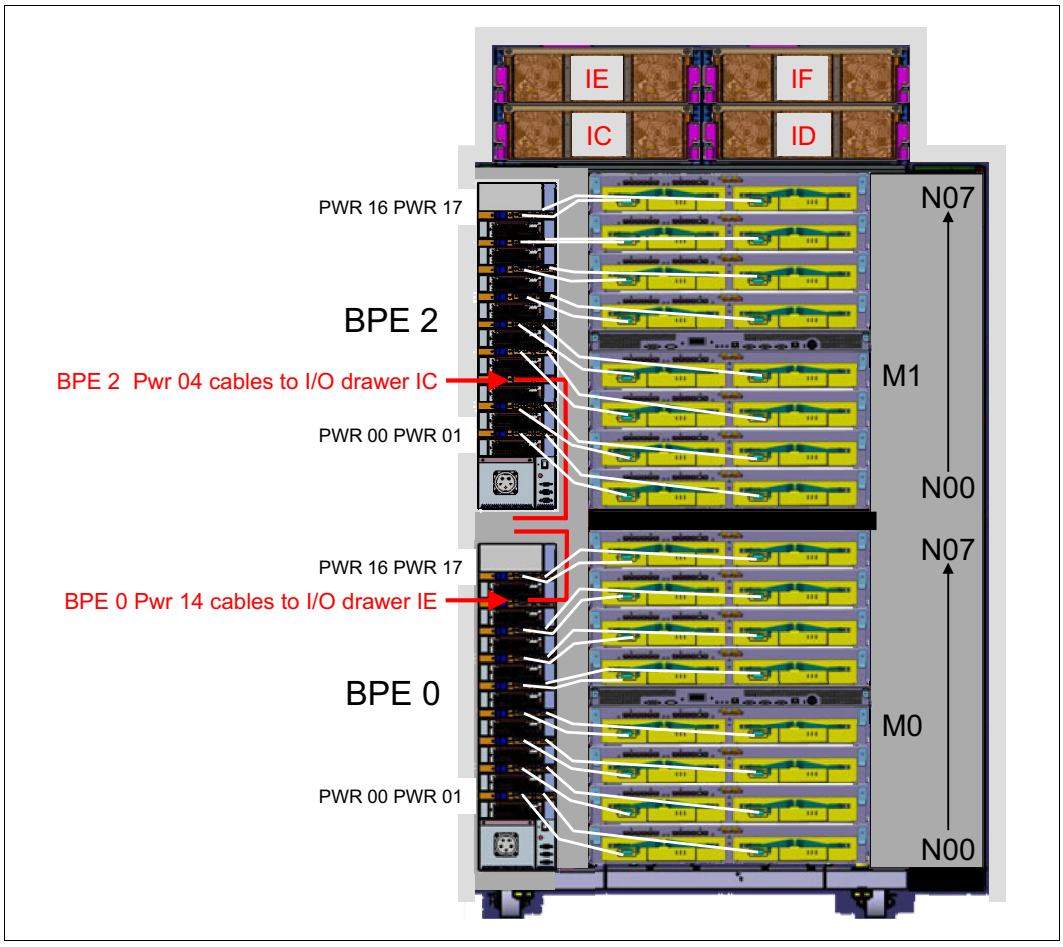


Figure 1-27 BPE to DCA power connection layout (front)

Figure 1-28 on page 23 shows the power cabling for the front of a system with one midplane.

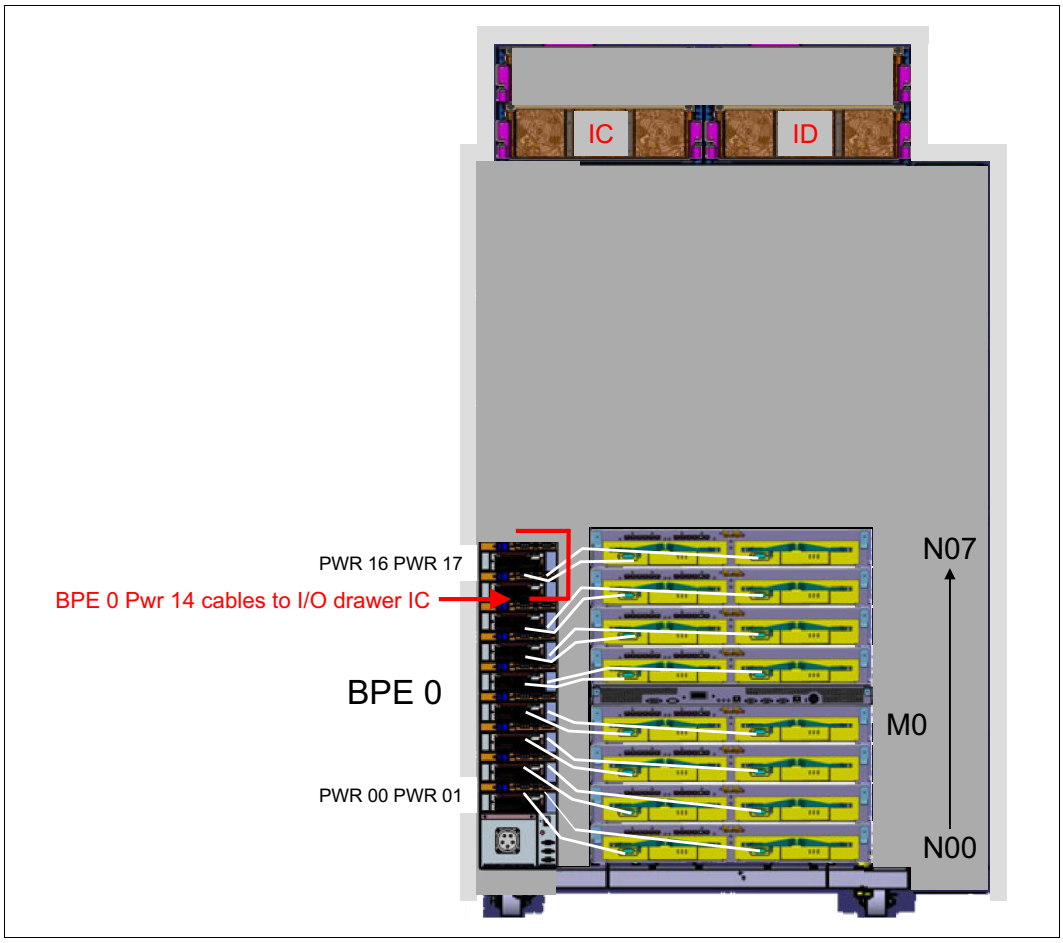


Figure 1-28 BPE to DCA power connection layout for a one midplane system (front)

Figure 1-29 on page 24 shows the power cabling for the rear of a system with two midplanes.

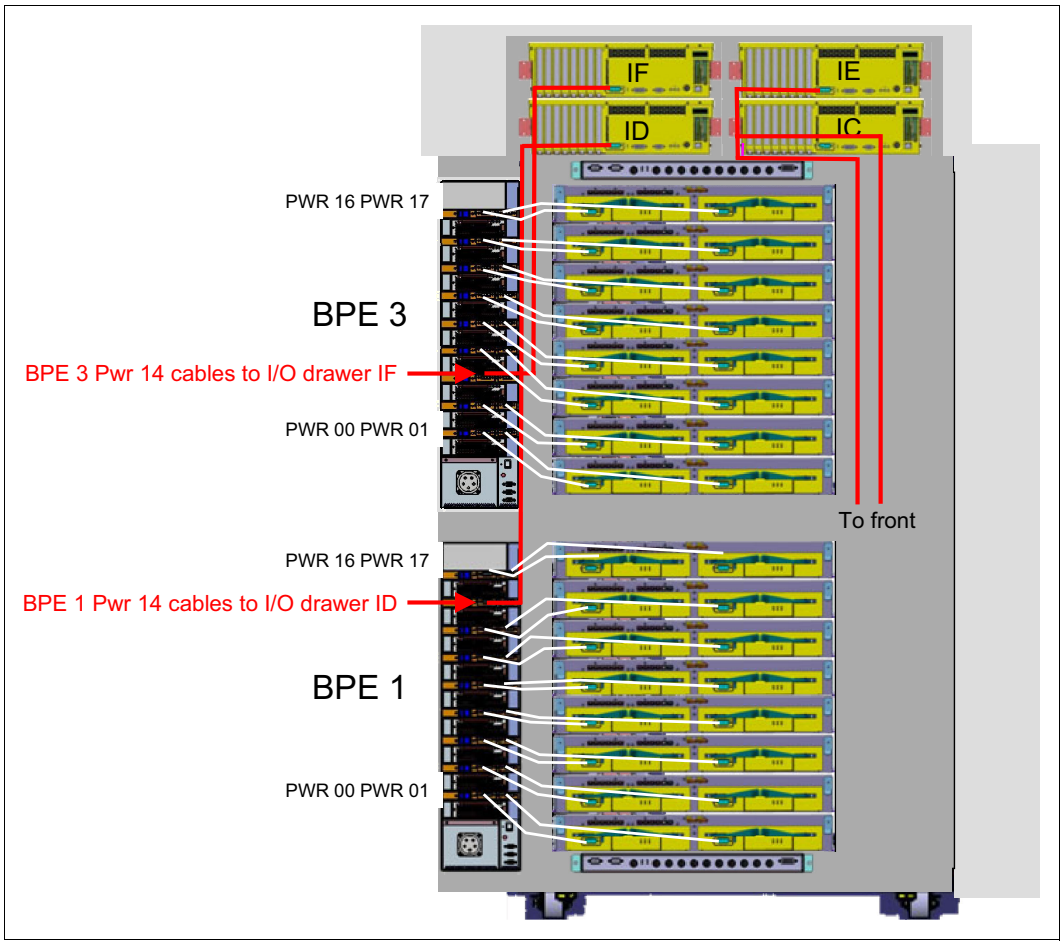


Figure 1-29 BPE to DCA power connection layout (back)

Figure 1-30 on page 25 shows the power cabling for the rear of a system with one midplane.

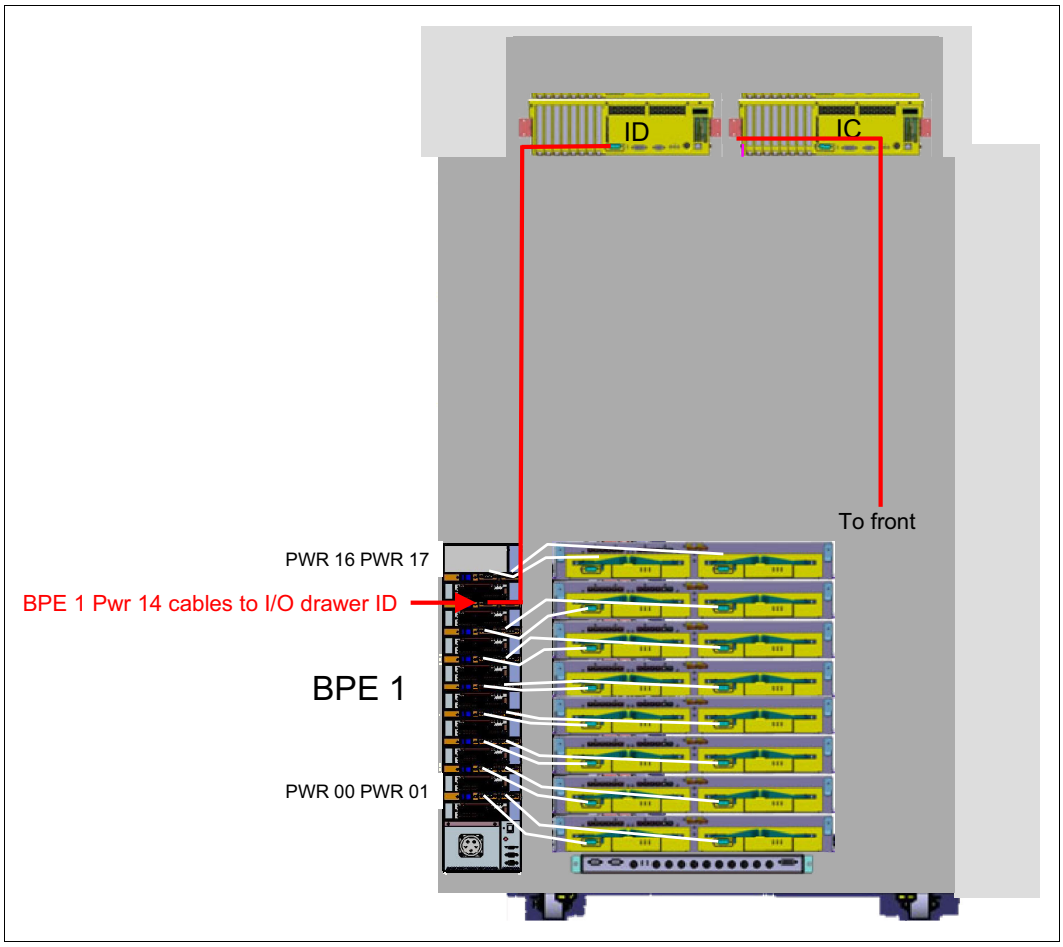


Figure 1-30 BPE to DCA power connection layout (rear) for a system with one midplane

4. Perform the following steps to attach the four 60 amp ac power cords to the BPEs.
   a. Perform the following steps to attach the ac power cord:
      i. Turn off the nine ac circuit breakers for the BPMs (there is one circuit breaker above each of the nine BPMs).
      ii. Turn off the Pwr 00 - Pwr 17 (51 V dc output) switches for each of the four BPEs in the rack.
      iii. Turn off the facility circuit breaker that feeds the facility connector for each power cord.

iv. Plug the power cord into the BPE by aligning the keyed tab and turning it clockwise until the blue dots are aligned.

Figure 1-31 shows the power cord key position.

Figure 1-31 Power cord key position

Figure 1-32 shows the power cord connection locking reference.

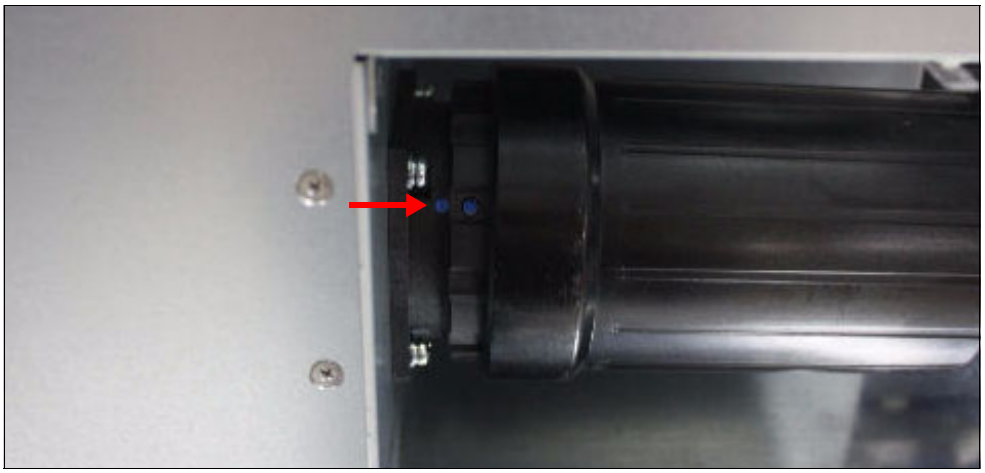


Figure 1-32 Power cord connection locking reference

Attention: Do not connect the power cords to facility power until coolant is flowing through the rack. If you connect the power cords before coolant is flowing, the coolant monitor fails during the bring-up process.

v. Route the power cord with the cable routing rail.

vi. Plug the power cords into the facility connector.

vii. Turn on the facility circuit breakers.

viii. Turn on the ac circuit breakers for the nine BPMs in each of the four BPEs in the rack. There is one circuit breaker above each of the nine BPMs.

ix. Turn on the Pwr 00 - Pwr 17 (51 V dc output) switch for each of the four BPEs in the rack.

1.6.2 Connecting torus cables

There are cable routing guides that contain notches on the right side of the rack, both front and back. Use these guides to attach the cables with hook-and-loop fasteners for correct cable management. See Figure 1-36 on page 30.

Figure 1-33 Cable management

Torus cables are bundled in groups of 16 when they connect racks. There are single cables for connections between the two midplanes in the same rack. Figure 1-34 shows the torus cable bundle.

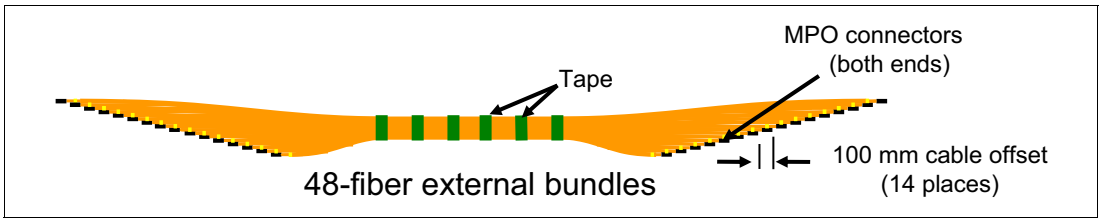


Figure 1-34 Torus cable specifications

Table 1-1 lists more information about the physical configuration of the torus cable bundle.

Table 1-1 Torus cables and FRUs

Cable or bundle part number	Description	FRU part number for replacing an individual fiber cable	Description
45D9470	48-fiber individual cables 2.2 m Violet	45D9470	2.2 m, 48-fiber cable
00E6196	48-fiber cable bundle 5.4 - 8.4 m Blue	45D9504	8.4 m, 48-fiber cable
00E6197	48-fiber cable bundle 7.4 - 10.4 m Green	45D9513	10.4 m, 48-fiber cable

Cable or bundle part number	Description	FRU part number for replacing an individual fiber cable	Description
00E6198	48-fiber cable bundle 9.8 - 12.9 m Yellow	45D9517	12.9 m, 48-fiber cable
00E6199	48-fiber cable bundle 14.7 - 17.7 m Orange	41T7991	17.7 m, 48-fiber cable
00E6200	48-fiber cable bundle 19.7 - 22.7 m Red	41U9998	22.7 m, 48-fiber cable

Each torus cable is prelabeled. The labeling of each of the cable ends contains from-to information and a cable bundle label. The top line of text provides the plug location for that end of the cable. The second line shows the plug location for the other end of the cable. The third line is a control number that indicates the intended rack number, whether the cable is intended for connection to the front or back of the rack, the bundle color, torus dimension, and the cable number.

The information on the label for each torus cable uses the syntax R*xx*-M*x*-N*xx*-T*xx* where:

- R*xx* is a value from R00 to RVV (the rack to which this cable connects)
- M*x* is either M0 or M1 (the midplane number to which this cable connects)
- N*xx* is a value from N00 to N15 (the node board to which this cable connects)
- T*xx* is a value from T04 to T11 (the connector to which this cable connects)

The cable bundles also have specific labeling. Each cable is identified by a color that is defined in Table 1-1 on page 27. Additional information about the cable bundle label shows the following information:

xx This value is the ship group number. It is a two-digit number that designates the rack to which the bundle connects.

S This value can be either F or B. This value indicates whether the bundle connects to the front (F) or back (B) of the rack.

D This value is A, B, C, or D. It indicates the torus network dimension of the bundle.

In each bundle, each cable is numbered 1 - 16.

1.6.3 Connecting I/O cables

Each I/O cable, on each end, has specific connectors with gray tape to differentiate between torus cables and I/O cables.

When the I/O drawers are in the I/O enclosure, the cable bundle is blue and brown.

When I/O drawers are installed in I/O racks, connections between I/O drawer and node boards from the same row are done using cable colors of gray, red, and orange.

Table 1-2 on page 29 shows the specifications for the I/O cables.

Table 1-2 I/O cables and FRUs

Cable or bundle part number	Description	FRU part number	Description
41U8220 and 41U8221	12-fiber cable bundle 4.3, 4.5, 4.7 and 4.9 m PN 41U8220 is a blue bundle and PN 41U8221 is a brown bundle.	4D9540	4.9 m, 12-fiber cable (gray pull tab), (cable runs in a single rack)
41U8217	12-fiber cable 10.3 m Orange cable	41U8217	10.3 m, 12-fiber cable (gray pull tab), used from the I/O rack to the first three racks in a row
41U8218	12-fiber cable 18.7 m Red cable	41U8218	18.7 m, 12-fiber cable (gray pull tab), used from the I/O rack to the fourth through ninth racks in a row
41U8219	12-fiber cable 26.6 m Gray cable	41U8219	26.6 m, 12-fiber cable (gray pull tab), used from the I/O rack to the 10th through 16th racks in a row

Attention: Be careful during installation and when performing service. Ensure that optical cable ends do not touch any hard surface, including the floor, and that they remain as clean as possible. Place protective covers on cable ends, and into cable receptacles, as cables are removed to help protect them.

1.6.4 Connecting clock cables

To connect clock cables:

1. Connect the two clock power cables to the two BPEs in the rear of the rack. These cables are redundant, and it does not matter which power connector on the clock card connects to which BPE.
2. Connect a clock cable to each of the two service cards and connect the other ends to the clock card, to any available port (Clk_0 through Clk_9).

   Figure 1-35 shows the clock card.

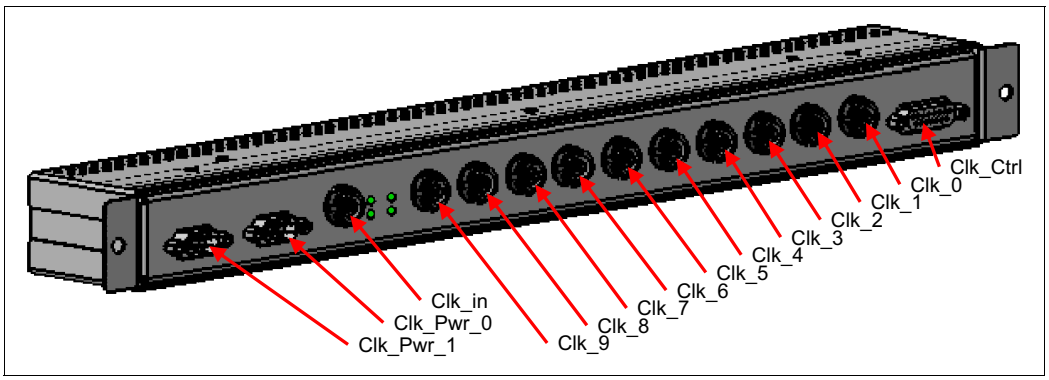


Figure 1-35 Clock card with naming

3. Route the cables using the cable routing rails.

4. Connect a clock cable from each I/O drawer (Clock_in) to the clock card, to any available port (Clk_0 through Clk_9).
5. If this clock is the master clock on the system, connect the master clock cable (PN 44V8223) to the Clock_Ctrl connector on the clock card (see Figure 1-35 on page 29) and the Clock_Ctrl connector on service card M0 on that rack (see Figure 4-25 on page 90). Thread this cable in the same location as the dc power cables (see Figure 1-27 on page 22).

   Figure 1-36 shows the rear of the rack.

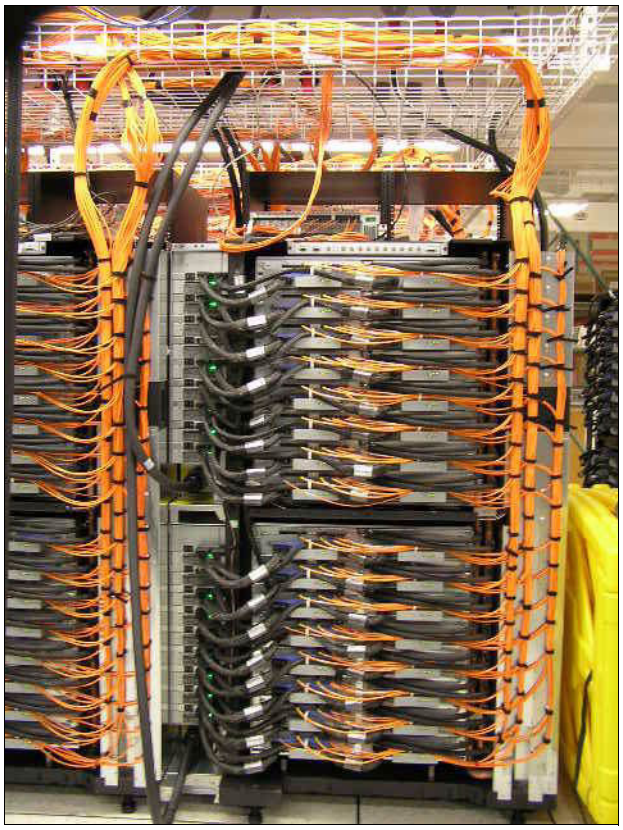


Figure 1-36 Back of installed Blue Gene/Q racks

1.7 Installing the covers

Figure 1-37 shows the rear of a single Blue Gene/Q rack when the covers are installed.

Figure 1-37 Blue Gene/Q rack with covers installed

Kit 00E5851 is a single, stand-alone rack cover set. This cover set must be ordered for a single, stand-alone rack, or with the first rack in any row. This kit provides a pair of doors, that open in the middle, to cover the front of the rack, a pair of doors, that open in the middle, to cover the back of the rack, and two side covers (which are identical), one for each of the sides of the rack.

Figure 1-38 shows the covers in kit 00E5851.

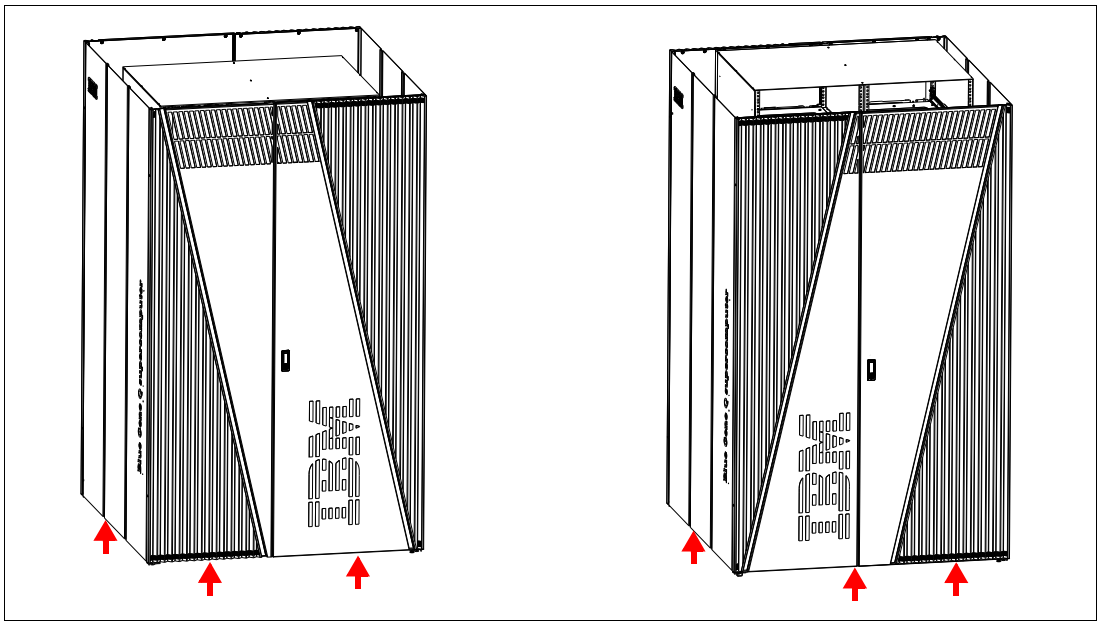


Figure 1-38 Covers in kit 00E5851

Part of the covers for the racks at each end of a row are provided in kit PN 00E5851. The remaining covers for the end-of-row racks are provided by one kit PN 00E5853. The covers for all other racks in the row are provided by ordering one kit PN 00E5853 per rack.

Figure 1-39 shows correct placement of kit 00E5851 on the front of the racks at the far-left and far-right ends of a row of two or more racks.

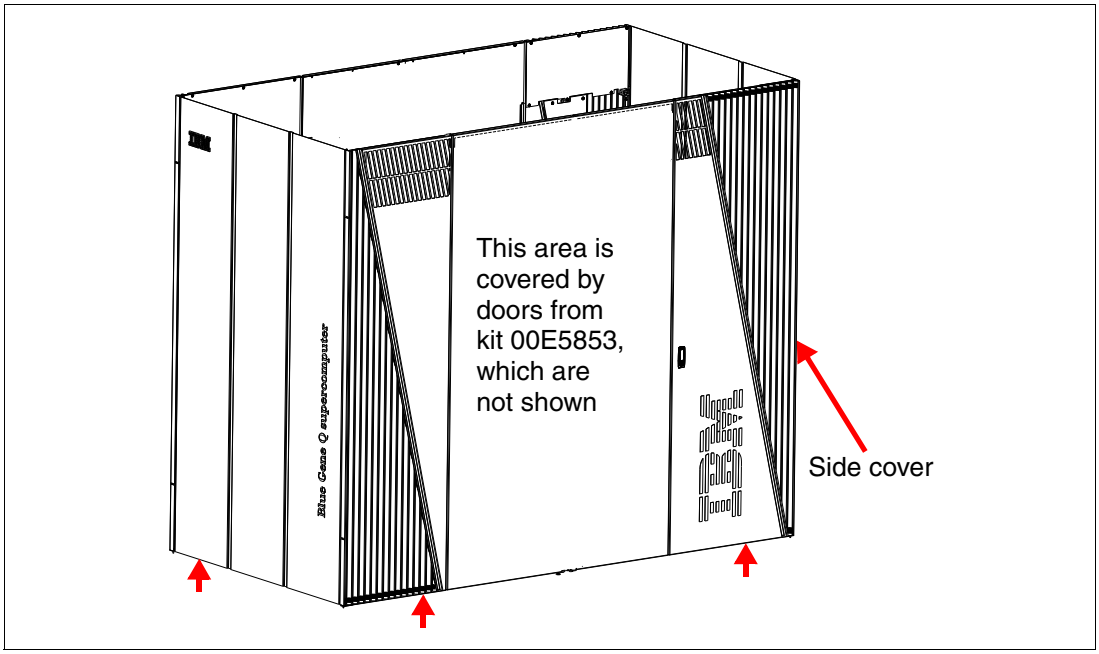


Figure 1-39 Covers from kit 00E5851 (front)

Figure 1-40 shows correct placement of kit 00E5851 on the rear of the racks at the far-left and far-right ends of a row of two or more racks.

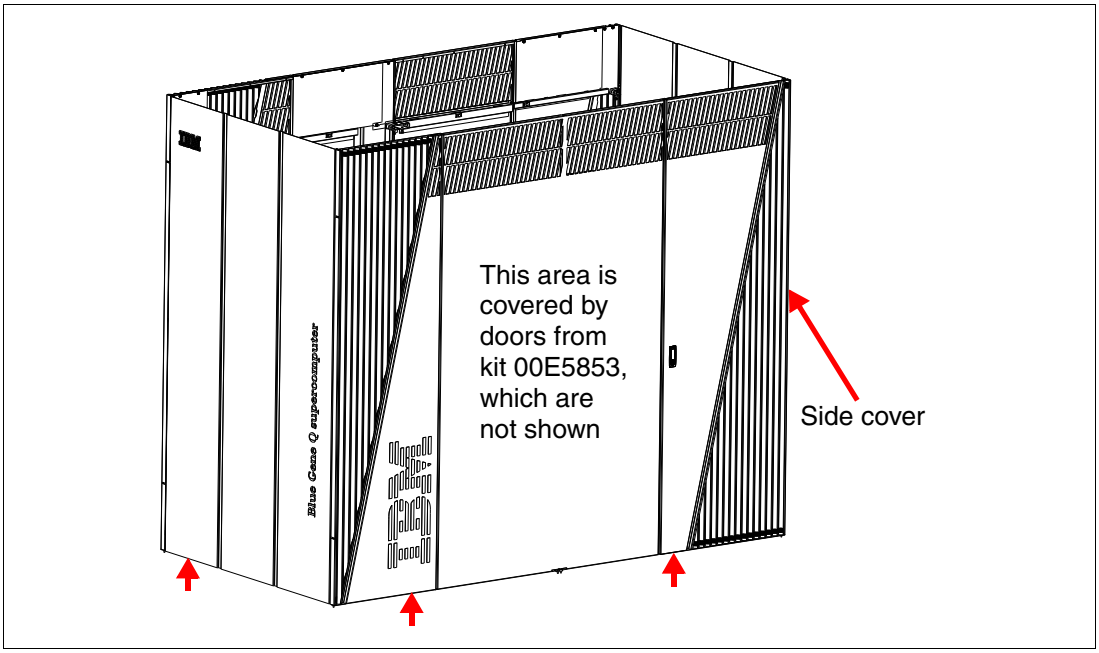


Figure 1-40 Covers from kit 00E5851 (rear)

Kit 00E5853 provides four doors (two left doors and two right doors) that can serve as all four doors for any single rack in the row, except the far-left or far-right rack. For the far-left and far-right racks, kit 00E5851 provides the side cover at each end of the row and one front door and one back door per rack. The doors in kit 00E5853 are shared between the far-left and far-right racks in the row to complete their doors, as shown in Figure 1-41 and Figure 1-42 on page 34.

Figure 1-41 shows the front of a row of racks when the covers from kits 00E5851 and 00E5853 are installed.

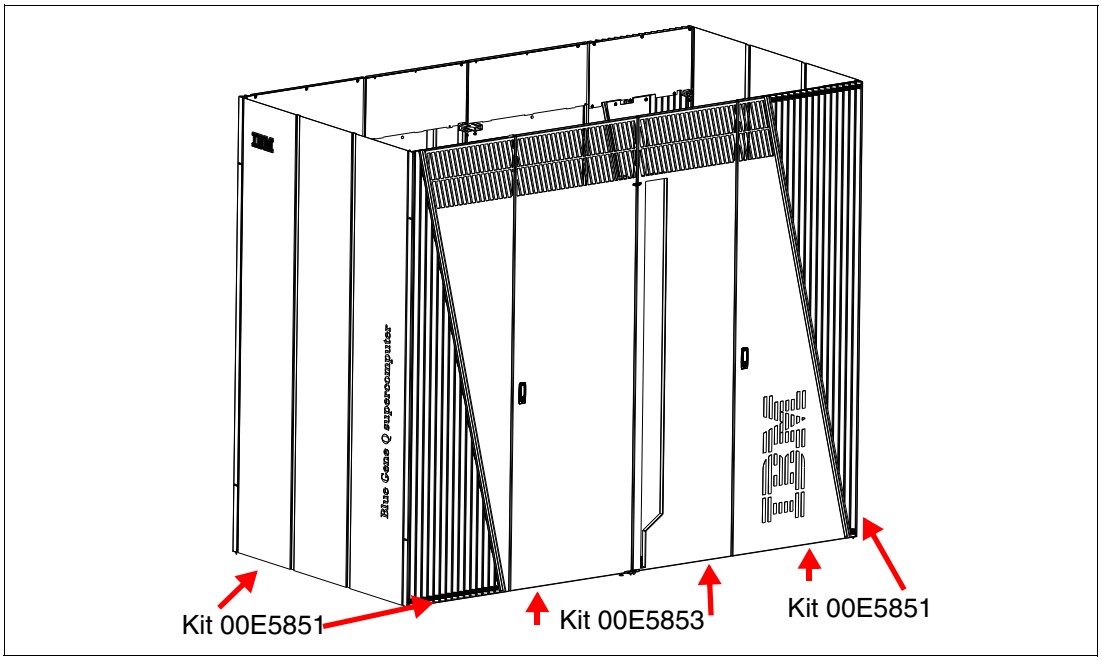


Figure 1-41 Covers from kits 00E5851 and 00E5853 (front)

Figure 1-42 shows the rear of a row of racks when the covers from kits 00E5851 and 00E5853 are installed.

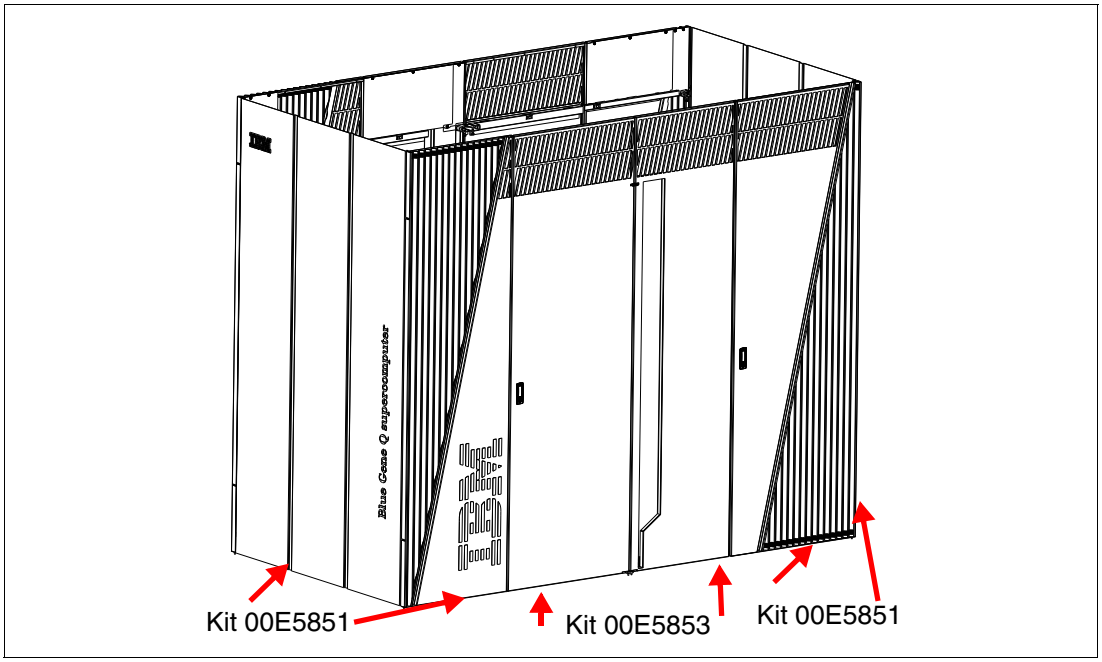


Figure 1-42 Covers from kits 00E5851 and 00E5853 (rear)

Perform the following steps to install the covers:

1. For racks at the end of a row, install the two L-brackets and the two lower J-brackets. All other brackets are used on every rack. See Figure 1-43.

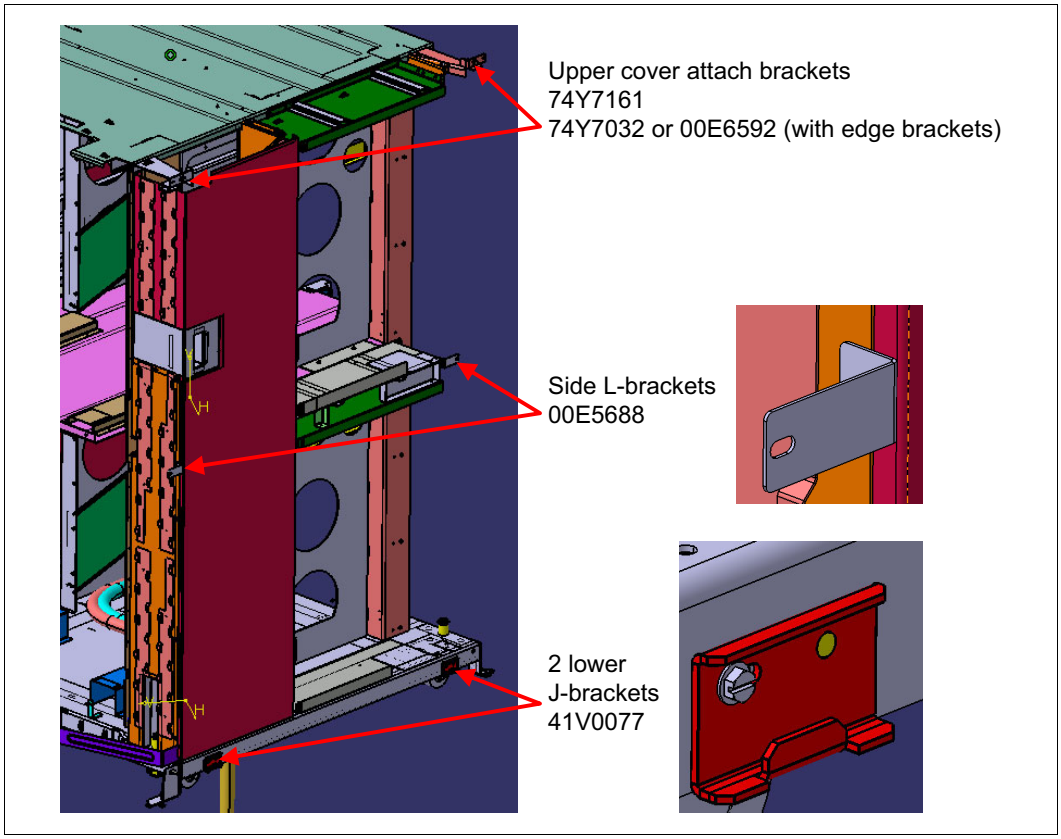


Figure 1-43 Side cover bracket installation

2. Install the cover attach (hinge) brackets and the cable management bracket with screws (part number 97P5047). See Figure 1-44.

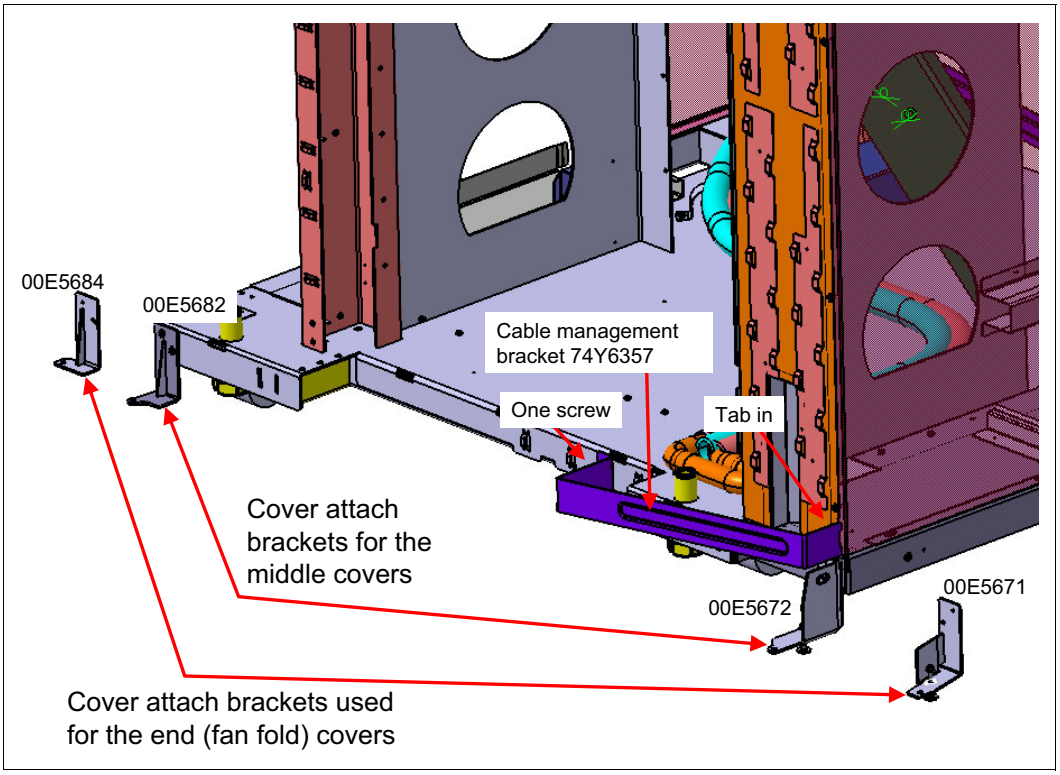


Figure 1-44 Cover end bracket installation

See 1.7.1, “Installing cover kit 00E5851” on page 36 and 1.7.2, “Installing the covers from kit 00E5853” on page 39 for information about which brackets to use with which covers.

1.7.1 Installing cover kit 00E5851

This section explains how to install cover kit 00E5851 for a stand-alone rack or for the far-left and far-right covers in a row of racks.

If there is *not* an I/O enclosure on the compute rack, install the following filler panels (part number 74Y9430) on the front covers (part numbers 74Y6283 and 74Y6293). The service cards indicate the front of the rack.

Important: Do not alter the filler panels on the rear doors. The rear doors come with fillers installed and these panels must always remain installed.

Figure 1-45 shows the front right cover when an I/O enclosure is not installed.

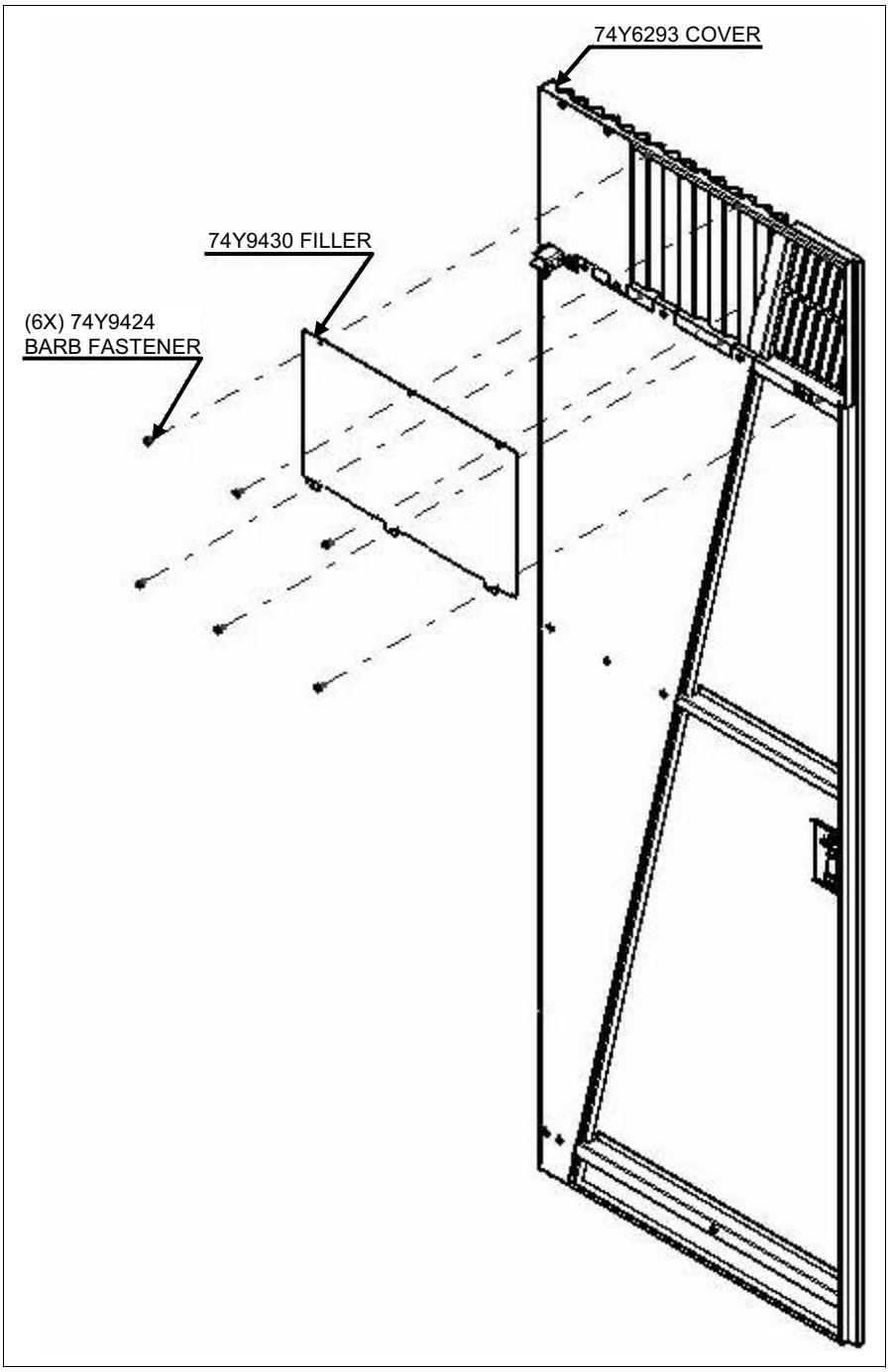


Figure 1-45 Filler installation on front right cover when an I/O enclosure is not installed

Figure 1-46 shows the front left cover when an I/O enclosure is not installed.

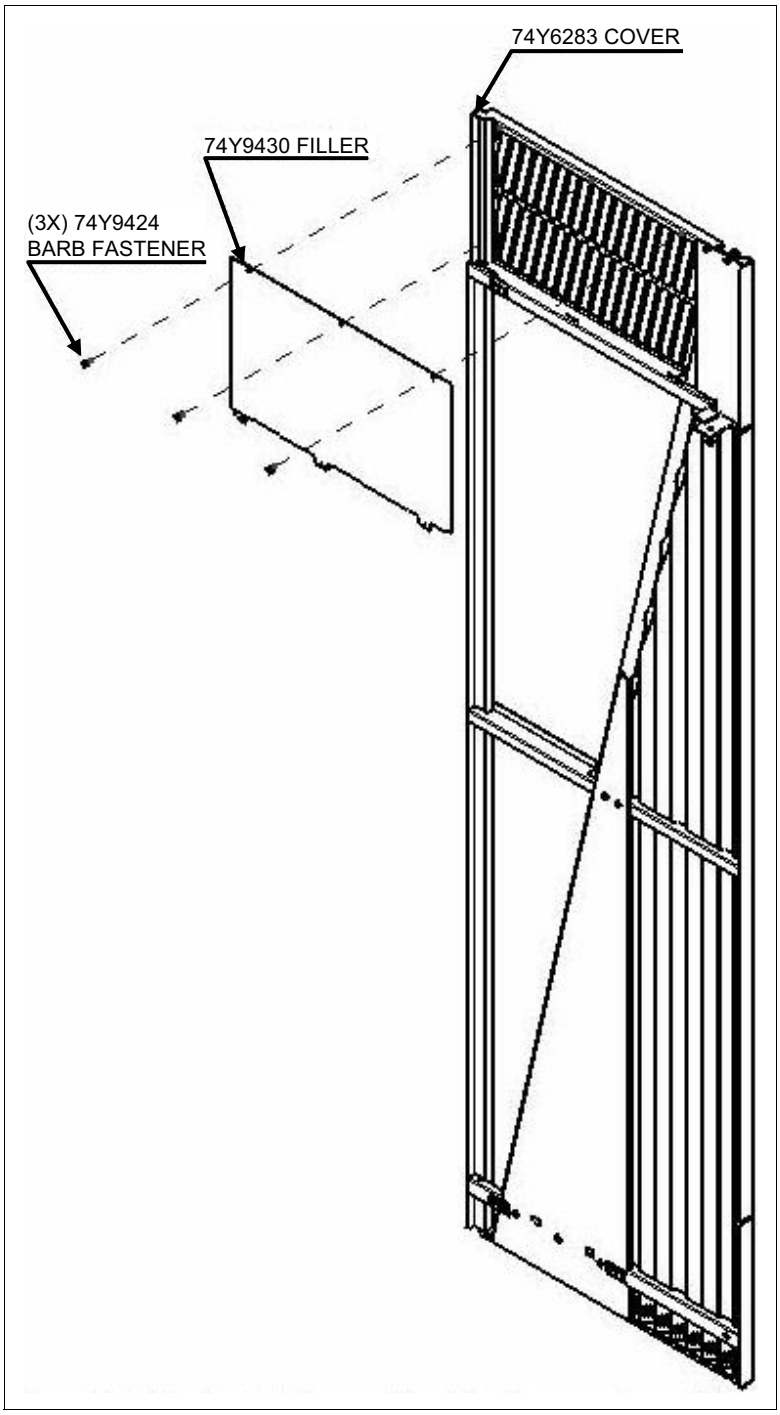


Figure 1-46 Filler installation on the front left cover when an I/O enclosure is not installed

Perform the following steps to install the covers for the front end of the rows:

1. Install the front left cover, part number 74Y6283:
    - 00E5684: Lower left end cover attach (hinge) bracket
    - 74Y7161: Upper left cover attach (hinge) bracket
    - 97P5047: M4 washer head screw

2. Install the front right cover, part number 74Y6293:
    - 00E5671: Lower right (latch side) end cover attach (hinge) bracket
    - 00E6592: Upper right cover attach (hinge) bracket
    - 97P5047: M4 washer head screw
3. Install the rear left cover, part number 74Y6290:
    - 00E5684: Lower left end cover attach (hinge) bracket
    - 74Y7161: Upper left cover attach (hinge) bracket
    - 97P5047: M4 washer head screw
4. Install the rear right cover, part number 74Y6292:
    - 00E5671: Lower right (latch side) end cover attach (hinge) bracket
    - 00E6592: Upper right cover attach (hinge) bracket
    - 97P5047: M4 washer head screw
5. Install each side cover, part number 74Y6278:
    - 41V0077: Side cover mount bracket
    - 00E5684: Side cover middle retention bracket
    - 97P5047: M4 washer head screw

1.7.2 Installing the covers from kit 00E5853

When covers are installed on additional racks, either partial or full filler panels are required.

Important: Do not alter the filler panels on the rear doors. The rear doors come with fillers installed and these panels must always remain installed.

If there is *not* an I/O enclosure on the compute rack, perform the following steps:

1. Install the filler panel (part number 74Y9456) on the front right (latch side) cover (part number 74Y6319). See Figure 1-47.

   The service cards indicate the front of the rack.

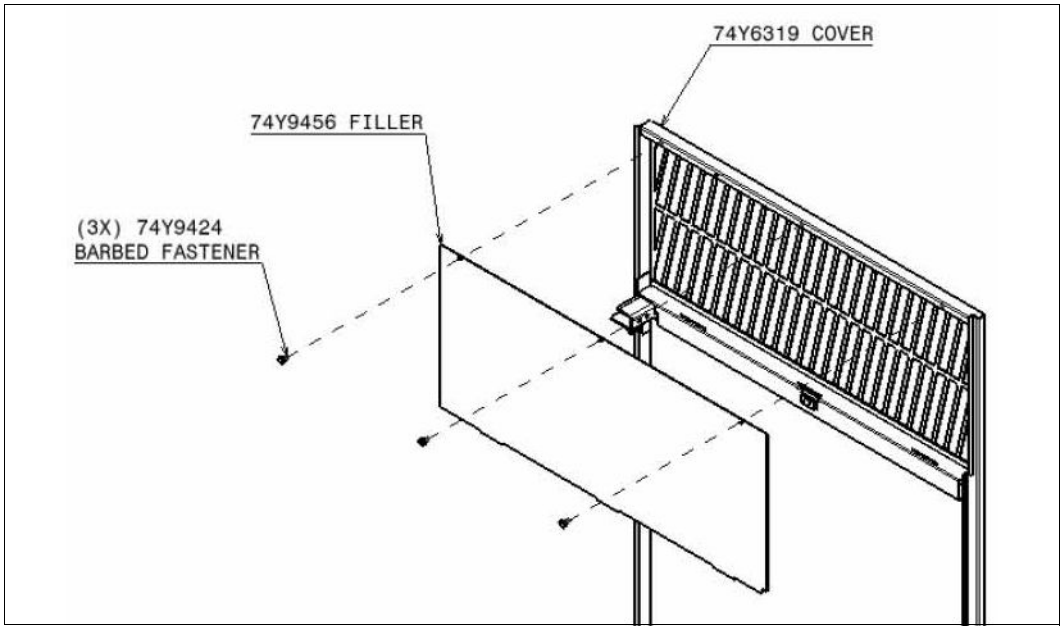


Figure 1-47 Full filler installation on front right (latch side) cover when an I/O enclosure is not *installed*

2. Install the full filler panels (part number 74Y9457) on the front left cover (part number 74Y6311), as shown in Figure 1-48.

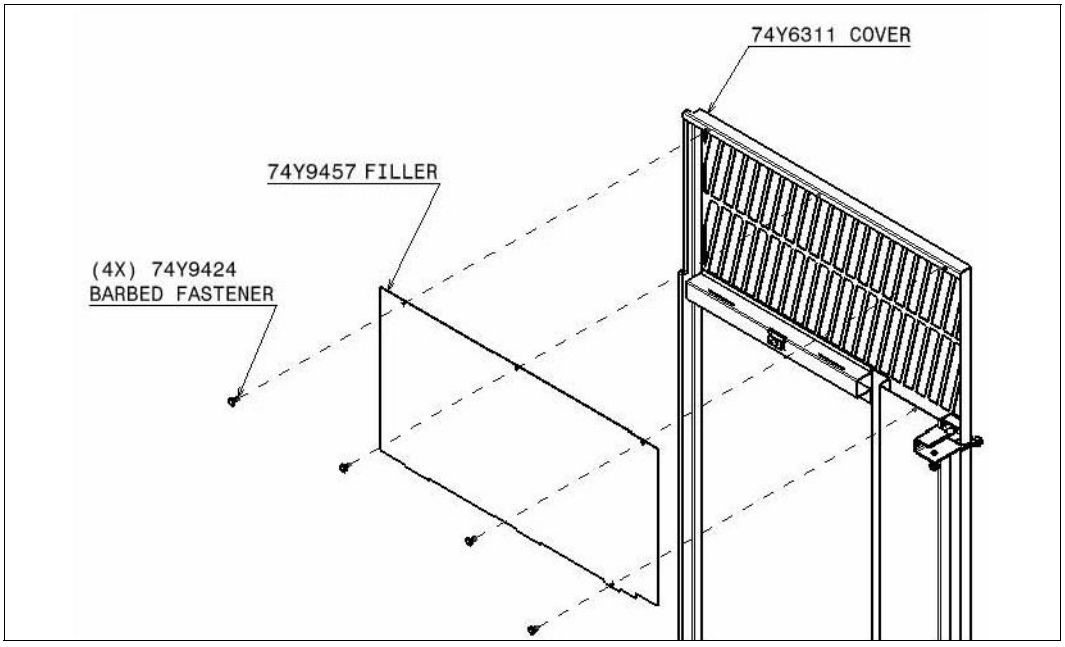


Figure 1-48 Full filler installation on the front left cover when an I/O enclosure is not installed

If there is an I/O enclosure on the compute rack, perform the following steps:

1. Install the partial filler panels (part number 74Y9458) on the front right (latch side) cover (part number 74Y6319). See Figure 1-49.

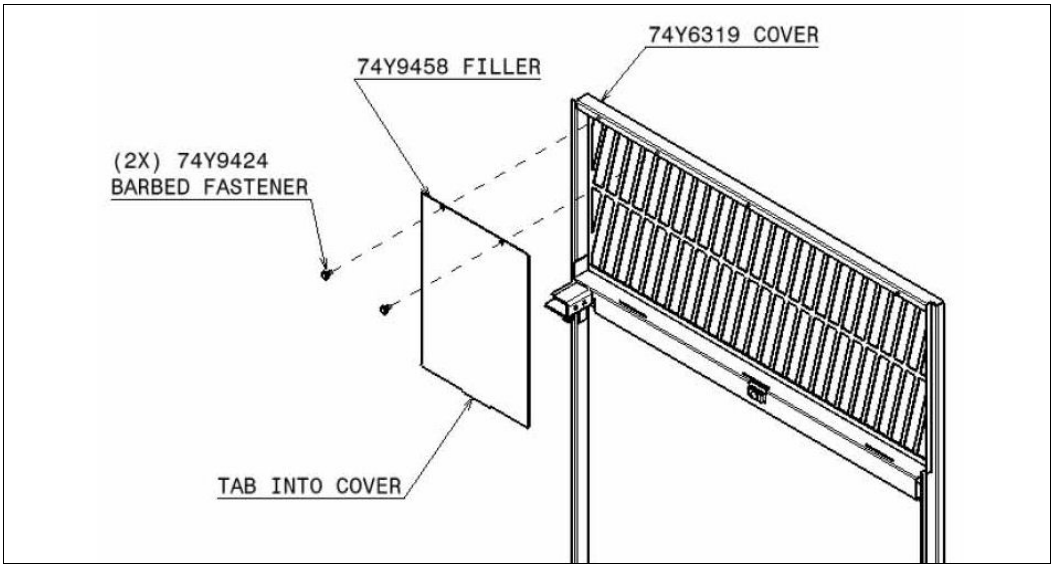


Figure 1-49 Partial filler installation on front right (latch side) cover when an I/O enclosure is installed

2. Install the partial filler (part number 74Y9459) on the front left cover (part number 74Y6311). See Figure 1-50.

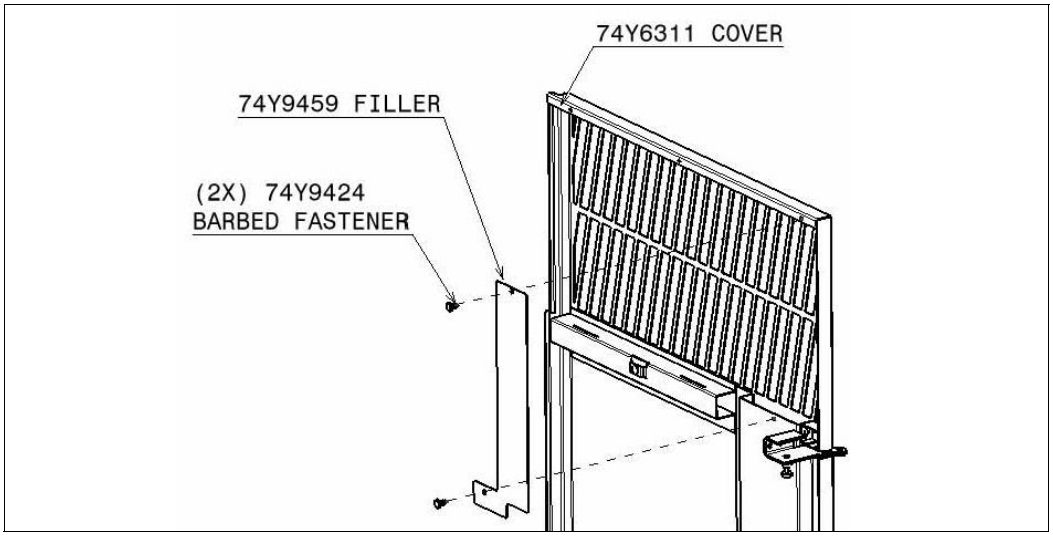


Figure 1-50 Partial filler installation on the front left cover when an I/O enclosure is installed

Perform the following steps to install the covers for the middle of the row:

1. Install the front left cover, part number 74Y6311:
    - 00E5682: Lower left middle cover attach (hinge) bracket
    - 74Y7161: Upper left cover attach (hinge) bracket
    - 97P5047: M4 washer head screw

2. Install the front right cover, part number 74Y6319:
    - 00E5672: Lower right (latch side) middle cover attach (hinge) bracket
    - 74Y7032: Upper right cover attach (hinge) bracket
    - 97P5047: M4 washer head screw
3. Install the rear left cover, part number 74Y6878:
    - 00E5682: Lower left middle cover attach (hinge) bracket
    - 74Y7161: Upper left cover attach (hinge) bracket
    - 97P5047: M4 washer head screw
4. Install the rear right cover part number 74Y6883:
    - 00E5672: Lower right (latch side) end cover attach (hinge) bracket
    - 74Y7032: Upper right cover attach (hinge) bracket
    - 97P5047: M4 washer head screw

1.8 Updating the coolant monitor firmware

The steps identified in this section must be performed by Installation Team personnel, if performed as part of rack installation, or by the IBM Blue Gene Support Team, if performed at any other time. SSRs must not perform this procedure. IBM Systems Services Representatives (SSR) time to assist with this procedure is billable, except to assist the Install Team personnel, when performed as part of rack installation.

Perform this task to update the coolant monitor firmware:

Note: Use the most recent version of the firmware, version 3.28 or later.

1. Start **mc_server** (by starting bgmaster and stopping **mmcs_server** with the **master_start bgmaster** and **master_stop mmcs_server** commands). See *IBM System Blue Gene Solution: Blue Gene/Q System Administration*, SG24-7869 Redbooks publication for more information about these commands.
2. For each compute rack that does NOT contain the service card that controls a master clock card, repeat steps 3 through 5.
3. Check the coolant monitor firmware level by running the following commands:

    cd /bgsys/drivers/ppcfloor/baremetal/tools
    ./displayCoolantMonitorStatus.py R*xx*

    Figure 4-41, “Example output from the displayCoolantMonitorStatus.py utility” on page 111 shows example output from the command.
4. Run the following command to update the firmware:

    ./updateCoolMonFirmware.py R*xx* 3.28

    /bgsys/drivers/ppcfloor/baremetal/firmware/coolantMonitor/
    LM3S6965_v3.28_20121029.hex

    Note: Use the most recent version of the firmware, version 3.28 or later.

    This step takes two to three minutes.
5. Run the following command to verify the firmware level:

    ./displayCoolantMonitorStatus.py R*xx*

6. Repeat steps 3 on page 42 through 5 on page 42 for the rack with the service card that controls the master clock card.
7. Run the following command to start bgmaster server:

   master_start bgmaster

1.9 Saving the coolant monitor calibration data

The steps identified in this section must be performed by Installation Team personnel, if performed as part of rack installation, or by the customer, if performed at any other time. SSRs must not perform this procedure. SSR time to assist with this procedure is billable, except to assist the Install Team personnel, when performed as part of rack installation.

Perform the following steps to save the coolant monitor calibration data:

1. Change the current directory to baremetal tools directory.

   cd /bgsys/drivers/ppcfloor/baremetal/tools

2. Run the following command to save the calibration data from the coolant monitor to a file in the `/bgsys/local/etc/baremetal` directory:

   ./saveCalibrationData.py R*xx*

   This command creates a text file named Rxx-L, which is the coolant monitor location in the `/bgsys/local/etc/baremetal` directory, and saves a set of registers from the coolant monitor in the file.

1.10 Recovering a compute rack from a shutdown caused by the coolant monitor

The steps identified in this section must be performed by Installation Team personnel, if performed as part of rack installation, or by the customer, if performed at any other time. SSRs must not perform this procedure. SSR time to assist with this procedure is billable, except to assist the Install Team personnel, when performed as part of rack installation.

1. Check to ensure that the following conditions are true:
   - The ac power cord must be connected.
   - The facility ac circuit breaker must be turned on.
   - The PWR 00 - PWR 17 (51 V DC output) switches must be turned on all BPEs.
   - The ac input circuit breakers must be on for all BPMs.
2. Prepare for a service action on all node boards and I/O drawers in the rack while leaving the service card operational. Run the following commands:

   cd /bgsys/drivers/ppcfloor/baremetal/bin
   ./ServiceRack R*xx* prepare --noservicecard

3. Run the following commands to check the coolant monitor status:

   cd /bgsys/drivers/ppcfloor/baremetal/tools
   ./displayCoolantMonitorStatus.py R*xx*

   Figure 4-41, “Example output from the displayCoolantMonitorStatus.py utility” on page 111 shows example output for this utility.

4. Based on the shut-off cause in the status output, determine what condition caused the coolant monitor to shut down the power, and resolve the problem.

5. Clear the shut-off cause, enable the catastrophic and slow leak detection mechanisms if they are disabled, and open the solenoid valve.

   ./clearShutoffCause.py R*xx*
   ./enableLeakDetection.py R*xx* 5 3
   ./openValve.py R*xx*

6. Wait for one minute to ensure that the coolant monitor does not shut down the power again.
7. End the Service Action on all node boards and I/O drawers in the rack by running the following commands:

   cd /bgsys/drivers/ppcfloor/baremetal/bin
   ./ServiceRack R*xx* end --noservicecard

2

Installing an I/O enclosure

This chapter describes the I/O enclosure installation procedures. It includes the following tasks:

- Installing an I/O enclosure
- Installing an I/O drawer into an I/O enclosure

2.1 Installing an I/O enclosure

The lift tool is required for this procedure.

Attention: Do not operate the lift until after you read the owner's manual and are familiar with safe operation of the lift. The maintenance and repair of the lift are the customer's responsibilities. Contact the lift manufacturer for assistance.

Perform the following steps to install the I/O enclosure:

Attention: The customer must retain all shipping and packing materials, brackets, and related items for the Blue Gene/Q product. These materials are required if the product is relocated. Replacement shipping and packaging materials, brackets, and other materials might not be available from IBM.

1. Unpack all of the components.
2. Use the lift tool to lift the empty I/O enclosure onto the top of the Blue Gene/Q rack from the front of the rack.
3. Using the alignment slot, slide the I/O enclosure backwards until it is fully seated. See Figure 2-1.

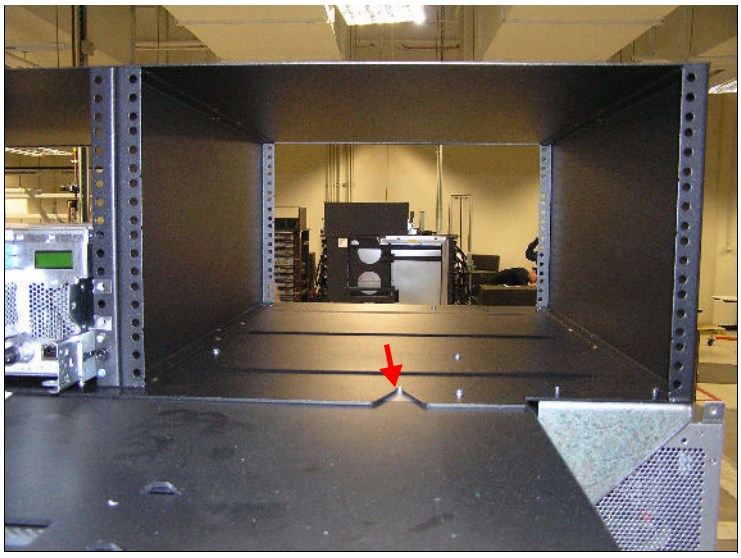


Figure 2-1 I/O enclosure alignment slot

4. Install the 11 screws (part number 97P5047) to fasten the I/O enclosure in place.

5. Install the I/O support bracket using four screws (part number 97P5047). Two screws are required for the I/O enclosure and two screws are required for the rack. This bracket is required if the rack is moved. See Figure 2-2.

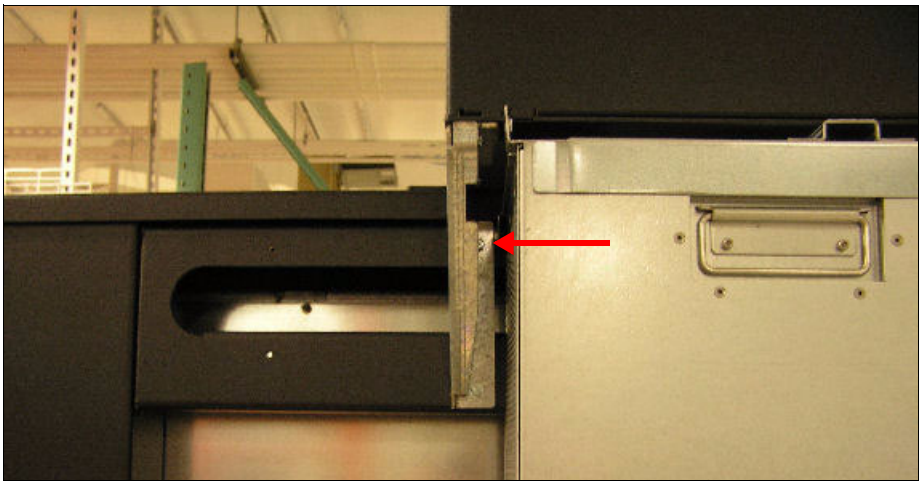


Figure 2-2 I/O support bracket

2.2 Installing an I/O drawer into an I/O enclosure

The lift tool is required for this procedure.

Attention: Do not operate the lift until after you read the owner's manual and are familiar with safe operation of the lift. The maintenance and repair of the lift are the customer's responsibilities. Contact the lift manufacturer for assistance.

Perform the following steps to install the I/O drawer into the I/O enclosure:

1. Install the I/O drawer rails into the appropriate I/O enclosure position:
   a. Remove the M6 screws from the back of the rails. See Figure 2-4 on page 48 for the screw locations.
   b. Position the rails in the enclosure.
   c. Install the nut clips (part number 74F1823) and M6 screws from the rail kit at the front of the enclosure. See Figure 2-3.

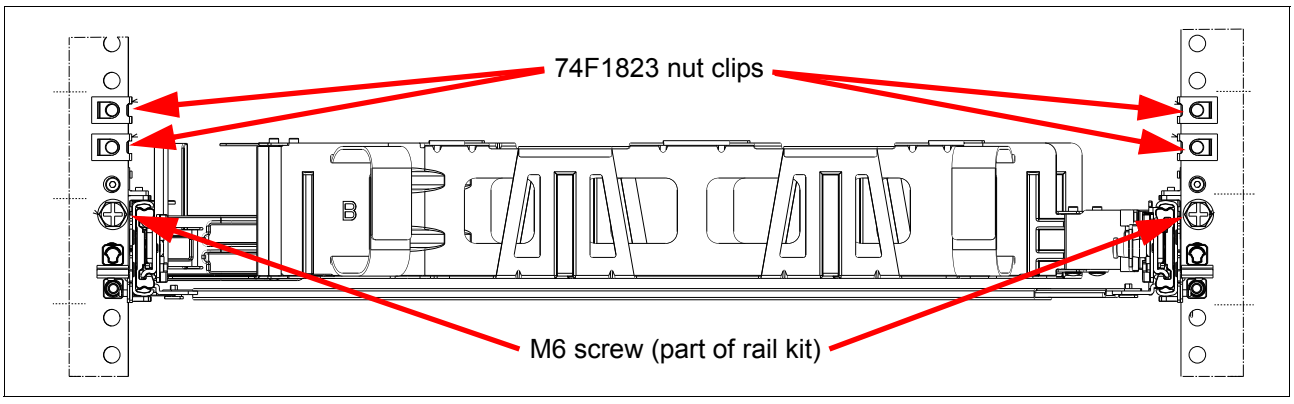


Figure 2-3 Screws and nut clips for the I/O enclosure rails (front)

d. Install the nut clips and the M6 screws from the rail kit at the back of the enclosure. See Figure 2-4.

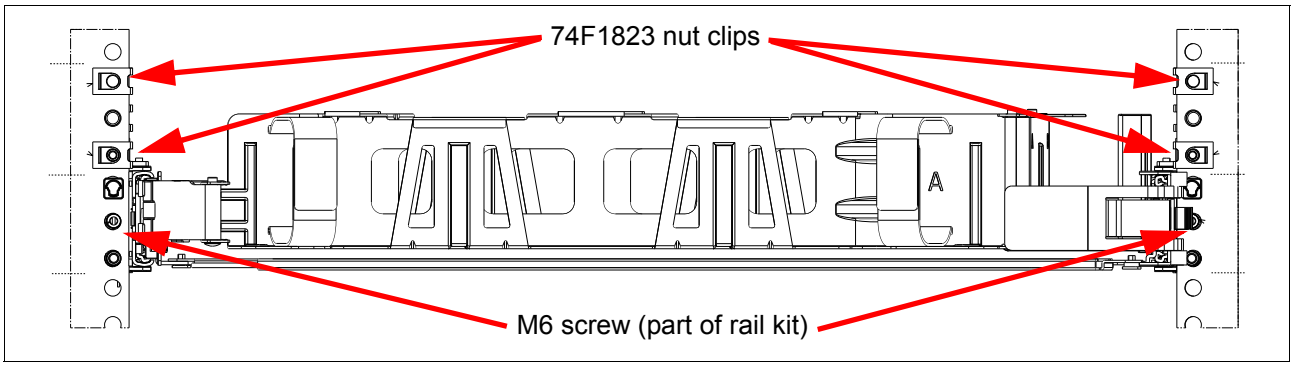


Figure 2-4 Screws and nuts for the I/O enclosure rails (back)

2. Use the lift tool to lift the drawer into position above the height of the drawer rails.
3. Extend the drawer rails fully until they are latched, below the drawer, and aligned with the drawer.

Attention: Slight adjustment of the lift tool position might be required. Avoid damaging surrounding cables and equipment when repositioning the lift.

4. Carefully lower the I/O drawer onto the drawer rails until the tabs on the drawer are fully seated and latched into the drawer rails.
5. Unlatch the drawer rails and slide the I/O drawer in until it is seated. The drawer latches automatically engage when the drawer is fully inserted.

6. Install the cable management arm. See Figure 2-5.

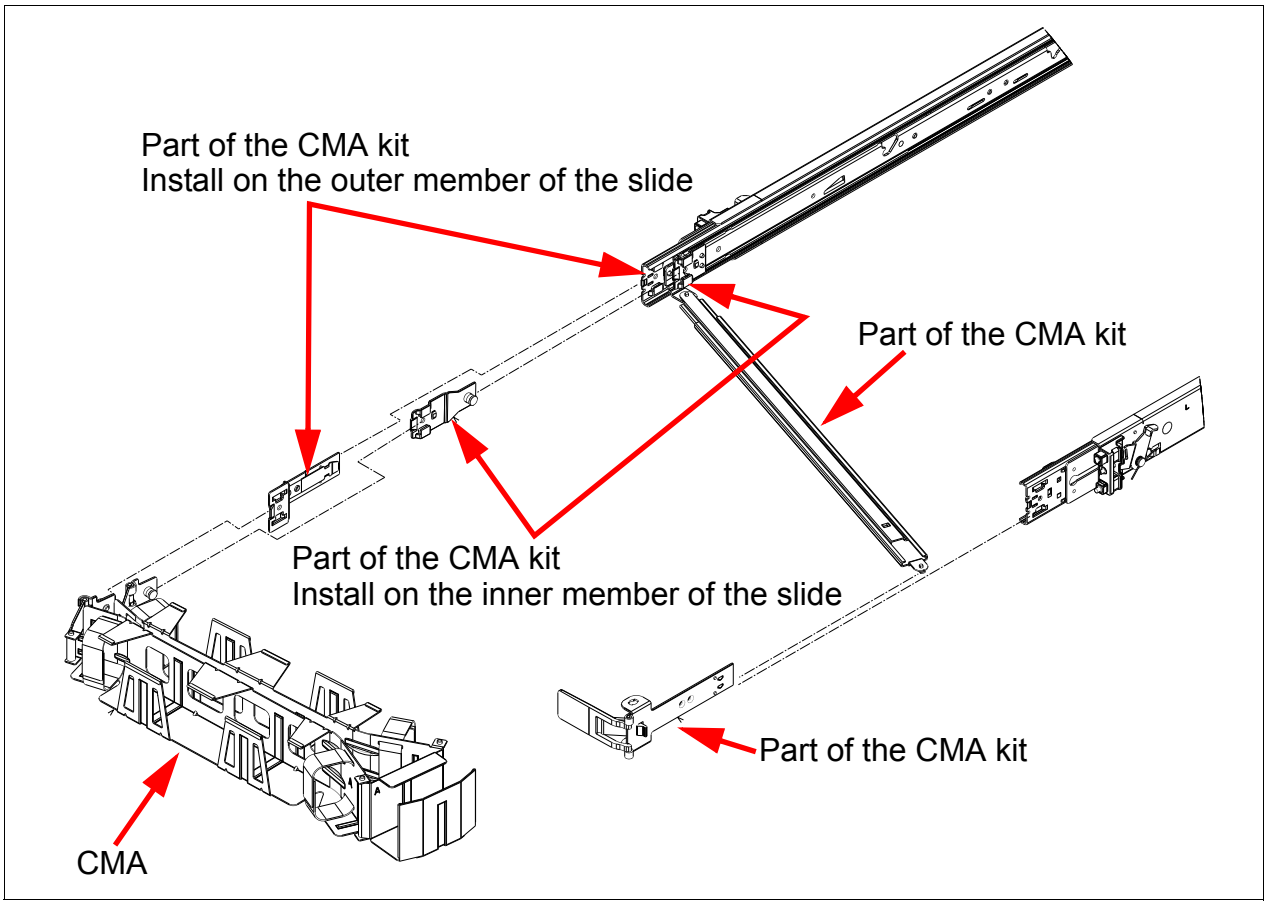


Figure 2-5 Cable management arm installation (rack not shown)

7. Install the I/O drawer interlock bracket. See Figure 2-6.

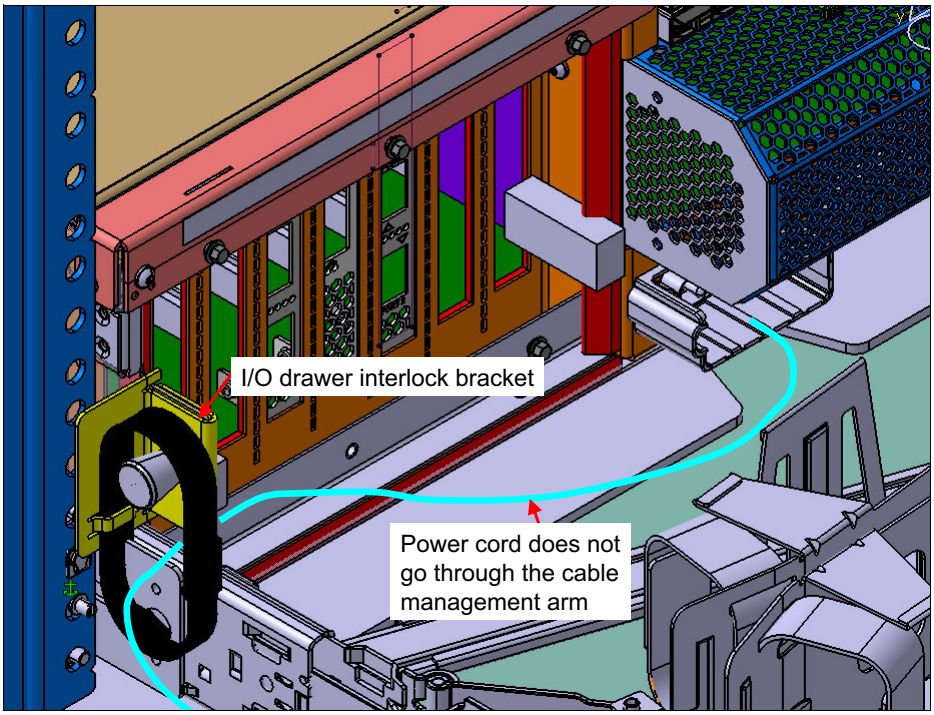


Figure 2-6 I/O drawer interlock bracket

8. Install the 51 V dc power cables and route them without using the cable management arm. See Figure 2-7.

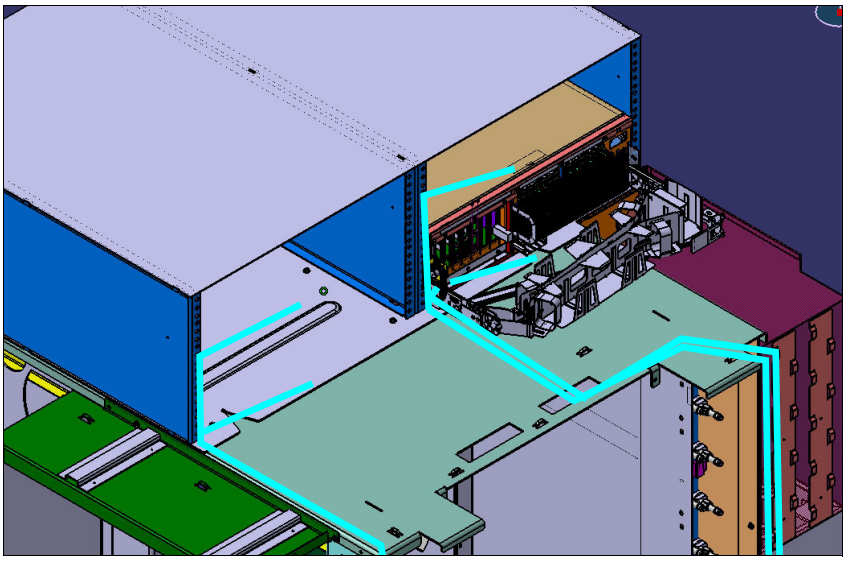


Figure 2-7 I/O enclosure 51 V power cable management

9. Connect all of the remaining cables (fiber, copper, and InfiniBand) according to the cabling plan. Route the cables through the cable management arm.
10. Install the EIA filler panels (97H9755) in the unused I/O drawer locations.

11. Ensure that the optional full-width filler panels on the front doors are NOT installed. The partial filler panels can be installed. The front of the I/O enclosures must have air flow through the front doors. Ensure that the filler panels on the rear door stay installed.

3

Installing an I/O rack

This chapter provides the installation procedure for the Blue Gene/Q (Machine type 0207, Model 200) 19" I/O rack with bulk power (FC 0215).

- Unpacking and installing an I/O rack
- Cabling the I/O rack
- Populating an empty I/O rack

3.1 Unpacking and installing an I/O rack

The I/O racks are shipped with a bulk power enclosure (BPE), bulk power modules (BPMs), and up to 10 of the 12 I/O drawers installed. If more than 10 drawers are ordered for the I/O rack, the top two drawers are not shipped in the rack. The drawers are shipped separately to prevent tipping.

The lift tool is required for this procedure.

Attention: Do not operate the lift until after you have read the owner's manual and are familiar with safe operation of the lift. The maintenance and repair of the lift are the customer's responsibilities. Contact the lift manufacturer for assistance.

Perform the following steps to unpack and install an I/O rack:

1. Remove the rack from the shipping crate using the ramps provided.
2. Place the rack into position, and extend and tighten down the rack leveler feet.
3. Remove the middle screw on the BPE front bezel to expose the BPM shipping bracket.

   Attention: Retain all the shipping brackets and all related hardware (nuts, bolts, washers, and other related parts). These parts might be required to protect the system if the rack is moved.

4. Remove the orange BPM shipping bracket.
5. Push all of the BPMs in until they are fully seated.

6. Replace the decorative bezel over the posts on the BPE using the keyhole slots on the bezel. Do NOT reinstall the screw PN 97P5047, but retain it with the packing materials for reuse if the rack is relocated. See Figure 3-1.

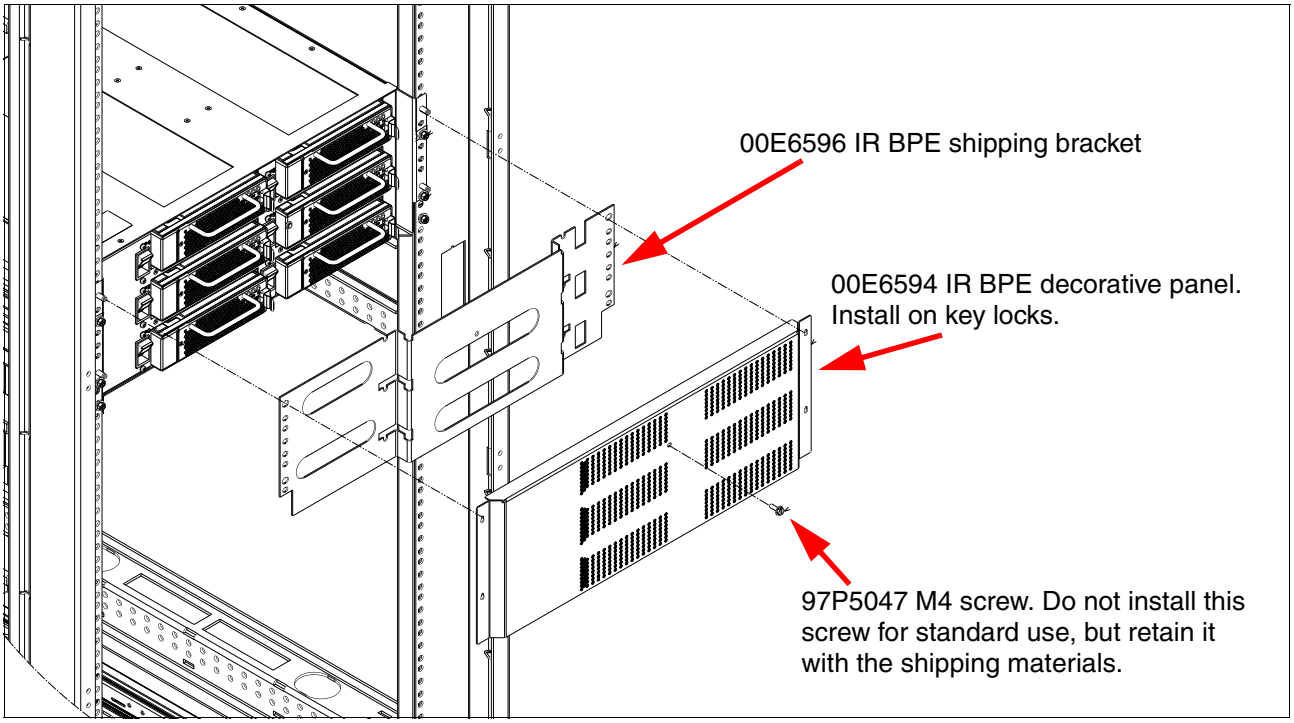


Figure 3-1 I/O rack front bezel and BPM shipping bracket

Attention: Retain all the shipping brackets and all related hardware (nuts, bolts, washers, and other related parts). These parts might be required to protect the system if the rack is moved.

7. Remove the I/O drawer shipping retaining brackets from each drawer location. The shipping brackets are installed on both sides of the drawer location.

   Figure 3-2 shows an I/O drawer shipping bracket.

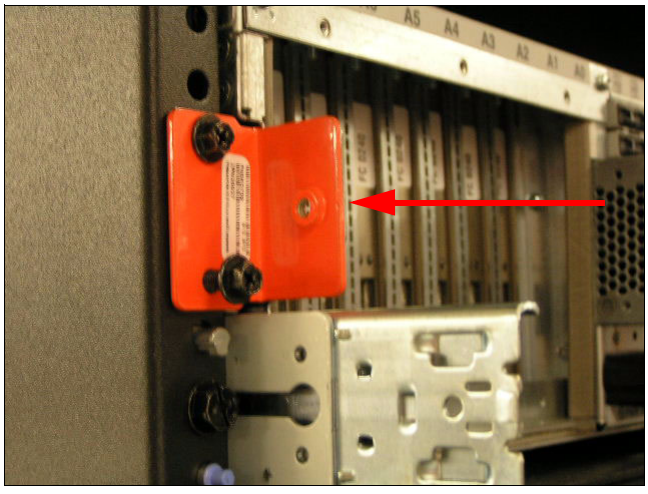


Figure 3-2 I/O drawer shipping bracket

8. Install the remaining two I/O drawer rails and the I/O drawer. See 2.2, “Installing an I/O drawer into an I/O enclosure” on page 47.
9. An I/O interlock bracket is required on each drawer. Install the interlock brackets where the orange shipping brackets were located. The bracket is installed on the rear, right side in an I/O rack and the rear, left side in the compute rack I/O enclosure (as viewed from the rear of the system). See Figure 3-3.

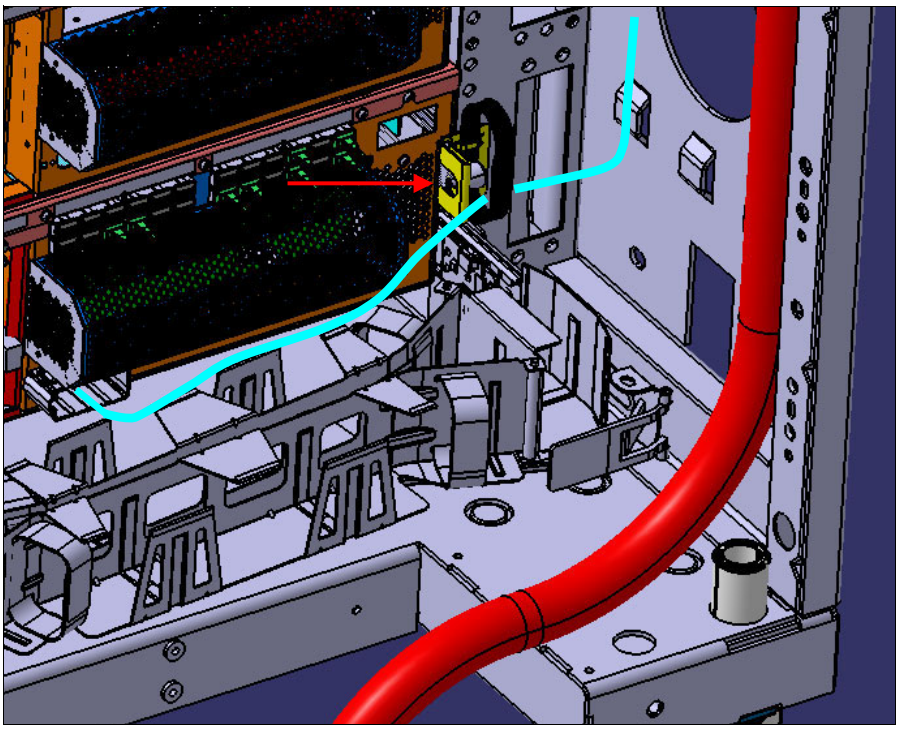


Figure 3-3 I/O drawer interlock bracket

10. Install the cable management arms. See Figure 3-4.

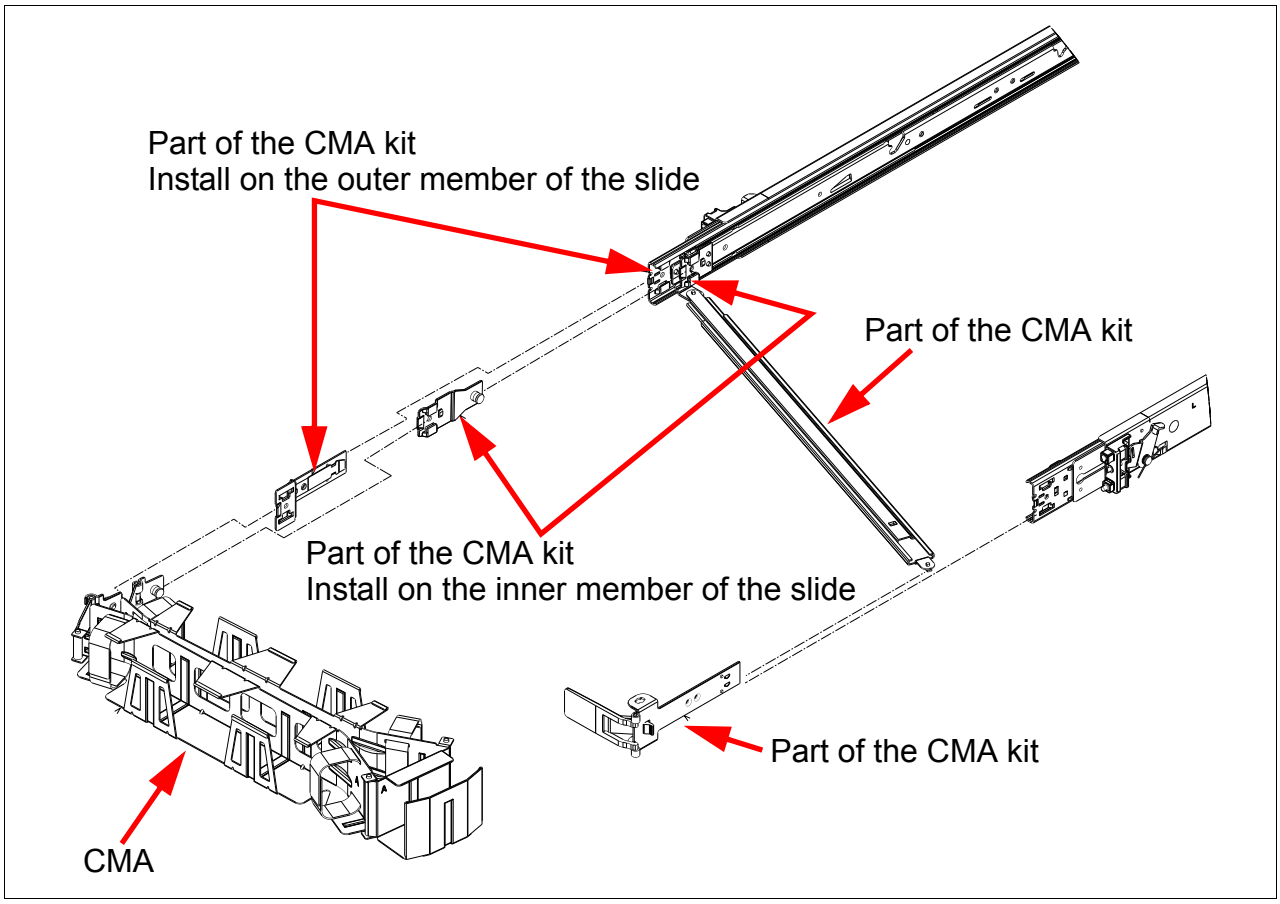


Figure 3-4 Cable management arms (rack not shown)

3.2 Cabling the I/O rack

Perform the following steps to install the BPE power cord, 51 V dc cables, fiber, and clock cables in the I/O rack:

1. Install the BPE power cord, but do not plug it into the facilities connector at this time. See Figure 3-5.

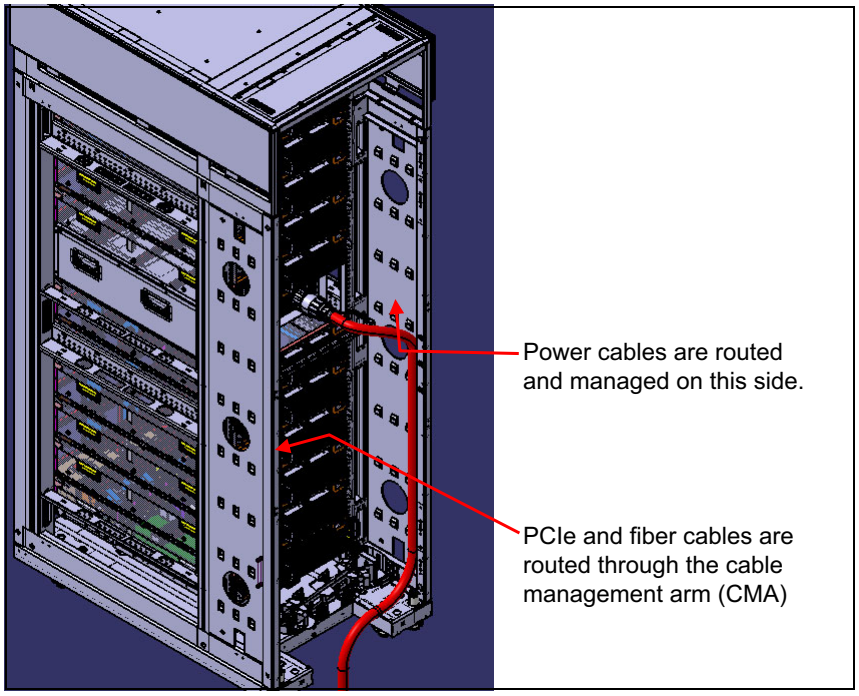


Figure 3-5 I/O rack BPE power cord

2. Route all cables except the 51 V dc cables through the cable management arm.

Attention: This routing allows the drawer to be fully extended on its slides with all cables, except the 51 V power cable, still plugged into the drawer.

3. Install the 51 V dc cables. See Figure 3-6.

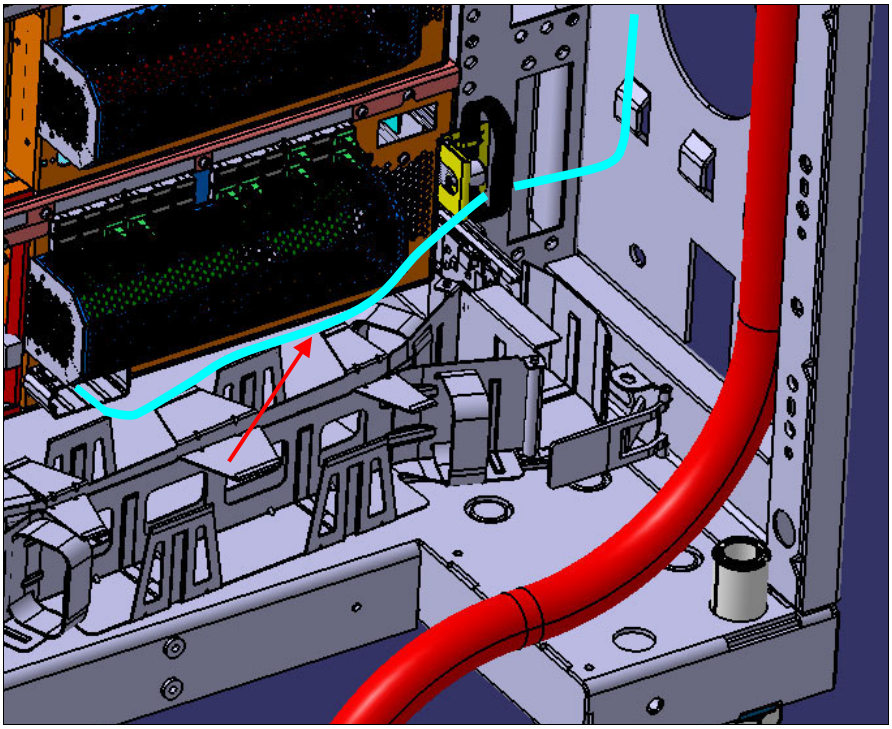


Figure 3-6 51 V dc cable management

4. Install the rest of the cables according to the cabling plan. See Figure 3-7 for the I/O rack locations.

   Figure 3-7 shows the naming convention for an I/O rack.

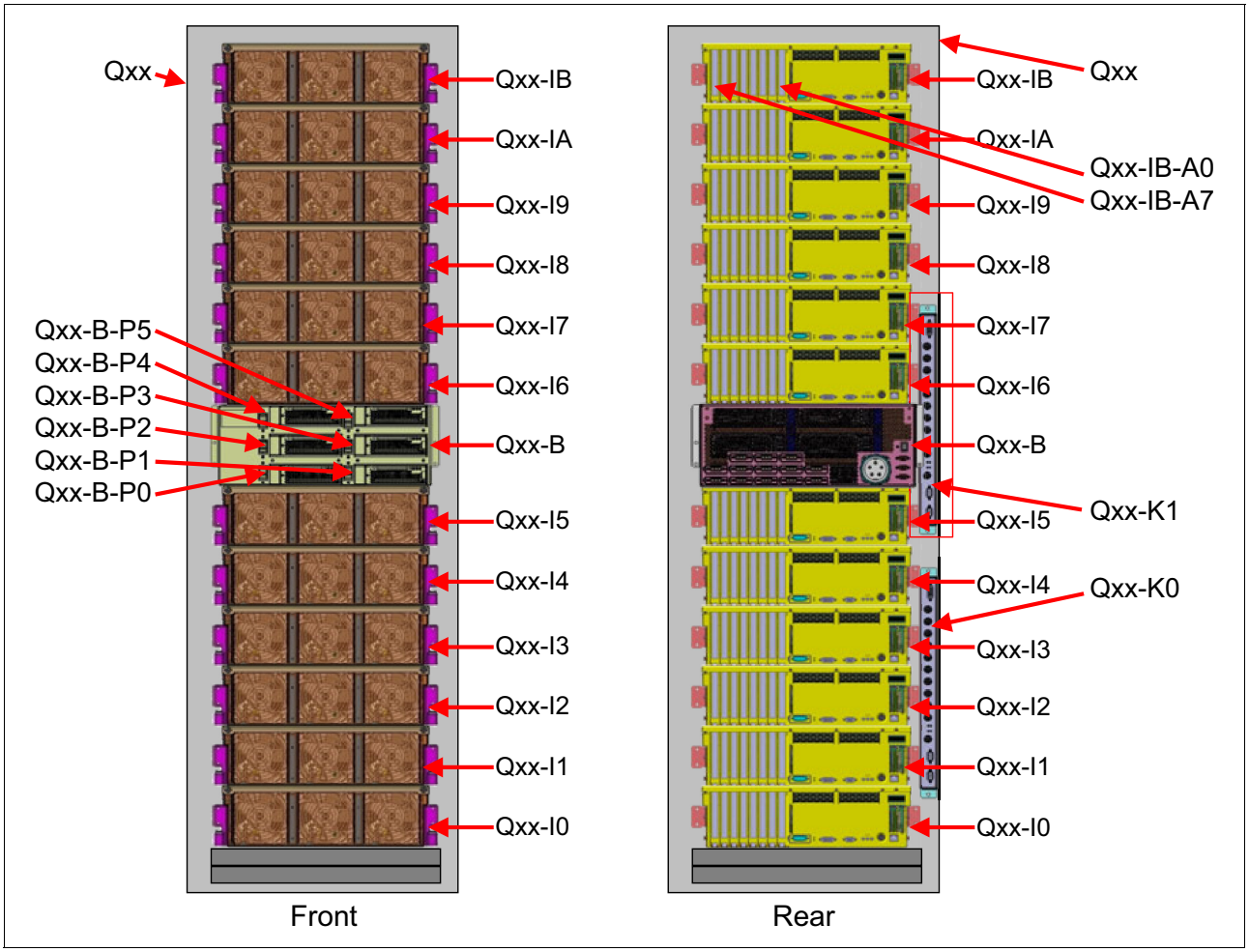


Figure 3-7 I/O rack naming convention

3.3 Populating an empty I/O rack

Use the tasks in this section to populate an empty Blue Gene/Q I/O rack for both above-rack and below-floor cabling.

3.3.1 Populating an I/O rack for below-floor cabling

Perform the following steps to install the I/O rack for below-floor cable trays. See Figure 3-8 on page 61 for information about the labels in this procedure:

1. Install clock K1.
2. Install clock K0 if it is used.

3. Install the BPE in U21 - U24. The BPE is 4 EIA units (U) high.

   Figure 3-8 shows the rack drawer positioning for below-floor cable management.

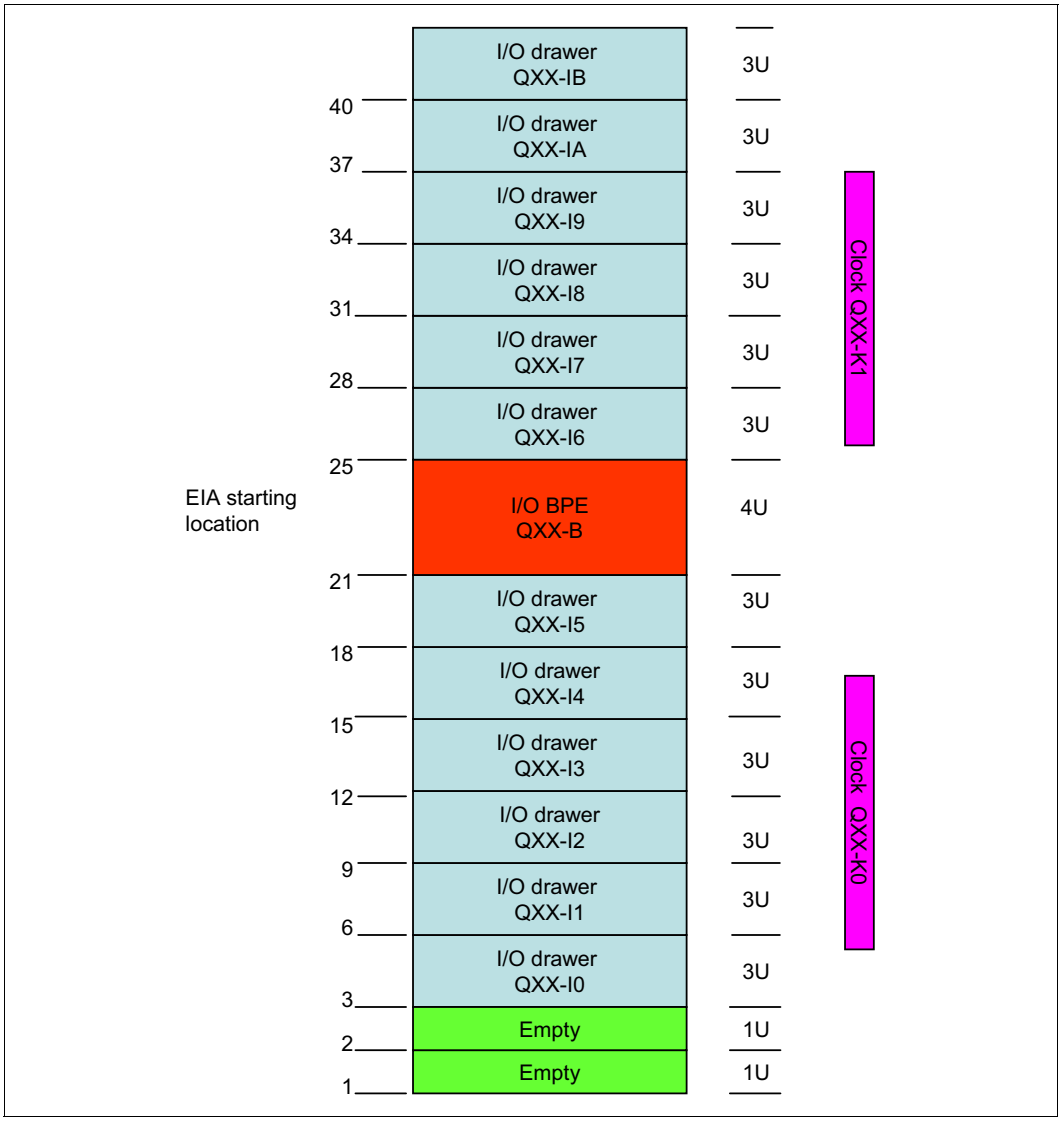


Figure 3-8 I/O rack population for below-floor cable management

   Install the I/O drawer Qxx-I5 first and then install the lower drawers leaving 2U empty on the bottom.

4. Install the I/O drawer Qxx-I6 and then install the rest of the upper I/O drawers. See Figure 3-8 for information about the rack drawer positioning. Install the cable management arms and interlock brackets.
5. Route the BPE power cord and all 51 V dc power cables.
6. Route all the fiber, clock, and InfiniBand cables according to the customer cabling plan.

3.3.2 Populating an I/O rack for overhead cabling

See Figure 3-9 for information about the labels that are used in this procedure. Perform the following steps to install the I/O rack for overhead cable trays:

1. Install clock K1.
2. Install clock K0 if it is used.
3. Install the BPE in U19 - U22. The BPE is 4U high.
4. Install the I/O drawer Qxx-I5, then install the remaining lower I/O drawers. Figure 3-9 shows the rack drawer positioning for overhead cable management.

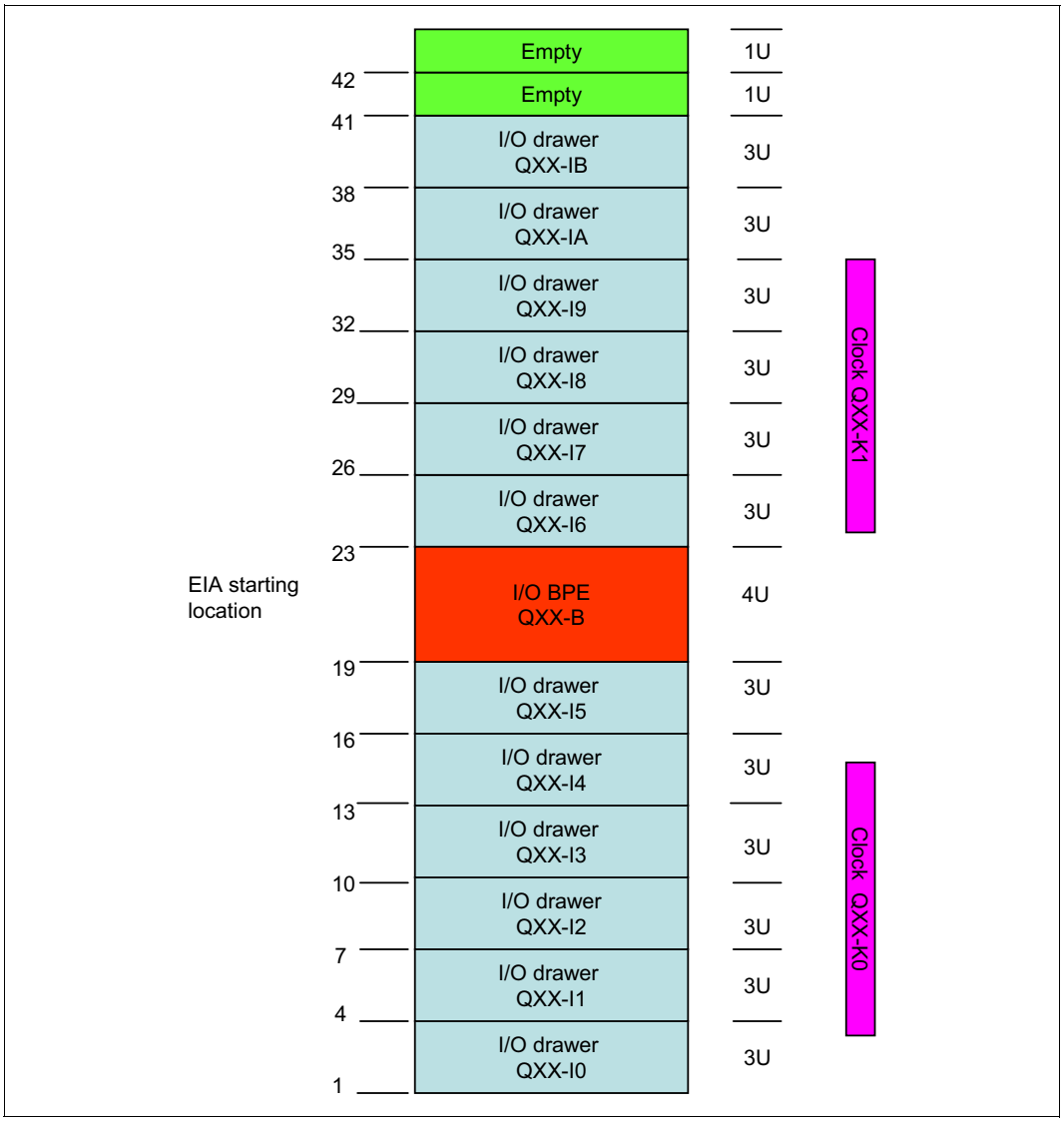


Figure 3-9 I/O rack population for above-floor cable management

5. Install the I/O drawer Qxx-I6.
6. Install the remaining upper I/O drawers. Leave 2U empty at the top of the rack. See Figure 3-9 for the rack drawer positioning. Install the cable management arms and interlock brackets.

7. Route the BPE power cord and all 51 V dc power cables.
8. Route all the fiber, clock, and InfiniBand cables according to the cabling plan.

4

Removing and replacing parts

This chapter describes the procedures for replacing field replaceable units (FRUs).

Important: Review the *IBM System Blue Gene Solution: Blue Gene/Q Safety Considerations*, REDP-4656 Redbooks publication before installing or servicing the system.

The Blue Gene/Q covers must be closed and locked after service.

This chapter contains the following sections:

- Service actions
- Blue Gene/Q component locations
- Disconnecting ac power cords
- Replacing a node board
- Draining coolant from a node board
- Replacing a compute card on a node board
- Replacing a direct current assembly
- Replacing a midplane
- Installing a midplane EMC insulator
- Replacing a service card
- Replacing a clock card
- Replacing a bulk power module
- Replacing a bulk power enclosure
- Servicing an I/O drawer
- Replacing a coolant monitor
- Performing flow sensor and hydrodynamic calibration and saving calibration data
- Performing hydrodynamic impedance calibration
- Replacing a pressure sensor
- Replacing an ambient air sensor
- Replacing a coolant manifold

4.1 Service actions

Replacing hardware on your Blue Gene/Q system requires the system administrator to perform a service action. Service actions prepare the hardware for removal or replacement by a trained IBM Systems Services Representative (SSR). When service actions are completed, the system administrator must run the appropriate service action command to return the equipment to customer operation.

Table 4-1 lists the service action commands for hardware maintenance.

Table 4-1 Service action commands for hardware maintenance

Hardware / Command	Node board	Node	Node DCA	I/O drawer	I/O node	PCIe adapter and fan	Master service card[a]	Other service card	BPM	Clock card	Other[b]
`ServiceNodeBoard`	X	X	X								
`ServiceNodeDCA`			X								
`ServiceIoDrawer`				X	X	X					
`ServiceMidplane`	X	X	X	X	X	X		X	X		
`ServiceBulkPowerModule`									X		
`ServiceRack`	X	X	X	X	X	X		X	X		
`ServiceClockCard`	X	X	X	X	X	X	X	X	X	X	X

a. This is the service card that controls the master clock card.
b. Any other hardware that requires tools to service (for example, bulk power enclosure, midplane, coolant monitor)

4.2 Blue Gene/Q component locations

The Blue Gene/Q locations have a front and rear format that is similar to the IBM Blue Gene/L® and IBM Blue Gene/P® formats. The main differences are the side mount for bulk power components and the relocation of the I/O to the compute rack I/O enclosure or a separate 19 inch I/O rack. See Figure 4-1 on page 67 and Figure 4-2 on page 68 for rack locations for a single compute rack. See also the location list Appendix A, “Hardware location naming conventions” on page 129.

Figure 4-1 shows the locations for the front of the rack.

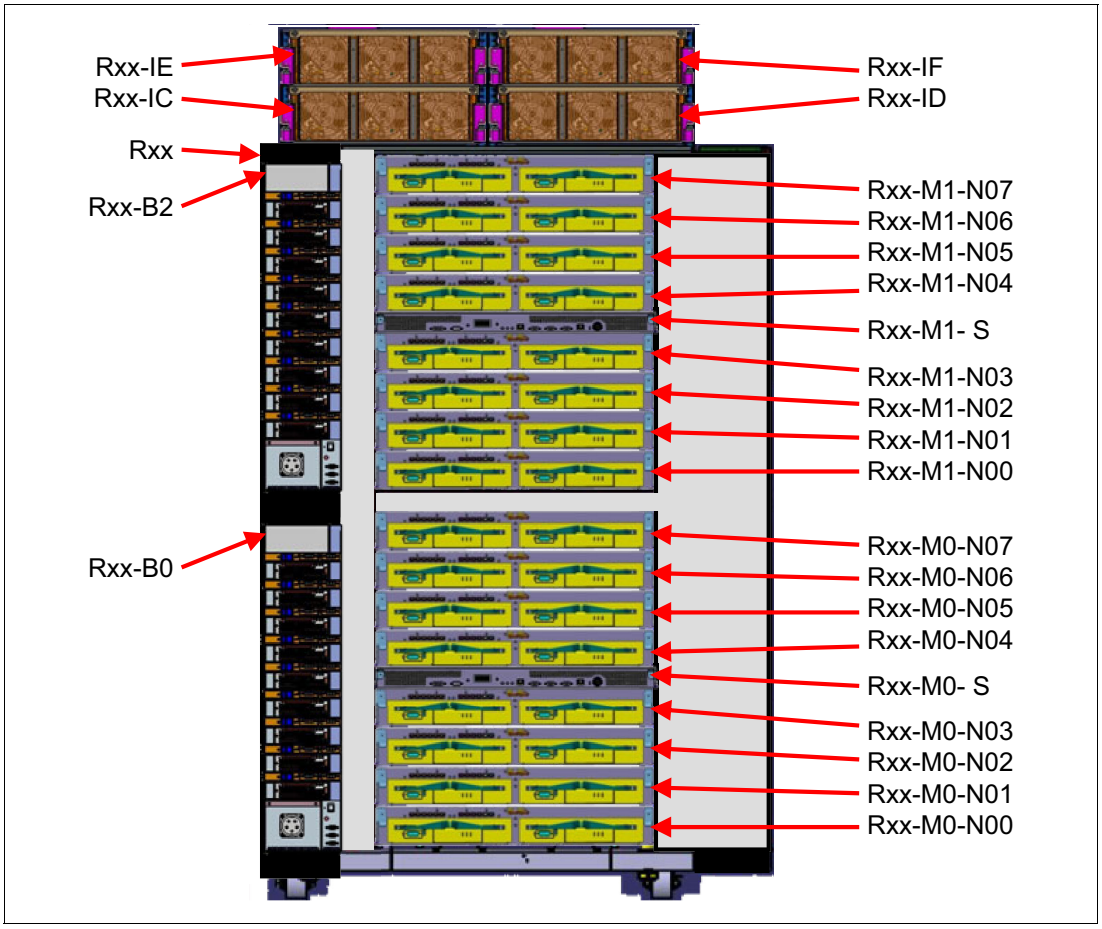


Figure 4-1 Blue Gene/Q component locations (front)

Figure 4-2 shows the locations for the rear of the rack.

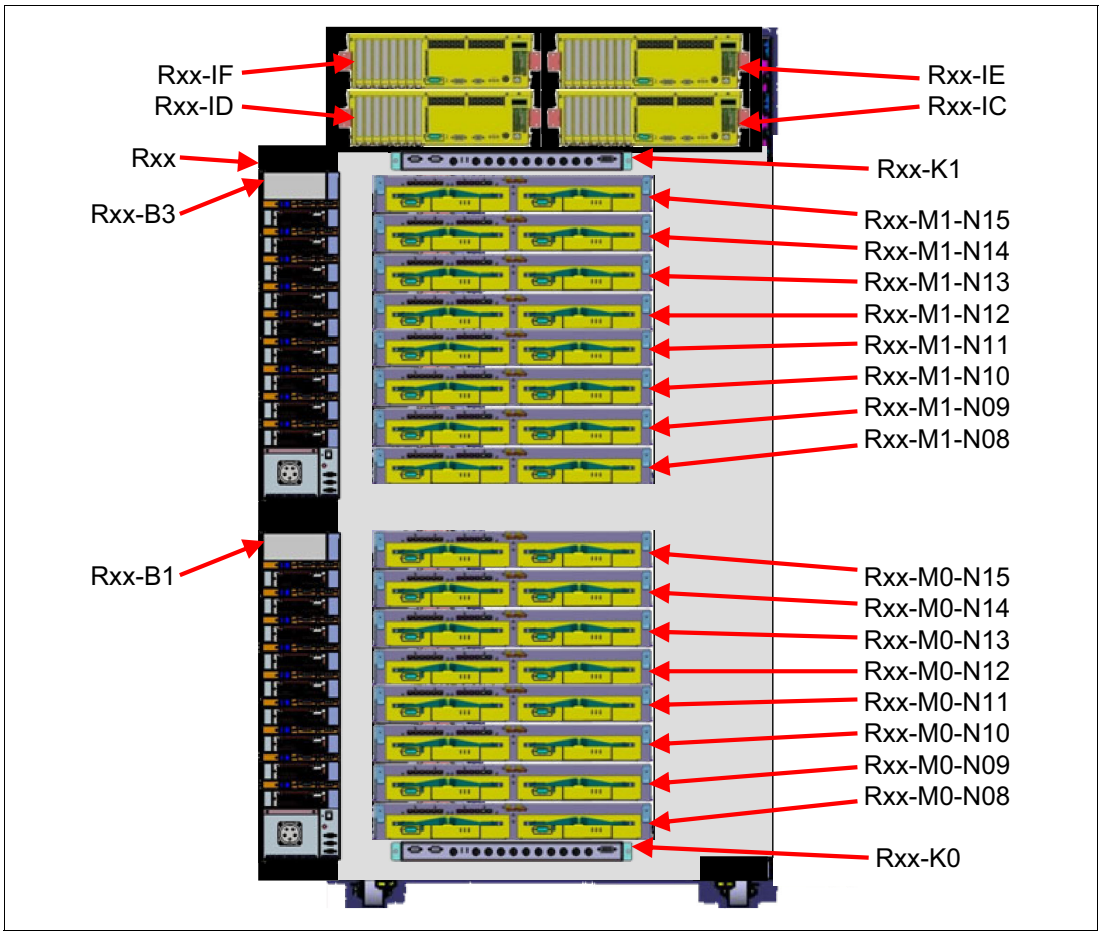


Figure 4-2 Blue Gene/Q component locations (rear)

4.3 Disconnecting ac power cords

Perform the following steps to disconnect the ac power cords:

1. If bgmaster is running, have the system administrator run the **`ServiceClockCard`** command.
2. Turn off the 51 V dc output switches for the BPE.
3. Turn off the BPM circuit breakers.
4. Turn off the facility circuit breaker.
5. Unplug the power cords from the facility connector.
6. Unplug the power cord from the BPE.

4.4 Replacing a node board

The lift tool is required for this procedure.

Attention: Do not operate the lift until after you read the owner's manual and are familiar with safe operation of the lift. The maintenance and repair of the lift are the customer's responsibilities. Contact the lift manufacturer for assistance.

Multiple node boards can be serviced concurrently with other operations, service actions, job running, and booting, on the same midplane.

Figure 4-3 shows a fully-populated node board.

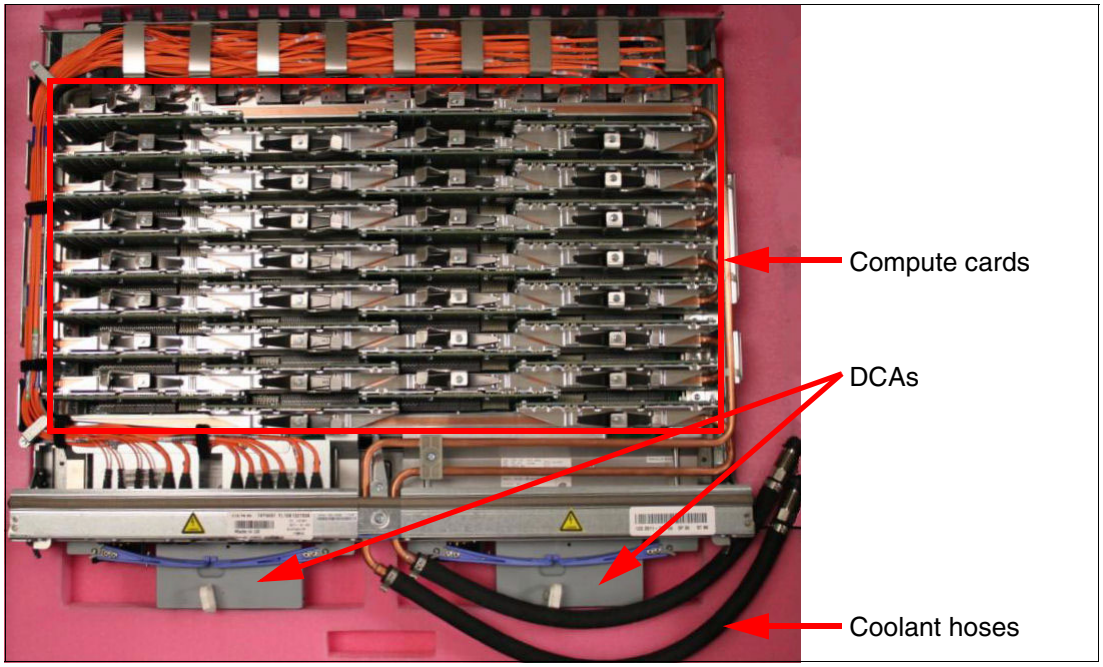


Figure 4-3 Node board

Figure 4-4 shows the locations for plugging the external cables into a node board.

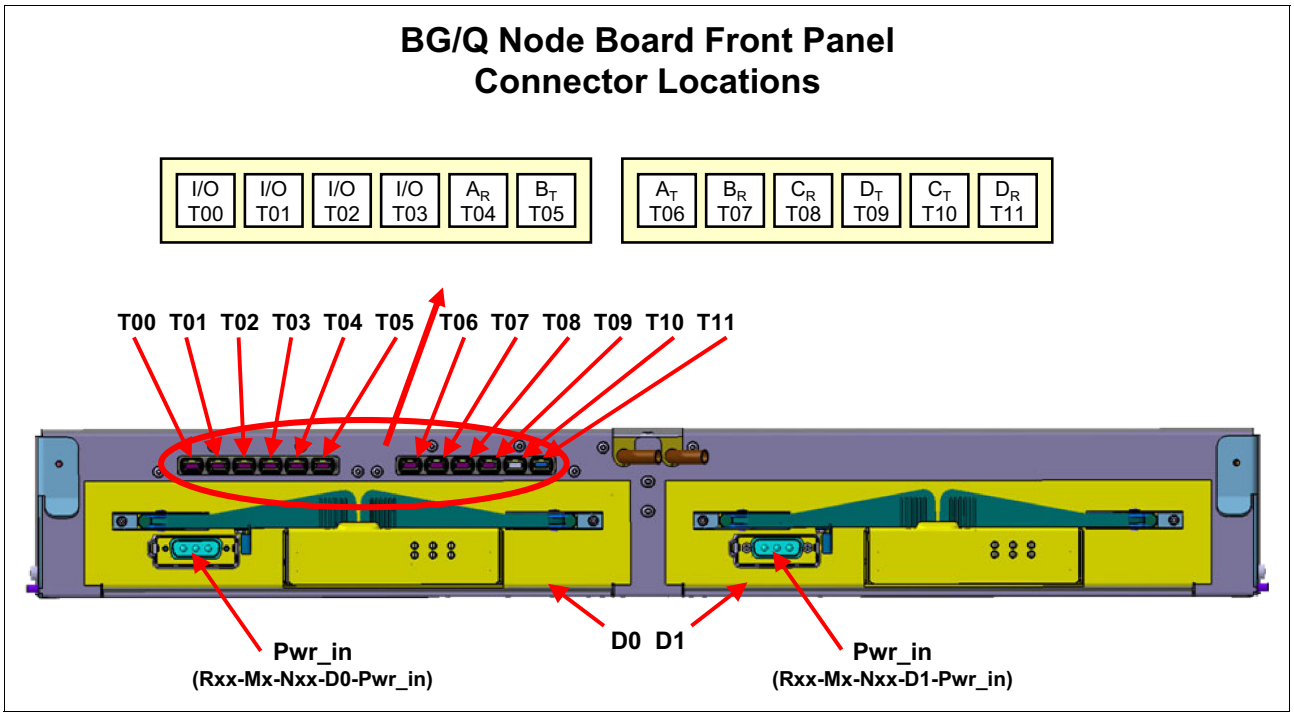


Figure 4-4 Node board front connections

Perform the following steps to remove and replace a node board:

1. Prepare the node board for service. Have the system administrator run the **`ServiceNodeBoard`** command, which powers off the node board and DCAs.
2. Locate the position of the node board, and verify the status of the DCA lights. Verify that the rightmost column of LEDs on both DCAs have the following status:
   - Green – any status (on, off, or blinking)
   - Amber – blinking
3. Ensure that all cables are labeled with the correct plug location before removing any cables.
4. Disconnect I/O and torus fiber cables from locations T00 – T11. Secure the cables away from the area that is being serviced. Ensure that the cable end caps are installed on all removed fiber cables and the related node board cable sockets as the cables are removed.

   Attention: Do not power off the Pwr 00 - Pwr 17 (51 V dc output) switches because the DCAs are supplied from a common power rail. Handle all 51 V dc cable connectors with extreme care because the 51 V dc voltage is still live in the cable.

5. Disconnect the 51 V dc power cables from the two node board DCAs and from the BPE.

Attention: Wear eye protection when connecting or disconnecting coolant connections.

When connecting or disconnecting node quick connects, do not stand directly in front of the connection. Stand to the side of the connection in a location where you can see the connection interface.

Disconnect the power cables before disconnecting the coolant hoses to prevent the node board from overheating and causing system damage.

6. Follow these steps to disconnect the two coolant hoses from the supply and return manifolds:
   a. Disconnect the two coolant hoses from the supply and return manifolds by pulling the quick connect retaining ring on the coolant hose.
   b. While gripping the node board quick connects, keep a firm grip on the hose assembly near the quick connect with fingers and thumb to maintain control of the hose for quick reconnect if needed. See Figure 4-5.
   c. Slide the quick connect retaining ring back to release the coolant hose from the manifold. Figure 4-5 shows the quick connects for the node board.

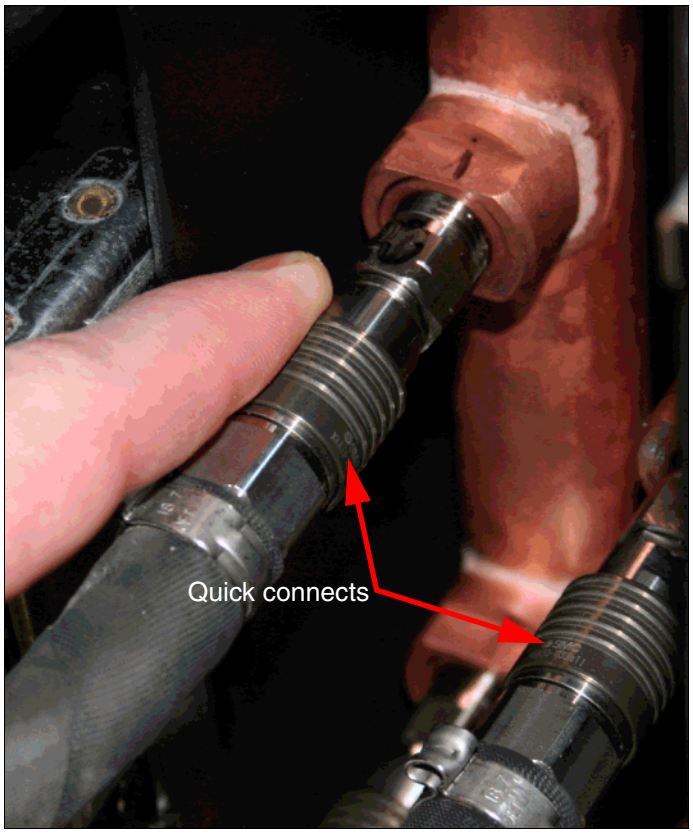


Figure 4-5 Node board coolant hose quick connects

   d. When disconnecting node board quick connects, disconnect them slowly.

      If coolant can be seen leaking from this location, immediately reconnect the fittings. Try slowly disconnecting the quick connect a few more times. Sometimes debris can cause a leak when the fittings are disconnecting. Reconnecting the fittings can often clear the debris.

If the quick connect is completely unplugged when the leak is evident, the leak can often be stopped by reconnecting the quick connect.

e. If the node board side of the quick connect does not work correctly, replace the node board:

   i. Disconnect the opposite hose quick connect that connects to the manifold.

   ii. Disconnect the quick connect that is determined to be bad, and hold this quick connect higher than the node assembly.

   Disconnecting in this order mitigates the future leak to less than 0.1 gallons. The only coolant that typically leaks out at this point is due to some pressure that is built up in the node board. Connect the node drain hose and bucket to the node board quick connect to allow as much coolant to drain out as possible.

f. If the manifold side quick connect does not work correctly, slowly disconnect the quick connect a few more times. Sometimes debris can cause a leak when the fittings are disconnecting. Reconnecting the fittings can often clear the debris. If the quick connect still does not work correctly, replace the entire manifold.

7. Remove the node board by sliding the locking latch out of the way and lifting the cam arms. See Figure 4-6. While holding the cam arms up, pull the node board two inches out of the frame.

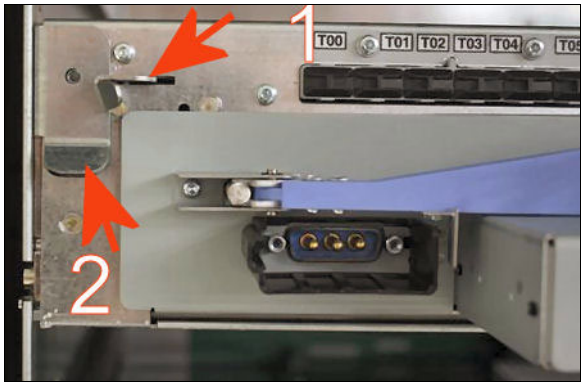
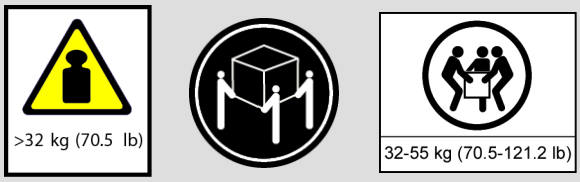


Figure 4-6 Node board retaining latches

CAUTION:
The weight of this part or unit is between 32 and 55 kg (70.5 and 121.2 lb.). It takes three persons to lift this part or unit. (C010)



A compute rack node board weighs approximately 73 lbs. and can be positioned at a height of 67 inches when installed in the system (overhead). Ensure proper handling methods and or equipment are used when removing or replacing a node.

8. Raise the lift tray level with the base of the node board and the node board slot. The lift tray must be within 1/4 inch (6 mm) of the bottom of the node board being removed. Before removing the node board, adjust the lift until you have this relationship.

   The tray of the lift tool must be within 1/4 inch (6 mm) of the bottom of the node board to prevent it from dropping down onto the node board below and being damaged. If the tray is not high enough, the contact with the node board below is likely to cause damage that requires replacement of the node board that is being removed.

   Important: Ensure that the lift tool does not interfere with system cables or components as it is being raised, lowered, or otherwise positioned.

   As the node board is pulled out and disengages from the rails in the card cage, it is still supported by the tailstock of the node card below it. Ensure that the lift is high enough to prevent the node board from falling and damaging the hose clamp on board below the board that is being removed.

9. Slide the node board onto the lift tool tray.
10. Transfer the node board to a flat, stable surface.
11. Transfer the compute cards to the new node board. See 4.6, “Replacing a compute card on a node board” on page 75 for instructions to remove and replace compute cards.
12. Transfer the DCAs to the new node board. See 4.7, “Replacing a direct current assembly” on page 81 for instructions to remove and replace DCAs.
13. Replace the node board using the supplied lift tool:
    - Align the lift tool tray with the base of the node board slot and slide the node board into the midplane.
    - Remove the lift tool.
    - Evenly pivot the cam arms closed and ensure that the latches secure the cam arms.
14. Reconnect the coolant hoses.

    Attention: Always connect the coolant hoses **first** (before the DCA cables are connected) to protect the node board from overheating and potential component damage.

    Perform the following steps to connect the air bleed tool to the node board:

    a. Locate one of the four air purge hoses and one of the two air purge assemblies. See Figure 1-23 on page 18.
    b. Attach the air purge hose to the air purge assembly.
    c. Loosen the small vent cap on the air purge assembly two turns for correct venting.
    d. Attach the node board return hose (the far-right hose exiting the node board) to the other connector on the air purge assembly.
    e. Keep the air purge assembly upright (vent cap at top).
    f. Attach the node board supply hose (the far-left hose coming out of the node board) to the supply manifold in the rack (the far-right manifold pipe).
    g. Listen for air release, and check for coolant leaks.

       Attention: You might not hear any of the air being vented, but ensure that the vent cap was loosened.

h. Attach the other end of the air purge hose to the return manifold in the rack (the far-left manifold pipe).

i. Leave the kit connected for a minimum of one minute, but no longer than two minutes.

j. Disconnect the node board return hose from the air purge device, disconnect the air purge hose from the rack return manifold, and immediately connect the node board return hose to the rack return manifold.

15. Check all hoses for leaks, and verify that they are connected correctly.
16. Reconnect the 51 V dc cables to the two node board DCAs and to the BPE.
17. Remove protective caps from fiber cables and connector locations on node board as you reconnect fiber cables to locations T00 - T11.
18. Verify that the cables are connected correctly.
19. Have the system administrator run the **ServiceNodeBoard** command to end the service action. The command powers on the DCAs and the node board.

4.5 Draining coolant from a node board

Node boards must be drained of all coolant before shipment to prevent freezing. In addition, the coolant is a chemical. Do not ship it. It is the customer's responsibility to dispose of the coolant.

There are two methods for the draining procedure: manually draining the board or using compressed air to drain the board.

The following tools are required for the node board drain procedure:

- Node drain hose (part number 00E6022)
- Node air inlet fitting (part number 00E6135)
- Waste bucket (part number 00E6039)
- Safety goggles and latex gloves

See Figure 1-22 on page 18 for pictures of the parts.

4.5.1 Manually draining coolant from node boards

Perform these steps to manually drain coolant from node boards:

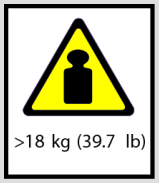
Attention:
This procedure requires three people.

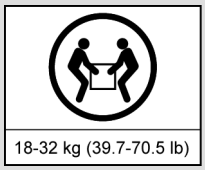
1. Ensure that all compute cards and DCAs are removed from the node board.
2. Thread one end of the drain hose (part number 00E6022) to the waste bucket. Connect the other end of the drain hose (the quick connect) to the return hose.
3. Raise the node board coolant supply hose above the node board, and attach the node air inlet fitting (part number 00E6135).

   Attention: If the node air inlet fitting is not plugged into the hose at a higher level than the node card, initial spilling might occur.

4. Have one person hold the node air inlet fitting above the level of the node board.

CAUTION:
The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)





5. Have two people hold the node board tilted down such that the coolant hoses are at the lowest point. Tilt the node board side to side 12 - 20 times to drain all coolant from the node board.
6. Disconnect all hoses and provide the drained coolant to the customer.

The customer must correctly dispose of the drained coolant according to the customer company guidelines and applicable laws and regulations.

4.5.2 Using compressed air to drain coolant from node boards

This procedure describes how to drain a node board with compressed air:

Prerequisite: The SSR or customer must provide the compressor or compressed air source.

1. Set the air source to 25 PSI. Open the valve to let air flow freely in the ambient atmosphere to ensure that 25 PSI is being supplied.
2. Thread one end of the drain hose (part number 00E6022) to the waste bucket. Connect the other end of the drain hose (the quick connect) to the return hose.
3. Attach the air source hose to the node coolant supply hose with the node air inlet fitting (part number 00E6135).
4. Let the air flow for at least one minute or until all coolant is purged from the node board.
5. Disconnect all hoses.
6. The customer must correctly dispose of the drained coolant according to the customer company guidelines and applicable laws and regulations.

4.6 Replacing a compute card on a node board

Perform the following steps to remove and replace a compute card on the node board:

1. Follow the node board replacement procedure in 4.4, “Replacing a node board” on page 68 to remove the node board and transfer it to a secure, flat surface.

2. See Figure 4-7 for the compute card locations. Verify the location of the compute card because the node board is not labeled with location codes.

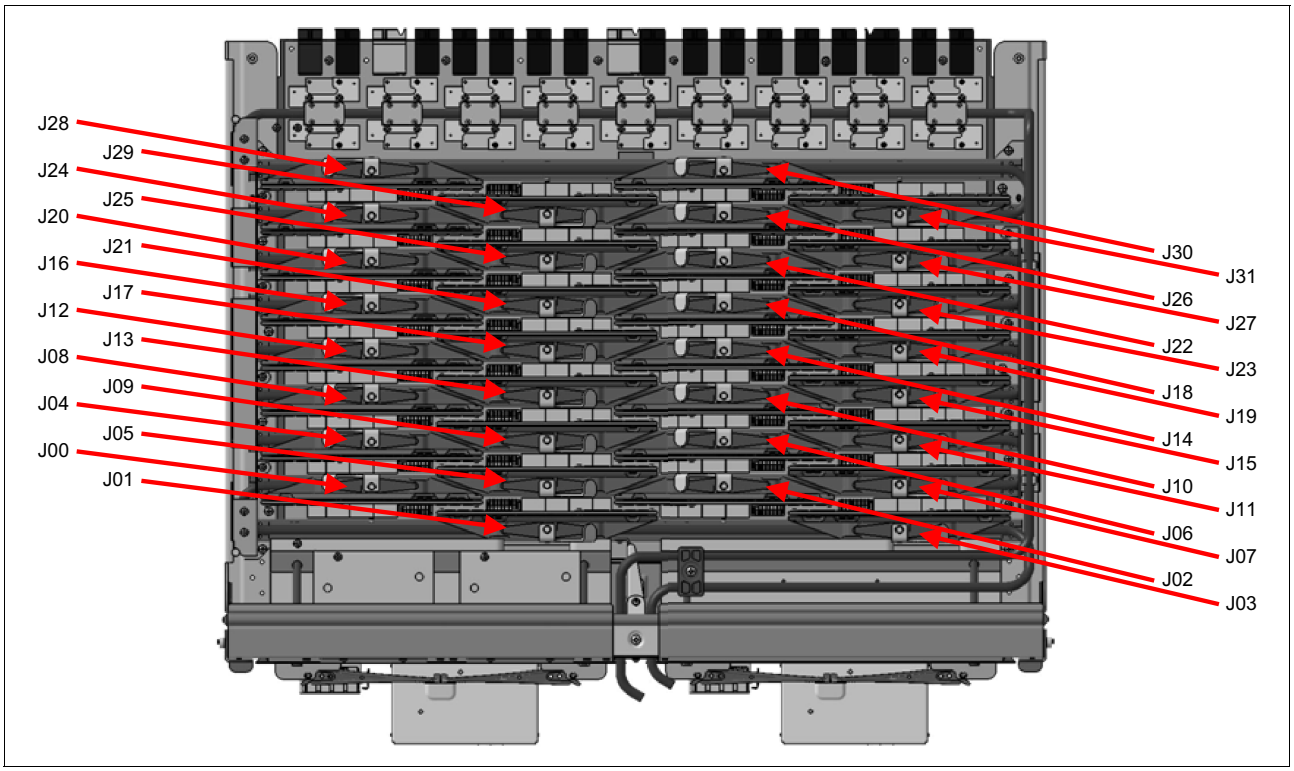


Figure 4-7 Compute card naming locations

3. Use a 5 mm wrench, socket, or nut driver to loosen the screw in the compute card retention bracket until the bracket moves freely. Do not completely remove the screw. See Figure 4-15 on page 80.

   Figure 4-8 shows the screw for the compute card retention bracket.

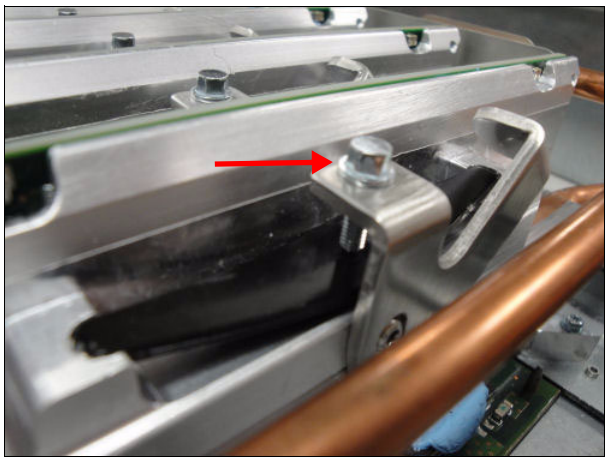


Figure 4-8 Compute card retention bracket M3.5 screw

Attention: DO NOT LIFT THE CARD OUT BY THE LATCH HANDLE. DAMAGE TO THE CARD OR NODE BOARD CONNECTORS MIGHT OCCUR. Remove the compute card by moving the latch handle until the part of the latch handle without the screw is straight above the compute card. Grasp the ends of the card. Be careful not to crush the modules on the card. Gently rock the card to the front and rear (DO NOT ROCK THE CARD SIDE TO SIDE) to break the seal between the thermal interface material (TIM) and the cold plate. Lift gently and evenly at each end of the card while gently rocking the card front to back (NOT side to side) and lift it out of the node board.

4. Remove the compute card.
5. Inspect all node board and compute card connectors for damage or debris.
6. Inspect the thermal interface material (TIM) on the replacement compute card per details, below. If creases are present, replace the TIM (part number 74Y6432) with a new TIM.

   Small indentations are acceptable. It is normal to see the clay colored TIM around the outside border. Note that indentations are more acceptable on the left and right sides of the TIM. It is more important for the middle to be smooth (see the red lines for an approximate range). Wrinkles on the end are acceptable. Figure 4-9 shows an acceptable TIM.

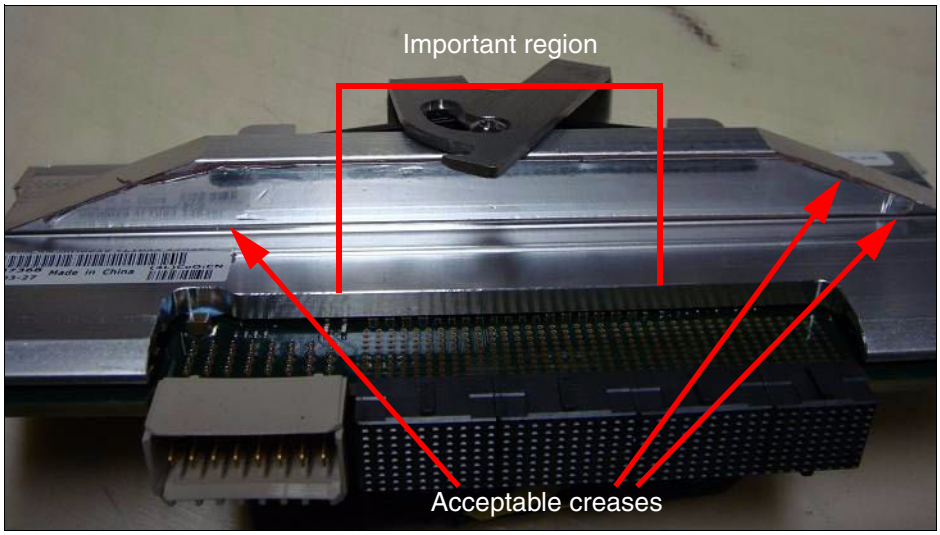


Figure 4-9 Acceptable compute card TIM material

The indentation is marginal. The acceptability depends on the location and the temperature at which the card is running.

If the foil on the TIM is torn enough to make the aluminum spreader visible at any location, the TIM must be replaced.

Figure 4-10 shows compute card TIM material that must be replaced.

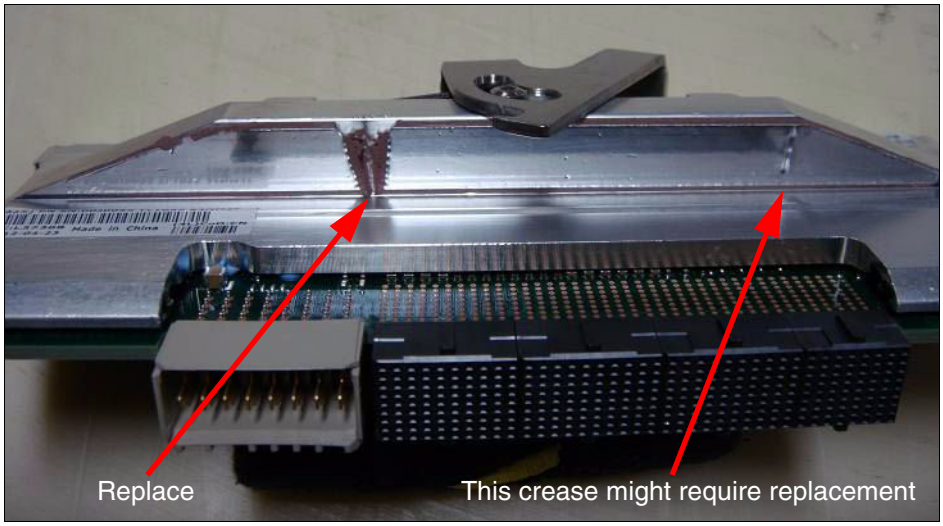


Figure 4-10 Compute card TIM material that should be replaced

The compute card TIM might need to be replaced if there is a noticeable indentation, but it is smaller than the indentation shown in Figure 4-10. Base the decision to replace this TIM on the reported compute temperature. If this compute card is running significantly hotter than neighboring compute cards, replace this TIM.

If the foil is damaged and rolled, the TIM material must be replaced. Figure 4-11 shows damaged TIM foil.

Figure 4-11 Compute card TIM with damaged foil

Figure 4-12 shows an indentation that is deep and wide, which sacrifices thermal transfer. It is also located in the critical region of heat transfer. This TIM must be replaced.

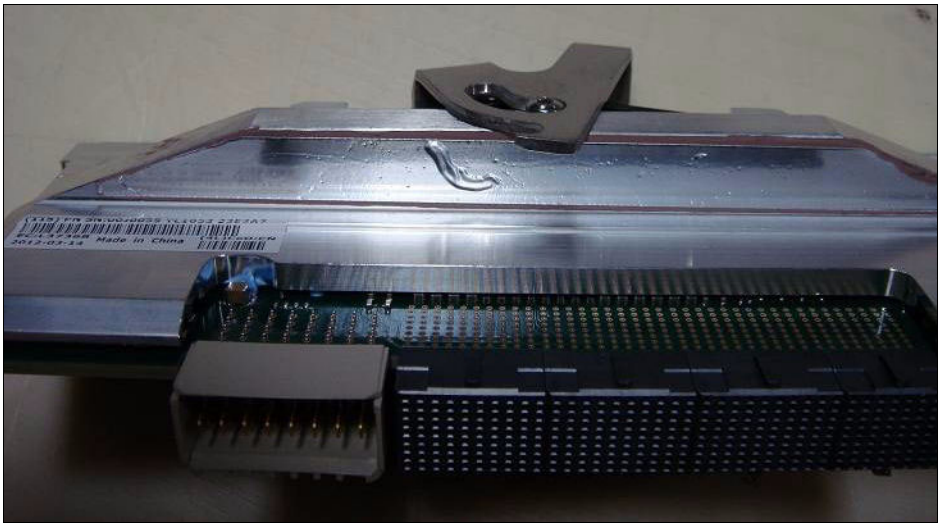


Figure 4-12 Compute card TIM with large indentation

When the TIM rolls onto the vertical surface, the TIM must be replaced. This rolling causes the compute card to sit unevenly on the node cooling structure. See Figure 4-13.

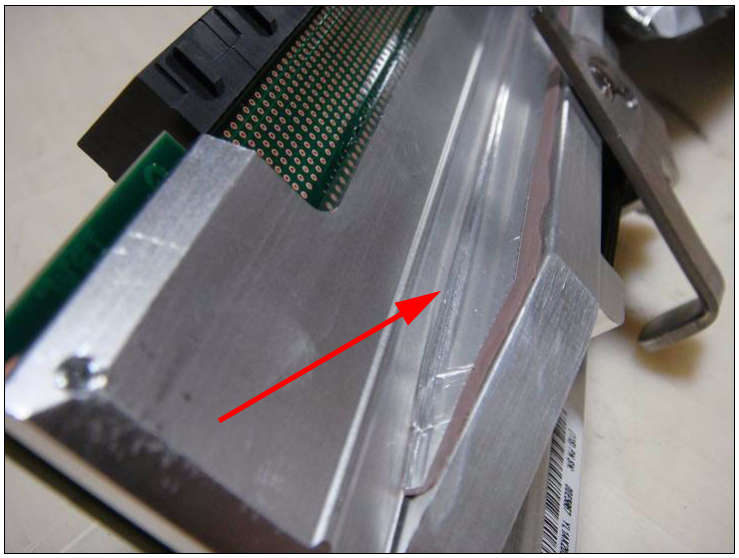


Figure 4-13 Compute card TIM material that is rolled onto the vertical surface

The replacement compute card part has a plastic film over the TIM that must be removed before placing the part in the node board. Also, if it is necessary to replace the TIM, the replacement TIM material has a plastic sheeting over the foil surface of the TIM. This plastic protects the TIM from damage during shipping and handling. Remove it from the foil on the TIM after the TIM is installed onto the compute card and before installing the compute card or DCA in the machine.

During system operation, an oily silicone substance might seep out of the compute card TIM and onto the cold rail. This oily substance is not harmful to humans, but it attracts sulfur in the atmosphere, which might cause solder corrosion. During compute card

replacement, use a clean wipe to remove any oily substance from the cold plate before plugging the replacement compute card into the node board.

Attention: Be careful to avoid bending pins when installing compute cards. Use two hands to insert the compute card parallel to the node board. Do *not* tip the compute card during insertion or drag the compute card from side-to-side. Either motion can catch and bend the compute card power blades. This pre-bending of power blades can cause them to bend when the card is inserted into the node board connector.

If resistance is detected during insertion, do not continue to press the compute card into the node board. Pull it out and inspect it before attempting to insert it again or before driving in the compute latch retention screw (see Figure 4-8). Use care to avoid contacting the blades of the power connector, which can cause misalignment and bend the blades, the connector, or both.

7. Manually insert the replacement compute card. Note the previously mentioned concerns. Ensure that the connector is fully seated by hand before the latch is actuated and the screw is tightened.

   Do not use either the latch or the screw to seat the connector. The latch is designed only to retain the card firmly in position, and the screw is designed only to compress the TIM against the cold plate.

8. Tighten the retention bracket screw with a 5 mm nut driver. Tighten the screw until the screw head snugly contacts the sheet metal latch.

   Figure 4-14 shows the compute card cam latch.

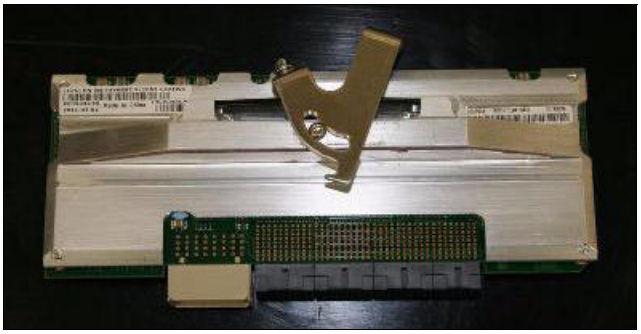


Figure 4-14 Compute card cam latch

Figure 4-15 shows the latch pin for a compute card on a node board.

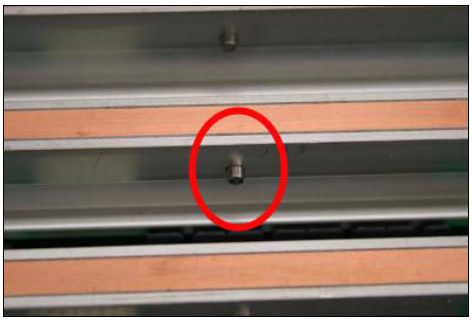


Figure 4-15 Latch pin for a compute card on a node board

9. Follow the node board replacement procedures to insert the node board into the midplane.
10. Have the system administrator run the **ServiceNodeBoard** command.

4.7 Replacing a direct current assembly

It is possible to service a direct current assembly (DCA) while the node board is operational because two DCAs are installed on a node board and N + 1 redundancy is supported. To service a DCA:

1. Prepare the DCA for service. Have the system administrator run the **ServiceNodeDCA** command. This command turns off the specified DCA, but the node board remains functional.
2. Locate the DCA to be replaced, and verify the status of the DCA lights. The two middle column DCA Status LEDs must show:
   - Green – solid, blink, or off
   - Amber – blink
3. See Figure 4-16, Table 4-2, Table 4-3, and Table 4-4 on page 82 for information about the DCA LED indicators for the node board. Figure 4-16 shows the DCA LED indicators.

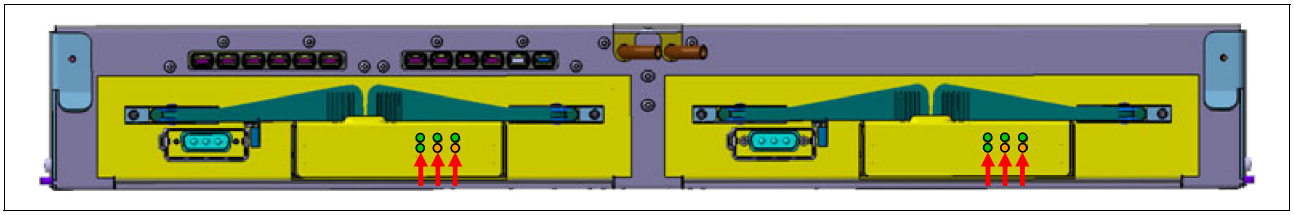


Figure 4-16 DCA LED indicators

Table 4-2 lists the values for the left column of DCA LEDs. These LEDs indicate the power input status for the DCA.

Table 4-2 DCA LED indicators for power input status, left column

Condition	Upper green LED	Lower green LED
No input power	Off	Off
Receiving 12 V power Not receiving 48 V power	On	Off
Not receiving 12 V power Receiving 48 V power	Off	On
Receiving all power	On	On

Table 4-3 lists the values for the middle column of DCA LEDs. These LEDs indicate the DCA status.

Table 4-3 DCA LED indicators for DCA status, middle column

Condition	Upper green LED	Lower amber LED
No input power to the DCA card	Off	Off
Microcontroller is running, No power domains are on	Blink (1 Hz)	On

Condition	Upper green LED	Lower amber LED
The DCA is functioning normally	On	Off
Node board is prepared for service (the node board can be removed)	Any	Blink (1 Hz)

Table 4-4 lists the values for the right column of DCA LEDs. These LEDs indicate the node board status.

Table 4-4 DCA LED indicators for node board status, right column

Condition	Upper green LED	Lower amber LED
No input power to the node card	Off	Off
Node board is functioning correctly	On	Off
Node board is in a transitional state (powering on or powering off)	Blink (1 Hz)	Off
Node board is prepared for service (the node board can be removed)	Any	Blink (1 Hz)

CAUTION:
Hazardous energy present. Voltages with hazardous energy might cause heating when shorted with metal, which might result in splattered metal, burns, or both. (L005)

In general, hazardous energy might be present when the front or back rack system cover is opened on the compute rack and the I/O rack. Hazardous energy can be present near exposed electrical components on DCAs, on Node cards, Service cards, and when the I/O Drawer cover is removed. Do not reach beyond the front opening for the Service, Node or DCA cards.

4. Disconnect the 51 V dc cables from the node board DCA.

DANGER:
Never reach inside the DCA opening. Hazardous voltages are present inside this area.

5. Remove the DCA:
   a. Push forward on the blue cam latches and then lift and release them from the cover notch.
   b. Pivot both blue cam latches to release the DCA from the draw rods.
   c. Slide the DCA out from the node board.
6. Inspect the thermal interface material (TIM) on the replacement DCA.

   The replacement DCA has a plastic film over the TIM that must be removed before placing the part in the node board. Also, if it is necessary to replace the TIM, the replacement TIM material has a plastic sheeting over the foil surface of the TIM. This plastic protects the

TIM from damage during shipping and handling. Remove it from the foil on the TIM after the TIM is installed onto the compute card or DCA and before installing the compute card or DCA in the machine.

Figure 4-17 shows good TIM. The TIM is not compressed against the node cooling rail at the bottom, so there is a discontinuous compression line. This is normal.

Figure 4-17 Good replacement DCA TIM

Figure 4-18 also shows good TIM. There is a location on the node cooling rail where there is a hole. This difference in compression on the TIM is normal. This crease line is normal. The guide pin hole is good.

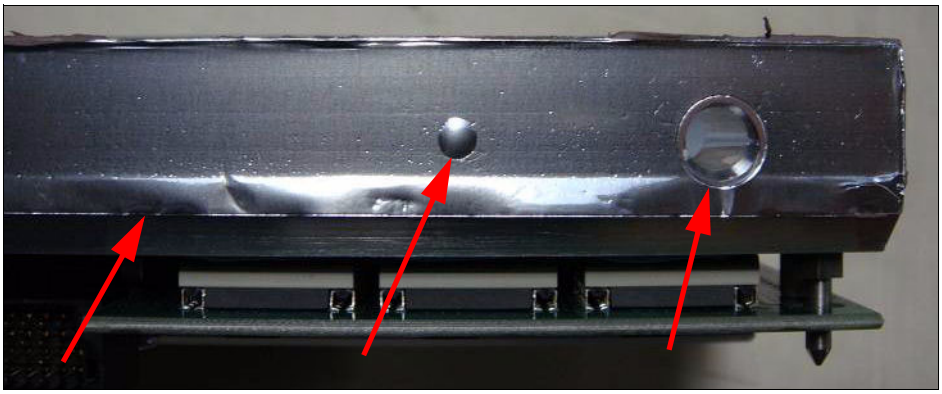


Figure 4-18 Good replacement TIM with normal crease lines

Inspect the following parts of the TIM:

- Inspect the hole around where the guide pin enters. If there is a substantial amount of damage or thickness buildup, replace it.
- Inspect the edge of the TIM. If the edge is folded, fix the edge or replace the TIM.
- Check for creases on the TIM. To determine if the TIM must be replaced, determine whether the DCA runs at higher temperatures than its neighbors.

7. Replace the DCA.

Attention: Ensure that the DCA draw rods are aligned well to the holes in the DCA cold plate. Be careful when aligning the rods. The TIM can be easily damaged by the ends of the draw rods.

8. Extend the blue cam arms and slide the DCA onto the draw rods.
9. Push the new DCA all the way in manually then pivot both cam arms in and secure the tabs on the DCA cover notch. Ensure that the blue cam latches engage evenly. Both arms must engage at the same time.

10. Connect the 51 V dc cables to the DCA.
11. End the service action. Have the system administrator run the **ServiceNodeDCA** command. This command powers on the DCA.

4.8 Replacing a midplane

The entire rack must be powered off before a midplane can be serviced. If the rack contains a clock card, the card also affects the operations in the midplanes that are connected to the clock card or are downstream in the clock topology.

The lift tool is required for this procedure.

Attention: Do not operate the lift until after you read the owner's manual and are familiar with safe operation of the lift. The maintenance and repair of the lift are the customer's responsibilities. Contact the lift manufacturer for assistance.

1. Prepare the rack for service. Have the system administrator run the **ServiceClockCard** command, even if there is no clock card in the rack. This command powers off all node boards and all I/O drawers in the rack. If a clock card is installed it also affects the operations downstream.
2. Turn off the BPE Pwr 00 - Pwr 17 (51 V dc output) switches for each of the four BPEs in the rack.
3. Turn off the nine ac circuit breakers for the BPMs in both BPEs (there is one circuit breaker above each of the nine BPMs).

DANGER:
Multiple power cords. The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. (L003)

Turn off the facility circuit breakers. There can be up to four ac mains power cords for a Compute rack. To remove all power from the Compute rack, turn off the circuit breaker for each power cord and disconnect the power cord plug(s) from the main's power source receptacle (facilities power source).

4. Unplug all four power cords from the facility connector and BPEs.
5. Ensure that all cables are labeled with the correct plug location to allow for correct reinstallation.
6. Ensure that the fiber cable end caps are installed on all removed I/O cables, torus cables, and the node board cable sockets as they are removed.
7. For the midplane that is being serviced, follow the removal procedures to remove all the node boards and the service card. See 4.4, "Replacing a node board" on page 68 and 4.10, "Replacing a service card" on page 90.
8. Check for any spillage when removing coolant connectors. There is no requirement to drain coolant from the node boards.

9. Make sure that all cables are safely positioned out of the way.
10. From the rear of the rack, the side without the service card, perform the following steps:
    a. Remove the 16 M4 screws that secure the front of the chassis with a 5.5 mm driver. See Figure 4-19.
    b. Do not remove the five M4 screws on the midplane on the back side of the rack.

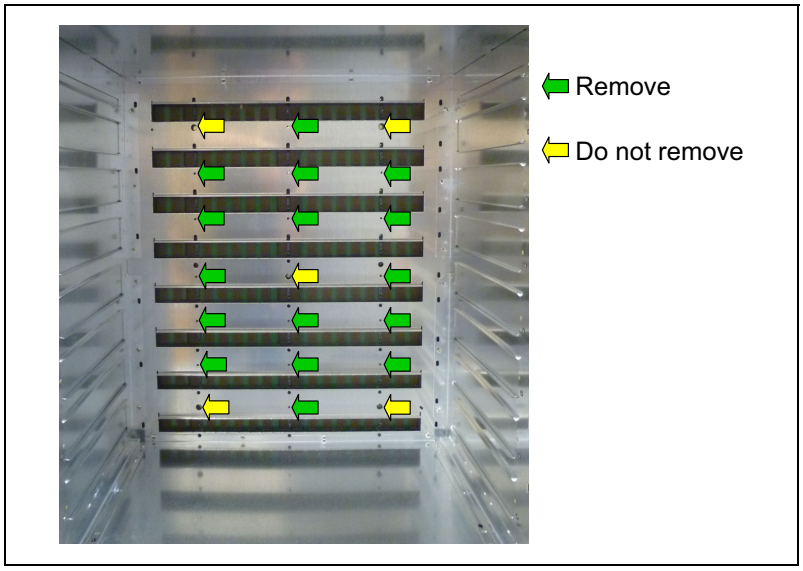


Figure 4-19 Midplane chassis screw location for removal (back)

11. From the front of the rack, the side with the service card, perform the following steps:
    a. Remove the 16 M5 screws (blue arrows) from front sides of the chassis and the two M4 screws from the bottom of the cage (red arrows) with an 8 mm driver. See Figure 4-20.
    b. Remove the eleven 7 mm screws (orange arrows) on the back of the chassis. See Figure 4-20.

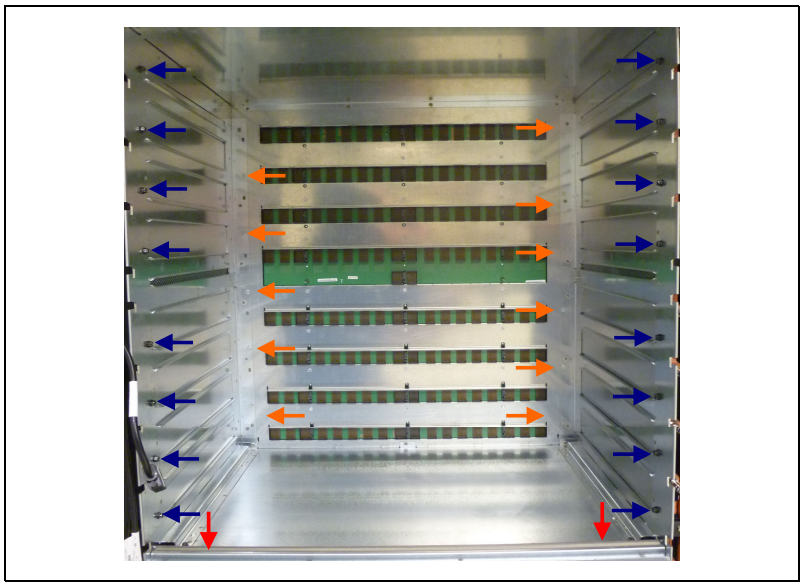


Figure 4-20 Midplane chassis screw locations (front)

12. Place the lift tool into position, and slide the midplane chassis (front card cage) from the rack.
13. Lower the rack (front card cage) to the floor and carefully position the open end of the chassis so that it is facing down.
14. Remove the five 7 M4 screws that fasten the midplane to the chassis with a 7 mm driver. See Figure 4-21.

Attention: Use extreme caution when removing and replacing the midplane to avoid damaging the midplane insulator and connectors.

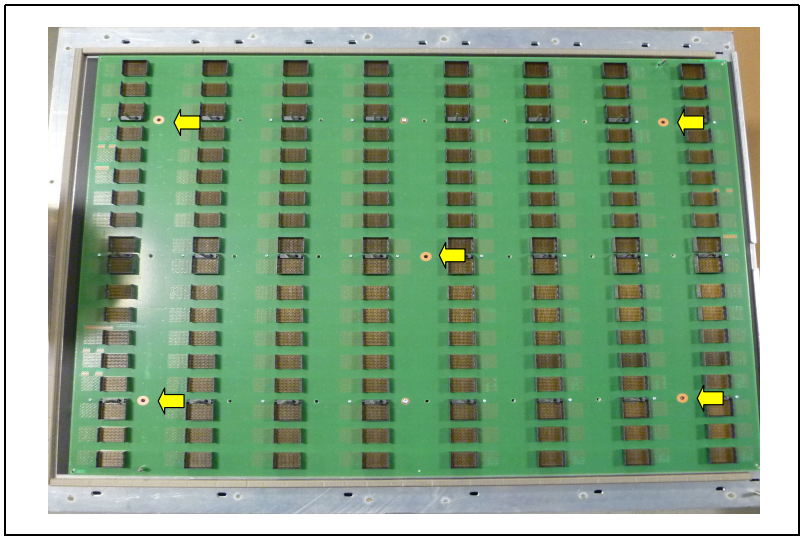


Figure 4-21 Midplane mounting screw locations

15. Remove the EMC bracket from the front cage by sliding it up and out of the slots in the card cage. No tools are required for this step.
16. Remove the midplane from the chassis and replace it with a new midplane.

Attention: Use extreme caution when lifting the front chassis and midplane in position in the rack to avoid damage to the connectors on the back side of the midplane.

17. Install a midplane EMC insulator (00E7857), if one is not already installed on the replacement midplane. To install a midplane EMC insulator, follow the steps in 4.9, “Installing a midplane EMC insulator” on page 87.
18. Follow the removal steps in reverse order for replacement.
19. Ensure that the node board coolant hoses are connected before applying power.
20. Plug the power cords into the BPE and the facility connector.
21. Turn on the facility circuit breakers.
22. Turn on the nine ac circuit breakers for the BPMs (there is one circuit breaker above each of the nine BPMs).
23. Turn on the BPE Pwr 00 - Pwr 17 (51 V dc output) switches.
24. Have the system administrator run the **`ServiceClockCard`** command. This command powers on the service cards, node boards, and rack I/O drawers. This brings them back into a functional state.

4.9 Installing a midplane EMC insulator

When the rear cage is installed, it rolls the gasket to the midplane and contacts the vias on the N00 cards. Figure 4-22 shows the vias for slot N00. This is the back side of the midplane. The connectors for slot N00 are on the front side of the midplane.

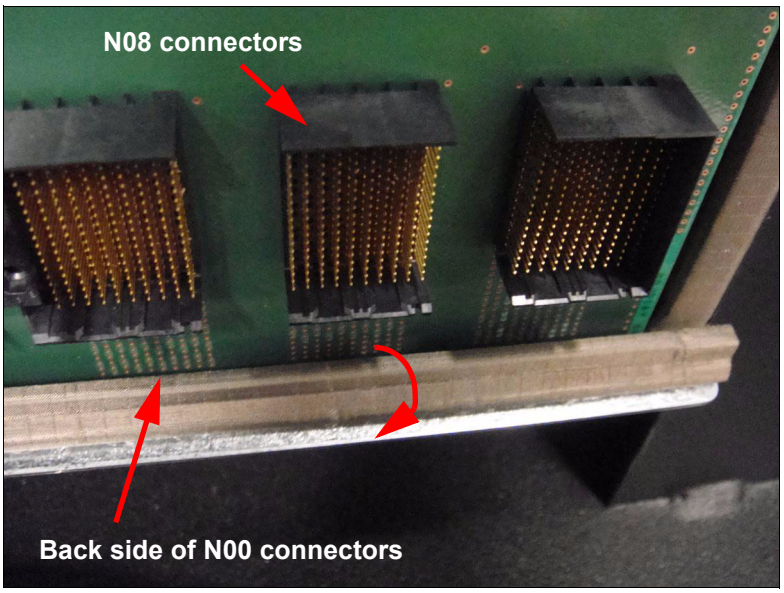


Figure 4-22 Back side of the midplane

In some cases, a gasket might deflect too much and contact vias on the midplane, which causes a short in the signal. If a short occurs, an EMC insulator is required. There are two possible solutions:

- Solution 1. If errors indicate that this gasket contact is occurring, the first step is to apply the insulator to the midplane and keep the same midplane installed in the rack. The insulator PN is 00E7857.
- Solution 2. If a midplane must be replaced, both the midplane and the insulator must be ordered. This insulator is not pre-installed on the midplanes.

The method for adding the insulator is the same whether the midplane is in the rack or outside the rack.

The entire rack must be powered off before a midplane can be serviced. If the rack contains a clock card, the card also affects the operations in the midplanes that are connected to the clock card or are downstream in the clock topology.

The lift tool is required for this procedure.

Attention: Do not operate the lift until after you read the owner's manual and are familiar with safe operation of the lift. The maintenance and repair of the lift are the customer's responsibilities. Contact the lift manufacturer for assistance.

Perform the following steps to install a midplane EMC insulator:

1. Prepare the rack for service. Have the system administrator run the **`ServiceClockCard`** command, even if there is no clock card in the rack. This command powers off all node

boards and all I/O drawers in the rack. If a clock card is installed, it also affects the operations downstream.

2. Turn off the BPE Pwr 00 - Pwr 17 (51 V dc output) switches for each of the four BPEs in the rack.
3. Turn off the nine ac circuit breakers for the BPMs in both BPEs (there is one circuit breaker above each of the nine BPMs).

DANGER:
Multiple power cords. The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. (L003)

Turn off the facility circuit breakers. There can be up to four ac mains power cords for a Compute rack. To remove all power from the Compute rack, turn off the circuit breaker for each power cord and disconnect the power cord plug(s) from the mains power source receptacle (facilities power source).

4. Unplug all four power cords from the facility connector and BPEs.
5. Ensure that all cables that are connected to the node cards in the rear of the rack for the midplane that is being serviced are labeled with the correct plug location. The labels allow for correct reinstallation.
6. Ensure that the fiber cable end caps are installed on all removed I/O cables, torus cables, and the node board cable sockets as they are removed. Caps are required only on the node cards in the rear of the rack for the midplane that is being serviced.
7. For the midplane that is being serviced, follow the removal procedures to remove all of the node boards for the midplane's rear cage only. See 4.4, "Replacing a node board" on page 68.
8. Check for any spillage when removing coolant connectors. There is no requirement to drain coolant from the node boards.
9. Make sure that all cables are safely positioned out of the way.
10. Remove the 16 M4 screws that secure the chassis with a 5.5 mm driver. See the green arrows in Figure 4-19 on page 85.
11. Remove the blue, red, and orange screws for the rear card cage. Figure 4-20 on page 85 shows the front chassis, but the locations are the same.
12. Remove the EMC bracket by sliding it up and out of the slots in the card cage. No tools are required for this step.
13. Add the midplane EMC insulator, PN 00E7857, to the bottom edge of the rear side of the midplane, over the vias for the N00 slot (the vias for the lowest slot in the midplane).

Figures Figure 4-22 on page 87 through Figure 4-24 show correct placement of the insulator.

Figure 4-23 shows the back side of the midplane, the midplane EMC insulator (grey strip), and the EMC bracket (yellow or gold color), left to right.

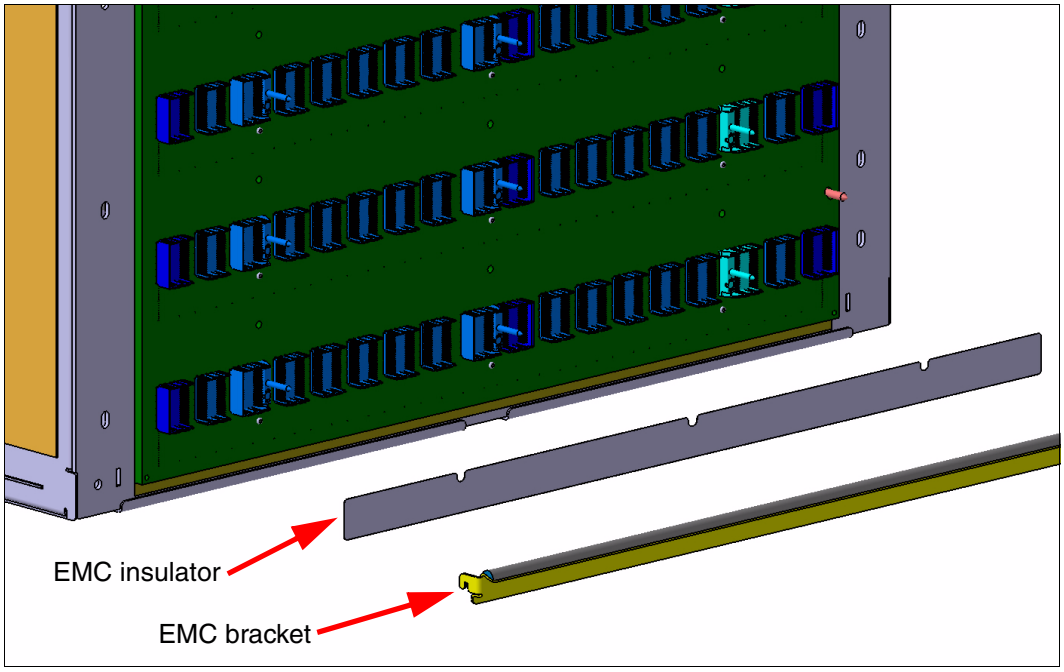


Figure 4-23 EMC insulator

Figure 4-24 shows the midplane EMC insulator (grey color) applied to the midplane at the bottom over the N00 vias. The insulator shields the vias from the EMC gasket. The EMC bracket (yellow or gold color) placed in position on the back side of the midplane.

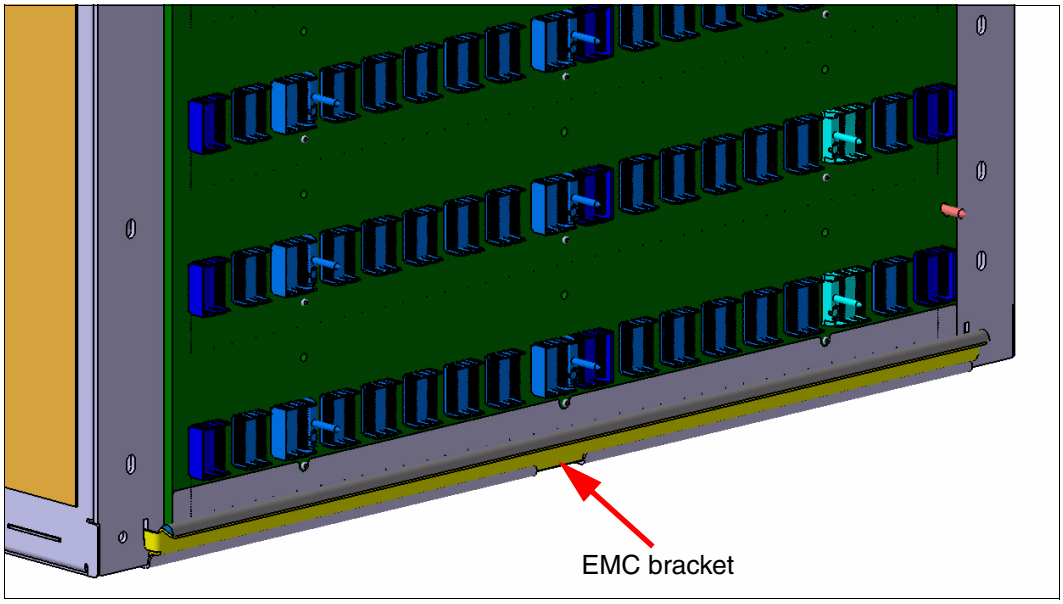


Figure 4-24 EMC insulator applied to the midplane

14. Follow the steps in 4.8, “Replacing a midplane” on page 84 to install the rear cage and the node cards.

4.10 Replacing a service card

The service card controls the node boards in the same midplane. Replacing a service card affects the midplane operation.

Attention: The environmental data for all the hardware controlled by the service card (that is, for the service card, node boards, BPEs and BPMs, midplane and, in the case of the bottom service card, the coolant monitor) becomes unavailable during the service action.

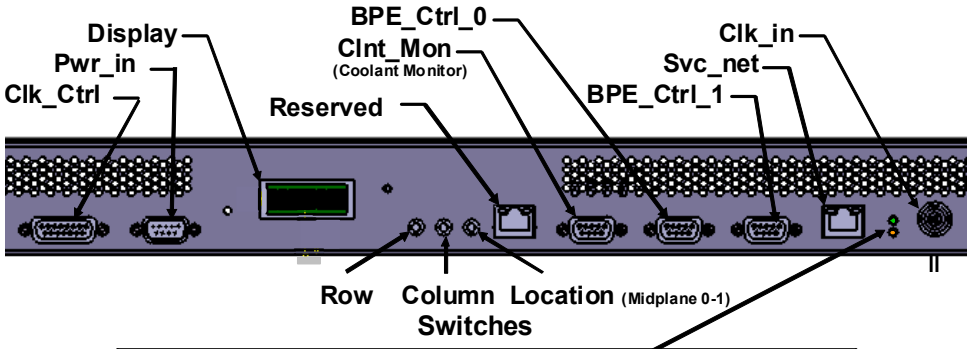
Perform the following steps to replace a service card:

1. Prepare the service card for service. Have the system administrator run the **`ServiceMidplane`** command. The command turns off the power to all node boards and I/O drawers in the midplane.

   Attention: If the rack contains the master service card (the service card that controls the master clock card), have the system administrator run the **`ServiceClockCard`** command. This command affects all compute racks and I/O racks in the installation.

   The service card is not powered off. There is +5 V dc persistent power on the service card. This persistent power cannot be disabled until the "Pwr_in" cable is unplugged from the service card.

2. Locate the position of the service card and verify the status of the LEDs. The green LED must be solid, blinking, or off. The amber LED must be blinking. See Figure 4-25 for information about service card LED indicators.



Service Card Status		
Condition	Upper, Green	Lower, Amber
No input power to the service card	Off	Off
Service card is functioning as expected	On	Off
Fault	Off	On
Service card is in a transitional state (powering on or powering off)	Blink (1 Hz)	Off
Service card is prepared for service (the service card can be removed)	Any	Blink (1 Hz)

Figure 4-25 Service card LED indicators

3. Disconnect all the cables from the service card.
4. Pivot down the cam arms on both sides of the service card by first releasing the cam latch.
5. Holding the cam arms, remove the service card from the midplane.
6. Set the address switches (that is, row, column and midplane switches) on the new service card to match the switch settings of the removed service card.
7. Insert the new service card into the midplane.
8. Connect all the cables except the power cable to the service card.
9. Connect the power cable to the service card.
10. Have the system administrator run the **ServiceMidplane** command (or the **ServiceClockCard** command if it was used in step 1 on page 90). This command powers on the service card, node boards, and I/O drawers powered by the midplane.

4.11 Replacing a clock card

Clock cards can be in either a Blue Gene/Q compute rack or an I/O rack. The locations are:

- Compute rack, in the rear of the rack:
  - Below the midplane M0, location Rxx-K0
  - Above the midplane M1, location Rxx-K1
- I/O rack side mount location Qxx-K0 (lower part of rack) or Qxx-K1 (upper part of rack)

Service of the clock card affects the operations in the midplanes or I/O nodes connected to the clock card and in the downstream of the clock topology. The **ServiceClockCard** command powers off the midplanes and I/O nodes.

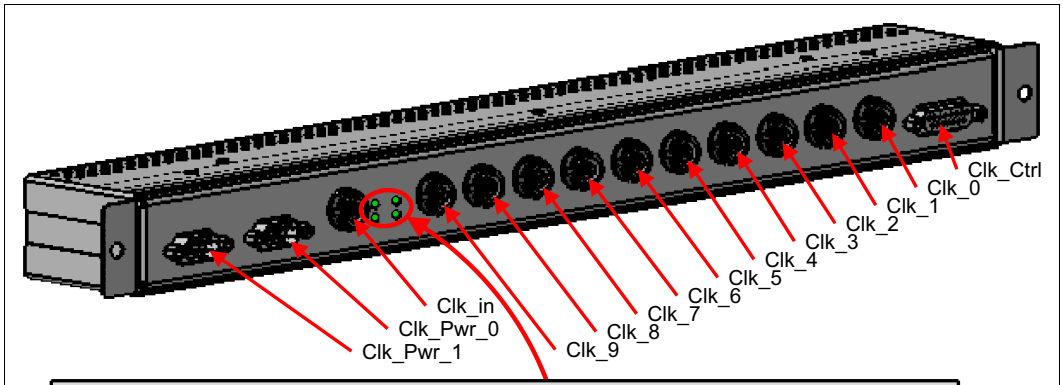
> **Attention:** The clock card is not powered off. Therefore the +5 V persistent power on the clock card cannot be disabled until the clock card power cables are removed.
>
> The master clock card is the only clock card that is connected to a service card using the master clock cable. In addition, there is no master/slave switch on the clock card.

To replace a clock card:

1. Prepare the rack for service. Have the system administrator run the **ServiceClockCard** command. The command powers off all node boards and all I/O drawers in the rack.

2. Locate the position of the clock card.

   Figure 4-26 shows the clock card connector and LED locations and LED status.



Clock Card Status				
Clock Card Condition	Upper Left, Input Power Green	Lower Left, +5V Green	Upper Right, Master Green	Lower Right, Redrive Green
No input power	OFF	OFF	OFF	OFF
No 5V power from Clk_Pwr_0 or Clk_Pwr_1	ON	OFF	OFF	OFF
Running as expected as master clock	ON	ON	ON	OFF
Running as expected as slave (redriver)	ON	ON	OFF	ON

Figure 4-26 Clock card LED indications

3. Verify that all cables are labeled. If any labels are missing, apply new labels before unplugging the cable to ensure that they can be correctly reinstalled.
4. Disconnect the power and the clock cables from the clock card.
5. Remove the screw at each side (or at top/bottom, if in an I/O rack), and remove the clock card.
6. Replace the clock card.
7. Connect the power and clock cables to the new clock card.
8. Have the system administrator run the **`ServiceClockCard`** command to end the service action. The command powers on the clock cards, service cards, all node boards, and rack I/O drawers bringing them back into a functional state in the topological order of the clock.

4.12 Replacing a bulk power module

Because of the N + 1 BPM redundancy supported by the BPE design, one BPM per BPE can be replaced without interrupting the system operation. Figure 4-27 shows a BPM.

Figure 4-27 Bulk power module

Perform the following steps to replace a BPM:

1. Verify the location of the BPM to be replaced. If the BPM already failed (for example, overvoltage, overcurrent, overtemperature, fan failure), the failure status LED (rightmost amber LED) on the front of the BPM is lit. However if the BPM is still functional, but exceeded error thresholds and is to be replaced, this status might not be evident in the LEDs.
2. Prepare the BPM for service. Have the system administrator run the **`ServiceBulkPowerModule`** command. This command powers off the BPM in the rack.
3. Verify that the BPM is ready for service by confirming that the LED status lights are:
   - Far left (green) LED is on solid
   - Middle (green) LED is blinking (1Hz)
   - Far right (amber) LED is off
   - Table 4-5 on page 94 indicates that this power supply condition is "ac present / 5VSB on (PSU OFF)"

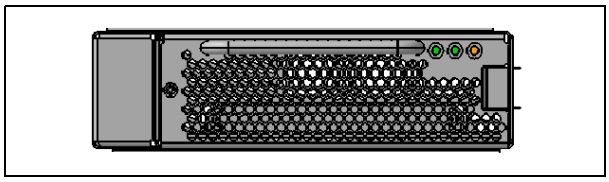


Figure 4-28 Blue Gene/Q bulk power module LED indicators

Table 4-5 Bulk power module status

Power supply condition	**Left (Green, AC_good) LED status**	**Middle (Green, PWR) LED status**	**Right (Amber, Fail) LED status**
No ac power to all supplies	Off	Off	Off
Power supply failure (over voltage, over current, over temperature, fan failure)	On	Off	On
Power supply warning events where power supply continues to operate (high temperature, high power, slow fan)	On	Off	Blink (1 Hz)
ac present / 5VSB on (PSU OFF)	On	Blink (1 Hz)	Off
Power supply on and okay	On	On[a]	Off
ac input fault	On	Off	Blink (1 Hz)
Bootloader mode	Off	On	On

a. When this module is on and working, the brightness of the middle LED is exponentially related to the amount of current output of the module. That is, the brighter the light, the more current is being drawn.

4. Turn off the ac input breaker for the BPM by setting the rocker switch above the BPM to the OFF position. In the I/O rack BPE, the circuit breaker is to the left. See Figure 4-29.

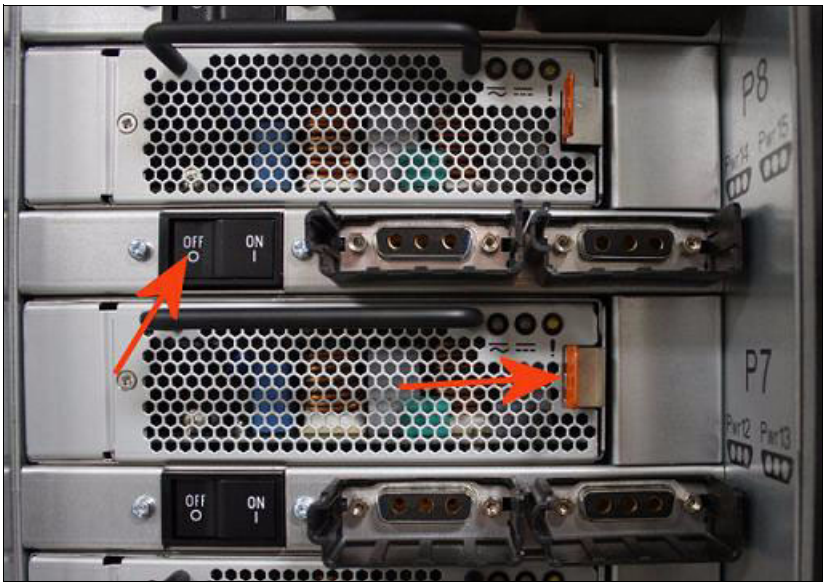


Figure 4-29 Removal tab and ac circuit breaker switch for a BPM

5. Remove the BPM by moving the orange release tab to the left and carefully pulling the unit out, using the BPM handle. No cables must be removed. However, depending on the location, you might need to shift 51 V dc power cables slightly to enable removal of the BPM.
6. Insert the replacement BPM. If you moved any cables, return them to the original routing.
7. Turn on the BPE ac circuit breaker for the BPM by setting the rocker switch above the BPM to the ON position. Make sure that the first two (left and middle) status LEDs on the BPM are green, and that the third (right) LED is off, to indicate that the BPM is operational (that is, the power supply is on and working correctly. See Figure 4-27 on page 93 and Table 4-5 on page 94.
8. Have the system administrator run the **`ServiceBulkPowerModule`** command to end the service action. This command powers on the BPM.

4.13 Replacing a bulk power enclosure

Service of the bulk power enclosure requires removal of power to the entire rack. If the rack contains a clock card, it also affects the operation of the midplanes that are connected to the clock card or are downstream of the clock topology.

Perform the following steps to replace a bulk power enclosure:

1. Prepare the rack for service by having the system administrator run the **`ServiceClockCard`** command, even if no clock card is present in the rack.

2. Turn off the Pwr 00 - Pwr 17 (51 V dc output) switch for the BPE. See Figure 4-30.
3. Turn off all of the BPM ac circuit breakers. See Figure 4-29 on page 95.

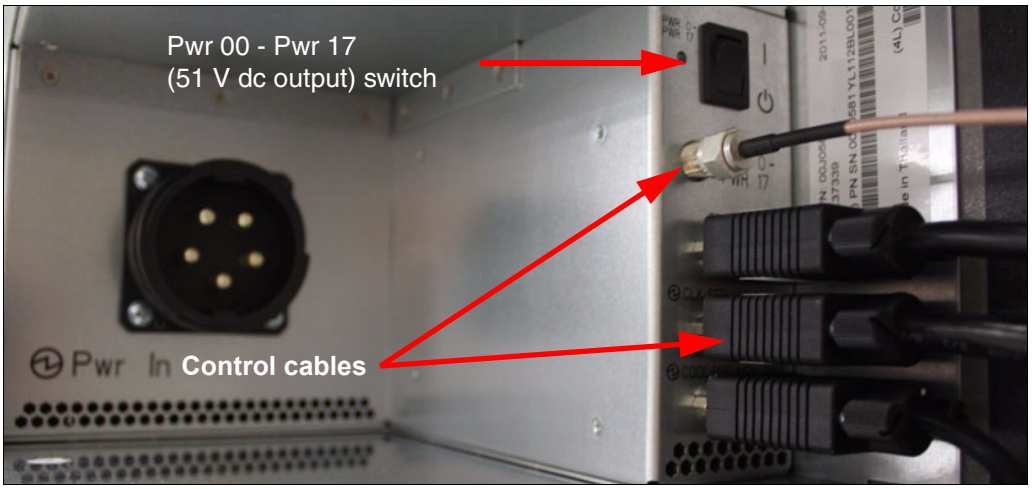


Figure 4-30 ac circuit breaker switch for a BPM

4. Turn off the facility circuit breakers.
5. Unplug the power cords from the facility connector and the BPEs.
6. Cables must be labeled by the installation team. If any labels are missing, apply new labels before removal to ensure that the cables can be reinstalled into the correct locations.
7. Disconnect all of the 51 V dc power cables from the BPE to the node board DCAs.

Attention: You must remove both ends of the 51 V dc power cables to prevent damage to the DCA connector.

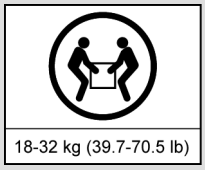
8. Disconnect all of the BPE control, clock, service, and coolant cables that are located below the Pwr 00 - Pwr 17 (51 V dc output) switch for the BPE. (See Figure 4-30.)
9. Carefully remove all of the BPMs. See 4.12, “Replacing a bulk power module” on page 93.

10. Remove the four BPE retaining screws on the front right panel of the BPE frame. See Figure 4-31.

Figure 4-31 BPE retaining screw locations

CAUTION:

The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)



A compute rack bulk power enclosure (BPE) weighs approximately 66 lbs. and can be positioned at a height of 39 inches from the floor. Ensure proper handling methods and or equipment are used when removing or replacing a BPE.

Attention: Do not operate the lift until after you read the owner's manual and are familiar with safe operation of the lift. The maintenance and repair of the lift are the customer's responsibilities. Contact the lift manufacturer for assistance.

11. Slide out the BPE. This is typically a two-person process because of the weight and bulk of the unit. Alternatively, it can be performed by one person if the lift is used.

12. Slide in the new BPE.
13. Replace the four BPE retaining screws.
14. Replace all of the BPMs and push them in until they latch.
15. Replace all cables.
16. Plug the power cords into the BPE and the facility connector.
17. Turn on the facility circuit breakers.
18. Turn on the ac circuit breakers for the BPMs.
19. Turn on the BPE Pwr 00 - Pwr 17 (51 V dc output) switch.
20. Have the system administrator run the **`ServiceClockCard`** command to end the service action. This command powers back on the BPE and all associated hardware powered down in step 1 on page 95.

4.14 Servicing an I/O drawer

This process is used to service the entire I/O drawer, I/O drawer compute cards, PCI adapters, and the fans on the I/O board. See Figure 4-32 for locations.

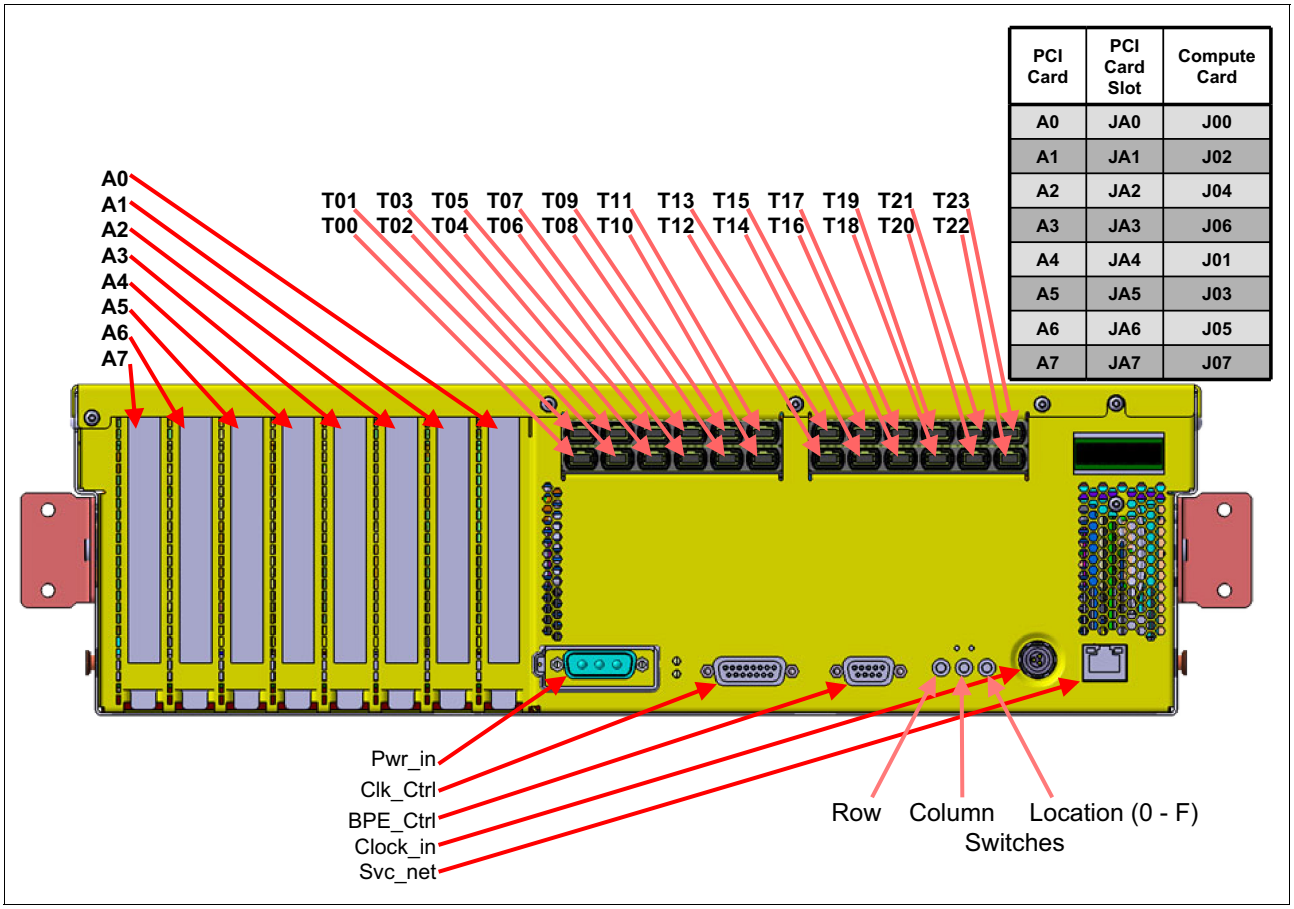


Figure 4-32 I/O drawer naming convention

4.14.1 Replacing an I/O drawer

The lift tool is required for this procedure.

Attention: Do not operate the lift until after you have read the owner's manual and are familiar with safe operation of the lift. The maintenance and repair of the lift are the customer's responsibilities. Contact the lift manufacturer for assistance.

Perform the following steps to replace the I/O drawer:

1. Prepare the I/O drawer for service. Have the system administrator run the **`ServiceIoDrawer`** command. This command turns off the power to the I/O drawer.
2. Make sure that the I/O drawer status LEDs, located above the location switches, indicate that the I/O drawer is ready for service. (The right amber LED blinks when the I/O drawer is ready for service.) The LED display panel also shows Qxx-Ixx-OFF or Rxx-Ixx-OFF when the drawer is in service. See Figure 4-33.

Figure 4-33 I/O status light

3. Verify that all cables are labeled. If any labels are missing, apply new labels before removal to ensure that the cables can be reinstalled to the correct locations.
4. Disconnect the 51 V dc power cable from the I/O drawer. If the I/O drawer is to be removed from its drawer slides, disconnect the rest of cables from the I/O drawer; otherwise, leave all other cables connected to the drawer.
5. Remove the I/O drawer interlock bracket. The two shipping bolts, one per side, might still be present on the front flanges. See Figure 4-37 on page 107.
6. Install the I/O drawer bracket onto the lift tool. The bottom of the bracket has a "c" shape on each corner. Slide the bracket onto the front edge of the table such that the "c" shaped

portion of the bracket engages the lift platform. This prevents the bracket from moving laterally on the lift platform. See Figure 4-34.

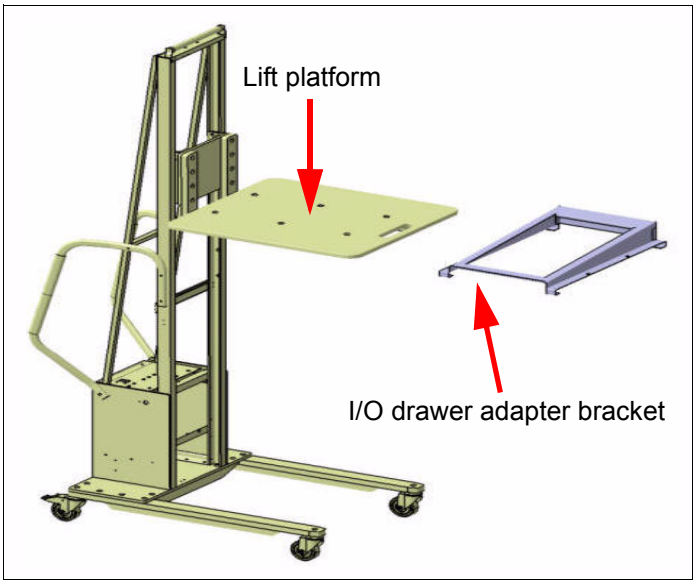


Figure 4-34 Lift tool and I/O drawer adapter bracket

Figure 4-35 shows the I/O adapter bracket on the lift platform.

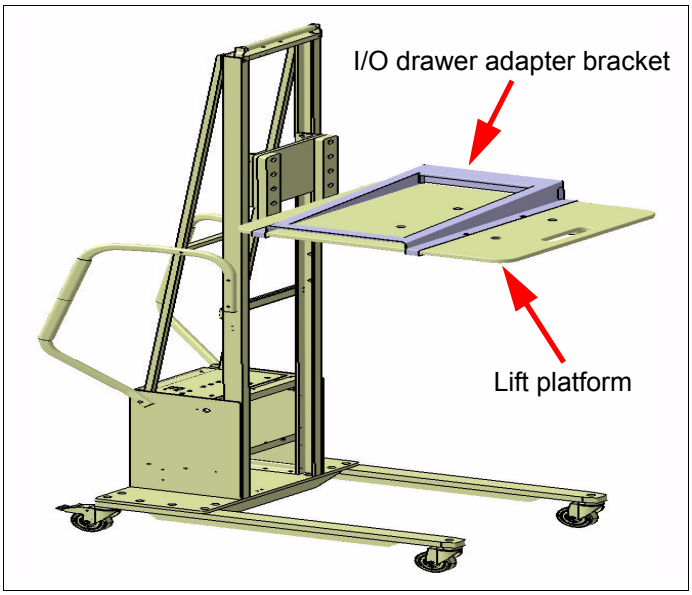


Figure 4-35 I/O adapter bracket on the lift platform

7. Position the lift tool in front of the rack.

Attention: Ensure that there is sufficient cable slack and no obstructions to cable management arm movement.

Ensure that the lift does not interfere with system cables or components as it is being raised, lowered, or otherwise positioned.

8. Press down on the rail release buttons and pull out the I/O drawer.
9. Extend the drawer rails until they latch.
10. Carefully and slowly raise the lift until it touches the drawer.
11. Unlatch the latches that hold the drawer into the rails and lift the drawer out of the rails just enough for the drawer to clear the slides, but not enough that the lift platform touches the drawer slides.
12. Unlatch the drawer slide latches and slide the slides back into the I/O drawer enclosure.
13. Lower the lift tool platform, and move the lift, with the drawer on it, to a suitable work surface.
14. Align the lift tool platform with the work surface and slide the drawer from the lift to the work surface.
15. Slide the replacement drawer from its packing material to the lift, and move the lift to the work surface.
16. Align the lift tool platform with the work surface and slide the replacement drawer to the work surface.
17. Set the rotary address switches on the replacement drawer to match those on the drawer being replaced.
18. Use a star 25 driver to unscrew the two safety thumbscrews at the front top corners of the drawer and slide the top forward to remove it.
19. Use a star 10 driver to remove the eight screws that secure the baffle above the compute cards and remove the baffle.

Attention: Grasp the ends of the card. Be careful not to crush the modules on the card. Lift gently and evenly at each end of the card while gently rocking the card front to back (NOT side to side) and lift it out of the I/O drawer.

Be careful to avoid bending pins when installing compute cards. Use two hands to insert the compute card parallel to the I/O drawer. Do not tip the compute card during insertion or drag the compute card from side to side. Either motion can catch and bend the compute card power blades. This pre-bending of power blades can cause them to bend when the card is inserted into the I/O drawer connector.

If resistance is detected during insertion, do not continue to press the compute card into the I/O drawer. Pull it out and inspect it before attempting to insert it again. Use care to avoid contacting the blades of the power connector, which can cause misalignment and bend the blades, the connector, or both.

20. Move all compute cards and PCI I/O cards from the existing I/O drawer to the new I/O drawer and reassemble the drawer.
21. Reattach the cover.
22. Slide the replacement drawer from the work station onto the I/O drawer bracket on the lift tool.
23. Lower the lift tool platform, and roll the lift tool back to the rack where the drawer is to be installed.

24. Use the lift tool and the I/O drawer bracket to return the new I/O drawer assembly to the I/O drawer rails:
    a. Using the lift tool, with the I/O drawer bracket installed, position the drawer in front of the I/O enclosure and raise the drawer to be installed until it is higher than the I/O drawer rails.
    b. Extend the I/O drawer rails until they latch into their fully extended position.
    c. Carefully and slowly lower the drawer, ensuring that each of the three pairs of tabs (rear, middle, and front, in that order) on the drawer engage the I/O drawer rails as the drawer is lowered.
    d. Ensure that the latches for the I/O drawer front tabs are latched.
    e. Remove the lift tool.
    f. Release the rail latches and slide the I/O drawer in until it is seated.
    g. Ensure that the drawer is locked into this position.
25. Reinstall the I/O drawer interlock bracket. See Figure 2-6 on page 50.
26. Reattach all of the cables and bolts. Route the cables through the cable management arm.

    Attention: Make sure that the 51 V dc power cables are managed away from the cable management arm, so that it does not get pinched.

27. Have the system administrator run the **`ServiceIoDrawer`** command to end the service action. This command powers on the I/O drawer.

4.14.2 Replacing compute cards on an I/O drawer board

Perform the following steps to replace the I/O drawer compute cards in the I/O drawer:

1. Follow steps 1 on page 99 through 5 of the I/O drawer removal process in 4.14.1, “Replacing an I/O drawer” on page 99.
2. Press down on the rail release buttons and pull out the I/O drawer. Extend the drawer rails until they latch.
3. Use a star 25 driver to unscrew the two safety thumbscrews at the front top corners of the drawer and slide the top forward to remove it.
4. Use a star 10 driver to remove the eight screws that secure the baffle above the compute cards and remove the baffle.

Attention: Grasp the ends of the card. Be careful not to crush the modules on the card. Lift gently and evenly at each end of the card while gently rocking the card front to back (NOT side to side) and lift it out of the I/O drawer.

Be careful to avoid bending pins when installing compute cards. Use two hands to insert the compute card parallel to the I/O drawer. Do not tip the compute card during insertion or drag the compute card from side to side. Either motion can catch and bend the compute card power blades. This pre-bending of power blades can cause them to bend when the card is inserted into the I/O drawer connector.

If resistance is detected during insertion, do not continue to press the compute card into the I/O drawer. Pull it out and inspect it before attempting to insert it again. Use care to avoid contacting the blades of the power connector, which can cause misalignment and bend the blades, the connector, or both.

5. Remove the compute card.
6. Replace the compute card with the replacement.
7. Replace the baffle above the compute cards.
8. Reattach the cover and perform steps 2 on page 102 and 1 on page 102. Perform all tasks in reverse order.
9. Have the system administrator run the **`ServiceIoDrawer`** command to end the service action. This command powers on the I/O drawer.

4.14.3 Replacing fans on an I/O drawer board

Perform the following steps to replace the I/O drawer fans on the I/O board:

1. Follow steps 1 on page 99 through 5 in 4.14.1, “Replacing an I/O drawer” on page 99.
2. Slide the I/O drawer out on the sides, to a service position.
3. Use a star 25 driver to unscrew the two safety thumbscrews at the front top corners of the drawer and slide the top forward to remove it.
4. Remove the fan by unscrewing the two blue thumbscrews, disconnecting the fan power cable from the I/O board, and unthreading the wire from the cable management arm inside the drawer.
5. Replace the fan with the replacement part, being careful to route the cable properly through the cable management arm inside the drawer.
6. Reattach the cover and perform steps 2 and then 1 of this section. Perform all tasks in reverse order.
7. Have the system administrator run the **`ServiceIoDrawer`** command to end the service action. This command powers on the I/O drawer.

4.14.4 Replacing PCI adapters on an I/O drawer board

Perform the following steps to replace the I/O drawer PCI adapters on the I/O drawer board:

1. Disconnect the PCI cable from the PCI card that is being serviced.
2. Slide the I/O drawer out on the slides, to a service position.
3. Follow steps 1 on page 99 through 5 in 4.14.1, “Replacing an I/O drawer” on page 99.

4. Use a star 25 driver to unscrew the two safety thumbscrews at the front top corners of the drawer and slide the top forward to remove it.
5. Remove the screw that holds the adapter.
6. Remove the PCI adapter by lifting it straight up.
7. Replace the adapter and lock it down with the screw.
8. Reattach the cover and perform steps 2 on page 103, then 1 of this section. Perform all tasks in reverse order.
9. Connect the PCI cable.
10. Have the system administrator run the **`ServiceIoDrawer`** command to end the service action. This command powers on the I/O drawer.

4.15 Replacing a coolant monitor

The coolant monitor is located behind the cable routing rail cover on the rear right of the frame.

Important: The coolant monitor and the sensors are calibrated as a group. All of the calibration data for the sensors in the manifold are stored in the coolant monitor. It is important to ensure that the correct calibration data is stored in the coolant monitor. If the coolant monitor does not have correct calibration data, inaccurate readings occur for all of the sensors in that rack. If the calibration data is lost, the MAC ID number on the coolant monitor can be used to acquire the correct calibration data. After this data is obtained, the flow sensors and the hydrodynamic impedance calibration must be performed.

Figure 4-36 shows the connections for the coolant monitor (component A, part number 00E5796).

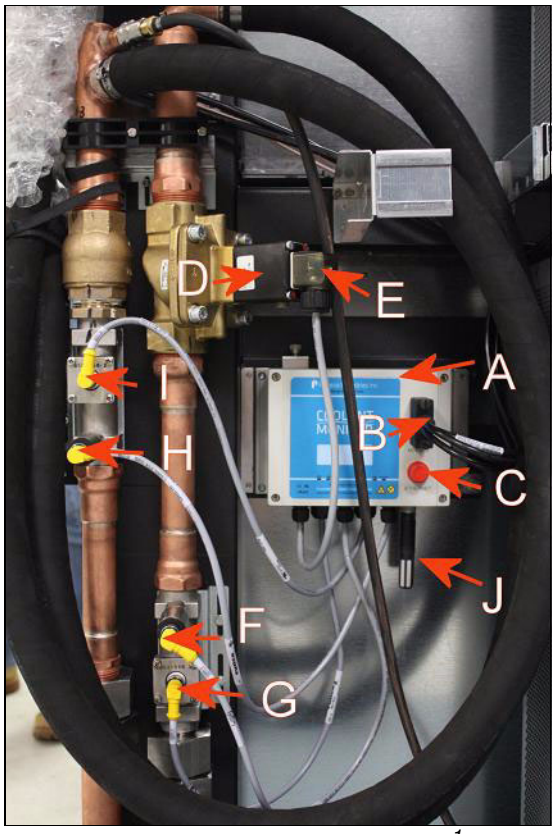


Figure 4-36 Coolant monitor connections[1]

Figure 4-36 shows the following components (the letters correspond with the letters in Figure 4-36):

- (A) Coolant monitor
- (B) Coolant monitor communication and power cable
- (C) Coolant monitor Ethernet connector. Not used or supported
- (D) Solenoid valve
- (E) Solenoid valve cable. This cable is secured with a thumbscrew
- (F) Supply pressure sensor
- (G) Supply flow sensor
- (H) Return pressure sensor
- (I) Return flow sensor
- (J) Ambient air temperature and humidity sensor

To replace the coolant monitor:

1. Before removing the coolant monitor, contact the remote support center (RSC). Ask for verification that the calibration data for all the sensors on that manifold are stored in a location that is accessible for loading the settings into the new monitor.
2. If the RSC representative cannot find this data on the system:
   a. Ask the RSC representative to access and write the calibration data from the coolant monitor to a location where it can be found after service.

[1] Image source: Courtesy of Proteus Industries

b. If it is not possible to access or write the data, identify the MAC ID of the failed coolant monitor. The MAC ID is on labels at the sensor locations on the manifold and on a label on the side surface of the coolant monitor.

c. Communicate this MAC ID number to the RSC representative as soon as it is available. Ask the representative to obtain the calibration data for that coolant monitor.

3. Prepare the coolant monitor for service. Have the system administrator run the **`ServiceClockCard`** command. This command turns off the power to the rack.
4. All ac power to the rack must be removed.
5. Turn off the BPE Pwr 00 - Pwr 17 (51 V dc output) switches for each of the four BPEs in the rack.
6. Turn off the nine ac circuit breakers for the BPMs in both BPEs (there is one circuit breaker above each of the nine BPMs).

DANGER:
Multiple power cords. The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. (L003)

Turn off the facility circuit breakers. There can be up to four ac mains power cords for a Compute rack. To remove all power from the Compute rack, turn off the circuit breaker for each power cord and disconnect the power cord plug(s) from the mains power source receptacle (facilities power source).

7. Unplug all four power cords from the facility connector and BPEs.

Attention: Ensure that all ac power to the rack is removed.

8. Before the cable routing rail can be removed, the machine cover (on that side of the machine) must be removed. All of the cables attached to the cable routing rail must be unbundled from the rail and carefully bundled together with cable ties.
9. Remove the cable routing rail from the right side of the back of the rack.

Important: If the coolant monitor is being replaced due to concerns only with the ambient air temperature or humidity readings, you should first replace the existing ambient temperature and humidity sensor with a replacement sensor (PN 00E7107). If this resolves the problem, you do not need to replace the entire coolant monitor assembly.

10. Disconnect the gray sensor cables from the sensors by unscrewing the locking ring at the yellow end of the cable, as shown in Figure 4-37 on page 107.

Attention: Do not twist the yellow connectors. They are keyed. Twisting these connectors will cause damage.

Figure 4-37 Yellow sensor locking ring[2]

11. Disconnect the solenoid valve cable by fully loosening the thumbscrew and pulling the cable straight away from the valve. If the thumbscrew cap comes off, use a 2.5 mm allen wrench. See Figure 4-38.

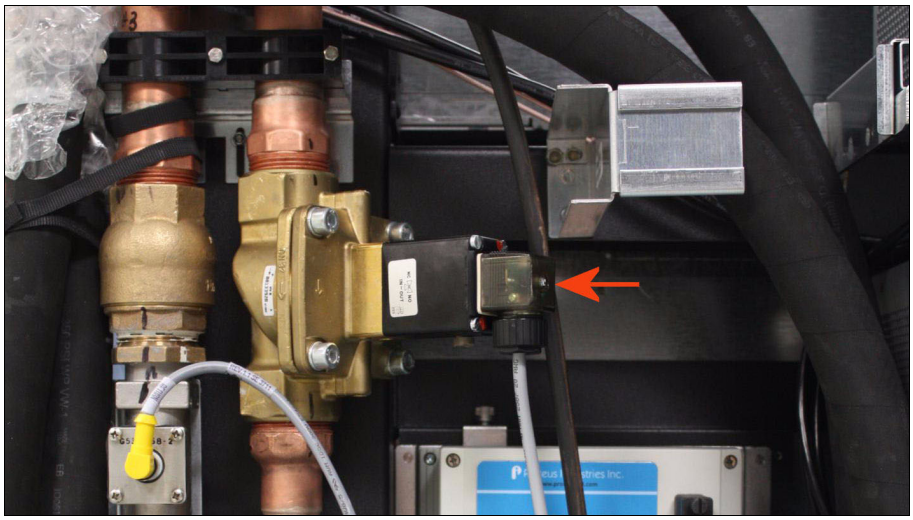


Figure 4-38 Coolant monitor solenoid connector screw location[3]

12. Disconnect the communication and power cable. Loosen the two thumbscrews for the D-shell connector on this cable and unplug the cable.

[2] Image source: Courtesy of Proteus Industries
[3] Image source: Courtesy of Proteus Industries

13. The coolant monitor is installed on a mounting plate in the rack, which has four keyhole slots. Studs on the back of the coolant monitor mounting bracket engage these keyhole slots. When it is in position in the machine, the monitor is secured to the frame with two thumbscrews (see the red arrows in Figure 4-39 on page 108). Loosen the thumbscrews and slide the coolant monitor up, then move away from the frame (to clear the mounting studs from the keyholes) and then out of the machine. See Figure 4-40 on page 109.

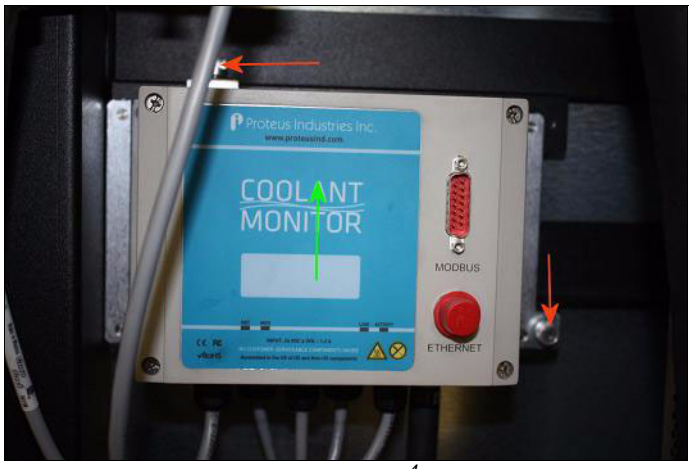


Figure 4-39 Coolant monitor removal[4]

14. Remove the coolant monitor and all the cables with care.
15. Verify that the new coolant monitor has an ambient air temperature/humidity sensor attached to the HUMIDITY connector on the bottom of the unit. If the new unit does not have this an ambient air temperature/humidity sensor, there are three options:
    - Move the ambient temperature and humidity sensor from the unit that is being replaced to the replacement unit (select this option unless the ambient temperature and humidity sensor function is suspect).
    - Order an ambient temperature and humidity sensor FRU.
    - Return the replacement coolant monitor part as new/defective part and order a replacement part (which should have an ambient temperature and humidity sensor attached).
16. Before installing the new unit, write the MAC ID number of the failed unit onto the new unit.
17. Ensure that the four sensor cables are labeled properly at the sensor end of the cable. If not, add labels to indicate where each sensor cable should be plugged. The information is shown on the bottom of the coolant monitor, but this information is not visible when the monitor is installed in the machine.
18. You cannot see the studs in the rack (see Figure 4-40 on page 109). To align the studs and the slots in the new coolant monitor, hold the top of the monitor higher than the top slots. Slide it toward you (that is, toward the back of the machine) until the monitor bracket touches the frame member. Slide the monitor slowly down and feel for the studs to align

[4] Image source: Courtesy of Proteus Industries

and drop into the slots. When the studs are in the slots, slide down to lock in place. Tighten the two thumbscrews to secure the monitor.

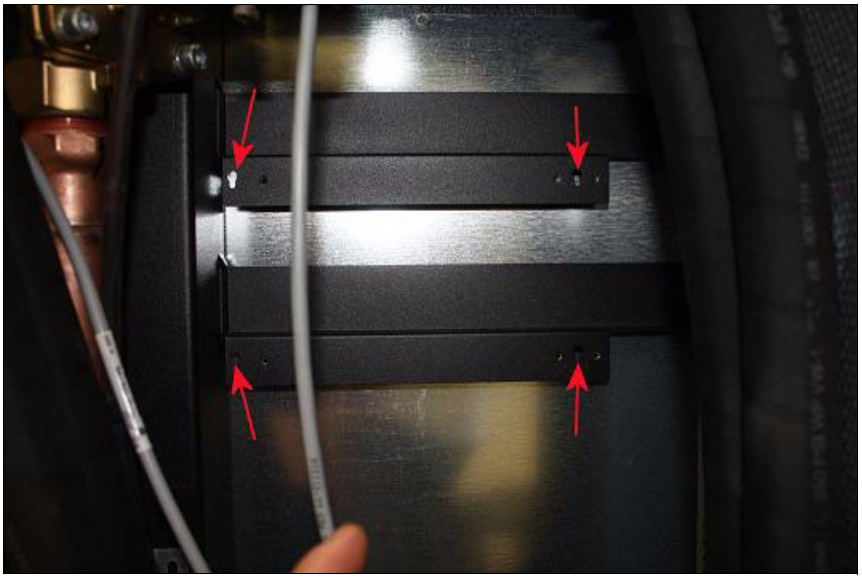


Figure 4-40 Coolant monitor mounting bracket

19. Connect all of the cables.
20. Reinstall the cable routing rail.
21. Properly reattach all cables to the cable routing rail.
22. Plug the power cords into the BPE and the facility connector.
23. Turn on the facility circuit breakers.
24. Turn on the ac circuit breakers for the BPMs.
25. Turn on the BPE Pwr 00 - Pwr 17 (51 V dc output) switch.
26. The SSR activity is complete. The SSR tells the customer that the coolant monitor replacement is complete and asks the customer to contact the Remote Support Center (RSC) to run the **ServiceClockCard** command and to write the calibration data to the new coolant monitor.
27. The RSC representative tells the customer when the **ServiceClockCard** command can be run and when the rack can be returned to functional status.
28. The RSC helps the customer enter the following commands to update the coolant monitor firmware:
    a. Prepare for a service action on all node boards and I/O drawers in the rack while leaving the service card operational. Run the following commands:

       ```
       cd /bgsys/drivers/ppcfloor/baremetal/bin
       ./ServiceRack Rxx prepare --noservicecard
       ```

    b. Run the following command to update the firmware:

       ```
       ./updateCoolMonFirmware.py Rxx 3.28
       /bgsys/drivers/ppcfloor/baremetal/firmware/coolantMonitor/
       LM3S6965_v3.28_20121029.hex
       ```

       Note: Use the most recent version of the firmware. The version must be version 3.28 or later.

This step takes two to three minutes.

c. Run the following commands to end the service action on all node boards and I/O drawers in the rack:

```
cd /bgsys/drivers/ppcfloor/baremetal/bin
./ServiceRack Rxx end --noservicecard
```

29. The RSC helps the customer with the appropriate process for loading calibration data into the coolant monitor:
    - If calibration data was stored before the coolant monitor replacement procedure, the RSC helps the customer write the calibration data to the new coolant monitor.
    - If the calibration data was obtained from the vendor (as opposed to obtaining it from the old unit), the flow sensor and hydrodynamic impedance calibration must be performed. The RSC can help the customer with this procedure if it is required.

4.16 Performing flow sensor and hydrodynamic calibration and saving calibration data

Perform this task if a shutdown occurs when there is no coolant leak. If there are continuous hydrodynamic impedance errors that cannot be cleared, perform the steps in 4.17, “Performing hydrodynamic impedance calibration” on page 112.

Note: This task is a customer responsibility. SSR participation in these activities is a billable service.

The RSC can provide guidance. A member of the facilities maintenance or customer personnel opens and closes the coolant valves during the procedure.

Perform the following steps to save the coolant monitor calibration data:

1. Ensure that the 5 V persistent power to the service cards and the 24 V power to the coolant monitors is on. On the BPMs, verify that the left-most green LED is on and the middle LED is blinking to indicate that ac power is present, the BPM is on, and 51 V output is off:
   - The ac power cord must be connected.
   - The facility ac circuit breaker must be turned on.
   - The PWR 00 - Pwr 17 (51 V dc output) switches must be turned off on all BPEs.
   - The ac input circuit breakers must be on for all BPMs.
2. Prepare for a service action on all node boards and I/O drawers in the rack while leaving the service card operational. Run the following commands:

   ```
   cd /bgsys/drivers/ppcfloor/baremetal/bin
   ./ServiceRack Rxx prepare --noservicecard
   ```

3. Check the coolant monitor status to ensure that the solenoid valves are open, the leak sensitivities are enabled, the flow rates are within the operating bounds that are defined in the *IBM System Blue Gene Solution: Blue Gene/Q Hardware Overview*, SG24-7872 Redbooks publication, and the shut-off cause is zero. Run the following commands:

   ```
   cd /bgsys/drivers/ppcfloor/baremetal/tools
   ./displayCoolantMonitorStatus.py Rxx
   ```

Figure 4-41 shows example output from the **displayCoolantMonitorStatus.py** utility.

```
Read the status for R03-L:
PROPERTY               VALUE       STATUS (DESC)              A1LO(ACT)  A1HI(ACT)  A2LO(ACT)  A2HI(ACT)
---------------------- ----------- -------------------------- ---------- ---------- ---------- ----------
Leak status                --      1 (No leak)
Valve status               --      1 (Opened)
Catastrophic leak sen.      5      0 (Disabled)
Slow leak sensitivity       3      0 (Disabled)
Supply flow rate        29.82 GPM  0 (Ok)                      17.00(M)   30.00(M)   12.00(P)   35.00(M)
Return flow rate        29.33 GPM  0 (Ok)                       0.00(N)  100.00(N)    0.00(N)  100.00(N)
Supply temperature      18.89 C    0 (Ok)                       2.00(M)   26.50(M)    1.00(W)   30.00(M)
Return temperature      29.94 C    0 (Ok)                       0.00(N)   40.00(N)    0.00(N)   46.00(N)
Supply pressure         60.12 PSI  0 (Ok)                      20.00(M)   95.00(M)   15.00(M)  110.00(W)
Differential pressure   17.65 PSI  0 (Ok)                       7.00(M)   45.00(M)    7.00(M)   50.00(M)
Ambient temperature     31.50 C    1 (Alarm 1 high)            16.00(M)   27.00(M)   15.00(M)   32.00(M)
Relative humidity        8.84 %    4 (Alarm 2 low)             25.00(M)   60.00(M)   20.00(M)   80.00(M)
Ambient dew point       -5.40 C    4 (Alarm 2 low)              5.50(M)   15.00(M)    0.00(M)   17.00(M)
System efficiency       87.22 kW   0 (Ok)
Hydrodynamic impedance     --      1 (Alarm 1 high)             0.00(N)  100.00(N)  100.00(N)  100.00(N)
Shut-off cause          0x0000     [No shut off detected]
Firmware level          3.19
Time of data capture    2012-02-23-10.42.56.378455 (N=none, M=msg only, P=shut pwr, W=shut wtr/pwr)
CoolMonEnv error code: 0
```

Figure 4-41 Example output from the displayCoolantMonitorStatus.py utility

4. Ensure that the solenoid valve is open, and verify that the catastrophic and slow leak detection mechanisms are disabled and that both supply and return flow rates show non-zero values.

   If catastrophic and slow leak detection must be disabled, wait for a few seconds and then open the solenoid valve. Run the following commands:

   ./disableLeakDetection.py R*xx*
   ./openValve.py R*xx*

5. Perform the following steps to calibrate the coolant monitor:

   a. Calibrate the coolant monitor for Flow Group 5:

      i. Open the return flow valve all the way.

      ii. Run the following command to calibrate for Flow Rate Group 5:

      ./calibrateCoolantMonitor.py R*xx* 5

      This process can take 10 - 20 minutes. When the calibration is done, the target flow rate for Group 4 is displayed (for example, "Adjust the RETURN FLOW RATE to be approx. 26.00 GPM and calibrate Group 4 next.").

   b. Calibrate the coolant monitor for Flow Group 4:

      i. Adjust the return flow valve to the specified flow rate for Group 4 while the using the following command to monitor the return flow rate:

      ./monitorFlowRate.py R*xx* <minutes>

      where <minutes> is the amount of time in minutes to monitor. You can specify 1, 2, or 3.

      ii. Run the following command to calibrate the coolant monitor for Flow Rate Group 4 by:

      ./calibrateCoolantMonitor.py R*xx* 4

When the calibration is done, the target flow rate for Group 3 is displayed.

c. Calibrate the coolant monitor for Flow Group 3 by following step b on page 111 (with **./calibrateCoolantMonitor.py R*xx* 3** this time).

d. Calibrate the coolant monitor for Flow Group 2 by following step b on page 111 (with **./calibrateCoolantMonitor.py R*xx* 2** this time).

e. Calibrate the coolant monitor for Flow Group 1 by following step b on page 111 (with **./calibrateCoolantMonitor.py R*xx* 1** this time).

6. Open the return flow valve all the way.
7. Monitor the flow rates for one minute to ensure that the coolant monitor is still calibrated: **./monitorFlowRate.py R*xx* 1**
8. Run the following command to enable the catastrophic and slow leak detection while setting their leak sensitivities appropriately:

   ./enableLeakDetection.py R*xx* 5 3

9. Run the following command to clear the shutoff cause:

   ./clearShutoffCause.py R*xx*

10. Save the coolant monitor calibration data to a file in the `/bgsys/local/etc/baremetal` directory.

    ./saveCalibrationData.py R*xx*

11. Turn on the 51 V power to all node boards and I/O drawers by turning on the PWR 00 - Pwr 17 (51 V dc output) switches on all BPEs.
12. End the Service Action on all node boards and I/O drawers in the rack by running the following commands:

```
cd /bgsys/drivers/ppcfloor/baremetal/bin
./ServiceRack Rxx end --noservicecard
```

4.17 Performing hydrodynamic impedance calibration

The hydrodynamic impedance calibration sets a unique flow versus pressure drop profile for every rack. The hydrodynamic impedance can be used for the following purposes:

- Identifying when node board hoses are not correctly reconnected after a service action
- Identifying when something internal to the rack causes a change in flow, such as a kinked hose or a clog

Remember the following information when monitoring hydrodynamic impedance calibration:

- A high impedance alarm (status "1" is displayed) means that the flow is higher than expected for that given pressure. This value implies that the impedance is low, which allows a higher flow rate.
- A low impedance alarm (status "2" is displayed) means that the flow is lower than expected at that given pressure. This value implies that the impedance is high, which allows a lower flow rate. This alarm is expected when a node board is disconnected for service.
- An impedance error does not impact the functionality of the rack if all node hoses are plugged in, the hoses are not kinked, and the quick connects for the node boards are not clogged (verify this by looking at the compute card temperatures).

- If an impedance error exists after a service action is completed, a notification is sent through the control system, but the service action is allowed to complete.
- One false hydrodynamic impedance alarm per week per rack is considered acceptable because this alarm does not cause an action to be taken by the coolant monitor.

Note: This task is a customer responsibility. SSR participation in these activities is a billable service.

Perform the following steps to run the hydrodynamic impedance calibration script and save the calibration data:

1. Verify that the rack had coolant running through it for at least 30 minutes.
2. The water flow rate must be consistent and without fluctuations during the calibration process. If the return flow sensor fluctuates more than about 0.3 GPM, calibrating the flow sensors will lead to suboptimal results.
3. Ensure that the ball valves are all turned to the fully opened position. See Figure 1-25 on page 20.
4. Run the following commands to display the coolant monitor status:

   cd /bgsys/drivers/ppcfloor/baremetal/tools
   ./displayCoolantMonitorStatus.py R*xx*

   Figure 4-41 on page 111 shows example output for the **./displayCoolantMonitorStatus.py** command.
5. Ensure that the solenoid valve is open, the catastrophic and slow leak detection mechanisms are disabled, and both supply and return flow rates show non-zero values. If necessary, disable the catastrophic and slow leak detection, wait for a few seconds and then open the solenoid valve.

   ./disableLeakDetection.py R*xx*
   ./openValve.py R*xx*
6. Set the hydrodynamic impedance for Flow Rate Group 5:
   a. Open the return flow valve all the way.
   b. Run ./**setHydrodynamicImpedance.py R*xx* 5.**

      This command takes about two minutes to run.
   c. The target flow rate for Group 4 is displayed (for example, `"Adjust the RETURN FLOW RATE to be approx.  26.00 GPM and calibrate Group 4 next."`).
7. Set the hydrodynamic impedance for Flow Rate Group 4:
   a. Adjust the return flow valve to the specified flow rate for Group 4 while monitoring the return flow rate with the following script, where <minutes> is the amount of time in minutes to monitor. This value can be 1, 2, or 3:

      ./monitorFlowRate.py R*xx* <minutes>
   b. Set the hydrodynamic impedance for Flow Rate Group 4 by running the following command:

      ./setHydrodynamicImpedance.py R*xx* 4

      The target flow rate for Group 3 is displayed.
8. Set the hydrodynamic impedance for Flow Group 3 by following step 7 (with ./**setHydrodynamicImpedance.py R*xx* 3** this time).

9. Set the hydrodynamic impedance for Flow Group 2 by following step 7 on page 113 (with ./**setHydrodynamicImpedance.py R***xx* **2** this time).
10. Set the hydrodynamic impedance for Flow Group 1 by following step 7 on page 113 (with ./**setHydrodynamicImpedance.py R***xx* **1** this time).
11. Open the return flow valve all the way.
12. Monitor the flow rates for one minute to ensure that the coolant monitor is still calibrated: **./monitorFlowRate.py R***xx* **1.** If the coolant monitor is not calibrated, return to step 3 on page 113.
13. Clear the shutoff cause:

    ./clearShutoffCause.py R*xx*
14. Enable the catastrophic and slow leak detection while setting their leak sensitivities appropriately:

    ./enableLeakDetection.py R*xx* **5 3**
15. Save the calibration data to /bgsys/local/etc/baremetal/Rxx-L:

    ./saveCalibrationData.py R*xx*

4.18 Replacing a pressure sensor

Perform the following steps to replace a pressure sensor. Figure 4-36 on page 105 shows the pressure sensor and the coolant monitor components:

1. Prepare the coolant monitor for service. Have the system administrator run the **ServiceClockCard** command. This command turns off the power to the rack.
2. Remove all ac power to the rack:
   a. Turn off the BPE Pwr 00 - Pwr 17 (51 V dc output) switches for each of the four BPEs in the rack.
   b. Turn off the nine ac circuit breakers for the BPMs in both BPEs (there is one circuit breaker above each of the nine BPMs).

DANGER:
Multiple power cords. The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. (L003)

Turn off the facility circuit breakers. There can be up to four ac mains power cords for a Compute rack. To remove all power from the Compute rack, turn off the circuit breaker for each power cord and disconnect the power cord plug(s) from the mains power source receptacle (facilities power source).

Wear appropriate personal protective equipment, including eye protection and latex gloves.

3. Close the rack ball valve on the supply hose. See Figure 1-25 on page 20.
4. Close the rack ball valve on the return hose. See Figure 1-25 on page 20.

5. Disconnect all supply and return hoses from the node boards to the manifold (if the supply sensor is being replaced, unhook the supply side node hoses. If the return sensor is being replaced, unhook the return side node hoses.)
6. Take one air purge hose (00E6020) and connect it to a drain hose (00E6022). Thread the other end of the drain hose to the bucket (00E6039).
7. Place the bucket on the cement floor under the raised floor (the goal is to get this as low as possible).
8. Connect the air purge hose and drain hose combination to the bottom quick connect fitting on the rear side of the manifold. Make the connection to the manifold (supply or return) on which the sensor is being replaced.
9. Connect another air purge hose (00E6020) to an air inlet fitting (00E6013). Hold the end with the air inlet fitting above the level of the top of the manifold, and connect the other end of the air purge hose onto the top fitting on the rear side of the manifold on the circuit in which the sensor is being replaced (supply or return).This process lets air into the manifold system and allows it to drain.

   Hold the end of the air inlet fitting higher than the top of the manifold for at least 20 seconds, to ensure that enough liquid has drained to avoid any backflow through the air inlet hose. After 20 seconds the SSR can stop holding the air inlet hose, but leave it connected to the manifold, and periodically check the drain bucket to see if the manifold has finished draining.
10. After the water flow stops, remove both hoses from the manifold.
11. Remove the baffle cover so that the coolant monitor can be accessed.
12. Remove the cable from the sensor that is being replaced.
13. Using a 21 mm open-ended wrench (or a crescent wrench), remove the pressure sensor and reducing nipple combination. The FRU that is removed looks like the hardware that is shown in Figure 4-42.

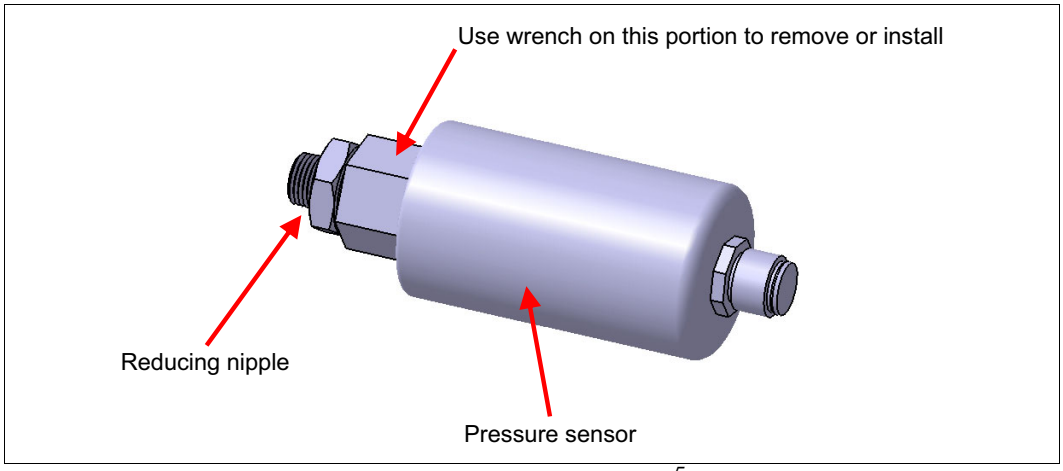


Figure 4-42 Pressure sensor and reducing nipple combination[5]

14. On the new FRU, add PTFE tape (commonly known as plumber's tape) to the threads on the reducing nipple. Note that the PTFE tape is NOT part of the FRU. Follow these guidelines when installing the PTFE tape:
   - When installing the PTFE tape, leave the first full thread (that first threads into the manifold body) free of tape. Do not allow the tape to extend past the reducing nipple threads into the manifold body.

[5] Image source: Courtesy of Proteus Industries

- Make three complete revolutions of the tape around the threads.
- Install the tape in the clockwise direction, as viewed from the end with the open thread. Start at the end of the threads, and work toward the pressure sensor body. See Figure 4-43.

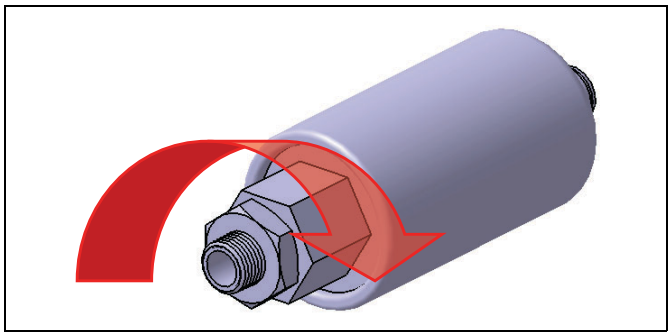


Figure 4-43 PTFE tape installation direction[6]

- When applying tape, pull the tape tight and use your fingers to press the tape into the threads.
- Cut off any loose or dangling pieces of tape. Do NOT install the pressure sensor if loose or dangling tape is present.

15. Thread the new pressure sensor FRU into the manifold body:
    a. Tighten the sensor with your hand.
    b. Use the same 21 mm open-ended wrench (or crescent wrench) wrench that was used to remove the old sensor to tighten the new sensor 3/4 to 1 full revolution.
16. Connect the pressure sensor cable.
17. Reconnect all of the node quick connects to the manifold.
18. Attach the air purge tool to the manifold as described in 1.5.1, “Purging the nitrogen from the coolant manifold” on page 18.
19. Open the rack ball valve on the return hose. See Figure 1-25 on page 20.
20. SLOWLY open the rack ball valve on the return hose. See Figure 1-25 on page 20.
21. Inspect the pressure sensor joint for leaks.
22. Install the baffle cover and properly manage the cables.
23. Restore ac power to the rack:
    a. Plug the power cords into the BPEs. Section 1.6.1, “Installing power cables” on page 20 provides more detailed information.
    b. Turn on the facility circuit breakers.
    c. Turn on the nine ac circuit breakers for the BPMs in both BPEs (there is one circuit breaker above each of the nine BPMs).
    d. Turn on the BPE Pwr 00 - Pwr 17 (51 V dc output) switches for each of the four BPEs in the rack.
24. Reinstall the cable routing rail.
25. Properly reattach all cables to the cable routing rail. The SSR task is complete.

[6] Image source: Courtesy of Proteus Industries

26. The customers runs the **ServiceClockCard** command to return the rack to the functional state.

4.19 Replacing an ambient air sensor

Perform the following steps to replace an ambient air temperature and humidity sensor:

1. Prepare the coolant monitor for service. Have the system administrator run the **ServiceClockCard** command. This command turns off the power to the rack.
2. Remove all ac power to the rack:
   a. Turn off the BPE Pwr 00 - Pwr 17 (51 V dc output) switches for each of the four BPEs in the rack.
   b. Turn off the nine ac circuit breakers for the BPMs in both BPEs (there is one circuit breaker above each of the nine BPMs).

   DANGER:
   Multiple power cords. The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. (L003)

   Turn off the facility circuit breakers. There can be up to four ac mains power cords for a Compute rack. To remove all power from the Compute rack, turn off the circuit breaker for each power cord and disconnect the power cord plug(s) from the mains power source receptacle (facilities power source).
3. Unplug all four power cords from the facility connector and BPEs.

   Attention: Ensure that all ac power to the rack is removed.

4. Before the cable routing rail can be removed, the machine cover (on that side of the machine) must be removed. All of the cables attached to the cable routing rail must be unbundled from the rail and carefully bundled together with cable ties.
5. Remove the cable routing rail from the right side of the back of the rack.
6. Unthread the collar that connects the ambient air temperature and humidity sensor to the coolant monitor.
7. Install the new ambient air sensor by aligning and plugging the connector and threading the collar to the coolant monitor.
8. Reinstall the baffle cover.
9. Perform steps 2 through 5 of this task in reverse order.
10. The RSC representative tells the customer when the **ServiceClockCard** command can be run and when the rack can be returned to functional status.

4.20 Replacing a coolant manifold

This section describes how to remove and replace the Blue Gene/Q coolant manifold and coolant monitor. These items are a calibrated pair. If the manifold is replaced, the manifold FRU includes a replacement coolant monitor.

Important: If the manifold is being replaced for a reason other than leakage, restricted flow in some part of the manifold, or a manifold quick-connect problem, it is advisable to replace only the coolant monitor first. This action requires less than an hour, and might resolve the problem without replacing the entire manifold assembly (over 11 hours labor). If replacing the coolant monitor does not resolve the problem, return the new coolant monitor part as a new return, and replace the manifold and coolant monitor FRU (upon receipt of the FRU assembly), per the following instructions.

The lift tool is required for this procedure.

Attention:

- Do not operate the lift tool until after you have read the owner's manual and are familiar with safe operation of the lift. The maintenance and repair of the lift are the customer's responsibilities. Contact the lift manufacturer for assistance.
- Label all optical cables, and other cables in the rack to ensure that they can be correctly reinstalled and replugged after removal during a repair activity.
- Two people are required for this procedure. A third person is required during the actual remove of the manifold and placement of the replacement manifold. The entire procedure requires approximately 11 hours for 2 people and 30 minutes for the third person.

In the tasks that follow, all cables that exit the rack (optical cables, power, Ethernet, clock cables) must be removed because the rack must be moved rearward 9.5" (228.6 mm). The cables must be carefully managed before moving the rack. Put protective caps on all cable ends and open plug locations as the cables are being removed. Use the caps that were retained during installation. Cables must be kept safe either by putting them under the floor or managing them above the rack. Maintain correct bend radius.

Attention: The following procedure assumes that the rack to be repaired can be moved rearward 9.5” (228.6 mm). Do not start this procedure until you have determined that the floor cutouts have been prepared according to instructions. These cutouts must allow the rack to safely be moved 9.5” rearward.

If the floor cutouts for the rack to be moved do not allow shifting the rack rearward the specified distance, racks must be removed from the row. Remove racks until the rack that requires manifold replacement can be removed from the row and accessed. If this method of replacement is required, all time to remove and replace racks in the row is billable to the customer. The row of racks must be disassembled in the reverse order that the racks were placed into the row. That is, the last rack placed must be the first rack removed, continuing until the rack to be repaired can be removed from the row to allow the manifold to be removed and replaced. It takes 5 - 6 hours to remove and replace each rack in the row. Two SSRs are required for approximately an hour for each rack (that is, there are 6 - 7 hours of billable time per rack). Advise the customer of this billable situation and provide an estimate of the amount of time involved before beginning repairs, so that the customer can make an informed decision about how to proceed and when they can anticipate powering off the number of racks involved for the amount of time that will be required.

The remove and replace procedure for the manifold is provided as part of the IBM maintenance agreement or warranty if the hardware is entitled to either item.

To replace a coolant manifold:

1. Prepare the rack for service. For a rack that contains a clock card, have the system administrator run the **`ServiceClockCard`** command. If a clock card is installed, this command affects the operations downstream.
2. Remove all rack doors. See 1.7, “Installing the covers” on page 31.
3. Remove the screws that attach the top cover hinge brackets to the adjacent rack (as shown in Figure 1-43 on page 35.
4. Remove all bottom hinge brackets (as shown in Figure 1-44 on page 36).
5. Remove the support leg that is shown in Figure 1-7 on page 8.
6. Turn off the Pwr 00 - Pwr 17 (51 V dc output) switch on each of the BPEs.
7. Turn off the nine BPM ac circuit breakers on each of the BPEs (there is one circuit breaker above each of the nine BPMs).
8. Turn off the facility circuit breakers for all four BPE power cords.
9. Unplug the power cords from the facility connector and the BPEs. Put the power cords under the floor or manage them above the rack to protect them. Be careful to maintain the correct bend radius.
10. Disconnect the rack coolant supply and return hoses from the facilities coolant supply and return hoses.
11. Verify that the cables are labeled. If any labels are missing, apply new labels before removal to ensure that the cables can be reinstalled in the correct locations.
12. In the next step, ensure that protective caps are installed on all fiber cables and node board cable sockets immediately upon removal of the fiber cables.
13. Follow 4.8, “Replacing a midplane” on page 84 to remove the lower midplane (midplane 0) from the machine, but stop after completing step 12. Repeat step 12 of this procedure to also remove the rear chassis from the rack. Put all removed items in a location where they are protected from static discharge and other potential sources of damage.

14. Unplug all cables which exit the rack from the remaining connection points in the rack. Ensure that protective caps are installed on all fiber cables and node board cable sockets immediately upon removal of the fiber cables.

    The 51 V dc DCA cables and other intra-rack cables are not required to be unplugged and removed, except for cables which are attached to the cable-routing baffles.

15. While being especially careful to maintain correct bend radius, carefully detach all cables from the front and rear cable routing baffles. Use cable ties as needed to keep cables in bundles. Using bundles simplifies the process of reattaching cables to the cable routing baffles later in this procedure.

16. Manage the cables which exit the rack carefully to ensure that they are kept safe. Put them under the floor or above the rack. Be careful to maintain the correct bend radius.

17. Disconnect the two coolant hoses for each node board in the top chassis (M1 midplane) from the supply and return manifolds by pulling the quick connect retaining ring on the coolant hose. See Figure 4-5 on page 71.

18. Remove the seven screws and remove the cable routing baffles on the right of the front and rear of the machine.

19. Slide the hoses up into the rack to protect them from physical damage when the rack is moved.

20. Raise the rack levelers and supports for cover brackets completely to allow the rack to move rearward. Ensure that the levelers do not interfere with cables, floor tiles, and so on.

21. To make it easier to move the rack, align the casters in the direction that the rack will be moved. You can use the channel lock pliers for this task.

22. The next step requires you to move the rack rearward 9.5 inches (228.6 mm).

    Attention: Do not move the rack until you have determined that the floor cutouts have been prepared according to instructions. They must allow the rack to be safely moved to the rear this distance.

23. Slide the rack back 9.5 inches to provide space to remove the side baffle. Be careful to avoid the floor cutouts.

24. When the rack has been moved rearward, lower the two levelers (one near the front manifold and one near the rear manifold). Lowering the levelers helps to prevent the rack from moving during the remaining steps of this procedure.

25. Remove the five screws and remove the right rear side cable routing baffle. See Figure 1-11 on page 10.

26. Follow the steps for removal of the coolant monitor in 4.15, “Replacing a coolant monitor” on page 104. You can ignore calibration information because a new, calibrated monitor is provided with the new manifold.

27. Remove the two screws from each of the hose clamps in the base of the rack.

    Note: See Figure 4-44 on page 121 for the following steps.

28. At the rear of the machine, perform the following steps (see Figure 4-44 on page 121):

    a. Remove one screw from each of the clamps on the manifold pipes.
    b. Remove three screws from the clamp on the rear side of the machine.
    c. Remove the two screws and nuts from the return flow sensor.
    d. Remove the two screws from the supply flow meter.

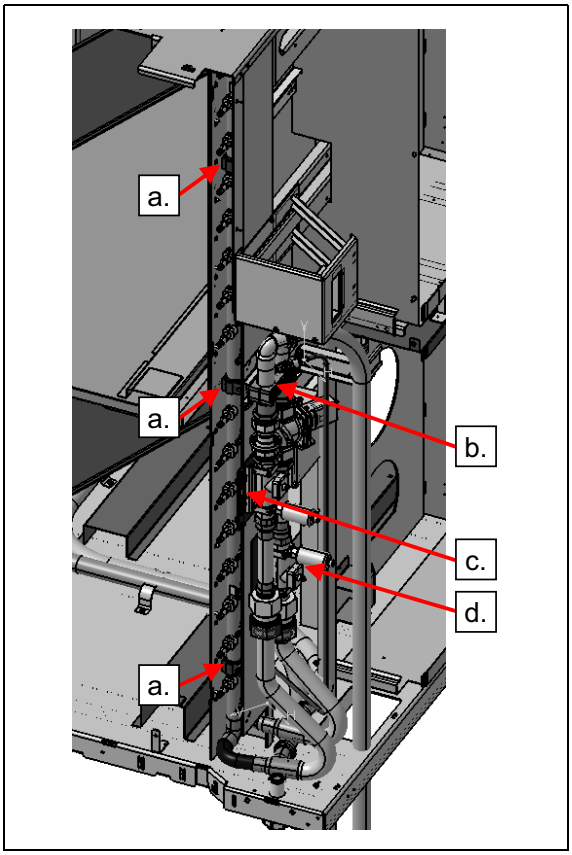


Figure 4-44 Coolant manifold replacement screw locations (rear)

- **Attention:** Three people are suggested to remove the manifold from the rack.
  - One person must be at the right rear of the rack to take the rear section of the manifold and the hoses and move it away from the rack.
  - One person must be at the rear right of the rack to control the manifold as it is fed through and removed from the rack.
  - One person must be at the right front of the rack to support the front manifold so that it does not fall or hit and damage other racks, and to feed it into the rack, toward the rear of the rack where the other two people are helping.

A compute rack manifold weighs approximately 57 lbs. Ensure proper handling methods and or equipment are used when removing or replacing a manifold in the compute rack.

CAUTION:
The weight of this part or unit is between 18 and 32 kg (39.7 and 70.5 lb). It takes two persons to safely lift this part or unit. (C009)

29. The person at the front of the machine must remove the three screws from the three manifold clamps (working bottom to top of the manifold), being careful to hold the manifold pipes, while removing the last screw, so that they do not fall. See Figure 4-45.

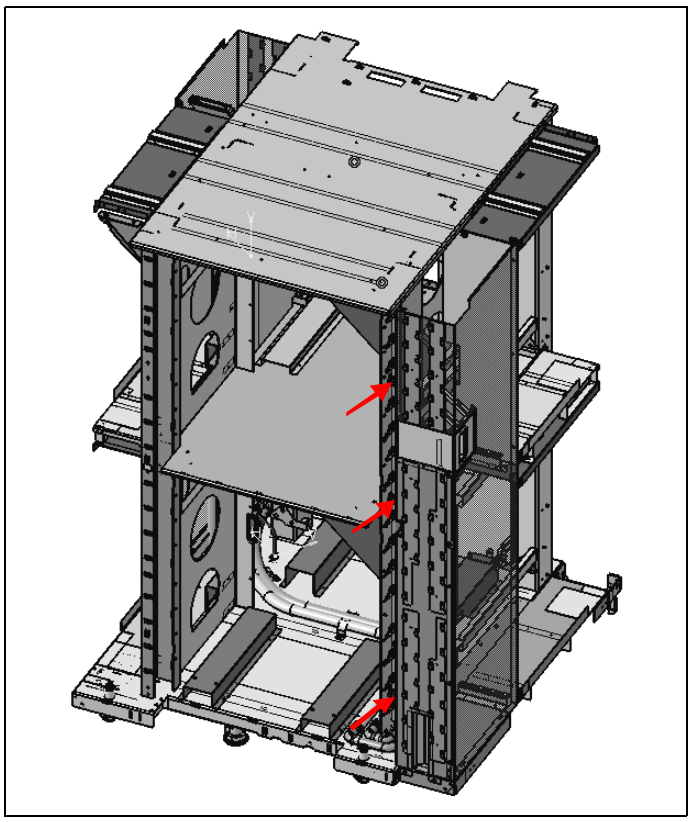


Figure 4-45 Coolant manifold replacement screw locations (front)

30. The person in the front of the machine lifts the front manifold pipes and tilts them approximately 45 degrees, to allow them to be fed through the bottom of the rack as the following steps are performed:
    a. One person takes the rear manifold and hoses that attach to the facility coolant, and begins moving away from the rack at a 45 degree angle.
    b. The remaining two people carefully feed the manifold through the rack, avoiding damage to the manifold, rack, or surrounding equipment.

31. Install the new manifold, and reinstall all hardware, by reversing the steps and the procedures in the preceding steps. Be careful to observe all cautions and the details in all steps.

    Attention: When installing the new manifold, ensure that the coolant connectors do not contact anything that might damage them.

    When the manifold is in the rack, and secured, the third person is no longer required.

    At the end of your activity, instruct the customer to call the RSC for assistance in bringing the machine up to productive status. Tell the customer to ask the representative to ensure that the operational parameters for the coolant monitor and sensors are all correctly set and stored in the system.

    Before attaching the node board hoses to the manifolds, follow the procedure in 1.5.1, “Purging the nitrogen from the coolant manifold” on page 18 to purge the nitrogen gas from the new manifold.

32. Install the new coolant monitor that was shipped with the manifold. Use the coolant monitor replacement instructions in 4.15, “Replacing a coolant monitor” on page 104. This coolant monitor is calibrated for the new manifold. Return the old coolant monitor.

    Do NOT write the old calibration data to the new coolant monitor.

    You might not be able to see the slots for the studs in the rack (see Figure 4-40 on page 109). To align the studs on the new coolant monitor with the slots in the rack, hold the top of the monitor higher than the top slots. Slide it toward you (that is, toward the back of the machine) until the monitor bracket touches the frame member. Then, slide the monitor slowly down and feel for the studs to align and drop into the slots. When the studs are in the slots, slide down to lock in place. Tighten the two thumbscrews to secure the monitor. See Figure 4-40 on page 109.

33. When the rack is reassembled, and back in its original location, with all covers in place, the SSR repair activity is complete. The SSR tells the customer that the manifold and coolant monitor replacement is complete and asks the customer to contact the Remote Support Center (RSC) before running the **ServiceClockCard** command or attempting to use the rack.

34. The RSC helps the customer enter the following commands to update the coolant monitor firmware:

    a. Prepare for a service action on all node boards and I/O drawers in the rack while leaving the service card operational. Run the following commands:

       ```
       cd /bgsys/drivers/ppcfloor/baremetal/bin
       ./ServiceRack Rxx prepare --noservicecard
       ```

    b. Run the following command to update the firmware:

       ```
       ./updateCoolMonFirmware.py Rxx 3.28
       /bgsys/drivers/ppcfloor/baremetal/firmware/coolantMonitor/
       LM3S6965_v3.28_20121029.hex
       ```

       Note: Use the most recent version of the firmware. The version should be version 3.28 or later.

       This step takes two to three minutes.

c. Run the following commands to end the service action on all node boards and I/O drawers in the rack.

```
cd /bgsys/drivers/ppcfloor/baremetal/bin
./ServiceRack Rxx end --noservicecard
```

35. The RSC helps the customer with the steps for restoring the rack to operational status. The steps include flow sensor and hydrodynamic impedance calibration, which must be performed by the customer. SSR assistance with these steps is a billable service.
36. Drain the removed coolant manifold. See 4.20.1, “Draining the coolant manifold” on page 124.
37. After the rack is in operational status, the customer writes the calibration data for the new coolant monitor. See 1.9, “Saving the coolant monitor calibration data” on page 43.

4.20.1 Draining the coolant manifold

The coolant manifold can be drained with compressed air or drained manually.

Attention: The coolant must always be drained before shipping to prevent damage to the coolant manifold.

Wear eye protection and latex gloves when you drain the manifold. Ask the customer if additional personal protective equipment is required.

Follow the steps in “Using compressed air to drain the coolant manifold” or “Manually draining the coolant manifold” on page 126.

Using compressed air to drain the coolant manifold

Attention: Ensure that you have proper personal protective equipment (PPE), including goggles and gloves, when draining the manifold. Ask the customer if additional PPE is required for the site.

Perform these steps to drain the coolant manifold with compressed air:

1. Ensure that you have the following items:
   - Source of compressed air, capable to deliver 25 PSI continuously
   - SMC socket fittings for the air source:
     - Two air inlets (PN 00E6135)
     - Four air purge hoses (PN 00E6020)
   - A 5-gallon container for the drained coolant (00E6039)

     Figure 1-22 on page 18 shows the items in the coolant and air purge kit.
2. Unplug all the node quick connects.
3. Set the compressed air at 25 PSI. Open the valve to let air flow freely. Ensure that 25 PSI is being supplied.
4. Hold the rack return manifold ball valve over the 5-gallon container and open the ball valve. Hold the open ball valve in the container while proceeding with the following steps.
5. Connect two air hoses to the return manifold on the front side of the rack (the inside leg of the manifold) to the top two node quick connects.
6. Let air pass through the hoses for three minutes.

7. After three minutes, take one of the air hoses from the front of the rack and move it to the rear of the rack. Connect it to the return side of the manifold on the top quick connect. Let air blow for two minutes. Remove the compressed air hoses and close the rack ball valve for the return side of the manifold.

   The return side of the manifold is drained.

8. To drain the supply side of the manifold, press the knob on the solenoid valve into the up position and turn it a quarter turn. This allows air to pass through the solenoid valve in the opposite direction from the normal coolant flow path. See Figure 4-46.

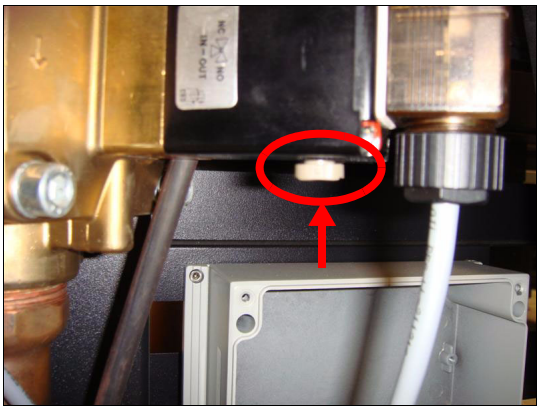


Figure 4-46 Solenoid valve in the "in" position[7]

9. Repeat steps 4 on page 124 through 7 on page 125 for the supply side of the manifold, and then continue to step 10.

10. Return the knob on the solenoid valve back to the out position by turning it a quarter turn and letting the knob drop down. See Figure 4-47.

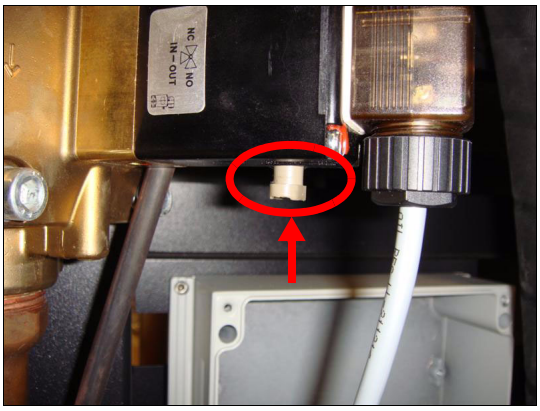


Figure 4-47 Solenoid valve in the "out" position[8]

The supply side of the manifold is drained.

[7] Image source: Courtesy of Proteus Industries
[8] Image source: Courtesy of Proteus Industries

Manually draining the coolant manifold

This section describes how to manually drain the coolant manifold.

Attention: Ensure that you are wearing proper PPE (personal protective equipment), including goggles and gloves. Ask the customer for site-specific PPE.

This procedure requires 2 - 3 people.

The drain and purge components are part number 66Y4607 in the US and 66Y4608 for world trade. See Figure 1-22 on page 18.

Consider the following guidelines when designing a manual drain procedure:

- The manifold has two closed loops: the return loop and the supply loop. Both loops must be drained.
- Drain from the lowest point.
- Air must be let into the system at the highest point for the coolant to drain. When draining the manifolds, an air inlet is required to allow air to flow into the highest manifold entry point so that the liquid being drained can flow out. When draining the supply and return hoses, no air inlet is required because the ball valves are large enough to allow air in at the same time that the liquid is draining.
- Liquid and air do not flow through the check valve in either direction during the manual drain procedure because gravity is not enough to overcome the check valve spring. Figure 4-48 shows the check valve and solenoid valve locations.

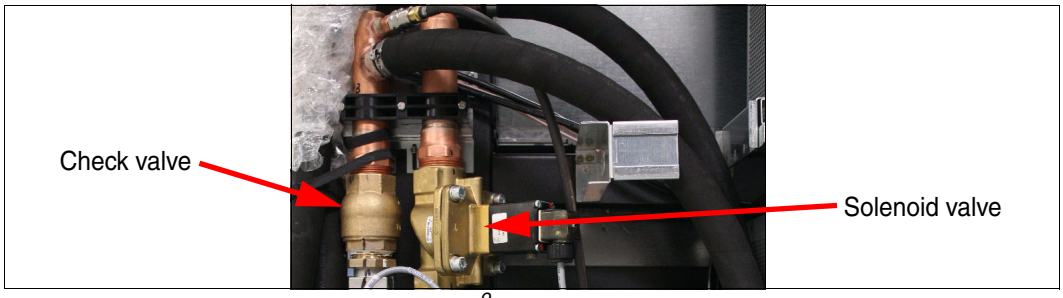


Figure 4-48 Check valve and solenoid valve[9]

- Liquid and air do not flow through the solenoid valve in either direction during the manual drain procedure because gravity is not enough to overcome the valve spring. See Figure 4-48.

See Figure 4-49 on page 127 for information about the parts and connections for manually draining a manifold.

[9] Image source: Courtesy of Proteus Industries

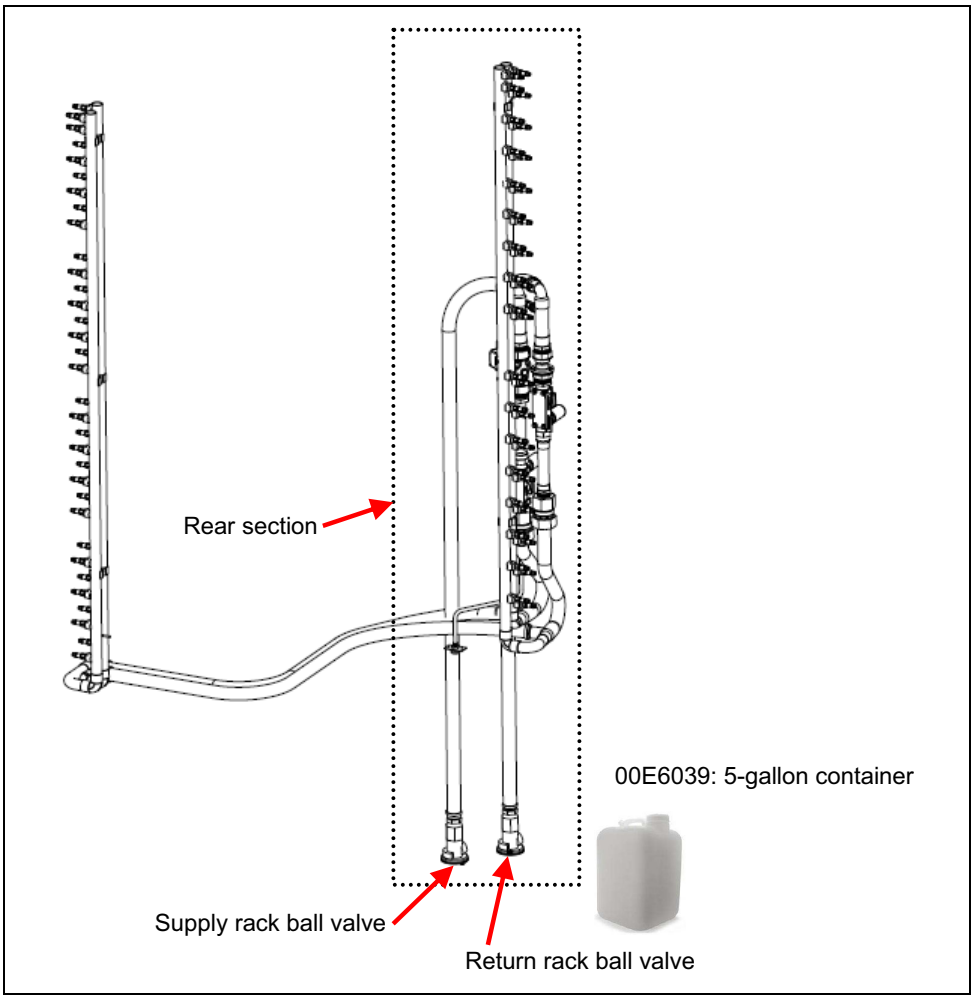


Figure 4-49 Connections for manually draining a manifold

Here is an example manual drain procedure:

1. Hold the rack return ball valve over the 5-gallon container and open the rack return ball valve. Let the liquid drain into the bucket.
2. Rotate the rear manifold section, keeping the rack ball valve low over the 5-gallon container, to drain all liquid from hoses.
3. Close the ball valve.
4. Repeat steps 1- 3 on the rack supply ball valve.
5. Drain return pipe 2 using the following steps. See Figure 4-50 for information about the required parts and connections:
   a. Thread the drain hose into the bucket, then attach the air purge hose to the drain hose. Connect the other end to the lowest quick connect on the return pipe 2.
   b. Attach the air purge hose and air inlet tool to the top most quick connect of return pipe 1 to let air into the system. Remember to keep the air inlet at the highest point so liquid does not escape.

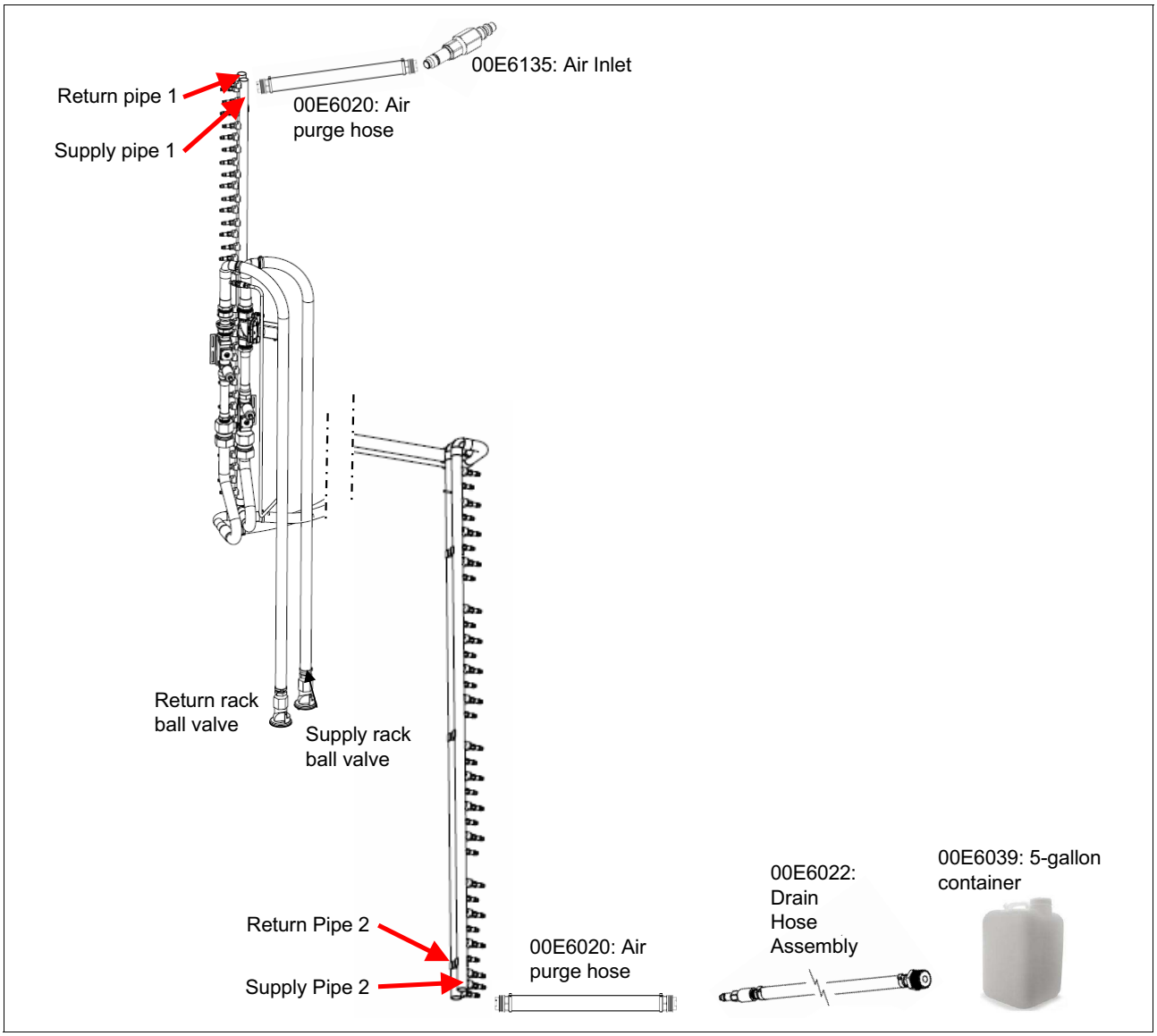


Figure 4-50 Draining pipe 2

6. Repeat the drain process on return pipe 1, supply pipe 1, and supply pipe 2.
7. To ensure that all water is out, repeat steps 5 - 6 while positioning the manifold to ensure that all liquid flows to the drain point.

A

Hardware location naming conventions

This appendix provides an overview of how the Blue Gene/Q hardware locations are assigned. This naming convention is used consistently throughout both the hardware and software.

Letter designation reference

The following letter designations are used for naming Blue Gene/Q hardware component locations:

```
A = PCI Adapter Card
B = Bulk Power Supply
C = Compute Card Core
D = Direct Current Assembly (DCA) Card
E = Fiber Optic Ribbon
F = Fan
H = Fan Assembly
I = I/O Drawer
J = Compute Card
K = Clock Card
L = Coolant Monitor
M = Midplane
N = Node Board
O = Optical Module
P = Power Module
Q = I/O rack
R = Compute Rack
S = Service Card
T = Node/IO Fiber Adapter Port
U = Link/Compute Module
```

Hardware location naming convention

Figure A-1 shows the Blue Gene/Q naming convention used when assigning locations for racks, power supplies, midplanes, and service cards.

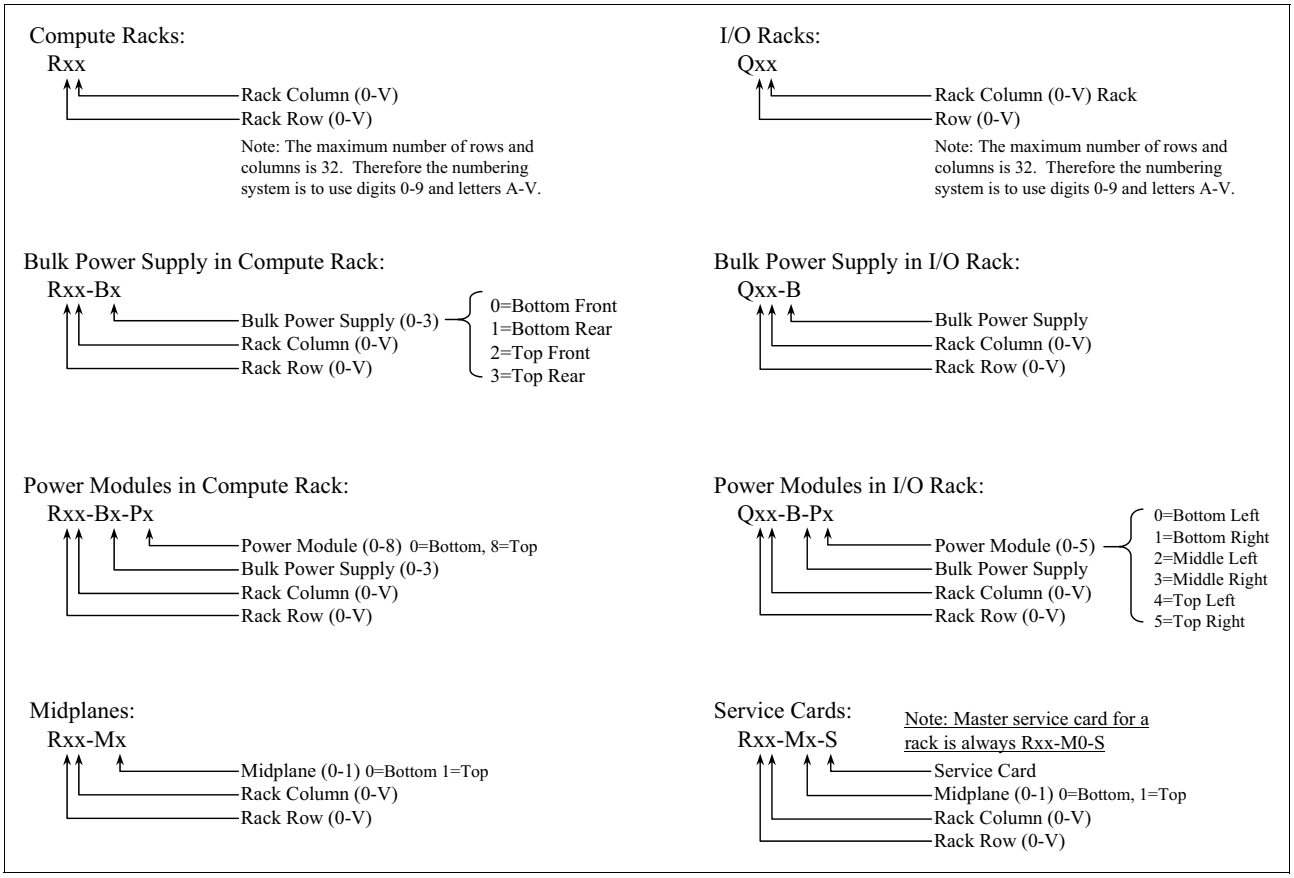


Figure A-1 Hardware naming convention for racks, power supplies, midplanes, and service cards

Figure A-2 shows the Blue Gene/Q naming convention used when assigning locations for clock cards, I/O drawers, node boards, and compute cards.

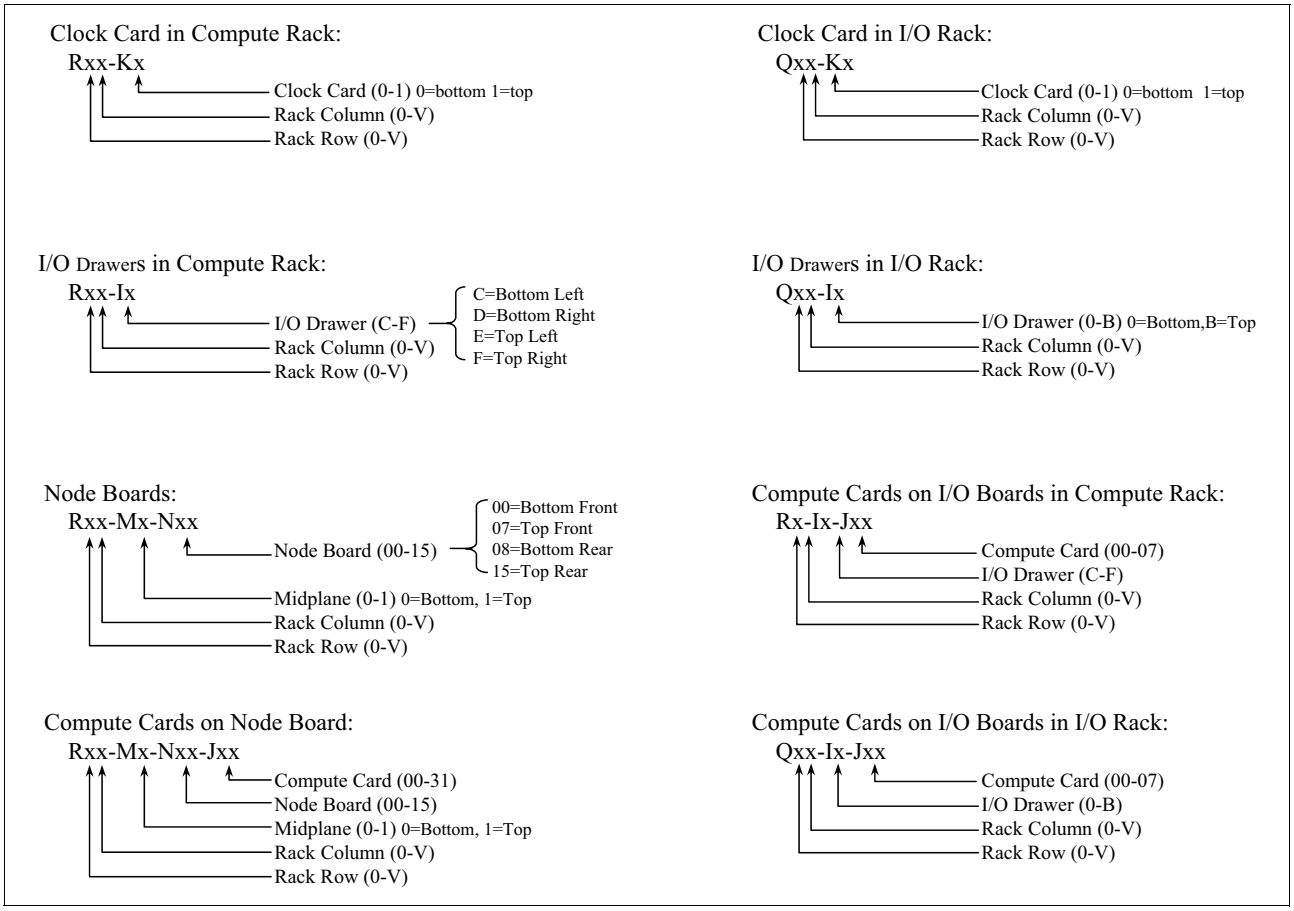


Figure A-2 Hardware naming convention for clock cards, I/O drawers, node boards, and compute cards

Figure A-3 shows the Blue Gene/Q naming convention used when assigning locations for cores, link modules, and Direct Current Assemblies (DCA).

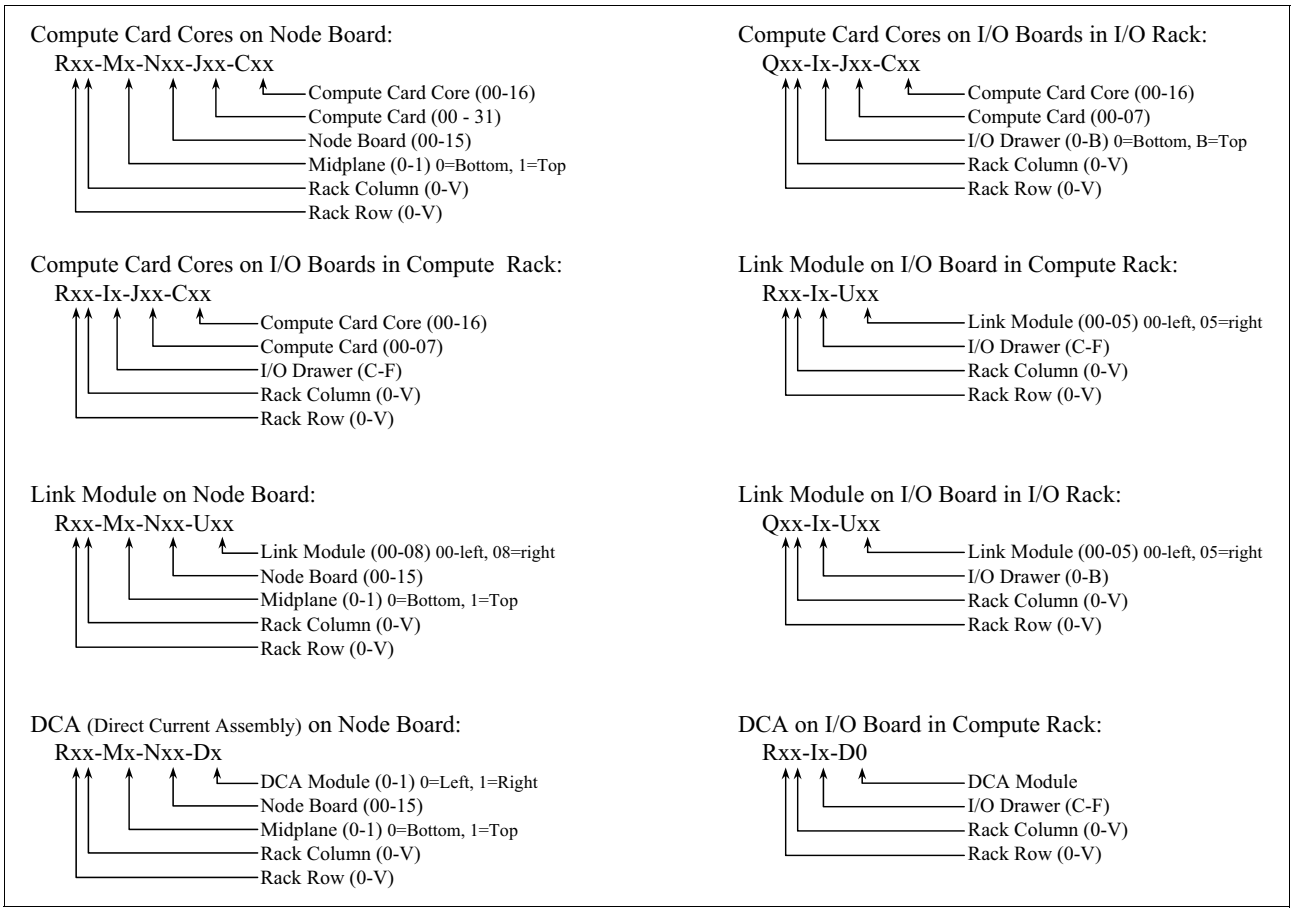


Figure A-3 Hardware naming convention for cores, link modules, and DCA

Figure A-4 shows the Blue Gene/Q naming convention used when assigning locations for optical modules, fans, and DCA.

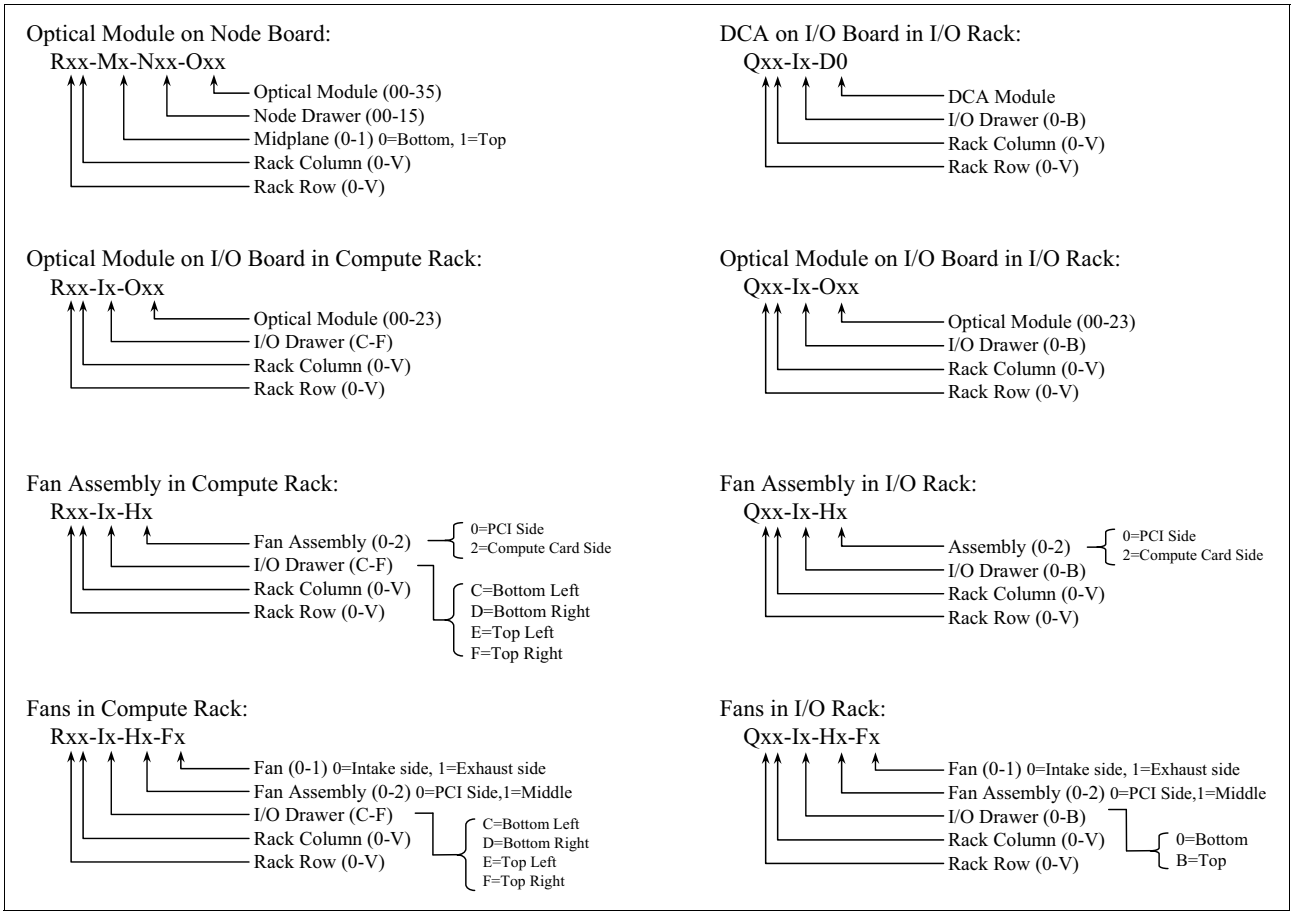


Figure A-4 Hardware naming convention for optical modules, fans, and DCA

Figure A-5 shows the Blue Gene/Q naming convention used when assigning locations for PCI adapters and coolant monitors.

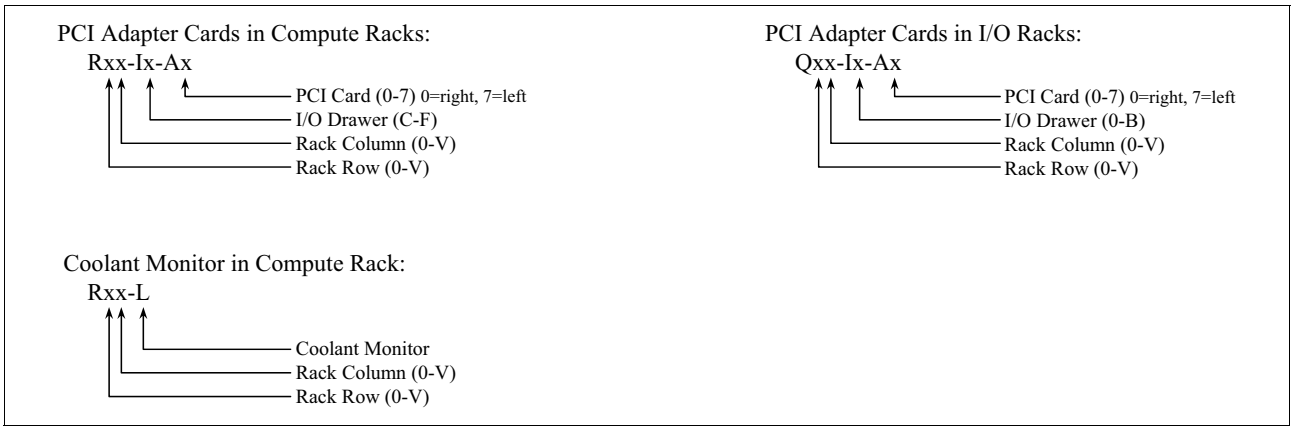


Figure A-5 Hardware naming convention for PCI adapters and coolant monitors

As an example, if you had an error in fan R23-IC-H1-F0 where would you go to look for it? The upper-left corner of Figure A-1 on page 130 shows that compute racks use the convention R*xx*. Looking at the error message, the rack involved is R23. From the chart, that rack is the

fourth rack in row two (remember that all numbering starts with 0). The bottom-left corner of Figure A-4 on page 133 indicates the bottom left I/O drawer of any rack is C. The chart shows that in the Fan Assemblies description, assembly 1 is in the middle. So, you are going to be checking for an attention light (Amber LED) on the middle Fan Assembly on the intake side because that fan is causing the error message to surface.

Table A-1 contains several examples of hardware location names.

Table A-1 Examples of location names

Card/Board	Element	Name	Example
Compute on node board	Card	J00 through J31	R23-M1-N02-J09
Link on node board	Module	U00 through U08 (00 left most, 08 right most)	R32-M0-N04-U03
Service	Card	S	R00-M0-S

Figure A-6 shows the layout of a system with 64 compute racks and 16 I/O racks and how the compute racks and I/O rack locations are named.

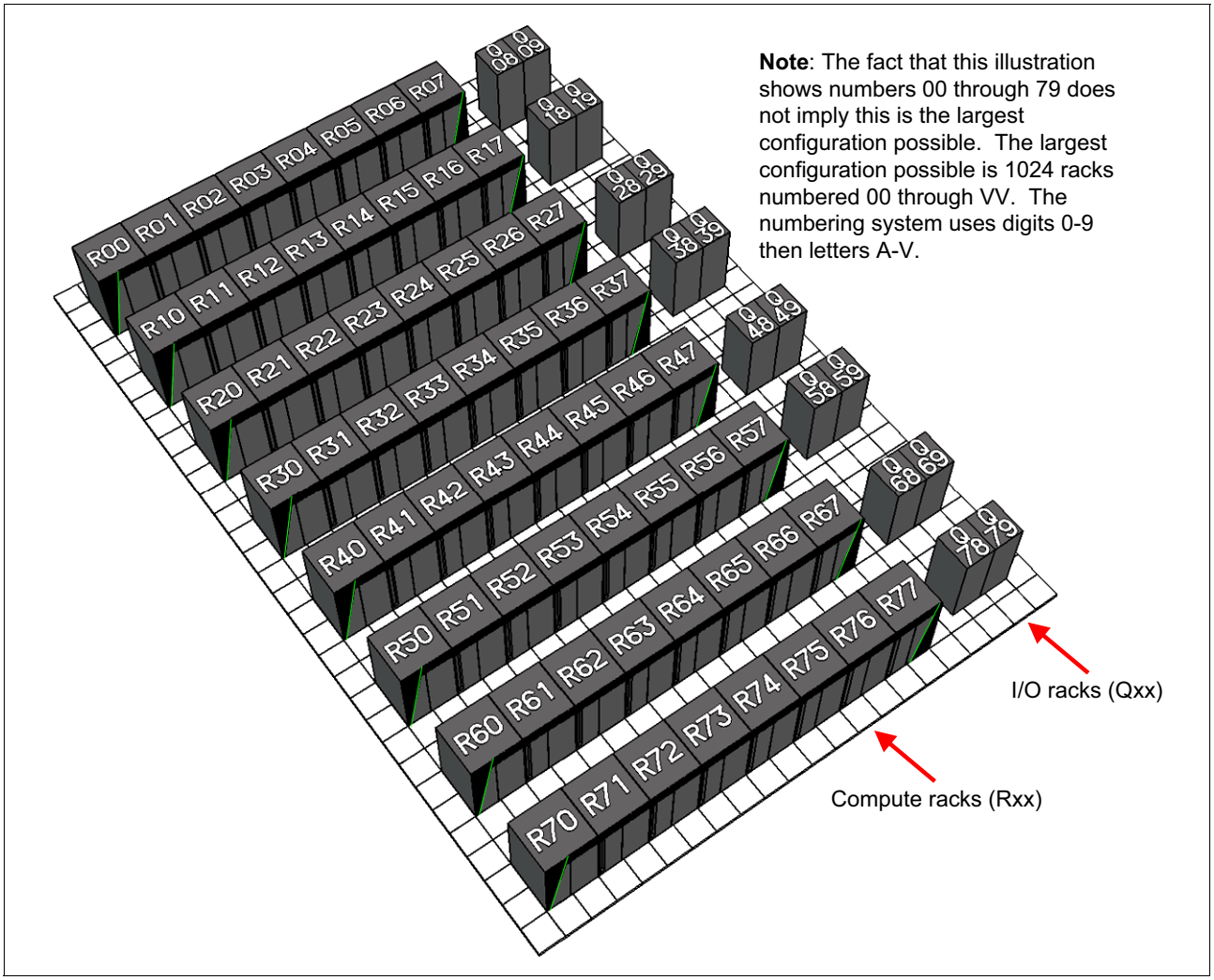


Figure A-6 Rack numbering

B

Relocation considerations

This chapter describes aspects of a move that must be carefully planned when Blue Gene/Q equipment is being relocated. The following topics are covered:

- General relocation considerations
- Relocation packaging considerations
- Special considerations for reconfiguration situations
- Special considerations for partial relocations
- One-per-location tools and service items for Blue Gene/Q

Important: The customer must be advised to retain all shipping and packaging materials for the Blue Gene/Q product for use in potential future relocations. Shipping brackets and other material associated with the original shipment must also be retained.

If not retained by the customer for future relocations, the customer might need to purchase replacement shipping and packaging materials, shipping brackets, and other material from IBM (if available). This material might not be available from IBM. Alternatively, the customer might need to have custom shipping and packaging materials constructed on site, at the customer's expense. If the required shipping brackets are not available, components might need to be removed from the rack for shipping. The customer might need to purchase additional custom packaging materials for those components.

General relocation considerations

IBM offers a broad range of services to support customer relocations. When planning the relocation of Blue Gene/Q equipment, IBM Systems Services Representatives (SSRs) must discuss relocations with local management for guidance and assistance.

When relocating Blue Gene/Q systems and equipment, keep in mind the following general considerations:

- All costs associated with the relocation of equipment are billable to the customer.
- Include the following items as part of the Blue Gene/Q relocation for all Blue Gene/Q racks affected:
  - All equipment, features, and parts that are part of the product or solution being relocated.
  - All interrack and intrarack cabling associated with the configuration of the racks being relocated.
  - The complete set of tools and service items required by IBM to effectively service the equipment. For more information, see “One-per-location tools and service items for Blue Gene/Q” on page 138.
- Blue Gene/Q equipment must be relocated in a climate-controlled van. The equipment must be kept in the temperature range 2°C - 60°C (35°F - 140°F). The relative humidity must be in the 5% - 100% range.
- Parts installed during the Blue Gene/Q installation must be removed for relocation. This requirement applies to both the Blue Gene/Q racks and the I/O racks. For more information, see Chapter 1, “Installing Blue Gene/Q racks” on page 1, Chapter 2, “Installing an I/O enclosure” on page 45, Chapter 3, “Installing an I/O rack” on page 53, and Chapter 4, “Removing and replacing parts” on page 65. The following parts must be removed or unhooked, as appropriate:
  - Covers and cover brackets
  - Coolant hoses. Unhook the Blue Gene/Q hoses from the site liquid cooling supply.
  - Cabling:
    - External and internal (interrack and intrarack) optical cables
    - ac power cables
    - Clock cables
    - Bulk power enclosure (BPE) direct current assembly (DCA) power cables. These cables can be left in place for relocation within the same building.
    - I/O drawer power cables
    - Cables attached to any components that are to be removed, such as BPEs and bulk power modules (BPMs)
  - Rear of the machine:
    - Baffles
    - BPMs, BPEs, and associated shelving and brackets
    - Black frame support (PN 46K5784)
    - Side panels
    - Cable support panel

- All parts that are removed must be properly packed for relocation in the original packaging or equivalent replacement materials. For more information, see “Relocation packaging considerations” on page 137.
- Parts removed during installation must be reinstalled for relocation. Reinstall all shipping brackets before relocating to another physical installation site (that is, to another building).
- Blue Gene/Q rack manifold and node boards do not need to be drained of cooling liquid for relocation, except where laws require it. If laws require draining the cooling liquid, see 4.5, “Draining coolant from a node board” on page 74 and 4.20.1, “Draining the coolant manifold” on page 124 for directions. Compressed air is required to drain the manifold and is recommended for use in draining the node boards.

Important: The customer is responsible for every aspect of ownership and handling related to the cooling liquid, except for draining cooling liquid from the Blue Gene/Q compute rack manifolds and node boards. Draining the cooling liquid is a billable service performed by trained IBM personnel.

The customer must choose one of the following approaches:

- Relocate the rack with the cooling liquid still in the rack.
- Remove, containerize, and relocate the cooling liquid.
- Dispose of the cooling liquid and provide new cooling liquid at the new installation site.

Whichever approach is chosen, the customer is responsible for everything related to the cooling liquid except for draining the cooling liquid from the system, which is a billable IBM service. The customer’s responsibilities include providing containers for the cooling liquid, disposing of or relocating the cooling liquid, and other handling of the cooling liquid. The customer must adhere to all applicable laws, regulations, and safety procedures.

Relocation packaging considerations

Relocation packaging materials are required for relocations to a new site and are recommended for all relocations. After the equipment is disconnected and ready for relocation, relocation packaging materials must be properly applied to protect the equipment during relocation.

Important: The customer must be advised to retain all shipping and packaging materials for the Blue Gene/Q product for use in potential future relocations. Shipping brackets and other material associated with the original shipment must also be retained.

If not retained by the customer for future relocations, the customer might need to purchase replacement shipping and packaging materials, shipping brackets, and other material from IBM (if available). Replacement shipping and packaging materials, shipping brackets, and other material might not be available from IBM. Alternatively, the customer might need to have custom shipping and packaging materials constructed on site, at the customer's expense. If the required shipping brackets are not available, components might need to be removed from the rack for shipping. The customer might need to purchase additional custom packaging materials for those components.

Special considerations for reconfiguration situations

There are special considerations when the relocated equipment is being reconfigured. That is, in the new location, the equipment is not installed in the same configuration. The same considerations apply when the equipment is being reconfigured but remains at the same site in the same building:

- Billable configuration planning and services are required to ensure that the reconfigured hardware meets configuration rules.
- An IBM Blue Gene/Q project manager's assistance might be required for planning and management of the reconfiguration.
- New cable purchases might also be necessary.
- Other considerations might arise.

Special considerations for partial relocations

There are special considerations for relocations that involve only part of a Blue Gene/Q solution. In a partial relocation, only a portion of the equipment currently installed is being relocated, or some equipment is being sent to different locations.

- The customer must determine which racks and cables to be relocated.
- Billable configuration planning and services are required to ensure that the relocated hardware, and the hardware remaining at the original location, meet configuration rules and can be configured to operate as the customer plans.
- An IBM Blue Gene/Q project manager's assistance might be required to plan and manage the relocation.
- Some interrack and intrarack cabling might not be reusable. New, additional, or replacement cabling might be needed, and new cable purchases might be necessary.
- Each installation site must have the complete set of *One-per-location Tools and Service Items for Blue Gene/Q* listed in Table B-1 and Table B-2 on page 139. Where equipment from a single installation is distributed to multiple locations, the customer must purchase the items in One-per-location tools and service items for Blue Gene/Q for each location that does not have them.
- Other considerations might arise.

One-per-location tools and service items for Blue Gene/Q

The equipment listed in Table B-1 must be available at every US location where a Blue Gene/Q system is installed.

Table B-1 Group BOM PN 66Y4607 for machines installed in US locations

Part Number (PN)	Quantity	Name	Description
00E5906[a]	1	LIFT	200 lb (90.7 kg) weight limit
00E6017	2	MECH ASM	Air bleed assembly
00E6020	4	HOSE	Air bleed hose

Part Number (PN)	Quantity	Name	Description
00E6022	1	HOSE	Drain hose assembly
00E6039	1	TANK	5-gallon (19 L) drain
00E6135	2	FITTING	Node air inlet
00E6357	1	BRACKET	Install I/O drawer
46G5947	1	LADDER	Ladder
93G1147	1	STOOL	Step stool

a. If a lift is required, the customer must purchase this exact item from the manufacturer or from IBM parts logistics. This item is not a FRU, and is not to be provided at IBM cost.

The equipment listed in Table B-2 must be available at every non US location where the Blue Gene/Q system is installed.

Table B-2 Group BOM PN 66Y4608 for machines installed in world trade (non US) locations

Part Number (PN)	Quantity	Name	Description
00E5907[a]	1	LIFT	200 lb (90.7 kg) weight limit
00E6017	2	MECH ASM	Air bleed assembly
00E6020	4	HOSE	Air bleed hose
00E6022	1	HOSE	Drain hose assembly
00E6039	1	TANK	5-gallon drain (19 L) drain
00E6135	2	FITTING	Node air inlet
00E6357	1	BRACKET	Install I/O drawer
46G5947	1	LADDER	Ladder
93G1147	1	STOOL	Step stool

a. If a lift is required, the customer must purchase this exact item from the manufacturer or from IBM parts logistics. This item is not a FRU, and is not to be provided at IBM cost.

C

IBM maintenance services acceptability and maintenance service qualification information

This section provides information for IBM Systems Services Representative (SSRs).

For documentation, information, or guidance related to IBM maintenance services acceptability inspections (MSAI) or maintenance service qualification (MSQ) for the Blue Gene/Q product, contact the Blue Gene/Q service planning focal point for your geography.

D

System parts

This appendix contains part number information for the Blue Gene/Q system.

Important: If a part is not a FRU part (that is, it does not show as orderable in the parts logistics systems), it must be ordered from the Code-A desk at the plant of manufacture. Most sheet metal parts in the rack must be ordered from the Code-A desk.

See the following sections for information about Blue Gene parts:

- Compute rack parts
- 0207-200 I/O Rack, Feature Code 0215
- FRU kits

Compute rack parts

This section lists the parts for the compute rack.

Covers

This section lists the covers for Blue Gene/Q racks. See 1.7, “Installing the covers” on page 31 for detailed information about cover locations and installing the covers.

Figure D-1 shows the front covers for the Blue Gene/Q rack.

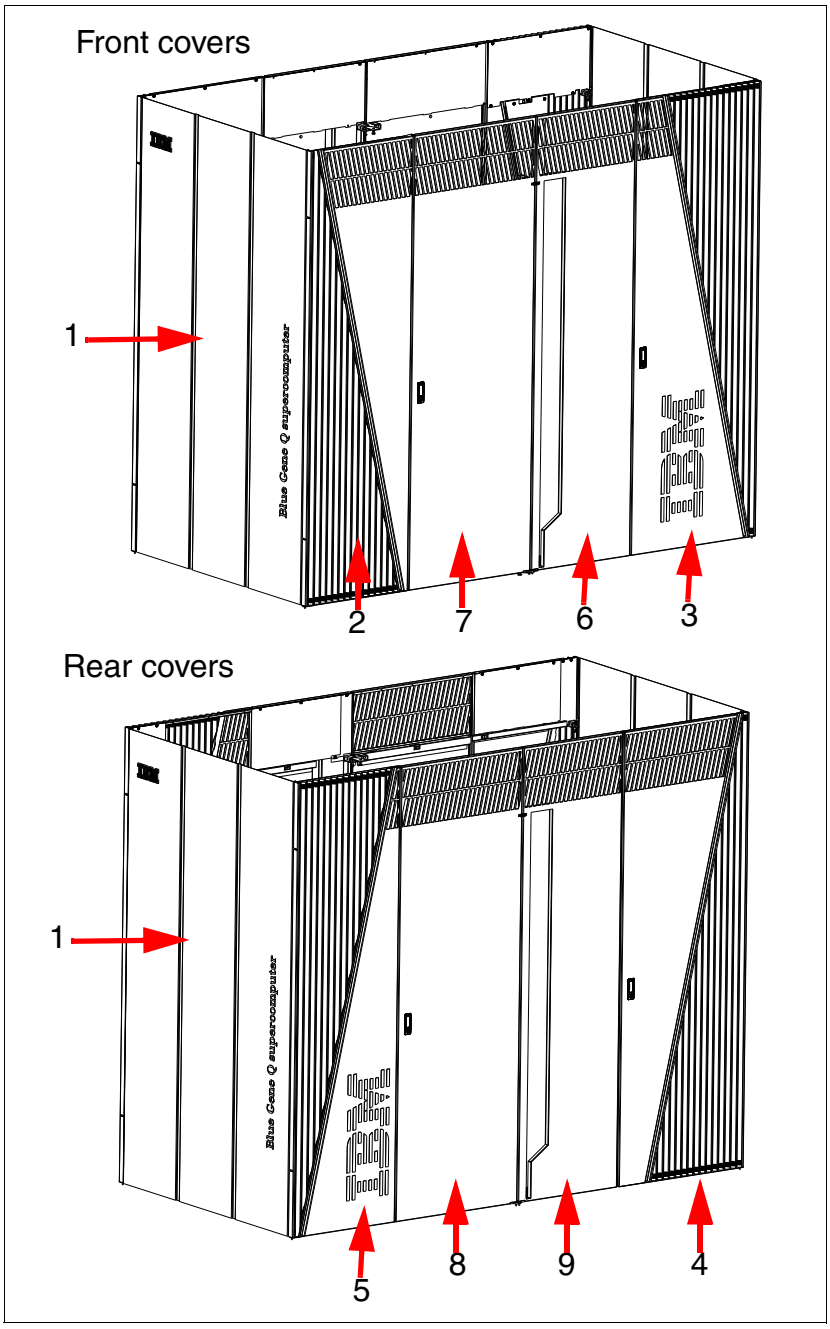


Figure D-1 Blue Gene/Q covers

Figure D-1 lists the part numbers for Blue Gene/Q covers.

Table D-1 Part numbers for Blue Gene/Q covers

Index number	Part number	Units	Description
1	74Y6278	Configuration dependent	Side cover

Index number	Part number	Units	Description
2	74Y6283	Configuration dependent	Front left end door
3	74Y6293	Configuration dependent	Front right end door
4	74Y6292	Configuration dependent	Rear right end door
5	74Y6290	Configuration dependent	Rear left end door
Not shown	74Y9430	Configuration dependent	Front left and right end door ¾ width filler
6	74Y6311	Configuration dependent	Front left middle door
7	74Y6319	Configuration dependent	Front right middle door
8	74Y6883	Configuration dependent	Rear right middle door
9	74Y6878	Configuration dependent	Rear left middle door
Not shown	74Y9459	Configuration dependent	Front left middle door short filler
Not shown	74Y9457	Configuration dependent	Front left middle door long filler
Not shown	74Y9458	Configuration dependent	Front right middle door short filler
Not shown	74Y9456	Configuration dependent	Front right middle door long filler
Not shown	74Y9424	Configuration dependent	Barb fastener for door filler

Rack hardware

Figure D-2 shows the rack hardware for a Blue Gene/Q rack.

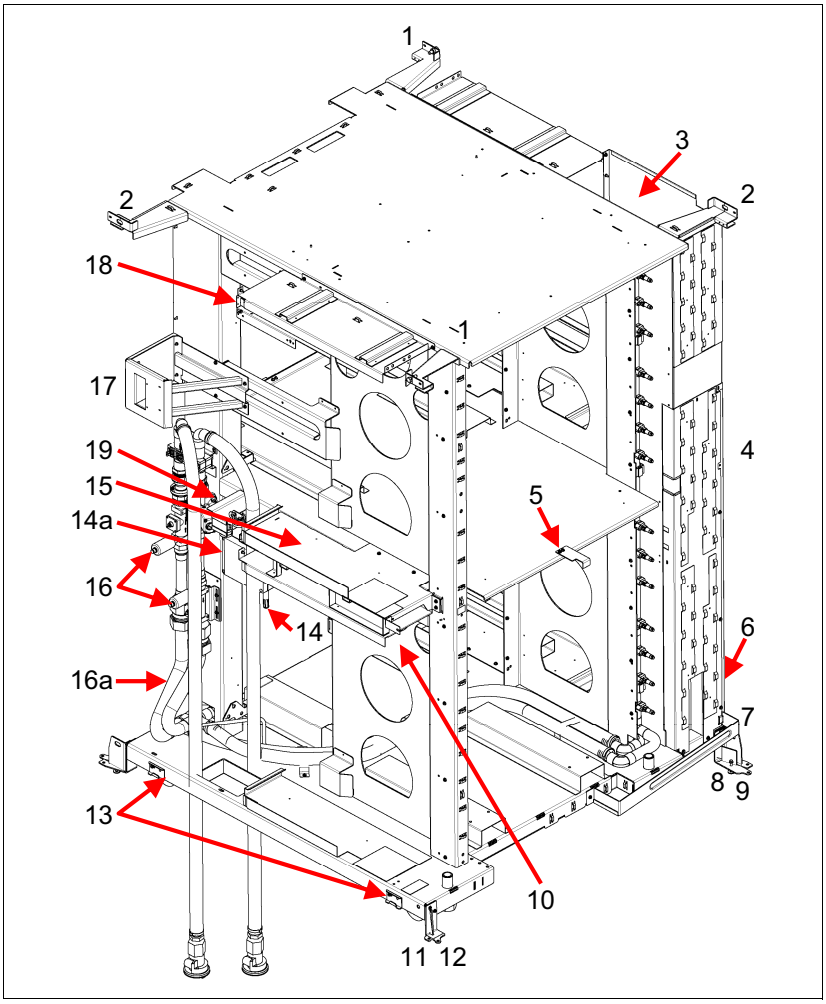


Figure D-2 Rack hardware

Table D-2 lists the part numbers for rack hardware.

Table D-2 Part numbers for rack hardware

Index number	Part number	Units	Description
Not shown	74Y9559	1	Rack and manifold assembly
1	74Y7161	2 per rack	Door attach bracket, upper left
2	00E6592	2 per rack	Door attach bracket, upper right
3	00J0427	2 per rack	Side baffle
4	46K5472	2 per rack	Front and rear baffle
5	74Y7029	1 per rack	Front door catch
	74Y7030	1 per rack	Rear door catch (not shown)
6	00E5661	1 per rack	Right lower BPE shelf (as viewed from front of rack)

Index number	Part number	Units	Description
7	74Y6357	2 per rack	Cable management (front and rear lower)
8	00E5671	1 per right end door	Lower-right end door attach bracket
9	00E5672[a]	1 per right middle door	Lower-right middle door attach bracket
10	00E5688	2 per end cover	Side cover L-bracket support, front and rear
11	00E5684	1 per left end door	Lower-left end door attach bracket
12	00E5682[a]	1 per left middle door	Lower-left middle door attach bracket
13	41V0077	2 per end cover	Side cover bottom brackets, front and rear
14	00E7107	1 per rack	Ambient air temperature and humidity sensor FRU
14a	00E5796	1 per rack	Coolant monitor with ambient air temperature and humidity sensor assembly
15	00J0429	2 per rack	Middle BPE shelf
16	00E7053	2 per rack	Pressure sensor
16a	00E6994	1 per rack	Manifold assembly (including coolant monitor)
17	46K5764	2 per rack	Push point
18	00J0428	2 per rack	Top BPE shelf
19	00E5701	1 per rack	Hose restraint bracket

a. This part is the same in the opposite corner.

Cages, midplane boards, node boards, and compute and DCA cards

Figure D-3 shows parts that are associated with cages, midplane boards, node boards, and compute and DCA cards.

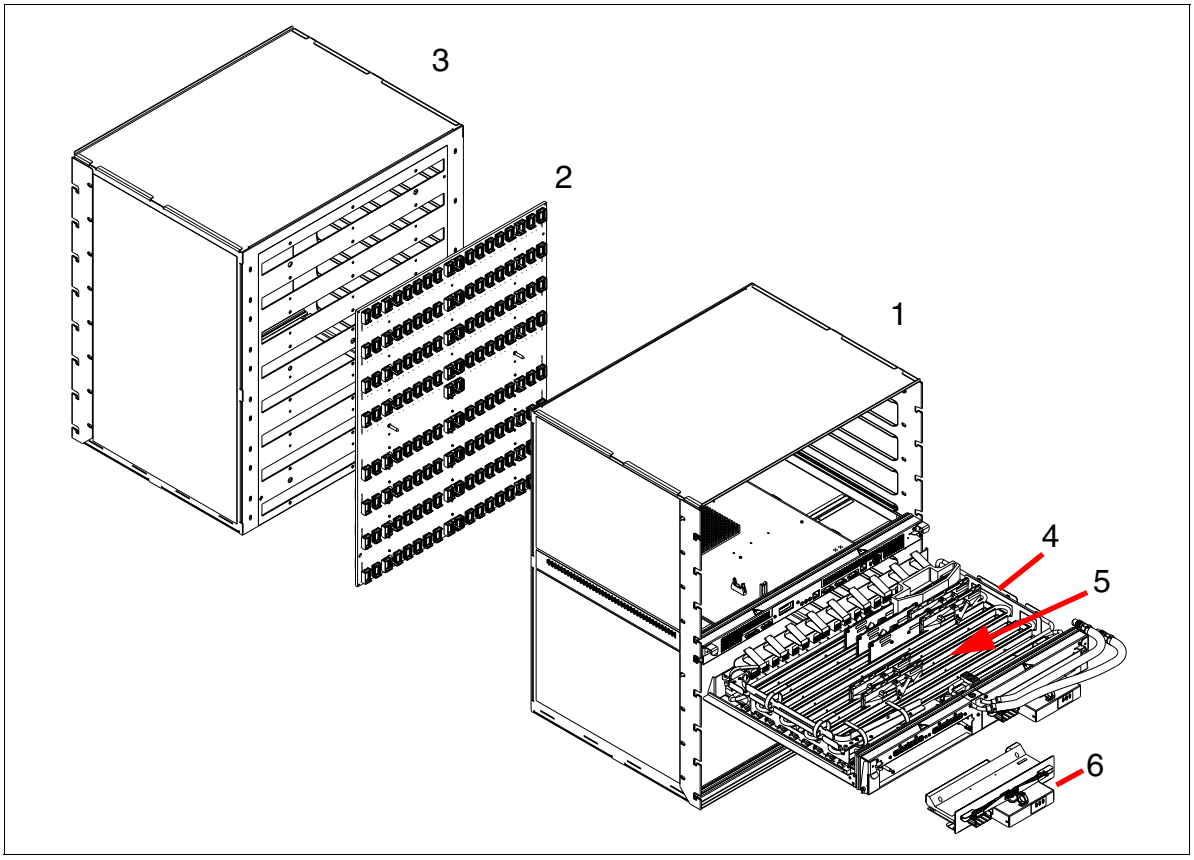


Figure D-3 Cages, midplane boards, node boards, and compute and DCA cards

Table D-3 lists part numbers for parts that are associated with cages, midplane boards, node boards, and compute and DCA cards.

Table D-3 Part numbers for cages, midplane boards, node boards, and compute and DCA cards

Index	Part number	Units	Description
1	74Y8945	1 or 2 per rack	Front cage
2	00J0164	1 or 2 per rack	Midplane board
3	74Y8946	1 or 2 per rack	Rear cage
4	00E6619	8 per midplane	Node board
Not shown	46K5332	2 per rack	Cage-to-cage EMC bracket

Index	Part number	Units	Description
5	00E5864 00E5867 00E5870 00E5873 00E5876	32 per node board	Blue Gene/Q compute card. If this card is replaced, you MUST use the same PN, or a direct substitute. Do NOT not mix compute PNs on a node board unless the parts system provides a substitute.
6	00E6616	2 per node board	DCA card

Part lists for I/O drawers

Figure D-4 shows parts that are associated with Blue Gene/Q I/O drawers.

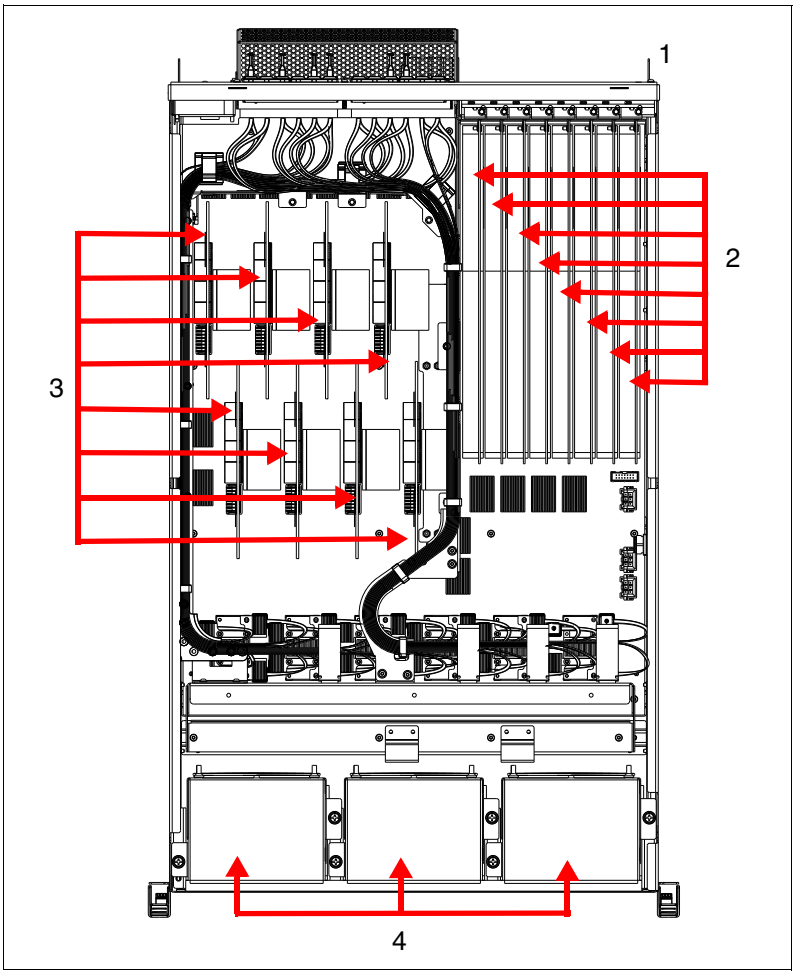


Figure D-4 I/O drawer locations

Table D-4 shows part numbers for parts that are associated with Blue Gene/Q I/O drawers.

Table D-4 Parts numbers for Blue Gene/Q I/O drawers

Index	Part number	Units	Description
1	00E6612	1 per I/O drawer	I/O drawer base assembly
Not shown	00J0582	1 per I/O rack	I/O BPE
Not shown	00E5694	1 per I/O BPE	I/O decorative bezel
Not shown	39J5190	1 per I/O BPE	I/O BPE stationary rail
Not shown	00E5786	1 per I/O rack	I/O rack cable management bracket
2	74Y9057	8 per I/O drawer when configured	Single-port 4x QDR IB (FC 0240)
	74Y9058	8 per I/O drawer when configured	4x QSFP 40 Gbps IB SFP+IB 10GbE combo (FC 0242)
	74Y9059	8 per I/O drawer when configured	74Y9059 Dual-port 10 GbE x8 (FC 0241)
3	00E5882	8 per I/O drawer	Air-cooled compute card
4	74Y8357	3 per I/O drawer	I/O drawer dual fan assembly
Not shown	77P9263	1 per single-port 4x QDR IB (FC 0240) or 1 per 4x QSFP 40 Gbps IB SFP + IB 10 GbE combo (FC 0242) when configured	QSFP-to-QSFP IB cable, 10 m
	77P9264	1 per single-port 4x QDR IB (FC 0240) or 1 per 4x QSFP 40 Gbps IB SFP + IB 10 GbE combo (FC 0242) when configured	QSFP-to-QSFP IB cable, 20 m
	77P9265	1 per Single-port 4x QDR IB (FC 0240) or 1 per 4x QSFP 40 Gbps IB SFP + IB 10 GbE combo (FC 0242) when configured	QSFP-to-QSFP IB cable, 30 m

Index	Part number	Units	Description
Not shown	41V2120	1 per 4x QSFP 40 Gbps IB SFP + IB 10 GbE combo (FC 0242) or 2 per 74Y9059 dual-port 10 GbE x8 (FC 0241) when configured	10 m Ethernet fiber-optic, high-bandwidth cable
	41V2121	1 per 4x QSFP 40 Gbps IB SFP + IB 10 GbE combo (FC 0242) or 2 per 74Y9059 dual-port 10 GbE x8 (FC 0241) when configured	20 m Ethernet fiber-optic, high-bandwidth cable
	41V2122	1 per 4x QSFP 40 Gbps IB SFP + IB 10 GbE combo (FC 0242) or 2 per 74Y9059 dual-port 10 GbE x8 (FC 0241) when configured	30 m Ethernet fiber-optic, high-bandwidth cable
Not shown	00E6364	1 per I/O drawer for locations ID and IF when installed in compute racks or every location for I/O drawers installed in I/O racks	I/O drawer 51 V dc power cable (short)
	00E6365	1 per I/O drawer for locations IE and IC - only when I/O drawers are in compute racks	I/O drawer 51 V dc power cable (long)
Not shown	74Y9063	1 per I/O drawer	2U cable management arm kit, with extension
Not shown	68Y7226	1 per I/O drawer	4U rack slide kit
Not shown	74F1823	8 per I/O drawer	M5 nut clip, for mounting rails
Not shown	00E5742	1 per I/O drawer	I/O drawer interlock bracket

Index	Part number	Units	Description
Not shown	41U8217	Single cable replacement FRU for orange 12-fiber bundle	10.3 m, 12-fiber cable
	41U8218	Single cable replacement FRU for red 12-fiber bundle	18.7 m, 12-fiber cable
	41U8219	Single cable replacement FRU for gray 12-fiber bundle	26.6 m, 12-fiber cable
	45D9540	Single cable replacement FRU for 12-fiber bundle for I/O drawers installed in compute racks	4.9 m, 12-fiber cable
Not shown	44V8072	Configuration dependent; 1 per I/O drawer in an I/O rack	Clock distribution cable
Not shown	74Y5088	Configuration dependent; 1 cable per clock card in an I/O rack	Long clock power cable
Not shown	44V8222	1 per I/O rack	Long communications cable, I/O drawer to BPE

Parts associated with Blue Gene/Q compute racks

Figure D-5 shows parts that are associated with Blue Gene/Q compute racks.

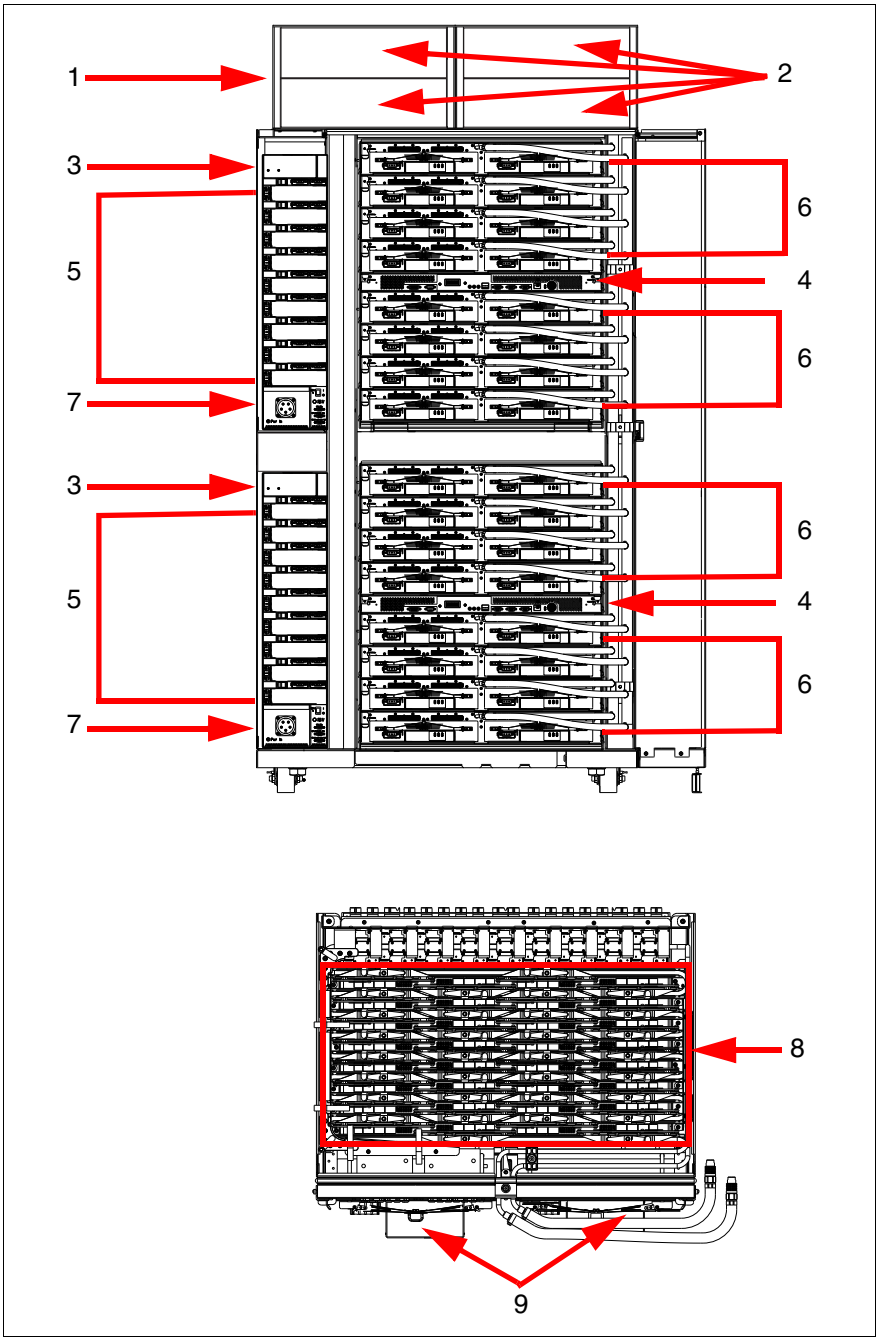


Figure D-5 Parts associated with Blue Gene/Q compute racks

Table D-5 shows parts that are associated with Blue Gene/Q compute racks.

Table D-5 Part numbers for parts associated with Blue Gene/Q compute racks

Label	Part number	Units	Description
1	44V8131	1 per rack	I/O enclosure

Label	Part number	Units	Description
2	N/A	0, 1, 2, or 4 per rack	I/O drawer locations. For more information about I/O drawer parts, see Figure D-4 on page 150.
Not shown	74Y9063	1 per I/O drawer	2U cable management arm kit, with extension
Not shown	68Y7226	1 kit per I/O drawer	Rack slide kit
Not shown	74F1823	8 per I/O drawer	M5 nut clip
Not shown	00E5706	0 or 1 per rack, depending on the configuration	Clock card. This card can be mounted at the top or bottom in the rear of the Blue Gene/Q rack.
Not shown	44V8072	Configuration dependent	Clock cable
Not shown	44V8223	1 per master clock card, 1 master clock card per system	Clock master cable
Not shown	74Y7008	1 short or long cable per clock card	Clock power cable, short
Not shown	74Y5088	1 short or long cable per clock card	Clock power cable, long
Not shown	00E6362	1 short to each DCA D0	51 V dc cable (short)
	00E6363	1 long to each DCA D1	51 V dc cable (long)
Not shown	00E6364	1 long or short cable per I/O drawer	51 V dc cable to I/O drawer (short) locations ID and IF when installed in compute racks
	00E6365	1 long or short cable per I/O drawer	51 V dc cable to I/O drawer (long) locations IE and IC when installed in compute racks
Not shown	N/A	1 - 2 per rack	Midplane and cages assembly. See Figure D-3 on page 149 for midplane and cage part numbers.
3	00J0581	2 or 4 per rack	BPE (bulk power enclosure)
Not shown	74Y7007	1 per pair of BPEs	BPE-BPE coaxial cable
4	00E5720	1 per midplane	Service cards, used only in front cages

Label	Part number	Units	Description
Not shown	44V8222	1 short and 1 long for each service card in the rack	Service-BPE communication cable, long
Not shown	74Y7009	1 short and 1 long for each service card in the rack	Service-BPE communication cable, short
Not shown	74Y7008	1 per service card	Service power cable
Coolant monitor cable (not shown)	00J0433	1 per rack	Coolant monitor power and signal cable
5	00E6218	9 BPMs per BPE (18 or 36 BPMs per rack)	BPM (bulk power module)
6	00E6619	16 per midplane	Node boards
7	46K6021	1 per BPE (2 or 4 per rack)	Rxx-Bx-BPE_Pwr_in (ac power cord, 480 V ac, US)
7	00J0288	1 per BPE (2 or 4 per rack)	Rxx-Bx-BPE_Pwr_in (ac power cord, 380 - 415 V ac, non-US)
Not shown	45D9470	Configuration dependent	2.2 m, 48-fiber optical single cable replacement FRU for violet cable
	45D9504	Configuration dependent	8.4 m, 48-fiber optical single cable replacement FRU for blue bundles
	45D9513	Configuration dependent	10.4 m, 48-fiber optical single cable replacement FRU for green bundles
	45D9517	Configuration dependent	12.9 m, 48-fiber optical single cable replacement FRU for yellow bundles
	41T7991	Configuration dependent	17.7 m, 48-fiber optical single cable replacement FRU for orange bundles
	41U9998	Configuration dependent	22.7 m, 48-fiber optical single cable replacement FRU for red bundles

Label	Part number	Units	Description
Not shown	42R5016	Configuration dependent	15 ft shielded copper Ethernet cable
	42R5018	Configuration dependent	30 ft shielded copper Ethernet cable
	42R5019	Configuration dependent	45 ft shielded copper Ethernet cable
	42R5020	Configuration dependent	60 ft shielded copper Ethernet cable
	42R5017	Configuration dependent	85 ft shielded copper Ethernet cable
	42R5021	Configuration dependent	110 ft shielded copper Ethernet cable
8	00E5864 00E5867 00E5870 00E5873 00E5876	32 per node board	Blue Gene/Q compute card (J00 - J31 on each node board). You MUST use the same PN, or a direct substitute, when replacing compute cards; do not mix compute PNs on a node board unless a substitute is provided by the parts system.
9	00E6616	2 per node board	DCA card
Card cage filler plate (not shown)	74Y6282	2 per single-midplane rack	Card cage filler plate (single-midplane systems only)
BPE filler plate -left (not shown)	74Y6281	1 per single-midplane rack	BPE filler plate - left
BPE filler plate - right (not shown)	74Y9056	1 per single-midplane rack	BPE filler plate - right
Node bypass hose (not shown)	00E6021	2 per single-midplane rack	Node bypass hose
Power cord edge guard bracket	00E7059	1 per rack	Power cord edge guard bracket
Line cord rubber edge guard	00E7060	1 per rack	Power cord rubber edge guard

0207-200 I/O Rack

This section lists the parts for the 0207-200 I/O Rack, FC 0215.

This topic contains indexed drawings and tables that cross-reference the enclosure's FRUs to part numbers, if applicable, and a part description. In this information, RoHS is European Union Directive 2002/95/EC on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment.

All parts are designed to comply with RoHS requirements unless otherwise indicated.

Frames, side panels, and top cover assembly for the 0207-200 I/O rack

Figure D-6 shows the frames, side panels, and top cover assembly.

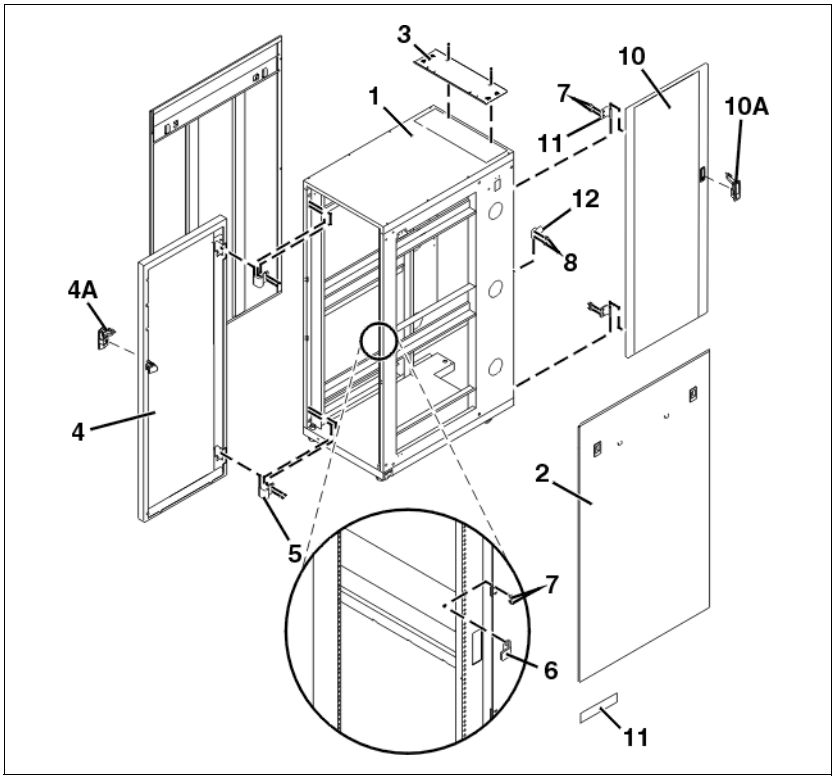


Figure D-6 Frames, side panels, and top cover assembly for the 0207-200 I/O rack

Table D-6 lists the part numbers for the frames, side panels, and top cover assembly.

Table D-6 Parts list for frames, side panels, and top cover assembly for the 0207-200 I/O rack

Index number	Part number	Units	Description
1	41V0486	1	Frame (black, 1.8 m)
	41V0087	1	Frame (black, 2.0 m)
2	05N6478	2	Side panel (black)
3	21L4277	1	Top cover (cable access)
4	41V0593	1	High perforation front door for 2M racks, black
4A	12R9307	1	Latch
5	09N9686	2	Hinge bracket (High perforation front door)
6	41V0082	1	Latch plate (55 mm)
7	31L8594	4	Screw
8	31L7540	2	Screw

Index number	Part number	Units	Description
9	51H9502[a]	11	Hook-and-loop fastener
10	39J4214	1	Rack rear door with foam, black (20 mm)
10A	12R9307	1	Latch
11	41V0080	2	Hinge bracket (20 mm)
12	NONUM	1	Latch plate (20 mm)
Not shown	00E5706	1 or 2 cards, depending on the configuration	Clock card. Install and access from the rear of the rack.
Not shown	74Y5088	1 per clock card	Long power cable
Not shown	00E6218	6 per I/O rack	BPM (bulk power module)
Not shown	00J0582	1 per I/O rack	BPE (bulk power enclosure)
Not shown	46K6021	1 cord per rack, appropriate for the country in which the hardware is installed	Power cord - US (480 V ac)
Not shown	00J0288	1 cord per rack, appropriate for the country in which the hardware is installed	Power cord - non-US (380 - 415 V ac)
Not shown	68Y7226	1 per drawer	4U rack slide kit
Not shown	74F1823	8 per I/O drawer	M5 nut clip

a. This part is not designed to comply with RoHS requirements.

Top frame assembly for the 0207-200 I/O Rack

Figure D-7 shows the top frame assembly.

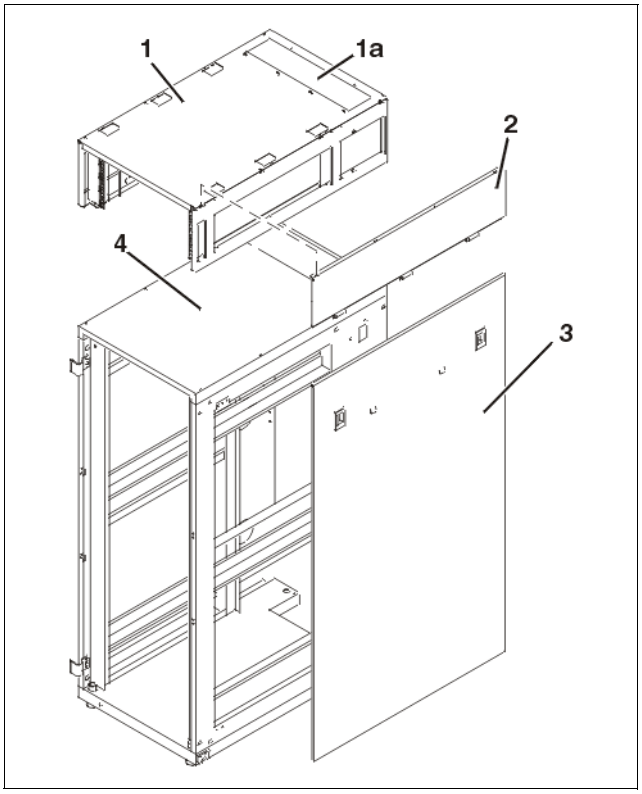


Figure D-7 Top frame assembly for the 0207-200 I/O rack

Table D-7 lists the part numbers for the top frame assembly.

Table D-7 Top frame assembly part numbers for the 0207-200 I/O Rack

Index	Part number	Units	Description
1	21L4296	1	Top frame. This is the only orderable top frame part number. This part has a default color of white. If you need a black top frame, request it when you place the order along with the 21L4296 part number.
1a	NONUM	1	Top Cable Access Cover (Black)
2	NONUM	2	Top Frame Side Panel (Black)
3	05N6478	2	Lower Side Panel (Black)
4	41V0087	1	Rack Frame (Black)

Earthquake brace assembly for the 0207-200 I/O Rack

Figure D-8 shows the earthquake brace assembly.

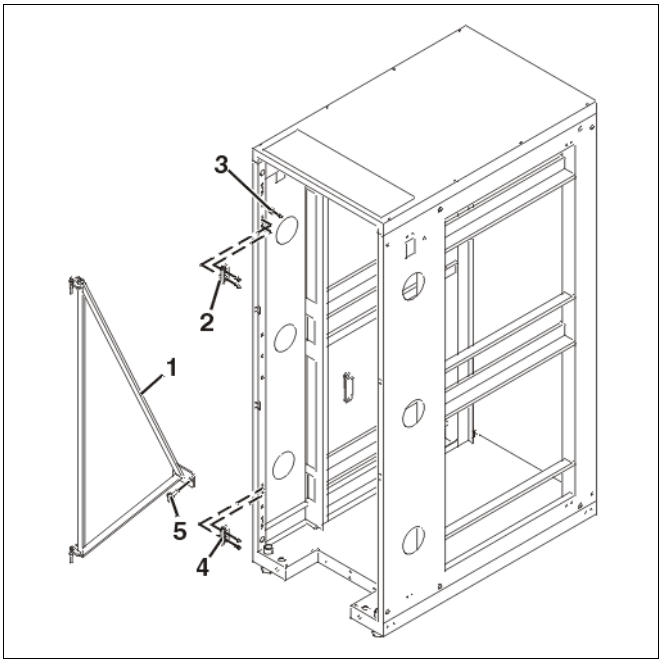


Figure D-8 Earthquake brace assembly for the 0207-200 I/O rack

Table D-8 lists the part numbers for the earthquake brace assembly.

Table D-8 Earthquake brace assembly part numbers for the 0207-200 I/O Rack

Index number	Part number	Units	Description
1	41V0488	1	Earthquake brace kit
2	REF	2	Hinge
3	REF	1	Spacer
4	REF	7	Screw
5	76X46874[a]	1	Bolt

a. This part is not designed to comply with RoHS requirements.

Blank fillers assembly for the 0207-200 I/O Rack

Figure D-9 shows the blank fillers assembly.

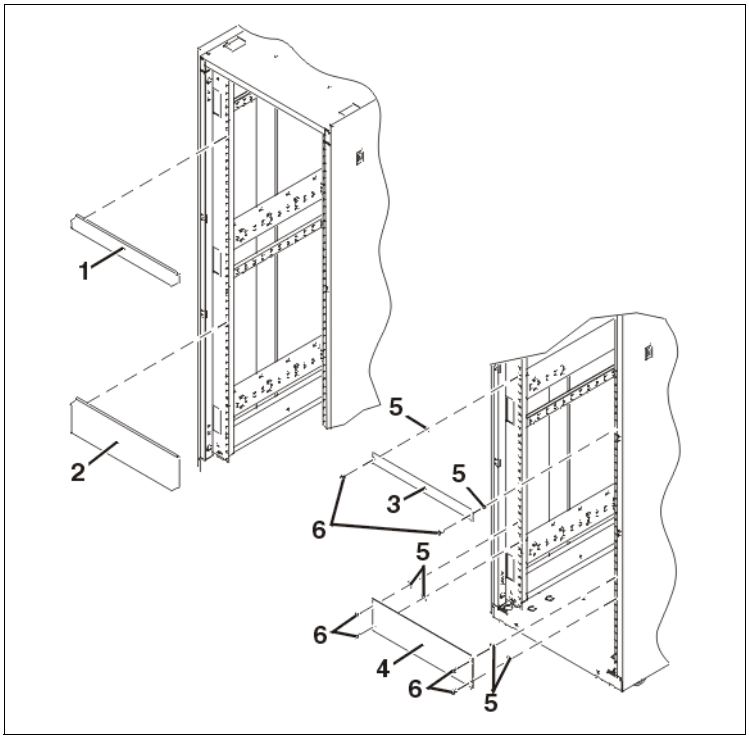


Figure D-9 Blank fillers assembly for the 0207-200 I/O rack

Table D-9 lists the part numbers for the blank fillers assembly.

Table D-9 Blank fillers assembly part numbers for the 0207-200 I/O rack

Index number	Part number	Units	Description
1	97H9754	AE	1U filler snap (black)
2	97H9755	AR	3U Filler snap (black)
3	12J4072	AR	1U Filler screw (black)
4	12J4073	AR	3U Filler screw (black)
5	74F1823	AR	M5 Nut clip
6	1624779	AR	M5 X 14 Hex flange

Stabilizer assembly for the 0207-200 I/O rack

Figure D-10 shows the stabilizer assembly.

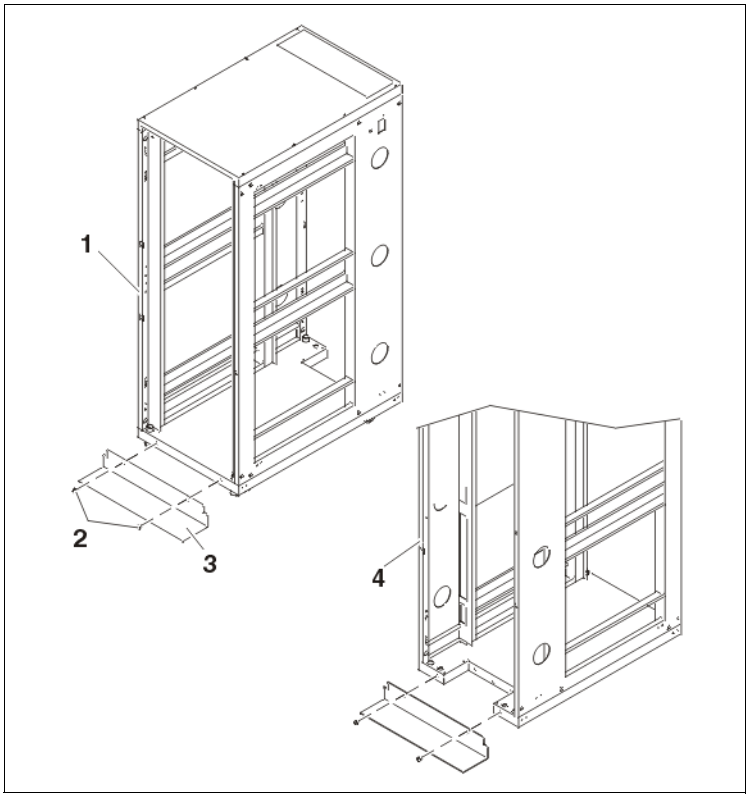


Figure D-10 Stabilizer assembly for the 0207-200 I/O rack

Table D-10 lists the part numbers for the stabilizer assembly.

Table D-10 Stabilizer assembly part list for the 0207-200 I/O Rack

Index number	Part number	Units	Description
1	REF	1	Rack frame
2	REF	2	Screw, M8X25 button head (provided as part of stabilizer kit)
3	41V0584	1	Front stabilizer kit (black)
	41V0586	1	Back stabilizer kit (black)
4	REF	1	Rack frame

Leveling feet assembly for the 0207-200 I/O rack

Figure D-11 shows the leveling feet assembly.

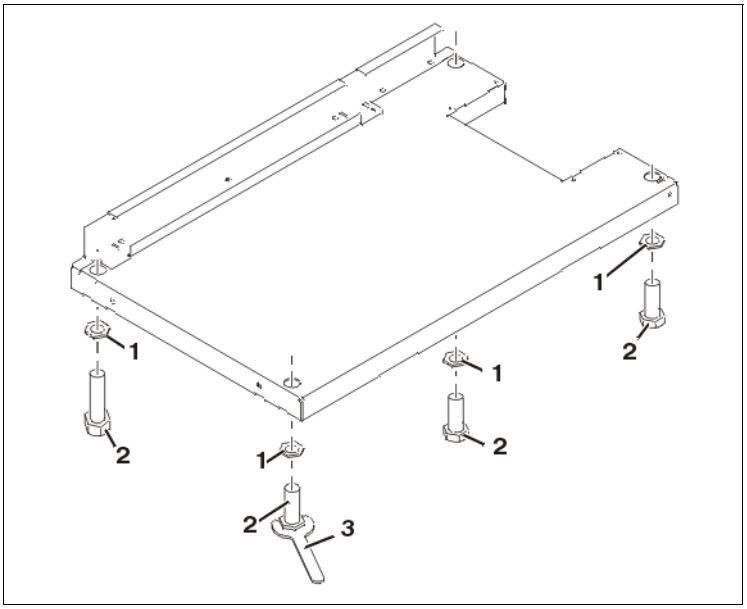


Figure D-11 Leveling feet assembly for the 0207-200 I/O Rack

Table D-11 lists the part numbers for the leveling feet assembly.

Table D-11 Leveling feet assembly parts list for the 0207-200 I/O rack

Index number	Part number	Units	Description
1	REF	4	Jam nut
2	REF	4	Leveling feet
3	31L8313[a]	1	Wrench

a. This part is not designed to comply with RoHS requirements.

Brace assembly for the 0207-200 I/O rack

Figure D-12 shows the brace assembly.

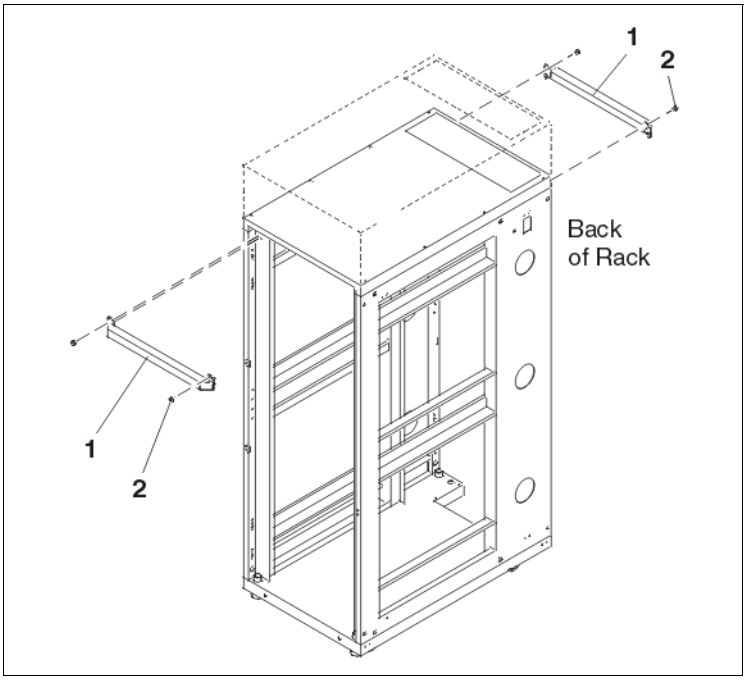


Figure D-12 Brace assembly for the 0207-200 I/O rack

Table D-12 lists the part numbers for the brace assembly.

Table D-12 Brace assembly parts list for the 0207-200 I/O rack

Index number	Part number	Units	Description
1	12K04896[a]	2	Brace
2	REF	4	Bolt

a. This part is not designed to comply with RoHS requirements.

Heat exchanger rear door for the 0207-200 I/O rack

Figure D-13 shows the heat exchanger rear door.

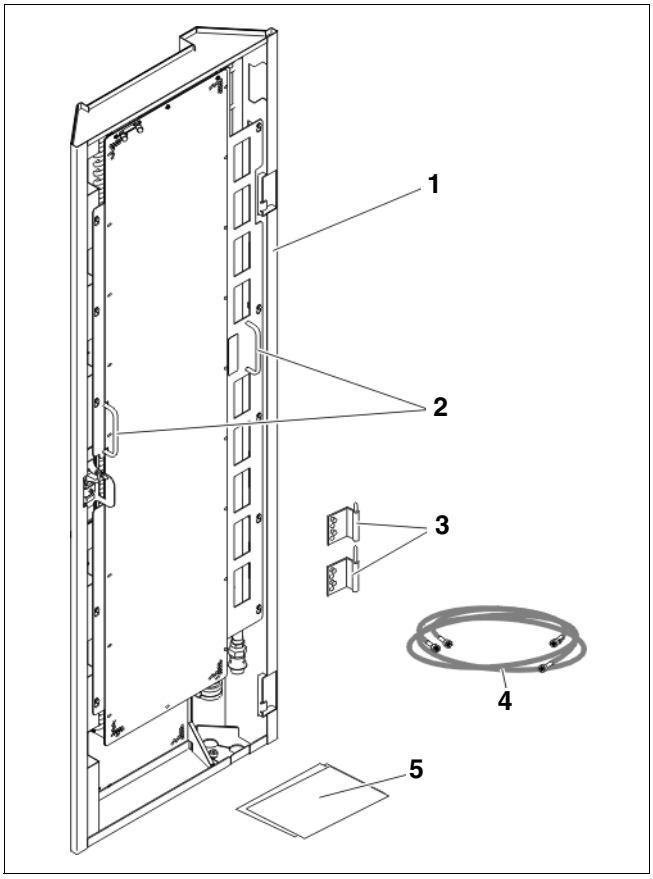


Figure D-13 Heat exchanger rear door for the 0207-200 I/O rack

Table D-13 lists the part numbers for the heat exchanger rear door.

Table D-13 Part numbers for the heat exchanger rear door for the 0207-200 I/O rack

Index number	Part number	Units	Description
1	32R0712	1	Heat exchanger rear door assembly (comes complete with parts shown)
2	N/A		Handles
3	N/A		Hinge bracket kit
4	N/A		Air-purging tool
5	N/A		Documentation

FRU kits

This section contains information about the Blue Gene/Q field replaceable unit (FRU) kits.

One-per-location tools and items

The equipment listed in Table D-14 must be available at every location where a Blue Gene/Q system is installed. Note that the lift for US and non-US installations is different.

Important: It is the customer's responsibility to maintain and replace these parts if a part fails, is not available, or is unusable.

Table D-14 One-per-location tools and items

Part number	Description
00E6017	Air bleed assembly (two per customer)
00E6020	Air bleed hose (four per customer)
00E6022	Drain hose (one per customer)
00E6039	Drain tank, 5 gal (one per customer)
00E6135	Air inlet fitting (two per customer)
00E6357	I/O lift riser plate (one per customer)
46G5947	Ladder (one per customer)
93G1147	Step stool (one per customer)
00E5906	Lift - US
00E5907	Lift - non-US

SSR on-site recommended items

The items in this section are recommended to be maintained at the customer location in the stated quantities.

Table D-15 shows part numbers for FRU kits.

Table D-15 FRU kit part numbers

Part number	Description
74Y0685	Fiber-optic cleaning cartridge (SSR supply item) Kit PN 46K6021 can be used if this kit PN is not available.
74Y6432	Compute card TIM. If possible, keep one compute card TIM on site at all times.
74Y6433	DCA TIM If possible, keep one DCA TIM on site at all times.
00E6541	SSR site kit, containing 15 each of shroud, clamp for DCA, and insulator, and 2 of the shroud installation tools.

Figure D-14 shows the parts in kit 00E6541.

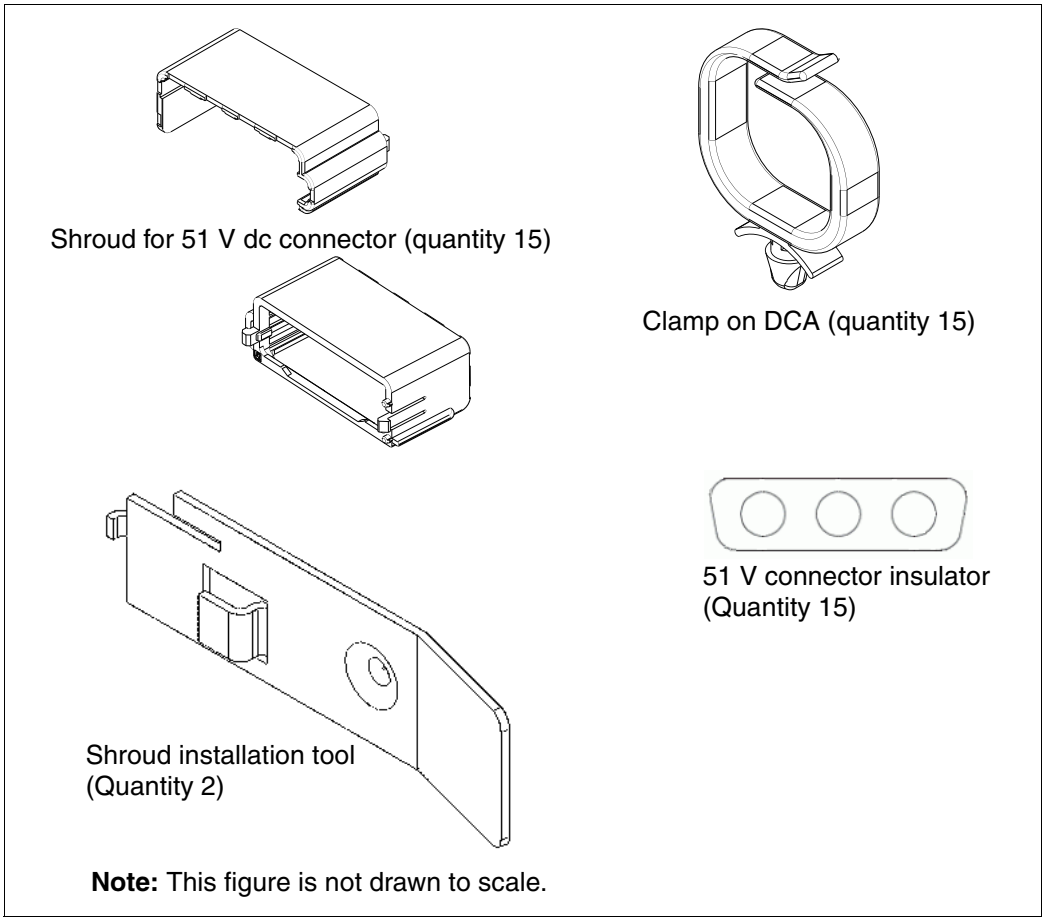


Figure D-14 Parts in kit 00E6541

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this book.

IBM Redbooks

For information about ordering these publications, see “How to get IBM Redbooks”. Note that some of the documents referenced here might be available in softcopy only:

- *IBM System Blue Gene Solution: Blue Gene/Q Safety Considerations*, REDP-4656
- *IBM System Blue Gene Solution: Blue Gene/Q Service Node Failover Using Linux High Availability*, REDP-4657
- *IBM System Blue Gene Solution: Blue Gene/Q Code Development and Tools Interface*, REDP-4659
- *IBM System Blue Gene Solution: Blue Gene/Q Hardware Overview*, SG24-7872
- *IBM System Blue Gene Solution: Blue Gene/Q System Administration*, SG24-7869
- *IBM System Blue Gene Solution: Blue Gene/Q Application Development*, SG24-7948

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Other publications

This publication is also relevant as a further information source:

- *General Parallel File System HOWTO for the IBM System Blue Gene/Q Solution*, SC23-6939-00

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IBM System Blue Gene Solution: Blue Gene/Q Hardware Installation and Maintenance Guide

Learn how to install the Blue Gene/Q rack

Learn how to install the Blue Gene/Q I/O enclosure

See how to remove and replace parts

This document is one of a series of IBM Redbooks written specifically for the IBM System Blue Gene supercomputer, Blue Gene/Q. Blue Gene/Q is the third generation of massively parallel supercomputers from IBM in the Blue Gene series. This document explains how to install the Blue Gene/Q rack and the Blue Gene/Q I/O enclosure. It shows you how to remove and replace parts.

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